Table 9.3.4.2 Civil Construction Cost Estimation of Sewerage Treatemt Plant (20,000m^3/day)

L= 850 W= 350 H= 8 H1= 2

Items	Banking	Tamping	Slope Protection(1)	Machine Excavation	Manual Subgrading	Slope Protection(2)	Gravel	Plain Concrete	Reinforced Concrete	Backfilling	Architecture
Unit	m3	m3	m2	m3	m2	m2	m3	m3	m3	m3	m2
Earthwork	2,134,870	2,134,870	37,426								
Grit Chamber				360	80		16	8	102	120	
Primary Sedimention Tank				4,184	628		126	63	768	728	
Facultative Lagoon				203,189	93,684	16,899		22,117			
Sludge Lagoon				67,582	40,584	8,045		9,726			
Disinfection Pond				1,248	222		45	22	303	384	
Outfall											
Outfall Sewer											
Connection Pipe											
Administration and Elec.Building											288

Items	Banking	Tamping	Slope Protection(1)	Machine Excavation	Manual Subgrading	Slope Protection(2)	Gravel	Plain Concrete	Reinforced Concrete	Backfilling	Architecture
Unit Cost	620	40	50	110	50	50	2000	7200	11500	40	37500
Earthwork	1,323,619,400	85,394,800	1,871,300								
Grit Chamber				39,600	4,000		32,000	57,600	1,173,000	4,800	
Primary Sedimention Tank				460,240	31,400		252,000	453,600	8,832,000	29,120	
Facultative Lagoon				22,350,790	4,684,200	844,950		159,242,400			
Sludge Lagoon				7,434,020	2,029,200	402,250		70,027,200			
Disinfection Pond				137,280	11,100		90,000	158,400	3,484,500	15,360	
Outfall											
Outfall Sewer											
Connection Pipe											
Administration and Elec.Building											10,800,000
	1,323,619,400	85,394,800	1,871,300	30,421,930	6,759,900	1,247,200	374,000	229,939,200	13,489,500	49,280	10,800,000

TAKA 1,703,966,510
(294,952,310)

Table 9.3.4.3 Civil Construction Cost Estimation of Sewerage Treatemt Plant (50,000m^3/day)

L= 1250 W= 500 H= 8 H1= 2

Items	Banking	Tamping	Slope Protection(1)	Machine Excavation	Manual Subgrading	Slope Protection(2)	Gravel	Plain Concrete	Reinforced Concrete	Backfilling	Architecture
Unit	m3	m3	m2	m3	m2	m2	m3	m3	m3	m3	m2
Earthwork	4,386,445	4,386,445	54,047								
Grit Chamber				420	96		19	10	102	132	
Primary Sedimention Tank				9,987	1,608		322	161	1,833	1,140	
Facultative Lagoon				491,425	233,244	26,513		51,951			
Sludge Lagoon				100,170	61,944	10,322		14,453			
Disinfection Pond				2,184	444		89	44	519	456	
Outfall											
Outfall Sewer											
Connection Pipe											
Administration and Elec.Building											216

Item	Banking	Tamping	Slope Protection(1)	Machine Excavation	Manual Subgrading	Slope Protection(2)	Gravel	Plain Concrete	Reinforced Concrete	Backfilling	Architecture
Unit Cost	620	40	50	110	50	50	2000	7200	11500	40	37500
Earthwork	2,719,595,900	175,457,800	2,702,350								
Grit Chamber				46,200	4,800		38,000	72,000	1,173,000	5,280	
Primary Sedimention Tank				1,098,570	80,400		644,000	1,159,200	21,079,500	45,600	
Facultative Lagoon				54,056,750	11,662,200	1,325,650		374,047,200			
Sludge Lagoon				11,018,700	3,097,200	516,100		104,061,600			
Disinfection Pond				240,240	22,200		178,000	316,800	5,968,500	18,240	
Outfall											
Outfall Sewer											
Connection Pipe											
Administration and Elec.Building											8,100,000
	2,719,595,900	175,457,800	2,702,350	66,460,460	14,866,800	1,841,750	860,000	479,656,800	28,221,000	69,120	8,100,000

TAKA 3,497,831,980
(602,778,280)

Table 9.3.4.4 Civil Construction Cost Estimation of Sewerage Treatemt Plant (100,000m^3/day)

L= 1250 W= 850 H= 8 H1= 2

Items	Banking	Tamping	Slope Protection(1)	Machine Excavation	Manual Subgrading	Slope Protection(2)	Gravel	Plain Concrete	Reinforced Concrete	Backfilling	Architecture
Unit	620	40	50	110	50	50	2000	7200	11500	40	37500
Earthwork	7,348,153	7,348,153	65,004								
Grit Chamber				420	96		19	10	102	132	
Primary Sedimention Tank				19,974	3,217		643	322	3,666	2,281	
Facultative Lagoon				982,851	466,488	53,025		103,903			
Sludge Lagoon				200,340	123,888	20,643		28,906			
Disinfection Pond				3,744	814		163	81	927	576	
Outfall											
Outfall Sewer											
Connection Pipe											
Administration and Elec.Building											216

	Banking	Tamping	Slope Protection(1)	Machine Excavation	Manual Subgrading	Slope Protection(2)	Gravel	Plain Concrete	Reinforced Concrete	Backfilling	Architecture
	620	40	50	110	50	50	2000	7200	11500	40	37500
Earthwork	4,555,854,860	293,926,120	3,250,200								
Grit Chamber				46,200	4,800		38,000	72,000	1,173,000	5,280	
Primary Sedimention Tank				2,197,140	160,850		1,286,000	2,318,400	42,159,000	91,240	
Facultative Lagoon				108,113,610	23,324,400	2,651,250		748,101,600			
Sludge Lagoon				22,037,400	6,194,400	1,032,150		208,123,200			
Disinfection Pond				411,840	40,700		326,000	583,200	10,660,500	23,040	
Outfall											
Outfall Sewer											
Connection Pipe											
Administration and Elec.Building											8,100,000
	4,555,854,860	293,926,120	3,250,200	132,806,190	29,725,150	3,683,400	1,650,000	959,198,400	53,992,500	119,560	8,100,000

TAKA 6,042,306,380
(1,192,525,400)

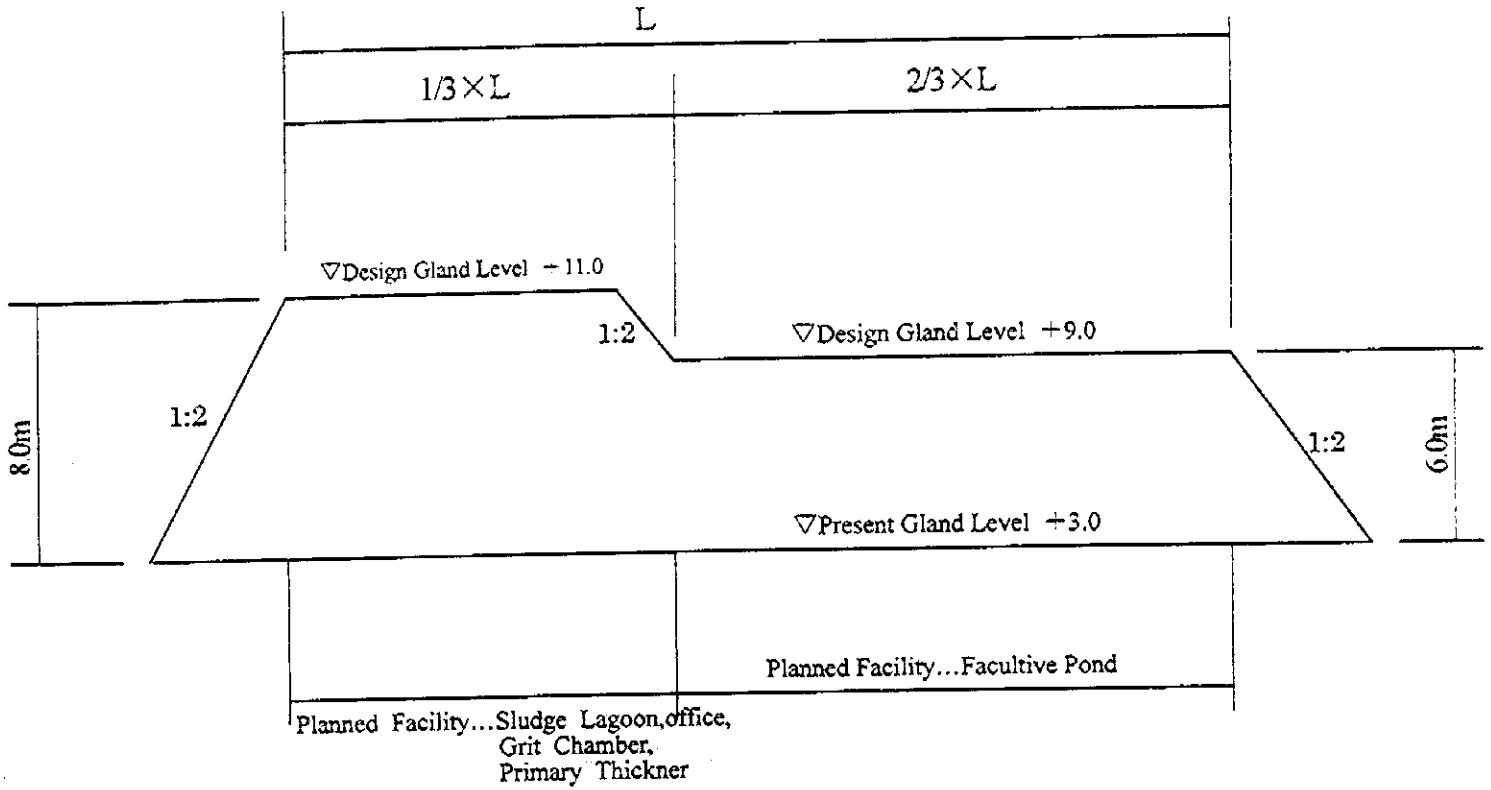


Figure 9.3.4.1
Designed Ground Level of Proposed sewerage Treatment Plant

Table 9.3.4.5 Design Calculation for Sewage Treatment Plant by Capacity

(1/3)

Capacity		100,000m³/day	50,000m³/day	20,000m³/day	REMARKS
1.Design Criteria					
1)Flow					
Daily Average	m³/day	100,000	50,000	20,000	
Daily Maximum	m³/day	125,000	63,000	25,000	
Hourly Maximum(Dry)	m³/day	163,000	82,000	33,000	
Hourly Maximum(Rain)	m³/day				
2)Water Quality					
Influent					
BOD5	mg/l	200	200	200	
SS	mg/l	200	200	200	
Effluent					
BOD5	mg/l	40	40	40	
SS	mg/l	40	40	40	
Removal Rate					
BOD5	%	80	80	80	
SS	%	80	80	80	
3)Load (Influent)					
BOD5 Load	kg-BOD5/day	25	13	5	
SS Load	kg-SS/day	25	13	5	
2.Outline of Major Facilities					
1)Grit Chamber					
Type		Rectangular	ditto	ditto	
Surface load	m3/m2/day	1,800	1,800	1,800	
Req'd Surface Area	m2	91	46	18	
Flow rate	m/s	0.30	0.30	0.30	
Depth	m	0.60	0.60	0.60	
Req'd Length	m	8.68	8.73	8.49	
Width	m	10.48	5.27	2.12	
Dimension L=	m	9.0	9.0	8.0	
W=	m	2.5	2.5	1.2	
D=	m	0.6	0.6	0.6	
Number	units	4	2	2	
(check)					
Surface load	m3/m2/day	1,811	1,822	1,719	
Flow rate	m/s	0.31	0.32	0.27	
Retention Time	s	28.6	28.4	30.2	

Capacity		100,000m³/day	50,000m³/day	20,000m³/day	REMARKS
2)Primary Thickner					
Type					
surface Load	m3/m2/day	50	50	50	
BOD Removal	%	40	40	40	
SS Removal	%	60	60	60	
Req.d Surface Area	m2	2,500	1,260	500	
Sedimented Sludge Volume		750	378	150	
Depth	m	3.5	3.5	3.5	
Dimension					
Diameter	m	30.0	30.0	18.0	
Depth	m	3.5	3.5	3.5	
Number	units	4	2	2	
(check)					
Surface Area	m2	2,826	1,413	509	
Surface Load		41	45	49	
Capacity	m3	9,891	4,946	1,782	
Retention Time	hours	1.9	1.9	1.7	
BOD-Effluent	mg/l	120	120	120	
3)Facultative Pond					
Type		Embanket Rectn etang. Pond	ditto	ditto	
Influent BOD5 Load	kg-BOD5/day	12,000	6,000	2,400	
BOD Area Load	kg-BOD5/ha/day	250	250	250	60.3*1.0993^T
where Temperature	C	18	18	18	from 1995 data
Safly Rate		1.33	1.33	1.33	1/4stanby: 4/3=1.33
Req'd Surface Area	ha	48.00	24.00	9.60	
Depth	m	1.5	1.5	1.5	
Dimension					
L(surface) =	m	350	350	220	
(bottom) =		341	341	211	
W(surface)=	m	180	180	120	
(bottom) =		171	171	111	
D =	m	1.5	1.5	1.5	
Numbers	unit	8	4	4	
(check)					
Capacity	m3	727,685	363,842	149,374	
Surface Area	ha	48.51	24.26	9.96	
Retention Days	days	5.8	5.8	6.0	
Area Load against Influent BOD5 Load	kg-BOD5/ha/day	238	238	227	
Volume of Sludge	m3/5years	75,000	37,800	15,000	need check
Dumping Sludge Volume	m3/5years	11,250	5,670	2,250	at 15%moisture
Depth of Sedimented Sludge	m	0.15	0.16	0.15	

Capacity		100,000m³/day	50,000m³/day	20,000m³/day	REMARKS
4)Disinfection Pond					
Type					
Retention time	min	15	15	15	
Req'd Volume	m3	1,042	521	208	
Dimension L=	m	35	35	35	
W=	m	20	10	4	
D=	m	2	2	2	
Numbers	units	1	1	1	
(check)					
volume		1,400	700	280	
Retention time		16	16	16	
5)Sludge Lagoon					
Type		Embanket Rectangular Pond	ditto	ditto	
Design SS Area Load	kg/m2/year	70	70	70	
Influent SS Volume	kg/day	12,000	6,000	2,400	from Primary thickner
Req'd Surface Area	m2	62,571	31,286	12,514	
Digestion Period	months/year	6	6	6	
Drying Period	months/year	6	6	6	
Depth D=	m	1	1	1	
Aqu'd Area	m2	62,571	31,286	12,514	
Dimension					
L(surface)=	m	180	180	120	
(bottom)=		174	174	114	
W(surface)=	m	95	95	95	
(bottom)=		89	89	89	
D =	m	1	1	1	
Numbers	unit	8	4	4	
(drying,incliude)	unit	4	2	2	
(check)					
Surface Area	m2	65,145	32,573	21,534	
Capacity	m3	65,145	32,573	21,534	
Retention days	days	109	109	179	
3.Power Consumption					
excluding:					
-office					
-lighting					
4.Area Requirement					
Grit Chamber	m2	90	45	19	
Primary Thickning	m2	2,826	1,413	509	
Facultative Pond	m2	485,100	242,600	99,600	
Disinfection pond	m2	700	350	140	
Sludge Lagoon	m2	65,145	32,573	21,534	
Total	m2	553,861	276,981	121,802	
Required Area	ha	106	63	30	

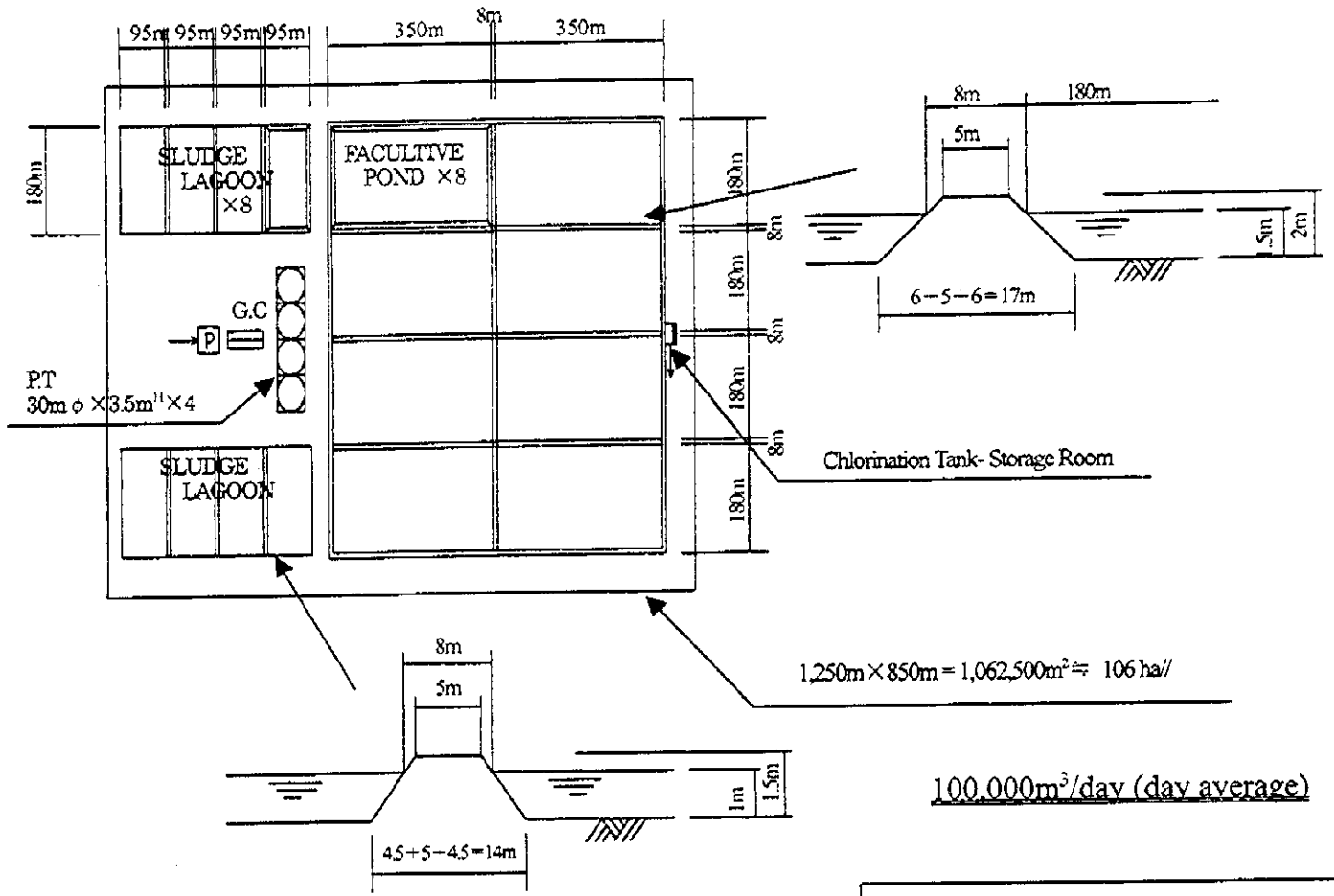
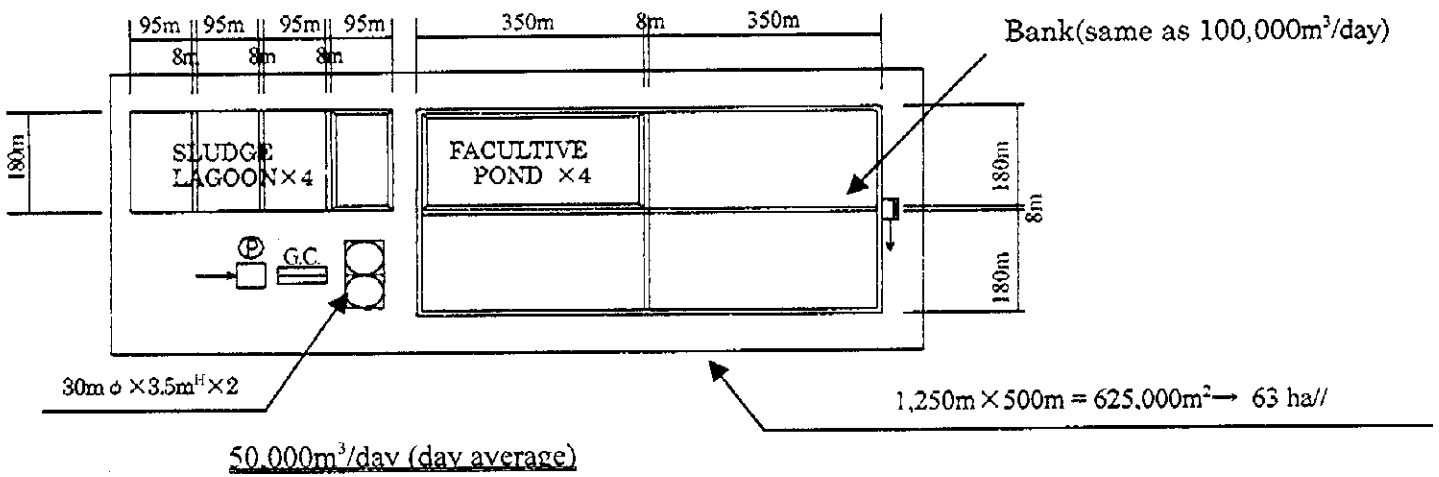


Figure 9.3.4.2
General Plan of Sewerage Treatment Plant(1/2)

The Study on the Sewerage System in North Dhaka



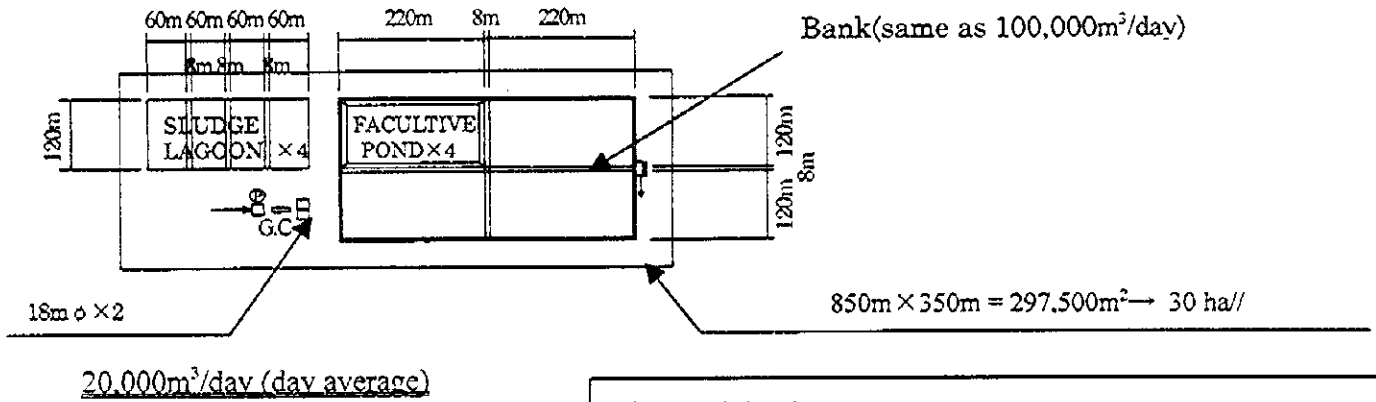


Figure 9.3.4.3
General Plan of Sewerage Treatment Plant(2/2)

The Study on the Sewerage System in North Dhaka

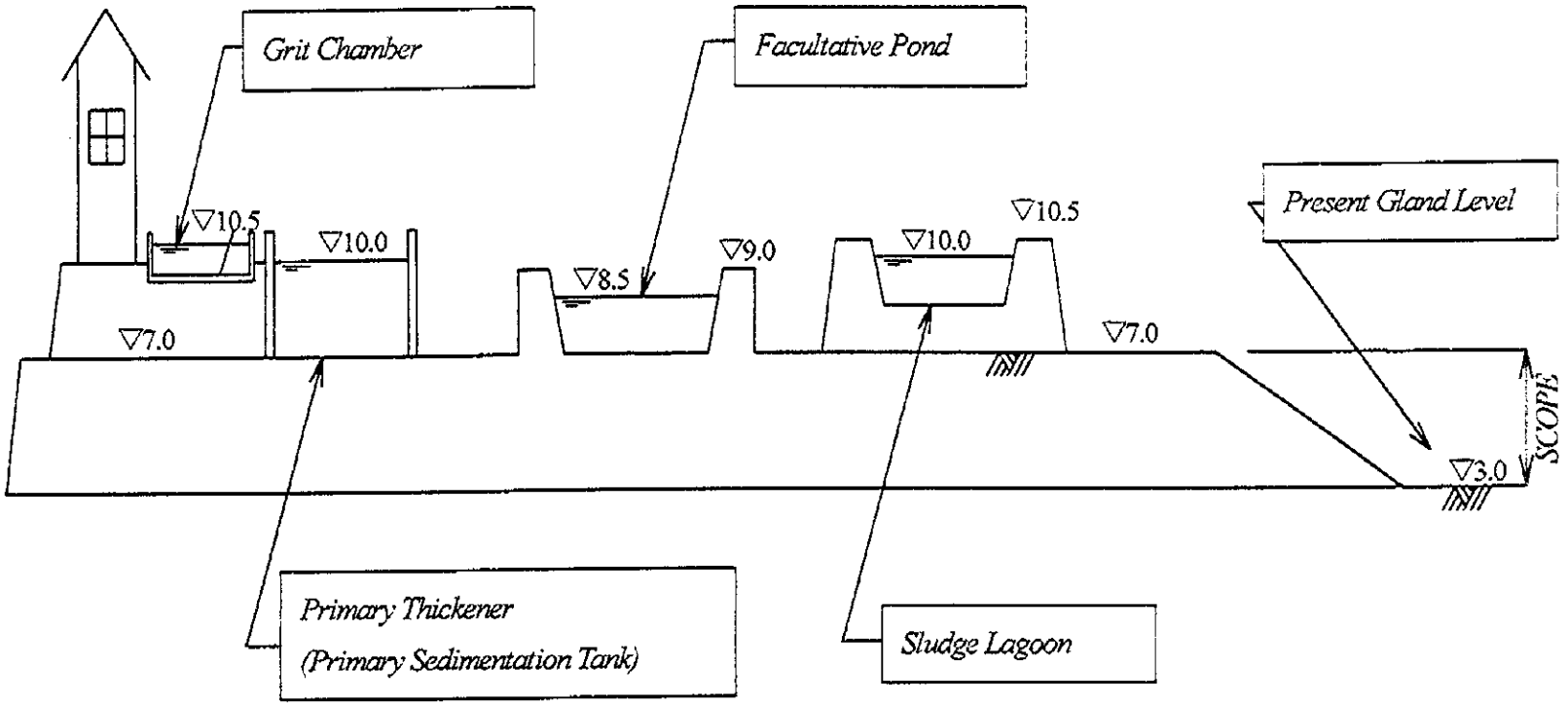


Figure 9.3.4.4
Hydraulic Profile Sewerage Treatment Plant

The Study on the Sewerage System in North Dhaka

Table 9.3.4.6 Equipment Cost & Power Consumption Estimation of STP (20,000m^3/day)

Daily Average/Daily Maximum/Hourly Maximum 20,000/25,000/33,000m^3/Day					
Designation	**Specification**		**Unit Cost**	**No.**	**Total**
Mechanical Equipment					**(YEN'000)**
Gate	Hand Operated Cast Iron Type	□1300mm	¥3,696	14	¥51,744
Movable Weir	Direct-Coupled Type	□1000mm	¥3,199	4	¥12,796
Screen	Hand Raked Bar Screen	W1.2m× OPEN20mm×	¥2,000	3	¥6,000
Sludge Collector	Circular Tank Sludge Scraper	φ 18m×0.4kW	¥26,962	2	¥53,924
Auxiliary Equipment of Sludge Collector	Circular Tank Sludge Scraper	φ 18m×0.4kW	¥18,491	2	¥36,981
Sludge Pump	Nonclogging Sludge Pump	φ 150mm× 1.0m^3/min	¥5,303	3(1)	¥15,909
Sludge Pump Motor	Totally Enclosed Fan	11kW	¥241	3(1)	¥723
Disinfection Equipment	Complete Set	20m^3	¥8,838	4	¥35,352
Chlorine Feeding Pump	Metering Pump	φ 25mm×P φ 32mm×0.8l/min×	¥4,191	3(1)	¥12,573
Instalation Work					¥113,001
Electrical Equipment					**(YEN'000)**
Power Distribution Facility	Complete Set			1	¥21,000
Operating Facility	Complete Set			1	¥17,500
Monitoring & Instrumentation facility	Complete Set			1	¥4,500
Instalation Work	Complete Set			1	¥30,100
Standby Generator	Complete Set			1	¥14,739
Transportation Cost	Complete Set			1	¥55,274
Grand Total					¥482,117
Electrical Load					**(kW)**
Sludge Collector	Circular Tank Sludge Scraper	0.4kW		2	0.8kW
Sludge Pump Motor	Totally Enclosed Fan	11kW		2	11.0kW
Chlorine Feeding Pump	Metering Pump	0.4kW		2	0.8kW
Lighting Facilities	Complete Set	9.0kW		1	9.0kW
Total					21.6kW
Annual Power Consumption					69,496kW

Table 9.3.4.7 Equipment Cost & Power Consumption Estimation of STP (50,000m^3/day)

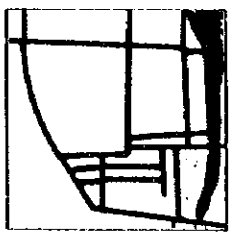
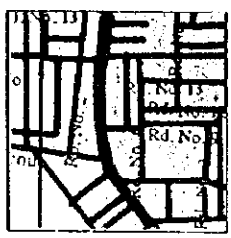
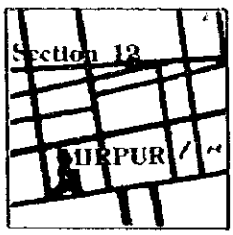
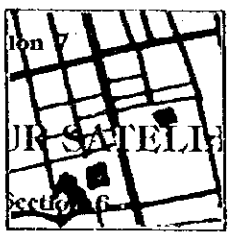
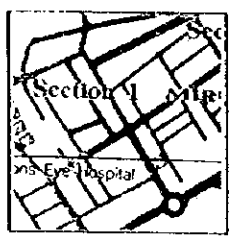
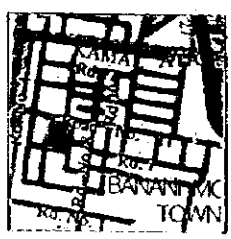
Daily Average/Daily Maximum/Hourly Maximum 50,000/63,000/82,000m^3/Day					
Designation	**Specification**		**Unit Cost**	**No.**	**Total**
Mechanical Equipment					**(YEN'000)**
Gate	Hand Operated Cast Iron Type	□1500mm	¥5,089	14	¥71,246
Movable Weir	Direct-Coupled Type	□1500mm	¥5,465	4	¥21,860
Screen	Hand Raked Bar Screen	W2.5m× OPEN20mm×	¥3,000	3	¥9,000
Sludge Collector	Circular Tank Sludge Scraper	φ30m×1.5kW	¥60,840	2	¥121,680
Auxiliary Equipment of Sludge Collector	Circular Tank Sludge Scraper	φ30m×1.5kW	¥27,807	2	¥55,615
Sludge Pump	Nonclogging Sludge Pump	φ200mm× 2.5m^3/min	¥5,303	3(1)	¥15,909
Sludge Pump Motor	Totally Enclosed Fan	11kW	¥241	3(1)	¥723
Disinfection Equipment	Complete Set	20m^3	¥8,838	2	¥17,676
Chlorine Feeding Pump	Metering Pump	φ25mm×Pφ 45mm×1.9l/min×	¥4,413	3(1)	¥13,239
Instalation Work					¥163,474
Electrical Equipment					**(YEN'000)**
Power Distribution Facility	Complete Set			1	¥19,900
Operating Facility	Complete Set			1	¥16,000
Monitoring & Instrumentation facility	Complete Set			1	¥8,600
Instalation Work	Complete Set			1	¥31,150
Standby Generator	Complete Set			1	¥23,746
Transportation Cost	Complete Set			1	¥76,664
Grand Total					¥666,482
Electrical Load					**(kW)**
Sludge Collector	Circular Tank Sludge Scraper	1.5kW		2	3.0kW
Sludge Pump Motor	Totally Enclosed Fan	11kW		2	22.0kW
Chlorine Feeding Pump	Metering Pump	0.4kW		2	0.8kW
Lighting Facilities	Complete Set	9.0kW		1	9.0kW
Total					34.8kW
Annual Power Consumption					104,828kW

Table 9.3.4.8 Equipment Cost & Power Consumption Estimation of STP (100,000m^3/day)

Daily Average/Daily Maximum/Hourly Maximum 100,000/125,000/163,000m^3/Day					
Designation	**Specification**		**Unit Cost**	**No.**	**Total**
Mechanical Equipment					**(YEN'000)**
Gate	Hand Operated Cast Iron Type	□1500mm	¥5,089	24	¥122,136
Movable Weir	Direct-Coupled Type	□1500mm	¥5,465	8	¥43,720
Screen	Hand Raked Bar Screen	W2.5m× OPEN20mm×	¥3,000	5	¥15,000
Sludge Collector	Circular Tank Sludge Scraper	φ30m×1.5kW	¥60,840	4	¥243,360
Auxiliary Equipment of Sludge Collector	Circular Tank Sludge Scraper	φ30m×1.5kW	¥27,807	4	¥111,230
Sludge Pump	Non-clogging Sludge Pump	φ200mm× 2.5m^3/min	¥5,303	5(1)	¥26,515
Sludge Pump Motor	Totally Enclosed Fan	11kW	¥241	5(1)	¥1,205
Disinfection Equipment	Complete Set	20m^3	¥8,838	4	¥35,352
Chlorine Feeding Pump	Metering Pump	φ25mm×Pφ 60mm×3.7l/min×	¥4,656	3(1)	¥13,968
Installation Work	Complete Set			1	¥306,243
Electrical Equipment					**(YEN'000)**
Power Distribution Facility	Complete Set			1	¥21,300
Operating Facility	Complete Set			1	¥16,000
Monitoring & Instrumentation facility	Complete Set			1	¥8,600
Installation Work	Complete Set			1	¥32,130
Standby Generator	Complete Set			1	¥40,805
Transportation Cost	Complete Set			1	¥135,758
Grand Total					¥1,173,321
Electrical Load					**(kW)**
Sludge Collector	Circular Tank Sludge Scraper	1.5kW		4	6.0kW
Sludge Pump Motor	Totally Enclosed Fan	11kW		4	44.0kW
Chlorine Feeding Pump	Metering Pump	0.4kW		2	0.8kW
Lighting Facilities	Complete Set	9.0kW		1	9.0kW
Total					59.8kW
Annual Power Consumption					163,228kW

Appendix 9.4.1 Calculation of Road Density of the Study Area

Area	No.1	No.2	No.3	Average
Uttara	67.67	72.00	104.33	81.33
Mirpur	83.67	89.67	100.00	91.11
Gulshan	98.33	89.00	131.00	106.11
Total	-	-	-	92.85

AREA	No.1	No.2	No.3
UTTARA			
MIRPUR			
GULSHAN			

Appendix 9.5.1 Project Cost by Sewerage Zone

Unit: TK'000

Service Area	Sewerage Zone		Construction Cost						Land Acquisition Cost			Grand Total
			Trunk Main	Branch Sewer	Pumping Station	Sub-total	STP	Total	Pumping Station	STP	Sub-total	
Tongi	Tongi	Core	98,207	61,785	294,520	454,512	646,157	1,100,669	3,030	733,740	736,770	1,837,439
		Transitional	43,150	364,979	0	408,129	0	408,129	0	0	0	408,129
North Dhaka East	Uttara	Core	49,249	206,221	81,493	336,963	0	336,963	1,320	0	1,320	338,283
		Transitional	100,304	209,495	0	309,799	0	309,799	0	0	0	309,799
	East	Core	445,851	111,551	898,318	1,455,720	1,663,590	3,119,310	30,325	1,440,780	1,471,105	4,590,415
		Transitional	93,269	731,755	0	825,024	0	825,024	0	0	0	825,024
North Dhaka West	West	Core	433,306	180,829	1,047,451	1,661,586	2,340,602	4,002,188	5,795	2,391,110	2,396,905	6,399,093
		Transitional	86,587	768,691	123,969	979,247	0	979,247	1,110	0	1,110	980,357
Total			1,349,923	2,635,306	2,445,751	6,430,980	4,650,349	11,081,329	41,580	4,565,630	4,607,210	15,688,539

Appendix 9.5.2 Project Implementation and Disbursement Schedule (MP)

Unit: TK'000

Items	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Implementation Schedule																					
1. Land Acquisition																					
East																					
West																					
Tongi																					
2. Construction Work																					
2.1 Collection System																					
East East Core																					
East East Transitional																					
East Uttara Core																					
East Uttara Transitional																					
West West Core																					
West West Transitional																					
Tongi Tongi Core																					
Tongi Tongi Transitional																					
2.2 Sewerage Treatment Plant																					
East																					
West																					
Tongi																					
Disbursement Schedule																					
1. Land Acquisition Cost	1,487,485				600,675	600,675				0	0	360,195	360,195		1,320		598,332	598,333			3,870,440
East	750,715											360,195	360,195		1,320						1,472,425
West					600,675	600,675											598,332	598,333			2,398,015
Tongi	736,770																368,385	368,385			1,473,540
2. Construction Cost	567,684	968,120	952,660	264,676	264,676	270,805	569,507	662,081	569,507	276,931	276,931	275,970	482,956	690,907	513,933	323,381	294,792	572,360	864,935	572,360	9,572,531
2.1 Collection System	567,684	552,223	536,762	264,676	264,676	270,805	276,931	276,931	276,931	276,931	276,931	275,970	275,008	275,008	305,985	323,381	294,792	279,785	279,785	279,785	5,568,339
East East Core	264,676	264,676	264,676	264,676	264,676	132,340															1,455,720
East East Transitional												137,504	275,008	275,008	137,504						825,024
East Uttara Core															168,481	168,482					336,963
East Uttara Transitional																154,899	154,900				309,799
West West Core						138,465	276,931	276,931	276,931	276,931	276,931	138,466									1,661,586
West West Transitional																	139,892	279,785	279,785	279,785	979,247
Tongi Tongi Core	303,008	151,504																303,008	151,504		909,024
Tongi Tongi Transitional		136,043	272,086																136,043	272,086	816,258
2.2 Sewerage Treatment Plant		415,897	415,898			0	292,576	585,150	292,576	0	0	0	207,948	415,899	207,948	0	0	292,575	585,150	292,575	4,004,192
East		415,897	415,898										207,948	415,899	207,948						1,663,590
West							292,576	585,150	292,576									292,575	585,150	292,575	2,340,602
Tongi		646,157																323,078	323,079		1,292,314
Total (including overhead etc.)	681,221	1,161,744	1,143,192	317,611	317,611	324,966	683,408	1,034,497	683,408	332,317	332,317	331,164	579,547	829,088	616,720	388,057	353,750	686,832	1,037,922	686,832	12,522,204
3. Engineering Service	20,437	34,852	34,296	9,528	9,528	9,749	20,502	31,035	20,502	9,970	9,970	9,935	17,386	24,873	18,502	11,642	10,613	20,605	31,138	20,605	375,668
4. Administration Cost	35,083	59,830	58,874	16,357	16,357	16,736	35,196	53,277	35,196	17,114	17,114	17,055	29,847	42,698	31,761	19,985	18,218	35,372	53,453	35,372	644,895
5. Physical Contingency	222,423	125,643	123,636	34,350	94,417	95,213	73,911	111,881	73,911	35,940	35,940	71,835	98,698	89,666	66,830	41,968	98,091	134,114	112,251	74,281	
Total (1+2+3+4+5)	2,446,649	1,382,069	1,359,998	377,846	1,038,588	1,047,339	813,017	1,230,690	813,017	395,341	395,341	790,184	1,085,673	986,325	735,133	461,652	1,079,004	1,475,256	1,234,764	817,090	19,964,976
6. Price Contingency	122,332	138,207	204,000	75,569	259,647	314,202	284,556	492,276	365,858	197,671	217,438	474,110	705,687	690,428	551,350	369,322	917,153	1,327,730	1,173,026	817,090	9,697,652
7. Project Cost	2,568,981	1,520,276	1,563,998	453,415	1,298,235	1,361,541	1,097,573	1,722,966	1,178,875	593,012	612,779	1,264,294	1,791,360	1,676,753	1,286,483	830,974	1,996,157	2,802,986	2,407,790	1,634,180	29,662,628

A. 14

ENVIRONMENTAL ASPECTS

Appendix 14.3.1 Questionnaire Survey of Residents' Awareness on Environmental Sanitation

As a part of the Stage 1 field work, the questionnaire survey of residents' awareness on environmental sanitation was carried out covering 200 households in the Study Area.

Contained in this Appendix is a excerpt from the Questionnaure Survey Report.

CHAPTER 2: THE PROPOSED PROJECT

DWASA-JICA is currently carrying out a ***Masterplan Study and Feasibility Study for Sewerage and Sanitation in North Dhaka***. The area comprises Tongi, Uttara, Mirpur, Mohammadpur, Banani, Badda, Gulshan and Baridhara. The study will include determination of current household sanitation situation and practices and demand for improved facilities. The survey shall form part of the Feasibility Study Report as "Survey of Residents Awareness of Environmental Sanitation"

1. OBJECTIVES AND SCOPE OF SURVEY

The consultant shall carry out a base-line socio-economic survey before the start of the detailed Master Plan and Feasibility Study. The survey would serve two purposes:

- provide socio-economic data of the households on which the detailed design of the Master Plan can be based; and

- provide a profile of the present sanitation practices and willing to pay for improved sanitation as a basis for the demand for improved facilities and future project monitoring and evaluation.

The survey shall comprise, but not necessary be limited to the collection of the following data:

- **Socio-economic Data**

  : *family size, literacy level, occupation;*

  : *income and expenditure pattern;*

  : *house type (construction, size, no of rooms, etc.);*

  : *number of occupants*

  : *mode of occupants (owned, rented, etc.);*

  : *water consumption (source, daily consumption volume);*

  : *monthly cost for acquiring water needs;*

  : *type of toilets and waste water disposal facilities*

- **Data Related to Sanitation Practice, Awareness and Demand**

  : *common sanitation habits, customs, beliefs or practice in the households;*

  : *positive and negative household hygiene or practices;*

  : *awareness of the relation between sanitation practices and diseases;*

: *attitude and awareness of the residents about environmental sanitation problem;*

: *perceived need for improving household sanitary practices;*

: *Willingness and Affordability of Pay for Improved Sanitation.*

The survey shall be conducted of about 200 households apportioned according to population size among the proposed areas.

CHAPTER 3 : METHODOLOGY

1. SAMPLING AND SURVEY

The methodology to collect the data has been designed based on a combination of participatory approaches together with standard household survey techniques.

The socio-economic and sanitation baseline data required for the project has been obtained using this integrated approach. By adopting a participatory approach which treats the community as an integrated whole, much information becomes available generated by community members on a voluntary basis. This improves the quality and nature of the data obtained, since use will be made of local expertise and knowledge, resulting in greater accuracy.

Thus, two main methods have been used (a) a rapid survey, otherwise known as a Participatory Rapid Appraisal (PA), and (b) a household survey drawn from a representative sample of households. For the PA, the method of data generation is through emphasis on joint activities carried out between community members and the survey team, through dialogue, group discussion and interaction with community members which allows for informal exchange and a consequent strengthening of rapport. This in turn enables information which is supplemented by observation, provides opportunities for cross-checking and reduces the chances of misinterpretation and misunderstanding.

The household survey is carried out in a representative sample of the households using a prepared questionnaire and checklist.

The PA survey is carried out first, in each of the eight selected areas, by facilitator trained in the methodology for the purpose. The household survey has been carried out subsequently as a separate activity, by surveyors trained for the purpose. The household survey has been carried out after the PA activities, as the rapport and familiarity generated in the PA improve the quality of the information provided by local people.

1.1 Participatory Rapid Appraisal

To meet the requirements of obtaining as full a picture as possible of the socio-economic condition in each specific participatory activities has been be undertaken.

The information has been largely collected by means of group activities, which are described

below. Generally, when such activities are undertaken, a large number of people attend initially. The composition may change over the period of two to three hours that is taken that women are encouraged to speak out, and take part. A wide cross-section of community members taking part in the activities will be ensured, as these will be held in central public locations, thus giving a high profile and easy access.

Community/Social Map

This is a map drawn by the community members, guided by the survey team. From this map, much locally specific information is obtained, including: population of target area, households, schools, location of households, location and distance of existing water sources, etc. In such a group activity, the time needed varies from 2-3 hours, as different community members take part, correct each other, and correlate the various contributions.

Wealth Ranking

Obtaining information on individual and family income has been done through the wealth ranking activity. This is carried out with small groups of community members, and focuses on identifying the criteria for wealth locally used, the range of resources within the community, and then comparing households in terms of wealth/income. The community map is used as a reference point, as households will be marked on it, and each group will then "rank" each household on the map according to whether it is rick, middle or poor.

Household Interview

With reference to the map, a few households, giving a representative cross-section of the households in the project areas, has been selected, which are then visited to discuss certain aspects related to study. A semi-structured interview together with a checklist is used to obtain such information.

Focus Group Discussions/Community Meetings

Focus Group Discussions (FGD) with groups is held on specific topics such as sanitation practice and water use. These provide the opportunity to gain spontaneous reactions from community members, particularly on controversial topics.

Triangulation, Transept Validation

Constant cross-referencing, which occurs as a result of using different participatory activities to obtain data, is an essential element of PA. "Triangulation" refers to the practice of obtaining information from several different sources as a means of cross-checking and verifying accuracy. For example, data obtained on household income from the Wealth Ranking activity is checked against information obtained during the household interview. The strength of PA is capitalising on the local knowledge and experience of community members, which provides the accurate and up-to date knowledge of the local situation.

A transept is an informal walk taken through the community. The path is determined from the Social Map, and is designed to transept" the community to gain a cross-sectional, three dimensional view of the area. In this way, observation of what hygiene practices are actually

being carried out in and around homes has been combined spontaneous and informal discussions.

KAP Survey

A knowledge, attitudes and practice (KAP) survey has been carried out to established existing sanitation practice. A questionnaire format has been used in combination with participatory techniques including semi-structured interviews and observation. An important element of obtaining data on personal hygiene behavior has been done by indirect methods, such as observation, focus group discussions, and "transepts". These methods assist in the identification of cultural perceptions on the relationship between good sanitation practices and personal hygiene, and in the assessment of the use of specific practices in relation to personal hygiene.

1.2 Household Survey

225 households have been surveyed in the whole of eight study areas: Tongi, Uttara, Mirpur, Mohammadpur, Banani, Badda, Gulshan and Baridhara by adopting random sampling technique.

It should have been ideal, if a list of households with respective income in the whole of the project area would be available and then select samples proportionately for high, medium and low income groups. Due to time and resource constraints, it was not possible to go by this way. However, to make the sample representative, conducting survey is proposed in the following manner.

Each study area has been divided into three zones of high, medium and low income group residences with the help of PA and community maps. Proportions of households in these are also determined by the same method. By adopting stratified random sampling technique, sample size in each zone is determined. In each Zone, again PA and community map activity has been done and the wealth ranking activity is applied to select the sample households. Distribution of sample households in eight zones is shown below:

Area	Types of Sample Households			Total
	Independent	Apartment	Slum	
Tongi	8	16	7	31
Uttara	19	12	0	31
Mirpur	11	19	5	35
Muhammadpur	13	22	7	42
Banani	8	10	0	18
Badda	9	24	5	38
Gulshan	4	16	0	20
Baridhara	2	7	1	10
Total	74	126	25	225

Preparation of Survey Questionnaire, Pre-test Modification and Operation

A survey questionnaire is prepared in accordance with the objectives of the study. The questionnaire contain very simple and direct open ended as well as pre-coded questions. Before the questionnaire is finalized it is pre-tested interviewing several target groups for judging the suitability of the prescribed questions. On the basis of the findings of the pre-test, the questionnaire is modified. Pre-testing highlights:

* Relevancy of questions;

* clear understanding by the respondents without interpretation or explanation;

* they are easily answerable;

Following the pre-testing alteration, changes and modifications questionnaire has been finalized. The questionnaire then has been reproduced in adequate number for the survey.

2 SURVEY OUTPUTS

The questionnaires thus prepared and data collected provide interalia, the following information:

* existing coverage and level of Sanitation
* level of services desired by the community
* technology options preferred by the community
* willingness to pay for what they want

Table 14.3.1 Results of Area-wise Questionnaire Survey

Item	Category	Unit	Tongi				Uttara				Mirpur				Mohammadpur			
			Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.
No. of respondents		**nos.**	**8**	**16**	**7**	**31**	**19**	**12**	**0**	**31**	**11**	**19**	**5**	**35**	**13**	**22**	**7**	**42**
Socio-Economic Profile																		
Family Size	Male	prs.	2.6	3.4	3.3		3.2	2.7			2.7	2.9	3.2		2.3	1.8	2.5	
	Female	prs.	3.5	4.0	3.0		2.8	2.7			3.3	2.2	4.8		4.5	5.7	3.1	
	Male/Female Ratio	%	73	85	67		112	98			84	133	67		83	100	0	
	Oveall Ave.	prs.	6.1	7.7	7.0		7.1	6.4			6.0	5.1	8.0		6.4	7.2	5.3	
Age Structure	Below 15 Years	prs.	1.7	2.8	3.3	2.3	2.2	1.7			2.1	1.2	3.0					
	15-60 Years	prs.	4.4	4.1	3.0	4.0	3.8	4.1			4.3	4.2	4.8		70.3	79.0	59.2	
	Above 60 Years	prs.	0.0	0.8	0.7	0.4	1.0	0.0			0.3	1.3	0.3					
Literacy Level	Overall	%				75				82				86				81
	Primary Level	%				83				60				56				55
	Secondary Level	%				54				10				20				21
	Higher Secondary Level	%				25				5				14				14
Occupational Status	Not Working	%				7				7								
(for more than 10 years	Looking for Work	%				1				14								
	Engaged in HH	%				30												
	Working	%				61												
(for working members)	Non-Government	%	55	51			75	40			65	42			53	47		
	Government	%		32			25	54				32				33		
	Own Private Business	%	45	17				6			35	26			47	20		
	Daily Labour	%			66													
(for income source)	Only 1	prs.	5	2	7	14	8	10			10	7	4		3	3	5	
	Only 2	prs.	10	5	0	15	4	9			8	1	0		17	6	2	
	Only 3	prs.	1	1	0	2	0	0			1	3	1		2	4	0	
	Ave.	prs.	1.9	1.8	1.0	1.5	1.3	1.5			1.5	1.6	1.4		2.0	2.1	1.3	
Income & Expenditure	Income	Tk	10,750	17,250	2,429		24,167	20,263			13,263	14,454	8,600		10,590	26,153	4,285	
	Expenditure	Tk	7,427	14,429	1,984		16,483	16,587			9,280	10,667	5,508		8,050	19,462	3,454	
	Expend./Income Ratio	%	69	84	82		68	82			70	74	64		76	75	80	

Table 14.3.2 Results of Area-wise Questionnaire Survey (Cont'd)

Item	Category	Unit	Tongi				Uttara				Mirpur				Mohammadpur			
			Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.
No. of respondents		nos.	8	16	7	31	19	12	0	31	11	19	5	35	13	22	7	42
Type of House	1970's	%			86												most	
(for construct. period)	1980's	%	*				67	74			42	36	60		42	36		
	1990's	%		62			33	26										
(for room composition)	1 + 1	%	36	0	0	13	0	0			15	0	0	9	17	0	0	3
	2 + 1	%	64	0	0	23	0	27			45	0	0	26	83	0	0	24
	3 + 1	%	0	67	0	19	0	73			0	80	0	34	0	63	0	29
	4 + 1	%	0	33	0	10	100	0			0	20	0	8	0	37	0	16
	G	%					0	0			0	0	0	0	0	0	0	0
	Other	%	0	0	100	35		0			40	0	0	23	0	0	100	26
(for eating place)	In the Living Room	%	63	13	100		8	0			42	18	80	40	9	8	100	29
	In the Dining Room	%	13	76	-		92	100			42	64	0	43	73	92	0	65
	In the Annex	%	25	13	-		0	0			16	18	20	17	18	0	0	6
Occupants	No. of Families	fam.	1.2	1.7	2.0		1.5	1.2			1.3	1.8	2.3		1.3	1.8	2.2	
Mode of Occupancy	Owned by Residence	%	55	100	0		100				100	100	0		100	100	0	83
	Rental from Private	%	35	0	100			100			0	0	100		0	0	100	17
	Rental from Public	%	10	0	0						0	0	0		0	0	0	0
Water Consumption	Tubewell	%	31	75														
	Piped Water System	%									90	100			80	100	8	
(for no. of faucets)	1	nos.	0	0			0	0			5	1			14	0		
	2	nos.	0	0			0	0			3	0			3	0		
	3	nos.	2	1			0	1			4	0			0	0		
	4	nos.	1	1			0	0			1	5			2	2		
	5	nos.	0	1			0	1			1	0			1	0		
	6	nos.	1	0			0	1			1	1			1	4		
	7	nos.	0	2			1	0			0	1			0	1		
	8	nos.	1	1			1	2			1	2			0	1		
	9	nos.	0	0			0	0			0	0			0	1		
	10	nos.	0	0			0	2			0	1			0	3		
	Ave.	nos.	4.8	5.7			7.2	7.1			2.9	5.5			1.6	5.5		
(for daily consumption)		gal/d	400	450	193		250	290			200	245	190		131	528	195	

Table 14.3.3 Results of Area-wise Questionnaire Survey (Cont'd)

Item	Category	Unit	Tongi				Uttara				Mirpur				Mohammadpur			
			Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.
No. of respondents		nos.	8	16	7	31	19	12	0	31	11	19	5	35	13	22	7	42
Monthly Water Cost		Tk	52	436	25		312	442			155	221	160		169	657	53	
Type of Toilet	Flush Toilet & Sewer	%					0	0				100			20	13	0	
	Flush Toilet w/ Sep. Tank	%		100			0	100			67				11	0	0	
	Flush Toilet w/ Soak. Pit	%					0	0							0	0	0	
	Dry Pit Latrine	%	100				0	0					100		0	0	0	
	Shared Latrine	%			63		0	0							0	0	10	
	Others	%			37		0	0							1	0	0	
Sanitation Practices, Awareness & Demand																		
Sanitation Habits	Empty their Tank	%	100	100			100	100							54	23		
	Cost per Operation	Tk	340	608			733	958			300		250		370	200		
Garbage Disposal (for disposal site)	To the Designated Place	%	100	86	0		100	100			100	96	0		34	69		
	To the Nearby Street	%				67							57				57	
	To the Drainage Canal	%				33							43					
(for canal cleaning-up)		%	12	62			8	11			12				23			
Awareness on Sanitation	Unsanitary Water Source	%	94	62	86		100	100			96	100	78		90	100	65	
	Toilet Eff. to Canal	%		100				100			100				53			
	Sickness by Tap Wat.	%	81	62	42		0	0			64	87	39		51	74	41	
Experience of Problem	Red Water from Faucets	%	19	37	14		0	10			16	7	20		38	56	5	
	Odor from Faucets	%	17	37	14		8	5			16	27	23		34	23	45	
Improvement of Sanitary Practice	Use of Flush Toilet	%	80	80			100	100			100	100			100	100		
	Use of Pit Latrine	%			10								5					
	Demand for Sewerage	%				90				100				95				95
Willingness & Affordability to Pay																		
Willingness to Pay		%				100				100				100				100
Affordability to Pay	100 - 200 per Month	nos.	11	1	1		11	9			10	3	1		13	4	3	
	200 - 300	nos.	2	4	0		0	5			3	3	0		3	4	0	
	300 - 400	nos.	2	1	0		0	1			2	0	0		1	1	0	
	400 - 500	nos.	1	2	0		0	0			0	0	0		0	3	0	
	Ave.	Tk	206	300	150		150	197			197	200	150		180	275	150	

Table 14.3.4 Results of Area-wise Questionnaire Survey

Item	Category	Unit	Banani				Badda				Gulshan				Baridhara			
			Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.
No. of respondents		nos.	8	10	0	18	9	24	5	38	4	16	0	20	2	7	1	10
Socio-Economic Profile																		
Family Size	Male	prs.	1.8	3.6			3.3	3.0	2.5		2.0	4.6			2.9	1.5	8.0	
	Female	prs.	3.6	2.8			3.4	3.3	3.0		3.9	3.8			2.9	2.0	5.0	
	Male/Female Ratio	%	44	132			98	89	83		44	132			100	75	160	
	Oveall Ave.	prs.	5.4	6.4			6.7	6.3	5.5		5.9	8.4			5.7	3.5	8.0	
Age Structure	Below 15 Years	prs.	1.2	1.6			2.3	2.2	2.2	2.2	1.2	1.6			2.6	1.0	2.0	
	15-60 Years	prs.	4.3	4.8			4.6	4.5	3.3	4.1	4.3	4.8			3.6	2.5	6.0	
	Above 60 Years	prs.	0.0	0.7			0.8	1.3	0.0	1.5	0.0	0.7			0.7	1.0	0.0	
Literacy Level	Overall	%				89				81				95				88
	Primary Level	%				51				55				41				55
	Secondary Level	%				32				21				39				21
	Higher Secondary Level	%				6				14				6				14
Occupational Status	Not Working	%																
(for more than 10 years	Looking for Work	%																
	Engaged in HH	%																
	Working	%																
(for working members)	Non-Government	%	53	56			53	47			53	58			53	47		
	Government	%		31				33				32				33		
	Own Private Business	%	47	13			47	20			47	10			47	20		
	Daily Labour	%																
(for income source)	Only 1	prs.	4	1							4	1			4	1	1	
	Only 2	prs.	3	6							3	6			3	1	0	
	Only 3	prs.	3	1							3	1			0	0	0	
	Ave.	prs.	1.9	2.0							1.9	2.0			1.4	1.5	1.0	
Income & Expenditure	Income	Tk	27,500	25,625			20,361	25,357	5,500		28,500	25,600			28,571	35,000	10,000	
	Expenditure	Tk	18,363	23,729			17,479	19,948	3,385		19,360	22,700			25,157	11,463	7,400	
	Expend./Income Ratio	%	67	93			86	78	62		67	88			88	33	74	

Table 14.3.5 Results of Area-wise Questionnaire Survey (Cont'd)

Item	Category	Unit	Banani				Badda				Gulshan				Baridhara			
			Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.
No. of respondents		**nos.**	**8**	**10**	**0**	**18**	**9**	**24**	**5**	**38**	**4**	**16**	**0**	**20**	**2**	**7**	**1**	**10**
Type of House	1970's	%					most								most			
(for construct. period)	1980's	%	50	56				67			70	60				67		
	1990's	%																
(for room composition)	1 + 1	%	0	0		3	19	0	0	12	0	0			0	0	100	
	2 + 1	%	100	0		24	26	0	0	16	100	0			14	0	0	
	3 + 1	%	0	50		29	0	100	0	26	0	50			72	50	0	
	4 + 1	%	0	50		16	55	0	0	35	0	50			0	50	0	
	G	%	0	0		0	0	0	0	11	0	0			14	0	0	
	Other	%	0	0		26	0	0	100	0	0	0			0	0	0	
(for eating place)	In the Living Room	%	1	1											3	0	1	
	In the Dining Room	%	8	12											4	2	0	
	In the Annex	%	2	0											0	0	0	
Occupants	No. of Families	fam.	1.8	1.3			1.3	1.8	2.2		1.3	1.2			1.3	1.8	2.2	
Mode of Occupancy	Owned by Residents	%					100	100	0	91	100	100			100	100	0	
	Rental from Private	%					0	0	100	9	0	0			0	0	100	
	Rental from Public	%					0	0	0	0	0	0			0	0	0	
Water Consumption	Tubewell	%																
	Piped Water System	%	100	100			97	100	8		100	100			97	100	8	
(for no. of faucets)	1	nos.	0	0			5				0	0			0	0	0	
	2	nos.	0	0			13				0	0			3	0	1	
	3	nos.	0	0							0	0			0	0	0	
	4	nos.	0	1							0	1			0	0	0	
	5	nos.	2	1							2	1			0	0	0	
	6	nos.	2	0							2	0			0	0	0	
	7	nos.	2	2							2	2			0	0	0	
	8	nos.	0	1							0	1			0	0	0	
	9	nos.	1	0							1	0			0	0	0	
	10	nos.	3	1							3	1			4	2	0	
	Ave.	nos.	7.5	6.8							7.5	6.8			7.0	10.0	1.0	
(for daily consumption)		gal/d	304	290							504	308			185	304	200	

Table 14.3.6 Results of Area-wise Questionnaire Survey (Cont'd)

Item	Category	Unit	Banani				Badda				Gulshan				Baridhara			
			Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.	Indep.	Apart.	Slum	Ave.
No. of respondents		nos.	8	10	0	18	9	24	5	38	4	16	0	20	2	7	1	10
Monthly Water Cost		Tk	557	522			169	657	53		786	825			390	450	200	
Type of Toilet	Flush Toilet & Sewer	%	0	100			32	100			100	100			58	50	0	
	Flush Toilet w/ Sep. Tank	%	100	0			53				0	0			14	50	0	
	Flush Toilet w/ Soak. Pit	%	0	0							0	0			14	0	0	
	Dry Pit Latrine	%	0	0					100		0	0			0	0	0	
	Shared Latrine	%	0	0							0	0			14	0	100	
	Others	%	0	0							0	0			0	0	0	
Sanitation Practices, Awareness & Demand																		
Sanitation Habits	Empty their Tank	%	53				54	23			-	-			54	23		
	Cost per Operation	Tk	390				340	220			-	-			300	2,400		
Garbage Disposal (for disposal site)	To the Designated Place	%	45	69			45	75			75	87			45	75		
	To the Nearby Street	%	55	31					57		25	13					100	
	To the Drainage Canal	%									0	0						
(for canal cleaning-up)		%	32				23				3				23			
Awareness on Sanitation	Unsanitary Water Source	%	93	100			90	65			90	100			90	100	100	
	Toilet Eff. to Canal	%	76				53								33			
	Sickness by Tap Wat.	%	45	44			51	74	41		45	55			64	74	100	
Experience of Problem	Red Water from Faucets	%	43	19			38	56	5		23	19			26	56	0	
	Odor from Faucets	%	22	37			34	23	45		12				34	23	100	
Improvement of Sanitary Practice	Use of Flush Toilet	%	100				100	100			100	100			100	100		
	Use of Pit Latrine	%							8		0	0					100	
	Demand for Sewerage	%				100				90				100				100
Willingness & Affordability to Pay																		
Willingness to Pay		%				100				100				100				100
Affordability to Pay	100 - 200 per Month	nos.	0	1			11	2	2		4	2			0	0	1	
	200 - 300	nos.	0	1			6	5	0		5	1			2	0	0	
	300 - 400	nos.	4	3			0	2	1		0	0			0	0	0	
	400 - 500	nos.	6	2			0	0	0		1	0			5	2	0	
	Ave.	Tk	410	336			185	205	216		230	184			393	450	150	

Appendix 14.4.1 Initial Environmental Examination

The Initial Environmental Examination (hereinafter referred to as "IEE") was conducted by subletting the field work to the local consultants under supervision of the Study Team during the Stage 1 field work.

The reconnaissance survey was carried out not only covering the alternative sites of sewage treatment plants, but also contacting local residents and officials concerned.

The laws and regulations pertaining to the environmental protection as well as the conduct of the environmental examination were scrutinized as bottom line information of this particular study.

Upon concluding the IEE study, a proposed scope of the Environmental Impact Assessment was also prepared in view of anticipated environmental impacts which may be brought out through the implementation of the proposed sewerage project.

Excerpts of the principal IEE study report is hereby attached.

CHAPTER 3 : POTENTIAL SIGNIFICANT IMPACTS

3.1. IEE Methodology

While conducting the initial examination the consultant has followed guidelines as prescribed in the Environmental Protection Act (EPA) of 1995 which became effective from June 1, 1995.

In conformity to the very basic definition that IEE is a preliminary environmental impact assessment of a project in a cursory review process and serves to indicate those aspects which deserve further in-depth study, the current study has been carried out to :

- identify the projects key impacts on the environment;
- evaluate their importance and recommend mitigation measures;
- list issues which are still unresolved and warrant further environmental examination i.e. EIA.

In accomplishing the above tasks baseline informations were collected through reviewing all available materials on the project and environmental setting and by performing field reconnaissance of the project area. Informal interviews were held with local residents near the proposed treatment plant sites and also the concerned local authorities to know the local situations.

After through review of the baseline informations the boundaries of required environmental examination were decided covering all phases of the project that is siting, construction, operation and closure. Government officials and other concerned parties were included in the scoping.

Of the several methodologies developed for assessing the impacts checklist method was adopted considering the current status of development in Bangladesh and the information available. The whole range of potential impacts on various environmental components due to various project activities were identified qualitatively and quantitatively where possible. These provide a frame work in identifying quickly the impacting activities and the environmental components to be impacted upon. Also the impacts without the project i.e. DO-NOTHING scenario were compared with the impacts of the project.

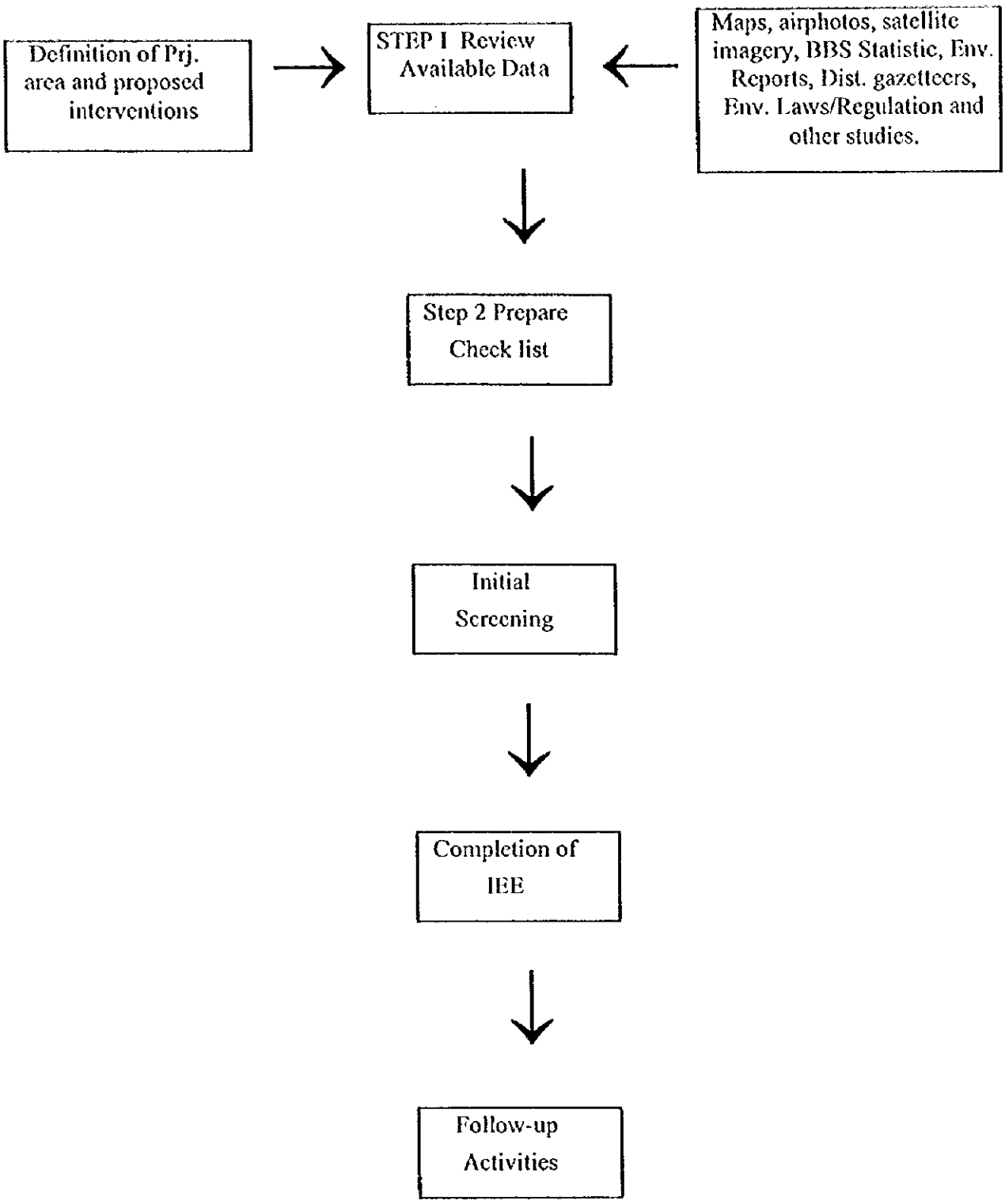
After the identification of significant impacts and issues arising out of them, mitigation measures or project modifications/alternatives have been proposed to address the environmental impact issues. An Environmental Management plan has also been formulated for mitigation, protection and enhancement of environmental quality.

Finally with a view to resolving the unresolved critical issues in the next stage a Terms of Reference (TOR) for detailed Environmental Impact Assessment (EIA) has been proposed.

An activty Schedule has been put up in **Fig. 4**

Fig. 4

ACTIVITY SCHEDULE -IEE



3.2. Check List and Magnitude of Impact

It may be seen in Table 3.1 that majority of the issues (more than 50%) falls within the group C and subject to further verification and this requires that such issues have to be taken care of during Feasibility Study/EIA. The major issues that have been identified are land (swamp/flood plain), traffic hazard and partially regional drainage problems. The are slight impacts anticipated in issues like movement of cattles, people, naise hazard, right of way for sewer net work re-settlement issues, down stream surface water quality, odour problem, air pollution and flood plain fisheries. There are no historic/culturalmonuments or endangered species of flora, fauna, aquatic life that may be affected by the interventions.

3.3. Screening

According to the Department of Environment screening is the first and the simplest tier of project evaluation from the environmental angle. Screening helps to identify the type of projects which are not likely to cause environmental problems.

The screening exercise is carried out based on several criteria such as type of project, it's size and location. The exercise itself can also be if analytical type or normative type. In Bangladesh normative type screening has been preferred according to which industries have been divided in 3 categories viz
- Green
- Orange
- Red

The list of industries or projects falling into these three categories are shown in Annex-3 including the application of the different categories.

3.4 Preliminary identification of Main Environmental Impacts

The major environmental issues both positive and negative of the study area were identified during the reconnaissance stage of the study and listed in **Table 3.2.** The process adopted in the table as shown allow the principal negative impacts to be identified and their differing and spatial variation to be studied. Pprovided it is considered sound overall, the recommendations are to be made as to how the negative impacts could be avoided or integrated for with in the frame work of an integrated environmental management plan. The ultimate goal is the expansion of sustainable basic sanitation services with respect to pollution abatement, to protect ground and surface water resources from pollution and to environmental conditions and to eliminate health hazards and the risk of human contacts with excreta and waste water in sensitive areas.

3.5 Proposed Treatment Plant Locations

The probable sites as indicated by NJS Ltd (expatriate consultants) has been shown as site 1, 2, 3 and A, B, C for the treatment plants and pump stations respectively in **Fig.2**

Table 3.1

Check List of
Initial Environmental Examination (IEE)
North Dhaka Sewerage Project

	Action Affecting Resources and Values	Effects on Environment	Magnitude of Impact				Recommeded feasible
			D	C	B	A	Protection measurs
1	2	3	4	5	6	7	8
A.	**Environmental effects due to site selection for treatment plant, pumping station & sewer routes**						
i)	Encroachment into forest/swamp lands	Ecological losses				✓	Alternative sites
ii)	Impediment to movement of wildlife, cattle, people	Losses in Community economy			✓		"
iii)	Excessive Traffic hazards for access Roads	Losses in Community economy and social values				✓	Careful planning & monitoring
iv)	Nuisance/hazards to neighbours	Do			✓		"
v)	Effects to adjacent property values	Do			✓		"
vi)	Plant drainage problems	Increasing in project cost		✓			"
vii)	Regional drainage problems	Losses in Community economy and social values				✓	"
viii)	Resettlement problems	Social injustice		✓			Careful planning & adequate compensation
ix)	Effects on precious ecology	Ecological loss		✓			Careful planning
x)	Socio-Economic Impacts	Dissatified neighbourhood population			✓		"
xi)	Depreciation of Environmental aesthetic by structures	Losses in environmental aesthetics		✓			"
xii)	Impairment of historic/cultural monuments/values by structures	Losses in historic value of society	✓				"
xiii)	Right of way for sewer network	Losses in Community economy and social values		✓			Proper planning, inter depart. communication, adequete compensation
xiv)	Interferences with other utilities	Do		✓			Proper planning, inter depart. communication
xv)	Disposal of sludge	Community health problem		✓			Careful planning
B.	**Problems related to oversight in Planning and design**						
	Conventional System						
i)	Downstream water quality problem (industrial uses, water supply, fisheries, recreation, irrigation.)	Losses in Community economy and social values				✓	Proper planning and design
ii)	Over flow hazards	Do		✓			"
iii)	Navigation	Do		✓			"
iv)	Sludge disposal	Do		✓			"
v)	Noise and vibrations	Do		✓			"

	Action Affecting Resources and Values	Effects on Environment	Magnitude of Impact				Recommeded feasible
			D	C	B	A	Protection measurs
1	2	3	4	5	6	7	8
vi)	Odour	Do			✓		"
vii)	Provision for recycling industrial waste water		✓				Needs proper planning
viii)	Recycled water standard		✓				"
ix)	Discharge of hazardous materials into sewers	Increase in operation cost		✓			Adequacy in design
	One-Site System						
	1. Over flow	Community health problem			✓		Adequacy in design
	2. Ground water pollution	Do		✓			Proper planning & Monitoring
	3. Sludge disposal	Do		✓			"
C.	**Problems during Construction**						
i)	Problems in access roads - (traffic related)	Losses in Community economy and social values				✓	Careful planning & monitoring
ii)	Construction hazard to workers (e.g. caving in excavation)	Health & economic loss to workers.			✓		Adequate planning and safty measures
iii)	Soil Erosion/Silt run-off	Enviornmental losses		✓			Adequate planning
iv)	Noise and Vibrations	Damage to worker and neighbourhood		✓			Adequate planning & protected measures
v)	Dusts and fumes	Do		✓			"
vi)	Monitoring during construction/excavation	Do		✓			"
vii)	High groundwater table (dewating)	Do		✓			"
D.	**Problems in O&M**						
i)	Pollution of Environmental Values	Damage to environment		✓			Adequate O&M and public relations
	a. Liquid Wastes	Damage to downsteam water		✓			"
	b. Solid Wastes/Sludge (disposal)	Damage to environment & neighbourhood health		✓			"
ii)	Noise and vibrations	Damage to workers & neighbourhood health	✓				"
iii)	Air pollutants (odour)	Do		✓			"
iv)	Occupational health and safety.	Damage to workers health		✓			Good planning & adequate safty measures
v)	Adequacy of O&M Staff	Do		✓			Proper planning
vi)	Adequacy of operation phase monitoring programme.	Damage to workers & neighbourhood health		✓			"
E.	**Critical Overall Environmental Review Criteria**						
i)	Unacceptable loss of precious/irreplaceable resources	Loss in precious natural resources		✓			Adequate O&M, good monitoring, public relation

	Action Affecting Resources and Values	Effects on Environment	Magnitude of Impact				Recommeded feasible
			D	C	B	A	Protection measurs
1	2	3	4	5	6	7	8
ii)	Excessive use of irreplaceable/precious resources for purpose of short term gain	Do		✓			"
iii)	Hazards to endangered species	Do	✓				"
iv)	Excessive use of energy in terms of national energy situation	Costing national economy	✓				Needs proper planning
v)	Inaccptable levels of public apprehension	Social values impairment			✓		Needs good public relations

D - Almost no impact anticipated and not subject to IEE and EIA.

C - Unknown (Subject to further verification)

B - Slight impact anticipated

A - Significant impact anticipated further quantitative analyses require.

Table 3.2. Preliminary Identification of Main Environmental Impacts North Dhaka Sewerage Project.

ENVIRONMENTAL IMPACTS PRODUCED BY THE INTERVENTION		
A. Positive Impacts		
1. Environmental	(i)	Through improved pollution abatement
	(ii)	Protection of surface and ground water from pollution
2. Community health	(i)	Risk of human contacts with excreta and waste water in sensitive areas.
	(ii)	Increase community efficiency (economic) through better sanitary condition
	(iii)	Less expenses on medical budget
3. Expansion of Service area	(i)	Take care of community spent water
4. Employment	(i)	During construction
	(ii)	During O&M
B. Negative Impacts.		
1. Ecological Losses	(i)	Acquisition of land (flood plain, swamp area, high land)
2. Land Acquisition	(i)	Resistance from community
	(ii)	Resettlement problems
	(iii)	Dissatisfied neighborhood population
3. Traffic hazard	(i)	Losses in community economy and social values
4. Regional drainage problems	(i)	losses in community economy and social values
5. Construction hazard	-	
6. Health hazard	-	
C. Environmental Risk		
1. Erosion	-	Erosion of developed land (swam, flood plain) due to wild rainfall.
2. Vulnerable to high flood	-	Failure (breach) of protection embankments or when they are over topped (X year flood)
3. Geological fault	-	Vulnerable to sudden settlements in case of earth quakes and tremors.

Site-1

Site 1 is an excellent locations (approximately 4 km west of Tongi Bridge) for a treatment plant which can take care of Tongi, Uttara Mirpur and a part of Cantonment as well. Prior to construction of Embankment under FAP 8B it was a flood plain area located at Dhaur, PS Uttara. It is a private land and at present single crop (Boro season) is produced. The effluent discharge will take place in the Turag river. Human habitation is on the south and partiality on the south-east and south west. The rest of the side is open to Embankment /river. The proposed site will not cause any major resettlement problem. The approach road access shouble be along the embankment which is at present part of recently opened Tongi-Sarurlia-Savar high way. There would be no navigation, drainage or flood plain fishery problems.

Site-2

This is an alternative site if it is decided to have a separate treatment plant for Tongi and further north upwards (in future). The site is a flood plain area and during monsoon period the land is under approximately 2 meter deep water. The land is partially owned by Tongi Pouroshava and the rest is private and located approximately 4 km east of Tongi bridge. On the south the land the Tongi river flows down stream towards Balu river. On the north, north west and east there are human habitation and as such the issue of resettlement will arise though not a large scale rehabilitation. The land is under single cropped boro cultivation and will not create any negative impact in respect of drainage, flood plain fishery and navigation. It is connected by asphalt/herring-bone bond Pouroshava road.

Site - 3

This site is intended for the southern area (Baridhara Badda, Gulshan, Banani, Cantonment, etc) and East of Progoti Sharani of the proposed NDSP. During the monsoon period the land is approximately under three meter deep water and located approximately 6 km east of Rampura bridge along Begunbari khal and situated on the left bank. During the winter season the area is a dry land and under Boro cultivation. Large scale resettlement issue may arise for construction of access road, trunk sewer and for the treatment plant, because there are human habitation on the north, north east and north west side. There will no negative impact in respect of navigation but may have some small negative impacts on flood plan fishery and regional drainage.

Sites A, B, C, etc.
These are intended for the lift pump stations and the problem of resettlement issues can be avoided by careful location of the sites. In case of private land it will be necessary for acquisition otherwise by re-location in khas land this problem can be avoided.

3.6 Residual Impacts

The most significant residual impact appears to be discharge of hazardous materials into the sewerage system when basically the system shall be designed for domestic sewage only. It is envisaged that all other negative impacts which can be mitigated to a large extent but regarding hazardous waste and other than domestic sewage, it is not only DWASA who can alone manage the problem. In such cases DWASA will need the assistance of other organisations like DCC, Tongi Pourashava. and DoE.

CHAPTER 4: EXISTING ENVIRONMENTAL LAWS AND REGULATIONS AND ENVIRONMENTAL QUALITY STANDARDS IN BANGLADESH

Like all other nations of the world, Bangladesh also acted to the global call for the protection and conservation of natural environment and ecology. A research in the regulatory regime shows that there are about 185 laws which have bearing on environment, directly or indirectly and casually. These laws provide for measures relevant to environment conservation, offer protection against various environmental offenses and by prescribing or prohibiting certain activities, lay down rights and duties. A great bulk of these environmental legislation were existent in the country right from the 19th century although they remained either unenforced to a large extent due to several factors or vaguely known to the responsible public agencies. The traditional practices prevailing in the legal regime were not much conductive to reading the law with new ideas like environmental protection or conservation of resources. More over lack of consciousness amongst the implementors or the executing agencies and the general public as to the very existence and scope of these laws rendered them ineffective functionally. There are various sectoral environmental legislations existing in Bangladesh. The laws most relevant to DWASA are summarised in **Table 4.1.** Environmental legislation in Bangladesh covers laws on the (I) Protection of environmental health (b) control of environment pollution, and (iii) conservation of natural and cultural resources. The above categorisation is being made on the basis of broad objectives of the environmental laws existing in Bangladesh.

The Environmental Pollution control ordinance of 1977 replaced the earlier water pollution control ordinance of 1970. A wide range of subject related to the environment were contained in this law including air, water, soil, food and shelter for all forms of life. Under this law the Environmental Pollution Control (EPC) Board is to frame the policies for controlling, preventing and abating environmental pollution and to recommend the required implementation procedure through the jurisdiction of the Director.

Till 1995 the existing laws were mutually exclusive. Many of the laws falling in one category were bound to be related to objectives falling in the other categories. This is only natural because of the fact that environment protection is a multi-sectoral phenomenon and not limited to any particular discipline of human activity or any particular aspect of nature. Through the Gazette notification of 16-2-1995 "Bangladesh Environment Preservation ordinance" has been treated as The Environmental Protection Act - 1995 (Act No. 1 of 1995). Through this Act the Department of Environment (DoE) has got the legal authority to perform as per rule against any person or group if he/they do something which will create environmental hazard by any means or activities. Thus, the 1977 ordinance has been replaced by the Environmental Protection Act of 1995, effective from June 1, 1995. A copy of Environmental Protection Act, 1995 is enclosed in **Annex – 4**

In annex -3 a list containing categories of industries for environmental clearance has been enclosed in which it may be seen that sewage treatment plant has been placed in the red category (Sl-41) indicating that EIA is mandatory for obtaining clearance from the Department of Environment. shall be necessary after obtaining site clearance at the I.E.E. stage from the Department of Environment.

Table 4.1 Basic Environmental Laws, Regulations and Standards

Year	Tittle	Objectives
1950	East Bengal Protection and Conservation of Fish Act	Conservation and development of fisheries resources
1953	Town improvement act	Improvement and development of Dhaka City
1958	Antiquities Act	Protection and preservation of Archaeological and historical artifacts
1960, 1966	Port Rules; Shipping Operation	Control of discharges in ports; waterway rules
1965	Factories Act	Industrial workers if health and working conditions
1971	Pesticide Ordinance	Pesticide use, production, selection and importations
1972, 1989	Forest Acts	Conservation and development of forests
1973	Bangladesh Wildlife (Preservation) Order	Preservation and protection of wildlife
1976	Antiquities (Amendment) Ordinance	Protection and prohibition export of archaeological artifacts
1977	Environment Pollution Control Ordinance	Environmental protection, conservation of natural resources and health
1977	Municipal Ordinance	Municipal activities in health, sanitation, water supply drainage etc in the city
1979	Factory Rules	Disposal of wastes and effluents
1980	Agricultural Pesticides (Amendment) Act	Selection, use and handling of pesticides in the agricultural sector
1982	Municipal Act	Drainage, sewerage, water supply and sanitation
1982	Protection and conservation of Fish (Amendment) Ordinance	Revised 1950 Fish Act
1983	Agricultural Pesticides (Amendment) Ordinance	Revised agricultural pesticides ordinance
1985	The Pesticide Rules	pesticide selling, use and safety measures
1990	Bangladesh Standard Specification for Drinking Water	Formulation and revision of national Standards
1991	Environmental Quality Standards for Bangladesh	Environmental Standards for air, water, soils and sound
1995	Environment Protection Act (EPA) 1995.	No industrial unit/project shall be established without prior approval of the DG, DoE.

CHAPTER 5 : ToR FOR DETAILED EIA

It has been resolved from the discussions in the previous chapter that some issue have been fully resolved due to adequacy of the proposed mitigative measures; some impacts have not been adequately assessed due to lack of data and some issues need more discussion to check the adequacy of mitigative measures. The identified significant impacts for which the adequacy of mitigative measuers could bot be agreed to on the basis of the IEE study have to be delt in EIA. In order to address the residual impacts a terms of refernce (TOR) for full scale EIA has been prepared and furnished in **Annex-5**

CHAPTER 6 SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1. Summary

The initial environmental examination (IEE) of the North Dhaka Sewerage Project has been conducted primarily based on field information gathered through extensive field visits particularly the proposed treatment plant locations and their neighborhood, discussions with the officials of the concerned agencies like the Dhaka WASA, DCC, Tongi Paurashava, DoE and RAJUK as well as with the potential beneficiaries of the project. While the proposed project would bring enormous benefits to the local community in terms of improved health, better environment, less chance of ground and surface water pollution and ultimately enhanced productivity. There are however, areas of major concern which the project could bring to the community unless properly investigated through further studies including objective analysis during the planning and design stages of the project. The present IEE identifies these impacts which needs a full scale environmental assessment before the project could be properly designed and implemented. These impacts have been identified in three different stages, e.g.

- site selection for treatment plants, pumping stations and sewer routes;
- construction of treatment plants, pumping station and the sewer network; and
- operation & maintenance of the entire sewerage project.

The impacts have been classified as A, B, C, & D representing significant impact, slight impact, unknown but requires further verification and almost no impacts respectively. The impacts under 'C' and 'A' categories are subject to further investigations. These are included in the checklist in **Table 3.1** and are discussed in chapter 3. The summary of main adverse impacts along with their suggested remedial measures is presented in **Table 6.1.** The terms of reference (ToR) for the full scale EIA has been prepared based on the findings of the IEE and is included in **Annex- 5** of this report.

6.2. Concluding remark and Recommendation

The present IEE leads to the firm conclusion that the NDSP will bring about significant improvment in the overall envrionment of the project area but needs a comprehensive environmental study (EIA) on some major potential impacts so that appropriate measures can be taken during planning, design and implementation phases in order to avoid costly repairs later. Some important issues to be assessed are –

- ecological losses particularly with respect to wet land ecology;
- loss of agricultural lands;
- resettlement issues;
- downstream water quality;
- occupational health & safety;
- traffic hazard particularly during construction; and

- adequate O&M facilities.

Some major activities of the EIA would include field measurments of water qulatiy parameters, quantification of some specific parameters e.g. fisheries, agriultural products, etc., actual sanitary situation of the project area, community health condition, and traffic volume on existing road systems under 'no' project condition; and prediction of impacts on water quality using water quality models, fish loss, losses in agricultural productivity, improvement in community health etc. under 'with' project condition. Such quantitative analyses of the existing environmental conditions and prediction of the potential losses or gains from the proposed project would lead to a more objective assessment and evaluation of impacts of the proposed project on the environment.

Table 6.1. Summary of Main negative Impact and related Mitigation/Monitoring

Sl. No.	Activity	Possible Impact	Mitigation/Monitoring
1	Land acquisition (flood plain, swanp land, high land)	- Ecological loss - Loss of agricultura lands - Loss of flood plain fisheries - Resettlement issues	- Careful re-location [alterate site (s)] - Provide adequate compensation
2	Construction of • Treatment palnt • Pump station • Sewer mains	- Community displacement - Construction hazard - Regional drainage problem - Navigation - Traffic hazard - health hazard	- Provide adequate compensation - Careful re-location of site - Employment of displaced persons in Prj. works - Proper planning & management - Navigation facility to local/ regional areas. - Adequate protection & public relations.
3	Operation & maintenance	- In-adequacy in O&M - Down stream water quality problem - Health hazards	- Check adequacy of design. - Develop proper O&M guidelines including monitoring - Application of preventive & remedial measures. - Monitor health problem - Proper monitoring and develop public relation

PART 2

FEASIBILITY STUDY

A. 3

WATER QUALITY EXAMINATION

Appendix 3.2.1 Method and Results of Sewage Quantity/Quality Survey (Dry Season)

Table 3.2.1.1 Methods for Testing Parameter

Parameter	Methods
Flow Rate	Volume/Time period
Atm.Temperature, Water Temperature	Thermometer/Digital Thermometer
DO, BOD	Winklers Method
COD	K2Cr2O7 digestion and titration Method
pH	pH-Meter
SS	Weighing and Drying Method
T-N	Kjeldahl Method
T-P	Pechloric acid digestion and SnCL2 Spectrophotometric Method
Total coliform count	Millipore membrane filter MacConkey Agar
Cu, Cd, Zn, Pb, Cr	Atomic absorption Spectrophotometric Method
Hg, Ni	Atomic absorption Spectrophotometric Method
As	Spectrophotometric SDDC Method

Analytical Sheet

Table-2
DOMESTIC SEWAGE QUALITY INVESTIGATION

Item	Sampling point	Time	Flow Rate l/m*	Atmos Temp. °C	Temp °C	pH	DO mg/l	BOD mg/l	COD mg/l	SS mg/l	T-N mg/l	T-P mg/l	FC No./ 100ml	Cl mg/l
Domestic Sewage	Detached House Back of Concord Gulshan-2	8am	42	29.9	29.2	7.4	2.8	42	115	148	0.59	0.66	5.8×10^4	101
		12am	86	29.7	29.6	7.5	4.0	2.0	7.0	65	1.641	0.57	6.5×10^4	13
		4pm	82	31.6	31.1	7.7	1.9	12	32	150	0.743	0.60	1.1×10^6	106
		8pm	62	29.8	29.3	7.7	2.0	12	30	154	0.59	0.69	7.5×10^5	115
		12p	40	27.6	26.9	7.5	1.5	30	82	350	0.717	0.49	1.8×10^5	100
		4am	38	27.0	26.7	7.6	2.6	28	64	170	0.82	0.60	6.2×10^5	96
Domestic Sewage	Apt. House Uttara Section-3 DIT Colony	6am	42	29.7	29.4	7.8	1.3	62	115	52	0.335	0.21	2.25×10^5	13
		10a	61	32.0	31.8	7.9	3.0	16	28	110	1.687	0.39	2.6×10^5	26
		2pm	58	33.8	33.8	8.0	2.3	10	29	40	0.635	0.20	7.5×10^4	11
		6pm	45	35.5	34.5	6.6	3.0	12	20	42	0.069	0.09	2.8×10^6	12
		10p	22	35.3	32.9	5.2	1.1	130	345	42	0.181	0.26	5×10^4	42
		2am	0.52	32.0	31.9	6.8	3.0	12	20	44	0.88	0.28	3.3×10^6	24
Domestic Sewage	Slum House Mirpur Phalpara Ghat	4am	23	28.0	30.0	10.0	3.2	4	15	55	0.344	0.46	5.5×10^4	41
		8am	73	33.0	32.0	10.4	2.0	12	30	62	0.383	0.45	1.25×10^5	37
		12a	75	33.0	31.0	10.0	2.3	12	29	74	0.502	0.38	2.3×10^6	18
		4pm	62	28.0	28.0	10.0	3.0	6	20	60	0.066	0.40	4×10^5	34
		8pm	56	26.0	26.5	9.8	1.1	70	190	70	0.436	0.44	2.5×10^5	24
		12p	12	26.0	27.0	9.9	1.8	70	195	62	0.12	0.47	1.2×10^4	43

l/m*=litre/minute

Table: 3
INDUSTRIAL WASTE WATER QUALITY INVESTIGATION

Item	Sampling Point	Atmos temp °C	Temp °C	pH	DO mg/l	BOD mg/l	COD mg/l	SS mg/l	T-N mg/l	T-P mg/l	FC No/ 100ml	Cl mg/l
Industrial	Back of Modern bread(combined) Tongi(BSIC)	32.5	35	10.1	0.5	180	380	298	0.45	0.35	4.2×10^4	170
waste	Textile & Dyes Tongi(BSIC)	30.5	37.2	10.7	0.58	140	260	227	4.078	0.26	1.1×10^4	100
water	Beximco, Tongi	32.7	31.9	5.6	1.4	200	317	150	1.058	0.22	1.3×10^4	100

		HEAVY METALS (mg/l)							
		Cd	Hg	As	Pb	Cr	Cu	Zn	Ni
Industrial	Back of Modern bread(combined) Tongi(BSIC)	0.033	0.03	0.15	<0.01	0.021	1.17	0.07	2.0
waste	Textile & Dyes Tongi(BSIC)	0.02	0.01	<0.05	<0.01	0.025	1.01	0.04	1.5
water	Beximco, Tongi	0.02	<0.01	0.05	<0.01	0.020	1.19	0.09	0.04

Table: 4

EXISTING SEWAGE TREATMENT PLANT

Item	Sampling Point	Time	Flow Rate	Atmos Temp. °C	temp °C	pH	DO mg/l	BOD mg/l	COD mg/l	SS mg/l	T-N mg/l	T-P mg/l	FC No/ 100ml	Cl mg/l
Existing STP	Influent Pagla Treatment Plant (PTP)	3pm	4533 cft/min	25.2	26.5	7.9	0.45	290	504	350	0.318	0.41	6×10^5	80
		7pm	4775 cft/min	24.5	26.0	8.2	0.52	390	720	330	0.998	0.38	5.2×10^5	80
		11pm	3615 cft/min	24.0	25.5	8.1	0.30	130	288	270	0.300	0.45	4.2×10^5	70
		3am	2052 cft/min	22.5	23.3	8.5	0.20	150	144	370	0.602	0.44	8×10^4	70
		7am	4243 cft/min	24.5	25.0	8.1	0.40	110	432	180	0.655	0.35	9.5×10^4	90
		11am	4775 cft/min	25.5	26.5	8.2	0.33	900	1368	380	0.471	0.38	3.5×10^5	100
	Effluent (PTP)	____	7000 gallon/min	25.5	26.0	8.8	0.42	232	576	90	0.154	0.35	4×10^4	80

Item	Sampling Point	HEAVY METALS (mg/l)							
		Cd	Hg	As	Pb	Cr	Cu	Zn	Ni
Existing STP	Influent Pagla Treatment Plant (PTP)	0.01	0.015	0.1	<0.01	<0.01	1.33	0.09	0.03
		0.01	0.02	0.1	<0.01	<0.01	1.54	0.05	1.0
		0.01	<0.01	<0.05	<0.01	<0.01	2.12	0.07	0.07
		0.03	0.03	<0.05	<0.01	<0.01	0.37	0.04	0.09
		0.025	0.02	<0.05	<0.01	0.06	0.53	0.09	1.2
		0.02	0.02	<0.05	<0.01	0.10	0.32	0.05	1.8
	Effluent (PTP)	0.03	0.035	<0.05	<0.01	0.10	0.58	0.04	2.5

Analytical Sheet

Table : 5
BURIGANGA RIVER WATER QUALITY INVESTIGATION

Item	Sampling Point	Atmos Temp. ^0C	temp ^0C	pH	DO mg/l	BOD mg/l	COD mg/l	SS mg/l	T-N mg/l	T-P mg/l	FC No/ 100ml	Cl mg/l
Receiving Water Body Buriganga)	Upstream of EP (Moheshkhola)	24.5	24.0	8.8	10.12	18	54	60	0.222	0.22	2.5×10^4	5.0
	Downstr. Of EP (Postagola)	24.5	25.0	8.5	9.92	18	52	50	0.803	0.20	9×10^3	4.0

Item	Sampling Point	HEAVY METALS (mg/l)							
		Cd	Hg	As	Pb	Cr	Cu	Zn	Ni
Receiving Water Body (Buriganga)	Upstream of EP (Moheshkhola)	0.01	<0.01	<0.05	<0.01	0.10	1.06	0.07	0.05
	Downstr. Of EP (Postagola)	0.03	<0.01	<0.05	<0.01	0.10	0.37	0.04	0.03

Analytical Sheet

Table 3.2.1.6 Results of Sludge Analysis Survey

Table:6
SEPTIC TANK SLUDGE QUALITY INVESTIGATION

Item	Samp. Point	T-N(mg/l)		T-P(mg/l)		HEAVY METALS (mg/l)								H_2O Cont. (w/v)	VSS (w/w) 600°C 1/2hr
		Slurry basis	Dry residue basis	Slurry basis	Dry residue basis	Cd	Hg	As	Pb	Cr	Cu	Zn	Ni		
Sludge	Existing STP Pagla	0.062	0.92	0.026	0.038	0.15	0.23	0.40	28.70	66.66	461.88	1193	23	46.7%	53.6%
	DO	0.059	0.59	0.031	0.31	0.23	0.52	0.80	40.65	63.32	1144.4	706	39	90%	92.6%

Item	Samp. Point	T-N (mg/l)	T-P (mg/l)	Cl (mg/l)	SS (mg/l)	VSS (w/w %)	HEAVY METALS (mg/l)							
							Cd	Hg	As	Pb	Cr	Cu	Zn	Ni
Sludge	Septic Tank (sector 8 Uttara Postal Colony	2.276	0.61	180	600	84.6	.015	.015	<.05	<.01	<.01	1.18	.050	0.01
		1.168	0.62	80	120	96.5	<.01	.02	<.05	<.01	.01	1.02	.030	0.03
		4.916	0.64	60	490	81.5	<.01	.02	<.05	<.01	.02	1.75	.045	0.02
		1.336	0.42	86	150	98.2	.02	.03	<.05	<.01	.01	0.98	.040	0.02
		18.26	0.70	90	200	97.6	.01	.02	.06	<.01	.03	1.02	.030	0.03
		2.191	0.49	310	115	97.2	<.01	.01	<.05	<.01	.02	0.75	.025	0.02
		1.676	0.45	120	170	97.6	.01	.02	<.05	<.01	<.01	1.40	.050	0.02
		1.05	0.21	240	120	94.5	.015	.01	.05	<.01	.02	1.20	.035	0.01

Table 3.2.1.7 Per Capita Pollution Load by Quantity and Quality Survey(Dry Season)

Item			Flow Rate	Water Quanuty		Load		Remark
			l/min	BOD mg/l	SS mg/l	BOD g/min	SS g/min	
Detached House	measure time	8:00	42	42	148	1.8	6.2	
		12:00	86	2	65	0.2	5.6	
		16:00	82	12	150	1.0	12.3	
		20:00	62	12	154	0.7	9.5	
		24:00	40	30	350	1.2	14.0	
		4:00	38	28	170	1.1	6.5	
	Arithmetic mean		58	21	173	-	-	Drainage
	Total (per day)		84,000	-	-	1,400	13,000	Population
	Weighted mean		-	17	155	-	-	180 person
	per capita		467	-	-	7.8	72	
Apartment House	measure time	2:00	1	12	44	0.0	0.0	
		6:00	42	62	52	2.6	2.2	
		10:00	61	16	110	1.0	6.7	
		14:00	58	10	40	0.6	2.3	
		18:00	45	12	42	0.5	1.9	
		22:00	22	130	42	2.9	0.9	
	Arithmetic mean		38	40	55	-	-	Drainage
	Total (per day)		54,800	-	-	1,800	3,400	Population
	Weighted mean		-	33	62	-	-	220 pers.
	per capita		249	-	-	8.2	15	
Slum House	measure time	4:00	23	4	55	0.1	1.3	
		8:00	73	12	62	0.9	4.5	
		12:00	75	12	74	0.9	5.6	
		16:00	62	6	60	0.4	3.7	
		20:00	56	70	70	3.9	3.9	
		24:00	12	70	62	0.8	0.7	
	Arithmetic mean		50	29	64	-	-	Drainage
	Total (per day)		72,200	-	-	1,700	4,700	Population
	Weighted mean		-	24	65	-	-	290 pers.
	per capita		249	-	-	5.9	16	
Total	Total (per day)		211,000	-	-	4,900	21,100	Drainage
	Weighted mean		-	23	100	-	-	Population
	per capita		306	-	-	7.1	31	690 pers.

Appendix 3.2.2 Method and Results of Sewage Quantity/Quality Survey (Rainy Season)

Table 3.2.2.1 Results of Domestic Sewage Quality/Quantity Survey

Table -2

DOMESTIC SEWAGE QUALITY INVESTIGATION

Item	Sampling Point & Date	Time Hour	Flow Rate L/min	Atmos. °C	Samp. Temp.°C	pH	DO mg/l	BOD_5 mg/l	COD mg/l	SS mg/l	T-N mg/l	T-P mg/l	FC No/100 ml	Cl mg/l
Domestic Sewage	Detached House Back of Concord Gulshan - 2	6.00	26	14	17.5	6.9	1.02	-	504	340	28.72	25.2	$9.2x10^5$	122.6
		10.00	78	17	21	6.8	1.10	-	620	350	30.53	40.2	$6.4x10^6$	139.4
		14.00	65	20	22.3	7.1	0.90	-	574	230	31.13	46.5	$1.08x10^7$	96.4
		18.00	82	18.5	19.5	7.3	1.0	-	578	110	31.60	38.8	$6.8x10^6$	92.5
		22.00	42	14	15	7.2	1.06	-	448	190	25.16	23.1	$1.28x10^7$	105.4
		2.00	7	12.5	14	7.5	1.1	-	132	195	19.65	28.0	$7.6x10^6$	103.7
		Com.	-	-	-	-	-	206.97	416	-		-	-	-
	Apt. House Uttara Section - 3 DIT Colony	6.00	45	17.5	22	7.5	3.55	-	362	505	26.12	19.8	$3x10^6$	30.6
		10.00	76	21.5	21.9	7.4	2.75	-	354	560	25.42	14.9	$32x10^6$	24.2
		14.00	62	25	22.3	7.2	0.96	-	496	225	23.31	31.2	$4.5x10^5$	26.3
		18.00	56	17	24	8.0	3.29	-	490	110	23.65	40.5	$6.9x10^6$	21.9
		22.00	35	15	18.5	7.3	0.81	-	1530	80	20.24	40.4	$2.1x10^6$	24.8
		2.00	6	13	17.5	7.8	2.32	-	864	70	12.41	49.1	$2.3x10^6$	24.7
		Com.	-	-	-	-	-	114	352	-		-		-
	Slum House Mirpur Phalpara Ghat	6.00	120	18.5	24	7.1	0.98	-	388	50	23.35	22.5	$1.4x10^7$	39.9
		10.00	160	19.5	23.4	7.1	1.20	-	448	130	21.68	56.4	$2.6x10^6$	70.8
		14.00	125	22	24.5	7.3	1.10	-	672	110	22.70	79.7	$4.6x10^4$	65.6
		18.00	75	19	23	7.4	1.3	-	681	70	26.45	29.3	$2.5x10^5$	27.6
		22.00	70	16.5	22	7.1	0.75	-	655	120	23.27	36.5	$2.8x10^5$	55.3
		2.00	10	14	19	7.5	1.10	-	352	80	24.21	52.2	$2.6x10^5$	56.7
		Com.	-	-	-	-		388.24	670	-	-	-		-

L/min = Liters /minute

Table -3

EXISTING PAGLA TREATMENT PLANT SEWAGE INVESTIGATION

Item	Sampling Point	Time Hour	Flow Rate	Atmos. Tem.°C	Samp. Temp.°C	pH	DO mg/l	BOD_5 mg/l	COD mg/l	SS mg/l	T-N mg/l	T-P mg/l	FC No/100 ml	Cl mg/l	Remark
Present Pagla Sewage Treatment Plant (PSTP)	Influent Point	2.00	2991 cf/m	27	26	7.1	1.2	136	290	300	58.02	75	$2.7x10^6$	130.5	Pumps were in operation at the time of all sampling
		6.00	2074 cf/m	28.5	25.5	6.5	0.41	148	539	320	55.11	70	$3.0x10^5$	124.8	
		10.00	3211 cf/m	28	26	6.9	0.56	221	3520	470	59.30	75	$3.1x10^5$	116.3	
		14.00	3382 cf/m	38	26	6.8	0.69	569	832	960	57.37	65	$3.3x10^5$	126.5	
		18.00	2659 cf/m	26	24	5.9	0.804	210	660	380	48.62	80	$3.2x10^5$	141.9	
		22.00	2895 cf/m	26	28	7.0	0.72	316	1100	310	43.54	70	$2.9x10^6$	121.9	
	Effluent Point(PC)	10.00	6200 g/m	26.5	22	7.6	2.27	181	196	95	31.26	83	$1.5x10^5$	133.3	Pums were in peration at the time of all sampling
		14.00	5500 g/m	27	24	7.9	1.01	130	828	180	35.29	75	$2.5x10^5$	94.2	
		18.00	5800 g/m	21	22	8.2	1.44	124	392	125	30.86	75	$2.4x10^5$	137.8	
	Effluent point (WL)	11.00	Bottle 1	-	-	7.9	4.1	70	102	42a	21.8	12	-	-	Pumps were not in operation from 15- 20 days before sampling and also in the time of sampling.
		11.00	Bottle 2	-	-	7.9	3.79	66	96	47b	26.3	10	-	-	

PC = Pump Chamber, WL = Water Lagoon, a = by passing 1 L sample, b = by passing 250 ml sample.

1 Cubic foot = 28.3 Litres = 7.48 Gallons; cf/m = cubic feet/ minute , g/m = gallons /minute.

Item	Sampling Point	Time Hour	Cd mg/l	Hg mg/l	As mg/l	Pb mg/l	Cr mg/l	Cu mg/l	Zn mg/l	Ni mg/l
Present Pagla Sewage Treatment Plant (PSTP)	Influent Point	2.00	0.05	0.02	<0.01	0.34	0.02	1.6	1.4	0.25
		6.00	0.07	0.04	0.02	0.34	<0.01	4.8	0.9	0.06
		10.00	0.044	0.025	0.01	0.57	<0.01	1.5	1.1	0.12
		14.00	0.05	0.02	<0.01	0.57	<0.01	3.1	0.9	0.03
		18.00	0.017	0.015	<0.01	0.54	0.01	1.6	1.5	0.04
		22.00	0.035	0.03	<0.01	0.42	<0.01	2.0	1.3	0.01
	Effluent Point	10.00	0.043	0.03	0.01	0.23	0.01	6.2	1.2	0.03
		14.00	0.045	0.03	<0.01	0.30	0.015	2.1	0.5	0.08
		18.00	0.048	0.025	<0.01	0.35	0.01	1.9	0.6	0.02

Table-4

RIVER WATER QUALITY INVESTIGATION

Item	Sampling Point	Time Hr.	Atmos. Temp.°C	Samp. Temp.°C	pH	DO mg/l	BOD_5 mg/l	COD mg/l	SS mg/l	T-N mg/l	T-P mg/l	FC No/100 ml	Cl mg/l
Public Water Body	Turag River Near Mirpur Bridge	10.00	22	21	8.1	5.02	25.6	160	90	6.18	2.5	2.5×10^{4}	12.62
		14.00	23	24	8.1	5.73	18.2	96	105	7.90	3.2	1.1×10^{4}	11.70
		18.00	20.5	21.5	8.8	5.52	31.9	140	70	7.33	3.0	2.3×10^{4}	13.83
	Turag River Behind Botanical Garden	10.00	22	23	8.2	7.47	20.8	64	65	8.50	3.0	1.0×10^{5}	11.35
		14.00	23	24.5	8.3	6.78	11.7	160	70	8.65	2.0	1.5×10^{4}	12.06
		18.00	21	23	8.2	6.27	16.9	128	65	5.16	2.5	1.6×10^{4}	10.75
	Balu River Near Demra Bridge	10.00	20.5	20	8.2	5.86	25.4	108	210	6.44	7.0	1.5×10^{4}	8.65
		14.00	21	21	8.3	6.23	29.6	132	120	5.51	6.8	1.7×10^{4}	7.81
		18.00	20	20	8.0	6.02	24.3	61	110	7.02	6.6	1.02×10^{5}	8.86
	Shitalakhya River Near Balu Ghat	10.00	20	21	8.2	5.78	22.1	36	140	7.71	3.5	8×10^{3}	9.22
		14.00	22	22.5	8.3	5.37	25.3	32	280	8.20	4.0	7.5×10^{3}	12.77
		18.00	20	20.5	8.3	5.66	29.6	32	90	6.72	3.0	6×10^{4}	10.08

Item	Sampling Point	Time Hr.	Cd mg/l	Hg mg/l	As mg/l	Pb mg/l	Cr mg/l	Cu mg/l	Zn mg/l	Ni mg/l
	Turag River Near Mirpur Bridge	10.00	0.03	<.01	<.01	0.28	<.01	0.30	0.60	0.02
		14.00	0.052	<.01	<0.1	0.31	.01	0.42	0.7	0.04
		18.00	0.070	<.01	<.15	0.30	.01	0.37	0.5	0.03
Public Water Body	Turag River Behind Botanical Garden	10.00	0.045	<.01	<.01	0.30	<.01	0.28	0.3	<.01
		14.00	0.038	<.01	<.01	0.25	<.01	0.17	0.4	<.01
		18.00	0.052	<.01	<.05	0.30	<.01	0.30	0.6	0.01
	Balu River Near Demra Bridge	10.00	0.076	0.02	<.01	0.25	.02	0.25	0.3	0.015
		14.00	0.07	0.01	<.01	0.34	.015	0.15	0.6	<.01
		18.00	0.08	0.015	<.01	0.23	<.01	0.10	0.9	0.01
	Shitalakhya River Near Balu Ghat	10.00	0.08	<.01	<.01	0.12	<.01	0.25	0.8	<.01
		14.00	0.033	<.01	<.01	0.18	<.01	0.15	0.4	<.01
		18.00	0.08	<.01	<.01	0.23	<.01	0.20	0.3	<.01

Table 3.2.2.4 Results of Lake Water Quality Survey

Table-5

LAKE WATER QUALITY INVESTIGATION

Location	BOD_5 mg/L
Near Baridhara	190
Near Badda Bridge	210
Near Srilanka High Comission	185
Bridge near BRAC Office	240
Near Rampura Bridge	265

Table 3.2.2.5 Per Capita Pollution Load by Quantity and Quality Survey (Rainy Season)

Item			Flow Rate	Water Quarity		Load		Remark
			l/min	BOD mg/l	SS mg/l	BOD g/min	SS g/min	
Detached House	measure time	8:00	42	42	148	1.8	6.2	
		12:00	86	2	65	0.2	5.6	
		16:00	82	12	150	1.0	12.3	
		20:00	62	12	154	0.7	9.5	
		24:00	40	30	350	1.2	14.0	
		4:00	38	28	170	1.1	6.5	
	Arithmetic mean		58	21	173	-	-	Drainage
	Total (per day)		84,000	-	-	1,400	13,000	Population
	Weighted mean		-	17	155	-	-	180 person
	per capita		467	-	-	7.8	72	
Apartment House	measure time	2:00	1	12	44	0.0	0.0	
		6:00	42	62	52	2.6	2.2	
		10:00	61	16	110	1.0	6.7	
		14:00	58	10	40	0.6	2.3	
		18:00	45	12	42	0.5	1.9	
		22:00	22	130	42	2.9	0.9	
	Arithmetic mean		38	40	55	-	-	Drainage
	Total (per day)		54,800	-	-	1,800	3,400	Population
	Weighted mean		-	33	62	-	-	220 pers.
	per capita		249	-	-	8.2	15	
Slum House	measure time	4:00	23	4	55	0.1	1.3	
		8:00	73	12	62	0.9	4.5	
		12:00	75	12	74	0.9	5.6	
		16:00	62	6	60	0.4	3.7	
		20:00	56	70	70	3.9	3.9	
		24:00	12	70	62	0.8	0.7	
	Arithmetic mean		50	29	64	-	-	Drainage
	Total (per day)		72,200	-	-	1,700	4,700	Population
	Weighted mean		-	24	65	-	-	290 pers.
	per capita		249	-	-	5.9	16	
Total	Total (per day)		211,000	-	-	4,900	21,100	Drainage
	Weighted mean		-	23	100	-	-	Population
	per capita		306	-	-	7.1	31	690 pers.

A. 5

SEWERAGE SYSTEM PLANNING

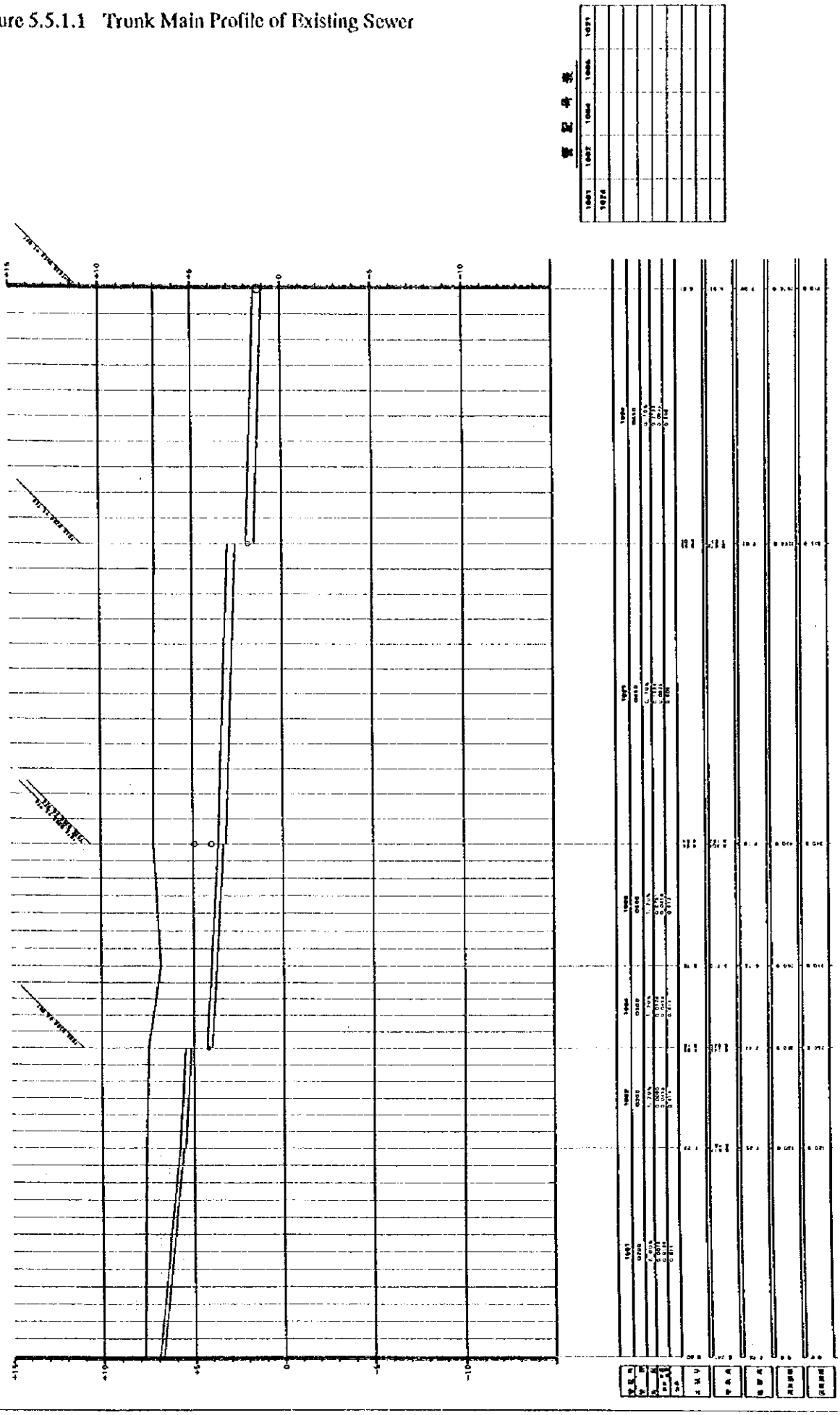
Appendix 5.5.1 Hydraulic Simulation of Existing Sewer System

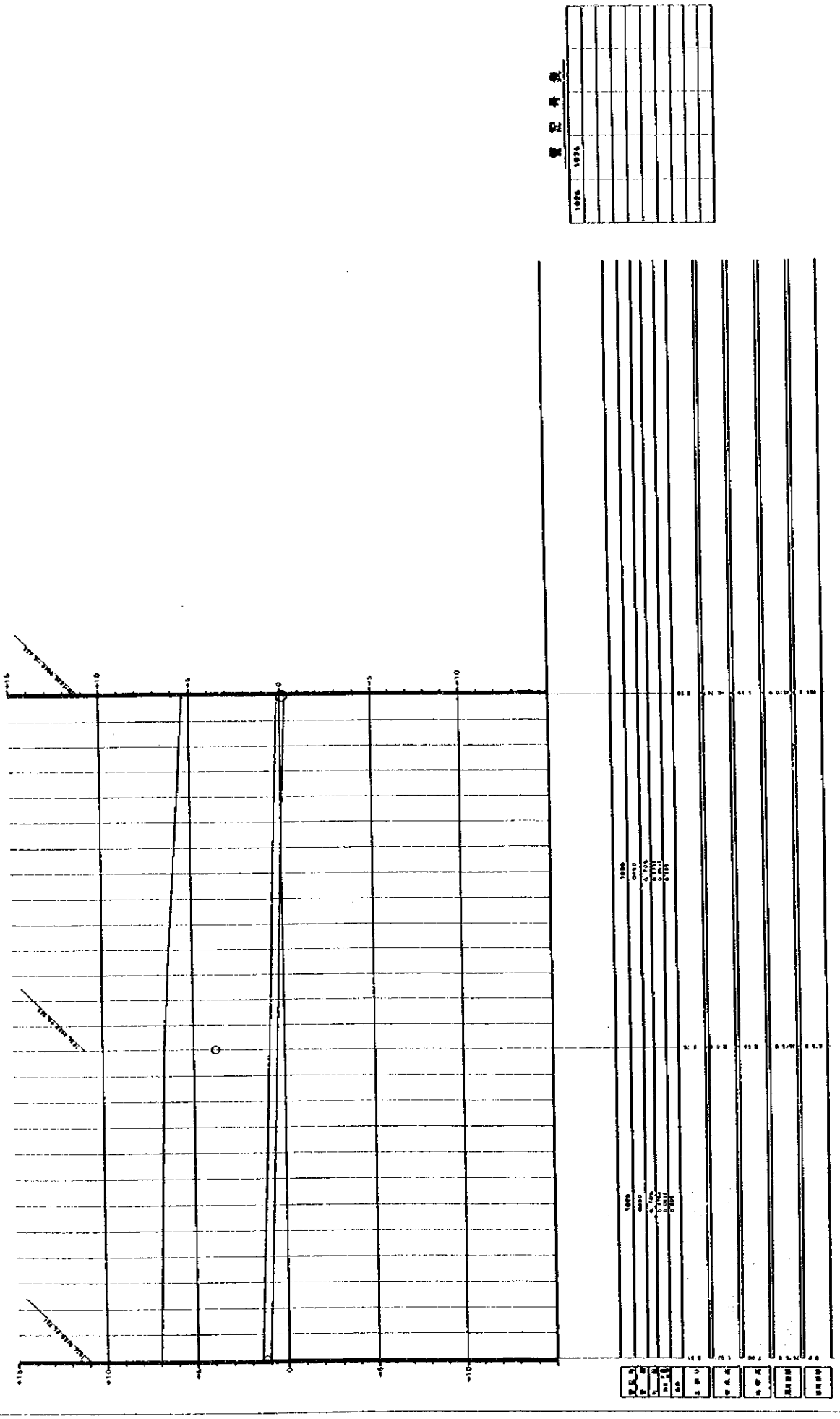
Table 5.5.1.1 Sewage Flow Calculation for Existing Sewer System

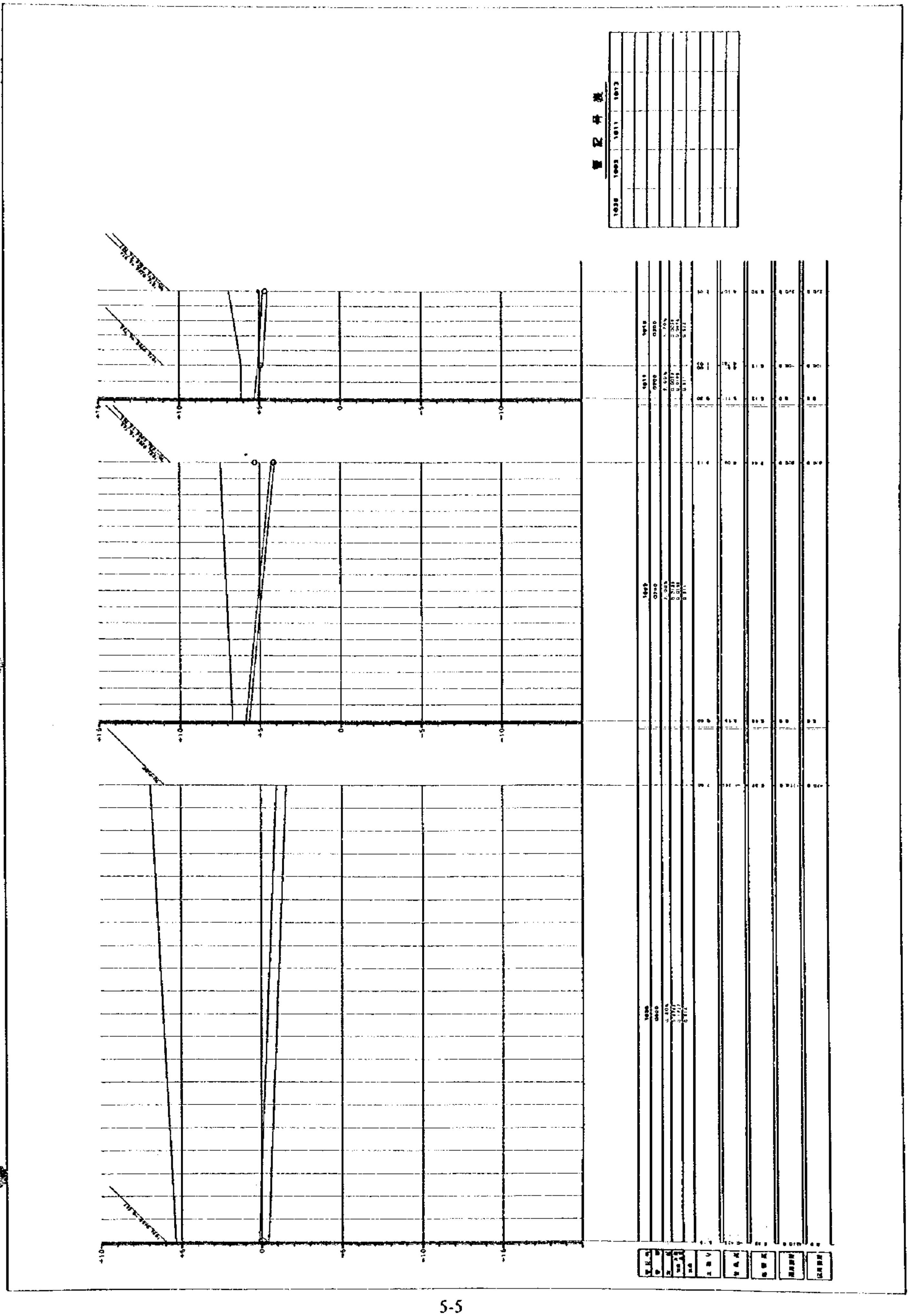
Sewer No.	Sewer No. of Downstream	Area		Length		Sewage Flow Rate				Design Sewer									Remark
							Population									Invert Level		Covering	
		Each	Total	Each	Total	Population Density	Each	Total	Sewage Flow	Material	Diameter	Gradient	Velocity	Flow Rate	Ground Level	Upstream	Downstream	Upstream	Downstream	
		ha	ha	m	m	Per./ha	Person	Person	cu.m/sec	-	mm	‰	m/sec	cu.m/sec	M	M	M	m	m	
1001	1002	7.26	7.26	580	580	561.06	4,073	4,073	0.0075	VP	200	2.00	0.607	0.0191	7.75	6.741	5.577	0.80	1.78	
1002	1004	1.43	8.69	280	860	561.06	802	4,876	0.0090	VP	300	1.20	0.616	0.0435	7.56	5.481	5.145	1.77	1.99	
1003	1004	17.64	17.64	800	800	561.06	9,897	9,897	0.0183	VP	200	2.00	0.607	0.0191	6.69	5.681	4.081	0.80	3.15	
1004	1005	0.00	26.33	230	1,090	561.06	0	14,773	0.0274	VP	300	1.20	0.616	0.0435	7.44	3.985	3.710	3.15	2.76	
1005	1021	49.79	76.12	340	1,430	561.06	27,935	42,708	0.0791	VP	300	1.20	0.616	0.0435	6.78	3.710	3.304	2.76	3.55	
1007	1008	7.02	7.02	550	550	561.06	3,939	3,939	0.0073	VP	200	2.00	0.607	0.0191	7.59	6.581	5.481	0.80	2.02	
1008	1010	4.84	11.86	415	965	561.06	2,716	6,654	0.0123	VP	300	1.20	0.616	0.0435	7.71	5.385	4.890	2.02	2.47	
1009	1010	8.82	8.82	630	630	561.06	4,949	4,949	0.0092	VP	200	2.00	0.607	0.0191	7.53	6.521	5.261	0.80	2.20	
1010	1021	0.46	21.14	95	1,060	561.06	258	11,861	0.0220	VP	300	1.20	0.616	0.0435	7.67	4.890	4.776	2.47	2.07	
1011	1013	2.21	2.21	100	100	561.06	1,240	1,240	0.0023	VP	200	2.00	0.607	0.0191	6.12	5.111	4.911	0.80	1.00	
1012	1013	0.38	0.38	25	25	561.06	213	213	0.0004	VP	300	1.20	0.616	0.0435	6.12	4.812	4.782	1.00	1.03	
1013	1015	3.09	5.68	230	330	561.06	1,734	3,187	0.0059	VP	300	1.20	0.616	0.0435	6.12	4.782	4.507	1.03	2.08	
1014	1015	6.76	6.76	420	420	561.06	3,793	3,793	0.0070	VP	200	2.00	0.607	0.0191	6.82	5.811	4.974	0.80	1.72	
1015	1020	2.43	14.87	230	650	561.06	1,363	8,343	0.0155	VP	300	1.20	0.616	0.0435	6.90	4.507	4.232	2.08	3.10	
1016	1017	2.01	2.01	215	215	561.06	1,128	1,128	0.0021	VP	200	2.00	0.607	0.0191	6.82	5.811	5.381	0.80	1.46	
1017	1019	1.97	3.98	260	475	561.06	1,105	2,233	0.0041	VP	300	1.20	0.616	0.0435	7.05	5.285	4.973	1.46	2.43	
1018	1019	3.91	3.91	440	440	561.06	2,194	2,194	0.0041	VP	200	2.00	0.607	0.0191	7.20	6.191	5.309	0.80	2.19	
1019	1020	0.27	8.16	75	550	561.06	151	4,578	0.0085	VP	300	1.20	0.616	0.0435	7.71	4.973	4.883	2.43	2.45	
1020	1021	8.94	31.97	340	990	561.06	5,016	17,937	0.0332	VP	300	1.20	0.616	0.0435	7.64	4.232	3.826	3.10	3.02	
1021	1024	17.42	146.65	835	2,265	561.06	9,774	82,279	0.1524	VP	450	0.70	0.617	0.0981	7.16	3.160	2.572	3.54	3.98	
1022	1023	48.07	48.07	1,040	1,040	561.06	26,970	26,970	0.0499	VP	200	2.00	0.607	0.0191	5.76	4.751	2.671	0.80	3.34	
1023	1024	47.13	95.20	600	1,640	561.06	26,443	53,413	0.0989	VP	250	1.50	0.610	0.0299	6.22	2.623	1.723	3.34	5.04	
1024	1025	59.65	301.50	710	2,975	561.06	33,467	169,160	0.3133	VP	450	0.70	0.617	0.0981	7.02	1.531	1.031	5.03	5.51	
1025	1035	60.79	362.29	870	3,845	561.06	34,107	203,266	0.3764	VP	450	0.70	0.617	0.0981	7.00	1.031	0.419	5.51	5.75	
1026	1028	7.93	7.93	285	285	561.06	4,449	4,449	0.0082	VP	300	1.20	0.616	0.0435	7.00	5.692	5.350	1.00	1.24	
1027	1028	7.12	7.12	170	170	561.06	3,995	3,995	0.0074	VP	200	2.00	0.607	0.0191	7.00	5.991	5.651	0.80	1.04	
1028	1030	1.14	16.19	115	400	561.06	640	9,084	0.0168	VP	300	1.20	0.616	0.0435	6.90	5.350	5.212	1.24	1.38	

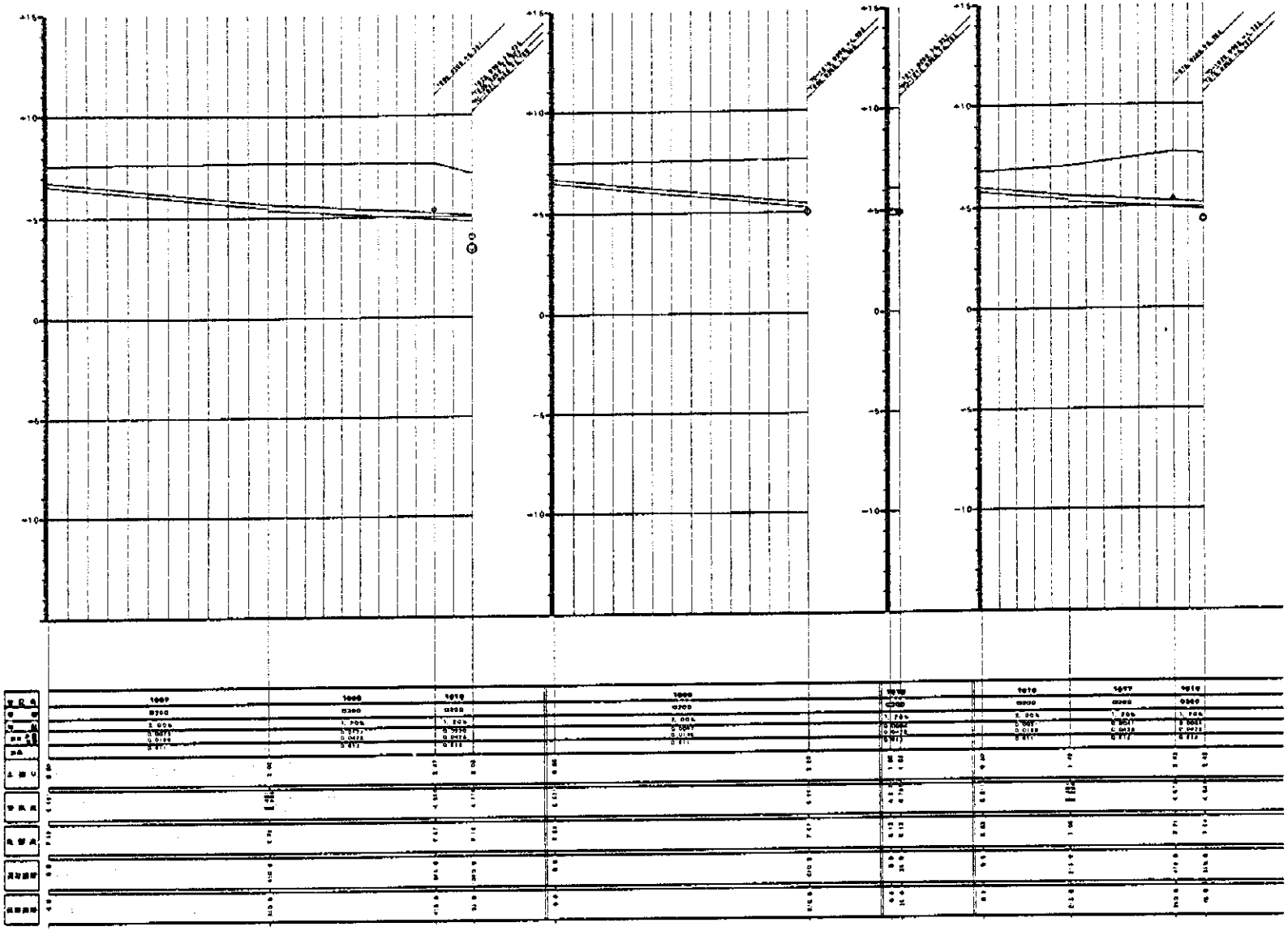
Sewer No.	Sewer No. of Downstream	Area		Length		Sewage Flow Rate				Design Sewer									Remark
							Population									Invert Level		Covering	
		Each	Total	Each	Total	Population Density	Each	Total	Sewage Flow	Material	Diameter	Gradient	Velocity	Flow Rate	Ground Level	Upstream	Downstream	Upstream	Downstream	
		ha	ha	m	m	Per./ha	Person	Person	cu.m/sec	-	mm	‰	m/sec	cu.m/sec	M	M	M	m	m	
1030	1034	8.10	24.29	620	1,020	561.06	4,545	13,628	0.0252	VP	450	0.70	0.617	0.0981	6.90	5.068	4.636	1.37	1.88	
1031	1033	72.50	72.50	385	385	561.06	40,677	40,677	0.0753	VP	300	1.20	0.616	0.0435	6.88	5.572	5.108	1.00	1.61	
1032	1033	21.46	21.46	310	310	561.06	12,040	12,040	0.0223	VP	200	2.00	0.607	0.0191	6.84	5.831	5.209	0.80	1.61	
1033	1034	6.66	100.62	500	885	561.06	3,737	56,454	0.1045	VP	300	1.20	0.616	0.0435	7.03	5.108	4.508	1.61	2.16	
1034	1035	128.88	253.79	1,140	2,160	561.06	72,309	142,391	0.2637	VP	450	0.70	0.617	0.0981	6.98	4.364	3.565	2.15	2.60	
1035	1036	37.92	654.00	985	4,830	561.06	21,275	366,933	0.6795	VP	450	0.70	0.617	0.0981	6.63	0.419	-0.267	5.75	5.19	
1036	PUMP	0.00	654.00	1,430	6,260	561.06	0	366,933	0.6795	HP	600	0.80	0.614	0.1737	5.39	-0.425	-1.565	5.16	7.80	Tejgaon LS

Figure 5.5.1.1 Trunk Main Profile of Existing Sewer









管記号表				
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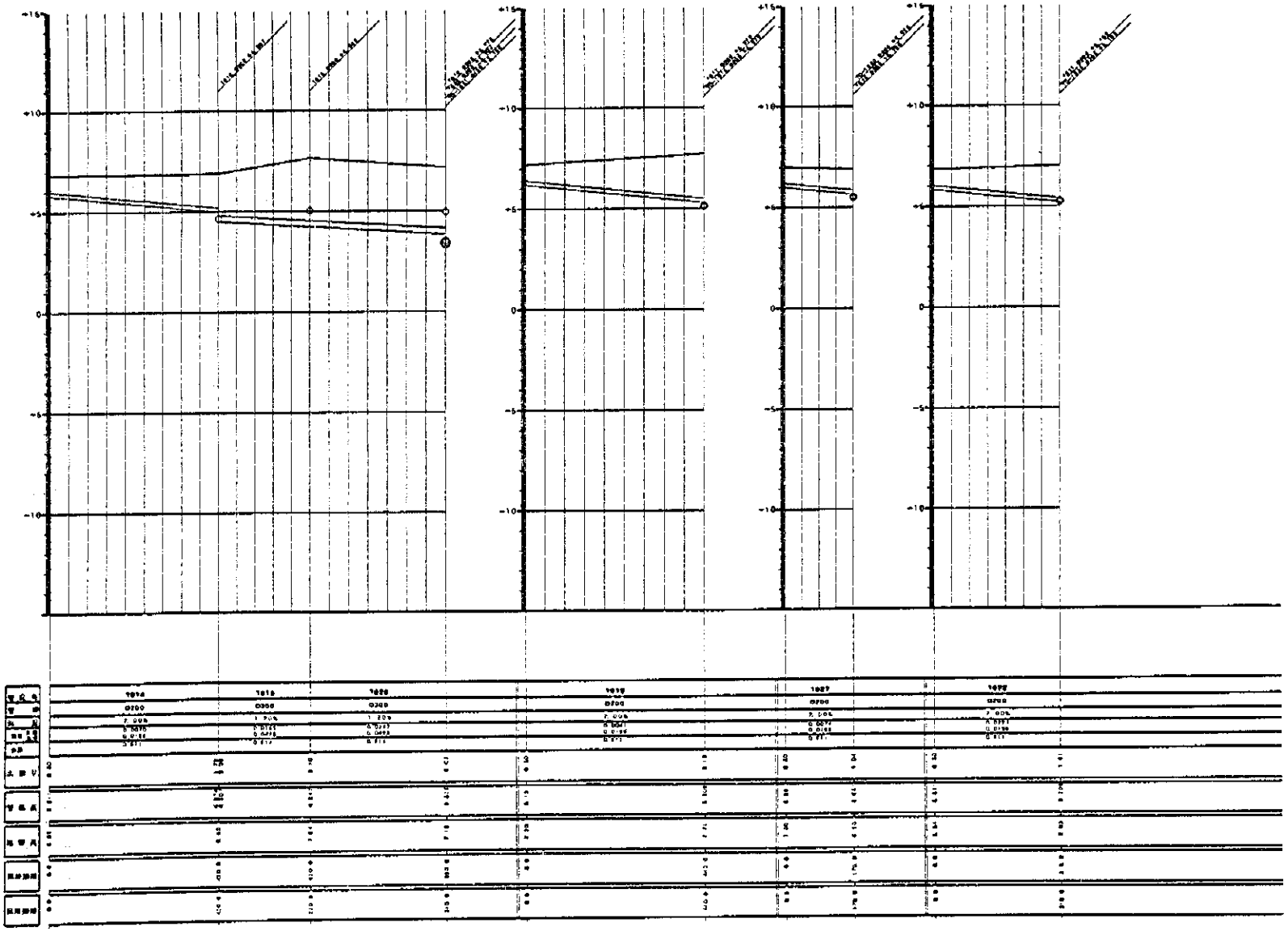
1018	1017	1019		



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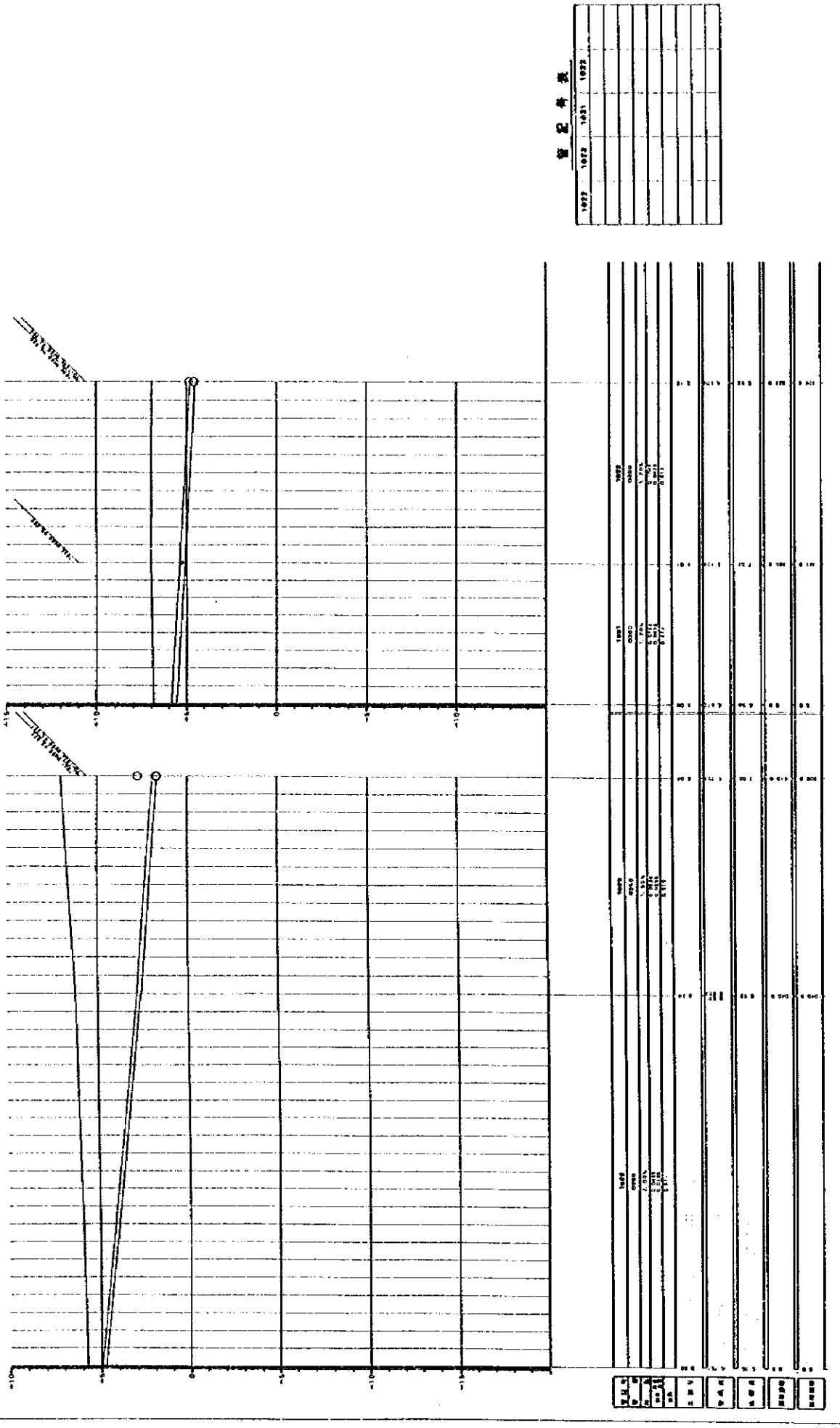
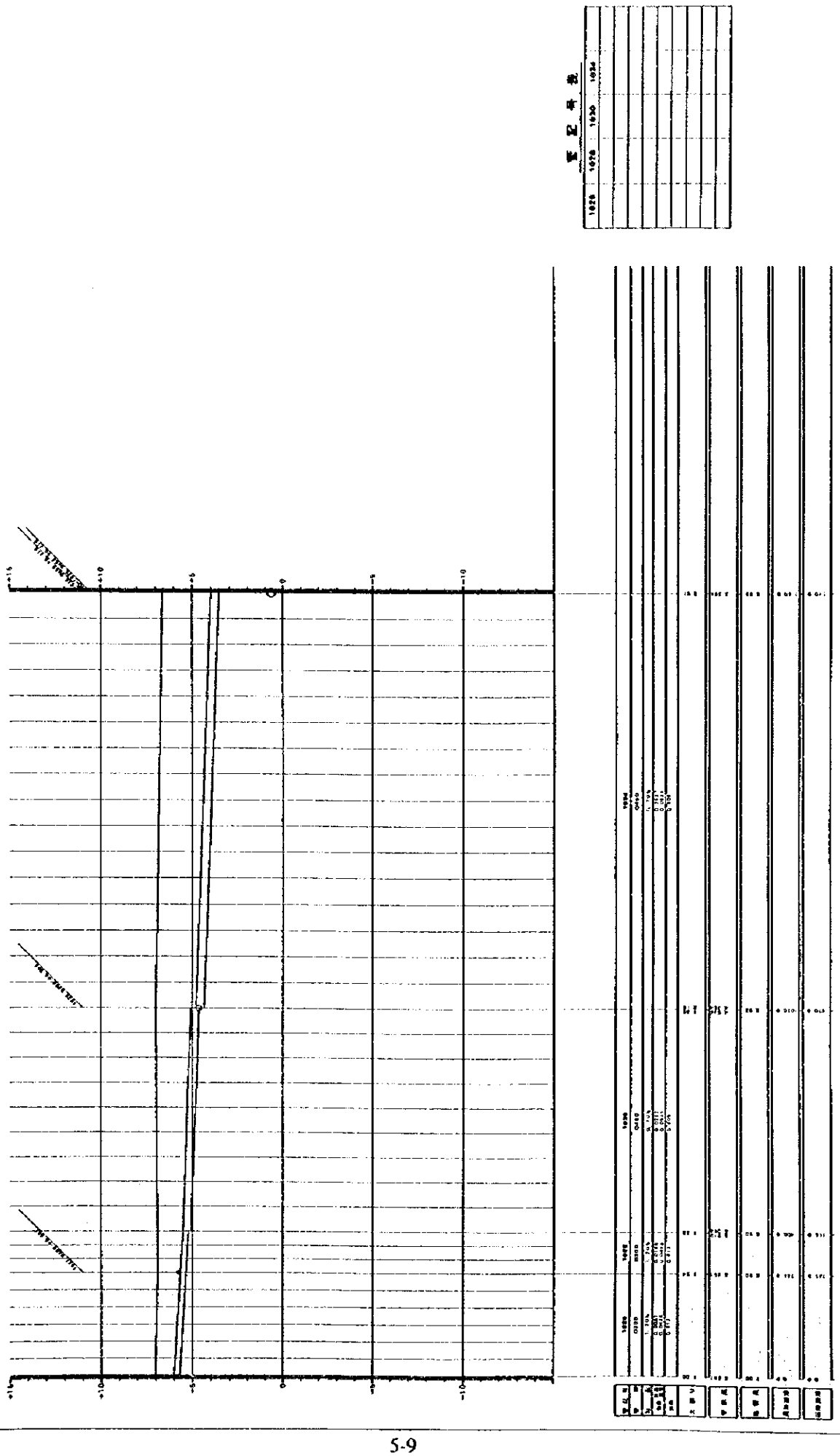
1032				





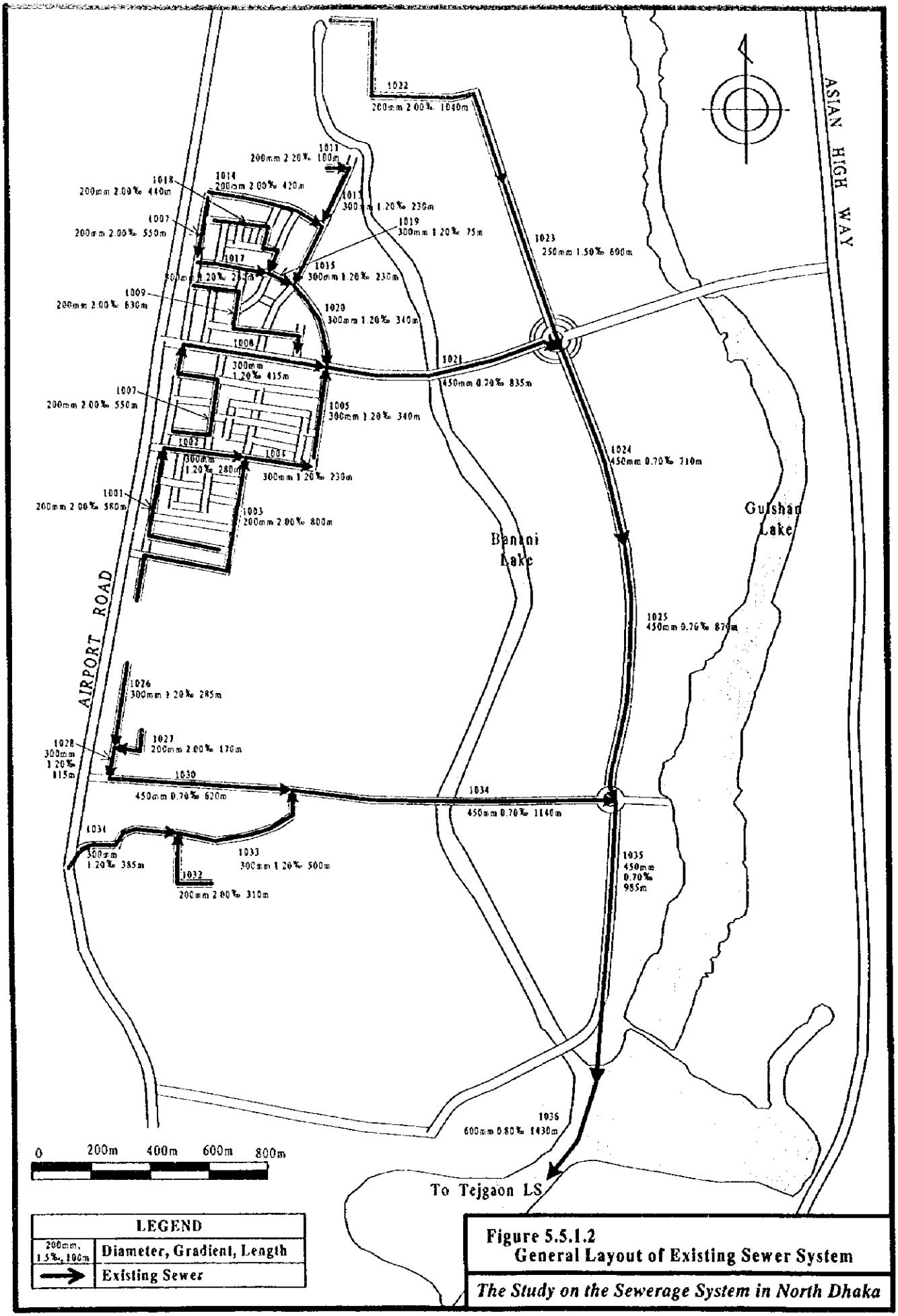


Figure 5.5.1.2
General Layout of Existing Sewer System

The Study on the Sewerage System in North Dhaka