PART IV

FEASIBILITY STUDY

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Contents

CHAPTER 1

BASIC CONDITIONS OF THE PROJECT

PART IV FEASIBILITY STUDY

CHAPTER 1 BASIC CONDITIONS OF THE PROJECT

1.1 Target Area & Policy

1.1.1 Target Area

The existing water sources in the 15 communes for the priority project consist of shallow wells, tube wells, river water, and rainwater. These sources are quite close to the residence and the water consumption amount per household ranges from 400 to 500 liters. Most of these water sources, however, are contaminated with coliform bacilli. In addition, water in the shallow wells is rich in iron, resulting in frequent complaints from the residents regarding the color, smell and taste of the water. The amount of water produced by these sources is also not stable, resulting in water shortage problems in the dry season.

Table 1.1 List of the Priority Communes

NO.	Province	District	Commune	Population(thousand) (thousand)
1	Hanoi	Tu Liem	Xuan Dinh	15.77
2			Dong Ngac	6.90
3	Ninh Binh	Tam Diep Town	Quang Son	7.50
4		Yen Mo	Yen Thang	8.53
5		Nho Quan	Dong Phong	10.00
6	Thanh Hoa	Nong Cong	Van Thang	6.66
7		Thieu Hoa	Thie Hung	6.75
8			Thieu Do	7.01
9		Yen Dinh	Dinh Tuong	6.52
10		Vin Loc	Vin Loc Town	5.08
11			Vinh Thanh	5.98
12	Thai Nguyen	Dong Hy	Dong Bam	5.28
13			Hoa Thuong	12.80
14		Pho Yen	Nam Tien	6.27
15		Thai Nguyen Town	Thinh Duc	6.24

1.1.2 Water Supply Facility Planning Policy

The water supply facilities will be constructed based on the following policies:

(1) Each commune will be constructed with its own water supply facility. The use of one water source for Vin Loc Town and Vinh Thanh is considered possible as these communes are adjacent to each other. Therefore, the water supply facility to be constructed in this area will be shared by these two communes.
(2) The water supply system will provide services through household connections (service level III). A 90 % service coverage rate is targeted by 2010.
(3) Water supply facility O&M will be independently carried out by each commune. A biological filter for water treatment will be planned, therefore, as it is easy and inexpensive to operate and maintain.

1.2 Water Demand Forecast &Design Water Amount

The water demand estimated in the master plan for 2010 will be adopted as the forecast water demand. The water demand for domestic and non-domestic use will also be adopted from the values established in the master plan. Table 1.1 shows the population in and design water amount for each commune.

1.3 Groundwater Resource

The number of deep wells every commune would need was determined based on the optimal pumpage estimated from the results of the boring and pumping test results (see *Part 2, 6.2*).

CHAPTER 2

PRELIMINARY DESIGN

CHAPTER 2 PRELIMINARY DESIGN

2.1 DESIGN CRITERIA

This chapter presents the design criteria which is applied for the priority projects. The criteria is based on the Vietnamese Standard and other international standards.

2.1.1 Service Level

(1) Type of Service

Water is supplied through the house connection system (Level III). Water meter is installed for billing purpose.

(2) Service Hours

The system, all facilities for raw water intake, treatment and distribution, is planned for 24 hours continuous operation.

2.1.2 Water Source

The water source of this water supply system is ground water which is pumped from the deep well.

(1) Design maximum daily pumping amount

Design maximum daily pumping amount is calculated as follows:

5Maximum Daily Supply31.05 (including transmission loss water of 5 %)
Maximum Daily Supply is defined in the Master Plan design criteria.

(2) Pumping capacity of the deep well

The capacity is set at the design maximum daily pumping amount. The standby well is not considered.

(3) Number of the deep wells

Number of the deep wells is decided considering the safe yield.

(4) Casing and screen

In principle, the steel pipe is used for the casing pipe. FRP (Fiber Glass Reinforced

Plastic Pipe) is also used for the area where water is acidic. The corrosiveness of raw water will be reconfirmed at the detailed design stage. The wire wound screen made of the stainless steel or the FRP screen is used.

2.1.3 Water Treatment Plant

(1) Capacity of Water Treatment Facilities

The standard capacity of the water treatment facilities are based on the Maximum Daily Supply.

(2) Purpose and method of treatment

The main purpose of treatment is to remove iron and manganese from the groundwater. In order to remove these contents from the raw water, a biological filtration system is introduced.

The principle of the biological filtration is iron-oxidization by bacteria. The iron and manganese ions are converted to the insoluble form by metabolism of the iron bacteria and precipitation of the hydro-oxide occurs.

The treatment process for the raw water is to touch with iron bacteria and to separate iron bacteria and water continuously by the sand filtration after iron and manganese absorbed. When iron bacteria breed too much and the filtration blockage occurs, the surface sand is removed or washed by back washing and the filtration ability is recovered. Even if the majority of iron bacteria are removed ability recovers at once.

This method can be operated at low cost by man power without using chemicals. However, as for the manganese, it is not oxidized easily. In case of relatively high concentration of manganese, pre-chlorination is needed (The concentration level is approximately more than 0.5 mg/ℓ).

(3) Main processing facilities

1) Biological Filtration Basin

a) If the raw water quality needs the process, the biological filtration basin is applied. The basin is gravity flow type and the filtration rate is set at 70 m/day. The standby basin is considered.

b) If the raw water quality meet the drinking water standard value, only the filtration process is employed and the standby basin is not installed. The structure of filtration

basin and the equipment will be simplified according to the raw water quality.

2) Receiving well

Receiving well is installed in order to stabilize raw water level at water treatment plant and operation of treatment facilities.

3) Chlorine injection equipment

Post-chlorination is applied for disinfection. The residual chlorine is more than 0.1 mg/ℓ at the tap.

Chlorine agent: Calcium Hypochlorite, or Sodium Hypochlorite

2.1.4 Distribution Facilities

(1) Distribution reservoir capacity

The capacity of distribution reservoir is set at 8 hours of the Maximum Daily Supply.

(2) Elevated tank capacity

The capacity of elevated tank is set at one hour volume of the Maximum Daily Supply in total capacity. This capacity is included in the capacity of distribution reservoir.

(3) Distribution Pump

Maximum out-let pressure of the distribution pump is estimated at 3~4 kg/cm^2.

Number of pump units: 4 units (for operation: 3 units, and 1 unit is for standby)

(4) Distribution pipe[1]

1) Hydraulic conditions

a) Water pressure

The maximum static water pressure is set at 3~4 kg/cm^2 (the outlet water pressure of the distribution pump). The minimum dynamic water pressure is set at 1.0 kg/cm^2 in the pipe end (Water supply: to the first floor at the target highest supply area).

[1] Definition of water supply pipe:
Distribution main:These pipes composes the main network, The diameter will be 100mm and more. House connection pipes can not be branched from these pipes.
Distribution pipe:The diameter will be more than 50mm to 75mm. House connection pipes can be branched from these pipes.

Service pipes:The diameter will be less than 50mm. These pipes can be branched from distribution pipes and supplies water through the house connection.

b) Time factor: 2.0

c) Coefficient of velocity:110 (in Hazen Williams' equation)

2) Pipe laying conditions

a) Road with automobile traffic

Laying depth of the main distribution pipe and the service pipe under the main roads or the local trunk line road considers the following specifications.

Traffic load: 4~10 t/m^2
Depth of pipe laying: 90 cm
Kind of pipe: Centrifugal Ductile Cast Iron Pipe
Diameter:75 mm or more.

b) Road with little automobile traffic

Pipe laying depth: 60 cm
Kind of pipe: Polyethylene Pipe (roll type)
Diameter: less than 75 mm

3) Pipe protection from corrosion

Appropriate countermeasure for the anti-corrosion will be conducted.

4) Standard for pipes

a) The quality standard: The international industrial standard such as JIS and JWWA (Japan Industrial Standard and Standard of Japan Waterworks Association) etc will be applied.

b) Dimension standard: ISO standard will be applied.

5) Other equipment

The sluice valve, fire hydrant and air valve are installed according to relevant technical standards of Vietnam.

2.2 FACILITY PLAN

2.2.1 Water Source Facilities

The water source facilities are composed of the production wells, pump house (intake pump

station) and the water transmission pipe to the treatment system.

(1) Production Well

13 test wells were drilled at the priority project communes in this study. However, in Dong Bam Commune of Thai Nguyen the test well was abandoned due to collapse. In Yen Thang Commune of Ninh Binh, the test well groundwater was highly salinized. In Van Thang, the test well was slightly salinized. In addition, the test wells drilled at Nam Tien and Thinh Duc Communes of Thai Nguyen showed low groundwater yield. In order to meet the maximum daily pumping amount, the production wells must be additionally drilled in the above communes.

The diameter and depth of the production well are planned at 150 to 200 mm and 80 m in average , respectively.

(2) Pump house and transmission pipe

The pump house (intake station) is built of brick with power supply. The material of the water transmission pipe is Ductile Cast Iron Pipe.

2.2.2 Water Treatment Facilities

The water treatment facilities are composed of receiving well, biological filtration basin, back-wash tank ,drainage basin and sludge drying bed.

(1) Confirmation of raw water quality

Ground water is suitable water quality for the growth of the iron bacteria. However, transplant of adequate bacteria is necessary if efficient bacteria is not find in the raw water. It is necessary to conduct the microbe control based on the biological knowledge.

(2) Biological filtration basin

In case that raw water quality is less than the drinking water standard, this water treatment facility is not necessary and the filtration basin is not installed.

(3) Standby basin

The numbers of the basin is more than 2 in total. One basin is kept for a standby (However, in case that the raw water quality is suitable for water quality standard value, the standby basin is not installed.).

(4) Unit of the filtration basin

Several units of the filtration basin will be prepared according to different capacity levels in each commune.

(5) Structure of water treatment facility

Structure of water treatment facility will be made of reinforced concrete, water-tight structure in all of the facilities.

(6) Administration house

The office room, workshop/water quality test room and warehouse for storing chlorine agent, spare parts and materials will be constructed.

(7) Drainage facilities

Wash water drainage is discharged to public drainage after sedimentation and solar drying are to be employed for treatment of sedimentation sludge.

2.2.3 Distribution facilities

The distribution facilities are composed of the distribution reservoir and pumps, elevated tank and pipeline.

(1) Distribution reservoir

The inner concrete surface will be coated with Epoxy Resin for deterioration measures and waterproof of concrete with chlorine.

(2) Distribution pump

3 pumps are regularly operated.

Voltage and current: 220~230 V and 50 MHz, Single phase

(3) Flow meter

A mechanical impeller type will be installed.

2.3 Preliminary Design

2.3.1 Capacities of the Facilities

(1) Water Source and Water Treatment Facilities

The capacity of the facilities in each commune is shown in Table 2.3.1. The main component and capacity of the water treatment facilities are shown in Table 2.3.2.

(2) Service and Distribution Pipes

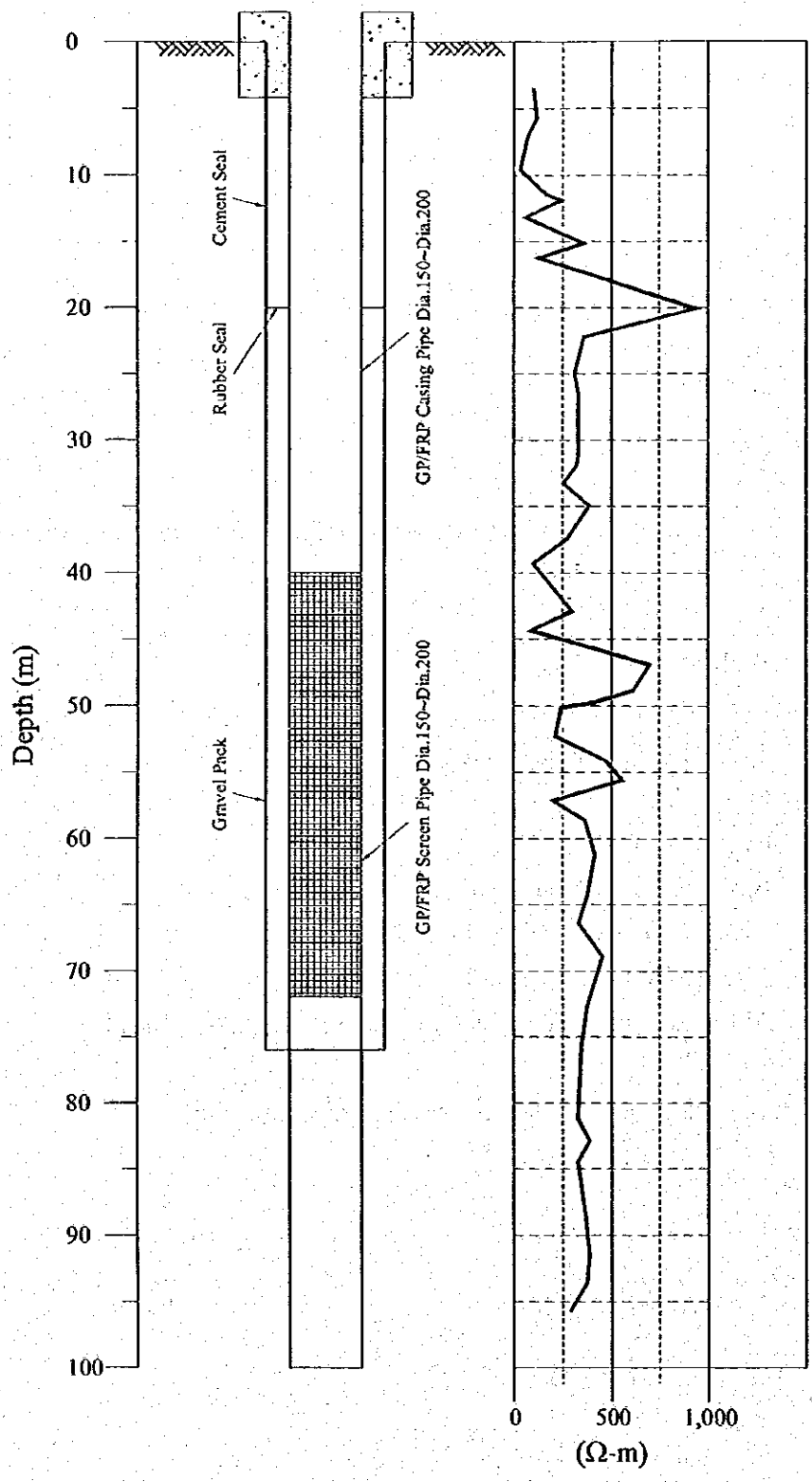
The route and length of distribution pipeline and number of house connection in each commune are shown in Table 2.3.3

2.3.2 General Facility Arrangement Plan

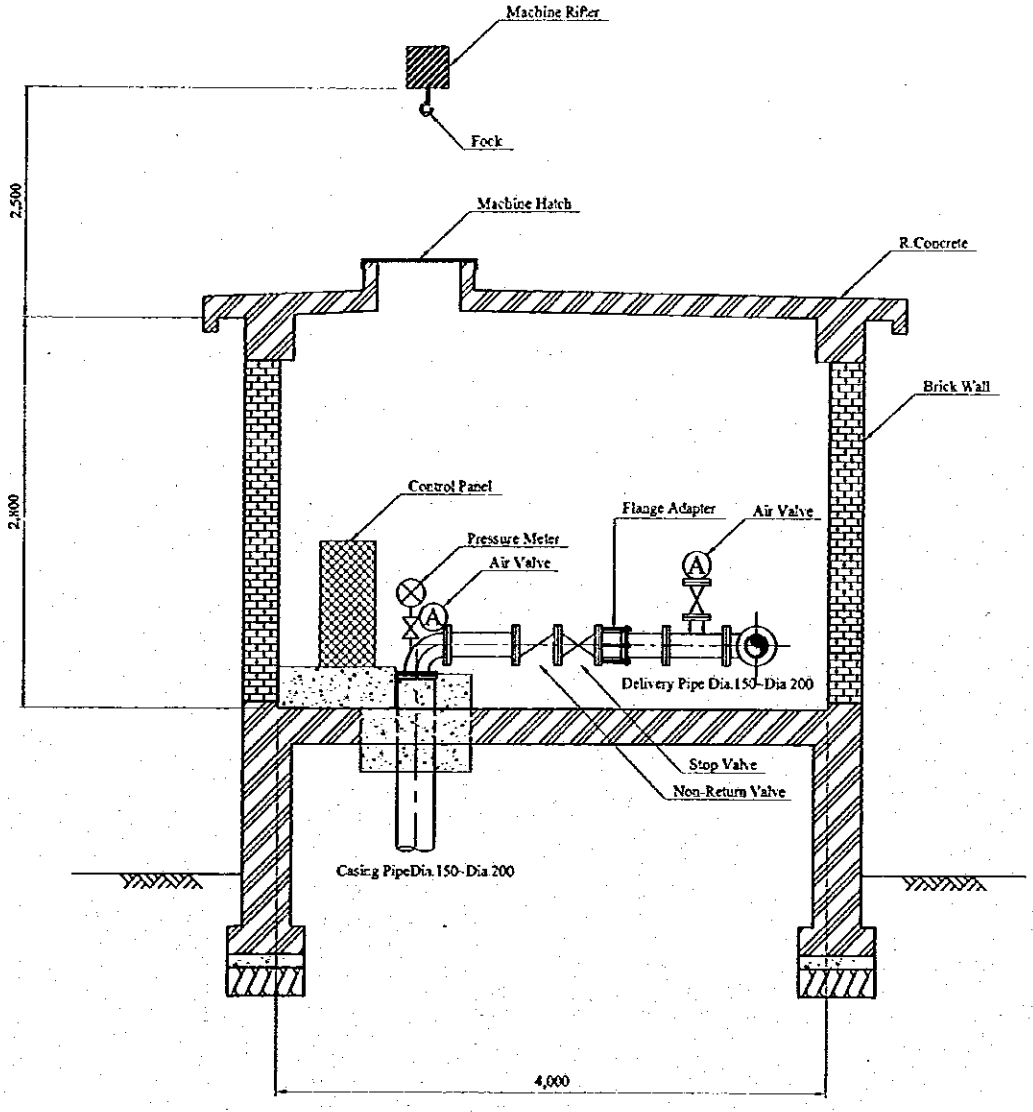
Typical water level diagram, arrangement of water treatment facilities and structural drawings (outline) of each facilities are shown in the drawings.

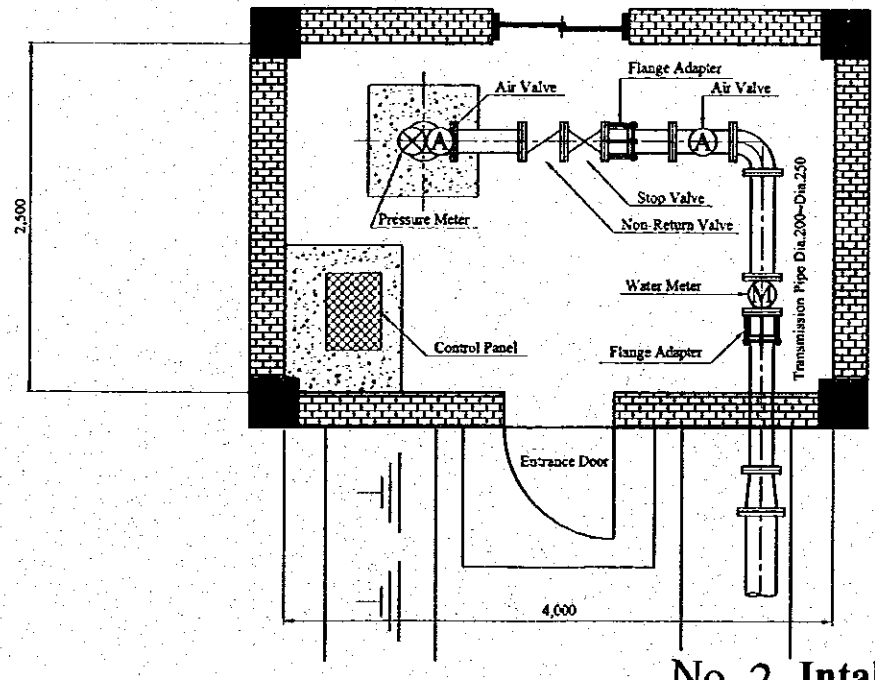
- Drawing No.1: Well Structure
- Drawing No.2: Intake Pump Station
- Drawing No.3: Typical Layout Plan of Treatment Plant
- Drawing No 4: Flow Diagram
- Drawing No.5: Receiving Well
- Drawing No.6: Biological Filtration Basin
- Drawing No.7: Distribution Reservoir Structure
- Drawing No.8: Alternative Plan Typical Layout Plan of Treatment Plant
- Drawing No.9: Alternative Plan Aeration Reaction Sedimentation Basin

Pipeline network drawings of each 15 communes are shown in the Data Report



No. 1 Well Structure

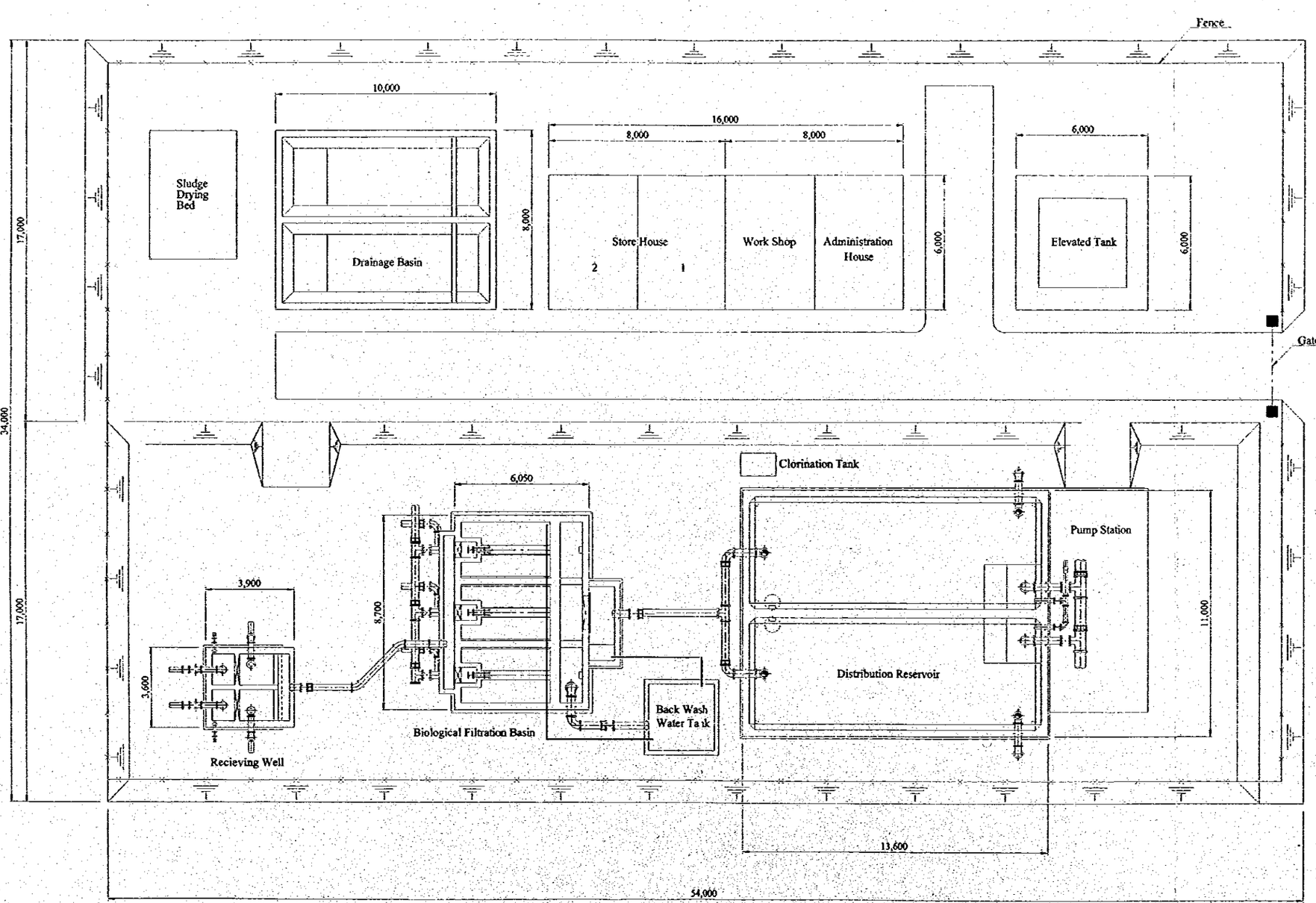




No. 2 **Intake Pump Station**

Typical Layout Plan of Treatment Plant

S=1/200

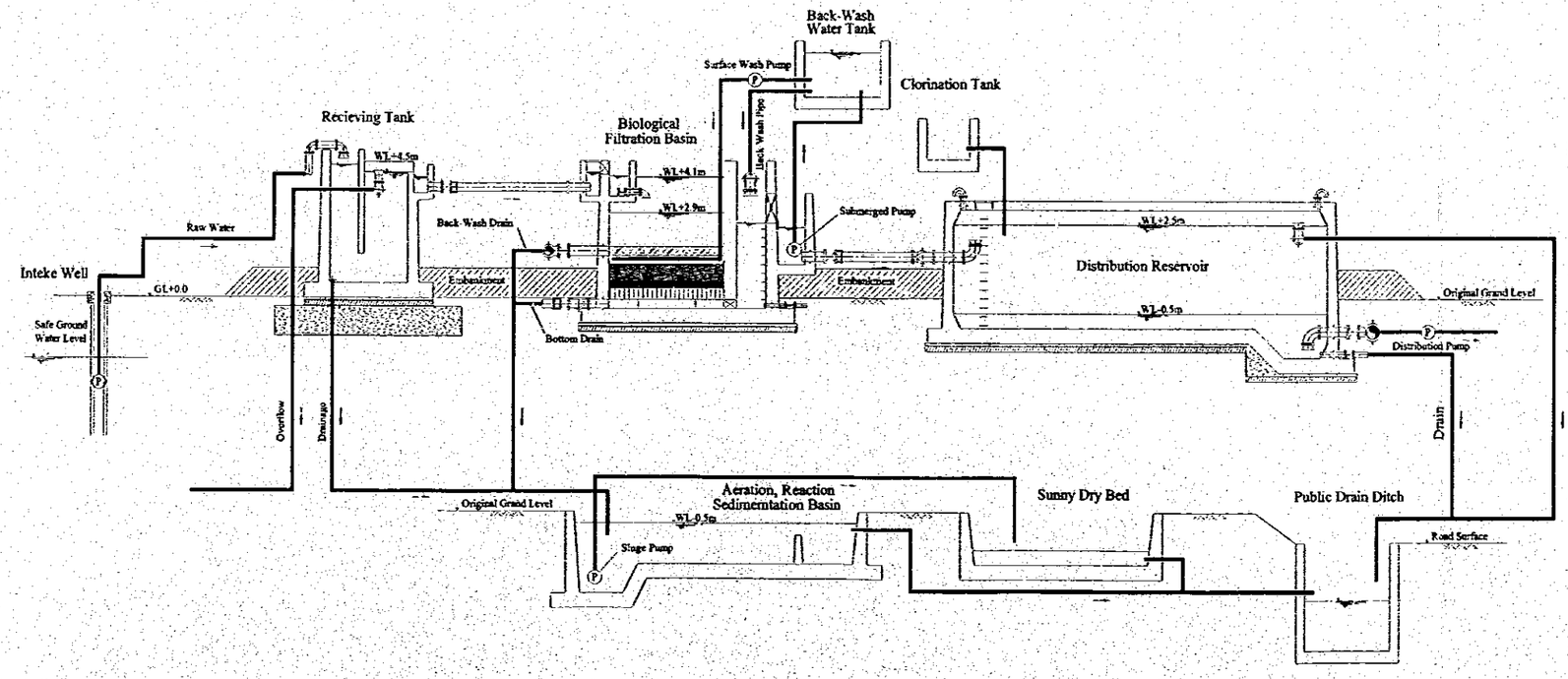


No. 3

The Study on Groundwater Development in the Rural Provinces of Northern Part in the Socialist Republic of Viet Nam		
Draw. Name: Typical Layout Plan of Treatment Plant		
June 1999	Scale. 1/200	Draw. No. 1 of 5
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)		

Flow Diagram

S=None

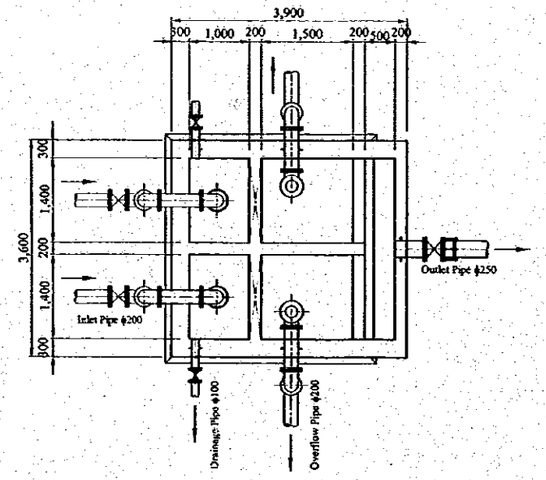


No. 4

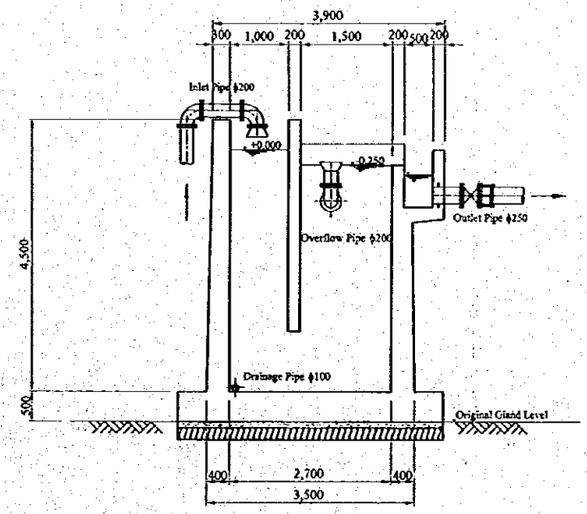
The Study on Groundwater Development in the Rural Provinces of Northern Part in the Socialist Republic of Viet Nam		
Draw. Name: Flow Diagram		
June 1999	Scale. None	Draw. No. 2 of 5
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)		

Recieving Well

S=1/100



Plan



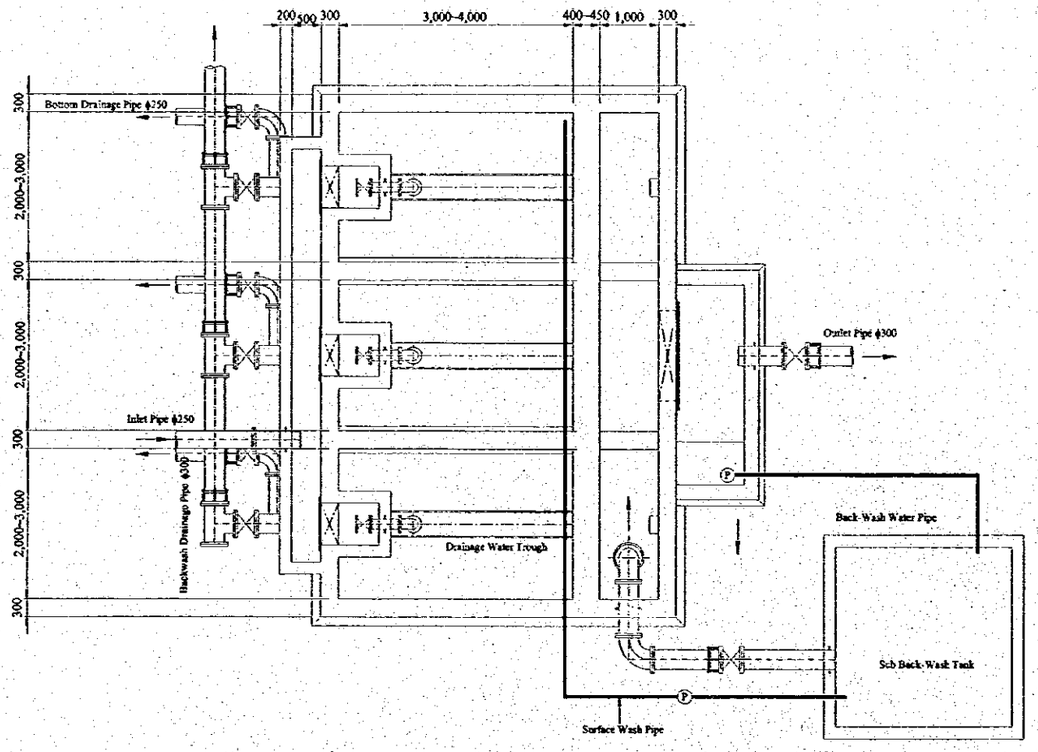
Section

No. 5

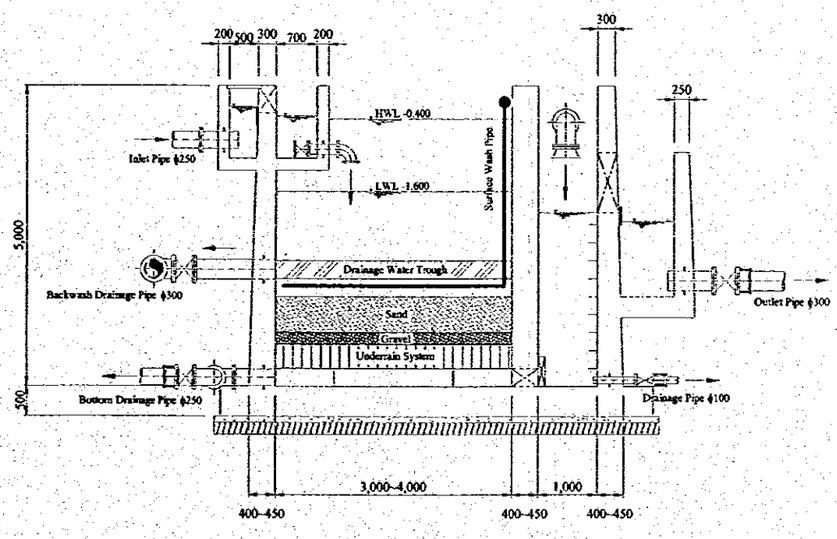
The Study on Groundwater Development in the Rural Provinces of Northern Part in the Socialist Republic of Viet Nam		
Draw. Name: Recieving Well		
June 1999	Scale. 1/100	Draw. No. 3 of 5
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)		

Biological Filtration Basin

S=1/100



Plan



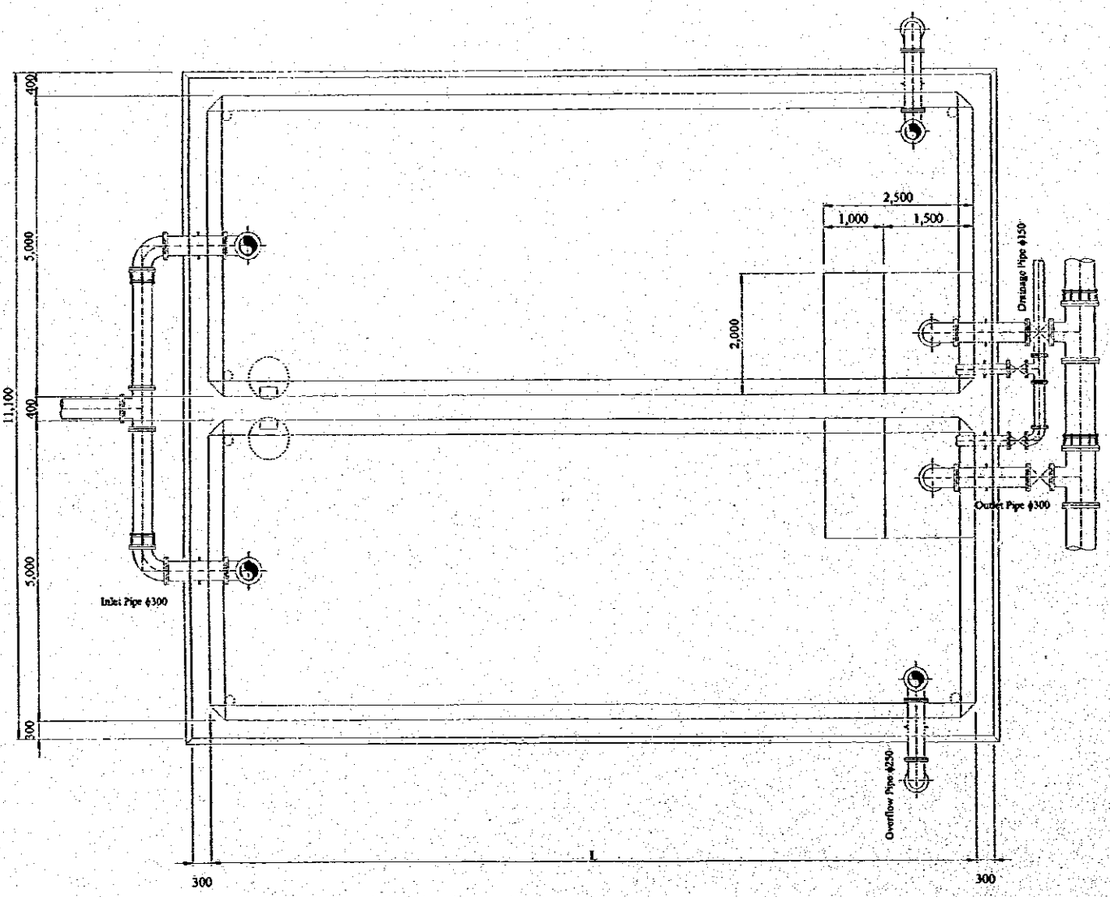
Section

No. 6

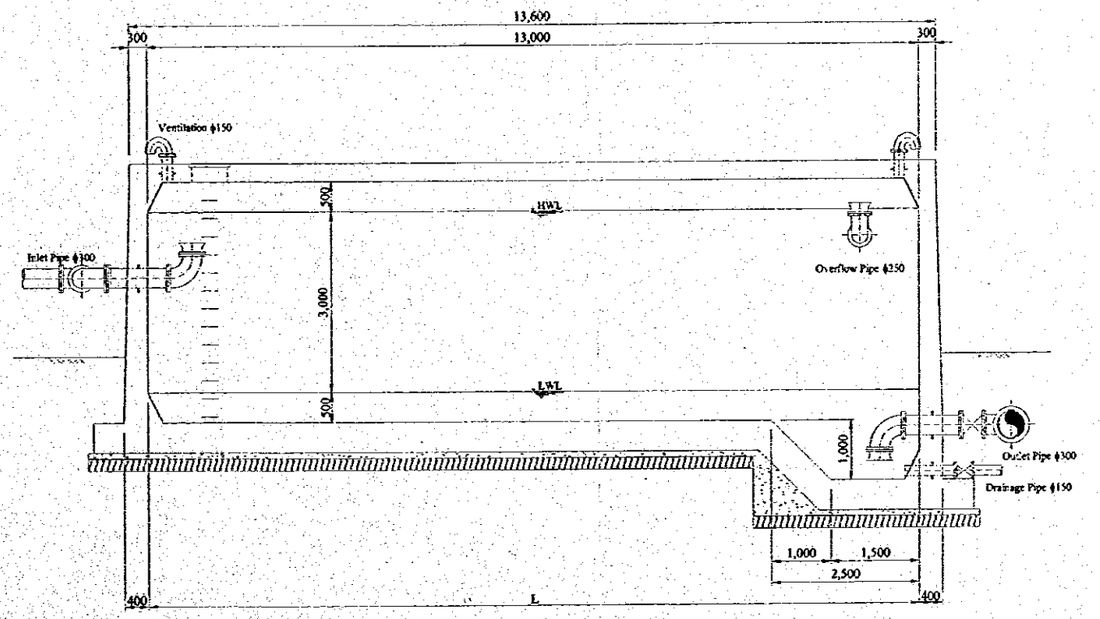
The Study on Groundwater Development in the Rural Provinces of Northern Part in the Socialist Republic of Viet Nam		
Draw. Name: Biological Filtration Basin		
June 1999	Scale. 1/100	Draw. No. 4 of 5
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)		

Distribution Reservoir

S=1/100



Plan



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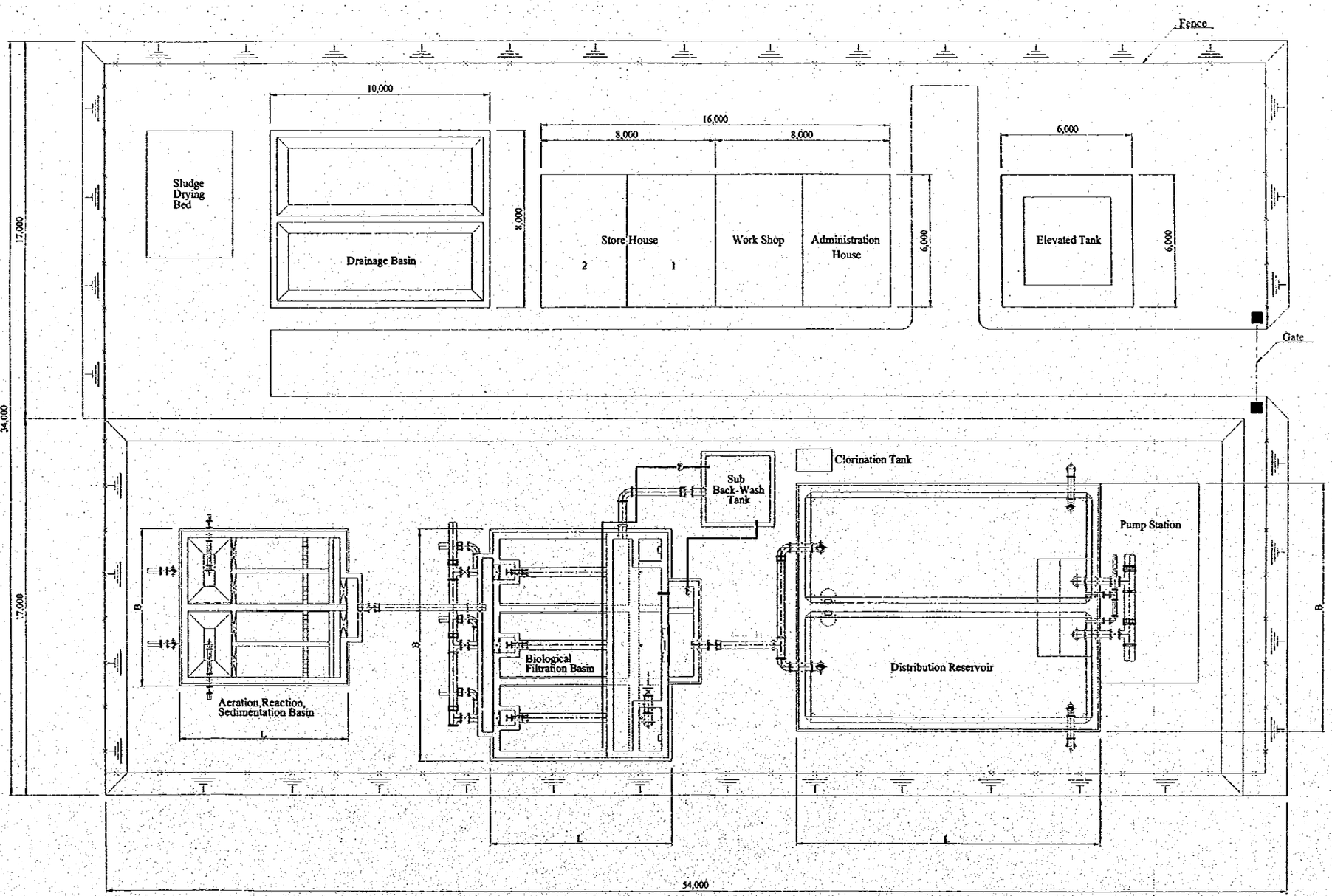
No. 7

The Study on Groundwater Development in the Rural Provinces of Northern Part in the Socialist Republic of Viet Nam		
Draw. Name: Distribution Reservoir		
June 1999	Scale. 1/100	Draw. No. 5 of 5
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)		

Typical Layout Plan of Treatment Plant

S=1/200

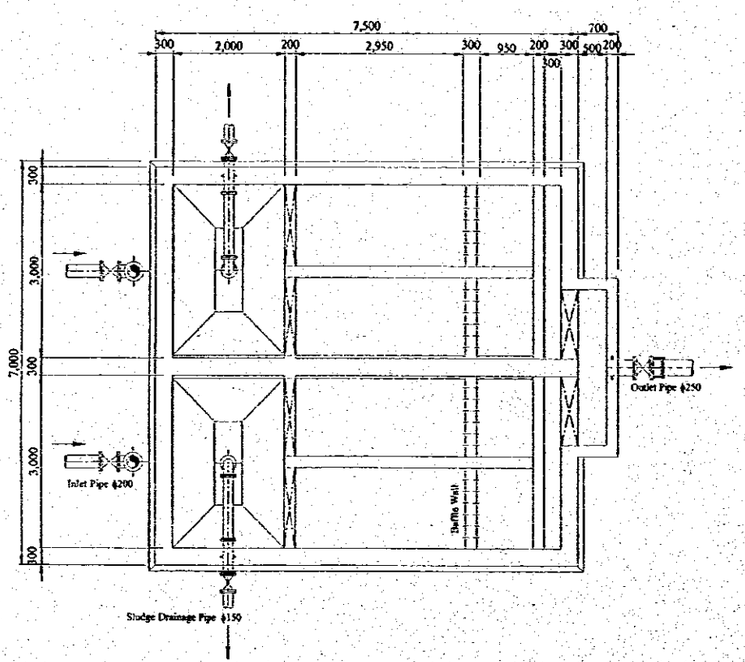


No. 8

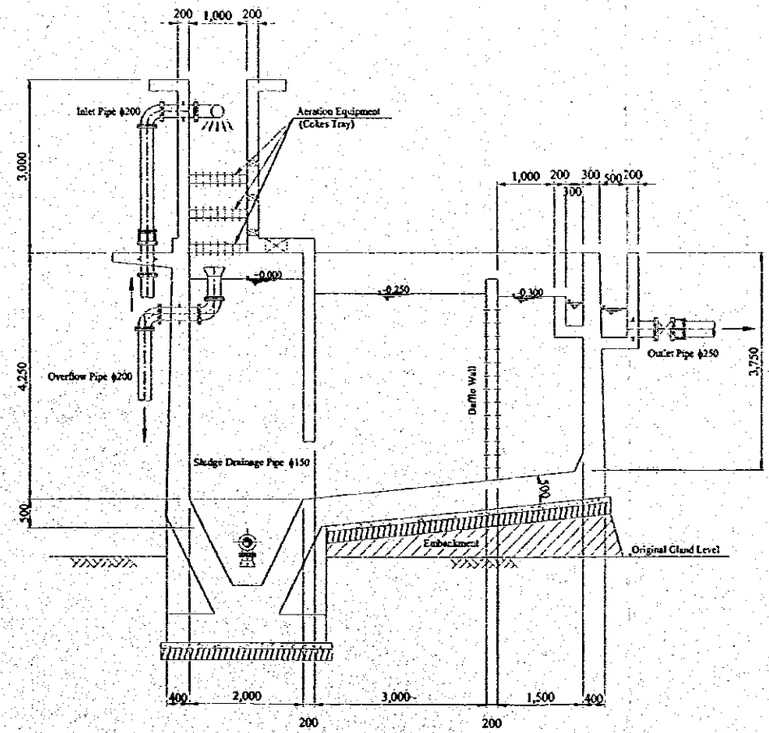
The Study on Groundwater Development in the Rural Provinces of Northern Part in the Socialist Republic of Viet Nam		
Draw. Name	Alternative Plan Typical Layout Plan of Treatment Plant	
June 1999	Scale. 1/200	Draw. No. A-1 of 2
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)		

Aeration, Reaction, Sedimentation Basin

S=1/50



Plan



Section

No. 9

The Study on Groundwater Development in the Rural Provinces of Northern Part in the Socialist Republic of Viet Nam		
Draw. Name	Alternative Plan Aeration, Reaction, Sedimentation Basin	
June 1999	Scale. 1/200	Draw. No. A-2 of 2
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)		

Table2.3-1 Water source Cap.

Capacity of Facilities of each Commune-1(Water Souece)

Supply Area		Population		Water Quantity		Water Source							
Province	Commune	Population in 2010	Population Supplied in 2010	Max. Daily Supply (m3/day)	Max. Daily Production (m3/day)	Pumping Quantity (l/min)	Pumping Quantity (m3/day)	No. of Test Well	No. of Additional Well	Depth of Test Well (m)	Total Depth of Additional Well (m)	Test Well: Optional Yield (m3/day)	Test Well: Permissible Water Level (m)
Thai Nguyen	Hoa Thuong	15,200	13,700	1,630	1,720	1,194	1,720	1	1	92	92	1,000	10
	Dong Bam	6,400	5,800	880	930	646	930	(1)	1	76	76	1,000	10
	Thinh Duc	7,400	6,700	700	740	514	740	1	4	100	400	150	20
	Nam Tien	7,500	6,800	1,010	1,060	736	1,060	1	10	22	220	100	
	Total	36,500	33,000	4,220	4,450	3,090	4,450	3	16	290	788		
Ha Noi	Dong Ngac	8,100	7,300	1,200	1,260	875	1,260	NO	1	80	80	(1,500)	15
	Xuan Dinh	18,200	16,400	2,710	2,850	1,979	2,850	NO	1	80	80	(3,000)	15
	Total	26,300	23,700	3,910	4,110	2,854	4,110	0	2	160	160		
Ninh Binh	Dong Phong	11,300	10,200	1,610	1,690	1,174	1,690	1	NO	130	NO	1,500	10
	Quang Son	8,700	7,800	1,230	1,290	896	1,290	1	5	120	600	250	30
	Yen Thang	9,800	8,800	1,380	1,450	1,007	1,450	(1)	3	120	360	120(665)	30(*15)
	Total	29,800	26,800	4,220	4,430	3,076	4,430	2	8	370	960		
Than Hoa	Vinh Thanh	6,300	6,500	1,010	1,060	736	1,060	1	NO	80	NO		
	Vinh Loc	7,200	5,700	1,030	1,080	750	1,080		NO		NO		
		13,500	12,200	2,040	2,140	1,486	2,140	1	1	80	0	1,500	20
	Dinh Tuong	7,700	6,900	1,080	1,140	792	1,140	1	NO	80	NO	1,700	15
	Thieu Hung	8,000	7,200	1,130	1,190	826	1,190	1	NO	91	NO	1,400	15
	Thieu Do	8,300	7,500	1,170	1,230	854	1,230	1	NO	52	NO	1,800	20
	Van Thang	7,900	7,100	1,110	1,170	813	1,170	1	3	68	204	300	30
	Total	45,400	40,900	6,530	6,870	4,771	6,870	5	4	150	204		
Total		138,000	124,400	18,880	19,860	13,792	19,860	10	30	970	2,112		
			l/c/day	152	159								

(): Can not use as water source

*New Location

Capacity of Facilities of each Commune-2

Supply Area		Water Quantuty	Aeration Tower	Contact & Sedimentation Basin	Filteration Basin (Excluding stand-by Basins)					Distribution Reservoir	
Province	Commune	Max. Daily Supply (m3/day)	Aeration Area 30m3/m2/h (m3/m2/h) 30.0 (m2)	Capacity of Basin 1hour (m3) 1.00	Necessary Filtration Area (m2)	Dimensions of Filtration Basin: Number of Basins	Dimension (m): B	Dimension (m): Min. L	Capacity of 1basin (m3/day)	Distribution Facility (Capacity): 8 hours /7hours (m3)	Elevated Tank
										8hours	
Thai Nguyen	Hoa Thuong	1,630	(NO)		23.3	2	3.0	3.9	815	543	NO
	Dong Bam	880	(NO)		12.6	2	2.0	3.1	440	293	NO
	Thinh Duc	700	NO			NO				233	NO
	Nam Tien	1,010	NO			NO				337	NO
	Total	4,220			35.9					1,407	
										7hours	
Ha Noi	Dong Ngac	1,200	1.7	50.0	17.1	3	2.0	2.9	400	350	* 50
	Xuan Dinh	2,710	3.8	112.9	38.7	3	3.0	4.3	903	903	* 129
	Total	3,910	Alternative	162.9	55.9					1,253	* 179
Ninh Binh	Dong Phong	1,610	NO			NO				537	77
	Quang Son	1,230	(NO)		17.6	2	2.5	3.5	615	410	59
	Yen Thang	1,380	(NO)		19.7	2	3.0	3.3	690	460	66
	Total	4,220			37.3					1,407	201
Than Hoa	Vinh Thanh Vinh Loc	1,010	(NO)		14.4	2	2.0	3.6	505	337	48
		1,030	(NO)		14.7	2	2.0	3.7	515	343	49
		2,040	(NO)		29.1	3	3.0	4.9	1,020	680	97
	Dinh Tuong	1,080	NO			NO				360	51
	Thieu Hung	1,130	(NO)		16.1	2	2.5	3.2	565	377	* 54
	Thieu Do	1,170	NO		16.7	NO				390	* 56
	Van Thang	1,110	(NO)		15.9	2	2.5	3.2	555	370	53
	Total	6,530			77.9					2,177	* 311
Total		18,880	5.4	162.9	206.9	m2				6,243	m3 402
										Total in 2010 *	691
					Treated water					*Alternative/2010	
					14,480	m3 70 m/day				Constructed in next expansion stage	

2.3.3 General Facility Plan in Each Commune

The capacity of each commune are shown in Table 2.3.1 and Table 2.3.2.

(1) Thai Nguyen

The lands for water treatment plant and distribution reservoirs are prepared on hills for all communes in this province.

1) Hoa Thuong and Dong Bam

The Treatment facilities are planned as follows.

- Receiving well
- Bacteria filtration basin: 3 basins
- Distribution Reservoir: 8 hours

2) Thinh Duc and Nam Tien

The concentration of iron is within drinking water quality standard. Small filtration basin will be employed according to the raw water quality.

- Receiving well
- Simplified filtration basin: 2 basins (no standby basins)
- Distribution Reservoir: 8 hours

(2) Ha Noi

1) Dong Ngac and Xuan Dinh

The concentration of iron is estimated at about 7 mg/ℓ. This level is rather high.

- Receiving well
- Bacteria filtration basin: 2 basins
- Distribution Reservoir: 7 hours

As alternatives of the above plan, two series of the aeration tower and two contact & sedimentation basins will be planned according to the raw water quality. Elevated tank should be considered in future expansion stage.

(3) Ninh Binh

1) Dong Phong

The concentration of iron is within drinking water quality standard. Small filtration

basin is employed according to the raw water quality.

- Receiving well
- Small filtration basin
- Distribution Reservoir: 7 hours
- Elevated tank: 1 hour

2) Quang Son and Yen Thang

In Quang Son, the iron concentration is 0.42 mg/ℓ.

- Receiving well
- Bacteria filtration basin: 2 basins
- Distribution Reservoir: 7 hours
- Elevated tank: 1 hours

(4) Than Hoa

1) Vinh Thanh and Vin Loc Town

These communes are planned to be supplied from one water supply system. There is a hill near the communes. This hill is advantageous for water supply base. If the land is available, distribution tank will be constructed on the hill.

- Receiving well
- Bacteria filtration basin: 3 basins
- Distribution Reservoir: 7 hours
- Elevated tank: 1 hour

2) Dinh Tuong and Thieu Do

The contamination level of Iron is within drinking water quality standard. Small filtration basin is employed.

- Receiving well
- Small filtration basin
- Distribution Reservoir: 7 hours
- Elevated tank: 1 hour

The elevated tank should be located outside Thiue Do Commune in future expansion stage because geo-technical condition of the commune is not suitable.

3) Thieu Hung and Van Thang

- Receiving well
- Bacteria filtration basin: 2 basins
- Distribution Reservoir: 7 hours
- Elevated tank: 1 hour

The elevated tank should be located outside Thieu Hung Commune in future expansion stage because geo-technical condition of the commune is not suitable.

2.4 Cost Estimation

Project cost consisting of construction cost, engineering service cost and physical contingency was estimated in year-1999 price level.

Total project cost estimated is:

VND 159,010 million: equivalent to US$ 11.41 million

As for financing, price contingency shall be added to the above cost for future price escalation. The total financing required is:

VND 191,000 million: equivalent to US$ 13.7 million

as shown in Table 2.4.1.

More detailed cost in each commune is shown in Annex 3.

2.5 Construction Plan

2.5.1 Implementation Schedule

The number of project site will be 4 provinces and 15 communes as a whole.

The construction work is scheduled to be executed during year of 2000~2004, as shown in Figure 2.5.1

One province should be applied one construction term because the project area extends over four provinces (Thai Nguyen, Hanoi, Ninth Binh, and Than Hoa). It is more advantageous for construction management to combine Ha Noi and Ninh Binh Province in one term.

Prior to the construction work, some administrative procedure and preparatory activities must be undertaken:

(1) Approval and decision of the project implementation of the Government of the Vietnam: by the end of 1999
(2) Detailed design: in 2000
(3) Land Acquisition or land use negotiation/approval: early 2000
(4) Bidding: early 2001
(5) Construction work: April 2001 to March 2002
(6) Complement of all work: March 2002

Table 2.4.1 Total Project Cost

Province	Commune	A	B	C	D		E		F		G		H		I	
		FACILITY (WATER SOURCE & TREATMENT PLANT) (MIL VD)	TRANSMISSION DISTRIBUTION PIPELINE & HOUSE CONNECTION (MIL VD)	LAND COST (MIL VD)	ENGINEERING DETAILED DESIGN (MIL VD)	ENGINEERING CONSTRUCTION SUPERVISION (MIL VD)	BASE COST (A+B+C+D) (MIL VD)	BASE COST (A+B+C+D) (MIL US$)	PHYSICAL CONTINGENCY (MIL VD)	PHYSICAL CONTINGENCY (MIL US$)	PROJECT COST (E+F) (MIL VD)	PROJECT COST (E+F) (MIL US$)	PRICE CONTINGENCY (MIL VD)	PRICE CONTINGENCY (MIL US$)	FINANCING REQUIRED (G+H) (MIL VD)	FINANCING REQUIRED (G+H) (MIL US$)
Thai Nguyen	Hoa Thuong	3,800	10,200	0	780	980	15,760	1.130	1,260	0.090	17,020	1.221	3,400	0.244	20,400	1.463
	Dong Bam	3,000	4,900	0	440	550	8,890	0.638	710	0.051	9,600	0.689	1,920	0.138	11,500	0.825
	Thinh Duc	3,000	6,400	0	520	660	10,580	0.759	850	0.061	11,400	0.818	2,280	0.164	13,700	0.983
	Nam Tien	2,900	6,100	0	500	630	10,130	0.727	810	0.058	10,940	0.785	2,190	0.157	13,100	0.940
	Sub total	12,700	27,600	0	2,240	2,820	45,360	3.250	3,630	0.260	48,990	3.514	9,800	0.703	58,800	4.21
Ha Noi	Dong Ngac	3,300	4,100	0	410	520	8,330	0.598	670	0.048	9,000	0.646	1,800	0.129	10,800	0.775
	Xuan Dinh	7,600	7,100	0	820	1,030	16,550	1.187	1,320	0.095	17,870	1.282	3,570	0.256	21,400	1.535
	Sub total	10,900	11,200	0	1,230	1,550	24,880	1.785	1,990	0.143	26,870	1.927	5,370	0.385	32,200	2.31
Ninh Binh	Dong Phong	3,200	6,000	0	510	640	10,350	0.742	830	0.060	11,180	0.802	2,240	0.161	13,400	0.961
	Quang Son	4,700	5,500	0	570	710	11,480	0.823	920	0.066	12,400	0.889	2,480	0.178	14,900	1.069
	Yen Thang	3,800	5,600	0	520	660	10,580	0.759	850	0.061	11,430	0.820	2,290	0.164	13,700	0.983
	Sub total	11,700	17,100	0	1,600	2,010	32,410	2.324	2,590	0.186	35,000	2.511	7,000	0.502	42,000	3.01
Than Hoa	Vin Loc Town															
	Vinh Thanh	4,200	5,900	0	560	710	11,370	0.816	910	0.065	12,280	0.881	2,460	0.176	14,700	1.054
	Dinh Tuong	2,700	4,600	0	410	510	8,220	0.590	660	0.047	8,880	0.637	1,780	0.128	10,700	0.768
	Thie Hung	2,800	3,900	0	370	470	7,540	0.541	600	0.043	8,140	0.584	1,630	0.117	9,800	0.703
	Thieu Do	2,200	3,900	0	340	430	6,870	0.493	550	0.039	7,420	0.532	1,480	0.106	8,900	0.638
	Van Thang	3,800	5,600	0	520	660	10,580	0.759	850	0.061	11,430	0.820	2,290	0.164	13,700	0.983
	Sub total	15,700	23,900	0	2,200	2,780	44,580	3.199	3,570	0.256	48,150	3.454	9,630	0.691	57,800	4.15
		51,000	79,800	0	7,270	9,160	147,230	10.558	11,780	0.845	159,010	11.406	31,800	2.281	191,000	13.7

Note: Cost 1999 year level
Exchange rate US$ 1.00=13,941VD(Vietnam Dong)

Figure 2.5.1 Proposed Construction Schedule

Item/Province/Commune		2000	2001	2002	2003	2004
Approval by the Government		End of 1999				
Dtailed Design						
Land Acquisition						
Bidding						
Preparation Work and Procurement						
Technical Guidance and Filter Ripening						
Main Work and Operation Guidance						
Thai Nguyen	Hoa Thuong					
	Dong Bam					
	Thinh Duc					
	Nam Tien					
Ha Noi	Dong Ngac					
	Xuan Dinh					
Ninh Binh	Dong Phong					
	Quang Son					
	Yen Thang					
Thanh Hoa	Vinh Loc Town, Vinh Thanh					
	Dinh Tuong					
	Thieu Hung					
	Thieu Do					
	Van Thang					

Source : JICA Study Team