(2) Water Supply Facility Design

The design criteria is mentioned below:

Drawing and Symbols:	To be based on Indonesian standards.
Mechanical and Electrical Facilities:	To be based on Japan Industrial Standard (JIS), Standards of the Japan Electrical Manufacturers' Association (JEM), Standard of Japan Electrotechnical Committee (JEC) and Standard of International Electrotechnical Committee (IEC)
Civil and Architectural Work:	To be based on the material and testing standards of Indonesia
Water Quality Standard:	To be based on the Indonesian Standards.
Labor Laws:	To be based on the Indonesian law.

1) System Design

There are six types of water supply systems; they are as follows:

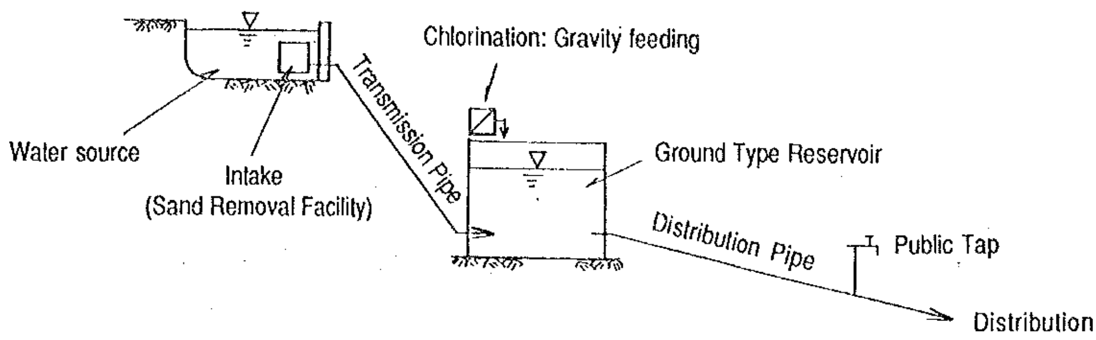
System A (Gravity Intake):	In a case where there is a sufficient hydraulic head for a water supply between a water source and a distribution area, the water is distributes through a ground type reservoir.
System B (Gravity Intake):	In a case where there is an insufficient hydraulic head for a water supply between a water source and a distribution area, the water distributes through an elevated reservoir

System C (Intake by pump):	In a case where a water source is lower than a reservoir, after intake by pumping, the water is distributed through a ground type reservoir.
System D (Intake by pump):	In a case where a water source is lower than a reservoir and a hydraulic head between a reservoir and a distribution area is insufficient for distribution, after intake by pumping, the water is distributed through an elevated reservoir.
System E (Well):	After intaking from a well, the water is distributed through a ground type reservoir.
System F (Well):	In a case where there is an insufficient hydraulic head for a water supply, after intake from a well, the water is distributed through an elevated reservoir.

Figure 4.1 Water Supply System

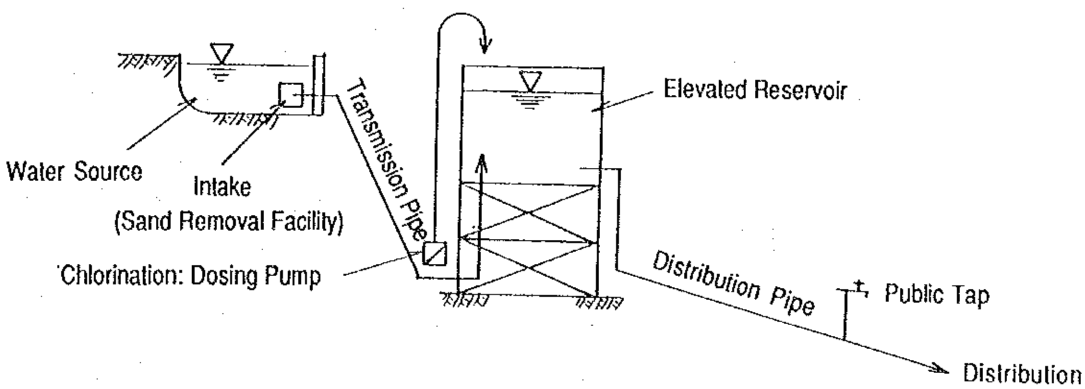
System A: Raw Water → (Sand Removal) → Reservoir Ground Type → (Chlorination Facilities) → Distribution

( ) means if necessary



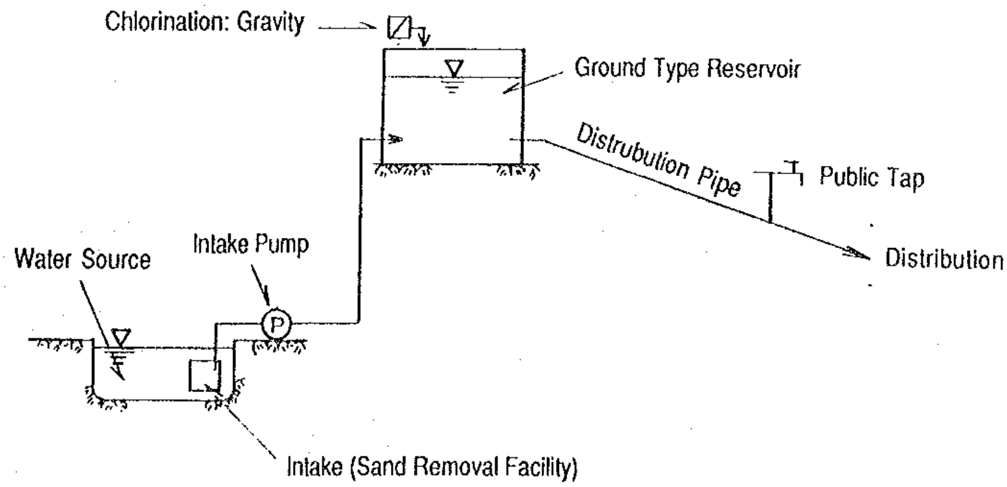
System B: Raw Water → (Sand Removal Facility) → Elevated Reservoir → (Chlorination Facility) → Distribution

( ) means if necessary



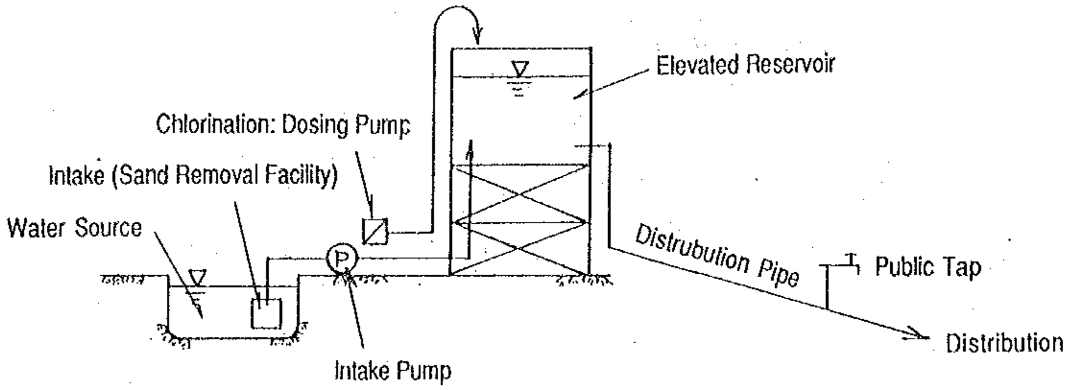
System C: Raw Water → (Sand Removal Facility) → Ground type Reservoir → (Chlorination Facility) → Distribution

( ) means if necessary



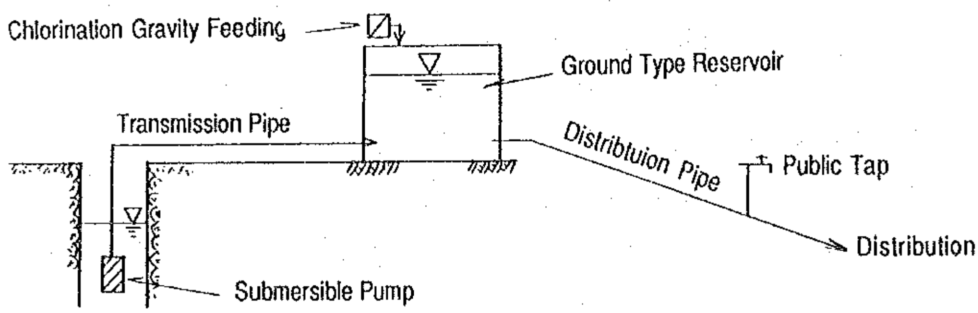
System D: Raw Water→(Sand Removal Facility)→Intake Pump→Elevated Reservoir→(Chlorination Facility)→Distribution

( ) means if necessary



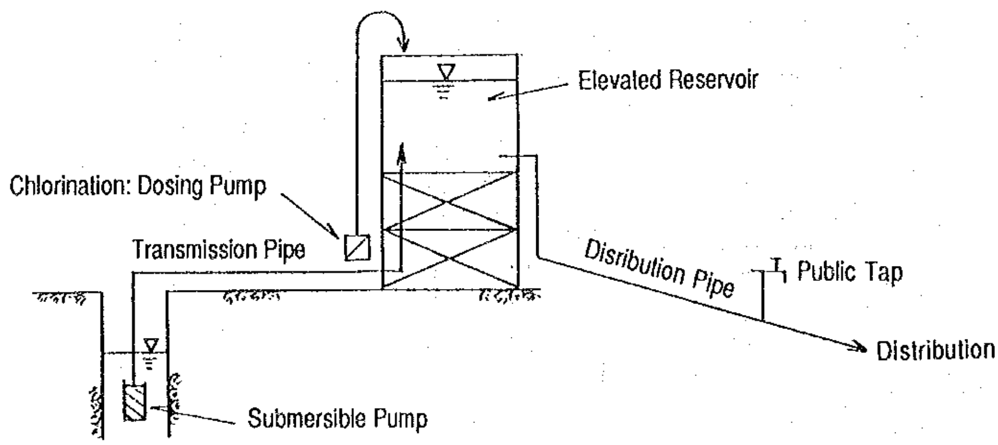
System E: Well → Submersible Pump → Ground Type Reservoir → (Chlorination Faciliyt) → Distribution

( ) means if necessary



System F: Well → Submersible Pump → Elevated Reservoir → (Chlorination Faciliyt) → Distribution

( ) means if necessary



a. Intake Facility

In principle, the water intake method is a gravity type. However when topographic conditions prevent, an electric intake pump must be installed. If there is no electric power supply at the pump site, a diesel generator must be installed.

Most Project areas' water sources are springs. If the turbidity of a mountain stream increases during rainy seasons or if free carbonate is present in large quantities, an increase of either a turbidity or hardness may occur as a result of the sedimentation of hydroxide Calcium and/or Carbonate Calcium. In such situations, a proper measure must be taken based on the Indonesian water quality standards.

b. Transmission Facility

To adjust the distribution quantity, a ground type or elevated type reservoir is to be installed according to the topographic conditions.

c. Water Treatment Facility

Colon bacillus was detected by water quality analysis at many Project sites. This contamination may be caused by inhabitants wastewater and by livestock. In such cases, treatment by chlorination is to be carried out.

d. Distribution Facility

Provided that the water service level is the public tap type, the hydraulic calculation is considered to be a 50% of the water quantity for house connection.

Table 4.14 Design Criteria Water Supply System

Project Area	Daily Maximum Water Demand (m³/day)	Hourly Maximum Water Demand (m³/hr)	*) System	Intake Facility				Trans-mission (m)	Disinfection	Distribution Facility				Remark.
				Intake Equipment	Sand Remoual Equipment	Intake pump	Electric Power Supply			Reservior		Distribution (m)	Pablic Tap	
1. South Sulawesi											(m³)			
1-1 ULUSALU	190	23.5	A	○	○	×	×	1.300	○	G	100	4.400	23	
1-2 SALU	152	19.4	A	○	×	×	×	800	○	G	100	5.100	19	
1-3 KAERO	195	19.4	A	○	×	×	×	1.900	○	G	100	6.600	24	
1-4 TIROMANDA	134	17.3	A	○	×	×	×	2.800	○	G	100	4.800	17	
1-5 MALILI	516	50.0	A	○	×	×	×	50	×	G	200	11.250	64	
1-6 MASAMBA	960	92.8	F	○	×	○	P L N	–	○	E	300	7.600	106	Well
2. Central Sulawesi														
2-1 TOAYA	251	25.5	A	○	×	×	×	700	○	G	100	5.800	30	
2-2 BINANGGA	534	46.9	A	○	×	×	×	1.400	○	G	200	10.400	66	
2-3 TAWAELI	857	92.8	A	○	×	×	×	600	○	G	300	11.000	106	
2-4 BONE BOBAKAL	98	12.2	C	○	×	○	G	2.700	×	G	50	3.500	12	
2-5 SAMBIUT	312	32.6	A	○	×	×	×	600	×	G	100	6.200	37	
2-6 BALANTAK	281	30.6	A	○	×	×	×	500	×	G	100	5.700	35	
2-7 SALAKAN	218	21.4	D	○	×	○	G	–	×	E	100	3.900	26	Well
2-8 LIANG	204	24.5	A	○	○	×	×	500	○	G	100	2.300	24	
3. Southeast Sulawesi														
3-1 LANDONO	343	37.7	E	○	×	○	G	–	×	E	150	6.800	42	Well
3-2 ANDUONOHU	396	39.8	D	○	○	○	P L N	1.300	○	E	150	6.900	49	
3-3 MOWEWE	440	39.8	D	○	○	○	G	2.000	○	E	150	4.800	54	
3-4 WAKADIA	364	35.7	D	○	×	○	G	2.100	○	E	150	5.600	45	
3-5 LAOMPO	315	33.7	C	○	○	○	G	1.400	○	G	100	5.600	38	
3-6 LAPUKO	264	27.5	B	○	×	×	×	1.400	○	E	100	3.500	32	
3-7 SANDANGPANGAN	253	31.6	C	○	×	○	G	900	○	G	100	3.200	31	
3-8 TAKIMPO	540	63.2	C	○	×	○	G	500	○	E	200	2.700	67	

○ : Required
× : Not required
G : Generator
P L N : Commercial Power Supply

G : Ground type
E : Elevated type

*) refer to Fig 5.1

2) Water Intake Facility

a. Design Intake Capacity

The planned water sources consist of springs and groundwater. Other than for chlorination, water treatment is not necessary. Thus, utility water for treatment is not required and transmission losses can be ignored. Therefore, the design daily maximum water demand is adopted as the design intake capacity.

Table 4.15 and Figs. 4.2 - 4.6 indicate design intake capacities.

Table 4.15 Design Intake Capacity

Project Area	Design Intake Capacity	
	(m^3/day)	(ℓ /s)
1. South Sulawesi		
1-1 ULUSALU	190	2.2
1-2 SALU	152	1.8
1-3 KAERO	195	2.3
1-4 TIROMANDA	134	1.6
1-5 MALILI	516	6.0
1-6 MASAMBA	960	11.1
2. Central Sulawesi		
2-1 TOAYA	251	2.9
2-2 BINANGGA	534	6.2
2-3 TAWAELI	857	9.9
2-4 BONE BOBAKAL	98	1.1
2-5 SAMBIUT	312	3.6
2-6 BALANTAK	281	3.3
2-7 SALAKAN	218	2.5
2-8 LIANG	204	2.4
3. Southeast Sulawesi		
3-1 LANDONO	343	4.0
3-2 ANDUONOHU	396	4.6
3-3 MOWEWE	440	5.1
3-4 WAKADIA	364	4.2
3-5 LAOMPO	315	3.6
3-6 LAPUKO	264	3.1
3-7 SANDANGPANGAN	253	2.9
3-8 TAKIMPO	540	6.3

b. Intake System

To stabilize intake, intake facilities are to be installed in water sources such as springs and mountain streams. In addition, a drain channel is to be installed surrounding the water source to prevent the inflow of soil, sand and wastewater into the raw water.

There are two intake types. One is the gravity type and the other is the pumping type. For either case, the design of intake facility is based on the water level, yield of spring, stream discharge and topographic conditions. Also the preservation of the environment and effects of flood water must be taken into consideration.

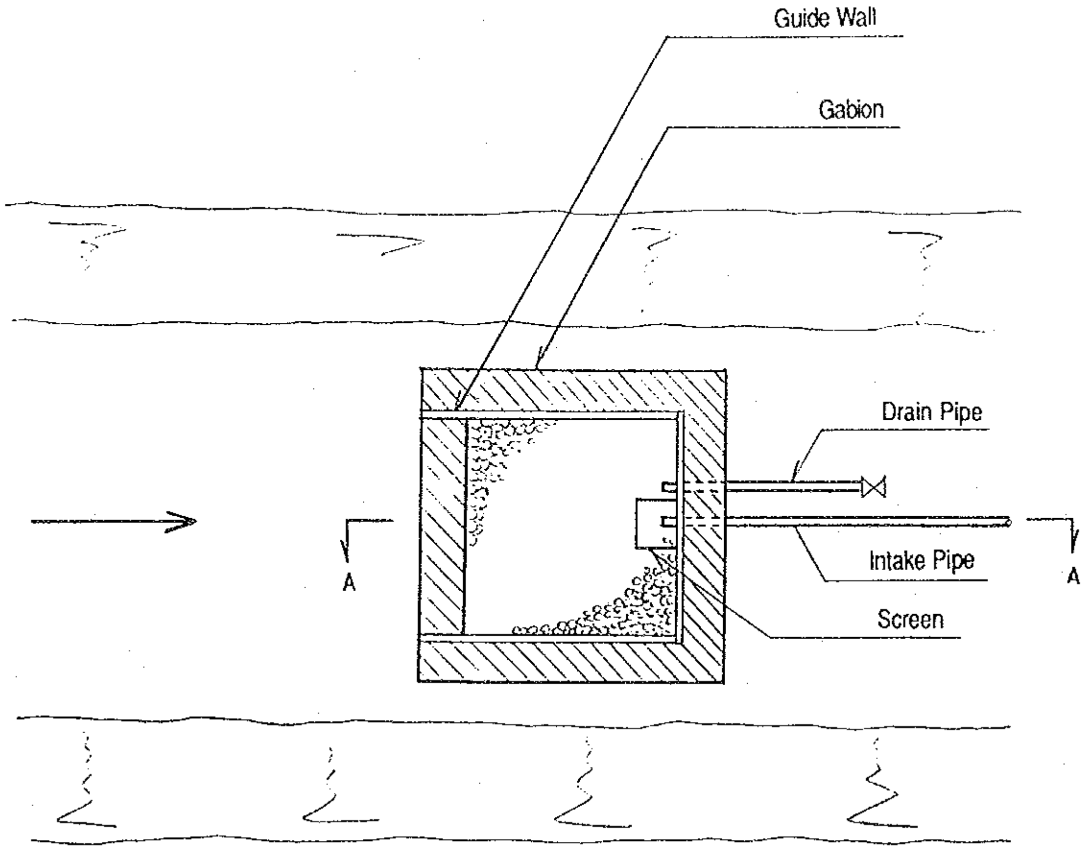
The intake facilities are listed in Table 4.16.

Table 4.16 (1) Type of Intake System

Type	Intake Type	Topography	Intake Facility	Note
Type A	Gravity	Spring in small valley	Gabion pit	Surrounding slope is brittle soil.
Type B	Gravity	Spring in narrow valley	Concrete Weir	Surrounding slope is rock. Necessary to secure the adequate water level for intake.
Type C	Gravity	Mountain stream	Gabion Weir	Necessary to secure the adequate water level for intake
Type D	Pumping	-	Concrete pit	If there is no need for sand removal, Type A is to be adopted, others are Type D.
Type E	Well	-	Screen casing	For protection against the inflow of sand and soil. A gravel pack is filled up outside the screen

Fig. 4.2 Type A: Gravity Intake

Surrounded by a brittle slope



A - A

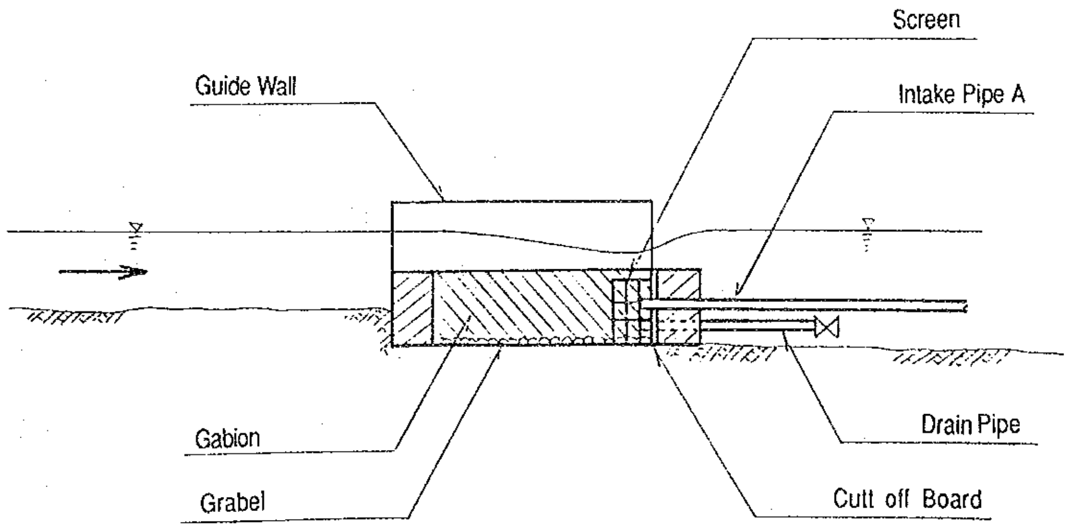
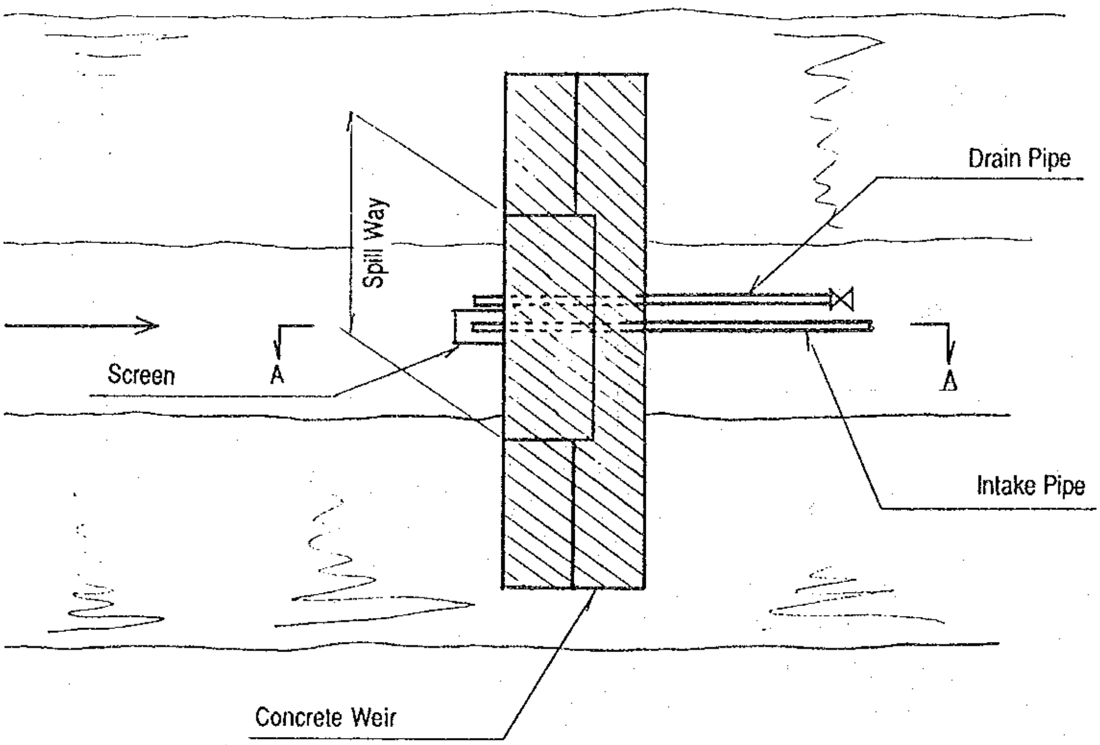


Fig. 4.3 Type B: Gravity Intake

Surrounded by a narrow rocky valley



A - A

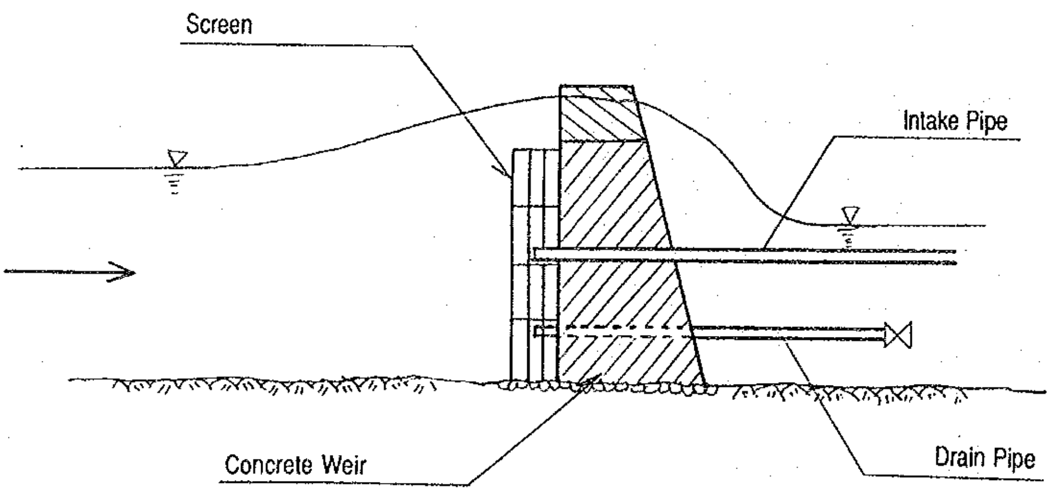
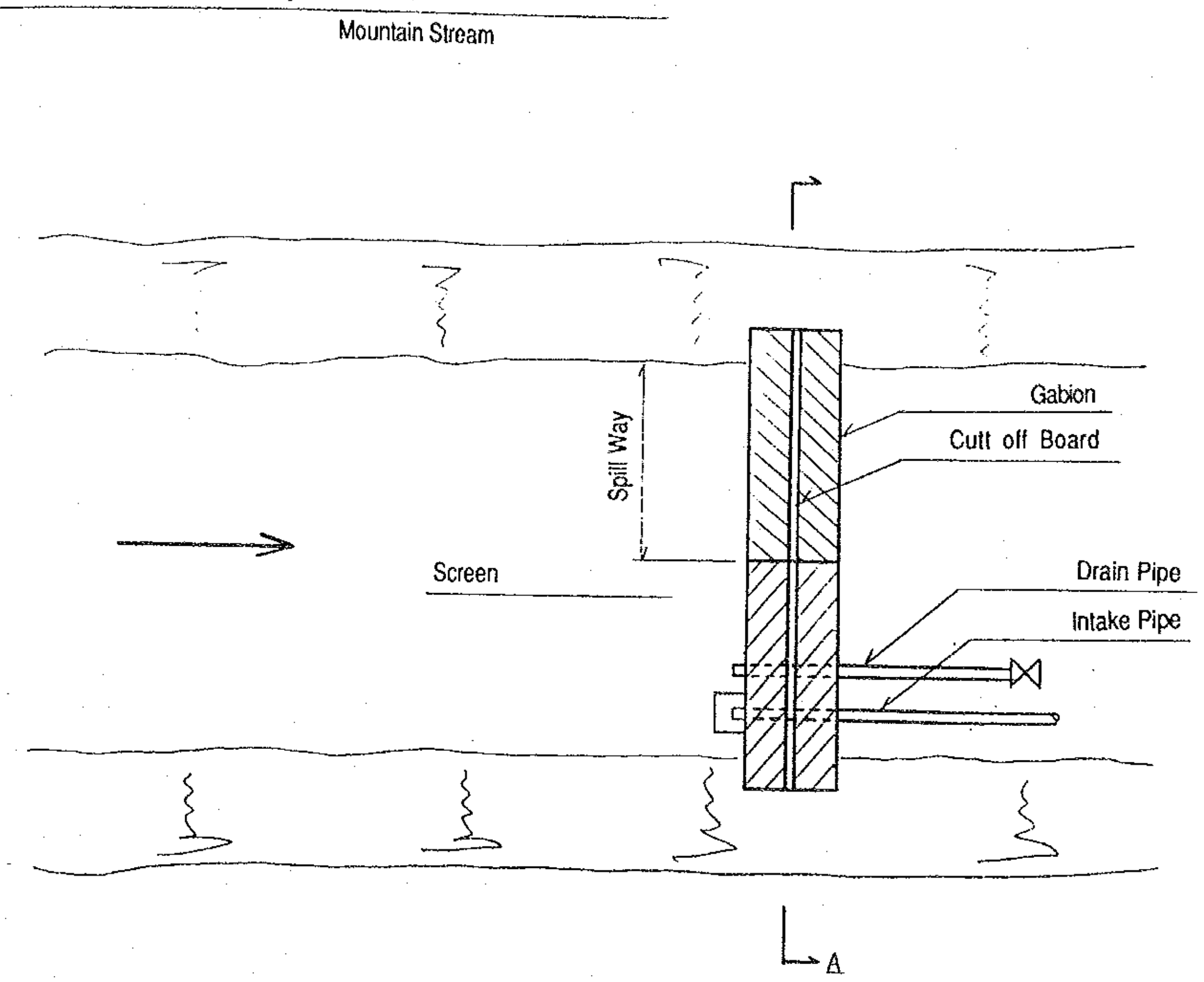


Fig. 4.4 Type C: Gravity Intake



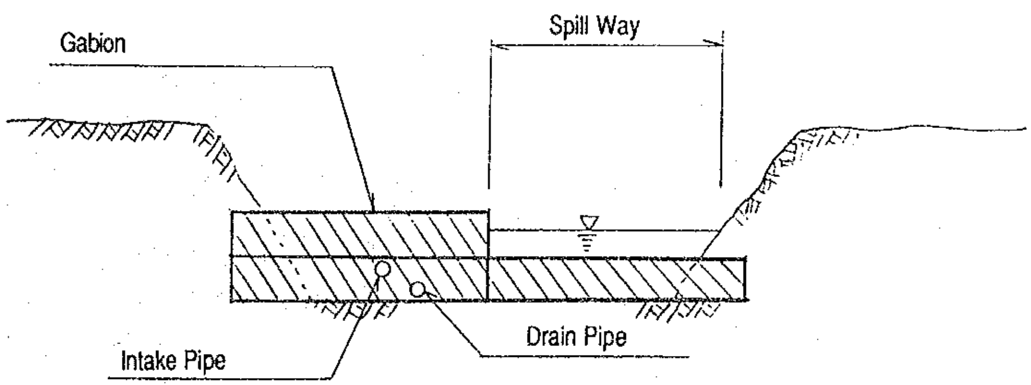
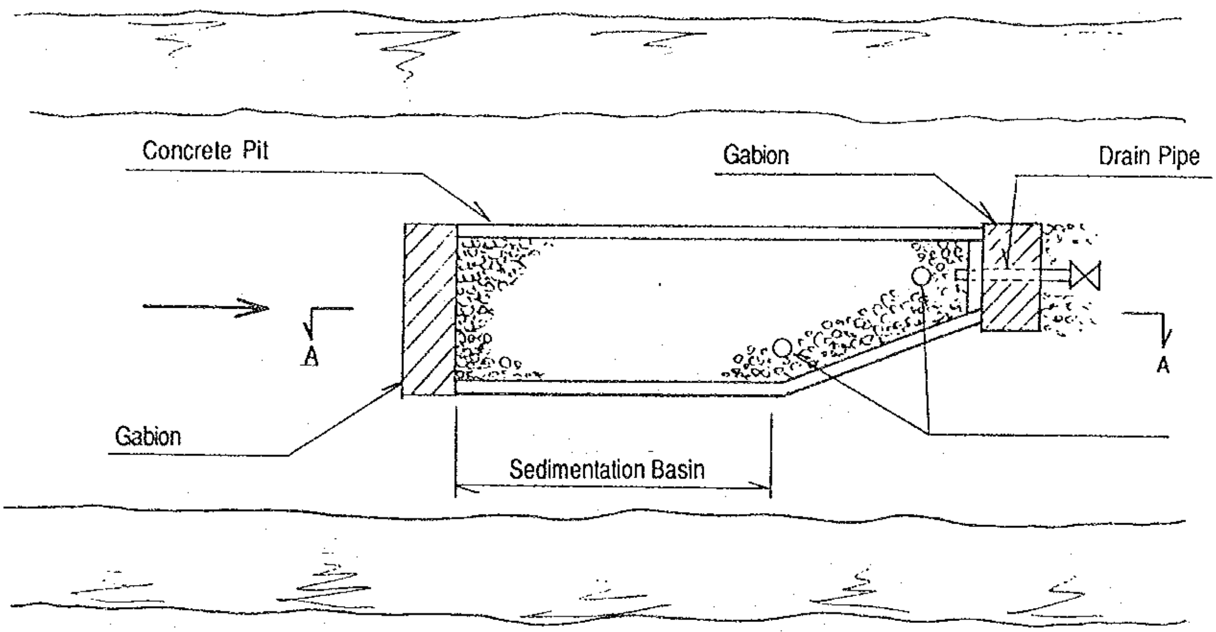


Fig. 4.5 Type D: Pumping Intake

(Combined with Sedimentation Basin)



A - A

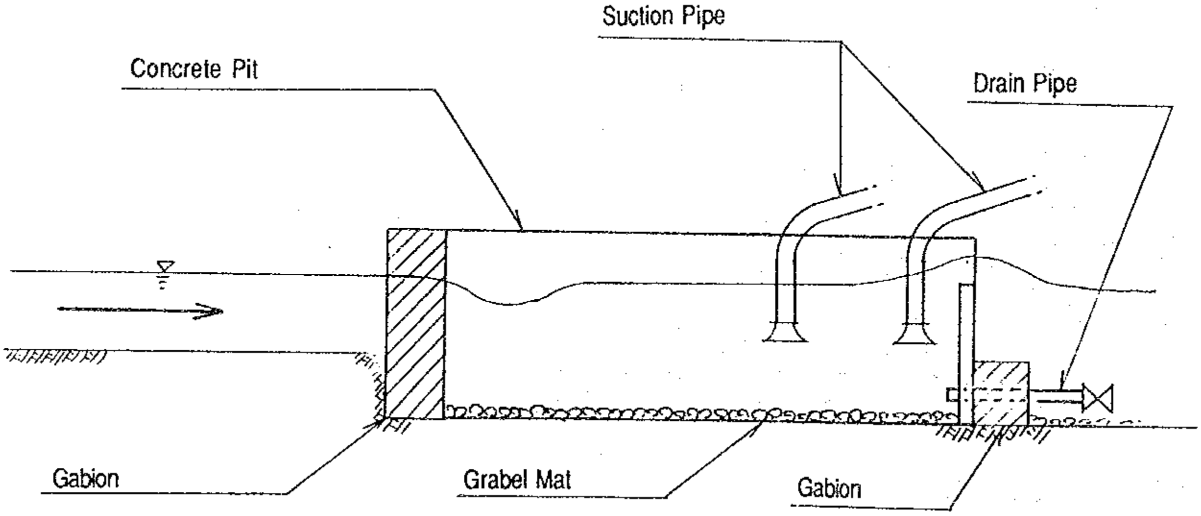


Fig. 4.6 Type E: Well

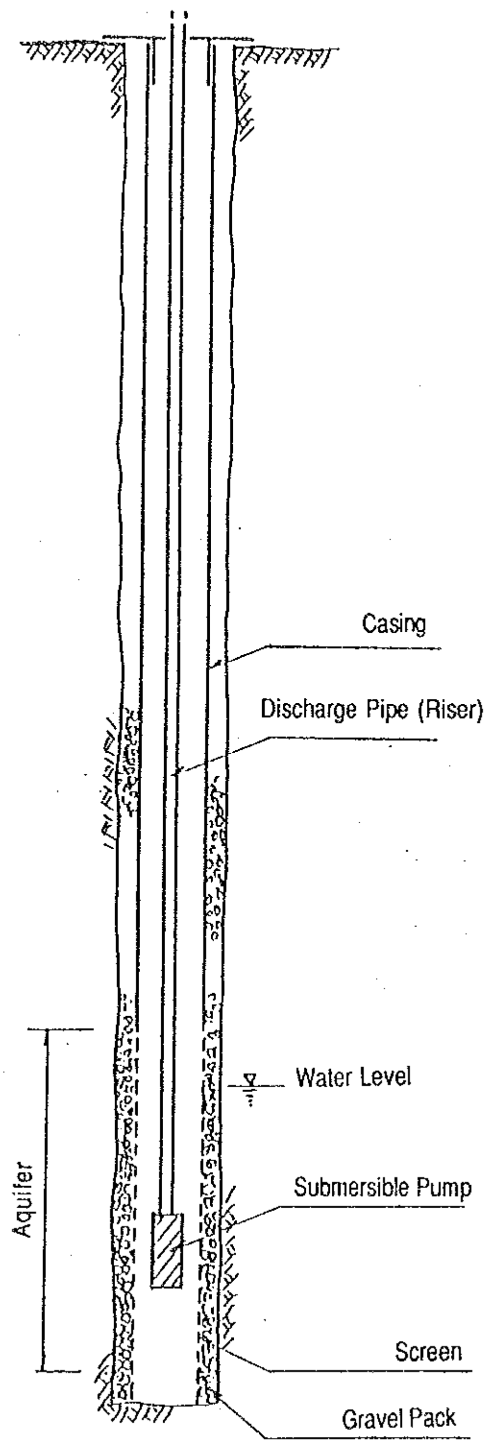


Table 4.16 (2) Intake System of Each Project Area

Project Area	Type	Intake Facility
1. South Sulawesi		
1-1 ULUSALU	C	Gabion Weir
1-2 SALU	B	Conecrete Weir
1-3 KAERO	A	Gabion Pit
1-4 TIROMANDA	B	Gabion Pit
1-5 MALILI	C	Gabion Weir
1-6 MASAMBA	E	Well
2. Central Sulawesi		
2-1 TOAYA	A	Gabion Pit
2-2 BINANGGA	A	Gabion Pit
2-3 TAWAELI	A	Gabion Pit
2-4 BONE BOBAKAL	A	Gabion Pit
2-5 SAMBIUT	A	Gabion Pit
2-6 BALANTAK	A	Gabion Pit
2-7 SALAKAN	E	Well
2-8 LIANG	A	Gabion Pit
3. Southeast Sulawesi		
3-1 LANDONO	E	Well
3-2 ANDUONOHU	D	Concrete Pit
3-3 MOWEWE	D	Concrete Pit
3-4 WAKADIA	A	Gabion Pit
3-5 LAOMPO	D	Concrete Pit
3-6 LAPUKO	C	Gabion Weir
3-7 SANDANGPANGAN	A	Gabion Pit
3-8 TAKIMPO	A	Gabion Pit

c. Intake Facility

The following aspects must be taken into consideration when deciding upon the intake facility:

i. Structure safety against buoyancy

ii. The design capacity must be the amount for 10 to 20 min. of the design intake

iii. The design intake velocity must be 2 to 7 cm/sec.

iv. The seasonal water level change.

d. Sand Removal Facility

A sand removal facility is to be installed, if turbidity given in the survey data exceeds 1 degree as of Kaoline.

For gravity intake, the sand removal facility is to be installed separate from the intake facility. For intake by pumping the intake facility is combined with the sand removal equipment.

Dimensions of the sand removal facility are determined as follow.

$$L = K \times (\frac{H}{U} \times V)$$

L : length of sand removal basin (m)
H : effective water depth (m)
U : sedimentation velocity of sand (cm/sec.)*
V : average stream velocity 2 cm/sec.
K : safety factor 1.5

* Design sedimentation velocity is determined by the grain size of sand. Assuming that grain size of sand is 0.10 mm, the design sedimentation Velocity is 0.8 cm/sec. by Ellms' table (see below).

Sedimentation Velocity and Grain Size by Ellms
(water purification 1982)

Grain size (mm)	Sedimentation Velocity (Secific gravity of Sand : 2.65, 10°C) unit = cm/sec.
0.30	3.2
0.20	2.1
0.15	1.5
0.10	0.8
0.08	0.6

Width of sand removal facility is 1/3 to 1/8 of its length. Sedimented matter is drained by gravity using a gate valve. Sedimentation capacity is 1% of the capacity of the intake facility.

Table 4.17 Specifications of the Sand Removal Facilities

No.	Project Area	Type of Intake	Daily Maximum Water Demand (m^3/day)	Capacity (m^3)	Average Flow Velocity (cm/sec.)
1-1	ULSALU	Gravity	190	1.5	0.2
2-8	LIANG	Gravity	204	1.5	0.3
3-2	ANDUONOHU	Pumping	394	2.7	0.5
3-3	HOWEWE	Pumping	440	3.0	0.4

e. Intake Facility of Well

A submersible pump is used for water intake. A gravel pack is combined with the sand removal facility.

i. Aquifers

Table 4.18 indicates the characteristics of the aquifers in Masamba Landono and Salakan (all having groundwater as their water sources) based on the results of the Basic Design Study.

Table 4.18 Characteristics of Aquifers

Project Area	Masamba	Landono	Salakan
Aquifer	Gravel bed	Gravel bed	Chalk
Thickness of Aquifer	115m	70m	over 100m
Transmissibility	200 m2/day	100	1,000
Static Water Level	GL-5m	GL-6m	GL-16.5m

ii. Drawdown (Sp)

① fully penetrating well (Masamba Landono)

$$Q = \pi \left(\frac{b_1 + b_2}{b_1}\right) T \cdot Sn \ / \ \ln \left(\frac{R}{\gamma w}\right)$$

Q : pumping rate (see Table 5.21)

Masamba $576m^3$/day/well x 2 wells
Landono $412m^3$/day/well x 1 well

R : radius of influence = 100m (assumed)

γw : radius of well = 0.100m

b_1 : thickness of saturated layer (before pumping)
Masamba 75m, Landono 44m

b_2 : thickness of saturated layer (during pumping)
Masamba 71m, Landono 34m

T : transmissibility (m^2/day) (see Table 5.18)

Sn : drawdown (no lining) (m)

π : pai (3.14)

Masamba Sn = 4.3m
Landono Sn = 11.6m

Sp = Sn/Ew

Sp : design drawdown (m)

Sn : drawdown of unlined well (m)

Ew : well efficiency (assumed 60%)

Masamba Sp = 7.2m
Landono Sp = 19.3m

② Partially Penetrating Well (Salakan)

$$Q = \{\pi \cdot k \cdot [(ho-t)^2-h^2] / \ln(\frac{R}{\gamma w})\} \times [1 + (0.3+\frac{10 \cdot \gamma w}{h o}) \times \sin(\frac{1.8t}{h o})]$$

Q : pumping rate : Salakan 262m³/day/well(Table 5.21)

R : radius of influence = 100m (assumed)

γw : radius of well = 0.100m

k : permeability (m/day) T/ho = 10m/day

h o : thickness between upper end of impermeable layer and water table (before pumping) = 100m

t : thickness between upper end of impermeable layer and bottom of well = 76.5m

π : pai (3.14)

Sn : Drawdown unlined well (m)

Sn = ho - h - t

Salakan Sn = 1.2m

Sp = Sn/Ew

Sp : design drawdown (m)

Ew : well efficiency (assumed 60%)

Salakan Sp = 2.0m

Table 4.19 Design Drawdown and Dynamic Water Level

Project Area	Masamba	Landono	Salakan
Static Water Level	GL-5m	GL-6m	GL-16.5m
Design Drawdown	7.2	19.3	2.0
Design Water Level	GL-12.2m	GL-25.3m	GL-18.5m

iii. Casing

Groundwater as raw water is brackish water. Therefore Fiber Rainforced Plastic (FRP) pipe is adopted for pump discharge pipe (riser). The diameter of casing is decided upon as 200mm, by taking into consideration the diameter of the pump outlet (standard 80mm) and the discharge allowance.

iv. Screen Length and Aperture Ratio

Aperture ratio of the screen is over 15%. The screen length is calculated as follows:

$$ls = \frac{Q}{q} \times \alpha \quad : \quad q = A \times N \times V$$

Q : pumping rate (m^3)
q : intake capacity per meter (m^3/m)
A : surface are of screen $0.628m^2$ (as 200mmϕ)
N : aperture ratio 15%
V : flow velocity 1.5 cm/sec. (assumed)
α : safety factor for decrease of flow velocity = 300%

v. Design Criteria of Well

Table 4.20 Design Criteria of Well

Project Area	Masamba	Landono	Salakan
Design Pumping Rate	0.800 m^3/min.	0.286 m^3/min.	0.182 m^3/min.
Number of Wells	2 wells interval length of wells = 300m	1 well	1 well
Drilling Depth	80m	50m	40m
Casing Length	60m	34m	28m
Screen Length	20m	16m	12m
Drilling Diameter	Diameter 356mm	Diameter 356mm	Diameter 356mm

f. Intake Pump

To prevent over loading and damage to the pump, the design capacity of pump is calculated as follows:

$Qp = Q\ max. \times \alpha$

Qp : design pump capacity
Q max. : Daily maximum water demand
α : safety factor = 24/20

Net head of the pump is a height from the water sources lowest water level to the outlet of the discharge pipe.

Table 4.21 shows the design capacity of a pump and the net head.

Table 4.21 Criteria of Intake Pump

Project Area	Design Pump Capacity (m3/day)	Discharge Head	Water Source
1. South Sulawesi			
1-6 Masamba	800	30.2	Ground Water
2. Central Sulawesi			
2-4 Bonebobakal	82	34.4	Spring
2-7 Salakan	182	21.5	Groundwater
3. Southeast Sulawesi			
3-1 Landono	286	38.3	Groundwater
3-2 Anduonohu	331	40.3	Spring
3-3 Mowewe	367	25.8	Spring
3-4 Wakadia	303	66.3	Spring
3-5 Laompo	263	24.4	Spring
3-7 Sandangpangan	211	277.6	Spring
3-8 Takimpo	450	28.8	Spring

3) Chlorination Equipment

Chlorination equipment is to be installed in areas. Drop type feeding equipment is to be installed at the top of ground type reservoirs. In case of for and elevated reservoir, a feeding pump is to be installed beneath the reservoir ---this is, in condition of the casiness of supplementing the chloride solution to reserve tank and for the convenience of maintenance.

Feeding rate is calculated as follows:

$$P = \frac{Q}{24} \times R \times \frac{1}{Sc \times Sd \times rd} \times 10^{-3}$$

P : feeding rate of 5% solution (*l*/hr)

W : daily maximum water demand (m^3/day)

R : dosing rate of hypochlorite : $NH4 > 0.1mg/l$ then 5mg/*l*
: $NH4 \leq 0.1mg/l$ then 3mg/*l*

Sc : effective density of hypochlorite 60%

Sd : density of solution 5%

γd : specific gravity of solution 1.05%/*l*

In addition, a tank for preparing the hypochlorite solution must be made available.

A 3-month reserve supply of hypochlorite is to be stored in a suitable place such as the pump house and amount of reserve is calculated as follows:

$$Cc = Q \cdot R \times \frac{1}{Sc} \times 90 \times 10^{-3}$$

Cc : amount of reserve (kg)

Table 4.22 shows the design standards for chlorination equipment.

Project Area	Type	Dosing Rate (mg/ℓ)	Capacity of Solution tanK (ℓ)	Dissolving tank (100ℓ)	Storage Chemical (kg/3months)
1. South Sulawesi					
1-1 ULUSALU	Grevity	3	54	1	85
1-2 SALU	Grevity	3	43	1	68
1-3 KAERO	Grevity	3	56	1	87
1-4 TIROMANDA	Grevity	3	38	1	60
1-5 MALILI	–	–	–	–	–
1-6 MASAMBA	dosing pump	3	274	1	432
2. Central Sulawesi					
2-1 TOAYA	Grevity	5	72	1	113
2-2 BINANGGA	Grevity	3	153	1	240
2-3 TAWAELI	Grevity	5	245	1	386
2-4 BONE BOBAKAL	–	–	–	–	–
2-5 SAMBIUT	–	–	–	–	–
2-6 BALANTAK	–	–	–	–	–
2-7 SALANTAK	–	–	–	–	–
2-8 LIANG	Grevity	3	58	1	92
3. Southeast Sulawesi					
3-1 LANDONO	–	–	–	–	–
3-2 ANDUONOHU	Feading Pump	3	113	1	178
3-3 MOWEWE	Feading Pump	3	125	1	198
3-4 WAKADIA	Feading Pump	5	104	1	164
3-5 LAOMPO	Feading Pump	3	90	1	141
3-6 LAPUKO	Grevity	3	75	1	118
3-7 SANDANGPANGAN	Feading Pump	3	72	1	113
3-8 TAKIMPO	Feading Pump	5	154	1	243

4) Distribution Reservoirs

Reservoirs are used to store water, to equalize flows, to distribute or equalize pressers, and to impound water. Such reservoirs are used to adjust a variable rate of demand to a rate of supply that is not equal to the rate of demand.

The distribution system's reservoir may be classified, according to their position, as surface or elevated.

a. Capacity

The design criteria of the tank capacity is shown in Table 4.23.

Table 4.23 Design Criteria for Tank Capacity

Design Served Population	Tank Capacity
more than 5,000	period of 8 hours of DMWS *
more than 3,000, less than 5,000	period of 9 hours of DMWS *
more than 2,000, less than 3,000	period of 10 hours of DMWS *
more than 1,000, less than 2,000	period of 12 hours of DMWS *
more than 5,000, less than 1,000	period of 14 hours of DMWS *
more than 3,000, less than 500	period of 16 hours of DMWS *
more than 1,000, less than 300	period of 18 hours of DMWS *
less than 100	period of 20 hours of DMWS *

Notes*: DMWS: Daily Maximum Water Supply

The tank capacity of each area is shown in Table 4.24.

Table 4.24 Design Capacity of Reservoir Tank

Name of IKK	Type	Design Capacity
1. South Sulawesi		
1-1 ULUSALU	Surface	100m³
1-2 SALU	Surface	100m³
1-3 KAERO	Surface	100m³
1-4 TIROMANDA	Surface	100m³
1-5 MALILI	Surface	200m³
1-6 MASAMBA	elevated	300m³
2. Central Sulawesi		
2-1 TOAYA	Surface	100m³
2-2 BINANGGA	Surface	200m³
2-3 TAWAELI	Surface	300m³
2-4 BONE BOBAKAL	Surface	50m³
2-5 SAMBIUT	Surface	100m³
2-6 BALANTAK	Surface	100m³
2-7 SALAKAK	elevated	100m³
2-8 LIANG	Surface	100m³
3. Southeast Sulawesi		
3-1 LANDONO	Surface	150m³
3-2 ANDUONOHU	Surface	150m³
3-3 MOWEWE	Surface	150m³
3-4 WAKADIA	Surface	150m³
3-5 LAOMPO	elevated	100m³
3-6 LAPUKO	Surface	100m³
3-7 SANDANGPANGAN	elevated	100m³
3-8 TAKIMPO	elevated	200m³

b. Materials to be used for Reservoir Tank

Materials to be used are FRP or R.C. (Refer to Section 3, Chapter 4, "Design of the materials")

5) Pipeline Systems

a. Design Criteria

The design criteria for the water conveyance and distribution pipes are shown in Table 4.25.

The selection of pipe materials, fittings and pressure regulating systems are shown in Section 3, Chapter 4, "Equipment Design".

Table 4.25 Design Criteria for Pipeline Systems

Descriptions	Conveyance Pipes	Distribution Pipes
Water Capacity	Daily Max. Water Demand	Hourly Max. Water Demand
Pipe Diameter	To be calculated from Hazen-Williams formula	
Pipe Materials	Pipes on surface : Steal pipe Pipes underground : PVC	
Pipe Fittings	Steal pipe : Screw joint PVC [more than 63mm diameter): RR connection system [less than 63mm diameter) : TS connection system	
Pressure Reducing system	To be used for regulating tank pressure which is maintained at less than 4 kg/cm^2. Tank capacity has a period of 3 minutes water supply (Detailed is shown Table 4.26)	
Water Taps	One tap serves 100 people and type the tap diameter for a single to five taps is 13mm. (Detailed is shown Table 4.27 and Fig. 4.7 to 4.9)	
Tap Diameter	The discharge capacity of 13mm diameter tap is 17 l/min. According to Hazen & Williams formula, the pipe diameter of single and double type taps are calculated as being 32mm. In the case of a 5-tap type, it should be calculated by hourly maxmum water supply capacity.	
Other Necessaries Equipment	Air relief valves, flashing values, etc. are needed	

Hazen and Williams Formula

$V = 0.84935\ C \cdot R^{0.63} \cdot I^{0.54}$ (m/sec.)

where V = velocity of flow (m/sec.)

R = hydraulic radius (m)*

C = coefficient depending on the roughness and age of the pipe (140)

I = slope of the hydraulic grade line

* hydraulic radius is d/4 under round pipe and the formula can be conducted also as

$V = 0.35464\ C \cdot R^{0.63} \cdot I^{0.54}$ (m/sec.) .... (1.4)

where $Q(m^3/sec.)$ = flow rate and $v = 4Q\pi/d^2$

then value of Q, d, I are given from (1.4) as

$Q = 0.27853\ C \cdot R^{2.63} \cdot I^{0.54}$ .... (1.5)

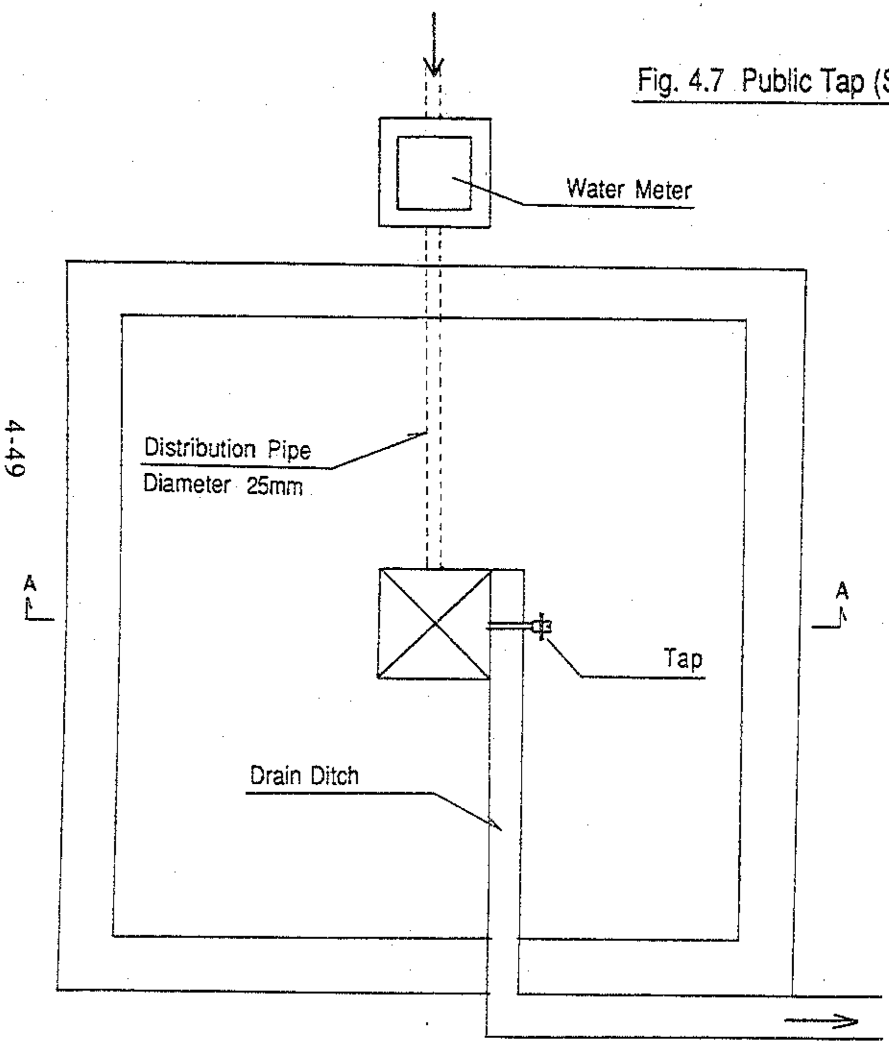
$d = 1.6257\ C \cdot R^{-0..38} \cdot I^{-0.205}$ ....(1.6)

$I = h/l = 10.666\ C \cdot R^{-0.85} \cdot d^{-4.87} \cdot Q^{-1.85}$ .... (1.7)

Table 4.26 No. of Water Pressure Regulating Tanks

Applications (Project Area)	No. of Tanks
Ulsalu	1
Tiromanda	5
Binanga	1

Fig. 4.7 Public Tap (Single Tap)



A - A

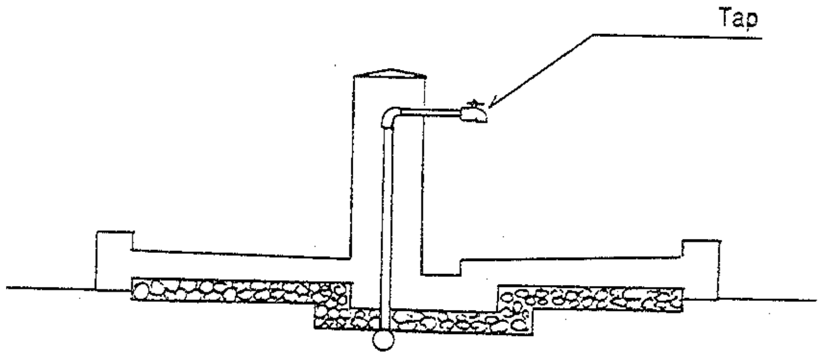
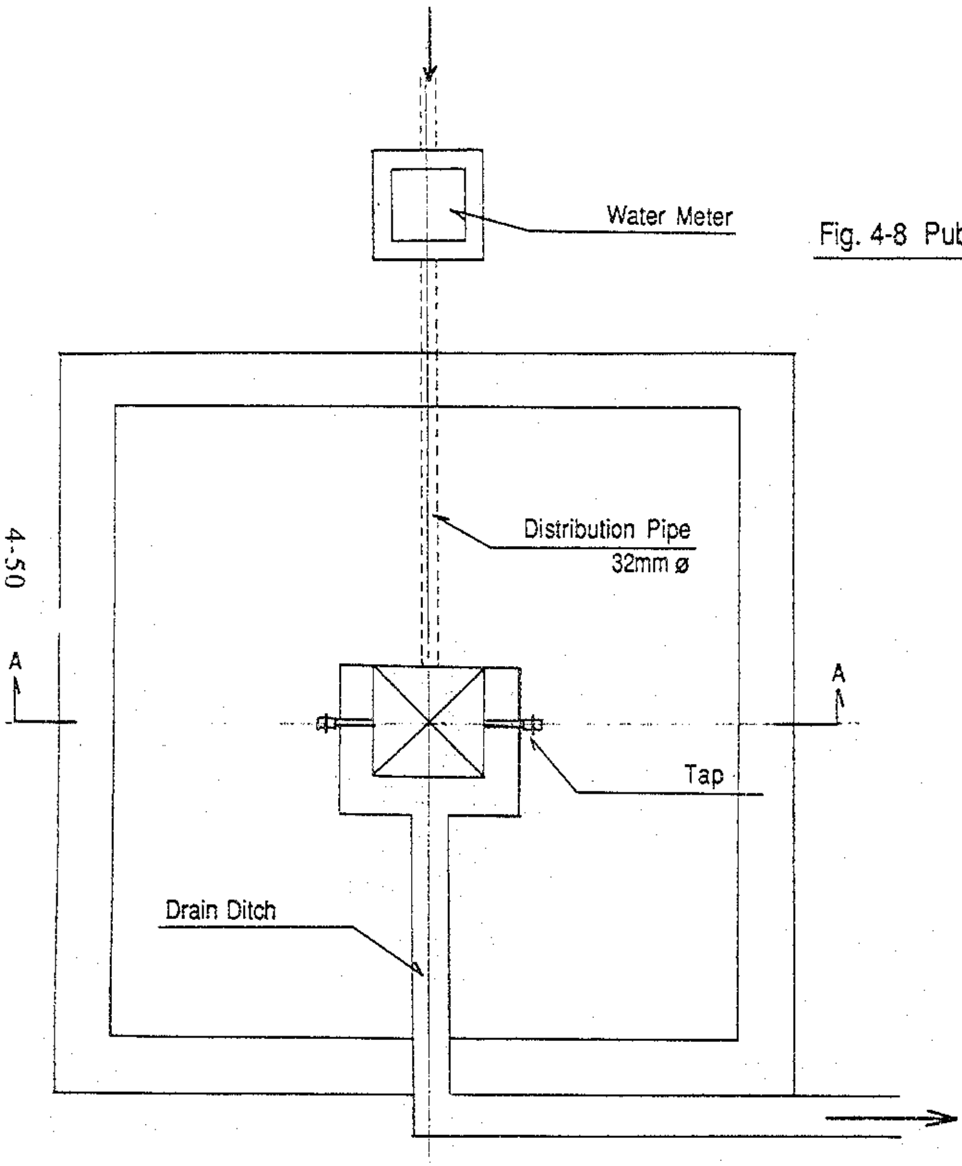
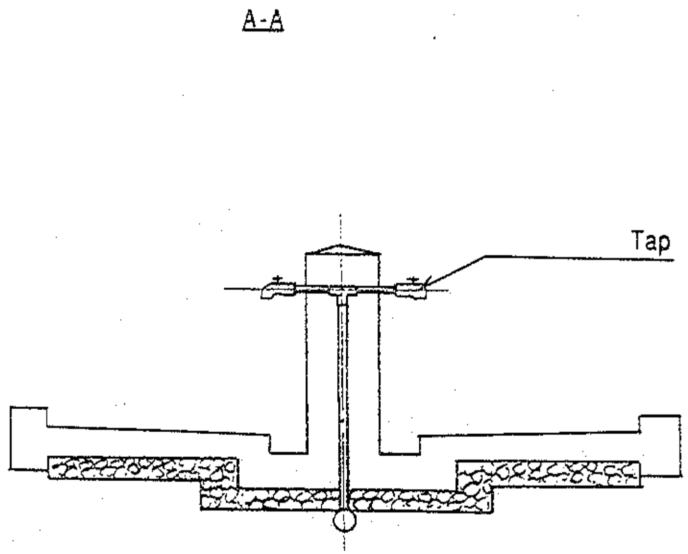


Fig. 4-8 Public Tap (Double Tap)





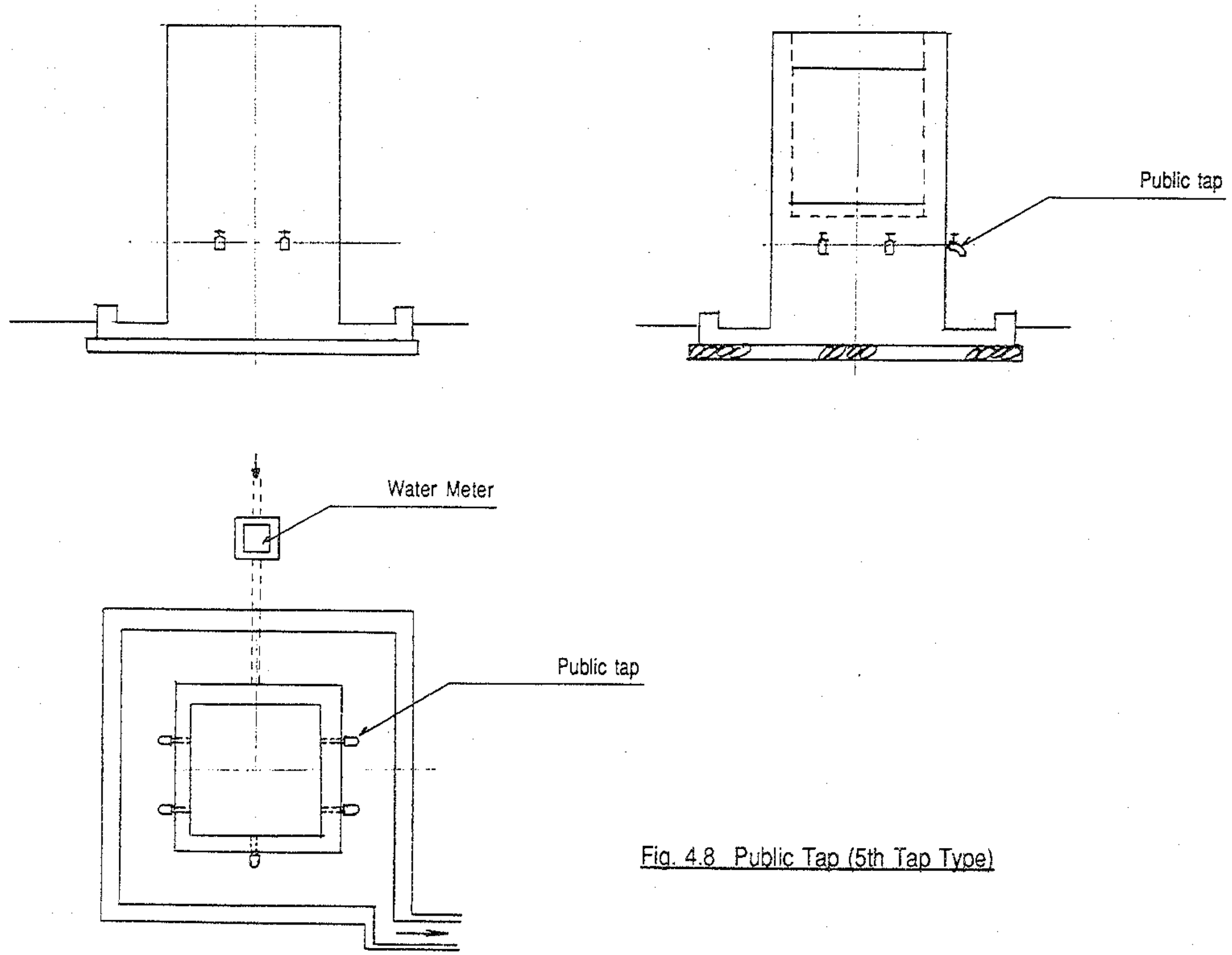


Fig. 4.8 Public Tap (5th Tap Type)

Table 4.27 No. of Public Taps

Project	No.of Taps	Installation of tap		
		Single	Double	5 System
1. South Sulawesi				
1-1 ULUSALU	23	9	7	
1-2 SALU	19	7	6	
1-3 KAERO	24	7	6	1
1-4 TIROMANDA	17	7	5	
1-5 MALILI	64	17	16	3
1-6 MASAMBA	106	31	30	3
Sub total	253	78	70	7
2. Central Sulawesi				
2-1 TOAYA	30	9	8	1
2-2 BINANGGA	66	16	15	4
2-3 TAWAELI	106	31	30	3
2-4 BONE BOBAKAL	12	4	4	
2-5 SAMBIUT	37	12	10	1
2-6 BALANTAK	35	10	10	1
2-7 SALAKAN	26	7	7	1
2-8 LIANG	24	8	8	
Sub total	336	101	95	11
3. Southeast Sulawesi				
3-1 LANDONO	42	13	12	1
3-2 ANDUONOHU	49	13	13	2
3-3 MOWEWE	54	13	13	3
3-4 WAKADIA	45	13	11	2
3-5 LAOMPO	38	11	11	1
3-6 LAPUKO		9	9	1
3-7 SANDANGPANGAN	31		10	
3-8 TAKIMPO	67	22	20	1
Sub total	947	105	99	11
Total	947	284	264	29

b. Pipe Lengths and Diameters

Pipe lengths and diameters are shown in Table 4.28. Their detailed computations including hydraulic condition are as per attached Appendix 6-7.

Table 4.28 Total Pipe Length

Project Area		Total (m)
A.	SOUTH SULAWESI	
	1. ULSALU	5,700
	2. SALU	5,900
	3. KAERO	8,500
	4. TIROMANDA	7,600
	5. MALILI	11,300
	6. MASAMBA	7,600
B.	CENTRAL SULAWESI	
	1. TOAYA	6,500
	2. BLNNAUGA	11,800
	3. TAWAELI	11,600
	4. BONEBOBAKAL	6,200
	5. SUMBIUT	6,800
	6. BALANTAK	6,200
	7. SALAKAN	3,900
	8. LIANG	2,800
C.	SOUTH EAST SULAWESI	
	1. LANDONO	6,800
	2. ANDUONOHU	8,200
	3. MOWEWE	6,800
	4. WAKADIA	7,700
	5. LAOMPO	7,000
	6. LAPUKO	4,900
	7. SANDANGPANGAN	4,100
	8. TAKIMPO	3,200
	TOTAL	151,100

6) Mechanical and Electrical Equipment

a. Intake Pump

Centrifugal pumps are to be used.
The design calculation for each pump system was made by using the following formula (specifications are shown in Table 4.29):

① Diameter

$D = 146 \times \sqrt{Q/V}$

where

- D = Diameter of pump (mm)
- Q = Pump discharge capacity (m^3/min), to be based on Table 4.18
- V = Velocity of flow in the discharge and suction pipes (m/sec)

② Total Head

$H = ha + \Sigma hf + ho$

where,

- H = Total pump head
- h a = Actual head (m), to be based on Table 4.18
- Σh f = Total head loss (m)
- h o = Velocity head of flow at the end of the discharge piping (m)

③ Motor Horsepower

$P = 0.163rQH/e \times (1 + a)$

where,

- P = Horsepower (kW)
- Q = Discharge capacity (m^3/min), to be based on Table 4.18
- H = Total head (m), to be based on Table 4.18
- e = Pump efficiency (65%)
- a = Safety factor (15%)

⑥ Stand-by Equipment

Stand-by intake pumps are to be insalled. A one-year supply of spare parts for the pumps should be provided.

Table 4.29 (1) Specification for Intake Pump (for Spring)

Project Area	Suction Pipe Dia (mm)	Discharge Pipe Dia (mm)	Discharge (m^3/min)	Total Head (m)	Motor Output (Kw)	No. of Sets ( )Stand by
Central Sulawesi Bonebobakai	φ 50 mm	φ 50 mm	0.082	105	5.5	1 + (1)
Southeast Sulawesi Anduonohu	φ 80 mm	φ 80 mm	0.331	44	7.5	1 + (1)
Mowewe	φ 80 mm	φ 80 mm	0.367	79	15	1 + (1)
Wakadia	φ 80 mm	φ 80 mm	0.303	129	15	1 + (1)
Laompo	φ150 mm	φ100 mm	0.263	58	5.5	1 + (1)
Sandangpangan	φ100 mm	φ100 mm	0.211	292	30	1 + (1)
Takimpo	φ150 mm	φ150 mm	0.450	39	7.5	1 + (1)

Table 4.29 (2) Specification for Submersible Pumps (Wells)

Project Area	Suction Pipe Dia (m)	Discharg Pipe (m^3/min)	Total Head (m)	Motor Output (Kw)	No.of Sets ( )Stand by
South Sulawesi MASAMBA	ϕ 80 mm	0.400	43.2	3.7	2+ (1)
Central Sulawesi SALAKAN	ϕ 80 mm	0.182	24.0	1.5	1+ (1)
Southeast Sulawesi LANDONO	ϕ 80 mm	0.286	32.8	3.7	1+ (1)

b. Diesel Engine Generator

A diesel engine generator should be supplied in areas where there is no permanent electric power supply. Stand-by generator units should be installed and a one-year supply of spare parts should be provided.

Table 4.30 Specification for Diesel Engine Generators

Project Area	No.of Units	Out put	
Central Sulawesi			
BONEBOBAKAL	1 + (1)	37 KVA	380 V
SALAKAN	1 + (1)	10 KVA	380 V
South-East Sulawesi			
SANDANPANGAN	1 + (1)	130 KVA	380 V
LANDONO	1 + (1)	20 KVA	380 V
WAKADIA	1 + (1)	70 KVA	380 V
TAKIMPO	1 + (1)	37 KVA	380 V
LAOMPO	1 + (1)	37 KVA	380 V
MOWEWE	1 + (1)	70 KVA	380 V

c. Engine Pump

In order to feed priming water to the pump, the pump must be instalaled in an area where the suction pipe length is longest. A one-year supply of spare parts should be provided.

Table 4.31 Specification for Engine Pumps

Project Area	No.of Units	Specifications
(Central Sulawesi)		
BONEBOKAL	1 Set	
(Southeast Sulawesi)		Nom.dia 2"
WAKADIA	1 Set	Pump Head 10m
SANDANGPANGAN	1 Set	

d. Control Panel

In take pumps are operated manually through local control panels. The panels are to be Indoor-Use types. Necessary spare parts are required.

A one-year supply of spare parts, such as fuses and lamps must be provided.

e. Chlorination Equipment

i) Chlorinator

The disinfectant to be used for treating water is 9 bleaching poweder solution containing chemicals easily obtainable in the area and which can be easily handled.
There are two types of chlorinators:

1. Gravity Chlorinator:

   Chlorination is by gravity flow into a ground reservoir tank,

2. Pressure Feeding Chlorinator :

   Chlorination is provided by presure dosing using chemical feeding pumps. Chlorine application points are high elevated tanks or pipes.

The chlorination system specifications are shown in Table 4.32 in accordance with Table 4.22.

Table 4.32 Chlorination system Specifications

Name of Type	Specification
Gravity Feeding	Gravity Chlorination
Pressure Feeding	Chlorine Feeding Pump Design Discharge : 3 l/hr Design Head : 4 kg/cm^2

ii) Solution Tank

The tanks are designed to hold a sufficient amount of solution for 3-day use. In each Project area, 2 tanks are to be installed. Chlorinator specifications for each area are shown in Tabl.e 4.33.

Table 4.33 Chlorinator Specification

Design area	System	Q'ty (Stand by)	Dosing Cap (ℓ /hr)	Salution tank
1. South Sulawesi				
1-1 ULUSALU	Gravity	1 + (1)	1	50 ℓ × 2sets
1-2 SALU	〃	1 + (1)	1	50 ℓ × 2sets
1-3 KAERO	〃	1 + (1)	1	100 ℓ × 2sets
1-4 TIROMANDA	〃	1 + (1)	1	100 ℓ × 2sets
1-6 MASAMBA	Pump	1 + (1)	4	300 ℓ × 2sets
2. Central Sulawesi				
2-1 TOAYA	Gravity	1 + (1)	1	100 ℓ × 2sets
2-2 BINANGGA	〃	1 + (1)	2	200 ℓ × 2sets
2-3 TAWAELI	〃	1 + (1)	6	400 ℓ × 2sets
2-4 LIANG	〃	1 + (1)	1	100 ℓ × 2sets
3. South-East Sulawesi				
3-2 ANDUONOHU	Pump	1 + (1)	2	200 ℓ × 2sets
3-3 MOWEWE	〃	1 + (1)	2	100 ℓ × 2sets
3-4 WAKADIA	〃	1 + (1)	3	200 ℓ × 2sets
3-5 LAOMPO	Gravity	1 + (1)	1	100 ℓ × 2sets
3-6 LAPUKO	Pump	1 + (1)	1	100 ℓ × 2sets
3-7 SANDANGPANGAN	Gravity	1 + (1)	1	100 ℓ × 2sets
3-8 TAKIMPO	Ppump	1 + (1)	4	300 ℓ × 2sets

7) Pump Houses

For the design of the pump houses, operations and maintenance, and the possibility of floods must be taken into consideration. Pump house structures are to be waterproof, ventilated and have electric lighting.

The following equipment is to be installed in a pump house:

- Intake Pump
- Diesel engine generator
- Chlorination pump
- Control panel
- Chlorination chemicals

The requied pump houses are shown in Table 4.34.

Table 4.34 Pump Houses

Project Area	Space	Remarks
(South Sulawesi)		
MASAMBA	$28m^2$ x 2 houses	2 pump houses are to be built.
(Central Sulawesi)		
BONEBOBAKAL	53.4 m^2	
SALAKAN	38.3 m^2	
(Southeast Sulawesi)		
LANDONO	53.4 m^2	
AUDUONOHU	24.0 m^2	
MOWEWE	24.0 m^2	
WAKADIA	81.3 m^2	
LAOMRO	53.4 m^2	
SANDANGPANGAN	81.3 m^2	15 tons truck crane access is required.
TAKIMPO	53.4 m^2	

(3) Material Plan

The results of the material selection are shown in the following Tables:

Table 4.35 Relative advantages of reservoir tank

Table 4.36 Relative advantages of pipe materials

Table 4.37 Relative advantages of pipe fittings

Tabel 4.38 Relative advantages of water pressure regulating system

TABLE 4.35 Relative Advantages of Distribution Reservoir

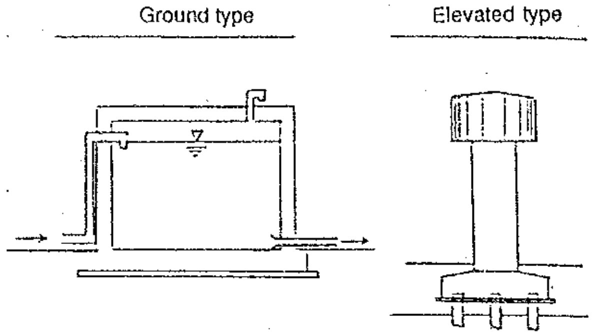
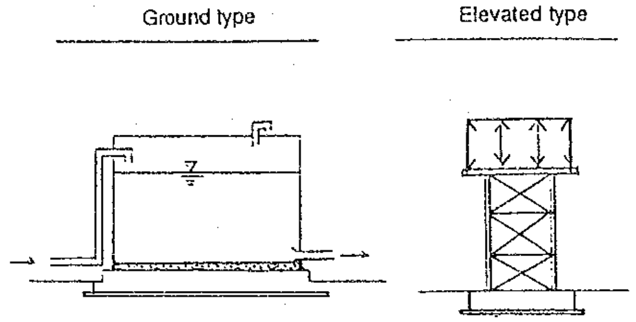
Systems	RC Structural Tank	FRP Panel Tank
Procurement	Local	From Japan
Outline Drawings		
Structures and Constructions	(Merits) 1. Strongest against impact from the outside (RC structure) 2. Procurement can be made locally (Demerits) 1. Many types of material are needed for the construction work, but it is difficult to transport the material because of conditions in the Project area. 2. Waterproof is required in the tank. 3. Requires the strongest foundation for supporting heavy tanks. 4. Construction materials, such as molding boxes (round shape), scaffolding, for the high elevated tank cannot be procured locally.	(Merits) 1. The foundation structure is the smallest. 2. Transportation is the easiest (Demerits) 1. The FRP structure is not very strong against impacts from the outside. 2. Tank materials (FRP) cannot be procured locally.
Construction Period	There are many items needed for construction, such as reinforcement, molding box, etc. Construction period is the longest. (Grand type: 5.5 months High elevated type: 12.5 months)	The only RC structure is the foundation. FRP material is light and the construction period is short. (Grand type: 2.2 months High elevated type: 4.4 months)
Economical Point	The ground type is inexpensive. Materials for the high elevated type is expensive.	The ground type is expensive, but the high elevated type is not so expensive.
Examination Results	Ground type: satisfactory. High elevated type: unsatisfactory	Ground type: unsatisfactory. High elevated type: satisfactory

TABLE 4.38 Relative Advantages of Water Pressure Regulating System

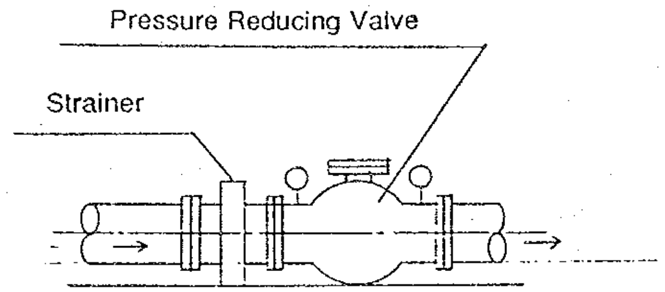
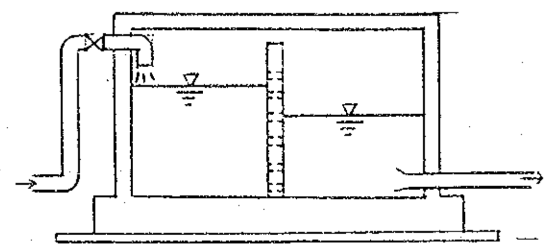
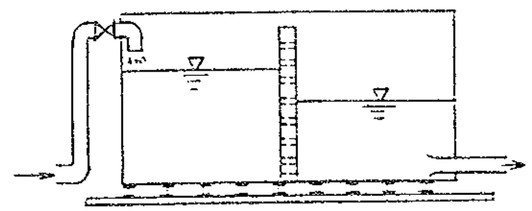
System / Description	Pressure Reducing Valve	Pressure Regulating Tank	
Structures	Valves	RC Structure	FRP Tank
Procurement	From Japan	Local	From Japan
			
Structure and Construction	(Merit) 1. The installation space is the smallest of all and construction items are very simple. (Demerits) 1. Value control requires a skilled technician. 2. Frequent maintenance work is required. (Valve and strainer maintenance)	(Merits) 1. The system's structure is simple. Maintenance is easy. 2. All material can be obtained in the area. 3. The strongest against impact from the outside. (Demerits) 1. Tank interior should be protected by water proof paint. 2. Transportation of material is difficult.	(Merits) 1. The system's structure is simple. Maintenance is easy. 2. Water proofing is not necessary. 3. The material is small, light, and easy to handle and transport. (Demerits) 1. The structure is prefabricated. FRP structures are not very strong against impact from the outside. 2. The material cannot be procured locally.
Construction Period	Only valves need to be installed. The construction period is the shortest of all.	The construction period is the longest of all.	Shorter of construction period transfer the RC structure.
Economical Point	The valves cannot be obtained in locally. Imported valves are costly.	The construction period is the longest of all.	Shorter construction period than foı the RC structure.
Examinations Results	X Unsatisfactory	O Satisfactory	Δ Not economical

TABLE 4.37 Relative Advantages of Pipe Fittings

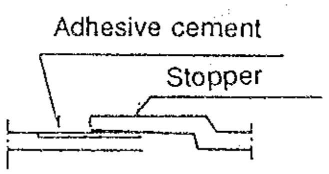
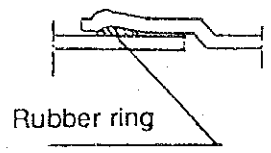
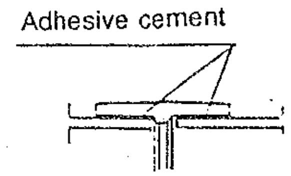
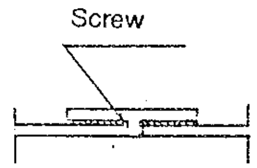
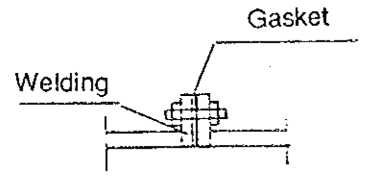
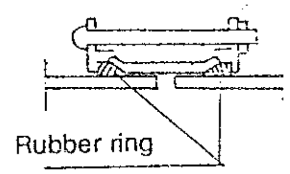
Descriptions \ Pipes			PVC	Steel	Pipe	Pipes
Fittings	TS Joint	R.R. Joint	TS Collar Joint	Screw Type Joint	Flanged Joint	Coupling Joint
						
Procurement	Local	Local· ring	Local	Local	Local	From Japan
Material	Adhesive cement, JWWASIOI	Rubber	PVC c ollar & Adhesive cement	FC Socket and Seal Paper	Steel and rubber gasket	Steel and rubber ring
Feature	Test pressure: 4 - 5 kg/cm^2 • Not flexible and not intensive. • Requires skilled technician for adhesive works	Test pressure: 12.3 kg/cm^2 • Flexible and intensive. Easy to construct.	Test pressure: 4 - 5 kg/cm^2 • Same as TS Joint	Test pressure: 4 - 5 kg/cm^2 • Subject to corrosion at screw. Material life is short. • Requires a skilled technician • Pipeline is not flexible.	Test pressure: 16 kg/cm^2 • Construction work is the simplest. • Requires a welding technician • Pipeline is not flexible.	Test pressure: 16 kg/cm^2 • Consturction works is most simple. • Flexibility is satisfactory under Project conditions. • Rubber rings keep joints watertight.
Cost Evaluation	Nominal Dia. / Cost ratio 250 / 1 200 / 1 160 / 1 110 / 1 90 / 1 40 / 1	Cost ratio of TS Joint 1.1 1.1 1.1 1.1 1.1 1.1	Cost ratio of TS Joint 1.1 1.2 1.2 1.1 1.1 1.1	Nominal Dia. / Cost ratio 250 / 1 200 / 1 150 / 1 100 / 1 75 / 1	Cost ratio of Screw Type 1 1 1 1 1.5	3.3 4.3 3.3 4.7 6.2
Examination	Less than 40 mm is satisfactory	Large size is satisfactory	Can be used the same as the TS Joint		This joint is available in local. Satisfactory	Cost is problem Unsatisfactory

TABLE 4.36 Relative Advantages of Pipe Material

Descriptions \ Type of pipe	Ductive Cost Iron Pipe	Steel Pipe	PVC
Procurement	From Japan	Local	Local
Materials Tension Bend Specific Gravity	 Min. 42.8 Min. 61.1 7.05	 Min. 41 Min. 41 7.85	 Min. 5.3 as 20°C 8 to 10 as 20°C 1.43
Characteristics • Impact from outside • Impact from inside (Max. static pressure)	6 to 10 kg - m/cm^2 7.5 to 4.0 kg/cm^2 Merits (1) Intensive and corrosion resistance (2) Strong against impact (3) Mechanical joint is flexible and expansive (4) Easy to construct (5) Many kinds of joints Demerits (1) Heavy (2) Needs specials protection against joint removal (3) Needs outside lining in humus (4) Large size pipes are impossible to repair from the inside	15 kg - m/cm^2 50 kg/cm^2 Merits (1) Intensive (tension and bend) (2) Strong to impact (3) No need countermeasure to joint remove by welding joint (4) Light (5) Easy to manufacture Demerites (1) Needs temperature expansion joint or flexible joint (2) Weak against electric corrosion (3) Takes a long time welding and line. Difficult to construct in spring ground. (4) Very flexible (large size pipe)	0.07 to 0.1 kg - m/cm^2 15.7 kg/cm^2 Merits (1) Corrosion and electric corrosion resistance (2) Light, easy to construct (3) Adhesive (4) Inside roughness does not change (5) Inexpensive Demerits (1) Weak against impact at low temperatures (2) Weak against ultraviolet rays and organic solvents (3) Caution to fire solvent.cement (4) Needs temperature expansive and flexible joints.
Costs φ 100 mm 150 200 250	 3.7 2.6 2.3 1.9	 2.4 1.9 - -	 1 1 1 1
Examination Results	Surface: Unsatisfactory Underground: Unsatisfactory	Surface: Satisfactory Underground: Satisfactory	Surface: Unsatisfactory Underground: Satisfactory

4.4 Implementation Plan

1 Implementation Policies

Preparation of the detailed design, assisting CIPTA KAYRYA with tendering, and Project construction supervision will be carried out by a Japanese consultant company who will entrust local consultants with the following work:

1) Test well borings and data collection of the water quality and well yield in three areas. The Japanese consultants will analyze the collected data and prepare the detailed design.

2) Surveys of the number of residents and households who will receive water supplies (these figures are needed to determine the installation locations of public taps) and the preparation of public standpipe installation location maps.

3) Levelling surveys for the plans prepared for the basic design and for completing the plans. Installation of temporary bench marks in the Project sites.

4) Confirmation of land acquisition for Project construction sites. The land acquisition shall be under taken by CIPTA KARYA based on the necessary area maps for Project facility installation that are prepared by the Japanese consultants according to the Project construction boundary agree upon by the Indonesian and Japanese Governments. The land acquisition must be completed at least one month prior to the commencement of Project construction.

Because of the nature of the Project, Project construction should be undertaken as a complete turnkey construction work by a general contractor through open tendering. The general contractor will be selected as a result of open tendering based on discussions between the Japanese consultant company and CIPTA KARYA.

The Directorate of General of Human Settlements of the Ministry of Public Works will be the responsible agency for Project implementation. The Directorate entrusts the project manager of each provincial water supply bureau to manage the water supply system. BPAM in each region will cooperate with the Project manager.

2 Implementation Method

Local contractors mainly conduct business in their own province. The Project sites are located in three provinces; thus, different local contractors will be used for Project construction work in these provinces.

Heavy rainfall occurs throughout the year in Project areas. However, there are noticeable dry and rainy seasons. Each province has its own rainfall pattern; therefore, the Project construction schedule must be prepared by taking into account these patterns.

The access road to each IKK's water source have yet to be improved. The road problem must be discussed with CIPTA KARYA and certain measures must be taken prior to the commencement of Project construction.

The Project's water distribution pipes will be installed along existing roads. Must of the roads are paved either with concrete or asphalt. Thus, special methods for excavating and refilling the road pavement should be used. Restoration of the paved roads must meet Indonesian standards and rules. Therefore, it is advisable that the restoration work be undertaken by the Indonesian side.

3 Construction and Supervisory Plan

- Detailed Design

The Project's detailed design is to be prepared based on the Basic Design. Project implementation will be carried out in two phases and the preparation of the Project's detailed design should be conducted for each phase.

The detailed design prepared by the consultants must be approved by CIPTA KARYA.

- Tendering

Contract documents prepared for the Project by the consultants must be approved by CIPTA KAYRYA. The consultants will assist CIPTA KARYA by making the tender announcement, accepting tender applications from contractors, issuing tender documents to the tender participants, accepting tender documents from the participants, and evaluating the tendering. After selecting a successful Japanese contractor, CIPTA KARYA will make a contract agreement with the contractor.

- Construction Supervision

The consultants will evaluate and approve the tender documents submitted after tendering by the selected contractor and will assist CIPTA KARYA with the procurement of Project use materials and equipment in order to start Project construction as soon as possible.

The consultants will hold a series of meetings with CIPTA KAYRYA officials and the contractor prior to commencement of Project construction work, witness the shipments of Project use materials and equipment going to the Project sites, and provide the contractor with instruction related to the construction work, equipment installation, test operations, and after-installation inspections.

Additionally, the consultants will control the Project's construction schedule, be responsible for quality control, and will exert an effort to complete the Project's construction by the completion date specified in the Exchange of Notes for the Project.

4 Procurement Plan

The results if the comparison made of procurable Project use materials and equipment in Sulawesi and in Japan are listed in Table 4.58.

1) Reinforcing Bars, Cement, and Plywood

Uniform quality cement and plywood are easily procurable in Sulawesi. The prices for these items are lower in Sulawesi than if they were procured and imported from Japan. Thus, local cement and plywood will be used for the Project. Although local reinforcing bars are more expensive than in Japan, their importation is prohibited. Thus, local reinforcing bars will be procured and used in the Project.

2) Well Construction Equipment

A great number of wells have been constructed by local contractors. They have extensive well construction experience.

If well construction equipment is imported from Japan for the Project, well construction costs will be high. As a result of the evaluation of capabilities of local contractors and construction costs, it was decided to use local contractors and locally leased construction equipment under the supervision of Japanese engineers for Project well construction.

3) Pumps

It would be difficult to procure pumps in Indonesia that could meet the requirements of the Project. It is felt that, due to the lack of spare parts, pumps procured locally would be difficult to maintain. The Study Team contends that it would not be advisable to procure pumps on the local market for Project use. Thus, Project use pumps will be imported from Japan.

4) Construction Equipment

During the field survey period a great deal of imported construction equipment (particularly, excavation machines, transportation equipment, and loading machines) were seen in Sulawesi. Since Project construction must be completed within a short period of time, Project construction cost would be high if such equipment were to be imported. Further, it would be difficult to maintain imported equipment. For this reason, it is felt that locally leased equipment would be more favourable for Project construction purposes.

Table 4.39 (1) Comparison of Procurable Project Use Materials and Equipment in Indonesia and Japan (1 of 2)

Item	Import from Japan	Procurement in Indonesia
Reinforcing Bars	Purchase price+Creating+Transportation: Uniform standard and uniform quality. Prices relatively stable. Importing is prohibited.	Local procurement: Standard material is procurable but is high priced.
Evaluation Result	x	o
Cement	Purchase price+Creating+Transportation: Uniform standard and uniform quality.	Local procurement: Standard material is easily available.
Evaluation Result	x	o
Plywood	Purchase price+Creating+Transportation:	Local procurement: Standard units are easily obtainable.
Evaluation Result	Δ	o
Pumps 0.382 m^3/mm x 94 m 15 KW 2 units	Easy maintenance work. Uniform standard and high quality.	Local procurement: Difficult to obtain spare parts. Hard to maintain due to the lack of spare parts.
Evaluation Result	o	Δ
Water Faucet (1/2 inch diameter)	13 mm diameter faucets. Purchase price + Packing + Transportation: Uniform standard.	Local procurement: Many different types are procurable. Easy to obtain spare parts.
Evaluation Result	Δ	o

Table 4.39 (2) Comparison of Procurable Project Use Materials and Equipment in Indonesia and Japan (2 of 2)

Item	Import from Japan	Procurement in Indonesia
PVC pipe 100 mm diameter	Purchase price + Transportation:	Local procurement: Locally obtainable.
Evaluation Result	Δ	o
GSP pipe	Purchase price + Transportation:	Local procurement: Locally obtainable.
Evaluation Result	Δ	o
Valve 100 mm diameter	Purchase price + Transportation: Quality if reliable.	Local procurement: Quality is unreliable. Difficult to procure.
Evaluation Result	o	Δ
Construction Equipment 0.6 m^3 capacity backhoe	Rental fee + Transportation (one way): Expensive	Local procurement: Lease company will thoroughly maintain. Various types of equipment are available.
Evaluation Result	Δ	o

5 Implementation Schedule

The Construction Schedule was prepared by taking into account the following two aspects (the schedule is shown in Table 4.41):

1) Rainfall

According to the rainfall data recorded in Sulawesi (see Appendix 6-5), rainy seasons are classified as follows:

South Sulawesi: March through June

Central Sulawesi: March through July

Southeast Sulawesi: November through July

Intake facility construction and river-crossing inverted siphon construction should avoid the above rainy seasons.

2) Construction Period

The Project construction period should be decided upon based on the following conditions:

1. By taking into account the scale of Project construction and the local construction industry's conditions, it is planned to use two local contractors in South Sulawesi, three in Central Sulawesi, and two in Southeast Sulawesi. Each local contractor should be responsible for Project facility construction in its own construction site.

2. A two month material and equipment procurement period must be included in the construction period.

3. The construction work in one Project site must be completed within one fiscal year.

4. By taking into consideration the above three conditions, Project construction should be carried out in two phases.

6 Scope of Works

This section describes the Scope of Works to be carried out the project.

(1) Undertaking of the Government of Indonesia

1. To acquire possession of land and structures which are needed for the implementation of the Project

2. To secure water rights

3. To clear the sites of the Project

4. To provide facilities for distribution of electricity leading up to the sites

5. To maintain the access road for construction of water supply facilities and for transportation of construction materials

6. To restore the pavement of the road which is laid the pipes

7. To ensure prompt unloading tax exemption and customs clearance of the Project goods at the port of disembarkation

8. To accord Japanese nationals whose services may be required in connection with the supply of the products and the services under the verified contracts such facilities as may be necessary for their entry into the Republic of Indonesia and stay therein for the performance of their work

9. To exempt Japanese nationals from customs duties, internal taxes and other fiscal levies which may be imposed in the Republic of Indonesia with respect to the supply of the products and services under the verified contracts

10. To bear all the expenses, other than those to be borne by the Grant Aid, necessary for the execution of the Project

11. To prepare all site office for construction of the consultant and the contractor.

(2) Undertaking of the Government of Japan

1. To design the adequate water supply systems (refer to Chapter 4, Section 3 Basic Design. Implementation schedules are shown in Figure 4.41).

2. To Procure the construction materials (refer to Chapter 4, Section 4.4 Procurement Plan)

3. To contract the contractor to construct the water supply facilities (refer to Chapter 4, Section 4.2 Implementation Method.)

4. To supervise the construction works

Table - 4.40 (1) Implementation Schedule (Phase 1)

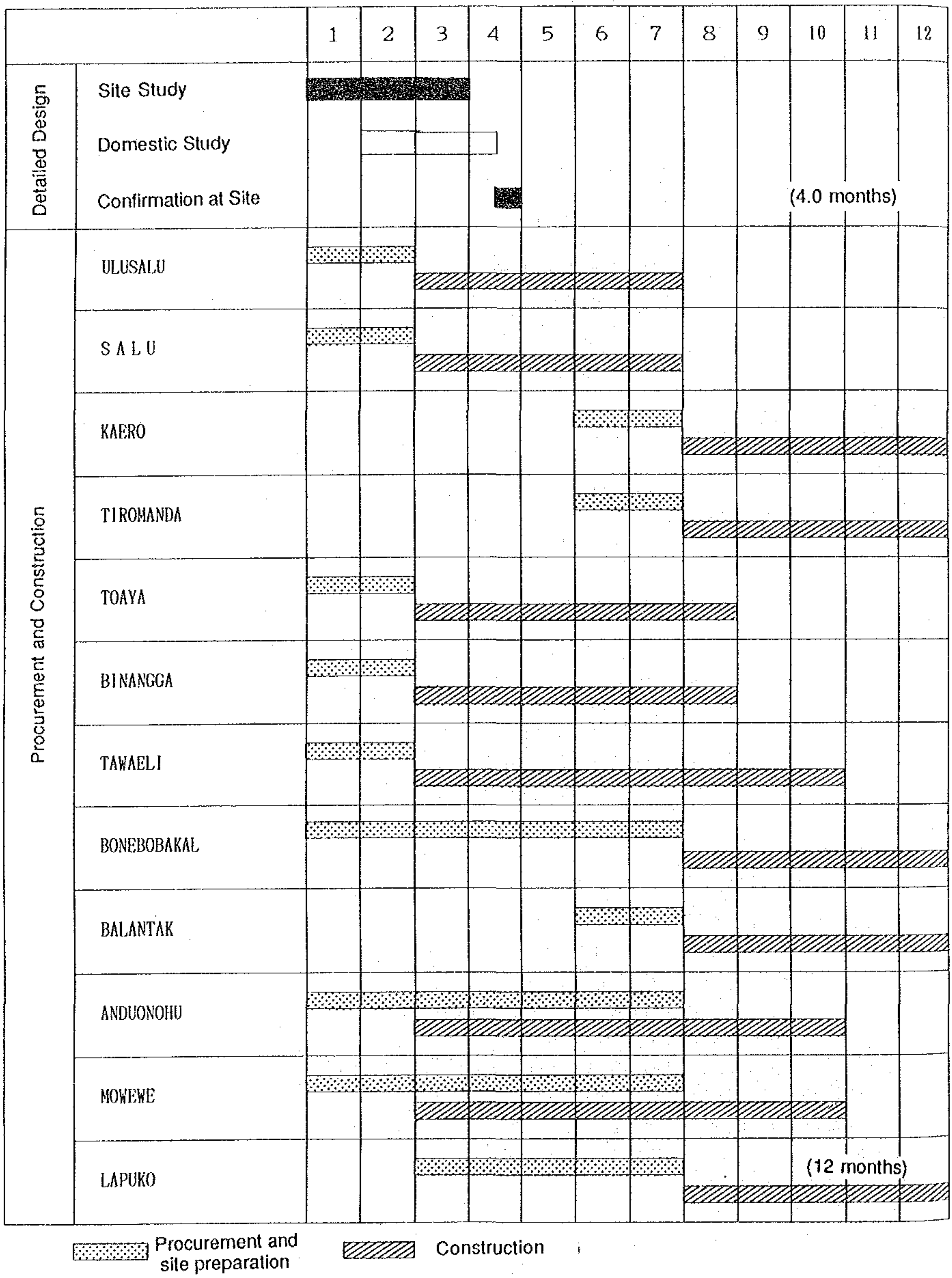
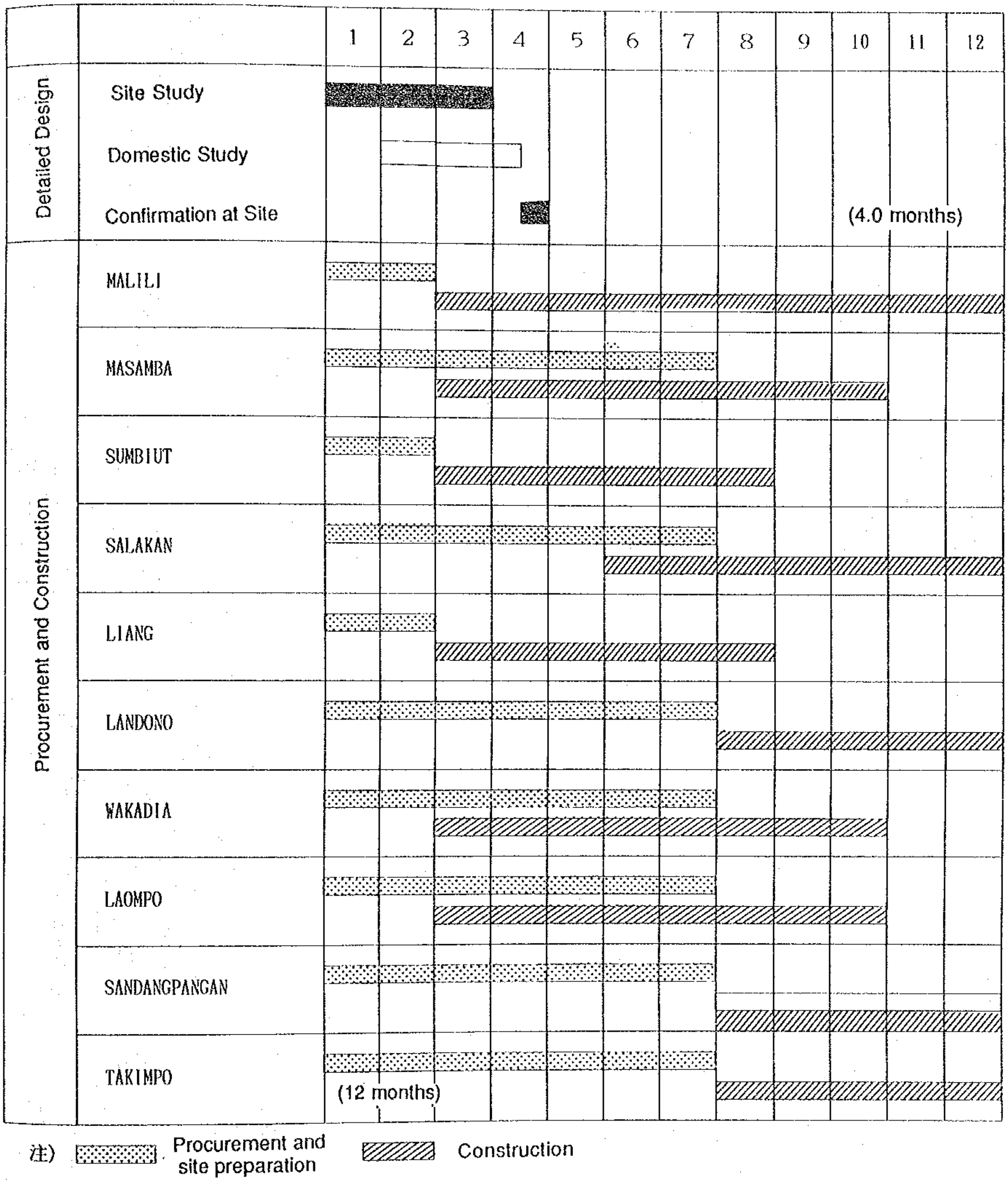


Table - 4.40 (2) Implementation Schedule (Phase 2)



CHAPTER 5 PROJECT EVALUATION AND CONCLUSION

CHAPTER 5 PROJECT EVALUATION AND CONCLUSION

The Government of Indonesia, in order to achieve a water supply rate of 60%, established the water supply plan in rural areas, including IKK, as one of the most important items in the Fifth 5-year National Development Plan. However, the plan was implemented in 1,100 IKKs during the period from the First through the Fourth National Development Plans and the remaining 2,400 IKKs still have unimproved water supply facilities.

In the Project areas, the number of IKKs having improved water supply facilities are only 20 in South Sulawesi, 16 in Central Sulawesi, and 10 in Southeast Sulawesi. In the other areas where the water supply facilities remain unimproved, water shortage is chronic and waterborne disease problems due to the poor water quality are prominent. Infant mortality rates are also very high in these areas. Further, the heavy labor required to fetch water has effected to prevent the upgrading of the residents' living standards. Area residents have been suffering because of the poor drinking water supply.

After completing Project, the number of IKKs and the population served by Project facilities are shown as the indices of the improved living environment in Table 5.1.

The table indicates that people presently receiving water supplies is only 3.8% of the total population in the Project's three provinces. However, after completing Project construction the water supply rate will reach 82% (population served/total area population). Approximately 90,000 people will be able to receive a safe supply of drinking water. Thus, Project implementation will greatly contribute to the rural water supply plan of the National Development Plan. Further, Project implementation will result in improving the living conditions of area residents. From the social health viewpoint, Project implementation is very meaningful.

The operation and maintenance cost for Project facilities varies depending upon each water supply system. By referring to the operation and maintenance of the water supply system managed by CIPTA KARYA, the annual cost for operating and maintaining the Project facilities in each province is estimated to be as follows:

South Sulawesi:	Rp 22,640,000
Central Sulawesi:	Rp 17,620,000
Southeast Sulawesi:	Rp 76,660,000

The costs indicated above represent approximately 1.5% of the average annual income of the households that will receive a water supply in each province.

In view the country's technical levels, comparatively simple systems are to be used for the Project's water supply. The pumps and generators will require special operating and maintenance techniques. As there are some types of pumps and generators already in use at certain existing water supply facilities, there are personnel who already possess a limited knowledge of the types of pumps and generators to be used in the Project. For this reason, it will be important to secure the required number of personnel for Project facilities by training new employees through a job rotation programme under the guidance of skilled personnel at each province.

TABLE 5.1 PROJECT EVALUATION (POPULATION SERVED : Year 2000)

PROJECT AREA	POPULATION	PRESENT SIUATION		AFTER IMPLEMENTATION	
		POPULATION SURVED	%	POPULATION SURVED	%
SOUTH SULAWESI					
ULUSALU	3,300	400	13	2,300	70
SALU	3,300	0	0	1,900	58
KAERO	3,000	500	18	2,400	80
TIROMANDA	1,900	0	0	1,700	89
MALILI	8,300	800	11	6,400	72
MASAMBA	12,000	0	0	10,600	87
SUB TOTAL	32,600	1,700	6.2	25,300	78
CENTRAL SULAWESI					
TOAYA	5,100	300	6	3,000	59
BINANGGA	8,300	600	10	6,600	80
TAWAELI	15,800	400	4	10,600	67
BONEBOBAKL	1,400	0	0	1,200	86
SUMBIUT	3,700	0	0	3,700	100
BALANTAK	3,500	0	0	3,500	100
SALAKAN	2,600	0	0	2,600	100
LIANG	2,400	300	15	2,400	100
SUB TOTAL	42,800	1,600	5	33,600	79
SOUTH-EAST SULAWESI					
LANDONO	5,100	0	0	4,200	82
ANDUONOHU	5,400	0	0	4,900	90
MOWEWE	5,400	0	0	5,400	100
WAKADIA	4,500	0	0	4,500	100
LAOMPO	4,100	0	0	3,800	93
LAPUKO	3,300	0	0	3,200	97
SANDANGPANGAN	3,100	0	0	3,100	100
TAKINPO	9,400	0	0	6,700	71
SUB TOTAL	40,300	0	0	35,800	89
GRAND TOTAL	115,700	3,300	3.8	94,700	82

APPENDIX

APPENDIX

1. Member List of Survey Team
2. Survey Schedule
3. Member List of Concerning Party in Indonesia
4. Minutes of Discussion
5. Country Data and Design Data

APPENDIX 1: Member List of Survey Team

1. Team Leader
   - Tusunao USAMI
     Director
     Planning Division
     Kanagawa Water Supply Authority

2. Coordinator
   - Satoru WATANABE
     Second Basic Design Study Division
     Dep. of Grant Aid Study and Design
     Japan International Cooperation Agency

   - Yoshitaro WATANABE
     Consultant Contract Division
     Procurement Department
     Japan International Cooperation Agency

3. Water Supply Planning
   - Kiyoshi NAKAHARA
     Pacific Consultants International .Co., Ltd.

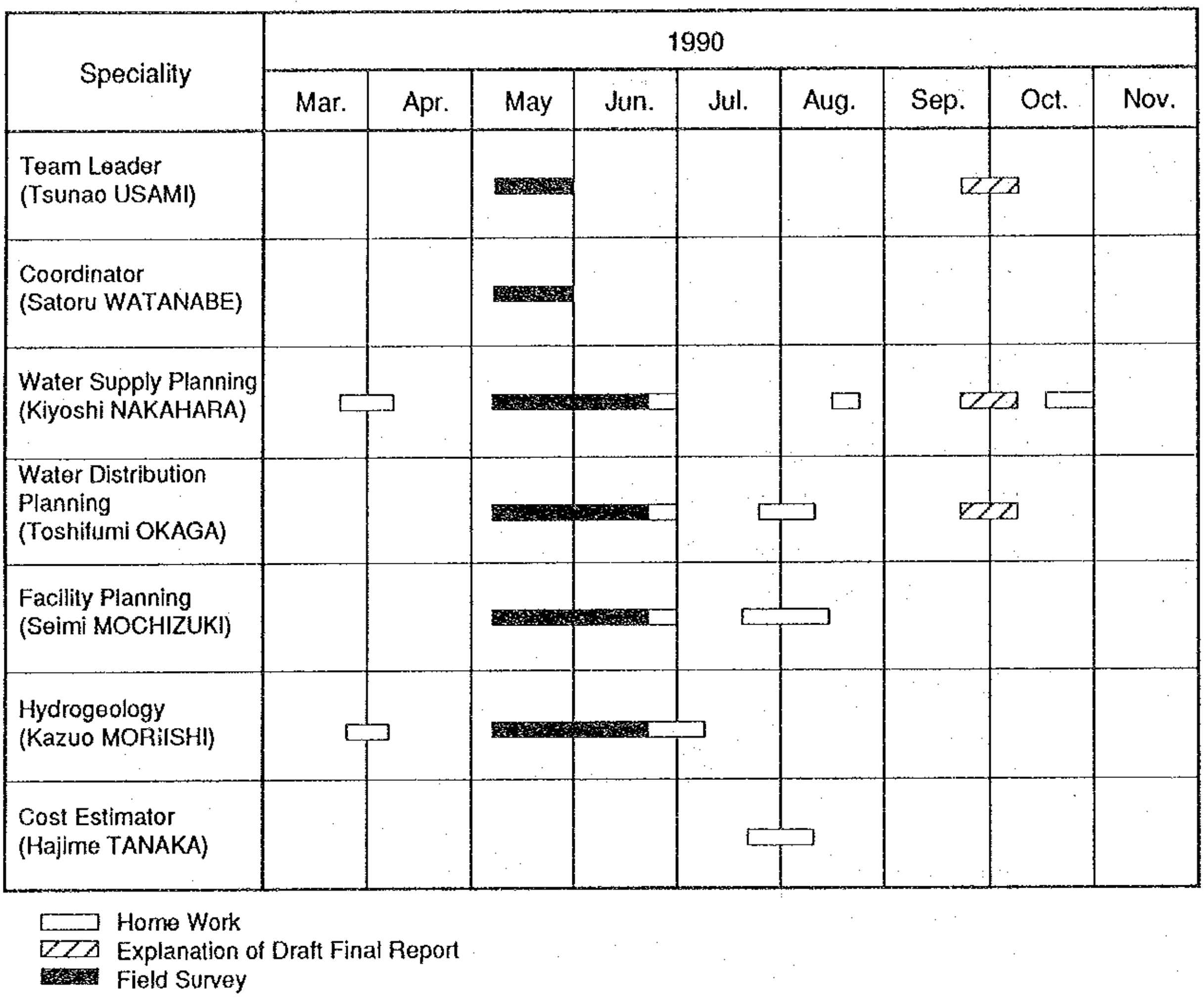
4. Water Distribution Planning
   - Toshifumi OKAGA
     Ditto

5. Facility Planning
   - Seimi MOCHIZUKI
     Wacos Japan Co., Ltd.

6. Hydrogeology
   - Kazuo MORIISHI
     Pacific Consultants International Co., Ltd.

7. Cost Estimator
   - Hajime TANAKA
     Ditto

APPENDIX 2: Survey Schedule



APPENDIX 3: Member List of Concerning Party in Indonesia

Agency	Name	Position
Ministry of Public Works		
Directorate General of Human Settlements	Ir. Sunaryono Danuojo	Director General
"	Ir. Soeratmo Notodipo	Secretary
Directorate of Water Supply (DAB)	Ir. A. R. Tambing	Director
"	Ir. Rachmat Rani	Sub Director Planning
"	Ir. Achad Ruyadi	Sub Director Construction
"	Ir. M. J. Amien	Chief of Technical Sector of Fact Region
"	Ir. Bambang Anggoro	Stuff
"	Ir. Iiliek Sri Mulyati	Stuff
"	Emon Kosmom	Stuff
"	Newman Suharta	Stuff
Directorate of Bina Program (DBP)	Ir. Parulian Sidabutar	Director
"	Ir. Priyono	Sub Director
	Dwi Menita	Stuff
	Saptorini	Stuff
	Naacih	Stuff
	Rozadhi Ismacen	Stuff
	Supriyanto	Stuff
	Rudy A. Arifin	Stuff
	Djamaludin A.	Stuff
	Ratnayani	Stuff
	Bombary S.	Stuff
South Sulawesi		
PPSAB	Ir. Didi Rochadi	Project Manager
"	Janti damajanti	Assistant Project Manager
"	Yusuf Allan	Technical Stuff
"	Nar Sadikin	Technical Stuff
"	Rusijanto	Technical Stuff
Makale BPAM	Anton Lebang BE	Head of BPAM
	Drs. D. Palamba	Secretary

Agency	Name	Position
Palopo BPAM	Abdu Majid	Head of BPAM
Luwu Kabupatan	M. D. Djampu	Bupati
Central Sulawesi		
PPSAB	Hazaddin T. S.	Project Manager
"	Yusuf Tambing	Ass. Perencanaan
"	Mansur	Perencanaan Pepesada
"	Sentot Budiono	Ass. Logistik
"	Kusmara Erwan	Kasubpro wil Donggala
"	Firman Hairun	Urs. Pengedalian
South East Sulawesi		
Dept. P. U. (Pekerjaan Umur)	Ir. Rido Soesilo	Chief of P.U. (Kakanwill P.U.)
PPSAB	Ir. Dwi Jati Pumono	Project Manager
"	Ir. Dien Wulandiati	Assistant Project Manager
"	Ir. Daniel Itto	Technical Stuff
"	BE. Gatot	Technical Stuff
Kolaka BPAM	Zaluddin Umar	Head of BPAM
	Muntro	Technical Stuff
Muna BPAM	BE. Purwanto	Head of BPAM
Buton BPAM	Harddin	Head of BPAM
	Mane	Chief of Technics
Ministry of Health Southeast Sulawesi Pro.	DRS. Laode Hamiru M. Sc.	Diane Kesehatan Doti I Sultro
	Timbul Supodo. SKM	Doctor
	DRA. Mardiana Muchtar	Chemistry
Lamdono Kecamatan	DRS. Barhanuddin Silonda	Camat
Moramo Kecamatan	DRS. ABD Hamid Basir	Camat
	Muglimin	Head of Administration & Development Plan
	Hamsyain	Secretary
Poasia Kecamatan	Banginduru BBA	Camat
Mowewe Kecamatan	DRS. Sjaharuddin	Camat
Kesambi kecamatan	DRS. Mustari A. Arifin	Camat
Pasarwajo Kecamatan	DRS. Makmuni	Camat

Agency	Name	Position
Pasarwajo Kecamatan	DRS. Makmuni	Camat
Landona Kelurahan	Israel Tawakal	Chief
	DR. I. Wayan Segara	Chief of Community Health Center
Lapuka Kelurahan	Ruslant. T	Chief
Anduorohu Kelurahan	Hasan Bungasari	Chief
Mowewe I Kelurahan	Basruddin	Chief
Mowewe II Kelurahan	Sainuddin	Chief
Takimpo Kelurahan	La Kabona	Chief
Caompo Kelurahan	Maskan	Chief
Wakadio Desa	Ladawanta	Chief
Sandang Pandan Desa	La Bairi	Chief

APPENDIX 4

MINUTES OF DISCUSSIONS ON THE PROJECT

FOR THE RURAL/IKKs WATER SUPPLY IN SULAWESI ISLAND

IN THE REPUBLIC OF INDONESIA

In response to the request of the Government of the Republic of Indonesia, the Government of Japan decided to conduct a basic design study on the Project for the Rural/IKKs Water Supply in Sulawesi Island (hereinafter referred to as "the Project") and entrusted the study to the Japan International Cooperation Agency (hereinafter referred to as "JICA"). JICA sent to the Republic of Indonesia the basic design study team headed by Mr. Tsunao Usami, Director, Planning Division, Planning Department, Kanagawa Water Supply Authority, carried out the study from 7th May to 20th June, 1990.

The Japanese team had a series of discussions and exchanged views on the Project with the officials concerned of the Government of the Republic of Indonesia and conducted a field survey in Sulawesi Island.

As a result of the study and discussions, both parties agreed to recommend to their respective Governments that the major points of understanding reached between them, attached herewith, should be examined towards the realization of the Project.

Jakarta, 22nd May, 1990

Mr. Tsunao Usami
Team Leader
Basic Design Study Team
JICA

Ir. Soenarjono Danoedjo
Director General
Directorate General of Human
Settlements (Cipta Karya)
Ministry of Public Works