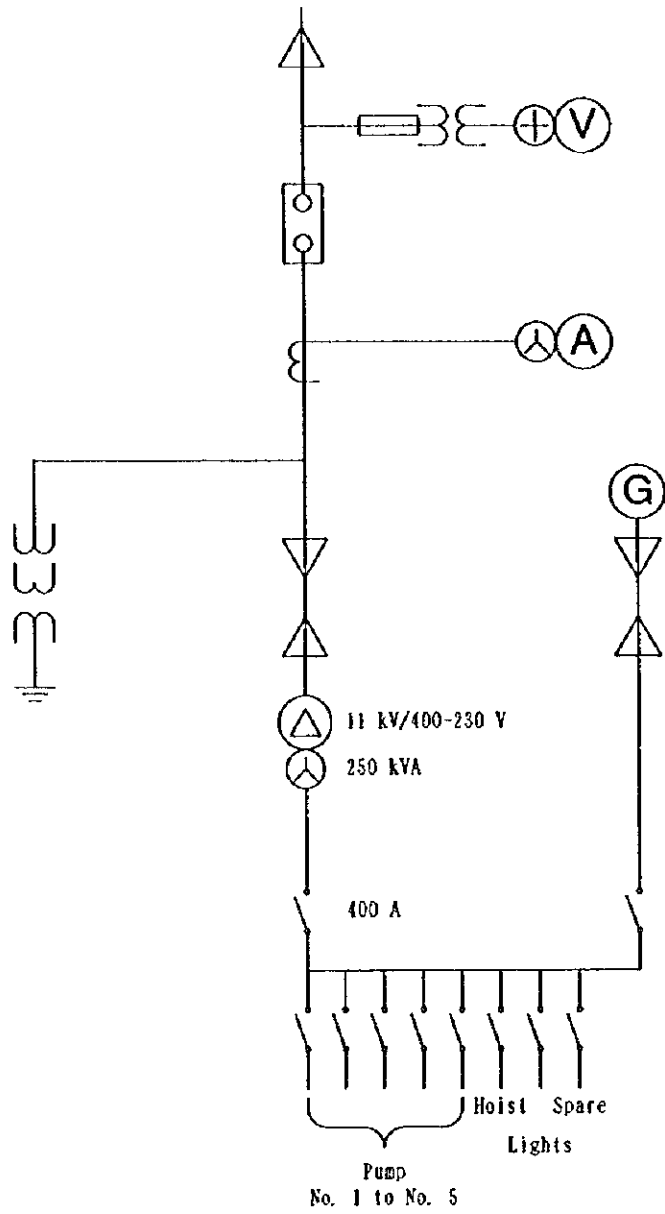
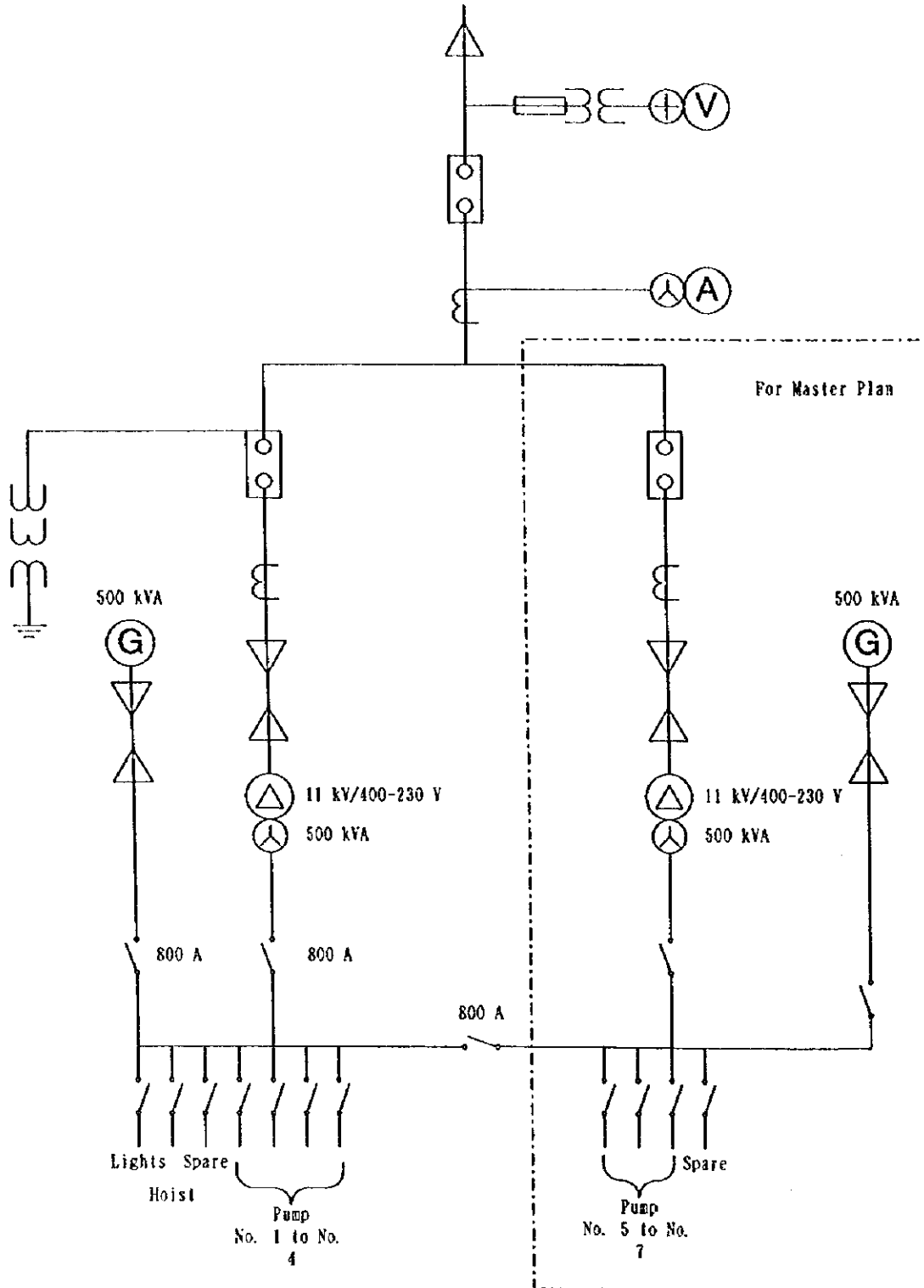


Appendix 5.5.9

Single Line Diagram of Gulshan Pump Station



Appendix 5.5.10 Single Line Diagram of Merul Pump Station



Appendix 5.5.11 Capacity Calculation of North Dhaka East Sewage Treatment Plant

1 BASIC CONDITIONS

1-1 BASIC ITEMS

- (1) Name : North Dhaka East Sewage Treatment Plant
- (2) Land Area : Approximately 1,200 ha
- (3) Elevation : 0.47 m
- (4) Inlet Pipe Level : 10.8 m
- (5) Pipe Diameter : 1,100mmx2Unit
- (6) Land Use : Low-lying Swamp Area
- (7) Collection System : Separate System
- (8) Treatment Method : Sewage Treatment : Stabilization Pond Process
Sludge Treatment : Sludge Lagoon
- (9) Effluent Point : Balu River
- (10) Effluent Point Water Level : +6.5 m
- (11) Target Year : 2020 (Master Plan)
2005 (Feasibility Study)
- (12) Lowest Monthly Average Temperature : 18 °C (December)

1-2 Design Population

- Design Population : 1,045,000 Persons (Master Plan)
456,000 Persons (Feasibility Study)

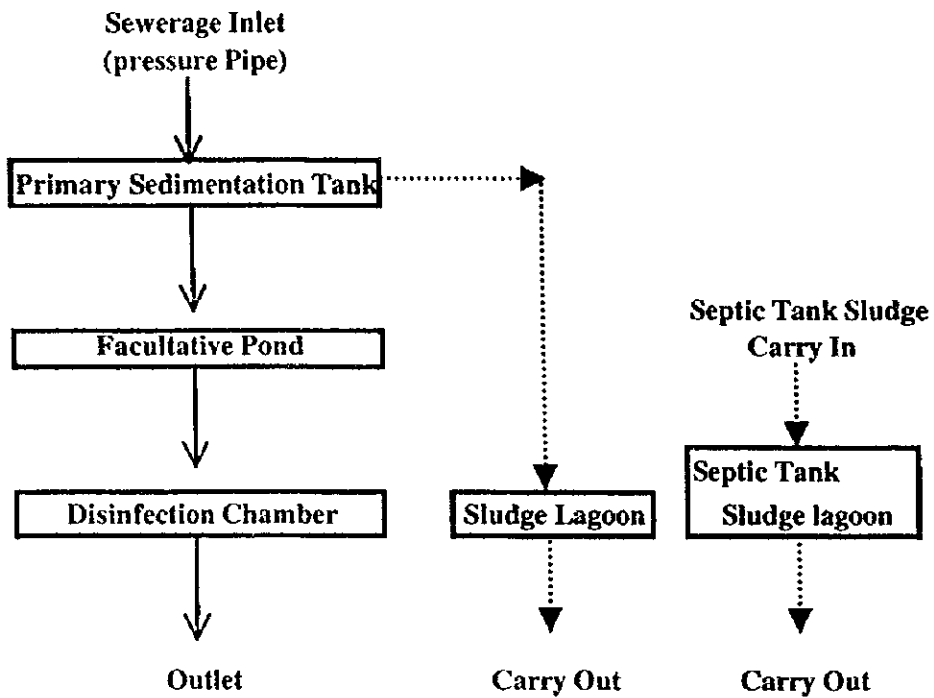
1-3 Design Sewage Flow

ITEM		m ³ /day	m ³ /hr	m ³ /min	m ³ /sec
Master Plan	Daily Average	104,500	4354.2	72.57	1.209
	Daily Maximum	130,625	5442.7	90.71	1.512
	Hourly Maximum-Dry	167,200	6966.7	116.11	1.935
Feasibility Study	Daily Average	43,320	1805.0	30.08	0.501
	Daily Maximum	52,440	2185.0	36.42	0.607
	Hourly Maximum-Dry	66,120	2755.0	45.92	0.765

1-4 Design Sewage Quality

ITEM	INFLUENT (mg/L)	EFFLUENT (mg/L)	REMOVAL RATIO (%)	REMARKS
BOD	200	40	80	
SS	200	50	75	

1-5 Flow Chart (Stabilization Pond)



1-6 Design Criteria for Stabilization Pond

ITEMS		UNIT	Formula or Value	Application
1-6-2	Primary Sedimentation Tank			
(1)	Surface Loading	m ³ /m ² /day	35.0	35.0
(2)	Retention Time	Hr	2.0	250
(3)	Weir Load	m ³ /m/day	250	2.0
(4)	BOD Removal Rate	%	40.0	40.0
(5)	SS Removal Rate	%	60.0	60.0
1-6-3	Facultative Pond			
(1)	BOD Surface Load	kg/ha/day	60.3x1.0993 ^T	Same as Left
(2)	Safety Factor	—	1.5	1.5
(3)	Depth	m	1.5 - 2.0	1.5
(4)	BOD Removal Rate	%	33.3	33.3
(5)	SS Removal Rate	%	37.5	37.5
1-6-4	Disinfection Chamber			
(1)	Retention Time	min	15	15.0
(2)	Depth	m	2.0	2.0
1-6-5	Sludge Lagoon, Septic Tank Sludge Lagoon			
(1)	SS Surface Load	kg/m ² /year	35	35
(2)	Depth	m	1.0	1.0
(3)	Retention Time	day	90	90

2 CAPACITY CALCULATION

2-1 Primary Sedimentation Tank

ITEM	SIGN	UNIT	CALCULATION	M/P	F/S
Type	-	-	Circular Type		
Design Flow	Q1	m ³ /day	Daily Maximum	130,625	52,440
	Q2	m ³ /hr	Daily Maximum	5,443	2,185
Surface Loading	AL	m ³ /m ² /day		35	35
Weir Load	WL	m ³ /m/day	-	250	250
Required Surface Area	A1	m ²	Q1/TN/AL	3,732	1,498
Tank Number	TN			6	3
Diameter	D			28.0	28.0
Surface Area	A2	m ²	D ² /4*3.14*TN	3,693	1,846
Retention Time	T	Hr	-	2.0	2.0
Required Volume	V1	m ³	Q2*T	10,885	4,370
Required Depth	H	m	V2/A2	2.9	2.4
	Therefore A	m ²	-	3.0	3.0
Dimension (Diameter) (Depth) (Tank)	D	m	D	28.0	28.0
	H	m	H	3.0	3.0
	-	basin	TN	6	3
BOD Removal Ratio	RR	%	-	40	40
Effluent BOD Quality	BQ	mg/L	Cx(100-RR)/100	120	120
SS Removal Ratio	RR	%	-	60	60
Effluent SS Quality	BQ	mg/L	Cx(100-RR)/100	80	80
Check		UNIT	APPLICATION	M/P	F/S
Surface Area Load		m ³ /m ² /day	35.0	35.4	28.4
Weir Load		m ³ /m/day	300	248	199
Retention Time		day	2.0	2.0	2.5
Sedimented Sludge Volume(dry solid) (water content 98%)		kg/day		15,675	6,293
		m ³ /day		784	315

2-2 Facultative Pond

ITEM	SIGN	UNIT	CALCULATION	M/P	F/S
Type	-	-	Embanked Rectangular Pond		
Design Flow	Q1	m ³ /day	Daily Average	104,500	43,320
Inlet BOD Quality	C	mg/L	-	120	120
Inlet BOD Load	IL	kg/day	$Q1 \times C \times 10^{-3}$	12,540	5,198
Lowest M.A. Temperature	T	°C	-	18	18
Pond Number	PN	basin	-	6	3
BOD Surface Loading	AL	kg/ha/day	$60.3 \times 1.0993^T \times (1/\alpha)$	221	221
Safety Factor	α	-	-	1.5	1.5
Required Surface Area	A1	ha	IL/AL	56.7	23.5
	A2	m ²	A1 * 10,000	567,000	235,000
Depth	H	m	-	1.5	1.5
Width	W	m	-	160	160
Length	L1	m	A2/WxBN	591	490
	Therefore L2	m	-	600	600
Dimension (Width, Surface)	W	m	W	160	160
		m		151	151
(Length, Surface)	L	m	L2	600	600
		m		591	591
(Depth)	H	m	H	1.5	1.5
(Pond)	-	unit	PN	6	3
BOD Removal Ratio	RR	%	-	66.7	66.7
Effluent BOD Quality	BQ	mg/L	$Cx(100-RR)/100$	40	40
SS Removal Ratio	RR	%	-	37.5	37.5
Effluent SS Quality	BQ	mg/L	$Cx(100-RR)/100$	50	50
(Check)		UNIT	APPLICATION	M/P	F/S
Capacity		m ³		833,500	416,700
BOD Area Load		kg/ha/day	221	218	180
Retention Day		day	7~15	8.0	9.6

Average Maximum and Minimum Temperature

(Dhaka Station)

Year	Maximum	Minimum
1989	34.6	18.1
1990	32.6	18.6
1991	30.1	22.0
1992	33.6	18.3
1993	33.0	17.5

Source: "1995 Statistical Yearbook of Bangladesh"
Bangladesh Bureau of Statistics, Dec. '96

2-3 Disinfection Tank

ITEM	SIGN	UNIT	CALCULATION	M/P	F/S
Type	-	-	Rectangular Type		
Design Flow	Q1	m ³ /day	Daily Average	104,500	43,320
	Q2	m ³ /min	Daily Average	72.57	30.08
Retention Time	RT	min	-	15.0	15.0
Required Volume	V	m ³	Q2*RT	1,089	451
Depth	H	m	-	2.0	2.0
Width	W	m	-	3.0	3.0
Length	L1	m	V2 / (HxW)	181.4	75.2
	Therefore L2	m	-	92.0	92.0
Dimension	(Width)	W	W	3.0	3.0
	(Length)	L2	L2	92.0	92.0
	(Depth)	H	H	2.0	2.0
	(Tank)	-	unit	TN	2
(Check)		UNIT	APPLICATION	M/P	F/S
Volume		m ³	-	1,104	552
Retention Time		min	15	15.2	18.3

2-4 Sludge Lagoon

ITEM	SIGN	UNIT	CALCULATION	M/P	F/S
Type	-	-	Embarked Rectangular Type		
Design SS Surface Loading	SAL	kg/m ² /year		35	35
Influent SS Weight	SW	kg/day	(from PST)	15,675	6,293
Influent Sludge Volume	SV	m ³ /day	(water content 98%)	784	315
Required Surface Area	RSA	m ²	-	163,500	65,600
Digestion Period		month/2year	-	18.0	18.0
Drying Period		month/2year	-	6.0	6.0
Depth	D	m	-	1.0	1.0
Required Area	RA	m ²	RSA/D	163,500	65,600
Dimension (Width, Surface)	W	m		120	120
(Width, Bottom)		m		114	114
(Length, Surface)	L	m		360	360
(Length, Bottom)		m		354	354
(Depth)	H	m		1.0	1.0
(Lagoon)		unit		4	2
(Check)		UNIT	APPLICATION	M/P	F/S
Surface Area		m ²		167,100	83,500
Volume		m ³		167,100	83,500
Retention Days		day		213	265

2-5 Septic Tank Sludge Lagoon

1760

ITEM	SIGN	UNIT	CALCULATION	M/P	F/S
Type	-	-	Embanked Rectangular Type		
Design SS Surface Loading	SAL	kg/m ² /year		35	35
Transport SS Weight	SW	kg/day	(from Septic Tank)	3,112	1,760
transport Sludge Volume	SV	m ³ /day	(water content 98%)	156	88
Required Surface Area	RSA	m ²	-	32,500	18,400
Digestion Period		month/2year	-	18.0	18.0
Drying Period		month/2year	-	6.0	6.0
Depth	D	m	-	1.0	1.0
Required Area	RA	m ²	RSA/D	32,500	18,400
Dimension (Width, Surface)	W	m		120	-
(Width, Bottom)		m		114	-
(Length, Surface)	L	m		80	-
(Length, Bottom)		m		74	-
(Depth)	H	m		1.0	-
(Lagoon)		unit		4	-
(Check)		UNIT	APPLICATION	M/P	F/S
Surface Area		m ²		36,000	-
Volume		m ³		36,000	-
Retention Days		day		231	-

Appendix 5.5.12 Design Criteria of Sludge Lagoon

(1) Setup of Design Criteria of Sludge Lagoon

The Purpose of Sludge Lagoon is digestion and drying by atmospheric temperature of Sludge from Primary Sedimentation Tank and Septic tank sludge.

So design Criteria of Sludge Lagoon should be settled from this two points.

(2) Capacity of Evaporation

(1) Equation of Evaporation

$$D = (0.0384 \cdot 10^{0.0231(T+10) - 0.017}) \cdot (100 - H) \dots\dots 1$$

Here, T: temperature (°C)

H: Relative Humidity (%)

(2) Design Temperature, Relative Humidity

Table 5.5.12.1 Monthly Average

Month	Monthly Average Maximum Temp. (°C)	Monthly Average Minimum Temp. (°C)	Monthly Average Relative Humidity (%)	Monthly Rainfall (mm)
Jan.	26.1	13.1	78	13
Feb.	26.5	14.3	68	54
Mar.	31.9	21.0	67	115
Apr.	33.2	22.8	70	201
May	33.6	25.1	76	254
Jun.	31.9	26.4	82	266
Jul.	32.1	26.6	80	153
Aug.	31.9	26.3	82	246
Sep.	32.8	25.8	78	169
Oct.	32.7	23.3	76	55
Nov.	30.2	18.8	75	14
Dec.	27.7	12.5	71	00

Source: "1995 Statistical Yearbook of Bangladesh"
Bangladesh Bureau of Statistics, Dec. 1996

3) Capacity of Evaporation

Capacity of Evaporation is Calculated as Table 5.5.12.2 using formula 1)

Judged by Rainfall, Evaporation from Sludge is Expected in Jan., Feb., Mar., Oct., Nov., and Dec.. It is about six months in each year. During these period Capacity of Evaporation is 4.4mm/day. So design Capacity of Evaporation is settled 4mm/day.

2) SS Surface Loading

Average Evaporation: 4mm/day

Drying Period in year: 6 months

SS concentration of Sludge drawn from PST: 2%

Reduced Ratio by Digestion:30%

SS concentration of Sludge at settled in Sludge Lagoon:5%

Required SS concentration:20%(Moisture:80%)

So,

Evaporation volume in year:

$$4\text{mm/day} \times 6\text{months} \times 30\text{day/month} = 720\text{mm/year}$$

Permission Depth of initial Sludge Layer:

$$X - (X \times 0.05 / 0.2) = 720 \quad X = 960\text{mm (nearly 1m)}$$

SS Surface Loading:

$$(1\text{m}^3) \times (1\text{su.m}) \times (0.35\text{kg}) \times (10^3\text{kg/t}) / (1-0.3) = 70\text{kg}/(\text{su.m})/\text{year}$$

Sludge Can not be fed to Sludge Lagoon during Drying period, so 1cycle is 2years.

Feed & Digestion Period:1year/2years

Digestion Period :0.5year/2years

Drying Period:0.5year/2years

So,concluded,

$$\text{SS Surface Loading: } 70\text{kg}/(\text{su.m})/\text{year} / 2 = 35\text{kg}/(\text{su.m})/\text{year}$$

Table 5.5.12.2 Calculation of Evaporation

Month	Temperature (°C)	Humidity (%)	Rainfall (mm)	Calculated	Evaporation	Without	rainfall
				mm/day	mm/M	mm/day	mm/M
Jan.	19.6	78	13	3.7	115	102	3.3
Feb.	20.4	68	54	5.6	157	103	3.7
Mar.	26.5	67	115	8.3	257	142	4.6
Apr.	28.0	70	201	8.2	246	45	-
May	29.4	76	254	7.1	220	-34	-
Jun.	29.2	82	266	5.3	159	-107	-
Jul.	29.4	80	153	5.9	183	30	-
Aug.	29.1	82	246	5.2	161	-85	-
Sep.	29.3	78	169	6.5	195	26	-
Oct.	28.0	76	55	6.5	202	147	4.7
Nov.	24.5	75	14	5.6	168	154	5.1
Dec.	20.1	71	00	5.0	155	155	5.0
Average	-	-	-	-	-	-	4.4

4) Digestion Time

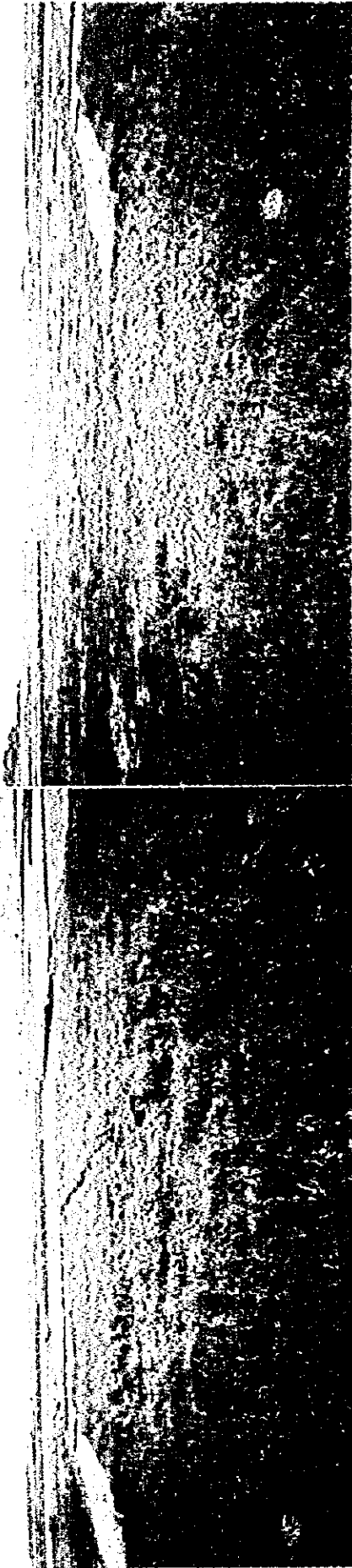
From drying SS Surface Loading and necessary depth are as above.

5.1.1.1.1 In this case, Digestion Time is as follows.

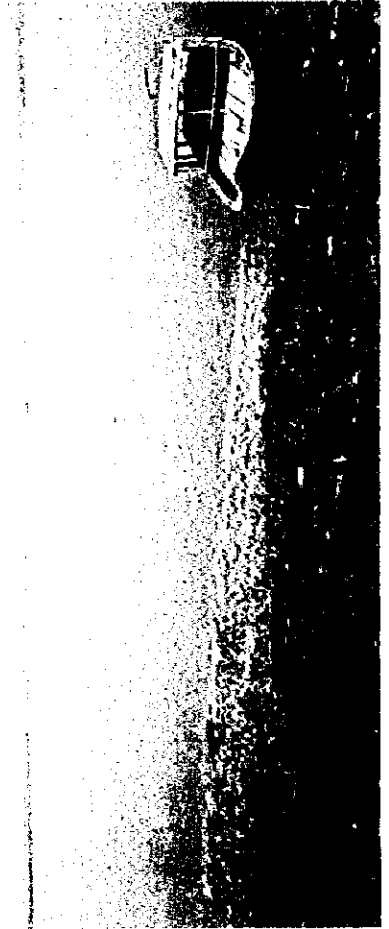
$$1 / (35 \times 10^{-3} \text{kg}/(\text{sq.m})/\text{year} \times 1\text{m} / 0.02(\text{t}/\text{cu.m})) = 0.57\text{year}$$

=209days(This time is fully for Digestion.)

Appendix 5.5.13 Photographs of Proposed Site of North Dhaka Sewage Treatment Plant



Proposed Site



A View of Proposed Site from the opposite Bank

Appendix 5.5.14 Hydraulic Calculation Sheet

Table 5.5.14.1 Hydraulic Calculation Outfall Pipe(3)

Facility		Outfall Pipe(3) (from Balu Riber Branch Crossing to Outlet)						Remarks
Item	Symbol	Unit	M/P			F/S		
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		2	2	2	1		
Unit Flow	q	m ³ /sec	0.605	0.756	0.968	0.765		
Dimension		Circular Pipe						
Diameter	D	1.10 m						
Area	A	0.950 m ²						
Length	L	350 m						
Roughness Coefficient	n	0.013						
Head Loss	Velocity	V	m/sec	0.636	0.796	1.019	0.805	V=q/A
	Velocity Head	$V^2/2g$	m	0.021	0.032	0.053	0.033	
	Hydraulic Gradient	I		0.000	0.001	0.001	0.001	$I=(nV)^2/R^{4/3}$
	Friction Loss	hf	m	0.134	0.210	0.343	0.215	
	Inlet Loss	hi	m	0.021	0.032	0.053	0.033	f=1.00
	Outlet Loss	ho	m	0.010	0.016	0.026	0.017	f=0.50
	Total		m	0.165	0.258	0.423	0.264	
Total Head Loss		m	0.170	0.260	0.430	0.270		
wns	Hd		6.500	6.500	6.500	6.500	Outlet	
Upstream Water Level	H		6.670	6.760	6.930	6.770	Siphon	

Table 5.5.14.2 Hydraulic Calculation of Inverted Siphon

Facility		Inverted Siphon(Balu River Branch Crossing)						
Item	Symbol	Unit	M/P			F/S	Remarks	
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		2	2	2	1		
Unit Flow	q	m ³ /sec	0.605	0.756	0.968	0.765		
(River Crossing)								
Diameter	D	1.00 m						
Area	A	0.785 m ²						
Length	L	20 m						
Roughness Coefficient	n	0.013						
(Man Hole)								
Inlet Orifice	W	1.10 m						
	H	1.10 m						
Number	N		2	2	2	1		
River Crossing	Required Flow Velocity	V ₁	m/sec	0.827	-	-	-	1.3*V'
	Required Cross Area	A ₁	m ²	0.731	-	-	-	
	Required Diameter	D ₁	m	0.965	-	-	-	
	therefore	D ₂	m	1.00	1.00	1.00	1.00	
	Full flow velocity	V ₀	m/sec	0.770	0.963	1.232	0.975	
	Velocity Head	V ₀ ² /2g	m	0.030	0.047	0.077	0.049	
	Hydraulic Gradient	I	-	0.001	0.001	0.002	0.001	I=(nV ₀) ² /R ^{4/3}
	Friction Loss	hf	m	0.013	0.020	0.033	0.020	
	Inlet and Outlet Loss	h _{io}	m	0.091	0.142	0.232	0.146	f=1.50*2
Manhole	Velocity	V ₁	m/sec	0.250	0.312	0.400	0.765	V=q/A
	Velocity Head	V ₁ ² /2g	m	0.003	0.005	0.008	0.030	
	Inlet and Outlet Loss	h _{io}	m	0.010	0.015	0.024	0.090	f=1.50*2
	Total			0.163	0.227	0.339	0.305	
Total Head Loss			0.170	0.230	0.340	0.310		
wns	H _d		6.790	6.760	6.930	6.770	Outfall Pipe(3)	
Upstream Water Level	H		6.960	6.990	7.270	6.680	Boundary M.H	

Table 5.5.14.3 Hydraulic Calculation of Outfall Pipe(2)

Facility		Outfall Pipe(2) (from STP boundary Manhole to Bale River Branch Crossing)						
Item	Symbol	Unit	M/P			F/S	Remarks	
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		2	2	2	1		
Unit Flow	q	m ³ /sec	0.605	0.756	0.968	0.765		
Dimension		Circular Pipe						
Diameter	D	1.10 m						
Area	A	0.950 m ²						
Length	L	280 m						
Roughness Coefficient	n	0.013						
Number								
Head Loss	Velocity	V'	m/sec	0.636	0.796	1.018	0.805	V=q/A
	Velocity Head	V ² /2g	m	0.021	0.032	0.053	0.033	
	Hydraulic Gradient	I		0.000	0.001	0.001	0.001	I=(nV) ² /R ^{4/3}
	Friction Loss	hf	m	0.107	0.168	0.274	0.172	
	Inlet and Outlet Loss	hio	m	0.031	0.048	0.079	0.050	f=1.50
	Total			0.138	0.216	0.354	0.221	
Total Head Loss			0.140	0.220	0.360	0.180		
wns	Hd		6.960	6.990	7.270	6.680	Siphon	
Upstream Water Level	H		7.100	7.210	7.630	6.860	Outfall Pipe(1)	

Table 5.5.14.4 Hydraulic Calculation of Outfall Pipe(1)

Facility		Outfall Pipe(1) (from Disinfection Tank to STP boundary Manhole)						
Item	Symbol	Unit	M/P			F/S	Remarks	
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		2	2	2	1		
Unit Flow	q	m ³ /sec	0.605	0.756	0.968	0.765		
Dimension		Circular Pipe						
Diameter	D	1.00 m						
Area	A	0.785 m ²						
Length	L	50 m						
Roughness Coefficient	n	0.013						
Head Loss	Velocity	V	m/sec	0.770	0.963	1.232	0.975	V=q/A
	Velocity Head	V ² /2g	m	0.030	0.047	0.078	0.048	
	Hydraulic Gradient	I		0.001	0.001	0.002	0.001	I=(nV) ² /R ^{4/3}
	Friction Loss	hf	m	0.032	0.050	0.082	0.051	
	Inlet Loss	hi	m	0.030	0.047	0.078	0.048	f=1.00
	Outlet Loss	ho	m	0.015	0.024	0.039	0.024	f=0.50
	Total			0.077	0.121	0.198	0.124	
Total Head Loss			0.080	0.130	0.200	0.130		
Downstream Water Level	Hd		7.100	7.210	7.630	6.860	Outfall Pipe(2)	
Upstream Water Level	H		7.180	7.340	7.830	6.990	D.T Wire	

Table 5.5.14.5 Hydraulic Calculation of Disinfection Chamber Outlet Weir

Facility		Disinfection Tank Outlet Weir						
Item	Symbol	Unit	M/P			F/S	Remarks	
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		2	2	2	1	Overflow Weir	
Unit Flow	q	m ³ /sec	0.605	0.756	0.968	0.765		
Dimension		Rectangular Weir						
Overflow Depth	Weir Width	B	m	3.00	3.00	3.00	3.00	
	Overflow Depth	h	m	0.229	0.266	0.313	0.268	$(q/1.84B)^{2/3}$
	Total		m	0.229	0.266	0.313	0.240	
Overflow Depth	h	m	0.230	0.270	0.320	0.240		
Weir Level		m	7.270	7.270	7.270	7.270	Outfall Pipe(1)	
Upstream Water Level		m	7.500	7.540	7.590	7.510	Disinfection T	

Table 5.5.14.6 Hydraulic Calculation of Disinfection Chamber

Facility		Disinfection Chamber						Remarks
Item	Symbol	Unit	M/P			F/S		
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		2	2	2	1		
Unit Flow	q	m ³ /sec	0.605	0.756	0.968	0.765		
Dimension		Rectangular Channel						
Width	W	3.00 m						
Depth	D	2.00 m						
Area	A	6.00 m ²						
Length	L	92 m						
Roughness Coefficient	n	0.013						
Head Loss	Velocity	V	m/sec	0.101	0.126	0.161	0.128	V=q/A
	Velocity Head	V ² /2g	m	0.001	0.001	0.001	0.001	
	Hydraulic Gradient	I		0.000	0.000	0.000	0.000	I=(nV) ² /R ^{4/3}
	Friction Loss	hf	m	0.000	0.000	0.000	0.000	
	Total			0.000	0.000	0.000	0.000	
Total Head Loss			0.000	0.000	0.000	0.000		
Downstream Water Level	Hd		7.500	7.540	7.590	7.510	Outlet Wire	
Upstream Water Level	H		7.500	7.540	7.590	7.510	FP Outlet P(4)	

Table 5.5.14.7 Hydraulic Calculation of Facultative Pond Outlet Pipe(4)

Facility		Facultative Pond Outlet Pipe (4)					Remarks	
Item	Symbol	Unit	M/P			F/S		
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		2	2	2	1		
Unit Flow	q	m ³ /sec	0.605	0.756	0.968	0.648		
Dimension		Circular Pipe						
Diameter	D	1.10 m						
Area	A	0.950 m ²						
Length	L	10 m						
Roughness Coefficient	n	0.013						
Head Loss	Velocity	V	m/sec	0.636	0.796	1.019	0.682	V=q/A
	Velocity Head	V ² /2g	m	0.021	0.032	0.053	0.024	
	Hydraulic Gradient	I		0.000	0.001	0.001	0.000	I=(nV) ² /R ^{4/3}
	Friction Loss	hf	m	0.004	0.204	0.333	0.004	
	Inlet Loss	hi	m	0.021	0.032	0.053	0.024	f=1.00
	Outlet Loss	ho	m	0.010	0.016	0.026	0.012	f=0.50
	Total			0.035	0.252	0.413	0.040	
Total Head Loss			0.040	0.260	0.420	0.050		
Downstream Water Level	Hd		7.500	7.540	7.590	7.510	Disinfection T	
Upstream Water Level	H		7.540	7.800	8.010	7.560	FP Outlet P(3)	

Table 5.5.14.8 Hydraulic Calculation of Facultative Pond Outlet Pipe(3)

Facility		Facultative Pond Outlet Pipe (3)						Remarks
Item	Symbol	Unit	M/P			F/S		
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		2	2	2	1		
Unit Flow	q	m ³ /sec	0.605	0.756	0.968	0.648		
Dimension		Circular Pipe						
Diameter	D	1.10 m						
Area	A	0.950 m ²						
Length	L	340 m						
Roughness Coefficient	n	0.013						
Head Loss	Velocity	V	m/sec	0.636	0.796	1.019	0.682	V=q/A
	Velocity Head	V ² /2g	m	0.021	0.032	0.053	0.024	
	Hydraulic Gradient	I		0.000	0.001	0.001	0.000	I=(nV) ² /R ^{4/3}
	Friction Loss	hf	m	0.130	0.204	0.333	0.150	
	Inlet Loss	hi	m	0.021	0.032	0.053	0.024	f=1.00
	Outlet Loss	ho	m	0.010	0.016	0.026	0.012	f=0.50
	Total			0.161	0.252	0.413	0.185	
Total Head Loss			0.170	0.260	0.420	0.190		
Downstream Water Level	Hd		7.540	7.800	8.010	7.560	FP Outlet P(4)	
Upstream Water Level	H		7.710	8.060	8.430	7.750	FP Outlet P(2)	

Table 5.5.14.9 Hydraulic Calculation of Facultative Pond Outlet Pipe(2)

Facility		Facultative Pond Outlet Pipe (2)						
Item	Symbol	Unit	M/P			F/S	Remarks	
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		3	3	3	3		
Unit Flow	q	m ³ /sec	0.403	0.504	0.645	0.255		
Dimension		Circular Pipe						
Diameter	D	0.90 m						
Area	A	0.636 m ²						
Length	L	170 m						
Roughness Coefficient	n	0.013						
Head Loss	Velocity	V	m/sec	0.634	0.793	1.014	0.401	V=q/A
	Velocity Head	V ² /2g	m	0.020	0.032	0.052	0.008	
	Hydraulic Gradient	I		0.000	0.001	0.001	0.000	I=(nV) ² /R ^{4/3}
	Friction Loss	hf	m	0.084	0.132	0.216	0.034	
	Inlet Loss	hi	m	0.020	0.032	0.052	0.008	f=1.00
	Outlet Loss	ho	m	0.010	0.016	0.026	0.004	f=0.50
	Total			0.115	0.180	0.295	0.046	
Total Head Loss			0.120	0.180	0.300	0.050		
Downstream Water Level	Hd		7.710	8.060	8.430	7.750	FP Outlet P(3)	
Upstream Water Level	H		7.830	8.240	8.730	7.800	FP Outlet P(1)	

Table 5.5.14.10 Hydraulic Calculation of Facultative Pond Outlet Pipe(1)

Facility		Facultative Pond Outlet Pipe (1)						Remarks
Item	Symbol	Unit	M/P			F/S		
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		6	6	6	3		
Unit Flow	q	m ³ /sec	0.202	0.252	0.323	0.255		
Dimension		Circular Pipe						
Diameter	D	0.65 m						
Area	A	0.332 m ²						
Length	L	180 m						
Roughness Coefficient	n	0.013						
Head Loss	Velocity	V	m/sec	0.608	0.760	0.972	0.769	V=q/A
	Velocity Head	V ² /2g	m	0.019	0.029	0.048	0.030	
	Hydraulic Gradient	I		0.001	0.001	0.002	0.001	I=(nV) ² /R ^{4/3}
	Friction Loss	hf	m	0.127	0.198	0.324	0.203	
	Inlet Loss	hi	m	0.019	0.029	0.048	0.030	f=1.00
	Outlet Loss	ho	m	0.009	0.015	0.024	0.015	f=0.50
	Total		m	0.155	0.242	0.397	0.248	
Total Head Loss		m	0.160	0.250	0.400	0.250		
Downstream Water Level	Hd		7.830	8.240	8.730	7.800	FP Outlet P(3)	
Upstream Water Level	H		7.990	8.490	9.130	8.050	FP Outlet Weir	

Table 5.5.14.11 Hydraulic Calculation of Facultative Pond Outlet Weir

Facility		Facultative Pond Outlet Weir						Remarks
Item	Symbol	Unit	M/P			F/S		
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m3/sec	1.209	1.512	1.935	0.765		
Number of Facility	N		6	6	6	3	Overflow Weir	
Unit Flow	q	m3/sec	0.202	0.252	0.323	0.255		
Dimension		Rectangular Weir						
Overflow Depth	Weir Width	B	m	1.500	1.500	1.500	1.500	
	Overflow Depth	h	m	0.175	0.203	0.239	0.204	$(q/1.84B)^{2/3}$
	Total		m	0.175	0.203	0.239	0.204	
Overflow Depth	h	m	0.180	0.210	0.240	0.210		
Weir Level		m	8.320	8.320	8.320	8.320	F.P Outlet P(1)	
Upstream Water Level		m	8.500	8.530	8.560	8.530	F.P	

Table 5.5.14.12 Hydraulic Calculation of Facultative Pond Inlet Pipe(2)

Facility		Facultative Pond Inlet Pipe(2)						Remarks
Item	Symbol	Unit	M/P			F/S		
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		6	6	6	3		
Unit Flow	q	m ³ /sec	0.202	0.252	0.323	0.255		
Dimension		Circular Pipe						
Diameter	D	0.70 m						
Area	A	0.385 m ²						
Length	L	300 m						
Roughness Coefficient	n	0.013						
Head Loss	Velocity	V	m/sec	0.524	0.655	0.838	0.663	V=q/A
	Velocity Head	V ² /2g	m	0.014	0.022	0.036	0.022	
	Hydraulic Gradient	I		0.000	0.001	0.001	0.001	I=(nV) ² /R ^{4/3}
	Friction Loss	hf	m	0.028	0.044	0.073	0.228	
	Inlet Loss	hi	m	0.014	0.022	0.036	0.022	f=1.00
	Outlet Loss	ho	m	0.007	0.011	0.018	0.011	f=0.50
	Total			0.049	0.077	0.127	0.261	
Total Head Loss				0.050	0.080	0.130	0.270	
Downstream Water Level		Hd		0.000	8.500	8.500	0.000	F.P.
Upstream Water Level		H		0.050	8.580	8.630	0.270	

Table 5.5.14.13 Hydraulic Calculation of Facultative Pond distribution Chamber

Facility		Facultative Pond Distribution Chamber						
Item	Symbol	Unit	M/P			F/S	Remarks	
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		6	6	6	3	Overflow Weir	
Unit Flow	q	m ³ /sec	0.202	0.252	0.323	0.255		
Dimension		Rectangular Weir						
Overflow Depth	Weir Width	B	m	1.50	1.50	1.50	1.50	
	Overflow Depth	h	m	0.175	0.203	0.239	0.204	$(q/1.84B)^{2/3}$
		Total		m	0.175	0.203	0.239	0.204
Overflow Depth	h	m	0.180	0.210	0.240	0.200		
Weir Level		m	8.680	8.680	8.680	8.680		
Upstream Water Level		m	8.860	8.890	8.920	8.880		

Table 5.5.14.14 Hydraulic Calculation of Facultative Pond Inlet Pipe(1)

Facility		Facultative Pond Inlet Pipe (1)						Remarks
Item	Symbol	Unit	M/P			F/S		
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		6	6	6	3		
Unit Flow	q	m ³ /sec	0.202	0.252	0.323	0.255		
Dimension		Circular Pipe						
Diameter	D	0.70 m						
Area	A	0.385 m ²						
Length	L	60 m						
Roughness Coefficient	n	0.013						
Head Loss	Velocity	V	m/sec	0.524	0.655	0.838	0.663	V=q/A
	Velocity Head	V ² /2g	m	0.014	0.022	0.036	0.022	
	Hydraulic Gradient	I		0.000	0.001	0.001	0.001	I=(nV) ² /R ^{4/3}
	Friction Loss	hf	m	0.028	0.044	0.073	0.046	
	Inlet Loss	hi	m	0.014	0.022	0.036	0.022	f=1.00
	Outlet Loss	ho	m	0.007	0.011	0.018	0.011	f=0.50
	Total			0.049	0.077	0.127	0.079	
Total Head Loss				0.050	0.080	0.130	0.080	
Downstream Water Level	Hd		8.500	8.860	8.860	8.530	F.P.	
Upstream Water Level	H		8.550	8.940	8.990	8.610	P.S.T.	

Table 5.5.14.15 Hydraulic Calculation of Primary Sedimentation Tank

Facility		Primary Sedimentation Tank						
Item	Symbol	Unit	M/P			F/S	Remarks	
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		6	6	6	3	Overflow Weir	
Unit Flow	q	m ³ /sec	0.202	0.252	0.323	0.255		
Dimension		Circular Tank					Triangle wire pitch=0.16m Rectangular	
Diameter		28.0 m						
Weir Length		81.6						
Weir High		0.06 m/unit						
Number of Weir		550 numbers/unit						
Traff Width	w	0.8 m						
Overflow Depth	Overflow Depth(weir)	h	m	0.037	0.040	0.044	0.040	$(q/1.42B)^{2/5}$
	Traff Velocity	V	m/sec	1.000	1.000	1.000	1.000	
	Velocity Head	$V^2/2g$	m	0.051	0.051	0.051	0.051	
	Water Depth	h	m	0.252	0.315	0.403	0.319	$h=q/(Vw)$
	Hydraulic Gradient	I	-	0.0020	0.0017	0.0014	0.0017	$I=(nV)^2/R^{4/3}$
	Friction Loss	hf	m	0.166	0.140	0.117	0.138	
	Total		m	0.203	0.180	0.162	0.179	
Overflow Depth	h	m	0.210	0.180	0.170	0.180		
Weir Level		m	9.120	9.120	9.120	9.120		
Upstream Water Level		m	9.330	9.300	9.290	9.300	P.S.T.	

Table 5.5.14.16 Hydraulic Calculation of Primary Sedimentation Tank Inlet Pipe

Facility		Primary Sedimentation Tank Inlet Pipe						Remarks
Item	Symbol	Unit	M/P			F/S		
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		6	6	6	3		
Unit Flow	q	m ³ /sec	0.202	0.252	0.323	0.255		
Dimension		Circular Pipe						
Diameter	D	0.70 m						
Area	A	0.385 m ²						
Length	L	50 m						
Roughness Coefficient	n	0.013						
Head Loss	Velocity	V	m/sec	0.524	0.655	0.838	0.663	V=q/A
	Velocity Head	V ² /2g	m	0.014	0.022	0.036	0.022	
	Hydraulic Gradient	I		0.000	0.001	0.001	0.001	I=(nV) ² /R ^{4/3}
	Friction Loss	hf	m	0.024	0.037	0.061	0.038	
	Inlet Loss	hi	m	0.014	0.022	0.036	0.022	f=1.00
	Outlet Loss	ho	m	0.007	0.011	0.018	0.011	f=0.50
	Bend Loss	hb	m	0.001	0.002	0.004	0.002	f=0.10
	Total			0.046	0.072	0.118	0.074	
Total Head Loss			0.050	0.080	0.120	0.080		
Downstream Water Level	Hd		9.330	9.300	9.300	9.300	P.S.T.	
Upstream Water Level	H		9.380	9.380	9.420	9.380	Distribution Chamber	

Table 5.5.14.17 Hydraulic Calculation of Primary Sedimentation Tank Distribution Chamber

Facility		Primary Sedimentation Tank Distribution Chamber						
Item	Symbol	Unit	M/P			F/S	Remarks	
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		6	6	6	3	Overflow Weir	
Unit Flow	q	m ³ /sec	0.202	0.252	0.323	0.255		
Dimension		Rectangular Weir						
Overflow Depth	Weir Width	B	m	1.50	1.50	1.50	1.50	
	Overflow Depth	h	m	0.175	0.203	0.239	0.204	$(q/1.84B)^{2/3}$
	Total		m	0.175	0.203	0.239	0.204	
Overflow Depth	h	m	0.180	0.210	0.240	0.200		
Weir Level		m	9.520	9.520	9.520	9.520		
Upstream Water Level		m	9.700	9.730	9.760	9.720		

Table 5.5.14.18 Hydraulic Calculation of Primary Sedim. Tank Distrib. Chamber Inlet Pipe

Facility		Primary Sedimentation Tank Distribution Tank Inlet Pipe						
Item	Symbol	Unit	M/P			F/S	Remarks	
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		2	2	2	1		
Unit Flow	q	m ³ /sec	0.605	0.756	0.968	0.765		
Dimension		Circular Pipe						
Diameter	D	1.10 m						
Area	A	0.950 m ²						
Length	L	100 m						
Roughness Coefficient	n	0.013						
Head Loss	Velocity	V	m/sec	0.636	0.796	1.019	0.805	V=q/A
	Velocity Head	V ² /2g	m	0.021	0.032	0.053	0.033	
	Hydraulic Gradient	I		0.000	0.001	0.001	0.001	I=(nV) ² /R ^{4/3}
	Friction Loss	hf	m	0.038	0.060	0.098	0.061	
	Inlet Loss	hi	m	0.021	0.032	0.053	0.033	f=1.00
	Outlet Loss	ho	m	0.010	0.016	0.026	0.017	f=0.50
	Bend Loss	hb	m	0.002	0.003	0.005	0.003	f=0.10
	Total			0.071	0.112	0.183	0.114	
Total Head Loss			0.080	0.120	0.190	0.210		
Downstream Water Level	Hd		9.700	9.730	9.760	9.720	Distribution Chamber	
Upstream Water Level	H		9.780	9.850	9.950	9.930	Grit Chamber	

Table 5.5.14.19 Hydraulic Calculation of Distribution Tank

Facility		Distribution Tank						
Item	Symbol	Unit	M/P			F/S	Remarks	
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		2	2	2	1	Overflow Weir	
Unit Flow	q	m ³ /sec	0.605	0.756	0.968	0.765		
Dimension		Rectangular Weir						
Overflow Depth	Weir Width	B	m	2.00	2.00	2.00	2.00	
	Overflow Depth	h	m	0.300	0.348	0.410	0.351	$(q/1.84B)^{2/3}$
	Total		m	0.300	0.348	0.410	0.351	
Overflow Depth	h	m	0.300	0.350	0.420	0.360		
Weir Level		m	10.000	10.000	10.000	10.000		
Upstream Water Level		m	10.300	10.350	10.420	10.360		

Table 5.5.14.20 Hydraulic Calculation of Parshall Flume

Facility	Parshall Flume							
Item	Symbol	Unit	M/P			F/S	Remarks	
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	1.209	1.512	1.935	0.765		
Number of Facility	N		1	1	1	1		
Unit Flow	q	m ³ /sec	1.209	1.512	1.935	0.765		
Dimension		Rectangular Channel No.10						
Throat Width	W	1.50 m						
Coefficient K	K	3.668 -					$q=K*ha^n$	
Coefficient n	n	1.586 -					$q=K*ha^n$	
Head Loss	Water Depth	ha	m	0.497	0.572	0.668	0.372	$ha=(q/K)^{(1/n)}$
		Total		m	0.497	0.572	0.668	0.372
Total Head Loss			m	0.500	0.580	0.670	0.380	
Downstream Water Level	Hd			10.300	10.350	10.120	10.360	
Upstream Water Level	H			10.800	10.930	10.790	10.740	

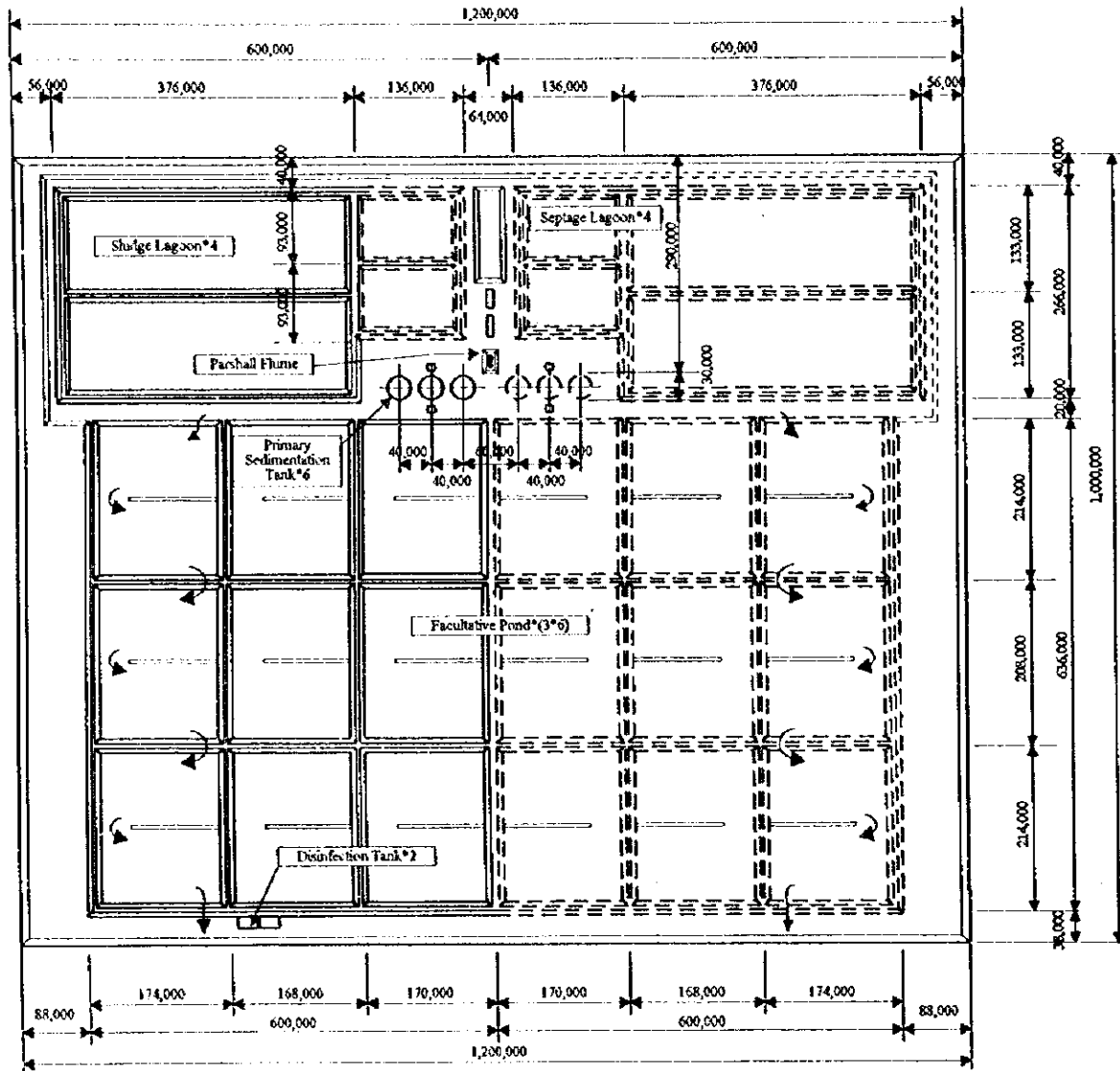
Table 5.5.14.21 Hydraulic Calculation of Sludge Lagoon Outlet Pipe

Facility		Sludge Lagoon Outlet Pipe						Remarks
Item	Symbol	Unit	M/P			F/S		
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	0.019	1.512	1.935	0.765		
Number of Facility	N		1	2	2	1		
Unit Flow	q	m ³ /sec	0.019	0.756	0.968	0.765		
Dimension		Circular Pipe						
Diameter	D	0.40 m						
Area	A	0.126 m ²						
Length	L	480 m						
Roughness Coefficient	n	0.013						
Head Loss	Velocity	V	m/sec	0.151	0.796	1.019	0.805	V=q/A
	Velocity Head	V ² /2g	m	0.001	0.032	0.053	0.033	
	Hydraulic Gradient	I		0.000	0.001	0.001	0.001	I=(nV) ² /R ^{4/3}
	Friction Loss	hf	m	0.040	0.210	0.343	0.215	
	Inlet Loss	hi	m	0.001	0.032	0.053	0.033	f=1.00
	Outlet Loss	ho	m	0.001	0.016	0.026	0.017	f=0.50
	Total		m	0.042	0.258	0.423	0.264	
	Total Head Loss		m	0.050	0.260	0.430	0.270	
	Downstream Water Level	Hd		8.920	6.500	6.500	6.500	FP Distr. Chamber
	Upstream Water Level	H		8.970	6.760	6.930	6.770	S.L.Outlet Weir.

Table 5.5.14.22 Hydraulic Calculation of Sludge Lagoon Outlet Weir

Facility		Sludge Lagoon Outlet Weir						
Item	Symbol	Unit	M/P			I/S	Remarks	
			Daily average	Daily Max.	Hourly Max.	Hourly Max.		
Design Flow	Q	m ³ /sec	0.060			0.765		
Number of Facility	N		1			1		
Unit Flow	q	m ³ /sec	0.060			0.765		
Dimension		Rectangular Weir						
Head Loss	Weir Width	B	m	1.00			2.00	
	Overflow Depth	h	m	0.102			0.351	$(q/1.84B)^{2/3}$
	Total		m	0.000	0.000	0.000	0.000	
Total Head Loss			m	0.000	0.000	0.000	0.000	
Downstream Water Level		Hd		8.970	6.500	6.500	6.500	Discharge Pipe
Upstream Water Level		H		9.000	6.500	6.500	6.500	S.L.

Appendix 5.5.15 Basic Design Drawings of North Dhaka East Sewage Treatment Plant



— : F/S
 - - - : Future

<p>Figure 5.5.15.1 General Layout</p> <p><i>The Study on the Sewerage System in North Dhaka</i></p>	Scale

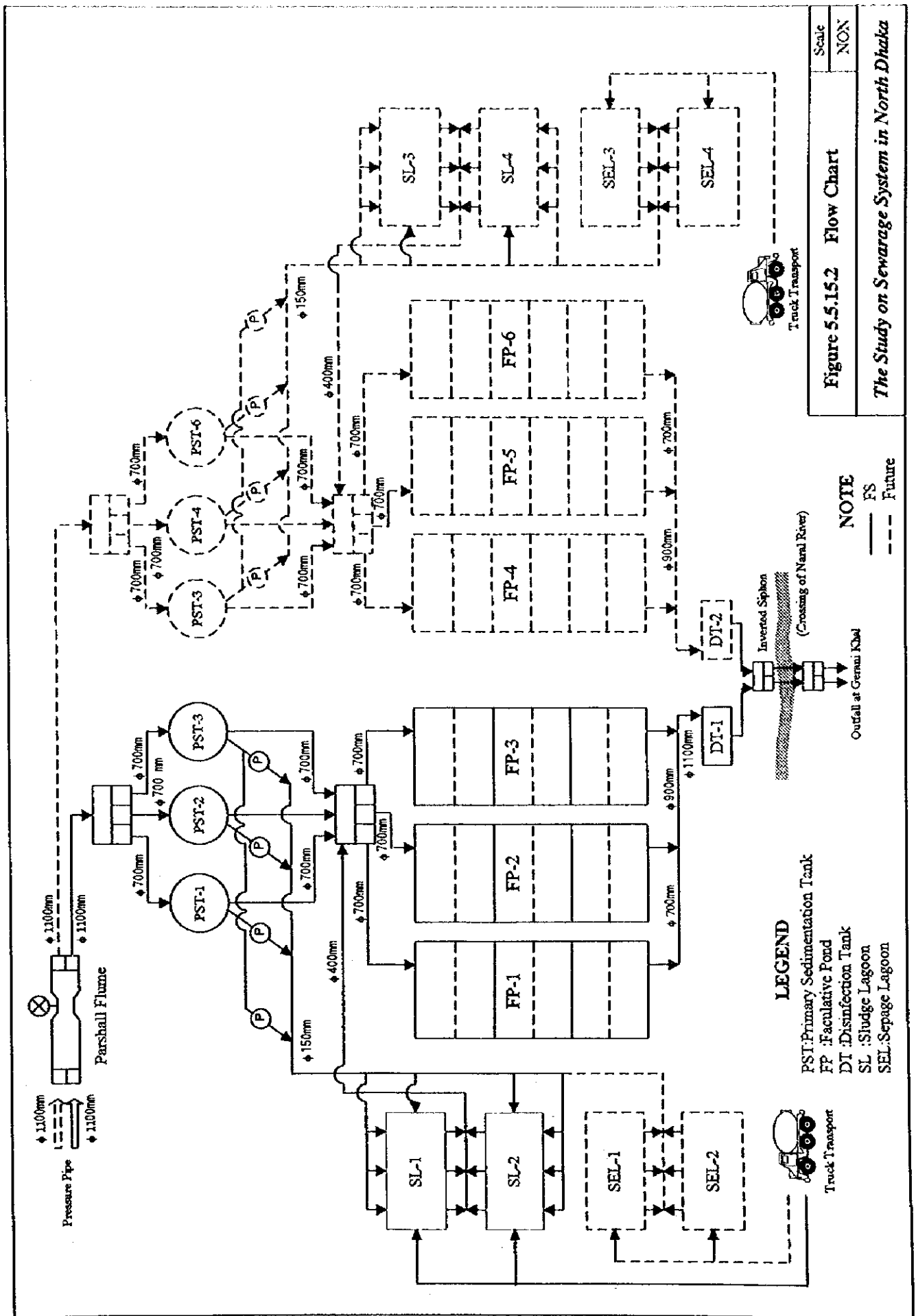


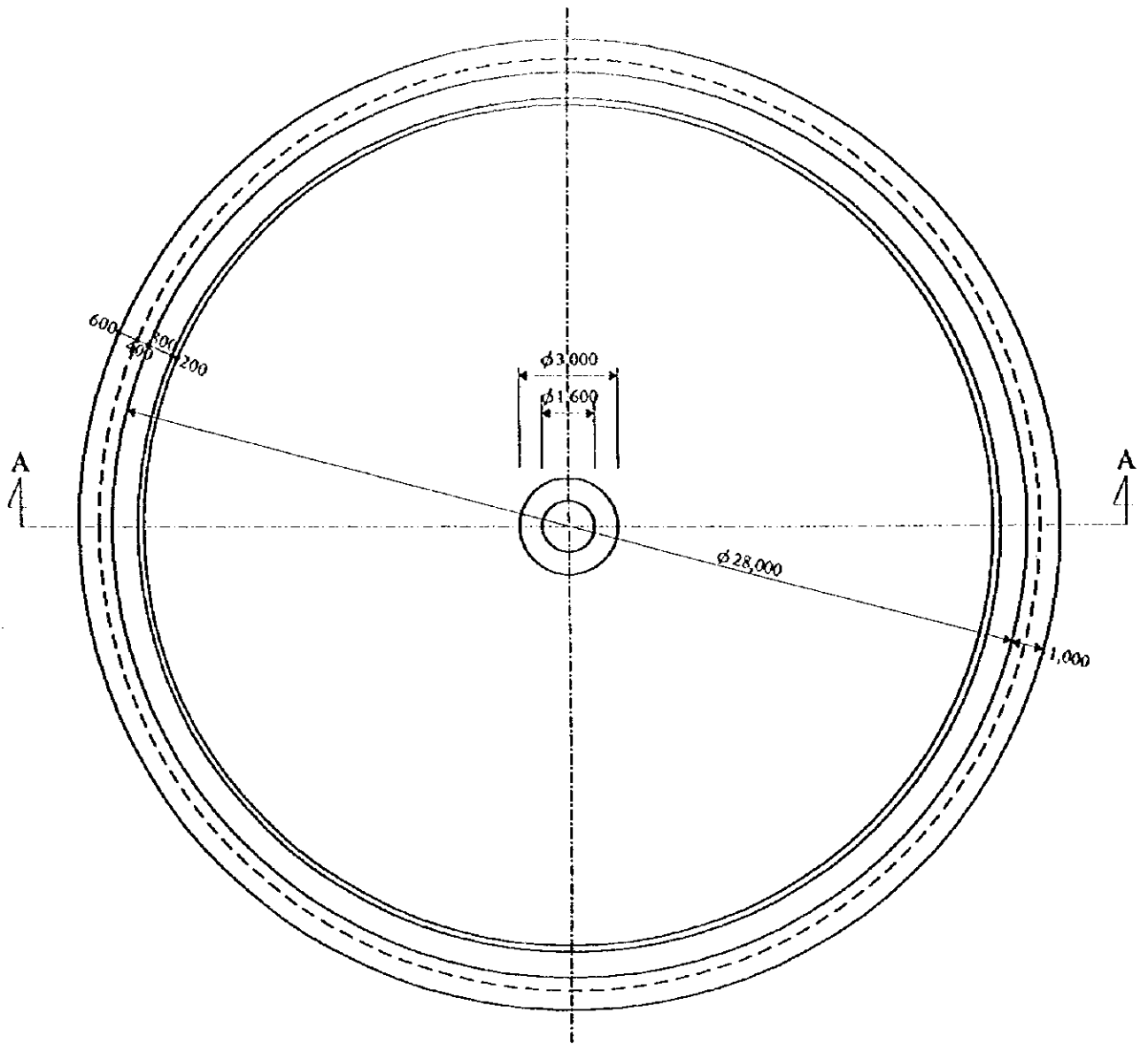
Figure 5.5.15.2 Flow Chart

Scale
NON

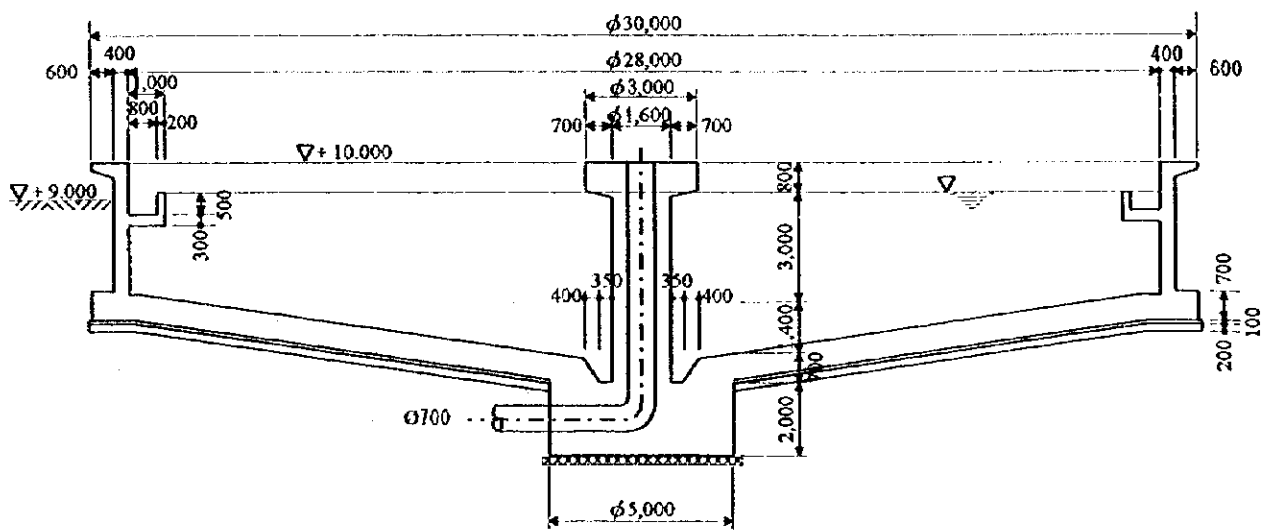
The Study on Sewerage System in North Dhaka

NOTE
 --- FS
 --- Future

LEGEND
 PST: Primary Sedimentation Tank
 FP : Facultative Pond
 DT : Disinfection Tank
 SL : Sludge Lagoon
 SEL: Sewage Lagoon



PLAN



A-A SECTION

Figure 5.5.15.4 Primary Sedimentation Tank

Scale
1/200

The Study on Sewerage System in North Dhaka

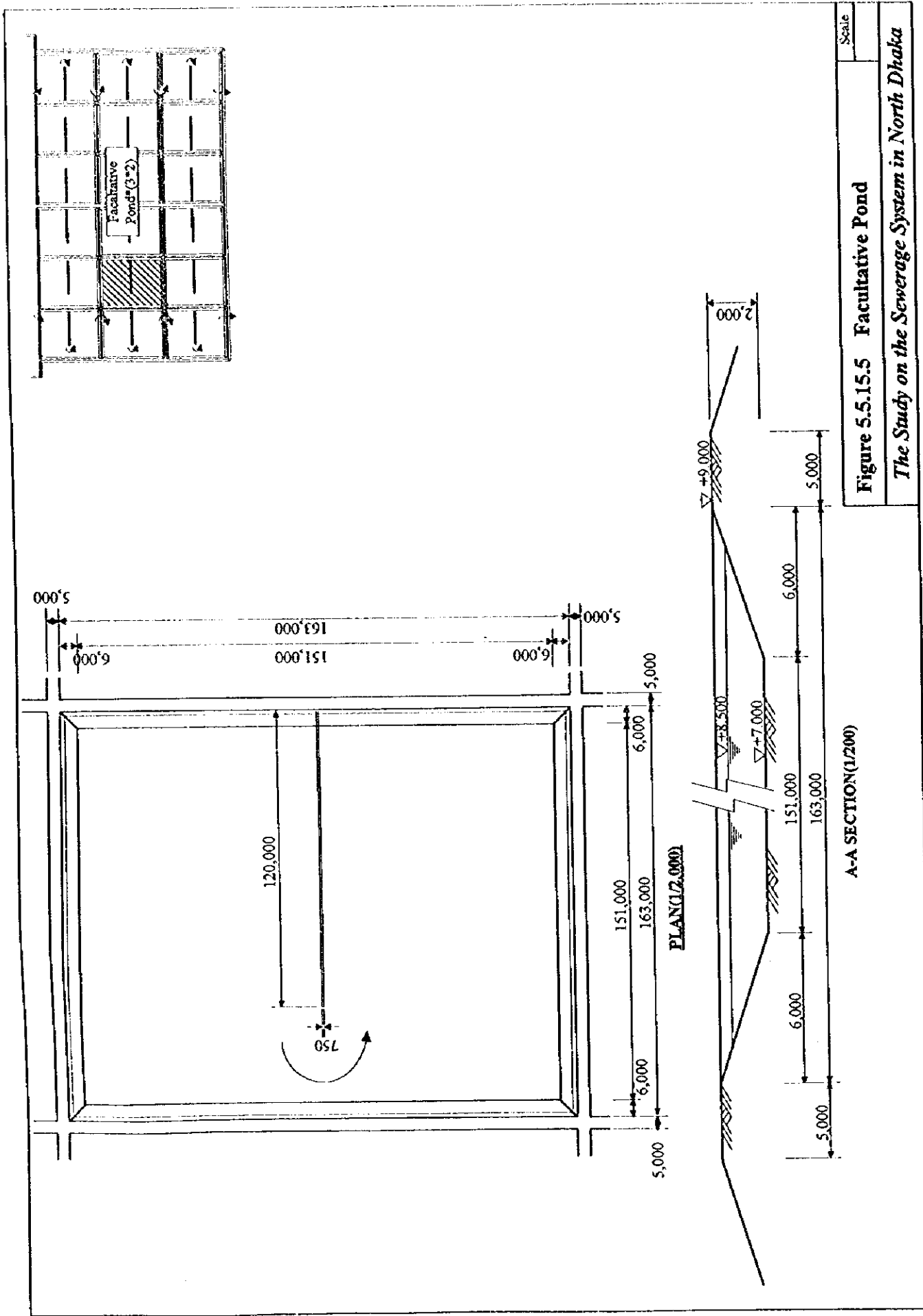


Figure 5.5.15.5 Facultative Pond
 The Study on the Sewerage System in North Dhaka

Scale

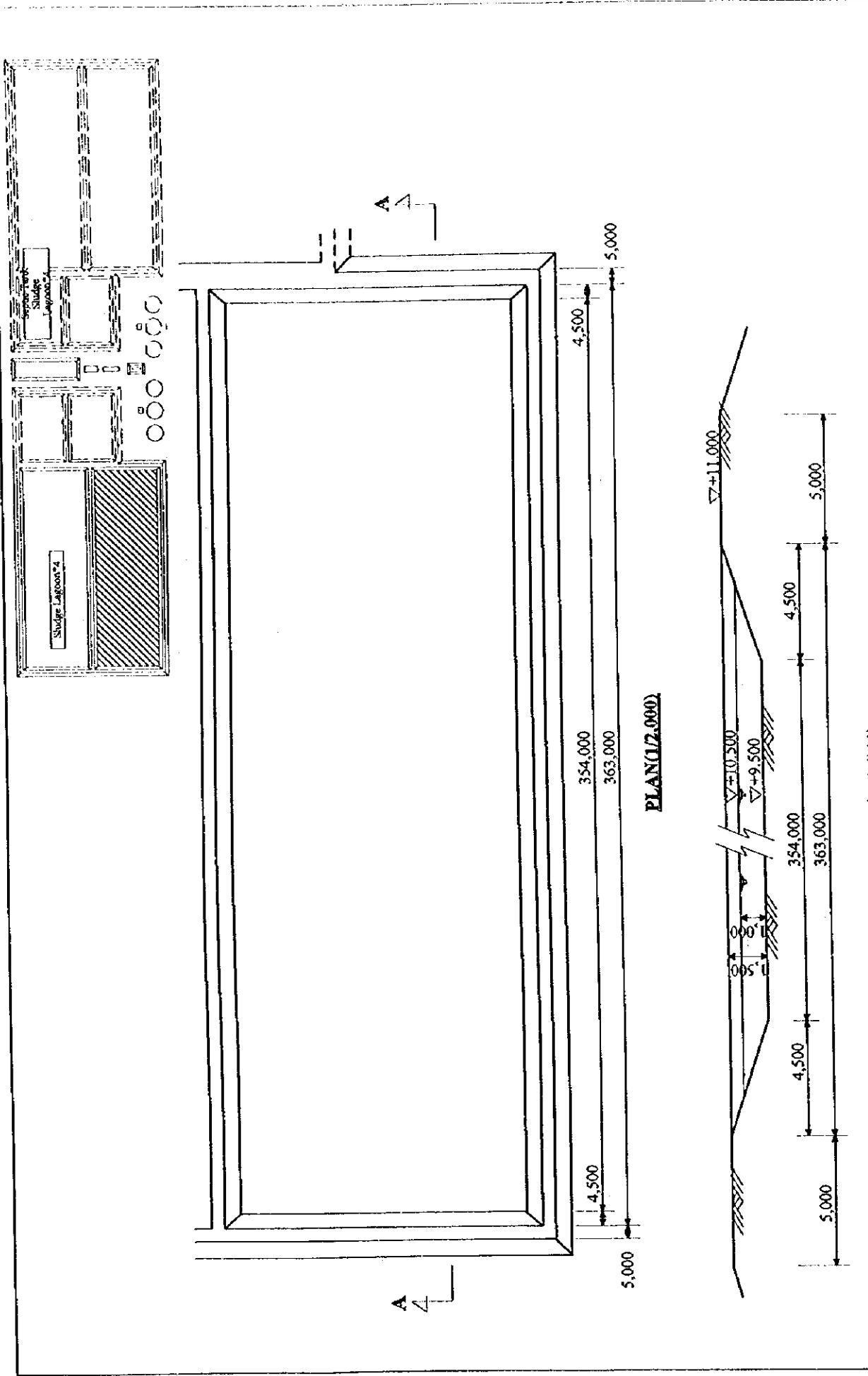
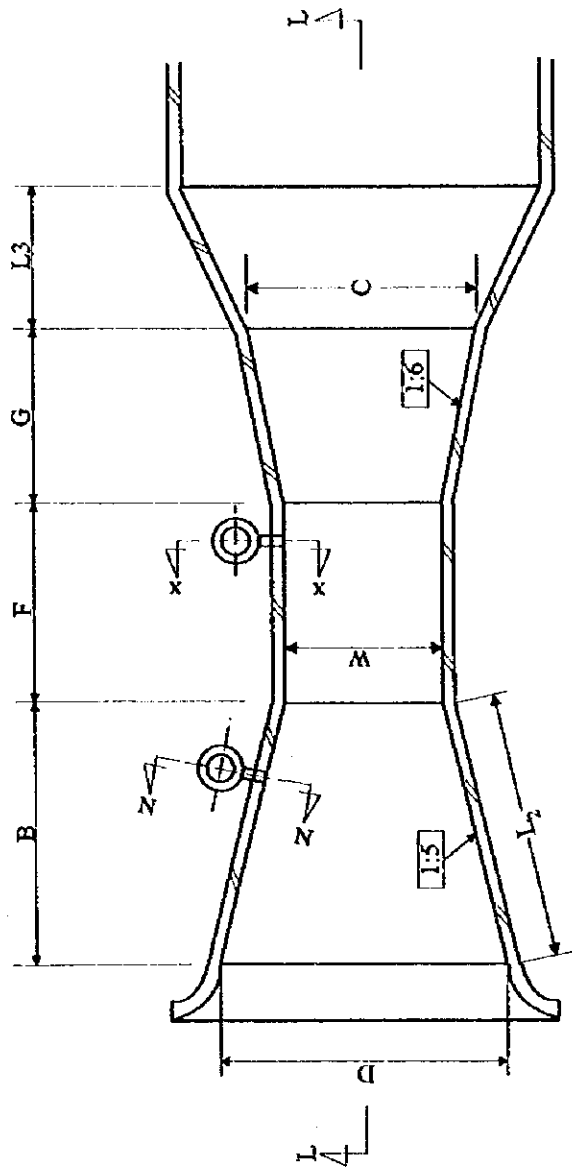


Figure 5.5.15.7 Sludge Lagoon
 The Study on the Sewerage System in North Dhaka

A-A SECTION (1/200)

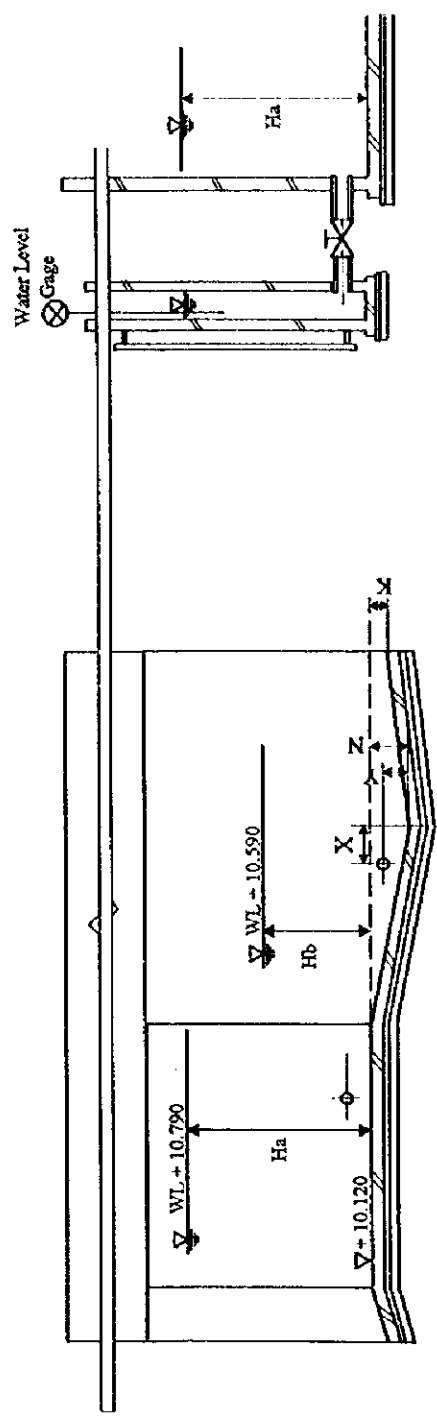


(unit: m)

W	1.50	B	1.950
F	0.60	L2	1.993
X	0.05	L3	1.329
Y	0.075	C	1.80
N	0.239	G	0.92
D	2.28	K	0.08

$Q_{max} = 2.500 \text{ m}^3/\text{sec}$
 $Q_{min} = 0.045 \text{ m}^3/\text{sec}$
 (International Standard No.10)

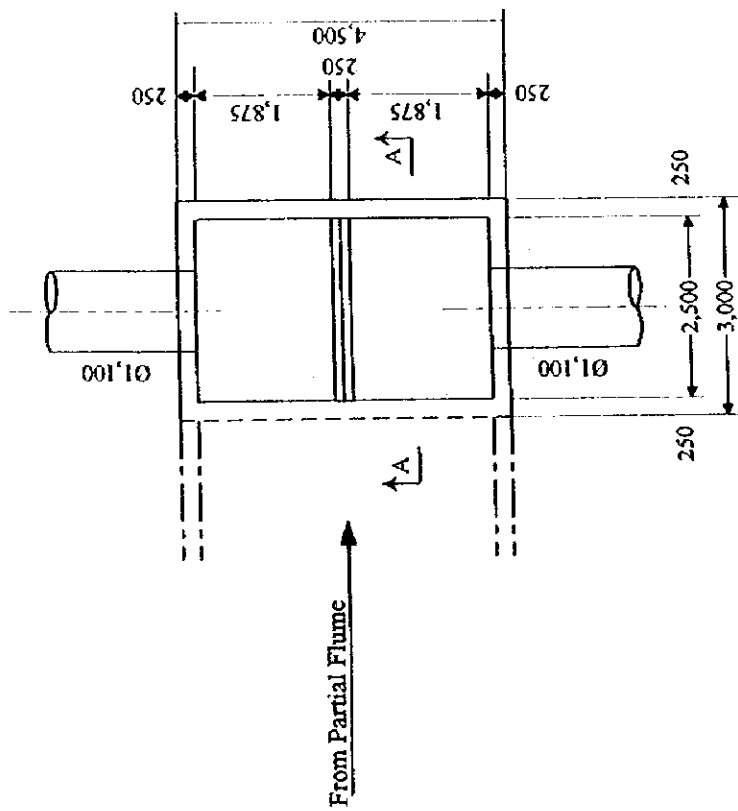
Plan (S = Not)



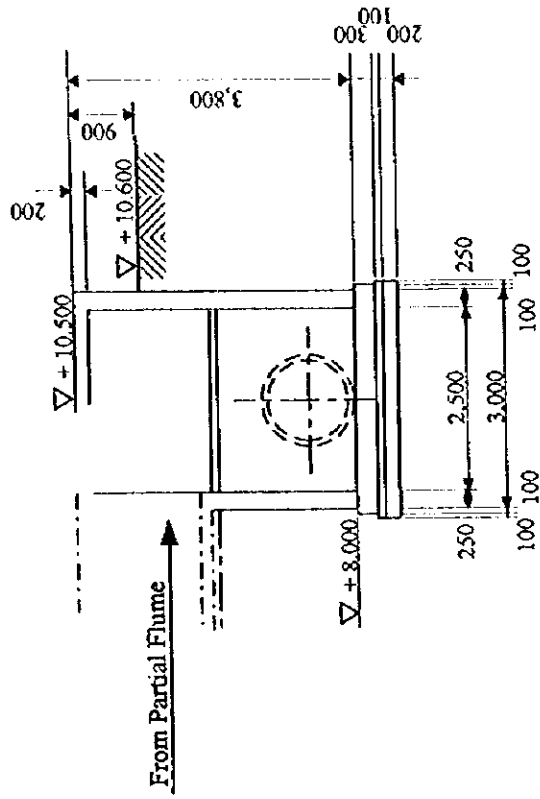
L-L Section (S = Not)

N-N Section (S = Not)

Figure 5.5.15.8 Parshall Flume
The Study on Sewerage System in North Dhaka



Plan

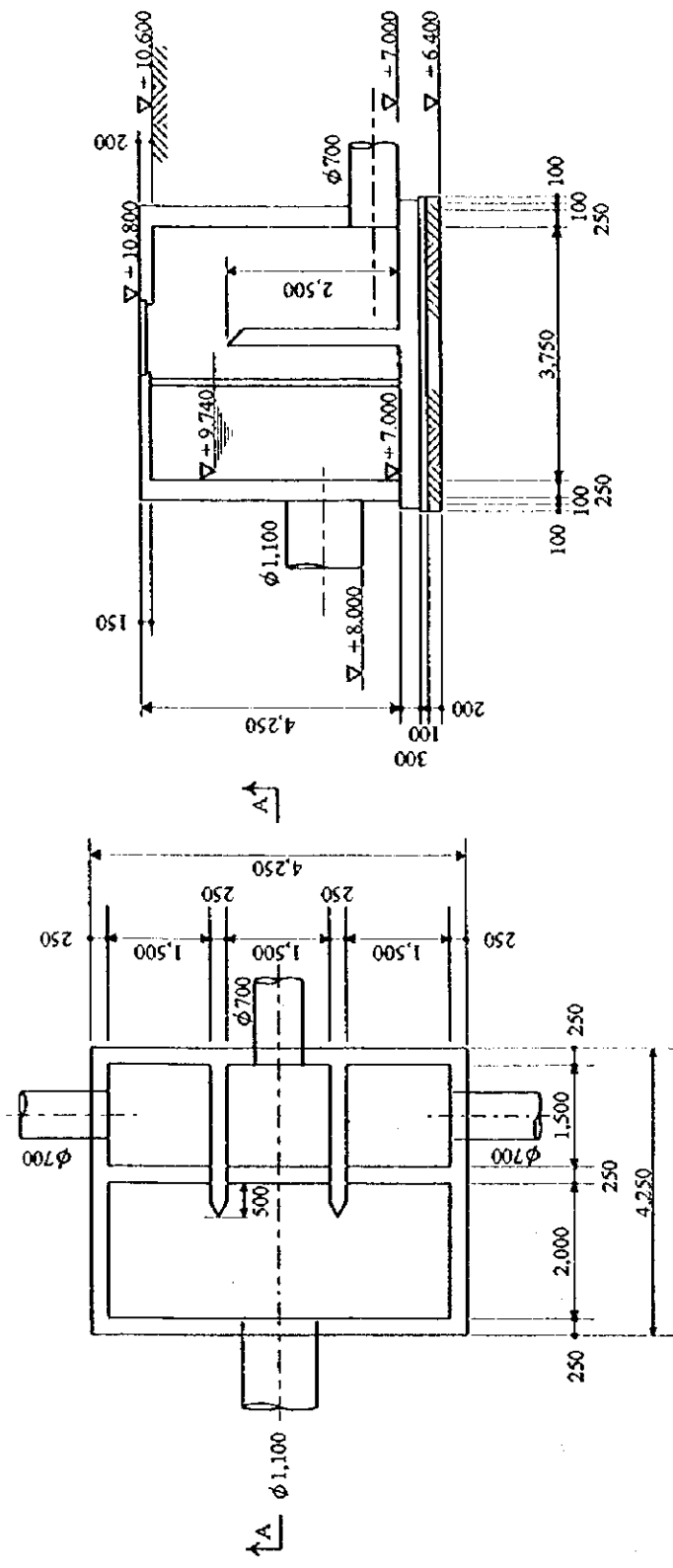


A-A Section

Figure 5.5.15.9 Distribution Chamber

Scale
1/100

The Study on Sewerage System in North Dhaka



A-A SECTION

PLAN

Figure 5.5.11.10

Primary Sedimentation Tank Distribution Chamber

Scale

1/100

The Study on Sewerage System in North Dhaka

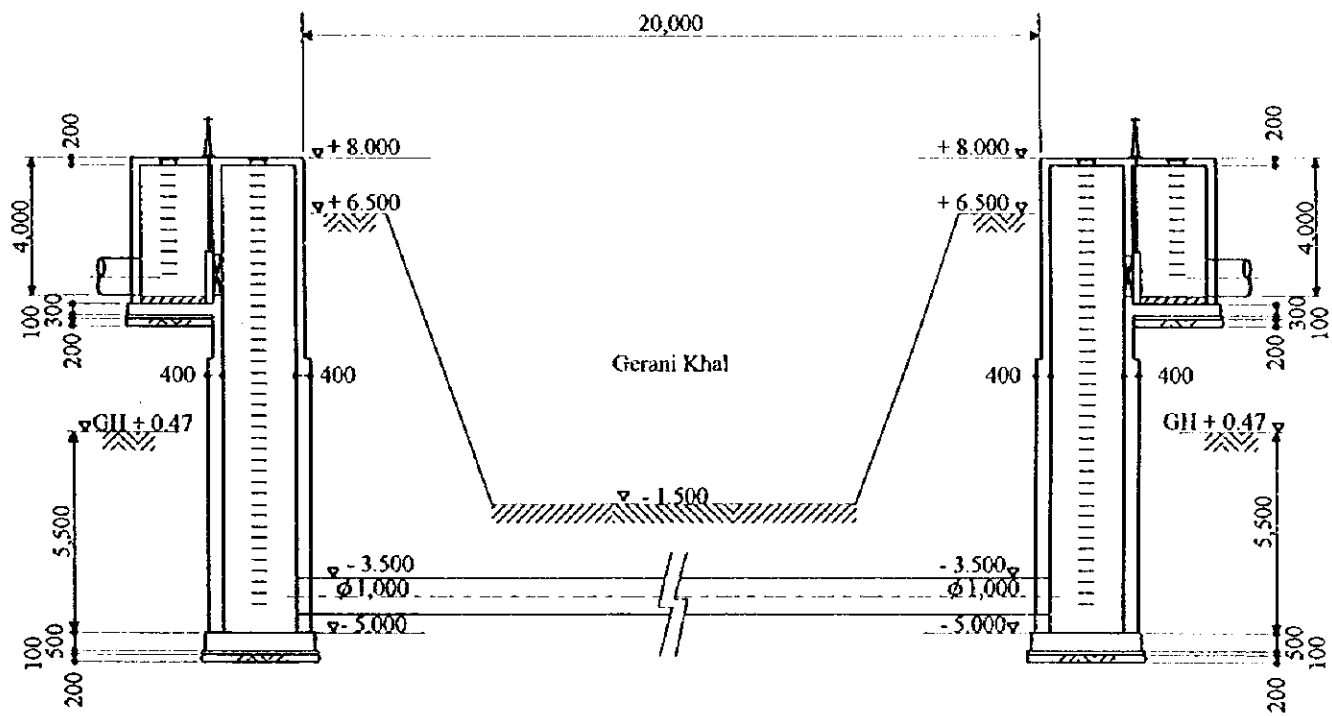
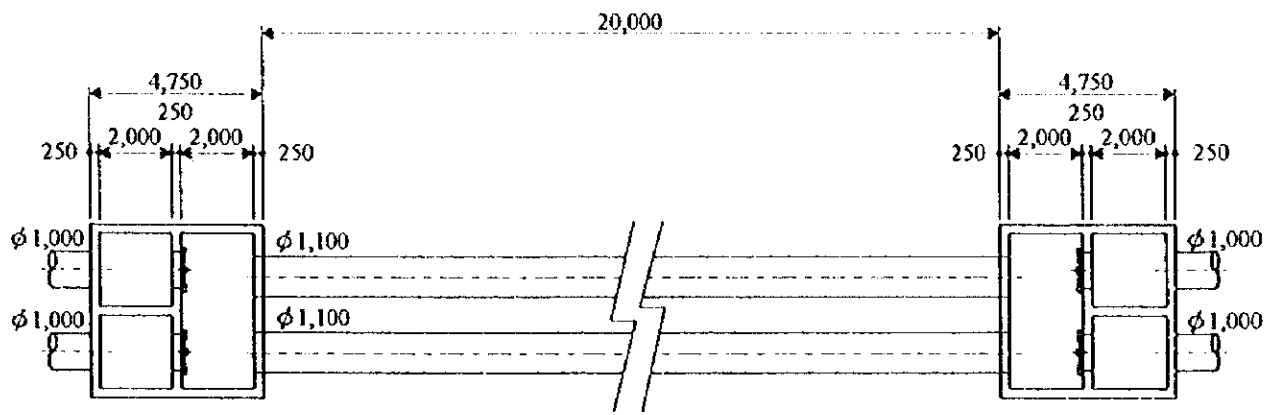
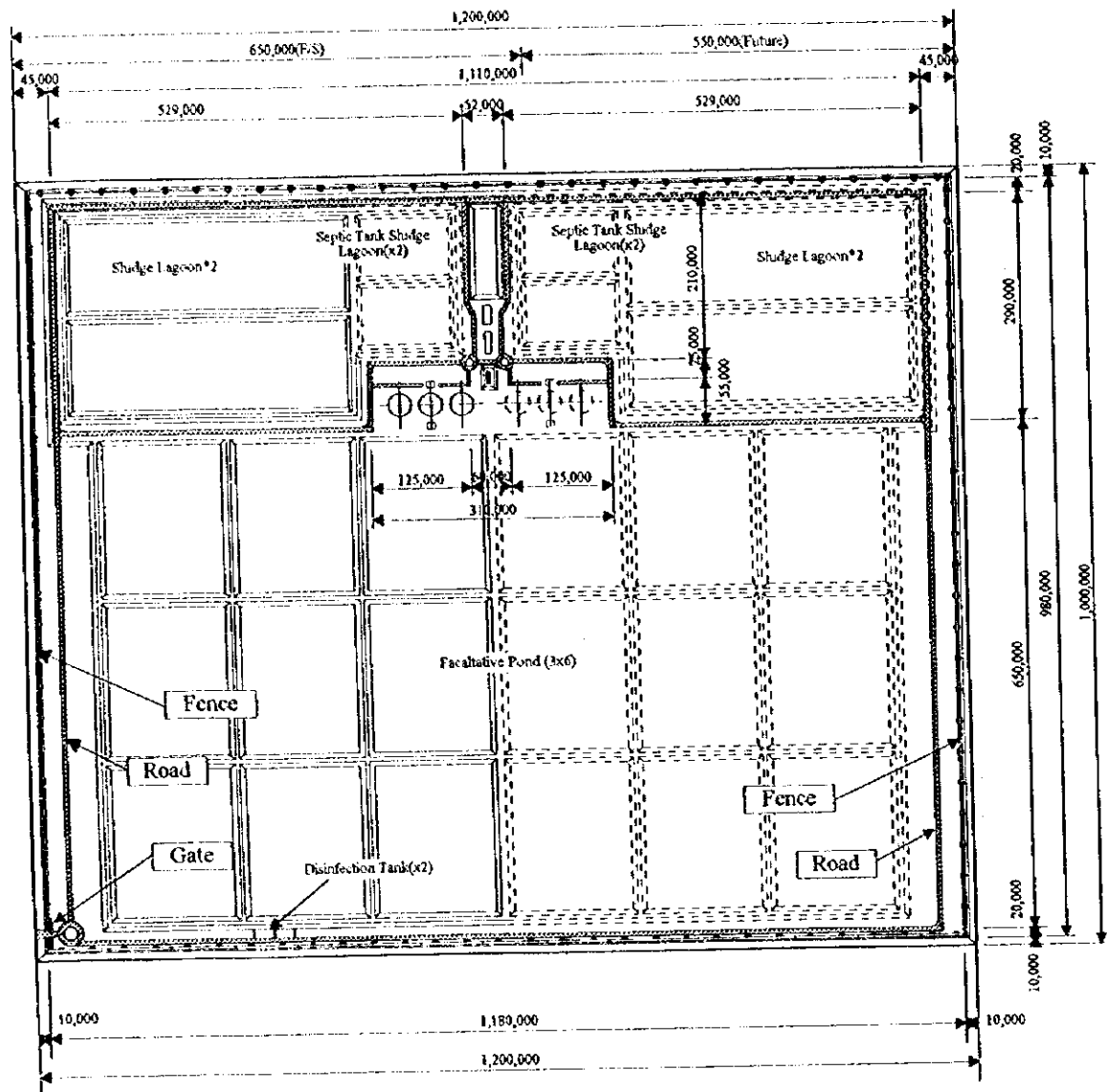


Figure 5.5.15.12 River Crossing Scale
1/200

The Study on Sewerage System in North Dhaka

Appendix 5.5.16 In-Plant Landscaping Plan



Legend	
	Fence
	Gate
	Road(Asfalt Surface, Width 5m)

Figure 5.5.16.1
In-plant Landscaping Plan
The Study on the Sewerage System in North Dhaka

Scale

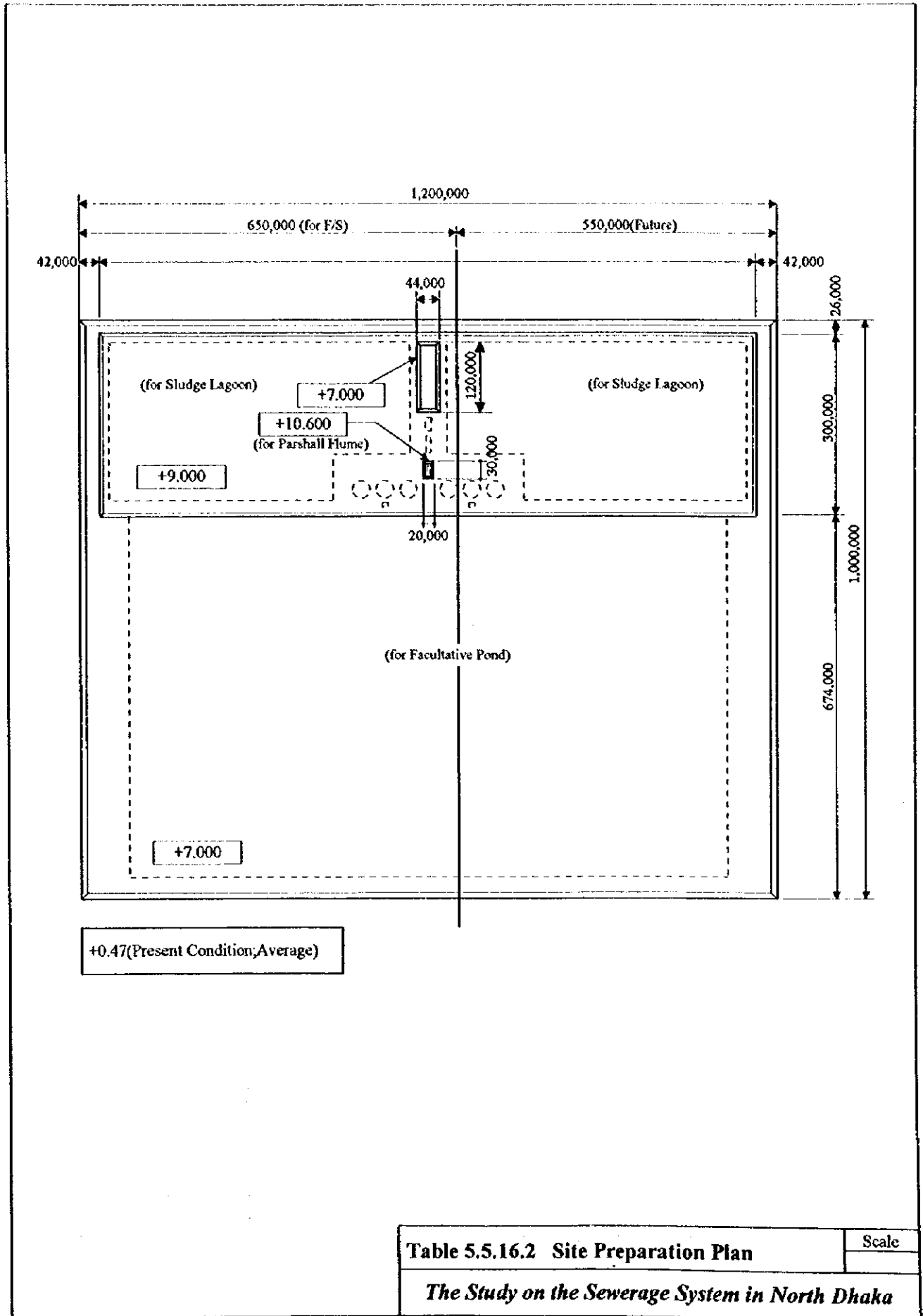


Table 5.5.16.2 Site Preparation Plan

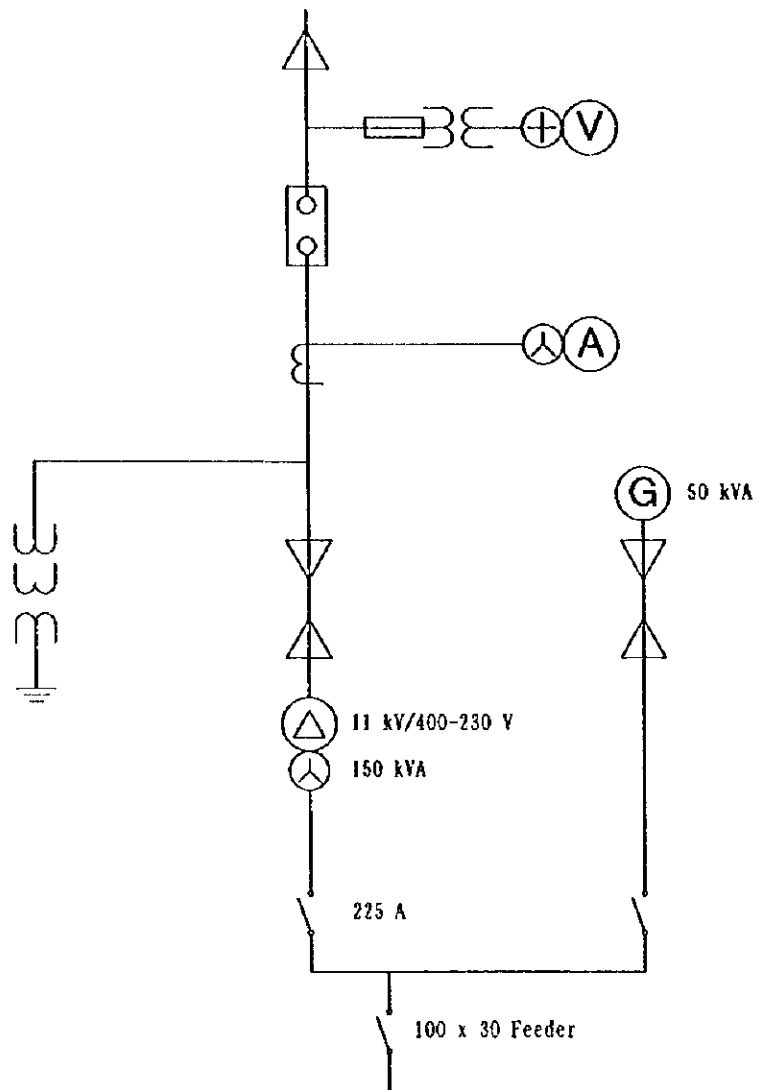
Scale

The Study on the Sewerage System in North Dhaka

Appendix 5.5.17 Equipment List of North Dhaka East Sewerage Treatment Plant

North Dhaka East Sewerage Treatment Plant							
Daily Average/Daily Maximum/Hourly Maximum							
M/P 104,500/130,625/167,200m ³ /day F/S 43,320/52,440/66,120m ³ /day							
Item No.	Name of Equipment	Specification	Power	Quantity		Remarks	
				M/P	F/S		
Mechanical Equipment							
1	Chain Hoist	Motor Operated Geared Trolley Chain Hoist	0.5ton × 12mH × 12mT	2.2kW 0.4kW	1	1	
2	Sludge Collector	Circular Tank Sludge Scraper Center Drive Floor Mount	φ 28m × 3.8m	1.5kW	6	3	
3	Auxiliary Equipment of Sludge Collector	Circular Tank Sludge Scraper Center Drive Floor Mount	φ 28m × 3.8m	---	6	3	
4	Sludge Pump	Nonclogging Sludge Pump	φ 150mm × 1.1m ³ /min × 20mH	11kW	8	4	Include 1 Standby
5	Sludge Pump Motor	Totally Enclosed Fan	200V × 50Hz × 4P	11kW	8	4	Include 1 Standby
6	Scum Return Pump	Submersible Pump	φ 80mm × 0.5m ³ /min × 10mH	1.5kW	4	2	Include 1 Standby
7	Sump Pump	Submersible Pump	φ 50mm × 0.2m ³ /min × 10mH	0.75kW	2	2	
8	Disinfection Equipment	Chlorine Gas Dosing Method	10kg/h	---	1	1	Ejector System
9	Booster Pump	Horizontal Multistage Pump	φ 50mm × 0.1m ³ /min × 40mH	3.7kW	3	3	Include 1 Standby
10	Strainer	Automatic Backwash Type	φ 50mm × 0.1m ³ /min	0.1kW	3	3	Include 1 Standby
11	Chain Hoist	Motor Operated Geared Trolley Chain Hoist	2ton × 6mH × 10mT	3.7kW 0.75kW	1	1	For Cl Cylinder
12	Movable Weir	Hand Operated Cast Iron Type Direct Connected	^w 2000mm × ^H 1500mm	---	2	1	
13	Inverted Siphon Gate	Manually operated Cast Iron Type	^w 1100mm × ^H 1100mm	---	4	4	
Electrical Equipment							
14	Power Receiving & Distribution Facility	Power Receiving Panel Transformer Distribution Panel	VCB 150kVA MCCB		1	1	
15	Operating Facility	Each Panel	Out Door Use		1	1	
16	Monitoring Instrumentation Facility	Monitoring Panel with Water Flow Meter	^w 1000mm × ^H 2350mm × ^D 600mm		1	1	
17	Standby Generator	Diesel Engine Generator	50kVA		1	1	
18	Lighting Facilities	Lighting Panel & Out door Lighting	300VA × 10	10kW	2	1	
Total Electrical Power (kW)					114.15	65.15	

Appendix 5.5.18 Single Line Diagram of North Dhaka East STP



A. 7

PROJECT COST

Appendix 7.2.1 Unit Cost

1. Wastewater Collection Facilities

(1) Pipe Laying (including materials + installation)

Reinforced Concrete Pipe		Polyvinyl Chloride Pipe		Steel Pipe	
Diameter (mm)	Unit Cost (Tk/m)	Diameter (mm)	Unit Cost (Tk/m)	Diameter (mm)	Unit Cost (Tk/m)
150	640	150	406	150	800
200	780	200	663	200	-
250	920	250	994	250	-
300	1,240	300	1,412	300	-
350	1,520	350	1,862	350	-
400	1,790	400	2,597	400	-
450	2,070	450	2,963	450	-
500	3,290	-	-	500	-
600	4,040	-	-	600	-
700	4,840	-	-	700	-
800	5,740	-	-	800	-
900	6,730	-	-	900	8,497
1000	8,980	-	-	1000	-
1100	11,070	-	-	1100	13,040
1200	13,010	-	-	1200	-
1300	15,360	-	-	1300	-
1400	17,700	-	-	1400	-
1500	20,050	-	-	1500	-
1600	22,870	-	-	1600	-
1700	25,560	-	-	1700	-
1800	28,600	-	-	1800	-
1900	31,800	-	-	1900	-
2000	35,180	-	-	2000	-
2100	38,740	-	-	2100	-
2200	42,470	-	-	2200	-
2400	46,930	-	-	2400	-

(2) House Connection

House Connection

1,500 Tk/house

(3) Earth Works

Excavation	(Backhoe 0.7cu.m)	90 Tk/cu.m
Excavation	(Cramshell)	160 Tk/cu.m
Excavation	(Manpower)	100 Tk/cu.m
Backfilling	(Backhoe, Original Soil)	150 Tk/cu.m
Backfilling	(Cramshell, Original Soil)	220 Tk/cu.m
Disposal	10km	230 Tk/cu.m
Sheet Pile	including driving and removal cost	Tk/m sheet
Pavement	Asphalt (Sub base course 300mm, Asphalt carpetting 38mm, Seal coat 12mm)	1,520 Tk/cu.m

(4) Manhole (including materials + installation)

H= 2.0m	1,500×1,500×200	62,200 Tk/pc
H= 3.0m	1,500×1,500×200	88,100 Tk/pc
H= 4.0m	1,500×1,500×200	114,100 Tk/pc
H= 5.0m	1,500×1,500×250	164,000 Tk/pc
H= 6.0m	1,500×1,500×250	194,300 Tk/pc
H= 7.0m	1,500×1,500×300	259,000 Tk/pc
H= 8.0m	1,500×1,500×300	293,900 Tk/pc
H= 9.0m	1,500×1,500×300	328,900 Tk/pc

2. Sewage Treatment Plant

Reclamation	(including Soil)	200 Tk/cu.m
Excavation	(Bulldozer)	110 Tk/cu.m
Backfilling	(Bulldozer)	40 Tk/cu.m
Banking	(Bulldozer + Soil)	620 Tk/cu.m
Manual Subgrading	(Man Power)	50 Tk/cu.m
Tamping	(Tamper)	40 Tk/cu.m
Slope Protection	(Manpower)	50 Tk/sq.m
Plain Concrete	180kg/sq.cm (including form-board)	7,200 Tk/cu.m
Reinforced Concrete(A)	210kg/sq.cm (including reinforcing	11,500 Tk/cu.m

(for Base)	bar and form-board)		
Reinforced Concrete(B)	210kg/sq.cm (including reinforcing	20,700	Tk/cu.m
(for beam and column)	bar and form-board)		
Road	Pavement (Asphalt) Surface 50mm	1,020	Tk/sq.m
do	Gravel t=300mm	500	Tk/sq.m
Architecture	Administration Office	37,500	Tk/sq.m
Fence	including materials + installation	610	Tk/m
Water Supply Connect	Administration Office 2 inch	9,850	Tk
Electric Power Connect	Under Ground Cable	7,400	Tk/m
Gas Connect	For 2 Burner	12,000	Tk/set
Telephone Connect	Administration Office	30,000	Tk/set
Water Supply Rate	Residential & Community	3.67	Tk/ton
Electric Power Rate	Under Ground Cable	4.5	Tk/kWh
Telephone Rate	Administration Office (PS STP)	190	Tk/day
Water Analysis Set	Include Laboratory Equipment	1,670,000	Tk/set
Dump Truck	4ton	1,500,000	Tk/set
Dump Truck	8ton	2,400,000	Tk/set
Bulldozer	40PS	1,800,000	T/set
Power Shovel	0.6cu.m	5,600,000	T/set
Small Boat	FRP work boat	867,000	T/set
Portable Engine Pump	10mH0.5cu.m/min	623,200	Tk/set

3. Civil Materials

Sand	Shylet Sand	860	Tk/cu.m
Gravel	for concreat	2,000	Tk/cu.m
Crushed Stone	Nominated Dia 40mm	2,600	Tk/cu.m
Cement		7,700	Tk/ton
Reinforcing Bar	Grade 40	34,300	Tk/ton

4. Labour Cost

Forman	260 Tk/day
Operator	260 Tk/day
Rigger	210 Tk/day
Skilled Worker	130 Tk/day
Unskilled Worker	100 Tk/day
Carpenter	210 Tk/day
Welder	210 Tk/day
Mason	210 Tk/day

- Note: 1) These unit costs are not included the tax and the overhead.
2) Exchange rate: 1Yen = 0.3333 Taka (as of Dec. 1997)
3) Exchange rate: US\$ 1.00= 43.333 Taka (as of Dec. 1997)

Appendix 7.2.2 Direct Construction Cost of Sewer by 1.0 m

Table 7.2.2.1 Unit Construction Cost of Sanitary Sewer

(Unit:TK/m)

Covering(m) Dla.(mm)	1.0	2.0	3.0	4.0	5.0	6.0	7.0
Reinforced Concrete Pipe							
250	-	5,031	6,626	31,022	36,136	41,541	48,154
300	-	5,486	7,100	31,651	36,778	42,216	48,845
350	-	5,612	7,081	31,802	36,609	46,757	48,105
400	-	6,021	7,509	32,406	37,225	47,406	48,771
450	-	6,440	7,949	33,081	37,915	48,127	49,513
500	-	7,815	9,342	34,763	39,612	49,868	51,272
600	-	9,019	10,598	40,197	42,520	51,615	54,280
700	-	10,110	11,654	41,488	46,951	52,742	55,250
800	-	11,351	12,932	43,984	49,532	55,361	57,930
900	-	12,894	14,527	45,842	51,456	57,322	62,923
1000	-	15,511	17,183	50,025	55,725	61,631	67,288
1100	-	17,978	19,612	52,741	63,218	64,189	69,685
1200	-	20,325	21,999	55,785	66,342	67,350	72,898
1300	-	23,317	25,039	61,829	71,123	73,524	81,571
1400	-	26,313	28,085	68,694	74,773	77,246	85,327
1500	-	29,094	30,902	73,514	79,635	82,145	90,264
1600	-	32,649	34,508	77,742	83,899	89,441	94,617
Polyvinyl Chloride Pipe							
200	3,132	4,552	6,119	30,503	36,164	-	-
250	3,579	5,055	6,587	31,006	36,683	-	-
300	4,088	5,545	7,144	31,595	37,292	-	-
350	4,592	5,838	7,880	32,135	38,099	-	-
400	5,369	6,696	8,755	33,044	39,024	-	-
450	5,851	7,194	9,270	33,597	39,595	-	-
Steel Pipe							
250	4667	-	-	-	-	-	-
900	12183	-	-	-	-	-	-
1100	18397	-	-	-	-	-	-

Table 7.2.2.2 Pipe Installation Cost for RC Pipe Installation, Earth Covering Depth = 2.0 m (Sand Foundation)

Diameter (mm)	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
(1) Quantity																	
Excavation (Pavement) (m ³)	1.17	1.21	1.25	1.29	1.32	1.36	1.44	1.52	1.59	1.68	1.75	1.83	1.90	1.98	2.06	2.13	2.22
Excavation(1) (m ³)	2.12	2.32	2.67	2.90	3.14	3.40	4.13	4.91	5.57	6.48	7.22	8.21	9.03	10.17	11.33	12.24	13.57
Excavation(2) (m ³)	0.22	0.26	0.36	0.40	0.44	0.49	0.67	0.89	1.01	1.27	1.41	1.70	1.87	2.20	2.55	2.74	3.15
Sand Foundation (m ³)	0.59	0.66	0.76	0.83	0.92	1.00	1.22	1.46	1.67	1.95	2.19	2.49	2.76	3.10	3.44	3.73	4.13
Backfilling(1) (m ³)	3.45	3.60	3.82	3.98	4.13	4.30	4.69	5.08	5.41	5.81	6.13	6.51	6.83	7.23	7.60	7.91	8.29
Backfilling(2) (m ³)																	
Sheetpile (sheet)																	
Timbering (t)																	
Concrete Pipe Laying (m)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pavement (m ²)	3.9	4.0	4.2	4.3	4.4	4.5	4.8	5.1	5.3	5.6	5.8	6.1	6.3	6.6	6.9	7.1	7.4
(2) Unit Cost (TM/Unit)																	
Concrete Pipe Laying	920	1240	1520	1790	2070	3290	4040	4840	5740	6730	8960	11070	13010	15360	17700	20050	22870
(2) Construction Cost (TM/AvM)																	
Excavation (Pavement)	90	105	112	116	118	122	129	136	143	151	157	164	171	178	185	191	199
Excavation(1)	90	190	208	261	282	306	371	441	501	583	649	738	812	915	1,019	1,101	1,221
Excavation(2)	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sand Foundation	860	189	223	344	378	421	576	765	868	1,092	1,212	1,462	1,608	1,892	2,193	2,356	2,709
Backfilling(1)	150	88	99	124	138	150	183	219	250	292	328	373	414	465	516	559	619
Backfilling(2)	150	517	540	597	619	645	703	762	811	871	919	976	1,024	1,084	1,140	1,186	1,243
Sheetpile (driving and removal)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Timbering		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Concrete Pipe Laying	920	1,240	1,520	1,790	2,070	3,290	4,040	4,840	5,740	6,730	8,980	11,070	13,010	15,360	17,700	20,050	22,870
Pavement	456	1,778	1,915	1,960	2,006	2,052	2,188	2,325	2,416	2,553	2,644	2,781	2,872	3,009	3,146	3,237	3,374
Manhole	62200	1,244	829	829	829	829	829	622	622	622	622	414	414	414	414	414	414
Total	5,031	5,496	5,612	6,021	6,440	7,815	9,019	10,110	11,351	12,894	15,511	17,978	20,325	23,317	26,313	29,094	32,649

Table 7.2.2.3 Quantity Calculation for RC Pipe Installation, Earth Covering Depth = 2.0 m (Sand Foundation)

D1	D2	D3	H1	H2	H3	H4	H5	H6	H7	H8	H9	H	W1	W2	W3	W4	W5	W6	Excavation (Pavement)	Excavation (1)	Sand Foundation	Backfilling (1)	Backfilling (2)	Pavement
250	28	306	2000	100	253	300	406	300	706	1400	1006	2406	300	906	1159	1612	3312	3912	1.17	2.12	0.22	0.59	3.45	3.9
300	30	360	2000	100	280	300	460	300	760	1400	1060	2460	300	960	1240	1720	3420	4020	1.21	2.32	0.26	0.66	3.60	4.0
350	32	414	2000	150	357	300	564	300	864	1400	1164	2564	300	1014	1371	1878	3578	4178	1.25	2.67	0.36	0.76	3.82	4.2
400	35	470	2000	150	385	300	620	300	920	1400	1220	2620	300	1070	1455	1990	3690	4290	1.29	2.90	0.40	0.83	3.98	4.3
450	38	526	2000	150	413	300	676	300	976	1400	1276	2676	300	1126	1539	2102	3802	4402	1.32	3.14	0.44	0.92	4.13	4.4
500	42	584	2000	150	442	300	734	300	1034	1400	1334	2734	300	1184	1626	2218	3918	4518	1.36	3.40	0.49	1.00	4.30	4.5
600	50	700	2000	200	550	300	900	300	1200	1400	1500	2900	300	1300	1850	2500	4200	4800	1.44	4.13	0.67	1.22	4.69	4.8
700	58	816	2000	250	658	300	1066	300	1366	1400	1666	3066	300	1416	2074	2782	4482	5082	1.52	4.91	0.89	1.46	5.08	5.1
800	66	932	2000	250	716	300	1182	300	1482	1400	1782	3182	300	1532	2248	3014	4714	5314	1.59	5.57	1.01	1.67	5.41	5.3
900	75	1050	2000	300	825	300	1350	300	1650	1400	1950	3350	300	1650	2475	3300	5000	5600	1.68	6.48	1.27	1.95	5.81	5.6
1000	82	1164	2000	300	882	300	1464	300	1764	1400	2064	3464	300	1764	2646	3528	5228	5828	1.75	7.22	1.41	2.19	6.13	5.8
1100	88	1276	2000	350	988	300	1626	300	1926	1400	2226	3626	300	1876	2864	3802	5502	6102	1.83	8.21	1.70	2.49	6.51	6.1
1200	95	1390	2000	350	1045	300	1740	300	2040	1400	2340	3740	300	1990	3035	4030	5730	6330	1.90	9.03	1.87	2.76	6.83	6.3
1300	103	1506	2000	400	1153	300	1906	300	2206	1400	2506	3906	300	2106	3259	4312	6012	6612	1.98	10.17	2.20	3.10	7.23	6.6
1400	108	1616	2000	450	1258	300	2066	300	2366	1400	2666	4066	300	2216	3474	4582	6282	6882	2.06	11.33	2.55	3.44	7.60	6.9
1500	112	1724	2000	450	1312	300	2174	300	2474	1400	2774	4174	300	2324	3636	4798	6498	7098	2.13	12.24	2.74	3.73	7.91	7.1
1600	120	1840	2000	500	1420	301	2340	301	2641	1398	2942	4340	301	2442	3862	5083	6782	7384	2.22	13.57	3.15	4.13	8.29	7.4

Table 7.2.2.4 Pipe Installation Cost for RC Pipe Installation, Earth Covering Depth = 3.0 m (Sand Foundation)

Diameter (mm)	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
(1) Quantity																	
Excavation (Pavement)	1.47	1.51	1.55	1.59	1.62	1.66	1.74	1.82	1.89	1.98	2.05	2.13	2.20	2.28	2.36	2.43	2.52
Excavation(1)	2.62	2.85	3.25	3.51	3.78	4.07	4.58	5.75	6.46	7.46	8.25	9.32	10.20	11.42	12.66	13.62	15.04
Excavation(2)	0.22	0.26	0.36	0.40	0.44	0.49	0.67	0.89	1.01	1.27	1.41	1.70	1.87	2.20	2.55	2.74	3.15
Sand Foundation	0.59	0.66	0.76	0.83	0.92	1.00	1.22	1.46	1.67	1.95	2.19	2.49	2.76	3.10	3.44	3.73	4.13
Backfilling(1)	7.11	7.37	7.75	8.02	8.28	8.56	9.24	9.92	10.47	11.16	11.71	12.36	12.91	13.59	14.24	14.76	15.43
Backfilling(2)																	
Sheetpile																	
Timbering																	
Concrete Pipe Laying	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pavement	4.9	5.0	5.2	5.3	5.4	5.5	5.8	6.1	6.3	6.6	6.8	7.1	7.3	7.6	7.9	8.1	8.4
(2) Unit Cost (Taka/Unit)																	
Concrete Pipe Laying	920	1240	1520	1790	2070	3290	4040	4840	5740	6730	8980	11070	13010	15360	17700	20050	22870
(2) Construction Cost (TAKA/m)																	
Excavation (Pavement)	90	132	139	143	145	149	156	163	170	178	184	191	198	205	212	218	226
Excavation(1)	90	235	292	315	340	366	439	517	581	671	742	838	918	1,027	1,139	1,225	1,353
Excavation(2)	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sand Foundation	860	189	223	309	344	421	576	765	868	1,092	1,212	1,462	1,608	1,892	2,193	2,356	2,709
Backfilling(1)	150	88	99	124	138	150	183	219	250	292	328	373	414	465	516	589	619
Backfilling(2)	150	1,066	1,105	1,203	1,242	1,284	1,386	1,488	1,570	1,674	1,756	1,854	1,936	2,038	2,136	2,214	2,314
Sheetpile (driving and removal)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Timbering		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Concrete Pipe Laying	920	1,240	1,520	1,790	2,070	3,290	4,040	4,840	5,740	6,730	8,980	11,070	13,010	15,360	17,700	20,050	22,870
Pavement	456	2,234	2,371	2,416	2,462	2,508	2,644	2,781	2,872	3,009	3,100	3,237	3,328	3,465	3,602	3,693	3,830
Manhole	88100	1,762	1,174	1,174	1,174	1,174	1,174	881	881	881	881	587	587	587	587	587	587
Total		6,626	7,100	7,509	7,949	9,342	10,598	11,654	12,932	14,527	17,183	19,612	21,999	25,039	28,085	30,902	34,508

Table 7.2.2.5 Quantity Calculation for RC Pipe Installation, Earth Covering Depth = 3.0 m (Sand Foundation)

D1	D2	D3	H1	H2	H3	H4	H5	H6	H7	H8	H9	H	W1	W2	W3	W4	W5	W6	Excavation (Pavement)	Excavation (1)	Sand Foundation	Backfilling (1)	Backfilling (2)	Pavement
250	28	306	3000	100	253	300	406	300	706	2400	1006	3406	300	906	1159	1612	4312	4912	1.47	2.62	0.22	0.59	7.11	4.9
300	30	360	3000	100	280	300	460	300	760	2400	1060	3460	300	960	1240	1720	4420	5020	1.51	2.85	0.26	0.66	7.37	5.0
350	32	414	3000	150	357	300	564	300	864	2400	1164	3564	300	1014	1371	1878	4578	5178	1.55	3.25	0.36	0.76	7.75	5.2
400	35	470	3000	150	385	300	620	300	920	2400	1220	3620	300	1070	1455	1990	4690	5290	1.59	3.51	0.40	0.83	8.02	5.3
450	38	526	3000	150	413	300	676	300	976	2400	1276	3676	300	1126	1539	2102	4802	5402	1.62	3.78	0.44	0.92	8.28	5.4
500	42	584	3000	150	442	300	734	300	1034	2400	1334	3734	300	1184	1626	2218	4918	5518	1.66	4.07	0.49	1.00	8.56	5.5
600	50	700	3000	200	550	300	900	300	1200	2400	1500	3900	300	1300	1850	2500	5200	5800	1.74	4.88	0.67	1.22	9.24	5.8
700	58	816	3000	250	658	300	1066	300	1366	2400	1666	4066	300	1416	2074	2782	5482	6082	1.82	5.75	0.89	1.46	9.92	6.1
800	66	932	3000	250	716	300	1182	300	1482	2400	1782	4182	300	1532	2248	3014	5714	6314	1.89	6.46	1.01	1.67	10.47	6.3
900	75	1050	3000	300	825	300	1350	300	1650	2400	1950	4350	300	1650	2475	3300	6000	6600	1.98	7.46	1.27	1.95	11.16	6.6
1000	82	1164	3000	300	882	300	1464	300	1764	2400	2064	4464	300	1764	2646	3528	6228	6828	2.05	8.25	1.41	2.19	11.71	6.8
1100	88	1276	3000	350	988	300	1626	300	1926	2400	2226	4626	300	1876	2864	3802	6502	7102	2.13	9.32	1.70	2.49	12.36	7.1
1200	95	1390	3000	350	1045	300	1740	300	2040	2400	2340	4740	300	1990	3035	4030	6730	7330	2.20	10.20	1.87	2.76	12.91	7.3
1300	103	1506	3000	400	1153	300	1906	300	2206	2400	2506	4906	300	2106	3259	4312	7012	7612	2.28	11.42	2.20	3.10	13.59	7.6
1400	108	1616	3000	450	1258	300	2066	300	2366	2400	2666	5066	300	2216	3474	4582	7282	7882	2.36	12.66	2.55	3.44	14.24	7.9
1500	112	1724	3000	450	1312	300	2174	300	2474	2400	2774	5174	300	2324	3636	4798	7498	8098	2.43	13.62	2.74	3.73	14.76	8.1
1600	120	1840	3000	500	1420	301	2340	301	2641	2398	2942	5340	301	2442	3862	5083	7782	8384	2.52	15.04	3.15	4.13	15.43	8.4

Table 7.2.2.6 Pipe Installation Cost for RC Pipe Installation, Earth Covering Depth = 4.0 m (Concrete Foundation)

Diameter (mm)	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
(1) Quantity																	
Excavation (Pavement) (m ³)	0.59	0.60	0.62	0.64	0.65	0.67	0.71	0.74	0.78	0.81	0.85	0.88	0.91	0.95	0.98	1.01	1.05
Excavation(1) (m ³)	5.79	6.08	6.49	6.79	7.15	7.52	8.31	9.10	10.01	10.82	11.80	12.64	13.52	14.61	15.53	16.61	17.60
Excavation(2) (m ³)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.31	0.76	1.13
Gravel (m ³)	0.11	0.11	0.12	0.13	0.14	0.15	0.22	0.24	0.27	0.29	0.31	0.34	0.36	0.38	0.40	0.43	0.45
Concrete Foundation (m ³)	0.09	0.11	0.15	0.17	0.19	0.22	0.26	0.31	0.42	0.47	0.61	0.67	0.74	0.91	0.99	1.17	1.26
Backfilling(1) (m ³)	0.93	1.01	1.15	1.24	1.34	1.44	1.69	1.93	2.22	2.48	2.80	3.07	3.36	3.72	4.04	4.39	4.73
Backfilling(2) (m ³)	4.62	4.79	5.00	5.17	5.37	5.58	5.95	6.36	6.77	7.14	7.55	7.92	8.30	8.70	9.08	9.45	9.83
Sheepile (sheet)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Timbering (t)	0.446	0.449	0.452	0.455	0.459	0.462	0.469	0.476	0.483	0.490	0.497	0.504	0.510	0.776	0.787	0.796	0.806
Concrete Pipe Laying (m)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pavement (m ²)	2.0	2.0	2.1	2.1	2.2	2.2	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.2	3.3	3.4	3.5
(2) Unit Cost (Taka/Unit)																	
Sheepile Length	9	9	9	9	9	9	10	10	10	10	11	11	11	11	12	12	12
Sheepile Driving	2435	2435	2435	2435	2435	2435	3193	3193	3193	3193	3193	3193	3193	3193	3193	3193	3193
Sheepile Removal	1948	1948	1948	1948	1948	1948	1948	1948	1948	1948	1948	1948	1948	1948	1948	1948	1948
Timbering Set Up	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589
Timbering Take Out	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640
Concrete Pipe Laying	920	1240	1520	1790	2070	3290	4040	4840	5740	6730	8980	11070	13010	15360	17700	20060	22870
(3) Construction Cost (Taka/m)																	
Excavation (Pavement)	90	54	55	57	58	60	63	66	70	72	76	79	81	85	88	90	94
Excavation(1)	90	521	547	584	611	676	747	819	900	973	1,062	1,137	1,216	1,314	1,397	1,494	1,584
Excavation(2)	90	0	0	0	0	0	0	0	0	0	0	0	0	1	27	68	101
Gravel	2000	220	240	260	280	300	440	480	540	580	620	680	720	760	800	860	900
Concrete Foundation	11500	1,035	1,265	1,955	2,185	2,530	2,990	3,565	4,830	5,405	7,015	7,705	8,510	10,465	11,385	13,455	14,490
Backfilling(1)	150	139	151	172	186	216	253	289	333	372	420	460	504	558	606	658	709
Backfilling(2)	150	693	718	775	805	837	892	954	1,015	1,071	1,132	1,188	1,245	1,305	1,362	1,417	1,474
Sheepile (driving and removal)	21,915	21,915	21,915	21,915	21,915	21,915	25,705	25,705	25,705	25,705	25,705	25,705	25,705	25,705	25,705	25,705	25,705
Timbering	2,332	2,347	2,363	2,379	2,400	2,415	2,452	2,489	2,525	2,562	2,598	2,635	2,666	4,057	4,115	4,162	4,214
Concrete Pipe Laying	920	1,240	1,520	1,790	2,070	3,290	4,040	4,840	5,740	6,730	8,980	11,070	13,010	15,360	17,700	20,060	22,870
Pavement	912	912	957	957	1,003	1,003	1,094	1,140	1,185	1,231	1,276	1,322	1,368	1,459	1,504	1,550	1,596
Manhole	2,282	2,282	1,521	1,521	1,521	1,521	1,521	1,141	1,141	1,141	1,141	760	760	760	760	760	760
Total	31,022	31,651	31,802	32,406	33,081	34,763	40,197	41,488	43,984	45,942	50,025	52,741	55,785	61,829	68,694	75,514	77,742

Table 7.2.2.7 Quantity Calculation for RC Pipe Installation, Earth Covering Depth = 4.0 m (Concrete Foundation)

D1	D2	D3	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H	W1	W2	W3	W4	W5	Excavation (m ²)	Excavation (l)	Excavation (m ³)	Gravel	Concrete Foundation	Backfilling (l)	Backfilling (m ³)	Shoerpile III (l)	Shoerpile III (m ³ /Sheet)	Timbering (l)	Pavement
250	28	306	4000	100	150	300	253	300	556	3400	856	6256	4556	102	510	300	1360	1960	0.59	5.79	0.00	0.11	0.09	0.93	4.62	2.700	9	0.446	2.0
300	30	360	4000	100	150	300	280	300	610	3400	910	4310	4610	100	590	300	1410	2010	0.60	6.08	0.00	0.11	0.11	1.01	4.79	2.700	9	0.449	2.0
350	32	414	4000	150	150	300	357	300	714	3400	1014	4414	4714	103	620	300	1470	2070	0.62	6.49	0.00	0.12	0.15	1.15	5.00	2.700	9	0.452	2.1
400	35	470	4000	150	150	300	385	300	770	3400	1070	4470	4770	100	670	300	1520	2120	0.64	6.79	0.00	0.13	0.17	1.24	5.17	2.700	9	0.455	2.1
450	38	526	4000	150	150	300	413	300	826	3400	1126	4526	4826	102	790	300	1580	2180	0.65	7.15	0.00	0.14	0.19	1.34	5.37	2.700	9	0.459	2.2
500	42	584	4000	150	150	300	442	300	884	3400	1184	4584	4884	103	790	300	1640	2240	0.67	7.52	0.00	0.15	0.22	1.44	5.58	2.700	9	0.462	2.2
600	50	700	4000	150	200	300	500	300	1050	3400	1350	4750	5050	100	900	300	1750	2350	0.71	8.31	0.00	0.22	0.26	1.69	5.95	3.000	10	0.469	2.4
700	58	816	4000	150	200	300	558	300	1166	3400	1466	4866	5166	102	1020	300	1870	2470	0.74	9.10	0.00	0.24	0.31	1.93	6.36	3.000	10	0.476	2.5
800	66	932	4000	200	200	300	666	300	1332	3400	1632	5032	5332	104	1140	300	1990	2590	0.78	10.01	0.00	0.27	0.42	2.22	6.77	3.000	10	0.483	2.6
900	75	1050	4000	200	200	300	725	300	1450	3400	1750	5150	5450	100	1260	300	2100	2700	0.81	10.82	0.00	0.29	0.47	2.48	7.14	3.000	10	0.490	2.7
1000	82	1164	4000	250	200	300	832	300	1614	3400	1914	5314	5614	103	1370	300	2220	2820	0.85	11.80	0.00	0.31	0.61	2.80	7.55	3.300	11	0.497	2.8
1100	88	1276	4000	250	200	300	888	300	1726	3400	2026	5426	5726	102	1480	300	2330	2930	0.88	12.64	0.00	0.34	0.67	3.07	7.92	3.300	11	0.504	2.9
1200	95	1390	4000	250	200	300	945	300	1840	3400	2140	5540	5840	100	1590	300	2440	3040	0.91	13.52	0.00	0.36	0.74	3.36	8.30	3.300	11	0.510	3.0
1300	103	1506	4000	300	200	300	1053	300	2006	3400	2306	5706	6006	102	1710	300	2560	3160	0.95	14.61	0.02	0.38	0.91	3.72	8.70	3.300	11	0.776	3.2
1400	108	1616	4000	300	200	300	1108	300	2116	3400	2416	5816	6116	102	1820	300	2670	3270	0.98	15.53	0.31	0.40	0.99	4.04	9.08	3.600	12	0.786	3.3
1500	112	1724	4000	350	200	300	1212	300	2274	3400	2574	5974	6274	103	1930	300	2780	3380	1.01	16.61	0.76	0.43	1.17	4.39	9.45	3.600	12	0.796	3.4
1600	120	1840	4000	350	200	300	1270	300	2390	3400	2690	6090	6390	100	2040	300	2890	3490	1.05	17.60	1.33	0.45	1.26	4.78	9.83	3.600	12	0.806	3.5

Table 7.2.2.8 Pipe Installation Cost for RC Pipe Installation, Earth Covering Depth = 5.0 m (Sand Foundation)

Diameter (mm)	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
(1) Quantity																	
Excavation (Pavement)	(m ³)	0.59	0.60	0.62	0.64	0.65	0.67	0.71	0.74	0.81	0.85	0.88	0.91	0.95	0.98	1.01	1.05
Excavation(1)	(m ³)	7.15	7.49	7.96	8.31	8.73	9.16	10.06	10.97	12.00	14.02	14.97	15.96	17.17	18.20	19.39	20.49
Excavation(2)	(m ³)	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.31	0.66	1.36	1.69	2.05	2.58	2.98	3.54	4.02
Gravel	(m ³)	0.11	0.11	0.12	0.13	0.14	0.15	0.22	0.24	0.27	0.31	0.34	0.36	0.38	0.40	0.43	0.45
Sand Foundation	(m ³)	0.09	0.11	0.15	0.17	0.19	0.22	0.26	0.31	0.42	0.61	0.67	0.74	0.91	0.99	1.17	1.26
Backfilling(1)	(m ³)	0.93	1.01	1.15	1.24	1.34	1.44	1.69	1.93	2.22	2.80	3.07	3.36	3.72	4.04	4.39	4.73
Backfilling(2)	(m ³)	5.98	6.20	6.47	6.69	6.95	7.22	7.70	8.23	8.76	9.24	10.25	10.74	11.26	11.75	12.23	12.72
Sheepile	(sheet)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Timbering	(t)	0.446	0.449	0.452	0.455	0.459	0.462	0.704	0.714	0.725	0.746	0.756	0.766	0.776	0.786	0.796	0.806
Concrete Pipe Laying	(m)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pavement	(m ²)	2.0	2.0	2.1	2.1	2.2	2.2	2.4	2.5	2.6	2.8	2.9	3.0	3.2	3.3	3.4	3.5
(2) Unit Cost	(Taka/Unit)																
Sheepile Length		11	11	11	11	11	11	11	12	12	12	13	13	13	13	14	14
Sheepile Driving		3193	3193	3193	3193	3193	3193	3193	3193	3193	3193	4167	4167	4167	4167	4167	4167
Sheepile Removal		1948	1948	1948	1948	1948	1948	1948	2597	2597	2597	2597	2597	2597	2597	2597	2597
Timbering Set Up		3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589
Timbering Take Out		1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640
Concrete Pipe Laying		920	1240	1520	1790	2070	3290	4040	4840	6730	8980	11070	13010	15360	17700	20050	22870
(3) Construction Cost (TAKA/m)																	
Excavation(1)		90	54	55	57	58	60	63	66	70	72	79	81	85	88	90	94
Excavation(2)		90	674	716	747	785	824	905	987	1,080	1,162	1,347	1,436	1,545	1,638	1,745	1,844
Gravel		90	0	0	0	0	0	8	27	59	122	152	184	232	268	318	361
Concrete Foundation		2000	220	240	260	280	300	440	480	580	620	680	720	760	800	860	900
Backfilling(1)		11500	1,035	1,265	1,955	2,185	2,530	2,990	3,565	4,830	5,405	7,705	8,510	10,465	11,585	13,455	14,490
Backfilling(2)		150	139	151	186	201	216	253	289	333	372	420	460	558	606	658	709
Sheepile (driving and removal)		150	897	970	1,003	1,042	1,083	1,155	1,234	1,314	1,386	1,537	1,611	1,689	1,762	1,834	1,908
Timbering		25,705	2,347	2,363	2,379	2,400	2,415	3,681	3,733	3,791	3,843	3,900	3,953	4,005	4,109	4,162	4,214
Concrete Pipe Laying		920	1,240	1,520	1,790	2,070	3,290	4,040	4,840	5,740	6,730	8,980	11,070	13,010	15,360	17,700	20,050
Pavement		456	912	957	957	1,003	1,003	1,094	1,140	1,185	1,231	1,322	1,368	1,459	1,504	1,550	1,596
Manhole		164000	3,280	2,186	2,186	2,186	2,186	2,186	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640	1,640
Total		36,136	36,778	36,609	37,225	37,915	39,612	42,520	46,951	49,552	51,456	55,725	63,218	66,342	74,773	79,635	83,899

Table 7.2.2.9 Quantity Calculation for RC Pipe Installation, Earth Covering Depth = 5.0 m (Concrete Foundation)

D1	D2	D3	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H	W1	W2	W3	W4	W5	Excavation (Pavement)	Excavation (1)	Excavation (2)	Gravel	Concrete Foundation	Backfilling (1)	Backfilling (2)	Sheepite III (1)	Sheepite III (2)	Timbering (1)	Pavement
250	25	306	5000	100	150	300	253	300	556	4400	856	5256	5556	102	510	300	1360	1660	0.59	7.15	0.00	0.11	0.09	0.93	5.98	3.900	11	0.446	2.0
300	30	360	5000	100	150	300	240	300	610	4400	910	5310	5610	100	560	300	1410	2010	0.60	7.49	0.00	0.11	0.11	1.01	6.20	3.900	11	0.449	2.0
350	35	414	5000	150	150	300	357	300	714	4400	1014	5414	5714	103	620	300	1470	2070	0.62	7.96	0.00	0.12	0.15	1.15	6.47	3.900	11	0.452	2.1
400	40	470	5000	150	150	300	385	300	770	4400	1070	5470	5770	100	670	300	1530	2130	0.64	8.51	0.00	0.13	0.17	1.24	6.69	3.900	11	0.455	2.1
450	45	526	5000	150	150	300	413	300	826	4400	1126	5526	5826	102	720	300	1590	2190	0.65	8.73	0.00	0.14	0.19	1.34	6.95	3.900	11	0.459	2.2
500	42	584	5000	150	150	300	442	300	884	4400	1184	5584	5884	103	790	300	1640	2240	0.67	9.16	0.00	0.15	0.22	1.44	7.22	3.900	11	0.462	2.2
600	50	700	5000	150	200	300	500	300	1050	4400	1350	5750	6050	100	900	300	1750	2350	0.71	10.06	0.09	0.22	0.26	1.69	7.70	3.900	11	0.704	2.4
700	58	816	5000	150	200	300	558	300	1166	4400	1466	5866	6166	102	1020	300	1870	2470	0.74	10.97	0.31	0.24	0.31	1.93	8.23	3.600	12	0.714	2.5
800	66	932	5000	200	200	300	666	300	1332	4400	1632	6032	6332	104	1140	300	1990	2590	0.78	12.00	0.66	0.27	0.42	2.22	8.76	3.600	12	0.725	2.6
900	75	1050	5000	200	200	300	725	300	1450	4400	1750	6150	6450	100	1250	300	2100	2700	0.81	12.92	0.95	0.29	0.47	2.48	9.24	3.600	12	0.735	2.7
1000	82	1164	5000	250	200	300	832	300	1614	4400	1914	6314	6614	103	1370	300	2220	2820	0.85	14.02	1.36	0.31	0.61	2.80	9.77	3.600	12	0.746	2.8
1100	88	1276	5000	250	200	300	888	300	1726	4400	2026	6426	6726	102	1480	300	2330	2930	0.88	14.97	1.69	0.34	0.67	3.07	10.25	3.900	13	0.756	2.9
1200	95	1390	5000	250	200	300	945	300	1840	4400	2140	6540	6840	100	1590	300	2440	3040	0.91	15.96	2.05	0.36	0.74	3.36	10.74	3.900	13	0.766	3.0
1300	103	1506	5000	300	200	300	1033	300	2006	4400	2306	6706	7006	102	1710	300	2560	3160	0.95	17.17	2.58	0.38	0.91	3.72	11.26	3.900	13	0.776	3.2
1400	108	1616	5000	300	200	300	1108	300	2116	4400	2416	6816	7116	102	1820	300	2670	3270	0.98	18.20	2.98	0.40	0.99	4.04	11.75	3.900	13	0.786	3.3
1500	112	1724	5000	350	200	300	1212	300	2274	4400	2574	6974	7274	103	1930	300	2780	3380	1.01	19.39	3.54	0.43	1.17	4.39	12.23	4.200	14	0.796	3.4
1600	120	1840	5000	350	200	300	1270	300	2390	4400	2690	7090	7390	100	2040	300	2890	3490	1.05	20.49	4.02	0.45	1.25	4.73	12.71	4.500	14	0.806	3.5

Table 7.2.2.10 Pipe Installation Cost for RC Pipe Installation, Earth Covering Depth = 6.0 m (Sand Foundation)

Diameter (mm)	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
(1) Quantity																	
Excavation (Pavement)	(m ³)	0.59	0.60	0.62	0.64	0.65	0.67	0.71	0.74	0.78	0.81	0.83	0.91	0.95	0.98	1.01	1.05
Excavation(1)	(m ³)	8.51	8.90	9.43	9.83	10.31	10.80	11.31	12.84	13.99	15.02	17.30	18.40	19.73	20.87	22.17	23.38
Excavation(2)	(m ³)	0.76	0.86	1.05	1.17	1.31	1.45	1.84	2.18	2.65	3.05	4.02	4.49	5.14	5.65	6.32	6.91
Gravel	(m ³)	0.11	0.11	0.12	0.13	0.14	0.15	0.22	0.24	0.27	0.29	0.34	0.36	0.38	0.41	0.43	0.45
Sand Foundation	(m ³)	0.09	0.11	0.15	0.17	0.19	0.22	0.26	0.31	0.42	0.47	0.67	0.74	0.91	0.99	1.17	1.26
Backfilling(1)	(m ³)	0.93	1.01	1.15	1.24	1.34	1.44	1.69	1.93	2.22	2.48	3.07	3.36	3.72	4.04	4.39	4.73
Backfilling(2)	(m ³)	7.34	7.61	7.94	8.21	8.53	8.86	9.45	10.10	10.75	11.34	12.58	13.18	13.82	14.42	15.01	15.61
Sheetpile	(sheet)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Timbering	(t)	0.668	0.673	0.678	0.683	0.688	0.694	0.704	0.714	0.725	0.735	0.756	0.766	1.035	1.048	1.062	1.075
Concrete Pipe Laying	(m)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pavement	(m ²)	2.0	2.0	2.1	2.1	2.2	2.2	2.4	2.5	2.6	2.7	2.9	3.0	3.2	3.3	3.4	3.5
(2) Unit Cost	(Tk/Unit)																
Sheetpile Length		11	12	13	13	13	13	13	13	14	14	14	14	15	15	15	16
Sheetpile Driving		3193	3193	4167	4167	4167	4167	4167	4167	4167	4167	4167	4167	4167	4167	4167	4167
Sheetpile Removal		2597	2597	2597	2597	2597	2597	2597	2597	2597	2597	2597	2597	2597	2597	2597	2597
Timbering Set Up		3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589
Timbering Take Out		1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640
Concrete Pipe Laying		920	1240	1520	1790	2070	3290	4040	4840	5740	6730	8980	11070	13010	15360	20050	22870
(3) Construction Cost (TKAK/m)																	
Excavation(1)		90	53	54	55	57	60	63	66	70	72	76	81	85	88	90	94
Excavation(2)		90	765	801	848	884	927	1,062	1,155	1,259	1,351	1,461	1,656	1,775	1,878	1,995	2,104
Gravel		90	68	77	94	105	117	130	196	238	274	322	404	462	508	568	621
Concrete Foundation		2000	220	220	240	260	300	440	480	540	580	620	720	760	820	860	900
Backfilling(1)		11500	1,035	1,265	1,725	1,955	2,530	2,990	3,565	4,830	5,405	7,015	8,510	10,465	11,385	13,455	14,490
Backfilling(2)		150	139	151	172	186	201	253	299	333	372	420	504	558	606	658	709
Sheetpile (aving and removal)		150	1,101	1,141	1,191	1,231	1,279	1,417	1,515	1,612	1,701	1,798	1,977	2,073	2,163	2,251	2,341
Timbering		28,950	28,950	33,820	33,820	33,820	33,820	33,820	33,820	33,820	33,820	33,820	33,820	33,820	33,820	33,820	36,800
Concrete Pipe Laying		3,492	3,519	3,545	3,571	3,597	3,628	3,681	3,733	3,791	3,843	3,900	4,005	5,412	5,479	5,553	5,621
Pavement		920	1,240	1,520	1,790	2,070	3,290	4,040	4,840	5,740	6,730	8,980	11,070	13,010	15,360	20,050	22,870
Manhole		456	912	912	957	957	1,003	1,094	1,140	1,185	1,231	1,276	1,368	1,459	1,504	1,550	1,596
Total		41,541	42,216	46,757	47,406	48,127	49,868	51,615	52,742	55,361	57,322	61,631	67,350	73,524	77,246	82,145	89,441

Table 7.2.2.11 Quantity Calculation for RC Pipe Installation, Earth Covering Depth = 6.0 m (Concrete Foundation)

D1	D2	D3	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H	W1	W2	W3	W4	W5	Excavation (Perimeter)	Excavation (3)	Excavation (2)	Orent	Concrete Foundation	Reinforcing (2)	Reinforcing (1)	Sheeping III (0)	Sheeping II (0)	Sheeping I (0)	Timbering (0)	Pavement
230	28	306	6000	100	150	300	253	300	556	5400	856	6256	6556	102	510	300	1360	1960	0.59	8.51	0.78	0.11	0.09	0.93	7.94	3.600	12	0.668	2.0	
300	30	360	6000	100	150	300	240	300	610	5400	910	6310	6610	100	560	300	1410	2010	0.60	8.90	0.86	0.11	0.11	1.01	7.61	3.600	12	0.673	2.0	
350	32	414	6000	150	150	300	357	300	714	5400	1014	6414	6714	103	620	300	1470	2070	0.62	9.43	1.05	0.12	0.15	1.15	7.94	3.900	13	0.678	2.1	
400	35	470	6000	150	150	300	365	300	770	5400	1070	6470	6770	100	670	300	1520	2120	0.64	9.93	1.17	0.13	0.17	1.24	8.21	3.900	13	0.683	2.1	
450	38	526	6000	150	150	300	413	300	826	5400	1126	6526	6826	102	730	300	1580	2180	0.65	10.31	1.21	0.14	0.19	1.34	8.53	3.900	13	0.688	2.2	
500	42	584	6000	150	150	300	442	300	884	5400	1184	6584	6884	103	790	300	1640	2240	0.67	10.80	1.45	0.15	0.22	1.44	8.86	3.900	13	0.694	2.2	
600	50	700	6000	150	200	300	500	300	1050	5400	1350	6750	7050	100	900	300	1750	2350	0.71	11.81	1.84	0.22	0.26	1.69	9.45	3.900	13	0.704	2.4	
700	58	816	6000	150	200	300	558	300	1166	5400	1466	6866	7166	102	1020	300	1870	2470	0.74	12.84	2.18	0.24	0.31	1.93	10.10	3.900	13	0.724	2.5	
800	66	932	6000	200	200	300	666	300	1332	5400	1632	7032	7332	104	1140	300	1990	2590	0.78	13.99	2.65	0.27	0.42	2.22	10.75	4.200	14	0.725	2.6	
900	75	1050	6000	200	200	300	725	300	1450	5400	1750	7150	7450	100	1250	300	2100	2700	0.81	15.02	3.05	0.29	0.47	2.48	11.34	4.200	14	0.725	2.7	
1000	82	1164	6000	250	200	300	832	300	1614	5400	1914	7314	7614	103	1370	300	2220	2820	0.85	16.24	3.58	0.31	0.61	2.80	11.99	4.200	14	0.746	2.8	
1100	88	1276	6000	250	200	300	888	300	1726	5400	2026	7426	7726	102	1480	300	2330	2930	0.88	17.30	4.02	0.34	0.67	3.07	12.58	4.200	14	0.756	2.9	
1200	95	1390	6000	250	200	300	945	300	1840	5400	2140	7540	7840	100	1590	300	2440	3040	0.91	18.40	4.49	0.36	0.74	3.36	13.18	4.500	15	0.766	3.0	
1300	103	1506	6000	300	200	300	1053	300	2006	5400	2306	7706	8006	102	1710	300	2560	3160	0.95	19.73	5.14	0.38	0.91	3.72	13.82	4.500	15	1.035	3.2	
1400	108	1616	6000	300	200	300	1108	300	2116	5400	2416	7816	8116	102	1820	300	2670	3270	0.98	20.87	5.65	0.40	0.99	4.04	14.42	4.500	15	1.048	3.3	
1500	112	1724	6000	350	200	300	1212	300	2274	5400	2574	7974	8274	103	1930	300	2780	3380	1.01	22.17	6.32	0.43	1.17	4.39	15.01	4.500	15	1.062	3.4	
1600	120	1840	6000	350	200	300	1270	300	2390	5400	2690	8090	8390	100	2040	300	2890	3490	1.05	23.38	6.91	0.45	1.26	4.73	15.61	4.800	16	1.075	3.5	
1700	128	1946	6000	350	200	300	1323	300	2496	5400	2796	8196	8496	102	2150	300	3000	3600	1.08	24.59	7.49	0.47	1.36	5.07	16.20	4.800	16	1.088	3.6	
1800	127	2054	6000	350	200	300	1377	300	2604	5400	2904	8304	8604	103	2260	300	3110	3710	1.11	25.83	8.10	0.49	1.46	5.42	16.79	4.800	16	1.101	3.7	
1900	136	2172	6000	350	200	300	1436	300	2722	5400	3022	8422	8722	104	2380	300	3230	3830	1.15	27.20	8.79	0.52	1.57	5.82	17.44	4.800	16	1.116	3.8	
2000	145	2290	6000	400	200	300	1543	300	2890	5400	3190	8590	8890	100	2490	300	3340	3940	1.18	28.69	9.65	0.54	1.79	6.27	18.04	5.100	17	1.129	3.9	
2100	152	2404	6000	400	200	300	1602	300	3004	5400	3304	8704	9004	103	2610	300	3460	4060	1.22	30.12	10.39	0.56	1.91	6.69	18.68	5.100	17	1.143	4.1	
2200	160	2520	6000	400	200	300	1660	300	3120	5400	3420	8820	9120	100	2720	300	3570	4170	1.25	31.49	11.14	0.58	2.02	7.12	19.28	5.100	17	1.156	4.2	
2400	175	2750	6000	400	200	300	1775	300	3330	5400	3630	9050	9350	100	2850	300	3680	4400	1.32	34.59	12.73	0.63	2.27	8.00	20.52	5.100	17	1.184	4.4	

Table 7.2.2.12 RC Pipe Installation Cost, Earth Covering Depth = 7.0 m (Concrete Foundation)

Diameter (mm)	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
(1) Quantity																	
Excavation (Pavement)	0.59	0.60	0.62	0.64	0.65	0.67	0.71	0.74	0.78	0.81	0.85	0.88	0.91	0.95	0.98	1.01	1.05
Excavation(1)	9.87	10.31	10.90	11.35	11.89	12.44	13.56	14.71	15.98	17.12	18.46	19.63	20.84	22.29	23.54	24.95	26.27
Excavation(2)	2.12	2.27	2.52	2.69	2.89	3.09	3.59	4.05	4.64	5.15	5.80	6.35	6.93	7.70	8.52	9.10	9.80
Gravel	0.11	0.11	0.12	0.13	0.14	0.15	0.22	0.24	0.27	0.29	0.31	0.34	0.36	0.38	0.41	0.43	0.45
Sand Foundation	0.09	0.11	0.15	0.17	0.19	0.22	0.26	0.31	0.42	0.47	0.61	0.67	0.74	0.91	0.99	1.17	1.26
Backfilling(1)	0.93	1.01	1.15	1.24	1.34	1.44	1.69	1.93	2.22	2.48	2.80	3.07	3.36	3.72	4.04	4.39	4.73
Backfilling(2)	8.70	9.02	9.41	9.73	10.11	10.50	11.20	11.97	12.74	13.44	14.21	14.91	15.62	16.38	17.09	17.79	18.50
Sheetpile	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
Timbering	0.668	0.673	0.678	0.683	0.688	0.694	0.938	0.952	0.967	0.980	0.994	1.008	1.021	1.035	1.048	1.062	1.075
Concrete Pipe Laying	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pavement	2.0	2.0	2.1	2.1	2.2	2.2	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.2	3.3	3.4	3.5
(2) Unit Cost																	
Sheetpile Length	14	14	14	14	15	15	15	15	15	16	16	16	16	17	17	17	17
Sheetpile Driving	4167	4167	4167	4167	4167	4167	4167	4167	4167	4167	4167	4167	4167	4925	4925	4925	4925
Sheetpile Removal	2597	2597	2597	2597	2597	2597	2597	2597	2597	2597	2597	2597	2597	3193	3193	3193	3193
Timbering Set Up	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589	3589
Timbering Take Out	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640	1640
Concrete Pipe Laying	920	1240	1520	1790	2070	3290	4040	4840	5740	6730	8980	11070	13010	15360	17700	20050	22870
(3) Construction Cost (TAKA/m)																	
Excavation(1)	53	54	55	57	58	60	63	66	70	72	76	79	81	85	88	90	94
Excavation(2)	938	927	981	1,021	1,070	1,119	1,220	1,323	1,438	1,540	1,661	1,766	1,875	2,006	2,118	2,245	2,364
Gravel	190	204	226	242	260	278	323	364	417	463	522	571	623	693	748	819	882
Concrete Foundation	220	220	240	260	280	300	440	480	540	580	620	680	720	760	820	860	900
Backfilling(1)	1,035	1,265	1,725	1,955	2,185	2,530	2,990	3,565	4,830	5,405	7,015	7,705	8,510	10,465	11,385	13,455	14,490
Backfilling(2)	150	151	172	186	201	216	253	289	333	372	420	460	504	558	606	658	709
Sheetpile (driving and removal)	150	1,305	1,411	1,459	1,516	1,575	1,680	1,795	1,911	2,016	2,131	2,236	2,343	2,457	2,563	2,668	2,775
Timbering	33,820	33,820	33,820	33,820	33,820	33,820	33,820	33,820	33,820	36,800	36,800	36,800	36,800	40,590	40,590	40,590	40,590
Concrete Pipe Laying	3,492	3,519	3,545	3,571	3,597	3,628	4,904	4,978	5,056	5,124	5,197	5,270	5,338	5,412	5,479	5,553	5,621
Pavement	920	1,240	1,520	1,790	2,070	3,290	4,040	4,840	5,740	6,730	8,980	11,070	13,010	15,360	17,700	20,050	22,870
Manhole	912	912	957	957	1,003	1,003	1,094	1,140	1,185	1,231	1,276	1,322	1,368	1,459	1,504	1,550	1,596
Total	5,180	5,180	3,453	3,453	3,453	3,453	5,272	5,250	57,930	62,923	67,288	69,685	72,898	81,571	85,327	90,264	94,617

Table 7.2.2.13 Quantity Calculation for RC Pipe Installation, Earth Covering Depth = 7.0 m (Concrete Foundation)

D1	D2	D3	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H	W1	W2	W3	W4	W5	Excavation (Pavement)	Excavation (1)	Excavation (2)	Ornval	Concrete Foundation	Backfilling (1)	Backfilling (2)	Slope III (m ² /Subera)	Timbering (1)	Pavement	
250	28	306	7000	100	150	300	253	300	556	6400	856	7256	7556	102	510	300	1360	1960	0.59	9.87	2.12	0.11	0.09	0.93	6.70	4.300	14	0.668	2.0
300	30	360	7000	100	150	300	280	300	610	6400	910	7310	7610	100	560	300	1410	2010	0.60	10.31	2.27	0.11	0.11	1.01	9.02	4.200	14	0.673	2.0
350	32	414	7000	150	150	300	357	300	714	6400	1014	7414	7714	103	620	300	1470	2070	0.62	10.90	2.52	0.12	0.15	1.15	9.41	4.200	14	0.678	2.1
400	35	470	7000	150	150	300	385	300	770	6400	1070	7470	7770	100	670	300	1520	2120	0.64	11.35	2.69	0.13	0.17	1.24	9.79	4.200	14	0.683	2.2
450	38	526	7000	150	150	300	413	300	826	6400	1126	7526	7826	102	720	300	1580	2180	0.65	11.89	2.89	0.14	0.19	1.34	10.11	4.500	15	0.688	2.2
500	42	584	7000	150	150	300	442	300	884	6400	1184	7584	7884	103	790	300	1640	2240	0.67	12.44	3.09	0.15	0.22	1.44	10.50	4.500	15	0.694	2.2
600	50	700	7000	150	200	300	500	300	1050	6400	1350	7750	8050	100	900	300	1750	2350	0.71	13.56	3.59	0.22	0.26	1.69	11.20	4.500	15	0.938	2.4
700	58	816	7000	150	200	300	556	300	1166	6400	1466	7866	8166	102	1020	300	1870	2470	0.74	14.71	4.05	0.24	0.31	1.93	11.97	4.500	15	0.952	2.5
800	66	932	7000	200	200	300	666	300	1332	6400	1632	8032	8332	104	1140	300	1990	2590	0.78	15.98	4.64	0.27	0.42	2.22	12.74	4.500	15	0.967	2.6
900	75	1050	7000	200	200	300	725	300	1450	6400	1750	8150	8450	100	1250	300	2100	2700	0.81	17.12	5.15	0.29	0.47	2.46	13.44	4.800	16	0.980	2.7
1000	82	1164	7000	250	200	300	832	300	1614	6400	1914	8314	8614	103	1370	300	2220	2820	0.85	18.46	5.80	0.31	0.61	2.80	14.21	4.800	16	0.994	2.8
1100	88	1276	7000	250	200	300	885	300	1726	6400	2026	8426	8726	102	1480	300	2330	2930	0.88	19.63	6.35	0.34	0.67	3.07	14.91	4.800	16	1.008	2.9
1200	95	1390	7000	250	200	300	945	300	1840	6400	2140	8540	8840	100	1590	300	2440	3040	0.91	20.84	6.93	0.36	0.74	3.36	15.62	4.800	16	1.021	3.0
1300	103	1506	7000	300	200	300	1053	300	2006	6400	2306	8706	9006	102	1710	300	2560	3160	0.95	22.29	7.70	0.38	0.91	3.72	16.38	5.100	17	1.035	3.2
1400	108	1616	7000	300	200	300	1108	300	2116	6400	2416	8816	9116	102	1820	300	2670	3270	0.98	23.54	8.32	0.40	0.99	4.04	17.09	5.100	17	1.048	3.3
1500	112	1724	7000	350	200	300	1212	300	2274	6400	2574	8974	9274	103	1930	300	2780	3380	1.01	24.95	9.10	0.43	1.17	4.39	17.79	5.100	17	1.062	3.4
1600	120	1840	7000	350	200	300	1270	300	2390	6400	2690	9090	9390	100	2040	300	2890	3490	1.05	26.27	9.80	0.45	1.26	4.73	18.50	5.100	17	1.075	3.5

Table 7.2.2.14 Pipe Installation Cost for PVC Pipe Installation, Earth Covering Depth = 1.0 m (Sand Foundation)

Diameter (mm)	150		200		250		300		350		400		450	
	Quantity	Unit	Quantity	Unit	Quantity	Unit	Quantity	Unit	Quantity	Unit	Quantity	Unit	Quantity	Unit
(1) Quantity														
Excavation (Pavement)	0.79	(m ³)	0.82		0.85		0.88		0.93		0.96		0.99	
Excavation(1)	1.35	(m ³)	1.35		1.65		1.66		1.94		2.11		2.29	
Sand Foundation	0.15	(m ³)	0.17		0.20		0.23		0.33		0.36		0.40	
Backfilling(1)	0.42	(m ³)	0.48		0.54		0.61		0.70		0.76		0.83	
Backfilling(2)	0.67	(m ³)	0.71		0.75		0.79		0.86		0.90		0.94	
Sheetpile		(sheet)												
Timbering		(t)												
PVC Pipe Laying	1	(m)	1		1		1		1		1		1	
Pavement	2.6	(m ²)	2.7		2.8		2.9		3.1		3.2		3.3	
(2) Unit Cost		(Tk/Unit)												
PVC Pipe Laying	406		663		994		1,412		1,862		2,597		2,963	
(3) Construction Cost (TAKA/m)														
Excavation (Pavement)	90		73		76		79		83		86		89	
Excavation(1)	90		121		148		149		174		189		206	
Sand Foundation	860		146		172		197		283		309		344	
Backfilling(1)	150		72		81		91		105		114		124	
Backfilling(2)	150		106		112		118		129		135		141	
Sheetpile (driving and removal)			0		0		0		0		0		0	
Timbering			0		0		0		0		0		0	
PVC Pipe Laying	456		663		994		1,412		1,862		2,597		2,963	
Pavement	36000		1,231		1,276		1,322		1,413		1,459		1,504	
Manhole			720		720		720		480		480		480	
Total			2,795		3,132		3,579		4,088		4,529		5,369	

Table 7.2.2.15 Pipe Quantity Calculation for PVC Pipe Installation, Earth Covering Depth = 1.0 m (Sand Foundation)

D1	D2	D3	H1	H2	H3	H4	H5	H6	H7	H8	H9	H	W1	W2	W3	W4	W5	W6	Excavation (Pavement)	Excavation (1)	Sand Foundation	Backfilling(1)	Backfilling(2)	Pavement
150	7.5	165	1000	100	182.5	300	265	300	565	400	965	1265	300	765	947.5	1330	2030	2630	0.79	1.35	0.15	0.42	0.67	2.6
200	8	216	1000	100	208	300	316	300	616	400	916	1316	300	816	1024	1432	2132	2732	0.82	1.35	0.17	0.48	0.71	2.7
250	8.5	267	1000	100	233.5	300	367	300	667	400	1067	1367	300	867	1101	1534	2234	2834	0.85	1.65	0.20	0.54	0.75	2.8
300	9	318	1000	100	259	300	418	300	718	400	1018	1418	300	918	1177	1636	2336	2936	0.88	1.66	0.23	0.61	0.79	2.9
350	10	370	1000	150	335	300	520	300	820	400	1120	1520	300	970	1305	1790	2490	3090	0.93	1.94	0.33	0.70	0.86	3.1
400	10	420	1000	150	360	300	570	300	870	400	1170	1570	300	1020	1380	1890	2590	3190	0.96	2.11	0.36	0.76	0.90	3.2
450	10	470	1000	150	385	300	620	300	920	400	1220	1620	300	1070	1455	1990	2690	3290	0.99	2.29	0.40	0.83	0.94	3.3

Table 7.2.2.16 Pipe Installation Cost for PVC Pipe Installation, Earth Covering Depth = 2.0 m (Sand Foundation)

Diameter (mm)	150	200	250	300	350	400	450
(1) Quantity							
Excavation (Pavement)	1.09	1.12	1.15	1.18	1.23	1.26	1.29
Excavation(1)	1.64	1.81	1.98	2.17	2.50	2.70	2.90
Sand Foundation	0.15	0.17	0.20	0.23	0.33	0.36	0.40
Backfilling(1)	0.42	0.48	0.54	0.61	0.70	0.76	0.83
Backfilling(2)	3.05	3.19	3.34	3.48	3.70	3.84	3.98
Sheetpile							
Timbering							
PVC Pipe Laying	1	1	1	1	1	1	1
Pavement	3.6	3.7	3.8	3.9	4.1	4.2	4.3
(2) Unit Cost (Taka/Unit)	406	663	994	1,412	1,862	2,597	2,963
PVC Pipe Laying							
(3) Construction Cost (Taka/m)							
Excavation (Pavement)	98	100	103	106	110	113	116
Excavation(1)	147	162	178	195	225	243	261
Sand Foundation	129	146	172	197	283	309	344
Backfilling(1)	63	72	81	91	105	114	124
Backfilling(2)	457	478	501	522	555	576	597
Sheetpile (driving and removal)	0	0	0	0	0	0	0
Timbering	0	0	0	0	0	0	0
PVC Pipe Laying	406	663	994	1,412	1,862	2,597	2,963
Pavement	1,641	1,687	1,732	1,778	1,869	1,915	1,960
Manhole	1,244	1,244	1,244	1,244	829	829	829
Total	4,185	4,552	5,005	5,545	6,696	7,194	

Table 7.2.2.17 Pipe Quantity Calculation for PVC Pipe Installation, Earth Covering Depth = 2.0 m (Sand Foundation)

D1	D2	D3	H1	H2	H3	H4	H5	H6	H7	H8	H9	H	W1	W2	W3	W4	W5	W6	Excavation (Pavement)	Excavation (1)	Sand Foundation	Backfilling (1)	Backfilling (2)	Pavement
150	7.5	165	2000	100	182.5	300	265	300	565	1400	865	2265	300	765	947.5	1330	3030	3630	1.09	1.64	0.15	0.42	3.05	3.6
200	8	216	2000	100	208	300	316	300	616	1400	916	2316	300	816	1024	1432	3132	3732	1.12	1.81	0.17	0.48	3.19	3.7
250	8.5	267	2000	100	233.5	300	367	300	667	1400	967	2367	300	867	1101	1534	3234	3834	1.15	1.98	0.20	0.54	3.34	3.8
300	9	318	2000	100	259	300	418	300	718	1400	1018	2418	300	918	1177	1636	3336	3936	1.18	2.17	0.23	0.61	3.48	3.9
350	10	370	2000	150	335	300	520	300	820	1400	1120	2520	300	970	1305	1790	3490	4090	1.23	2.50	0.33	0.70	3.70	4.1
400	10	420	2000	150	360	300	570	300	870	1400	1170	2570	300	1020	1380	1890	3590	4190	1.26	2.70	0.36	0.76	3.84	4.2
450	10	470	2000	150	385	300	620	300	920	1400	1220	2620	300	1070	1455	1990	3690	4290	1.29	2.90	0.40	0.83	3.98	4.3

Table 7.2.2.18 Pipe Installation Cost for PVC Pipe Installation, Earth Covering Depth = 3.0 m (Sand Foundation)

Diameter (mm)	Diameter (mm)											
	150	200	250	300	350	400	450					
(1) Quantity												
Excavation (Pavement)	1.39	1.42	1.45	1.48	1.53	1.56	1.59					
Excavation(1)	2.07	2.27	2.47	2.67	3.06	3.28	3.51					
Sand Foundation	0.15	0.17	0.20	0.23	0.33	0.36	0.40					
Backfilling(1)	0.42	0.48	0.54	0.61	0.70	0.76	0.83					
Backfilling(2)	6.43	6.68	6.92	7.17	7.54	7.78	8.02					
Sheetpile												
Timbering												
PVC Pipe Laying	1	1	1	1	1	1	1					
Pavement	4.7	4.7	4.8	4.9	5.1	5.2	5.3					
(2) Unit Cost												
PVC Pipe Laying	406	663	994	1,412	1,862	2,597	2,963					
(3) Construction Cost (TAKA/m)												
Excavation (Pavement)	90	127	130	133	137	140	143					
Excavation(1)	90	204	222	240	275	295	315					
Sand Foundation	860	146	172	197	283	309	344					
Backfilling(1)	150	72	81	91	105	114	124					
Backfilling(2)	150	1,002	1,038	1,075	1,131	1,167	1,203					
Sheetpile (driving and removal)		0	0	0	0	0	0					
Timbering		0	0	0	0	0	0					
PVC Pipe Laying	406	663	994	1,412	1,862	2,597	2,963					
Pavement	2,143	2,143	2,188	2,234	2,325	2,371	2,416					
Manhole	1,762	1,762	1,762	1,762	1,762	1,762	1,762					
Total	5,778	6,110	6,587	7,144	7,880	8,755	9,270					

Table 7.2.2.19 Pipe Quantity Calculation for PVC Pipe Installation, Earth Covering Depth = 3.0 m (Sand Foundation)

D1	D2	D3	H1	H2	H3	H4	H5	H6	H7	H8	H9	H	W1	W2	W3	W4	W5	W6	Excavation (Pavement)	Excavation (1)	Sand Foundation	Backfilling (1)	Backfilling (2)	Pavement
150	7.5	165	3000	100	182.5	300	265	300	565	2400	865	3265	300	765	947.5	1330	4030	4630	1.39	2.07	0.15	0.42	6.43	4.6
200	8	216	3000	100	208	300	316	300	616	2400	916	3316	300	816	1024	1432	4132	4732	1.42	2.27	0.17	0.48	6.68	4.7
250	8.5	267	3000	100	233.5	300	367	300	667	2400	967	3367	300	867	1101	1534	4234	4834	1.45	2.47	0.20	0.54	6.92	4.8
300	9	318	3000	100	259	300	418	300	718	2400	1018	3418	300	918	1177	1636	4336	4936	1.48	2.67	0.23	0.61	7.17	4.9
350	10	370	3000	150	335	300	520	300	820	2400	1120	3520	300	970	1305	1790	4490	5090	1.53	3.06	0.33	0.70	7.54	5.1
400	10	420	3000	150	360	300	570	300	870	2400	1170	3570	300	1020	1380	1890	4590	5190	1.56	3.28	0.36	0.76	7.78	5.2
450	10	470	3000	150	385	300	620	300	920	2400	1220	3620	300	1070	1455	1990	4690	5290	1.59	3.51	0.40	0.83	8.02	5.3

Table 7.2.2.20 Pipe Installation Cost for PVC Pipe Installation, Earth Covering Depth = 4.0 m (Sand Foundation)

Diameter (mm)	150	200	250	300	350	400	450
(1) Quantity							
Excavation (Pavement)	(m ³) 1.69	1.72	1.75	1.78	1.83	1.86	1.89
Excavation(1)	(m ³) 2.51	2.72	2.95	3.18	3.62	3.87	4.12
Excavation(2)	(m ³) 0.15	0.17	0.20	0.23	0.33	0.36	0.40
Sand Foundation	(m ³) 0.42	0.48	0.54	0.61	0.70	0.76	0.83
Backfilling(1)	(m ³) 10.81	11.16	11.51	11.85	12.38	12.72	13.06
Backfilling(2)	(m ³) 5	5	5	5	5	5	5
Sheepile	(sheet) 0.440	0.443	0.446	0.449	0.452	0.455	0.459
Timbering	(t) 1	1	1	1	1	1	1
PVC Pipe Laying	(m) 5.6	5.7	5.8	5.9	6.1	6.2	6.3
Pavement	(m ²) 9	9	9	9	9	9	9
(2) Unit Cost (Tk/Unit)							
Sheepile Length	2435	2435	2435	2435	2435	2435	2435
Sheepile Driving	1948	1948	1948	1948	1948	1948	1948
Sheepile Removal	3589	3589	3589	3589	3589	3589	3589
Timbering Set Up	1640	1640	1640	1640	1640	1640	1640
Timbering Take Out	406	663	994	1412	1862	2597	2963
PVC Pipe Laying							
(3) Construction Cost (TAKA/m)							
Excavation (Pavement)	90	154	157	160	164	167	170
Excavation(1)	90	244	265	286	325	348	370
Sand Foundation	860	146	172	197	283	309	344
Backfilling(1)	150	72	81	91	105	114	124
Backfilling(2)	150	1674	1726	1777	1857	1908	1959
Sheepile (driving and removal)		21,915	21,915	21,915	21,915	21,915	21,915
Timbering		2,316	2,332	2,347	2,363	2,379	2,400
PVC Pipe Laying		663	994	1,412	1,862	2,597	2,963
Pavement	456	2,599	2,644	2,690	2,781	2,827	2,872
Manhole		720	720	720	480	480	480
Total	30,084	30,503	31,006	31,595	32,135	33,044	33,597

Table 7.2.2.21 Pipe Quantity Calculation for PVC Pipe Installation, Earth Covering Depth = 4.0 m (Sand Foundation)

D1	D2	D3	H1	H2	H3	H4	H5	H6	H7	H8	H9	H	W1	W2	W3	W4	W5	W6	Excavation (Pavement)	Excavation (1)	Sand Foundation	Backfilling (1)	Backfilling (2)	Pavement
150	7.5	165	4000	100	182.5	300	265	300	565	3400	865	4265	300	765	947.5	1330	5030	5630	1.69	2.51	0.15	0.42	10.81	5.6
200	8	216	4000	100	308	300	316	300	616	3400	916	4316	300	816	1024	1432	5132	5732	1.72	2.72	0.17	0.48	11.16	5.7
250	8.5	267	4000	100	233.5	300	367	300	667	3400	967	4367	300	867	1101	1534	5234	5834	1.75	2.95	0.20	0.54	11.51	5.8
300	9	318	4000	100	259	300	418	300	718	3400	1018	4418	300	918	1177	1636	5336	5936	1.78	3.18	0.23	0.61	11.85	5.9
350	10	370	4000	150	335	300	520	300	820	3400	1120	4520	300	970	1305	1790	5490	6090	1.83	3.62	0.33	0.70	12.38	6.1
400	10	420	4000	150	360	300	570	300	870	3400	1170	4570	300	1020	1380	1890	5590	6190	1.86	3.87	0.36	0.76	12.72	6.2
450	10	470	4000	150	385	300	620	300	920	3400	1220	4620	300	1070	1455	1990	5690	6290	1.89	4.12	0.40	0.83	13.06	6.3

Table 7-2.2.22 Pipe Installation Cost for PVC Pipe Installation, Earth Covering Depth = 5.0 m (Sand Foundation)

Diameter (mm)	150	200	250	300	350	400	450
(1) Quantity							
Excavation (Pavement)	(m ³) 1.99	2.02	2.05	2.08	2.13	2.16	2.19
Excavation(1)	(m ³) 2.94	3.18	3.43	3.69	4.18	4.45	4.73
Excavation(2)	(m ³) 0.15	0.17	0.20	0.23	0.33	0.36	0.40
Sand Foundation	(m ³) 0.42	0.48	0.54	0.61	0.70	0.76	0.83
Backfilling(1)	(m ³) 16.19	16.64	17.09	17.54	18.22	18.66	19.10
Backfilling(2)	(sheet) 5	5	5	5	5	5	5
Sheepile	(t) 0.440	0.443	0.446	0.449	0.452	0.455	0.459
Timbering	(m) 1	1	1	1	1	1	1
PVC Pipe Laying	(m ²) 6.6	6.7	6.8	6.9	7.1	7.2	7.3
(2) Unit Cost							
Sheepile Length	11	11	11	11	11	11	11
Sheepile Driving	3193	3193	3193	3193	3193	3193	3193
Sheepile Removal	1948	1948	1948	1948	1948	1948	1948
Timbering Set Up	3589	3589	3589	3589	3589	3589	3589
Timbering Take Out	1640	1640	1640	1640	1640	1640	1640
PVC Pipe Laying	406	663	994	1412	1862	2597	2963
(3) Construction Cost (TAKA/m)							
Excavation (Pavement)	90	181	184	187	191	194	197
Excavation(1)	90	286	308	332	376	400	425
Sand Foundation	860	146	172	197	283	309	344
Backfilling(1)	150	72	81	91	105	114	124
Backfilling(2)	150	2,496	2,563	2,631	2,733	2,799	2,865
Sheepile (driving and removal)	25,705	25,705	25,705	25,705	25,705	25,705	25,705
Timbering	2,300	2,316	2,332	2,347	2,363	2,379	2,400
PVC Pipe Laying	406	663	994	1,412	1,862	2,597	2,963
Pavement	3,009	3,055	3,100	3,146	3,237	3,283	3,328
Manhole	1,244	1,244	1,244	1,244	1,244	1,244	1,244
Total	35,727	36,164	36,683	37,292	38,099	39,024	39,595

Table 7.2.2.23 Pipe Quantity Calculation for PVC Pipe Installation, Earth Corvering Depth = 5.0 m (Sand Foundation)

D1	D2	D3	H1	H2	H3	H4	H5	H6	H7	H8	H9	H	W1	W2	W3	W4	W5	W6	Excavation (Pavement)	Excavation (1)	Sand Foundation	Backfilling (1)	Backfilling (2)	Pavement
150	7.5	165	5000	100	182.5	300	265	300	565	4400	865	5265	300	765	947.5	1330	6030	6630	1.99	2.94	0.15	0.42	16.19	6.6
200	8	216	5000	100	208	300	316	300	616	4400	916	5316	300	816	1024	1432	6132	6732	2.02	3.18	0.17	0.48	16.64	6.7
250	8.5	267	5000	100	233.5	300	367	300	667	4400	967	5367	300	867	1101	1534	6234	6834	2.05	3.43	0.20	0.54	17.09	6.8
300	9	318	5000	100	259	300	418	300	718	4400	1018	5418	300	918	1177	1636	6336	6936	2.08	3.69	0.23	0.61	17.54	6.9
350	10	370	5000	150	335	300	520	300	820	4400	1120	5520	300	970	1305	1790	6490	7090	2.13	4.18	0.33	0.70	18.22	7.1
400	10	420	5000	150	360	300	570	300	870	4400	1170	5570	300	1020	1380	1890	6590	7190	2.16	4.45	0.36	0.76	18.66	7.2
450	10	470	5000	150	385	300	620	300	920	4400	1220	5620	300	1070	1455	1990	6690	7290	2.19	4.73	0.40	0.83	19.10	7.3

Table 7.2.2.24 Pipe Installation Cost for Steel Pipe Installation, Earth Covering Depth = 1.0 m (Sand Foundation)

Diameter (mm)	250	300	350	400	450	500	600	700	800	900	1000	1100	1200	1300
(1) Quantity														
Excavation(Pavement)	0.85	0.88	0.92	0.95	0.98	1.01	1.09	1.15	1.22	1.28	1.36	1.42	1.50	1.59
Excavation(1)	1.64	1.64	1.91	2.08	2.26	2.45	2.99	3.44	4.08	4.59	5.33	5.92	6.75	7.75
Excavation(2)														
Sand Foundation	0.20	0.23	0.32	0.36	0.39	0.43	0.59	0.69	0.89	0.99	1.23	1.36	1.63	1.77
Backfilling(1)	0.54	0.60	0.69	0.75	0.82	0.90	1.08	1.24	1.46	1.64	1.89	2.10	2.36	2.72
Backfilling(2)	0.75	0.79	0.95	0.89	0.93	0.97	1.07	1.15	1.25	1.33	1.43	1.52	1.62	1.74
Sheetpile														
Timbering														
Steel Pipe Laying	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Pavement	2.8	2.9	3.1	3.2	3.3	3.4	3.6	3.8	4.1	4.3	4.5	4.7	5.0	5.3
(2) Unit Cost														
Steel Pipe Laying	2,083	3,569	3,623	3,678	3,732	3,498	6,014	6,846	7,442	8,039	10,855	13,643	16,605	20,922
(3) Construction Cost (TAKA/m)														
Excavation (Pavement)	90	76	82	85	88	90	98	103	109	115	122	127	135	143
Excavation(1)	90	147	171	187	203	220	269	309	367	413	479	532	607	697
Excavation(2)	90	0	0	0	0	0	0	0	0	0	0	0	0	0
Sand Foundation	860	172	197	309	335	369	507	593	765	851	1,057	1,169	1,401	1,522
Backfilling(1)	150	81	90	112	123	135	162	186	219	246	282	315	354	408
Backfilling(2)	150	112	118	133	139	145	160	172	187	199	214	228	243	261
Sheetpile (driving and removal)	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Timbering	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Steel Pipe Laying	2,083	3,569	3,623	3,678	3,732	3,498	6,014	6,846	7,442	8,039	10,855	13,643	16,605	20,922
Pavement	1,276	1,322	1,413	1,459	1,504	1,550	1,641	1,732	1,869	1,960	2,082	2,143	2,280	2,371
Manhole	36000	720	480	480	480	480	480	360	360	360	360	240	240	240
Total	4,667	6,242	6,274	6,443	6,604	8,487	9,331	10,301	11,318	12,183	15,421	18,397	21,865	26,564

Table 7.2.2.25 Quantity Calculation for RC Pipe Installation, Earth Covering Depth = 1.0 m (Sand Foundation)

D1	D2	D3	H1	H2	H3	H4	H5	H6	H7	H8	H9	H	W1	W2	W3	W4	W5	W6	Excavation (Pavement)	Excavation (1)	Sand Foundation	Backfilling (1)	Backfilling (2)	Pavement
150	5	160	1000	100	180	300	260	300	560	400	960	1260	300	760	940	1320	2020	2620	0.79	1.33	0.14	0.42	0.67	2.6
200	5.8	211.6	1000	100	205.8	300	311.6	300	611.6	400	911.6	1312	300	811.6	1017	1423	2123	2723	0.82	1.34	0.17	0.48	0.71	2.7
250	6.6	263.2	1000	100	231.6	300	363.2	300	663.2	400	1063	1363	300	863.2	1095	1526	2226	2826	0.85	1.64	0.20	0.54	0.75	2.8
300	6.9	313.8	1000	100	256.9	300	413.8	300	713.8	400	1014	1414	300	913.8	1171	1628	2328	2928	0.88	1.64	0.23	0.60	0.79	2.9
350	6	362	1000	150	331	300	512	300	812	400	1112	1512	300	962	1293	1774	2474	3074	0.92	1.91	0.32	0.69	0.85	3.1
400	6	412	1000	150	356	300	562	300	862	400	1162	1562	300	1012	1368	1874	2574	3174	0.95	2.08	0.36	0.75	0.89	3.2
450	6	462	1000	150	381	300	612	300	912	400	1212	1612	300	1062	1443	1974	2674	3274	0.98	2.26	0.39	0.82	0.93	3.3
500	6	512	1000	150	406	300	662	300	962	400	1262	1662	300	1112	1518	2074	2774	3374	1.01	2.45	0.43	0.90	0.97	3.4
600	6	612	1000	200	506	300	812	300	1112	400	1412	1912	300	1212	1718	2524	3024	3624	1.09	2.99	0.59	1.08	1.07	3.6
700	7	714	1000	200	557	300	914	300	1214	400	1514	1914	300	1314	1871	2528	3228	3828	1.15	3.44	0.69	1.24	1.15	3.8
800	8	816	1000	250	658	300	1066	300	1366	400	1666	2066	300	1416	2074	2782	3482	4082	1.22	4.08	0.89	1.46	1.25	4.1
900	8	916	1000	250	708	300	1166	300	1466	400	1766	2166	300	1516	2224	2982	3682	4282	1.28	4.59	0.99	1.64	1.33	4.3
1000	9	1018	1000	300	809	300	1318	300	1618	400	1918	2318	300	1618	2427	3236	3936	4536	1.36	5.33	1.23	1.88	1.43	4.5
1100	10	1120	1000	300	860	300	1420	300	1720	400	2020	2420	300	1720	2580	3440	4140	4740	1.42	5.92	1.36	2.10	1.52	4.7
1200	11	1222	1000	350	961	300	1572	300	1872	400	2172	2572	300	1822	2783	3694	4394	4994	1.50	6.75	1.63	2.36	1.62	5.0
1300	12	1324	1000	350	1012	300	1674	300	1974	400	2274	2674	300	1924	2936	3898	4598	5198	1.56	7.42	1.77	2.60	1.70	5.2
1400	12	1424	1000	400	1112	300	1824	300	2124	400	2424	2824	300	2024	3136	4148	4848	5448	1.63	8.33	2.07	2.89	1.80	5.4
1500	14	1528	1000	400	1164	300	1928	300	2228	400	2528	2928	300	2128	3292	4356	5056	5656	1.70	9.08	2.24	3.15	1.88	5.7
1600	15	1630	1000	450	1265	300	2080	300	2380	400	2680	3080	300	2230	3495	4610	5310	5910	1.77	10.10	2.58	3.48	1.98	5.9

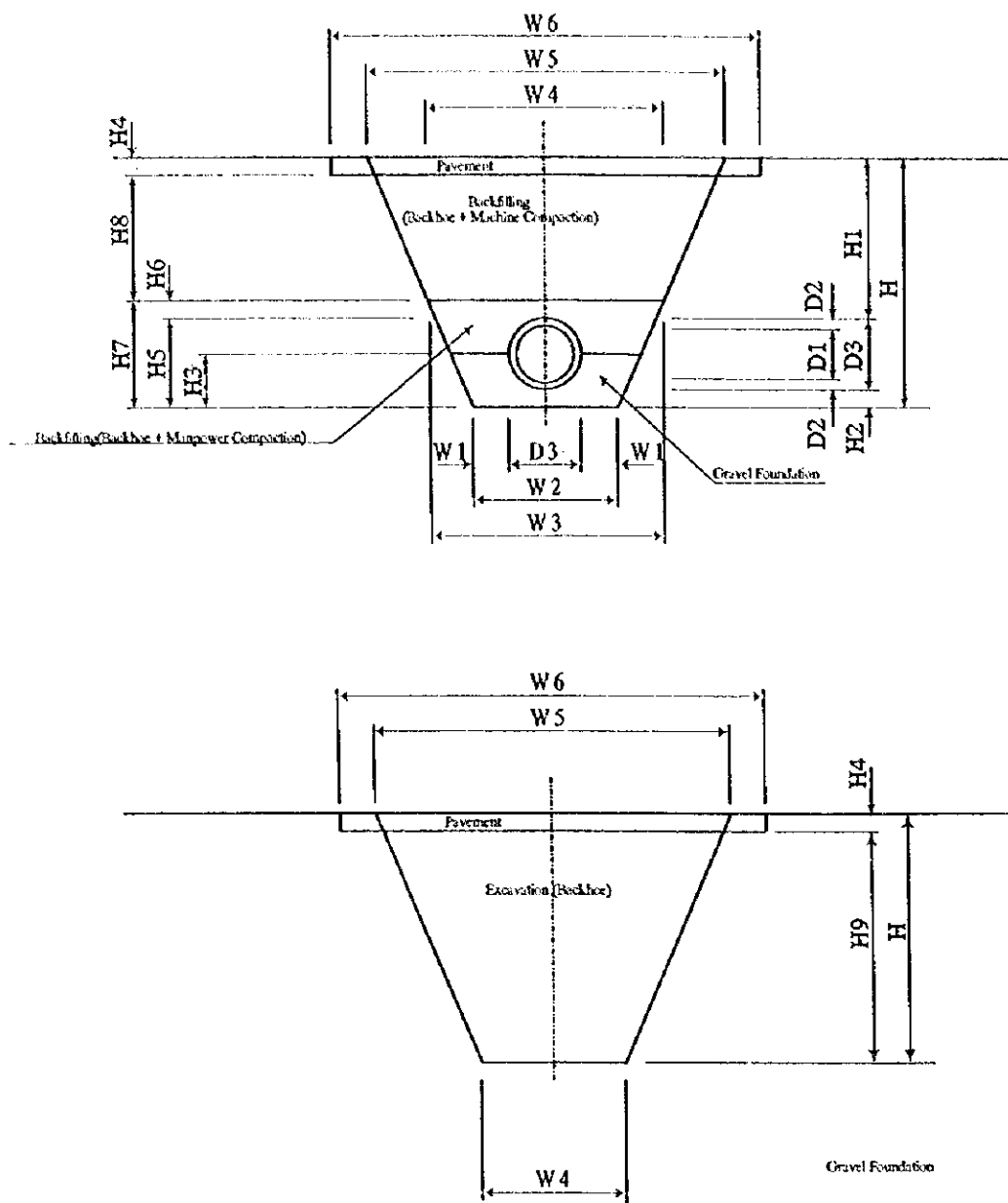


Figure 7.2.2.3

Typical Standard of Pipe Laying
(Open Cut & Gravel Foundation)

The Study on the Sewerage System in North Dhaka

Appendix 7.2.3 Direct Construction Cost of Sewer
Table 7.2.3.1 Bill of Quantity of Sewer

Unit: m

Area	Material	Diameter	Average Sewer Covering							Total	
			1.0 m	2.0 m	3.0 m	4.0 m	5.0 m	6.0 m	7.0 m		
New Service Area	PVC	200	23,965	8,485	1,905	145	0	0	0	34,500	
	PVC	250	0	90	0	95	260	0	0	445	
	RC	900	0	1,095	0	0	0	0	0	1,095	
	RC	1000	0	220	680	285	0	0	0	1,185	
	RC	1100	0	0	0	1,300	450	0	0	1,750	
	RC	1200	0	0	0	0	290	0	0	290	
	RC	1500	0	0	0	0	340	1,290	30	1,660	
	Sub-total			23,965	9,890	2,585	1,825	1,340	1,290	30	40,925
	SP	1100		4,400	0	0	0	0	0	0	4,400
Total			28,365	9,890	2,585	1,825	1,340	1,290	30	45,325	
Existing Service Area	PVC	300	385	0	340	0	0	0	0	725	
	PVC	350	10	500	0	600	0	0	0	1,110	
	PVC	400	620	0	0	835	0	0	0	1,455	
	RC	700	0	0	0	0	710	0	0	710	
	RC	800	0	1,140	0	0	870	0	0	2,010	
	RC	1100	0	0	0	800	0	0	0	800	
	Sub-total			1,015	1,640	340	2,235	1,580	0	0	6,810
	SP	900		1,340	0	0	0	0	0	0	1,340
	Total			2,355	1,640	340	2,235	1,580	0	0	8,150

Note: PVC: Polyvinyl Chloride Pipe, RC: Reinforced Concrete Pipe, SP: Steel Pipe

Table 7.2.3.2 Direct Construction Cost of Sewer

Unit: Tk

Area	Material	Diameter	Average Sewer Covering							Total	
			1.0 m	2.0 m	3.0 m	4.0 m	5.0 m	6.0 m	7.0 m		
New Service Area	PVC	200	75,058,380	38,623,720	11,656,695	4,422,935	0	0	0	129,761,730	
	PVC	250	0	454,950	0	2,945,570	9,537,580	0	0	12,938,100	
	RC	900	0	14,118,930	0	0	0	0	0	14,118,930	
	RC	1000	0	3,412,420	11,684,440	14,257,125	0	0	0	29,353,985	
	RC	1100	0	0	0	68,563,300	28,448,100	0	0	97,011,400	
	RC	1200	0	0	0	0	19,239,180	0	0	19,239,180	
	RC	1500	0	0	0	0	27,075,900	105,967,050	2,707,920	135,750,870	
	Sub-total			75,058,380	56,610,020	23,341,135	90,188,930	84,300,760	105,967,050	2,707,920	438,174,195
	SP	1100		80,946,800	0	0	0	0	0	0	80,946,800
Total			156,005,180	56,610,020	23,341,135	90,188,930	84,300,760	105,967,050	2,707,920	519,120,995	
Existing Service Area	PVC	300	1,573,880	0	2,428,960	0	0	0	0	4,002,840	
	PVC	350	45,920	2,919,000	0	19,281,000	0	0	0	22,245,920	
	PVC	400	3,328,780	0	0	27,591,740	0	0	0	30,920,520	
	RC	700	0	0	0	0	33,335,210	0	0	33,335,210	
	RC	800	0	12,940,140	0	0	43,092,840	0	0	56,032,980	
	RC	1100	0	0	0	42,192,800	0	0	0	42,192,800	
	Sub-total			4,948,580	15,859,140	2,428,960	89,065,540	76,428,050	0	0	188,730,270
	SP	900		16,325,220	0	0	0	0	0	0	16,325,220
	Total			21,273,800	15,859,140	2,428,960	89,065,540	76,428,050	0	0	205,055,490
Grand Total	F/S	Local	75,058,380	39,078,670	11,656,695	7,368,505	9,537,580	0	0	142,699,830	
		Foregin	61,747,200	33,390,490	14,113,400	171,885,965	151,191,230	105,967,050	2,707,920	541,003,255	
		Total	136,805,580	72,469,160	25,770,095	179,254,470	160,728,810	105,967,050	2,707,920	683,703,085	
	M/P	Local	75,058,380	39,078,670	11,656,695	7,368,505	9,537,580	0	0	142,699,830	
		Foregin	102,220,600	33,390,490	14,113,400	171,885,965	151,191,230	105,967,050	2,707,920	581,476,655	
Total			177,278,980	72,469,160	25,770,095	179,254,470	160,728,810	105,967,050	2,707,920	724,176,485	

Note: PVC: Polyvinyl Chloride Pipe, RC: Reinforced Concrete Pipe, SP: Steel Pipe