(2) Intake Facilities and Raw Water Main

The raw water for the current Maros water supply system is supplied through three intakes. Raw water for the Batu Bassi Water Treatment Plant is taken via Bantimurung Upstream Intake and Bantimurung Downstream Intake from Bantimurung River. Bantimurung Upstream Intake is located 2 km upstream from Batu Bassi WTP with an intake volume of 20 l/sec using a gravity system during the wet season. This system closes during the dry season due to shortage of water flow to the National Park. Bantimurung Downstream Intake is equipped with a pump system with a capacity of 20 l/sec during the dry season and 40 l/sec during the wet season, and this is located beside the Batu Bassi WTP.

The raw water main from the intake to the Batu Bassi Water Treatment Plant is laid along the road with a length of 200m. Raw water for the Pattontongang Water Treatment Plant is taken from Lekopancing Canal, which is located at 1.8 km from Pattontongang WTP.

The existing intake facilities and raw water main are described in Table 2.4.

Table-2.4 Existing Intake Facilities and Raw Water Main

Facility	Capacity and Number	Type and Structure
Batu Bassi Water Treatment Plant		
1. Bantimurung Upstream Intake	3.0 L x 1.2 W x 0.7 H x 1	Made of concrete
2. Bantimurung Downstream Intake	Submersible Pumps TH =30 m, Q=12 l/sec x 2 TH =80 m, Q=10 l/sec x 4	Pump system, intake is made of concrete
3. Raw Water Main for Bantimurung Upstream Intake	Diameter 250 mm, Length 1.2 km Diameter 200 mm, Length 0.8 km	Steel pipe, Gravity system
4. Raw Water Main for Bantimurung Downstream Intake	Diameter 200 mm, Length 0.2 km.	Steel pipe, Supplied by Pump
Pattontongang Water Treatment Plant		
1. Lekopancing Canal Intake	10.0 L x 2.0 W x 2.0 H x 1	Made of concrete
2. Raw Water Main	Diameter 300 mm, Length 1.8 km x 1 line.	Steel and uPVC pipe, Gravity system

Source: PDAM Maros

(3) Water Treatment Facilities

The production capacity of the Batu Bassi water treatment plant is 40 l/sec in total, and that of the Pattontongang Water Treatment Plant is 50 l/sec. Table-2.5 below summarizes the water treatment component facilities giving size and capacity.

Table-2.5 Existing Water Treatment Facilities

Facility	Capacity and Number	Type and Structure
Batu Bassi Water Treatment Plant		
1. Treatment Unit	10 l/sec x 2 (1978) 20 l/sec x 1 (1995)	Rapid sand filter, gravity, simple media filter made of steel
2. Chlorination Unit	1	Made of steel
3. Storage Reservoir	125 m3 x 1	Made of concrete
4. Backwash Tank	25 m3 x 1	Elevated tank, made of steel
Pattontongang Water Treatment Plant		
1. Treatment Unit	4,320 m3/day x 1	Rapid sand filter, gravity, simple media filter made of steel
2. Chlorination	1 m3 x 3	Pumped type, made of uPVC
3. Storage Reservoir	200 m3 x 1	
4. Backwash Pump	-	Back washed by booster pump

Source: PDAM Maros

(4) Treated Water Quality

Treated water from the water treatment plants does not comply with the Indonesian treated water standard for drinking water (Air Minum), especially turbidity. Turbidity is one of the important indices to confirm the PDAM operation capacity. Turbidity is over the drinking water requirement in both water treatment plants due to mismanagement by operators during the flocculation process and shortage of equipment for controlling the water quality. Results of the treated water quality are summarized as follows.

Table-2.6 Treated Water Quality Analysis

No.	Parameter	Unit	Batu Bassi WTP	Pattontongan WTP	Drinking Water Quality
1	Scent	−	None	None	None
2	Total Dissolved Solid (TDS)	mg/l	188	188	1,000
3	Turbidity	NTU	6.3	6.3	5
4	Taste	−	None	None	None
5	Temperature	ºC	30	30	Air Temperature ± 3ºC
6	Color	TCU	0.2	0.1	15
7	PH	mg/l	6.8	6.5	6.5 - 8.5
8	Total hardness ($CaCO_3$)	mg/l	134.0	39.0	500
9	Chloride	mg/l	6.5	1.9	250
10	Organic Substance	mg/l	0.6	2.6	10
11	Sulphate (SO_4)	mg/l	12.7	10.2	400
12	Nitrate (NO_3)	mg/l	3.5	2.2	10
13	Nitrite (NO_2)	mg/l	0.02	None	1.0
14	Iron (Fe)	mg/l	0.3	0.3	0.3
15	Lead (Pb)	mg/l	None	0.1842	0.05
16	E. Coli	Amount/100mls	0	0	0
17	Total Coliform	Amount/100mls	0	0	0

Source: PDAM Maros

(5) Booster Pump and Distribution Facilities

PDAM Maros have a direct boosting system in the whole area. Treated water is directly boosted by pump from each water treatment plant to the customers. However, distributed water does not reach the four kechamatan located in the coastal area due to water shortage. Table-2.7 below summarizes the water treatment component facilities giving size and capacity.

Table-2.7 Booster Pumps for Distribution

Facility	Capacity and Number	Type and Structure
Batu Bassi Water Treatment Plant		
Booster Pump	TH =80 m, Q=10 l/sec x 3	Centrifugal Single Stage Pump
Pattontongang Water Treatment Plant		
Booster Pump	TH =80 m, Q=50 l/sec x 2 TH =80 m, Q=30 l/sec x 1	Centrifugal Single Stage Pump

Source: PDAM Maros

Distribution is through one distribution main from each water treatment plant. The distribution main from the Batu Bassi water treatment plant conveys treated water to the eastern supply area including the most densely populated area in Maros Regency. Another distribution main from Pattontongang Water Treatment Plant conveys treated water to the southern area.

Pipe materials used are mainly uPVC. DCIP and steel pipes were used in an early construction stage before the year 1995 and these have leaks due to aged pipes. Table-2.8 below summarizes the distribution facilities giving year of installation, length and diameter.

Table-2.8 Total Pipe Length of Distribution Pipeline

Name	Diameter (mm)	Pipe Type	Length of Installation (m)					Total
			1989-2000	2001	2002	2003	2004	
Distribution Main	300	uPVC	1,450	0	0	0	4,500	5,950
	250	Steel	0	0	0	0	24	24
	250	uPVC	8,890	0	0	0	0	8,890
	250	DCIP	210	0	0	0	0	210
	200	Steel	0	0	0	0	80	80
	200	DCIP	7,630	0	0	0	0	7,630
	200	uPVC	20,180	0	0	0	10,290	30,470
	150	Steel	0	0	0	0	48	48
	150	DCIP	2,310	0	0	0	0	2,310
	150	uPVC	17,387	0	0	0	7,200	24,587
	100	Steel	0	0	0	0	102	102
	100	uPVC	14,688	0	0	0	11,400	26,088
Secondary	75	Steel	0	0	0	0	30	30
	75	uPVC	18,509	3,504	0	90	11,658	33,761
	50	uPVC	56,835	3,489	108	2,822	3,968	67,222
	50	Steel	66	0	0	0	0	66
	40	uPVC	2,185	0	0	0	0	2,185
Total			150,340	8,994	2,110	4,915	51,304	217,663

Source: PDAM Maros

(6) Service Pipe and Public Hydrants

The service main and public hydrants are important facilities for developing a total water system. The operation and maintenance of public hydrants have, however, proved to be problematical in the past. To improve on this performance it is suggested that recipient communities be involved in their planning and location. They should contribute towards their cost and undertake training before it is agreed to construct each facility. For this reason they should not be constructed until these provisions have been successfully completed.

Additionally, it is noted that no maps of service pipes and public hydrants are available.

2.3.2 Water Production and Consumption

(1) Coverage

At the end of 2004, PDAM Maros's piped water supply coverage was approximately 9.7 %, including the population served by direct house connections and public hydrants (See Table 2.9).

Table-2.9 Water Supply Coverage in 2004

Item No	Category	No of Connections (Dec-04)	Persons per Connection	Population Served	Coverage in Maros (%)	Coverage in Target Area (%)
1	Domestic	5,114	5	25,570	8.3	10.0
2	Public Hydrant	44	100	4,400	1.4	1.7
3	Other	542	-	-	-	
	Total	5,700		29,970	9.7	11.7

Source: PDAM Maros
Note: Assumptions: (i) each public tap supplies 20 families, (ii) 5.0 persons per household.
Coverage in Maros and target area (Stage-1 and Stage-2 area) is based on overall population of 307,770 and 256,914 populations respectively (Estimated population in the MMA Master Plan: 2004).

(2) Water Production and Consumption

Based on the water production data from PDAM Maros, two water treatment plants produced 7,552m^3/day in 2005, which is 97% of the production capacity of the water treatment plants. As a result, the treatment plants are being fully loaded by the production capacity.

Per capita domestic consumption of households connected to the PDAM supply system in 2004 was approximately 113 lcpd, similar to the Indonesian guideline.

Service connections have been rapidly increasing in the last two years from 4,343 connections in 2003 to 5,114 connections in 2004 due to the increase of water production capacity (4,320m^3/day).

Table-2.10 Number and Type of Customer Connection

Type of Connection	Connections (no.)		Connection Ratio (2004)
	2003	2004	
Household	4,343	5,114	89.7%
Small Commerce	198	389	6.8%
Large Commerce	1	2	0.0%
Public Hydrant	44	44	0.8%
Small Industry	3	6	0.1%
Large Industry	4	6	0.1%
Specific Social	66	75	1.3%
Government Office	59	63	1.1%
Particular	0	1	0.0%
Total	4,718	5,700	100.0%
Rate of Increase	-	121%	

Source: PDAM Maros

2.3.3 Water Loss / Unaccounted for Water

PDAM Maros's records (Table-2.11) indicate that unaccounted for water (UFW) was about 50 % in 2005. However, reliability of the figures is low, because (i) production volumes are taken from un-calibrated bulk meters, and (ii) sales volumes are derived from water meters of doubtful accuracy.

PDAM Maros has little information concerning the magnitude of the various sources of UFW. However, the principal causes of UFW are thought to include: (i) defective or inaccurate meters, (ii) distribution mains and service connections that leak at high rates because of age, inferior quality, poor joints, and poor construction standards, (iii) deficient administrative procedures and practices, (iv) illegal connections, (v) poor operation and maintenance practices that result in delayed and inadequate repairs to pipe bursts and leaks, (vi) lack of investment in pipe replacement and rehabilitation, (vii) absence of leak detection teams, and (viii) low priority given to UFW reduction by previous PDAM managements.

Table-2.11 Unaccounted for Water

Year	2001	2002	2003	2004	2005
Distribution Volume (m^3)	1,152,045	1,308,802	1,332,192	2,268,047	2,745,515
Billed Volume (m^3)	779,719	808,319	926,964	1,237,113	1,362,006
Ratio of Unaccounted for Water (%)	32 %	38 %	30 %	46 %	50 %

Source: PDAM Maros

(1) PDAM's UFW Control Activities

PDAM Maros has not made the necessary attempts to reduce UFW except taking flow measurement to find the problems in a limited area and leakage or burst repairs. As a result, UFW has increased from 32 % in 2001 to 50% in 2005.

(2) Bulk Meters

PDAM Maros has two bulk meters measuring production at its water treatment plants. However, neither of these meters have been calibrated since installation. At least one of these needs to be replaced. All bulk meters should be calibrated on an annual basis.

(3) Household Meters

PDAM Maros has one set of household meter test bench equipment and it is used to test the accuracy of household meters. However, it is not regularly used.

(4) Leak Repairs

In 2005, PDAM Maros made about 108 leak repairs, corresponding to 0.5 leaks per km of distribution pipes. This is relatively low, but probably reflects low pressures rather than the condition of the distribution network.

2.3.4 Operational Equipment

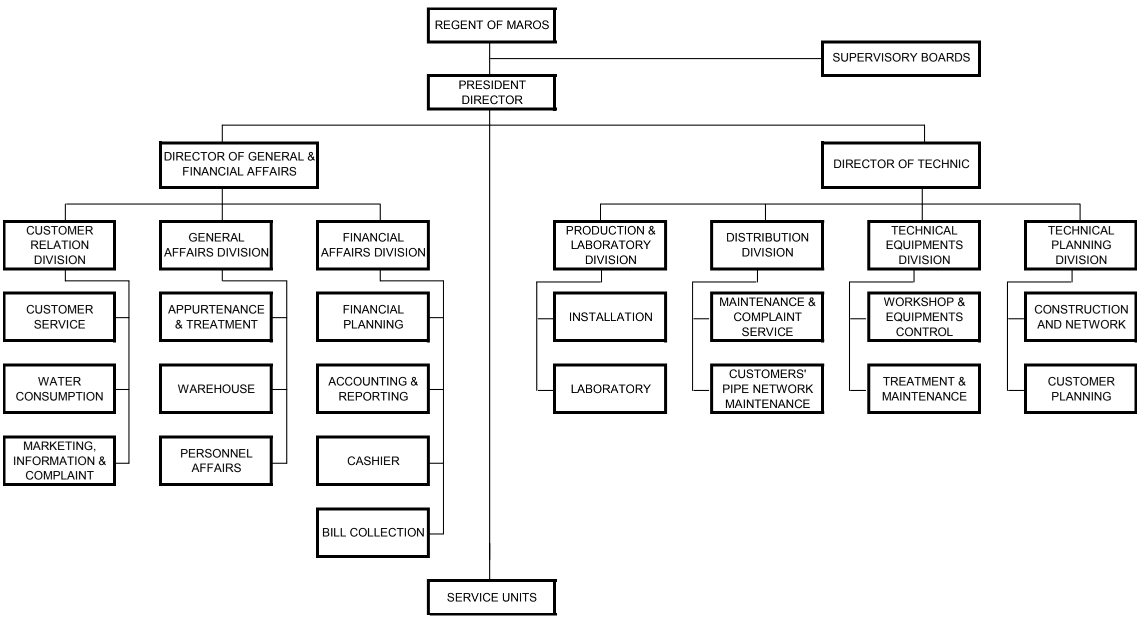
PDAM Maros suffers from a serious shortage of operational equipment. Four vehicles, being two sedans, one pick up truck and one truck, are available in PDAM Maros. The two sedans are used for the financial department, the one pick up is used by the President Director and the one truck is used for operation and maintenance, such as monitoring and patrol of the distribution network. This shortage of vehicles places a serious restriction on facilities maintenance. Pipes and fitting are chronically in short supply. Furthermore, there are not enough tools for maintenance to manage over 270km of the existing pipeline system. The major reason for this situation is due to the weak financial standing of PDAM Maros.

2.3.5 Institution Setting

(1) PDAM Staffing

The President Director of PDAM Maros presides over two sections under which 53 staff and personnel are employed. The President Director manages and controls water supply in Maros except for a private water supply scheme. The Technical Director manages and controls technical issues with 21 staff and a Director of General and Financial Affairs responsible for non-technical issues.

At the current level of staffing, PDAM Maros has 9.7 persons per 1000 connections (= (53)/5,700 con. x 1,000). This figure seems to be high in comparison with the international ratio in water supply schemes.



Source : PDAM Maros

Figure-2.3 Organization Chart of PDAM Maros

(2) Water Tariff

The drinking water tariff of Maros PDAM is set within the Decree of Maros Regent No.: 02/II/2005 on February 18, 2005 concerning the setting of Drinking Water Tariff for PDAM Maros and within the Decree of Maros House of Representatives No.: 02/KPTS/DPRD/II/2005 on February 17, 2005 regarding the approved drinking water tariff of Maros Regency. The tariff is prevailing with an annual progressive increase from 2005 to 2007 as presented in Table-2.12.

Table-2.12 Water Tariff for PDAM Maros

No.	Customer Category		Year	Water Tariff (Rp.)			
				0 - 10 m3	11 - 20 m3	21 - 30 m3	>30 m3
1	Social	General Social	2005	-	-	-	1,300
			2006	-	-	-	1,600
			2007	-	-	-	1,900
		Specific Social	2005	1,400	1,550	1,600	1,650
			2006	1,700	1,850	1,900	1,950
			2007	2,000	2,150	2,200	2,250
2	Non-Commercial	House A	2005	1,500	1,650	1,800	1,950
			2006	1,800	1,950	2,100	2,250
			2007	2,100	2,250	2,400	2,550
		House B	2005	1,500	1,700	1,900	2,100
			2006	1,800	2,000	2,200	2,400
			2007	2,100	2,250	2,400	2,550
		Governemnt	2005	1,650	1,850	2,050	2,250
			2006	1,950	2,150	2,350	2,550
			2007	2,250	2,450	2,650	2,850
3	Commercial	Small Commerce	2005	1,900		2,100	2,300
			2006	2,200		2,400	2,600
			2007	2,500		2,700	2,900
		Large Commerce	2005	2,100		2,300	3,000
			2006	2,400		2,600	3,300
			2007	2,700		2,900	3,600
4	Industry	Small	2005	1,900		2,750	2,950
			2006	2,200		3,050	3,250
			2007	2,500		3,350	3,550
		Large	2005	2,750		5,500	7,000
			2006	3,050		5,800	7,300
			2007	3,350		6,100	7,600
5	Special	Air Port, Sea Port	2005	5,500			7,900
			2006	5,800			8,200
			2007	6,100			8,500

Source: PDAM Maros

Table-2.13 Installation Cost for New Connection

No.	Customer Category		Year	Installation Cost for New Connection		
				WARRANTY	PLANNING/INSTALLATION TOOLS	AMOUNT
1	Social		2006-2007	20,000	750,000	770,000
			2008-2009	20,000	950,000	970,000
2	Non- Commercial		2006-2007	20,000	750,000	770,000
			2008-2009	20,000	950,000	970,000
3	Commercial	Small Commerce	2006-2007	30,000	1,042,000	1,072,000
			2008-2009	30,000	1,342,000	1,372,000
		Large Commerce	2006-2007	30,000	1,042,000	1,072,000
			2008-2009	30,000	1,342,000	1,372,000
4	Industry	Small	2006-2007	30,000	1,042,000	1,072,000
			2008-2009	30,000	1,342,000	1,372,000
		Large	2006-2007	30,000	1,352,000	1,382,000
			2008-2009	30,000	1,652,000	1,682,000
5	Special	Air Port, Sea Port	2006-2007	100,000	2,000,000	2,100,000
			2008-2009	150,000	2,500,000	2,500,000

Source: PDAM Maros

(3) Customer Registration

The number of customers of PDAM Maros is rapidly increasing, and reached 5,700 in 2004 as shown in Table-2.10. Registration is carried out by PDAM Maros. Registration fees, including connection fees, material costs and meter rental fees, are charged to every customer.

(4) Metering, Accounting and Billing System

Meter readers read every household meter on a monthly basis. PDAM Maros provides two customer counters and the billing and payment of water charges is to these customer counters.

(5) Operation and Maintenance

Based on the results of investigations, technicians and workers for water treatment plants and the water distribution are doing their operation and maintenance tasks. However, because of lack of knowledge and low attitude, the level of performance is low in the area of operation and maintenance for the water treatment plant and distribution pipelines. Further, no operational plan for water treatment and the distribution system has been developed by a higher level engineer. This has caused inefficiency in operation and maintenance.

The engineer or manager level staff should prepare periodical maintenance schedules for the required frequency, such as daily, monthly and yearly, maintenance work.

2.3.6 Major Problems of PDAM Maros

The major problems identified in the course of the field surveys are listed below.

- Water supply from PDAM Maros is only 8 hours per day and covered only four kechamatans because of a serious shortage of water production.
- The quality of treated water does not comply with Indonesian drinking water standards due to mismanagement by operators during the flocculation process and shortage of equipment for controlling the water quality.
- Some mechanical equipment and piping materials installed at Batu Bassi water treatment plant are defective and leakage losses were identified.
- Some of the installed service meters are malfunctioning due to the long-term absence of proper maintenance.
- Distribution pipes installed before 1995 have developed leaks due to the age of the pipes.
- PDAM Maros has a substantial lack of operation equipment such as vehicle, tools and materials for proper operation and maintenance of the water supply facilities.
- Existing water supply data such as pipeline maps and equipment details are missing.
- A lack of O&M knowledge and attitude were observed.

3. WATER DEMAND PROJECTION IN MAROS

3.1 Population Projections

In the MMA Master Plan, a population projection for the years 2000 to 2020 was made as a base for making a water demand projection. The projected population is given in Table-3.1 by target year and stages.

Table-3.1 Population Projection

No.	Kecamatan	2005	2010	2015	2020
1	Turikale	38,207	41,855	45,334	48,431
2	Bontoa	27,050	29,512	31,979	34,282
3	Simbang	22,169	24,063	25,894	27,556
4	Bantimurung	29,204	31,512	33,809	35,900
5	Maros Baru	23,842	26,200	28,477	30,529
6	Lau	24,682	26,946	29,178	31,200
Stage 1 Area Population		165,152	180,090	194,671	207,896
7	Mandai	31,925	35,040	37,927	40,585
8	Marusu	23,669	25,839	27,932	29,776
9	Tanralili	24,727	27,108	29,295	31,190
10	Moncongloe	11,440	12,474	13,448	14,302
Stage 2 Area Population		91,761	100,462	108,602	115,853
Target Area Total Population		256,914	280,551	303,272	323,749

3.2 Water Demand Projection

3.2.1 Criteria Applied for Water Demand Calculation

The Ministry of Public Works (Departmen Pekerjaan Umum, Direktorat Jenderal Cipta Karya) published Technical Guidelines for Water Supply Planning (Retunjuk Teknis Perencanaan Rancangan Teknik Sistem Penyediaan air Minum Perkotaan Volume VI) No.: 08/SE/Dc/1998 in December 1998.

According to the above criteria, the target area falls within the 100,000 to 500,000 population group. Table-3.2 shows water demand projection criteria, and the applied figures and conditions are described below.

Table-3.2 Water Demand Projection Criteria

Items	Criteria based on population (x 1000 capita)				
	> 1,000	500 – 1,000	100 - 500	20 - 100	< 20
Domestic water consumption for house connection (lcpd)	190	170	150	130	100
Domestic water consumption for public hydrant (l/c/d)	30	30	30	30	30
Non domestic water consumption (%)	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30
Unaccounted-for-Water (%)	20 - 30	20 - 30	20 - 30	20 - 30	20 - 30
Maximum day factor	1.1	1.1	1.1	1.1	1.1
Peak hour factor	1.5	1.5	1.5	1.5	1.5
Persons per house connection	5	5	6	6	10
Persons per public tap	100	100	100	100-200	200
Head-loss in distribution	10	10	10	10	10
Time of operation (hour)	24	24	24	24	24
Volume of reservoir (20%)	20	20	20	20	20
House connection: Public tap	50:50 - 80:20	50:50 - 80:20	80:20	70:30	70:30
Service Population	90	90	90	90	70

Source: Retunjuk Teknis Perencanaan Rancangan Teknik Sistem Penyediaan air Minum Perkotaan Volume VI

(1) Per Capita Domestic Consumption

The per capita domestic consumption of households applied is 100 lcpd in rural areas and 130 lcpd in urban areas for the following reasons:

- Domestic consumption of PDAM Maros was 113 lcpd in 2004.
- Domestic consumption proposed by PDAM Maros is 100 lcpd in rural areas and 130 lcpd in urban areas respectively.
- Most kechamatan populations fall in the range 10,000 to 30,000.

Consumption of public hydrants is set as 30 lcpd in accordance with the above mentioned criteria.

(2) Non-domestic Water Consumption

According to customer registration in PDAM Maros, about 90 % of customers are domestic. Therefore, the percentage of non-domestic water consumption applied has been taken as 20 % as the lowest value of the range given in the above-mentioned criteria.

(3) Service Population

The service population in the target sites is set as 80 % in urban areas and 60 % in rural areas of the projected 2015 water demand, based on the target of MGDs of Maros Regency.

(4) Unaccounted for Water

In accordance with the MMA Master Plan, it is planned to reduce the UFW to 25 % by 2015 by using a UFW reducing program. However, this figure did not consider the expansion and improvement of the distribution network system in Maros. Therefore, the target ratio of UFW has been revised to 20 % in 2015.

3.2.2 Projected Water Demand

Water Demand Projections based on the design criteria and the projected population are summarized below for each kechamatan.

Table-3.3 Water Demand for Prioritized Area

No.	Kecamatan	Target Coverage	Water Demand Projection (m3/day)		
			2,005	2,010	2,015
Stage-1 Area					
1	Turikale	80%	4,035	4,420	4,787
2	Bontoa	60%	1,675	1,827	1,980
3	Simbang	60%	1,373	1,490	1,603
4	Bantimurung	60%	1,808	1,951	2,093
5	Maros Baru	60%	1,476	1,622	1,763
6	Lau	60%	1,528	1,669	1,807
Water Demand (1)			11,895	12,979	14,034
Quantity of UFW (2)			11,895	5,563	3,509
Required Production Capacity (3)			23,790	18,542	17,543
Stage-2 Area					
7	Marusu	60%	1,466	1,600	1,730
8	Mandai	60%	1,977	2,170	2,348
9	Tanralili	60%	1,531	1,679	1,814
10	Moncongloe	60%	708	772	833
Water Demand (4)			5,682	6,221	6,725
Quantity of UFW (5)			5,682	2,666	1,681
Required Production Capacity (6)			11,364	8,887	8,406
Total Water Demand (1)+(4)			17,577	19,200	20,759
Total Quantity of UFW (2)+(5)			17,577	8,229	5,190
Total Required Production Capacity (3)+(6)			**35,154**	**27,429**	**25,949**

Note Target of UFW ratio : 2005 : 50 %, 2010 : 30%, 2015 : 20%
JICA Study Team

4. PRELIMINARY DESIGN OF FACILITIES IN MAROS

4.1 Water Supply Facilities

4.1.1 Design Framework

(1) Objectives

The object of this project is to improve, rehabilitate and extend the Maros water supply scheme.

The preliminary design of Maros Stage-1 water supply facilities aims at improving the ease of operation and maintenance of the water supply facilities by the use of good quality raw water requiring minimum treatment and zoning of the distribution network.

(2) Scope

The preliminary design includes an intake weir, a raw water main, an intake pumping station, treatment plant facilities, transmission pumps, transmission and distribution pipelines and reservoirs required to meet the water demand in Stage 1 areas, and procurement of equipment.

The water demand projection for the whole area is given in Chapter-3. It shows that the water production requirement is approx. 300 l/sec (25,949 m^3/day). The Stage 1 area requires 203 l/sec, while the requirement is 97 l/sec in Stage-2.

The existing usable treatment production capacity is 40 l/sec in Stage 1 areas and 50 l/sec in Stage 2 areas. It can therefore be seen that an additional 210 l/sec will be required to meet the total demand by the year 2015. Therefore, production capacity in Stage 1 is set as 163 l/sec and future expansion of Pattontongang water treatment plant in Stage 2 is set to produce 47 l/sec.

(3) Strategic Consideration

i) Distribution Method

The current distribution system applies a direct supply from the booster pump without distribution reservoirs. However, the new system will cover most of the Stage 1 area and needs to have a supply capacity more than three times that of the existing booster pump. Under this condition, the operation cost of a direct supply system for the new water system is estimated at about twice that for an elevated reservoir (gravity system), in terms of electricity cost and ease of operation and maintenance. High-pressure pumps can also cause massive leaks and can burst the pipes. Therefore, an elevated reservoir system has been applied in the preliminary design of the distribution system.

ii) Priorities

Approximately 70% of the demand is located in the Stage 1 area, where the consequence of inadequate water supply on public health is seen to be greatest. The improvement and expansion of supplies to these urban areas is therefore of the highest priority. Stage 1 will therefore concentrate on these areas and those rural areas where there are the most acute water shortages.

iii) Water Losses

In addition to any improvement in water supply infrastructure, a parallel improvement of the high level of UFW in the water supply system is essential, through improvement in the institutional arrangements for the operation, maintenance and management of the system.

iv) Zoning

A zoning system has not been applied in the existing distribution system. The establishment of a zoning system is effective in terms of reducing the UFW as well as in financial aspects. Therefore, improvement of the water supply system will introduce a zoning system. The zoning system has been planned based on the distribution pipeline route and the population as well as considering the existing administration boundaries of kechamatan. Based on the above condition, the Stage-1 water supply system will be divided into six zones. The proposed zoning system is described as follows.

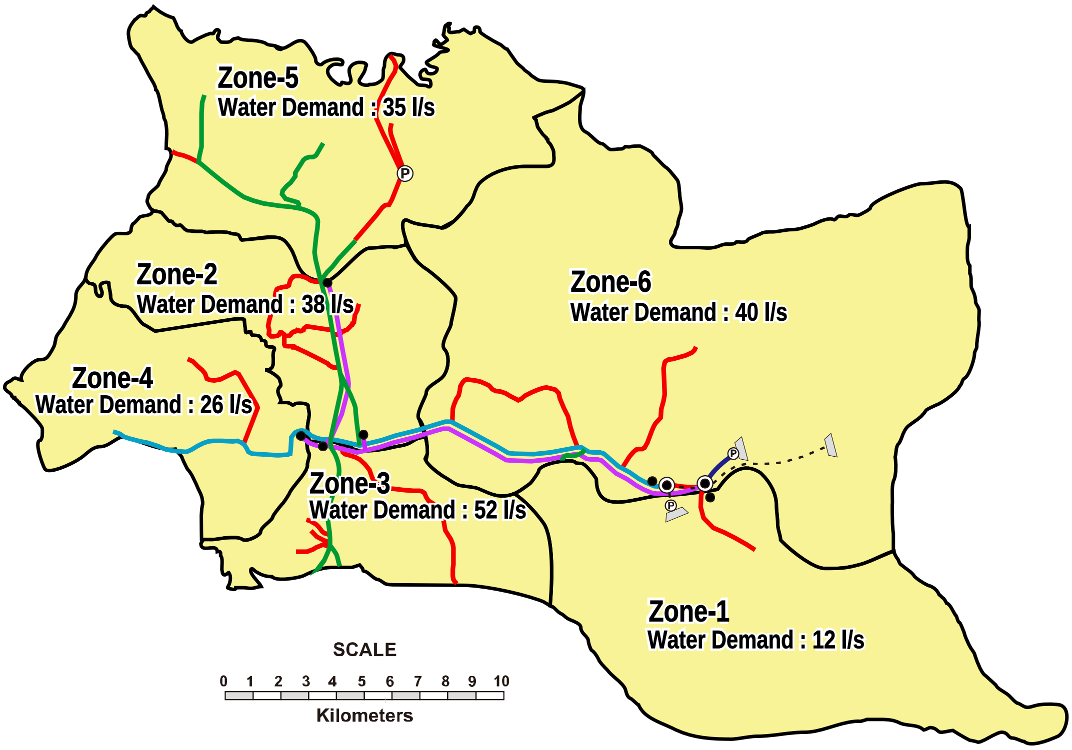


Figure-4.1 Zoning System in Stage-1 Area

4.1.2 Proposed Water Supply Improvement Plan

Salient Feature	2004 (Existing Condition)	2010 (After Completion of Stage-1)	2015 (After completion of Stage-2)
Service Population (Peoples)	2I11.7%	184,646	233,775
Service Coverage	11.7%	61.0%	77.0%
Intake Facilities (incl. Pump Station)	2 nos.	3 nos.	3 nos.
Treatment Plant Facilities (capacity)	2nos. (90 l/s)	3 nos. (253 l/s)	3 nos. (303 l/s)
Clear Water Tank	None	325 m3	Suggested to be studied during the Stage-1 implementation
Pumping Station (incl. Booster pump)	2 nos.	4 nos.	
Reservoir (capacity)	2 nos. (325 m3)	8 nos. (4,075 m3)	
Raw Water Main (ø500 mm)	2.2 km	3.3 km	
Transmission Pipeline (ø200 - 600 mm)	-	22 km	
Distribution Pipeline (ø100 - 300 mm)	106 km	199 km	
Secondary Pipe (ø40 - 75 mm)	103 km	251 km	

LEGEND
: Proposed Target Area (Stage-1)
: Future Expansion Area (Stage-2)
: Kecamatan Boundary
: Existing Raw Water Main
: Existing Distribution Pipeline
: Proposed Raw Water Main
: Proposed Transmission Pipeline
: Replacement of Distribution Pipeline
: Proposed Distribution Pipeline
: Future Raw Water Main
: Future Distribution Pipeline

Figure-4.2 Proposed Water Supply Improvement Plan in Maros

4.1.3 Intake Facilities

The intake, pumping station and raw water main have been designed with a capacity of 180 l/sec, which is 10% above the projected demand (163 l/sec), to allow possible future treatment plant losses due to sand washing and cleaning.

(1) Intake Facilities

There is a water pond at the proposed spring site, which is equipped with a weir and a diversion gate beside the proposed spring site. However, these are aged and in need of total reconstruction. Also, the slope of the water pond needs to be rehabilitated so as to reduce leakage. Details of the proposed intake and diversion chamber are given in Table-4.1.

Table-4.1 Outline of Intake Facilities

	Dimensions / Specifications	Number of Units
Intake Weir	11.0 m W x 3.5 m H	1
Diversion Gate	2.0 m W x 2.5 m H, Manual type	1
Baffle Wall	11 m W x 3 m H	1
Screen	2.0 m W x 3.0 m H	1
Raw Water Intake Gate	Diameter : 500 mm, Manual type	1

(2) Intake Pumping Station

As a result of the topographic survey, it has been shown that the proposed intake site and water treatment plant are almost level, thus it is necessary to equip an intake pump to transmit the necessary water quantity to the water treatment plant. Location of the pumping station has been designed at 150 m downstream from the proposed intake site, considering the limitation of space at the proposed intake site and it being within the national park. The specifications of pumping well, pumping station, intake pump and power receiving equipment are given in Table-4.2.

Table-4.2 Outline of Intake Pumping Station

	Dimensions / Specifications	Number of Units
Pump Well	7.4 m W x 9.2 m L x 4.0 m D	1
Pumping Station	7.4 m W x 6.0 m x 4.3 m H	1
Power Reviving Room	3.0 m W x 5 m L x 4.3 m H	1
Intake Pumps	Discharge : 180 l/sec, Head : approx 5-8 m, Output : 30 kw, Diameter : 300 mm	2 (including standby)

(3) Raw Water Main

One pipeline will be constructed for conveying the amount of the 2015 demand. The raw water pipeline route and profile are shown on the drawing. 500 mm diameter PE pipe with a length of 1.2 km will be used for the raw water main.

4.1.4 Facilities of Water Treatment

The site of the water treatment plant includes a slow sand filtration unit with inlet and outlet chambers, a disinfection system, sand wash basin, clear water tank with booster pump station and an elevated tank for operation and maintenance. In addition, an elevated reservoir for supply to Zone-1 is also located at the site of the water treatment plant. This facility is explained in the subsequent section 4.1.5 Distribution System.

The site of the proposed water treatment plant, which is already registered as government land, amounts to approximately 2.6 hectare. This land is large enough for construction of the water supply facilities for the year 2015 water demand projection in the Stage 1 area. It is about 1 km downstream from the Jamalah Spring intake site.

(1) Water Treatment Plant

In carrying out the design of treatment facilities, practical computation has been made for the target year 2015. The treatment process units have been selected and designed with a view to economic construction and easy operation and maintenance. Simple structures will remove unpredictable constraints on operation and maintenance work. The construction materials have been considered to enable acquisition from the local markets as much as possible.

Water samples were taken from the Jamalah Spring for analysis. Values for the samples are given below, together with the Indonesia Drinking Water Standards.

Table-4.3 Results of Water Quality Analysis

No.	Parameter	Unit	Jamalah Spring	Drinking Water Quality
1	Scent	–	Nil	None
2	Turbidity	NTU	17	5
3	Taste	–	Nil	None
4	Temperature	ºC	28	Air Temperature ± 3ºC
5	PH	mg/l	7.1	6.5 - 8.5
6	Total hardness	mg/l	151	500
7	Chloride	mg/l	17	250
8	Nitrate (NO_3)	mg/l	Nil	10
9	Nitrite (NO_2)	mg/l	Nil	1.0
10	NH_4	Mg/l	Nil	0.5
11	Iron (Fe)	mg/l	Nil	0.3
12	DO	Mg/l	Nil	6
13	Magnesium	mg/l	7	150
14	Organic Substance	mg/l	39	10

Source: JICA Study Team

These results indicate that the raw water was of good physical and chemical quality. The only parameters that failed to meet the drinking water standard values were turbidity and organic substance.

On the basis of these results, a slow sand filter with chlorination has been proposed, since PDAM Maros has already acquired enough space for water treatment facilities from Maros Regency, about 1 km downstream from the Jamalah Spring intake site.

Table-4.4 Outline of the Water Treatment Plant

	Dimensions / Specifications	Number of Units
Slow Sand Filters	Treatment capacity : 180 l/sec 20 m W x 40 m H	4
Inlet Chamber	4.0 m W x 86 m L x 3.2 m H	1
Outlet Chambers	8.8 m W x 2.1 m L x 3.2 m H	4

(2) Sedimentation Basin

The design concept of the sedimentation facility is to utilize the existing water pond as a sedimentation basin, which will be constructed with a baffle wall in order to get a uniform water flow. However, no settlement analysis has been conducted on the raw water. Therefore, careful optimization of this design concept will need to be considered during the final design after settlement analysis has been conducted.

(3) Disinfection

Disinfection will be done by using calcium hypochlorite. Storage space for up to three months requirements have been allowed for, together with two mixing tanks, each with capacity for 12 hours, assuming a maximum dosage rate of 1.5 mg/l and a solution strength of 2 %. Dosing will be by pumped injection before the water enters the clear water tank.

(4) Clear Water Tank

A clear water tank is required at the treatment plant site to provide chlorination contact time.

The contact period required for chlorination to be effective is normally taken as 30 minutes. Therefore, the capacity of the clear water tank is estimated as 324 m^3.

Filtered water is conveyed by connection pipes 500 mm in diameter to the clear water tank located downstream of the filter basin. The structure is reinforced concrete. The dimensions of the structure are 15 m width, 10 m length and 3.5 m depth as given in Drawing M-012. The clear water tank is attached to the pump house provided for clear water transmission to the elevated reservoirs.

(5) Sand Wash Basin and Sand Wash Machine

The sand wash basin and the sand wash machine are to be provided at the the water treatment plant site. The purpose of the sand wash basin and the sand wash machine is to wash the filtration media. The structure of the sand wash basin is reinforced concrete, approximately 5 m width, 20 m length and 1m depth, while the sand wash machine is the unit type.

(6) Transmission Pumps

A transmission pump is to supply clear water to each zone in the Stage 1 area. The water for Zone-1 will be transmitted by a transmission pump located at the new water treatment plant. The water for Zone-2, Zone-3 and Zone-5 will be directly transmitted to each reservoir tank by the same transmission pump located at the new water treatment plant. The water for Zone-4 will be transmitted from the reservoir tank of Zone-3 by gravity. Zone-6 will be served by a transmission pump located with the existing Batu Bassi water treatment plant.

Table-4.5 Outline of Transmission Pumps

Supply Zone	Location of Pumping Station	Dimension of Pumping Station	Pump Specification	Number of Units	Remarks
Zone-1	Inside new water treatment plant building	8 m W x 10 m L x 3 m H	Q : 13.5 l/sec, TH : 21 m Output : 5.5 kw	2 (including one standby)	
Zone-2, 3 and 5			Q : 166 l/sec, TH : 45 m Output : 132 kw	2 (including one standby)	With flow control system

Note: Zone-4 is supplied by T-3 elevated reservoir.
Supply to Zone-6 is explained in "Sub Clause 4.1.6 Rehabilitation".

A topographic survey should be carried out along the transmission line at the detailed design stage in order to confirm the actual ground level.

(7) Other Facilities

The site of the treatment plant includes administration buildings and operation and maintenance facilities as follows:

- Basic office with washroom (100 m^2)
- Laboratory with basic equipment for chemical and bacteriological measurements of raw and treated water (50 m^2)
- Store (120 m^2)
- Chemical room (50 m^2)
- Guard house (16 m^2)
- Power receiving facility (25 m^2)
- Elevated tank (H : 25 m, Volume : 75 m^3) with pump (Quantity : 10 l/sec, TH: 30 m)

4.1.5 Transmission Pipeline

One pipeline will be constructed to convey the amount of water for the 2015 demand in Zone-2, 3 and 5. The transmission pump for Zone-1 and 6 are to be equipped just beside the reservoir tanks.

(1) Design Value and Specifications

Maximum flow : 1.1 times the daily average flow

Maximum velocity in pipe : Maximum 1.0 m/s
Pipe Material : PE Pipe

(2) Details of Transmission Pipeline

Details of transmission pipelines are summarized in Table-4.6.

Table-4.6 Outline of Transmission Pipelines

	Diameter	Length	Flow
New Treatment plant to T-2 reservoir	Main : 500 mm Branch : 300 mm	11,200 m 100 m	Pumping from treatment plant
T-2 reservoir to T-3 reservoir	Main : 500 mm Branch : 200 mm	2,018 m 100 m	Pumping from treatment plant
T-3 reservoir to T-4 reservoir	Main : 200 mm	2,100 m	Gravity
T-3 reservoir to T-5 reservoir	Main : 400 mm	6,152 m	Pumping from treatment plant

In addition to transmission mains, fittings such as bends, flow meters, sectional valves, wash out valves, air valves, and appurtenances such as road and river crossings, thrust blocks, and valve chambers, will be needed for the entire system.

4.1.6 Distribution System

The projected water demand in 2015 is estimated at 163 l/sec, to be described in Chapter 4 "Water Demand Projection".
The proposed system in Stage 1 receives treated water from two water treatment plants. One source is based on supplying water from the existing treatment plant, and the other is from the proposed treatment plant, which has a much larger supply capacity. Most of the Stage 1 areas are covered by the existing distribution system. However, the capacities of the pipelines are not meeting the water demand, and expansion of distribution capacity is needed so as to supply the necessary quantity of water.

(1) Design Values

Basic design flow : Average demand
Peak hourly factor : 1.5 times average flow
Maximum day factor : 1.1 times average flow
Volume of reservoir : 20 % of average water demand

Maximum water pressure : 100 m
Minimum water pressure : 10 m
Hydraulic equation used : Hazen-Williams formula

(2) Supply Area

The supply area of the proposed Stage 1 system extends over the entire Maros central area, including kechamatans of Bontoa, Lau Maros Baru, Bantiurung, Turikale and Simbang, totaling approximately 417 km^2, out of the whole study area of 628 km^2 as shown in the Drawings No. G-001. The estimated population of the Stage-1 area is 165,000 people in year 2005.

The served area will be divided into six zones in the Stage 1 area and supplied by elevated reservoirs from the existing and new water treatment plants. One of the zones is partially supplied by booster pump in view of its economical advantage.

(3) Pipe Materials

Polyethylene pipe (PE pipe), which complies with ISO Standards, is recommended by the Indonesian Government in order to reduce leakage and provide cost-effective performance. Therefore, PE pipe is proposed for the majority of distribution mains. Steel pipes are proposed for those adjacent to the water treatment plant and pumping station.

(4) Pipeline Design

The total length of distribution pipes to be constructed in Stage 1 is about 72 km, as summarized in Table-4.7.

Table-4.7 Outline of Distribution Pipeline

Diameter	Material	Length (m)
300 mm	PE Pipe	3,683
200 mm	PE Pipe	16,586
150 mm	PE Pipe	41,515
100 mm	PE Pipe	10,118
Total		71,899

A topographic survey for the raw water main route was conducted as shown in Drawing No.M-013 to M-018. Meanwhile, the hydraulic gradient along the transmission and distribution main route has been estimated based on the map with a scale of 1 to 50,000. Therefore, the topographic survey is necessary to improve the precision of calculations.

In addition to distribution mains, fittings such as bends, flow meters, sectional valves, wash out valves, and air valves, and appurtenances such as road and river crossings, thrust blocks, and valve chambers, will be needed for the entire system.

(5) Reservoirs

At present, PDAM Maros has only about 125 m3 of usable storage at Bats Bassi treatment plant in the Stage 1 area, which represents less than 1 hour's supply at current production capacity in Stage 1. Because of changing to a zoning distribution system, the existing reservoir of 125 m^3 will be used as a clear water tank for Bats Bassi water treatment plant.

Reservoirs will be provided for each zone. Each reservoir provides water that can be withdrawn during peak periods of demand and then replenished during the night when the system demand is low.

Table-4.8 Outline of Reservoirs

Tank No.	Type of reservoir	Height (m)	Capacity (m^3)	To be supplied to
T-001	Elevated	11m	220	Zone-1
T-002	Elevated	35m	930	Zone-2
T-003	Elevated	20m	1,000	Zone-3
T-004	Elevated	20m	380	Zone-4
T-005A	Elevated	15m	610	Zone-5
T-005B	Ground	-	220	Zone-5
T-006	Elevated	11m	640	Zone-6
Total			4,000	

The new reservoirs to be constructed during Stage 1 are listed in Table-4.8. The proposed reservoirs will increase the total system storage to 20 % of the average day demand. A total storage capacity of 4,000 m^3 from six tanks has been planned for the Stage 1 area.

(6) Booster Pump and Pumping Station

A booster pump will be provided next to the T-005B reservoir in Zone-5 which supplies the high level area in Zone-5.

Table-4.9 Outline of Booster Pump and Pumping Station

Dimension of Pumping Station	Pump Specification	Number of Units
8 m W x 10 m x L x 3 m H	Q : 12.6 l/sec, TH : 42 m Output : 11 kw	2 (including one standby)

(7) Service Pipeline and Public Hydrants

The total length of service main to be constructed is 148.3 km, as summarized in Table-4.10. The calculation of service main is based on 10 m per household and 20 m per public hydrant. There are 252 public hydrants to be constructed.

Table-4.10 Outline of Service Pipeline

Diameter	Material	Length (m)
75 mm	PE Pipe	111,181
50 mm	PE Pipe	37,060
Total		148,241

(8) Bulk Meters

Bulk meters installed at existing water treatment plants are not calibrated. To establish a metering system, and initiate leakage control activities, bulk meters will be provided at the inflow and out flow points of the water treatment plants and reservoirs.

4.1.7 Rehabilitation of Existing Pipeline and Pumps

As stated in Chapter 2, more than half of the pipeline was installed between 1989 and 2000. Full-scale pipe rehabilitation is considered premature and impractical. However, some old facilities and pipelines, especially steel pipe installed before 1995, need to be replaced, since leakages have been observed. The actual condition of the other existing pipes will be confirmed during the UFW program and the places where it is necessary to provide replacements will be identified. Replacement of damaged pipe will be undertaken with the UFW program after confirmation of the condition.

Table-4.11 Outline of Existing Distribution Pipeline Rehabilitation

Description	Material	Diameter (mm)	Length (m)
Zone-2	PE pipe	200	3,900
Zone-4	PE pipe	150 200 300	4,160 1,300 2,200
Zone-6	PE pipe	200 300	4,154 3,041
Total	PE pipe	150 200 300	4,160 9,354 5,241

The existing pumps, with adjacent equipment, need to be replaced, since the specifications of the pumps do not meet the requirements of the new supply system.

Table-4.12 Outline of Existing Transmission Pumps and Back Wash Pump Replacement

Facilities	Specification	Quantity	Scope
Transmission Pumps	40 l/sec, TH : 16 m, Output : 11 kw	2	Replacement
Back Wash Pump	30 l/sec, TH : 20 m, Output : 11 kw	1	Replacement

4.2 Operation and Maintenance and System

To achieve efficient operation of the expanded water supply facilities, the following equipment will be provided under Stage 1.

4.2.1 Metering

In PDAM Maros, the entire cost of installing service connections is borne by customers. Accordingly, the cost of materials and equipment required for establishing the metering system is only that for replacement and repair of the defective customer meters so far installed.

According to PDAM Maros, a quarter of the meters installed before 2003 are not accurate or malfunction. Thus 1,180 sets of meters (a quarter of 4,718) will be required.

4.2.2 Equipment for Leakage Control

To initiate activities for leakage control at the earliest date possible, early establishment of the metering system is recommended. Leakage control is considered most effective in attaining a reasonable level of accounted for water ratio. For this purpose, acoustic bars for iron and PE pipes, leak noise correlators, portable flow meters and pressure gauges, and two survey vehicles will be required by the project.

Table-4.13 Outline of Leakage Control Equipment

Description	Type	Quantity
Acoustic Bar	For Iron	3 sets
Acoustic Bar	For PE and uPVC	3 sets
Leak Noise Correlator	Digital Signal Processing	3 sets
Leak detector	Sounding	3 sets
Portable Flow Meter	Ultra Sonic	2 sets
Pressure Gauge	24 hours recording	6 sets
Survey Vehicle	4WD	2

4.2.3 Laboratory Equipment

PDAM Maros does not have necessary water quality testing equipment except for a Jar Tester. The equipment for water quality tests will be supplied in order to maintain a safe water quality. The outline of the equipment for water quality testing is described in the following table.

Table-4.14 Outline of Laboratory Equipment

Description	Quantity
Micro Scope	1 set
Incubator	1 set
Pressure Gauge	1 set
Turbidity Meter	1 set
Spectrophotometer	1 set

Description	Quantity
pH meter	1 set
DO meter	1 set
Conductivity meter	1 set
Chlorine meter	1 set

4.3 Strengthening of Institutional Capacity

Current institutional capacity of PDAM Maros is low due to the lack of finance, qualified staff and also low morale. The strengthening of the capacity of the organization to deal with commercial and operation and maintenance tasks will not only depend on the availability of finance but on correct staffing levels, transport and equipment and also on the attitude of management and the workforce towards addressing the task in hand. Operation and maintenance improvement is starting from the current level and everyone will require a change of attitude if rapid improvements are to take place.

In order to strengthen the organization capacity, a staff training program is to be conducted under the project. The proposed training program is divided into three categories for management personnel, administration staff and technical staff. Each component of the training program is mentioned below.

1) Training program for Management (President Director, Technical and Financial Directors)

- Management system for water supply
- Present situation of water supply
- Water tariff, problems and solution
- Water supply and finance
- Economic and financial analysis
- Business planning
- Personnel management
- Survey and control of water leakage
- Customers and water conservation behavior
- Management of pumps and plant

2) Training Program for Administration staff

- Introduction to water supply
- Customer relations
- Accounting
- Financing
- Contracts
- Rate collection
- Procurement

3) Training Program for Technical Staff

- Basic engineering technology
- Water supply installation
- Water quality management

4.4 UFW Program

UFW in the PDAM Maros water supply system was about 50% in 2005. A UFW program will be conducted, both in Stage 1 and Stage 2 areas, since PDAM Maros has not made the necessary attempts yet to reduce UFW except taking flow measurement to find the problems in a limited area and leakage or burst repairs.

4.4.1 Outline of UFW Program

It is proposed that PDAM will commence a UFW Program, with the objective of reducing technical and non-technical losses, through training PDAM staff in water

loss control, establishing a permanent organization structure for water loss control, and building the human capacity and systems to continue the UFW activities on a long term basis.
The recommended targets of the UFW Program are as follows.

(1) Short Term Target (– 2010)

Target: UFW reduced to 30 % by 2010

- Permanent UFW Special Division established and trained, and operating
- Visible leakage repairs (main and service pipes to house connection) in Stage-1 and Stage-2 areas
- Zoning and installation of district meters in Stage-2 area
- Replacement of defective water meters
- Invisible leakage repairs (main and service pipes to house connection) detected by district metering, step test, and use of technical testing and equipment.

(2) Mid Term Target (2011 – 2015)

Target: UFW reduced to 20 % by 2015

In the MMA Master Plan, the target of UFW is designated as 25%. This value is based on the implementation of the UFW reduction program. Renewal or extension of distribution pipes had not been considered. In Stage-1, revision and extension of distribution pipe is planned and lengths of new distribution pipe will increase conspicuously. Considering this condition, the target of UFW under this program is revised from 25% to 20%.

- Installation of district meters in Stage-1 area
- Invisible leakage repairs (main and service pipes to house connection) detected by the district metering, step test, and use of technical testing and equipment

In the process for the reduction of UFW, detection of illegal connections will be also emphasized, assuming that there are a number of illegal connections which contribute to a higher ratio of UFW. Detection is possible by applying methods widely used for detection of water loss such as district metering, step test and so on.

The UFW Program will be implemented in two stages. In Stage 1, PDAM staff will carry out the UFW Program with the assistance of advisors or consultants. From 2011, PDAM staff members will continue the UFW Program. The UFW

Program will consist of four types of activities, namely Organizational, Management, Zoning and Repair/Rehabilitation, as summarized in Table-4.15.

As a first step, PDAM Maros will need to establish a UFW taskforce, having a permanent UFW manager reporting directly to the PDAM President Director. The taskforce will include representatives of all departments in PDAM concerned with UFW. The UFW manager will coordinate, plan and report on UFW activities and manage the UFW consultants. During Stage 1, PDAM should establish a permanent Water Loss Control Section to continue the UFW Program on a continuing basis.

To successfully implement the UFW Program, PDAM Maros will require technical assistance in Stage 1. Such technical experts include:

- A Water Supply Distribution/Water Loss Control Specialist to provide intermittent inputs (6 months per year) over four years for Zoning activities, advice on UFW control and distribution system operation, and training of PDAM water loss control teams, and
- A Network Analyst to update the network model and provide training of PDAM operations and planning staff for one year full time.

Zoning involves the establishment and training of PDAM water loss control teams to undertake physical and non-physical loss control on a zone-by-zone basis.

Table-4.15 Summary of UFW Activities

1. Organization
・ Appoint a UFW Manager to plan, co-ordinate and manage the UFW Program ・ Set up a UFW taskforce to co-ordinate the water loss control activities of the various departments in PDAM, and assist in monitoring and planning of water loss control activities ・ Establish a permanent Water Loss Control Section in PDAM Maros ・ Engage and manage consultants to assist with the UFW Program
2. Management
・ Improved meter management, including routine calibration and/or replacement of customer meters ・ Replacement, repair, calibration and/or replacement of bulk meters ・ Verification of customer registration ・ Review of un-metered consumption if necessary ・ Improved meter reading, billing and collection systems ・ Detecting and eliminating illegal practices in the water supply system ・ Introducing decrees and regulations to support the UFW program ・ Public awareness and public relations for water loss control ・ Updating water supply drawings and record systems ・ Improved procedures for dealing with and recording leaks and bursts ・ Improved record system for water supply assets ・ Updating and improving the network computer model ・ Pressure control in the distribution network ・ Improved distribution system management ・ Improved operation and maintenance ・ Procurement of UFW materials and equipment (valves, meters, pipes and fittings)
3. Zoning
・ Training of water loss control teams by the consultant ・ Creating zones for monitoring and control of flow and pressure ・ District meter installation ・ Valve location and repair ・ Proof testing of zone networks ・ Leak detection and reypair ・ Step-testing ・ Non-technical loss investigations on a zone-by-zone basis (customer registration, illegal connections, meter replacement, etc.)
4. Repair and Rehabilitation
・ Repair, rehabilitation or replacement of pipes in distribution network ・ Repair, rehabilitation or replacement of service connections ・ Repair or replacement of consumer meters

4.4.2 Actions by PDAM Maros

PDAM will need to support the leak detection teams by providing resources such as leak repair teams, transportation, pipes and materials for leak repairs, a small number of distribution pipes and valves, and chambers for the UFW meters and valves.

In conjunction with the leak detection and repair work PDAM will need to undertake a distribution improvement program that will include:

- improved procedures for dealing with leaks and bursts;
- pipe rehabilitation or replacement;
- valve rehabilitation program;
- improved record system for water supply assets;
- pressure control in the distribution network and;
- improved operation and maintenance.

5. ESTIMATED COST OF IMPROVEMENT IN MAROS

5.1 Construction Cost Estimate

5.1.1 Basis of Estimate

The project financial cost comprises the following items.

(1) Direct construction cost
(2) Procurement of equipment cost
(3) Land acquisition
(4) Government's administration cost
(5) Engineering services expenses
(6) Staff training cost including UFW program cost
(7) Physical contingency

For the estimate of costs, the following conditions and assumptions are to be applied.

(1) Exchange Rate

The base date for the costs estimate is May 2006, with an exchange rate of US$ 1 = Rp. 8,760

(2) Foreign and Local Currency Portions

Project cost estimates are divided into the foreign currency portion and local currency portion assuming that the implementation costs will be funded by foreign donor/s for the foreign currency portion.

Steel and PE pipes as well as cement are manufactured locally in Indonesia to international standards, and the raw materials in both cases are locally available, resulting in no foreign exchange requirement for pipes and cement.

On the other hand, electrical and mechanical items of good quality such as pumps, gates, valves and control panels and all of the procurement costs for equipment are not available locally and so are imported, resulting in significant foreign exchange being required. The main requirement for importation for the contract will therefore be electrical and mechanical, and procurement of, equipment items.

5.2 Cost Estimate

(1) Direct Construction Cost

The unit construction price has been collected from recent tender rates for the construction of similar works, and suppliers' quotations for material. These rates have been used to make an estimate of the construction costs for the works identified to be included under Stage-1 of the proposed project. To facilitate cost estimates, these rates have also been used to calculate "all in" costs for concrete, pipeline construction using different materials and estimates for the cost of standard reservoir sizes.

(2) Procurement of Equipment Cost

The costs of the procurement of equipment have been collected from suppliers.

(3) Land Acquisition Cost

Sites for four reservoir tanks and two pumping stations have been included for land acquisition cost. Each reservoir needs an area of 624 m2 and the two pumping stations need an area of 300 m2 and 500 m2 each, respectively. Land for the new water treatment plant was already registered by Maros Regency, so the land acquisition cost for the water treatment plant is excluded. The unit cost for land acquisition was obtained from PDAM Maros. These land acquisition costs have been estimated on a lump sum basis.

(4) Government's administration cost

The Government's administration expenses for the project implementation are considered to be in proportion to the amount of the local portion of the direct construction cost. Two percent was applied and incorporated into the local currency portion.

(5) Engineering Services Expenses

The engineering services expenses are estimated in proportion to the direct construction cost to cover for the tender design and construction supervision. Fifteen percent is applied, excluding contingency and government's administration cost, and has been incorporated into the foreign and local currency portions at 80 percent and 20 percent, respectively.

(6) Staff training cost including UFW Program Cost

In the course of the implementation of the project, it will be necessary for various levels of the PDAM Maros staff to have proper training for relevant issues. Ten percent was applied, excluding contingency and government's administration cost, and incorporated into foreign and local currency portions at 80 percent and 20 percent, respectively.

(7) Physical Contingency

The physical contingency is provided to cover minor differences between actual and estimated quantities, omissions of minor items of work, to pay for incidental items, difficulties unforeseeable at the site, possible changes in plans, and other uncertainties. Fifteen percent of the base cost is applied.

Based on the above conditions, the cost of the Maros Water Supply Improvement Project System been estimated as summarized in Table-5.1 below.

Table-5.1 Estimated Project Cost

Item	Unit	Foreign (US$)	Local (US$)
1 Direct construction			
1) Civil Works			
a Intake works			
Intake facilities	LS.	15,500	118,300
New water treatment plant facility	LS.	80,000	873,290
Intake pumping station	LS.	1,080	46,908
Clear water tank with Pumping Station	LS.	1,800	98,779
Ground reservoir with booster pumping station	LS.	720	51,218
Elevated reservoir (220m^3) ; T1	LS.	0	139,367
Elevated reservoir (690m^3); T2	LS.	0	360,275
Elevated reservoir (910m^3); T3	LS.	0	500,569
Elevated reservoir (450m^3); T4	LS.	0	282,800
Elevated reservoir (580m^3); T5A	LS.	0	357,896
Elevated reservoir (700m^3); T6	LS.	0	412,224
2) Pipe Works			
a Raw water pipe	LS.	12,629	370,500
b Transmission pipe	LS.	528,651	5,821,558
c Distribution pipe	LS.	184,437	2,784,270
d Distribution pipe for rehabilitation	LS.	80,405	1,276,909
e Tertiary pipe	LS.	0	963,565
d Road crossing, Pipe bridg, etc.	LS.	337,884	497,566
3) Electrical and Mechanical	LS.	670,000	0
4) Procurement of Equipment	LS.	102,550	0
Sub-Total-1		2,015,656	14,955,994
2 Land Acquisition	LS.	0	7,494
Sub-Total-2		0	7,494
3 Engineering Services			
1) Engineering design and construction advice (15%)	LS.	2,036,598	509,150
2) Staff training cost including UFW Program (5%)	LS.	1,357,732	339,433
Sub Total-3		3,394,330	848,583
4 Government's Administration Cost (2%)	LS.		299,120
Sub Total-4		0	299,120
5 Physical Contingency (10%)	LS.	540,999	1,611,119
Sub Total-5		540,999	1,611,119
Total Estimate Cost		5,950,985	17,722,310

5.3 Recurrent Cost Estimate

(1) Operation and Maintenance

Historically levels of operation and maintenance cost have generally been low, but this would appear to have resulted in a deterioration of the water supply infrastructure and reduced its expected lifetime. Therefore, to safeguard investments in infrastructure so they continue to provide a reliable service for the whole of their expected lifetime, it is advisable to budget for higher levels of maintenance costs. The design manuals of other developing countries suggest annual maintenance budgets based on a reasonable percentage of the investment costs which can be simplified as shown in Table-5.2.

Table-5.2 Annual Maintenance Costs

Assets	Annual maintenance cost as % of investment costs
Civil works	1 %
Pipelines	1 %
Electrical & Maintenance works	5 %

The actual maintenance costs will tend to be lower initially but increase as the assets become older. However, the above rates represent a reasonable average to be expected over the asset lifetime, and have been applied to the investment costs to arrive at the annual maintenance cost of assets.

(2) Economic Life

All assets have an economic lifetime, after which it is no longer considered economic to maintain them. The design manual of other development countries provide the following guidance:

Table-5.3 Economic Life of Assets

Asset	Economic Lifetime (Years)
Civil works	30
Pipelines	30
Electrical & Maintenance works	10

These economic lifetimes are again similar to those used in other developing countries, although they are much lower than those currently used in most developed countries. This is probably due to the harsher conditions in developing countries, and the higher levels of training and commercialization in developed countries.

(3) Power Costs

Power costs are significant for the proposed water supply scheme, as it is designed for use of a booster pump system. The annual cost has been calculated for the Stage 1 area using the Indonesian tariff as follows:

Table-5.4 Electricity Tariff

Items	Electricity fee (US Dollars)
Pump use	106,000
Water treatment use	2,600
Others	2,000
Total	110,600

(4) Staffing Costs

Staffing requirements have been estimated for the treatment plant and distribution system, as given below. Staffing includes for local management, meter reading, billing, collections and the UFW team. The annual projections have been calculated, using a similar salary scale as currently applicable for PDAM Maros, by applying the staffing figures in Table-5.5.

Table-5.5 Staffing in Stage 1

Description	New Treatment Plant	Distribution	UFW team
Engineer 1	1	1	1
Senior operator	2	1	0
Leak investigator	0	0	2
Pump operator	4	1	0
Meter reader	0	10	0
Line patrollers	0	3	2
Laboratory Technician	1	0	0
Clarks,	2	0	0
Watchman	4	0	0
Driver	0	2	1
Total	14	18	6

(5) Chemical Costs

The new water treatment plant will not use coagulants other than chlorine. The chlorination costs have been estimated using current unit costs for supply of chemicals, as quoted by suppliers, and using a dosage rate appropriate to the raw water quality. The cost for dosing chlorine is given in Table-5.6.

Table-5.6 Chemical Cost

Chemical	Cost in US $/kg	Dosage rate (mg/l)	Cost of water US $/m^3	Cost of water US $/day
Chlorine	2.0	1.5	0.003	42

5.4 Implementation Plan

5.4.1 Basic Consideration

(1) Planned Period

The MMA Master Plan stage of this study proposed an overall plan for the provision of water to the supply area, using a design horizon of 2015. Stage 1 and Stage 2 of this overall plan, to provide facilities to meet the expected water demand of the year 2015, is the subject of the Study. Therefore, the implementation schedule for Stage-1 covers the period up to the year 2010 and Stage-2 covers the period from 2011 to 2015. This indicates that to ensure sufficient water is supplied beyond the year 2015 in the whole area there must be some further work done.

(2) Institutional Strengthening and UFW Program

As mentioned earlier, the UFW program is divided into two targets as a short term target and a mid term target. The short term target period is up to 2010 while the mid term target is from 2011 to 2015. The work towards the short team target will conducted in collaboration with advisors or consultants, and the work for the next target will be conducted by trained PDAM staff. Institutional strengthening will also be conducted together with the UFW program in the period up to 2010.

(3) Division of Contract

The construction of the raw water intake, pumping station, raw water main, water treatment plant, transmission pipeline, distribution pipeline and reservoirs all require fairly high levels of planning, skilled workmanship and supervision. In order to make the work attractive to the larger contractors, who are more likely to have these skills, it is desirable to tender these works as one large contract. The electrical and mechanical components have been designed to not be as large as the civil works. No separate contract is required for these items.

5.4.2 Implementation Schedule

The implementation schedule allows for 32 months construction period for the contract. The implementation schedule for Stage 1 is shown in Figure-5.1.

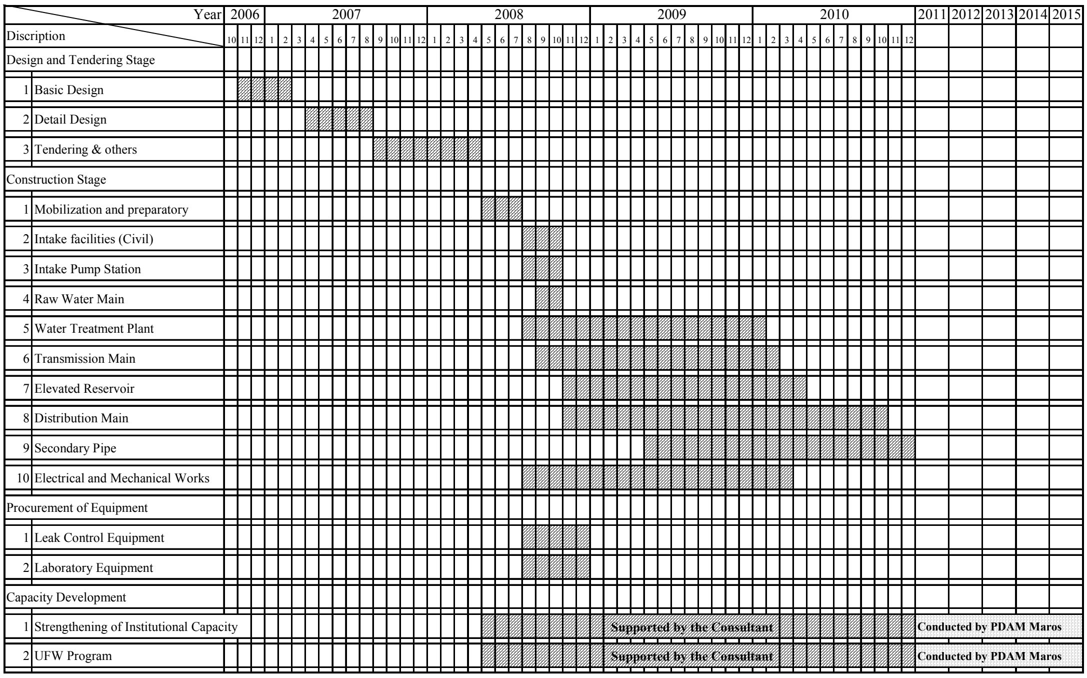


Figure-5.1 Implementation Schedule for Improvement of Water Supply System in Maros

PART-B IMPROVEMENT OF WATER SUPPLY SYSTEM IN TAKALAR

6. OVERVIEW OF WATER SUPPLY IN TAKALAR

6.1 Background

The coverage of the piped supply in Takalar regency was 4.0 % in 2005. Takalar center and IKK Polombangkeng Utara are covered by piped supply systems. Consumption of PDAM piped water in Takalar regency is limited by the capacity of clean water production. The current state of supply is 8 hours per day in Takalar center and 3 to 4 hours in IKK Polombangkeng Utara.

Under such conditions, PDAM Takalar and the stakeholders requested expansion and rehabilitation of two existing water supply systems, and provision of one new water supply system in Kechamatan Galesong Selatan which has seriously suffered from a shortage of clean water. Based on this request, a preliminary water sources survey has been conducted in the three requested areas and the following issues have been confirmed.

(1) Takalar Center Water Supply System

PDAM Takalar requested the improvement of the water supply capacity at Bajeng weir where 10 l/sec of water is taken from Palleco river.

- Palleco River is not a stable source for drinking water supply due to water right for irrigation upstream and the insufficient quantity of river water during the dry season.
- Takalar regency has a plan to increase the intake capacity to 20 l/sec, and this plan has been accepted and budgeted already by the Takalar regency.

For these reasons, the priority of this system improvement is comparatively low from the view points of urgency and reality.

(2) Kechamatan Galesong Selatan New Water Supply System

Regarding the proposed water source for Kechamatan Galesong Selatan, the following issues have been identified.

- Kechamatan Galesong Selatan is located along the coast and salt-water intrusion is reported in the rivers in Kechamatan Galesong Selatan. Therefore, the surface water is not suitable for a source of drinking water supply.

- The well water is not suitable for drinking water due to salinity.
- It was also requested that Bonto Mangape weir be utilized as a water source. Bonto Mangape weir is currently utilized for collecting irrigation drain water and supplying the water to downstream irrigation fields. The discharge capacity of this weir is insufficient during the dry season due to the drain canal. In addition, the water quality is not suitable for drinking water use, since drain water may contain residual chemicals.

Though the improvement of a water supply system is required in this area, it is not possible to carry out an urgent project due to the limitation of the water potential available. Therefore, it is recommended that a detail plan of a water supply facility for this area be prepared as an integrated water resource management plan based on the long-term vision in Takalar and that this area be precluded now from the Pre-Feasibility Study.

(3) IKK Polombangkeng Utara Water Supply System

The Palleco river flows in the western area of Kechamatan Polombangkeng Utara and the river water is utilized for irrigation in the upstream area. The water source cannot be termed stable due to the lack of possible intake capacity in the dry season. In addition, shallow wells cannot provide a stable supply from the viewpoint of water quantity. On the other hand, potential deep wells with significant capacity have been found and the yielding capacity would be sufficiently secured. The capacity of the existing shallow well has been decreased by 24 % over the last two years. Therefore a secure water source is urgently needed.

Based on the survey result and discussion with PDAM Takalar and other stakeholders, improvement of IKK Polombangkeng Utara Water Supply System will be taken up for the Pre-Feasibility Study. This improvement work aims to meet the target water coverage ratio set by PDAM Takalar in the target area, and includes the following:

i) Development of new deep wells and a distribution system.
ii) Procurement of operation and maintenance equipment.
iii) Reducing unaccounted-for-water by controlling technical and non-technical losses.
iv) Improving operation and human resources development.

6.2 Project Objectives

The objective of PDAM Takalar water supply improvement with the groundwater available in the target area will include the following:

- increasing water production and water supply coverage,
- improving the existing water supply system and service levels, and
- improving the performance of PDAM Takalar through capacity development.

By achieving these objectives, development of groundwater in the target area will enable PDAM Takalar to expand and improve the coverage, water and system quality of their water supplies, thereby supporting economic and social development and improving health profiles in the target kechamatan.

This Pre-Feasibility Study aims at providing a preliminary assessment of the technical, economic and financial viability of the expansion of IKK Polombangkeng Utara Water Supply System with the groundwater available in the target area in Takalar regency. The improvement work for the Takalar water supply system has been defined in the following manner.

Table-6.1 PDAM Takalar Water Supply Improvement

Period	Item	Description
2007-2010	Immediate work	• Construction of new deep wells and their pumping stations. • Expansion of new distribution systems in nine target Desa. • A UFW Program, including UFW taskforce, PDAM staff training, bulk meter calibration and repair, leak detection and repair, non-technical loss reduction in both the target site and Takalar center water supply system. • PDAM capacity development program and operation and maintenance, distribution system management, corporate management, capital works program management, and customer relations.
2011-2015	Mid term work	• Continue UFW Program

7. EXISTING CONDITIONS IN TAKALAR

7.1 Socio - economic Conditions

7.1.1 Administration and Population

Takalar regency is located in the southern part of South Sulawesi between 4.3’ to 5.38’ in south latitude and between 119.02’ and 119.39’ in east longitude, surrounded by Gowa Regency and the Makassar Strait. The total area is 519.5 km^2. The regency is composed of seven kechamatan and 73 desa /kelurahan. The total population of this area was 247,870 in 2005, growing at the rate of approximately 1.2 % per year. The population and areas by kechamatan are shown in the following figure.

Table-7.1 Population and Areas in Takalar Regency

Kechamatan	Population	Area (ha)
Mangara Bombang	35,113	9,504.83
Mappakasunggu	26,967	3,036.59
Plombangkeng Selatan	24,524	7,968.33
Pattallassang	30,134	2,685.37
Plombangkeng Utara	42,028	22,702.85
Galesong Selatan	46,048	2,685.37
Galesong Utara	43,058	3,997.97
Total	247,871	51,946.83

Source: The MMA Master Plan

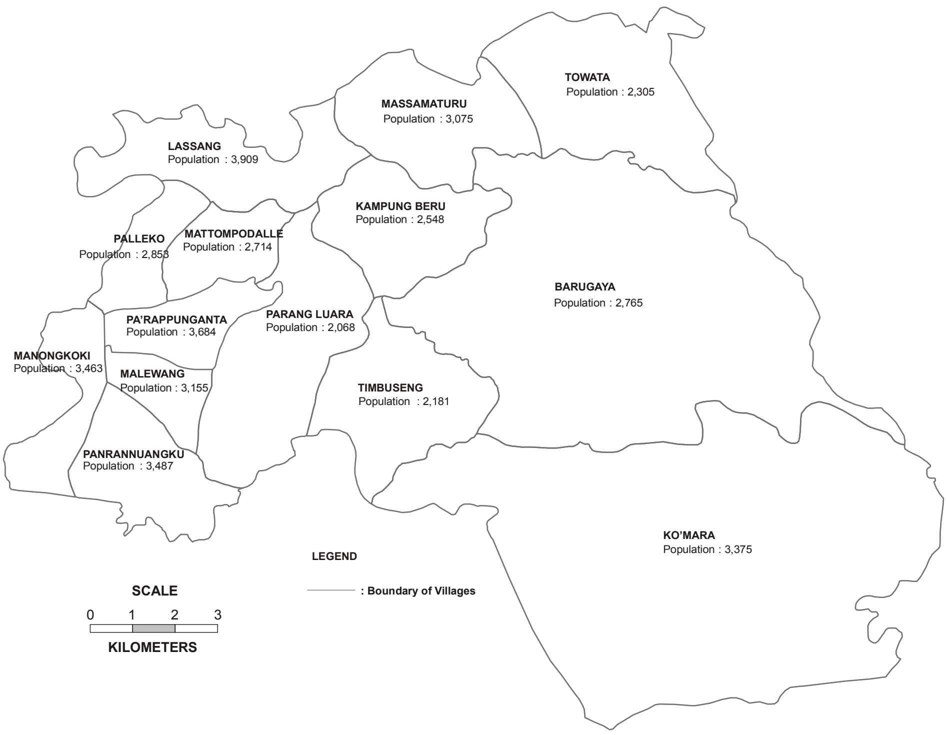


Figure-7.1 Administrative Boundaries and Population in Kechamatan Polombangkeng Utara

Kechamatan Polongbangkeng Utara is located in the northern part of Takalar regency, where it borders onto Gowa regency. The administration of Kechamatan Polongbangkeng Utara consists of 14 desas. The total population of this area was 42,028 in 2005, growing at the rate of approximately 1 % per year. The population and administrative boundaries are shown in the following figure.

7.1.2 Land Use

The major land use in Takalar is agriculture (50% of the total land) followed by dry land (25%). The coastal area is covered with irrigated land of the Bili-Bili, Bissua and Kampili areas. The dry land in the southern part is not utilized due to its geological and topological condition. Residential use accounts for 1.4 % of the total area.

Table-7.2 Land Use

Categories	Land Use
Urban Area	7.8
Agricultural Area	264.9
Green Area	104.4
Water	36.2
Others	136.4

Source: The MMA Master Plan Report

Land use in kechamatan Polombangkeng Utara is classified into paddy field and forestry areas. The western part is occupied by paddy fields and the eastern part is a forestry area. Some parts of the forestry area are preserved by law as national parks.

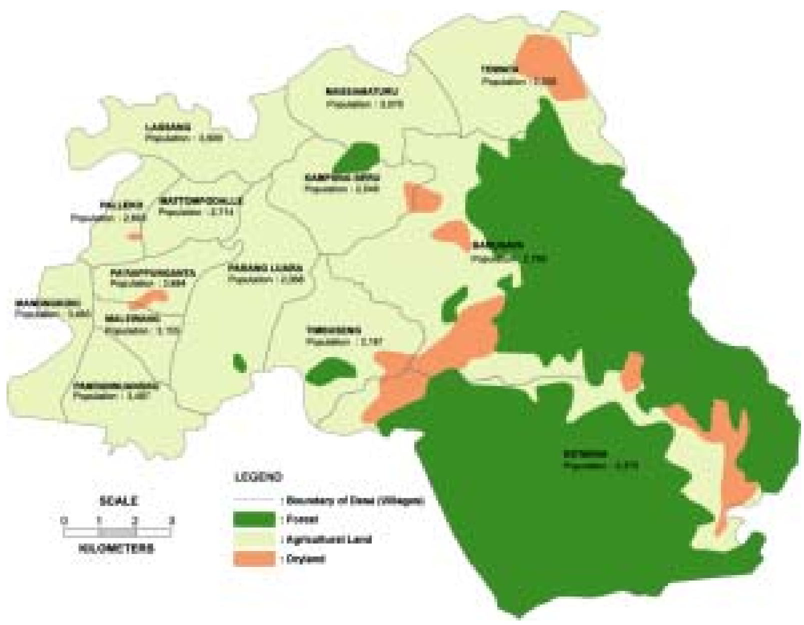


Figure-7.2 Land Use in Kechamatan Polombangkeng Utara

Thus, the proposed service area is set in the west side of Kechamatan Polombangkeng Utara, which is also a densely populated area, and the forest areas and other similar areas are to be conserved.

7.2 Water Resource

The Project Area is located on the western part of Kechamatan Polombangkeng Utara area. Major water sources pass into the study area, namely Pareco and Patta rivers, which are used for agriculture. The water ground source is also available which was also used for agriculture. However, since completion of the Bissua weir, those deep wells have no longer been used for irrigation purposes.

7.2.1 Water Sources

(1) Surface Water Potential

The Palleco river, which flows down through the border of Kechamatan Polonbanken Utara, has a small catchment area of 91 km^2 which is supplied from Bissua weir. The Pappa river which flows down in parallel to the Palleco river has a relatively big catchment area of 389 km^2 in the Mamminasata metropolitan area. The monthly average, maximum and minimum discharge data of the Pappa river from 1980 to 1999 is shown below.

Table-7.3 Monthly Discharge of Pappa River (1980~1999)

	Max.	Min.	Ave.
Pappa River 8 (m^3/sec)	28.3	0.6	9.4

Source: Comprehensive Water Management Plan Study for Maros-Jeneponto River Basin

The data for the Palleco river discharge is not available. As this river is utilized as an irrigation canal for the Bissua irrigation scheme, the river flow is dependent on the diverted discharge from Bissua weir on the Jeneberang river. On the other hand, as the catchment area of the Pappa river is located near Jeneponto regency, the river discharge is very low in the dry season that is influenced by the meteorological characteristics of Jeneponto.

(2) Groundwater Potential and Water Quality

i) Shallow Groundwater

Most of the residents in Takalar regency use hand-dug wells that are used mainly for domestic use. The depth of a hand dug well generally ranges from 5 m to 20 m and the water level is 1 m to 15 m. The water quality of these hand-dug wells is contaminated by coliforms in most of the Takalar regency and many are affected by salinity and color, especially in the dry season.

In terms of water quality, the target area is in a better situation than the costal area. However, the water quantity of the target area decreases in the dry season and many of the wells dry up. The results of the water quality analysis are as follows.

Table-7.4 Shallow Wells Water Quality Analysis

Parameters	Governmental Regulations No.82-2001				National Standard for Drinking Water (No.907-2002)	Unit	Wells around the Landfill Dumping Site			
							2006/2/10			
							1	2	3	4
	Class I	Class II	Class III	Class IV			Takalar Regency (TaW.1)	Takalar Regency (TaW.2)	Takalar Regency (TaW.3)	Takalar Regency (TaW.4) Polombangkeng Utara
Physical :										
Temperature	±3℃	±3℃	±3℃	±5℃	±3℃	℃	29.0	30.5	30.8	29.5
Color	(-)	(-)	(-)	(-)	15	TCU	3	1	2	5
Total Suspended Solid (TSS)	50	50	400	400	1,000	mg/l	6.45	4.25	5.27	5.35
Electric Conductivity	(-)	(-)	(-)	(-)			258	787	1,698	197
Chemical										
pH	6-9	6-9	6-9	5-9	6.5-8.5	-	6.5	6.4	6.6	6.9
BOD_5	2	3	6	12	(-)	mg/l	0.90	1.09	0.89	1.06
COD	10	25	50	100	(-)	mg/l	2.01	3.05	1.24	2.39
Disolved Oxigen (DO)	6	4	3	0	(-)	mg/l	6.2	6.30	6.15	6.1
Phosphorus (P)	0.2	0.2	1	5	(-)	mg/l	tt	tt	tt	tt
Nitrate (NO_3-N)	10	10	20	20	50	mg/l	0.29	0.15	0.24	0.022
Amonium (NH_3-N)	0.5	(-)	(-)	(-)	1.5	mg/l	0.009	0.006	0.014	0.09
Arsenic (As)	0.05	1.0	1.0	1.0	0.01	mg/l	tt	tt	tt	tt
Cadmium (Cd)	0.01	0.01	0.01	0.01	0.003	mg/l	tt	tt	tt	tt
Chromium (Cr^{6+})	0.05	0.05	0.05	1.0	0.05	mg/l	tt	tt	tt	tt
Lead (Pb)	0.03	0.03	0.03	1.0	0.01	mg/l	tt	tt	tt	tt
Mercury (Hg)	0.001	0.002	0.002	0.005	0.001	mg/l	tt	tt	tt	tt
Mineral oil	0.6	0.8	1.0	(-)	(-)	mg/l	tt	tt	tt	tt
Detergent	0.2	0.2	0.2	(-)	0.05	mg/l	tt	tt	tt	tt
Phenol compounds	0.001	0.001	0.001	(-)	(-)	mg/l	tt	tt	tt	tt
Bacteriology :										
Fecal Coliform	100	1,000	2,000	2,000	0	MPN/100ml	15	0	1	2
Total Coliforms	1,000	5,000	10,000	10,000	0	MPN/100ml	100	10	25	30

Source : Mamminasata JICA study team data Year 2006

ii) Deep Groundwater

The data are available from three existing deep wells located in the target area that were used for irrigation. Currently, these wells are not utilized since Bissua weir was constructed for irrigation purposes. Based on the deep well data, the discharges of the three deep wells are 12.5 l/sec, 6.93 l/sec and 2.5 l/sec respectively and the deep well depths range from 60m to 100 m. The results of water quality tests are also available, which indicate that the ground water from all three wells is suitable for domestic use. The existing deep well data are listed below.

Table-7.5 Specifications of Existing Deep Wells

Deep Well	Location	Diameter (mm)	Depth (m)	Yield (l/sec)	SWL (m)	DWL (m)	Year of Construction
SDTK58	Desa Lassang	250 150	36 93	> 12.52	3	4.8	1992
SDTK 59	Desa Lassang	250 150	30 76	> 2.51	3	8.3	1992
SMTK 125	Desa Parapunganta	150 100	14 44	> 6.93	2.5	9.4	1995

Source: Laporan Pelaksanaan Pemboran 1994/1995, Laporan Prlaksanaan (Kelompok 264)

Table-7.6 Deep Wells Water Quality Analysis

Parameters	Standard for Drinking Water	Unit	SDTK 58	SDTK 59	SMTK125
Physical :					
Odor	no smell	-	Nil	Nil	Nil
Turbidity	5	NTU	Nil	Nil	1.4
Total Dissolved Solids (TDS)	1,000	mg/l	298	100	6.9
Taste	no taste	-	Normal	Normal	Normal
DHL	-	μh/cm	35	32	-
Color	15	TCU	Nil	Nil	Nil
Chemical					
pH	6.5-8.5	-	6.5	7.5	7
Mercury (Hg)	0.001	mg/l			-
Arsenic (As)	0.01	mg/l	Nil	Nil	-
Iron (Fe)	0.3	mg/l	0.02	0.26	Nil
Fluorine (F^-)	1.5	mg/l	-	-	-
Cadmium (Cd)	0.003	mg/l	-	-	-
Calcium Carbonate ($CaCO_3$)	-	mg/l	-	-	22.34
Chlouride (Cl^2)	250	mg/l	20	8	168.6
Chromium (Cr^{6+})	0.05	mg/l	-	-	-
Manganese (Mn)	0.1	mg/l	Nil	Nil	-
Nitrate (NO_3-N)	50.0	mg/l	Nil	Nil	7.4
Nitrite (NO_2-N)	3.0	mg/l	Nil	Nil	Nil
Slenium (Se)	0.01	mg/l	-	-	-
Zinc (Zn)	3.0	mg/l	-	-	-
Cyanide (CN)	0.07	mg/l	-	-	-
Sulphate (SO_4)	250	mg/l	12.7	29.3	-
Lead (Pb)	0.01	mg/l	Nil	Nil	-
Organic matter ($KMnO_4$)	-	mg/l	5.62	4.88	4.75
Calcium (Ca2)	200.00	mg/l	88	28	9.88
Carium (K)	-		2.4	1.62	-
Magnesium (Mg)	150.00		47.86	7.79	3.65
Natrium (Na)	-		12.96	5.52	-
Bacteriology :					
Fecal Coliform	0	MPN/100ml	-	-	-
Total Coliforms	0	MPN/100ml	-	-	-

Source: Laporan Pelaksanaan Pemboran 1994/1995, Laporan Prlaksanaan (Kelompok 264)

7.3 Existing Water Supply and Facilities

In PDAM Takalar, two water supply systems are operated. One water supply system, called “Takalar Center Water Supply System”, supplies the central area of Takalar and the other water supply system, called “IKK Polombangkeng Utara Water Supply System”, supplies part of Kechamatan Polombangkeng Utara.

Takalar Center Water Supply System has a capacity of 10 l/sec, serving 8,200 population (27 %) and partially covers Kechamatan Pattallassang.

IKK Polombangkeng Utara Water Supply System was constructed in 2002. Initially, the water source of this facility had a capacity of 12.5 l/sec. This water supply facility was planned to serve approximately 8,830 population in 2010 partially covering four Desas in the Kechamatan Polombangkeng Utara. However, the water source capacity has decreased to 3 l/sec during the dry season since 2004, and this resulted in a decrease of the served population to 1,765 persons, especially during the dry season.

The description of PDAM Takalar water supply in the following paragraph is mainly based on the Basic Design Study for the Rural Water Supply Project in Sulawesi Island, PDAM Takalar and/or site observation.

7.3.1 Existing Water Supply Facilities

(1) Takalar Centre Water Supply System

The Takalar Center Water Supply System has two water treatment plants. One of the water treatment plants was constructed in 1996 with a capacity of 10 l/sec at Bontomatene. However this treatment plant is not operational. Another water treatment plant was constructed in 2003 at Mattompodalle with a capacity of 10 l/sec. This water treatment plant supplies piped water only to Takalar center.

Table-7.7 Outline of Takalar Center Water Supply System

No.	Facility	Type/Specification	Quantity	Note
A.	Intake			
A-1	Raw Water Intake	Water source: Palleko river, Bajeng weir	1 no.	24 hr/day operation
A-2	Intake Pump	Design capacity: 10 liter/sec Submersible type	2 no.	Including one standby
B.				
B-1	Bontomatene water treatment plant	Capacity : 10 l/sec	1 unit	1996 made, out of order
B-2	Mattompodalle water treatment	Capacity : 10 l/sec	1 unit	2002 made,

No.	Facility	Type/Specification	Quantity	Note
	plant			functioning
C.	Booster pump	Capacity : 10 l/sec	2 sets	
C. C-1 C-2	Reservoirs Bontomatene reservoir Mattompodalle reservoir	 RC made, Capacity : 200 m^3 RC made, Capacity : 250 m^3	 1 no. 1 no.	 1996 made, height of reservoir. 3 m 2002 made, height of reservoir. 26 m
D.	Calcium hypochlorite as chlorination	Feeding rate: ave. 2 mg/l	1 no.	
E. E-1	Pipeline Transmission pipeline	 dia. 200 mm dia. 150 mm	 6.2 km 2.0 km	 Including one standby
E-2	Distribution pipeline	dia. 150 mm dia. 100 mm dia. 75 mm dia. 50 mm	7.3 km 14.2 km 10.0 km 47.5 km	Including one standby
		Total	87.2 km	
F.	House connection		1,739 nos.	In November 2005

Source: PDAM Takalar

The data of the water quality for Takalar Centre Water Supply System is not available. According to the PDAM Takalar, water quality could not be maintained during the wet season due to the high turbidity of raw water.

(2) IKK Polombangkeng Utara Water Supply System

The present water supply for IKK Polombangkeng Utara Water Supply System is operated and maintained by the northern branch of Polombangkeng under PDAM Takalar.

This facility was constructed by the Japanese Grant Aid Project in 2002. A shallow radial well is utilized for water supply and the well water is yielded by well pump and is transported to an elevated reservoir. The water is distributed to each household by gravity. A serviced population of 8,830 persons in 2010 was planned and the service ratio is estimated at 70%. The overall information about existing facilities is summarized in the following table.

Table-7.8 List of Facilities (IKK Polombangkeng Utara)

No.	Facility	Type/Specification	Quantity	Note
A. A-1 A-2 A-3	Raw Water Intake Shallow Radial Well Well Pump	Water source: groundwater dia. 2.0 x D 8.0 m Design capacity: 12.5 liter/sec vertical multistage volute pump, 0.7 m^3m/min x 41m 11 kw	 1 2	24 hr/day operation Including one standby
B.	Well pump house Raw water transmission pipe	RC made, W 4.5 x L 4.5 m Material : uPVC, OD 160 mm	1 1	

C.	Elevated Reservoir	RC made, dia 10.4 x 3.0 m H ($250\ m^3$)	0.2 km	Height of reservoir. 18.5 m
D.	Calcium hypochlorite as chlorination	Feeding rate: max 4, ave 2 mg/l	1	Feeding by pump
E.				
E-1	- Solution tank	Polyethylene made : 500 liter	1	Including one standby
E-2	- Feeding pump	7.7 liter/hr x 0.2 MPa	2	
E-3	Chlorination house	Wooden made, W 2 x L 2 m	1	Including one standby
E-4	Operation building	RC made W 5 x L 8 m	1	
	Distribution pipeline	uPVC, OD 250 mm – OD 50 mm	15 km	
F.	Water service facilities			
F-1	House connection	dia. 13 mm	353	In Dec. 2005
F-2	Public hydrant	dia. 13 mm	49	Not in operational
F-3	Others	-	8	In Dec. 2005

Source: Basic Design Study Report

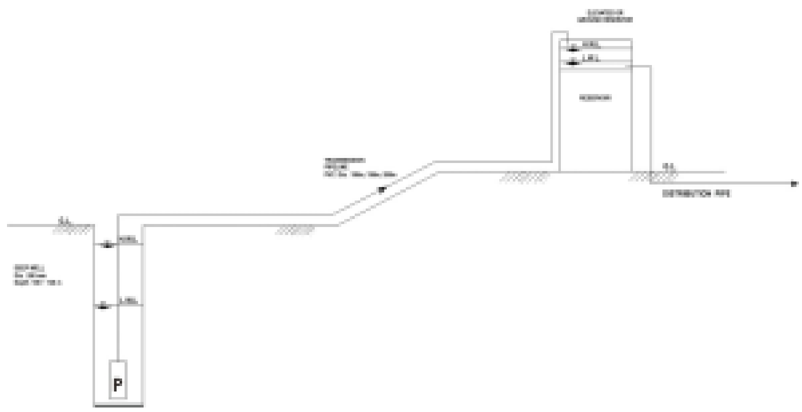


Figure-7.3 Existing Water Supply Facility

The water quality of the existing shallow well complies with the Indonesian water standard for drinking water (Air Minum) excluding bacteria as mentioned in Table-7.4 (Takalar Regency (TaW.4) Polombangkeng Utara). Therefore, the system is equipped with a chlorination system.

(3) Public Hydrant

Public hydrants are important facilities for developing a total water system. However, the public hydrant has been closed due to the lack of a working relationship between PDAM Takalar and its customers. To improve this performance it is suggested that recipient communities be involved in the planning and location of public hydrants. They should contribute towards their cost and undertake training before it is agreed to construct each facility. For this reason they should not be constructed until these provisions have been successfully completed.

7.3.2 Water Production and Consumption

(1) Coverage

At the end of 2005, PDAM Takalar covered only 4 % of Takalar Regency.

Takalar Center Water Supply System coverage was approximately 27 % in Kechamatan Patallasang. Table-7.9 shows the number of connections, served population and coverage.

Table-7.9 Water Supply Coverage in Takalar Center

Item No	Category	No of Connections (Dec-05)	Persons per Connection	Population Served	Coverage (%)
1	Domestic	1,640	5	8,200	6.5
2	Public Hydrant	0**	100*	0	4.6.
3	Other	99	-	-	-
	Total	1,739	-	8,200	27.0

Kechamatan Polombanken Utara service coverage was approximately 4.1 % as follows.

Table-7.10 Water Supply Coverage in Kechamatan Polombanken Utara

Item No	Category	No of Connections (Dec-05)	Persons per Connection	Population Served	Coverage (%)
1	Domestic	353	5	1,765	4.1
2	Public Hydrant	49***	100*	-	-
3	Other	8	-	-	-
	Total	372	-	1,765	4.1

Source: PDAM Takalar
Note: Assumptions: * each public hydrant supplies 20 families, (ii) 5.0 persons per household.
Coverage based on overall population of 28,180 (Estimated population in MMA Master Plan: 2005). "Other" is not included for calculation of coverage. UFW has not been calculated.
Population of Kechamatan Patallasang is set at 30,134.
Population of Kechamatan Polombanken Utara is set at 42,028.
** the data of public hydrant is not available, so it is not counted.
*** public hydrant is not in operational

7.3.3 Water Loss / Unaccounted For Water

PDAM Takalar has had the same problem regarding water loss and/or UFW as PDAM Maros as stipulated in section 2.3.3, but a more serious situation has been confirmed during the site survey.

PDAM Takalar's records (Table-7.11) indicate that unaccounted-for-water (UFW) was about 50 % in 2005 and is estimated to be same figure in 2006. However, reliability of the figures is low, because (i) production volumes are taken from un-calibrated or defective bulk meters, (ii) sales volumes are derived from water meters of doubtful accuracy, and (iii) the record file is not available.

Table-7.11 Unaccounted for Water

Year	2005	2006 (Estimated)
Production Volume of Takalar Center water supply system (m^3) (1)	306,720	303,240*
Production Volume of Kechamatan POLUT water supply system (m^3) (2)	102,384	102.384**
Sold Volume (m^3) (3)	204,015	198,000
Un-accounted for Water (%) (1)+(2)/(3)	50 %	51 %

Source: PDAM Maros
Note: * is estimated from the 3 months record (January to March 2006) x 4. ** applied 2005 result

(1) PDAM's UFW Control Activities

PDAM Takalar has not taken any measures to reduce UFW except for any necessary leakage or burst repairs.

(2) Bulk Meters

IKK Polombangkeng Utara water supply system has one bulk meter measuring distribution at its elevated reservoir site. However, meter reading has not been carried out on a daily basis since operation began.

Further, none of the meters have been calibrated since installation. The bulk meters should be calibrated on an annual basis.

(3) Household Meters

PDAM Takalar does not have a household meter test bench. None of the household meters have been calibrated since installation.

(4) Leak Repairs

The leak repair records are not available.

7.3.4 Operational Equipment

The same problem as with PDAM Maros has been confirmed in PDAM Takalar. PDAM Takalar also suffers from a serious shortage of operational equipment. Four vehicles, including one pick-up truck, two trucks and one motorbike, are available in PDAM Takalar. The pick-up truck is used by the President Director and the motorbike is used by the head of north Polombangkeng, while two trucks are used for operation and maintenance, such as monitoring and patrol of the distribution network. This shortage of vehicles has created a serious restriction for facilities maintenance. Further, tools for maintenance are not adequate for the existing pipeline system. The major reason for this situation is the weak financial standing of PDAM Takalar.

However, pipes and fittings for customer connections are available in the store.

7.3.5 Organization and Institution

(1) PDAM Staffing

The President Director of PDAM Takalar presides over two sections and one branch under which 16 staff personnel are employed. The President Director manages and controls water supply in Takalar except for private water supply schemes. The Technical Director manages and controls technical issues with 4 staff and the Director of General and Financial Affairs is responsible for non-technical issues with 5 staff. The branch of north Polombangkeng is directly managed by the President Director and this branch manages and controls technical and non-technical issues for IKK Pattontongang Utara Water Supply System with 5 staff.

At the current level of staffing, PDAM Takalar has 7.6 staff members per 1000 connections (= 16/2,111 con. × 1,000).

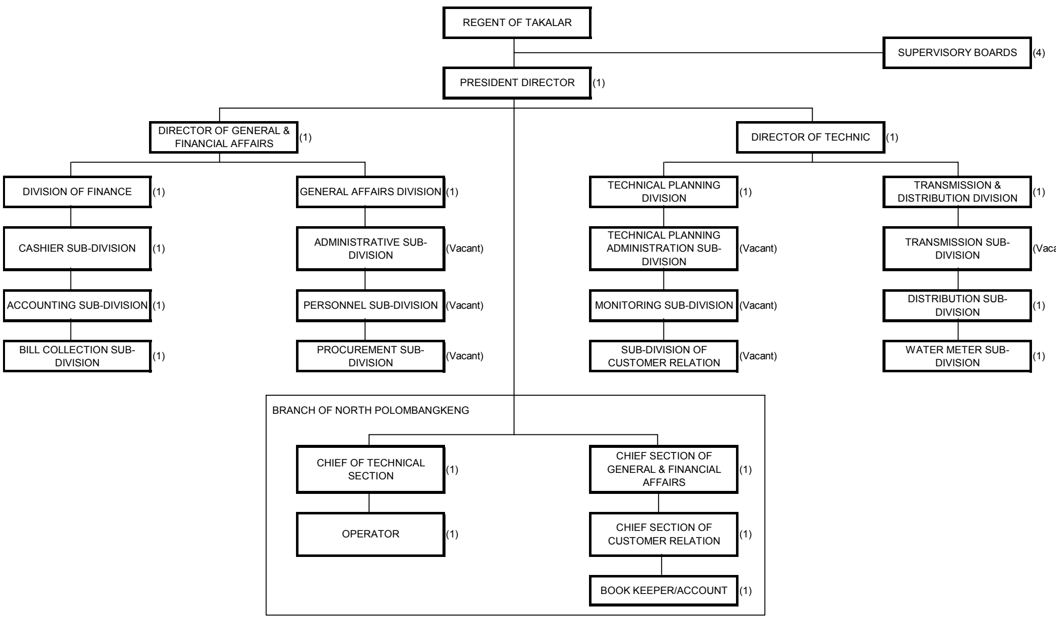


Figure-7.4 Organization Chart of PDAM Takalar

(2) Water Tariff

A new drinking water tariff for PDAM Takalar was set under the Decree of Takalar Regency in December 2004 due to the inflation of electrical, chemical and other operational costs.

Table-7.12 Water Tariff for PDAM Takalar

Group	Customer Category		Water Tariff (Rp.)			
			0 -10 m^3	11 - 20 m^3	21 -30 m^3	> 30 m^3
1	Social	Public	1,000	1,150	1,300	1,450
		Private	1,000	1,150	1,300	1,450
2	Non-Commercial	Household (A)	1,500	1,600	1,750	1,900
		Household (B)	1,700	1,850	2,000	2,150
		Government Office	2,000	2,100	2,200	2,300
		Official House	2,000	2,100	2,200	2,300
3	Commercial	Small Commerce	2,250		2,400	2,550
		Large Commerce	2,600		2,850	3,000
4	Industry	Small Industry	3,000		3,300	3,650
		Large Industry	3,500		3,800	4,100
5	Private	Harbor/Airport	4,000		4,250	4,500

Source: PDAM Takalar

Table-7.13 Installation Cost for New Connections

No.	Item	Cash (Rp.)
1	Registration	50,000
2	Warranty	100,000
3	Equipment	450,000
4	Installation	100,000
	Total	700,000

Source: PDAM Takalar

(3) Customer Registration

The number of customers of PDAM Takalar has not significantly changed due to the shortage of water since starting the operation of IKK Polombangken Utara Water Supply System in 2002. Registration is carried out by PDAM Takalar. Registration fees, including connection fees, material costs and meter rental fees, are charged to every customer.

(4) Metering, Accounting and Billing Collection

Meter readers read every household meter on a monthly basis. PDAM Takalar provides two customer counters, the billing and payment of water charges is based on these customer counters. The billing and payment for the customers of IKK Polombangkeng Utara Water Supply System are managed by the branch of north Polombangkeng.

7.3.6 Problems for PDAM Takalar

The major problems identified in the course of the field surveys are listed below.

- The raw water source for drinking use is absolutely limited in the Takalar regency.
- Water supply is only 8 hours per day in the Takalar Center Water Supply System and 3 to 4 hours per day in IKK Polombangkeng Utara Water Supply System during the dry season.
- High turbidity of the raw water causes overload for the water treatment plant.
- All of the installed service meters are not calibrated.
- Since PDAM Takalar does not read the bulk meter, the UFW ratio is not known accurately.
- PDAM Takalar substantially lacks operational equipment, such as vehicle and tools, for proper operation and maintenance of the water supply facilities.
- Existing water supply data, such as a pipeline map and equipment details, are missing.
- Lack of O&M knowledge and attitude have been observed.

8. WATER DEMAND PROJECTION IN TAKALAR

8.1 Population Projection

In the MMA Master Plan, a population projection for the years 2000 to 2020 was made for the water demand projection. The projected population is given in Table-8.1 by target year and stages.

Table-8.1 Population Projections

No.	DESA	2005	2010	2015	2020
1	Lassang	3,951	4,044	4,117	4,135
2	Palleko	2,884	2,951	3,005	3,018
3	Mattompodalle	2,743	2,807	2,859	2,871
4	Kampung Beru	2,575	2,636	2,684	2,695
5	Manongkoki	3,500	3,582	3,648	3,663
6	Pa'rappunganta	3,723	3,811	3,880	3,897
7	Parang luara	2,090	2,139	2,178	2,188
8	Malewang	3,189	3,264	3,323	3,337
9	Panrannuangku	3,524	3,607	3,673	3,689
Target Area Population		28,180	28,841	29,367	29,492
10	Timbuseng	2,204	2,256	2,297	2,307
11	Massamaturu	3,108	3,181	3,239	3,253
12	Towata	2,330	2,384	2,428	2,438
13	Barugaya	2,795	2,860	2,912	2,925
14	Ko'mara	3,411	3,491	3,555	3,570
Non-Target Area Population		13,848	14,173	14,431	14,493
Polonbangkeng Utara Population		42,028	43,013	43,799	43,985

Source: The MMA Master Plan

8.2 Water Demand Projection

8.2.1 Criteria Applied for the Water Demand Calculation

The criteria of the Basic Design Study for the Rural Water Supply Project in Sulawesi Island has basically been applied for the calculation of water demand projection in order to unify the criteria of existing water supply systems.

Table-8.2 shows water demand projection criteria, and the applied figures and conditions are described below.

Table-8.2 Criteria Applied in Basic Design Study

Items	Criteria based on population (x 1000 capita)
Domestic water consumption for house connection (lcpd)	100
Domestic water consumption for public hydrant (l/c/d)	30
Non-domestic water consumption (%)	20
Unaccounted for Water (%)	20
Maximum day factor	1.1

Items	Criteria based on population (x 1000 capita)
Peak hour factor	1.5
Persons per house connection	According to the site survey done by the Basic Design Study, persons per house connection ranged from 4 to 7 persons and PDAM Takalar planned five persons. Therefore, this value has been applied: five persons per house connection.
Persons per public tap	100
Head-loss in distribution	10
Time of operation (hours/day)	24
Volume of reservoir (%)	20
House connections: Public taps	70:30
Service Population	Service population in the target area is set as 80 % in the urban area and 60 % in the rural area of the projected 2015 water demand, based on the target of MGDs of Takalar Regency.

Source: Basic Design Study Report on the Rural Water Supply Project in Sulawesi Island

8.2.2 Projected Water Demand

Water Demand Projections based on the design criteria and the population is projected for each kechamatan, which is summarized in the following.

Table-8.3 Water Demand for Target Area

No.	Desa	Target Coverage	Water Demand Projection (m3/day)		
			2005	2010	2015
1	Lassang	60 %	225	230	234
2	Palleko	80 %	219	224	228
3	Mattompodalle	60 %	156	160	163
4	Kampung Beru	60 %	146	150	153
5	Manongkoki	60 %	199	204	207
6	Pa'rappunganta	60 %	212	217	221
7	Parang luara	60 %	119	122	124
8	Malewang	60 %	181	186	189
9	Panrannuangku	60 %	200	205	209
Water Demand			1658	1696	1727
Quantity of UFW (20%)			414	424	432
Required Production Capacity			2072	2121	2159

JICA Study Team

9. PRELIMINARY DESIGN OF FACILITIES IN TAKALAR

9.1 Water Supply Facilities

9.1.1 Design Framework

(1) Objectives

The objective of this project is to improve, rehabilitate and extend the IKK Polombangkeng Utara Water Supply System by increasing the water source. After completion of the improvement of the facilities, as well as building the capacity development, the piped water coverage ratio will be greatly increased from 4.1 % to 50 % in Kechamatan Polombangkeng Utara, and the served population will be 21,470 persons.

(2) Scope

The preliminary design includes deep wells, submersible pump stations, transmission and distribution pipelines and reservoirs required to meet the water demand in target areas, and procurement of equipment.

The water production requirement is approx. 25 l/sec (2,159 m^3/day). The existing usable water production capacity is 3 l/sec. It can therefore be seen that an additional 22 l/sec will be required to meet the total demand by the year 2015. Therefore, the design production capacity in the target area is set to be 25 l/sec.

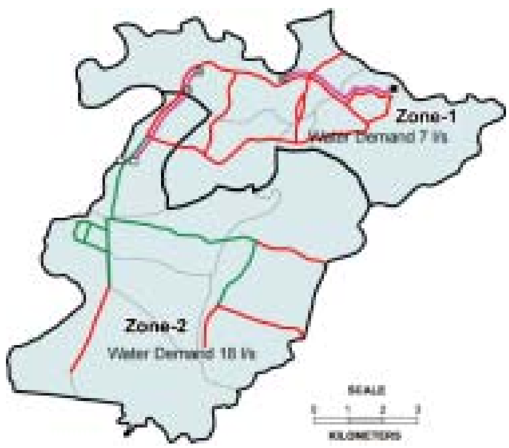


Figure-9.1 Zoning System in Kchamatan Pattontongan Utara Water Supply System

(3) Strategic Consideration

i) Distribution

In view of the cost efficiency, the current distribution system will be utilized as much as possible. Therefore, reservoirs and a gravity system will be applied in the preliminary design of the distribution system.

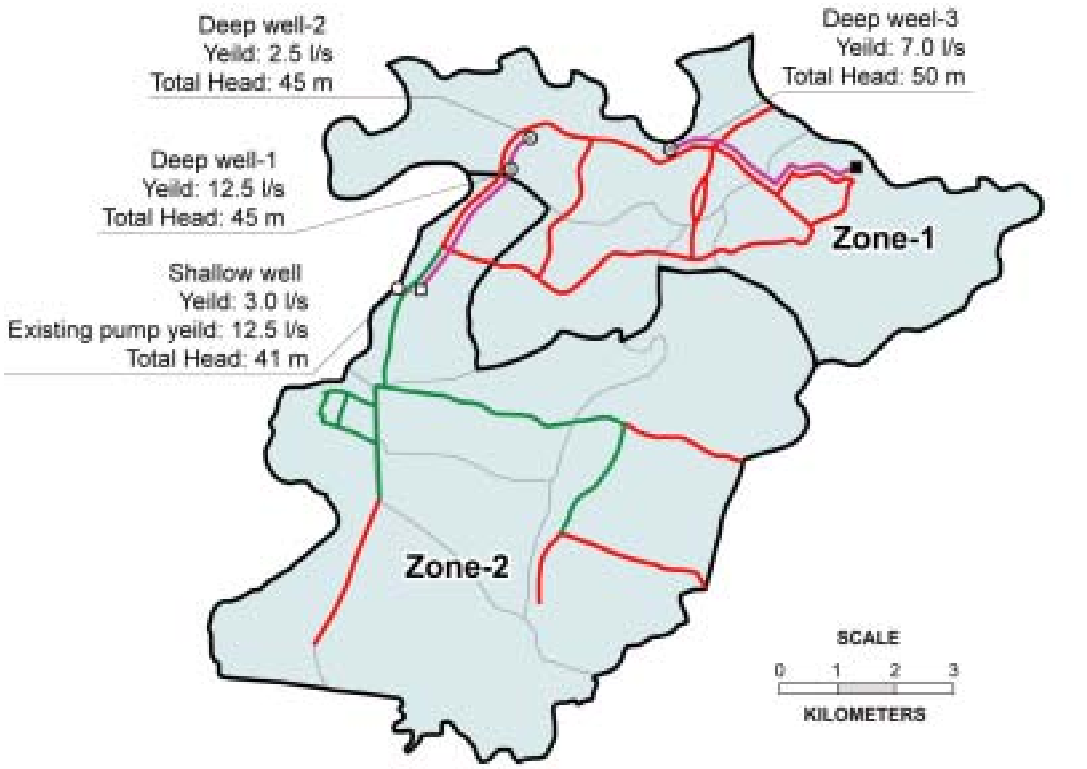
ii) Water Losses

In addition to any improvement in water supply infrastructure, improvement of the high level of UFW in the water supply system is essential through improvement in the institutional arrangements for the operation, maintenance and management of the system in parallel.

iii) Zoning

After expansion of the distribution system, zoning is to be considered to establish easy operation and maintenance. The zoning system is planned based on the distribution pipeline route and the population size as well as considering the existing administration boundaries of Desas. Based on the above conditions, the water supply system will be divided into two zones. The proposed zoning system is described as follows.

9.1.2 Proposed Water Supply in Polonbankeng Utara Water Supply System



Salient Feature	2005 (Existing Condition)	2010 (After Completion of the Works)
Service Population (Peoples)	1,765	21,474
Service Coverage*	4.10%	50%
Water Source	Shallow well: 1 no. (3 l/s)	Shallow well: 1 no. (3 l/s) Deep well: 3 nos. (22 l/s)
Submergible pump	0 no.	3 nos.
Booster pump	2 nos	2 nos
Reservoir (capacity)	1 no (250 m^3)	2 nos (500m^3)
Transmission Pipeline (Dia. 100 – 200 mm)	0.2 km	6.0 km
Distribution Pipeline (Dia. 63 – 250mm)	14.9 km	47.2 km
Tertiary Pipe (Dia. 40 mm -75 mm)	-	30.5 km

* is calculated as Service Population / Polombangkeng Utara Population in each year

Figure-9.2 Proposed Water Supply Improvement Plan for IKK Polombangkeng Utara Water Supply System

9.1.3 Water Source Facilities

The existing shallow well and the three deep wells will be used for water sources for expansion of the IKK Polombangkeng Utara Water Supply System. The total quantity to be developed has been designed with a capacity of 25 l/sec.

(1) Deep Well Facility

Two drilling sites will be set beside the used deep wells in order to minimize the risk of unsuccessful wells. One drilling site is to be set near the Palleco river because of recharge from this river. The existing shallow well will be also utilized as part of the water source, since the facility is in good condition and a yield of 3 l/sec has been confirmed during the dry season.

i) Standard Design of Boreholes

The geology throughout the study area can be considered as similar. Therefore, a standard deep well structural design is proposed.

ii) Diameter of Boreholes

Casings with a diameter of 250 mm for submergible pumps is adopted as the bases of the boreholes in order to ensure their long-term stability. Since this diameter is generally used in Indonesia, no engineering problems should arise.

iii) Drilling Diameter

A drilling diameter with sufficient clearance for casing work is designed, assuming the above casing diameters. The adopted material for the casing screen pipe is PVC. This has been used previously in other countries and its long-term stability has been proven in the existing deep wells. The screen is designed to be a slot-type, common in Indonesia.

iv) Electrical Logging

The design allows for electrical logging to be undertaken after drilling the boreholes in order to identify the aquifer depth for provision of screen pipe at appropriate locations. This is expected to increase the success rate of the boreholes.

v) Gravel Packing, Slime Packing and Cementing

Gravel packing is to be provided for gaps between the casing/screen pipe and the inside of the drilled hole from the bottom to 10 m above static water level. The section to within 10 m of the ground surface will be packed with slime produced by the drilling, and the upper part to the ground surface will be filled with cement mortar.

This cementing is designed to prevent intrusion of rainwater and wastewater from near the borehole. Bottom plugs and temporary top covers will be provided.

vi) Pumping Tests

A series of pumping tests will be undertaken after completion of borehole construction in order to identify the water yield:

Trial test	:	by identification of clean water, maximum 8 hours
Step test	:	4 steps, 2 hours for each step
Continuous test	:	72 hours for a handpump
Recovery test	:	24 hours.

vii) Proposed Well Facilities

Proposed deep wells and the shallow well are as follows.

Table-9.1 Outline of Well Facilities

Name	Dimensions / Specifications	Remark
Deep well 1	Dia. 250 mm, depth 130 m, yeild 12.5 l/sec	Drilled beside existing deep well (SDTK58)
Deep well 2	Dia. 250 mm, depth 110 m, yield 2.5 l/sec	Drilled beside existing deep well (SDTK59)
Deep well 3	Dia. 250 mm, depth 130 m, yield 7 l/sec	New site will be selected
Existing Shallow well	Dia. 2,000 mm, depth 8 m, yield 3 l/sec	Use existing shallow well

Source: JICA Study Team

(2) Pumping Station

New pumping stations will be constructed. The existing shallow well facility will be utilized and no rehabilitation will be done. Dimensions and pump specifications for the new wells are shown in the following table.

Table-9.2 Outline of Deep Well Pumping Station

Name	Pumping House Dimension	Pump Specifications
Deep well 1 pumping station	5 m W x 5 m L x 3.5 m H	Quantity : 12.5 l/sec, TH : 45 m, Output : 11 kw Deep well submersible pump
Deep well 2 pumping station	5 m W x 5 m L x 3.5 m H	Quantity : 2.5 l/sec, TH : 45 m, Output : 1.9 kw Deep well submersible pump
Deep well 3 pumping station	5 m W x 5 m L x 3.5 m H	Quantity : 7 l/sec, TH : 50 m, Output : 5.5 kw Deep well submersible pump

(3) Disinfection

For piped water facilities using groundwater, contamination might occur during the distribution of the water. Therefore, chlorination systems will be equipped to maintain the Indonesian drinking water standards.

9.1.4 Transmission Pipeline

One pipeline will be constructed to convey the amount of water to meet the 2015 demand in the target area.

(1) Design Value and Specifications

Maximum flow : 1.1 times the daily average flow
Maximum velocity in pipe : Maximum 1.0 m/s
Pipe Material : PE Pipe

(2) Details of Transmission Pipeline

Details of the transmission pipelines are summarized in Table-9.3.

Table-9.3 Outline of Transmission Pipelines

Line	Diameter	Length	Flow
Deep well 1 to deep well 2	Main : 100 m	700m	Pumping
Deep well 2 to existing elevated reservoir	Main : 200 mm Branch : 150 mm	2,500 m 20 m	Pumping
Deep well 3 to new ground type reservoir	Main : 150 mm	2,600 m	Pumping

In addition to transmission mains, fittings such as bends, flow meters, sectional valves, wash out valves, and air valves, and appurtenances such as road and river crossings, thrust blocks, and valve chambers, will be needed for the entire system.

9.1.5 Distribution System

The projected water demand in 2015 is estimated at 25 l/sec, as described in Chapter 8 “Water Demand Projection”.

(1) Design Values

The criteria of the Basic Design Study for the Rural Water Supply Project in Sulawesi Island has basically been applied for the calculation of the distribution network in order to unify the criteria of existing water supply systems.

Basic design flow : Average demand
Peak hourly factor : 1.5 times average flow
Maximum day factor : 1.1 times average flow
Volume of reservoir : 20 % of average water demand
Maximum water pressure : 100 m
Minimum water pressure : 5 m*
Hydraulic equation used : Hazen-Williams formula

(2) Supply Area

The supply area extends in nine Desa including Lassang, Palleko, Mattompodalle, Kampung Beru, Manongkoki, Pa'rappunganta, Parang luara, Malewang and Panrannuangku totaling approximately 58 km^2 as shown in the Drawings No. T-001, and the estimated population of the target area is 21,470 persons in 2010. The served area will be divided into two zones in the target area and supplied by elevated reservoirs.

(3) Pipe Materials

Polyethylene pipe (PE pipe), which complies with ISO Standards, is recommended by the Indonesian Government in order to reduce leakages and improve cost performance. Therefore PE pipes are proposed for the majority of the distribution mains. Steel pipes are proposed for adjacent to the pumping stations.

(4) Pipeline Design

The total length of distribution pipes to be constructed in Stage 1 is 32 km, as summarized in Table-9.4.

Table-9.4 Outline of Distribution Pipeline

Diameter	Material	Length (m)
250 mm	PE Pipe	100
200 mm	PE Pipe	3,750
150 mm	PE Pipe	17,012
100 mm	PE Pipe	10,517
90 mm	PE Pipe	1,000
Total		32,379

The hydraulic gradient along the transmission and distribution main route has been estimated based on a map at a scale of 1 to 50,000. Therefore, a topographic survey is necessary to improve the precision of calculations.

In addition to distribution mains, fittings such as bends, flow meters, sectional valves, wash out valves, and air valves, and appurtenances such as road and river crossings, thrust blocks, and valve chambers, will be needed for the entire system.

(5) Reservoirs

At present, PDAM Takalar has 250 m^3 of usable storage at IKK Palleco. Another 250 m^3 storage tank will be added in Desa Kampang Beru.
Reservoirs will be provided for each zone. Each reservoir provides water that can be withdrawn during peak periods of demand and then replenished during the night when the system demand is low. The proposed reservoirs will increase the total system storage to 20 % of the average day demand. A total storage capacity of 4,000 m^3 from six tanks has been planned for the Stage 1 area. An outline of reservoirs is listed in Table-9.5.

Table-9.5 Outline of Reservoirs

Tank No.	Type of reservoir	Height (m)	Capacity (m^3)	To be supplied to
T-001	Ground	3 m	250	Zone-1
T-002 **(existing)**	Elevated	25m	250	Zone-2
Total			500	

(6) Service Pipeline and Public Hydrants

The total length of service main to be constructed is 34 km, as summarized in Table-9.6. It is possible to install the pipe immediately, since there is no objection in the target area. Therefore, calculation of service mains is set at 7 m per household and 10 m per public hydrant. There are 64 public hydrants to be constructed.

Table-9.6 Outline of Service Pipeline

Diameter	Material	Length (m)
75 mm	PE Pipe	21,000
50 mm	PE Pipe	640
Total		21,640

(7) Bulk Meters

To establish a metering system, and initiate leakage control activities, bulk meters will be provided at the inflow and out flow points of the water treatment plants and reservoirs.

9.2 Operation and Maintenance and System

To achieve efficient operation of the expanded water supply facilities, the following equipment will be provided under the project.

9.2.1 Metering

In PDAM Takalar, the entire cost of installing service connections is borne by customers. Accordingly, the cost of materials and equipment required for establishing the metering system is only that for replacement and repair of the defective customer meters so far installed.
According to PDAM Takalar, meters are functioning. However, they have not been calibrated since installation. In order to calibrate the existing meters, a meter test bench shall be procured.

9.2.2 Equipment for Leakage Control

To initiate activities for leakage control at the earliest date possible, early establishment of the metering system is recommended. Leakage control is considered most effective in attaining a reasonable level of accounted for water ratio. For this purpose, an acoustic bar for iron and PE pipes, a leak noise correlator, a portable flow meter and pressure gauges, and one survey vehicle will be required in the project.

Table-9.7 Outline of Leakage Control Equipment

Description	Type	Quantity
Acoustic Bar	For Iron	1 set
Acoustic Bar	For PE and PVC	1 set
Leak Noise Correlator	Digital Signal Processing	1 set
Leak detector	Sounding	1 set
Portable Flow Meter	Ultra Sonic	1 set
Pressure Gauges	24 hours recording	2 sets
Survey Vehicle	4WD	1

9.2.3 Laboratory Equipment

PDAM Takalar does not have the necessary water quality testing equipment except for a Jar Tester. The equipment for water quality tests will be supplied in order to maintain a safe water quality. The outline of the equipment for water quality testing is described in the following table.

Table-9.8 Outline of Laboratory Equipment

Description	Quantity
Micro Scope	1 set
Incubator	1 set
Pressure	1 set
Turbidity Meter	1 set
pH meter	1 set
DO meter	1 set
Conductivity meter	1 set
Chlorine meter	1 set
Spectrophotometer	1 set

9.3 Strengthening of Institutional Capacity and UFW Program

PDAM Takalar has the same problem as PDAM Maros regarding operation and maintenance as well as a high level of UFW ratio as stipulated in "Chapter 4.3 Strengthening of Institutional Capacity" and "Chapter 4.4 UFW Program".

Therefore, capacity development in terms of organization capacity, staff training program and UFW Program, as stipulated in Chapter 4.3 and 4.4, will be conducted under the project.

10. ESTIMATED COST OF IMPROVEMENT IN TAKALAR

The criteria for cost estimating have been applied in the same manner as applied for the improvement in Maros and described in Chapter 5 in this Report.

10.1 Estimated Cost

The project cost has been estimated as summarized in Table-10.1 below.

Table -10.1 Estimated Cost of Improvement in Takalar

Item	Unit	Foreign (US$)	Local (US$)
1 Construction Cost			
1) Civil Works			
a Deep Well	LS.	0	90,411
b Pump House	LS.	0	54,623
c Reservoir Tank (250m3)	LS.	0	51,941
d Public Hydrant	LS.	0	198,904
2) Pipe Works			
a Transmission Pipe	LS.	16,445	283,395
b Distribution Pipe	LS.	182,192	425,114
3) Electrical and Mechanical	LS.	58,767	0
4) Procurement of Equipment	LS.	80,365	0
Sub Total-1		337,769	1,104,388
2 Land Acquisition	LS.	0	2,497
Sub Total-2		0	2,497
3 Engineering Services	LS.		
1) Engineering design and construction advice (15%)	LS.	173,059	43,265
2) Staff training cost including UFW Program (5%)	LS.	115,373	28,843
Sub Total-3		288,432	72,108
4 Government's Administration Cost (2%)	LS.	0	22,088
Sub Total-4		0	22,088
5 Physical Contingency (10%)	LS.	62,620	120,108
Sub Total-5		62,620	120,108
Total Estimate Cost		688,821	1,321,189

10.2 Recurrent Cost Estimate

(1) Operation and Maintenance

The criteria for operation and maintenance, as well as economic life, have been applied in the same manner as applied for the improvement in Maros and described in Chapter 5.3 in this Report.

(2) Power Cost

Power costs are significant for the proposed water supply system, as it is designed for submersible pump and existing pump systems. The annual cost has been calculated for the proposed water supply improvement using the Indonesian tariff as follows:

Table-10.2 Electricity Tariff

Items	Electricity fee (US Dollars)
Pump use	12,000
Others	2,000
Total	14,000

(3) Staffing Costs

Staffing requirements have been estimated for the new deep wells and distribution system, as given below. Staffing is required for local management, meter reading, billing, collections and the UFW team. The annual projections are shown in Table-10.3, using a similar salary scale as currently applicable for PDAM Takalar.

Table-10.3 Staffing of Proposed Water Supply Facility

Description	Well facilities	Distribution	UFW team
Engineer 1	1	0	1
Senior operator	0	1	0
Leak investigator	0	0	1
Pump operator	2	0	0
Meter reader	0	1	0
Line patrollers	0	0	2
Laboratory Technician	1	0	0
Clerks	1	0	0
Driver	0	1	1
Total	5	3	5

(4) Chemical Costs

The Chlorination costs have been estimated based on current unit costs for supply of chemicals as quoted by suppliers and a dosage rate appropriate to the raw water quality. The cost for dosing chlorine is given in Table-10.4.

Table-10.4 Chemical Cost

Chemical	Cost per US \$/kg	Dosage rate (mg/l)	Cost of water US \$/m^3	Cost of water US \$/day
Chlorine	2.0	1.5	0.003	6.5

10.3 Implementation Plan

10.3.1 Basic Consideration

(1) Planned Period

In the MMA Master Plan stage of this study, an overall plan for the provision of water to the supply area proposed applying the design horizon of 2015. This horizon has been considered for the implementation of the long term UFW program. Therefore, the construction period has been set for between 2008 and 2010.

(2) Institutional Strengthen and UFW Program

As mentioned earlier, the UFW program has been divided into two targets as a short-term target and a mid-term target. The short-term target period is up to 2010, while the mid-term target is from 2011 to 2015. The short-term target will be conducted in collaboration with advisors or consultants, and the next target will be conducted by trained PDAM staff. Institutional strengthening will also be conducted together with the UFW program period up to 2010.

(3) Division of Contract

The construction of the deep wells, pumping station, raw water main, water treatment plant and the transmission pipeline, distribution pipeline and reservoirs requires fairly high levels of planning, skilled workmanship and supervision. In order to make the work attractive to the larger contractors who are more likely to have these skills, it is desirable to arrange one large contract package for tender. The cost for the electrical and mechanical components is not as large as that for civil works, so no separate contract is required for these items.

10.3.2 Implementation Schedule

The implementation schedule allows for 22 months of construction period. The project implementation schedule for the target area is shown in Figure-10.1.

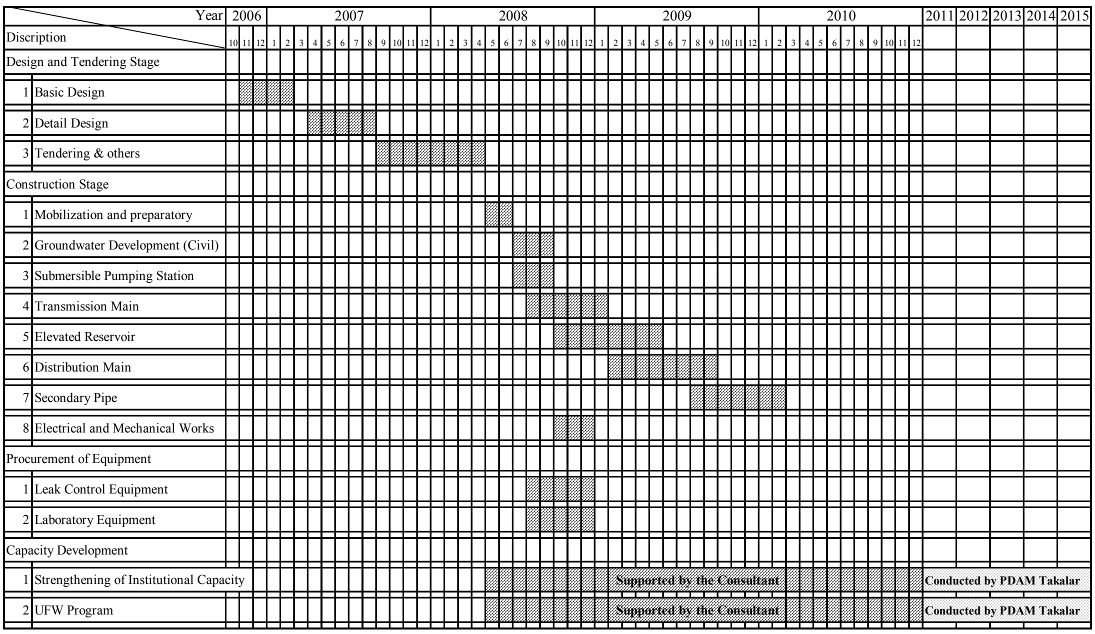


Figure-10.1 Implementation Schedule for Improvement of Water Supply System in Takalar

PART-C EVALUATION OF WATER SUPPLY IMPROVEMENT IN MAROS AND TAKALAR

11. INITIAL ENVIRONMENTAL EXAMINATION

The Initial Environmental Examination (IEE) has been carried out as a part of the pre-feasibility study on the Improvement of the Water Supply System in Maros and Takalar. The objectives of the IEE are shown below.

- To evaluate preliminarily the impacts of the project on to the natural and social environments
- To propose countermeasures for mitigating the impacts and make recommendations for environmental conservation.

11.1 Approach to the IEE Study

11.1.1 Environmental Laws and Regulations

The IEE was conducted referring to the relevant laws, regulations and standards applicable in the Republic of Indonesia, and the JICA Environmental Guideline, including in particular:

(1) Relevant Laws

i) Decree of the State Minister for the Environment No.17/2001

Providing types of business and/or activity plans that are required to be completed with the Environmental Impact Assessment (EIA)

ii) The Governor Decree No.494/VII/2003

Stipulating types and activity plans in South Sulawesi Province for which an EIA is required (AMDAL), as well as an environmental management plan (RKL) and environmental monitoring plan (RPL)

iii) The Decree of the Ministry of Living Environment No.40/2000

Providing the responsibility and relationship of Central Government and Regency/City for assessing an environmental impact analysis

(2) Environmental Standards and Regulations Referenced

There are various environmental standards at of National and Provincial level as listed below. Basically, Provincial Environmental Standards are prescribed under the national standards.

i) The Government Regulations No.82/2001

Regulation of Water Pollution Control stipulating the physical, chemical and bacteriological criteria values for every water type

ii) The Government Regulation No.41/1999

Regulation of Ambient Air Quality Standards providing 13 parameters

iii) Decree of State Minister for Living Environment No.KEP-48 /MENLH/XI/1996

Regulation of Ambient Noise Level Standard

iv) Decree of State Minister for Living Environment No. KEP-49/MENLH/XI/1996

Regulation of Vibration Level Standard

v) South Sulawesi Provincial Government, Governor's Decree No.14/2003

Stipulating a) environmental water quality, b) discharged wastewater quality, c) ambient air quality, d) industrial emission gas quality, e) noise and f) vibration

vi) Water Quality Standard in South Sulawesi (Class I to Class IV) (ref. Table 6.1)

Class I: Water that can be used as raw water for drinking water and/or other uses requiring the same water quality standards.

Class II: Water that can be used for recreation, freshwater fish aquaculture, farming, plantation irrigation purposes and/or other uses requiring the same water quality standards.

Class III: Water that can be used for freshwater fish aquaculture, animal husbandry, plantation irrigation purposes and/or other uses requiring the same water quality standards.

Class IV: Water that can be used for plantation irrigation purposes and/or other uses requiring the same water quality standards.

Land acquisition and compensation for resettlements need to comply with Presidential Regulation No.36/2005. For the processes of land acquisition and compensation it should be necessary to incorporate the participation of communities. In addition, the monitoring programs during the construction and operation phase must be done and the results should be compared with proposed values and conditions.

Table-11.1 Water Quality Standard in South Sulawesi

Parameters	South Sulawesi Governor's Regulations (No.14-2003)				Unit
	Class I	Class II	Class III	Class IV	
Physical :					
Temperature	±3℃	±3℃	±3℃	±5℃	℃
Total Dissolved Solids (TDS)	800	1,000	1,000	2,000	mg/l
Total Suspended Solid (TSS)	50	50	400	400	mg/l
Chemical :					
pH	6-8.5	6-8.5	6-8.5	5-8.5	-
BOD_5	2	3	6	12	mg/l
COD	10	25	50	100	mg/l
Disolved Oxigen (DO)	6	4	3	0	mg/l
Phosphorus (P)	0.2	0.2	1	5	mg/l
Nitrate (NO_3-N)	10	10	20	20	mg/l
Amonium (NH_3-N)	0.5	(-)	(-)	(-)	mg/l
Arsenic (As)	0.05	1.0	1.0	1.0	mg/l
Cobalt (Co)	0.2	0.2	0.2	0.2	mg/l
Barium (Ba)	1.0	(-)	(-)	(-)	mg/l
Boron (B)	1.0	1.0	1.0	1.0	mg/l
Slenium (Se)	0.01	0.05	0.05	0.05	mg/l
Cadmium (Cd)	0.01	0.01	0.01	0.01	mg/l
Chromium (Cr^{6+})	0.05	0.05	0.05	1	mg/l
Copper (Cu)	0.02	0.02	0.02	0.2	mg/l
Iron (Fe)	0.3	(-)	(-)	(-)	mg/l
Lead (Pb)	0.03	0.03	0.03	1.0	mg/l
Manganese (Mn)	0.1	(-)	(-)	(-)	mg/l
Mercury (Hg)	0.001	0.002	0.002	0.005	mg/l
Zinc (Zn)	0.05	0.05	1.0	2.0	mg/l
Chloride (Cl^-)	600	(-)	(-)	(-)	mg/l
Cyanide (CN)	0.02	0.02	0.02	(-)	mg/l
Fluorine (F^-)	0.5	1.5	1.5	(-)	mg/l
Nitrite (NO_2-N)	0.06	0.06	0.06	(-)	mg/l
Sulphate (SO_4)	400	(-)	(-)	(-)	mg/l
Free Chlorine (Cl_2)	0.03	0.03	0.03	(-)	mg/l
Hydrogen Sulphide (H_2S^-)	0.002	0.002	0.002	(-)	mg/l
Bacteriology :				-	
Fecal Coliform	100	1,000	2,000	2,000	MNP/100ml
Total Coliforms	1,000	5,000	10,000	10,000	MNP/100ml
Radioactivity :					
Gross A	0.1	0.1	0.1	0.1	Bq/L
Gross B	1.0	1.0	1.0	1.0	Bq/L
Organic Chemical :					
Mineral oil	600	800	1,000	(-)	ug/l
Detergent	100	100	100	(-)	ug/l
Phenol componds	1	1	1	(-)	ug/l
BHC(Lindane)	100	150	200	(-)	ug/l
Aldrin/Dieldrin	17	(-)	(-)	(-)	ug/l
Chlordane	3	(-)	(-)	(-)	ug/l
DDT	2	2	2	2	ug/l
PCB	1	(-)	(-)	(-)	ug/l
Heptachlor/Heptachlor epoxide	15	(-)	(-)	(-)	ug/l
Pesticide	1	3	4	(-)	ug/l
Toxaphan	5	(-)	(-)	(-)	ug/l

11.1.2 Assessment Procedures

(1) Existing Procedure

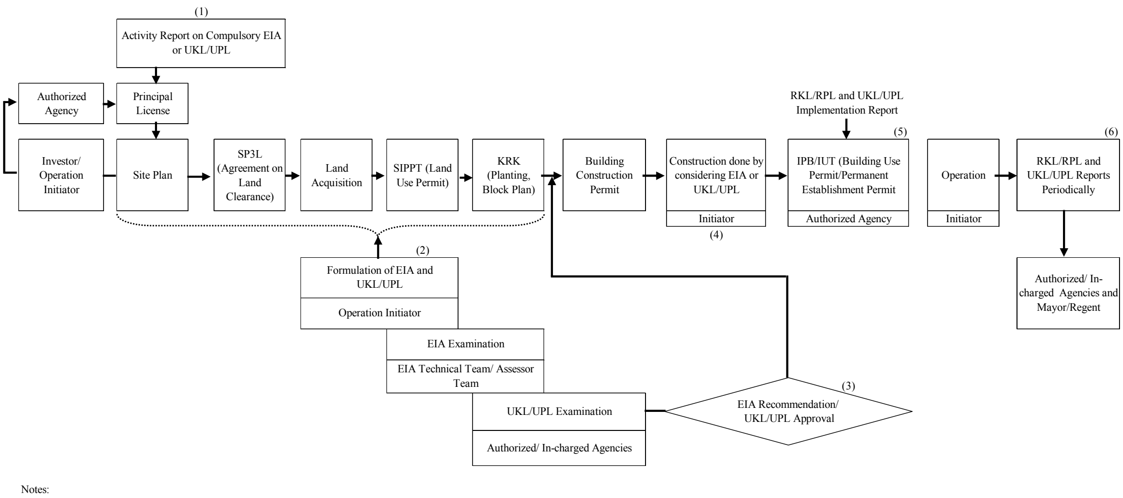
In cases where the determination of the authority is that an EIA is to be conducted, it must be considered for the whole influenced area, which includes indirectly affected areas as well. Therefore, it is recommended that the influenced area is not limited to only in and around the project site, where the assessment is fairly and reasonably done by the concerned AMDAL. The existing procedure for an EIA is shown in Figure-11.1.

(2) Proposed Procedure

In order to further promote public involvement in the project from the planning phase, it is recommended that the concept of participation of residents and stakeholders be introduced to the existing EIA process for this project at the initial stage, such as when the basic design and preliminary implementation program are being prepared.

The people's knowledge and their experience with the local issues can be utilized to predict any potential serious environmental constraints on the project and save the cost and time dealing with them later in the project implementation. Meanwhile it will be seen that the project may create job opportunities for the local residents.

Therefore, it is desirable to set up a desk at the project site or in the office of the project executive organization to accept any complaints, offers and/or suggestions by residents and stakeholders from NGOs, etc.



Notes:
1. The authorized agency shall inform type of environmental document to be formulated (EIA or UKL/UPL)
2. Formulation of EIA or UKL/UPL
3. EIA or UKL/UPL is a requirement for Building Construction Permit
4. Development/Construction done by considering EIA or UKL/UPL
5. To report implementation of RKL/RPL and UKL/UPL
6. Periodic report for RKL/RPL and UKL/UPL implementations

Figure-11.1 Environmental Impact Assessment Procedure Flow

11.2 Anticipated Environmental Impacts

11.2.1 Maros System

The target project involves the construction of a new water treatment plant and distribution network covering the supply area of about 417 km^2. The total network length of the new pipeline is about 281 km and the treatment capacity of the proposed Bantimurung new water treatment plant (WTP) is about 163 l/sec. For this project the National criteria on WTP is applicable and this requires that an environmental impact assessment (EIA) be conducted. The scope of the assessment is determined by taking account of the magnitude of the project and the present environmental conditions of the project area.

This project is in the category of a clean water network project in the metropolitan area of which the service area of the distribution network is more than 500 ha and the total pipe length is more than 10 km. Moreover, in South Sulawesi the regulation covering the EIA procedure is applied for the construction of WTP with a treatment capacity more than 50 l/sec. The IEE in this study has been carried out focusing on the key environmental issues given below.

- Hydrological Situation
- Landscape
- Social Communities
- Water Rights and Right of Common

In the following Table, items marked with ○ require further assessment of the current environmental conditions, and a forecast and assessment of the impacts through that site survey of the current conditions. On the basis of these results, suitable countermeasures are recommended. Regarding items with △, soundness of the plan should be assessed based on the existing survey/analysis reports and the planned studies around the project area. A schedule of the preventive and counter-measures for the impacts needs to be recommended.

Table-11.2 Summary of IEE for Maros System

Environmental Impacts / Effective Factors		Pollution						Natural Environment									Social Environment													
		1 Air Pollution	2 Water Pollution	3 Soil Contamination	4 Noise and Vibration	5 Land Subsidence	6 Offensive Odor	7 Topography and Geology	8 Soil Erosion	9 Groundwater	10 Hydrological Situation	11 Coastal Zone	12 Biology (Flora and Fauna)	13 Meteorology	14 Landscape	15 Global Warming	16 Resettlement	17 Economic Activities	18 Landuse and Resional Resource	19 Social Communities	20 Infrastructure and Public Service	21 Minorities and Low Income People	22 Uneven Distribution of Interest	23 Gendor	24 Right of Children	25 Cultural Property	26 Public Health Condition	27 Waste and Garbage	28 Water Rights・Right of Common	29 Hazards and Accident
General		△			△						○				△			＋		△									△	
Construction Phase	Change of Topography・Occupation		△				△		△		△				△		△	＋	△	△		＋	△					△	△	△
	Construction Vehicles	△			△																									
	Construction Machines	△			△															△										
Operation Phase	Occupation														△				＋											
	Operation									△	○							＋			＋	＋					＋		△	

○:significant negative impact
△:less negative impact
brank:no effect
＋:positive impact as expected

One significant negative impact due to the project is assumed to be a change of the hydrological situation of the Bantimurung River.

The items with less negative impact are: landscape in the natural environment sector, and social communities and water rights/right of common in the social sector. These items are described in the subsequent sections. The other items will have negligible negative impact. Favorable impact is expected in the items of economic activities, infrastructure and public service, and low income people in the social sector.

11.2.2 Takalar System

The target project involves the drilling of new deep and shallow wells and the associated distribution network. The proposed supply area is about 49 ha, the total network length of new pipeline is about 54 km, total capacity of the proposed new deep well is about 22 l/sec and the shallow well capacity is 3 l/sec. For this project the South Sulawesi criteria for drinking water projects apply, it is necessary to conduct an environmental impact assessment (EIA), and the scope of the assessment is determined by the magnitude of the project and the present environmental conditions of the area.

Clean water network projects in the metropolitan area are required by the regulations to conduct an EIA if the total length of pipeline is more than 10 km. Moreover, in South Sulawesi any drinking water supply project in which groundwater withdrawal discharge volume is between 5 l/sec and 50 l/sec, is required to carry out the EIA procedure. However, certain items may not need to be covered by the assessment depending on the magnitude of the project or the site conditions. The IEE in this study has been carried out focusing on the key environmental issues given below.

- Groundwater
- Social Communities

In the following Table, items marked with ○ require further assessment of the current environmental conditions, and a forecast and assessment of the impacts through that site survey of the current conditions. On the basis of such results, suitable countermeasures are recommended. Regarding items with △, the soundness of the plan should be assessed based on the existing survey/analysis reports and the planned studies around the project area, and a schedule of the preventive and counter-measures for the impacts are to be recommended.

Table-11.3 Summary of IEE for Takalar System

Effective Factors \ Environmental Impacts		Pollution						Natural Environment									Social Environment													
		1 Air Pollution	2 Water Pollution	3 Soil Contamination	4 Noise and Vibration	5 Land Subsidence	6 Offensive Odor	7 Topography and Geology	8 Soil Erosion	9 Groundwater	10 Hydrological Situation	11 Coastal Zone	12 Biology (Flora and Fauna)	13 Meteorology	14 Landscape	15 Global Warming	16 Resettlement	17 Economic Activities	18 Landuse and Resional Resource	19 Social Communities	20 Infrastructure and Public Service	21 Minorities and Low Income People	22 Uneven Distribution of Interest	23 Gendor	24 Right of Children	25 Cultural Property	26 Public Health Condition	27 Waste and Garbage	28 Water Rights・Right of Common	29 Hazards and Accident
General										○										△										
Construction Phase	Change of Topography・Occupation		△							△	△									△		＋	△					△	△	△
	Construction Vehicles																													
	Construction Machines																			△										
Operation Phase	Occupation														△				＋											
	Operation									○								＋			＋						＋			

○:significant negative impact
△:less negative impact
brank:no effect
＋:positive impact as expected

One significant negative impact on to the groundwater condition due to the project is assumed. The proposed water supply project utilizes two deep wells and one shallow well as water resources. In the objective project area three new wells will be dug and the new wells are assumed to affect the surrounding existing wells, which are utilized by the residents.

11.3 Mitigation Measures

11.3.1 Maros System

(1) Hydrological Situation

The proposed Jamalah spring is to be utilized as the discharge resource of new Bantimurung WTP. It is assumed that the discharge from this spring presently flows into the Bantimurung river which is a tributary of the Maros river. Therefore, the discharge flow of the Bantimurung river will certainly be influenced in the dry season.

Jamalah spring intake is located on the Bantimurung riverside. This river is fed by many springs in the National Park. Although detailed flow discharge data is not available for both Jamalah spring and the main stream of the Bantimurung river, the spring flow can preliminarily be estimated to be 500 to 800 l/sec. The authorized intake water volume from the Jamalah spring is 300 l/sec. and the regular intake water volume is planned at less than that. Therefore, the planned water intake from the spring will not produce any significant affect on the hydrological situation of the Bantimurung river system in terms of the water quantity. It is, however, recommended that a discharge flow and water quality survey of Jamalah spring be done by the project executive organization for further detailed examination.

The existing intake and irrigation canal are located in the downstream of the Bantimurung main flow so influence on intake discharge volume is anticipated. It is important to properly assess the water demand and supply balance considering the river maintenance flow and so on.

(2) Landscape

The landscape around the new WTP site is a typical limestone mountainous part of the Bantimurung area. A precipitous mountain is located behind this site, so the surrounding environmental condition is comparatively good. Nevertheless, waste and garbage are scattered in and around the proposed site.
During the construction phase, the large amount of excavation will not bring about great changes to this site. After a small-scale landfill is implemented at this site, treatment tank, storage tank, pumping facilities and an office, etc. will be constructed. The proposed site is located at the entrance of the National Park, so it is also necessary to consider the building form, color and height, etc.

(3) Social Communities

As the new network pipeline will be planned along the causeway of Maros regency, it is feared that traffic jams will occur during the construction period while installing it along the road. It is necessary to consider appropriate countermeasures, i.e. construction at the times of low traffic density, a proper construction schedule, allocation of site traffic operators, etc.

(4) Water Rights and Right of Common

There are two irrigation schemes (Bantimurung Left and Right) downstream of the new WTP site. There is no available data concerning the land ownership of the new WTP site at present. It is therefore necessary to investigate the rights regarding the land at the site.
As the discharge flow at the existing intake point of the Bantimurung river will be decreased by using the upstream spring as the new WTP resource, the balance of domestic and irrigation water demand in the dry season must be assessed.

11.3.2 Takalar System

(1) Groundwater

The two proposed new deep wells and the one shallow well are located in the north part of Lassang village in the Polombangkeng Utara region. No public water supply facility is available in this village and the water for daily use is dependent on the shallow wells around the houses. Therefore, it is assumed that an assessment for the influence against the surrounding shallow wells is needed. This will be done after site pumping and well permeability tests, and fact-finding on the spot with the surrounding residents have been executed, which are necessary for a proper evaluation regarding the project implementation.
Basically, aquifer deep wells are different from shallow wells. It is inferred that the influence of deep wells on surrounding shallow wells is not so significant. However, in case it is claimed that the proposed new wells will impact on the existing shallow wells, proper countermeasures should be implemented by the project executive organization.

(2) Social Communities

As the new network pipeline will be planned along the causeway and the village main road of Kechamatan Polombangkeng Utara, it is feared that traffic jams will occur during the period of construction of installing the pipeline along these roads. It is necessary to consider the countermeasures, i.e. construction at times of low traffic density, a proper construction schedule, allocation of site traffic operators, etc, especially when the installation of the pipeline network along the National road is implemented. On the other hand, it is also necessary to prepare a proper construction scheme for the cases of rural roads, on which the traffic density is very low.

11.4 Environmental Monitoring

(1) Introduction

In order to identify the project's environmental impact and to minimize the negative impact on the project area, environmental monitoring should be conducted during both the construction and operation phases. The aims of monitoring are to evaluate whether the construction is implemented in accordance with the plan with inevitable consideration for the environment, and to judge whether unexpected or serious effects occur during the project.

(2) Preconstruction Phase

In the detailed design phase, it is necessary to understand the environmental conditions in order to decide the proper construction scheme for consideration of the environment preservation. The project plan should be decided in consideration of the following items:

- Selection of environmentally-sound construction technology
- Identification of potential environmental impact associated with the work
- Development of the details of the mitigating measures
- Development of the plan to audit the performance of the mitigating measures

Before construction, a detailed investigation of the project area needs to be carried out. The objective of this investigation is to obtain background information about the surrounding environment. The results should be utilized effectively to assess the impact of construction activities. The investigation items that it is necessary to understand with respect to the environmental conditions include, but are not limited to, the following:

i) Environmental Pollution

- water pollution (spring and surface water, etc.).

ii) Natural Environment

- hydrological situation (spring and river discharge, etc.)
- groundwater (yield, quality, permeability, etc.)
- landscape (photography and elements, etc.).

iii) Social Environment

- public health conditions
- water rights
- land ownership (new WTP).

(2) Construction Phase

The construction should be monitored against the targets, such as the components of the construction (number of construction vehicles, machines, and operating persons, etc.), the mitigation measures, the water quality of drainage, the construction noise level and so on.

(3) Operation Phase

At the end of the construction phase, the project executive organization must prepare and submit the operation-phase environmental monitoring plan to AMDAL. The monitoring plan is aimed to identify the environmental performance of this project, and to mitigate any unexpected environmental impact in the operation phase. The environmental elements that need to be monitored in the operation phase should include, but not be limited to:

- Water quality condition (river and the intake, surrounding shallow wells, etc.)
- Landscape (photographic assessment, etc.)
- Land acquisition (new WTP)
- Public health conditions (disease and causes, etc.).

12. PRELIMINARY FINANCIAL AND ECONOMIC EVALUATION

12.1 Basic Assumption

Financial and Economic analysis were made for the proposed water supply project, in Maros, and Takalar, South Sulawesi Province. The projects in Maros and Takalar are situated in Batu Bassi and North Polombangken, respectively. It is assumed that the project in Maros will be completed December 2010, and will start commercial operation on the 1st day of 2011. Construction work of the project in Takalar will be finished in February 2010. Commercial operation will start operation from March 2010. After the project completion, these facilities will be operated by regional water supply enterprises (PDAMs) in respective region.

Costs and benefits included in the analysis are attributed to the projects on a with-project and without project basis. The economic life of the project is assumed as 30 years after the completion. All prices and costs are expressed Indonesian Rupiah in year 2006 value. Consumer Price Index (CPI) is utilized for adjusting the current price to base year price. The foreign currency based costs are converted to Rupiah using exchange rate of Rp. 8,760 per US$ (average exchange rate in May 2006).

12.2 Financial Analysis

12.2.1 Financial Costs

Financial costs of the project are consists of capital investment cost, operation and maintenance (O&M) cost and major rehabilitation costs. Following the general principles, costs and benefits are entered in the analysis in the year in which they occur, interest during construction (IDC) is excluded from the costs used in the financial analysis.

Capital investment costs consist of construction cost, land acquisition cost, engineering service costs, government administration cost, and physical contingency (10% of construction cost). Capital investment cost of the projects is Rp. 16,913 million for Takalar and Rp. 168,060 million for Maros.

O&M costs include maintenance cost of project facilities, electricity tariff, staffing costs, and chemical costs. Maintenance costs of the project facilities are estimated as the sum of 5% of mechanical equipment, 1% of civil work and 1% of pipe works. After the full operation, O&M costs of project facilities are calculated Rp. 316 million per annum for Takalar and Rp. 2,933 million per annum for Maros.

After the 10 years and 20 years of their operations, major rehabilitation is assumed to be required. The cost of major rehabilitation is estimated 100% of initial mechanical equipment costs, which is Rs. 6,456 million for Maros and Rp. 566 million for Takalar.

In adopting 5% of discount rate, present value of the financial costs through out the economic life is calculated Rp. 184,438 million for the Maros project and Rp. 19,759 million for the Takalar project (please refer to the table below).

Table 12-1: Present Value of Costs during Project Life (Rp. million)

	Capital Investment Cost	Major Rehabilitation Cost	O&M Costs	Total Costs
Maros	140,983.5 (76.4%)	5,663.9 (3.1%)	37,790.3 (20.5%)	184,437.7 (100.0%)
Takalar	14,855.3 (75.2%)	496.8 (2.5%)	4,407.3 (22.3%)	19,759.3 (100.0%)

Source: JICA Study Team
Note: Discount Rate Used: 5.0%

12.2.2 Financial Benefits

(1) Water Tariff and Revenue Collection Ratio

Revenue from water sales is regarded as financial benefit of the projects. Revenue from water sales is calculated as the product of incremental sales volume of water, revenue collection ratio and water tariff. To simplify the analysis, water tariff is divided domestic tariff and non-domestic tariff (including commercial, industrial, and public).

It is assumed that 80% of water consumption was occupied by domestic consumer, and remaining 20% was consumed by non-domestic consumers. Based on the actual average tariff of all the PDAMs in South Sulawesi in 2005, water tariff for domestic consumer and non- domestic consumer in 2006 fixed price is worked out as Rp. 2,297.8 /m^3 and Rp.3,172.3 /m^3, respectively, with an assumed annual tariff increase of 2.0% in real price until 2015. A collection efficiency factor of 95% was adopted based on assumed successful ADB's institutional and community programs.

(2) Sales Volume of Water

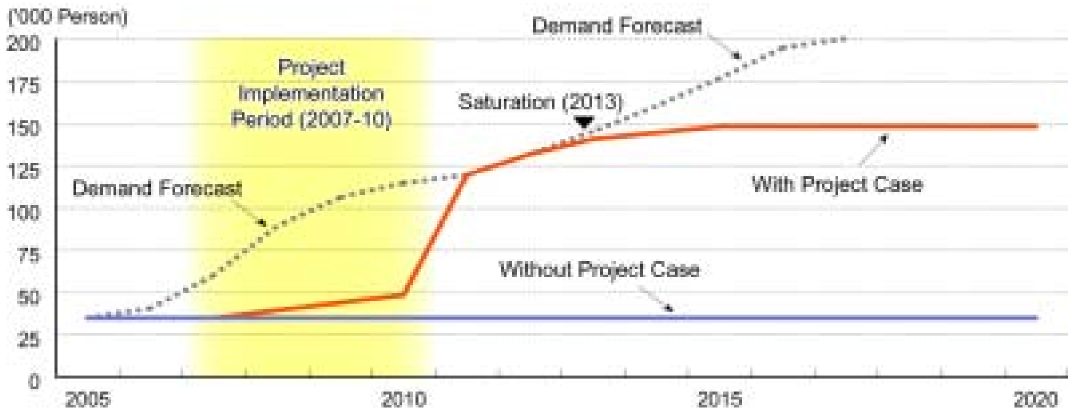
Maros Project

After the completion Batu Bassi project in December 2010, water supply volume will be increased by 12,960 m^3/day (without the projects: 7,776 m^3/day, with the project:

20,736 m^3/day). In addition, since the projects included the rehabilitation and expansion of some existing systems, it is assumed that the project is contributed to reduce UFW gradually from present level of 49.6% to 30% in 2010, and 20% from 2015 onwards.

According to the demand forecast of PDAM Maros, number of domestic consumers will progressively increased from 5,950 households (equivalent to 35,105 personnel) in 2005 to 20,358 households (119,552 personnel) in 2011. However, when using weighted average per capita daily consumption of 89.6 liter[*1], there is no surplus water yield for additional consumers.

On the other hand, if the Project is successfully implemented, PDAM Maros can cope with the increasing demand from domestic consumer by 2013 (148,135 personnel received sufficient water supply). From 2014 onwards water demand will exceed supply capacity. And thus, if there are no additional water sources, sales volume of water and number of population served will remain unchanged at 16,589 m^3/day (13,271 m^3/day for domestic, and 3,337 m^3/day for non-domestic) and 148,135 personnel, respectively. Please refer to the following figure 13-1.



Source: PDAM Maros, JICA Study Team

Figure 12-1: Number of Population Served (Maros)

<u>Takalar Project</u>

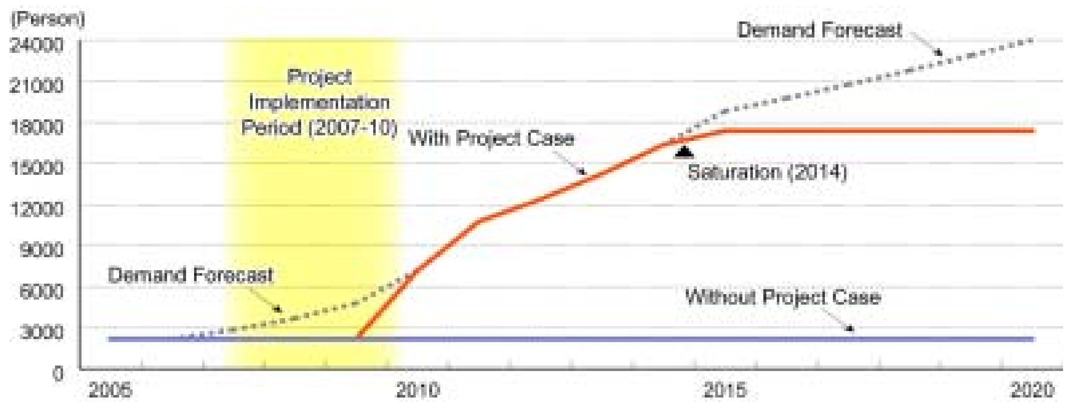
Water supply yield of the existing piped water supply system was originally 12.5 liter/sec. However, actual supply is 12.1 liter/second during wet season and only 3.0 liter/second during dry season. After the completion of the project in February 2010, water supply volume will be increased by 15.0 liter/second throughout a year. In addition, supply hours will increase from 6 hours to 24 hours. Weighted average water supply yield per day is augmented from 212 m^3/day of present level to 2,145

[1] The pre-feasibility study assumed that 80% of domestic consumer will be supplied through piped system and consuming 130 lcd in Turikale sub-district (population: 45,334), 100 lcd in other sub-districts (total population: 257,398), and remaining 20% of beneficially will be covered by public hydrant and using 30 lcd. Thus, weighted average of water consumption is calculated as 89.6 lcd.

m^3/day after the project. While only four years has passed after the completion of the existing system, current UFW is estimated as 50% due to insufficient management capacity. It is assumed that the project is contributed to reduce UFW gradually from present level of 50.0% to 30% in 2010, and 20% from 2015 onwards.

Currently, 400 households (equivalent to 2,176 personnel) are receiving water supply from existing system. When using weighted average per capita daily consumption of 79 liter*2, current system suffice 60.1% of demand during wet season, and only 15.1% of demand during dry season. Since the current system cannot cope with the existing demand, connection to additional consumers cannot be expected without augmentation of supply yield.

While the water demand for piped system in Takalar has already saturated, it is assumed that unrestricted demand will increased with an annual ratio of 30% up to 2009. After the completion of the project, demand will rapidly increased 50% per annum 2010- 2011, 15% from 2011 to 2015, and then 5% from 2016 onwards. Given the rough assumptions, water demand will be able to meet the increasing demand up to 2014. From 2014 onwards, number of population served will remain unchanged at 17,376 (please refer to the figure 13-2). And water demand is also remained stagnant 1,715.9 m^3/day (1,372.7 m^3/day for domestic and 343.2 m^3/day for non-domestic) from 2014 onwards. .



Source: JICA Study Team

Figure 12-2: Number of Population Served (Takalar)

2 The pre-feasibility study assumed that 70% of domestic consumer will be supplied through piped system and consuming 100 lcd, and remaining 30% of beneficially will be covered by public hydrant and using 30 lcd. Thus, weighted average of water consumption is calculated as 79.0 lcd.

(3) Financial Benefits

Revenue from sales of water is calculated based on the water tariff and additional sales volume of water (sales of water with the Project – sales of water without the Project). Water tariff for residential category and non-residential categories used for this analysis is Rp. 2,297.8 /m^3 and Rp.3,172.3 /m^3, respectively, with an assumed annual tariff increase of 2.0% in real price until 2015.

Financial benefits of the Maros project are worked out Rp. 116.3~ 12,983.1 million per year, and that of the Takalar project are calculated Rp. 657.2~ 1758.3 million per year.

12.2.3 Results of the Financial Analysis

Given the assumptions mentioned above, Financial Internal Rate of Return (FIRR) is calculated to be 3.40% for Maros and 5.67% for Takalar. Consolidated FIRR of the projects is worked out 3.66%. Results of financial analysis are summarized as below;

Table 12-2: Summary of Financial Analysis (Rp. million)

	Financial Costs			Financial Benefits			Net Benefit (NPV)	FIRR
	Capital Cost	O&M Cost	Total Cost	Domestic	Non-domestic	Total Benefit		
Maros	155,533 (82.7%)	36,591 (19.5%)	188,101 (100.0%)	119,057 (74.3%)	41,091 (25.7%)	160,148 (100.0%)	-27,953	3.40%
Takalar	15,681 (79.4%)	4,859 (24.6%)	19,759 (100.0%)	17,264 (82.0%)	5,958 (28.3%)	21,063 (100.0%)	1,828	5.67%
Consolidated	162,308 (79.0%)	43,048 (21.0%)	205,356 (100.0%)	141,451 (74.3%)	48,820 (25.7%)	190,272 (100.0%)	-26,649	3.63%

Source: JICA Study Team

Both projects include rehabilitation of existing transmission and distribution system. Since existing system in Maros is much more deteriorated than system in Takalar, sizable investment is required for the project in Maros. As a result, FIRR of Maros project is considerably lower than the Takalar project. FIRR of whole project is also calculated using consolidated cash flow of the projects. Since the estimated FIRRs are relatively lower, soft loan and/or capital subsidy will be required for the projects. Financial structure of the projects is further examined in the “13.4 Cash Flow Analysis” of this report.

Table 12-3: Financial Internal Rate of Return (Maros) (Unit: Million Rp.)

		Costs			Incremental Revenue			Net
		Capital Cost	O&M Cost	Sub-total	Domestic	Non-domestic	Sub-total	Income
2007		12,437.8	0.0	12,437.8	0.0	0.0	0.0	-12,437.8
2008		34,001.5	117.6	34,001.5	337.1	116.3	453.4	-33,548.1
2009		81,982.1	235.3	81,982.1	687.6	237.3	924.9	-81,057.2
2010		39,638.1	352.9	39,638.1	1,052.0	363.1	1,415.1	-38,223.0
2011	1		2,191.1	2,191.1	6,661.9	2,299.3	8,961.2	6,770.1
2012	2		2,508.6	2,508.6	7,779.9	2,685.1	10,465.0	7,956.5
2013	3		2,740.7	2,740.7	8,669.8	2,992.3	11,662.1	8,921.3
2014	4		2,836.7	2,836.7	9,152.9	3,159.0	12,311.9	9,475.2
2015	5		2,932.7	2,932.7	9,651.9	3,331.2	12,983.1	10,050.4
2016	6		2,932.7	2,932.7	9,651.9	3,331.2	12,983.1	10,050.4
2017	7		2,932.7	2,932.7	9,651.9	3,331.2	12,983.1	10,050.4
2018	8		2,932.7	2,932.7	9,651.9	3,331.2	12,983.1	10,050.4
2019	9	3,228.1	2,932.7	6,160.8	9,651.9	3,331.2	12,983.1	6,822.4
2020	10	3,228.1	2,932.7	6,160.8	9,651.9	3,331.2	12,983.1	6,822.4
2021	11		2,932.7	2,932.7	9,651.9	3,331.2	12,983.1	10,050.4
:	:		:	:	:	:	:	:
2028	18		2,932.7	2,932.7	9,651.9	3,331.2	12,983.1	10,050.4
2029	19	3,228.1	2,932.7	6,160.8	9,651.9	3,331.2	12,983.1	6,822.4
2030	20	3,228.1	2,932.7	6,160.8	9,651.9	3,331.2	12,983.1	6,822.4
2031	21		2,932.7	2,932.7	9,651.9	3,331.2	12,983.1	10,050.4
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2039	30		2,932.7	2,932.7	9,651.9	3,331.2	12,983.1	10,050.4

Financial Internal Rate of Return (FIRR) = 3.40%

Table 12-4: Financial Internal Rate of Return (Takalar) (Unit: Million Rp.)

		Costs			Incremental Revenue			Net Income
		Capital Cost	O&M Cost	Sub-total	Domestic	Non-domestic	Sub-total	
2007		459.5	0.0	459.5	0.0	0.0	0.0	-459.5
2008		6,554.6	0.0	6,554.6	0.0	0.0	0.0	-6,554.6
2009		7,990.9	0.0	7,990.9	0.0	0.0	0.0	-7,990.9
2010	1	1,907.9	150.1	2,058.0	488.6	168.6	657.2	-1,400.8
2011	2		225.2	225.2	747.5	258.0	1,005.5	780.3
2012	3		259.0	259.0	876.9	302.6	1,179.5	920.5
2013	4		297.8	297.8	1,028.6	355.0	1,383.5	1,085.7
2014	5		342.5	342.5	1,206.5	416.4	1,622.9	1,280.4
2015	6		363.8	363.8	1,307.1	451.1	1,758.3	1,394.5
2016	7		363.8	363.8	1,307.1	451.1	1,758.3	1,394.5
2017	8		363.8	363.8	1,307.1	451.1	1,758.3	1,394.5
2018	9	283.1	363.8	647.0	1,307.1	451.1	1,758.3	1,111.3
2019	10	283.1	363.8	647.0	1,307.1	451.1	1,758.3	1,111.3
2020	11		363.8	363.8	1,307.1	451.1	1,758.3	1,394.5
:	:		:	:	:	:	:	:
2027	18		363.8	363.8	1,307.1	451.1	1,758.3	1,394.5
2028	19	283.1	363.8	647.0	1,307.1	451.1	1,758.3	1,111.3
2029	20	283.1	363.8	647.0	1,307.1	451.1	1,758.3	1,111.3
2030	21		363.8	363.8	1,307.1	451.1	1,758.3	1,394.5
:	:		:	:	:	:	:	:
2039	30		363.8	363.8	1,307.1	451.1	1,758.3	1,394.5

Financial Internal Rate of Return (FIRR) = 5.67%

Table 12-5: Financial Internal Rate of Return (Consolidated) (Unit: Million Rp.)

		Costs			Incremental Revenue			Net Income
		Capital Cost	O&M Cost	Sub-total	Domestic	Non-domestic	Sub-total	
2007		12,897.2	0.0	12,897.2	0.0	0.0	0.0	-12,897.2
2008		40,556.1	117.6	40,673.7	337.1	116.3	453.4	-40,220.3
2009		89,973.1	235.3	90,208.4	687.6	237.3	924.9	-89,283.5
2010		41,546.0	503.1	42,049.0	1,540.6	531.7	2,072.3	-39,976.7
2011	1		2,416.3	2,416.3	7,409.4	2,557.3	9,966.7	7,550.4
2012	2		2,767.6	2,767.6	8,656.8	2,987.8	11,644.5	8,877.0
2013	3		3,038.6	3,038.6	9,698.3	3,347.3	13,045.6	10,007.0
2014	4		3,179.2	3,179.2	10,359.4	3,575.4	13,934.8	10,755.6
2015	5		3,296.5	3,296.5	10,959.0	3,782.4	14,741.4	11,444.9
2016	6		3,296.5	3,296.5	10,959.0	3,782.4	14,741.4	11,444.9
2017	7		3,296.5	3,296.5	10,959.0	3,782.4	14,741.4	11,444.9
2018	8	283.1	3,296.5	3,579.7	10,959.0	3,782.4	14,741.4	11,161.7
2019	9	3,511.2	3,296.5	6,807.7	10,959.0	3,782.4	14,741.4	7,933.7
2020	10	3,228.1	3,296.5	6,524.6	10,959.0	3,782.4	14,741.4	8,216.8
2021	11	0.0	3,296.5	3,296.5	10,959.0	3,782.4	14,741.4	11,444.9
:	:	:	:	:	:	:	:	:
2027	17		3,296.5	3,296.5	10,959.0	3,782.4	14,741.4	11,444.9
2028	18	283.1	3,296.5	3,579.7	10,959.0	3,782.4	14,741.4	11,161.7
2029	19	3,511.2	3,296.5	6,807.7	10,959.0	3,782.4	14,741.4	7,933.7
2030	20	3,228.1	3,296.5	6,524.6	10,959.0	3,782.4	14,741.4	8,216.8
2031	21		3,296.5	3,296.5	10,959.0	3,782.4	14,741.4	11,444.9
:	:	:	:	:	:	:	:	:
3039	29		3,296.5	3,296.5	10,959.0	3,782.4	14,741.4	11,444.9
2040	30		2,932.7	2,932.7	9,651.9	3,331.2	12,983.1	10,050.4

Financial Internal Rate of Return (FIRR) = 3.63%

12.3 Economic Analysis

12.3.1 Economic Costs

Economic Analysis was carried out by comparing economic cost and economic benefit streams. The economic costs streams of the projects include capital costs, O&M costs, and major rehabilitation costs. Local currency portion is converted to economic costs by applying a standard conversion factor of 0.85 (adopted same figure as ADB's rural water supply project[*3]).

Table 12-6: Economic Costs of the Project

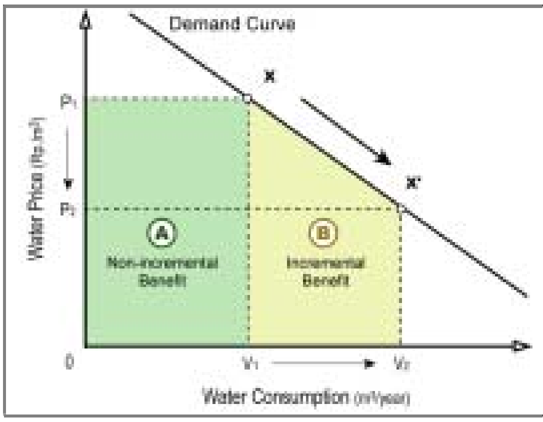
	Capital Costs (Rp. million)		O&M Costs (Rp. million/year)	
	Financial	Economic	Financial	Economic
Maros	168,059.5	148,819.4	2,932.7	2,536.8
Takalar	16,912.9	15,193.0	363.8	316.4

Source: JICA Study Team

12.3.2 Economic Benefits

(1) Methodology

Project benefits were calculated in terms of incremental and non-incremental outputs of the scheme. The figure below illustrates non-incremental benefits and incremental benefits of water supply project.



Economic Benefits= (A) Non-incremental Benefit + (B) Incremental Benefit

(A) Non-incremental Benefit= $V_1 * P_1$

(B) Incremental Benefit= $(P_1 + P_2) * (V_2 - V_1) /2$

here;

V_1= Total Consumption (Without Project)

V_2= Total Consumption (With Project)

P_1= Average Cost of Water (Without Project)

P_2= Average Cost of Water (With Project)

Figure 12-3: Schematic Figure of Economic Benefits

Non-incremental inputs are project demands that are met by existing supplies while incremental inputs are project demands that are met by an increase in the total supply of the input. Non-incremental outputs are project outputs that replace existing outputs while incremental outputs expand supply to meet new or additional demands.

[3] Project Completion Report on the Rural Water Supply and Sanitation Sector Project in Indonesia, Oct. 2002, ADB

(2) Increase in Water Consumption

Maros Project

Existing water supply system has enough capacity to fulfill existing consumers. Thus, to simplify the analysis, water consumption of existing consumers is assumed to be remained unchanged between with and without situations. So, the project beneficially is only incremental consumers. Type of project beneficially can be broadly divided in to following two types: i) systems where consumers are required to collect water from public hydrant, called “PH consumer;” and ii) systems that delivered water to house connections, called “HC consumer.”

The Project is expected to serve additional 148,135 personnel. Of which, according to pre- feasibility study, 80% of domestic customers received piped supply system, and remaining 20% will be covered by public hydrant. The study estimated that while the HC consumer uses 100 liter (in the case of Turikale sub-district 130 liter) per capita per day (lcd) of water, and the PH consumer uses 30 lcd. While the HC consumer using water only from piped system, in the case of consumers using public hydrant, it is assumed that they are using 15 lcd of water from private well and other sources for washing cloth and for bathing, besides 30 lcd from public hydrant.

On the other hand, the majority of the households in the target area have access to a water source such as a private hydrant or river, and most of them purchase water from venders for drinking and cooking purposes. Since water consumption survey at target site is not executed, water consumption of these un-supplied consumers are estimated as below table based on the past ADB’s rural water supply project*4 and site observation.

Table 12-7: Assumption of Per Capita Daily Water Consumption by Beneficially Type

	Without Project		With Project
Type-1 (80%)	No Supply - Purchase from Vender: 3 lcd - Collected from river, private well, and other sources: 27 lcd	→	House Connection (HC) - Piped Water (Turikale): 130 lcd - Piped Water (Other Areas): 100 lcd
Type-2 (20%)	No Supply - Purchase from Vender: 3 lcd - Collected from river, private well, and other sources: 27 lcd	→	Public Hydrant (PH) - Public Hydrant: 30 lcd - Collected from river, private well, and other sources: 15 lcd

Source: JICA Study Team

The non-incremental demand for water is the amount of water used prior to the

4 According to the ADB’s “Rural Water and Supply and Sanitation Sector Project in Indonesia”, water consumption in typical rural area is about 30 lcd.

Project, which is estimated to be 30.0 lcd. The weighted average of incremental demand for collected water is calculated to be 89.6 lcd.

Maros Project

As mentioned previously, existing system cannot meet the demand from their consumers. So, the project is expected to contribute not only for incremental consumers but also existing consumers. Type of project beneficially can be broadly divided in to following four types. Since water consumption survey was not executed, actual water consumption pattern of the project site are unknown. Accordingly, water consumption of without the project case are roughly estimated based on the current water supply volume of existing system, number of existing consumer , and site survey observation.

Table 12-8: Assumption of Per Capita Daily Water Consumption by Beneficially Type

	Without Project		With Project
Type 1 (8.8%)	House Connection (HC) - Piped Water: 49.4 lcd - Purchase from Vender 10.6 lcd	→	House Connection (HC) - Piped Water: 100 lcd
Type 2 (61.2%)	No Supply - Purchase from Vender: 3 lcd - Collected from river, private well, and other sources: 27 lcd	→	
Type 3 (3.8%)	Public Hydrant (PH) - Public Hydrant: 14.8 lcd - Purchase from Vender: 5.2 lcd - Collected from river, private well, and other sources: 20 lcd	→	Public Hydrant (PH) - Public Hydrant: 30 lcd - Collected from river, private well, and other sources: 15 lcd
Type 4 (26.2%)	No Supply - Purchase from Vender: 3 lcd - Collected from river, private well, and other sources: 27 lcd	→	

Source: JICA Study Team

Given assumptions, the non-incremental demand for water is the amount of water used prior to the project, which is estimated to be 33.0 lcd. The weighted average of incremental demand for collected water is calculated to be 83.5 lcd.

(3) Reduction in Economic Cost of Water

While in some cases dry season access to water may be reduced, generally people in the target areas collect water from private/ public hydrant rather than purchase from a vendor. Water purchased from vender is generally expensive (Rp. 25,000 per m^3), which is about 10 times higher than PDAM's domestic tariff. For this reason, people usually utilized purchased water only for drinking and cooking purposes.

On the other hand, the economic cost of water collected from private/ public hydrant and a river is calculated based on the value of time spent on water collection, including time for walking and pumping. The majority of people in the target area using not electric pump system but hand pump system, electricity or diesel costs of pumping are deemed to be negligible.

Based on the site visits, the study team estimates that a household spent around 30 minutes per day on water collection. Minimum wage rate in South Sulawesi Province in 2006 is Rp. 612,000 per month, which was decided under Government Decree No. 766/XI in 2005. There is a range of approaches for converting this to the value of time spent on domestic work, and for this analysis the financial cost was calculated from the minimum wage rate, as suggested in the Asian Development Bank (ADB) Handbook for the Economic Analysis of Water Supply. The economic cost was calculated by applying a shadow wage rate factor of 0.65 (quoted from ADB's rural water supply project in Indonesia). Assuming 8 hours of domestic work per day, the economic cost of water collection each year is estimated to be Rp. 298,350.

The value of non-incremental water is calculated as the resource cost saving on the non-incremental supply of collected water and water used at site. Collected water costs Rp. 298,350 per year. The average household size is 5.90 (Maros) and 5.44 (Takalar), and so the amount collected per year is 86.1 m^3 making the cost of collection Rp. 5,131/m^3 (Maros) and Rp. 5,565/m^3 (Takalar).

Economic costs of water using in the economic analysis are shown below.

Table 12-9: Economic Costs of Water (Rp./m^3)

Piped Water	Public Hydrant	Purchase from Vender	Collected Water*
Rp. 2,429 /m^3	Rp. 1,123 /m^3	Rp. 25,000 /m^3	Rp. 5,131- 5,565 /m^3

* Water collected from river, private well and other sources
Source: JICA Study Team

Given the assumptions mentioned above, weighted average economic cost of water of the with and without situation is calculated as follows;

Table 12-10: Weighted Average Cost of Water (Rp./m^3)

	Without Project (W/O)	With Project (W/H)
Maros	Rp. 7,118.1 /m^3	Rp. 2,330.1 /m^3
Takalar	Rp. 7,269.8 /m^3	Rp. 2,347.3 – 6,038.0 /m^3

Source: JICA Study Team

(4) Calculation of Economic Benefits

Economic benefits of the project are calculated using following formula;

$$EB = \sum_{t=1}^{25} \{V_1 \times P_1 + (P_1 + P_2) \times (V_2 - V_1)\}$$

Where;
V_1= Total Consumption (Without Project)
V_2= Total Consumption (With Project)
P_1= Average Cost of Water (Without Project)
P_2= Average Cost of Water (With Project)

12.3.3 Results of the Economic Analysis

Calculated EIRR, present value of costs/benefits and net present value using discount rate of 10%, for the projects and consolidated case are summarized as following tables.

In all cases, EIRR are above the cost of capital in Indonesia of 10.0%, and thus the projects are considered to be economically viable.

Table 12-11: Summary of Economic Analysis (Rp. million)

	Economic Costs			Economic Benefits			Net Benefit (NPV)	EIRR
	Capital Cost	O&M Cost	Total Cost	Domestic	Non-domestic	Total Benefit		
Maros	136,394 (83.2%)	31,651 (19.3%)	164,023 (100.0%)	152,348 (58.1%)	110,031 (41.9%)	262,379 (100.0%)	98,356	10.32%
Takalar	14,179 (80.0%)	3,863 (21.8%)	17,713 (100.0%)	19,746 (50.6%)	21,219 (54.4%)	39,015 (100.0%)	21,301	15.51%
Consolidated	146,221 (80.5%)	35,515 (19.5%)	181,736 (100.0%)	171,154 (56.9%)	130,239 (43.3%)	300,628 (100.0%)	118,892	10.77%

Source: JICA Study Team

Table 12-12: Economic Internal Rate of Return (Maros) (Unit: Million Rp.)

		Costs			Incremental Revenue			Net Income
		Capital Cost	O&M Cost	Sub-total	Domestic	Non-domestic	Sub-total	
2007		9,210.3		9,210.3				-9,210.3
2008		30,265.7	101.8	30,367.5	489.8	353.7	843.5	-29,524.0
2009		71,769.2	203.5	71,972.7	979.6	707.5	1,687.1	-70,285.6
2010		34,953.8	305.3	35,259.1	1,469.4	1,061.2	2,530.6	-32,728.5
2011	1		1,895.3	1,895.3	9,122.5	6,588.6	15,711.1	13,815.9
2012	2		2,169.9	2,169.9	10,444.6	7,543.4	17,988.1	15,818.1
2013	3		2,370.7	2,370.7	11,411.1	8,241.4	19,652.5	17,281.8
2014	4		2,453.8	2,453.8	11,810.7	8,530.1	20,340.8	17,887.1
2015	5		2,536.8	2,536.8	12,210.4	8,818.7	21,029.1	18,492.4
2016	6		2,536.8	2,536.8	12,210.4	8,818.7	21,029.1	18,492.4
2017	7		2,536.8	2,536.8	12,210.4	8,818.7	21,029.1	18,492.4
2018	8		2,536.8	2,536.8	12,210.4	8,818.7	21,029.1	18,492.4
2019	9	3,228.1	2,536.8	5,764.8	12,210.4	8,818.7	21,029.1	15,264.3
2020	10	3,228.1	2,536.8	5,764.8	12,210.4	8,818.7	21,029.1	15,264.3
2021	11		2,536.8	2,536.8	12,210.4	8,818.7	21,029.1	18,492.4
:	:		:	:	:	:	:	:
2028	18		2,536.8	2,536.8	12,210.4	8,818.7	21,029.1	18,492.4
2029	19	3,228.1	2,536.8	5,764.8	12,210.4	8,818.7	21,029.1	15,264.3
2030	20	3,228.1	2,536.8	5,764.8	12,210.4	8,818.7	21,029.1	15,264.3
2031	21		2,536.8	2,536.8	12,210.4	8,818.7	21,029.1	18,492.4
:	:		:	:	:	:	:	:
2040	30		2,536.8	2,536.8	12,210.4	8,818.7	21,029.1	18,492.4

Economic Internal Rate of Return (FIRR) = 10.32%

Table 12-13: Economic Internal Rate of Return (Takalar) (Unit: Million Rp.)

		Costs			Incremental Revenue			Net Income
		Capital Cost	O&M Cost	Sub-total	Domestic	Non-domestic	Sub-total	
2007		440.6		440.6				-440.6
2008		5,925.7		5,925.7				-5,925.7
2009		7,127.5		7,127.5				-7,127.5
2010	1	1,703.9	141.2	1,845.1	687.3	1,521.8	2,209.1	364.0
2011	2		207.0	207.0	1,007.6	1,521.8	2,529.4	2,322.4
2012	3		234.8	234.8	1,142.8	1,521.8	2,664.6	2,429.8
2013	4		265.7	265.7	1,293.3	1,521.8	2,815.1	2,549.4
2014	5		300.2	300.2	1,461.4	1,521.8	2,983.2	2,683.0
2015	6		316.4	316.4	1,540.0	1,521.8	3,061.8	2,745.4
2016	7		316.4	316.4	1,540.0	1,521.8	3,061.8	2,745.4
2017	8		316.4	316.4	1,540.0	1,521.8	3,061.8	2,745.4
2018	9	283.1	316.4	599.5	1,540.0	1,521.8	3,061.8	2,462.3
2019	10	283.1	316.4	599.5	1,540.0	1,521.8	3,061.8	2,462.3
2020	11		316.4	316.4	1,540.0	1,521.8	3,061.8	2,745.4
:	:		:	:	:	:	:	:
2027	18		316.4	316.4	1,540.0	1,521.8	3,061.8	2,745.4
2028	19	283.1	316.4	599.5	1,540.0	1,521.8	3,061.8	2,462.3
2029	20	283.1	316.4	599.5	1,540.0	1,521.8	3,061.8	2,462.3
2030	21		316.4	316.4	1,540.0	1,521.8	3,061.8	2,745.4
:	:		:	:	:	:	:	:
2039	30		316.4	316.4	1,540.0	1,521.8	3,061.8	2,745.4

Economic Internal Rate of Return (FIRR) = 15.51%

Table 12-14: Economic Internal Rate of Return (Consolidated) (Unit: Million Rp.)

		Costs			Incremental Revenue			Net Income
		Capital Cost	O&M Cost	Sub-total	Domestic	Non-domestic	Sub-total	
2007		9,650.9	0.0	9,650.9	0.0	0.0		-9,650.9
2008		36,191.4	101.8	36,293.2	489.8	353.7		-36,293.2
2009		78,896.7	203.5	79,100.2	979.6	707.5		-77,413.1
2010		36,657.7	446.5	37,104.2	2,156.7	2,583.0	4,739.8	-32,364.5
2011	1	0.0	2,102.3	2,102.3	10,130.2	8,110.4	18,240.6	16,138.3
2012	2	0.0	2,404.7	2,404.7	11,587.4	9,065.2	20,652.6	18,247.9
2013	3	0.0	2,636.4	2,636.4	12,704.4	9,763.2	22,467.6	19,831.2
2014	4	0.0	2,754.0	2,754.0	13,272.1	10,051.9	23,324.0	20,570.1
2015	5	0.0	2,853.1	2,853.1	13,750.4	10,340.5	24,090.9	21,237.8
2016	6	0.0	2,853.1	2,853.1	13,750.4	10,340.5	24,090.9	21,237.8
2017	7	0.0	2,853.1	2,853.1	13,750.4	10,340.5	24,090.9	21,237.8
2018	8	283.1	2,853.1	3,136.3	13,750.4	10,340.5	24,090.9	20,954.6
2019	9	3,511.2	2,853.1	6,364.3	13,750.4	10,340.5	24,090.9	17,726.6
2020	10	3,228.1	2,853.1	6,081.2	13,750.4	10,340.5	24,090.9	18,009.7
2021	11	0.0	2,853.1	2,853.1	13,750.4	10,340.5	24,090.9	21,237.8
:	:	:	:	:	:	:	:	:
2028	18	283.1	2,853.1	3,136.3	13,750.4	10,340.5	24,090.9	20,954.6
2029	19	3,511.2	2,853.1	6,364.3	13,750.4	10,340.5	24,090.9	17,726.6
2030	20	3,228.1	2,853.1	6,081.2	13,750.4	10,340.5	24,090.9	18,009.7
2031	21	0.0	2,853.1	2,853.1	13,750.4	10,340.5	24,090.9	21,237.8
:	:	:	:	:	:	:	:	:
2039	29	0.0	2,853.1	2,853.1	13,750.4	10,340.5	24,090.9	21,237.8
2040	30	0.0	2,536.8	2,536.8	12,210.4	8,818.7	21,029.1	18,492.4

Economic Internal Rate of Return (FIRR) = 10.77%

12.4 Cash Flow Analysis

12.4.1 Basic Assumptions

The project's cash flow projections during the project life are prepared based on the same sales revenue and O&M cost estimated for financial analysis. Most of assumptions (including tariff level, sales volume, O&M cost, economic life) adopted for cash flow analysis are same as financial analysis.

The underlying financial projections are prepared in current price of Indonesian Rupiah, using the domestic inflation rates of 8.93% (average inflation rate between Jan. 1999 – Dec. 2005).

Fixed assets are depreciated at 10.9% per annum on a declining balance bases. Income taxes are calculated at a rate of 25% of net revenue. No value added tax is collected on sales from the projects. 45% of profit after tax is assumed to be pay for local government as dividend, and then remaining 55% will be retained by PDAM.

12.4.2 Financial Structure

While the both projects are economically viable, the projects are financially vulnerable, particularly the project in Maros. In addition, PDAMs in Takalar and Maros are suffering form chronic financial deficit. So, it is impossible for PDAMs to execute the project without capital subsidy from the government. With these backgrounds, it is assumed that the financial structures of the projects consist of ODA loan and capital subsidy from central government and local government.

ODA loan is assumed to be disbursed through central government to PDAMs. Financing came through subsidiary loan agreements (SLAs) between the MOF and the PDAM. Under this arrangement, MOF assumed the credit risk. The conditions for loan from MOF to PDAMs under the projects are assumed repayment period of 25 years including 5 years grace period with an annual interest rate of 11.5%. PDAMs are fully responsible for repayment of interest and principal of the ODA loan. It is assumed that ODA loan covers not only capital investment and interest during construction but also interest payment for first six month of operation. Financial structures for the initial capital investment costs of the projects are tentatively established as follows.

While Takalar project rely 33% of capital cost on subsidy, Maros project rely 45% of capital cost on subsidy. Since the financial profitability of Takalar project (FIRR=

5.67) is higher than the Maros project (FIRR= 3.40), the former is financially more self-sustainable than the latter.

Table 12-15: Financial Structures of the Projects (Rp. million)

	ODA Loan	Capital Subsidy from Central Govt.	Capital Subsidy from Local Govt.	Total
Maros	92.433 (55%)	25,209 (15%)	50,416 (30%)	168,060 (100%)
Takalar	11,332 (67%)	1,860 (11%)	3,721 (22%)	16,913 (100%)

Source: JICA Study Team

The projects need major rehabilitation after 10 years and 20 years of project completion to replace deteriorated electrical and mechanical equipments. Investments for rehabilitations are assumed to be covered by equity and borrowing from local commercial bank. Terms of conditions of local commercial loan is assumed as 5 years repayment period with interest rate of 16.0% per annum.

Both projects require loan from commercial bank for 1st major rehabilitation work but not for 2nd rehabilitation. Assumed financial structure of major rehabilitation works are as follows;

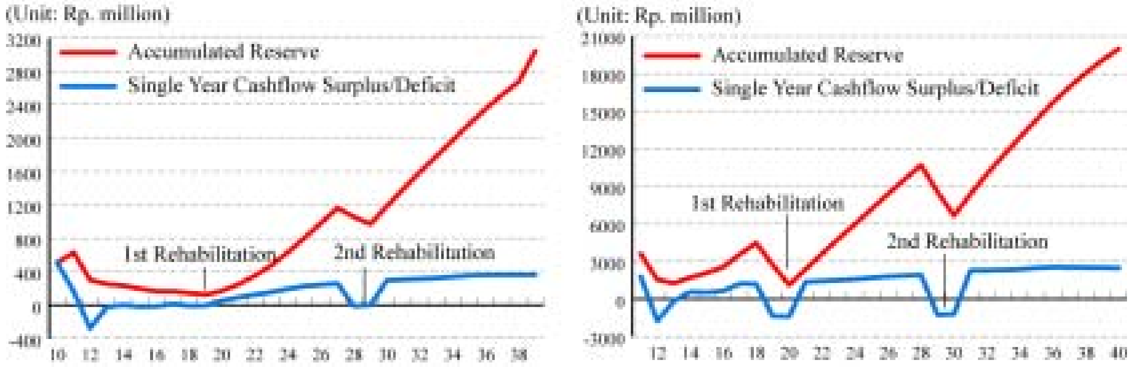
Table 12-16: Financial Sources for Rehabilitation (2006 Fixed Price) (Rp. million)

	1st Rehabilitation			2nd Rehabilitation		
	PDAM's Equity	Commercial Bank	Total	PDAM's Equity	Commercial Bank	Total
Maros	5,164.9 (80%)	1,291.2 (20%)	6,456.1 (100%)	6,456.1 (100%)	0.0 (0%)	6,456.1 (100%)
Takalar	113.3 (20%)	453.0 (80%)	566.3 (100%)	566.3 (100%)	0.0 (0%)	566.3 (100%)

Source: JICA Study Team

12.4.3 Results of the Analysis

Given the mentioned assumptions, it has proven that while single year's cash balance will turn negative during initial operation period and rehabilitation period, accumulated reserve will remain positive through out the project life. In the case of Takalar project, accumulated reserve is forecasted to be gradually decreased till 2019, then expected to take an upward turn from 2020. On the other hand, accumulated reserve of Maros project is expected to increase gradually from 2013 except for two-time rehabilitation periods.



Source: JICA Study Team

Takalar **Maros**

Figure 12-4: Single Year Cash Flow Surplus/Deficit and Accumulated Deposit (2006 Fixed Price)

Distribution of cash out flow (during construction and operation) of both projects are shown as follows. Both projects start principal payment of ODA loan in 2013. Repayment of ODA loan is occupied more than 40% of total cash out flow from 2011 to 2022 (Maros) and from 2011 to 2021 (Takalar). Debt-service coverage ratio*[5] of both projects reveals the same financial weakness in the early years. The ratio of Maros project averages 5.20 and is less than 1.3 for first 9 years (2009- 2017). Debt-service coverage ratio of Takalar project averages 18.73 but is less than 1.3 for first 8 years (2009- 2016).

As the burden on repayment of ODA loan gets lesser, PDAM start to earn profit. While the project in Maros earn current account surplus from 2014 onwards, project in Takalar earn current account surplus from 2017 onwards.

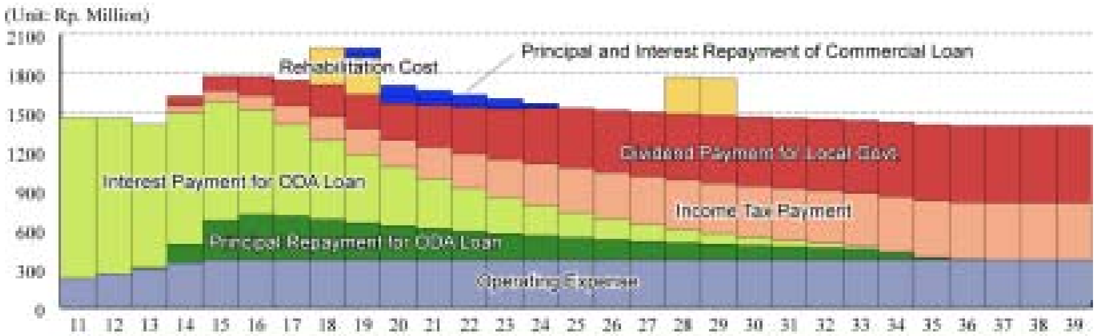


Figure 12-5: Single Year Cash Flow and Accumulated Deposit of Maros (2006 Fixed Price)

5 Estimated as (net cash flow from operation)/ (debt service payments)

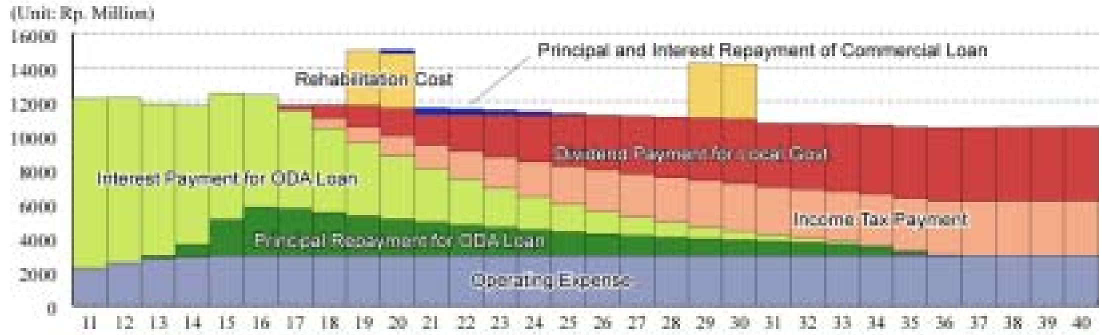


Figure 12-6: Single Year Cash Flow and Accumulated Deposit of Takalar **(2006 Fixed Price)**

12.5 Conclusion of Financial and Economic Analysis

Since the both projects are economically feasible (Takalar: 15.5%, Maros: 10.3%), they are worth execution. However, they are financially vulnerable (Takalar: 5.7%, Maros: 3.6%). When taking chronic state of deficit of PDAM Maros and PDAM Takalar into consideration, capital cost should cover capital subsidy from local/ central government and ODA loan.

Cash flow analysis reveals that the project in Takalar and Maros needs subsidy for capital costs (33% of total cost: Takalar, 45% of total cost: Maros). Once such capital subsidy is disbursed, the projects are financially self-standing throughout the life time. They are capable of repaying principals and interests of ODA and commercial loan, of earning profit, and of striking dividend for local governments.

13. ORGANIZATION AND MANAGEMENT

PDAM Maros and PDAM Takalar in the Maminasata Metropolitan area have their respective responsibility of water supply. Therefore, the improvement plans have been prepared separately in this report.

In the future, there might be a possibility that PDAM Maros, PDAM Takalar, PDAM Makassar and PDAM Gowa could be reorganized as PDAM Mamminasata. Water resources and water supply management at the Mamminasata level would be more effective than water supply management at city or each regency level. PDAM Makassar is a large organization and could form the core of the new organization of PDAM Mamminasata, and the integration would be an effective measure for more efficient administration.

In this Chapter, however the re-establishment, operation and management organization of PDAM Maros and PDAM Takalar is explained. The future integration into PDAM Mamminasata will be studied in the later stages of the project implementation.

13.1 Organization for Project Implementation

PU Makassar will act as the executing agency for the project implementation. Under the direction of the PU Makassar, PDAMs Maros and Takalar will supervise, through the use of professional supervising engineers, all construction works, managing coordination and liaison with the agencies concerned throughout the period of implementation. For this purpose, a project management unit (PMU) will be established at PU Makassar. Core members of PMU will be PDAMs Maros and Takalar. However, both PDAM have insufficient capacity to conduct the implementation. In this connection, they would count on PDAM Makassar for the administration, logistics, design and inspection section. Engineers and staff will be mobilized by PU Makassar.

To assist the PMU in engineering design and construction supervision, engineering consultants will be retained through international tender.

13.2 Organization for Operation and Maintenance

PDAMs Maros and Takalar have direct and overall responsibility for the operation and maintenance of the constructed facilities. The main roles of PDAMs Maros and Takalar are as follows;

- To supply safe and reliable water,
- To plan, design, operate and maintain efficient water supply facilities,

- To take preventive measures for maintenance of the water supply facilities by conducting periodical patrols at the water sources, transmission and distribution pipelines,
- To establish an efficient metering system
- To improve the financial status of the project by adopting accepted accounting principles and to improve monitoring and reporting,
- To conduct an intensive campaign to obtain public understanding of water supply.

In order to attain these objectives, it is proposed that the PDAM Maros and Takalar are strengthened in the following areas.

For PDAM Maros

PDAM Maros needs nearly 40 additional personnel by year 2010 for the following:

(1) To organize new subsections for:
   - Production for operating the new intake and treatment plant (7 personnel x 2 teams in addition).
   - UFW team (6 personnel in addition).

(2) To rearrange the customer connection division and distribution division responsible for the distribution pipeline (18 personnel in addition).

(3) To strengthen Financial Affairs Division by introducing a data base system for billing and accounting.

Currently, the staff of PDAM Maros is 53 personnel who are in charge of operation and maintenance for 5700 connections in 2004. After completion of the water supply improvement, number of connections will be increased to 20,500. To provide 4.5 personnel per 1000 connections, PDAM Maros requires about 92 personnel, which means about a nearly 40 additional personnel. The additional personnel would preferably be retained from PDAM Makassar which in turn is needed to reduce its staff for better management.

For PDAM Takalar

PDAM Takalar need about 13 personnel in addition by year 2010:

(1) To organize a new subsection of UFW team (5 personnel in addition)

(2) To rearrange the north Polombangkeng Utara branch to be responsible for the issues with the well facilities and distribution pipeline (8 personnel in total),

(3) To strengthen Financial Affairs Division by introducing a data base system for billing and accounting. (It is recommended that financing and customer relation in north Polonbangkeng Utara be integrated to PDAM Takalar headquarter.)

Currently, the staff of PDAM Takalar is 16 personnel for 2,100 connections in 2005. Within 16 personnel, PDAM Takalar assign five staff for operation and maintenance of Kechamatan Polombangkeng Utara Water Supply System. After completion of the proposed improvement, the potential customer will increase by about 2,600 households, so that total customers will be 4,700 connections. Therefore, 24 staff will be needed for operation and maintenance, based on the assumption that 5 personnel are required per 1,000 connections – there additional personnel will be recruited from PDAM Makassar, too.

13.3 Staffing and Mobilization

A number of staff and personnel as described above are required for system operation and maintenance as well as reducing the level of the UFW ratio. Since the current staffing level of PDAMs Maros and Takalar are not sufficient to reduce UFW, staff will be required.

As mentioned above, additional staff will be shifted from PDAM Makassar. Such a staff transfer from PDAM Makassar is possible by decreasing the number of PDAM Makassar staff in view of the current ratio of 5.83 peoples/1,000 connections. Capacity building will be executed for the currently employed and transferred personnel for better operation of PDAMs Maros and Takalar.

14. FURTHER STUDIES

14.1 Engineering Study

To ensure a sustainable water supply system for the people living in Maros and Takalar regencies, it is recommended that the following engineering studies be executed further in the subsequent stage of project implementation.

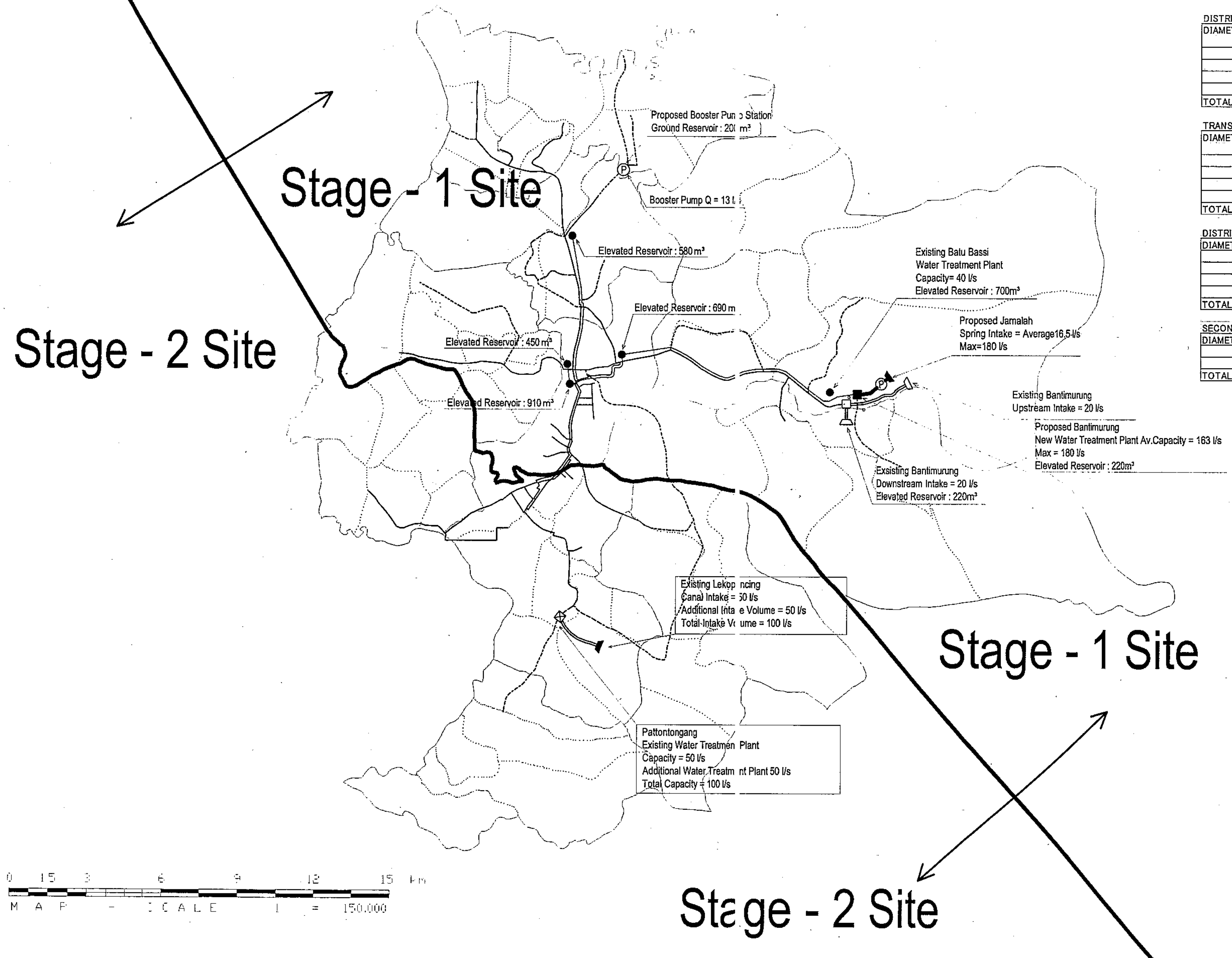
- The discharge of Jamalah Spring in Maros should be measured in detail to re-confirm the available water volume in dry season and rainy season.
- A settling analysis of the raw water of Jamalah Spring in Maros should be undertaken to determine the possibility of utilization for existing water pond as a sedimentation basin.
- A topographic survey for the transmission and distribution pipeline routes as well as reservoir tank sites, should be carried out to improve design accuracy.
- An electric sounding survey at the new deep well site should be undertaken to improve the success rate.
- The number and type of industries, commercial shops and government offices as well as future development plans in Maros and Takalar should be confirmed in detail to improve the water demand projection.
- During the implementation of Stage-1 in Maros, a study for expansion of Stage-2 implementation will be conducted for stage wise implementation.
- Reduction of the UFW is one of the core issues. The detailed UFW reduction program should be discussed with PDAMs Maros and Takalar to make them aware of the detailed program so they can undertake the necessary preparations.

14.2 Institutional Study

The operation and maintenance procedures, inclusive of the integration of PDAMs in city and regencies in Mamminasata should be considered in line with the Mamminasata policy in order to attain more efficient operation of the regional water supply system.

LIST OF DRAWINGs

No.		*Drawing Title*
G-001	:	GENERAL LOCATION MAP
M-001	:	LOCATION OF INTAKE FACILITY, RAW WATER MAIN AND WTP
M-002	:	REHABILITATION OF EXISTING WEIR
M-003	:	RAW WATER MAIN (1)
M-004	:	RAW WATER MAIN (2)
M-005	:	RAW WATER MAIN (3)
M-006	:	RAW WATER MAIN (4)
M-007	:	INTAKE PUMPING STATION
M-008	:	LAYOUT OF WATER TREATMENT FACILITIES
M-009	:	SLOW SAND FILTER
M-010	:	OUTLET CHAMBER
M-011	:	FILTER UNDER DRAIN SYSTEM
M-012	:	CLEAR WATER TANK WITH PUMPING STATION (325m^3)
M-013	:	DISTRIBUTION NETWORK (A-1)
M-014	:	DISTRIBUTION NETWORK (A-2)
M-015	:	DISTRIBUTION NETWORK (A-3)
M-016	:	DISTRIBUTION NETWORK (B-1)
M-017	:	DISTRIBUTION NETWORK (B-2)
M-018	:	DISTRIBUTION NETWORK (B-3)
M-019	:	GROUND TYPE RESERVOIR WITH PUMPING STATION (200m^3)
M-020	:	ELVATED RESERVOIR
T-001	:	GENERAL LOCATION MAP IN POLOMBANKENG UTARA OF TAKALAR
T-002	:	GENERAL FLOW DIAGRAM
T-003	:	GENERAL FLOW DIAGRAM (DW-3)
T-004	:	GROUND TYPE RESERVOIR (250m^3)
T-005	:	DEEP WELL PUMPING STATION



DISTRIBUTION PIPE

DIAMETER(mm)	LENGTH	
	EXISTING (m)	PROPOSED (m)
100	5,490	10,118
150	14,829	41,515
200	570	16,586
300	0	3,680
TOTAL	20,889	71,899

TRANSMISSION PIPE

DIAMETER(mm)	LENGTH	
	EXISTING (m)	PROPOSED (m)
200	-	2,200
300	-	100
400	-	6,152
500	-	13,218
TOTAL		21,550

DISTRIBUTION PIPE FOR REHABILITATION

DIAMETER(mm)	LENGTH (m)
100	0
150	4,160
200	9,354
300	5,241
TOTAL	18,755

SECONDARY PIPE

DIAMETER(mm)	LENGTH (m)
50	111,181
75	37,060
TOTAL	148,241

LEGEND

: BUNDARY OF STAGE
: BUNDARY OF KECAMATAN
: BUNDARY OF DESA
: EXISTING INTAKE
: PROPOSED INTAKE
: EXISTING RAW WATER MAIN
: PROPOSED RAW WATER MAIN
: PROPOSED TRANSMISSION MAIN
: PROPOSED PUMPING STATION
: EXISTING WATER TREATMENT PLANT
: PROPOSED WATER TREATMENT PLANT
: RESERVOIR
: FUTURE WATER TREATMENT PLANT
: EXISTING DISTRIBUTION NETWORK
: PROPOSED DISTRIBUTION NETWORK

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

KRI INTERNATIONAL CORPORATION

NIPPON KOEI CO., LTD.

PROJECT TITLE:

PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS
THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR
THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA

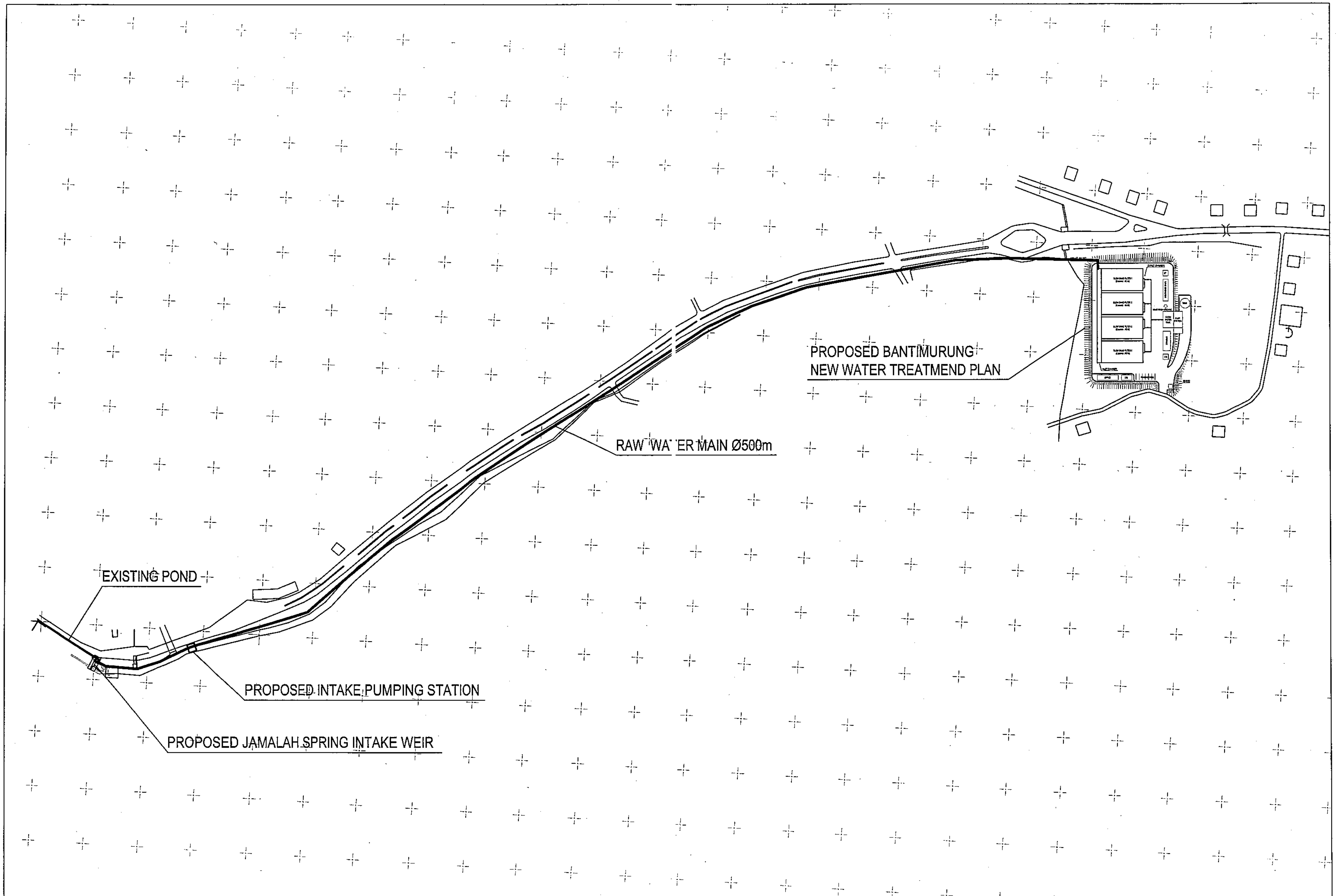
DRAWING TITLE :

GENERAL LOCATION MAP

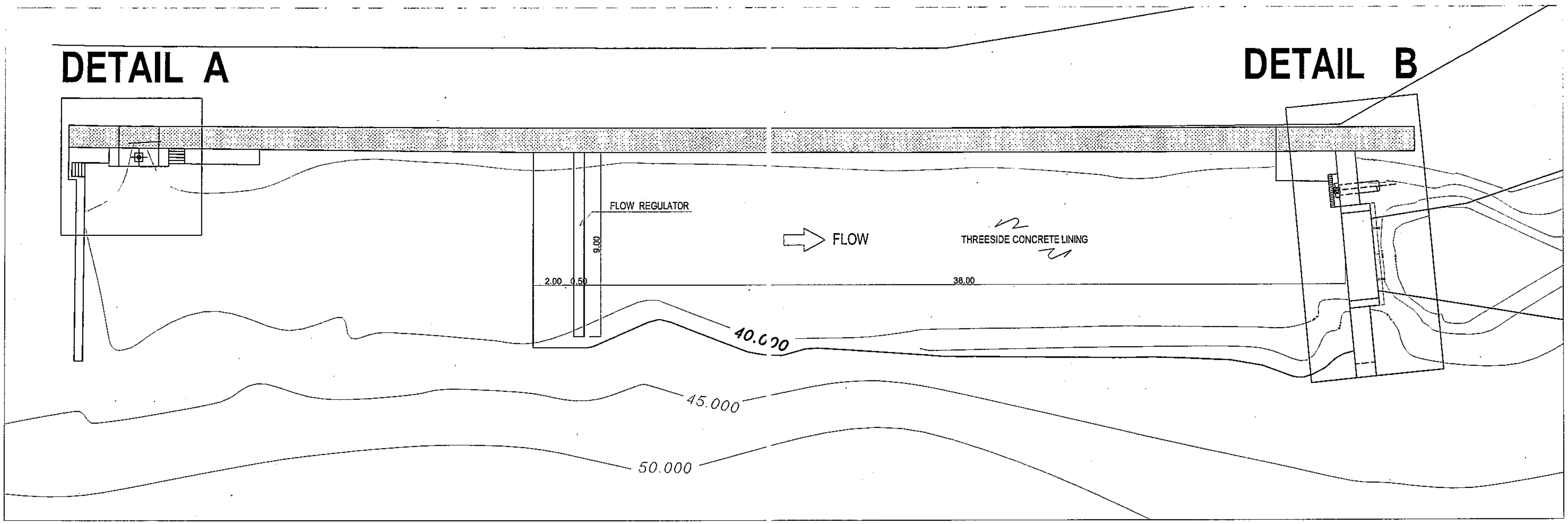
SCALE = 1 : 150,000

DRAWING NO. G-001

DATE: JUNE 2006



JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM N MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN IN)ONESIA	DRAWING TITLE : LOCATION OF INTAKE FACILITY, RAW WATER MAIN AND WTP	DRAWING NO. M-001
KRI INTERNATIONAL CORPORATION NK NIPPON KOEI CO., LTD.		SCALE = 1 : 3000	DATE: JUNE 2006



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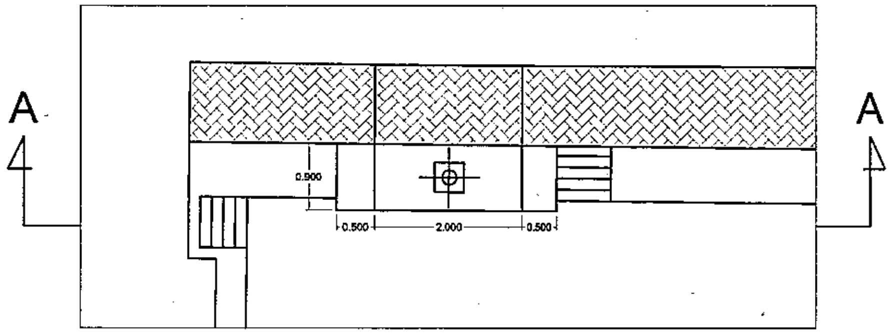

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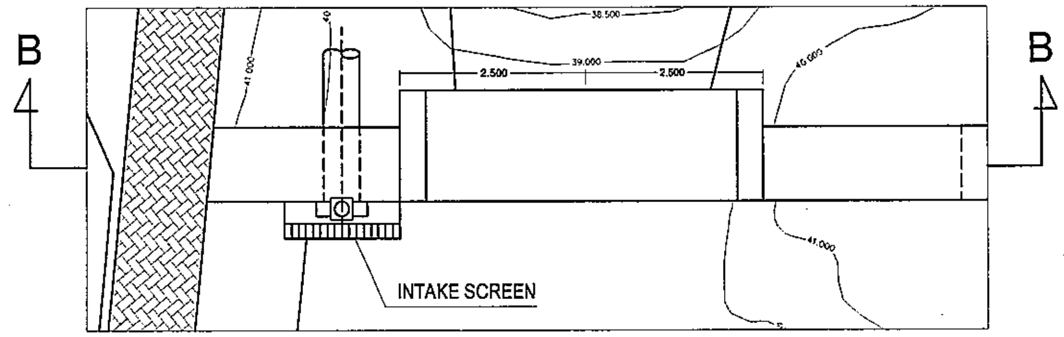

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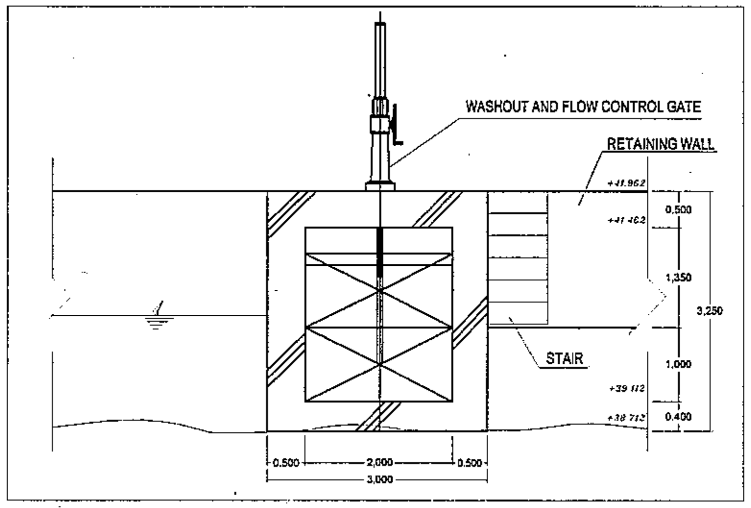

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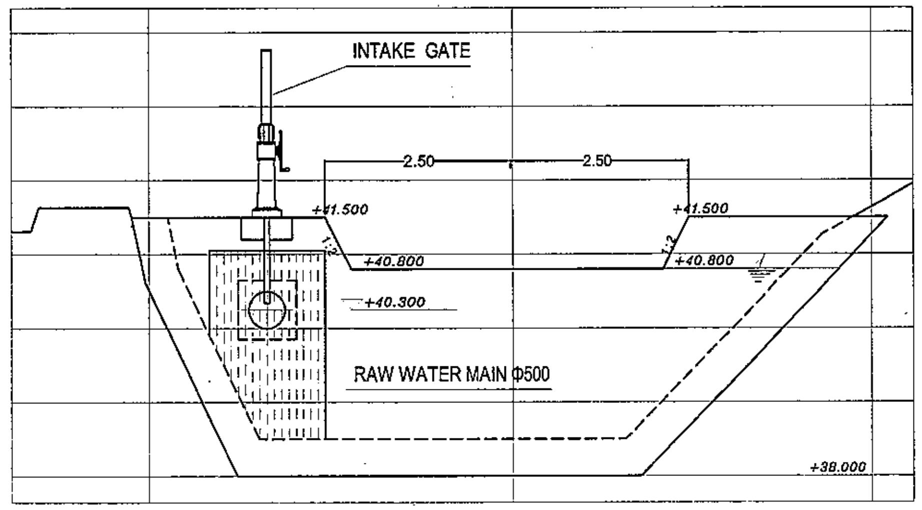

SECTION B - B
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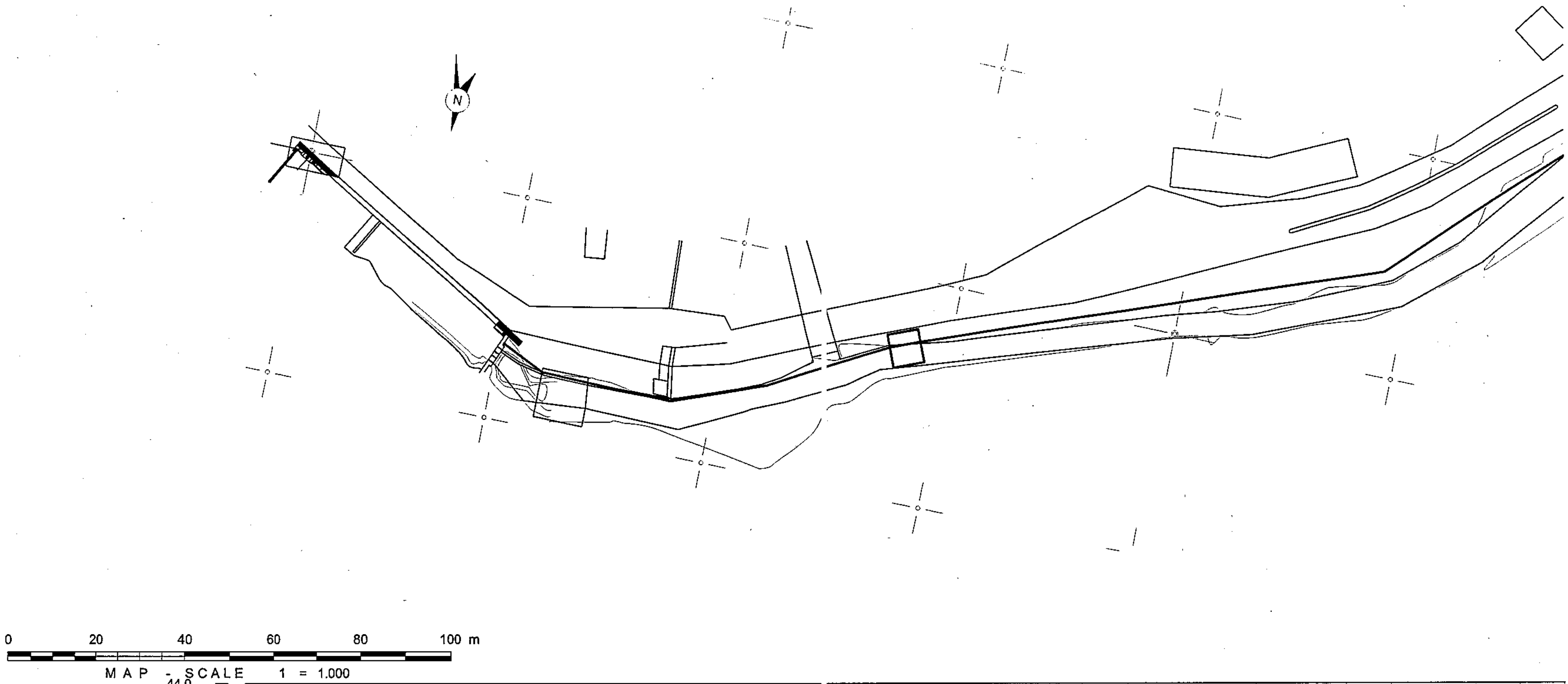
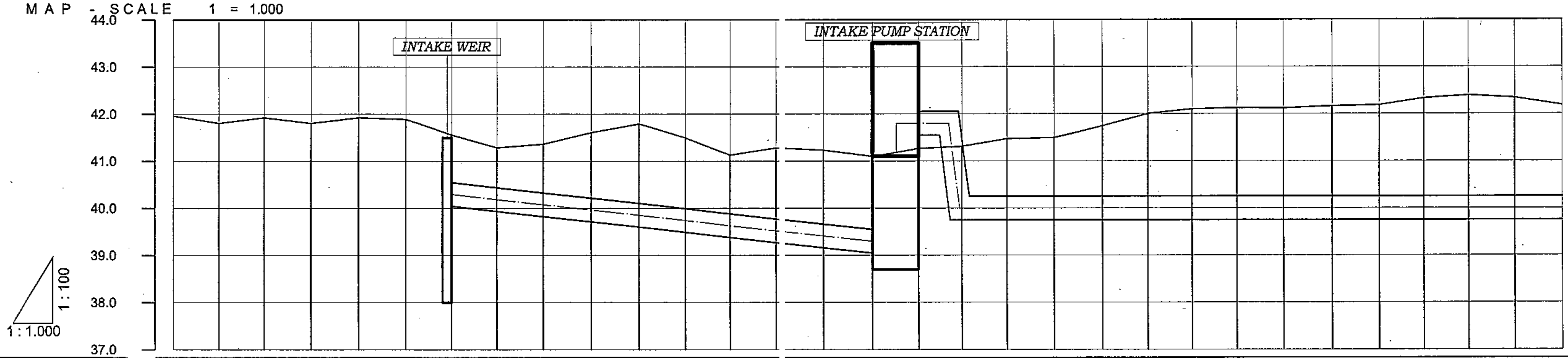
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : REHABILITATION OF EXISTING WEIR	DRAWING NO. M-002
KRI INTERNATIONAL CORPORATION / NIPPON KOEI CO., LTD.		SCALE = 1 : 100 1 : 200	DATE: JUNE 2006





PIPE ELEVATION				40.300				39.300	40.00	40.00	40.00	40.00	40.00	40.00
GROUND ELEVATION	41.96	41.57	41.89		41.28	41.80	41.15	41.10	41.39	41.75	42.13	42.16	42.40	42.18
STATION NAMBER	0+000		0+050			0+100		0+150		0+200		0+250		0+300

JICA JAPAN INTERNATIONAL COOPERATION AGENCY

KRI INTERNATIONAL CORPORATION NIPPON KOEI CO., LTD.

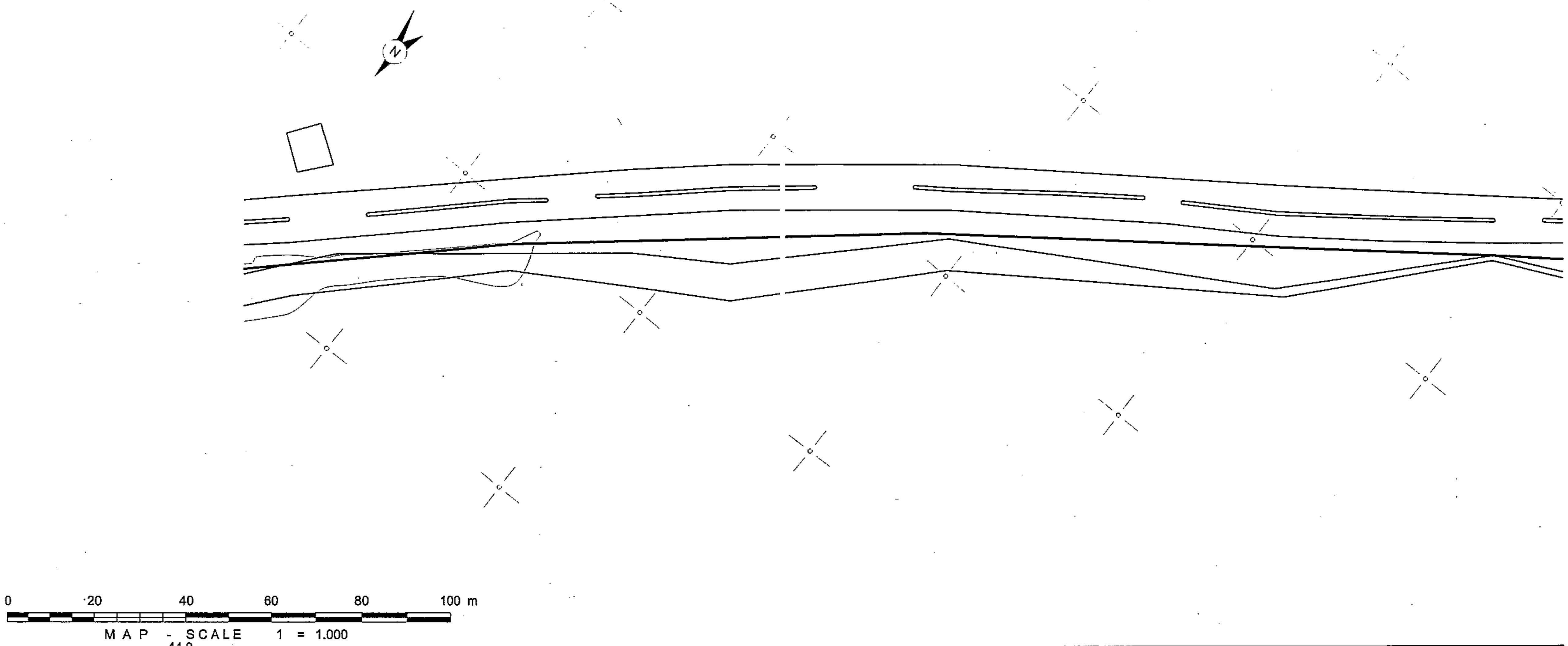
PROJECT TITLE:
PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS
THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR
THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA

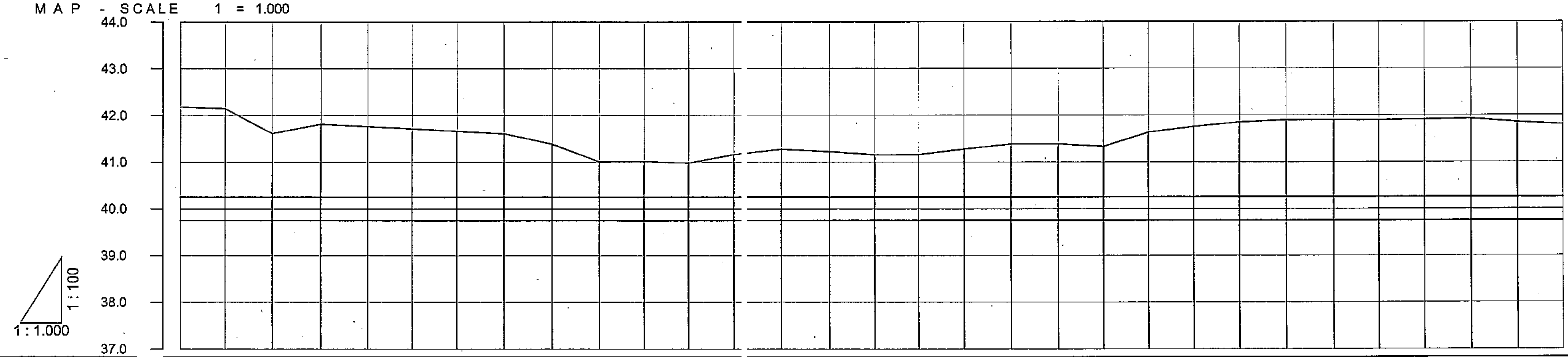
DRAWING TITLE :
RAW WATER MAIN(1)

SCALE = 1 : 1.000

DRAWING NO.
M-003

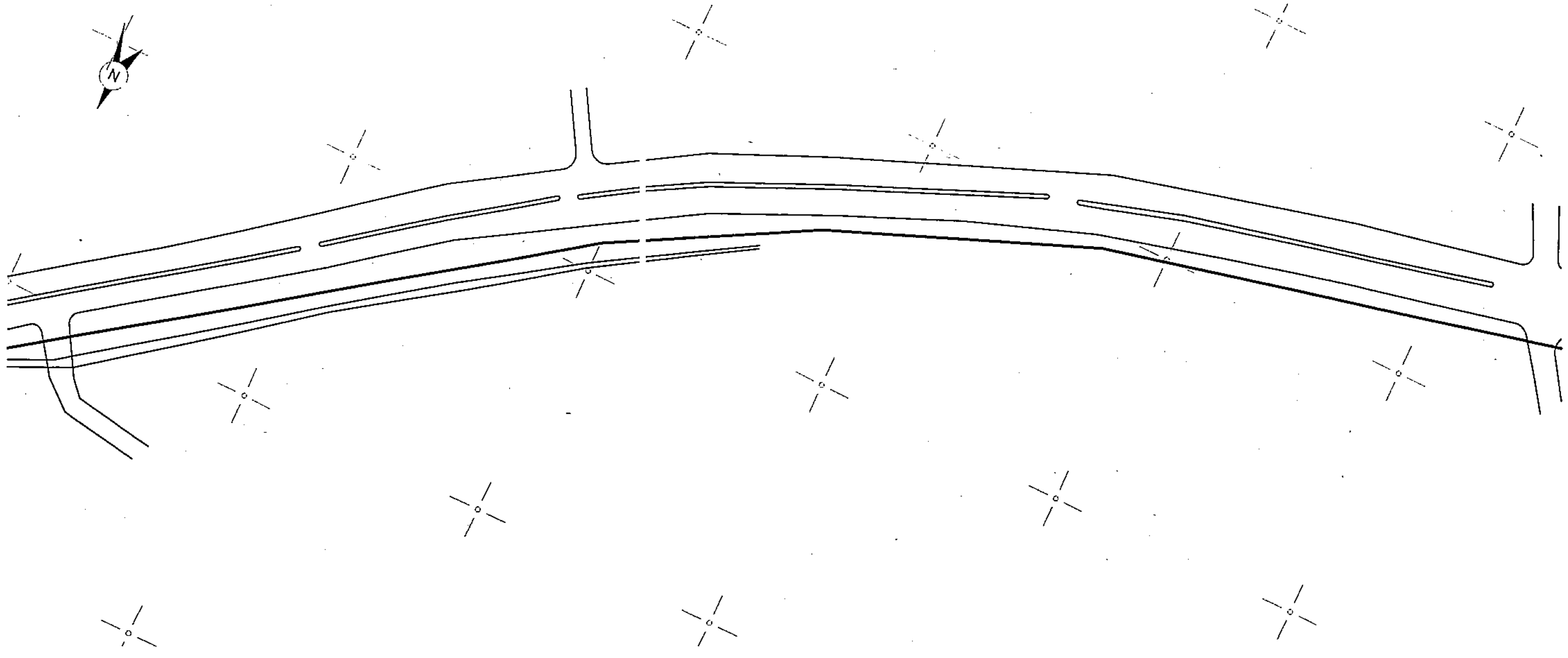
DATE:
JUNE 2006

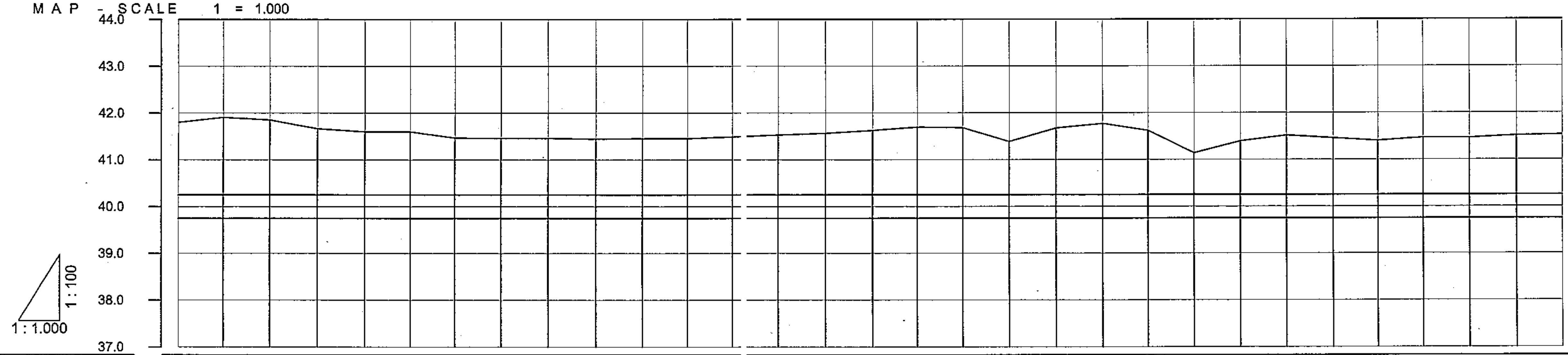




PIPE ELEVATION	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
GROUND ELEVATION	42.18	41.76	41.71	41.50	41.02	41.24	41.16	41.33	41.33	41.80	41.90	41.92	41.80
STATION NAMBER	0+300		0+350		0+400		0+450		0+500		0+550		0+600

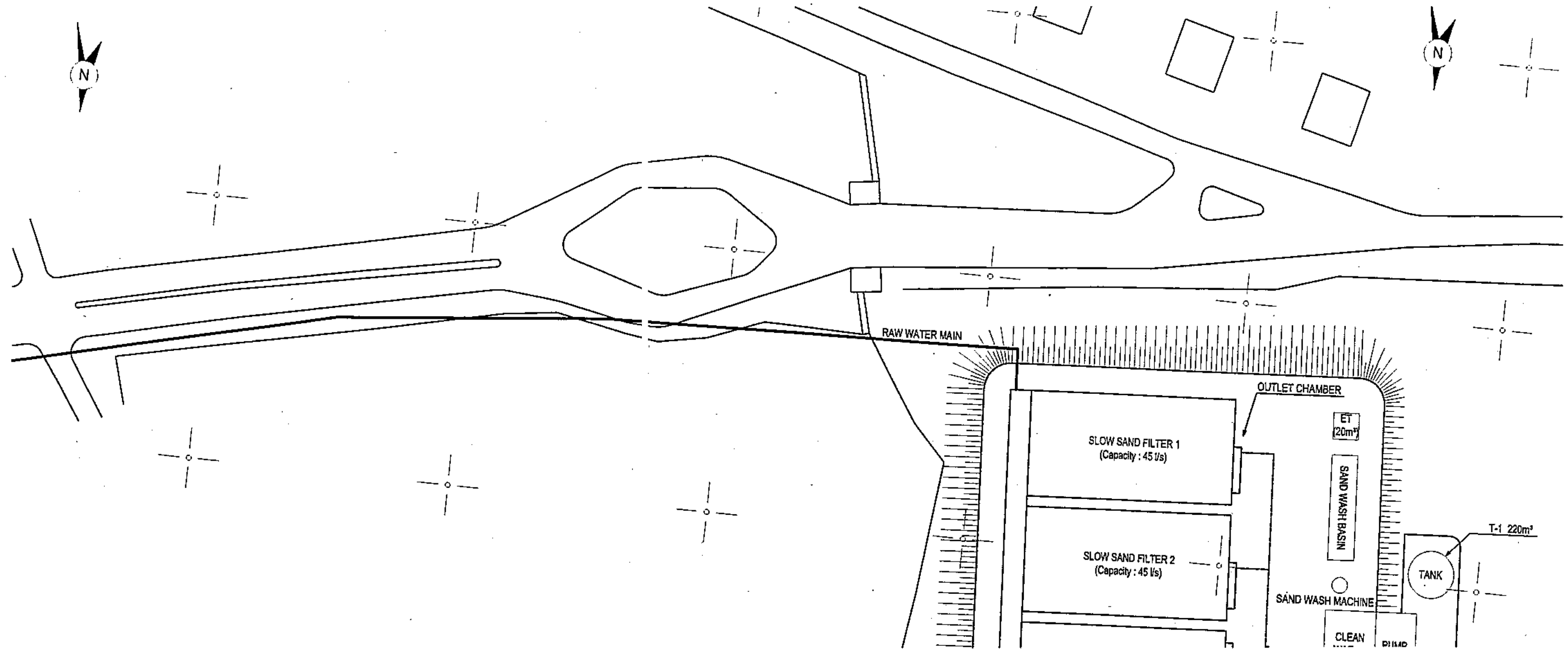
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTE 1 IN MAROS	DRAWING TITLE : RAW WATER MAIN(2)	DRAWING NO. M-004
KRI INTERNATIONAL CORPORATION — NIPPON KOEI CO., LTD.	THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN NDONESIA	SCALE = 1 : 1.000	DATE: JUNE 2006

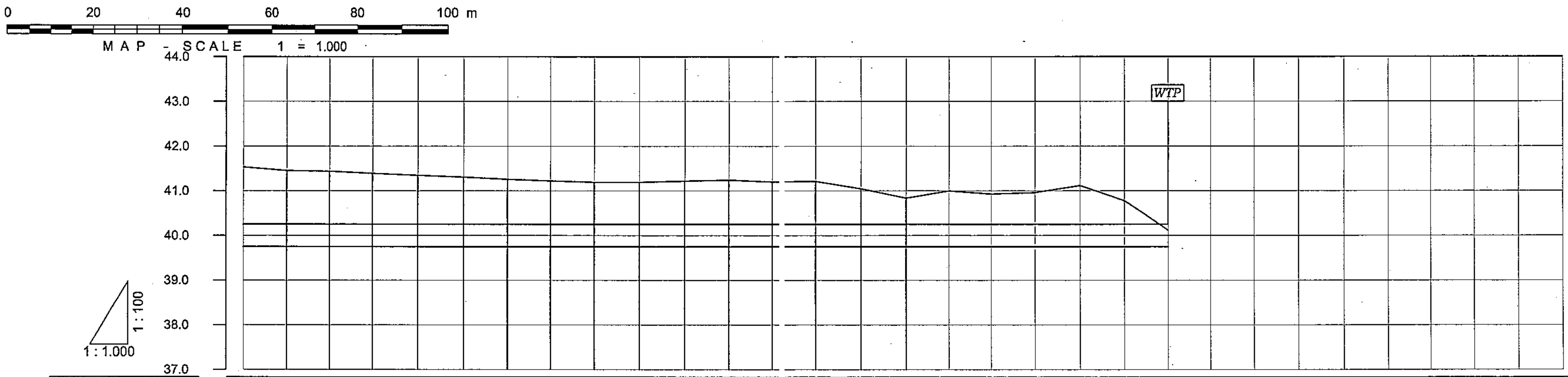




PIPE ELEVATION	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
GROUND ELEVATION	41.80	41.76	41.60	41.46	41.46	41.51	41.63	41.69	41.77	41.27	41.46	41.47	41.53
STATION NAMBER	0+600		0+650		0+700		0+750		0+800		0+850		0+900

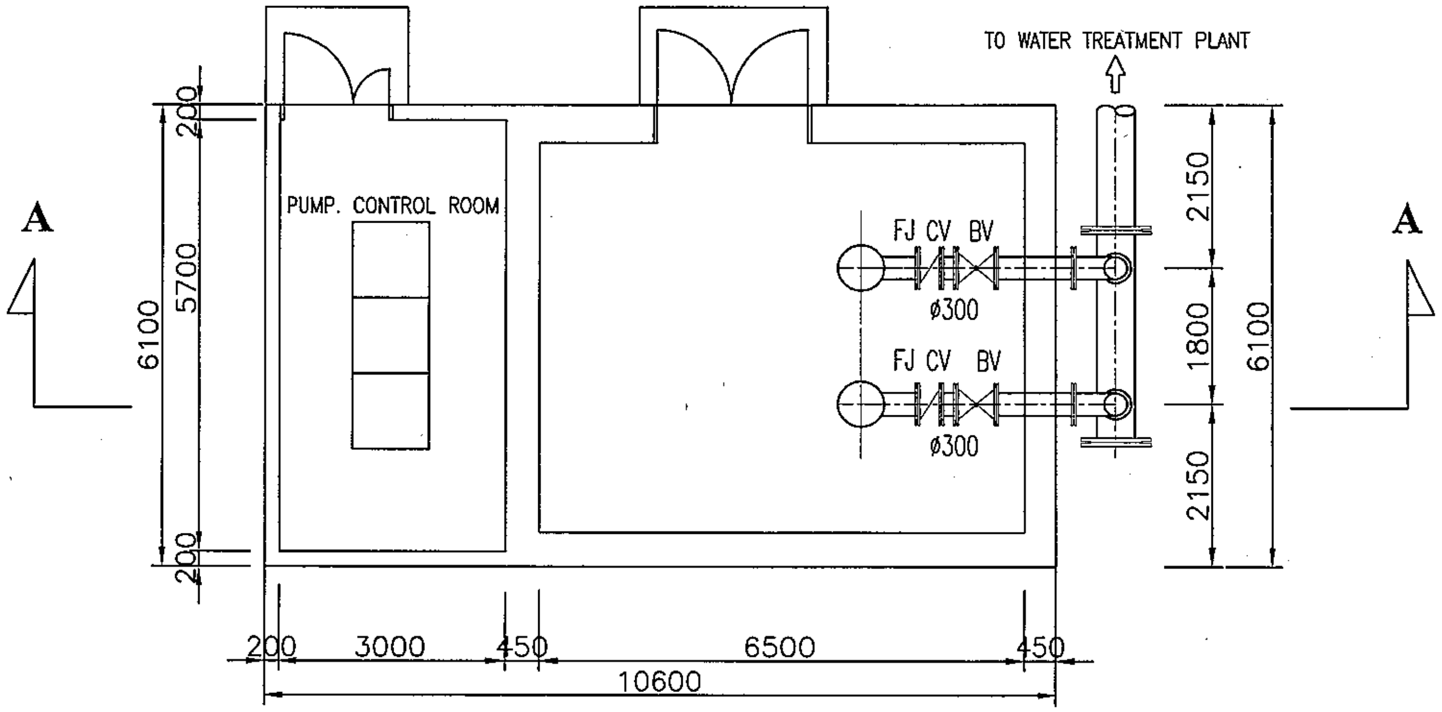
JICA JAPAN INTERNATIONAL COOPERATION AGENCY KRI INTERNATIONAL CORPORATION — NIPPON KOEI CO., LTD.	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEI I IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN NDONESIA	DRAWING TITLE : RAW WATER MAIN(3) SCALE = 1 : 1.000	DRAWING NO. M-005 DATE: JUNE 2006



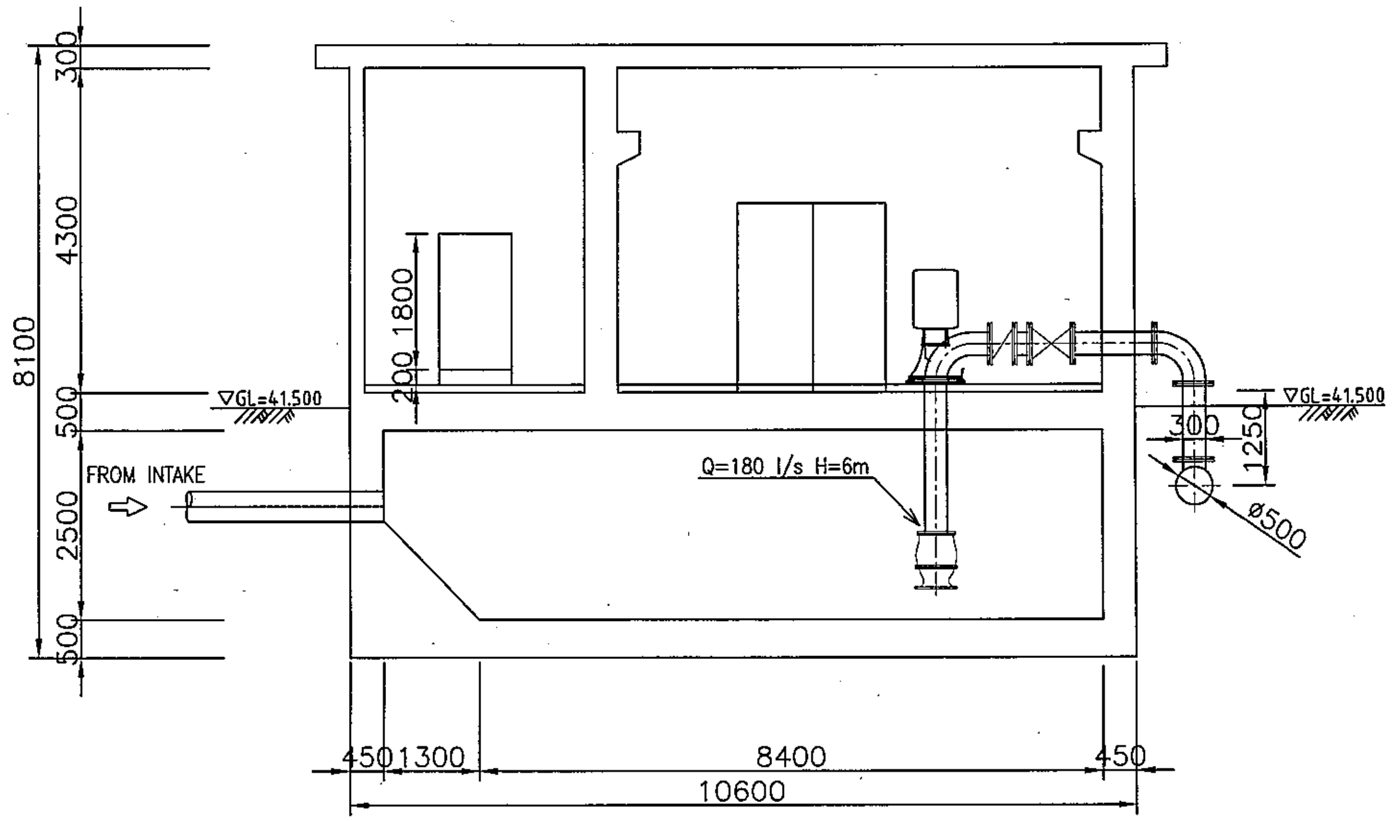


PIPE ELEVATION	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
GROUND ELEVATION	41.53	41.42	41.31	41.21	41.22	41.21	40.84	41.00	40.93	40.96	41.12	40.78	40.12
STATION NAMBER	0+900		0+950		1+000		1+050					1+100	

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : RAW WATER MAIN(4)	DRAWING NO. M-006
KRI INTERNATIONAL CORPORATION / NIPPON KOEI CO., LTD.		SCALE = 1 : 1.000	DATE: JUNE 2006

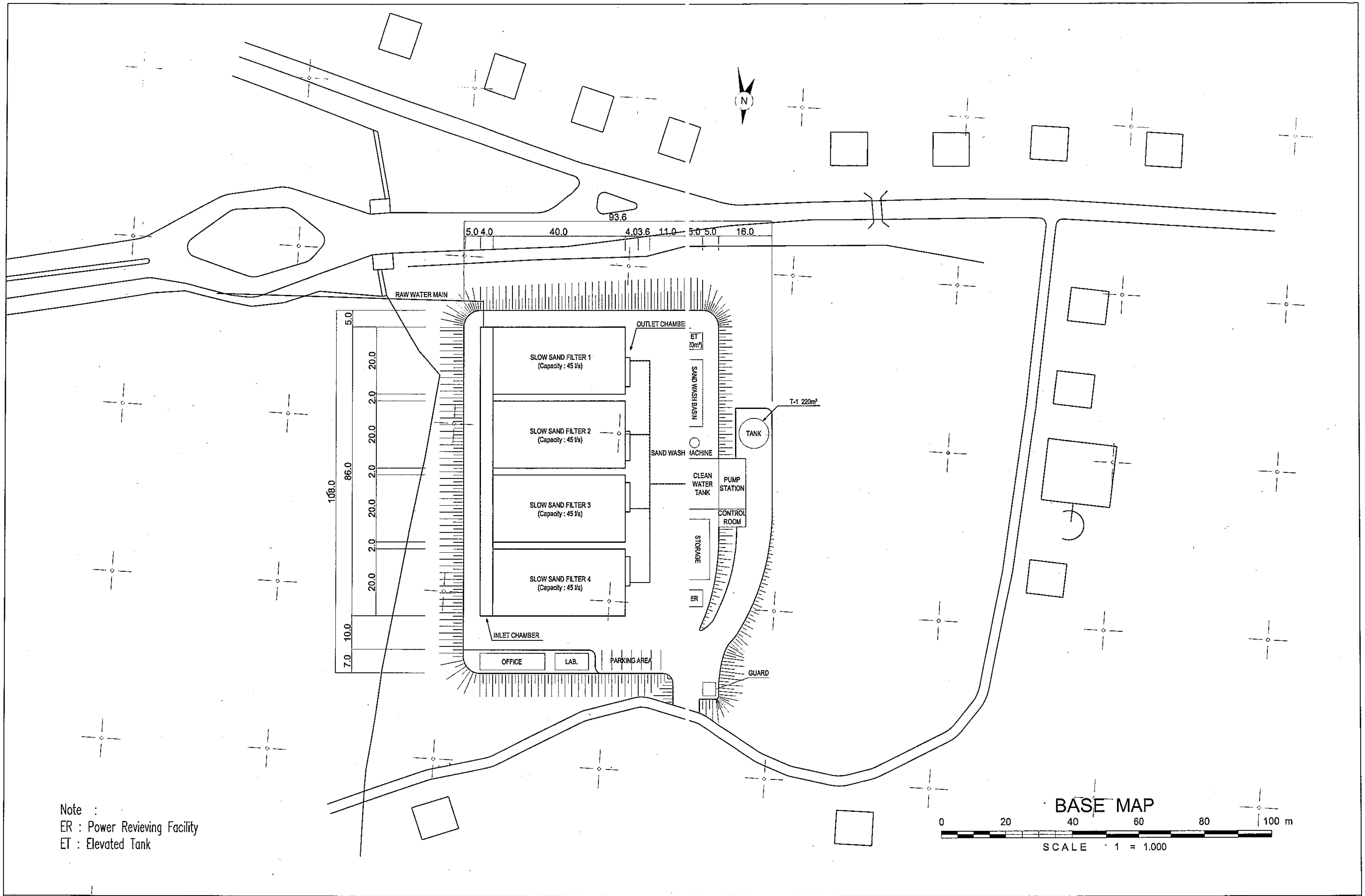


PLAN

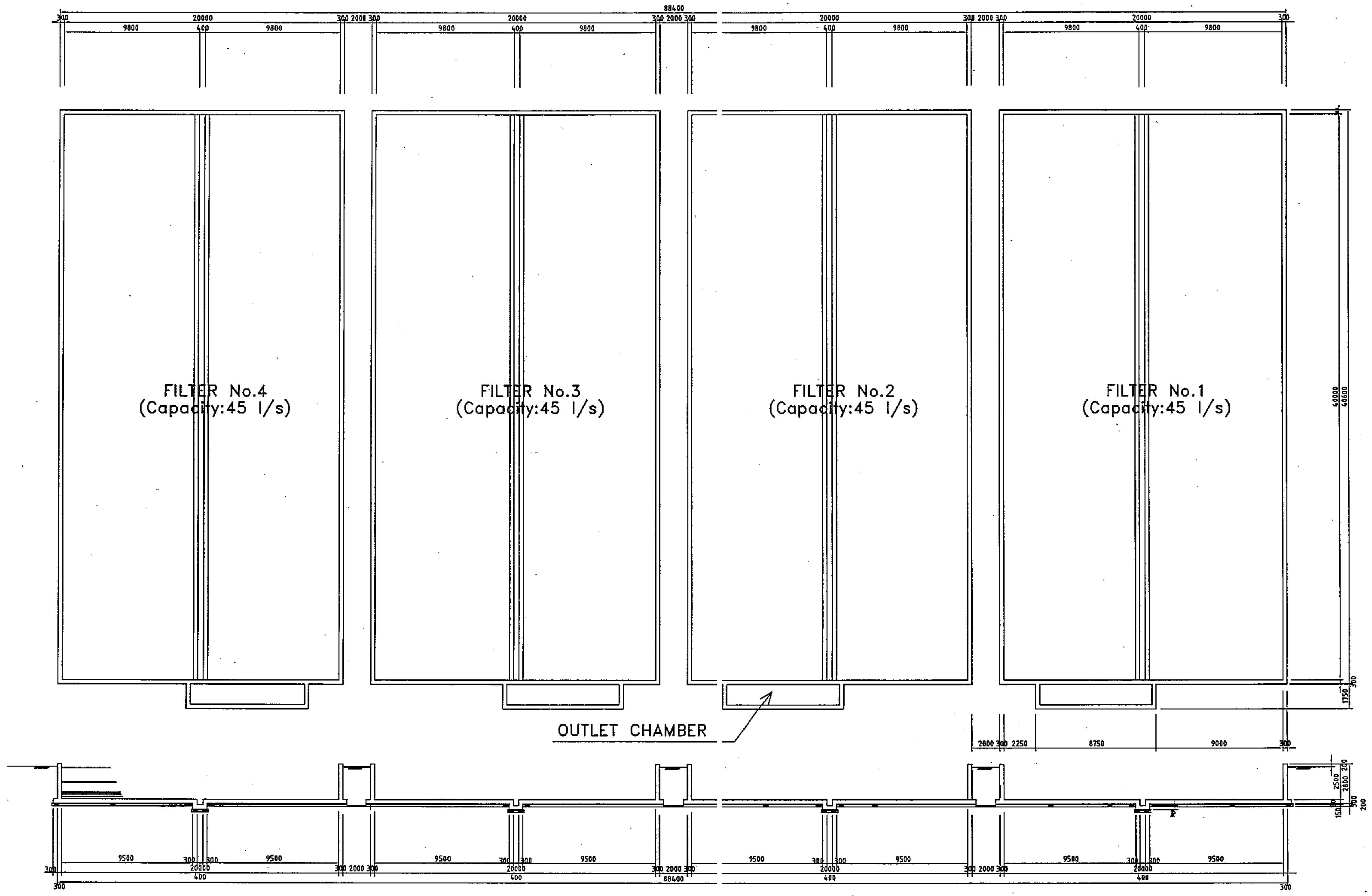


SECTION A- A

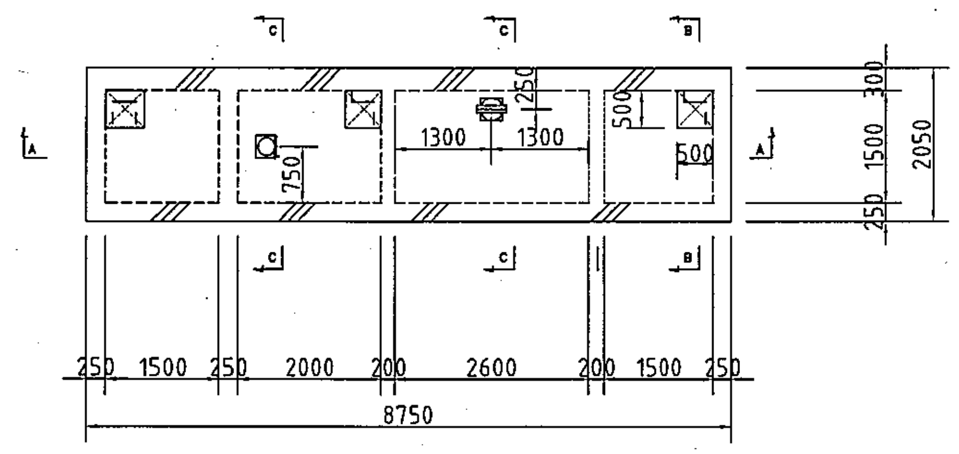
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OFWATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : INTAKE PUMPING STATION	DRAWING NO. M - 007
KRI INTERNATIONAL CORPORATION NIPPON KOEI CO., LTD.		SCALE = 1 : 100	DATE: JUNE 2006



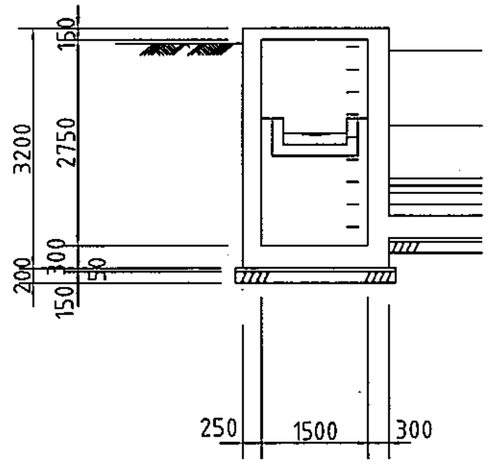
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : LAYOUT OF WATER TREATMENT FACILITIES	DRAWING NO. M - 008
KRI INTERNATIONAL CORPORATION / NIPPON KOEI CO., LTD.		SCALE = 1 : 1.000	DATE: JUNE 2006



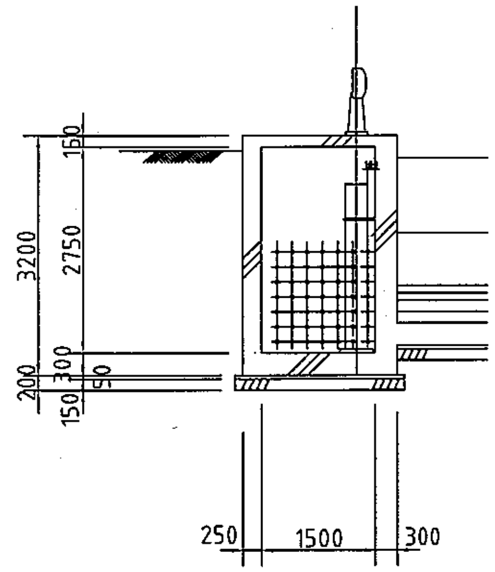
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : SLOW SAND FILTER	DRAWING NO. M - 009
KRI INTERNATIONAL CORPORATION · NIPPON KOEI CO., LTD.		SCALE = 1 : 300	DATE: JUNE 2006



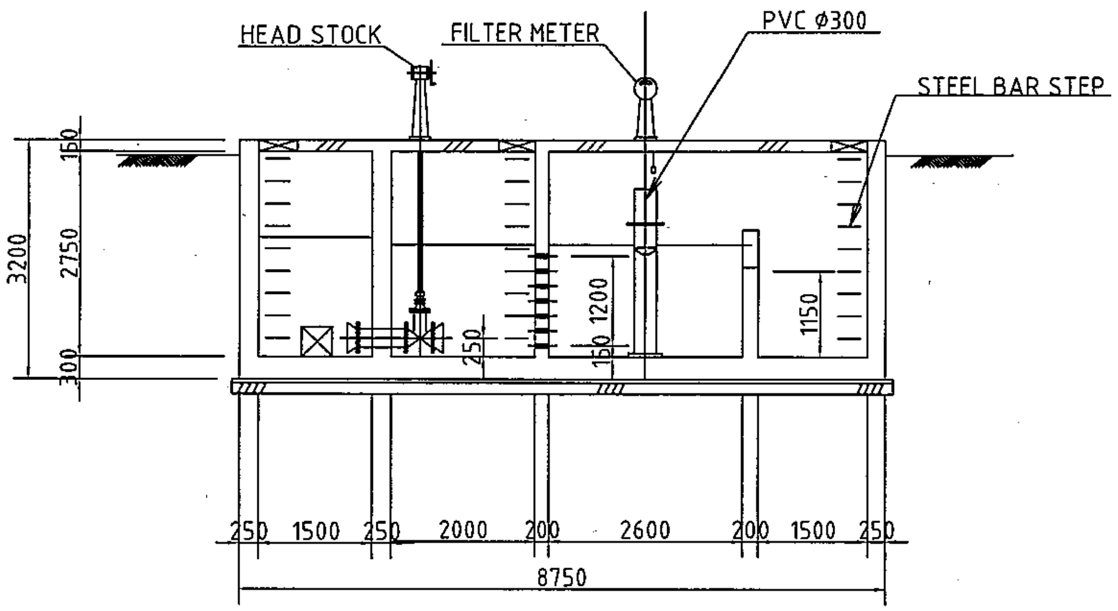
PLAN



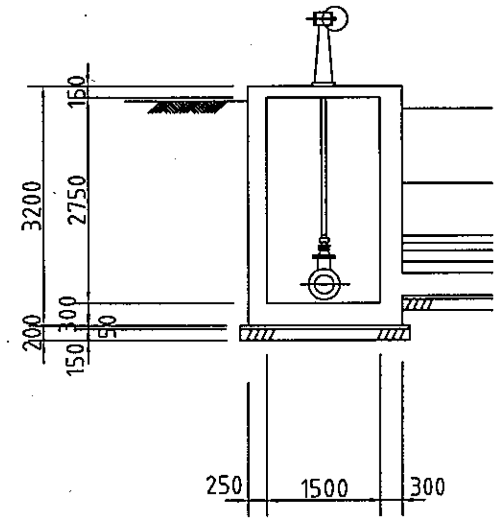
SECTION B–B



SECTION C–C

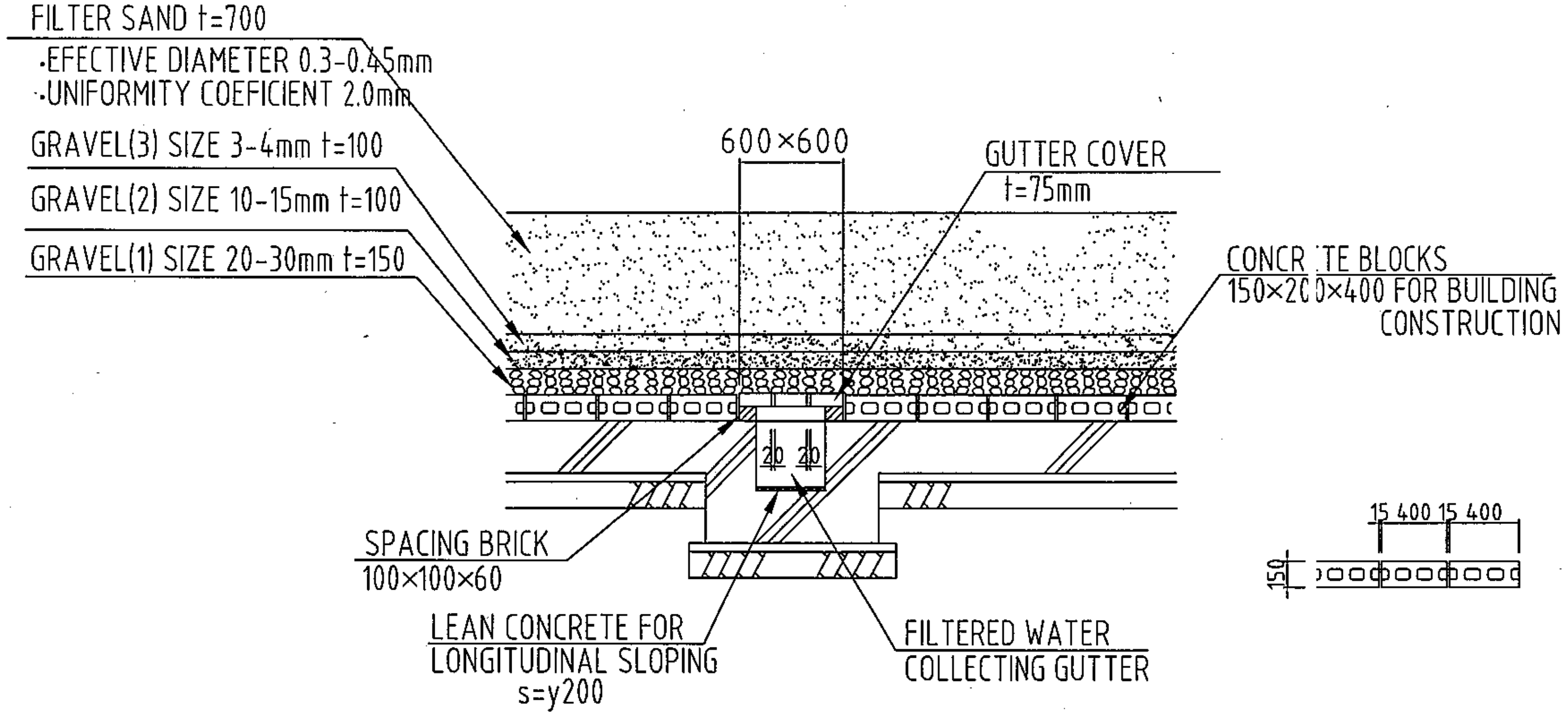


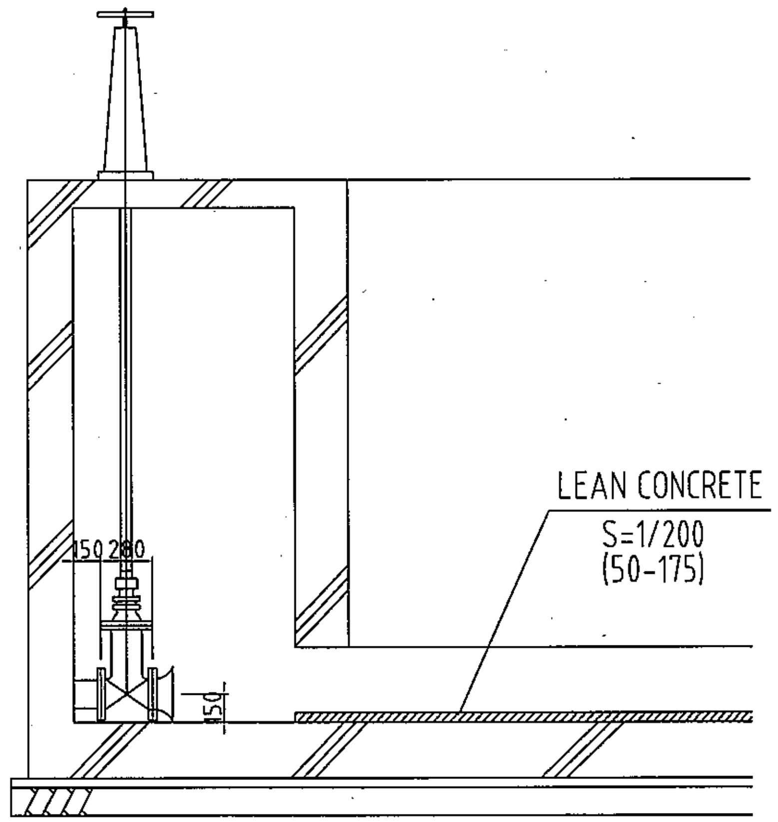
SECTION A–A

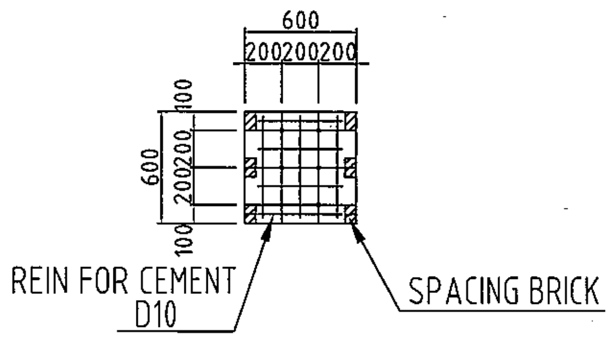


SECTION D–D

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : OUTLET CHAMBER	DRAWING NO. M - 010
KRI INTERNATIONAL CORPORATION NIPPON KOEI CO., LTD.		SCALE = 1 : 100	DATE: JUNE 2006

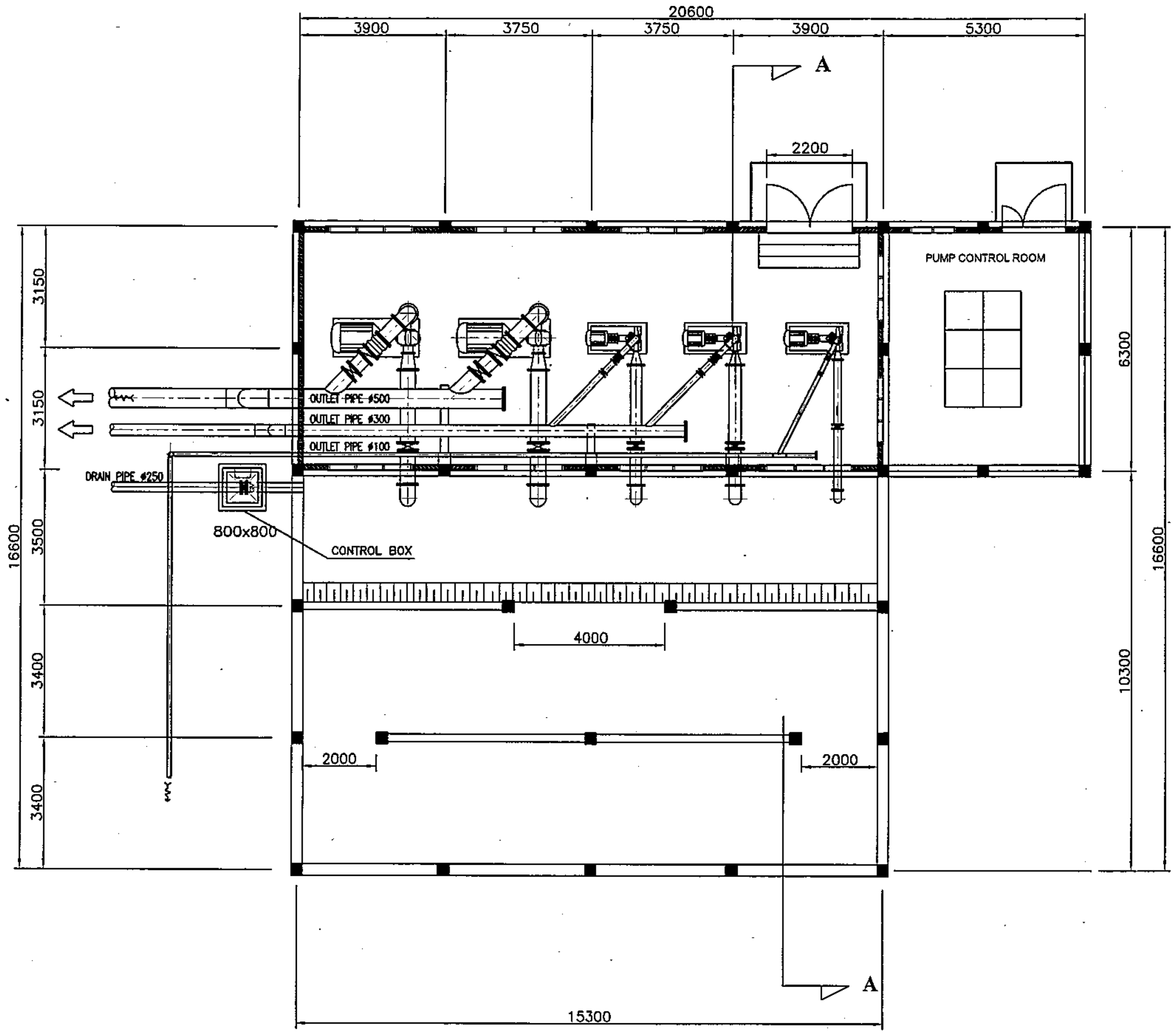






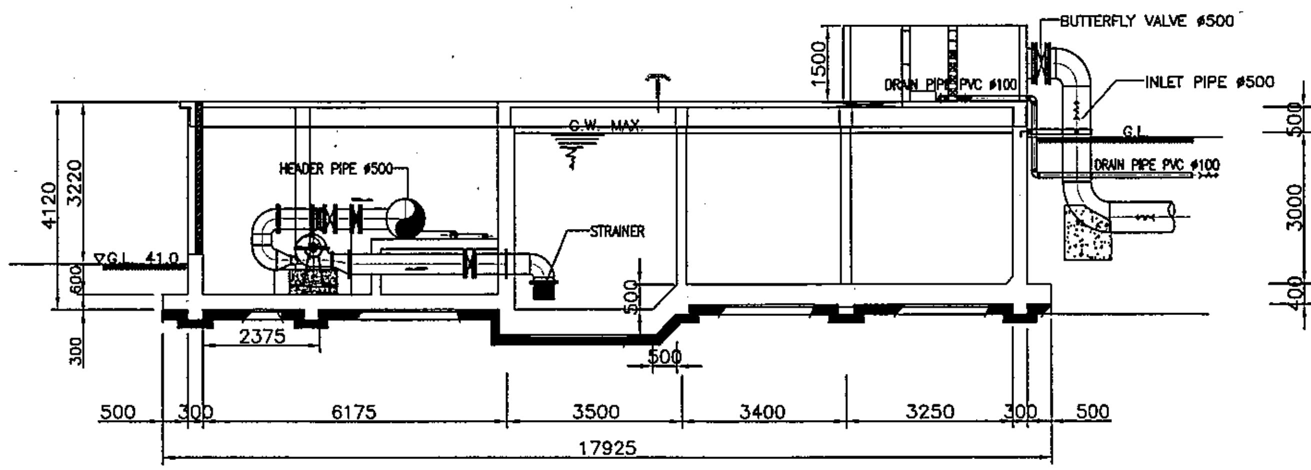
GUTTER COVER

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : FILTER UNDER DRAIN SYSTEM	DRAWING NO. M - 011
KRI INTERNATIONAL CORPORATION NIPPON KOEI CO., LTD.		SCALE = 1 : 40	DATE: JUNE 2006



PLAN

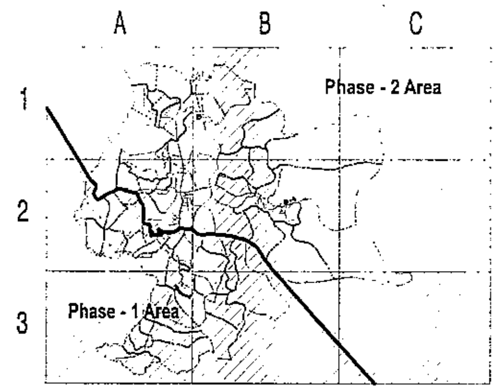
SCALE 1:150

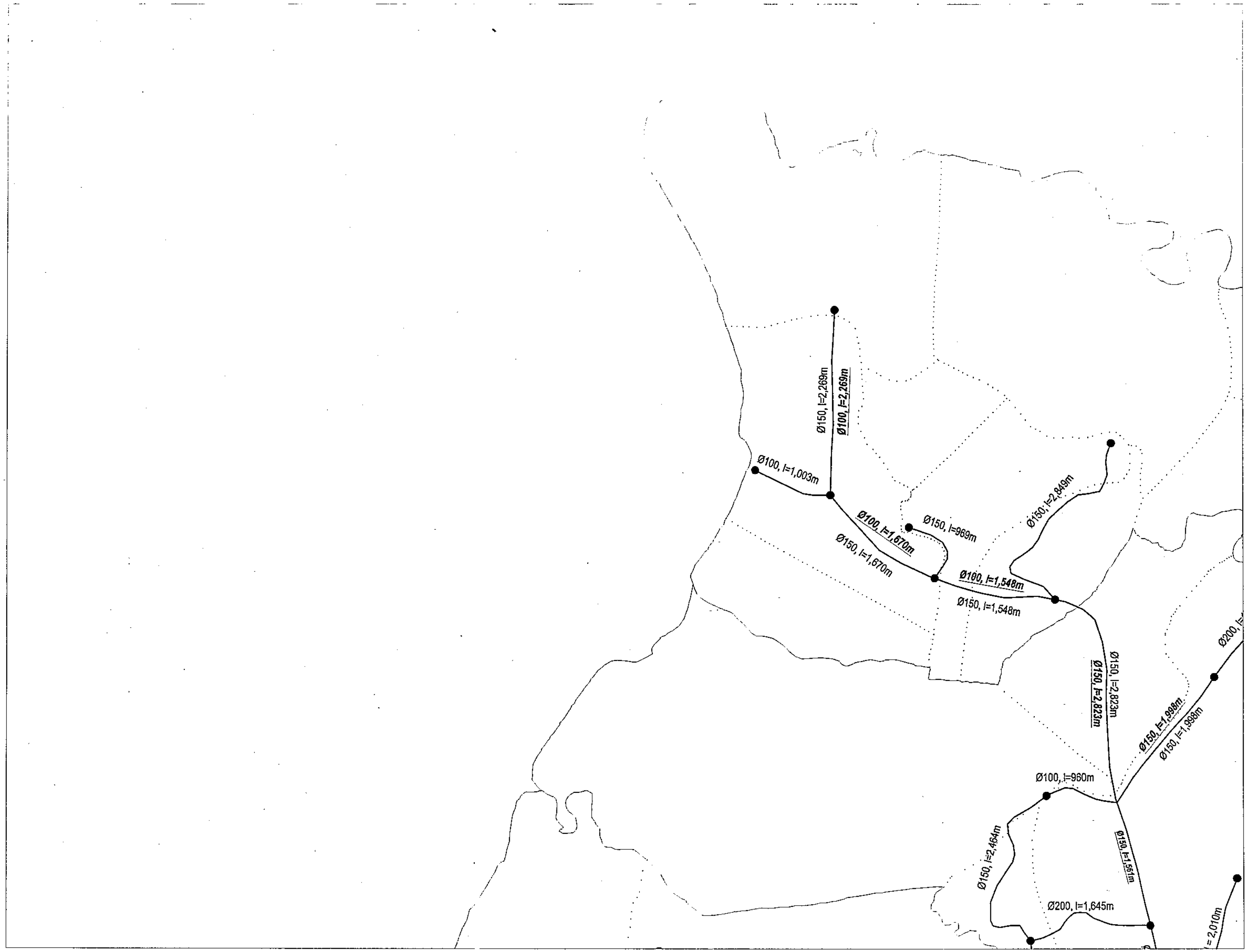


SECTION A - A

SCALE 1:150

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : CLEAR WATER TANK WITH PUMPING STATION (325 m³)	DRAWING NO. M-012
KRI INTERNATIONAL CORPORATION / NIPPON KOEI CO., LTD.		SCALE = 1 : 150	DATE: JUNE 2006





LEGEND

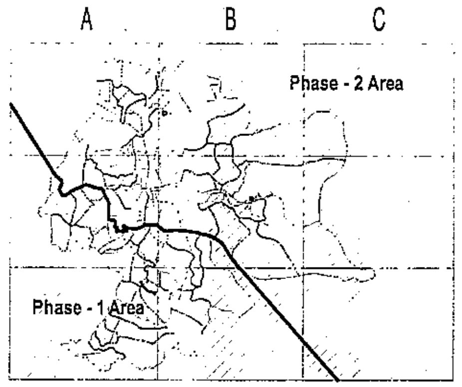
- : BUNDARY OF KECAMATAN
- : BUNDARY OF DESA
- : EXISTING INTAKE
- : PROPOSED INTAKE
- : EXISTING RAW WATER MAIN
- : PROPOSED RAW WATER MAIN
- Ⓟ : PROPOSED PUMPING STATION
- □ : EXISTING WATER TREATMENT PLANT
- ■ : PROPOSED WATER TREATMENT PLANT
- ⊠ : EXPANSION WATER TREATMENT PLANT
- : EXISTING DISTRIBUTION NETWORK
- : PROPOSED DISTRIBUTION NETWORK

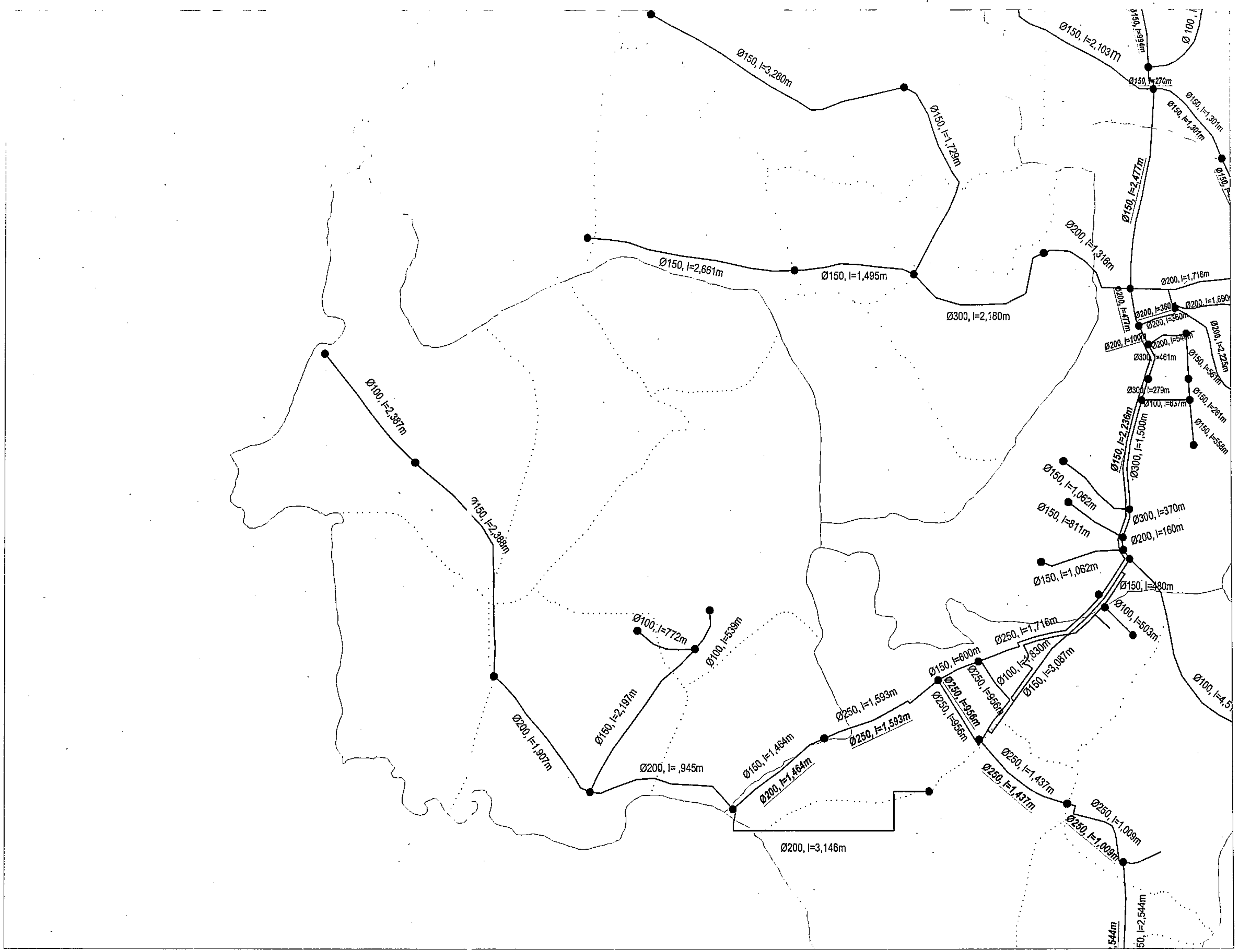
Note :
All pipe material is PE unless existing pipes.
Existing pipe is mentrond by under bar and bold.

0 0.5 1 2 3 4 5 Km

MAP - SCALE 1 = 50,000

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : DISTRIBUTION NETWORK (A - 1)	DRAWING NO. M-013
KRI INTERNATIONAL CORPORATION NIPPON KOEI CO., LTD.		SCALE = 1 : 50,000	DATE: JUNE 2006





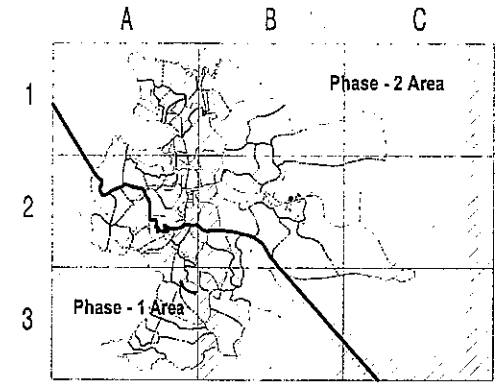
LEGEND

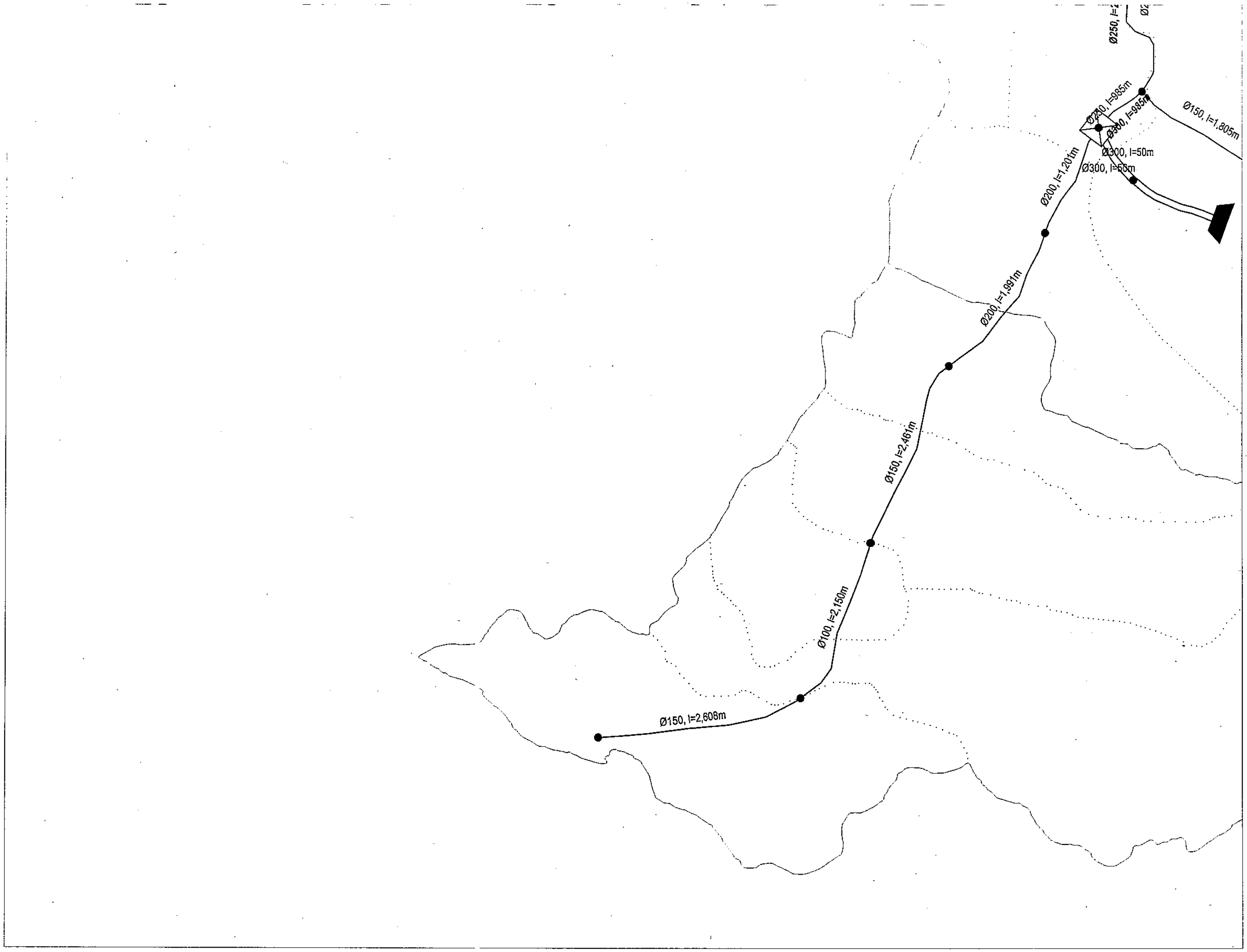
- : BUNDARY OF KECAMATAN
- : BUNDARY OF DESA
- : EXISTING INTAKE
- : PROPOSED INTAKE
- : EXISTING RAW WATER MAIN
- : PROPOSED RAW WATER MAIN
- : PROPOSED PUMPING STATION
- : EXISTING WATER TREATMENT PLANT
- : PROPOSED WATER TREATMENT PLANT
- : EXPANSION WATER TREATMENT PLANT
- : EXISTING DISTRIBUTION NETWORK
- : PROPOSED DISTRIBUTION NETWORK

Note :
All pipe material is PE unless existing pipes.
Existing pipe is mentrond by under bar and bold.

0 0.5 1 2 3 4 5 km
MAP - SCALE 1 = 50,000

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN NDONESIA	DRAWING TITLE : DISTRIBUTION NETWORK (A - 2)	DRAWING NO. M-014
KRI INTERNATIONAL CORPORATION NIPPON KOEI CO., LTD.		SCALE = 1 : 50,000	DATE: JUNE 2006





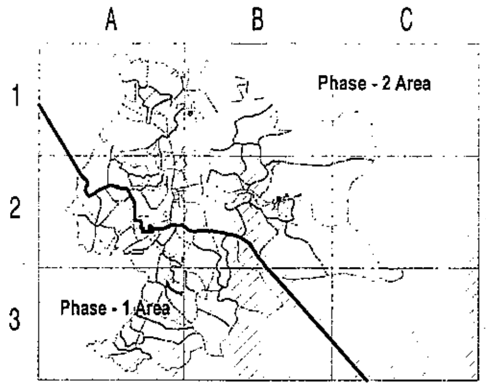
LEGEND

- : BUNDARY OF KECAMATAN
- : BUNDARY OF DESA
- : EXISTING INTAKE
- : PROPOSED INTAKE
- : EXISTING RAW WATER MAIN
- : PROPOSED RAW WATER MAIN
- : PROPOSED PUMPING STATION
- : EXISTING WATER TREATMENT PLANT
- : PROPOSED WATER TREATMENT PLANT
- : EXPANSION WATER TREATMENT PLANT
- : EXISTING DISTRIBUTION NETWORK
- : PROPOSED DISTRIBUTION NETWORK

Note :
All pipe material is PE unless existing pipes.
Existing pipe is mentrond by under bar and bold.

0 0.5 1 2 3 4 5 Km
MAP - SCALE 1 = 50,000

JICA JAPAN INTERNATIONAL COOPERATION AGENCY KRI INTERNATIONAL CORPORATION / NIPPON KOEI CO., LTD.	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : DISTRIBUTION NETWORK (A - 3) SCALE = 1 : 50,000	DRAWING NO. M-015 DATE: JUNE 2006



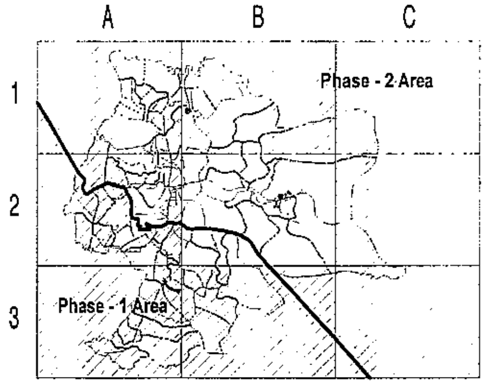
LEGEND

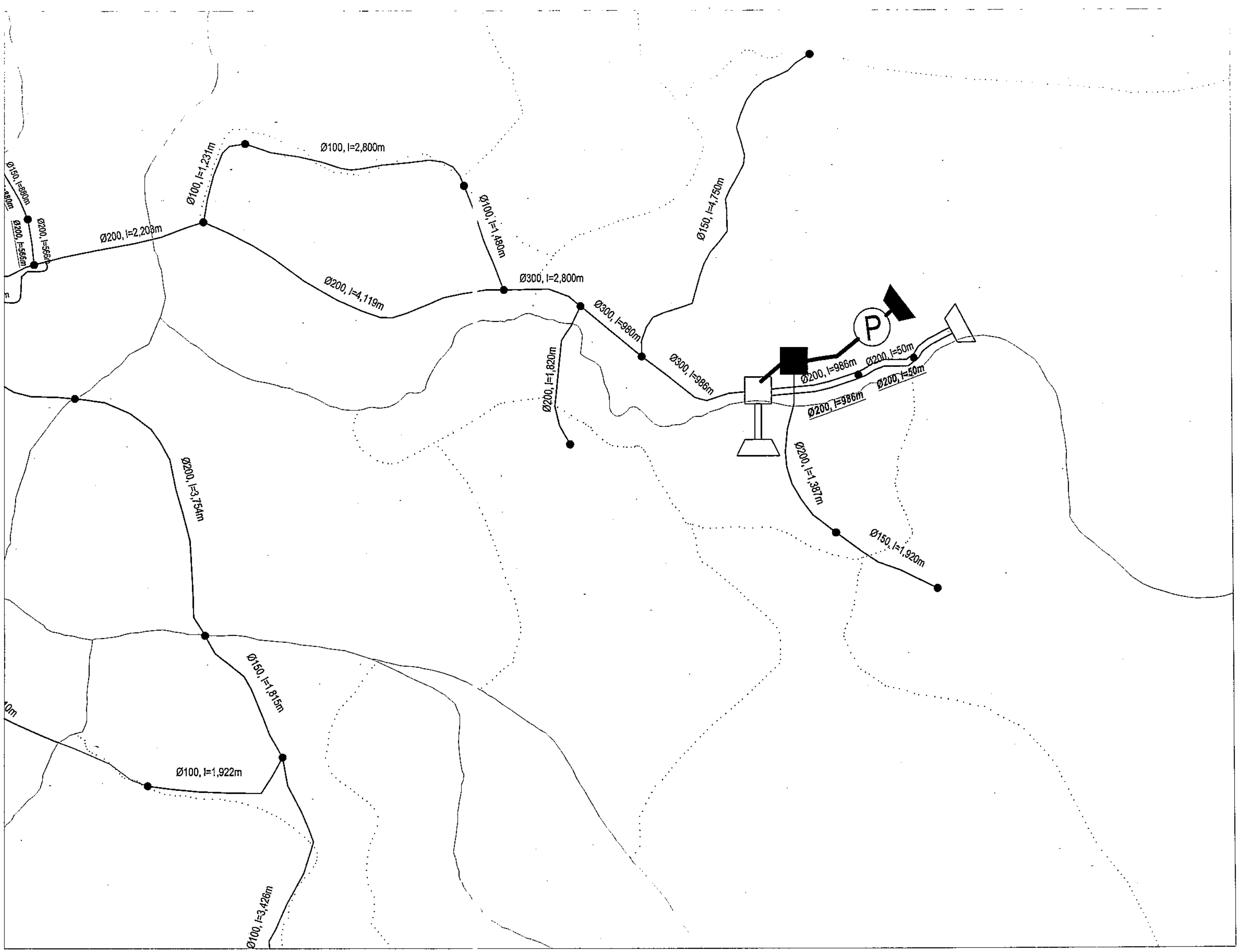
- : BUNDARY OF KECAMATAN
- : BUNDARY OF DESA
- : EXISTING INTAKE
- : PROPOSED INTAKE
- : EXISTING RAW WATER MAIN
- : PROPOSED RAW WATER MAIN
- : PROPOSED PUMPING STATION
- : EXISTING WATER TREATMENT PLANT
- : PROPOSED WATER TREATMENT PLANT
- : EXPANSION WATER TREATMENT PLANT
- : EXISTING DISTRIBUTION NETWORK
- : PROPOSED DISTRIBUTION NETWORK

Note :
All pipe material is PE unless existing pipes.
Existing pipe is mentrond by under bar and bold.

0 0.5 1 2 3 4 5 Km
MAP SCALE 1 = 50,000

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : DISTRIBUTION NETWORK (B - 1)	DRAWING NO. M-016
KRI INTERNATIONAL CORPORATION NIPPON KOEI CO., LTD.		SCALE = 1 : 50,000	DATE: JUNE 2006





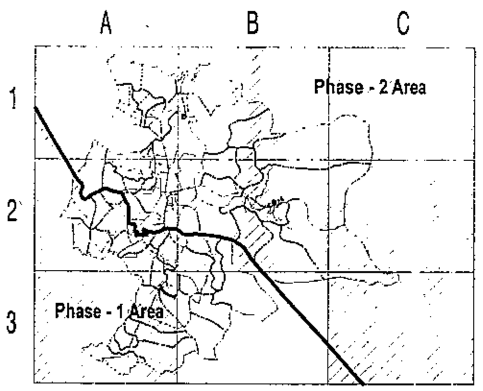
LEGEND

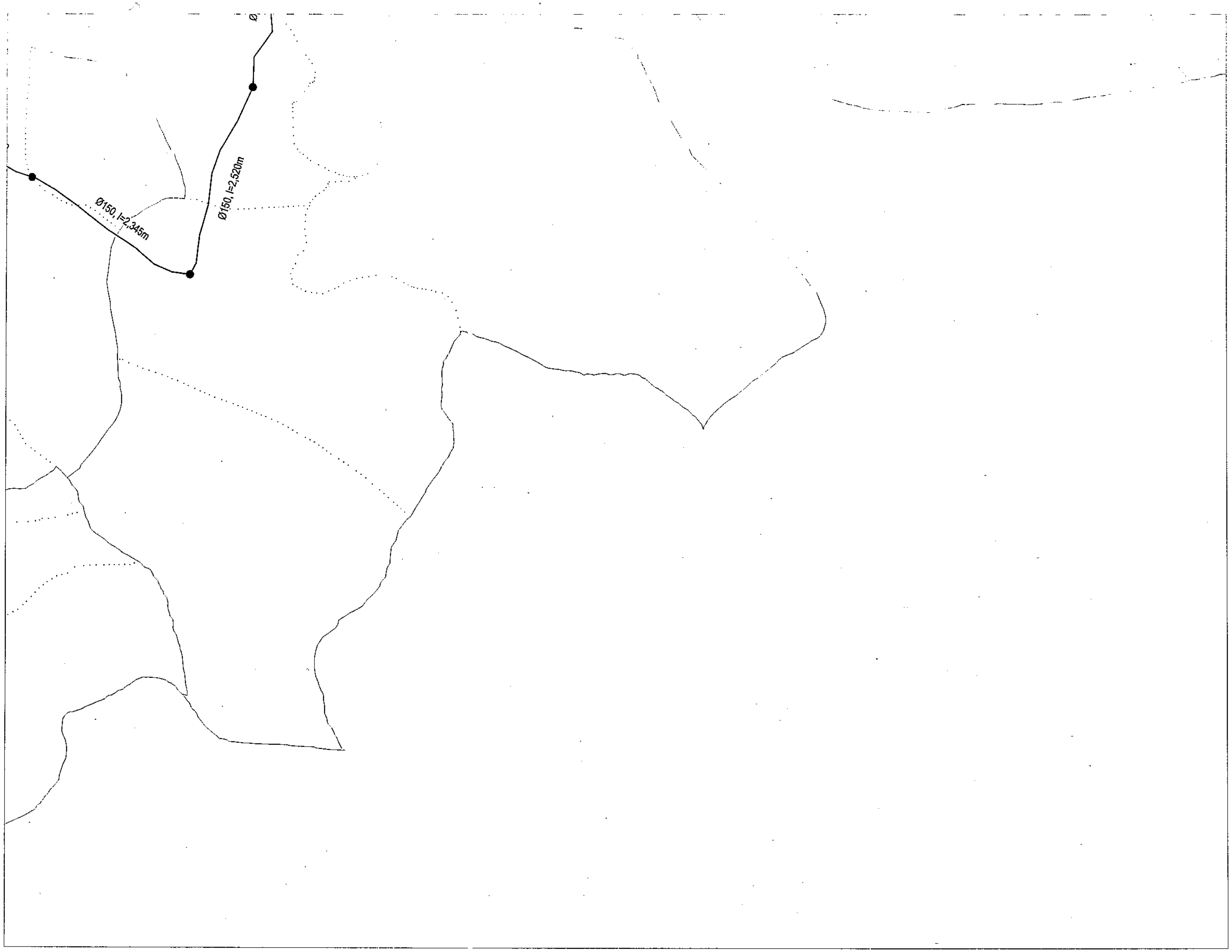
———	: BUNDARY OF KECAMATAN
······	: BUNDARY OF DESA
◁	: EXISTING INTAKE
◀	: PROPOSED INTAKE
═══	: EXISTING RAW WATER MAIN
━━━	: PROPOSED RAW WATER MAIN
Ⓟ	: PROPOSED PUMPING STATION
□	: EXISTING WATER TREATMENT PLANT
■	: PROPOSED WATER TREATMENT PLANT
⊠	: EXPANSION WATER TREATMENT PLANT
———	: EXISTING DISTRIBUTION NETWORK
———	: PROPOSED DISTRIBUTION NETWORK

Note :
All pipe material is PE unless existing pipes.
Existing pipe is mentrond by under bar and bold.

0 0.5 1 2 3 4 5 Km
MAP - SCALE 1 = 50,000

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : DISTRIBUTION NETWORK (B - 2)	DRAWING NO. M-017
KRI INTERNATIONAL CORPORATION — NIPPON KOEI CO., LTD.		SCALE = 1 : 50,000	DATE: JUNE 2006





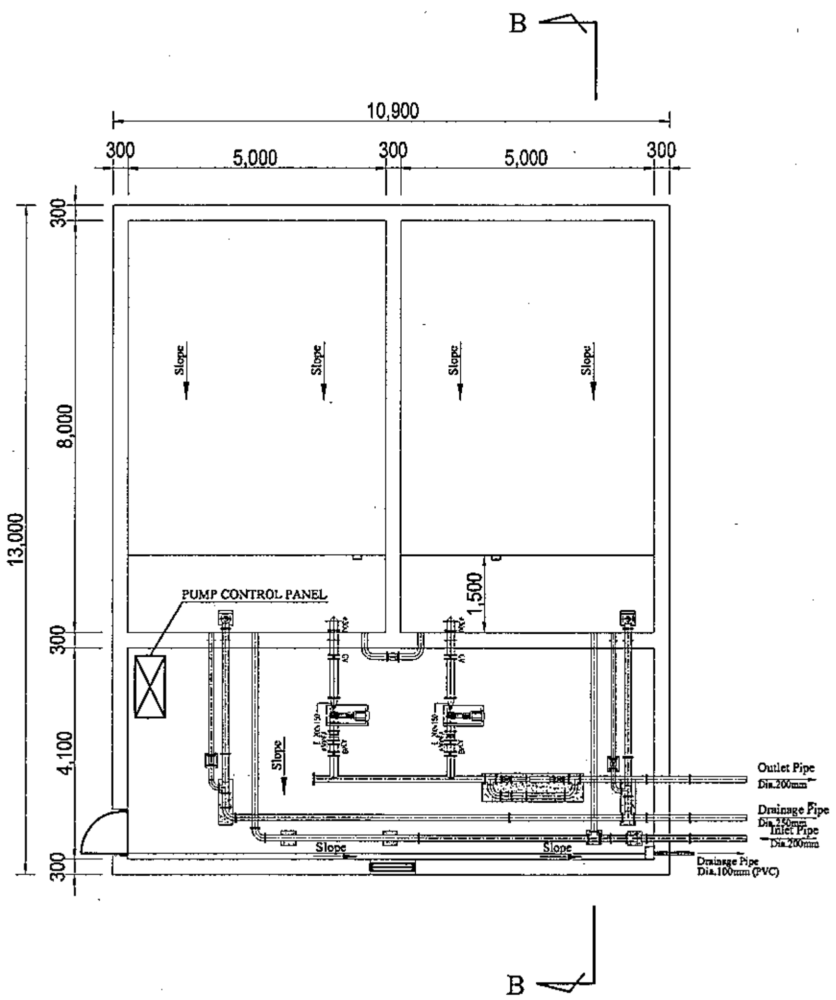
LEGEND

- : BUNDARY OF KECAMATAN
- : BUNDARY OF DESA
- : EXISTING INTAKE
- : PROPOSED INTAKE
- : EXISTING RAW WATER MAIN
- : PROPOSED RAW WATER MAIN
- : PROPOSED PUMPING STATION
- : EXISTING WATER TREATMENT PLANT
- : PROPOSED WATER TREATMENT PLANT
- : EXPANSION WATER TREATMENT PLANT
- : EXISTING DISTRIBUTION NETWORK
- : PROPOSED DISTRIBUTION NETWORK

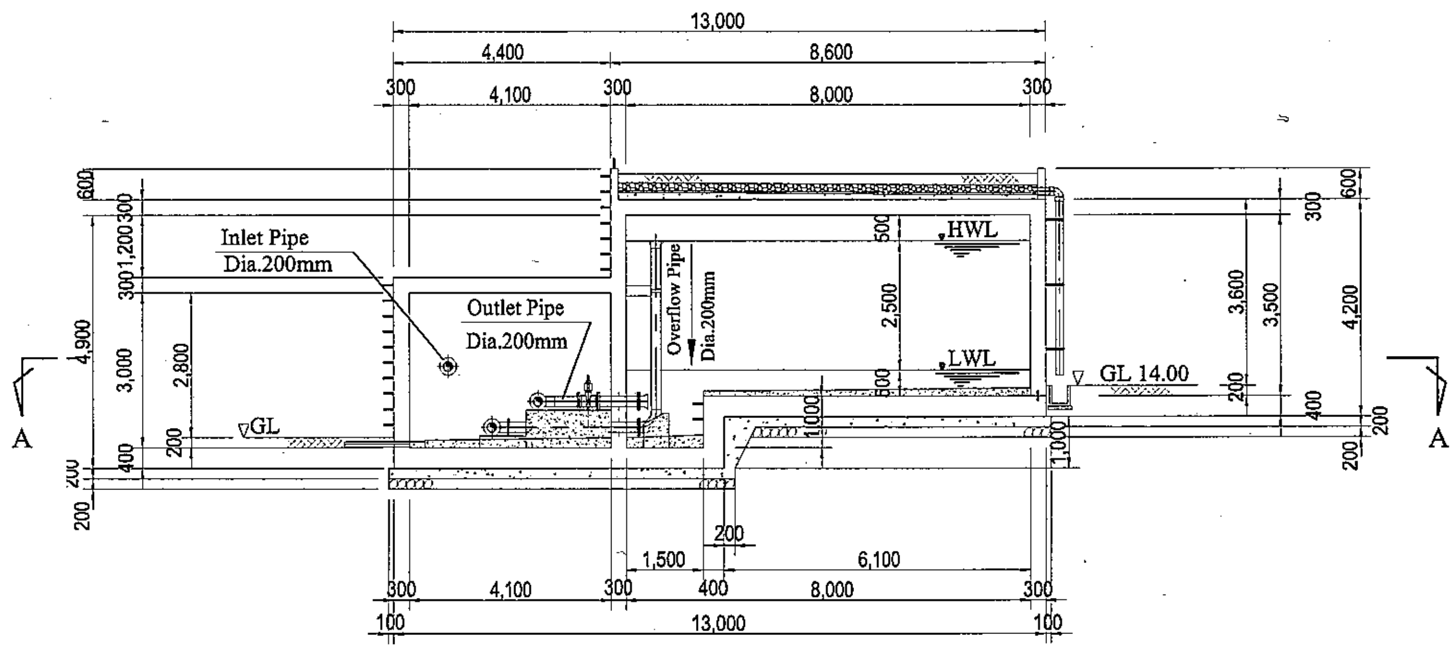
Note :
All pipe material is PE unless existing pipes.
Existing pipe is mentrond by under bar and bold.

0 0.5 1 2 3 4 5 Km
MAP - SCALE 1 = 50,000

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : DISTRIBUTION NETWORK (B - 3)	DRAWING NO. M-018
KRI INTERNATIONAL CORPORATION / NIPPON KOEI CO., LTD.		SCALE = 1 : 50,000	DATE: JUNE 2006

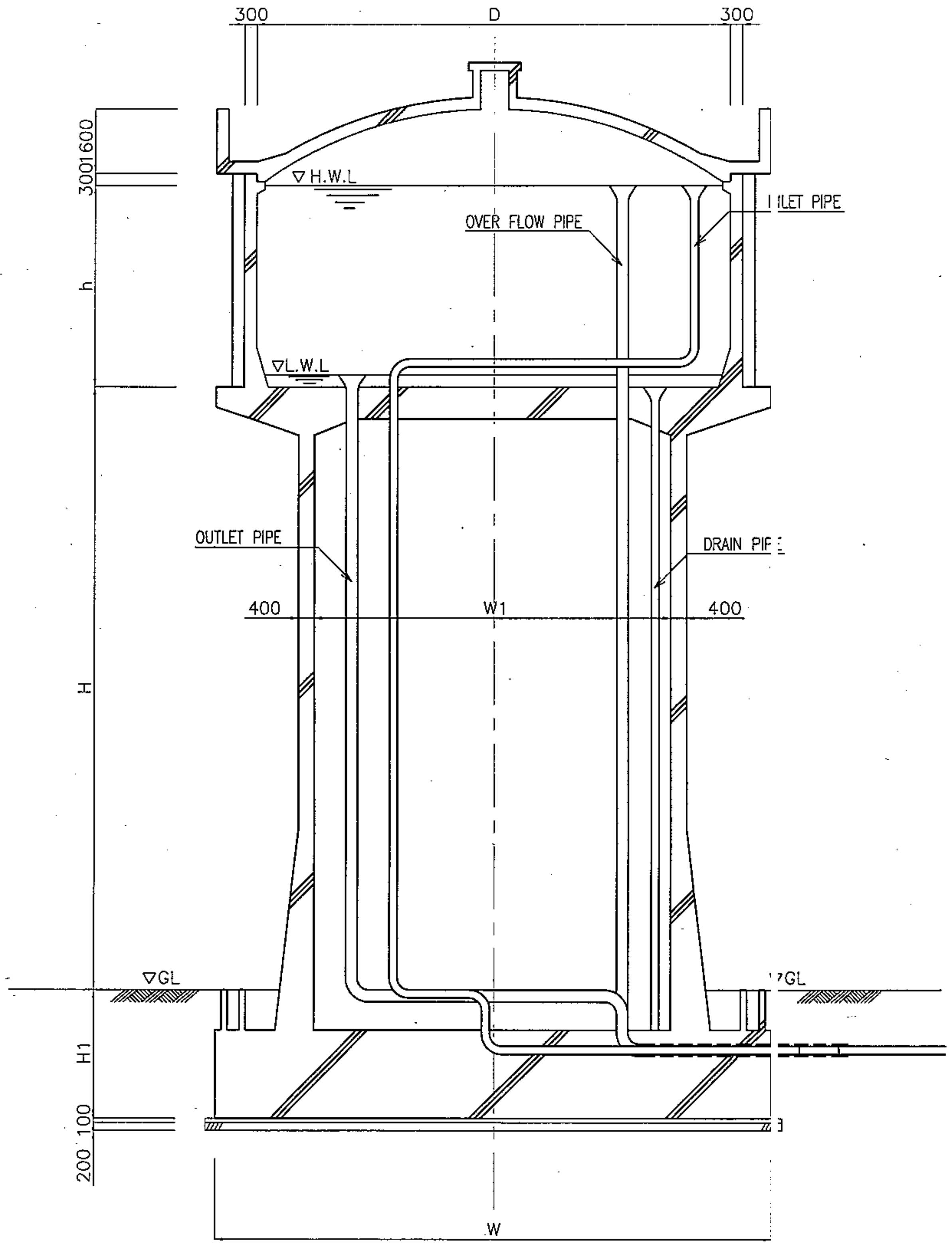


(Section A - A)



Section B - B

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : GROUND TYPE RESERVOIR WITH PUMPING STATION (200 m³)	DRAWING NO. M-019
KRI INTERNATIONAL CORPORATION / NIPPON KOEI CO., LTD.		SCALE = 1 : 150	DATE: JUNE 2006



	Capacity(m^3)	H(mm)	h(mm)	D(mm)	W(mm)	W1(mm)	H1(mm)
T-1	220	10,000	5,000	7,480	9,480	4,480	2,000
T-2	690	15,000	5,000	13,260	15,260	10,260	2,500
T-3	910	20,000	5,000	15,230	17,230	12,230	2,700
T-4	450	10,000	4,000	11,970	13,970	8,970	2,300
T-5A	580	20,000	5,000	12,160	14,160	9,160	2,500
T-6	700	20,000	5,000	13,350	15,350	10,350	2,300

JAPAN INTERNATIONAL COOPERATION AGENCY

KRI INTERNATIONAL CORPORATION NIPPON KOEI CO., LTD.

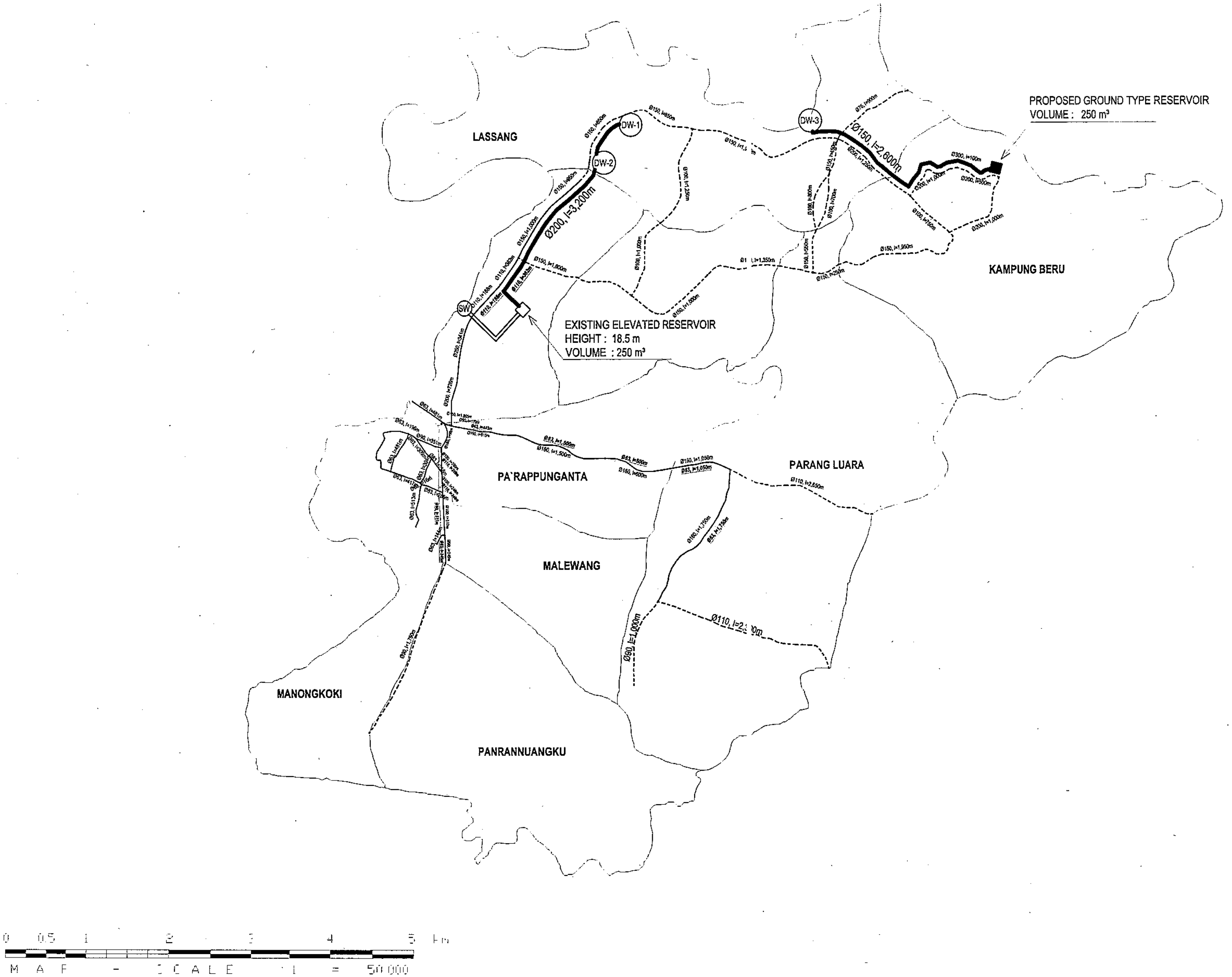
PROJECT TITLE:
PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS
THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR
THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA

DRAWING TITLE: ELEVATED RESERVOIR

SCALE = 1 : 150

DRAWING NO. M - 020

DATE: JUNE 2006



DISTRIBUTION PIPE

DIAMETER (mm)	LENGTH EXISTING (m)	LENGTH PURPOSED (m)
63	8,953	
90	1,038	1,000
110	1,097	10,517
160	1,944	17,012
200	1,359	3,750
250	480	100
TOTAL	14,871	32,379

TRANSMISSION PIPE

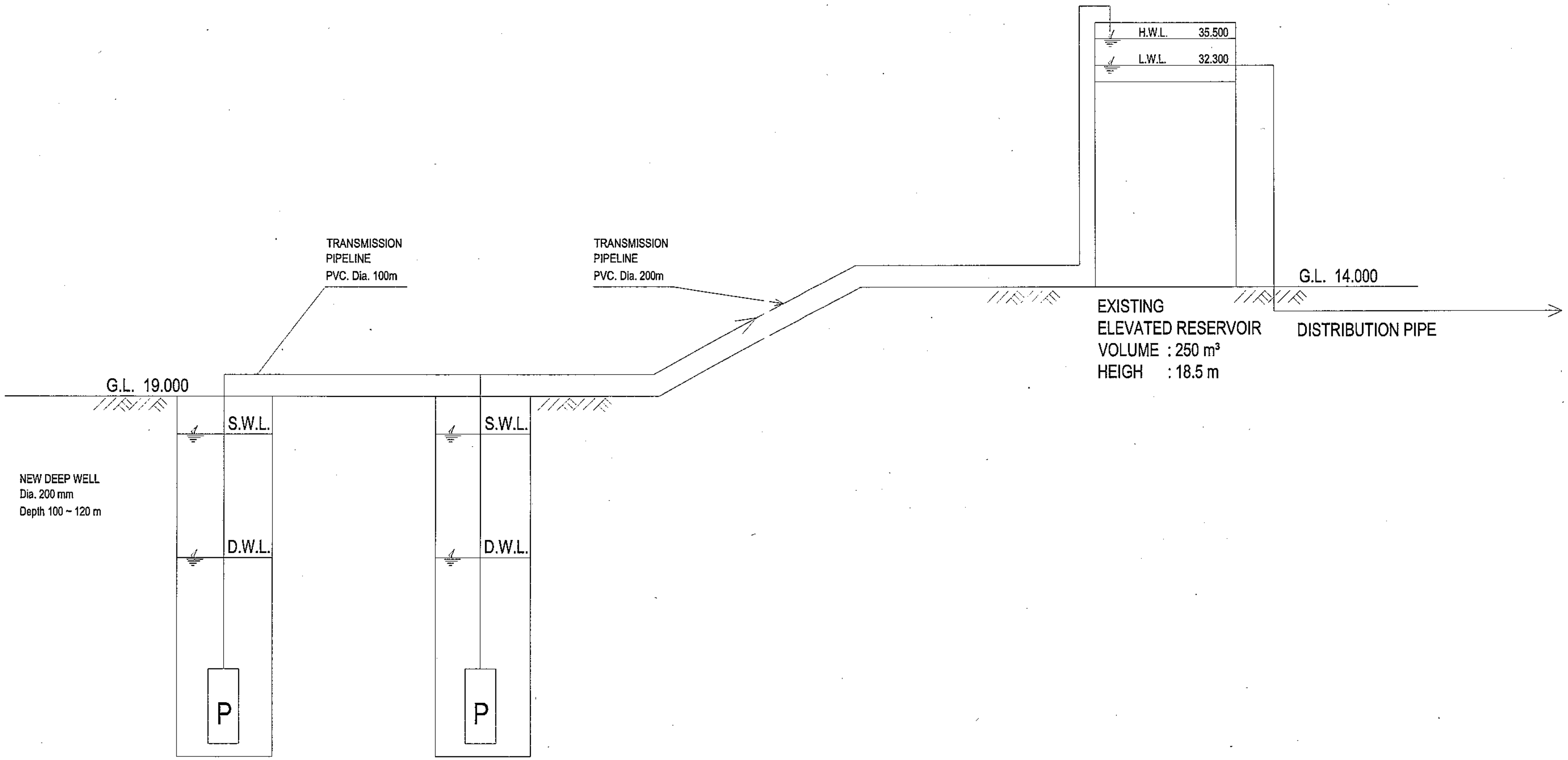
DIAMETER (mm)	PURPOSED (m)
100	700
150	2,620
200	2,500
TOTAL	5,800

LEGEND

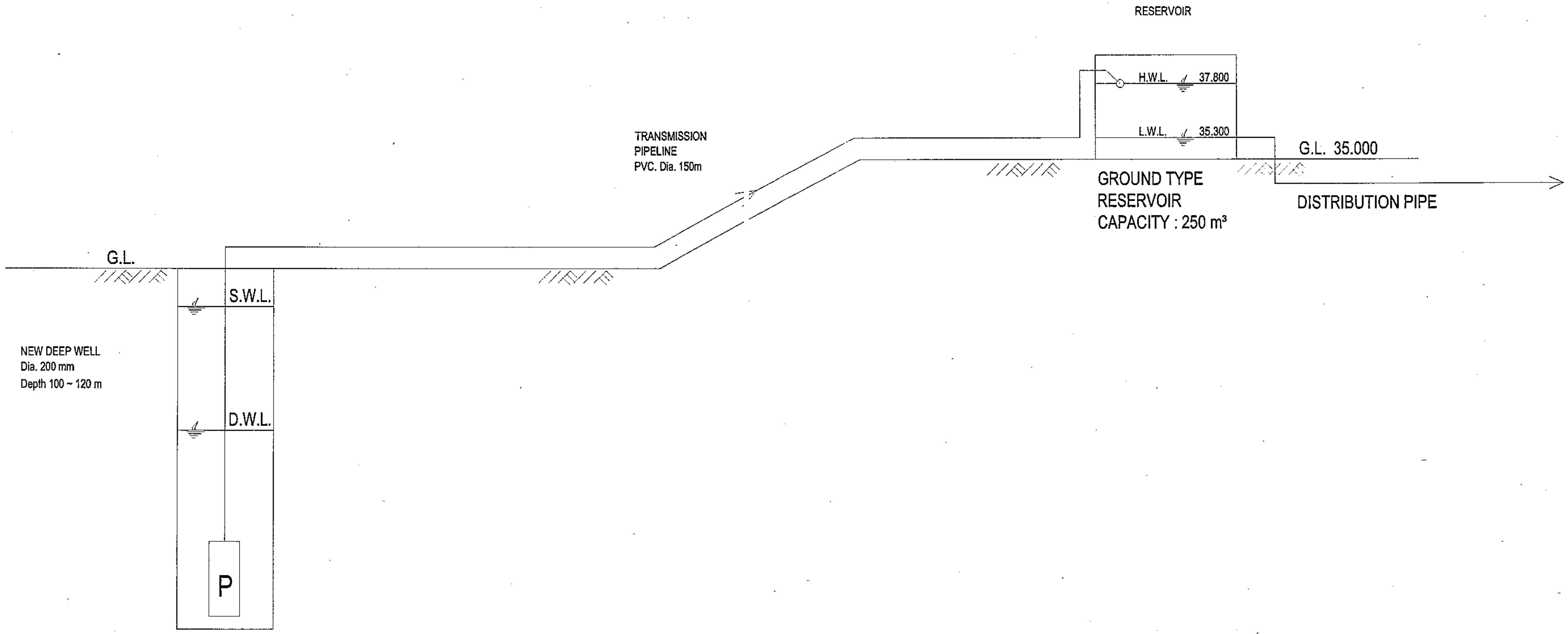
- : BUNDARY OF DESA
- SW : EXISTING SHALLOW WELL
- : EXISTING TRANSMISION MAIN
- : PROPOSED TRANSMISION MAIN
- DW : PROPOSED DEEPWELL SITE
- ☐ : EXISTING ELEVATED RESERVOIR
- ■ : PROPOSED GROUND RESERVOIR
- : EXISTING DISTRIBUTION NETWORK
- : PROPOSED DISTRIBUTION NETWORK

Note :
All pipe material is PE unless existing pipes.
Existing pipe is mentrond by under bar and bold.

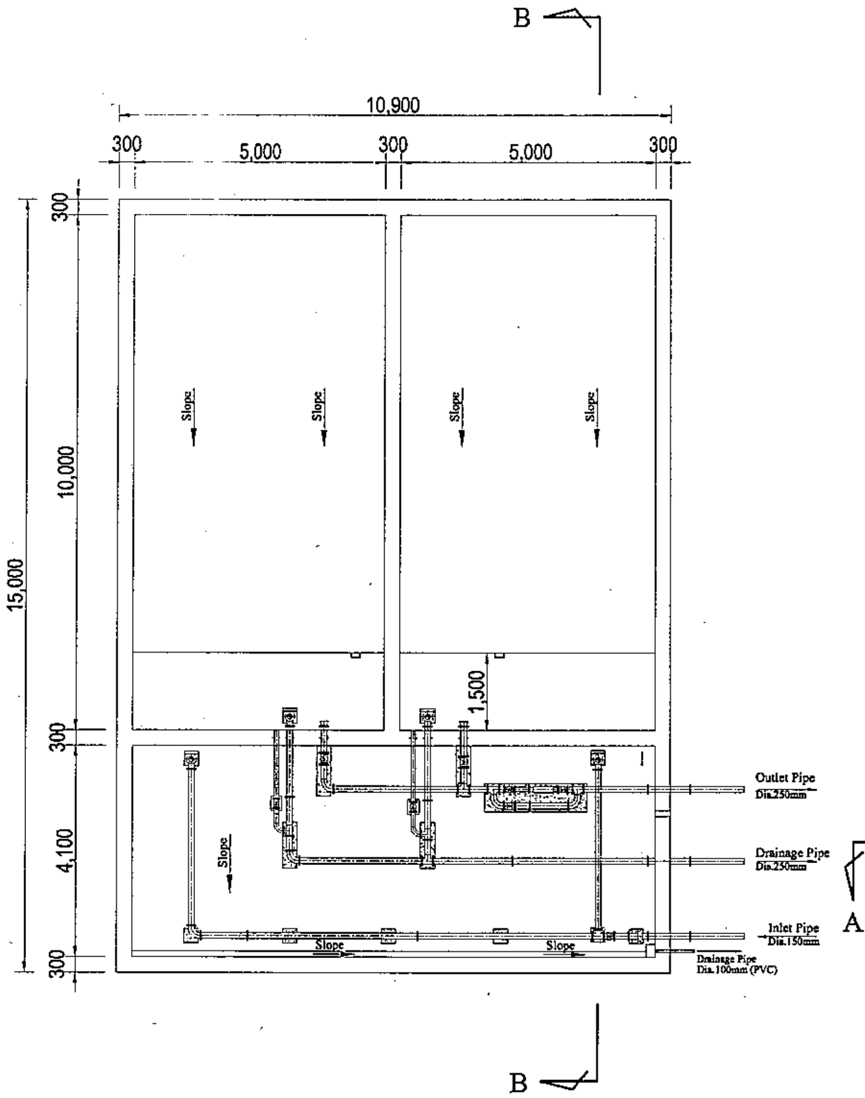
JICA JAPAN INTERNATIONAL COOPERATION AGENCY KRI INTERNATIONAL CORPORATION · NK NIPPON KOEI CO., LTD.	PROJECT TITLE: PRE FEASIBILITY STUDY FOR WATER SUPPLY SYSTEM IN TAKALAR THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : GENERAL LOCATION MAP IN POLONGBANGKENG UTARA OF TAKALAR SCALE = 1 : 50,000	DRAWING NO. T-001 DATE: JUNE 2006



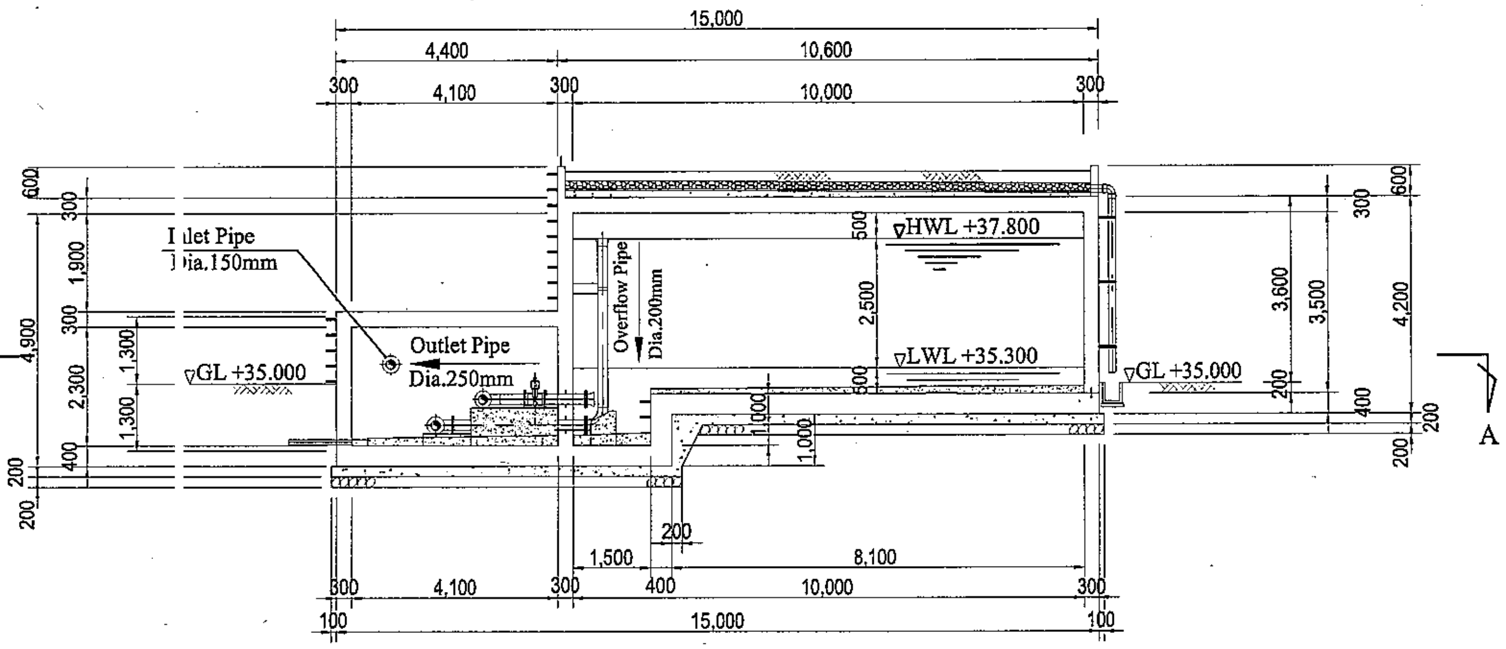
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR WATER SUPPLY INPROVEMENT PLAN IN TAKAI AR THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN NDONESIA	DRAWING TITLE : GENERAL FLOW DIAGRAM (DW-1.2)	DRAWING NO. T -002
KRI INTERNATIONAL CORPORATION / NIPPON KOEI CO., LTD.		SCALE = NOT TO SCALE	DATE: JUNE 2006



JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR WATER SUPPLY INPROVEMENT PLAN IN TAKALAR THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : GENERAL FLOW DIAGRAM (DW - 3)	DRAWING NO. T -003
KRI INTERNATIONAL CORPORATION / NIPPON KOEI CO., LTD.		SCALE = NOT TO SCALE	DATE: JUNE 2006



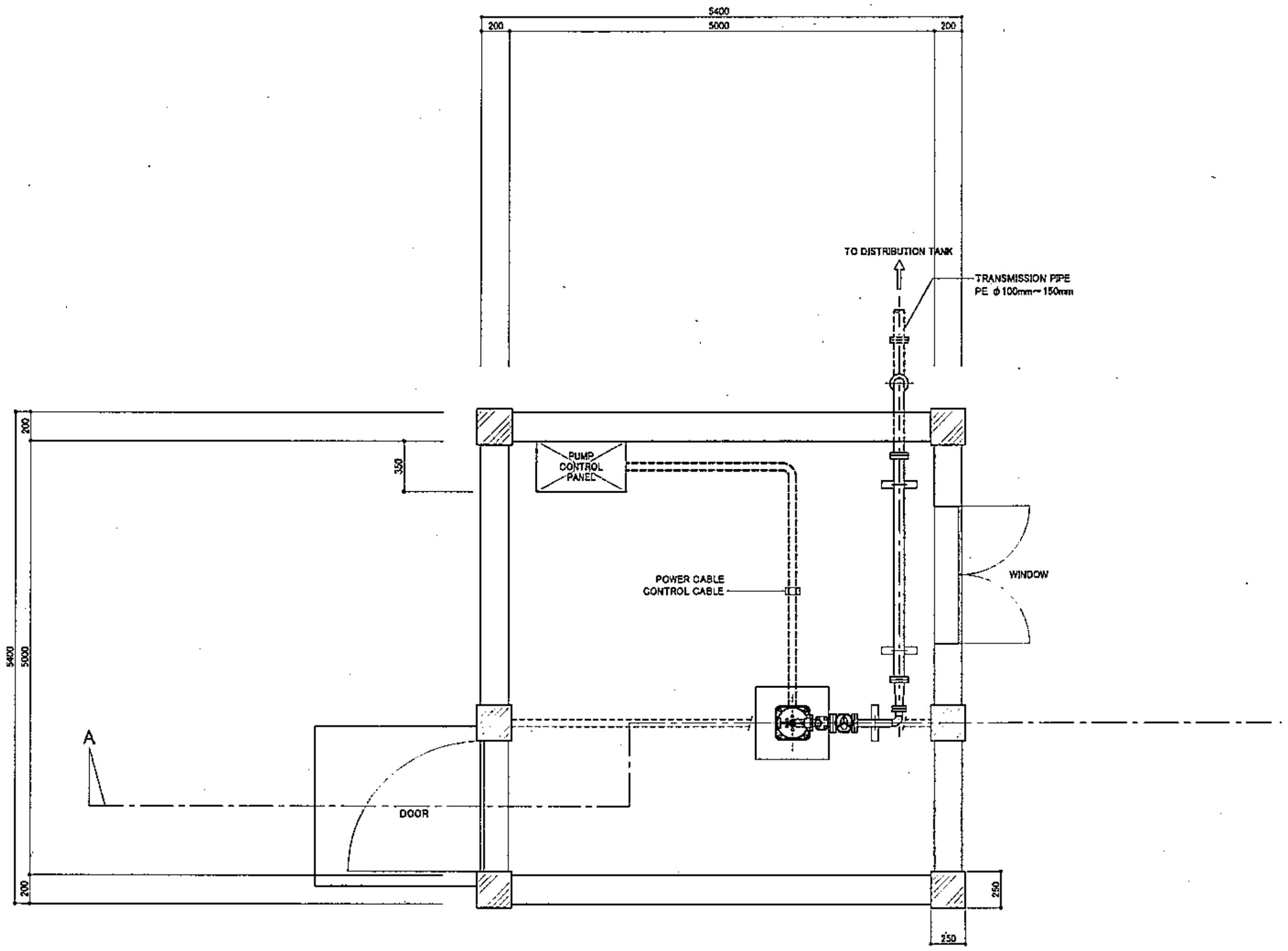
(Section A - A)



Section B - B

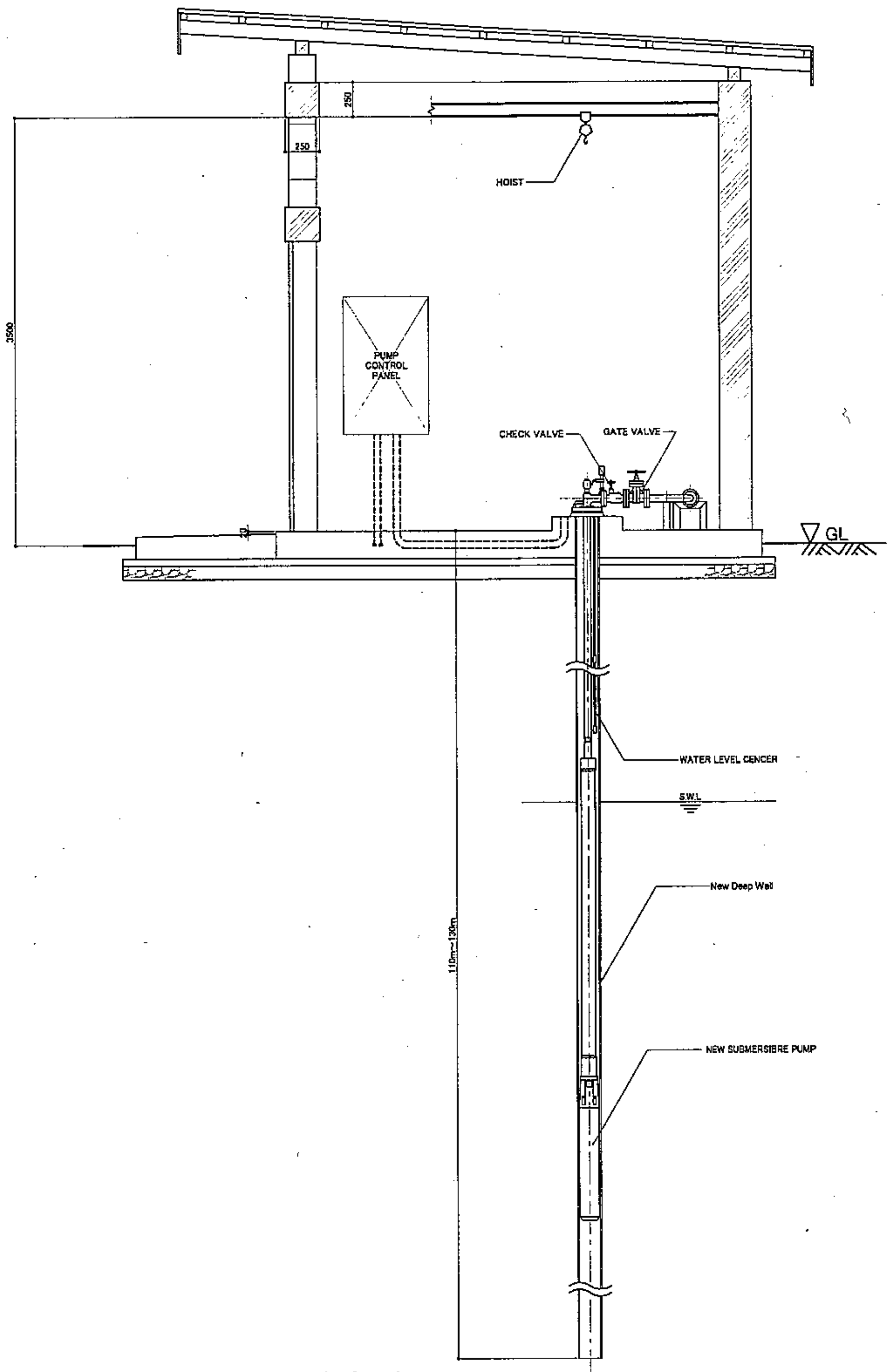
JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEI I IN TAKALAR THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN NDONESIA	DRAWING TITLE : GROUND TYPE RESERVOIR (250 m³)	DRAWING NO. T-004
KRI INTERNATIONAL CORPORATION NIPPON KOEI CO., LTD.		SCALE = 1 : 150	DATE: JUNE 2006

PLATE No. 26



PLAN

Name	
Deep Well 1 Pumping station	Quantity:12.5 1/sec,TH:45m,Output:11kw, Deep well submersible pump
Deep Well 2 Pumping station	Quantity:2.5 1/sec,TH:45m,Output:1.9kw, Deep well /secubmersible pump
Deep Well 3 Pumping station	Quantity:71/sec,TH:50m,Output:5.5kw, Deep well submersible pump



SECTION A-A

JICA JAPAN INTERNATIONAL COOPERATION AGENCY	PROJECT TITLE: PRE FEASIBILITY STUDY FOR THE IMPROVEMENT OF WATER SUPPLY SYSTEM IN MAROS THE STUDY ON IMPLEMENTATION OF INTEGRATED SPATIAL PLAN FOR THE MAMMINASATA METROPOLITAN AREA, SOUTH SULAWESI PROVINCE IN INDONESIA	DRAWING TITLE : DEEP WELL PUMPING STATION	DRAWING NO. T - 005
KRI INTERNATIONAL CORPORATION / NIPPON KOEI CO., LTD.		SCALE = 1 : 50	DATE: JUNE 2006