Table I.2 Design Calculation of C2+E1 WWTP (1/11)

1 BASIC CONDITIONS

1-1 Basic Items

(1) Name : **C2+E1 WWTP**

(2) Land Area : Approximately xxxx ha

(3) Ground Level (Elevatio : + 4.00 m (Plan)

(4) Inlet Pipe Invert Level : - 15.82 m

(5) Pipe Diameter : 3,200 mm

(6) Land Use : —

(7) Collection System : ~~Combined System~~ Separate System

(8) Treatment Process : Conventional Activated Sludge Process

(9) Effluent Point : Ngamoeyeik Creek

(10) Water Level at the Effluent Poir :
High water leve = 3.70 m
Low water leve = — m

(11) Target Year : 2020 (F/S Stage)
2040 (M/P Stage)

1-2 Service Area and Design Population

(1) Service Area : 11,286 ha

(2) Design Population

Item		Year 2020	Year 2040
Design Population	person	-	1,902,000

Table I.2 Design Calculation of C2+E1 WWTP (2/11)

1-3 Design Sewage Flow

(Year 2020)

Item	m^3/day	m^3/hr	m^3/min	m^3/sec
Maximum Daily Flow		0.0	0.00	0.000
Maximum Hourly Flow	0	0.0	0.00	0.000

(Year 2040)

Item	m^3/day	m^3/hr	m^3/min	m^3/sec
Maximum Daily Flow	744,000	31,000.0	516.67	8.611
Maximum Hourly Flow	1,116,000	46,500.0	775.00	12.917

1-4 Design Sewage Quality

Item	BOD	SS	T-N	Coli-group	Oil&Greese
	(mg/l)	(mg/l)	(mg/l)	(MPN/cm^3)	(mg/l)
Influent	200	180	-	-	-
Effluent	20	30	-	3,000	5

1-5 Process Flow Diagram

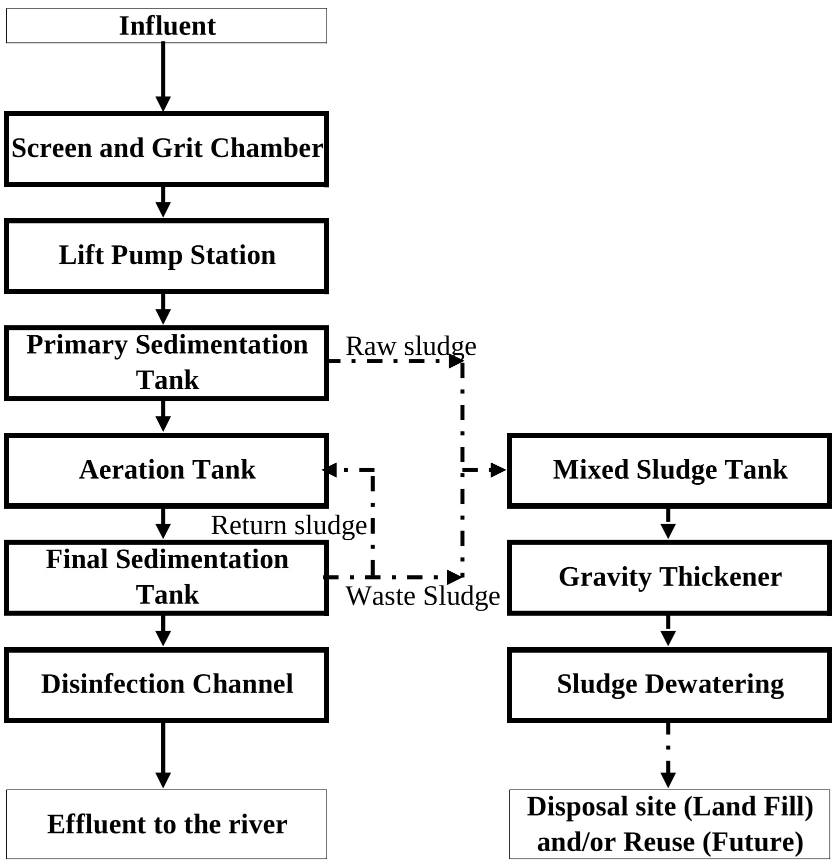


Table I.2 Design Calculation of C2+E1 WWTP (3/11)

1.6 Design Criteria

ITEMS		UNIT	Formula or Value	Application
1	Grit Chamber (For Maximum Hourly Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	1,800	1,800
(2)	Average Velocity	m/sec	0.3	0.3
2	Primary Sedimentation Tank (For Maximum Daily Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	35.0-70.0	50
(2)	Settling Time (Ref.)	hour	1.5	1.5
(3)	Water Depth	m	2.5-4.0	3.5
(4)	Weir Loading	$m^3/m/day$	250	250
3	Aeration Tank (For Maximum Daily Flow)			
(1)	Hydraulic Retention Time (HRT)	hour	6 - 8	6.0
(2)	MLSS Concentration	mg/l	1,500 -2,000	2,000
(3)	BOD-SS Load (Reference only)	kg/kg/day	0.2 - 0.4	-
4	Final Sedimentation Tank (For Maximum Daily Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	20.0-30.0	25
(2)	Settling Time (Ref.)	hour	3.0-4.0	-
(3)	Water Depth	m	2.5-4.0	3.5
(4)	Weir Loading	$m^3/m/day$	150	150
5	Disinfection Tank (For Maximum Daily Flow)			
(1)	Retention (Chlorination) Time	min	15	15
6	Gravity Thickener (For Maximum Daily Flow)			
(1)	Solids Loading	$kg/m^2/day$	60-90	75
(2)	Water Depth	m		4.0

Table I.2 Design Calculation of C2+E1 WWTP (4/11)

2 CAPACITY CALCULATION

2-1 Grit Chamber

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			1,116,000
(Maximum Hourly Flow)	Q2	m^3/sec			12.917
Water Surface Load	WSL	m^3/m^2/day			1,800
Required Surface Area	RSA	m^2	Q1/WSL		620.00
Basin Number	BN	basin			16
Average Velocity	AV	m/sec			0.3
Depth	H	m			1
Width	W1	m	Q2/(AV×H×BN)		2.69
Therefore	W2	m			3.0
Length	L1	m	RSA/(W2×BN)		12.92
Therefore	L2	m			13.0
Dimension (Width)	W	m			**3.0**
(Length)	L	m	L2		**13.0**
(Depth)	H	m	H		**1.0**
(Basin Number)	N	basin			**16**
(Check)					
Water Surface Load		m^3/m^2/day	Q1/(W×L×N)		1,788
Average Velocity		m/sec	Q2/(W×H×N)		0.269

2-2 Lift Pump Station

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Vertical shaft Volute type mixed flow pump		
Design Sewage Flow	Q1	m^3/min	Peak Flow/4Nos		193.75
Pump Unit -1 Number	UN1	unit			2
Discharge per Unit	DU1	m^3/min	1/10×Q1		19.38
Pump Diameter(V=1.5~3.0m/s	D1	mm	$146\times(DU1/1.5\sim3.0)^{0.5}$		371 ～525
Therefore	D1	mm			450
Pump Unit -2 Number	UN2	unit			2
Discharge per Unit	DU2	m^3/min	2/10×Q1		38.75
Pump Diameter(V=1.5~3.0m/s	D2	mm	$146\times(DU2/1.5\sim3.0)^{0.5}$		525 ～742
Therefore	D2	mm			600
Pump Unit -3 Number	UN3	unit	including 1 stand-by		2
Discharge per Unit	DU3	m^3/min	4/10×Q1		77.50
Pump Diameter(V=1.5~3.0m/s	D3	mm	$146\times(DU3/1.5\sim3.0)^{0.5}$		742 #####
Therefore	D3	mm			900

Table I.2 Design Calculation of C2+E1 WWTP (5/11)

2-3 Primary Sedimentation Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			744,000
(Maximum Daily Flow)	Q2	m^3/hr			31,000.0
Basin Number	BN	basin			64
Hydraulic Load	HL	m^3/m^2/day			50.0
Required Surface Area	A1	m^2	Q1/HL		14,880
	A2	m^2/basin	A1/BN		233
Width	W1	m	3.0m~4.0m, Max5.0m		5.0
Length	L1	m	A2/W1		46.50
Therefore	L2	m			47.0
Water Depth	WD	m			3.5
Overflow Weir Load	OWL	m^3/m/day			250
Required Weir Length	WL1	m/basin	Q1/(BN×OWL)		46.50
Therefore	WL2	m/basin			47.0
Dimension (Width)	W	m			**5.0**
(Depth)	D	m			**3.5**
(Length)	L	m	Two-story Sedimentation Tan		**47.0**
			Upper Tank		**18.8**
			Lower Tank		**28.2**
(Basin Number)	N	basin			**64**
(Check)					
Hydraulic Load	HL	m^3/m^2/day	Q1/(N×W×L)		49.47
Retention(Settling) Time	T	hour	(N×W×D×L)/Q2		1.70
Overflow Weir Load	OWL	m^3/m/day	Q1/(N×WL2)		247.34

Table I.2 Design Calculation of C2+E1 WWTP (6/11)

2-4 Aeration Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Multi-tank Complete mixing Type		
Design Sewage Flow	Q1	m^3/day			744,000
(Maximum Daily Flow)	Q2	m^3/hr			31,000.0
Hydraulic Retention Time	HRT	hr			6.0
Basin Number	BN	basin			32
Required Volume per basin	RV	m^3/basin	Q2×RT/BN		5,813
Width	W	m	1~2H		10.5
Water Depth	H	m	Deep Aeration Tank		10.0
Length	L1	m	RV/(W×H)		55.4
Therefore	L2	m			56.0
Dimension (Width)	W	m			**10.5**
(Depth)	H	m			**10.0**
(Length)	L	m			**56.0**
(Basin Number)	N	basin			**32**
(Check)					
Hydraulic Retention Time	HRT	hour	W×H×L×N/Q2		6.1
BOD-SS load	BSS_L	kgBOD/kgSS/d	(Q1×BODin)/(W×H×L×N×Xa)		0.24
BOD_{in} : Inflow BOD Concentration			120 mg/L (Removal Rate in PST : 40%)		
Xa : MLSS Concentration			2,000 mg/L		
Aerobic Sludge Retention Time	ASRT	day	HRT/24×Xa / (a×S-BODin + b×SSin - c×HRT/24×Xa) =		4.805
$S\text{-}BOD_{in}$: Inflow S-BOD Concentration			80 mg/L (S-BOD[Solved BOD]=BODin×0.67		
SS_{in} : Inflow SS Concentration			90 mg/L (Removal Rate in PST : 50%)		
a : Sludge converting ratio of solved BOD			0.5 mgMLSS/mgBOD (0.4~0.6)		
b : Sludge converting ratio of SS			0.95 mgMLSS/mgSS (0.9~1.0)		
c : Sludge reduction ratio caused by endogenous respiration			0.04 (1/day)(0.03~0.05)		
Effluent Quality (C-BOD)	EQ	mg/L	$10.42 \times A\text{-}SRT^{(-0.519)}$ (15~20℃)		4.614
Water Temperature			20 ℃		
Effluent Water Quality (C=BOD Maximum)			EQ×3 20mg/l >		14
					-OK-
			1 : 1.5 : 1.5 : 2.25		
Partition of Aeration Tank			No.1 No.2 No.3 No.4		
Total Length of Tank	TL	m			56.0
No.1 Tank Length	L1	m	TL×1/(1+1.5+1.5+2.25)		9.0
No.2 Tank Length	L2	m	TL×1.5/(1+1.5+1.5+2.25)		13.4
No.3 Tank Length	L3	m	TL×1.5/(1+1.5+1.5+2.25)		13.4
No.4 Tank Length	L4	m	TL×2.25/(1+1.5+1.5+2.25)		20.2
			Total		**56.0**

Table I.2 Design Calculation of C2+E1 WWTP (7/11)

2-5 Final Sedimentation Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			744,000
(Maximum Daily Flow)	Q2	m^3/hr			31,000.0
Basin Number	BN	basin			64
Hydraulic Load	HL	m^3/m^2/day			25.0
Required Surface Area	A1	m^2	Q1/HL		29,760
	A2	m^2/basin	A1/BN		465
Width	W1	m	3.0m~4.0m, Max5.0m		5.0
Length	L1	m	A2/W1		93.00
Therefore	L2	m			93.0
Water Depth	WD	m			3.5
Overflow Weir Load	OWL	m^3/m/day			150
Required Weir Length	WL1	m/basin	Q1/(BN×OWL)		77.50
Therefore	WL2	m/basin			78.0
Dimension (Width)	W	m			**5.0**
(Depth)	D	m			**3.5**
(Length)	L	m	Two-story Sedimentation Tan		**93.0**
			Upper Tank		**37.2**
			Lower Tank		**55.8**
(Basin Number)	N	basin			**64**
(Check)					
Hydraulic Load	HL	m^3/m^2/day	Q1/(N×W×L)		25.00
Retention(Settling) Time	T	hour	(N×W×D×L)/Q2		3.36
Overflow Weir Load	OWL	m^3/m/day	Q1/(N×WL2)		149.04

Table I.2 Design Calculation of C2+E1 WWTP (8/11)

2-6 Disinfection Channel

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Chlorination		
Design Sewage Flow	Q1	m^3/day			744,000
(Maximum Daily Flow)	Q2	m^3/min			516.7
Retention(Chlorination) Time	RT	min			15.0
Required Volume	RV	m^3	Q2×RT		7,750
Width of channel	W	m			2.0
Depth of channel	H	m			3.0
Pass Number	PN	pass			32
Length of channel	L1	m/pass	RV/(W×H×PN)		40.4
Therefore	L2	m/pass			41.0
Dimension (Width)	W	m			**2.0**
(Depth)	H	m			**3.0**
(Length)	L	m/pass			**41.0**
(Pass Number)	N	pass			**32**
(Check)					
Retention(Chlorination) Time	RT	min	(W×H×L×PN)/Q2		15.2

2-7 Sludge Thickening Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Gravity Thickener (Radial Flow Circular Type)		
Generated Sludge Solids	GS	t-DS/day	Refer to Mass Balance Cal.		138.68
Generated Sludge Volume	GSV	m^3/day	Refer to Mass Balance Cal.		17,464
Solid Matter Load	SML	kg/m^2/day			75
Required Surface Area	SA	m^2	$(GS\times10^3)/SML$		1849.1
Water Depth	H	m			4.0
Basin Number	BN	basin			16
Required Tank Diameter	TD1	m	$(SA\times4/(3.14\times BN))^{0.5}$		12.13
Therefore	TD2	m			12.5
Dimension (Diameter)	D	m/basin			**12.5**
(Depth)	H	m			**4.0**
(Basin Number)	BN	basin			**16**
(Check)					
Solid Matter Load	SML	kg/m^2/day	$GS\times10^3/(3.14\times D^2/4)\times BN$		70.7
Sludge Thickened Time	T	hr	$(3.14\times D^2/4)\times H\times BN\times24/GSV$		10.8

Table I.2 Design Calculation of C2+E1 WWTP (9/11)

2-8 Sludge Dewatering

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Mechanical Dewatering (Screw Press Type)		
Thickened Sludge Solids	TS	t-DS/day	Refer to Material Balance		126.062
Unit Number	UN	Unit			24
Operating Time	OT	hr/day			24.0
Required Dewatering Capacity	DC	kg/hr/unit	$TS\times10^3/(OT\times UN)$		218.9
Solids Loading	Q_{100}	kg-ds/hr/φ100			3.0
Screen Diameter	SD1	mm	$100\times(DC/Q_{100})$^(1/2.2)		702.8
Therefore	SD2	mm			800
Dimension (unit)	UN	Unit			**24**
(Screen Diameter)	SD	mm			**800**
(Check)					
Dewatering Capacity	DC	kg/hr/unit	(SD/100)^2.2$\times Q_{100}$		291.0
Operating Time	OT	hour/day	$TS\times10^3/(DC\times(UN-1))$		18.0

Table I.2 Design Calculation of C2+E1 WWTP (10/11)

Material Balance Calculation (Primary and Secondary Sedimentation Tank + Thickening Tank + Mechanical Dewatering)

Table-1 Input Data

1. Calculation Manner		1	1:Premise that the quality of supernatants are same level removed with inlet sewage
			2:Premise that the entire supernatants are removed at treatment process
2. Selection of Treatment Efficiency		1	1:Total Removal Ratio 2:Outlet Water Quality(input 1or2)
In case of 1 : input data		90	(%)
In case of 2 : input data			(mg/l)
3. Excess Sludge Generation		1	1:Consideration of Solid Matter Only 2:Consideration of Converting of Solved BOD (input 1or2)
In case of 1:Input data (Sludge generation)		100	Sludge generation ratio per removal SS(%)
In case of 2:Input data	a		T2=Q2*S2=(a*S_{BOD}+b*S1-c*θ*XA)*Q1/10^6**(Excess sludge generation formula)
	b		a:Converting ratio of solved BOD(mgMLSS/mgBOD)
	c		b:Converting ratio of SS(mgMLSS/mgSS)
	SBOD		c:Sludge reduction ratio caused by endogenous respiration of activated sludge(1/day)
	XA		S_{BOD}:Solved BOD quality at inlet to reactor
	θ		XA:MLSS concentration(mg/l)
			θ:Hydraulic retention time(day)

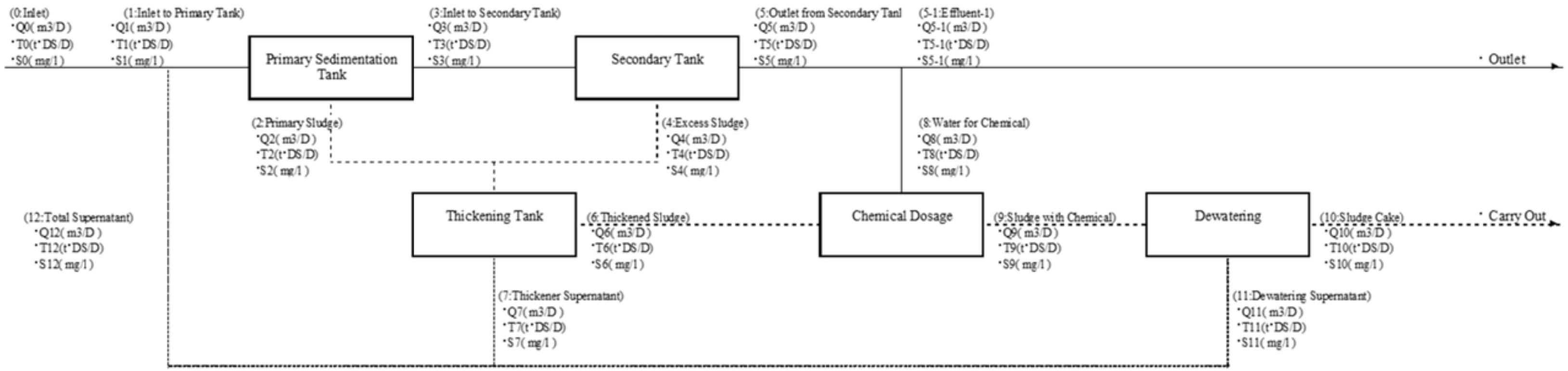
Table-2 Basic Conditions

Water Flow and Quality		Sludge Moisture and Recovery Ratio				Chemical Conditions for Dewatering			
*Inlet flow : Q0(m3/D)	744000	*Primary sludge moisture ratio : W1(%)	98.5	*Removal ratio in primary tank : A2(%)	50.0	*Chemical dosage : A5(%)	1.0		
*Inlet quality : S0(mg/l)	180	*Excess sludge moisture ratio : W2(%)	99.5	*Recoveryratio in sludge thickener : A3(%)	90.0	*Chemical dissolve concentration : A6(%)	0.2		
*Total removal ratio : A1(%)	90.0	*Thickened sludge moisture ratio : W3(%)	98.0	*Recoveryratio in dewatering : A4(%)	95.0				
*Effluent quality: St(mg/l)	-	*Dewatered sludge moisture ratio : W4(%)	80.0						
*Sludge generation ratio per removal SS : Si(%)	100.0								

Table-3 Material Balance Calculation

	0	1	2	3	4	5	6	7	8	9	10	11	12			5-1		
Q(m3/day)	744,000	761,489	5,136	756,353	12,327	744,025	6,241	11,223	624	6,865	599	6,266	17,489			743,401		
T(t*DS/day)	133.920	154.091	77.046	77.046	61.637	15.409	124.814	13.868	1.248	126.062	119.759	6.303	20.171			14.161		
S(mg/l)	180	202	15,000	102	5,000	21	20,000	1,236	2,000	18,364	200,000	1,006	1,153			21		
X(Ti/T0*100)	100	115.1	57.5	57.5	46.0	11.5	93.2	10.4	0.9	94.1	89.4	4.7	15.1			10.6		

Figure-1 Material Balance Model



Calculation Formula

*Q0=Input Data *T0=Q0*S0*10^(-6) *S0=Input Data	*Q3=Q1-Q2 *T3=T1*(100-A2)/100 *S3=T3*10^6/Q3	*Q6=T4*100/(100-W3) *T6=(T2+T4)*A3/100 *S6=10^6*(100-W3)/100	*Q9=Q6+Q8 *T9=T6+T8 *S9=T9*10^6/Q9	*Q12=Q7+Q11 *T12=T7+T11 *S11=T11*10^6/Q11	*Q5-1=Q5-Q8 *T5-1=T5-T8 *S5-1=S5
*Q1=Q0+Q13 *T1=T0+T13 *S1=T1*10^6/Q1	*Q4=T4*100/(100-W2) *T4={(T1-T5)*Si/100}-T2 *S4=10^6*(100-W2)/100	*Q7=(Q2+Q4)-Q6 *T7=(T2+T4)-T6 *S7=T7*10^6/Q7	*Q10=T10*100/(100-W4) *T10=T9*A4/100 *S10=10^6*(100-W4)/100		
*Q2=T2*100/(100-W1) *T2=T1-T3 *S2=10^6*(100-W1)/100	*Q5=Q3-Q4*(T3-T5)/T4 *T5=T1*(100-A1)/100 *S5=T5*10^6/Q5	*Q8=T6*A5/A6 *T8=Q8*S8/10^6 *S8=10^4*A6	*Q11=Q9-Q10 *T11=T9-T10 *S11=T11*10^6/Q11		

Table I.2 Design Calculation of C2+E1 WWTP (11/11)

Material Balance Sheet

0:Inlet	
Q0(m3/D)	744,000
T0(t･DS/D)	133.920
S0(mg/l)	180

1:Inlet to Primary Tank	
Q1(m3/D)	761,489
T1(t･DS/D)	154.091
S1(mg/l)	202
X1 (%)	115.1

3:Inlet to Secondary Tank	
Q3(m3/D)	756,353
T3(t･DS/D)	77.046
S3(mg/l)	102
X3 (%)	57.5

5:Outlet from Secondary Tank	
Q5(m3/D)	744,025
T5(t･DS/D)	15.409
S5(mg/l)	21
X5 (%)	11.5

5-1:Effluent-1	
Q5-1(m3/D)	743,401
T5-1(t･DS/D)	14.161
S5-1(mg/l)	21
X5-1 (%)	10.6

Primary Sedimentation Tank (SS Removal : %)

Secondary Tank

・Outlet

2:Primary Sludge	
Q2(m3/D)	5,136
T2(t･DS/D)	77.046
S2(mg/l)	15,000
X2 (%)	57.5

4:Excess Sludge	
Q4(m3/D)	12,327
T4(t･DS/D)	61.637
S4(mg/l)	5,000
X4 (%)	46.0

8:Water for Chemical	
Q8(m3/D)	624
T8(t･DS/D)	1.248
S8(mg/l)	2,000
X8 (%)	0.9

12:Total Supernatants	
Q12(m3/D)	17,489
T12(t･DS/D)	20.171
S12(mg/l)	1,153
X12 (%)	15.1

* Sludge to Thickener	
Q(m3/D)	17,464
T(t･DS/D)	138.682
S(mg/l)	7,941

Thickening Tank (SS Recovery : %)

Chemical Dosage

Dewatering (SS Recovery : %)

・Carry Out

6:Thickened Sludge	
Q6(m3/D)	6,241
T6(t･DS/D)	124.814
S6(mg/l)	20,000
X6 (%)	93.2

9:Sludge with Chemical	
Q9(m3/D)	6,865
T9(t･DS/D)	126.062
S9(mg/l)	18,364
X9 (%)	94.1

10:Sludge Cake	
Q10(m3/D)	599
T10(t･DS/D)	119.759
S10(mg/l)	200,000
X10 (%)	89.4

7:Thickener Supernatant	
Q7(m3/D)	11,223
T7(t･DS/D)	13.868
S7(mg/l)	1,236
X7 (%)	10.4

11:Dewatering Supernatant	
Q11(m3/D)	6,266
T11(t･DS/D)	6.303
S11(mg/l)	1,006
X11 (%)	4.7

LEGEND
Q: Water Flow : (m3/day)
T: Solid Matter : (t･DS/day)
S: Solid Concentration : (mg/l)
X: Ratio for Inlet Solid : (%)

・ Water
・ Sludge
・ Supernatant

Table I.3 Design Calculation of W1 WWTP (1/11)

1 BASIC CONDITIONS

1-1 Basic Items

(1) Name : **W1 WWTP**

(2) Land Area : Approximately xxxx ha

(3) Ground Level (Elevatio : + 4.10 m (Plan)

(4) Inlet Pipe Invert Level : - 7.60 m

(5) Pipe Diameter : 2,000 mm

(6) Land Use : —

(7) Collection System : ~~Combined System~~ Separate System

(8) Treatment Process : Conventional Activated Sludge Process

(9) Effluent Point : Hlaing River

(10) Water Level at the Effluent Poir :
High water leve = 3.70 m
Low water leve = — m

(11) Target Year : 2020 (F/S Stage)
2040 (M/P Stage)

1-2 Service Area and Design Population

(1) Service Area : 1,654 ha

(2) Design Population

Item		Year 2020	Year 2040
Design Population	person	-	483,300

Table I.3 Design Calculation of W1 WWTP (2/11)

1-3 Design Sewage Flow

(Year 2020)

Item	m^3/day	m^3/hr	m^3/min	m^3/sec
Maximum Daily Flow		0.0	0.00	0.000
Maximum Hourly Flow	0	0.0	0.00	0.000

(Year 2040)

Item	m^3/day	m^3/hr	m^3/min	m^3/sec
Maximum Daily Flow	184,000	7,666.7	127.78	2.130
Maximum Hourly Flow	276,000	11,500.0	191.67	3.194

1-4 Design Sewage Quality

Item	BOD	SS	T-N	Coli-group	Oil&Greese
	(mg/l)	(mg/l)	(mg/l)	(MPN/cm^3)	(mg/l)
Influent	200	180	-	-	-
Effluent	20	30	-	3,000	5

1-5 Process Flow Diagram

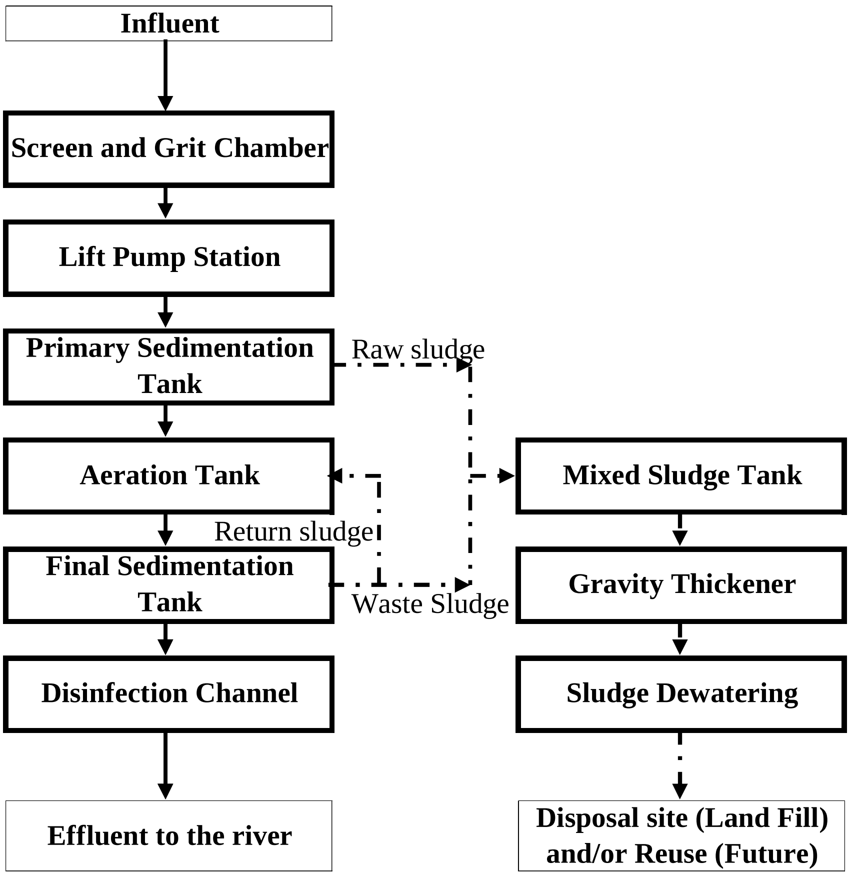


Table I.3 Design Calculation of W1 WWTP (3/11)

1.6 Design Criteria

ITEMS		UNIT	Formula or Value	Application
1	Grit Chamber (For Maximum Hourly Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	1,800	1,800
(2)	Average Velocity	m/sec	0.3	0.3
2	Primary Sedimentation Tank (For Maximum Daily Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	35.0-70.0	50
(2)	Settling Time (Ref.)	hour	1.5	1.5
(3)	Water Depth	m	2.5-4.0	3.5
(4)	Weir Loading	$m^3/m/day$	250	250
3	Aeration Tank (For Maximum Daily Flow)			
(1)	Hydraulic Retention Time (HRT)	hour	6 - 8	6.0
(2)	MLSS Concentration	mg/l	1,500 -2,000	2,000
(3)	BOD-SS Load (Reference only)	kg/kg/day	0.2 - 0.4	-
4	Final Sedimentation Tank (For Maximum Daily Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	20.0-30.0	25
(2)	Settling Time (Ref.)	hour	3.0-4.0	-
(3)	Water Depth	m	2.5-4.0	3.5
(4)	Weir Loading	$m^3/m/day$	150	150
5	Disinfection Tank (For Maximum Daily Flow)			
(1)	Retention (Chlorination) Time	min	15	15
6	Gravity Thickener (For Maximum Daily Flow)			
(1)	Solids Loading	$kg/m^2/day$	60-90	75
(2)	Water Depth	m		4.0

Table I.3 Design Calculation of W1 WWTP (4/11)

2 CAPACITY CALCULATION

2-1 Grit Chamber

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			276,000
(Maximum Hourly Flow)	Q2	m^3/sec			3.194
Water Surface Load	WSL	m^3/m^2/day			1,800
Required Surface Area	RSA	m^2	Q1/WSL		153.33
Basin Number	BN	basin			4
Average Velocity	AV	m/sec			0.3
Depth	H	m			1
Width	W1	m	Q2/(AV×H×BN)		2.66
Therefore	W2	m			3.0
Length	L1	m	RSA/(W2×BN)		12.78
Therefore	L2	m			12.5
Dimension (Width)	W	m			**3.0**
(Length)	L	m	L2		**12.5**
(Depth)	H	m	H		**1.0**
(Basin Number)	N	basin			**4**
(Check)					
Water Surface Load		m^3/m^2/day	Q1/(W×L×N)		1,840
Average Velocity		m/sec	Q2/(W×H×N)		0.266

2-2 Lift Pump Station

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Vertical shaft Volute type mixed flow pump		
Design Sewage Flow	Q1	m^3/min	Peak Flow		191.67
Pump Unit -1 Number	UN1	unit			2
Discharge per Unit	DU1	m^3/min	1/10×Q1		19.17
Pump Diameter(V=1.5~3.0m/s	D1	mm	$146\times(DU1/1.5\sim3.0)^{0.5}$		369 ～522
Therefore	D1	mm			450
Pump Unit -2 Number	UN2	unit			2
Discharge per Unit	DU2	m^3/min	2/10×Q1		38.33
Pump Diameter(V=1.5~3.0m/s	D2	mm	$146\times(DU2/1.5\sim3.0)^{0.5}$		522 ～738
Therefore	D2	mm			600
Pump Unit -3 Number	UN3	unit	including 1 stand-by		2
Discharge per Unit	DU3	m^3/min	4/10×Q1		76.67
Pump Diameter(V=1.5~3.0m/s	D3	mm	$146\times(DU3/1.5\sim3.0)^{0.5}$		738 #####
Therefore	D3	mm			800

Table I.3 Design Calculation of W1 WWTP (5/11)

2-3 Primary Sedimentation Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			184,000
(Maximum Daily Flow)	Q2	m^3/hr			7,666.7
Basin Number	BN	basin			12
Hydraulic Load	HL	m^3/m^2/day			50.0
Required Surface Area	A1	m^2	Q1/HL		3,680
	A2	m^2/basin	A1/BN		307
Width	W1	m	3.0m~4.0m, Max5.0m		5.0
Length	L1	m	A2/W1		61.33
Therefore	L2	m			62.0
Water Depth	WD	m			3.5
Overflow Weir Load	OWL	m^3/m/day			250
Required Weir Length	WL1	m/basin	Q1/(BN×OWL)		61.33
Therefore	WL2	m/basin			62.0
Dimension (Width)	W	m			**5.0**
(Depth)	D	m			**3.5**
(Length)	L	m	Two-story Sedimentation Tan		**62.0**
			Upper Tank		**24.8**
			Lower Tank		**37.2**
(Basin Number)	N	basin			**12**
(Check)					
Hydraulic Load	HL	m^3/m^2/day	Q1/(N×W×L)		49.46
Retention(Settling) Time	T	hour	(N×W×D×L)/Q2		1.70
Overflow Weir Load	OWL	m^3/m/day	Q1/(N×WL2)		247.31

Table I.3 Design Calculation of W1 WWTP (6/11)

2-4 Aeration Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Multi-tank Complete mixing Type		
Design Sewage Flow	Q1	m^3/day			184,000
(Maximum Daily Flow)	Q2	m^3/hr			7,666.7
Hydraulic Retention Time	HRT	hr			6.0
Basin Number	BN	basin			6
Required Volume per basin	RV	m^3/basin	Q2×RT/BN		7,667
Width	W	m	1~2H		10.5
Water Depth	H	m	Deep Aeration Tank		10.0
Length	L1	m	RV/(W×H)		73.0
Therefore	L2	m			73.0
Dimension (Width)	W	m			**10.5**
(Depth)	H	m			**10.0**
(Length)	L	m			**73.0**
(Basin Number)	N	basin			**6**
(Check)					
Hydraulic Retention Time	HRT	hour	W×H×L×N/Q2		6.0
BOD-SS load	BSS_L	kgBOD/kgSS/d	(Q1×BODin)/(W×H×L×N×Xa)		0.24
BOD_{in} : Inflow BOD Concentration			120 mg/L	(Removal Rate in PST : 40%)	
Xa : MLSS Concentration			2,000 mg/L		
Aerobic Sludge Retention Time	ASRT	day	HRT/24×Xa / (a×S-BODin + b×SSin - c×HRT/24×Xa) =		4.738
$S\text{-}BOD_{in}$: Inflow S-BOD Concentration			80 mg/L	(S-BOD[Solved BOD]=BODin×0.67	
SS_{in} : Inflow SS Concentration			90 mg/L	(Removal Rate in PST : 50%)	
a : Sludge converting ratio of solved BOD			0.5 mgMLSS/mgBOD	(0.4~0.6)	
b : Sludge converting ratio of SS			0.95 mgMLSS/mgSS	(0.9~1.0)	
c : Sludge reduction ratio caused by endogenous respiration			0.04	(1/day)(0.03~0.05)	
Effluent Quality (C-BOD)	EQ	mg/L	$10.42\times A\text{-}SRT^{(-0.519)}$ (15~20℃)		4.648
Water Temperature			20 ℃		
Effluent Water Quality (C=BOD Maximum)			EQ×3	20mg/l >	14
					-OK-
			1 : 1.5 : 1.5 : 2.25		
Partition of Aeration Tank			No.1 | No.2 | No.3 | No.4		
Total Length of Tank	TL	m			73.0
No.1 Tank Length	L1	m	TL×1/(1+1.5+1.5+2.25)		11.7
No.2 Tank Length	L2	m	TL×1.5/(1+1.5+1.5+2.25)		17.5
No.3 Tank Length	L3	m	TL×1.5/(1+1.5+1.5+2.25)		17.5
No.4 Tank Length	L4	m	TL×2.25/(1+1.5+1.5+2.25)		26.3
			Total		**73.0**

Table I.3 Design Calculation of W1 WWTP (7/11)

2-5 Final Sedimentation Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			184,000
(Maximum Daily Flow)	Q2	m^3/hr			7,666.7
Basin Number	BN	basin			12
Hydraulic Load	HL	m^3/m^2/day			25.0
Required Surface Area	A1	m^2	Q1/HL		7,360
	A2	m^2/basin	A1/BN		613
Width	W1	m	3.0m~4.0m, Max5.0m		5.0
Length	L1	m	A2/W1		122.67
Therefore	L2	m			123.0
Water Depth	WD	m			3.5
Overflow Weir Load	OWL	m^3/m/day			150
Required Weir Length	WL1	m/basin	Q1/(BN×OWL)		102.22
Therefore	WL2	m/basin			103.0
Dimension (Width)	W	m			**5.0**
(Depth)	D	m			**3.5**
(Length)	L	m	Two-story Sedimentation Tan		**123.0**
			Upper Tank		**49.2**
			Lower Tank		**73.8**
(Basin Number)	N	basin			**12**
(Check)					
Hydraulic Load	HL	m^3/m^2/day	Q1/(N×W×L)		24.93
Retention(Settling) Time	T	hour	(N×W×D×L)/Q2		3.37
Overflow Weir Load	OWL	m^3/m/day	Q1/(N×WL2)		148.87

Table I.3 Design Calculation of W1 WWTP (8/11)

2-6 Disinfection Channel

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Chlorination		
Design Sewage Flow	Q1	m^3/day			184,000
(Maximum Daily Flow)	Q2	m^3/min			127.8
Retention(Chlorination) Time	RT	min			15.0
Required Volume	RV	m^3	Q2×RT		1,917
Width of channel	W	m			2.5
Depth of channel	H	m			3.0
Pass Number	PN	pass			4
Length of channel	L1	m/pass	RV/(W×H×PN)		63.9
Therefore	L2	m/pass			64.0
Dimension (Width)	W	m			**2.5**
(Depth)	H	m			**3.0**
(Length)	L	m/pass			**64.0**
(Pass Number)	N	pass			**4**
(Check)					
Retention(Chlorination) Time	RT	min	(W×H×L×PN)/Q2		15.0

2-7 Sludge Thickening Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Gravity Thickener (Radial Flow Circular Type)		
Generated Sludge Solids	GS	t-DS/day	Refer to Mass Balance Cal.		34.298
Generated Sludge Volume	GSV	m^3/day	Refer to Mass Balance Cal.		4,319
Solid Matter Load	SML	kg/m^2/day			75
Required Surface Area	SA	m^2	$(GS\times10^3)/SML$		457.3
Water Depth	H	m			4.0
Basin Number	BN	basin			4
Required Tank Diameter	TD1	m	$(SA\times4/(3.14\times BN))^{0.5}$		12.07
Therefore	TD2	m			12.0
Dimension (Diameter)	D	m/basin			**12.0**
(Depth)	H	m			**4.0**
(Basin Number)	BN	basin			**4**
(Check)					
Solid Matter Load	SML	kg/m^2/day	$GS\times10^3/(3.14\times D^2/4)\times BN$		75.9
Sludge Thickened Time	T	hr	$(3.14\times D^2/4)\times H\times BN\times24/GSV$		10.1

Table I.3 Design Calculation of W1 WWTP (9/11)

2-8 Sludge Dewatering

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Mechanical Dewatering (Screw Press Type)		
Thickened Sludge Solids	TS	t-DS/day	Refer to Material Balance		31.177
Unit Number	UN	Unit			8
Operating Time	OT	hr/day			24.0
Required Dewatering Capacity	DC	kg/hr/unit	$TS\times10^3/(OT\times UN)$		162.4
Solids Loading	Q_{100}	kg-ds/hr/φ10(			3.0
Screen Diameter	SD1	mm	$100\times(DC/Q_{100})$^(1/2.2)		613.6
Therefore	SD2	mm			700
Dimension (unit)	UN	Unit			**8**
(Screen Diameter)	SD	mm			**700**
(Check)					
Dewatering Capacity	DC	kg/hr/unit	(SD/100)^2.2×Q_{100}		216.9
Operating Time	OT	hour/day	$TS\times10^3/(DC\times(UN-1))$		18.0

Table I.3 Design Calculation of W1 WWTP (10/11)

Material Balance Calculation (Primary and Secondary Sedimentation Tank + Thickening Tank + Mechanical Dewatering)

Table-1 Input Data

1. Calculation Manner		1	1:Premise that the quality of supernatants are same level removed with inlet sewage 2:Premise that the entire supernatants are removed at treatment process
2. Selection of Treatment Efficiency		1	1:Total Removal Ratio 2:Outlet Water Quality(input 1or2)
In case of 1 : input data		90	(%)
In case of 2 : input data			(mg/l)
3. Excess Sludge Generation		1	1:Consideration of Solid Matter Only 2:Consideration of Converting of Solved BOD (input 1or2)
In case of 1:Input data (Sludge generation)		100	Sludge generation ratio per removal SS(%)
In case of 2:Input data	a		T2=Q2・S2=(a・S_{BOD}+b・S1-c・θ・XA)・Q1/10^6・・(Excess sludge generation formula)
	b		a:Converting ratio of solved BOD(mgMLSS/mgBOD)
	c		b:Converting ratio of SS(mgMLSS/mgSS)
	SBOD		c:Sludge reduction ratio caused by endogenous respiration of activated sludge(1/day)
	XA		Sboo:Solved BOD quality at inlet to reactor
	θ		XA:MLSS concentration(mg/l)
			θ:Hydraulic retention time(day)

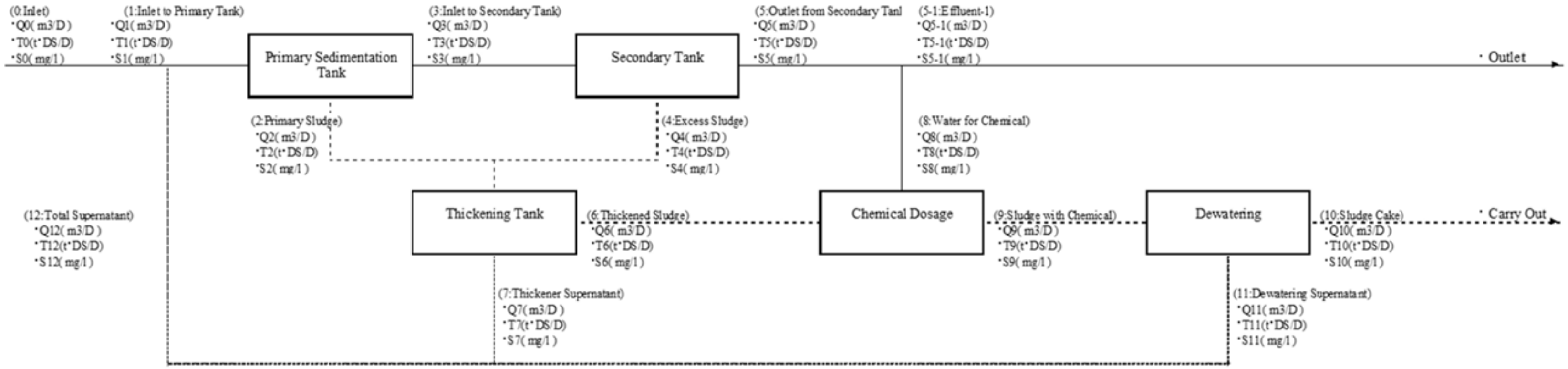
Table-2 Basic Conditions

Water Flow and Quality		Sludge Moisture and Recovery Ratio				Chemical Conditions for Dewatering		
・Inlet flow : Q0(m3/D)	184000	・Primary sludge moisture ratio : W1(%)	98.5	・Removal ratio in primary tank : A2(%)	50.0	・Chemical dosage : A5(%)	1.0	
・Inlet quality : S0(mg/l)	180	・Excess sludge moisture ratio : W2(%)	99.5	・Recoveryratio in sludge thickener : A3(%)	90.0	・Chemical dissolve concentration : A6(%)	0.2	
・Total removal ratio : A1(%)	90.0	・Thickened sludge moisture ratio : W3(%)	98.0	・Recoveryratio in dewatering : A4(%)	95.0			
・Effluent quality: St(mg/l)	-	・Dewatered sludge moisture ratio : W4(%)	80.0					
・Sludge generation ratio per removal SS : Si(%)	100.0							

Table-3 Material Balance Calculation

	0	1	2	3	4	5	6	7	8	9	10	11	12			5-1		
Q(m3/day)	184,000	188,325	1,270	187,055	3,049	184,006	1,543	2,776	154	1,698	148	1,550	4,325			183,852		
T(t・DS/day)	33.120	38.109	19.054	19.054	15.243	3.811	30.868	3.430	0.309	31.177	29.618	1.559	4.989			3.502		
S(mg/l)	180	202	15,000	102	5,000	21	20,000	1,236	2,000	18,364	200,000	1,006	1,153			21		
X(Ti/T0*100)	100	115.1	57.5	57.5	46.0	11.5	93.2	10.4	0.9	94.1	89.4	4.7	15.1			10.6		

Figure-1 Material Balance Model



Calculation Formula

・Q0=Input Data ・T0=Q0*S0*10^(-6) ・S0=Input Data	・Q3=Q1-Q2 ・T3=T1*(100-A2)/100 ・S3=T3*10^6/Q3	・Q6=T4*100/(100-W3) ・T6=(T2+T4)*A3/100 ・S6=10^6*(100-W3)/100	・Q9=Q6+Q8 ・T9=T6+T8 ・S9=T9*10^6/Q9	・Q12=Q7+Q11 ・T12=T7+T11 ・S11=T11*10^6/Q11	・Q5-1=Q5-Q8 ・T5-1=T5-T8 ・S5-1=S5
・Q1=Q0+Q13 ・T1=T0+T13 ・S1=T1*10^6/Q1	・Q4=T4*100/(100-W2) ・T4={(T1-T5)*Si/100}-T2 ・S4=10^6*(100-W2)/100	・Q7=(Q2+Q4)-Q6 ・T7=(T2+T4)-T6 ・S7=T7*10^6/Q7	・Q10=T10*100/(100-W4) ・T10=T9*A4/100 ・S10=10^6*(100-W4)/100		
・Q2=T2*100/(100-W1) ・T2=T1-T3 ・S2=10^6*(100-W1)/100	・Q5=Q3-Q4*(T3-T5)/T4 ・T5=T1*(100-A1)/100 ・S5=T5*10^6/Q5	・Q8=T6*A5/A6 ・T8=Q8*S8/10^6 ・S8=10^4*A6	・Q11=Q9-Q10 ・T11=T9-T10 ・S11=T11*10^6/Q11		

Table I.3 Design Calculation of W1 WWTP (11/11)

Material Balance Sheet

0:Inlet	
Q0(m3/D)	184,000
T0(t･DS/D)	33.120
S0(mg/l)	180

1:Inlet to Primary Tank	
Q1(m3/D)	188,325
T1(t･DS/D)	38.109
S1(mg/l)	202
X1 (%)	115.1

Primary Sedimentation Tank (SS Removal : %)

3:Inlet to Secondary Tank	
Q3(m3/D)	187,055
T3(t･DS/D)	19.054
S3(mg/l)	102
X3 (%)	57.5

Secondary Tank

5:Outlet from Secondary Tank	
Q5(m3/D)	184,006
T5(t･DS/D)	3.811
S5(mg/l)	21
X5 (%)	11.5

5-1:Effluent-1	
Q5-1(m3/D)	183,852
T5-1(t･DS/D)	3.502
S5-1(mg/l)	21
X5-1 (%)	10.6

・Outlet

2:Primary Sludge	
Q2(m3/D)	1,270
T2(t･DS/D)	19.054
S2(mg/l)	15,000
X2 (%)	57.5

4:Excess Sludge	
Q4(m3/D)	3,049
T4(t･DS/D)	15.243
S4(mg/l)	5,000
X4 (%)	46.0

8:Water for Chemical	
Q8(m3/D)	154
T8(t･DS/D)	0.309
S8(mg/l)	2,000
X8 (%)	0.9

12:Total Supernatants	
Q12(m3/D)	4,325
T12(t･DS/D)	4.989
S12(mg/l)	1,153
X12 (%)	15.1

* Sludge to Thickener	
Q(m3/D)	4,319
T(t･DS/D)	34.298
S(mg/l)	7,941

Thickening Tank (SS Recovery : %)

Chemical Dosage

Dewatering (SS Recovery : %)

・Carry Out

6:Thickened Sludge	
Q6(m3/D)	1,543
T6(t･DS/D)	30.868
S6(mg/l)	20,000
X6 (%)	93.2

9:Sludge with Chemical	
Q9(m3/D)	1,698
T9(t･DS/D)	31.177
S9(mg/l)	18,364
X9 (%)	94.1

10:Sludge Cake	
Q10(m3/D)	148
T10(t･DS/D)	29.618
S10(mg/l)	200,000
X10 (%)	89.4

7:Thickener Supernatant	
Q7(m3/D)	2,776
T7(t･DS/D)	3.430
S7(mg/l)	1,236
X7 (%)	10.4

11:Dewatering Supernatant	
Q11(m3/D)	1,550
T11(t･DS/D)	1.559
S11(mg/l)	1,006
X11 (%)	4.7

LEGEND
Q : Water Flow : (m3/day)
T : Solid Matter : (t･DS/day)
S : Solid Concentration : (mg/l)
X : Ratio for Inlet Solid : (%)

・ Water
・ Sludge
・ Supernatant

Table I.4 Design Calculation of W2 WWTP (1/11)

1 BASIC CONDITIONS

1-1 Basic Items

(1) Name : **W2 WWTP**

(2) Land Area : Approximately xxxx ha

(3) Ground Level (Elevatio : + 4.50 m (Plan)

(4) Inlet Pipe Invert Level : - 6.54 m

(5) Pipe Diameter : 1,800 mm

(6) Land Use : ―

(7) Collection System : ~~Combined System~~ Separate System

(8) Treatment Process : Conventional Activated Sludge Process

(9) Effluent Point : Hlaing River

(10) Water Level at the Effluent Poir :
High water leve = 3.70 m
Low water leve = ― m

(11) Target Year : 2020 (F/S Stage)
2040 (M/P Stage)

1-2 Service Area and Design Population

(1) Service Area : 2,356 ha

(2) Design Population

Item		Year 2020	Year 2040
Design Population	person	-	349,500

Table I.4 Design Calculation of W2 WWTP (2/11)

1-3 Design Sewage Flow

(Year 2020)

Item	m^3/day	m^3/hr	m^3/min	m^3/sec
Maximum Daily Flow		0.0	0.00	0.000
Maximum Hourly Flow	0	0.0	0.00	0.000

(Year 2040)

Item	m^3/day	m^3/hr	m^3/min	m^3/sec
Maximum Daily Flow	126,000	5,250.0	87.50	1.458
Maximum Hourly Flow	189,000	7,875.0	131.25	2.188

1-4 Design Sewage Quality

Item	BOD	SS	T-N	Coli-group	Oil&Greese
	(mg/l)	(mg/l)	(mg/l)	(MPN/cm^3)	(mg/l)
Influent	200	180	-	-	-
Effluent	20	30	-	3,000	5

1-5 Process Flow Diagram

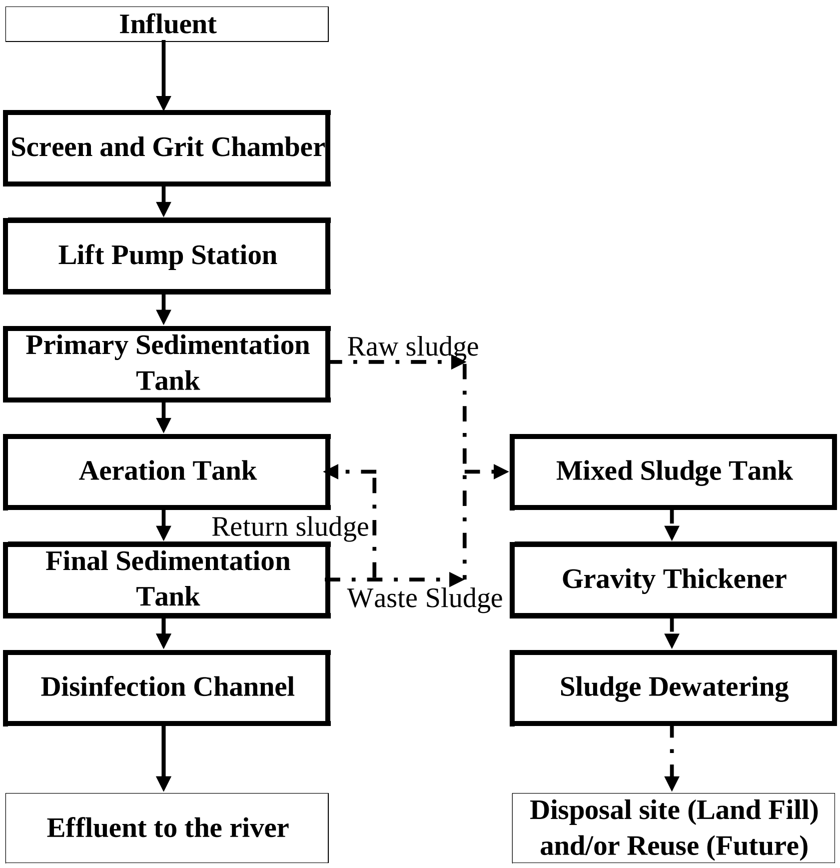


Table I.4 Design Calculation of W2 WWTP (3/11)

1.6 Design Criteria

	ITEMS	UNIT	Formula or Value	Application
1	Grit Chamber (For Maximum Hourly Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	1,800	1,800
(2)	Average Velocity	m/sec	0.3	0.3
2	Primary Sedimentation Tank (For Maximum Daily Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	35.0-70.0	50
(2)	Settling Time (Ref.)	hour	1.5	1.5
(3)	Water Depth	m	2.5-4.0	3.5
(4)	Weir Loading	$m^3/m/day$	250	250
3	Aeration Tank (For Maximum Daily Flow)			
(1)	Hydraulic Retention Time (HRT)	hour	6 - 8	6.0
(2)	MLSS Concentration	mg/l	1,500 -2,000	2,000
(3)	BOD-SS Load (Reference only)	kg/kg/day	0.2 - 0.4	-
4	Final Sedimentation Tank (For Maximum Daily Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	20.0-30.0	25
(2)	Settling Time (Ref.)	hour	3.0-4.0	-
(3)	Water Depth	m	2.5-4.0	3.5
(4)	Weir Loading	$m^3/m/day$	150	150
5	Disinfection Tank (For Maximum Daily Flow)			
(1)	Retention (Chlorination) Time	min	15	15
6	Gravity Thickener (For Maximum Daily Flow)			
(1)	Solids Loading	$kg/m^2/day$	60-90	75
(2)	Water Depth	m		4.0

Table I.4 Design Calculation of W2 WWTP (4/11)

2 CAPACITY CALCULATION

2-1 Grit Chamber

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			189,000
(Maximum Hourly Flow)	Q2	m^3/sec			2.188
Water Surface Load	WSL	m^3/m^2/day			1,800
Required Surface Area	RSA	m^2	Q1/WSL		105.00
Basin Number	BN	basin			4
Average Velocity	AV	m/sec			0.3
Depth	H	m			0.8
Width	W1	m	Q2/(AV×H×BN)		2.28
Therefore	W2	m			2.5
Length	L1	m	RSA/(W2×BN)		10.50
Therefore	L2	m			11.0
Dimension (Width)	W	m			**2.5**
(Depth)	L	m	L2		**11.0**
(Length)	H	m	H		**0.8**
(Basin Number)	N	basin			**4**
(Check)					
Water Surface Load		m^3/m^2/day	Q1/(W×L×N)		1,718
Average Velocity		m/sec	Q2/(W×H×N)		0.273

2-2 Lift Pump Station

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Vertical shaft Volute type mixed flow pump		
Design Sewage Flow	Q1	m^3/min	Peak Flow		131.25
Pump Unit -1 Number	UN1	unit			2
Discharge per Unit	DU1	m^3/min	1/10×Q1/UN1		13.13
Pump Diameter(V=1.5~3.0m/s	D1	mm	$146\times(DU1/1.5\sim3.0)^{0.5}$		305 ～432
Therefore	D1	mm			350
Pump Unit -2 Number	UN2	unit			2
Discharge per Unit	DU2	m^3/min	2/10×Q1/UN2		26.25
Pump Diameter(V=1.5~3.0m/s	D2	mm	$146\times(DU2/1.5\sim3.0)^{0.5}$		432 ～611
Therefore	D2	mm			500
Pump Unit -3 Number	UN3	unit	including 1 stand-by		2
Discharge per Unit	DU3	m^3/min	4/10×Q1/UN3		52.50
Pump Diameter(V=1.5~3.0m/s	D3	mm	$146\times(DU3/1.5\sim3.0)^{0.5}$		611 ～864
Therefore	D3	mm			700

Table I.4 Design Calculation of W2 WWTP (5/11)

2-3 Primary Sedimentation Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			126,000
(Maximum Daily Flow)	Q2	m^3/hr			5,250.0
Basin Number	BN	basin			16
Hydraulic Load	HL	m^3/m^2/day			50.0
Required Surface Area	A1	m^2	Q1/HL		2,520
	A2	m^2/basin	A1/BN		158
Width	W1	m	3.0m~4.0m, Max5.0m		5.0
Length	L1	m	A2/W1		31.50
Therefore	L2	m			32.0
Water Depth	WD	m			3.5
Overflow Weir Load	OWL	m^3/m/day			250
Required Weir Length	WL1	m/basin	Q1/(BN×OWL)		31.50
Therefore	WL2	m/basin			32.0
Dimension (Width)	W	m			**5.0**
(Depth)	D	m			**3.5**
(Length)	L	m			**32.0**
(Basin Number)	N	basin			**16**
(Check)					
Hydraulic Load	HL	m^3/m^2/day	Q1/(N×W×L)		49.22
Retention(Settling) Time	T	hour	(N×W×D×L)/Q2		1.71
Overflow Weir Load	OWL	m^3/m/day	Q1/(N×WL2)		246.09

Table I.4 Design Calculation of W2 WWTP (6/11)

2-4 Aeration Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Multi-tank Complete mixing Type		
Design Sewage Flow	Q1	m^3/day			126,000
(Maximum Daily Flow)	Q2	m^3/hr			5,250.0
Hydraulic Retention Time	HRT	hr			6.0
Basin Number	BN	basin			8
Required Volume per basin	RV	m^3/basin	Q2×RT/BN		3,938
Width	W	m	1~2H		10.5
Water Depth	H	m	4.0m~6.0m		6.0
Length	L1	m	RV/(W×H)		62.5
Therefore	L2	m			63.0
Dimension (Width)	W	m			**10.5**
(Depth)	H	m			**6.0**
(Length)	L	m			**63.0**
(Basin Number)	N	basin			**8**
(Check)					
Hydraulic Retention Time	HRT	hour	W×H×L×N/Q2		6.0
BOD-SS load	BSS_L	kgBOD/kgSS/d	(Q1×BODin)/(W×H×L×N×Xa)		0.24
BOD_{in} : Inflow BOD Concentration			120 mg/L	(Removal Rate in PST : 40%)	
Xa : MLSS Concentration			2,000 mg/L		
Aerobic Sludge Retention Tim	ASRT	day	HRT/24×Xa / (a×S-BODin + b×SSin - c×HRT/24×Xa) =		4.785
$S\text{-}BOD_{in}$: Inflow S-BOD Concentration			80 mg/L	(S-BOD[Solved BOD]=BODin×0.6	
SS_{in} : Inflow SS Concentration			90 mg/L	(Removal Rate in PST : 50%)	
a : Sludge converting ratio of solved BO			0.5 mgMLSS/mgBOD	(0.4~0.6)	
b : Sludge converting ratio of SS			0.95 mgMLSS/mgSS	(0.9~1.0)	
c : Sludge reduction ratio caused by endogenous respiration			0.04	(1/day)(0.03~0.05)	
Effluent Quality (C-BOD)	EQ	mg/L	10.42×A-SRT$^{(-0.519)}$ (15~20℃)		4.624
Water Temperature			20 ℃		
Effluent Water Quality (C=BOD Maximum)			EQ×3 20mg/l >		14
					-OK-
			1 : 1.5 : 1.5 : 2.25		
Partition of Aeration Tank			No.1 | No.2 | No.3 | No.4		
Total Length of Tank	TL	m			63.0
No.1 Tank Length	L1	m	TL×1/(1+1.5+1.5+2.25)		10.1
No.2 Tank Length	L2	m	TL×1.5/(1+1.5+1.5+2.25)		15.1
No.3 Tank Length	L3	m	TL×1.5/(1+1.5+1.5+2.25)		15.1
No.4 Tank Length	L4	m	TL×2.25/(1+1.5+1.5+2.25)		22.7
			Total		**63.0**

Table I.4 Design Calculation of W2 WWTP (7/11)

2-5 Final Sedimentation Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			126,000
(Maximum Daily Flow)	Q2	m^3/hr			5,250.0
Basin Number	BN	basin			16
Hydraulic Load	HL	m^3/m^2/day			25.0
Required Surface Area	A1	m^2	Q1/HL		5,040
	A2	m^2/basin	A1/BN		315
Width	W1	m	3.0m~4.0m, Max5.0m		5.0
Length	L1	m	A2/W1		63.00
Therefore	L2	m			63.0
Water Depth	WD	m			3.5
Overflow Weir Load	OWL	m^3/m/day			150
Required Weir Length	WL1	m/basin	Q1/(BN×OWL)		52.50
Therefore	WL2	m/basin			53.0
Dimension (Width)	W	m			**5.0**
(Depth)	D	m			**3.5**
(Length)	L	m			**63.0**
(Basin Number)	N	basin			**16**
(Check)					
Hydraulic Load	HL	m^3/m^2/day	Q1/(N×W×L)		25.00
Retention(Settling) Time	T	hour	(N×W×D×L)/Q2		3.36
Overflow Weir Load	OWL	m^3/m/day	Q1/(N×WL2)		148.58

Table I.4 Design Calculation of W2 WWTP (8/11)

2-6 Disinfection Channel

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Chlorination		
Design Sewage Flow	Q1	m^3/day			126,000
(Maximum Daily Flow)	Q2	m^3/min			87.5
Retention(Chlorination) Time	RT	min			15.0
Required Volume	RV	m^3	Q2×RT		1,313
Width of channel	W	m			2.0
Depth of channel	H	m			2.5
Pass Number	PN	pass			8
Length of channel	L1	m/pass	RV/(W×H×PN)		32.8
Therefore	L2	m/pass			33.0
Dimension (Width)	W	m			**2.0**
(Depth)	H	m			**2.5**
(Length)	L	m/pass			**33.0**
(Pass Number)	N	pass			**8**
(Check)					
Retention(Chlorination) Time	RT	min	(W×H×L×PN)/Q2		15.1

2-7 Sludge Thickening Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Gravity Thickener (Radial Flow Circular Type)		
Generated Sludge Solids	GS	t-DS/day	Refer to Mass Balance Cal.		23.487
Generated Sludge Volume	GSV	m^3/day	Refer to Mass Balance Cal.		2,958
Solid Matter Load	SML	kg/m^2/day			75
Required Surface Area	SA	m^2	$(GS\times10^3)/SML$		313.2
Water Depth	H	m			4.0
Basin Number	BN	basin			4
Required Tank Diameter	TD1	m	$(SA\times4/(3.14\times BN))^{0.5}$		9.99
Therefore	TD2	m			10.0
Dimension (Diameter)	D	m/basin			**10.0**
(Depth)	H	m			**4.0**
(Basin Number)	BN	basin			**4**
(Check)					
Solid Matter Load	SML	kg/m^2/day	$GS\times10^3/(3.14\times D^2/4)\times BN$		74.8
Sludge Thickened Time	T	hr	$(3.14\times D^2/4)\times H\times BN\times24/GSV$		10.2

Table I.4 Design Calculation of W2 WWTP (9/11)

2-8 Sludge Dewatering

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Mechanical Dewatering (Screw Press Type)		
Thickened Sludge Solids	TS	t-DS/day	Refer to Material Balance		21.349
Unit Number	UN	Unit			4
Operating Time	OT	hr/day			24.0
Required Dewatering Capacity	DC	kg/hr/unit	$TS \times 10^3/(OT \times UN)$		222.4
Solids Loading	Q_{100}	kg-ds/hr/φ100			3.0
Screnn Diameter	SD1	mm	$100 \times (DC/Q_{100})$^(1/2.2)		707.9
Therefore	SD2	mm			800
Dimension (unit)	UN	Unit			**4**
(Screen Diameter)	SD	mm			**800**
(Check)					
Dewatering Capacity	DC	kg/hr/unit	(SD/100)^2.2×Q_{100}		291.0
Operating Time	OT	hour/day	$TS \times 10^3/(DC \times (UN-1))$		18.3

Table I.4 Design Calculation of W2 WWTP (10/11)

Material Balance Calculation (Primary and Secondary Sedimentation Tank + Thickening Tank + Mechanical Dewatering)

Table-1 Input Data

1. Calculation Manner		1	1:Premise that the quality of supernatants are same level removed with inlet sewage 2:Premise that the entire supernatants are removed at treatment process
2. Selection of Treatment Efficiency		1	1:Total Removal Ratio 2:Outlet Water Quality(input 1or2)
In case of 1 : input data		90	(%)
In case of 2 : input data			(mg/l)
3. Excess Sludge Generation		1	1:Consideration of Solid Matter Only 2:Consideration of Converting of Solved BOD (input 1or2)
In case of 1:Input data (Sludge generation)		100	Sludge generation ratio per removal SS(%)
In case of 2:Input data	a		T2=Q2・S2=(a・S_{BOD}+b・S1-c・θ・XA)・Q1/10^6・・(Excess sludge generation formula)
	b		a:Converting ratio of solved BOD(mgMLSS/mgBOD)
	c		b:Converting ratio of SS(mgMLSS/mgSS)
	SBOD		c:Sludge reduction ratio caused by endogenous respiration of activated sludge(1/day)
	XA		S_{BOD}:Solved BOD quality at inlet to reactor
	θ		XA:MLSS concentration(mg/l)
			θ:Hydraulic retention time(day)

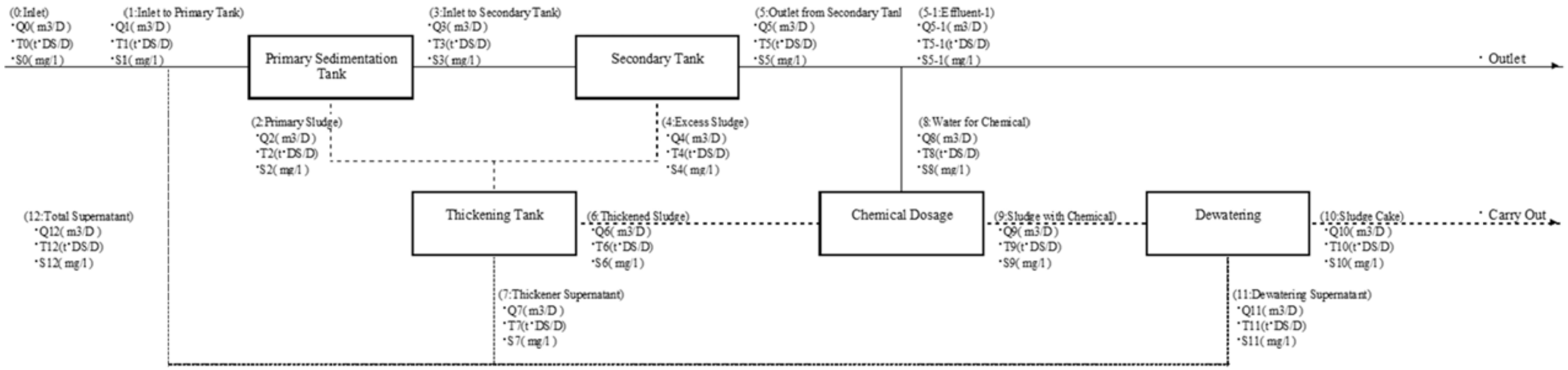
Table-2 Basic Conditions

Water Flow and Quality		Sludge Moisture and Recovery Ratio				Chemical Conditions for Dewatering			
・Inlet flow : Q0(m3/D)	126000	・Primary sludge moisture ratio : W1(%)	98.5	・Removal ratio in primary tank : A2(%)	50.0	・Chemical dosage : A5(%)	1.0		
・Inlet quality : S0(mg/l)	180	・Excess sludge moisture ratio : W2(%)	99.5	・Recoveryratio in sludge thickener : A3(%)	90.0	・Chemical dissolve concentration : A6(%)	0.2		
・Total removal ratio : A1(%)	90.0	・Thickened sludge moisture ratio : W3(%)	98.0	・Recoveryratio in dewatering : A4(%)	95.0				
・Effluent quality: St(mg/l)	-	・Dewatered sludge moisture ratio : W4(%)	80.0						
・Sludge generation ratio per removal SS : Si(%)	100.0								

Table-3 Material Balance Calculation

	0	1	2	3	4	5	6	7	8	9	10	11	12			5-1		
Q(m3/day)	126,000	128,962	870	128,092	2,088	126,004	1,057	1,901	106	1,163	101	1,061	2,962			125,899		
T(t・DS/day)	22,680	26,096	13,048	13,048	10,438	2,610	21,138	2,349	0,211	21,349	20,282	1,067	3,416			2,398		
S(mg/l)	180	202	15,000	102	5,000	21	20,000	1,236	2,000	18,364	200,000	1,006	1,153			21		
X(Ti/T0*100)	100	115.1	57.5	57.5	46.0	11.5	93.2	10.4	0.9	94.1	89.4	4.7	15.1			10.6		

Figure-1 Material Balance Model



Calculation Formula

・Q0=Input Data ・T0=Q0*S0*10^(-6) ・S0=Input Data	・Q3=Q1-Q2 ・T3=T1*(100-A2)/100 ・S3=T3*10^6/Q3	・Q6=T4*100/(100-W3) ・T6=(T2+T4)*A3/100 ・S6=10^6*(100-W3)/100	・Q9=Q6+Q8 ・T9=T6+T8 ・S9=T9*10^6/Q9	・Q12=Q7+Q11 ・T12=T7+T11 ・S11=T11*10^6/Q11	・Q5-1=Q5-Q8 ・T5-1=T5-T8 ・S5-1=S5
・Q1=Q0+Q13 ・T1=T0+T13 ・S1=T1*10^6/Q1	・Q4=T4*100/(100-W2) ・T4={(T1-T5)*Si/100}-T2 ・S4=10^6*(100-W2)/100	・Q7=(Q2+Q4)-Q6 ・T7=(T2+T4)-T6 ・S7=T7*10^6/Q7	・Q10=T10*100/(100-W4) ・T10=T9*A4/100 ・S10=10^6*(100-W4)/100		
・Q2=T2*100/(100-W1) ・T2=T1-T3 ・S2=10^6*(100-W1)/100	・Q5=Q3-Q4*(T3-T5)/T4 ・T5=T1*(100-A1)/100 ・S5=T5*10^6/Q5	・Q8=T6*A5/A6 ・T8=Q8*S8/10^6 ・S8=10^4*A6	・Q11=Q9-Q10 ・T11=T9-T10 ・S11=T11*10^6/Q11		

Table I.4 Design Calculation of W2 WWTP (11/11)

Material Balance Sheet

0:Inlet	
Q0(m3/D)	126,000
T0(t･DS/D)	22.680
S0(mg/l)	180

1:Inlet to Primary Tank	
Q1(m3/D)	128,962
T1(t･DS/D)	26.096
S1(mg/l)	202
X1 (%)	115.1

Primary Sedimentation Tank
(SS Removal : %)

3:Inlet to Secondary Tank	
Q3(m3/D)	128,092
T3(t･DS/D)	13.048
S3(mg/l)	102
X3 (%)	57.5

Secondary Tank

5:Outlet from Secondary Tank	
Q5(m3/D)	126,004
T5(t･DS/D)	2.610
S5(mg/l)	21
X5 (%)	11.5

5-1:Effluent-1	
Q5-1(m3/D)	125,899
T5-1(t･DS/D)	2.398
S5-1(mg/l)	21
X5-1 (%)	10.6

・Outlet

2:Primary Sludge	
Q2(m3/D)	870
T2(t･DS/D)	13.048
S2(mg/l)	15,000
X2 (%)	57.5

4:Excess Sludge	
Q4(m3/D)	2,088
T4(t･DS/D)	10.438
S4(mg/l)	5,000
X4 (%)	46.0

8:Water for Chemical	
Q8(m3/D)	106
T8(t･DS/D)	0.211
S8(mg/l)	2,000
X8 (%)	0.9

12:Total Supernatants	
Q12(m3/D)	2,962
T12(t･DS/D)	3.416
S12(mg/l)	1,153
X12 (%)	15.1

* Sludge to Thickener	
Q(m3/D)	2,958
T(t･DS/D)	23.487
S(mg/l)	7,941

Thickening Tank
(SS Recovery : %)

Chemical Dosage

Dewatering
(SS Recovery : %)

・Carry Out

6:Thickened Sludge	
Q6(m3/D)	1,057
T6(t･DS/D)	21.138
S6(mg/l)	20,000
X6 (%)	93.2

9:Sludge with Chemical	
Q9(m3/D)	1,163
T9(t･DS/D)	21.349
S9(mg/l)	18,364
X9 (%)	94.1

10:Sludge Cake	
Q10(m3/D)	101
T10(t･DS/D)	20.282
S10(mg/l)	200,000
X10 (%)	89.4

7:Thickener Supernatant	
Q7(m3/D)	1,901
T7(t･DS/D)	2.349
S7(mg/l)	1,236
X7 (%)	10.4

11:Dewatering Supernatant	
Q11(m3/D)	1,061
T11(t･DS/D)	1.067
S11(mg/l)	1,006
X11 (%)	4.7

LEGEND
Q : Water Flow : (m3/day)
T : Solid Matter : (t･DS/day)
S : Solid Concentration : (mg/l)
X : Ratio for Inlet Solid : (%)

・ Water
・ Sludge
・ Supernatant

Table I.5 Design Calculation of E3 WWTP (1/11)

1 BASIC CONDITIONS

1-1 Basic Items

(1) Name : **E3 WWTP**

(2) Land Area : Approximately xxxx ha

(3) Ground Level (Elevatio : + 6.90 m (Plan)

(4) Inlet Pipe Invert Level : - 10.82 m

(5) Pipe Diameter : 2,400 mm

(6) Land Use : ―

(7) Collection System : ~~Combined System~~ Separate System

(8) Treatment Process : Conventional Activated Sludge Process

(9) Effluent Point : Ngamoeyeik Creek

(10) Water Level at the Effluent Poir :
High water leve = 3.70 m
Low water leve = ― m

(11) Target Year : 2020 (F/S Stage)
2040 (M/P Stage)

1-2 Service Area and Design Population

(1) Service Area : 5,418 ha

(2) Design Population

Item		Year 2020	Year 2040
Design Population	person	-	921,000

Table I.5 Design Calculation of E3 WWTP (2/11)

1-3 Design Sewage Flow

(Year 2020)

Item	m^3/day	m^3/hr	m^3/min	m^3/sec
Maximum Daily Flow		0.0	0.00	0.000
Maximum Hourly Flow	0	0.0	0.00	0.000

(Year 2040)

Item	m^3/day	m^3/hr	m^3/min	m^3/sec
Maximum Daily Flow	264,000	11,000.0	183.33	3.056
Maximum Hourly Flow	396,000	16,500.0	275.00	4.583

1-4 Design Sewage Quality

Item	BOD	SS	T-N	Coli-group	Oil&Greese
	(mg/l)	(mg/l)	(mg/l)	(MPN/cm^3)	(mg/l)
Influent	200	180	-	-	-
Effluent	20	30	-	3,000	5

1-5 Process Flow Diagram

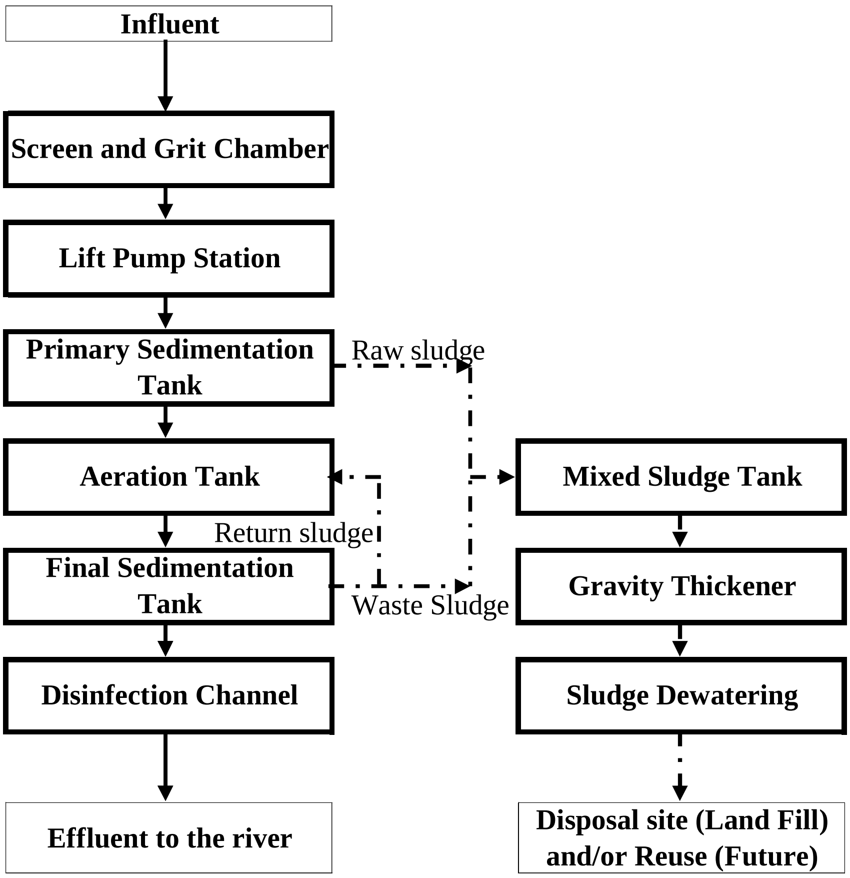


Table I.5 Design Calculation of E3 WWTP (3/11)

1.6 Design Criteria

	ITEMS	UNIT	Formula or Value	Application
1	Grit Chamber (For Maximum Hourly Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	1,800	1,800
(2)	Average Velocity	m/sec	0.3	0.3
2	Primary Sedimentation Tank (For Maximum Daily Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	35.0-70.0	50
(2)	Settling Time (Ref.)	hour	1.5	1.5
(3)	Water Depth	m	2.5-4.0	3.5
(4)	Weir Loading	$m^3/m/day$	250	250
3	Aeration Tank (For Maximum Daily Flow)			
(1)	Hydraulic Retention Time (HRT)	hour	6 - 8	6.0
(2)	MLSS Concentration	mg/l	1,500 -2,000	2,000
(3)	BOD-SS Load (Reference only)	kg/kg/day	0.2 - 0.4	-
4	Final Sedimentation Tank (For Maximum Daily Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	20.0-30.0	25
(2)	Settling Time (Ref.)	hour	3.0-4.0	-
(3)	Water Depth	m	2.5-4.0	3.5
(4)	Weir Loading	$m^3/m/day$	150	150
5	Disinfection Tank (For Maximum Daily Flow)			
(1)	Retention (Chlorination) Time	min	15	15
6	Gravity Thickener (For Maximum Daily Flow)			
(1)	Solids Loading	$kg/m^2/day$	60-90	75
(2)	Water Depth	m		4.0

Table I.5 Design Calculation of E3 WWTP (4/11)

2 CAPACITY CALCULATION

2-1 Grit Chamber

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			396,000
(Maximum Hourly Flow)	Q2	m^3/sec			4.583
Water Surface Load	WSL	m^3/m^2/day			1,800
Required Surface Area	RSA	m^2	Q1/WSL		220.00
Basin Number	BN	basin			4
Average Velocity	AV	m/sec			0.3
Depth	H	m			1
Width	W1	m	Q2/(AV×H×BN)		3.82
Therefore	W2	m			4.0
Length	L1	m	RSA/(W2×BN)		13.75
Therefore	L2	m			14.0
Dimension (Width)	W	m			**4.0**
(Length)	L	m	L2		**14.0**
(Depth)	H	m	H		**1.0**
(Basin Number)	N	basin			**4**
(Check)					
Water Surface Load		m^3/m^2/day	Q1/(W×L×N)		1,768
Average Velocity		m/sec	Q2/(W×H×N)		0.286

2-2 Lift Pump Station

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Vertical shaft Volute type mixed flow pump		
Design Sewage Flow	Q1	m^3/min	Peak Flow		275.00
Pump Unit -1 Number	UN1	unit			2
Discharge per Unit	DU1	m^3/min	1/10×Q1		27.50
Pump Diameter(V=1.5~3.0m/s	D1	mm	$146×(DU1/1.5〜3.0)^{0.5}$		442 ～625
Therefore	D1	mm			500
Pump Unit -2 Number	UN2	unit			2
Discharge per Unit	DU2	m^3/min	2/10×Q1		55.00
Pump Diameter(V=1.5~3.0m/s	D2	mm	$146×(DU2/1.5〜3.0)^{0.5}$		625 ～884
Therefore	D2	mm			700
Pump Unit -3 Number	UN3	unit	including 1 stand-by		2
Discharge per Unit	DU3	m^3/min	4/10×Q1		110.00
Pump Diameter(V=1.5~3.0m/s	D3	mm	$146×(DU3/1.5〜3.0)^{0.5}$		884 #####
Therefore	D3	mm			1000

Table I.5 Design Calculation of E3 WWTP (5/11)

2-3 Primary Sedimentation Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			264,000
(Maximum Daily Flow)	Q2	m^3/hr			11,000.0
Basin Number	BN	basin			16
Hydraulic Load	HL	m^3/m^2/day			50.0
Required Surface Area	A1	m^2	Q1/HL		5,280
	A2	m^2/basin	A1/BN		330
Width	W1	m	3.0m~4.0m, Max5.0m		5.0
Length	L1	m	A2/W1		66.00
Therefore	L2	m			66.0
Water Depth	WD	m			3.5
Overflow Weir Load	OWL	m^3/m/day			250
Required Weir Length	WL1	m/basin	Q1/(BN×OWL)		66.00
Therefore	WL2	m/basin			66.0
Dimension (Width)	W	m			**5.0**
(Depth)	D	m			**3.5**
(Length)	L	m	Two-story Sedimentation Tan		**66.0**
			Upper Tank		**26.4**
			Lower Tank		**39.6**
(Basin Number)	N	basin			**16**
(Check)					
Hydraulic Load	HL	m^3/m^2/day	Q1/(N×W×L)		50.00
Retention(Settling) Time	T	hour	(N×W×D×L)/Q2		1.68
Overflow Weir Load	OWL	m^3/m/day	Q1/(N×WL2)		250.00

Table I.5 Design Calculation of E3 WWTP (6/11)

2-4 Aeration Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Multi-tank Complete mixing Type		
Design Sewage Flow	Q1	m^3/day			264,000
(Maximum Daily Flow)	Q2	m^3/hr			11,000.0
Hydraulic Retention Time	HRT	hr			6.0
Basin Number	BN	basin			8
Required Volume per basin	RV	m^3/basin	Q2×RT/BN		8,250
Width	W	m	1~2H		10.5
Water Depth	H	m	Deep Aeration Tank		10.0
Length	L1	m	RV/(W×H)		78.6
Therefore	L2	m			78.0
Dimension (Width)	W	m			**10.5**
(Depth)	H	m			**10.0**
(Length)	L	m			**78.0**
(Basin Number)	N	basin			**8**
(Check)					
Hydraulic Retention Time	HRT	hour	W×H×L×N/Q2		6.0
BOD-SS load	BSS_L	kgBOD/kgSS/d	(Q1×BODin)/(W×H×L×N×Xa)		0.24
BOD_{in} : Inflow BOD Concentration			120 mg/L	(Removal Rate in PST : 40%)	
Xa : MLSS Concentration			2,000 mg/L		
Aerobic Sludge Retention Tim	ASRT	day	HRT/24×Xa / (a×S-BODin + b×SSin - c×HRT/24×Xa) =		4.698
$S\text{-}BOD_{in}$: Inflow S-BOD Concentration			80 mg/L	(S-BOD[Solved BOD]=BODin×0.6	
SS_{in} : Inflow SS Concentration			90 mg/L	(Removal Rate in PST : 50%)	
a : Sludge converting ratio of solved BO			0.5 mgMLSS/mgBOD	(0.4~0.6)	
b : Sludge converting ratio of SS			0.95 mgMLSS/mgSS	(0.9~1.0)	
c : Sludge reduction ratio caused by endogenous respiration			0.04	(1/day)(0.03~0.05)	
Effluent Quality (C-BOD)	EQ	mg/L	$10.42 \times A\text{-}SRT^{(-0.519)}$ (15~20℃)		4.668
Water Temperature			20 ℃		
Effluent Water Quality (C=BOD Maximum)			EQ×3	20mg/l >	14
					-OK-
			1 : 1.5 : 1.5 : 2.25		
Partition of Aeration Tank			No.1 | No.2 | No.3 | No.4		
Total Length of Tank	TL	m			78.0
No.1 Tank Length	L1	m	TL×1/(1+1.5+1.5+2.25)		12.5
No.2 Tank Length	L2	m	TL×1.5/(1+1.5+1.5+2.25)		18.7
No.3 Tank Length	L3	m	TL×1.5/(1+1.5+1.5+2.25)		18.7
No.4 Tank Length	L4	m	TL×2.25/(1+1.5+1.5+2.25)		28.1
			Total		**78.0**

Table I.5 Design Calculation of E3 WWTP (7/11)

2-5 Final Sedimentation Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			264,000
(Maximum Daily Flow)	Q2	m^3/hr			11,000.0
Basin Number	BN	basin			16
Hydraulic Load	HL	m^3/m^2/day			25.0
Required Surface Area	A1	m^2	Q1/HL		10,560
	A2	m^2/basin	A1/BN		660
Width	W1	m	3.0m~4.0m, Max5.0m		5.0
Length	L1	m	A2/W1		132.00
Therefore	L2	m			132.0
Water Depth	WD	m			3.5
Overflow Weir Load	OWL	m^3/m/day			150
Required Weir Length	WL1	m/basin	Q1/(BN×OWL)		110.00
Therefore	WL2	m/basin			110.0
Dimension (Width)	W	m			**5.0**
(Depth)	D	m			**3.5**
(Length)	L	m	Two-story Sedimentation Tan		**132.0**
			Upper Tank		**52.8**
			Lower Tank		**79.2**
(Basin Number)	N	basin			**16**
(Check)					
Hydraulic Load	HL	m^3/m^2/day	Q1/(N×W×L)		25.00
Retention(Settling) Time	T	hour	(N×W×D×L)/Q2		3.36
Overflow Weir Load	OWL	m^3/m/day	Q1/(N×WL2)		150.00

Table I.5 Design Calculation of E3 WWTP (8/11)

2-6 Disinfection Channel

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Chlorination		
Design Sewage Flow	Q1	m^3/day			264,000
(Maximum Daily Flow)	Q2	m^3/min			183.3
Retention(Chlorination) Time	RT	min			15.0
Required Volume	RV	m^3	Q2×RT		2,750
Width of channel	W	m			3.0
Depth of channel	H	m			3.0
Pass Number	PN	pass			8
Length of channel	L1	m/pass	RV/(W×H×PN)		38.2
Therefore	L2	m/pass			38.5
Dimension (Width)	W	m			**3.0**
(Depth)	H	m			**3.0**
(Length)	L	m/pass			**38.5**
(Pass Number)	N	pass			**8**
(Check)					
Retention(Chlorination) Time	RT	min	(W×H×L×PN)/Q2		15.1

2-7 Sludge Thickening Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Gravity Thickener (Radial Flow Circular Type)		
Generated Sludge Solids	GS	t-DS/day	Refer to Mass Balance Cal.		49.21
Generated Sludge Volume	GSV	m^3/day	Refer to Mass Balance Cal.		6,197
Solid Matter Load	SML	kg/m^2/day			75
Required Surface Area	SA	m^2	$(GS\times10^3)/SML$		656.1
Water Depth	H	m			4.0
Basin Number	BN	basin			4
Required Tank Diameter	TD1	m	$(SA\times4/(3.14\times BN))^{0.5}$		14.46
Therefore	TD2	m			15.0
Dimension (Diameter)	D	m/basin			**15.0**
(Depth)	H	m			**4.0**
(Basin Number)	BN	basin			**4**
(Check)					
Solid Matter Load	SML	kg/m^2/day	$GS\times10^3/(3.14\times D^2/4)\times BN$		69.7
Sludge Thickened Time	T	hr	$(3.14\times D^2/4)\times H\times BN\times24/GSV$		10.9

Table I.5 Design Calculation of E3 WWTP (9/11)

2-8 Sludge Dewatering

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Mechanical Dewatering (Screw Press Type)		
Thickened Sludge Solids	TS	t-DS/day	Refer to Material Balance		44.732
Unit Number	UN	Unit			8
Operating Time	OT	hr/day			24.0
Required Dewatering Capacity	DC	kg/hr/unit	$TS\times10^3/(OT\times UN)$		233.0
Solids Loading	Q_{100}	kg-ds/hr/φ100			3.0
Screen Diameter	SD1	mm	$100\times(DC/Q_{100})$^(1/2.2)		723.1
Therefore	SD2	mm			800
Dimension (unit)	UN	Unit			**8**
(Screen Diameter)	SD	mm			**800**
(Check)					
Dewatering Capacity	DC	kg/hr/unit	(SD/100)^2.2×Q_{100}		291.0
Operating Time	OT	hour/day	$TS\times10^3/(DC\times(UN-1))$		19.2

Table I.5 Design Calculation of E3 WWTP (10/11)

Material Balance Calculation (Primary and Secondary Sedimentation Tank + Thickening Tank + Mechanical Dewatering)

Table-1 Input Data

1. Calculation Manner		1	1:Premise that the quality of supernatants are same level removed with inlet sewage
			2:Premise that the entire supernatants are removed at treatment process
2. Selection of Treatment Efficiency		1	1:Total Removal Ratio 2:Outlet Water Quality(input 1or2)
In case of 1 : input data		90	(%)
In case of 2 : input data			(mg/l)
3. Excess Sludge Generation		1	1:Consideration of Solid Matter Only 2:Consideration of Converting of Solved BOD (input 1or2)
In case of 1:Input data (Sludge generation)		100	Sludge generation ratio per removal SS(%)
In case of 2:Input data	a		T2=Q2･S2=(a･S_{BOD}+b･S1-c･θ･XA)･Q1/10^6･･(Excess sludge generation formula)
	b		a:Converting ratio of solved BOD(mgMLSS/mgBOD)
	c		b:Converting ratio of SS(mgMLSS/mgSS)
	SBOD		c:Sludge reduction ratio caused by endogenous respiration of activated sludge(1/day)
	XA		S_{BOD}:Solved BOD quality at inlet to reactor
	θ		XA:MLSS concentration(mg/l)
			θ:Hydraulic retention time(day)

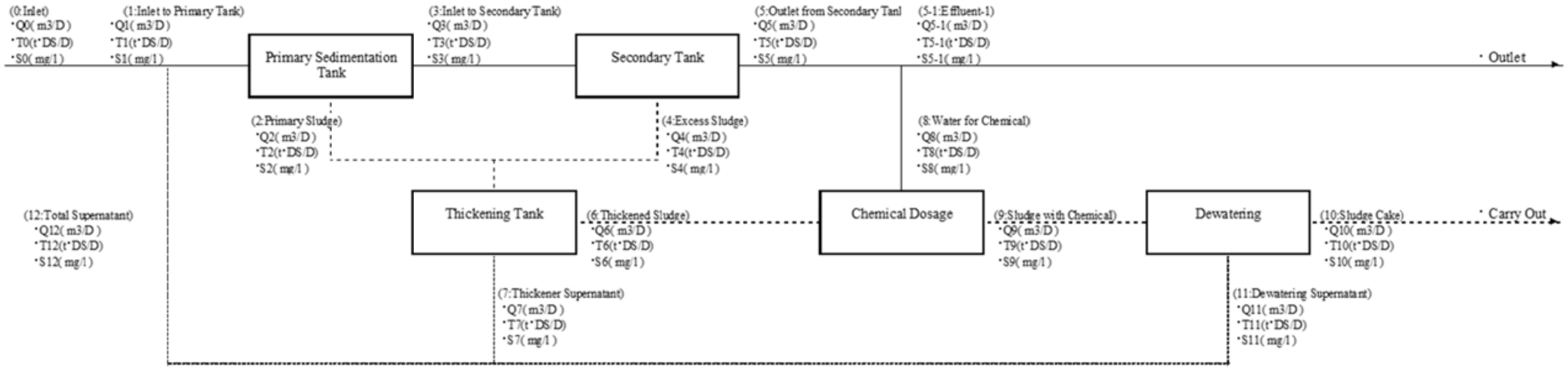
Table-2 Basic Conditions

Water Flow and Quality		Sludge Moisture and Recovery Ratio				Chemical Conditions for Dewatering		
･Inlet flow : Q0(m3/D)	264000	･Primary sludge moisture ratio : W1(%)	98.5	･Removal ratio in primary tank : A2(%)	50.0	･Chemical dosage : A5(%)	1.0	
･Inlet quality : S0(mg/l)	180	･Excess sludge moisture ratio : W2(%)	99.5	･Recoveryratio in sludge thickener : A3(%)	90.0	･Chemical dissolve concentration : A6(%)	0.2	
･Total removal ratio : A1(%)	90.0	･Thickened sludge moisture ratio : W3(%)	98.0	･Recoveryratio in dewatering : A4(%)	95.0			
･Effluent quality: St(mg/l)	-	･Dewatered sludge moisture ratio : W4(%)	80.0					
･Sludge generation ratio per removal SS : Si(%)	100.0							

Table-3 Material Balance Calculation

	0	1	2	3	4	5	6	7	8	9	10	11	12			5-1		
Q(m3/day)	264,000	270,206	1,823	268,383	4,374	264,009	2,214	3,982	221	2,436	212	2,223	6,206			263,788		
T(t･DS/day)	47.520	54.678	27.339	27.339	21.871	5.468	44.289	4.921	0.443	44.732	42.495	2.237	7.158			5.025		
S(mg/l)	180	202	15,000	102	5,000	21	20,000	1,236	2,000	18,364	200,000	1,006	1,153			21		
X(Ti/T0*100)	100	115.1	57.5	57.5	46.0	11.5	93.2	10.4	0.9	94.1	89.4	4.7	15.1			10.6		

Figure-1 Material Balance Model



Calculation Formula

･Q0=Input Data ･T0=Q0*S0*10^(-6) ･S0=Input Data	･Q3=Q1-Q2 ･T3=T1*(100-A2)/100 ･S3=T3*10^6/Q3	･Q6=T4*100/(100-W3) ･T6=(T2+T4)*A3/100 ･S6=10^6*(100-W3)/100	･Q9=Q6+Q8 ･T9=T6+T8 ･S9=T9*10^6/Q9	･Q12=Q7+Q11 ･T12=T7+T11 ･S11=T11*10^6/Q11	･Q5-1=Q5-Q8 ･T5-1=T5-T8 ･S5-1=S5
･Q1=Q0+Q13 ･T1=T0+T13 ･S1=T1*10^6/Q1	･Q4=T4*100/(100-W2) ･T4={(T1-T5)*Si/100}-T2 ･S4=10^6*(100-W2)/100	･Q7=(Q2+Q4)-Q6 ･T7=(T2+T4)-T6 ･S7=T7*10^6/Q7	･Q10=T10*100/(100-W4) ･T10=T9*A4/100 ･S10=10^6*(100-W4)/100		
･Q2=T2*100/(100-W1) ･T2=T1-T3 ･S2=10^6*(100-W1)/100	･Q5=Q3-Q4*(T3-T5)/T4 ･T5=T1*(100-A1)/100 ･S5=T5*10^6/Q5	･Q8=T6*A5/A6 ･T8=Q8*S8/10^6 ･S8=10^4*A6	･Q11=Q9-Q10 ･T11=T9-T10 ･S11=T11*10^6/Q11		

Table I.5 Design Calculation of E3 WWTP (10/11)

Material Balance Sheet

0:Inlet	
Q0(m3/D)	264,000
T0(t･DS/D)	47.520
S0(mg/l)	180

1:Inlet to Primary Tank	
Q1(m3/D)	270,206
T1(t･DS/D)	54.678
S1(mg/l)	202
X1 (%)	115.1

Primary Sedimentation Tank (SS Removal : %)

3:Inlet to Secondary Tank	
Q3(m3/D)	268,383
T3(t･DS/D)	27.339
S3(mg/l)	102
X3 (%)	57.5

Secondary Tank

5:Outlet from Secondary Tank	
Q5(m3/D)	264,009
T5(t･DS/D)	5.468
S5(mg/l)	21
X5 (%)	11.5

5-1:Effluent-1	
Q5-1(m3/D)	263,788
T5-1(t･DS/D)	5.025
S5-1(mg/l)	21
X5-1 (%)	10.6

・Outlet

2:Primary Sludge	
Q2(m3/D)	1,823
T2(t･DS/D)	27.339
S2(mg/l)	15,000
X2 (%)	57.5

4:Excess Sludge	
Q4(m3/D)	4,374
T4(t･DS/D)	21.871
S4(mg/l)	5,000
X4 (%)	46.0

8:Water for Chemical	
Q8(m3/D)	221
T8(t･DS/D)	0.443
S8(mg/l)	2,000
X8 (%)	0.9

12:Total Supernatants	
Q12(m3/D)	6,206
T12(t･DS/D)	7.158
S12(mg/l)	1,153
X12 (%)	15.1

* Sludge to Thickener	
Q(m3/D)	6,197
T(t･DS/D)	49.210
S(mg/l)	7,941

Thickening Tank (SS Recovery : %)

Chemical Dosage

Dewatering (SS Recovery : %)

・Carry Out

6:Thickened Sludge	
Q6(m3/D)	2,214
T6(t･DS/D)	44.289
S6(mg/l)	20,000
X6 (%)	93.2

9:Sludge with Chemical	
Q9(m3/D)	2,436
T9(t･DS/D)	44.732
S9(mg/l)	18,364
X9 (%)	94.1

10:Sludge Cake	
Q10(m3/D)	212
T10(t･DS/D)	42.495
S10(mg/l)	200,000
X10 (%)	89.4

7:Thickener Supernatant	
Q7(m3/D)	3,982
T7(t･DS/D)	4.921
S7(mg/l)	1,236
X7 (%)	10.4

11:Dewatering Supernatant	
Q11(m3/D)	2,223
T11(t･DS/D)	2.237
S11(mg/l)	1,006
X11 (%)	4.7

LEGEND
Q : Water Flow : (m3/day)
T : Solid Matter : (t･DS/day)
S : Solid Concentration : (mg/l)
X : Ratio for Inlet Solid : (%)

・ Water
・ Sludge
・ Supernatant

Table I.6 Design Calculation of N1 WWTP (1/11)

1 BASIC CONDITIONS

1-1 Basic Items

(1) Name : **N1 WWTP**

(2) Land Area : Approximately xxxx ha

(3) Ground Level (Elevatio : + 4.00 m (Plan)

(4) Inlet Pipe Invert Level : - 5.82 m

(5) Pipe Diameter : 1,650 mm

(6) Land Use : ―

(7) Collection System : ~~Combined System~~ Separate System

(8) Treatment Process : Conventional Activated Sludge Process

(9) Effluent Point : Hlaing River

(10) Water Level at the Effluent Poir :
High water leve = 3.70 m
Low water leve = ― m

(11) Target Year : 2020 (F/S Stage)
2040 (M/P Stage)

1-2 Service Area and Design Population

(1) Service Area : 3,163 ha

(2) Design Population

Item		Year 2020	Year 2040
Design Population	person	-	377,200

Table I.6 Design Calculation of N1 WWTP (2/11)

1-3 Design Sewage Flow

(Year 2020)

Item	m^3/day	m^3/hr	m^3/min	m^3/sec
Maximum Daily Flow		0.0	0.00	0.000
Maximum Hourly Flow	0	0.0	0.00	0.000

(Year 2040)

Item	m^3/day	m^3/hr	m^3/min	m^3/sec
Maximum Daily Flow	140,000	5,833.3	97.22	1.620
Maximum Hourly Flow	210,000	8,750.0	145.83	2.431

1-4 Design Sewage Quality

Item	BOD (mg/l)	SS (mg/l)	T-N (mg/l)	Coli-group (MPN/cm^3)	Oil&Greese (mg/l)
Influent	200	180	-	-	-
Effluent	20	30	-	3,000	5

1-5 Process Flow Diagram

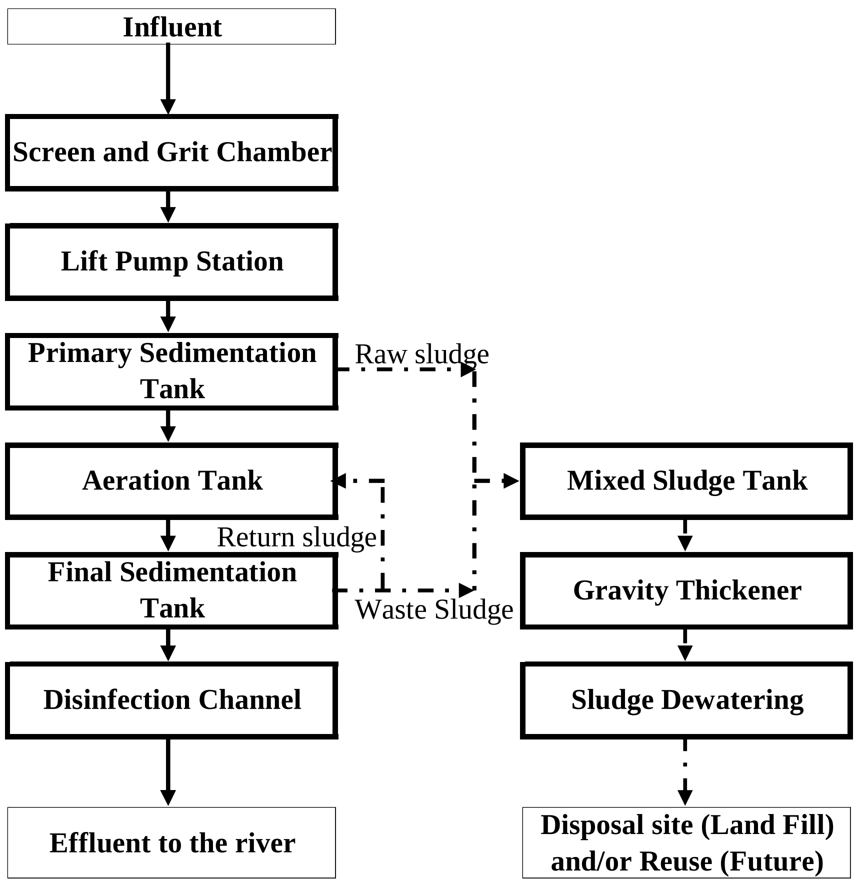


Table I.6 Design Calculation of N1 WWTP (3/11)

1.6 Design Criteria

ITEMS		UNIT	Formula or Value	Application
1	Grit Chamber (For Maximum Hourly Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	1,800	1,800
(2)	Average Velocity	m/sec	0.3	0.3
2	Primary Sedimentation Tank (For Maximum Daily Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	35.0-70.0	50
(2)	Settling Time (Ref.)	hour	1.5	1.5
(3)	Water Depth	m	2.5-4.0	3.5
(4)	Weir Loading	$m^3/m/day$	250	250
3	Aeration Tank (For Maximum Daily Flow)			
(1)	Hydraulic Retention Time (HRT)	hour	6 - 8	6.0
(2)	MLSS Concentration	mg/l	1,500 -2,000	2,000
(3)	BOD-SS Load (Reference only)	kg/kg/day	0.2 - 0.4	-
4	Final Sedimentation Tank (For Maximum Daily Flow)			
(1)	Hydraulic Load	$m^3/m^2/day$	20.0-30.0	25
(2)	Settling Time (Ref.)	hour	3.0-4.0	-
(3)	Water Depth	m	2.5-4.0	3.5
(4)	Weir Loading	$m^3/m/day$	150	150
5	Disinfection Tank (For Maximum Daily Flow)			
(1)	Retention (Chlorination) Time	min	15	15
6	Gravity Thickener (For Maximum Daily Flow)			
(1)	Solids Loading	$kg/m^2/day$	60-90	75
(2)	Water Depth	m		4.0

Table I.6 Design Calculation of N1 WWTP (4/11)

2 CAPACITY CALCULATION

2-1 Grit Chamber

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			210,000
(Maximum Hourly Flow)	Q2	m^3/sec			2.431
Water Surface Load	WSL	m^3/m^2/day			1,800
Required Surface Area	RSA	m^2	Q1/WSL		116.67
Basin Number	BN	basin			4
Average Velocity	AV	m/sec			0.3
Depth	H	m			1
Width	W1	m	Q2/(AV×H×BN)		2.03
Therefore	W2	m			2.5
Length	L1	m	RSA/(W2×BN)		11.67
Therefore	L2	m			12.0
Dimension (Width)	W	m			**2.5**
(Depth)	L	m	L2		**12.0**
(Length)	H	m	H		**1.0**
(Basin Number)	N	basin			**4**
(Check)					
Water Surface Load		m^3/m^2/day	Q1/(W×L×N)		1,750
Average Velocity		m/sec	Q2/(W×H×N)		0.243

2-2 Lift Pump Station

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Vertical shaft Volute type mixed flow pump		
Design Sewage Flow	Q1	m^3/min	Peak Flow		145.83
Pump Unit -1 Number	UN1	unit			2
Discharge per Unit	DU1	m^3/min	1/10×Q1/UN1		14.58
Pump Diameter(V=1.5~3.0m/s	D1	mm	$146\times(DU1/1.5\sim3.0)^{0.5}$		322 ～455
Therefore	D1	mm			400
Pump Unit -2 Number	UN2	unit			2
Discharge per Unit	DU2	m^3/min	2/10×Q1/UN2		29.17
Pump Diameter(V=1.5~3.0m/s	D2	mm	$146\times(DU2/1.5\sim3.0)^{0.5}$		455 ～644
Therefore	D2	mm			500
Pump Unit -3 Number	UN3	unit	including 1 stand-by		2
Discharge per Unit	DU3	m^3/min	4/10×Q1/UN3		58.33
Pump Diameter(V=1.5~3.0m/s	D3	mm	$146\times(DU3/1.5\sim3.0)^{0.5}$		644 ～910
Therefore	D3	mm			700

Table I.6 Design Calculation of N1 WWTP (5/11)

2-3 Primary Sedimentation Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			140,000
(Maximum Daily Flow)	Q2	m^3/hr			5,833.3
Basin Number	BN	basin			16
Hydraulic Load	HL	m^3/m^2/day			50.0
Required Surface Area	A1	m^2	Q1/HL		2,800
	A2	m^2/basin	A1/BN		175
Width	W1	m	3.0m~4.0m, Max5.0m		5.0
Length	L1	m	A2/W1		35.00
Therefore	L2	m			35.0
Water Depth	WD	m			3.5
Overflow Weir Load	OWL	m^3/m/day			250
Required Weir Length	WL1	m/basin	Q1/(BN×OWL)		35.00
Therefore	WL2	m/basin			35.0
Dimension (Width)	W	m			**5.0**
(Depth)	D	m			**3.5**
(Length)	L	m			**35.0**
(Basin Number)	N	basin			**16**
(Check)					
Hydraulic Load	HL	m^3/m^2/day	Q1/(N×W×L)		50.00
Retention(Settling) Time	T	hour	(N×W×D×L)/Q2		1.68
Overflow Weir Load	OWL	m^3/m/day	Q1/(N×WL2)		250.00

Table I.6 Design Calculation of N1 WWTP (6/11)

2-4 Aeration Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Multi-tank Complete mixing Type		
Design Sewage Flow	Q1	m^3/day			140,000
(Maximum Daily Flow)	Q2	m^3/hr			5,833.3
Hydraulic Retention Time	HRT	hr			6.0
Basin Number	BN	basin			8
Required Volume per basin	RV	m^3/basin	Q2×RT/BN		4,375
Width	W	m	1~2H		10.5
Water Depth	H	m	4.0m~6.0m		6.0
Length	L1	m	RV/(W×H)		69.4
Therefore	L2	m			70.0
Dimension (Width)	W	m			**10.5**
(Depth)	H	m			**6.0**
(Length)	L	m			**70.0**
(Basin Number)	N	basin			**8**
(Check)					
Hydraulic Retention Time	HRT	hour	W×H×L×N/Q2		6.0
BOD-SS load	BSS_L	kgBOD/kgSS/d	(Q1×BODin)/(W×H×L×N×Xa)		0.24
BOD_{in} : Inflow BOD Concentration			120 mg/L (Removal Rate in PST : 40%)		
Xa : MLSS Concentration			2,000 mg/L		
Aerobic Sludge Retention Tim	ASRT	day	HRT/24×Xa / (a×S-BODin + b×SSin - c×HRT/24×Xa) =		4.785
$S\text{-}BOD_{in}$: Inflow S-BOD Concentration			80 mg/L (S-BOD[Solved BOD]=BODin×0.6		
SS_{in} : Inflow SS Concentration			90 mg/L (Removal Rate in PST : 50%)		
a : Sludge converting ratio of solved BOI			0.5 mgMLSS/mgBOD (0.4~0.6)		
b : Sludge converting ratio of SS			0.95 mgMLSS/mgSS (0.9~1.0)		
c : Sludge reduction ratio caused by endogenous respiration			0.04 (1/day)(0.03~0.05)		
Effluent Quality (C-BOD)	EQ	mg/L	$10.42×A\text{-}SRT^{(-0.519)}$ (15~20℃)		4.624
Water Temperature			20 ℃		
Effluent Water Quality (C=BOD Maximum)			EQ×3 20mg/l >		14
					-OK-
			1 : 1.5 : 1.5 : 2.25		
Partition of Aeration Tank			No.1 | No.2 | No.3 | No.4		
Total Length of Tank	TL	m			70.0
No.1 Tank Length	L1	m	TL×1/(1+1.5+1.5+2.25)		11.2
No.2 Tank Length	L2	m	TL×1.5/(1+1.5+1.5+2.25)		16.8
No.3 Tank Length	L3	m	TL×1.5/(1+1.5+1.5+2.25)		16.8
No.4 Tank Length	L4	m	TL×2.25/(1+1.5+1.5+2.25)		25.2
			Total		**70.0**

Table I.6 Design Calculation of N1 WWTP (7/11)

2-5 Final Sedimentation Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Parallel Flow Type		
Design Sewage Flow	Q1	m^3/day			140,000
(Maximum Daily Flow)	Q2	m^3/hr			5,833.3
Basin Number	BN	basin			16
Hydraulic Load	HL	m^3/m^2/day			25.0
Required Surface Area	A1	m^2	Q1/HL		5,600
	A2	m^2/basin	A1/BN		350
Width	W1	m	3.0m~4.0m, Max5.0m		5.0
Length	L1	m	A2/W1		70.00
Therefore	L2	m			70.0
Water Depth	WD	m			3.5
Overflow Weir Load	OWL	m^3/m/day			150
Required Weir Length	WL1	m/basin	Q1/(BN×OWL)		58.33
Therefore	WL2	m/basin			60.0
Dimension (Width)	W	m			**5.0**
(Depth)	D	m			**3.5**
(Length)	L	m			**70.0**
(Basin Number)	N	basin			**16**
(Check)					
Hydraulic Load	HL	m^3/m^2/day	Q1/(N×W×L)		25.00
Retention(Settling) Time	T	hour	(N×W×D×L)/Q2		3.36
Overflow Weir Load	OWL	m^3/m/day	Q1/(N×WL2)		145.83

Table I.6 Design Calculation of N1 WWTP (8/11)

2-6 Disinfection Channel

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Chlorination		
Design Sewage Flow	Q1	m^3/day			140,000
(Maximum Daily Flow)	Q2	m^3/min			97.2
Retention(Chlorination) Time	RT	min			15.0
Required Volume	RV	m^3	Q2×RT		1,458
Width of channel	W	m			2.0
Depth of channel	H	m			2.5
Pass Number	PN	pass			8
Length of channel	L1	m/pass	RV/(W×H×PN)		36.5
Therefore	L2	m/pass			37.0
Dimension (Width)	W	m			**2.0**
(Depth)	H	m			**2.5**
(Length)	L	m/pass			**37.0**
(Pass Number)	N	pass			**8**
(Check)					
Retention(Chlorination) Time	RT	min	(W×H×L×PN)/Q2		15.2

2-7 Sludge Thickening Tank

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Gravity Thickener (Radial Flow Circular Type)		
Generated Sludge Solids	GS	t-DS/day	Refer to Mass Balance Cal.		26.096
Generated Sludge Volume	GSV	m^3/day	Refer to Mass Balance Cal.		3,286
Solid Matter Load	SML	kg/m^2/day			75
Required Surface Area	SA	m^2	$(GS\times10^3)/SML$		347.9
Water Depth	H	m			4.0
Basin Number	BN	basin			4
Required Tank Diameter	TD1	m	$(SA\times4/(3.14\times BN))^{0.5}$		10.53
Therefore	TD2	m			10.5
Dimension (Diameter)	D	m/basin			**10.5**
(Depth)	H	m			**4.0**
(Basin Number)	BN	basin			**4**
(Check)					
Solid Matter Load	SML	kg/m^2/day	$GS\times10^3/(3.14\times D^2/4)\times BN$		75.4
Sludge Thickened Time	T	hr	$(3.14\times D^2/4)\times H\times BN\times24/GSV$		10.1

Table I.6 Design Calculation of N1 WWTP (9/11)

2-8 Sludge Dewatering

Item	Sign	Unit	Calculation	F/S	M/P
Type	-	-	Mechanical Dewatering (Screw Press Type)		
Thickened Sludge Solids	TS	t-DS/day	Refer to Material Balance		23.721
Unit Number	UN	Unit			4
Operating Time	OT	hr/day			24.0
Required Dewatering Capacity	DC	kg/hr/unit	$TS \times 10^3/(OT \times UN)$		247.1
Solids Loading	Q_{100}	kg-ds/hr/φ100			3.0
Screnn Diameter	SD1	mm	$100 \times (DC/Q_{100})$^(1/2.2)		742.7
Therefore	SD2	mm			800
Dimension (unit)	UN	Unit			**4**
(Screen Diameter)	SD	mm			**800**
(Check)					
Dewatering Capacity	DC	kg/hr/unit	(SD/100)^2.2×Q_{100}		291.0
Operating Time	OT	hour/day	$TS \times 10^3/(DC \times (UN-1))$		20.4

Table I.6 Design Calculation of N1 WWTP (10/11)

Material Balance Calculation (Primary and Secondary Sedimentation Tank + Thickening Tank + Mechanical Dewatering)

Table-1 Input Data

1. Calculation Manner		1	1:Premise that the quality of supernatants are same level removed with inlet sewage 2:Premise that the entire supernatants are removed at treatment process
2. Selection of Treatment Efficiency		1	1:Total Removal Ratio 2:Outlet Water Quality (input 1or2)
In case of 1 : input data		90	(%)
In case of 2 : input data			(mg/l)
3. Excess Sludge Generation		1	1:Consideration of Solid Matter Only 2:Consideration of Converting of Solved BOD (input 1or2)
In case of 1:Input data (Sludge generation)		100	Sludge generation ratio per removal SS(%)
In case of 2:Input data	a		T2=Q2・S2=(a・S_{BOD}+b・S1-c・θ・XA)・Q1/10^6・・(Excess sludge generation formula)
	b		a:Converting ratio of solved BOD(mgMLSS/mgBOD)
	c		b:Converting ratio of SS(mgMLSS/mgSS)
	SBOD		c:Sludge reduction ratio caused by endogenous respiration of activated sludge(1/day)
	XA		Sbod:Solved BOD quality at inlet to reactor
	θ		XA:MLSS concentration(mg/l)
			θ:Hydraulic retention time(day)

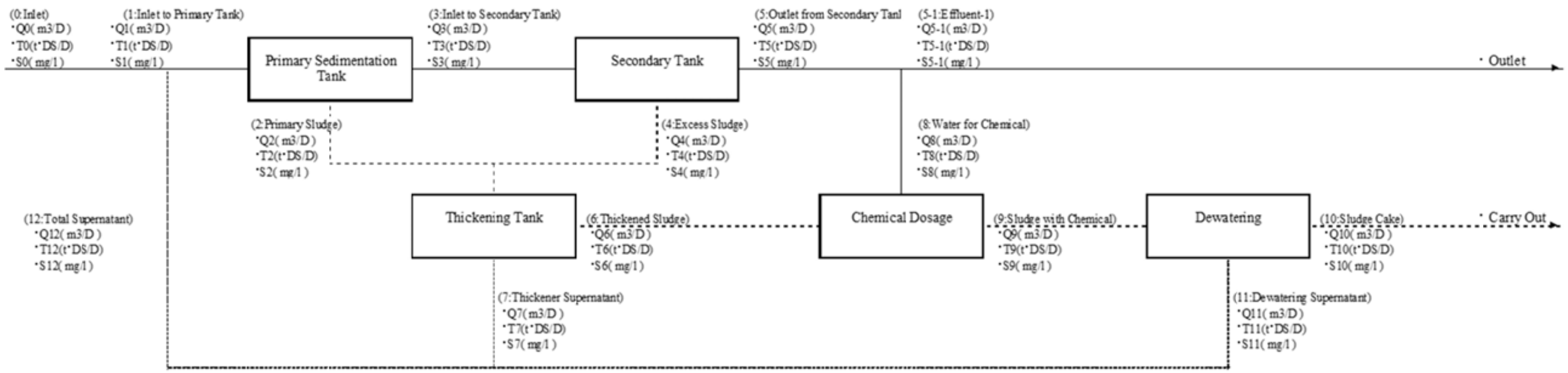
Table-2 Basic Conditions

Water Flow and Quality		Sludge Moisture and Recovery Ratio				Chemical Conditions for Dewatering		
・Inlet flow : Q0(m3/D)	140000	・Primary sludge moisture ratio : W1(%)	98.5	・Removal ratio in primary tank : A2(%)	50.0	・Chemical dosage : A5(%)	1.0	
・Inlet quality : S0(mg/l)	180	・Excess sludge moisture ratio : W2(%)	99.5	・Recovery ratio in sludge thickener : A3(%)	90.0	・Chemical dissolve concentration : A6(%)	0.2	
・Total removal ratio : A1(%)	90.0	・Thickened sludge moisture ratio : W3(%)	98.0	・Recovery ratio in dewatering : A4(%)	95.0			
・Effluent quality: St(mg/l)	-	・Dewatered sludge moisture ratio : W4(%)	80.0					
・Sludge generation ratio per removal SS : Si(%)	100.0							

Table-3 Material Balance Calculation

	0	1	2	3	4	5	6	7	8	9	10	11	12			5-1
Q(m3/day)	140,000	143,291	967	142,324	2,320	140,005	1,174	2,112	117	1,292	113	1,179	3,291			139,887
T(t・DS/day)	25.200	28.996	14.498	14.498	11.598	2.900	23.487	2.610	0.235	23.721	22.535	1.186	3.796			2.665
S(mg/l)	180	202	15,000	102	5,000	21	20,000	1,236	2,000	18,364	200,000	1,006	1,153			21
X(Ti/T0*100)	100	115.1	57.5	57.5	46.0	11.5	93.2	10.4	0.9	94.1	89.4	4.7	15.1			10.6

Figure-1 Material Balance Model



Calculation Formula

・Q0=Input Data ・T0=Q0*S0*10^(-6) ・S0=Input Data	・Q3=Q1-Q2 ・T3=T1*(100-A2)/100 ・S3=T3*10^6/Q3	・Q6=T4*100/(100-W3) ・T6=(T2+T4)*A3/100 ・S6=10^6*(100-W3)/100	・Q9=Q6+Q8 ・T9=T6+T8 ・S9=T9*10^6/Q9	・Q12=Q7+Q11 ・T12=T7+T11 ・S11=T11*10^6/Q11	・Q5-1=Q5-Q8 ・T5-1=T5-T8 ・S5-1=S5
・Q1=Q0+Q13 ・T1=T0+T13 ・S1=T1*10^6/Q1	・Q4=T4*100/(100-W2) ・T4={(T1-T5)*Si/100}-T2 ・S4=10^6*(100-W2)/100	・Q7=(Q2+Q4)-Q6 ・T7=(T2+T4)-T6 ・S7=T7*10^6/Q7	・Q10=T10*100/(100-W4) ・T10=T9*A4/100 ・S10=10^6*(100-W4)/100		
・Q2=T2*100/(100-W1) ・T2=T1-T3 ・S2=10^6*(100-W1)/100	・Q5=Q3-Q4*(T3-T5)/T4 ・T5=T1*(100-A1)/100 ・S5=T5*10^6/Q5	・Q8=T6*A5/A6 ・T8=Q8*S8/10^6 ・S8=10^4*A6	・Q11=Q9-Q10 ・T11=T9-T10 ・S11=T11*10^6/Q11		

Table I.6 Design Calculation of N1 WWTP (11/11)

Material Balance Sheet

0:Inlet	
Q0(m3/D)	140,000
T0(t･DS/D)	25.200
S0(mg/l)	180

1:Inlet to Primary Tank	
Q1(m3/D)	143,291
T1(t･DS/D)	28.996
S1(mg/l)	202
X1 (%)	115.1

3:Inlet to Secondary Tank	
Q3(m3/D)	142,324
T3(t･DS/D)	14.498
S3(mg/l)	102
X3 (%)	57.5

5:Outlet from Secondary Tank	
Q5(m3/D)	140,005
T5(t･DS/D)	2.900
S5(mg/l)	21
X5 (%)	11.5

5-1:Effluent-1	
Q5-1(m3/D)	139,887
T5-1(t･DS/D)	2.665
S5-1(mg/l)	21
X5-1 (%)	10.6

Primary Sedimentation Tank (SS Removal : %)

Secondary Tank

・Outlet

2:Primary Sludge	
Q2(m3/D)	967
T2(t･DS/D)	14.498
S2(mg/l)	15,000
X2 (%)	57.5

4:Excess Sludge	
Q4(m3/D)	2,320
T4(t･DS/D)	11.598
S4(mg/l)	5,000
X4 (%)	46.0

8:Water for Chemical	
Q8(m3/D)	117
T8(t･DS/D)	0.235
S8(mg/l)	2,000
X8 (%)	0.9

12:Total Supernatants	
Q12(m3/D)	3,291
T12(t･DS/D)	3.796
S12(mg/l)	1,153
X12 (%)	15.1

* Sludge to Thickener	
Q(m3/D)	3,286
T(t･DS/D)	26.096
S(mg/l)	7,941

Thickening Tank (SS Recovery : %)

Chemical Dosage

Dewatering (SS Recovery : %)

・Carry Out

6:Thickened Sludge	
Q6(m3/D)	1,174
T6(t･DS/D)	23.487
S6(mg/l)	20,000
X6 (%)	93.2

9:Sludge with Chemical	
Q9(m3/D)	1,292
T9(t･DS/D)	23.721
S9(mg/l)	18,364
X9 (%)	94.1

10:Sludge Cake	
Q10(m3/D)	113
T10(t･DS/D)	22.535
S10(mg/l)	200,000
X10 (%)	89.4

7:Thickener Supernatant	
Q7(m3/D)	2,112
T7(t･DS/D)	2.610
S7(mg/l)	1,236
X7 (%)	10.4

11:Dewatering Supernatant	
Q11(m3/D)	1,179
T11(t･DS/D)	1.186
S11(mg/l)	1,006
X11 (%)	4.7

LEGEND
Q : Water Flow : (m3/day)
T : Solid Matter : (t･DS/day)
S : Solid Concentration : (mg/l)
X : Ratio for Inlet Solid : (%)

・ Water
・ Sludge
・ Supernatant

J. WATER PURIFICATION DEMONSTRATION EXPERIMENT AT KANDAWGYI LAKE

Water Purification Demonstration Experiment

at Kandawgyi Lake

in connection with

Feasibility Study for Yangon City Water and Wastewater

Improvement Program Cooperation

(Fast Track Applicable Case)

REPORT

June 26, 2013

TESCO CO., LTD.

1. Purpose of Experiment

Kandawgyi Lake locates in the northern downtown of Yangon city, the largest city in Myanmar, is very important area as a place of recreation and relaxation for Yangon citizens providing stroll, recreation, concert and so on, with surrounding parks and many restaurants.

It is also externally important place as a typical point of Yangon city with luxury hotels and embassies of various countries. Presently, there are inflows of restaurants wastewater as well as domestic sewage from 5 drains at Kandawgyi Late. These wastewater inflows cause accumulation of nutrients and eutrophication in the lake. In addition, accumulated nutrients and strong sunshine accelerate a growing of large amount of Blue-green algae in recent years.

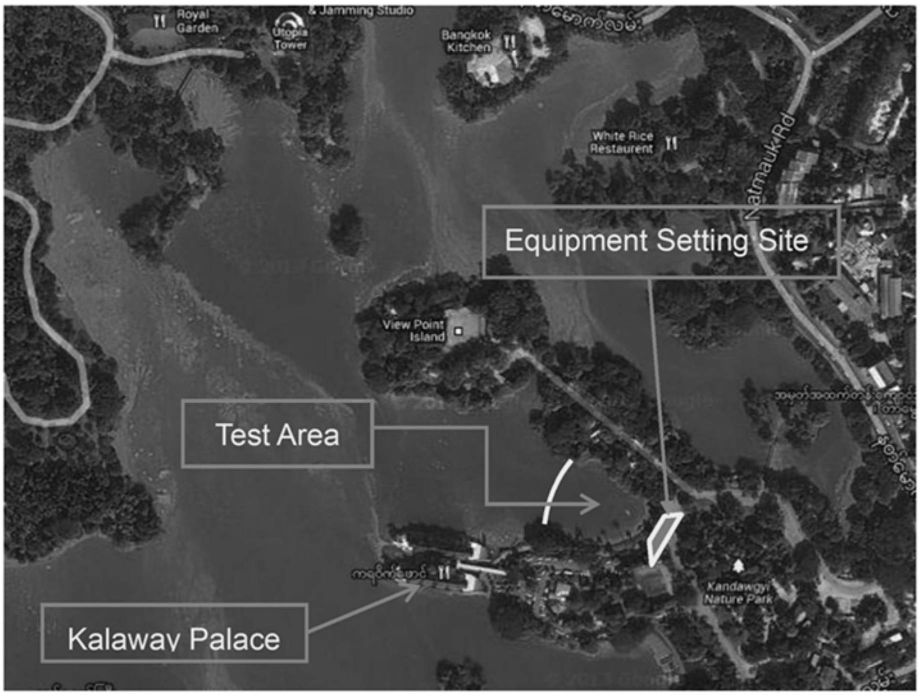
Therefore, the purpose of this experiment is to establishment of water quality improvement technology including blue-green algae removal through the implementation of the demonstration experiment at Kandawgyi Lake.

2. Test Implementation Period

From 23rd May to 21st June, 2013. Number of operation days: 24 days

3. Area of Test Site

Area of test site is described in the picture below. The test was conducted by setting test area near the restaurant "Kalaway Palace".



The detail of test site is as follows;

- Area of test site: approximately 3,500m^2
- Operation water depth: from surface to 50cm depth
- Volume of water treatment: 3,500m^2 × 50cm＝1,750m^3

4. Pictures of Test Site

Mr. U. Hla Myint, Yangon mayor, and city executives visiting the site at early stage.

Collecting blue-green algae by Algae collection fence

Whole view of Algae processing system

5. Preliminary Test

As a preliminary test, algae sampling were conducted twice at Kandawgyi Late and 3 times at Hirosawa Pond in Kyoto, and verification of test condition was made as to selection of the most suitable coagulant injection ratio and treatment condition of Chlorophyll-a (Chl.a), COD, T-N, T-P and SS in the samples.

As a result, it was deemed that using “Aquafrog S” with the injection rattio of 200mg/L was the most suitable condition for treatment.

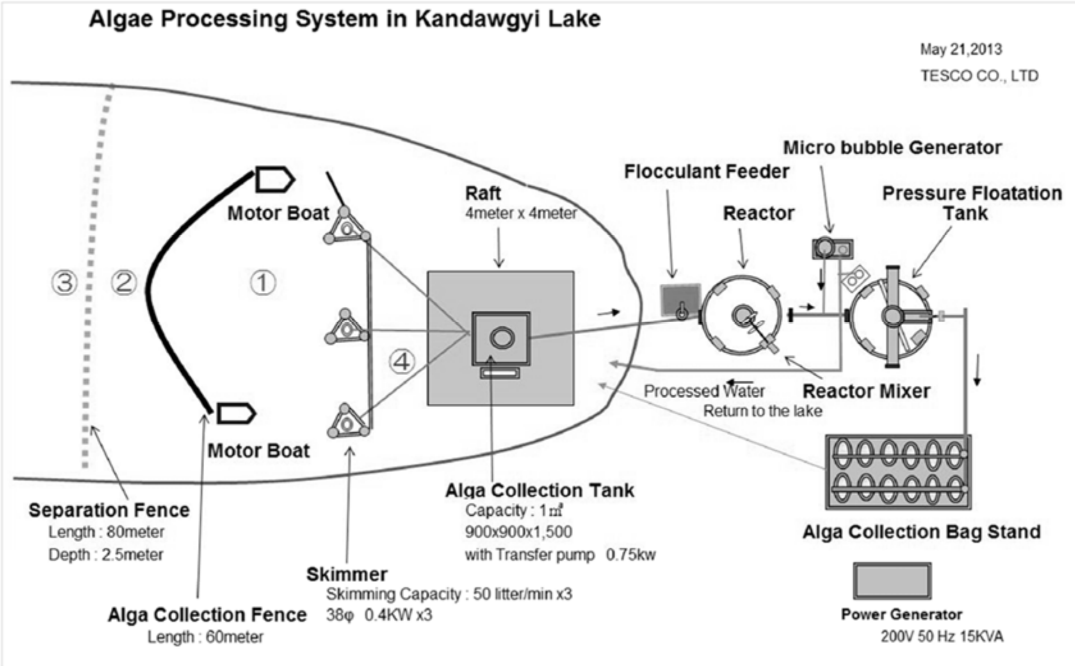
Preliminary test result of sampling from Kandawgyi Lake

Flocculant Feeding ratio：200mg/L

Item	Initial concentration (mg/L)	concentration in supernatant water (mg/L)	Removal ratio (%)
Chl.a	6.033	0.064	100
CODcr	1,902	129	94
T-N	53	1.98	96
T-P	31	0.42	99

6. Outline of Test Equipment

Outline of Test equipment is as follows:



① through ④ indicate water sampling points

1) Blue-green Algae Collection Equipment

Separation Fence（80m）& Algae Collection Fence (60m) before installation

Algae Collection Tank & Raft equipped with Skimmer（4m×4m）

3) Pressure Floatation Unit & Treated Water Return Unit

Micro Bubble Generator

Pressurized Floatation Tank

Treated Water Siphon

Effluent
Purified by treatment

4）Algae Scraper & Alga Collection Jute Bag Stand

Algae Scraper
To scrape and collect floating algae floc

Algae Collection Jute Bag & Stand
To dehydrate and collect by Jute Bag

7. Operation Procedure

1) Collecting algae forcibly by collection fence

Algae floating on the surface were collected with collection fence towed by two motorboats. (It was conducted only three times during the early stage of test, because algae were widely spread under the water surface due to rainy seasons.)

2) Algae collection

Algae were collected into the collection tank on the raft by suction pumps of three skimmers. Then they were transferred to reactor tank on the ground site.

3) Flocculation treatment

Proper amount of inorganic flocculant was fed into the tank by powder feeder equipped with inverter control, and then flocculation reaction was made by high speed mixer.

4) Floatation separation of algae by pressure floatation unit

Flocculated algae were floated and separated from water by micro bubble of 10-30μm.

5) Collection of flocculated algae

Floatation separated algae aggregate were dropped down to outlet port of reactor tank by scraper, then collected in jute bag and dehydrated.

8. Test Result

1) Observation result of operation condition

① Operation record

Refer to the attached "Operation Record".

② Water volume treated by test equipment

- Water volume treated during one month:
  141.9L/minX60minXAverage7.83hours/dayX24days＝1,600m^3
  (compared to the target of 150L/minX60minX8hours/dayX22days＝1,584m^3)
  It corresponds to 91% of planned volume of 1,750m^3.
- Test period : 24 days (compared to the target of 22 days)
- Operation hours ：188 hours (compared to the target of 172 hours)

③ Cost of expendables consumed during 24 days operation

- Diesel fuel：420L (according to Operation Record)
  420L x 860Kyat/L =361,200Kyat: Approximately 36,000 JPY
- Flocculant: 375kg (used 15bags x 25kg/bag)

375kg x 800Yen/kg ＝ 300,000Yen

It is under review to lower the price of flocculant to around 500JPY/kg by means of i.e. changing purchasing source.

• Cost of expendables per unit quantity of algae

Total volume of algae collected during 24 days was 2,760kg (including 80% of water).

Therefore,

(36,000JPY+300,000JPY) /2,760kg=121.7JPY/1kg

2）Test result regarding water quality improvement of the test area

＜Method＞

The assessment of water quality improvement by the test equipment was made by analysis and comparing water quality of the samplings inside and outside the test area

① Assessment method

Comparison of water quality inside and outside (control) of the test area

- Sampling point

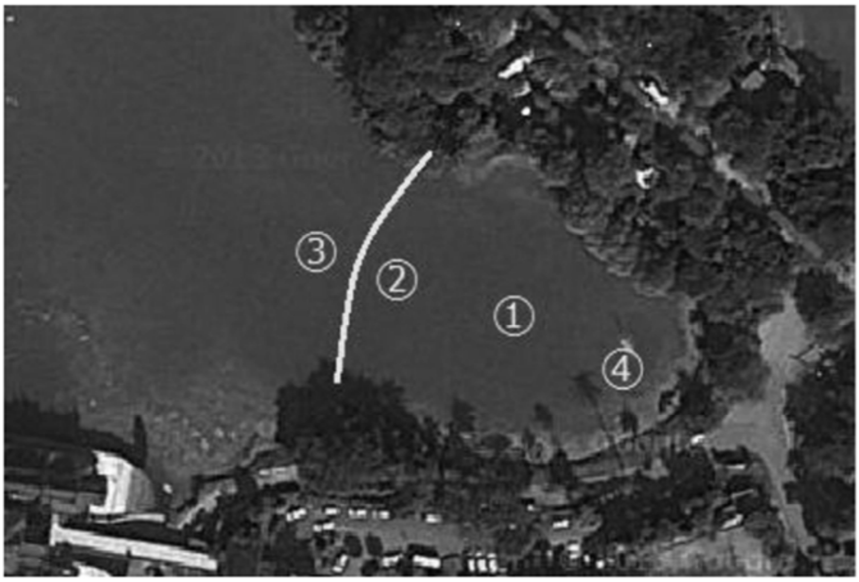
  Samplings were made at the following 4points. (Refer to the picture below)

  ① Center of test area

  ② Border of test area

  ③ Control

  ④ Near raft



- Water quality items

  Transparency, SS, CODcr, T-N and T-P

- Sampling frequency (Total 14 times)
  Before test (21/May)
  During test (23/May～20/Jun): twice a week、
  At the completion of test

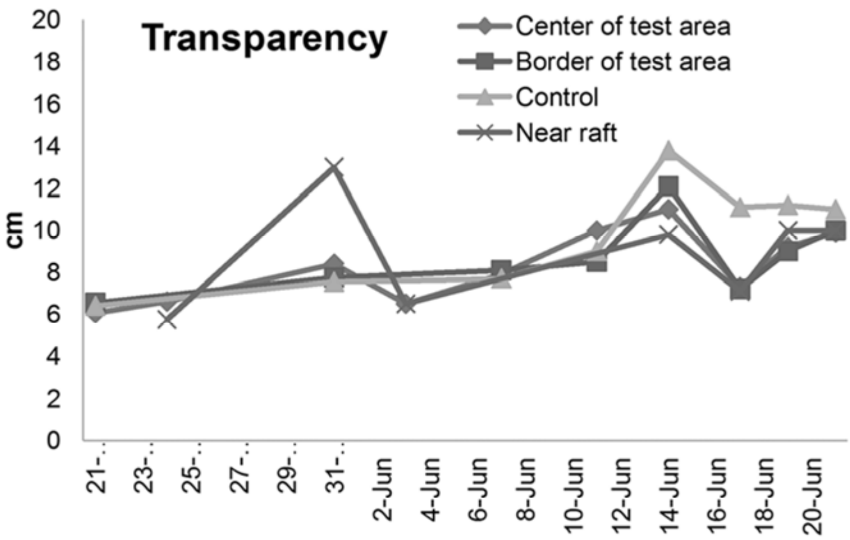
In the afternoon of 20th May, the sampling point was set by surrounding the specified area with fence, and the first sampling (before the start of test) was made on 21st May. From 23rd May, it started continuous operation of purification treatment and it continued to 21st June principally every day except Sunday.
On 21st June, water sampling was collected after the completion of test and the final measurement of its water quality was conducted.

＜Result＞

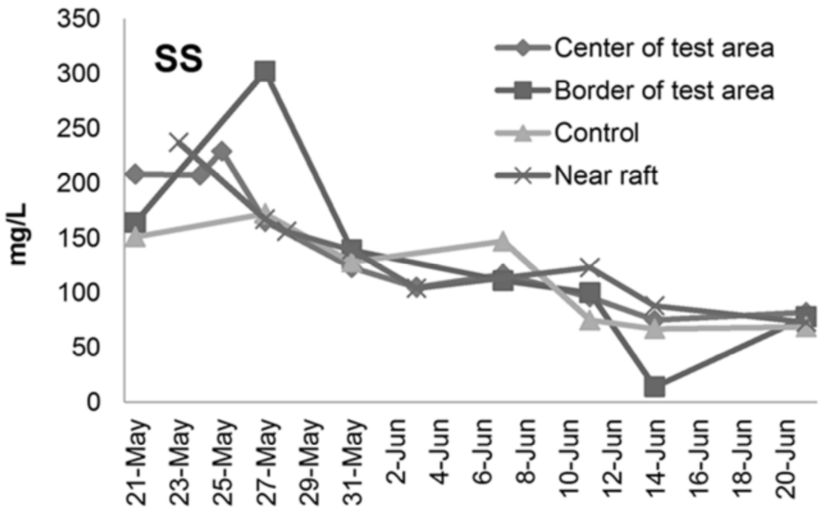
Test result is presented in the attached "Water Quality of Sampling Points". Weather information at the site is presented in the list. It became much rainy weather after the second week.

The following describes the change of water quality.

Transparency and SS



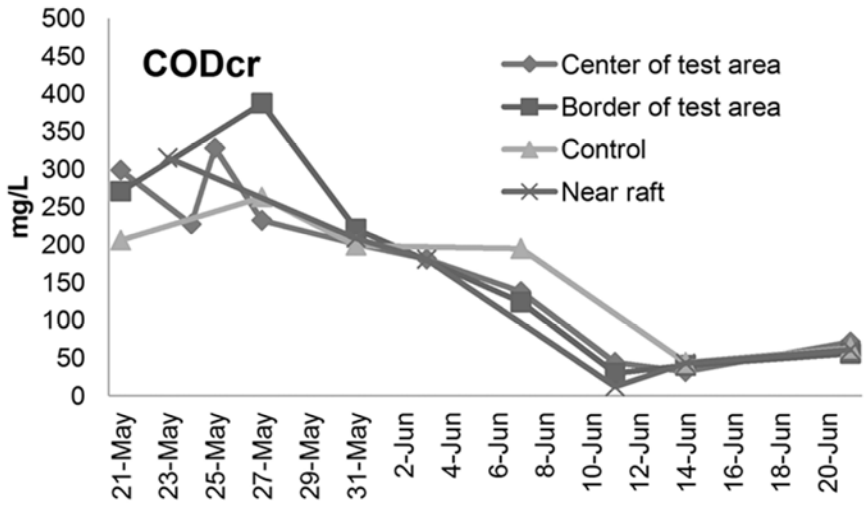
In general, it shows a trend that transparency increased gradually, although the values are unstable because measurement in the open air is likely to be affected by light and shade.



Since there was a little rainfall in the first week (till 27/May), the SS value in the point ①, ② and ④ inside the test area shows higher than those outside test area (control). After the second week, these values had gradually decreased in points ①, ②, ④ and point ③ (control). It was deemed that the decrease was an affect of dilution due to rainfall after the second week.

Since SS concentration inside the test area was higher than outside (control) at the beginning of the test, its decreasing rate of inside was accordingly higher than outside. This was deemed as an effect of algae removal equipment.

CODcr



As to the concentration change of CODcr, the same trend was observed as SS. Namely, during the first week (till 27/May), the values in point ①, ② and ④ inside the test area showed higher than in control ③. However, these had decreased both inside and outside of test area after the latter half of the second week. It was also deemed as an affect of rainfall.

The decreasing rate of CODcr was more apparent than that of SS. CODcr inside test area (point ①, ② and ④) showed lower value compared to that of control.

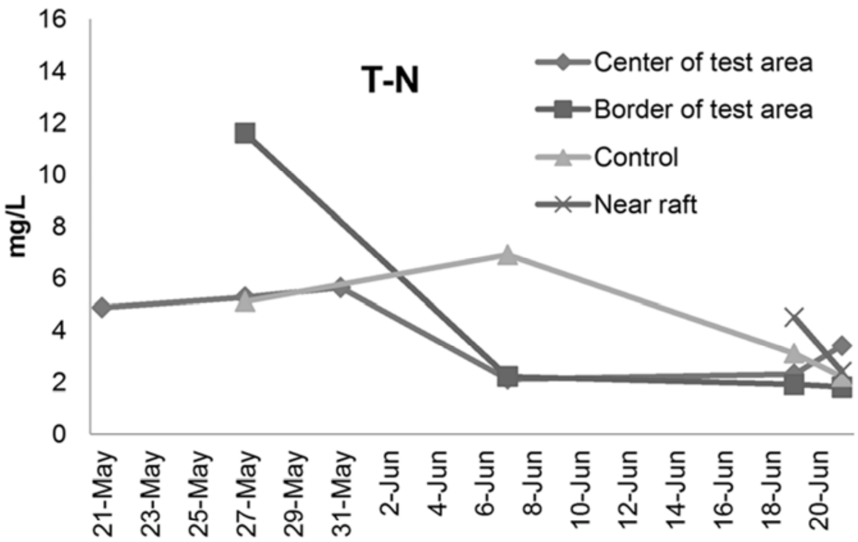
Especially, CODcr inside test area had declined more rapidly than that of control after 2nd June.

Same as SS, concentration change was observed because of an affect of dilution by rainfall. However, the decline of value inside test area after 2nd June was deemed as an effect of algae removal equipment.

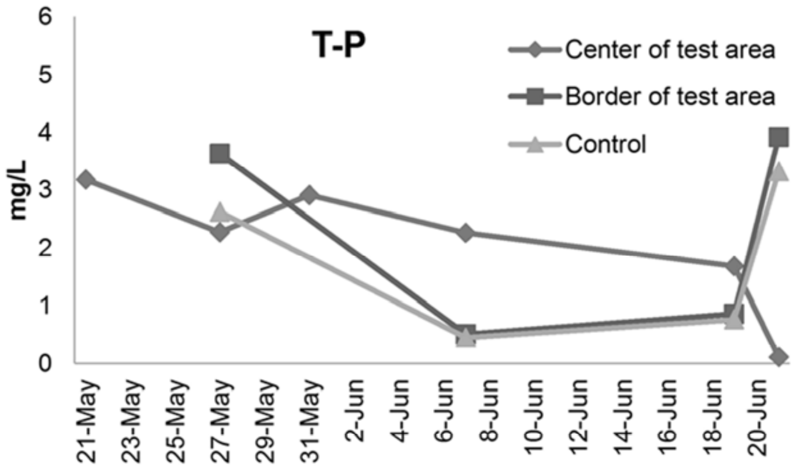
T-N and T-P

Decrease of T-N and T-P concentration were observed.

This decrease was assumed that the effect of progress of algae collection..



In the first two weeks, the first half of the test period, T-N concentration inside the test area decreased to 1/3 of the concentration at the beginning, thereafter it also decreased outside the test area (control). It is deemed that the concentration decrease at the control in the latter half of the test period is an effect of rainfall. Meanwhile, the density decrease inside the test area is deemed as an effect of the algae removal equipment..



As to T-P, a trend was observed that the concentration decreased gradually as the test progressed at the center of the test area. Meanwhile, at the border of test area and control, the concentration once decreased, then increased on the last day of the test period.

Although the reason of this concentration change at the border of test area and at control is not clear, however, the concentration decrease inside test area is deemed as an effect of the algae removal equipment.

According to visual observation, the general condition of algae growing is as follows. At the beginning of test, there observed thick belt-like zone of blue-green algae on the surface of water in the test area (creek area). It was not seen in the center of the lake (control). Through the continuous observation, it was found that the density of algae varied locally depending on direction and strength of wind. This often resulted to belt-like staying of algae drifted to the creek and fence area. The variation was significant at the sampling point ②, inside the fence, and ④, near the coast, and those were deemed as one of the reason for unstable water quality at those area.

Staying of algae on the surface of lake water was especially remarkable in the morning on sunny days. But, it was not seen on rainfall and thereafter. Therefore, it was deemed that this phenomenon was due to stirring, temperature drop and so forth on water surface by rainfall.

There observed very little staying of algae in the area of test site two weeks after the beginning of test.

＜Observation＞

There became much rainfall after Tuesday of the second week because of rainy

season (refer to the list below). It is deemed that increase of transparency and measured value of SS and CODcr were affected by dilution caused by rainfall.
(Assumed volume of rainfall overwhelmingly more than that of treated water)

Date			Weather
23-May	Thr	AM	Little rain
		PM	Cloudy→Fine
25-May	Sat	AM	Fine
		PM	Little rain
27-May	Mon	AM	Little rain
		PM	Rain
28-May	Tue	AM	Fine
		PM	
29-May	Wed	AM	Rain
		PM	
30-May	Thr	AM	Fine
		PM	
31-May	Fri	AM	Rain
		PM	
1-Jun	Sat	AM	Rain
		PM	
3-Jun	Mon	AM	Heavy Rain
		PM	Rain
4-Jun	Tue	AM	Heavy rain and strong wind
		PM	
5-Jun	Wed	AM	Rain
		PM	Cloudy-->clear
6-Jun	Thu	AM	Rain
		PM	

Date			Weather
9-Jun	Sun	AM	Heavy Rain
		PM	
10-Jun	Mon	AM	Exteamly heavy rain
		PM	
11-Jun	Tue	AM	Exteamly heavy rain
		PM	
12-Jun	Wed	AM	Fine & wind
		PM	
13-Jun	Thu	AM	Rain
		PM	
14-Jun	Fri	AM	Cloudy
		PM	Heavy Rain
15-Jun	Sat	AM	Fine
		PM	Fine
17-Jun	Mon	AM	Fine
		PM	Fine
18-Jun	Tue	AM	Fine
		PM	Rain
19-Jun	Wed	AM	Weak rain
		PM	Fine
20-Jun	Thu	AM	Rain
		PM	Rain
21-Jun	Fri	AM	Fine
		PM	Rain

However, values at both inside of test area, points ①, ② and ④, and outside ③ were evenly decreased after the second week, those indicate the affection of dilution by rainfall.
As to concentration of SS, CODcr, T-N and T-P, they show, at inside of test area, ①, ② and ④, lower values than at outside ③ (control), before the beginning of test through the second week. Also, degree of concentration decrease is rather higher at inside of test area through the test period.
The result indicates that there seems to be, slightly but still, the effectiveness of algae removal equipment, although the test is affected by dilution due to rainfall.

There is much volume of belt-like algae staying observed visually on the surface of lake especially along the coast at creek area. This is due to wind blow that often leads to form thick staying layer of algae. It is apparent on sunny days but disappears on rainfall. Likewise, at the beginning of test, thick belt-like algae staying were observed in the test area (creek area), It was not seen in the center of the lake.
Staying of algae was almost never seen in the test area after two weeks from the beginning of test, but it was seen in the other creeks outside test area. Therefore, it is deemed that the equipment was sufficiently effective to remove thick algal belt in creek area.

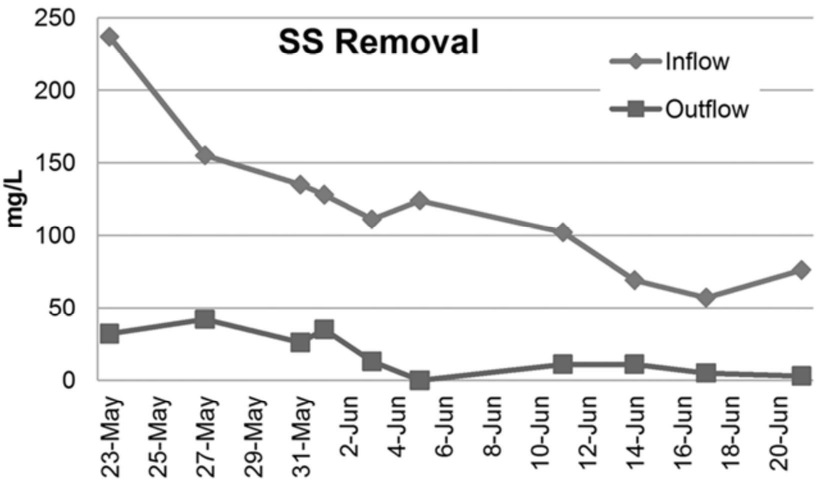
Algal belt staying near raft at early period of test

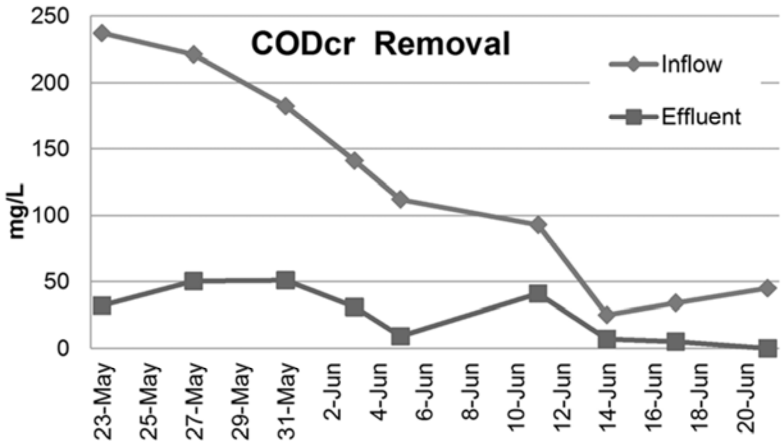
No algal belt observed two weeks after the test start (3rd June)

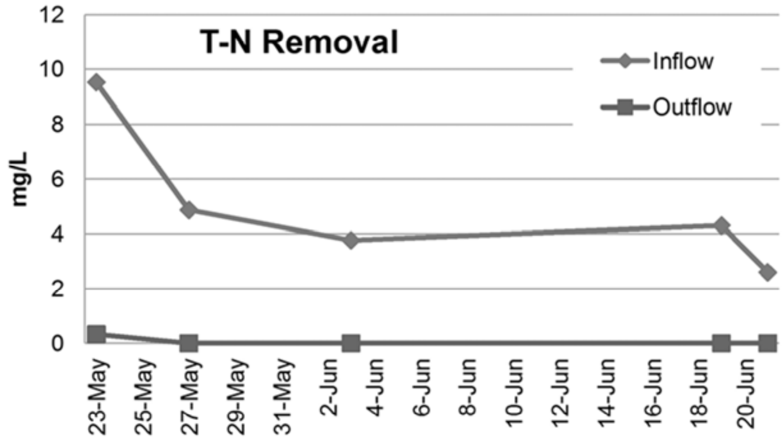
3) Water treatment capacity of test equipment

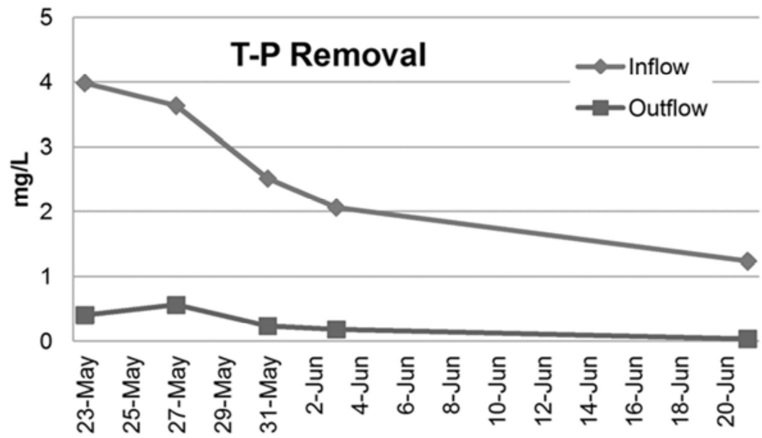
＜Method＞

Sampling were implemented, one from influent into the collection tank on raft and the other from treated water with algae removed through pressurized floatation, and they were measured SS, CODcr, T-N and T-P, and compared each other.




CODcr Removal
Inflow
Effluent
mg/L
250
200
150
100
50
0
23-May
25-May
27-May
29-May
31-May
2-Jun
4-Jun
6-Jun
8-Jun
10-Jun
12-Jun
14-Jun
16-Jun
18-Jun
20-Jun


T-N Removal
Inflow
Outflow
mg/L
12
10
8
6
4
2
0
23-May
25-May
27-May
29-May
31-May
2-Jun
4-Jun
6-Jun
8-Jun
10-Jun
12-Jun
14-Jun
16-Jun
18-Jun
20-Jun

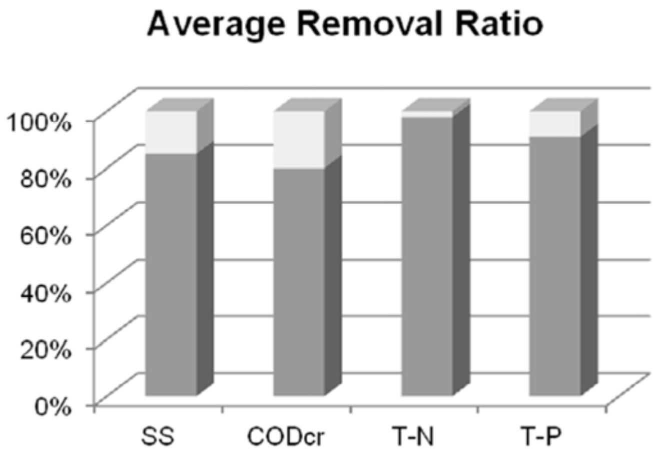

T-P Removal
Inflow
Outflow
mg/L
5
4
3
2
1
0
23-May
25-May
27-May
29-May
31-May
2-Jun
4-Jun
6-Jun
8-Jun
10-Jun
12-Jun
14-Jun
16-Jun
18-Jun
20-Jun

＜The result and observation＞

Getting into rainy season, concentrations of SS, CODcr, T-N and T-P in the influent were gradually decreased as rainfall volume increased.

However, concentrations of those in the treated water were always lower than those in the influent. Therefore it was deemed that the treatment by the equipment was properly made.

Average removal ratio of each parameter is as follows:



All parameters shows removal ratio of 80 to 90% that proves the equipment is effective for purification of water quality.

For details of data, refer to the attached data "Water Quality of Inflow and Outflow".

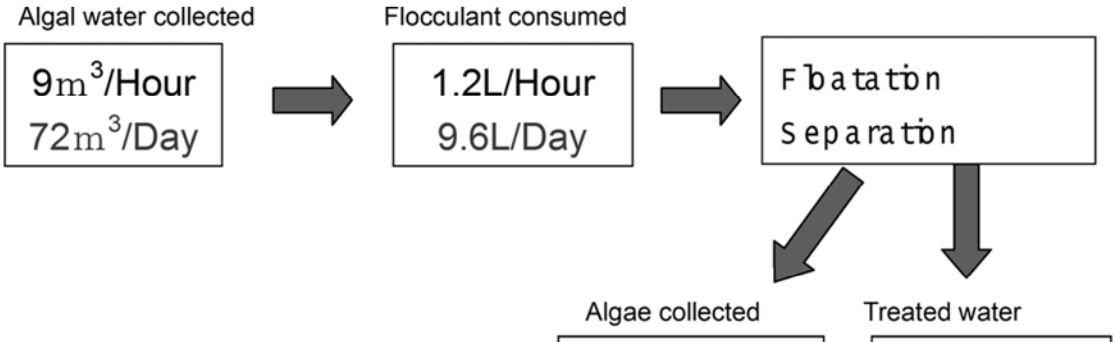
4) Pictures of raw water, treated water and collected algae after treatment

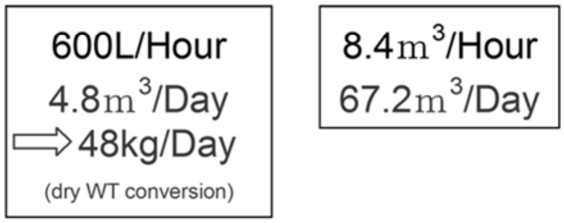
From the left: Raw water, treated water (returned water), collected algae
(Sampling collected on 2013/6/21)

It is apparent that the treated water is very clear and pure compared to raw water.

9. Estimation of Material Balance, Required Days and Cost of Expendables in case of purification of entire Kandawgyi Lake with the equipment

1) Material Balance (under rated operation)





Left: Algae Influent   Right: Treated water returned to the lake

- 48kg of blue-green algae (dry weight conversion) was removed from 72m^3 of algal water per day
- 67.2 m^3 of treated water was returned to Kandawgyi Lake.

2) Required days and cost of treatment for the entire lake with the equipment

- Required days

  Presuming 0.5m of water depth with algae to the entire lake area of 430,000m^2

  Total volume of algal water: 430,000m^2 x 0.5m=215,000 m^3

  Total volume of algae (SS conversion):

  215,000 m^3 x 121.3mg/L(average SS in the test)= 26,080kg

  i.e. Required days: 26,080kg/48kg=543 days

- Cost of expendables

  According to the result of the demonstration test

  14,000JPY (flocculant + diesel fuel)/day x 543days =7,602,000JPY

10. Conclusion

Continuous operation started on 23rd May. From the 1st June, rated capacity was demonstrated under the condition such as water treatment volume of 150L/min and flocculant feeding rate of 250mg/L, which was close to the planned condition, by adjusting inflow water volume and flocculant feeding volume.
Then, flocculant feeding rate was adjusted at 205mg/L from 19th June.
The average removal ratio under the above condition was, 85% for SS, 80% for CODcr, 98% for T-N and 91% for T-P during the test period.

The test showed that algae were removed properly not only when their density was high but also when they were spread by rainfall and high removal ratio was achieved for T-N and T-P. It was confirmed that the equipment achieved sufficiently its function and capability.

The area of test site is 3,500m^2 which is 1/123 of the total lake of 0.43 km^2. Assuming if no newly developed algae are considered by the eutrophicated sludge at the bottom of lake, it will require approximately 530 days to remove algae from the entire lake with the same equipment.
It is assumed to require 53 days for removal of algae if equipment of ten times of the capacity (e.g. 5 units of twice capacity) is used.
Therefore, it is expected to be able to remove blue-green algae more effectively by using this equipment intensively for three to four months period in dry season when there is little spread of algae.

11. Future Issues

1) It is deemed that the return of 72m^3 of treated clear water to the lake contributes to the improvement of transparency and of diminution of algae. However, since the test was implemented in rainy season, and so, floating algae spread widely in the water because of large volume of rainfall, it is assumed that algae collecting rate has decreased. Therefore, it shall be necessary to implement the test further in dry season.

2) Collected blue-green algae of 48kg/day (dry weight conversion) contain rich phosphorus and nitrogen and are expected to be useful material for organic fertilizer. YCDC is very much interested in recycle of those. Therefore, as for the blue-green algae collected in this test, we will undertake componential analysis later and will research recycle possibility also.

Attachment

(A) Operation Record

(B) Water Quality of Sampling Points

(C) Water Quality of Inflow and Outflow

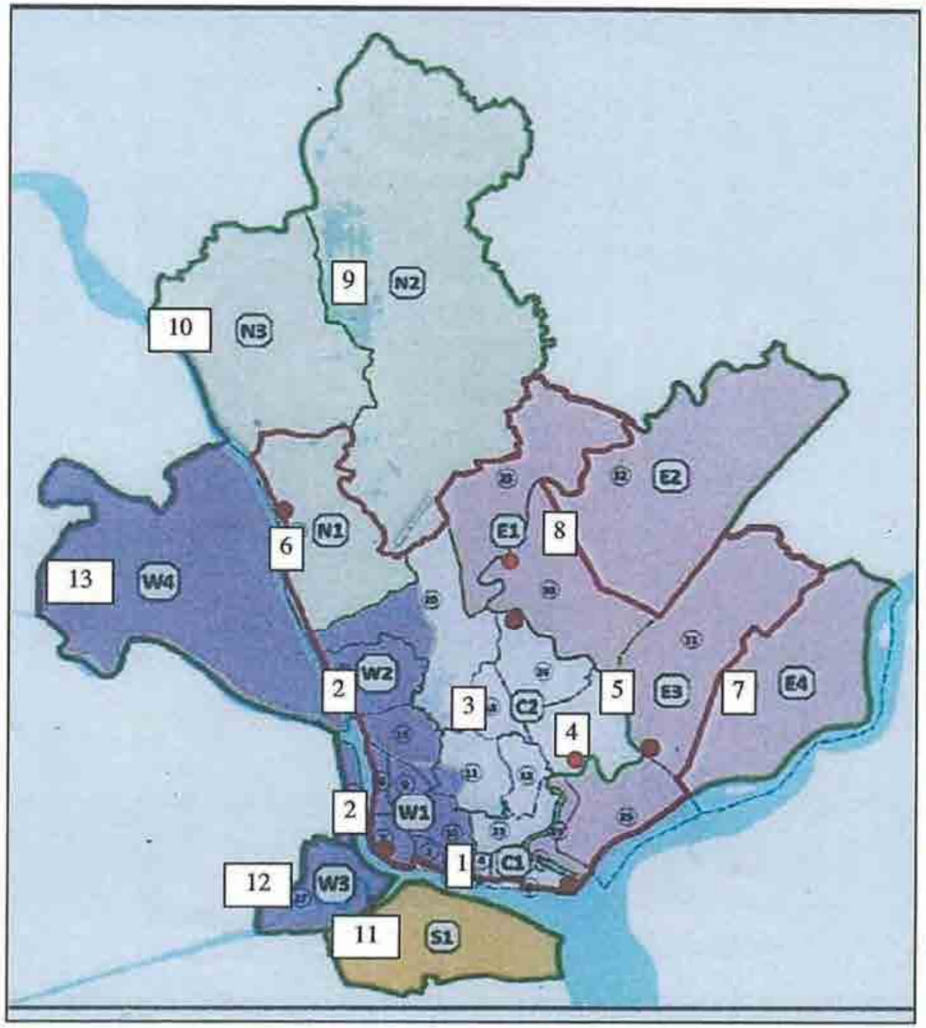
(D) Document for Report Meeting at YCDC on 25th June:
"Blue-green Algae Processing Test in Kandawgyi Lake

K. CHANGE OF SITES FOR WWTPS

The following WWTP sites were changed. Location map is shown in Figure K.1.

C2+E1	Permission from Ministry of Information could not be obtained to use a land, of which area is 44 acre. Therefore, only 22.86 acre is available at the current site (ref. to Figure K.2). Reformation of C2+E1 sewerage zone is necessary.
C2+ E1	A new land with 5.142 acre is proposed in Thingangyun Township (ref. to Figure K.3). Reformation of C2+E1 sewerage zone is necessary.
E1+E2	A new land with 23 acre was obtained in North Dagon Township (ref. to Figure K.4). E2 sewerage zone is to be combined with E1 sewerage zone.
N1	A new land with 11 acre was obtained near the current WWTP. However the land is divided into two parts by a main road (ref. to Figure K.5).
E3	Permission for land acquisition could not be obtained. E3 sewerage zone is to be combined with C2 sewerage zone.

Sewerage Zones



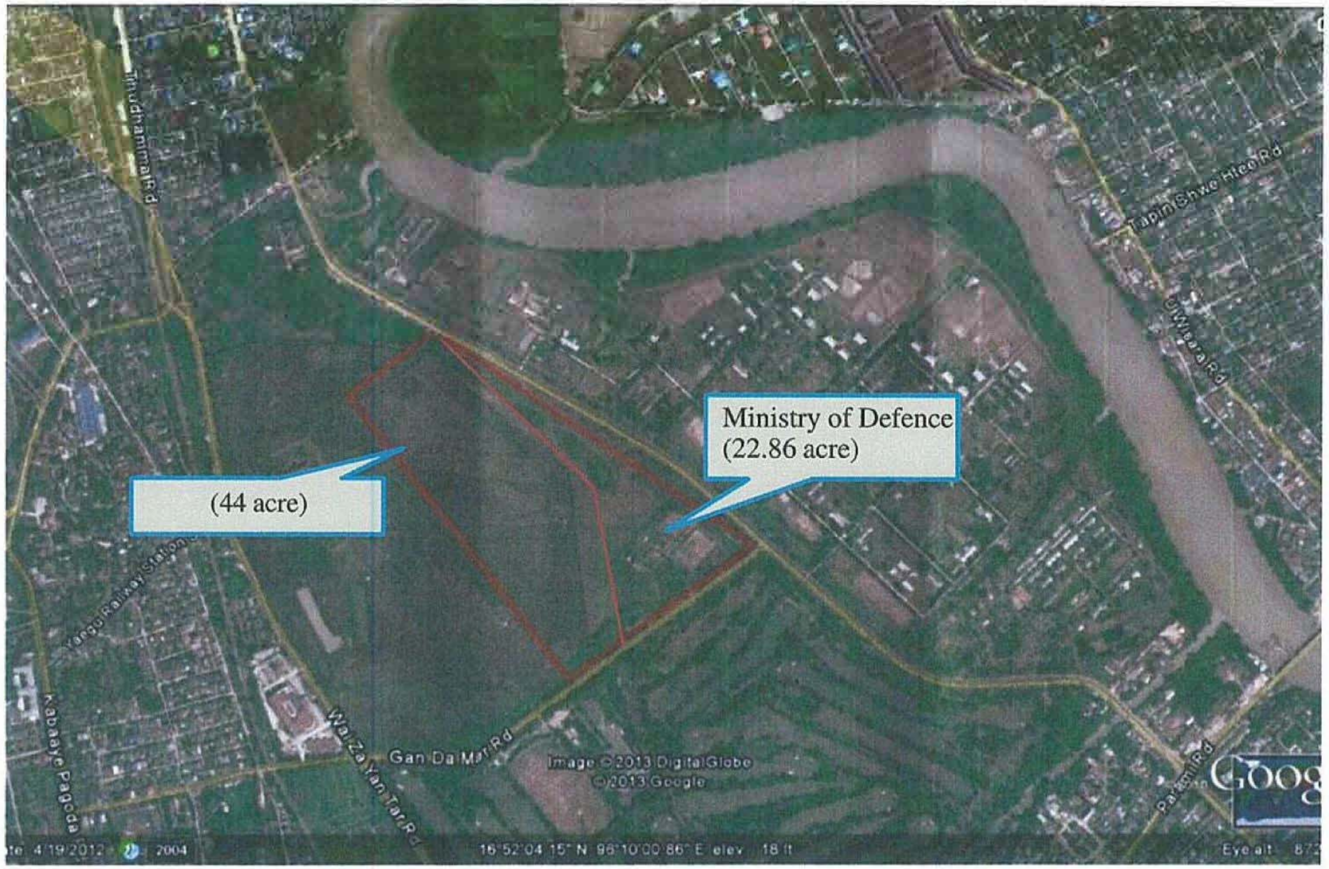
Sr	Zone	Township
1	C1	Pazundaung, Botahtaung, Kyauktada, Pabedan
2	W1+W2	Lanmadaw , Latha, Ahlone , a part of Kyee Myin Daing , Dagon , a part of Bahan , Kamaryut , Sanchaung, Hlaing , a part of Mayangone
3	C2+E1	a part of Bahan, Mingalar Taung Nyunt, Yankin, Tamwe, South Okkalapa, a part of Mayangone, North Okkalapa
4	C2+E1	Thingangyun
5	E3	Taketa, Dawbon, South Dagon
6	N1	Insein
7	E4	Dagon Seikkan
8	E1 + E2	North Dagon, East Dagon
9	N2	Mingalardon
10	N3	Shwe Pyi Thar
11	S1	Dala
12	W3	A part of Kyee Myin Daing, Seikgyikhanaungto, Seikkan
13	W4	Hlaing Tharyar

Source: YCDC

Figure K.1 Change of Sites for WWTPs, Location Map

ဇုန် (C2+E1) Mayangone

Existing Area : (22.86 Acre)



Source: YCDC

Figure K.2 Change of Sites for C2+E1 WWTP

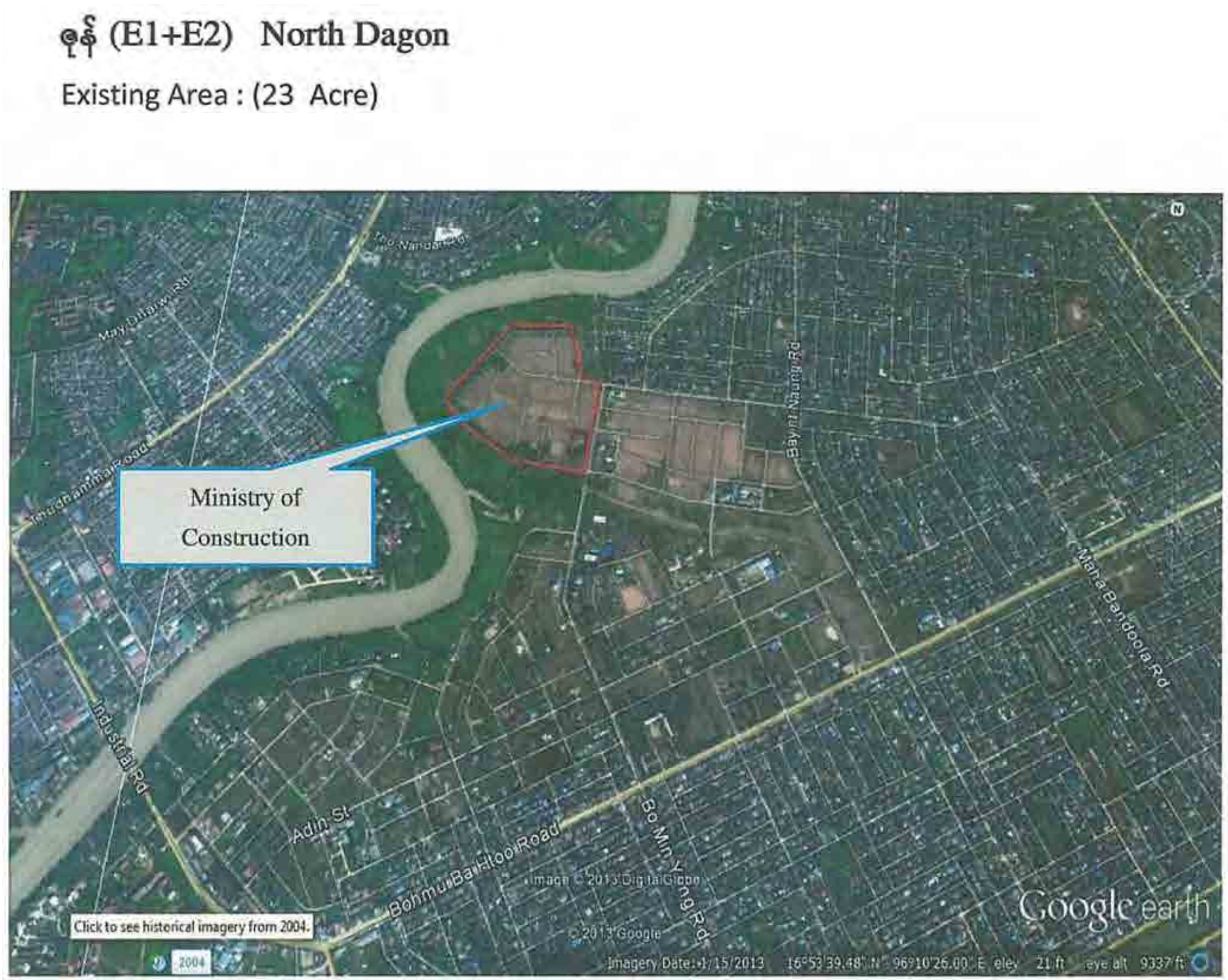
ဇုန် (C2+E1) Thingangyun

Existing Area : (5.142 Acre)

(2) Storey (or) Multi Storey

Source: YCDC

Figure K.3 Change of Sites for C2+E1 WWTP



Source: YCDC

Figure K.4 Change of Sites for E1+E2 WWTP

ဇုန် (N1) Insein

Existing Area : (11 Acre)

Source: YCDC

Figure K.5 Change of Sites for N1 WWTP