HA NAM PROVINCE PEOPLE'S COMMITTEE

PREPARATORY SURVEY ON HA NAM PROVINCE INVESTMENT CLIMATE IMPROVEMENT PROJECT IN VIETNAM

FINAL REPORT

VOLUME II
APPENDICES

MARCH 2019

JAPAN INTERNATIONAL COOPERATION AGENCY

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VOLUME I: MAIN REPORT

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APPENDIX1:
SEWERAGE SECTOR

1. Standards related to the Project (Sewerage Sector)

1.1 QCVN 28:2010/BTNMT

The maximum value (C_{max}) of the factors and pollutants in the medical wastewater when being discharged from the outlet is calculated as follows:

$$C_{max} = C \times K$$

In particular: C is the value of the factors and the pollutants as the basis for calculating C_{max}, specified in **Table 1.1**. K is the coefficient of the scale and the form of the medical facility, specified in **Table 1.2**. The factors of pH, *total coliforms, Salmonella, Shigella* and *Vibrio cholera* in the medical wastewater, use the coefficient K=1.

Table 1.1 Value of C of Pollution Factors

No.	Factor	Unit	Value of C	
			A	B
1	pH	-	6.5 – 8.5	6.5 – 8.5
2	BOD_5 (20^0C)	mg/l	30	50
3	COD	mg/l	50	100
4	Total suspended solid (TSS)	mg/l	50	100
5	Sulfur (in H_2S)	mg/l	1.0	4.0
6	Ammonium (in N)	mg/l	5	10
7	Nitrate (in N)	mg/l	30	50
8	Phosphate (in P)	mg/l	6	10
9	Vegetable oil and animal fat	mg/l	10	20
10	Gross α activity	Bq/l	0.1	0.1
11	Gross β activity	Bq/l	1.0	1.0
12	*Gross coliforms*	MPN/ 100ml	3000	5000
13	*Salmonella*	Bacteria/100ml	Not found	Not found
14	*Shigella*	Bacteria/100ml	Not found	Not found
15	*Vibrio cholerae*	Bacteria/100ml	Not found	Not found

Notes:
The factor of gross α activity and β activity are only applicable to the medical facilities that use radioactive sources.
In Table 1:
Column A provides the value of C of the factors and the pollutants as the basis for calculating the limits in medical wastewater when being discharged into the sources of water for living. Column B provides the value of C of the factors and the pollutants as the basis for calculating the limits in medical wastewater when being discharged into the sources of water not for living.
The medical wastewater being discharged into the common sewer of residential areas shall apply the value of C in column B. The medical wastewater being discharged into the collecting system and taken to concentrated sewage treatment site must be sterilized, other factors and pollutants shall apply the provisions of the operators of the concentrated sewage treatment system.

Table 1.2 Value of K-Factor

Type	Scope	Value of K- factor
Hospital	> = 300 beds	1,0
	< 300 beds	1,2
Other clinics		1,2

1.2 QCVN 14:2008/BTNMT

1.2.1 General Provisions

1.2.1.1 Scope of adjustment

This regulation specifies the permissible maximum value of the pollution parameters in the domestic wastewater being discharged into the environment. Do not apply this Regulation for domestic wastewater discharged into the concentrated wastewater treatment system.

1.2.1.2 Subjects of application

This regulation applies to public institutions, armed forces barracks, service facilities, apartment buildings and residential areas and businesses discharging domestic wastewater into the environment.

1.2.1.3 Explanation of terms

In this Regulation, the terms below are construed as follows:

1) Domestic wastewater is the wastewater discharged from human activities of people such as eating, drinking, bathing, personal hygiene.

2) The water resource receiving wastewater is the surface water resource or coastal waters with a specified purpose of use and is the place where the wastewater is discharged into.

1.2.2 Technical Regulations

1.2.2.1 Permissible maximum value of pollution parameters in domestic wastewater

Permissible maximum value of pollution parameters in domestic wastewater as being discharged into the water resource receiving wastewater must not exceed C_{max} value calculated as follows:

$C_{max} = C \times K$

In which:

C_{max} is the permissible maximum concentration of pollution parameters in domestic wastewater as being discharged into the receiving water resource calculated by milligram per liter of wastewater (mg/l);

C is the concentration values of pollution parameters specified in **Section 1.2.2.2.**

K is a coefficient taking into account the size and type of services facilities, public facilities and condominium specified in **Section 1.2.2.3**.

Do not apply the formula for calculating the permissible maximum concentration in effluent for parameter pH and total coliforms.

1.2.2.2 C value of pollution parameters as a basis for calculating the permissible maximum value

C value of pollution parameters as a basis for calculating the permissible maximum value C_{max} in domestic wastewater as being discharged into water resources receiving wastewater as specified in **Table 1.3**.

Table 1.3 Value of pollution parameters as a basis for calculating the permissible maximum value in domestic wastewater

No.	Parameter	Unit	C value	
			A	B
1	pH	-	5 - 9	5 - 9
2	BOD_5 (200C)	mg/l	30	50
3	Total suspended solids (TSS)	mg/l	50	100
4	Total dissolved solids	mg/l	500	1000
5	Sulfide (as H_2S)	mg/l	1.0	4.0
6	Ammonium (as N)	mg/l	5	10
7	Nitrate (NO_3^-) (as N)	mg/l	30	50
8	Animal fat and vegetable grease	mg/l	10	20
9	Total surface-active substances	mg/l	5	10
10	Phosphate (PO_4^{3-}) (as P)	mg/l	6	10
11	Total coliforms	MPN/ 100ml	3,000	5,000

In which:

- Column A specifies value of pollution parameters as a basis for calculating the permissible maximum value in domestic wastewater as being discharged into water resources used for the purpose of domestic water supply (with water quality equivalent to that in column A1 and A2 of the national technical Regulation on surface water quality).

- Column B specifies C value of pollution parameters as a basis for calculating the permissible maximum value in domestic wastewater as being discharged into water resources not used for the purpose of domestic water supply (with water quality equivalent to that in column B1 and B2 of the

national technical Regulation on surface water or coastal water quality).

1.2.2.3 Value of K coefficient

Depending on the type, size and area of use of service facilities, public facilities, apartment buildings and residential areas, businesses, the K value is applied under **Table 1.4**.

Table 1.4 Value of K coefficient corresponding to type of service facilities, public facilities, apartment buildings

Type of facilities	Size and area of use of facilities	Value of K coefficient
1. Hotel, rest house	From 50 rooms or hotel rated 3 stars or higher	1
	Less than 50 rooms	1.2
2. Agencies, offices, schools, research institutions	Greater than or equal to 10,000 m^2	1.0
	Less than 10,000 m^2	1.2
3. Department stores, supermarkets	Greater than or equal to 5,000 m^2	1.0
	Less than 5,000 m^2	1.2
4. Markets	Greater than or equal to 1,500 m^2	1.0
	Less than 1,500 m^2	1.2
5. Restaurants, food stores	Greater than or equal to 500 m^2	1.0
	Less than 500 m^2	1.2
6. Production facilities, armed force barracks	From 500 people or more	1.0
	Less than 500 people	1.2
7. Condominiums, residential areas	From 50 apartments or more	1.0
	Less than 50 apartments	1.2

2. Water Supply Plan in Hospital

2.1 Hospital Area

Hospital area includes three communes, namely, Liem Tiet, Liem Tuyen, Dinh Xa. At present, clean water is supplied by Rural Clean Water Center (RCWC). RCWC has two water supply plants servicing water to the communes, as shown in **Table 2.1**.

In addition, Hanwako also install water supply pipe with diameter 600 mm in the hospital area for the future demand in the area.

Table 2.1 Water Supply Plan of RCWC

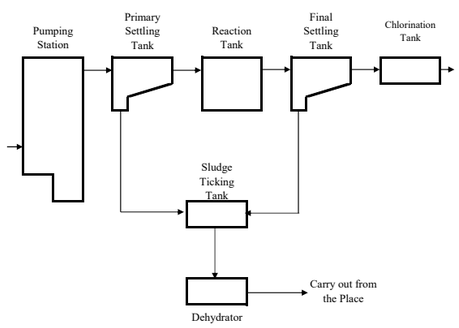
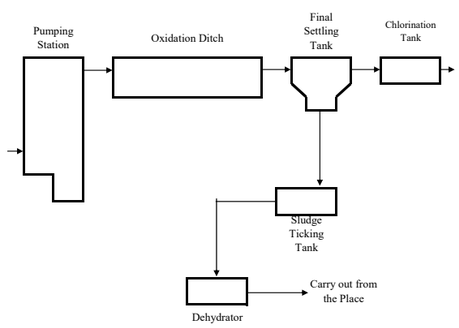
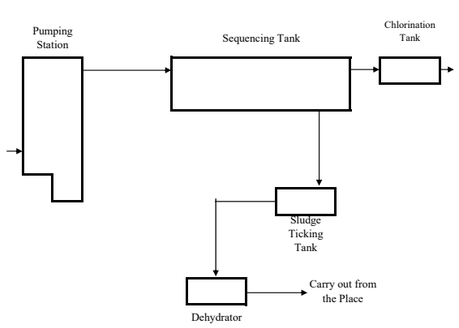
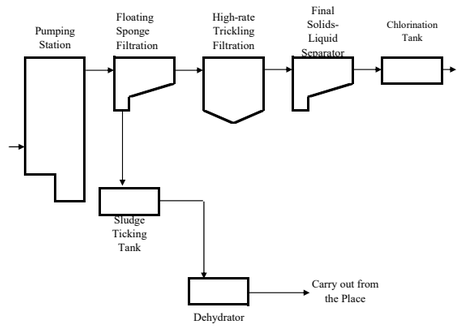
	Present Capacity (m^3/day)…(1)	Population …(2)	Future Capacity (2030) (m3/day)…(3)	Population for Future Capacity…(4)	(1)/1000×(2) (L/capita/day)	(3)/1000×(4) (L/capita/day)
WTP, covering Liem Tiet, Liem Tuyen	1,200	8,116	4,500[2)]	12,778	148	352[2)]
WTP, covering Dinh Xa	1,200	13,921	8,000	43,721	86[1)]	183

Note 1) Water supply per capita is not large because most of household use together with water from RCWC and groundwater.

Note 2) Water supply per capita is large because the future capacity is set including water demand Back Mai and Viet Duc Hospitals

Source: RCWC

3. Comparison Review of the Processing Method

Item		Conventional Activated Sludge Process	Oxidation Ditch Process	Sequencing Batch Process	Pre-treated Tricking Filtration Process
Summary		Conventional Activated Sludge Process consists of Primary setting tank, Reaction tank and Final setting tank. Also, this process utilizes activated sludge microorganisms. Currently, it is adopted in many Wastewater Treatment Plant.	Oxidation Ditch Process consists of Reaction tank , Final setting tank. This process omits the Primary setting tank. The operation management is easy by adopting mechanical aeration.	Sequencing Batch Process consists of only one Reaction tank. Also, this process is an activated sludge process in which Inflow, Reaction, Precipitation and Effluent is done in the reaction tank. It is difficult to operation and maintenance of this process.	Pre-treated Tricking Filtration Process consists of Floating Sponge Filtration, High-rate Trickling Filtration, Final Solids-Liquid Separator. This process is biofilm treatment method of filtration and microorganisms attached to filter material. It is an alternative wastewater treatment technology of conventional activated sludge process.
Process Flow					
Consideration of Design Removal Ratio		BOD:90～95%	BOD:90～95%	BOD:90～95%	BOD:90%
		SS:90～95%	SS:90～95%	SS:90～95%	SS:90%
Evaluation		○	○	○	○
Required land Area		Small area	Large area	Small area	Small area
Evaluation		○	△	○	○
Design Sludge Generation Volume		Many sludge	Few sludge	Many sludge	Few sludge
Evaluation		△	○	△	○
Power Consumption Amount		・0.4kwh/m3	・0.8kwh/m3	・0.9kwh/m3	・0.1kwh/m3
Evaluation		○	△	△	○
Operation		Ordinarily	Easy	Very Difficult	Easy
Evaluation		○	◎	△	◎
Maintenance		Ordinarily	Easy	Difficult	Easy
Evaluation		○	◎	△	◎
Estimated Construction Costs Case of Q=3,000m3/d	**Initial Cost (Civil engineering and Architecture)**	・354 million yen	・380 million yen	・448 million yen	・395 million yen
	Initial Cost (Mechanical and Electric)	・528 million yen	・431 million yen	・526 million yen	・498 million yen
	Electricity Cost(15years)	・0.4kwh/m3×3,000m3/d×365days×20yen/m3×15years≒130 million yen	・0.8kwh/m3×3,000m3/d×365days×20yen/m3×15years≒260 million yen	・0.9kwh/m3×3,000m3/d×365days×20yen/m3×15years≒300 million yen	・0.1kwh/m3×3,000m3/d×365days×20yen/m3×15years≒40 million yen
	Life Cycle Cost	**1,012 million yen(337,000yen/m3)**	**1,071 million yen(357,000yen/m3)**	**1,274 million yen(425,000yen/m3)**	**933 million yen(311,000yen/m3)**
Evaluation		○	△	△	◎
Comprehensive Evaluation		○	○	△	◎

4. Flow Calculation

Flow Calculation Table - 1/5

Hospital Area Treatment Area

Unit flow **0.000103** $m^3/s \cdot ha$

No	Inflow No	Treatment Area		Design Wastewater Flow						Section Characteristics								Remaks
				Domestic		Factory		Other	Total WW Flow	Diameter	Slope	Velocity	Capacity	Length	Invert EL	Ground EL	Cover	
		Unit Area	Total Area	Flow per hectare	WW Flow	Flow per hector	WW Flow								Upper Lower	Upper Lower	Upper Lower	
		ha	ha	$m^3/s \cdot ha$	m^3/s	$m^3/s \cdot ha$	m^3/s	m^3/s	m^3/s	mm	‰	m/s	m^3/s	m	m	m	m	
25		45.25	45.25		0.005				0.005	HDPE ◎ 300	2.1	0.8	0.035	260.00	-0.979 -1.525	1.33 1.33	2.00 2.55	
25A-1	F1 F2	3.27	(74.22) 122.74		0.013				0.013	HDPE ◎ 300	2.1	0.8	0.035	231.00	-1.525 -2.010	1.33 1.75	2.55 3.45	
25A-2	G7	14.81	(4.55) 142.10		0.015				0.015	HDPE ◎ 300	2.1	0.8	0.035	790.00	-2.010 -3.669	1.75 2.20	3.45 5.56	
26-1	27A F3,F4	7.42	(147.78) 297.30		0.031				0.031	HDPE ◎ 300	2.1	0.8	0.035	347.00	0.391 -0.338	2.20 1.24	1.50 1.27	
26-2	G8	18.55	(23.28) 339.13		0.035				0.035	HDPE ◎ 300	2.1	0.8	0.035	655.00	-0.763 -2.139	1.24 1.24	1.69 3.07	
2	1-2	15.72	(36.70) 391.55		0.040				0.040	RC ◎ 400	2.4	0.9	0.085	578.00	-2.239 -3.626	3.55 3.65	5.33 6.81	
3	15	18.23	(30.66) 440.44		0.045				0.045	RC ◎ 400	2.4	0.9	0.085	575.00	-3.626 -5.006	3.65 3.65	6.81 8.19	
4	18	0.46	(86.82) 527.72		0.054				0.054	RC ◎ 400	2.4	0.9	0.085	50.00	-5.006 -5.126	3.65 3.65	8.19 8.31	
5	20-2	2.32	(22.44) 552.48		0.057				0.057	RC ◎ 400	2.4	0.9	0.085	255.00	-5.126 -5.738	3.65 3.63	8.31 8.91	
6	F8 23	8.50	(62.17) 623.15		0.064				0.064	RC ◎ 400	2.4	0.9	0.085	742.00	-5.738 -7.519	3.63 3.50	8.91 10.56	
9	8 11	2.39	(242.14) 867.68		0.089				0.089	RC ◎ 500	1.7	0.9	0.142	210.00	-7.619 -7.976	3.50 3.65	10.55 11.06	
10	G11	40.30	(22.02) 930.00		0.096				0.096	RC ◎ 500	1.7	0.9	0.142	1004.00	-7.976 -9.683	3.65 3.65	11.06 12.76	
Flow to WWTP																		

Flow Calculation Table - 2/5

Hospital Area Treatment Area

Unit flow **0.000103** $m^3/s \cdot ha$

No	Inflow No	Treatment Area		Design Wastewater Flow						Section Characteristics								Remaks
				Domestic		Factory		Other	Total WW Flow	Diameter	Slope	Velocity	Capacity	Length	Invert EL	Ground EL	Cover	
		Unit Area	Total Area	Flow per hectare	WW Flow	Flow per hector	WW Flow								Upper Lower	Upper Lower	Upper Lower	
		ha	ha	$m^3/s \cdot ha$	m^3/s	$m^3/s \cdot ha$	m^3/s	m^3/s	m^3/s	mm	‰	m/s	m^3/s	m	m	m	m	
F1		54.00	54.00		0.006				0.006	HDPE ◎ 300	2.1	0.8	0.035	1140.00	0.991 -1.403	3.30 3.20	2.00 4.29	
Flow to 25A-1																		
F2		20.22	20.22		0.002				0.002	HDPE ◎ 300	2.1	0.8	0.035	424.00	0.891 0.001	3.20 3.20	2.00 2.89	
Flow to 25A-1																		
G7		4.55	4.55		0.000				0.000	HDPE ◎ 300	2.1	0.8	0.035	150.00	-0.429 -0.744	1.88 3.20	2.00 3.64	
Flow to 25A-2																		
F3		28.01	28.01		0.003				0.003	HDPE ◎ 300	2.1	0.8	0.035	705.00	0.891 -0.590	3.20 2.20	2.00 2.48	
Flow to 26-1																		
27		13.31	13.31		0.001				0.001	HDPE ◎ 300	2.1	0.8	0.035	316.00	0.801 0.137	3.11 2.20	2.00 1.75	
27A	G6	33.64	(18.23) 65.18		0.007				0.007	HDPE ◎ 300	2.1	0.8	0.035	976.00	-0.323 -2.373	2.70 3.20	2.71 5.26	
Flow to 26-1																		
G6		18.23	18.23		0.002				0.002	HDPE ◎ 300	2.1	0.8	0.035	340.00	0.391 -0.323	2.70 2.13	2.00 2.14	
Flo to 27A																		
F4		54.59	54.59		0.006				0.006	HDPE ◎ 300	2.1	0.8	0.035	992.00	0.891 -1.192	3.20 2.20	2.00 3.08	
Flow to 26-1																		
G8		23.28	23.28		0.002				0.002	HDPE ◎ 300	2.1	0.8	0.035	460.00	0.203 -0.763	2.51 3.35	2.00 3.80	
Flow to 26-2																		
1-1		16.05	16.05		0.002				0.002	HDPE ◎ 300	2.1	0.8	0.035	415.00	1.141 0.270	3.45 2.03	2.00 1.45	
1-2	G9	9.07	(11.58) 36.70		0.004				0.004	HDPE ◎ 300	2.1	0.8	0.035	456.00	-1.035 -1.993	2.03 3.55	2.76 5.23	
Flow to 2																		
G9		11.58	11.58		0.001				0.001	HDPE ◎ 300	2.1	0.8	0.035	360.00	-0.279 -1.035	2.03 2.03	2.00 2.76	
Flow to 1-2																		

Flow Calculation Table - 3/5

Hospital Area Treatment Area

Unit flow **0.000103** $m^3/s \cdot ha$

No	Inflow No	Treatment Area		Design Wastewater Flow						Section Characteristics								Remaks
				Domestic		Factory		Other	Total WW Flow	Diameter	Slope	Velocity	Capacity	Length	Invert EL	Ground EL	Cover	
		Unit Area	Total Area	Flow per hectare	WW Flow	Flow per hector	WW Flow								Upper Lower	Upper Lower	Upper Lower	
		ha	ha	$m^3/s \cdot ha$	m^3/s	$m^3/s \cdot ha$	m^3/s	m^3/s	m^3/s	mm	‰	m/s	m^3/s	m	m	m	m	
F5		23.56	23.56		0.002				0.002	HDPE ◎ 300	2.1	0.8	0.035	520.00	0.891 -0.201	3.20 3.20	2.00 3.09	
15		7.10	30.66		0.003				0.003	HDPE ◎ 300	2.1	0.8	0.035	398.00	-0.201 -1.037	3.20 3.65	3.09 4.38	
Flow to 3																		
18	17-2 19	7.05	(79.77) 86.82		0.009				0.009	RC ◎ 300	3.0	0.8	0.036	420.00	-1.376 -2.636	3.50 3.65	4.52 5.93	
Flow to 4																		
17-1		29.48	29.48		0.003				0.003	HDPE ◎ 300	2.1	0.8	0.035	415.00	1.041 0.170	3.35 3.50	2.00 3.02	
17-2	G5	4.30	(12.91) 46.69		0.005				0.005	HDPE ◎ 300	2.1	0.8	0.035	213.00	-0.402 -0.849	3.50 3.50	3.59 4.04	
Flow to 18																		
G5		12.91	12.91		0.001				0.001	HDPE ◎ 300	2.1	0.8	0.035	330.00	0.291 -0.402	2.60 3.50	2.00 3.59	
Flow to 17-2																		
G4		11.28	11.28		0.001				0.001	HDPE ◎ 300	2.1	0.8	0.035	310.00	0.291 -0.360	2.60 3.60	2.00 3.65	
19		21.80	33.08		0.003				0.003	HDPE ◎ 300	2.1	0.8	0.035	484.00	-0.360 -1.376	3.60 3.50	3.65 4.57	
Flow to 18																		
20-1		19.09	19.09		0.002				0.002	HDPE ◎ 300	2.1	0.8	0.035	660.00	0.791 -0.595	3.10 3.65	2.00 3.94	
20-2		3.35	22.44		0.002				0.002	HDPE ◎ 300	2.1	0.8	0.035	330.00	-0.595 -1.288	3.65 3.65	3.94 4.63	
Flow to 5																		

Flow Calculation Table - 4/5

Hospital Area Treatment Area

Unit flow **0.000103** $m^3/s \cdot ha$

No	Inflow No	Treatment Area		Design Wastewater Flow						Section Characteristics								Remaks
				Domestic		Factory		Other	Total WW Flow	Diameter	Slope	Velocity	Capacity	Length	Invert EL	Ground EL	Cover	
		Unit Area	Total Area	Flow per hectare	WW Flow	Flow per hector	WW Flow								Upper Lower	Upper Lower	Upper Lower	
		ha	ha	$m^3/s \cdot ha$	m^3/s	$m^3/s \cdot ha$	m^3/s	m^3/s	m^3/s	mm	‰	m/s	m^3/s	m	m	m	m	
21		10.59	10.59		0.001				0.001	HDPE ◎ 300	2.1	0.8	0.035	358.00	0.791 0.039	3.10 2.80	2.00 2.45	
23	22	8.33	(30.76) 49.68		0.005				0.005	HDPE ◎ 300	2.1	0.8	0.035	580.00	-1.019 -2.237	2.80 3.63	3.51 5.56	
Flow to 6																		
24		9.81	9.81		0.001				0.001	HDPE ◎ 300	2.1	0.8	0.035	140.00	0.491 0.197	2.80 2.80	2.00 2.29	
22	G3	5.11	(15.84) 30.76		0.003				0.003	HDPE ◎ 300	2.1	0.8	0.035	227.00	-0.542 -1.019	2.80 2.80	3.03 3.51	
Flow to 23																		
G3		15.84	15.84		0.002				0.002	HDPE ◎ 300	2.1	0.8	0.035	492.00	0.491 -0.542	2.80 2.80	2.00 3.03	
Flow to 22-2																		
F8		12.49	12.49		0.001				0.001	HDPE ◎ 300	2.1	0.8	0.035	450.00	1.191 0.246	3.50 3.63	2.00 3.08	
Flow to 6																		
12-1		3.97	3.97		0.000				0.000	HDPE ◎ 300	2.1	0.8	0.035	172.00	1.191 0.830	3.50 3.50	2.00 2.36	
12-2	G10	11.14	(0.00) 15.11		0.002				0.002	HDPE ◎ 300	2.1	0.8	0.035	698.00	-0.720 -2.186	3.50 3.30	3.91 5.18	
13-1	F6	2.57	(48.45) 66.13		0.007				0.007	RC ◎ 300	3.0	0.8	0.036	92.00	-2.186 -2.462	3.30 3.30	5.13 5.41	
13-2		12.43	78.56		0.008				0.008	RC ◎ 300	3.0	0.8	0.036	390.00	-2.462 -3.632	3.30 3.41	5.41 6.69	
14	F7	28.47	(40.80) 147.83		0.015				0.015	RC ◎ 400	2.4	0.9	0.085	335.00	-3.632 -4.436	3.41 3.50	6.58 7.47	
8	7-2	0.42	(15.61) 163.86		0.017				0.017	RC ◎ 400	2.4	0.9	0.085	70.00	-4.436 -4.604	3.50 3.50	7.47 7.64	
Flow to 9																		
G10		0.00	0.00		0.000				0.000	HDPE ◎ 300	2.1	0.8	0.035	210.00	-0.279 -0.720	2.03 3.50	2.00 3.91	
Flow to 12-2																		
F6		48.45	48.45		0.005				0.005	HDPE ◎ 300	2.1	0.8	0.035	670.00	1.241 -0.166	3.55 3.30	2.00 3.16	
Flow to 13-1																		

Flow Calculation Table - 5/5

Hospital Area Treatment Area

Unit flow **0.000103** $m^3/s \cdot ha$

No	Inflow No	Treatment Area		Design Wastewater Flow						Section Characteristics								Remaks
				Domestic		Factory		Other	Total WW Flow	Diameter	Slope	Velocity	Capacity	Length	Invert EL	Ground EL	Cover	
		Unit Area	Total Area	Flow per hectare	WW Flow	Flow per hector	WW Flow								Upper Lower	Upper Lower	Upper Lower	
		ha	ha	$m^3/s \cdot ha$	m^3/s	$m^3/s \cdot ha$	m^3/s	m^3/s	m^3/s	mm	‰	m/s	m^3/s	m	m	m	m	
F7		40.80	40.80		0.004				0.004	HDPE ◎ 300	2.1	0.8	0.035	725.00	1.341 -0.182	3.65 3.41	2.00 3.28	
Flow to 14																		
7-1		9.84	9.84		0.001				0.001	HDPE ◎ 300	2.1	0.8	0.035	313.00	1.341 0.684	3.65 3.50	2.00 2.51	
7-2		5.77	15.61		0.002				0.002	HDPE ◎ 300	2.1	0.8	0.035	336.00	0.681 -0.025	3.50 3.50	2.51 3.22	
Flow to 8																		
F9		10.01	10.01		0.001				0.001	HDPE ◎ 300	2.1	0.8	0.035	530.00	1.141 0.028	3.45 3.50	2.00 3.16	
11	G1 G2	1.86	(66.41) 78.28		0.008				0.008	HDPE ◎ 300	2.1	0.8	0.035	193.00	-1.539 -1.944	3.50 3.50	4.73 5.14	
Flow to 9																		
G1		49.68	49.68		0.005				0.005	HDPE ◎ 300	2.1	0.8	0.035	800.00	0.141 -1.539	2.45 3.50	2.00 4.73	
Flow to 11																		
G2		16.73	16.73		0.002				0.002	HDPE ◎ 300	2.1	0.8	0.035	660.00	0.741 -0.645	3.05 3.50	2.00 3.84	
Flow to 11																		
G11		22.02	22.02		0.002				0.002	HDPE ◎ 300	2.1	0.8	0.035	480.00	-0.309 -1.317	2.00 3.65	2.00 4.66	
Flow to 11																		
F10		0.00	0.00		0.000				0.000	HDPE ◎ 300	2.1	0.8	0.035	1070.00	1.191 -1.056	3.50 3.50	2.00 4.25	
Flow to 11																		

5. Capacity Calculation (Wastewater Treatment Plant)

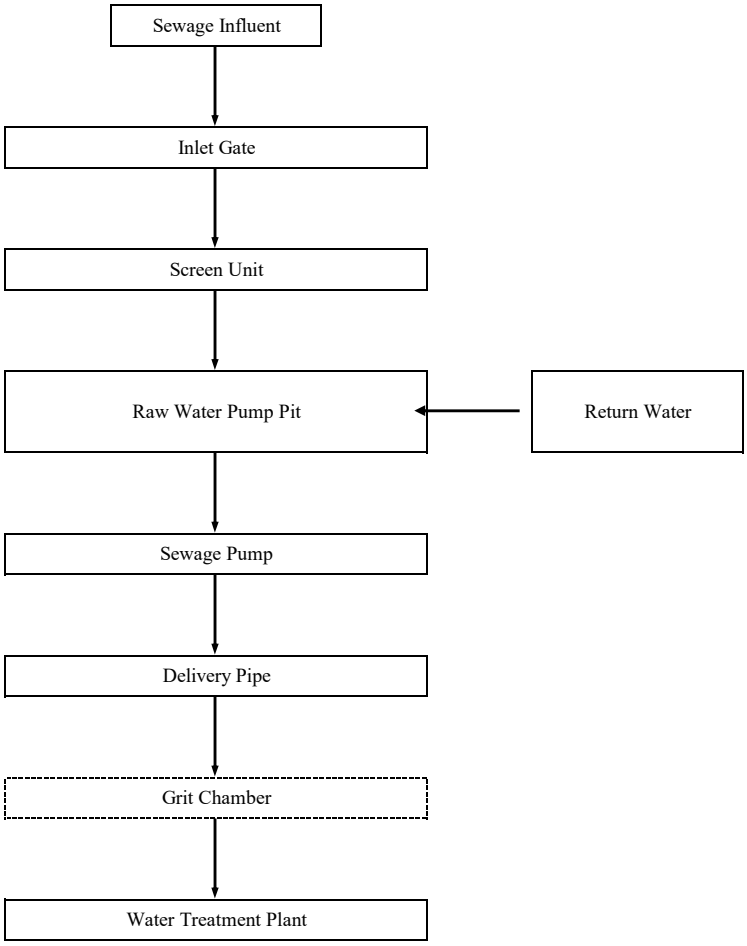
・ Capacity Calculation of Raw Water Pump Pit (Target Year: 2030)

Item \ Planning Division	Contents (Target Year: 2030)
1.Flow Conditions	
(1)Sewage Influent Pipe Diameter	500 mmφ H.P
(2)Sewage Influent Pipe Gradient	1.7 ‰
(3)Ground Height	+3.650 M
(4)Sewage Influent Pipe Bottom High	-9.683 M
(5)Full Pipe Flow Rate	0.156 m3/sec（Manning = 0.013）
(6)Full Pipe Velocity	0.793 m/sec（Manning = 0.013）

2. Design Flow Rate

	Average Daily	Maximum Daily	Maximum Hourly	Maximum Hourly+Return Water
(m3/d)	2,300	3,000	**3,900**	**4,837**
(m3/min)	1.60	2.08	2.71	3.36
(m3/sec)	0.027	0.035	0.045	0.056

3. Flow Sheet



Item \ Planning Division	Contents (Target Year: 2030)

4. Sewage Influent Pipe

	Average Daily	Maximum Daily	Maximum Hourly
Velocity(m/sec)	0.594	0.640	0.686
Water Depth（m）	0.141	0.161	0.184
Flow Ratio	0.173	0.224	0.288
Velocity Ratio	0.749	0.807	0.865
Water Depth Ratio	0.282	0.322	0.368
Sewage Influent Pipe Water Level(M)	-9.542	-9.522	-9.499
Outflow Head Loss(m)	+0.018	+0.021	+0.024
Gate Chamber Inlet Water Level(M)	-9.560	-9.543	-9.523

5. Inlet Gate

(1)Gate Chamber Inlet Water Level

Average Daily -9.560 M

Maximum Daily -9.543 M

Maximum Hourly -9.523 M

(2)Gate Chamber Bottom High -9.700 M

(3)Gate Pass Water Depth Gate Chamber Inflow Water Level－Gate Chamber Bottom High

Average Daily -9.560 － (-9.700) = 0.140 m

Maximum Daily -9.543 － (-9.700) = 0.157 m

Maximum Hourly -9.523 － (-9.700) = 0.177 m

(4)Gate Specification

Type Motor drive type

Gate Size W 0.40 m × H 0.40 m × 1 (Use Only One Gate)

Motor Power 0.75 kw

(5)Gate Pass Velocity

Average Daily 0.027/(0.140×0.4×1) = 0.482 m/sec

Maximum Daily 0.035/(0.157×0.4×1) = 0.557 m/sec

Maximum Hourly 0.045/(0.177×0.4×1) = 0.636 m/sec

(6)Gate Head Loss

Average Daily 1.5×0.482^2 / (2×9.8) = 0.018 m

Maximum Daily 1.5×0.557^2 / (2×9.8) = 0.024 m

Maximum Hourly 1.5×0.636^2 / (2×9.8) = 0.031 m

Item \ Planning Division	Contents (Target Year: 2030)
6. Screen Unit	
(1)Screen Inflow Water Level	Gate Chamber Inflow Water Level － Gate Head Loss
Average Daily	-9.560 － 0.018 = -9.578 m
Maximum Daily	-9.543 － 0.024 = -9.567 m
Maximum Hourly	-9.523 － 0.031 = -9.554 m
(2)Screen Bottom High	-9.800 m
(3)Screen Water Depth	Screen Inflow Water Level － Screen Bottom High
Average Daily	-9.578 － (-9.800) = 0.222 m
Maximum Daily	-9.567 － (-9.800) = 0.233 m
Maximum Hourly	-9.554 － (-9.800) = 0.246 m
(4)Screen Specification	
Type	Motor drive
Effective width	25 mm
Bar Thickness	9 mm
Installation Angle	70°
Waterway Width	Width 0.9m × 1Waterway (Use Only One Waterway)
(5)Approach Velocity	
Average Daily	0.027 / (0.222×0.9×1)×(25+9) / 25 = 0.184m/sec
Maximum Daily	0.035 / (0.233×0.9×1)×(25+9) / 25 = 0.227m/sec
Maximum Hourly	0.045 / (0.246×0.9×1)×(25+9) / 25 = 0.276 m/sec
(6)Pass Velocity	Clogging Rate = 50%
Average Daily	0.184 / 0.50= 0.370 m/sec
Maximum Daily	0.227 / 0.50= 0.450 m/sec
Maximum Hourly	0.276 / 0.50= 0.550 m/sec
(7)Head Loss	2.34 × sinθ × (t/b)^(4/3) × V^2 / (2×g)
Average Daily	2.34 × sin70° × (9 / 25)^(4/3) × 0.370^2 / (2×9.8) = 0.004m
Maximum Daily	2.34 × sin70° × (9 / 25)^(4/3) × 0.450^2 / (2×9.8) = 0.006m
Maximum Hourly	2.34 ×sin70° × (9 / 25)^(4/3) × 0.550^2 / (2×9.8) = 0.009m

Item \ Planning Division	Contents (Target Year: 2030)

7. Sewage Pump

(1)Pump Well Water Level

Screen Inflow Water Level － Screen Head Loss

Average Daily　-9.578 － 0.004 = -9.582 m
Maximum Daily　-9.567 － 0.006 = -9.573 m
Maximum Hourly　-9.554 － 0.009 = -9.563 m

(2)Pump Capacity

Pump Number	Pump Capcity（m3/min)	Number（unit）
NO.1	4.0	2　Standby　1
NO.2	—	—　Standby　—

(3)Pump Diameter

$$D = 146 \times \left(\frac{Q}{V}\right)^{0.5}$$

Q：Pump Capacity of 1units（m3/min)
V： Velocity （m/sec)

	Pump Capacity （m3/min)	Velocity （m/sec)	Pump Diameter（mm)	Pump Caliber of Decision （mm)
NO.1	4.0	1.5	238	200
		3.0	169	
NO.2	—	1.5	—	—
		3.0	—	

(4)Delivery Pipe

$$V = \frac{Q/60}{\pi/4 \times D^2}$$

$$hf = 10.666 \times \left(\frac{Q}{60 \times C}\right)^{1.85} \times D^{-4.87} \times L$$

V： Velocity（m/sec)
Q：Pump Capacity（m3/min)
D：Pipe Diameter（m)
hf:：Head Loss(m)
L：Pipe Length（m)
C：Flow Rate Coefficient=110

	Pipe Diameter （mm)	Velocity （m/sec)	Pipe Length (m)	Head Loss （m)
Pipe 1	300	0.94	30	0.13

(5)Pump Head

Actual Head =Pipe Top Level - Pump Well HWL
Total Head = Actual Head +Delivery Pipe Loss + Pump Around Loss
(Practical ＝1.5m)

	Pipe Top Level（M）	The Pump Well HWL(M）	Actual Head （m)	Total Head （m)
Pipe 1	12.00	-9.56	21.6	23.2

Item \ Planning Division	Contents (Target Year: 2030)

(6)Calculation of Pump Output

$$P = \frac{0.163 \times \gamma \times Q \times H}{n} \times (1+\alpha)$$

P：Pump Output（kw）

γ：Weight per Unit Volume of the Liquid Being Pumped（kg/l）：1.0

Q：Pump Capacity（m3/min)
H：Total Head(m)
n：Pump Efficiency
α：Margin

	Pump Efficiency	Margin	Pump Output（kw）	Pump Output of Decision（kw）
NO.1	0.7	0.15	26.8	30.0
NO.2	—	—	—	—
Request Value			26.8	

(7)Pump Specification

	NO.1	NO.2	
Type	Submergible Pump with Screw Blade Suction Type		
Specifications	φ200 4.0m3/min 25 m	— — —	
Pump Capacity	4.0 m3/min	—	
Pump Output of Decision	30.0 kw	—	**30.0** kw
Number(unit)	2 Unit (Standby1Unit)	—	

(8)Overview of the Water Level etc

	Average Daily	Maximum Daily	Maximum Hourly
Sewage Influent Pipe Bottom High	-9.683	-9.683	-9.683
Gate Chamber Bottom High	-9.700	-9.700	-9.700
Screen Bottom High	-9.800	-9.800	-9.800
Screen Inflow Water Level	-9.578	-9.567	-9.554
Pump Well Water Level	-9.582	-9.573	-9.563

Item \ Planning Division	Contents (Target Year: 2030)
8. Overground Grit Chamber	
(1)Inlet Gate	
1)Plan Water Quantity	4,837 m3/d＝ 0.045 m3/sec
2)Gate Chamber Inlet Water Level	+12.200 M
3)Gate Chamber Bottom High	+11.200 M
4)Gate Pass Water Depth	Gate Chamber Inflow Water Level－Gate Chamber Bottom High +12.200 － (+11.200) ＝ 1.000 m
5)Gate Specification	
Type	Motor Drive Type
Gate Size	W 0.4 m × H 0.4 m × 1 (Use Only One Gate)
Motor Power	0.75 kw
6)Gate Pass Velocity	0.045/(1.000×0.4×1) ＝ 0.113 m/sec
7)Gate Head Loss	1.5×0.113^2 / (2×9.8) ＝ 0.001 m
(2)Grit Chamber	
1)Plan Water Quantity	4,837 m3/d＝ 0.045 m3/sec
2)Water Area Load	1,800 m3/m2・d
3)Required Water Area	4,837 / 1,800 ＝ 2.7 m2
4)Shape Size	Width 1.5 × Length 2.0 m × 1 Pond (Use Only One Pond)
5)Water Area	1.5 × 2.0 × 1 ＝ 3.0 m2
6)Grit Chamber Bottom High	11.100 M
7)Water Depth	Gate Chamber Inflow Water Level－Grit Chamber Bottom High 12.200 － 11.100 ＝ 1.000 m
8) Examination	
Actual Water Area Load	4,837 / 3.0 ＝ 1,612 m3/m2･day
Pass Flow Rate	0.045 / (1.5×1.0×1) ＝ 0.030 m/s
Residence Time	2.0 / 0.030 ＝ 67 sec
9) Grit Removal Pump	
Type	Sand Pump
Specification	φ 100.0 mm ×V 0.5 m3/min ×H 5.0m × 1Unit
Motor Power	0.75 kw

・Capacity Calculation of Wastewater Treatment Plant (Target Year: 2030)

Item	Contents (Target Year: 2030)

1. Design Parameters

(1)Design Flow Rate

①Average Daily Flow Rate(DA)	2,300	m3/d=	1.60	m3/min＝	0.027	m3/sec
②Maximum Daily Flow Rate(DM)	3,000	m3/d=	2.08	m3/min＝	0.035	m3/sec
③Maximum Hourly Flow Rate (HM)	3,900	m3/d＝	2.71	m3/min=	0.045	m3/sec

(2)Design Influent Quality

①BOD	220	mg/l	（P-BOD 88 mg , S-BOD 132 mg/L） ＊P-BOD:Particulate BOD , S-BOD:Soluble BOD
② SS	250	mg/l	
③T-N	43	mg/l	
④T-P	7	mg/l	

(3)Removal Ratio is Assumed (Total System)

①BOD	≦	90.0	%	(Removal Ratio of 90**%** was Confirmed on Demonstration Experiment)
②SS	≦	90.0	%	(Removal Ratio of 90**%** was Confirmed on Demonstration Experiment)
③T-N	≦	55.0	%	(Removal Ratio of 55-58**%** was Confirmed on Demonstration Experiment)
④T-P	≦	80.0	%	(Removal Ratio of 80-85**%** was Confirmed on Demonstration Experiment)

(4)Design Effluent Quality

					QCVN14:2008/BTNMT Cvalue:A
①BOD	=	22	mg/l	≦	30 mg/l
②SS	=	25	mg/l	≦	50 mg/l
③T-N	=	19	mg/l	≦	35 mg/l
④T-P	=	1	mg/l	≦	6 mg/l

(5)Sewage Influent and Influent Quality considering Return water

Sewage Influent and Return Water flow into the Raw Water Pump Pit..
Also,The Return Water is Sludge Thickener Supernatant and Dehydrated Filtrate.

Item	Sewage Influent	Return Water	Total (Influent Quality is Average)
Flow Rate（m3/d）	3,000	937	3,937
BOD（mg/L）	220	143	202
S-BOD（mg/L）	132	74	118
SS（mg/L）	250	143	224

Item	Contents (Target Year: 2030)
2. Floating Sponge Filter(FSF)	
(1) Sewage Influent	
	Flow Rate（m3/d） 3,937 BOD（mg/L） 202 S-BOD（mg/L） 118 SS（mg/L） 224
(2)Facility Size	
①Design Filtration rate	= 250 m/d
②Required Filtration Area	= Flow Rate 3,937 m^3/d ÷ Design Filtration rate 250 m/d = 15.7 m^2
③Number of Tank	= 2 Tanks
④Area of Tank	= 15.7 m^2 ÷ 2 Tank ＝ 7.9 m^2
⑤Shape of Tank	Square
⑥Size of Tank ・Width ・Length	 = 2.5 m = 7.9 m^2 ÷ 2.5 m ＝ 3.149 → 3.5 m
⑦Filtration Area per Tank	= 8.8 m^2/Tanks
⑧Actual Filtration Rate	3,937 m^3/d ÷ 8.8 m^2/Tank × 2 Tank ＝ 223.7 m/d
(3)Removal Performance	
①SS Removal Ratio	= -0.0915 × Filtration Rate (m/d) ＋ 80.059 = -0.0915 × 224 m/d ＋ 80.059 = 59.6 %
②P-BOD Removal Ratio	= 0.9143 × SS Removal Ratio(%) = 0.9143 × 59.6 = 54.5 %
③S-BOD Removal Ratio	= 0 % （Filtration Equipment can not remove S- BOD.）
(4)Sewage Effluent	
①SS Concentration	= 224 mg/l × (100 － 59.6) ÷ 100 = 90.7 mg/l
②P-BOD Removal Ratio	= (202 － 118) mg/l × (100 － 54.5) ÷ 100 = 38.0 mg/L
③S-BOD Removal Ratio	= 118 × (100 － 0.0) ÷ 100 = 118.1 mg/l
④BOD Concentration	= P-BOD ＋ S-BOD = 38.0 ＋ 118.1 = 156.1 mg/l
(5)Washing Drainage	
①Average Filtration Loss Head	= Set to 40 cm
②SS Inflow Surface Area Loading	= (40 ÷ 0.5124) ^ (1 / 1.1747) = 40.8 kg/m2・d (SS Inflow Surface Area Loading when Washing Frequency is 24 times / day)
③SS Inflow Surface Area Loading per Washing	＝ 40.8 ÷ 24 ＝ 1.7 kg / m^2・times
④Washing Frequency	= 223.7 m/d × 224 mg/L ÷ 1000 ÷ 1.7 = 29.5 times/d
⑤Per time Washing Drainage Rate	= Filtration Area (m^2) × Washing height (m/time) = 17.6 × 1.5 m/times = 26.4 m^3/times
⑥Washing Drainage Rate	= 26.4 m^3/times × 29.5 times/d = 779 m^3/d
(6)Solid Balance	
①Filtered Effluent SS	= (3,937 － 779) m^3/d × 90.7 mg/L ÷ 1000 = 286 kg/d
②Washing Drainage SS	= 3,937 m^3/d × 224 mg/l ÷ 1000 － 286 kg/d = 597 (kg/d) (⇒To the Drain Tank)

Item	Contents (Target Year: 2030)
3. High-rate Trickling Filter(HTF)	
(1)Sewage Influent	
①Flow Rate	= 3,158 m3/d
②Sewage Influent BOD Rate	= 3,158 m^3/d × 156.1 mg/l / 1,000 = 493 kgBOD/d
③Sewage Influent SS Rate	= 3,158 m^3/d × 90.7 mg/l / 1,000 = 286 kgBOD/d
(2)Facility Size	
①BOD Volumetric Loading	The BOD obtained by subtracting the Flow Rate × 15 mg-BOD/ L from the Sewage Influent BOD is set to 1.6 kg /m 3·d. （Japan specification 26B can achieve 15 mg /lL or less as treated water BOD at 1.6 kg / m 3·d. Overseas specifications are calculated assuming that parts exceeding 1.6 kg / m 3·d will shift to treated water. = 1.6 kg/m^3・d
②Filter Bed Volumetric	= 493 kgBOD/d — 47 kgBOD/d ÷ 1.6 kg/m^3・d = 278 (m^3)
③Filter Bed Height	= 2.3 m is set.
④Filter Bed Area	= 278 m^3 ÷ 2.3 m = 121.1 m2
⑤Area of 1tank per	= 81 m2/Tanks is set.
⑥Number of Tank	= 121.1 m^2 ÷ 81 m2/Tank = 1.5 tanks ⇒ 2 Tanks
⑦Actual BOD Volumetric Loading	= 492.9 ÷ (81 × 2.3 × 2) = 1.32 kg/m^3・d
⑧Shape of Tank	Square
⑨Size of Tank ・Width ・Length	 = 9.0 m = 9.0 m
⑩Area of 1tank per	= 81 m2/Tanks
⑪Filter Bed Height	= 2.3 m
⑫Bottom Height of Filter Bed	= 0.7 m
(3)Washing Drainage	
①Washing Frequency	Weekly make 1 time washing
②Water Level Height at Washing	From the filter media surface 0.4 m
③Washing Drainage Rate	= (81 m2/Tank × 2 Tank × (0.7 + 0.4) m + 81 m2/Tank × 2 Tank × 2.3 m × Carrier Porosity 0.9) × 1 time/week ÷ 7 day/week = 73.4 (m^3/d)
(4)Sewage Effluent	
①SS Concentration	= 6.2335 × Ln(BOD Volumetric Loading) + 22.233 = 6.2335 × Ln 1.323 kg/m^3・d + 22.233 = 24.0 mg/l
②SS Rate	= (3158 — 73.4) m3/d × 24.0 mg/L ÷ 1000 = 74 kg/d
③P-BOD（Particulate BOD）	= SS Concentration mg/L × P-BOD vs SS Ratio = 24.0 mg/l × 1.4008 = 33.6 mg/l
④S-BOD（Solute BOD） (Filter Bed Height 2.3 m Conversion)	= (0.7538 × Ln(BOD Volumetric Loading) + 2.6562) × 9.87715 × 2.3 ^ -0.92 ÷ 4.25 + 15 = (0.7538 × Ln 1.323 kg/m^3・d + 2.6562) × 9.87715 × 2.3 ^ -0.92 ÷ 4.25 + 15 = 18.1 mg/l
⑤BOD(mg/L)	= P-BOD mg/L + S-BOD mg/L = 33.6 mg/l + 18.1 mg/l = 51.7 mg/l
(5)Solid Balance	
①Washing Drainage SS	= 3,158 m^3/d × 90.7 mg/l ÷ 1000 × 0.12 = 33.7 (kg/d) (⇒To the Drain Tank)

Item	Contents (Target Year: 2030)
4. Final Solids-Liquid Separator (SLS)	
(1) Sewage Influent	
①Flow Rate	= 3,084 m3/d
(2)Facility Size	
①Design Filtration rate	= 150 m/d
②Required Filtration Area	= Flow Rate 3,084 m^3/d ÷ Design Filtration rate 150 m/d = 20.6 m^2
③Number of Tank	= 2 Tanks
④Area of Tank	= 20.6 m^2 ÷ 2 Tanks = 10.3 m^2
⑤Shape of Tank	Square
Size of Tank ・Width ・Length	 = 3.0 m = 10.3 m^2 ÷ 3.0 m = 3.427 → 3.5 m
⑥Filtration Area per Tank	= 10.5 m^2/Tanks
⑦Actual Filtration Rate	3,084 m^3/d ÷ 10.5 m^2/Tanks × 2 Tanks = 146.9 m/d
(3)Removal Performance	
①SS Removal Ratio	= 0.2549 × Sewage Influent SS Rate mg/l + 78.088 = 0.2549 × 24 mg/l + 78.088 = 84.2 %
②S-BOD Removal Ratio	= 0 % （Filtration Equipment can not remove S- BOD.）
(4)Sewage Effluent	
①SS Concentration	= 24 mg/l × (100 − 84.2) ÷ 100 = 3.79 mg/l
②P-BOD Removal Ratio	= 3.79 mg/l × 1.4008 = 5.31 mg/l
③S-BOD Removal Ratio	= 18.1 × (100 − 0.0) ÷ 100 = 18.1 mg/l
④BOD Concentration	= P-BOD + S-BOD = 5.3 + 18.1 = 23.4 mg/l
(5)Washing Drainage	
①SS Inflow Surface Area Loading per Washing	= 3,084 m/d × 24 mg/l ÷ 21.0 m^2 ÷ 1000 = 3.5 kgSS / m^2・times
②Washing Interval	= 20 hr/d
③Washing Drainage Time	= 0.5 hr/times
④Washing Drainage Rate	= 3,084 × 24 ÷ 20 × 0.5 ÷ 24 = 77 m^3/d
(6)Solid Balance	
①Effluent SS	= Effluent SS mg/l × (Flow Rate m^3/d − Washing Drainage Rate m^3/d) ÷ 1000 3.79 mg/l × (3,084 m^3/d − 77 m^3/d) ÷ 1000 = 11 kg/d
②Total generated sludge SS	= Washing Drainage SS kg/d + Settling Sludge SS kg/d = 74 kg/d − 11 kg/d = 63 kg/d
③Washing Drainage SS	= Final filtration total generated sludge kg/d × Final filtration total generated sludge / Final filtration tank sludge ratio (-) = 63 kg/d × 0.6 = 38 kg/d (⇒To the Drain Tank)
④Settling Sludge SS	= Total generated sludge kg/d − Washing Drainage SS kg/d = 63 kg/d − 38 kg/d = 25 kg/d (⇒To the Drain Tank)
⑤Settling Sludge SS Concentration	= 4,090 mg/l (From the result of demonstration experiment)
⑥Settling Sludge Volume	= Settling Sludge SS kg/d ÷ Settling Sludge SS Concentration mg/l × 1000 = 25 kg/d ÷ 4,090 mg/l × 1000 = 6 (m^3/d)

Item	Contents (Target Year: 2030)

(7) SLS Settling Sludge Transfer Pump

①Pump Capacity
= 6 m3/d ÷ 2 Times/d ÷ 15 min/Times ÷ 2 Tanks
= 0.10 m3/min/Tanks

②Liquid Specific Gravity (γ) = 1.0 to set
③Head Loss(H) = 10 m
④Pump Shaft Power

$$Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{0.7} = 0.24 \text{ kw}$$

⑤Motor Output
P= Ps×(1+α) (α:Margin)
= 0.24 ×(1 + 0.15)
= 0.27 kw → 0.3 kw(Catalogue Value)

⑥ Specifications

Type	Centrifugal Pump	
Discharge Diameter	100	A
Pump Capacity	0.10	m3/min
Pump Head	10	m
Motor Output	0.3	kw
Number	3	Pumps (Including Standby of 1 Pumps)

5. Drain Tank

(1)Drainage Volume

	Drainage Volume m3/d	SS Concentration mg/L	Solids kg-DS/d
FSF Washing Drainage Rate	779	767	597
HTF Washing Drainage Rate	73	459	34
SLS Washing Drainage Rate	77	487	38
SLS Settling Sludge Volume	6	4,090	25
Total	936	741	693

(2)Capacity of the Drainage Tank
＊The capacity of the drainage tank shall be the capacity that can accept the total of one wash drainage per tank of FSF, HTF, SLS.

①1 Tank · 1 Washing Drainage Volume
・FSF Washing Drainage Rate = 13 m^3
・HTF Washing Drainage Rate = 256.77 m^3
・SLS Washing Drainage Rate = 32 m^3
・Capacity of the Drainage Tank = 13 + 256.77 + 32 = 302 m^3 ⇒ 350 m^3

②Number of Tank = 1 Tanks

(3) Sludge Transfer Pump (Drain Tank to Sludge Thickening)

The Capacity of the Sludge Transfer Pump is set based on the Generation Interval of Each Washing Drainage .

	A	B	C	D	E	A/E
	1 Tank · 1 Time per	Washing Frequency	Number of Tank	Number of Washing Cycles	Washing Interval	
	(m3/time・tank)	(time/day・tank)	(tank)	(time/day)	(minute)	(m3/min)
FSF	13	29.5	2	59	24.4	0.54
HTF	256.77	0.14	2	0.3	5,460	0.05
SLS	32	1.20	2	2.4	650	0.05

①Pump Capacity = (0.54 + 0.05 + 0.05) ÷ 1 = 0.64 m3/min

②Liquid Specific Gravity (γ) = 1.0
③Head Loss(H) = 10 m
④Pump Shaft Power

$$Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{0.7} = 1.48 \text{ kw}$$

⑤Motor output
P= Ps×(1+α) (α:Margin)
= 1.48 ×(1 + 0.15)
= 1.71 kw → 2.0 kw(Catalogue Value)

⑥ Specifications

Type	Submersible Pump	
Discharge Diameter	150	A
Pump Capacity	0.7	m3/min
Pump Head	10	m
Motor Output	2.0	kw
Number	2	Pumps (Including Standby of 1 Pumps)

(4) HTF Washing Drainage Transfer Pump

①Pump Capacity = 0.05 m3/min ÷ 2 Pumps = 0.024 m3/min

②Liquid Specific Gravity (γ) = 1.0
③Head Loss(H) = 10 m
④Pump Shaft Power

$$Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{0.7} = 0.05 \text{ kw}$$

⑤Motor output
P= Ps×(1+α) (α:Margin)
= 0.05 ×(1 + 0.15)
= 0.06 kw → 0.1 kw(Catalogue Value)

⑥ Specifications

Type	Submersible pump	
Discharge Diameter	100	A
Pump Capacity	0.05	m3/min
Pump Head	10	m
Motor Output	0.1	kw
Number	2	Pumps

Item	Contents (Target Year: 2030)
(5) SLS Washing Drainage Tank	
SLS 1 Tank Capacity shall be accepted for 20 minutes of Washing Drainage .	
①Washing Drainage Volume for 20 minutes	= 10 m3/d ÷ 24 ÷ 60 ÷ 0 × 20 = 1 m3
②Washing Drainage Tank Volume	= 25 m3
③Number of Tank	= 1 Tanks
(6) SLS Washing Drainage Transfer Pump	
①Pump Capacity	= 0.05 m3/min ÷ 1 Pumps = 0.05 m3/min
②Liquid Specific Gravity (γ)	= 1.0
③Head Loss(H)	= 10 m
④Pump Shaft Power	$Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{0.7}$ = 0.12 kw
⑤Motor output	P= Ps×(1+α) (α:Margin) = 0.12 ×(1 + 0.15) = 0.13 kw → 0.2 kw(Catalogue Value)
⑥ Specifications	Type Submersible pump Discharge Diameter 100 A Pump Capacity 0.10 m3/min Pump Head 10 m Motor Output 0.2 kw Number 2 Pumps (Including Standby of 1 Pumps)
6. Sludge Thickening	
(1) Sludge Thickener	
①Maximum Daily Flowrate	= 936 m^3/d
②Number of Tank	= 1 Tanks
③Design Water Area Load	= Below 30 m/d
④Require Water Area	= 936 m^3/d ÷ 30 m/d ÷ 1 Tanks = 31.2 m^2/Tanks
⑤Water Depth	= 4 m
⑥Diameter of Tank	= 6.5 m
⑦Area of Tank	= 33.2 m^2/Tanks
⑧Surface Loading	= 936 m^3/d ÷ 33.2 m^2 = 28.2 m/d
⑨Solid Material Load	= 693 kg/d ÷ 33.2 m^2 = 20.9 kg/m^2・d
⑩Retention time	= 33.2 m^2/Tanks × 1 Tanks × 4 m ÷ 936 m^3/d × 24 = 3.40 hr
⑪Performance	
・Density of Concentrated Sludge	= 1.0 %
・Solid Capture Rate	= 85.0 %
⑫Thickened Sludge	
・Solids SS	= Total Solids (kgSS/d) × Solid Capture Rate(%) = 693 kg/d × 85 (%) × 0.01 = 589 kg/d
・Thickened Sludge Volume	= Solids kg/d / Density of Concentrated Sludge % = 589 kg/d / 1.0 % × 100 ÷ 1000 = 59 m^3/d
・SS Concentration	= Solids SS kg/d / Thickened Sludge Volume m3/d × 1000 = 589 kg/d / 59 m^3/d × 1000 = 10,000 mg/l
・Thickener Effluent	= Drainage Volume m^3/d − Thickened Sludge Volume m^3/d = 936 m3/d − 59 m3/d = 877 (m^3/d)
・Thickener Effluent Solids SS	= Total Solids (kgSS/d) × (1 − Solid Capture Ratio) = 693 kg/d × (1 − 0.85) = 104 (kg/d)
・SS Concentration	= Solids SS kg/d / Thickener Effluent m3/d × 1000 = 104 kg/d / 877 m^3/d × 1000 = 119 mg/l
・BOD	= SS Concentration mg/l × Primary Thickener Effluent BOD / SS ratio = 119 mg/l × 1.0 = 119 mg/l

Item	Contents (Target Year: 2030)
(2) Sludge Thickener Transfer Pump	
①Thickened Sludge Volume	= 59 m3/d
②Pump Capacity	= 59 m3/d ÷ 360 min/d ÷ 1 pumps = 0.16 m3/min
③Liquid Specific Gravity (γ)	= 1.0
④Head Loss(H)	= 10 m
⑤Pump Shaft Power	$Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{0.7}$ = 0.38 kw
⑥Motor Output	P= Ps×(1+α) (α: Margin) = 0.38 ×(1 + 0.15) = 0.44 kw → 0.5 kw(Catalogue Value)
⑦ Specifications	Type: Centrifugal Pump Discharge Diameter: 80 A Pump Capacity: 0.20 m3/min Pump Head: 10 m Motor Output: 0.5 kw Number: 2 Pumps (Including Standby of 1 Pumps)
7. Sludge Dehydration	
(1) Sludge Storage Tank	
The Sludge Storage Tank should be a Capacity that can store one day of Thickened Sludge.	
①Thickened Sludge Volume	= 59 m3/d
②Number of Tank	= 1 Tanks
③Req.Volume	= 59 m3/d ÷ 1 Tanks ÷ 1 day = 59 m3/tanks
④Size of tank ・Water Depth ・Width ・Length	 = 3.0 m = 3.5 m = 6.5 m
⑤Volume	= 3.5 m × 6.5 m × 3.0 m = 68 m3
(2) Dehydrator Supply Pump	
①Thickened Sludge Volume	= 59 m3/d
②Pump Capacity	= 59 m3/d ÷ 24 hr/d ÷ 2 Pumps = 1.23 m3/hr
③Head Loss(H)	= 15 m
④Specifications	Type: Uniaxial Screw Pump Discharge Diameter: 100 A Pump Capacity: 1.3 m3/hr Pump Head: 15 m Motor Output: 3.7 kw Number: 3 Pumps (Including Standby of 1 Pumps)
(3) Dehydrator	
①Sludge Concentration	= 1.0 %
②Sludge Weight	= 59 m3/d × 1.0 % × 0.01 × 1,000 kg/m^3 589 kg/d
③Operation Conditions	= 24 hr/d and 7 days in a week
④Supply Solid Weight	= 589 kg/d ÷ 24 hr/d × 7 ÷ 7 days ÷ 2 unit = 12 kg/h
⑤Specifications	Type: Volute Dewatering Press(SUS) Supply Sludge Concentration: 1.0 % Capacity: Max 20 kg/h (Catalogue Value) SS Recovery: ≧ 95 % Sludge Cake Moisture Content: ≦ 80 % Motor Output: 3.95 kw Number: 2 units

Item	Contents (Target Year: 2030)
(4) Chemical Injection System	
①Polymer Injection Pump	
・Dewatering Capacity	＝ 12 kg-DS/h
・Injection Rate	＝ 1.0 % to Set
・Injection Dose	＝ 12 kg-DS/h × 0.01 ＝ 0.12 kg/h
・Solution concentration	＝ 0.2 %
・Req.Volume	＝ 0.12 ÷ 0.002 ÷ 60 min ＝ 1.0 L/min
・Flexibility	＝ 0.5 ～ 1
・Pump Capacity	＝ 0.5 ～ 1.0 L/min
・Specifications	Type: Diaphragm Metering Pump Discharge Diameter: 40 A Pump Capacity: 0.5～1.0 L/min Motor Output: 0.1 kw Number: 2 Pumps (Including Standby of 1 Pumps) Max.Discharge Pressure: 0.3 Mpa
②Polymer Solution Tank	
・Retention Time	＝ 2 hr
・Req.Volume	＝ 1.02 L/min × 120 min ÷ 1000 ＝ 0.12 m3/Tanks → 0.5 m3/Tanks
・Number of Tank	＝ 2 Tanks
・Specifications	Type: Circle Tank Volume: 0.5 m3 Number: 2 Tanks Agitator: 2 Unit/Tank(1.5kw)
③Ferric Polysulfide Injection Pump	
・Dewatering Capacity	＝ 12 kg-DS/h
・Injection Rate	＝ 15 %
・Injection Dose	＝ 12 kg-DS/h × 0.15 ＝ 1.8 kg-DS/h
・Solution Density	＝ 1.45
・Req.Volume	＝ 1.8 ÷ 1.45 ÷ 60 min ＝ 0.02 L/min
・Flexibility	＝ 0.5 ～ 1.5
・Pump Capacity	＝ 0.011 ～ 0.032 L/min → 0.1 ～ 0.3 L/min
・Specifications	Type: Diaphragm Metering Pump Discharge Diameter: 15 A Pump Capacity: 0.1～0.3 L/min Motor Output: 0.1 kw Number: 2 Pumps (Including Standby of 1unit) Discharge Pressure: 0.5 Mpa
④Ferric Polysulfide Solution Tank	
・Retention Time	＝ 1 days＝ 24 hr
・Req.Volume	＝ 1.8 kg-DS/h ÷ 1.45 × 24 hr ＝ 0.1 m3/Tanks
・Number of Tank	＝ 1 Tanks
・Specifications	Type: Circle Tank Volume: 0.1 m3 Number: 1 Tanks Agitator: 1 Unit/Tank(0.1kw)
(5) Cake Hopper * Cake Hopper Volume is Calculated Based on Maximum Daily Flowrate .	
①Sludge Volume	＝ 12 kg/d × 2 Units × 24 hr/d × 7 / 7 ＝ 589 kg/d
②SS Recovery Rate	＝ 95 %
③Sludge Amount per a Day	＝ 589 kg/d × 0.95 ＝ 560 kg/d ＝ 0.6 t-DS/d
④Sludge Amount per a Day	＝ 560 kg-DS/d
⑤Water Content	＝ 80 %
⑥Dewatered Sludge	＝ 560 / (1 － 80 %) ÷ 1000 ＝ 2.8 m3/d
⑦No of Hopper	＝ 2 Units
⑧Req.Volume	＝ 1.4 m3/d → 2.0 m3/Units
⑨Specifications	Type: Auto Cut Gate Type Volume: 2.0 m3 Motor Output: 1.5 kw × 2 Number: 2 Units
(6) Filtered Water	
①Thickened Sludge Volume	＝ 59 m3/d
②Polymer Flocculent Dissolved Water	＝ 3 m3/d
③Water content in Sludge Cake	＝ 1 m3/d
④ Filtered Water Volume	＝ 61 m3/d
⑤SS in Filtered Water	＝ 29 kg/d
⑥Filtered Water SS	＝ 485 mg/l
⑦Filtered Water BOD	＝ 485 mg/l
⑧Filtered Water S-BOD	＝ 109 mg/l

Item	Contents (Target Year: 2030)
8. Chlorination	
(1)Chlorination Tank * Chlorination Tank volume is Calculated based on Maximum Daily Flowrate .	
①Maximum Flow rate	= 3,084 m3/d
②Contact Time	= 15 min
③Number of Tank	= 1 Tanks
④Req.Volume of Tank	= 3,084 m3/d × 15 min/d ÷ 1,440 ÷ 1 Tanks = 32 m3
⑤Shape of Tank	Rectangular
⑥Size of Tank	
・Width	= 1.5 m
・Length	= 30.0 m
・Effective Depth	= 1.5 m
・Volume of Tank	= 68 m3
(2)Sodium Hypochlorite Dosing Pump * Sodium Hypochlorite Dosing Pump Volume is Calculated Based on Maximum Hourly Flowrate.	
①Disinfection Volume	= 3,900 m3/d
②Dosing Rate	= 3 mg/L
③Disinfectant Concentration	= 10 %
④Disinfectant Density	= 1.1 t/m3
⑤Dosing Pump Capacity	= 3,900 m3/d × 3 mg/L ÷ 10 % ÷ 1.1 = 0.07 L/min
⑥Specifications	Type: Diaphragm Metering Pump Pump Capacity: 0.2 L/min Motor Output: 0.2 kw Number: 2 Units (Including Standby) Max.Discharge Pressure: 1.0 Mpa
(3)Sodium Hypochlorite Storage	
①Storage Time	= 2.5 days
② Req.Volume	= 0.07 L/min× 1,440 min/d × 2.5 days × 10^{-3} = 0.27 m3/Tanks → 0.7 m3/Tanks
③Number of Tank	= 1 tanks
④Specificatioı	Type: Circle Tank Volume: 0.7 m3 Number: 1 Tanks
9. Polishing Pond	
Design Inflow	= 3,000 m3/d
Size	Width= 50.0 m (Effective width= 41.0 m) (Slope, 1:1) Length= 83.0 m (Effective length= 74.0 m) Depth= 4.5 m (Effective depth= 2.0 m)
Number of pond	1 pond
Required retention time	2.0 days
Effective volume	41.0 m x 74.0 m x 2.0 m x 1 pond = 6,068 m3
Retention time	6,068 m3÷ 3,000 m3/day= 2.0 days
10. Water Discharge	
(1)Outfall Pump * Water Discharge Pump is calculated based on Maximum Hourly Flowrate .	
①Pump Capacity	= 2.77 m3/min = QMax
②Pump Distribution	= QMax = 2.77 m3/min
③Pump Head	
④Specification for Pressure Piping	
・Diameter	φ 250 mm
・Number	1 pipe
・Highest Level (End of Pipe)	+ 3.400 M
・Length	500 m
(2)Head Loss at Pressure Pipe (PP)	
Pumping Flow Rate(Maximum)	Q= QMax= 2.77 m3/min= 0.046 m3/sec
①Cross Section	A= 0.25 m^2×π×1/4= 0.049 m2
②Flow Rate	V= 0.046 / 0.049 = 0.9 m/s
③Loss Calculation	
・Head Loss	hf= 10.666 ×(0.046 / 110)$^{1.85}$× 0.25 $^{-4.87}$× 500 = 2.57 m
・Outlet Loss	h0= 1.0 × 0.9 ^2/2g = 0.045 m
・Total	H=hf ＋ h0 = 2.62 m
④Head Loss Around Pump	H= 1.5 m
⑤Actual Pump Head	H=(Highest Level － Pumping Level) = 3.400 M － -2.500 M = 5.900 m
⑥Total Pump Head	H=(Actual Pump Head ＋ Pressure Pipe ＋ Around Pump) = 5.900 ＋ 2.62 ＋ 1.50 = 10.019 m → 11 m
⑦Motor Output	
・Pumping Flow Rate Q	2.8 m3/min
・Liquid Specific Gravity γ	1.0
・Pump Efficiency η	0.7
・Pump Shaft Power	$Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{\eta}$ = 7.09 kw
⑧Motor Output	P= Ps×(1＋α) (α:Margin) = 7.09 ×(1 ＋ 0.15) = 8.15 kw → **11.0** kw(Catalogue Value)
⑨Specifications	Type: Submersible Pump Diameter: 250 A Motor Output: 11.0 kw Total Pump Head: 11 m Pump Capacity: 3.0 m3/min Number: 2 Pump (Including Standby of 1 Pump)

Item	Contents (Target Year: 2030)
8. Chlorination	
(1)Chlorination Tank	
* Chlorination Tank volume is Calculated based on Maximum Hourly Flowrate(Wet) .	
①Maximum Flow rate	= 17,000 m3/d
②Contact Time	= 15 min
③Number of Tank	= 1 Tanks
④Req.Volume of Tank	= 17,000 m3/d × 15 min/d ÷ 1,440 ÷ 1 Tanks
	= 177 m3
⑤Shape of Tank	Rectangular
⑥Size of Tank	
・Width	= 1.5 m
・Length	= 45.0 m
・Effective Depth	= 1.5 m
・Volume of Tank	= 101 m3
・Volume of Outfall Pipe	= 98.1 m3
・Total Volume	= 199.4 m3
(2)Sodium Hypochlorite Dosing Pump	
* Sodium Hypochlorite Dosing Pump Volume is Calculated Based on Maximum Hourly Flowrate(Wet).	
①Disinfection Volume	= 17,000 m3/d
②Dosing Rate	= 3 mg/L
③Disinfectant Concentration	= 10 %
④Disinfectant Density	= 1.1 t/m3
⑤Dosing Pump Capacity	= 17,000 m3/d × 3 mg/L ÷ 10 % ÷ 1.1
	= 0.32 L/min
⑥Specifications	Type: Diaphragm Metering Pump Pump Capacity: 0.40 L/min Motor Output: 0.2 kw Number: 2 Units (Including Standby) Max.Discharge Pressure: 1.0 Mpa
(3)Sodium Hypochlorite Storage	
①Storage Time	= 2.5 days
② Req.Volume	= 0.32 L/min× 1,440 min/d × 2.5 days × 10^{-3}
	= 1.16 m3/Tanks → 1.5 m3/Tanks
③Number of Tank	= 1 tanks
④Specificatioı	Type: Circle Tank Volume: 1.5 m3 Number: 1 Tanks
9. Water Discharge	
(1)Outfall Pump	
* Water Discharge Pump is calculated based on Maximum Hourly Flowrate (Wet).	
①Pump Capacity	= 11.81 m3/min = QMax
②Pump Distribution	= QMax = 11.81 m3/min
③Pump Head	
④Specification for Pressure Piping	
・Diameter	φ 500 mm
・Number	1 pipe
・Highest Level (End of Pipe)	+ 3.400 M
・Length	500 m
(2)Head Loss at Pressure Pipe (PP)	
Pumping Flow Rate(Maximum)	Q= QMax= 11.81 m3/min= 0.197 m3/sec
①Cross Section	A= 0.50 m^2×π×1/4= 0.196 m2
②Flow Rate	V= 0.197 / 0.196 = 1.0 m/s
③Loss Calculation	
・Head Loss	$hf = 10.666 \times (0.197 / 110)^{1.85} \times 0.50^{-4.87} \times 500 = 1.29$ m
・Outlet Loss	h0= 1.0 × 1.0 ^2/2g = 0.051 m
・Total	H=hf + h0 = 1.34 m
④Head Loss Around Pump	H= 1.5 m
⑤Actual Pump Head	H=(Highest Level − Pumping Level) = 3.400 M − -2.500 M = 5.900 m
⑥Total Pump Head	H=(Actual Pump Head + Pressure Pipe + Around Pump) = 5.900 + 1.34 + 1.50 = 8.740 m → 9 m
⑦Motor Output	
・Pumping Flow Rate Q	5.9 m3/min
・Liquid Specific Gravity γ	1.0
・Pump Efficiency η	0.7
・Pump Shaft Power	$Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{\eta} = 12.37$ kw
⑧Motor Output	P= Ps×(1+α) (α:Margin) = 12.37 ×(1 + 0.15) = 14.23 kw → **17.5** kw(Catalogue Value)
⑨Specifications	Type: Submersible Pump Diameter: 500 A Motor Output: 17.5 kw Total Pump Head: 9 m Pump Capacity: 6.0 m3/min Number: 3 Pump (Including Standby of 1 Pump)

・Solid Balance Calculation ：Target Year: 2030

	Flow Rate	3,000 m^3/d
	Soluble	132 mg/L
BOD	Particulate	88 mg/L
	Total	220 mg/L
	SS	250 mg/L

	Flow Rate＋Return Water	3,937 m^3/d
	Soluble	118 mg/L
BOD	Particulate	84 mg/L
	Total	202 mg/L
	SS	224 mg/L

Floating Sponge Filter(FSF)

Required Filtration Area	15.7 m^2
Actual Filtration Rate	223.7 m/d
SS Removal Ratio	59.6 %
P-BOD Removal Ratio	54.5 %
S-BOD Removal Ratio	0 %
Average Filtration Loss Head	40 cmAq
SS Inflow Surface Area Loading per Washing	1.70 kg/m2・times
Washing Frequency	29.5 times

	FSF Flow Rate	3,158 m^3/d
	Soluble	118 mg/L
BOD	Particulate	38 mg/L
	Total	156 mg/L
	SS	91 mg/L

High-rate Trickling Filter(HTF)

Area of 1tank per	81 m2/Tanks
Filter Bed Height	2.3 m
Number of Tank	2 Tanks
Area of Total Tank	162 m2
Volume of Tank	373 m3
Actual BOD Volumetric Loading	1.32 kg/m3・d
Trickling Loading	19.5 m/d

	HTF Flow Rate	3,084 m^3/d
	Soluble	18.1 mg/L
BOD	Particulate	33.6 mg/L
	Total	51.7 mg/L
	SS	24.0 mg/L

Final Solids-Liquid Separator (SLS)

Filtration Area per Tank	10.5 m^2
Actual Filtration Rate	146.9 m/d

	SLS Flow Rate	3,001 m^3/d
	Soluble	18.1 mg/L
BOD	Particulate	5.3 mg/L
	Total	23.4 mg/L
	SS	3.8 mg/L

FSF	Washing Drainage Rate	779 m^3/d
	SS	767 mg/L

HTF	Washing Drainage Rate	73.4 m^3/d
	SS	459 mg/L

	Settling Sludge Volume	6.1 m^3/d
	SS	4,090 mg/L

SLS	Washing Drainage Rate	77 m^3/d
	SS	487 mg/L

Drain Tank

	Drainage Volume	936 m^3/d
	SS	741 mg/L

Sludge Thickener

Area of Tank	33.2 m2
Surface Loading	28.2 m3/m2・d
Solid Material Load	20.9 kg/m2・d

	Thickened Sludge Volume	59 m^3/d
	SS	10,000 mg/L

Sludge Dehydration

	Dewatered Sludge	2.80 m^3/d
	Water Content	80 %

	Return Water	937 m^3/d
	Soluble	74 mg/L
BOD	Particulate	69 mg/L
	Total	143 mg/L
	SS	143 mg/L

	Thickener Effluent	877 m^3/d
	Soluble	71 mg/L
BOD	Particulate	48 mg/L
	Total	119 mg/L
	SS	119 mg/L

Polymer	5.9 kg/d
Polymer Flocculent Dissolved Water	3 m3/d

Ferric Polysulfide	44 kg/d
Dissolved Water	44 L/d

	Filtered Water	61 m^3/d
	Soluble	109 mg/L
BOD	Particulate	376 mg/L
	Total	485 mg/L
	SS	485 mg/L

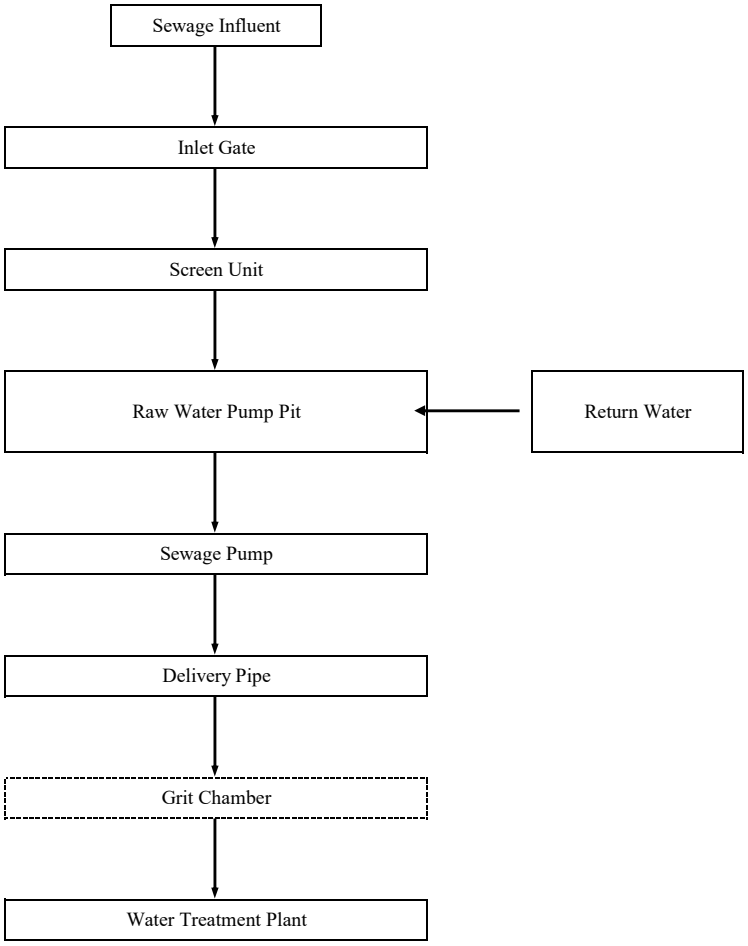
▪ Capacity Calculation of Raw Water Pump Pit (Target Year: After 2035)

Item \ Planning Division	Contents (Target Year: After 2035)
1.Flow Conditions	
(1)Sewage Influent Pipe Diameter	500 mmφ H.P
(2)Sewage Influent Pipe Gradient	1.7 ‰
(3)Ground Height	+3.650 M
(4)Sewage Influent Pipe Bottom High	-9.683 M
(5)Full Pipe Flow Rate	0.156 m3/sec（Manning = 0.013）
(6)Full Pipe Velocity	0.793 m/sec（Manning = 0.013）

2. Design Flow Rate

	Average Daily	Maximum Daily	Maximum Hourly	Maximum Hourly+Return Water
(m3/d)	4,900	6,000	**8,300**	**10,173**
(m3/min)	3.40	4.17	5.76	7.06
(m3/sec)	0.057	0.069	0.096	0.118

3. Flow Sheet



Item \ Planning Division	Contents (Target Year: After 2035)

4. Sewage Influent Pipe

	Average Daily	Maximum Daily	Maximum Hourly
Velocity(m/sec)	0.731	0.769	0.834
Water Depth（m）	0.209	0.233	0.284
Flow Ratio	0.365	0.442	0.615
Velocity Ratio	0.922	0.970	1.052
Water Depth Ratio	0.418	0.466	0.568
Sewage Influent Pipe Water Level(M)	-9.474	-9.450	-9.399
Outflow Head Loss(m)	+0.027	+0.030	+0.036
Gate Chamber Inlet Water Level(M)	-9.501	-9.480	-9.435

5. Inlet Gate

(1)Gate Chamber Inlet Water Level

Average Daily -9.501 M

Maximum Daily -9.480 M

Maximum Hourly -9.435 M

(2)Gate Chamber Bottom High -9.700 M

(3)Gate Pass Water Depth Gate Chamber Inflow Water Level－Gate Chamber Bottom High

Average Daily -9.501 － (-9.700) = 0.199 m

Maximum Daily -9.480 － (-9.700) = 0.220 m

Maximum Hourly -9.435 － (-9.700) = 0.265 m

(4)Gate Specification

Type motor drive type

Gate Size W 0.40 m × H 0.40 m × 2

motor Power 0.75 kw

(5)Gate Pass Velocity

Average Daily 0.057/(0.199×0.4×2) = 0.358 m/sec

Maximum Daily 0.069/(0.220×0.4×2) = 0.392 m/sec

Maximum Hourly 0.096/(0.265×0.4×2) = 0.453 m/sec

(6)Gate Head Loss

Average Daily 1.5×0.358^2 / (2×9.8) = 0.010 m

Maximum Daily 1.5×0.392^2 / (2×9.8) = 0.012 m

Maximum Hourly 1.5×0.453^2 / (2×9.8) = 0.016 m

Item \ Planning Division	Contents (Target Year: After 2035)
6. Screen Unit	
(1)Screen Inflow Water Level	Gate Chamber Inflow Water Level － Gate Head Loss
Average Daily	-9.501 － 0.010 = -9.511 m
Maximum Daily	-9.480 － 0.012 = -9.492 m
Maximum Hourly	-9.435 － 0.016 = -9.451 m
(2)Screen Bottom High	-9.800 m
(3)Screen Water Depth	Screen Inflow Water Level － Screen Bottom High
Average Daily	-9.511 － (-9.800) = 0.289 m
Maximum Daily	-9.492 － (-9.800) = 0.308 m
Maximum Hourly	-9.451 － (-9.800) = 0.349 m
(4)Screen Specification	
Type	Motor drive
Effective width	25 mm
Bar Thickness	9 mm
Installation Angle	70°
Waterway Width	Width 0.9m × 1Waterway (Use Only One Waterway)
(5)Approach Velocity	
Average Daily	0.057 / (0.289×0.9×1)×(25+9) / 25 = 0.298m/sec
Maximum Daily	0.069 / (0.308×0.9×1)×(25+9) / 25 = 0.339m/sec
Maximum Hourly	0.096 / (0.349×0.9×1)×(25+9) / 25 = 0.416 m/sec
(6)Pass Velocity	Clogging Rate = 50%
Average Daily	0.298 / 0.50= 0.600 m/sec
Maximum Daily	0.339 / 0.50= 0.680 m/sec
Maximum Hourly	0.416 / 0.50= 0.830 m/sec
(7)Head Loss	2.34 × sinθ × (t/b)^(4/3) × V^2 / (2×g)
Average Daily	2.34 × sin70° × (9 / 25)^(4/3) × 0.600^2 / (2×9.8) = 0.010m
Maximum Daily	2.34 × sin70° × (9 / 25)^(4/3) × 0.680^2 / (2×9.8) = 0.013m
Maximum Hourly	2.34 ×sin70° × (9 / 25)^(4/3) × 0.830^2 / (2×9.8) = 0.020m

Item \ Planning Division	Contents (Target Year: After 2035)

7. Sewage Pump

(1)Pump Well Water Level

Screen Inflow Water Level － Screen Head Loss

Average Daily　-9.511 － 0.010 = -9.521 m
Maximum Daily　-9.492 － 0.013 = -9.505 m
Maximum Hourly　-9.451 － 0.020 = -9.471 m

(2)Pump Capacity

Pump Number	Pump Capcity（m3/min)	Number（unit）		
NO.1	4.0	2	Standby	1
NO.2	4.0	1	Standby	—

(3)Pump Diameter

$$D = 146 \times \left(\frac{Q}{V}\right)^{0.5}$$

Q：Pump Capacity of 1units（m3/min)
V： Velocity （m/sec)

	Pump Capacity （m3/min)	Velocity （m/sec)	Pump Diameter（mm)	Pump Caliber of Decision （mm)
NO.1	4.0	1.5	238	200
		3.0	169	
NO.2	4.0	1.5	238	200
		3.0	169	

(4)Delivery Pipe

$$V = \frac{Q/60}{\pi/4 \times D^2}$$

$$hf = 10.666 \times \left(\frac{Q}{60 \times C}\right)^{1.85} \times D^{-4.87} \times L$$

V： Velocity（m/sec)
Q：Pump Capacity（m3/min)
D：Pipe Diameter（m)
hf:：Head Loss(m)
L：Pipe Length（m)
C：Flow Rate Coefficient=110

	Pipe Diameter （mm)	Velocity （m/sec)	Pipe Length (m)	Head Loss （m)
Pipe 1	300	1.89	30	0.13

(5)Pump Head

Actual Head =Pipe Top Level - Pump Well HWL
Total Head = Actual Head +Delivery Pipe Loss + Pump Around Loss
(Practical ＝1.5m)

	Pipe Top Level（M)	The Pump Well HWL(M)	Actual Head （m)	Total Head （m)
Pipe 1	12.00	-9.47	21.5	23.1

Item \ Planning Division	Contents (Target Year: After 2035)

(6)Calculation of Pump Output

$$P = \frac{0.163 \times \gamma \times Q \times H}{n} \times (1+\alpha)$$

P：Pump Output（kw）

γ：Weight per Unit Volume of the Liquid Being Pumped（kg/l）：1.0

Q：Pump Capacity（m3/min)
H：Total Head(m)
n：Pump Efficiency
α：Margin

	Pump Efficiency	Margin	Pump Output (kw)	Pump Output of Decision (kw)
NO.1	0.7	0.15	26.8	30.0
NO.2	0.7	0.15	26.8	30.0
Request Value			53.6	

(7)Pump Specification

	NO.1	NO.2	
Type	Submergible Pump with Screw Blade Suction Type		
Specifications	φ200 4.0m3/min 25 m	φ200 4.0m3/min 25 m	
Pump Capacity	4.0 m3/min	4.0 m3/min	
Pump Output of Decision	30.0 kw	30.0 kw	**60.0** kw
Number(unit)	2 Unit (Standby1Unit)	1 Unit	

(8)Overview of the Water Level etc

	Average Daily	Maximum Daily	Maximum Hourly
Sewage Influent Pipe Bottom High	-9.683	-9.683	-9.683
Gate Chamber Bottom High	-9.700	-9.700	-9.700
Screen Bottom High	-9.800	-9.800	-9.800
Screen Inflow Water Level	-9.511	-9.492	-9.451
Pump Well Water Level	-9.521	-9.505	-9.471

Item \ Planning Division	Contents (Target Year: After 2035)
8. Overgrand Grit Chamber	
(1)Inlet Gate	
1)Plan Water Quantity	10,173 m3/d＝ 0.096 m3/sec
2)Gate Chamber Inlet Water Level	+12.200 M
3)Gate Chamber Bottom High	+11.200 M
4)Gate Pass Water Depth	Gate Chamber Inflow Water Level－Gate Chamber Bottom High +12.200 － (+11.200) ＝ 1.000 m
5)Gate Specification	
Type	Motor Drive Type
Gate Size	W 0.4 m × H 0.4 m × 2
motor Power	0.75 kw
6)Gate Pass Velocity	0.096/(1.000×0.4×2) ＝ 0.120 m/sec
7)Gate Head Loss	1.5×0.120^2 / (2×9.8) ＝ 0.001 m
(2)Grit Chamber	
1)Plan Water Quantity	10,173 m3/d＝ 0.096 m3/sec
2)Water Area Load	1,800 m3/m2・d
3)Required Water Area	10,173 / 1,800 ＝ 5.7 m2
4)Shape Size	Width 1.5 × Length 2.0 m × 2 Pond
5)Water Area	1.5 × 2.0 × 2 ＝ 6.0 m2
6)Grit Chamber Bottom High	11.100 M
7)Water Depth	Gate Chamber Inflow Water Level－Grit Chamber Bottom High 12.200 － 11.100 ＝ 1.000 m
8) Examination	
Actual Water Area Load	10,173 / 6.0 ＝ 1,696 m3/m2･day
Pass Flow Rate	0.096 / (1.5×1.0×2) ＝ 0.032 m/s
Residence Time	2.0 / 0.032 ＝ 63 sec
9) Grate Removal Pump	
Type	Sand Pump
Specification	φ 100.0 mm ×V 0.5 m3/min ×H 5.0m × 2Unit
motor Power	0.75 kw

・Capacity Calculation of Wastewater Treatment Plant (Target Year: After 2035)

Item	Contents (Target Year: After 2035)

1. Design Parameters

(1)Design Flow Rate

①Average Daily Flow Rate(DA)	4,900	m3/d=	3.40	m3/min＝	0.057	m3/sec
②Maximum Daily Flow Rate(DM)	6,000	m3/d=	4.17	m3/min＝	0.069	m3/sec
③Maximum Hourly Flow Rate (HM)	8,300	m3/d＝	5.76	m3/min=	0.096	m3/sec

(2)Design Influent Quality

①BOD	220	mg/l	（P-BOD 88 mg/ , S-BOD 132 mg/L） ＊P-BOD:Particulate BOD , S-BOD:Soluble BOD
② SS	250	mg/l	
③T-N	43	mg/l	
④T-P	7	mg/l	

(3)Removal Ratio is Assumed (Total System)

①BOD	≦	90.0	%	(Removal Ratio of 90% was Confirmed on Demonstration Experiment)
②SS	≦	90.0	%	(Removal Ratio of 90% was Confirmed on Demonstration Experiment)
③T-N	≦	55.0	%	(Removal Ratio of 55-58% was Confirmed on Demonstration Experiment)
④T-P	≦	80.0	%	(Removal Ratio of 80-85% was Confirmed on Demonstration Experiment)

(4)Design Effluent Quality

					QCVN14:2008/BTNMT Cvalue:A
①BOD	=	22	mg/l	≦	30 mg/l
②SS	=	25	mg/l	≦	50 mg/l
③T-N	=	19	mg/l	≦	35 mg/l
④T-P	=	1	mg/l	≦	6 mg/l

(5)Sewage Influent and Influent Quality considering Return water

Sewage Influent and Return Water flow into the Raw Water Pump Pit. .
Also,The Return Water is Sludge Thickener Supernatant and Dehydrated Filtrate.

Item	Sewage Influent	Return Water	Total (Influent Quality is Average)
Flow Rate（m3/d）	6,000	1873	7,873
BOD（mg/L）	220	143	202
S-BOD（mg/L）	132	74	118
SS（mg/L）	250	143	225

Item	Contents (Target Year: After 2035)
2. Floating Sponge Filter(FSF)	
(1) Sewage Influent	
	Flow Rate(m3/d) 7,873 BOD(mg/L) 202 S-BOD(mg/L) 118 SS(mg/L) 225
(2)Facility Size	
①Design Filtration rate	= 250 m/d
②Required Filtration Area	= Flow Rate 7,873 m^3/d ÷ Design Filtration rate 250 m/d = 31.5 m^2
③Number of Tank	= 4 Tanks
④Area of Tank	= 31.5 m^2 ÷ 4 Tank ＝ 7.9 m^2
⑤Shape of Tank	Square
⑥Size of Tank ・Width ・Length	 = 2.5 m = 7.9 m^2 ÷ 2.5 m ＝ 3.149 → 3.5 m
⑦Filtration Area per Tank	= 8.8 m^2/Tanks
⑧Actual Filtration Rate	7,873 m^3/d ÷ 8.8 m^2/Tank × 4 Tank ＝ 223.7 m/d
(3)Removal Performance	
①SS Removal Ratio	= -0.0915 × Filtration Rate (m/d) ＋ 80.059 = -0.0915 × 224 m/d ＋ 80.059 = 59.6 %
②P-BOD Removal Ratio	= 0.9143 × SS Removal Ratio(%) = 0.9143 × 59.6 = 54.5 %
③S-BOD Removal Ratio	= 0 % （Filtration Equipment can not remove S- BOD.）
(4)Sewage Effluent	
①SS Concentration	= 225 mg/l × (100 － 59.6) ÷ 100 = 90.7 mg/l
②P-BOD Removal Ratio	= (202 － 118) mg/l × (100 － 54.5) ÷ 100 = 38.0 mg/L
③S-BOD Removal Ratio	= 118 × (100 － 0.0) ÷ 100 = 118.2 mg/l
④BOD Concentration	= P-BOD ＋ S-BOD = 38.0 ＋ 118.2 = 156.2 mg/l
(5)Washing Drainage	
①Average Filtration Loss Head	= Set to 40 cm
②SS Inflow Surface Area Loading	= (40 ÷ 0.5124) ^ (1 / 1.1747) = 40.8 kg/m2・d (SS Inflow Surface Area Loading when Washing Frequency is 24 times / day)
③SS Inflow Surface Area Loading per Washing	＝ 40.8 ÷ 24 ＝ 1.7 kg / m^2・times
④Washing Frequency	= 223.7 m/d × 225 mg/L ÷ 1000 ÷ 1.7 = 29.5 times/d
⑤Per time Washing Drainage Rate	= Filtration Area (m^2) × Washing height (m/time) = 35.2 × 1.5 m/times = 52.8 m^3/times
⑥Washing Drainage Rate	= 52.8 m^3/times × 29.5 times/d = 1,559 m^3/d
(6)Solid Balance	
①Filtered Effluent SS	= (7,873 － 1,559) m^3/d × 90.7 mg/L ÷ 1000 = 573 kg/d
②Washing Drainage SS	= 7,873 m^3/d × 225 mg/l ÷ 1000 － 573 kg/d = 1,195 (kg/d) (⇒To the Drain Tank)

Item	Contents (Target Year: After 2035)
3. High-rate Trickling Filter(HTF)	
(1)Sewage Influent	
①Flow Rate	= 6,314 m3/d
②Sewage Influent BOD Rate	= 6,314 m^3/d × 156.2 mg/l / 1,000 = 986 kgBOD/d
③Sewage Influent SS Rate	= 6,314 m^3/d × 90.7 mg/l / 1,000 = 573 kgBOD/d
(2)Facility Size	
①BOD Volumetric Loading	The BOD obtained by subtracting the Flow Rate × 15 mg-BOD/ L from the Sewage Influent BOD is set to 1.6 kg /m 3·d. （Japan specification 26B can achieve 15 mg /lL or less as treated water BOD at 1.6 kg / m 3·d. Overseas specifications are calculated assuming that parts exceeding 1.6 kg / m 3·d will shift to treated water. = 1.6 kg/m^3・d
②Filter Bed Volumetric	= 986 kgBOD/d − 95 kgBOD/d ÷ 1.6 kg/m^3・d = 557 (m^3)
③Filter Bed Height	= 2.3 m is set.
④Filter Bed Area	= 557 m^3 ÷ 2.3 m = 242.3 m2
⑤Area of 1tank per	= 81 m2/Tanks is set.
⑥Number of Tank	= 242.3 m^2 ÷ 81 m2/Tank = 3.0 tanks ⇒ 4 Tanks
⑦Actual BOD Volumetric Loading	= 986.3 ÷ (81 × 2.3 × 4) = 1.32 kg/m^3・d
⑧Shape of Tank	Square
⑨Size of Tank ・Width ・Length	 = 9.0 m = 9.0 m
⑩Area of 1tank per	= 81 m2/Tanks
⑪Filter Bed Height	= 2.3 m
⑫Bottom Height of Filter Bed	= 0.7 m
(3)Washing Drainage	
①Washing Frequency	Weekly make 1 time washing
②Water Level Height at Washing	From the filter media surface 0.4 m
③Washing Drainage Rate	= (81 m2/Tank × 4 Tank × (0.7 + 0.4) m + 81 m2/Tank × 4 Tank × 2.3 m × Carrier Porosity 0.9) × 1 time/week ÷ 7 day/week = 146.7 (m^3/d)
(4)Sewage Effluent	
①SS Concentration	= 6.2335 × Ln(BOD Volumetric Loading) + 22.233 = 6.2335 × Ln 1.324 kg/m^3・d + 22.233 = 24.0 mg/l
②SS Rate	= (6314 − 146.7) m3/d × 24.0 mg/L ÷ 1000 = 148 kg/d
③P-BOD（Particulate BOD）	= SS Concentration mg/L × P-BOD vs SS Ratio = 24.0 mg/l × 1.4008 = 33.6 mg/l
④S-BOD（Solute BOD） (Filter Bed Height 2.3 m Conversion)	= (0.7538 × Ln(BOD Volumetric Loading) + 2.6562) × 9.87715 × 2.3 ^ -0.92 ÷ 4.25 + 15 = (0.7538 × Ln 1.324 kg/m^3・d + 2.6562) × 9.87715 × 2.3 ^ -0.92 ÷ 4.25 + 15 = 18.1 mg/l
⑤BOD(mg/L)	= P-BOD mg/L + S-BOD mg/L = 33.6 mg/l + 18.1 mg/l = 51.7 mg/l
(5)Solid Balance	
①Washing Drainage SS	= 6,314 m^3/d × 90.7 mg/l ÷ 1000 × 0.12 = 67.4 (kg/d) (⇒To the Drain Tank)

Item	Contents (Target Year: After 2035)
4. Final Solids-Liquid Separator (SLS)	
(1) Sewage Influent	
①Flow Rate	= 6,168 m3/d
(2)Facility Size	
①Design Filtration rate	= 150 m/d
②Required Filtration Area	= Flow Rate 6,168 m^3/d ÷ Design Filtration rate 150 m/d = 41.1 m^2
③Number of Tank	= 4 Tanks
④Area of Tank	= 41.1 m^2 ÷ 4 Tanks = 10.3 m^2
⑤Shape of Tank Size of Tank ・Width ・Length	Square = 3.0 m = 10.3 m^2 ÷ 3.0 m = 3.426 → 3.5 m
⑥Filtration Area per Tank	= 10.5 m^2/Tanks
⑦Actual Filtration Rate	6,168 m^3/d ÷ 10.5 m^2/Tanks × 4 Tanks = 146.8 m/d
(3)Removal Performance	
①SS Removal Ratio	= 0.2549 × Sewage Influent SS Rate mg/l + 78.088 = 0.2549 × 24 mg/l + 78.088 = 84.2 %
②S-BOD Removal Ratio	= 0 % （Filtration Equipment can not remove S- BOD.）
(4)Sewage Effluent	
①SS Concentration	= 24 mg/l × (100 − 84.2) ÷ 100 = 3.79 mg/l
②P-BOD Removal Ratio	= 3.79 mg/l × 1.4008 = 5.31 mg/l
③S-BOD Removal Ratio	= 18.1 × (100 − 0.0) ÷ 100 = 18.1 mg/l
④BOD Concentration	= P-BOD + S-BOD = 5.3 + 18.1 = 23.4 mg/l
(5)Washing Drainage	
①SS Inflow Surface Area Loading per Washing	= 6,168 m/d × 24 mg/l ÷ 42.0 m^2 ÷ 1000 = 3.5 kgSS / m^2・times
②Washing Interval	= 20 hr/d
③Washing Drainage Time	= 0.5 hr/times
④Washing Drainage Rate	= 6,168 × 24 ÷ 20 × 0.5 ÷ 24 = 154 m^3/d
(6)Solid Balance	
①Effluent SS	= Effluent SS mg/l × (Flow Rate m^3/d − Washing Drainage Rate m^3/d) ÷ 1000 3.79 mg/l × (6,168 m^3/d − 154 m^3/d) ÷ 1000 = 23 kg/d
②Total generated sludge SS	= Washing Drainage SS kg/d + Settling Sludge SS kg/d = 148 kg/d − 23 kg/d = 125 kg/d
③Washing Drainage SS	= Final filtration total generated sludge kg/d × Final filtration total generated sludge / Final filtration tank sludge ratio (-) = 125 kg/d × 0.6 = 75 kg/d (⇒To the Drain Tank)
④Settling Sludge SS	= Total generated sludge kg/d − Washing Drainage SS kg/d = 125 kg/d − 75 kg/d = 50 kg/d (⇒To the Drain Tank)
⑤Settling Sludge SS Concentration	= 4,090 mg/l (From the result of demonstration experiment)
⑥Settling Sludge Volume	= Settling Sludge SS kg/d ÷ Settling Sludge SS Concentration mg/l × 1000 = 50 kg/d ÷ 4,090 mg/l × 1000 = 12 (m^3/d)

Item	Contents (Target Year: After 2035)

(7) SLS Settling Sludge Transfer Pump

①Pump Capacity = 12 m3/d ÷ 2 Times/d ÷ 15 min/Times ÷ 4 Tanks
= 0.10 m3/min/Tanks

②Liquid Specific Gravity (γ) = 1.0 to set
③Head Loss(H) = 10 m
④Pump Shaft Power $Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{0.7} = 0.24$ kw

⑤Motor Output P= Ps×(1+α) (α:Margin)
= 0.24 ×(1 + 0.15)
= 0.27 kw → 0.3 kw(Catalogue Value)

⑥ Specifications

Type	Centrifugal Pump	
Discharge Diameter	100	A
Pump Capacity	0.10	m3/min
Pump Head	10	m
Motor Output	0.3	kw
Number	6	Pumps (Including Standby of 2 Pumps)

5. Drain Tank

(1)Drainage Volume

	Drainage Volume m3/d	SS Concentration mg/L	Solids kg-DS/d
FSF Washing Drainage Rate	1,559	767	1,195
HTF Washing Drainage Rate	147	459	67
SLS Washing Drainage Rate	154	487	75
SLS Settling Sludge Volume	12	4,090	50
Total	1,872	741	1,387

(2)Capacity of the Drainage Tank
＊The capacity of the drainage tank shall be the capacity that can accept the total of one wash drainage per tank of FSF, HTF, SLS.

①1 Tank · 1 Washing Drainage Volume
・FSF Washing Drainage Rate = 13 m^3
・HTF Washing Drainage Rate = 256.77 m^3
・SLS Washing Drainage Rate = 32 m^3
・Capacity of the Drainage Tank = 13 + 256.77 + 32 = 302 m^3 ⇒ 350 m^3

②Number of Tank = 2 Tanks

(3) Sludge Transfer Pump (Drain Tank to Sludge Thickening)

The Capacity of the Sludge Transfer Pump is set based on the Generation Interval of Each Washing Drainage .

	A	B	C	D	E	A/E
	1 Tank · 1 Time per	Washing Frequency	Number of Tank	Number of Washing Cycles	Washing Interval	
	(m3/time・tank)	(time/day・tank)	(tank)	(time/day)	(minute)	(m3/min)
FSF	13	29.5	4	118	12.2	1.08
HTF	256.77	0.14	4	0.6	2,730	0.09
SLS	32	1.20	4	4.8	325	0.10

①Pump Capacity = (1.08 + 0.09 + 0.10) ÷ 2 = 0.64 m3/min

②Liquid Specific Gravity (γ) = 1.0
③Head Loss(H) = 10 m
④Pump Shaft Power $Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{0.7} = 1.48$ kw

⑤Motor output P= Ps×(1+α) (α:Margin)
= 1.48 ×(1 + 0.15)
= 1.71 kw → 2.0 kw(Catalogue Value)

⑥ Specifications

Type	Submersible Pump	
Discharge Diameter	150	A
Pump Capacity	0.7	m3/min
Pump Head	10	m
Motor Output	2.0	kw
Number	4	Pumps (Including Standby of 2 Pumps)

(4) HTF Washing Drainage Transfer Pump

①Pump Capacity = 0.09 m3/min ÷ 4 Pumps = 0.024 m3/min

②Liquid Specific Gravity (γ) = 1.0
③Head Loss(H) = 10 m
④Pump Shaft Power $Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{0.7} = 0.05$ kw

⑤Motor output P= Ps×(1+α) (α:Margin)
= 0.05 ×(1 + 0.15)
= 0.06 kw → 0.1 kw(Catalogue Value)

⑥ Specifications

Type	Submersible pump	
Discharge Diameter	100	A
Pump Capacity	0.05	m3/min
Pump Head	10	m
Motor Output	0.1	kw
Number	4	Pumps

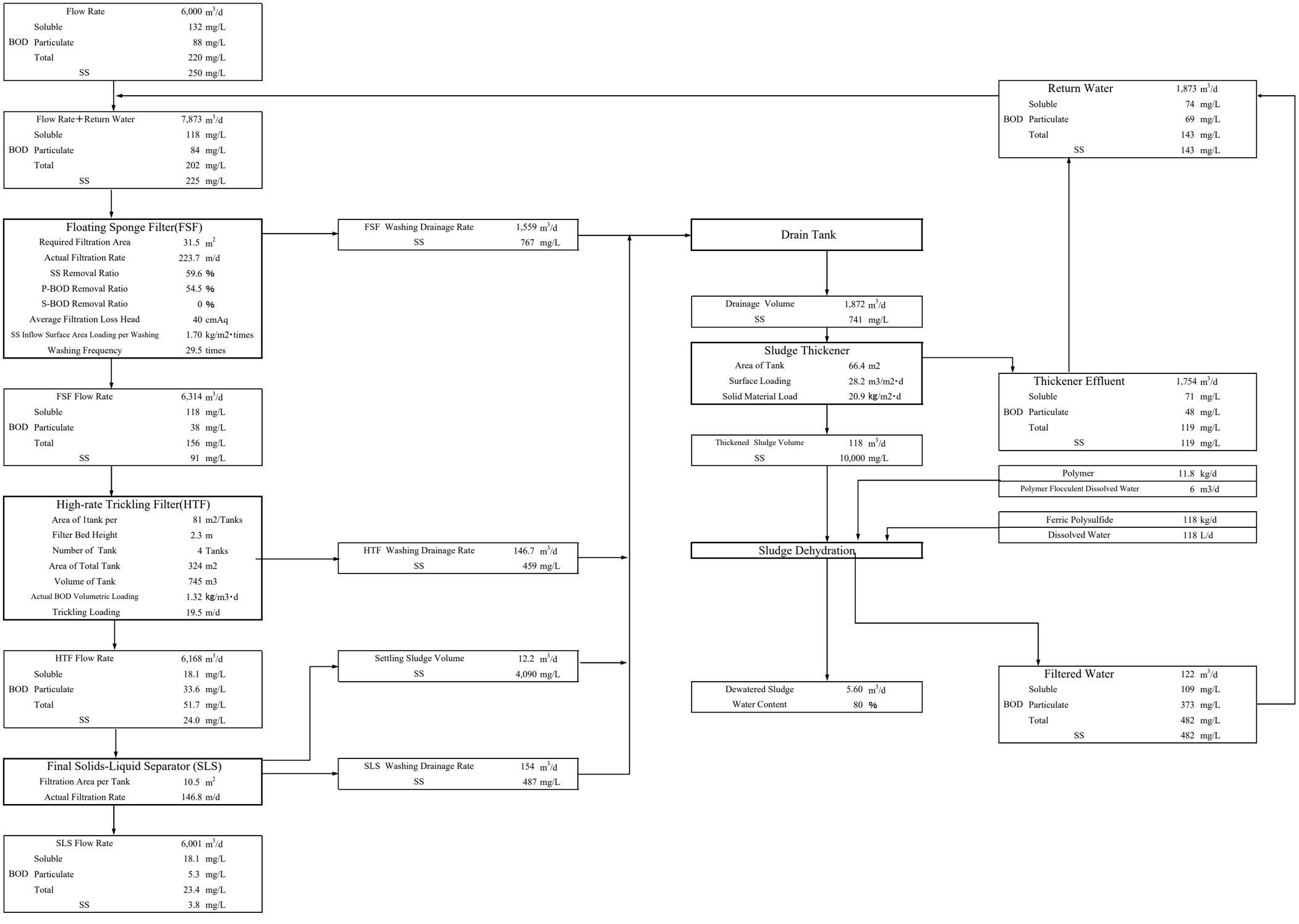
Item	Contents (Target Year: After 2035)
(5) SLS Washing Drainage Tank	
SLS 1 Tank Capacity shall be accepted for 20 minutes of Washing Drainage .	
①Washing Drainage Volume for 20 minutes	= 6,168 m3/d ÷ 24 ÷ 60 ÷ 4 × 20 = 21 m3
②Washing Drainage Tank Volume	= 25 m3
③Number of Tank	= 2 Tanks
(6) SLS Washing Drainage Transfer Pump	
①Pump Capacity	= 0.10 m3/min ÷ 0 Pumps = #DIV/0! m3/min
②Liquid Specific Gravity (γ)	= 1.0
③Head Loss(H)	= 10 m
④Pump Shaft Power	$Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{0.7}$ = 0.23 kw
⑤Motor output	P= Ps×(1＋α) (α:Margin) = 0.23 ×(1 ＋ 0.15) = 0.26 kw → 0.2 kw(Catalogue Value)
⑥ Specifications	Type Submersible pump Discharge Diameter 100 A Pump Capacity 0.10 m3/min Pump Head 10 m Motor Output 0.2 kw Number 4 Pumps (Including Standby of 2 Pumps)
6. Sludge Thickening	
(1) Sludge Thickener	
①Maximum Daily Flowrate	= 1,872 m^3/d
②Number of Tank	= 2 Tanks
③Design Water Area Load	= Below 30 m/d
④Require Water Area	= 1,872 m^3/d ÷ 30 m/d ÷ 2 Tanks = 31.2 m^2/Tanks
⑤Water Depth	= 4 m
⑥Diameter of Tank	= 6.5 m
⑦Area of Tank	= 33.2 m^2/Tanks
⑧Surface Loading	= 1,872 m^3/d ÷ 66.4 m^2 = 28.2 m/d
⑨Solid Material Load	= 1,387 kg/d ÷ 66.4 m^2 = 20.9 kg/m^2･d
⑩Retention time	= 33.2 m^2/Tanks × 2 Tanks × 4 m ÷ 1,872 m^3/d × 24 = 3.40 hr
⑪Performance	
･Density of Concentrated Sludge	= 1.0 %
･Solid Capture Rate	= 85.0 %
⑫Thickened Sludge	
･Solids SS	= Total Solids (kgSS/d) × Solid Capture Rate (%) = 1,387 kg/d × 85 (%) × 0.01 = 1,179 kg/d
･Thickened Sludge Volume	= Solids kg/d / Density of Concentrated Sludge % = 1,179 kg/d / 1.0 % × 100 ÷ 1000 = 118 m^3/d
･SS Concentration	= Solids SS kg/d / Thickened Sludge Volume m3/d × 1000 = 1,179 kg/d / 118 m^3/d × 1000 = 10,000 mg/l
･Thickener Effluent	= Drainage Volume m^3/d − Thickened Sludge Volume m^3/d = 1,872 m3/d − 118 m3/d = 1754 (m^3/d)
･Thickener Effluent Solids SS	= Total Solids (kgSS/d) × (1 − Solid Capture Ratio) = 1,387 kg/d × (1 − 0.85) = 208 (kg/d)
･SS Concentration	= Solids SS kg/d / Thickener Effluent m3/d × 1000 = 208 kg/d / 1,754 m^3/d × 1000 = 119 mg/l
･BOD	= SS Concentration mg/l × Primary Thickener Effluent BOD / SS ratio = 119 mg/l × 1.0 = 119 mg/l

Item	Contents (Target Year: After 2035)
(2) Sludge Thickener Transfer Pump	
①Thickened Sludge Volume	＝ 118 m3/d
②Pump Capacity	＝ 118 m3/d ÷ 360 min/d ÷ 2 pumps ＝ 0.16 m3/min
③Liquid Specific Gravity (γ)	＝ 1.0
④Head Loss(H)	＝ 10 m
⑤Pump Shaft Power	$Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{0.7}$ ＝ 0.38 kw
⑥Motor Output	P= Ps×(1＋α) (α: Margin) ＝ 0.38 ×(1 ＋ 0.15) ＝ 0.44 kw → 0.5 kw(Catalogue Value)
⑦ Specifications	Type: Centrifugal Pump Discharge Diameter: 80 A Pump Capacity: 0.20 m3/min Pump Head: 10 m Motor Output: 0.5 kw Number: 4 Pumps (Including Standby of 2 Pumps)
7. Sludge Dehydration	
(1) Sludge Storage Tank	
The Sludge Storage Tank should be a Capacity that can store one day of Thickened Sludge.	
①Thickened Sludge Volume	＝ 118 m3/d
②Number of Tank	＝ 2 Tanks
③Req.Volume	＝ 118 m3/d ÷ 2 Tanks ÷ 1 day ＝ 59 m3/tanks
④Size of tank ・Water Depth ・Width ・Length	 ＝ 3.0 m ＝ 3.5 m ＝ 6.5 m
⑤Volume	＝ 3.5 m × 6.5 m × 3.0 m ＝ 68 m3
(2) Dehydrator Supply Pump	
①Thickened Sludge Volume	＝ 118 m3/d
②Pump Capacity	＝ 118 m3/d ÷ 24 hr/d ÷ 3 Pumps ＝ 1.64 m3/hr
③Head Loss(H)	＝ 15 m
④Specifications	Type: Uniaxial Screw Pump Discharge Diameter: 100 A Pump Capacity: 1.3 m3/hr Pump Head: 15 m Motor Output: 3.7 kw Number: 6 Pumps (Including Standby of 2 Pumps)
(3) Dehydrator	
①Sludge Concentration	＝ 1.0 %
②Sludge Weight	＝ 118 m3/d × 1.0 % × 0.01 × 1,000 kg/m^3 1,179 kg/d
③Operation Conditions	＝ 24 hr/d and 7 days in a week
④Supply Solid Weight	＝ 1,179 kg/d ÷ 24 hr/d × 7 ÷ 7 days ÷ 3 unit ＝ 16 kg/h
⑤Specifications	Type: Volute Dewatering Press(SUS) Supply Sludge Concentration: 1.0 % Capacity: Max 20 kg/h (Catalogue Value) SS Recovery: ≧ 95 % Sludge Cake Moisture Content: ≦ 80 % Motor Output: 3.95 kw Number: 3 units

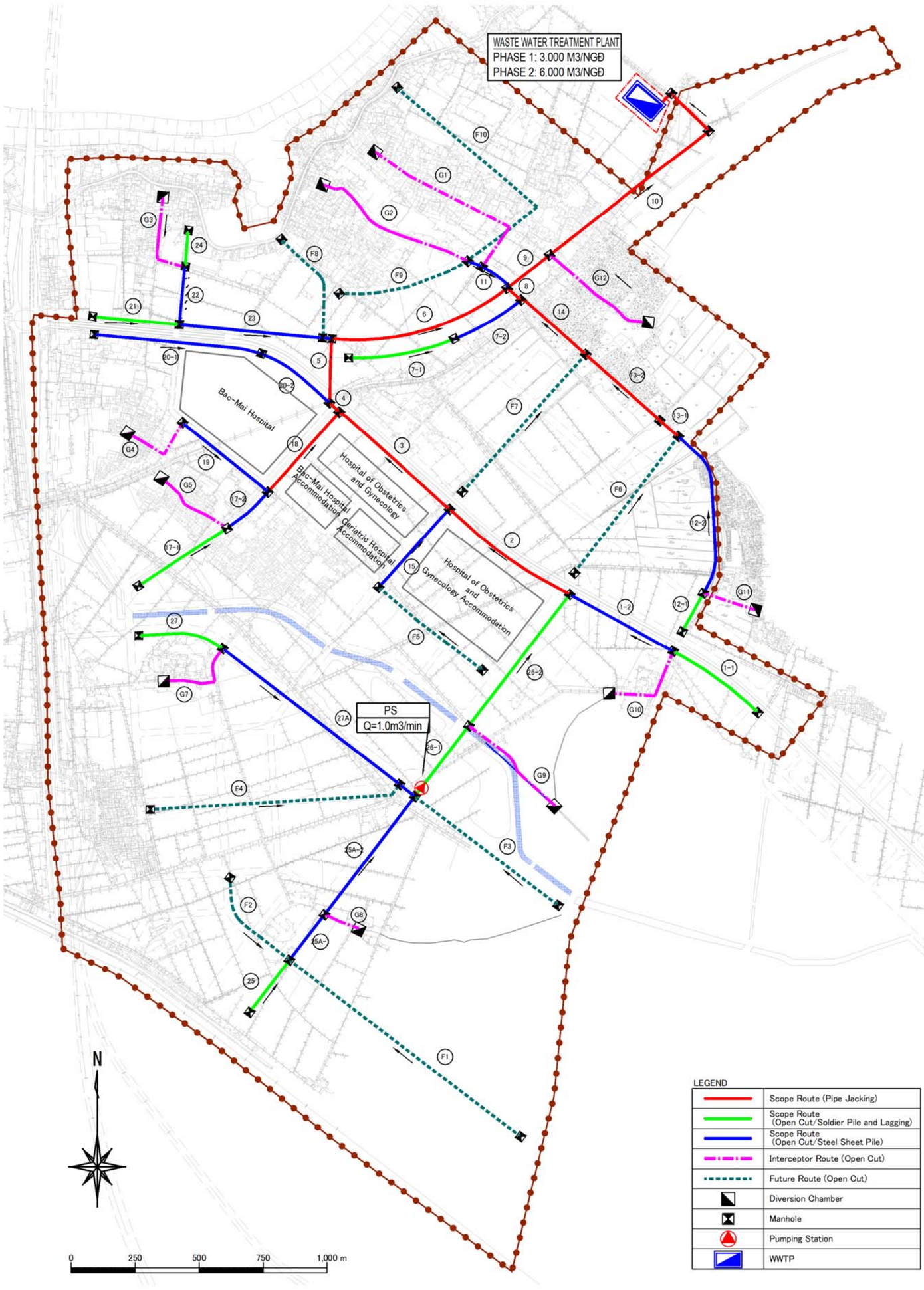
Item	Contents (Target Year: After 2035)
(4) Chemical Injection System	
①Polymer Injection Pump	
・Dewatering Capacity	＝ 16 kg-DS/h
・Injection Rate	＝ 1.0 % to Set
・Injection Dose	＝ 16 kg-DS/h × 0.01 ＝ 0.16 kg/h
・Solution concentration	＝ 0.2 %
・Req.Volume	＝ 0.16 ÷ 0.002 ÷ 60 min ＝ 1.4 L/min
・Flexibility	＝ 0.5 ～ 1
・Pump Capacity	＝ 0.7 ～ 1.4 L/min
・Specifications	Type: Diaphragm Metering Pump Discharge Diameter: 40 A Pump Capacity: 0.5～1.0 L/min Motor Output: 0.1 kw Number: 3 Pumps (Including Standby of 2 Pumps) Max.Discharge Pressure: 0.3 Mpa
②Polymer Solution Tank	
・Retention Time	＝ 2 hr
・Req.Volume	＝ 1.36 L/min × 120 min ÷ 1000 ＝ 0.16 m3/Tanks → 0.5 m3/Tanks
・Number of Tank	＝ 4 Tanks
・Specifications	Type: Circle Tank Volume: 0.5 m3 Number: 4 Tanks Agitator: 4 Unit/Tank(1.5kw)
③Ferric Polysulfide Injection Pump	
・Dewatering Capacity	＝ 16 kg-DS/h
・Injection Rate	＝ 15 %
・Injection Dose	＝ 16 kg-DS/h × 0.15 ＝ 2.5 kg-DS/h
・Solution Density	＝ 1.45
・Req.Volume	＝ 2.5 ÷ 1.45 ÷ 60 min ＝ 0.03 L/min
・Flexibility	＝ 0.5 ～ 1.5
・Pump Capacity	＝ 0.014 ～ 0.042 L/min → 0.1 ～ 0.3 L/min
・Specifications	Type: Diaphragm Metering Pump Discharge Diameter: 15 A Pump Capacity: 0.1～0.3 L/min Motor Output: 0.1 kw Number: 4 Pumps (Including Standby of 2unit) Discharge Pressure: 0.5 Mpa
④Ferric Polysulfide Solution Tank	
・Retention Time	＝ 1 days＝ 24 hr
・Req.Volume	＝ 2.5 kg-DS/h ÷ 1.45 × 24 hr ＝ 0.1 m3/Tanks
・Number of Tank	＝ 2 Tanks
・Specifications	Type: Circle Tank Volume: 0.1 m3 Number: 2 Tanks Agitator: 2 Unit/Tank(0.1kw)
(5) Cake Hopper * Cake Hopper Volume is Calculated Based on Maximum Daily Flowrate .	
①Sludge Volume	＝ 16 kg/d × 3 Units × 24 hr/d × 7 / 7 ＝ 1,179 kg/d
②SS Recovery Rate	＝ 95 %
③Sludge Amount per a Day	＝ 1,179 kg/d × 0.95 ＝ 1,120 kg/d ＝ 1.1 t-DS/d
④Sludge Amount per a Day	＝ 1,120 kg-DS/d
⑤Water Content	＝ 80 %
⑥Dewatered Sludge	＝ 1120 / (1 － 80 %) ÷ 1000 ＝ 5.6 m3/d
⑦No of Hopper	＝ 3 Units
⑧Req.Volume	＝ 1.9 m3/d → 2.0 m3/Units
⑨Specifications	Type: Auto Cut Gate Type Volume: 2.0 m3 Motor Output: 1.5 kw × 2 Number: 3 Units
(6) Filtered Water	
①Thickened Sludge Volume	＝ 118 m3/d
②Polymer Flocculent Dissolved Water	＝ 6 m3/d
③Water content in Sludge Cake	＝ 1 m3/d
④ Filtered Water Volume	＝ 122 m3/d
⑤SS in Filtered Water	＝ 59 kg/d
⑥Filtered Water SS	＝ 482 mg/l
⑦Filtered Water BOD	＝ 482 mg/l
⑧Filtered Water S-BOD	＝ 109 mg/l

Item	Contents (Target Year: After 2035)
8. Chlorination	
(1)Chlorination Tank	
* Chlorination Tank volume is Calculated Based on Maximum Daily Flowrate .	
①Maximum Flow rate	= 6,168 m3/d
②Contact Time	= 15 min
③Number of Tank	= 1 Tanks
④Req.Volume of Tank	= 6,168 m3/d × 15 min/d ÷ 1,440 ÷ 1 Tanks = 64 m3
⑤Shape of Tank	Rectangular
⑥Size of Tank	
・Width	= 1.5 m
・Length	= 30.0 m
・Effective Depth	= 1.5 m
・Volume of Tank	= 68 m3
(2)Sodium Hypochlorite Dosing Pump	
* Sodium Hypochlorite Dosing Pump Volume is Calculated Based on Maximum Hourly Flowrate.	
①Disinfection Volume	= 8,300 m3/d
②Dosing Rate	= 3 mg/L
③Disinfectant Concentration	= 10 %
④Disinfectant Density	= 1.1 t/m3
⑤Dosing Pump Capacity	= 8,300 m3/d × 3 mg/L ÷ 10 % ÷ 1.1 = 0.16 L/min
⑥Specifications	Type: Diaphragm Metering Pump Pump Capacity: 0.16 L/min Motor Output: 0.2 kw Number: 2 Units (Including Standby) Max.Discharge Pressure: 1.0 Mpa
(3)Sodium Hypochlorite Storage	
①Storage Time	= 2.5 days
② Req.Volume	= 0.16 L/min× 1,440 min/d × 2.5 days × 10^{-3} = 0.57 m3/Tanks → 0.7 m3/Tanks
③Number of Tank	= 1 tanks
④Specificatio	Type: Circle Tank Volume: 0.7 m3 Number: 1 Tanks
9. Polishing Pond	
Design Inflow	= 6,000 m3/d
Size	Width= 50.0 m (Effective width= 41.0 m) (Slope, 1:1) Length= 83.0 m (Effective length= 74.0 m) Depth= 4.5 m (Effective depth= 2.0 m)
Number of pond	2 ponds
Required retention time	2.0 days
Effective volume	41.0 m x 74.0 m x 2.0 m x 2 ponds = 12,136 m3
Retention time	12,136 m3÷ 6,000 m3/day= 2.0 days
9. Water Discharge	
(1)Outfall Pump	
* Water Discharge Pump is calculated based on Maximum Hourly Flowrate .	
①Pump Capacity	= 5.88 m3/min = QMax
②Pump Distribution	= QMax = 5.88 m3/min
③Pump Head	
④Specification for Pressure Piping	
・Diameter	φ 250 mm
・Number	2 pipe
・Highest Level (End of Pipe)	+ 3.400 M
・Length	500 m
(2)Head Loss at Pressure Pipe (PP)	
Pumping Flow Rate(Maximum)	Q= QMax= 2.94 m3/min= 0.049 m3/sec
①Cross Section	A= 0.25 m^2×π×1/4= 0.049 m2
②Flow Rate	V= 0.049 / 0.049 = 1.0 m/s
③Loss Calculation	
・ Head Loss	hf= 10.666 ×(0.049 / 110)$^{1.85}$× 0.25 $^{-4.87}$× 500 = 2.88 m
・ Outlet Loss	h0= 1.0 × 1.0 ^2/2g = 0.051 m
・Total	H=hf ＋ h0 = 2.93 m
④Head Loss Around Pump	H= 2.0 m
⑤Actual Pump Head	H=(Highest Level － Pumping Level) = 3.400 M － -2.500 M = 5.900 m
⑥Total Pump Head	H=(Actual Pump Head ＋ Pressure Pipe ＋ Around Pump) = 5.900 ＋ 2.93 ＋ 2.00 = 10.830 m → 11 m
⑦Motor Output	
・Pumping Flow Rate Q	2.8 m3/min
・Liquid Specific Gravity γ	1.0
・Pump Efficiency η	0.7
・Pump Shaft Power	$Ps = \frac{0.163 \cdot \gamma \cdot Q \cdot H}{\eta}$ = 7.17 kw
⑧Motor Output	P= Ps×(1＋α) (α:Margin) = 7.17 ×(1 ＋ 0.15) = 8.25 kw → **11.0** kw(Catalogue Value)
⑨Specifications	Type: Submersible Pump Diameter: 250 A Motor Output: 11.0 kw Total Pump Head: 11 m Pump Capacity: 3.0 m3/min Number: 3 Pump (Including Standby of 1 Pump)

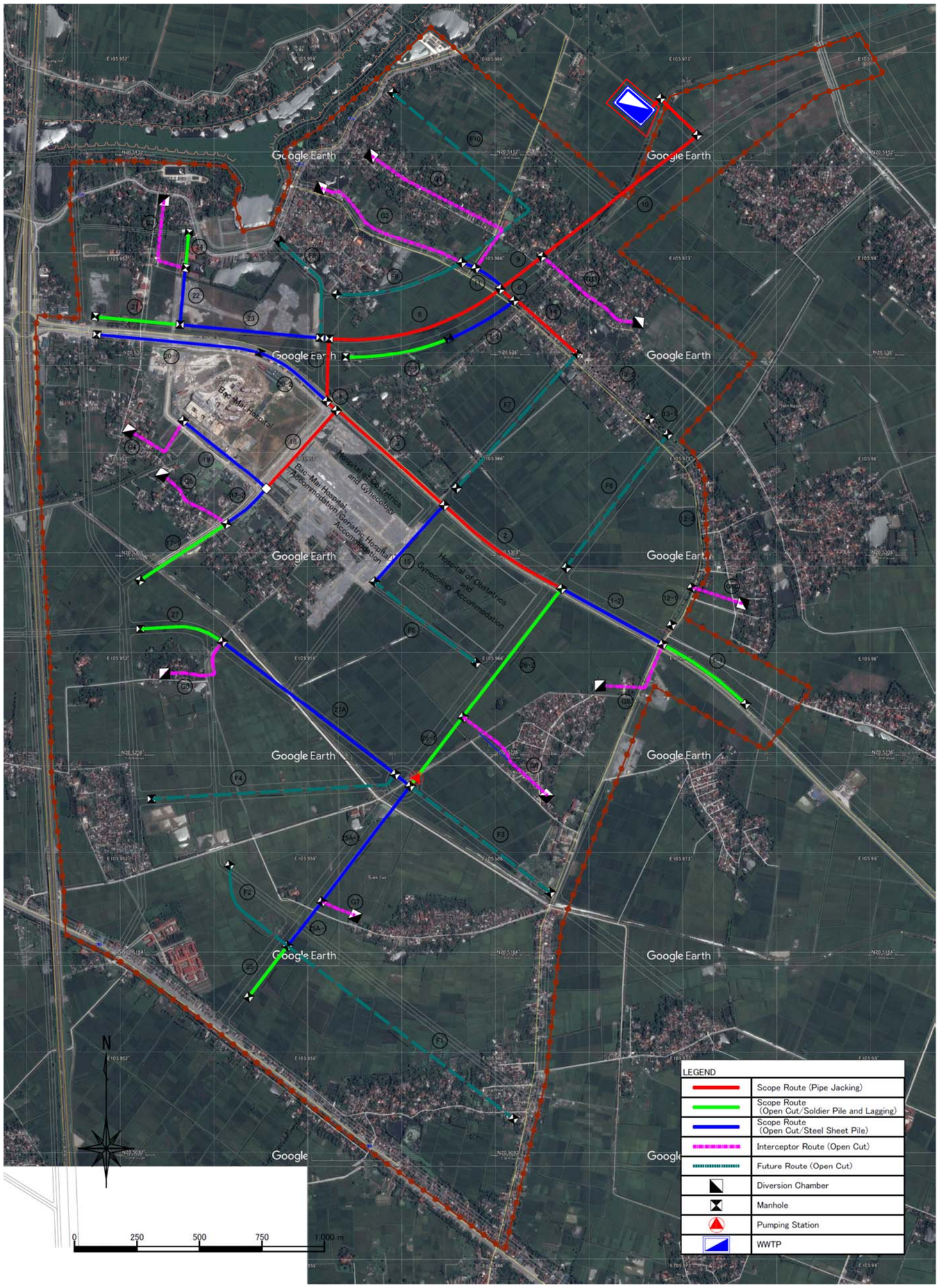
・Solid Balance Calculation ：Target Year: After 2035)



6. Drawings



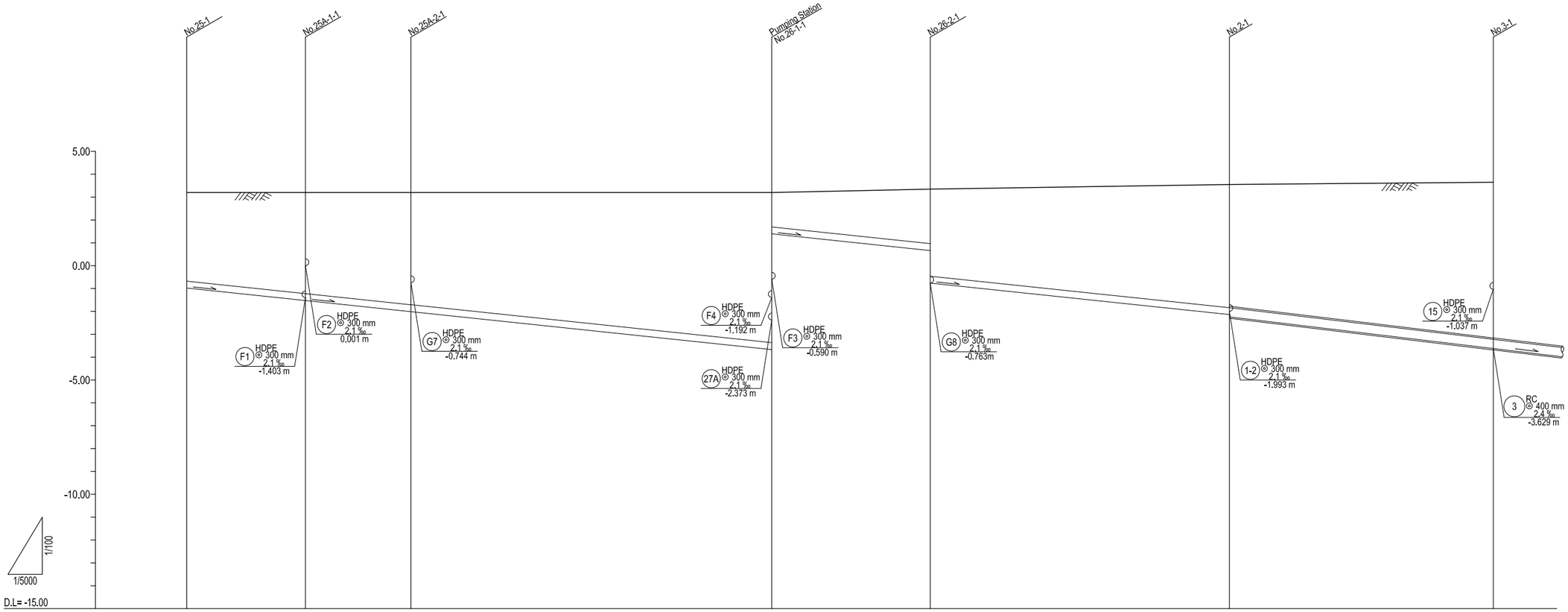
General Layout of Sewer Network



General Layout of Sewer Network (with Image of Present Development Condition)

Profile of Main Sewer

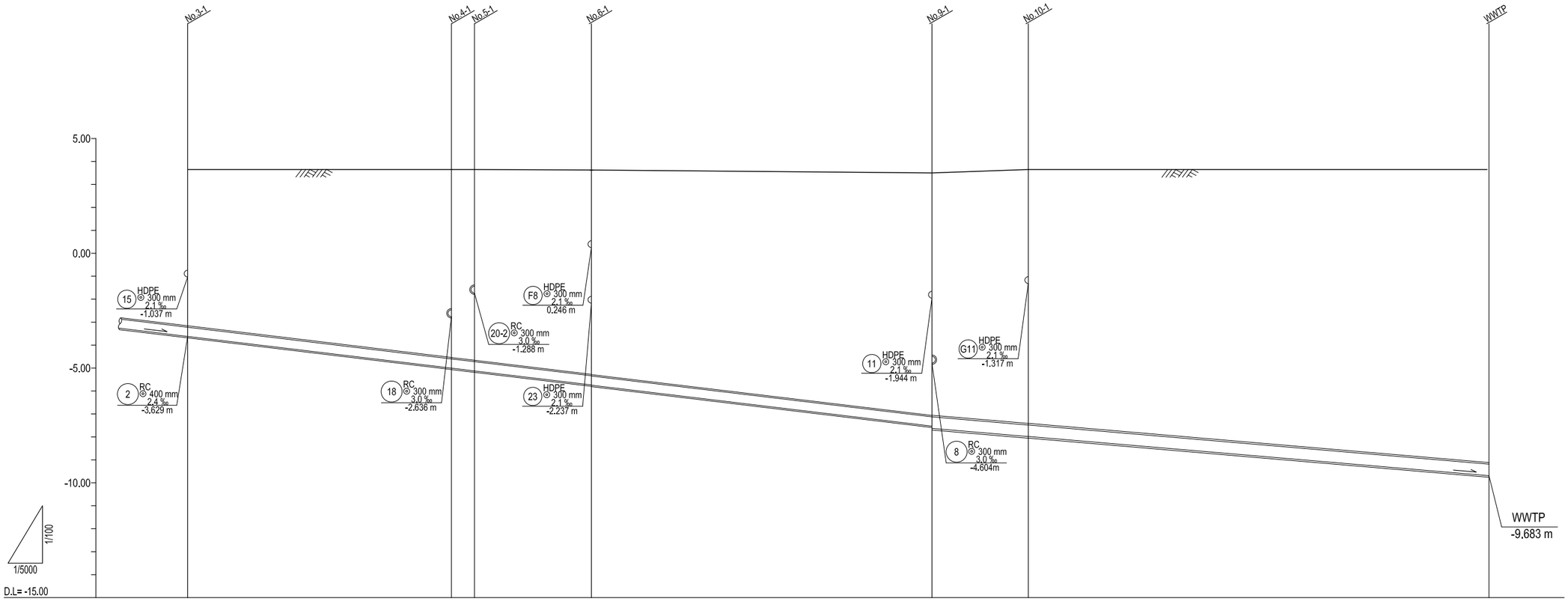
Scale V = 1:100 L = 1:5000



No		25	25A-1	25A-2	26-1	26-2	2	
DIAMETER		HDPE ⊙ 300	HDPE ⊙ 300	HDPE ⊙ 300	HDPE ⊙ 300	HDPE ⊙ 300	RC ⊙ 400	
GRADIENT		2.1 ‰	2.1 ‰	2.1 ‰	2.1 ‰	2.1 ‰	2.4 ‰	
LENGTH		260.0 m	231.00m	790.00m	347.00m	655.00m	578.00m	
GROUND ELEVATION (FH)	3.20	3.20	3.20	3.20	3.35	3.55	3.65	
COVERING DEPTH	3.87	4.42	4.90	6.56 2.50	3.38 3.80	5.38 5.33	6.82	
INVERT ELEVATION	-0.979	-1.525	-2.010	-3.669 0.391	-0.338 -0.763	-2.139 -2.239	-3.629	
ACCUMULATED	0.00	260.00	491.00	1281.00	1628.00	2283.00	2861.00	

25 25A-1 25A-2 26-1 26-2 2

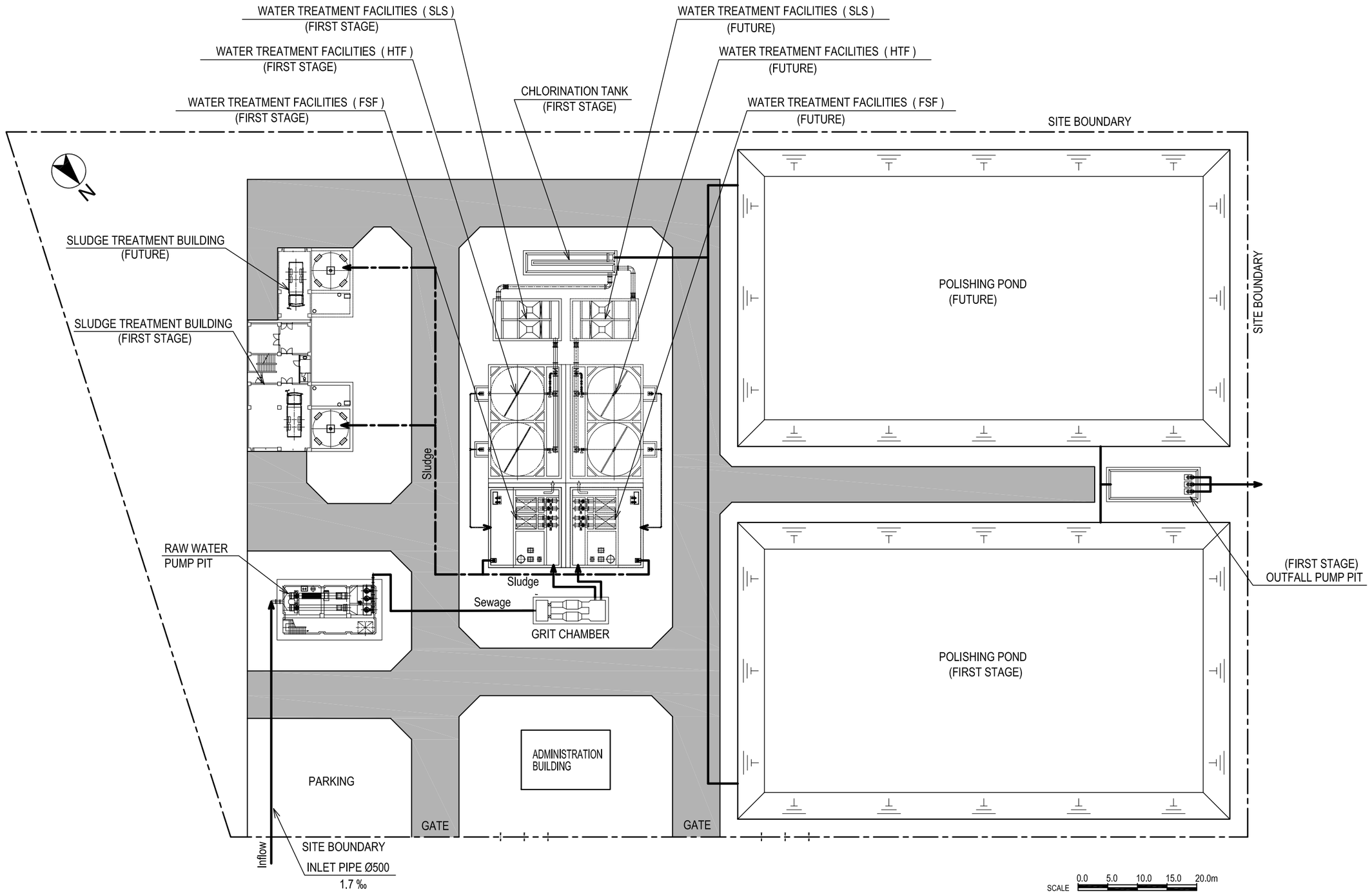
NAME OF DRAWINGS	PROFILE OF MAIN SEWER (1/2)	SCALE: A1 V=1/100 H=1/5000 A3 V=1/200 H=1/10000
DESIGNED BY	JICA SURVEY TEAM	



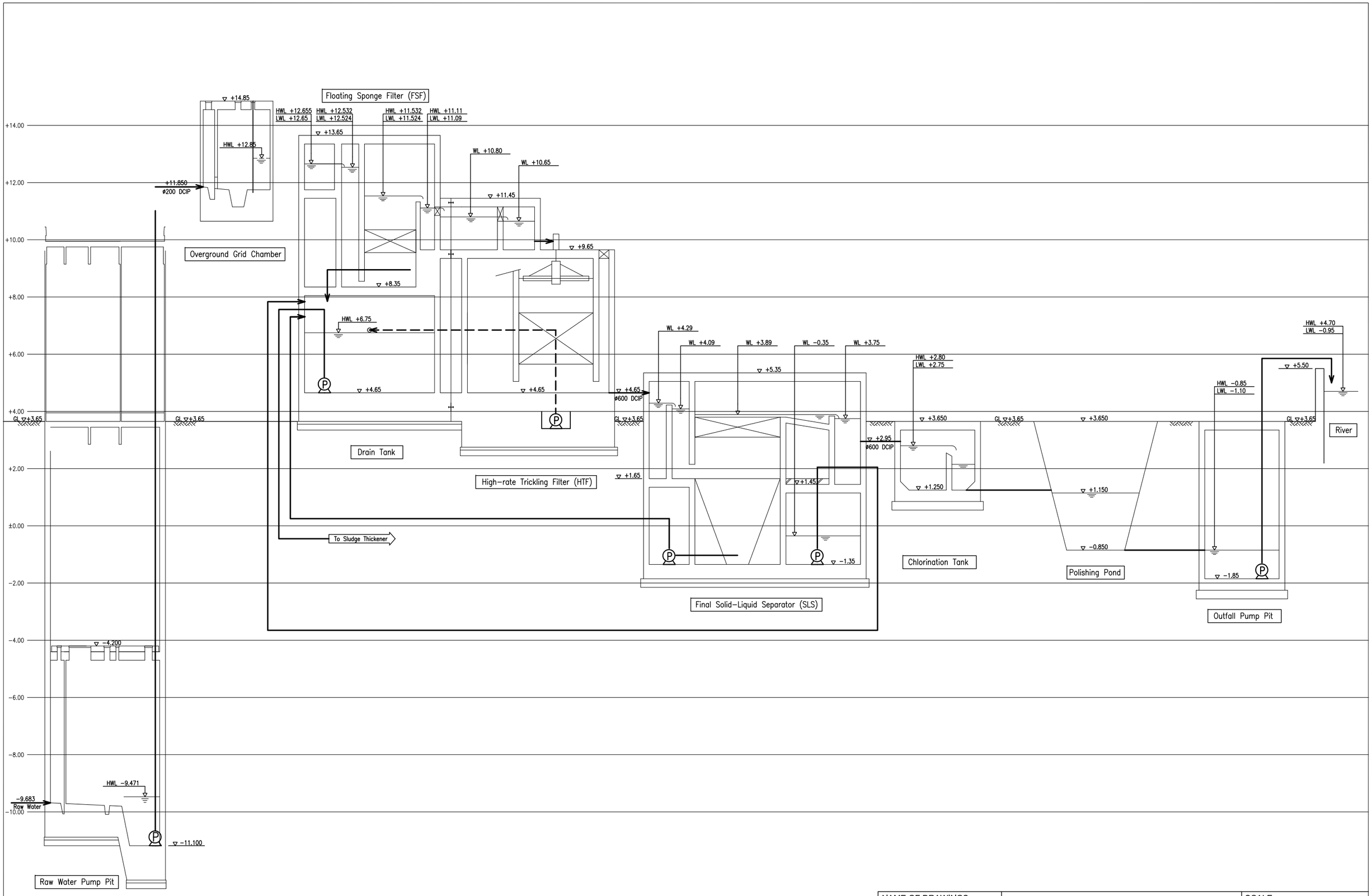
No	3	4	5	6	9	10
DIAMETER	RC ⊙ 400	RC ⊙ 400	RC ⊙ 400	RC ⊙ 400	RC ⊙ 500	RC ⊙ 500
GRADIENT	2.4 ‰	2.4 ‰	2.4 ‰	2.4 ‰	1.7 ‰	1.7 ‰
LENGTH	575.0 m	50.0 m	255.0 m	742.00m	210.00m	1004.00m
GROUND ELEVATION (FH)	3.65	3.65	3.65	3.63	3.50	3.65	3.65
COVERING DEPTH	6.81	8.19	8.31	8.91	10.56 10.55	11.06	12.76
INVERT ELEVATION	-3.626	-5.006	-5.126	-5.738	-7.519 -7.619	-7.976	-9.683
ACCUMULATED	2861.00	3436.00	3486.00	3741.00	4483.00	4693.00	5697.00

3 4 5 6
9 10

NAME OF DRAWINGS	PROFILE OF MAIN SEWER (2/2)	SCALE: A1 V=1/100 H=1/5000 A3 V=1/200 H=1/10000
DESIGNED BY	JICA SURVEY TEAM	

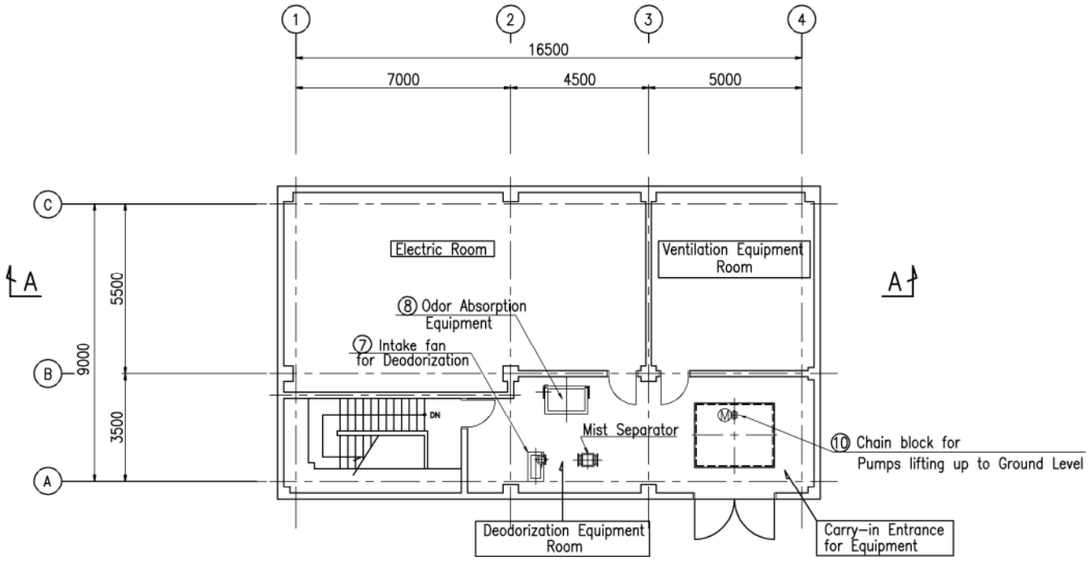


NAME OF DRAWINGS	GENERAL LAYOUT	SCALE:
DESIGNED BY	JICA SURVEY TEAM	

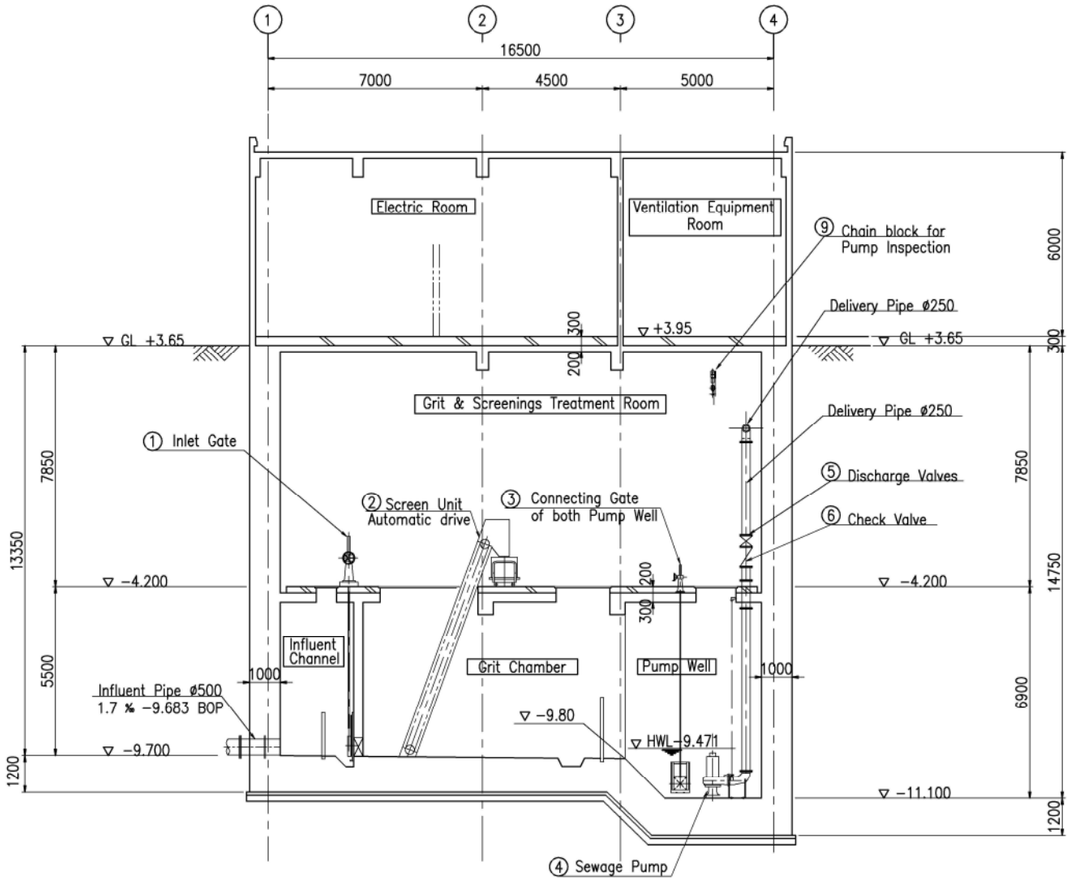


NAME OF DRAWINGS	HYDRAULIC PROFILE	SCALE: A1 V=1:60 H=NTS A3 V=1:120 H=NTS
DESIGNED BY	JICA SURVEY TEAM	

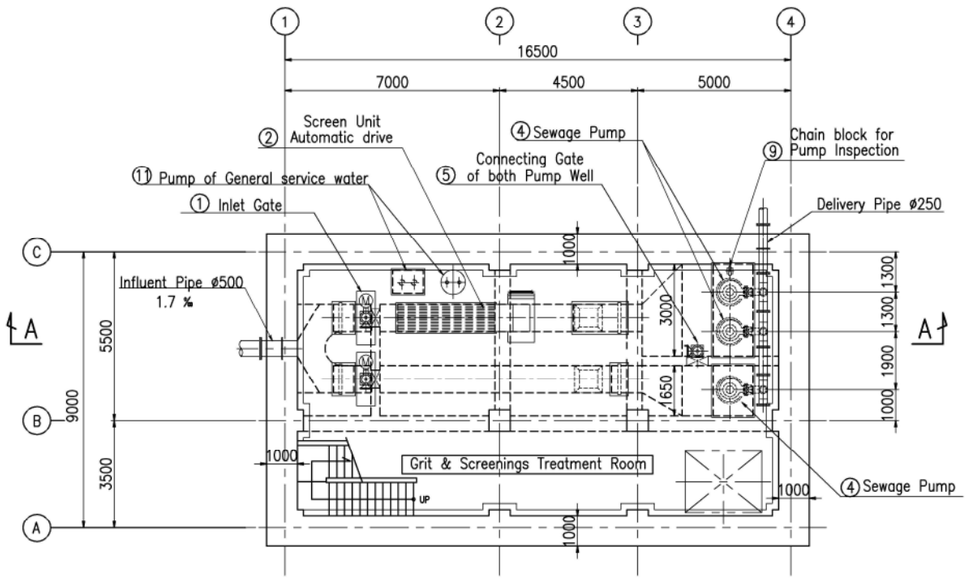
Raw Water Pump Pit



Plan of 1st Floor (GL ± 0.30)



A–A Section



Plan of B1 Floor (GL−7.850)

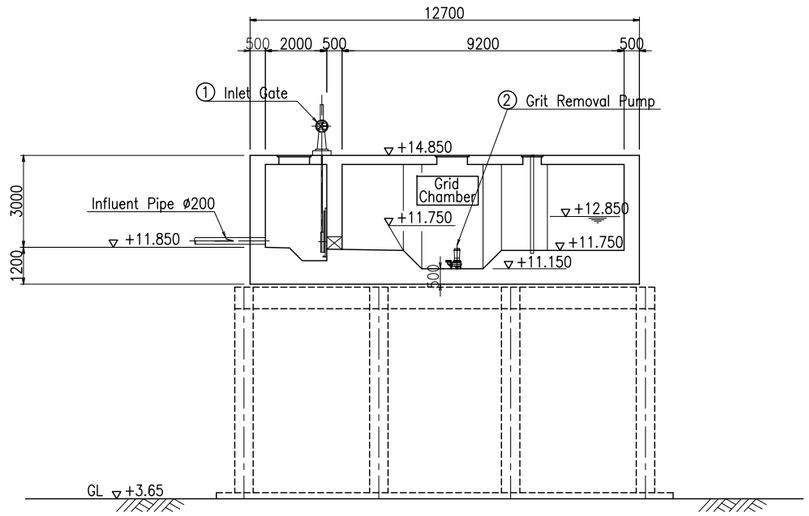
No.	①			②			③			④			⑤			⑥		
Equipment	Inlet Gate			Screen Unit of Automatic drive			Connecting Gate of both Pump Well			Sewage Pump			Discharge Valves			Check Valve		
Specification	Cast iron made, Motor drive type			Motor Drive			Cast iron made, Manual drive type			Submergible Pump with Screw blade suction type			Manual operation			Swing model		
Model, Size & Capacity	B:400mmxH:400mm			Water course B:900mmxD:5.7m x Screen opening Size:25mm			W:500mmxH:500mm			ø200x4.0m³/minx25m			ø200			ø200		
Motor Power(kW)	0.75			0.4						30 : 2units 30 : 1unit (30 : 1unit)								
Unit	Future		First Stage	Future		First Stage	Future		First Stage	Future		First Stage	Future		First Stage	Future		First Stage
	2	–	1	1	–	1	1	–	1	3(1)	–	2(1)	3	–	2	3	–	2
Remarks																		

No.	⑦			⑧			⑨			⑩			⑪					
Equipment	Intake fan for Deodorization			Odor Absorption Equipment			Chain block for Pump Inspection			Chain block for Pumps lifting up to Ground Level			Pump of General service water					
Specification	Turbo fan Single Suction Type			Upright model, Dry filter			Manual			Motor Drive Chain block			Automatic supply unit					
Model, Size & Capacity	10m³/min			10m³/min			Lift capacity: 0.5t			Lifting Capacity: 1.0t			1m³					
Motor Power(kW)	0.75			–						0.8			1.5x2					
Unit	Future		First Stage	Future		First Stage	Future		First Stage	Future		First Stage	Future		First Stage			
	1	–	1	1	–	1	1	–	1	1	–	1	1	–	1			
Remarks																		

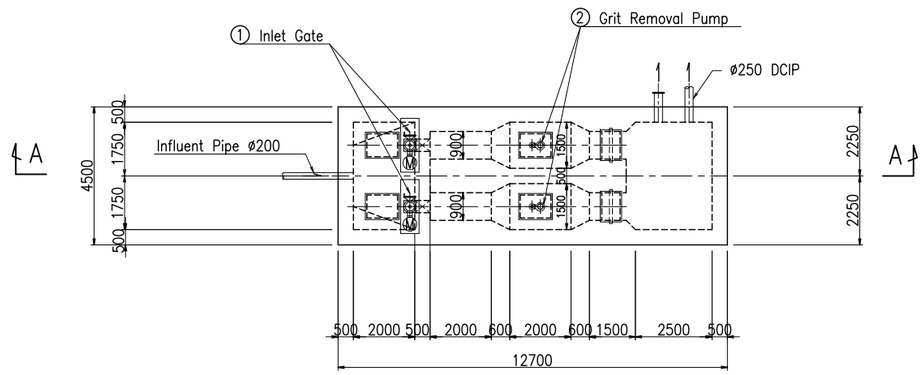
Notes:

1. ( ) : Stand–by
2. First Stage : Up to 2030
   Future : Year after 2035

NAME OF DRAWINGS	RAW WATER PUMP PIT	SCALE: A1 1:100 A3 1:200
DESIGNED BY	JICA SURVEY TEAM	



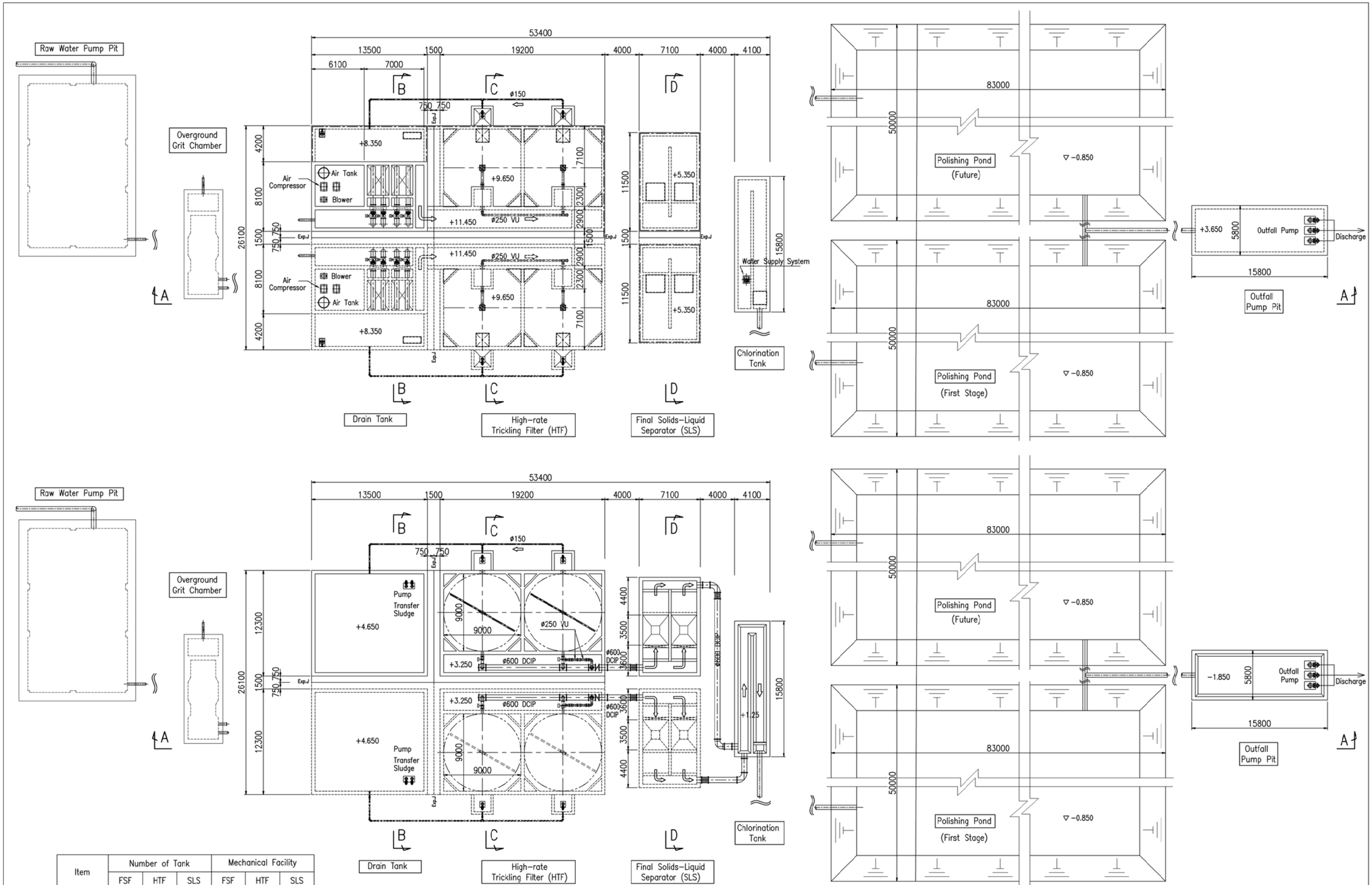
A – A SECTION



PLAN

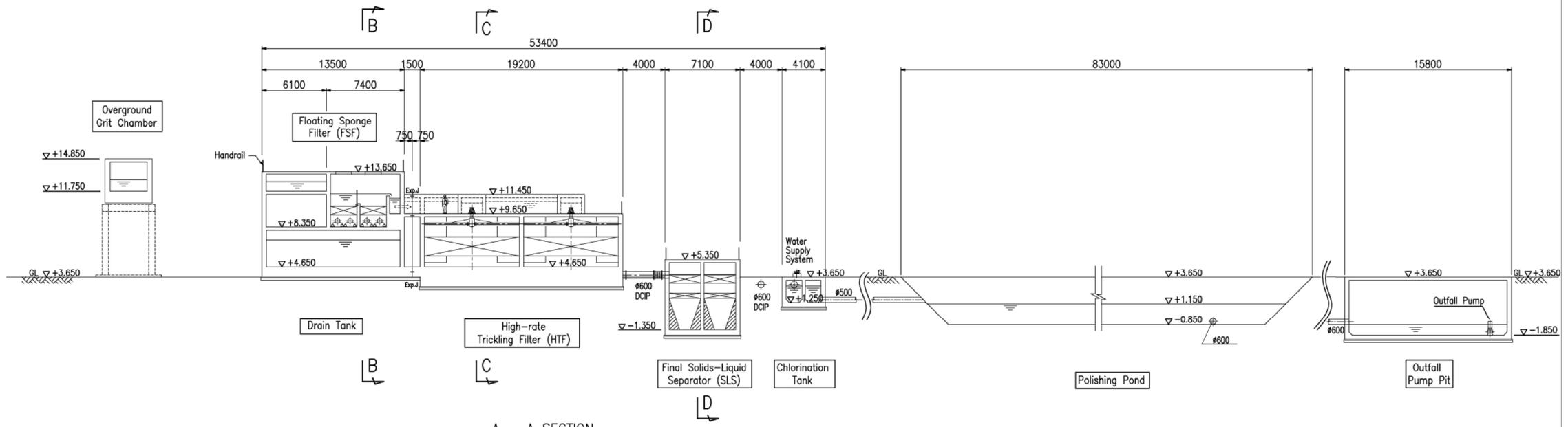
No.	①	②	
Equipment	Inlet Gate	Grit Removal Pump	
Specification	Cast iron made, Motor drive type	Sand Pump	
Model, Size & Capacity	B:400mmxH:400mm	ø100x0.5m³/minx15m	
Motor Power(kW)	0.75	–	
Unit	2	2	
Remarks			

NAME OF DRAWINGS	OVERGROUND GRIT CAMBER	SCALE: A1 1:100 A3 1:200
DESIGNED BY	JICA SURVEY TEAM	

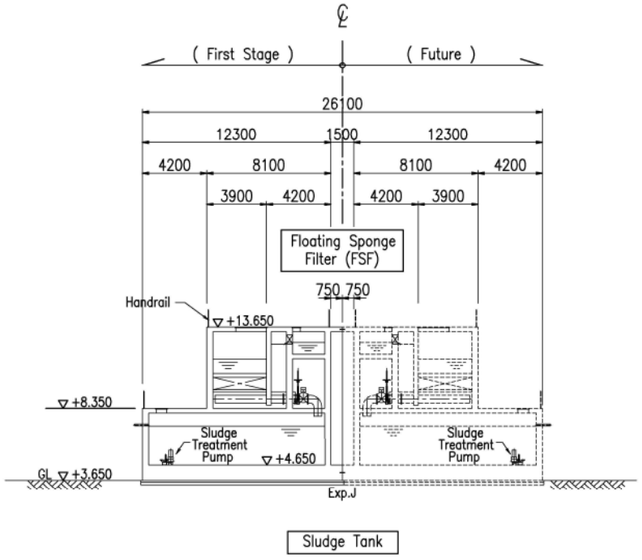


Item	Number of Tank			Mechanical Facility		
	FSF	HTF	SLS	FSF	HTF	SLS
First Stage	2	2	2	2	2	2
Future	4	4	4	4	4	4

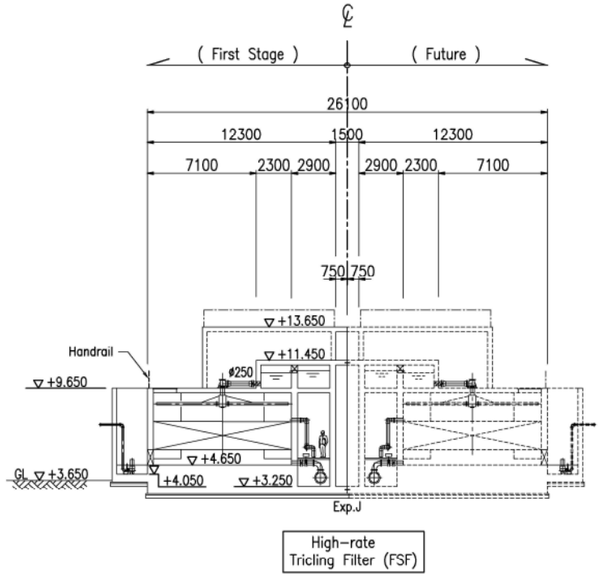
NAME OF DRAWINGS	WATER TREATMENT FACILITIES 1/2	SCALE: A1 1:200 A3 1:400
DESIGNED BY	JICA SURVEY TEAM	



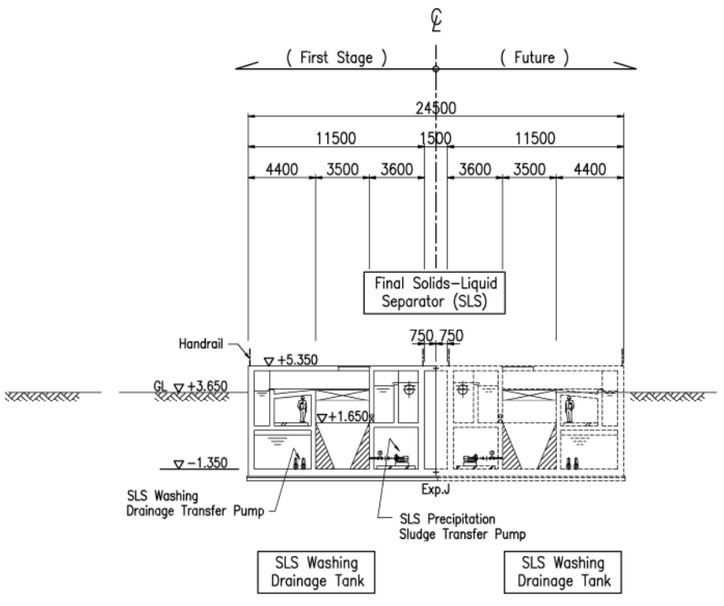
A − A SECTION



B − B SECTION

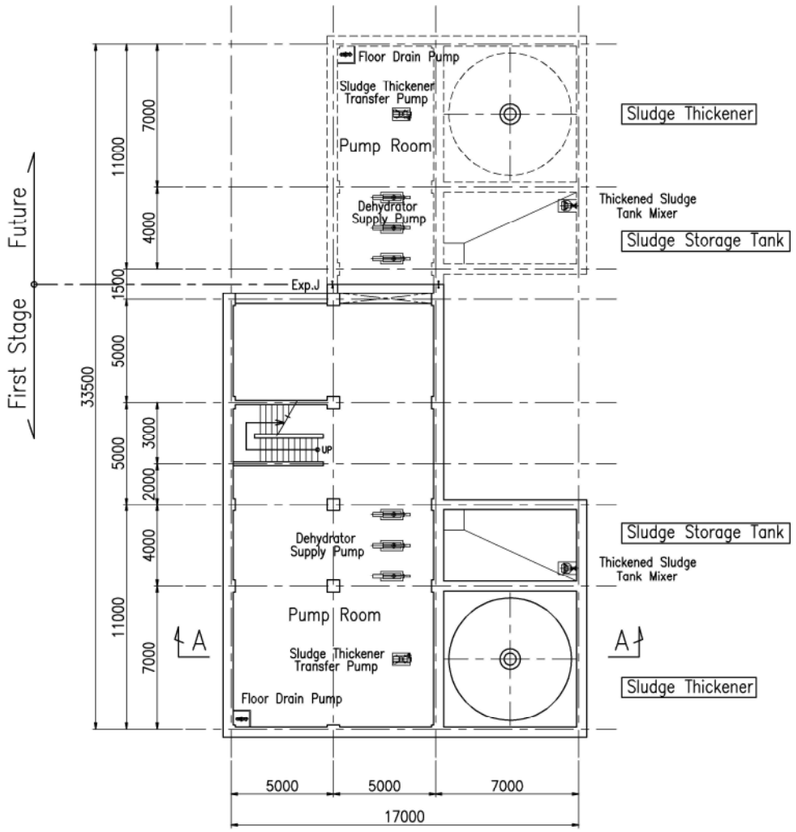


C − C SECTION

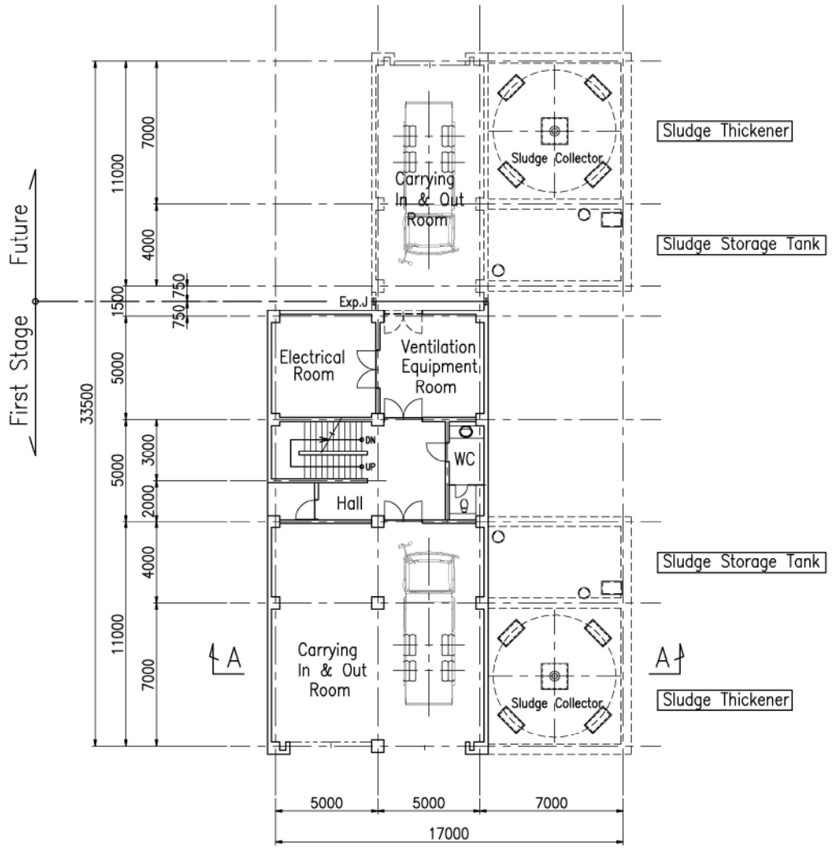


D − D SECTION

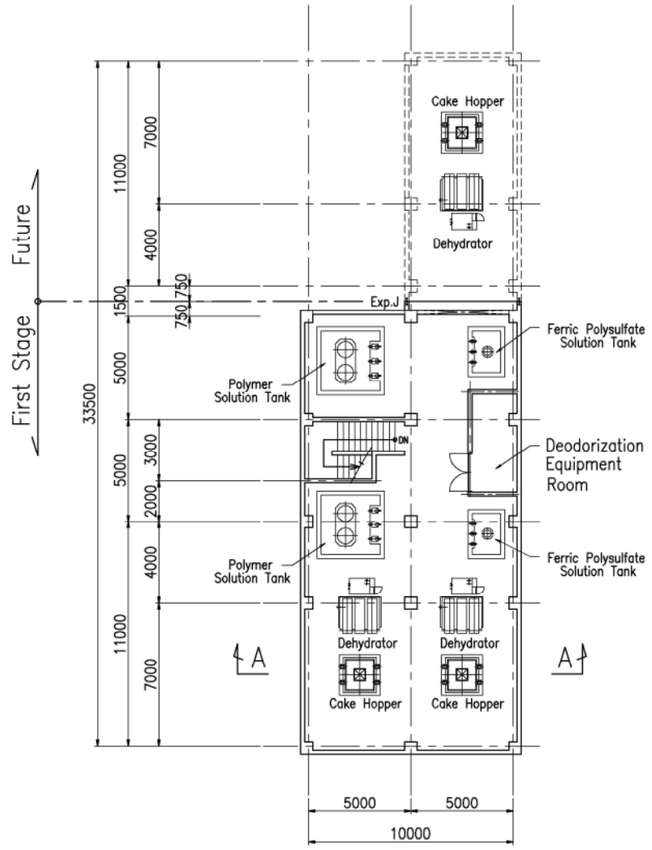
NAME OF DRAWINGS	WATER TREATMENT FACILITIES 2/2	SCALE: A1 1:200 A3 1:400
DESIGNED BY	JICA SURVEY TEAM	



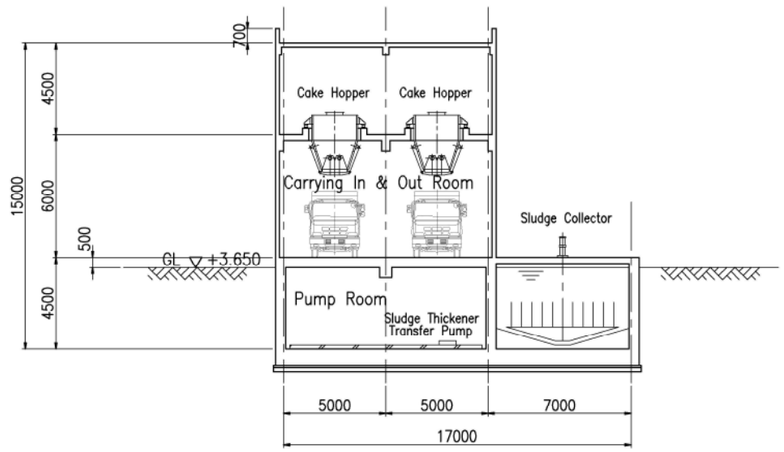
PLAN OF B1 FLOOR



PLAN OF 1st FLOOR



PLAN OF 2nd FLOOR



A – A SECTION

NAME OF DRAWINGS	SLUDGE TREATMENT BUILDING	SCALE: A1 1:150 A3 1:300
DESIGNED BY	JICA SURVEY TEAM	

7. Cost Breakdown (Sewerage Sector)

(1) Cost Breakdown (Sewer)

1) Summary of Direct Cost

		Quantity	Unit	Unit Price		Cost			Total	
				Foreign	Local	Foreign	Local			
				JPY	VND	JPY	VND	(JPY)	JPY	VND
Hospital Area	D300-OC		m							
	H<=3.0m	4,583	m	0	6,850,000	0	31,393,550,000	149,433,298	149,433,298	31,393,550,000
	H > 3.0m	9,972	m	0	22,825,472	0	227,615,604,631	1,083,450,278	1,083,450,278	227,615,604,631
	Manhole(OC)	522	set	0	93,480,000	0	48,796,560,000	232,271,626	232,271,626	48,796,560,000
	Manhole(DC)	12	set	0	130,870,000	0	1,570,440,000	7,475,294	7,475,294	1,570,440,000
	D300-PJ	902	m	64,440	9,318,872	58,124,880	8,405,622,544	40,010,763	98,135,643	20,616,731,788
	D400-PJ	2,605	m	76,500	11,062,907	199,282,500	28,818,871,433	137,177,828	336,460,328	70,684,942,861
	D500-PJ	1,214	m	88,560	12,806,941	107,511,840	15,547,626,374	74,006,702	181,518,542	38,134,147,382
	Shaft(PJ)	36	set	0	529,480,000	0	19,061,280,000	90,731,693	90,731,693	19,061,280,000
	Manhole(PJ)	36	set	0	295,590,000	0	10,641,240,000	50,652,302	50,652,302	10,641,240,000
	Pump Station	1	L.S	0	1,390,650,000	0	1,390,650,000	6,619,494	6,619,494	1,390,650,000
	Total	19,276	m			364,919,220	393,241,444,981	1,871,829,278	2,236,748,498	469,905,146,662

2) Cost Breakdown

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SUMMARY CONSTRUCTION COST ESTIMATES

PROJECT: INVESTMENT CLIMATE IMPROVEMENT PROJECT IN HA NAM PROVINCE

ITEM: PIPE D315 - HTMB

No.	Item	Code	Formula	Cost
I	DIRECT COST			
0	*Technology section*			*920,000.0*
1	*Materials*	*VL*	A	*1,299,176.0*
	+ Based on direct unit cost	A1	Cost calculation sheet	1,236,976.0
	+ Difference of materials	CL	Cost compensation sheet	62,200.0
	Sub-Total	A	A1 + CL	1,299,176.0
2	*Man Power*	*NC*	NC1	*1,231,133.0*
	+ Based on direct unit cost	B1	Cost calculation sheet	1,383,296.0
	Multiple with a factor specified for construction man power	NC1	B1 x 0,89	1,231,133.4
3	*Construction Equipment*	*M*	C	*3,396,607.0*
	+ Based on direct unit cost	C1	Cost calculation sheet	3,744,260.0
	+ Difference of equipment	CLMay	Cost compensation sheet	-347,653.0
	Sub-Total	C	C1 + CLMay	3,396,607.0
	Total of Direct Cost	*T*	VL + NC + M	***6,846,916.0***

COST ESTIMATE OF WORK ITEMS

STRENGTHENING THE ENVIRONMENTAL INVESTMENT OF HA NAM PROVINCE

DRAINAGE PIPE D315 - HTMB

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount			
	Unit price				Material	Labor	Machinery	Material	V.L phụ	Labor	Machinery
	HM	DRAINAGE PIPE D315 - HTMB									
1	AL.22111	Groove cutting, the yard is casted by dry cutting method, groove 1x4	10m	0.220	226,659.0	120,601.0	61,767.0	49,865.0	0.0	26,532.2	13,588.7
2	AA.22415	Removal of road asphalt concrete pavement, removed thickness <=7 cm	100m2	0.010	215,050.0	775,015.0	3,000,840.0	2,172.0	0.0	7,827.7	30,308.5
3	AB.25114	Foundation excavation, foundation width <=6 m, by excavator <=0,8 m3, soil grade IV	100m3	0.004		1,640,369.0	1,717,355.0	0.0	0.0	5,741.3	6,010.7
4	AB.41414	Soil hauling by dump truck, distance <=1000m, 5T ruck, soil grade IV	100m3	0.004			2,416,827.0	0.0	0.0	0.0	10,392.4
5	AB.42314	Subsequent soil hauling distance of <=7 km by 5T dump truck, soil grade IV	100m3	0.004			3,753,192.0	0.0	0.0	0.0	16,138.7
6	TT	Formed steel pile depreciation (I200x110x5)	ton	0.028	14,700,000.0			410,130.0	0.0	0.0	0.0
7	AC.22512	Formed steel pile driving (U, I shape) height >100 mm on the ground, pile length <=10 m, soil grade II	100m	0.264		1,105,814.0	7,021,822.0	0.0	0.0	291,934.9	1,853,761.0
8	AC.23110	Formed steel pile extraction, soil retaining wall by steel pipes, working platform on the ground	100m	0.264		628,518.0	4,548,706.0	0.0	0.0	165,928.8	1,200,858.4
9	AI.11221	Fabrication of steel bracing	ton	0.000	16,436,654.0	1,539,310.0		6,574.7	0.0	615.7	0.0
10	AI.61131	Erection of steel bracing	ton	0.038	522,878.0	957,793.6	2,440,009.6	19,660.2	0.0	36,013.0	91,744.4
11	TT	Depreciation of 10mm thick steel plate	ton	0.006	15,636,000.0			87,561.6	0.0	0.0	0.0
12	AC.11710 -VD	Construction of soil retaining wall by steel plates	100m2	0.062		8,990,275.2		0.0	0.0	553,801.0	0.0
13	AB.11622	Soil excavation to install pipeline, cable line without creating slope, soil grade II	m3	0.238		331,105.0		0.0	0.0	78,968.5	0.0

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount			
	Unit price				Material	Labor	Machinery	Material	V.L phụ	Labor	Machinery
		Minus destruction quantity:									
		-0.043296									
14	AB.25112	Foundation excavation, foundation width <=6 m, by excavator <=0,8 m3, soil grade II	100m3	0.021		1,235,839.0	1,059,463.0	0.0	0.0	26,570.5	22,778.5
15	AB.66143	Sand filling by tamper, required compactness K=0,95	100m3	0.002	11,590,000.0	968,849.0	918,884.0	23,180.0	0.0	1,937.7	1,837.8
16	AB.13412	Sand filling for pipeline, drain pipe foundation	m3	0.033	118,218.0	117,314.0		3,924.8	0.0	3,894.8	0.0
17	AB.66142	Sand filling by tamper, required compactness K=0,90	100m3	0.003	11,590,000.0	938,510.0	863,081.0	34,770.0	0.0	2,815.5	2,589.2
18	AB.65120	Sand filling by tamper, required compactness K=0,90	100m3	0.017		2,088,759.0	1,620,018.0	0.0	0.0	34,673.4	26,892.3
19	AB.41412	Soil hauling by dump truck, distance <=1000m, 5T ruck, soil grade II	100m3	0.007			1,890,812.0	0.0	0.0	0.0	13,613.8
20	AB.42312	Subsequent soil hauling distance of 4 km by 5T dump truck, soil grade II	100m3	0.007			3,036,672.0	0.0	0.0	0.0	21,864.0
		Return									
21	AD.11211	Construction of macadam sub-base course, road expansion	100m3	0.002	24,424,000.0	992,397.0	3,336,509.0	53,732.8	0.0	2,183.3	7,340.3
22	AD.11221	Construction of macadam base course, road expansion	100m3	0.002	24,424,000.0	1,086,911.0	3,241,313.0	53,732.8	0.0	2,391.2	7,130.9
23	AD.23225	Laying asphalt concrete pavement, medium size aggregate asphalt concrete, compacted thickness 7 cm	100m2	0.010		602,527.0	623,689.0	0.0	0.0	6,085.5	6,299.3
24	AD.26222	Manufacturing of medium size aggregate asphalt concrete at 50-60 ton/h batching	100 ton	0.002	117,672,450.0	1,291,994.0	7,973,598.0	200,043.2	0.0	2,196.4	13,555.1
25	AD.24213	Spraying bituminous oil as binding course at 1,0 kg bitumen/m2	100m2	0.010	1,872,822.0	68,852.0	413,769.0	18,915.5	0.0	695.4	4,179.1
26	AD.23233	Laying asphalt concrete pavement, fine aggregate asphalt concrete, compacted thickness 5 cm	100m2	0.010		437,127.0	528,895.0	0.0	0.0	4,415.0	5,341.8
27	AD.26223	Manufacturing of fine aggregate asphalt concrete at 50-60 ton/h batching plant	100 ton	0.001	126,523,695.0	1,353,517.0	7,973,598.0	151,828.4	0.0	1,624.2	9,568.3
		0,1115/100 = 0,0011									
28	AD.24211	Spraying of binding course by bituminous oil at 0,5 kg bitumen/m2	100m2	0.010	834,867.0	68,852.0	413,769.0	8,432.2	0.0	695.4	4,179.1

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount			
	Unit price				Material	Labor	Machinery	Material	V.L phụ	Labor	Machinery
29	AD.27243	Hauling of black macadam, asphalt concrete from batching plant to site at 4km distance by 12 ton truck	100 ton	0.003			5,398,760.0	0.0	0.0	0.0	15,656.4
30	AD.27253	Hauling of black macadam, asphalt concrete from batching plant to the site, subsequent 1km, 12 ton truck	100 ton	0.003			6,290,933.0	0.0	0.0	0.0	18,243.7
31	TT	Other works		0.100	1,124,523.2	1,257,541.4	3,403,872.4	112,452.3	0.0	125,754.1	340,387.2
	THM	**TOTAL: DRAINAGE PIPE D315 - HTMB**						**1,236,976**	0.0	**1,383,296**	**3,744,260**

1. Installation cost of sewer pipe with DN 300 mm of open cut area

No			Quantity	Unit	Unit Price (JPY)		Cost (JPY)			Total	
					Foreign	Local	Foreign	Local			
					JPY	VND	JPY	VND	(JPY)	JPY	VND
	1-1	Excavation of soil, level II land	1.22	m3		403,460	0	493,835	2,329	2,329	493,835
	1-2	Foundation excavation, foundation width <= 6m, excavator <= 1.25m3, land level II	5.18	m3		28,197	0	146,174	689	689	146,174
	1-3	Sand embankment works with compactor, the required density K = 0.90	1.08	m3		438,201	0	473,257	2,232	2,232	473,257
	1-4	Background sand embankment works with compactor toad, the required density K = 0.95	3.35	m3		164,230	0	550,005	2,594	2,594	550,005
	1-5	Embankment works required density K = 0.98	0.81	m3		52,043	0	42,155	199	199	42,155
	1-6	Embankment materials	1.05	m3		225,427	0	237,375	1,120	1,120	237,375
	1-7	Manipulation of subgrade rock layers	0.32	m3		686,831	0	222,533	1,050	1,050	222,533
	1-9	Asphalt concrete pavement, thickness 5cm	1.62	m2		11,771	0	19,069	90	90	19,069
	1-10	Sprinkle with oil-based plastics, plastic 0.5kg / m2	1.62	m2		16,054	0	26,007	123	123	26,007
	1-11	Asphalt concrete pavement, thickness 7cm	1.62	m2		14,942	0	24,206	114	114	24,206
	1-12	Sprinkle with oil-based plastics, plastic 1.0 kg / m2	1.62	m2		28,702	0	46,497	219	219	46,497
1	1-13	Production of asphalt concrete	0.19	Ton		1,641,656	0	304,199	1,435	1,435	304,199
	1-14	Asphalt production medium by mixing plant seeds 80T / h	0.25	Ton		1,533,333	0	389,697	1,838	1,838	389,697
	1-15	Transportation of stone, asphalt trash from the mixing station to the dumping site, L=4km distance, 12T cars	0.47	Ton		65,785	0	30,610	144	144	30,610
	1-16	Transportation of stone, asphalt trash from the mixing station to the dumping site, L=1km distance, 12T cars	2.79	Ton		6,969	0	19,455	92	92	19,455
	1-17	Installation of a HDPE with 300mm	1.00	m		10,581	0	10,581	50	50	10,581
	1-18	Concrete mixer - manual, concrete foundation, stone 4x6, width <= 250cm	0.07	m3		1,155,277	0	83,180	392	392	83,180
	1-19	Foundation by Crusher run stone	0.05	m3		716,739	0	32,253	152	152	32,253
	1-20	Bamboo pile ; length <= 2.5 m into the land level II	23.40	m		11,211	0	262,329	1,237	1,237	262,329
	1-21	Steel pile (Larsen piles) on the ground, Piles L<= 12m, land level II	40.00	m		336,039	0	13,441,565	63,404	63,404	13,441,565
	1-22	Pile the steel sheet piles (piles Larsen 3, larsen 4) on land	40.00	m		144,562	0	5,782,479	27,276	27,276	5,782,479
	1-23	Surplus soil transportation by dump trucks, range L<= 1000m, 7T cars, grade II land	6.48	m3		21,025	0	136,241	643	643	136,241
	1-24	Carrying land for distance <= 7km by dump truck 7T, land level II	6.48	m3		7,989	0	51,772	244	244	51,772
	1-25	Total (Installation cost of DN 300 mm pipe per meter)					0	**22,825,472**	**107,667**	**107,667**	**22,825,472**

SUMMARY CONSTRUCTION COST ESTIMATES

PROJECT: INVESTMENT CLIMATE IMPROVEMENT PROJECT IN HA NAM PROVINCE

ITEM: MANHOLE TYPE-1

No.	Item	Code	Formula	Cost
I	DIRECT COST			
1	*Materials*	*VL*	A	*45,004,684.0*
	+ Based on direct unit cost	A1	Cost calculation sheet	42,731,766.0
	+ Difference of materials	CL	Cost compensation sheet	2,272,918.0
	Sub-Total	A	A1 + CL	45,004,684.0
2	*Man Power*	*NC*	NC1	*19,572,099.0*
	+ Based on direct unit cost	B1	Cost calculation sheet	21,991,122.0
	Multiple with a factor specified for construction man power	NC1	B1 x 0,89	19,572,098.6
3	*Construction Equipment*	*M*	C	*28,903,529.0*
	+ Based on direct unit cost	C1	Cost calculation sheet	31,172,543.0
	+ Difference of equipment	CLMay	Cost compensation sheet	-2,269,014.0
	Sub-Total	C	C1 + CLMay	28,903,529.0
	Total of Direct Cost	*T*	VL + NC + M	*93,480,312.0*

COST ESTIMATE OF WORK ITEMS

STRENGTHENING THE ENVIRONMENTAL INVESTMENT OF HA NAM PROVINCE

TYPE 1 MANHOLE

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit price				Material	Labor	Machinery	Material	Labor	Machinery
	HM	TYPE 1 MANHOLE								
1	AL.22111	Groove cutting, the yard is casted by dry cutting method, groove 1x4	10m	1.5616	226,659.0	120,601.0	61,767.0	353,950.7	188,330.5	96,455.3
2	AA.22415	Removal of road asphalt concrete pavement, removed thickness <=7 cm	100m2	0.1249	215,050.0	775,015.0	3,000,840.0	26,859.7	96,799.4	374,804.9
3	AB.25114	Foundation excavation, foundation width <=6 m, by excavator <=0,8 m3, soil grade IV	100m3	0.0437		1,640,369.0	1,717,355.0	0.0	71,684.1	75,048.4
4	AB.41414	Soil hauling by dump truck, distance <=1000m, 5T truck, soil grade IV	100m3	0.0537			2,416,827.0	0.0	0.0	129,783.6
5	AB.42314	Subsequent soil hauling distance of <=7 km by 5T dump truck, soil grade IV	100m3	0.0537			3,753,192.0	0.0	0.0	201,546.4
6	TT	Formed steel pile depreciation (I200x110x5)	tấn	0.1986	14,700,000.0			2,919,420.0	0.0	0.0
7	AC.22512	Formed steel pile driving (U, I shape) height >100 mm on the ground, pile length <=10 m, soil grade II	100m	1.8739		1,105,814.0	7,021,822.0	0.0	2,072,184.9	13,158,192.2
8	AC.23110	Formed steel pile extraction, soil retaining wall by steel pipes, working platform on the ground	100m	1.8739		628,518.0	4,548,706.0	0.0	1,177,779.9	8,523,820.2
9	AI.11221	Fabrication of steel bracing	ton	0.0066	16,436,654.0	1,539,310.0		108,481.9	10,159.4	0.0
10	AI.61131	Erection of steel bracing	ton	0.5631	522,878.0	957,793.6	2,440,009.6	294,432.6	539,333.6	1,373,969.4

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit price				Material	Labor	Machinery	Material	Labor	Machinery
11	TT	Depreciation of 10mm thick steel plate	ton	0.0388	15,636,000.0			606,676.8	0.0	0.0
12	AC.11710 -VD	Construction of soil retaining wall by steel plates	100m2	0.5153		8,990,275.2		0.0	4,632,688.8	0.0
13	AB.11442	Excavation of column, pier foundation, manhole, width >1 m, depth >1 m, soil	m3	4.1226		210,356.0		0.0	867,213.6	0.0
14	AB.25112	Foundation excavation, foundation width <=6 m, by excavator <=0,8 m3, soil grade II	100m3	0.3710		1,235,839.0	1,059,463.0	0.0	458,496.3	393,060.8
15	AB.13412	Sand filling for pipeline, drain pipe	m3	0.8918	118,218.0	117,314.0		105,426.8	104,620.6	0.0
16	AB.66142	Sand filling by tamper, required compactness K=0,90	100m3	0.0803	11,590,000.0	938,510.0	863,081.0	930,677.0	75,362.4	69,305.4
17	AB.65120	Sand filling by tamper, required compactness K=0,90	100m3	0.2047		2,088,759.0	1,620,018.0	0.0	427,569.0	331,617.7
18	AB.41412	Soil hauling by dump truck, distance <=1000m, 5T truck, soil grade II	100m3	0.2075			1,890,812.0	0.0	0.0	392,343.5
				0.3710						
19	AB.42312	Subsequent soil hauling distance of 4 km by 5T dump truck, soil grade II	100m3	0.2075			3,036,672.0	0.0	0.0	630,109.4
20	AF.11111	Concrete manufacturing by mixer - manual casting, foundation lining concrete, 4x6 aggregate, width <=250 cm,grade 100	m3	0.7027	551,165.0	287,216.0	50,365.0	387,303.6	201,826.7	35,391.5
21	AF.31115	Concrete manufactured at site batching plant or commercial concrete, casted by pump, foundation concrete, foundation width <=250 cm, M300	m3	1.7714	1,024,817.0	171,925.0	92,631.0	1,815,360.8	304,547.9	164,086.6
22	AF.82511	Formwork for cast-in-place concrete, formwork for long foundation	100m2	0.0322	1,449,697.0	2,894,491.0		46,680.2	93,202.6	0.0

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit price				Material	Labor	Machinery	Material	Labor	Machinery
23	AF.61120	Fabrication and erection of rebar for cast-in-place concrete, foundation rebar, diameter <=18 mm	tấn	0.2214	16,281,026.0	1,828,754.0	470,798.0	3,604,619.2	404,886.1	104,234.7
24	AF.32115	Concrete manufactured at site batching plant or commercial concrete, casted by pump, wall concrete, thickness <=45cm, height <=4m, grade 300	m3	5.4052	1,181,880.0	561,344.0	115,098.0	6,388,297.8	3,034,176.6	622,127.7
25	AF.82111	Formwork for cast-in-place concrete, metal formwork, wall formwork, square column, rectangular column, girder, bracing, height <=16 m	100m2	0.3680	3,243,995.0	9,044,990.0	637,657.0	1,193,790.2	3,328,556.3	234,657.8
26	AF.61321	Fabrication and erection of rebar for cast-in-place concrete, wall rebar, diameter <=18 mm, wall height <= 4 m	tấn	0.6756	16,281,026.0	2,449,302.0	470,798.0	10,999,461.2	1,654,748.4	318,071.1
27	TT	Composite manhole cover plate	pce	1.0000	2,850,000.0			2,850,000.0	0.0	0.0
28	AG.42111	Installation of precast concrete structures, manual installation of precast concrete structures, weight <= 50 kg	pce	1.0000	2,509.0	35,443.0		2,509.0	35,443.0	0.0
		Return								
29	AD.11211	Construction of macadam sub-base course, road expansion	100m3	0.0250	24,424,000.0	992,397.0	3,336,509.0	610,600.0	24,809.9	83,412.7
30	AD.11221	Construction of macadam base course, road expansion	100m3	0.0188	24,424,000.0	1,086,911.0	3,241,313.0	459,171.2	20,433.9	60,936.7
31	AD.23225	Laying asphalt concrete pavement, medium size aggregate asphalt concrete, compacted thickness 7 cm	100m2	0.1249		602,527.0	623,689.0	0.0	75,255.6	77,898.8
32	AD.26222	Manufacturing of medium size aggregate asphalt concrete at 50-60 ton/h batching	100 ton	0.0207	117,672,450.0	1,291,994.0	7,973,598.0	2,435,819.7	26,744.3	165,053.5

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit price				Material	Labor	Machinery	Material	Labor	Machinery
33	AD.24213	Spraying bituminous oil as binding course at 1,0 kg bitumen/m2	100m2	0.1249	1,872,822.0	68,852.0	413,769.0	233,915.5	8,599.6	51,679.7
34	AD.23233	Laying asphalt concrete pavement, fine aggregate asphalt concrete, compacted thickness 5 cm	100m2	0.1249		437,127.0	528,895.0	0.0	54,597.2	66,059.0
35	AD.26223	Manufacturing of fine aggregate asphalt concrete at 50-60 ton/h batching plant	100 ton	0.0190	126,523,695.0	1,353,517.0	7,973,598.0	2,403,950.2	25,716.8	151,498.4
36	AD.24211	Spraying bituminous oil as binding course at 0,5 kg bitumen/m2	100m2	0.1249	834,867.0	68,852.0	413,769.0	104,274.9	8,599.6	51,679.7
37	AD.27243	Hauling of black macadam, asphalt concrete from batching plant to the site, distance 4km, 12 ton truck	100 ton	0.0412			5,398,760.0	0.0	0.0	222,428.9
38	AD.27253	Hauling of black macadam, asphalt concrete from batching plant to the site, subsequent 1km, 12 ton truck	100 ton	0.0412			6,290,933.0	0.0	0.0	259,186.4
39	TT	Other works		0.1000	38,500,868.6	19,667,553.0	27,540,821.8	3,850,086.9	1,966,755.3	2,754,082.2
	THM	**TOTAL: TYPE 1 MANHOLE**						**42,731,766**	**21,991,122**	**31,172,543**

SUMMARY CONSTRUCTION COST

PROJECT: INVESTMENT CLIMATE IMPROVEMENT PROJECT IN HA NAM PROVINCE

Item: Diversion Chamber

No.	Item	Code	Formula	Cost
I	DIRECT COST			
1	*Materials*	*VL*	A	*77,487,430*
	+ Based on direct unit cost	A1	Cost calculation sheet	80,671,426
	+ Difference of materials	CL	Cost compensation sheet	-3,183,996
	Sub-Total	A	A1 + CL	77,487,430
2	*Man Power*	*NC*	NC1	*34,862,931*
	+ Based on direct unit cost	B1	Cost calculation sheet	39,171,832
	Multiple with a factor specified for construction man power	NC1	B1 x 0,89	34,862,931
3	*Construction Equipment*	*M*	C	*18,522,925*
	+ Based on direct unit cost	C1	Cost calculation sheet	21,653,980
	+ Difference of equipment	CLMay	Cost compensation sheet	-3,131,055
	Sub-Total	C	C1 + CLMay	18,522,925
	Total of Direct Cost	***T***	**VL + NC + M**	***130,873,286***

COST ESTIMATE OF WORK ITEMS

STRENGTHENING THE ENVIRONMENTAL INVESTMENT OF HA NAM PROVINCE

Diversion Chamber

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit				Material	Labor	Machinery	Material	Labor	Machinery
		DIVISION CHAMBER								
		Wooden pile								
111	AC.22512	Driving formed steel pile >100mm on the ground, pile length <=10m, soil grade II (coefficient of material lost duringconstruction 1,17%X 1 monthg+3,5%/driving or extraction=4,67% to be revised directly in the norm)	100m	1.195	1,062,191	1,105,814	7,021,822	1,268,893	1,321,005	8,388,269
112	AC.23110	Extraction of formed steel pile, retaining wall made by steel pipe, construction of working platform on the ground	100m	1.195		628,518	4,548,706	0	750,828	5,433,884
113	AI.11211	Fabrication of steel bracing (depreciation 1,17%)	tấn	0.023	17,231,969	3,179,488	350,007	403,228	74,400	8,190
		Bracing strut I120:								
		Steel plate:								
114	AI.63311	Installation, removal of steel frame, working platform on the ground	tấn	1.214	323,753	2,244,708	1,793,672	393,166	2,725,973	2,178,235
		Longitudinal bracing strut I120:								
115	AC.11710	Construction of diaphragm wall	100m2	0.451		8,990,275		0	4,054,614	0
		Steel plate:								
		Demolishment								
116	AA.21322	Demolishment of cement brick floor	m2	18.517		17,542		0	324,818	0

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit				Material	Labor	Machinery	Material	Labor	Machinery
117	AB.41424	Soil hauling by 7T dump truck, distance <=1000m, soil grade IV	100m3	0.011			2,208,554	0	0	24,515
118	AB.42224	Subsequent soil hauling distance of <=4 km by 7T dump truck, soil grade IV (next 4km)	100m3	0.011			3,174,796	0	0	35,240
		Excavation and filling								
119	AB.11443	Excavation for column, pier, manhole foundation, width >1 m, depth >1 m, soil	m3	14.385		305,420		0	4,393,375	0
120	AB.25123	Foundation excavation, foundation width <=6 m, by <=1,25 m3 excavator, soil grade III	100m3	0.336		1,512,942	1,253,993	0	507,743	420,840
121	AB.65130	Soil filling by tamper, required compactness K=0,95	100m3	0.227		2,405,381	1,865,587	0	546,022	423,488
122	AB.41423	Soil hauling by 7T dump truck, distance <=1000m, soil grade III	100m3	0.253			2,070,520	0	0	522,806
123	AB.42223	Subsequent soil hauling distance of <=4 km by 7T dump truck, soil grade III (next 4km)	100m3	0.253			2,898,728	0	0	731,929
		Restoration								
124	AD.12121	Construction of cement reinforced yellow sand base course, batching plant 30 m3/h, 6% cement reinforced yellow sand	100m3	0.009	43,261,187	6,852,265	7,271,121	398,003	63,041	66,894
125	AK.55320	Pavement of yard, road base, sidewalk by interlocking brick, thickness 5,5 cm, fine sand cement mortar grade 75	m2	18.517	50,500	30,717		935,088	568,774	0
		Construction								
126	AC.11112	Driving of <=2,5 m long bamboo pile	100m	5.335	525,321	394,695		2,802,588	2,105,698	0

NO.	Code / Unit	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
					Material	Labor	Machinery	Material	Labor	Machinery
127	AK.98110	Construction of base lining stone course by Dmax <=4 stone	m2	2.668	238,500	349,702		636,199	932,830	0
128	AF.11121	Concrete manufacturing by mixer - manual casting, foundation lining concrete, 4x6 aggregate, width >250 cm,grade 100	m3	1.331	551,165	238,673	50,365	733,601	317,674	67,036
129	AF.11224	Concrete manufacturing by mixer - manual casting, foundation concrete, 1x2 aggregate, width >250 cm, grade 250	m3	3.210	860,197	398,462	50,657	2,761,232	1,279,063	162,609
130	AF.12124	Concrete manufacturing by mixer - manual casting, straight wall concrete, 1x2 aggregate, thickness <=45 cm, height <=16 m, grade 250	m3	6.644	968,708	925,341	116,964	6,436,096	6,147,966	777,109
131	AF.12414	Concrete manufacturing by mixer - manual casting, roof floor concrete, 1x2 aggregate, grade 250	m3	1.826	813,735	543,802	94,720	1,485,880	992,983	172,959
132	AF.81111	Formwork for cast-in-place concrete, wooden formwork, long foundation formwork, machine base	100m2	0.044	4,026,971	2,984,333		177,187	131,311	0
133	AF.81311	Formwork for cast-in-place concrete, wooden formwork, straight wall formwork, thickness <=45 cm	100m2	0.528	4,101,517	6,563,997		2,165,601	3,465,790	0
134	AF.81151	Formwork for cast-in-place concrete, wooden formwork, roof floor formwork	100m2	0.077	4,626,005	6,367,881		356,202	490,327	0
135	AF.61110	Fabrication and installation of rebar for cast-in-place concrete, foundation rebar, diameter <=10 mm	tấn	0.011	16,224,107	2,482,193	98,488	178,465	27,304	1,083

NO.	Code Unit	Work name / Quantity description	Unit	Quantity	Unit Price Material	Labor	Machinery	Amount Material	Labor	Machinery
136	AF.61120	Fabrication and installation of rebar for cast-in-place concrete, foundation rebar, diameter <=18 mmông	tấn	0.451	16,281,026	1,828,754	470,798	7,342,743	824,768	212,330
137	AF.61311	Fabrication and installation of rebar for cast-in-place concrete, wall rebar, diameter <=10 mm, wall height <= 4 m	tấn	0.022	16,224,107	2,988,718	98,488	356,930	65,752	2,167
138	AF.61321	Fabrication and installation of rebar for cast-in-place concrete, wall rebar, diameter <=18 mm, wall height <= 4 m	tấn	1.575	16,281,026	2,449,302	470,798	25,647,500	3,858,385	741,648
139	AF.61331	Fabrication and installation of rebar for cast-in-place concrete, wall rebar, diameter >18 mm, wall height <= 4 m	tấn	0.044	16,191,302	1,995,403	483,904	712,417	87,798	21,292
140	AF.61721	Fabrication and installation of rebar for cast-in-place concrete, roof floor rebar, height <=16 m, diameter >10 mm	tấn	0.300	16,280,598	2,392,290	497,629	4,884,179	717,687	149,289
141	AF.11213	Concrete manufacturing by mixer - manual casting, foundation concrete, 1x2 aggregate, width <=250 cm, grade 200	m3	1.600	746,940	331,715	50,657	1,194,731	530,578	81,026
142	TT	Composite manhole cover plate	cái	2.000	6,620,000			13,240,000	0	0
143	TT	Composite manhole cover plate	cái	1.000	2,320,000			2,320,000	0	0
	TT	Other works		0.050	76,829,930	37,306,507	20,622,838	3,841,497	1,865,325	1,031,142
	THM	**TOTAL: DIVERSION CHAMBER**						**80,671,426**	**39,171,832**	**21,653,980**

Break down of Construction cost of SEWAGE SECTOR

3&5. Installation of sewer pipe by Jacking method

No	Items		Formula	Quantity	Unit	Unit Price (JPY)		Cost (JPY)			Total	
						Foreign	Local	Foreign	Local			
						JPY	VND	JPY	VND	(JPY)	JPY	VND
	SEWAGE PIPE		Sub-Total	1,000.0	m	64,440	9,318,872	64,440,000	9,318,872,000	47,246,681	111,686,681	22,028,931,172
3		φ300	RC Pipe D300mm				4,026,022		4,026,022,480	20,411,934		
			Pipe Jacking Grout			1,076		1,076,343				
			Other Materials			799	1,295,978	799,455	1,295,977,552	6,570,606		
			Soil Stebilizer				1,511,558		1,511,558,076	7,663,599		
			Other Materials				30,469		30,469,302	154,479		
			Labour			28,484	343,090	28,484,002	343,090,454	1,739,469		
			Equipment			34,080	2,111,754	34,080,199	2,111,754,137	10,706,593		
			Sub-Total	1,000.0	m	88,560	12,806,941	88,560,000	12,806,941,000	64,931,191	153,491,191	30,274,396,621
5		φ500	RC Pipe D500mm				6,044,162		6,044,161,519	30,643,899		
			Pipe Jacking Grout			2,361		2,360,787				
			Other Materials			1,241	2,601,677	1,241,280	2,601,677,407	13,190,504		
			Soil Stebilizer				1,310,963		1,310,963,342	6,646,584		
			Other Materials				36,517		36,516,835	185,140		
			Labour			38,106	399,783	38,105,842	399,782,682	2,026,898		
			Equipment			46,852	2,413,839	46,852,091	2,413,839,215	12,238,165		

SUMMARY CONSTRUCTION COST ESTIMATES

PROJECT: INVESTMENT CLIMATE IMPROVEMENT PROJECT IN HA NAM PROVINCE

ITEM: SHAFT FOR PIPE JACKING

No.	Item	Code	Formula	Cost
I	DIRECT COST			
1	*Materials*	*VL*	A	*128,389,185*
	+ Based on direct unit cost	A1	Cost calculation sheet	125,803,272
	+ Difference of materials	CL	Cost compensation sheet	2,585,913
	Sub-Total	A	A1 + CL	128,389,185
2	*Man Power*	*NC*	NC1	*161,327,176*
	+ Based on direct unit cost	B1	Cost calculation sheet	181,266,490
	Multiple with a factor specified for construction man power	NC1	B1 x 0,89	161,327,176
3	*Construction Equipment*	*M*	C	*239,766,017*
	+ Based on direct unit cost	C1	Cost calculation sheet	280,594,143
	+ Difference of equipment	CLMay	Cost compensation sheet	-40,828,126
	Sub-Total	C	C1 + CLMay	239,766,017
	Total of Direct Cost	*T*	VL + NC + M	*529,482,378*

COST ESTIMATE OF WORK ITEMS

STRENGTHENING THE ENVIRONMENTAL INVESTMENT OF HA NAM PROVINCE

SHAFT FOR UNDERGROUND PIPE JACKING

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit Price				Material	Labor	Machinery	Material	Labor	Machinery
	HM	SHAFT FOR UNDERGROUND PIPE JACKING								
		SHAFT EXCATION								
1	AB.25213	Foundation excavation, foundation width <=10 m, by excavator <=0,8 m3, soil grade III	100m3	4.990		592,636	1,275,913	0	2,957,017	6,366,296
2	TT	Wooden pile depreciation IV (3,5%+1,17% depreciation)	ton	5.596	16,800,000			94,012,800	0	0
3	AC.27120	wooden pile pressing by hydraulic	100m	14.434		5,080,128	8,038,564	0	73,327,584	116,030,241
4	AC.27120	wooden pile pressing by hydraulic compressor (exposed section NC&Mx0.75)	100m	1.312		3,810,096	6,028,923	0	4,999,608	7,911,153
5	AC.27110	Wooden pile extraction by hydraulic compressor	100m	15.746		1,689,438	5,359,043	0	26,602,567	84,385,635
6	AI.11211	Fabrication of bracing strut (1,17% depreciation)	ton	0.085	17,231,969	3,179,488	350,007	1,464,717	270,257	29,751
		H SHAPE STEEL 300X300:								
		V7 SHAPE STEEL:								
7	AI.61141	Erection of connecting steel bracing by rivet (LD và TD NC&Mx1.6)	ton	7.265	592,178	7,571,126	7,017,786	4,301,936	55,001,205	50,981,405
8	AB.65120	Soil filling by tamper, required compactness K=0,90	100m3			2,088,759	1,620,018	0	0	0
		Excavation quantity:								
				4.990						
		Minus concrete quantity:								

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit Price				Material	Labor	Machinery	Material	Labor	Machinery
		Minus crushed stone quantity:								
9	AF.31213	Site batching plant manufactured or commercial concrete, casted by pump, base concrete, grade 200	m3	4.234	874,237	125,404	92,336	3,701,170	530,910	390,914
10	AB.41412	Soil hauling by dump truck, distance <=1000m, 5T truck, soil grade II	100m3				1,890,812	0	0	0
		Excavated quantity - compressed quantity:								
11	AB.42312	Subsequent soil hauling distance of <=7 km by 5T dump truck, soil grade II	100m3	0.000			3,036,672	0	0	0
12	AK.98120	Foundation lining stone layer using Dmax<=6 stone	m3	6.350	214,500	330,799		1,362,161	2,100,706	0
13	AF.32113	Site batching plant manufactured or commercial concrete, casted by pump, wall concrete, thickness <=45cm, height <=4m, grade 200	m3	6.912	1,021,196	561,344	115,098	7,058,507	3,880,010	795,557
14	AF.82111	Formwork for cast-in-place concrete, metal formwork, wall formwork, square column, rectangular column, beam, shoring, height <=16 m	100m2	0.207	3,243,995	9,044,990	637,657	672,805	1,875,931	132,250
15	AF.61321	Fabrication and erection of rebar for cast-in-place concrete, wall rebar, diameter <=18 mm, wall height <= 4 m	ton	0.445	16,281,026	2,449,302	470,798	7,238,544	1,088,960	209,317
16	TT	*Other works*		0.050	119,812,640	172,634,753	267,232,517	5,990,632	8,631,738	13,361,626
	THM	**TOTAL: SHAFT FOR UNDERGROUND PIPE JACKING**						**125,803,272**	**181,266,490**	**280,594,143**

SUMMARY CONSTRUCTION COST ESTIMATES

PROJECT: INVESTMENT CLIMATE IMPROVEMENT PROJECT IN HA NAM PROVINCE

ITEM: MANHOLE TYPE-2

No.	Item	Code	Formula	Cost
I	DIRECT COST			
1	*Materials*	*VL*	A	*208,499,712*
	+ Based on direct unit cost	A1	Bảng dự toán hạng mục	200,540,739
	+ Difference of materials	CL	Theo bảng bù giá	7,958,973
	Sub-Total	A	A1 + CL	208,499,712
2	*Man Power*	*NC*	NC1	*60,481,985*
	+ Based on direct unit cost	B1	Bảng dự toán hạng mục	67,957,286
	Multiple with a factor specified for construction man power	NC1	B1 x 0,89	60,481,985
3	*Construction Equipment*	*M*	C	*26,606,572*
	+ Based on direct unit cost	C1	Bảng dự toán hạng mục	24,915,072
	+ Difference of equipment	CLMay	Theo bảng bù giá	1,691,500
	Sub-Total	C	C1 + CLMay	26,606,572
	Total of Direct Cost	*T*	VL + NC + M	*295,588,269*

COST ESTIMATE OF WORK ITEMS

STRENGTHENING THE ENVIRONMENTAL INVESTMENT OF HA NAM PROVINCE

TYPE 2 MANHOLE

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit				Material	Labor	Machinery	Material	Labor	Machinery
	HM	TYPE 2 MANHOLE								
1	AA.22211	Concrete structure demolishment by driller, reinforced concrete	m3	7.040	27,900	442,936	343,385	196,416	3,118,269	2,417,430
2	AA.22212	Concrete structure demolishment by driller, non-reinforced concrete	m3	4.312		412,237	180,263	0	1,777,566	777,294
3	AA.22221	Stony brick tructure demolishment by driller	m3	6.468		361,804	162,737	0	2,340,148	1,052,583
4	AB.55311	Stone mixture shoveled to transportation means by <=1,25m3 bucket excavator	100m3	0.178		241,909	1,403,441	0	43,108	250,093
5	AB.53411	Stone hauling by 5 ton dump truck within <=1000 m distance	100m3	0.178			3,214,380	0	0	572,803
6	AB.54311	Subsequent hauling <=7 km (4km) of stone by 5 ton dump truck	100m3	0.178			4,156,944	0	0	740,767
7	AB.13412	Sand filling for pipeline, drain pipe base	m3	1.349	118,218	117,314		159,429	158,210	0
8	AB.66142	Sand filling by tamper, required compactness K=0,90	100m3	0.121	11,590,000	938,510	863,081	1,407,026	113,935	104,778
9	AB.65120	Soil filling by tamper, required compactness K=0,90	100m3	1.747		2,088,759	1,620,018	0	3,649,271	2,830,333
10	AB.41412	Soil hauling by 5T dump truck, distance <=1000m, soil grade II	100m3	1.025			1,890,812	0	0	1,937,893
11	AB.42312	Subsequent hauling of 4 km by 5T dump truck, soil grade II	100m3	1.025			3,036,672	0	0	3,112,285
12	AF.11111	Concrete manufacturing by mixer - manual casting, foundation lining concrete, 4x6 aggregate, width <=250 cm,grade 100	m3	1.758	551,165	287,216	50,365	968,838	504,868	88,532

NO.	Code / Unit	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
					Material	Labor	Machinery	Material	Labor	Machinery
13	AF.31115	Concrete manufactured at site batching plant or commercial concrete, casted by pump, foundation concrete, foundation width <=250 cm, M300	m3	7.920	1,024,817	171,925	92,631	8,116,551	1,361,646	733,638
14	AF.82511	Formwork for cast-in-place concrete, formwork for long foundation	100m2	0.085	1,449,697	2,894,491		122,789	245,163	0
15	AF.61120	Fabrication and erection of rebar for cast-in-place concrete, foundation rebar, diameter <=18 mm	ton	0.990	16,281,026	1,828,754	470,798	16,118,216	1,810,467	466,090
16	AF.32115	Concrete manufactured at site batching plant or commercial concrete, casted by pump, wall concrete, thickness <=45cm, height <=4m, grade 300	m3	42.049	1,181,880	561,344	115,098	49,696,636	23,603,842	4,839,733
17	AF.82111	Formwork for cast-in-place concrete, metal formwork, formwork for wall, square column, girder, bracing, height <=16 m	100m2	0.931	3,243,995	9,044,990	637,657	3,018,862	8,417,268	593,404
		2(3+1,7)*9/100 = 0,846*								
18	AF.61321	Fabrication and erection of rebar for cast-in-place concrete, wall rebar, diameter <=18 mm , wall height <= 4 m	ton	6.307	16,281,026	2,449,302	470,798	102,689,315	15,448,483	2,969,464
19	AF.32315	Concrete manufactured at site batching plant or commercial concrete, casted by pump, girder, bracing, roof floor concrete, grade 300	m3	1.560	1,024,817	561,344	115,098	1,598,715	875,697	179,553
20	AF.61711	Fabrication and erection of rebar for cast-in-place concrete, roof floor rebar, height <=16 m, diameter <=10 mm	ton	0.236	16,224,107	3,207,993	100,458	3,828,889	757,086	23,708
21	AF.82311	Formwork for cast-in-place concrete, metal formwork, formwork for roof floor, height <=16 m	100m2	0.060	3,616,509	7,679,263	637,657	216,991	460,756	38,259

NO.	Code / Unit	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
					Material	Labor	Machinery	Material	Labor	Machinery
22	TT	Composite manhole cover plate	pce	1.000	2,850,000			2,850,000	0	0
23	AG.42111	Manual installation of various precast concrete structures, weight <= 50 kg	pce	1.000	2,509	35,443		2,509	35,443	0
24	TT	Other works		0.050	190,991,180	64,721,225	23,728,640	9,549,559	3,236,061	1,186,432
	THM	**TOTAL: TYPE 2 MANHOLE**						**200,540,739**	**67,957,286**	**24,915,072**

SUMMARY CONSTRUCTION COST ESTIMATES

PROJECT: INVESTMENT CLIMATE IMPROVEMENT PROJECT IN HA NAM PROVINCE

ITEM: Pumping Station

No.	Item	Unit	Quantity	Cost
I	DIRECT COST			
0	*Technology section*	*Station*	1	*173,660,000.0*
1	*Construction section*	*Station*	1	*589,850,000.0*
2	*Electrical section*	*Station*	1	*127,140,000.0*
3	*Equipment section*	*Station*	1	*500,000,000.0*
	Total of Direct Cost	*T*		***1,390,650,000.0***

SUMMARY CONSTRUCTION COST

PROJECT: INVESTMENT CLIMATE IMPROVEMENT PROJECT IN HA NAM PROVINCE

Item: Pumping Station - Construction Portion

No.	Item	Code	Formula	Cost
I	DIRECT COST			
1	*Materials*	*VL*	A	*307,934,742*
	+ Based on direct unit cost	A1	Cost calculation sheet	310,219,054
	+ Difference of materials	CL	Cost compensation sheet	-2,284,312
	Sub-Total	A	A1 + CL	307,934,742
2	*Man Power*	*NC*	NC1	*156,628,017*
	+ Based on direct unit cost	B1	Cost calculation sheet	175,986,536
	Multiple with a factor specified for construction man power	NC1	B1 x 0,89	156,628,017
3	*Construction Equipment*	*M*	C	*125,289,495*
	+ Based on direct unit cost	C1	Cost calculation sheet	137,112,182
	+ Difference of equipment	CLMay	Cost compensation sheet	-11,822,687
	Sub-Total	C	C1 + CLMay	125,289,495
	Total of Direct Cost	***T***	**VL + NC + M**	***589,852,254***

COST ESTIMATE OF WORK ITEMS

STRENGTHENING THE ENVIRONMENTAL INVESTMENT OF HA NAM PROVINCE

WASTEWATER PUMPING STATION (WWPS) - CONSTRUCTION COMPONENT

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit price				Material	Labor	Machinery	Material	Labor	Machinery
	HM	WASTEWATER PUMPING STATION - CONSTRUCTION COMPONENT								
		STEEL PILE PART								
1	TT	Depreciation of wooden pile u	kg	1,377.107	16,800.			23,135,396	0	0
		WWPS								
2	AC.27120	Pressing wooden pile by hydraulic	100m	3.581		5,080,128.	8,038,564.	0	18,190,414	28,783,686
		WWPS								
3	AC.27110	Wooden pile extraction by hydraulic compressor	100m	3.581		1,689,438.	5,359,043.	0	6,049,371	19,189,125
4	AC.22512	Driving formed steel pile (U, I shape) height >100 mm on the ground, pile length <=10 m	100m	0.628	1,062,191.	1,105,814.	7,021,822.	666,844	694,230	4,408,300
5	AC.23110	Formed steel pile extraction, soil retaining wall by steel pipes, working platform on the	100m	0.628		628,518.	4,548,706.	0	394,584	2,855,678
6	AI.11211	Fabrication of steel bracing (depreciation 1,17%)	ton	0.027	17,231,969.	3,179,488.	350,007.	460,094	84,892	9,345
		WWPS:								
		Manhole HG2:								
7	AI.63311	Erection, removal of steel rafter frame, working platform on the ground	ton	0.557	323,753.	2,244,708.	1,793,672.	180,428	1,250,976	999,613
		WWPS:								
		Manhole HG2:								
8	AC.11710	Installation, removal of 5mm thick retaining wall by steel plate	100m2	0.439		5,618,922.		0	2,469,516	0
		Manhole HG2:								
		CONSTRUCTION COMPONENT								

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit price				Material	Labor	Machinery	Material	Labor	Machinery
9	AB.11443	Excavation of column, pier foundation, manhole, width >1 m, depth >1 m, soil	m3	13.679		305,420.		0	4,177,749	0
		WWPS:								
10	AB.25123	Foundation excavation, foundation width <=6 m, by excavator <=1,25 m3, soil grade III	100m3	1.231		1,512,942.	1,253,993.	0	1,862,432	1,543,665
				13.679						
11	AB.13113	Foundation soil filling, required compactness K=0,95 (10%)	m3	6.649		141,586.		0	941,448	0
				13.679						
				1.982						
		Minus manhole occupied volume:								
12	AB.65130	Soil filling by tamper, required compactness K=0,95 (90%)	100m3	0.598		2,405,381.	1,865,587.	0	1,439,380	1,116,367
				6.649						
13	AB.41423	Soil hauling by dump truck, distance <=1000m, 7T truck, soil grade III	100m3	0.703			2,070,520.	0	0	1,455,369
				13.679						
				6.649						
14	AB.42223	Subsequent soil hauling distance of <=4 km by 7T dump truck, soil grade III (4km)	100m3	0.703			2,898,728.	0	0	2,037,516
15	AF.11111	Concrete manufacturing by mixer - manual casting, foundation lining concrete, 4x6 aggregate, width <=250 cm,grade 100	m3	0.975	551,165.	287,216.	50,365.	537,221	279,949	49,091
16	AF.11121	Concrete manufacturing by mixer - manual casting, foundation lining concrete, 4x6 aggregate, width >250 cm,grade 100	m3	1.007	551,165.	238,673.	50,365.	555,133	240,391	50,728
		WWPS:								
17	AF.81111	Formwork for cast-in-place concrete, wooden formwork, long foudation formwork,	100m2	0.100	4,026,971.	2,984,333.		403,100	298,732	0
		WWPS:								
18	AF.81311	Formwork for cast-in-place concrete, wooden formwork, formwork for straigth wall, thickness <=45 cm	100m2	0.827	4,101,517.	6,563,997.		3,393,185	5,430,395	0

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit price				Material	Labor	Machinery	Material	Labor	Machinery
19	AF.81151	Formwork for cast-in-place concrete, wooden formwork, formwork for roof floor	100m2	0.079	4,626,005.	6,367,881.		364,992	502,426	0
		WWPS:								
20	AF.61110	Fabrication and installation of rebar for cast-in-place concrete, foundation rebar, diameter <=10 mm	ton	0.013	16,224,107.	2,482,193.	98,488.	209,291	32,020	1,271
21	AF.61120	Fabrication and installation of rebar for cast-in-place concrete, foundation rebar, diameter <=18 mm	ton	0.455	16,281,026.	1,828,754.	470,798.	7,409,495	832,266	214,260
22	AF.61312	Fabrication and installation of rebar for cast-in-place concrete, wall rebar, diameter <=10 mm, wall height <=16 m	ton	0.032	16,224,107.	3,096,163.	116,801.	519,171	99,077	3,738
23	AF.61322	Fabrication and installation of rebar for cast-in-place concrete, wall rebar, diameter <=18 mm, wall height <=16 m	ton	5.122	16,281,026.	2,675,155.	496,558.	83,386,531	13,701,341	2,543,221
24	AF.61721	Fabrication and installation of rebar for cast-in-place concrete, roof floor rebar, height <=16 m, diameter >10 mm	ton	0.044	16,280,598.	2,392,290.	497,629.	717,974	105,500	21,945
25	AF.11214	Concrete manufacturing by mixer - manual casting, foundation concrete, 4x6 aggregate, width <=250 cm, grade 250	m3	2.547	813,735.	331,715.	50,657.	2,072,664	844,911	129,028
26	AF.11224	Concrete manufacturing by mixer - manual casting, foundation concrete, 1x2 aggregate, width >250 cm, grade 250	m3	2.636	860,197.	398,462.	50,657.	2,267,135	1,050,186	133,512
27	AF.12124	Concrete manufacturing by mixer - manual casting, straigth wall concrete, 1x2 aggregate, thickness <=45 cm, height <=16	m3	22.492	968,708.	925,341.	116,964.	21,788,665	20,813,232	2,630,813
28	AI.13111	Fabrication of steel structures embedded in concrete, weight of one structure <=10 kg	ton	0.068	18,224,164.	8,946,545.	1,946,178.	1,239,243	608,365	132,340

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit price				Material	Labor	Machinery	Material	Labor	Machinery
29	AI.64211	Embedding steel structure in concrete, weight of one structure <=10 kg	tấn	0.068	677,143.	3,945,960.	592,912.	46,046	268,325	40,318
30	AF.12414	Concrete manufacturing by mixer - manual casting, roof floor concrete, 1x2 aggregate, grade 250	m3	1.491	813,735.	543,802.	94,720.	1,213,360	810,863	141,237
31	AE.26214	Construction of unburnt brick 6,5x10,5x22, construction of manhole, valve chamber,	m3	1.789	1,098,877.	701,680.	9,066.	1,966,221	1,255,516	16,222
32	AK.21124	Plastering outer wall, 1,5 cm thick, cement mortar grade 75	m2	12.993	9,102.	61,434.	793.	118,261	798,200	10,303
33	AK.42114	Troweling 1,0 cm thick of grade 75 mortar for eaves, louver, gutter	m2	3.479	8,672.	27,882.	755.	30,173	97,010	2,627
34	AG.11414	Fabrication of precast concrete structures, slab, louver, lintel, aggregate 1x2, grade 250	m3	0.938	801,807.	519,821.	28,902.	752,416	487,800	27,122
35	AG.31311	Fabrication, installation, removal of formwork of precast concrete, wooden formwork, slab, apron formwork	100m2	0.046	353,654.	5,182,029.		16,268	238,373	0
36	AG.13221	Fabrication, installation of rebar for precast concrete, slab, window, apron, cantilever spoke	ton	0.098	16,224,107.	3,749,603.	98,488.	1,589,963	367,461	9,652
37	AG.42131	Mtanual installation of precast concrete structures, various precast concrete structures, weight <= 250 kg	pce	12.000	5,855.	106,328.		70,260	1,275,936	0
	TT	*Other works*		1.000	155,109,527.	87,993,268.2	68,556,091.1	155,109,527	87,993,268	68,556,091
	THM	**TOTAL : WWPS- CONSTRUCTION COMPONENT**						**310,219,054**	**175,986,536**	**137,112,182**

SUMMARY CONSTRUCTION COST

PROJECT: INVESTMENT CLIMATE IMPROVEMENT PROJECT IN HA NAM PROVINCE

Item: Pumping Station - Lighting System

No.	Item	Code	Formula	Cost
I	DIRECT COST			
1	*Materials*	*VL*	A	*121,110,089*
	+ Based on direct unit cost	A1	Cost calculation sheet	116,585,495
	+ Difference of materials	CL	Cost compensation sheet	4,524,594
	Sub-Total	A	A1 + CL	121,110,089
2	*Man Power*	*NC*	NC1	*5,269,370*
	+ Based on direct unit cost	B1	Cost calculation sheet	5,587,879
	Multiple with a factor specified for construction man power	NC1	B1 x 0,943	5,269,370
3	*Construction Equipment*	*M*	C	*757,569*
	+ Based on direct unit cost	C1	Cost calculation sheet	830,485
	+ Difference of equipment	CLMay	Cost compensation sheet	-72,916
	Sub-Total	C	C1 + CLMay	757,569
	Total of Direct Cost	***T***	**VL + NC + M**	***127,137,028***

COST ESTIMATE OF WORK ITEMS

STRENGTHENING THE ENVIRONMENTAL INVESTMENT OF HA NAM PROVINCE

WASTEWATER PUMPING STATION - LIGHTING

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit price				Material	Labor	Machinery	Material	Labor	Machinery
	HM	PUMPING STATION - LIGHTING SYSTEM								
		On-land station								
1	AB.11512	Excavation of canal, ditch width <=3 m, depth <=1 m, soil class II	m3	0.200		184,061		0	36,812	0
2	AB.25212	Footing excavation, footing width <=10 m, by excavator <=0,8 m3, soil class II	100m3	0.039		481,391	1,008,199	0	18,678	39,118
3	AB.13113	Foundation soil filling, required compactness K=0,95	m3	0.300		141,586		0	42,476	0
4	AB.65130	Soil filling by tamper, required compactness K=0,95	100m3	0.039		2,405,381	1,865,587	0	93,329	72,385
5	BA.20102	Installation of ready-made lightning rod	cọc	3.000	94,940	62,855		284,820	188,565	0
6	BA.20202	Flat steel 40x4	m	5.000	12,753	4,889	1,547	63,765	24,445	7,735
		Power cable for Pumping Station								
7	AB.11512	Excavation of drainage trench, width <=3 m, depth <=1 m, soil grade II	m3	1.473		184,061		0	271,067	0
8	AB.25212	Foundation excavation, width <=10 m, by excavator of <=0,8 m3, soil grade II	100m3	0.280		481,391	1,008,199	0	134,693	282,094
9	AB.13113	Foundation soil filling, required compactness K=0,95	m3	1.473		141,586		0	208,514	0

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit price				Material	Labor	Machinery	Material	Labor	Machinery
10	AB.13113	Foundation soil filling, required compactness K=0,95	m3	0.302		141,586		0	42,717	0
11	TT	Cable warning net	m	100.000	1,000			100,000	0	0
12	CS.2.03.10	Underground cable CXV/DSTA(3x35+1x16)mm2 - 0,6/1kV	100m	1.720	28,233,950	349,192		48,562,394	600,610	0
13	CS.2.03.10	Underground cable CXV(4x4)mm2 - 0,6/1kV	100m	0.205	5,271,402	349,192		1,080,637	71,584	0
14	CS.2.03.10	Underground cable CXV(4x1,5)mm2 - 0,6/1kV	100m	0.172	2,320,899	349,192		399,195	60,061	0
		PS panel								
15	TT	Outdoor 2-layer panel case, grey color electrostatic painting of 1,5mm thick.	tủ	1.000	1,400,000			1,400,000	0	0
16	BA.19302	Attomat MCB-3P-20A	cái	1.000	306,000	69,838		306,000	69,838	0
17	BA.19302	Attomat chống giật RCCB-3P-16A	cái	2.000	306,000	69,838		612,000	139,676	0
18	BA.19201	Attomat MCB-1P-10A	cái	1.000	40,845	25,607		40,845	25,607	0
19	BA.19302	Contactor 3p-18A	cái	2.000	306,000	69,838		612,000	139,676	0
20	BA.19104	Heat relay 6-9A	cái	2.000	96,900	51,215		193,800	102,430	0
21	BA.19104	Intermediate relay	cái	2.000	96,900	51,215		193,800	102,430	0
22	TT	Wiring terminal	bộ	1.000	16,091			16,091	0	0
23	BA.19104	Meter	cái	2.000	96,900	51,215		193,800	102,430	0
24	BA.18101	Push button + lamp	cái	3.000	11,758	18,624		35,274	55,872	0
25	BA.18101	Warning light	cái	3.000	11,758	18,624		35,274	55,872	0
26	TT	Isolating transformer 1000VA-	cái	1.000	340,000			340,000	0	0
27	TT	Bridge rectification 24 VAC	cái	1.000	1,205,000			1,205,000	0	0
28	TT	3-terminal level measuring switch	cái	1.000	1,143,000			1,143,000	0	0
		Panel foundation								
29	AB.11412	Foundation excavation for column, pier, manhole, width <=1 m, depth <=1 m,	m3	0.196		240,695		0	47,128	0
30	AF.11213	Concrete manufacturing by mixer - manual casting, foundation lining concrete, 1x2 aggregate, width <=250	m3	0.275	746,940	331,715	50,657	205,110	91,089	13,910

NO.	Code	Work name / Quantity description	Unit	Quantity	Unit Price			Amount		
	Unit price				Material	Labor	Machinery	Material	Labor	Machinery
31	AF.81111	Formwork for cast-in-place concrete, wooden formwork, for long foundation or machine base	100m2	0.023	4,026,971	2,984,333		92,218	68,341	0
32	TT	Foundation concrete frame M16x950x350x500	bộ	1.000	1,000,000			1,000,000	0	0
33	TT	HDPE pipe 65/50	m	5.000	35,545			177,725	0	0
	TT	Other works		1.000	58,292,747	2,793,940	415,242	58,292,747	2,793,940	415,242
	THM	**TOTAL: WARD QUANG TRUNG - WASTEWATER PUMPINE STATION**						**116,585,495**	**5,587,879**	**830,485**

(2) Cost Breakdown of Wastewater Treatment Plant : Target Year (2030) : Q=3,000m3/d

1JPY= 210.1 VND

NO.	Item	Item	Quantity	Unit	Unit Price(JPV)		Cost(JPY)			Total	
					Foreign	Local	Foreign	Local			
					JPY	VND	JPY	VND	JPY	JPY	VND
1-1	**Raw Water Pump Pit**										
	1-1-1	Preparation	1	set	0	1,719,689,950	0	1,719,689,950	8,185,724	8,185,724	1,719,689,950
	1-1-2	Architectural works of Pump Building	184	m2	0	11,834,320	0	2,177,514,880	10,364,971	10,364,971	2,177,514,880
	1-1-3	Civil engineering work	438	m3	0	9,861,933	0	4,319,526,654	20,560,947	20,560,947	4,319,526,654
	1-1-4	Diaphragm wall construction method	832	m3	0	6,903,353	0	5,743,589,696	27,339,487	27,339,487	5,743,589,696
	1-1-5	Miscellaneous WorksΣ(1-4)of 20%	1	set	0	2,448,126,246	0	2,448,126,246	11,653,081	11,653,081	2,448,126,246
	1-1-6	Soil Excavation	1,752	m3	0	104,528	0	183,133,056	871,713	871,713	183,133,056
	1-1-7	Soil Disposal	1,752	m3	0	160,740	0	281,616,480	1,340,494	1,340,494	281,616,480
	1-1-8	Pile Foundation: PHCφ600 L=30m(Pile constructionL=44m)	37	PCS	0	55,226,824	0	2,043,392,488	9,726,548	9,726,548	2,043,392,488
		Sub Total					**0**	**18,916,589,450**	**90,042,966**	**90,042,966**	**18,916,589,450**
	1-1-9	Inlet Gate □400×400	1	set	0	526,400,000	0	526,400,000	2,505,664	2,505,664	526,400,000
	1-1-10	Screen Unit B900mm Size25mm	1	set	0	2,368,800,000	0	2,368,800,000	11,275,488	11,275,488	2,368,800,000
	1-1-11	Connecting Gate of both Pump Well □500×500	1	set	0	342,160,000	0	342,160,000	1,628,682	1,628,682	342,160,000
	1-1-12	Sewage Pump φ200mm 4.0m3/min	2	set	0	1,579,200,000	0	3,158,400,000	15,033,984	15,033,984	3,158,400,000
	1-1-13	Intake fan for Deodorization 10m3/min	1	set	0	421,120,000	0	421,120,000	2,004,531	2,004,531	421,120,000
	1-1-14	Odor Absorption Equipment 10m3/min	1	set	0	526,400,000	0	526,400,000	2,505,664	2,505,664	526,400,000
	1-1-15	Chain block for Pump inspection 0.5t	1	set	0	13,160,000	0	13,160,000	62,642	62,642	13,160,000
	1-1-16	Chain block for Pumps lifting up Ground block 1.0t	1	set	0	105,280,000	0	105,280,000	501,133	501,133	105,280,000
	1-1-17	Pump of General service water 1m3	1	set	0	789,600,000	0	789,600,000	3,758,496	3,758,496	789,600,000
		Sub Total					**0**	**8,251,320,000**	**39,276,283**	**39,276,283**	**8,251,320,000**
1-2	**Overground Grit Camber**										
	1-2-1	Preparation	1	set	0	469,230,766	0	469,230,766	2,233,538	2,233,538	469,230,766
	1-2-2	Civil engineering work	475	m3	0	6,903,353	0	3,279,092,675	15,608,481	15,608,481	3,279,092,675
	1-2-3	Miscellaneous WorksΣ(1-2)of 20%	1	set	0	655,818,535	0	655,818,535	3,121,696	3,121,696	655,818,535
	1-2-4	Pile Foundation: PHCφ600 L=30m(Pile constructionL=30m)	16	PCS	0	47,337,278	0	757,396,448	3,605,207	3,605,207	757,396,448
		Sub Total					**0**	**5,161,538,424**		**24,568,923**	**5,161,538,424**
	1-2-5	Inlet Gate □400mm×400mm	1	set	0	526,400,000	0	526,400,000	2,505,664	2,505,664	526,400,000
	1-2-6	Grit Removal Pump φ100 0.5m3/min	1	set	0	263,200,000	0	263,200,000	1,252,832	1,252,832	263,200,000
		Sub Total					**0**	**789,600,000**		**3,758,496**	**789,600,000**
1-3	**Floating Sponge Filter**										
	1-3-1	Preparation	1	set	0	517,199,208	0	517,199,208	2,461,868	2,461,868	517,199,208
	1-3-2	Civil engineering work	491	m3	0	6,903,353	0	3,389,546,323	16,134,240	16,134,240	3,389,546,323
	1-3-3	Miscellaneous WorksΣ(1-2)of 20%	1	set	0	677,909,265	0	677,909,265	3,226,848	3,226,848	677,909,265
	1-3-4	Pile Foundation: PHCφ600 L=25m(Pile constructionL=25m)	28	PCS	0	39,447,732	0	1,104,536,496	5,257,594	5,257,594	1,104,536,496
		Sub Total					**0**	**5,689,191,292**		**27,080,551**	**5,689,191,292**
1-4	**High-rate Trickling Filter**										
	1-4-1	Preparation	1	set	0	994,043,300	0	994,043,300	4,731,646	4,731,646	994,043,300
	1-4-2	Civil engineering work	951	m3	0	6,903,353	0	6,565,088,703	31,249,822	31,249,822	6,565,088,703
	1-4-3	Miscellaneous WorksΣ(1-2)of 20%	1	set	0	1,313,017,741	0	1,313,017,741	6,249,964	6,249,964	1,313,017,741
	1-4-4	Pile Foundation: PHCφ600 L=25m(Pile constructionL=27m)	50	PCS	0	39,447,732	0	1,972,386,600	9,388,560	9,388,560	1,972,386,600
	1-4-5	Soil Excavation	364	m3	0	104,528	0	38,048,192	181,109	181,109	38,048,192
	1-4-6	Backfill	80	m3	0	78,020	0	6,241,600	29,710	29,710	6,241,600
	1-4-7	Soil Disposal	284	m3	0	160,740	0	45,650,160	217,295	217,295	45,650,160
		Sub Total					**0**	**10,934,476,295**	**52,048,107**	**52,048,107**	**10,934,476,295**
1-5	**Final Solids- Liquid Separator**										
	1-5-1	Preparation	1	set	0	271,650,603	0	271,650,603	1,293,057	1,293,057	271,650,603
	1-5-2	Civil engineering work	217	m3	0	6,903,353	0	1,498,027,601	7,130,611	7,130,611	1,498,027,601
	1-5-3	Miscellaneous WorksΣ(1-2)of 20%	1	set	0	299,605,520	0	299,605,520	1,426,122	1,426,122	299,605,520
	1-5-4	Pile Foundation: PHCφ600 L=20m(Pile constructionL=25m)	19	PCS	0	39,447,732	0	749,506,908	3,567,653	3,567,653	749,506,908
	1-5-5	Soil Excavation	713	m3	0	104,528	0	74,528,464	354,755	354,755	74,528,464
	1-5-6	Backfill	239	m3	0	78,020	0	18,646,780	88,759	88,759	18,646,780
	1-5-7	Soil Disposal	474	m3	0	160,740	0	76,190,760	362,668	362,668	76,190,760
		Sub Total					**0**	**2,988,156,637**	**14,223,626**	**14,223,626**	**2,988,156,637**
1-6	**Chlorination Tank and Outfall Pump Pit**										
	1-6-1	Preparation	1	set	0	327,725,900	0	327,725,900	1,559,975	1,559,975	327,725,900
	1-6-2	Civil engineering work	259	m3	0	6,903,353	0	1,787,968,427	8,510,730	8,510,730	1,787,968,427
	1-6-3	Miscellaneous WorksΣ(1-2)of 20%	1	set	0	357,593,685	0	357,593,685	1,702,146	1,702,146	357,593,685
	1-6-4	Pile Foundation: PHCφ600 L=20m(Pile constructionL=26m)	23	PCS	0	39,447,732	0	907,297,836	4,318,738	4,318,738	907,297,836
	1-6-5	Soil Excavation	932	m3	0	104,528	0	97,420,096	463,720	463,720	97,420,096
	1-6-6	Backfill	276	m3	0	78,020	0	21,533,520	102,500	102,500	21,533,520
	1-6-7	Soil Disposal	656	m3	0	160,740	0	105,445,440	501,920	501,920	105,445,440
		Sub Total					**0**	**3,604,984,905**	**17,159,728**	**17,159,728**	**3,604,984,905**
1-6-1	**Polishing pond Store Q = 6000 m 3 for 2 days.**										
	1-6-1	Preparation	1	set	0	1,574,233,351	0	1,574,233,351	7,493,351	7,493,351	1,574,233,351
	1-6-2	Civil engineering work	1,420	m3	0	6,903,353	0	9,802,761,260	46,661,144	46,661,144	9,802,761,260
	1-6-3	Miscellaneous WorksΣ(1-2)of 20%	1	set	0	1,960,552,252	0	1,960,552,252	9,332,229	9,332,229	1,960,552,252
	1-6-4	Pile Foundation: PHCφ600 L=20m(Pile constructionL=26m)	0	PCS	0	39,447,732	0	0	0	0	0
	1-6-5	Soil Excavation	15,000	m3	0	104,528	0	1,567,920,000	7,463,299	7,463,299	1,567,920,000
	1-6-6	Backfill	0	m3	0	78,020	0	0	0	0	0
	1-6-7	Soil Disposal	15,000	m3	0	160,740	0	2,411,100,000	11,476,836	11,476,836	2,411,100,000
		Sub Total					**0**	**17,316,566,863**	**82,426,858**	**82,426,858**	**17,316,566,863**
1-7	**Sludge Thickener and Sludge Building**										
	1-7-1	Preparation	1	set	0	1,169,913,185	0	1,169,913,185	5,568,787	5,568,787	1,169,913,185
	1-7-2	Architectural works of Pump Building	248	m2	0	11,834,320	0	2,934,911,360	13,970,178	13,970,178	2,934,911,360
	1-7-3	Civil engineering work	638	m3	0	6,903,353	0	4,404,339,214	20,964,655	20,964,655	4,404,339,214
	1-7-4	Miscellaneous WorksΣ(1-2)of 20%	1	set	0	1,467,850,115	0	1,467,850,115	6,986,967	6,986,967	1,467,850,115
	1-7-5	Soil Excavation	2,287	m3	0	104,528	0	239,055,536	1,137,904	1,137,904	239,055,536
	1-7-6	Backfill	413	m3	0	78,020	0	32,222,260	153,378	153,378	32,222,260
	1-7-7	Soil Disposal	1,874	m3	0	160,740	0	301,226,760	1,433,839	1,433,839	301,226,760
	1-7-8	Pile Foundation: PHCφ600 L=35m(Pile constructionL=40m)	42	PCS	0	55,226,824	0	2,319,526,608	11,040,947	11,040,947	2,319,526,608
		Sub Total					**0**	**12,869,045,038**	**61,256,654**	**61,256,654**	**12,869,045,038**
1-8	**Administration Building**										
	1-8-1	Preparation	1	set	0	244,575,946	0	244,575,946	1,164,182	1,164,182	244,575,946
	1-8-2	Architectural works of Pump Building	150	m2	0	11,834,320	0	1,775,148,000	8,449,704	8,449,704	1,775,148,000
	1-8-3	Miscellaneous WorksΣ(1-2)of 20%	1	set	0	355,029,600	0	355,029,600	1,689,941	1,689,941	355,029,600
	1-8-4	Pile Foundation: PHCφ600 L=25m(Pile constructionL=25m)	8	PCS	0	39,447,732	0	315,581,856	1,502,170	1,502,170	315,581,856
		Sub Total					**0**	**2,690,335,402**		**12,805,997**	**2,690,335,402**
1-9	**Discharge Pipe**										
	1-9-1		1	FL	9,678,500	2,778,195,500	9,678,500	2,778,195,500	13,224,211	22,902,711	4,811,493,819
		Sub Total					**9,678,500**	**2,778,195,500**	**13,224,211**	**22,902,711**	**4,811,493,819**
2-1	**Mechanical Facility of WWTP**										
	2-1-1	Floating Sponge Filter (FSF) : Filtration Area 8.8m2	2	set	24,000,000	0	48,000,000	0	0	48,000,000	10,084,033,613
	2-1-2	High-rate Trickling Filter (HTF) : Filtration Area 81m2	2	set	70,000,000	0	140,000,000	0	0	140,000,000	29,411,764,706
	2-1-3	Final Solid-Liquid Separator (SLS) : Filtration Area 10.5m2	2	set	13,000,000	0	26,000,000	0	0	26,000,000	5,462,184,874
	2-1-4	Air Compressor : Flow rate 240 l/min	2	set	2,000,000	0	4,000,000	0	0	4,000,000	840,336,134
	2-1-5	Air Tank : Volume 2.0m3	1	set	3,000,000	0	3,000,000	0	0	3,000,000	630,252,101
	2-1-6	Backwash Blower : Flow rate 20m3/min	1	set	2,400,000	0	2,400,000	0	0	2,400,000	504,201,681
	2-1-7	Ventilation Blower : Flow rate 5m3/min	2	set	1,200,000	0	2,400,000	0	0	2,400,000	504,201,681
	2-1-8	HTF Washing Drainage Transfer Pump : φ100mm 0.05m3/min	2	set	1,000,000	0	2,000,000	0	0	2,000,000	420,168,067
	2-1-9	SLS Settling Sludge Transfer Pump : ϕ 100mm 0.1m3/min	3	set	1,000,000	0	3,000,000	0	0	3,000,000	630,252,101
	2-1-10	SLS Washing Drainage Transfer Pump : φ100mm 0.1m3/min	2	set	1,000,000	0	2,000,000	0	0	2,000,000	420,168,067
	2-1-11	Sludge Transfer Pump(Drain Tank to Sludge Thickening): φ150mm 0.7m3/min	2	set	1,500,000	0	3,000,000	0	0	3,000,000	630,252,101
	2-1-12	Sludge Thickener : ϕ 6.5m	1	set	5,000,000	0	5,000,000	0	0	5,000,000	1,050,420,168
	2-1-13	Sludge Thickener Transfer Pump : ϕ 80mm 0.2m3/min	2	set	1,000,000	0	2,000,000	0	0	2,000,000	420,168,067
	2-1-14	Dehydrator Supply Pump : φ100mm 1.3m3/min	3	set	1,000,000	0	3,000,000	0	0	3,000,000	630,252,101
	2-1-15	Dehydrator : Disposal Amount Max 20kg･Ds/h	2	set	11,800,000	0	23,600,000	0	0	23,600,000	4,957,983,193
	2-1-16	Polymer Injection Pump : Pump Capacity 0.5-1.0L/min	2	set	1,000,000	0	2,000,000	0	0	2,000,000	420,168,067
	2-1-17	Polymer Solution Tank : Volume 0.5m3	2	set	1,000,000	0	2,000,000	0	0	2,000,000	420,168,067
	2-1-18	Ferric Polysulfate Injection Pump : Pump Capacity 0.1-0.3L/min	2	set	1,000,000	0	2,000,000	0	0	2,000,000	420,168,067
	2-1-19	Ferric Polysulfate Solution Tank : Volume 0.1m3	1	set	1,000,000	0	1,000,000	0	0	1,000,000	210,084,034
	2-1-20	Cake Hopper : Volume 2.0m3	2	set	2,500,000	0	5,000,000	0	0	5,000,000	1,050,420,168
	2-1-21	Deodorizing equipment	1	set	10,000,000	0	10,000,000	0	0	10,000,000	2,100,840,336
	2-1-22	Sodium Hypochlorite Dosing Pump : Pump Capacity 0.16L/min	2	set	1,000,000	0	2,000,000	0	0	2,000,000	420,168,067
	2-1-23	Sodium Hypochlorite Storage Tank : Volume 0.7m3	1	set	1,000,000	0	1,000,000	0	0	1,000,000	210,084,034
	2-1-24	Outfall Pump φ250mm 3.0m3/min	2	set	1,500,000	0	3,000,000	0	0	3,000,000	630,252,101
		Sub Total			32,600,000		**297,400,000**	**0**	**0**	**297,400,000**	**62,478,991,596**
2-2	**Electric and Instrumentation Facility of WWTP**										
	2-2-1	Power receiving equipment	1	FL	26,000,000	0	26,000,000	0	0	26,000,000	5,462,184,874
	2-2-2	Standby generator	1	FL	7,500,000	0	7,500,000	0	0	7,500,000	1,575,630,252
	2-2-3	SCADA	1	FL	36,000,000	0	36,000,000	0	0	36,000,000	7,563,025,210
		Sub Total					**69,500,000**	**0**	**0**	**69,500,000**	**14,600,840,336**
2-3	**Installation Works**										
	2-3-1	Installation of facility	1	FL	24,000,000	0	24,000,000	0	0	24,000,000	5,042,016,807
	2-3-2	Pipe installation works	1	FL	30,000,000	0	30,000,000	0	0	30,000,000	6,302,521,008
	2-3-3	Wiring	1	FL	17,000,000	0	17,000,000	0	0	17,000,000	3,571,428,571
		Sub Total					**71,000,000**	**0**	**0**	**71,000,000**	**14,915,966,386**
2-4	**Transportation**										
	2-4-1	Transportation	1	FL	3,000,000	0	3,000,000	0	0	3,000,000	630,252,101
		Sub Total					**3,000,000**	**0**	**0**	**3,000,000**	**630,252,101**
2-5	**Commissioning Test**										
	2-5-1	Commissioning test	1	FL	9,000,000	0	9,000,000	0	0	9,000,000	1,890,756,303
		Sub Total					**9,000,000**	**0**	**0**	**9,000,000**	**1,890,756,303**
2-6	**Insurance**										
	2-6-1	Insurance	1	FL	3,000,000	0	3,000,000	0	0	3,000,000	630,252,101
		Sub Total					**3,000,000**	**0**	**0**	**3,000,000**	**630,252,101**
2-7	**Pipe cleaning equipment**										
	2-7-1		1	FL	50,000,000	0	50,000,000	0	0	50,000,000	10,504,201,681
		Sub Total					**50,000,000**	**0**	**0**	**50,000,000**	**10,504,201,681**
		Total					**512,578,500**	**91,989,999,805**	**356,434,223**	**950,450,899**	**199,674,558,628**

8. Cost Breakdown (Allocation of Cost from LCB-4 to ICB-2)

LCB-4 Allocation of Sidewalk from LCB-4 to ICB-2 (North-South Cross Section)

	Category	Items	Qty	Unit	Unit Cost		Total Cost
1. Original Plan (LCB-4 Full Implementation)	Embankment Work	Excavation (by machine)	89,260	m3	17,860	VND/m3	1,594,183,600
		Backfill (by machine)	89,260	m3	8,395	VND/m3	749,337,700
		Embankment (by machine)	341,198	m3	173,451	VND/m3	59,181,134,298
		Transportation of soil	26,778	m3	12,457	VND/m3	333,573,546
		Removal of Excavated Unsuitable Soil	26,778	m3	32,457	VND/m3	869,133,546
		Slope Protection	8,820	m2	69,579	VND/m2	613,686,780
	Rain Water Dranage	L gutter	5,880	m	661,504	VND/m	3,889,646,225
		U Ditch with Cover (1,000*1,000)	5,880	m	3,758,419	VND/m	22,099,503,720
		Catch Basin (1,200*1,200)	196	nos.	11,099,351	VND/nos	2,175,472,796
	Pavement Work at Sidewalk	Base Course (Crushed Stone 10cm)	45,142	m2	33,146	VND/m2	1,496,284,356
		Sand and Mortar Buffer	45,142	m2	44,044	VND/m2	1,988,244,378
		Interlocking Block	45,142	m2	120,258	VND/m2	5,428,714,295
		Concrete Curb	5,880	m	155,062	VND/m	911,764,560
Sidewalk (Allocation Portion)	Embankment Work	Excavation (by machine)	6,050	m3	17,860	VND/m3	108,053,000
		Backfill (by machine)	6,050	m3	8,395	VND/m3	50,789,750
		Embankment (by machine)	24,200	m3	173,451	VND/m3	4,197,514,200
		Transportation of soil	1,815	m3	12,457	VND/m3	22,609,455
		Removal of Excavated Unsuitable Soil	1,815	m3	32,457	VND/m3	58,909,455
		Slope Protection	3,450	m2	69,579	VND/m2	240,047,550
	Rain Water Dranage	L gutter	0	m	661,504	VND/m	0
		U Ditch with Cover (1,000*1,000)	0	m	3,758,419	VND/m	0
		Catch Basin (1,200*1,200)	0	nos.	11,099,351	VND/nos	0
	Pavement Work at Sidewalk	Base Course (Crushed Stone 10cm)	12,386	m2	33,146	VND/m2	410,546,356
		Sand and Mortar Buffer	12,386	m2	44,044	VND/m2	545,528,984
		Interlocking Block	12,386	m2	120,258	VND/m2	1,489,515,588
		Concrete Curb	2,200	m	155,062	VND/m	341,136,400
Diffrence (1-2)	Embankment Work	Excavation (by machine)	83,210	m3	17,860	VND/m3	1,486,130,600
		Backfill (by machine)	83,210	m3	8,395	VND/m3	698,547,950
		Embankment (by machine)	316,998	m3	173,451	VND/m3	54,983,620,098
		Transportation of soil	24,963	m3	12,457	VND/m3	310,964,091
		Removal of Excavated Unsuitable Soil	24,963	m3	32,457	VND/m3	810,224,091
		Slope Protection	5,370	m2	69,579	VND/m2	373,639,230
	Rain Water Dranage	L gutter	5,880	m	661,504	VND/m	3,889,646,225
		U Ditch with Cover (1,000*1,000)	5,880	m	3,758,419	VND/m	22,099,503,720
		Catch Basin (1,200*1,200)	196	nos.	3,758,420	VND/m	736,650,320
	Pavement Work at Sidewalk	Base Course (Crushed Stone 10cm)	32,756	m2	33,146	VND/m2	1,085,738,000
		Sand and Mortar Buffer	32,756	m2	44,044	VND/m2	1,442,715,394
		Interlocking Block	32,756	m2	120,258	VND/m2	3,939,198,707
		Concrete Curb	3,680	m	155,062	VND/m	570,628,160
						Total Cost (VND)	92,427,206,586

	Category	Items	Qty	Unit	Unit Cost		Total Cost
Remove the duplicate part for Embankment Work between Road and Sewerage	Embankment Work	Excavation (by machine)	3,850	m3	17,860	VND/m3	68,761,000
		Backfill (by machine)	3,850	m3	8,395	VND/m3	32,320,750
		Embankment (by machine)	24,200	m3	173,451	VND/m3	4,197,514,200
		Transportation of soil	1,155	m3	12,457	VND/m3	14,387,835
		Removal of Excavated Unsuitable Soil	1,155	m3	32,457	VND/m3	37,487,835
		Slope Protection	3,450	m2	69,579	VND/m2	240,047,550
	Rain Water Dranage	L gutter	0	m	661,504	VND/m	0
		U Ditch with Cover (1,000*1,000)	0	m	3,758,419	VND/m	0
		Catch Basin (1,200*1,200)	0	nos.	3,758,420	VND/m	0
	Pavement Work at Sidewalk	Base Course (Crushed Stone 10cm)	12,386	m2	33,146	VND/m2	410,546,356
		Sand and Mortar Buffer	12,386	m2	44,044	VND/m2	545,528,984
		Interlocking Block	12,386	m2	120,258	VND/m2	1,489,515,588
		Concrete Curb	2,200	m	155,062	VND/m	341,136,400
						Total Cost (VND)	7,377,246,498

LCB-4 Allocation of Sidewalk from LCB-4 to ICB-2 (East-West Cross Section)

	Category	Items	Qty	Unit	Unit Cost		Total Cost
1. Original Plan (LCB-4 Full Implementation)	Embankment Work	Excavation (by machine)	38,200	m3	17,860	VND/m3	682,252,000
		Backfill (by machine)	38,200	m3	8,395	VND/m3	320,689,000
		Embankment (by machine)	70,758	m3	173,451	VND/m3	12,273,122,350
		Transportation of soil	11,460	m3	12,457	VND/m3	142,757,220
		Removal of Excavated Unsuitable Soil	11,460	m3	32,457	VND/m3	371,957,220
		Slope Protection	4,680	m2	69,579	VND/m2	325,629,720
	Rain Water Dranage	L gutter	3,120	m	661,504	VND/m	2,063,893,915
		U Ditch with Cover (1,000*1,000)	3,120	m	3,758,419	VND/m	11,726,267,280
		Catch Basin (1,200*1,200)	104	nos.	11,099,351	VND/nos	1,154,332,504
	Pavement Work at Sidewalk	Base Course (Crushed Stone 10cm)	25,501	m2	33,146	VND/m2	845,239,904
		Sand and Mortar Buffer	25,501	m2	44,044	VND/m2	1,123,144,462
		Interlocking Block	25,501	m2	120,258	VND/m2	3,066,640,332
		Concrete Curb	3,120	m	155,062	VND/m	483,793,440
Sidewalk (Allocation Portion)	Embankment Work	Excavation (by machine)	5,460	m3	17,860	VND/m3	97,515,600
		Backfill (by machine)	5,460	m3	8,395	VND/m3	45,836,700
		Embankment (by machine)	21,840	m3	173,451	VND/m3	3,788,169,840
		Transportation of soil	1,638	m3	12,457	VND/m3	20,404,566
		Removal of Excavated Unsuitable Soil	1,638	m3	32,457	VND/m3	53,164,566
		Slope Protection	2,340	m2	69,579	VND/m2	162,814,860
	Rain Water Dranage	L gutter	0	m	661,504	VND/m	0
		U Ditch with Cover (1,000*1,000)	0	m	3,758,419	VND/m	0
		Catch Basin (1,200*1,200)	0	nos.	11,099,351	VND/nos	0
	Pavement Work at Sidewalk	Base Course (Crushed Stone 10cm)	9,917	m2	33,146	VND/m2	328,708,882
		Sand and Mortar Buffer	9,917	m2	44,044	VND/m2	436,784,348
		Interlocking Block	9,917	m2	120,258	VND/m2	1,192,598,586
		Concrete Curb	1,560	m	155,062	VND/m	241,896,720
Diffrence (1-2)	Embankment Work	Excavation (by machine)	32,740	m3	17,860	VND/m3	584,736,400
		Backfill (by machine)	32,740	m3	8,395	VND/m3	274,852,300
		Embankment (by machine)	48,918	m3	173,451	VND/m3	8,484,952,510
		Transportation of soil	9,822	m3	12,457	VND/m3	122,352,654
		Removal of Excavated Unsuitable Soil	9,822	m3	32,457	VND/m3	318,792,654
		Slope Protection	2,340	m2	69,579	VND/m2	162,814,860
	Rain Water Dranage	L gutter	3,120	m	661,504	VND/m	2,063,893,915
		U Ditch with Cover (1,000*1,000)	3,120	m	3,758,419	VND/m	11,726,267,280
		Catch Basin (1,200*1,200)	104	nos.	11,099,351	VND/nos	1,154,332,504
	Pavement Work at Sidewalk	Base Course (Crushed Stone 10cm)	15,584	m2	33,146	VND/m2	516,531,022
		Sand and Mortar Buffer	15,584	m2	44,044	VND/m2	686,360,114
		Interlocking Block	15,584	m2	120,258	VND/m2	1,874,041,746
		Concrete Curb	1,560	m	155,062	VND/m	241,896,720
						Total Cost (VND)	28,211,824,679

	Category	Items	Qty	Unit	Unit Cost		Total Cost
Remove the duplicate part for Embankment Work between Road and Sewerage	Embankment Work	Excavation (by machine)	3,900	m3	17,860	VND/m3	69,654,000
		Backfill (by machine)	3,900	m3	8,395	VND/m3	32,740,500
		Embankment (by machine)	21,840	m3	173,451	VND/m3	3,788,169,840
		Transportation of soil	1,170	m3	12,457	VND/m3	14,574,690
		Removal of Excavated Unsuitable Soil	1,170	m3	32,457	VND/m3	37,974,690
		Slope Protection	2,340	m2	69,579	VND/m2	162,814,860
	Rain Water Dranage	L gutter	0	m	661,504	VND/m	0
		U Ditch with Cover (1,000*1,000)	0	m	3,758,419	VND/m	0
		Catch Basin (1,200*1,200)	0	nos.	11,099,351	VND/nos	0
	Pavement Work at Sidewalk	Base Course (Crushed Stone 10cm)	9,917	m2	33,146	VND/m2	328,708,882
		Sand and Mortar Buffer	9,917	m2	44,044	VND/m2	436,784,348
		Interlocking Block	9,917	m2	120,258	VND/m2	1,192,598,586
		Concrete Curb	1,560	m	155,062	VND/m	241,896,720
						Total Cost (VND)	6,305,917,116

LCB-4 Allocation of Sidewalk from LCB-4 to ICB-2 (Both CrossRoad)

	Category	Items	Qty	Unit	Unit Cost		Total Cost
1. Original Plan (LCB-4 Full Implementation)	Embankment Work	Excavation (by machine)	127,460	m3	17,860	VND/m3	2,276,435,600
		Backfill (by machine)	127,460	m3	8,395	VND/m3	1,070,026,700
		Embankment (by machine)	411,956	m3	173,451	VND/m3	71,454,256,648
		Transportation of soil	38,238	m3	12,457	VND/m3	476,330,766
		Removal of Excavated Unsuitable Soil	38,238	m3	32,457	VND/m3	1,241,090,766
		Slope Protection	13,500	m2	69,579	VND/m2	939,316,500
	Rain Water Dranage	L gutter	9,000	m	661,504	VND/m	5,953,540,140
		U Ditch with Cover (1,000*1,000)	9,000	m	3,758,419	VND/m	33,825,771,000
		Catch Basin (1,200*1,200)	300	nos.	11,099,351	VND/nos	3,329,805,300
	Pavement Work at Sidewalk	Base Course (Crushed Stone 10cm)	70,643	m2	33,146	VND/m2	2,341,524,260
		Sand and Mortar Buffer	70,643	m2	44,044	VND/m2	3,111,388,841
		Interlocking Block	70,643	m2	120,258	VND/m2	8,495,354,627
		Concrete Curb	9,000	m	155,062	VND/m	1,395,558,000
Sidewalk (Allocation Portion)	Embankment Work	Excavation (by machine)	11,510	m3	17,860	VND/m3	205,568,600
		Backfill (by machine)	11,510	m3	8,395	VND/m3	96,626,450
		Embankment (by machine)	46,040	m3	173,451	VND/m3	7,985,684,040
		Transportation of soil	3,453	m3	12,457	VND/m3	43,014,021
		Removal of Excavated Unsuitable Soil	3,453	m3	32,457	VND/m3	112,074,021
		Slope Protection	5,790	m2	69,579	VND/m2	402,862,410
	Rain Water Dranage	L gutter	0	m	661,504	VND/m	0
		U Ditch with Cover (1,000*1,000)	0	m	3,758,419	VND/m	0
		Catch Basin (1,200*1,200)	0	nos.	11,099,351	VND/nos	0
	Pavement Work at Sidewalk	Base Course (Crushed Stone 10cm)	22,303	m2	33,146	VND/m2	739,255,238
		Sand and Mortar Buffer	22,303	m2	44,044	VND/m2	982,313,332
		Interlocking Block	22,303	m2	120,258	VND/m2	2,682,114,174
		Concrete Curb	3,760	m	155,062	VND/m	583,033,120
Diffrence (1-2)	Embankment Work	Excavation (by machine)	115,950	m3	17,860	VND/m3	2,070,867,000
		Backfill (by machine)	115,950	m3	8,395	VND/m3	973,400,250
		Embankment (by machine)	365,916	m3	173,451	VND/m3	63,468,572,608
		Transportation of soil	34,785	m3	12,457	VND/m3	433,316,745
		Removal of Excavated Unsuitable Soil	34,785	m3	32,457	VND/m3	1,129,016,745
		Slope Protection	7,710	m2	69,579	VND/m2	536,454,090
	Rain Water Dranage	L gutter	9,000	m	661,504	VND/m	5,953,540,140
		U Ditch with Cover (1,000*1,000)	9,000	m	3,758,419	VND/m	33,825,771,000
		Catch Basin (1,200*1,200)	300	nos.	11,099,351	VND/nos	3,329,805,300
	Pavement Work at Sidewalk	Base Course (Crushed Stone 10cm)	48,340	m2	33,146	VND/m2	1,602,269,022
		Sand and Mortar Buffer	48,340	m2	44,044	VND/m2	2,129,075,509
		Interlocking Block	48,340	m2	120,258	VND/m2	5,813,240,453
		Concrete Curb	5,240	m	155,062	VND/m	812,524,880
						Total Cost (VND)	122,077,853,741

	Category	Items	Qty	Unit	Unit Cost		Total Cost
Remove the duplicate part for Embankment Work between Road and Sewerage	Embankment Work	Excavation (by machine)	7,750	m3	17,860	VND/m3	138,415,000
		Backfill (by machine)	7,750	m3	8,395	VND/m3	65,061,250
		Embankment (by machine)	46,040	m3	173,451	VND/m3	7,985,684,040
		Transportation of soil	2,325	m3	12,457	VND/m3	28,962,525
		Removal of Excavated Unsuitable Soil	2,325	m3	32,457	VND/m3	75,462,525
		Slope Protection	5,790	m2	69,579	VND/m2	402,862,410
	Rain Water Dranage	L gutter	0	m	661,504	VND/m	0
		U Ditch with Cover (1,000*1,000)	0	m	3,758,419	VND/m	0
		Catch Basin (1,200*1,200)	0	nos.	11,099,351	VND/nos	0
	Pavement Work at Sidewalk	Base Course (Crushed Stone 10cm)	22,303	m2	33,146	VND/m2	739,255,238
		Sand and Mortar Buffer	22,303	m2	44,044	VND/m2	982,313,332
		Interlocking Block	22,303	m2	120,258	VND/m2	2,682,114,174
		Concrete Curb	3,760	m	155,062	VND/m	583,033,120
						Total Cost (VND)	13,683,163,614