2-3 Population

Projection of the future population is a basis for estimation of water demand, which is in turn the basic factor for planning the water supply system. From this standpoint, the two subjects, trend of the past population growth and population served studied by the existing Report, will be reviewed in the following two paragraphs, before proceeding to the review of water requirements.

2-3-1 Population Data

The Report carries some data related to population, out of which statistics of population are shown in Table 2-3-1 Population Data, quoted from the Report. The average growth rate over 1970 to 1977 was computed by the Report as 5.56 % excluding 1968 and 1969, because the growth rate for the two years is not normal. The computed rate is remarkably high compared with those of Banggai Regency and the whole country. Regarding this high growth rate, the Report said that probable causes for it are 1) construction of educational facilities, 2) moving-in of people into the kota area, and 3) inclusion of two kampungs in the municipal area. The Report has given due consideration to this unusual growth rate as described above, before proceeding to project the future population. This is considered quite appropriate.

Table 2-3-1 Population Data
(quoted from the Report)

Year	Population	Growth Rate (%)
1968	12,148	-
1969	12,246	0.8
1970	12,345	0.81
1971	12,946	4.87
1972	13,782	6.46
1973	14,479	5.06
1974	15,314	5.77
1975	15,922	4.03
1976	16,897	6.12
1977	18,019	6.64

Sources : Office of Kecamatan Kota Luwuk

2-3-2 Population Projection

With an attempt to alleviate the effect of the high growth rate on the population projection in mind, and also not to neglect the actual high growth rate, the Report calculated the future population up to the year of 2005, as shown in Table 2-3-2 Projected Population. In projecting the future population, the Report, first, tried three kinds of methods, that is, arithmetic, logistic curve and geometric methods, and then selected the results of calculation by the latter two methods in combination. The combination is the geometric method for the near future period, and the logistic curve method for the long future period.

Comments by the present review are as follows (Refer to Appendix A). The geometric method among the above three methods would give a rather high side results in estimation, when the growth rate is fairly high. But as it is not proper to disregard the high growth rate in the recent years, the Report adopted this method for the near future term with the growth rate gradually decreasing. And then for the long future years, the Report adopted the logistic curve method which makes the growth rate to gradually reduce. This measure is considered very realistic and appropriate.

As for the calculation, the Report made some assumptions on the growth rate to be employed, taking into consideration future probable trend of the growth rate, and then proceeded with the calculation. There were found some minor mistakes in the calculation, but as a whole they are not serious. As is seen in the same table, the annual increments of population up to the year of 1985, the target year of the present project, are 1,100 persons in average. This figure corresponds to the recent growth, so it is considered appropriate and usable for projection of population served.

In the opinion of the Study Team, however, it is advisable that review of this projected population including all calculation processes and assumptions be reviewed in the near future, considering the fairly unstable past trend of population growth in Luwuk.

Table 2-3-2 Projected Population

(quoted from the Report)

Year	Population	Year	Population
1980	21,195	1995	33,891
1985	26,706	2000	36,972
1990	30,805	2005	40,053

2-4 Population Served and Water Demand

When to project the future water demand, most important factors needed are the unit consumption and population served. These two factors are usually obtained from the conditions of present water use. Therefore, the Report will be reviewed from this standpoint in order of present water use, population served and water requirements.

2-4-1 Present Water Use

In order to know the actual unit consumption, figures so far obtained are checked here. As already stated in 2-2 Existing Water Supply, the water quantity served from the spring is 30 l/sec and the population served is 2,500 persons. These figures are taken from the Report. To ascertain its reliability, a field reconnaissance was undertaken. But it was not verified, because there are no meters installed at the spring and all the connections. In the present water system, mere division of the supplied quantity by the supplied people does not give the true value of unit consumption. Hence, regarding the unit consumption, review will be made from another standpoint in 2-4-3 Water Requirements.

Further, regarding current use of water in the study area, it is very outstanding that the served area by the existing system is very limited within a small part of the built-up area. And besides the served population is also very limited, and so majority of the population are obliged to take their domestic water from the streams and springs nearby. As the condition of water use is such, the people desire realization of the public water supply system at an earliest possible date.

2-4-2 Population Served

Taking into consideration the matter so far described, the Report made an estimation of population served, which is shown in Table 2-4-1 Population Served after correction and compilation by the present study. The Report made the estimation of population served by multiplying the total population by assumed percentages. This method is very usual and considered appropriate. In the same table, the percentage of population served for 1980 is 70 %, and for 1985, 85 %. At the time of preparing the Report, the target year of completion was 1980, but as the actual start of the operation of the present project is, at the moment, delayed, the percentage 70 % for 1980 has proved not attainable. And further, about the percentage 85 % for 1985, its realization may similarly be somewhat difficult. However, the delay of the project implementation is no more than one or two years, so the percentage for 1985 may not be widely off the target. If the acute condition, as stated in the preceding paragraphs, of water use in the built-up area requiring water supply is considered, the target percentage is not, in the opinion of the Study Team, necessary to be revised.

Table 2-4-1 Population Served

Year	Population	Percentage (%)	Population Served
1980	21,195	70	14,837
1985	26,706	85	22,701
1990	30,805	85	27,724
1995	33,891	90	30,502
2000	36,972	95	35,123
2005	40,053	95	38,050

Source : the existing Report

2-4-3 Water Requirements

Based on the study in 2-3 Population, 2-4-1 and 2-4-2, the report calculated the future water requirements as shown in Table 2-4-2 Water Requirements, together with corrections by the present study.

The process of calculation adopted by the Report was to multiply unit consumptions by population served or number of beds, facilities, etc. as shown below (Refer to Appendix B). This method, widely practiced for water supply planning, is considered appropriate for the present project.

1)	Domestic use by house taps	served population	x 100	l/c/d
2)	Domestic use by public hydrants	served population	x 30	l/c/d
3)	Institutions	office workers	x 15	l/c/d
4)	Industrial facilities	number of factories	x 3.5	cu m/d
5)	Hotels	number of beds	x 200	l/bed/d
6)	Shops & Markets	number of units	x 1.0	cu m/d
7)	Medical facilities	number of beds	x 300	l/bed/d
8)	Schools	pupils	x 20	l/c/d
9)	Religious institutions	number of units	x 1.5	cu m/d
10)	Harbor	number of ships per day	x 7.5	cu m/d

Regarding the unit consumptions employed by the Report, brief explanations and comments by the present study are as follows. Unit consumptions per capita per day for domestic use are 100 l/c/d for house tap and 30 l/c/d for public hydrant. These values are considered adequate from precedents in the country and the results of the present study. As regards with the non-domestic uses, unit consumptions such as 3.5 cu m/day for factories, 20 l/c/d for school, etc. are acceptable, compared with data of other cities in Indonesia and examples of other countries. As for the unit consumption for industries, the value 3.5 cu m/day seems to be on a rather high side, and the total requirement for industries is also rather high. However, from the tendency of industries, increasing in the water consumption and number of factories, the estimation is considered acceptable for the stage of the present study.

Table 2-4-2 Water Requirements

Item and Unit		1980	1985	1990	1995	2000	2005
Domestic Use	(1)	100	100	125	125	150	150
	(2)	848	1,602	2,503	2,966	4,159	4,806
Public Hydrant	(1)	30	30	30	30	30	30
	(2)	191	200	231	203	222	180
Sub-Total	(2)	1,039	1,802	2,734	3,169	4,372	4,986
Institutions	(2)	10	15	16	17	23	24
Industrial Facilities	(2)	223	243	278	536	590	720
Hotels, Shops & Markets	(2)	89	112	164	227	291	360
Medical Facilities	(2)	33	62	75	97	108	135
Schools	(2)	178	187	270	297	324	350
Religious Institutions	(2)	32	41	62	68	111	120
Harbour	(2)	5	8	9	12	13	15
Sub-Total	(2)	570	668	874	1,254	1,460	1,724
a. Total Water Consumption	(1)	108	109	130	145	166	176
	(2)	1,609	2,470	3,608	4,423	5,841	6,710
	(3)	19	29	42	51	68	78
b. Unaccounted-for Water b = a x 0.25	(2)	402	618	902	1,106	1,460	1,678
c. Average Day c = a + b	(1)	136	136	163	181	208	220
	(2)	2,011	3,088	4,510	5,529	7,301	8,388
	(3)	23	36	52	64	84	97
d. Maximum Day d = c x 1.25	(1)	169	170	203	227	260	276
	(2)	2,514	3,860	5,638	6,911	9,126	10,486
	(3)	29	45	65	80	105	121

Note: (1) = liter per capita per day (l/c/d)
(2) = cubic meter per day (cu m/d)
(3) = liter per second (l/sec)

Further, the Report calculated the water requirements after the present target, 1985, using the results of projection of population served and also assuming annual increments of unit consumptions and number of facilities. This concept is quite acceptable, but all these figures must be reviewed after the completion of the present project.

2-5 Water Source

The spring Mangkio is the source for the present project recommended by the existing Report. To make its suitability certain, a field survey was carried out in the present study, as described below, together with other sources in the area.

1) Mangkio Spring

The yield of the spring is enough for the present project as already stated in the section 2-2 Existing Water Supply.

As for the water quality, it is suitable for drinking as shown in Tables 2-5-1 and 2-5-2. With this regard, it was hinted but not verified at the time of field investigation, that the spring water would sometimes get a little turbid after heavy rains. Although all the analyses do not indicate any sign of contamination, it is advisable to check regularly the quality of the spring water for some time.

Another matter to be noted about the water quality is its content of carbon dioxide. It contains over 20 mg/l of carbon dioxide, which seems to have accelerated deterioration of pipelines.

2) Other Water Sources

There are a fair number of springs, in addition to the spring Mangkio, used by the inhabitants for domestic purpose. But they are mostly less in yield and more inconvenient for use of water supply. Therefore, all these may be used by inhabitants nearby but not for the present project.

Table 2-5-1 Analytical Results of Water Quality

I t e m	Unit	Mangkio Spring	
Date, Time		1979*	2-4-80**
		-	8:30
Weather		-	fine
Atmospheric Temperature	^{o}C	-	28
Water Temperature	^{o}C	-	25
Color as Pt.Co.	Unit	10	0
Turbidity	FTU	2	1
pH		7.3	7.2
Alkalinity as CaCO3	mg/l	245	180
Total Hardness as CaCO3	mg/l	$7.16^{o}D$	370
Chloride as C12	mg/l	4.75	12
Total Iron as Fe	mg/l	0.0	less than 0.1
Coliform Groups	/100 ml	-	negative
Total Bacteria	/ml	-	15
Ammonia-N as NH4	mg/l	-	less than 0.2
Aggressive CO2 as CO2	mg/l	24	28

* quoted from the existing Report

** tested by the Study Team

Table 2-5-2 Water Quality Standard
(WHO and Indonesian Standards for Drinking Water)

Item	Unit	WHO Standards		Indonesian Standards	
		Recommended Limit	Acceptable Limit	Permissible Value	Maximum Permissible Value
Color as Pt.Co.	unit	5	50	5	50
Turbidity	FTU	5	25	5	25
Total Solids	mg/l	500	1500	500	1500
pH		7 - 8.5	6.5 - 9.2	-	6.5 - 9.2
Detergents	mg/l	0.2	1.0	-	-
Mineral Oil	mg/l	0.01	0.3	-	-
Phenol	mg/l	0.001	0.002	-	-
Total Hardness (as CaCO3)	mg/l	100	500	-	5 - 10 (1)
Calcium as Ca	mg/l	75	200	75	200
Magnesium as Mg	mg/l	30	150	30	150
Chloride as Cl2	mg/l	200	600	200	600
Copper as Cu	mg/l	0.05	1.5	0.05	1.5
Total Iron as Fe	mg/l	0.1	1.0	0.1	1.0
Manganese as Mn	mg/l	0.05	0.5	0.05	0.5
Sulfates as SO4	mg/l	200	400	250	-
Zinc as Zn	mg/l	5	15	5	15
Coliform Groups	/100 ml	negative	-	negative	-
Total Bacteria	/100 ml	10	-	100,000	-

Note : (1) German System of Degrees of Hardness (^{o}D)

Source : Indonesian Standard from Departemen Kesehatan R.I.

2-6 Water Treatment

The existing Report has proposed the following work concerning water treatment (Refer to Appendix C).

- Treatment facilities to decrease carbon dioxide (CO_2) content and chlorinate and neutralize.

The proposed method to remove CO_2 is to feed lime, which would form an insoluble compound reacting on the dissolved CO_2 according to pH value of water. As far as its effectiveness in removing CO_2 is concerned, it is useful, but if this method should be employed, sedimentation or filtration facilities, as well as constant supply of lime, would probably be needed. In addition, the operation is not necessarily easy.

To overcome, therefore, these shortcomings of the proposed lime method and economize the construction cost, the Study Team made an experiment of aeration to remove it. As a result thereof it was found that the concentration of carbon dioxide 28 mg/l decreased to as low as 5 mg/l in 4 minutes. The method employed in the field was to stir the water for the purpose of aeration instead of the lime method proposed by the existing Report, because it is simpler and less expensive.

Regarding chlorination and neutralization, it is appropriate to practice chlorination by calcium hypochlorite as a preventive measure against water-borne diseases, although the water does not have any contamination. Neutralization is unnecessary, because the water is not acidic, and besides pH value of the water becomes alkaline by the aeration.

2-7 Future Water Supply System

The following are the works proposed by the existing Report to extend the supply capacity of the present project along with the increase of water demand :

a. Expansion of the water treatment plant together with the intake pipe.
b. Expansion of the distribution networks.
c. Expansion of the storage capacity.

The concept of the water supply system expansion proposed by the existing Report is considered reasonable and adequate as a whole, that is, to expand the water supply system with the water source from the spring Mangkio. But with regard to the two items of work, a. Expansion of the treatment plant and c. Expansion of the storage capacity, the concept can, in the opinion of the Study Team, be modified as stated below.

The present study has already proposed the treatment of water by aeration instead of the treatment method by lime proposed by the existing Report. For the future extension project, the aeration method will also be applicable.

Regarding the storage capacity, the present study has proposed no service reservoir, because the spring yield is available in quantity more than the peak hour demand. Unless the peak hour demand surpasses the spring yield in the future, there is no need to construct a service reservoir.

As regards the distributon networks, the peak hour factor presently employed should be checked upon after the completion of the present project. If deemed necessary, the peak hour factor should be revised accordingly and then applied to the planning of the expansion work.

III. REVIEW OF DESIGN CRITERIA AND PRELIMINARY DESIGN

3-1 Design Criteria

The existing Report contains all design criteria required for the water supply facilities for 1995. The design criteria are in compliance with the current engineering practice in Indonesia and the guidelines prepared by Cipta Karya. They are, by the review of the Study Team, found acceptable for the present project except the water treatment by lime for removing CO2 and other very minor points. The design criteria proposed in the Report are as follows:

1)	Treatment capacity	: for maximum daily requirement
2)	Intake pipe	: for maximum daily requirement
3)	Distribution pipe	: for peak hour demand
4)	Secondary mains	: for peak hour demand
5)	Velocity of flow	: 0.8 to 3 m/sec
6)	Residual pressure	: for primary mains 2 kg/sq cm for secondary mains 1.5 kg/sq cm
7)	Pressure	: maximum static pressure 75 m minimum residual pressure 15 m
8)	Friction factor	: C=120 for new pipe in Hazen-Williams formula
9)	Pipe size	: minimum diameter 75 mm
10)	Pump efficiency	: 75 %
11)	Consumption	: for direct connection 100 - 150 l/c/d for public hydrant 30 l/c/d, with 250 - 125 persons per hydrant
12)	Reservoir	: capacity 1,000 cu m

Out of all items enumerated in the above para, items for which revisions are proposed by the present study are as follows :

1) Method to remove CO2. As already described in the section 2-6 Water Treatment, an alternative treatment method, i.e., removal of CO2 by aeration, is proposed here, as it is found effective as well as simpler and less expensive.

2) No reservoir is proposed here, because peak hour demand is within the yield of the spring, so that there is no need to store water to cover the peak hour demand.

3) Intake pipe should be designed based on the peak hour demand.

3-2 Preliminary Design

As previously stated, the existing Report conducted preliminary designs based on the following contents,

a. Installation of a new pipeline network together with taps.
b. Treatment facilities to decrease CO2 content and chlorinate and neutralize.
c. Improvement of the intake facilities, and installation of measuring device and protection of the spring area.
d. Replacement of transmission pipes.
e. Construction of a reservoir.

Item b treatment facilities was already discussed in the preceding section 2-6 Water Treatment, where the aeration method was proposed.

Regarding the other items of work, the present study proposes as follows :

a. Design of the pipelines be made to meet the requirement in 1985. The value for 1985 is shown in Table 2-4-2 Water Requirements, that is, 3,860 cu m/d.
b. The existing collection chamber is still usable and no improvement work is needed. The measuring device be installed at the starting point of the distribution line. And a fence be built to protect the spring area.
c. A transmission pipeline, from the collection chamber to the aeration facility be newly installed.

Dimensions, structural features, etc. of the major facilities prepared by the present study are as follows and Fig 3-2-1 shows the proposed water supply system.

1) Transmission Pipeline

From the collection chamber to the aeration facility.

Material : DCIP or GSP

Length : Ø 300 x 100 m

2) Aeration

Made of reinforced concrete and hollow brick as shown in Fig 3-2-2.

Aeration method : Coke tray

Number of tray : 6 trays

Area of each tray: 4 sq m

3) Solution Tank of Calcium Hypochlorite

Material : Fiberglass

Conpornent: 2 solution tanks with capacity 200 liter together with a feeding device.
Solution tank to be equipped with a stirrer.

4) Distribution Pipelines

Material : DCIP/ACP/PVC

Length : Ø 300 x 300 m
Ø 200 x 3200 m
Ø 150 x 1800 m
Ø 100 x 1200 m
Ø 75 x 750 m

5) House Connection and Public Hydrant

Fig 3-2-3 shows a sketch of typical public hydrant

Number of house connection : 2,500 units

Number of public hydrant : 33 units

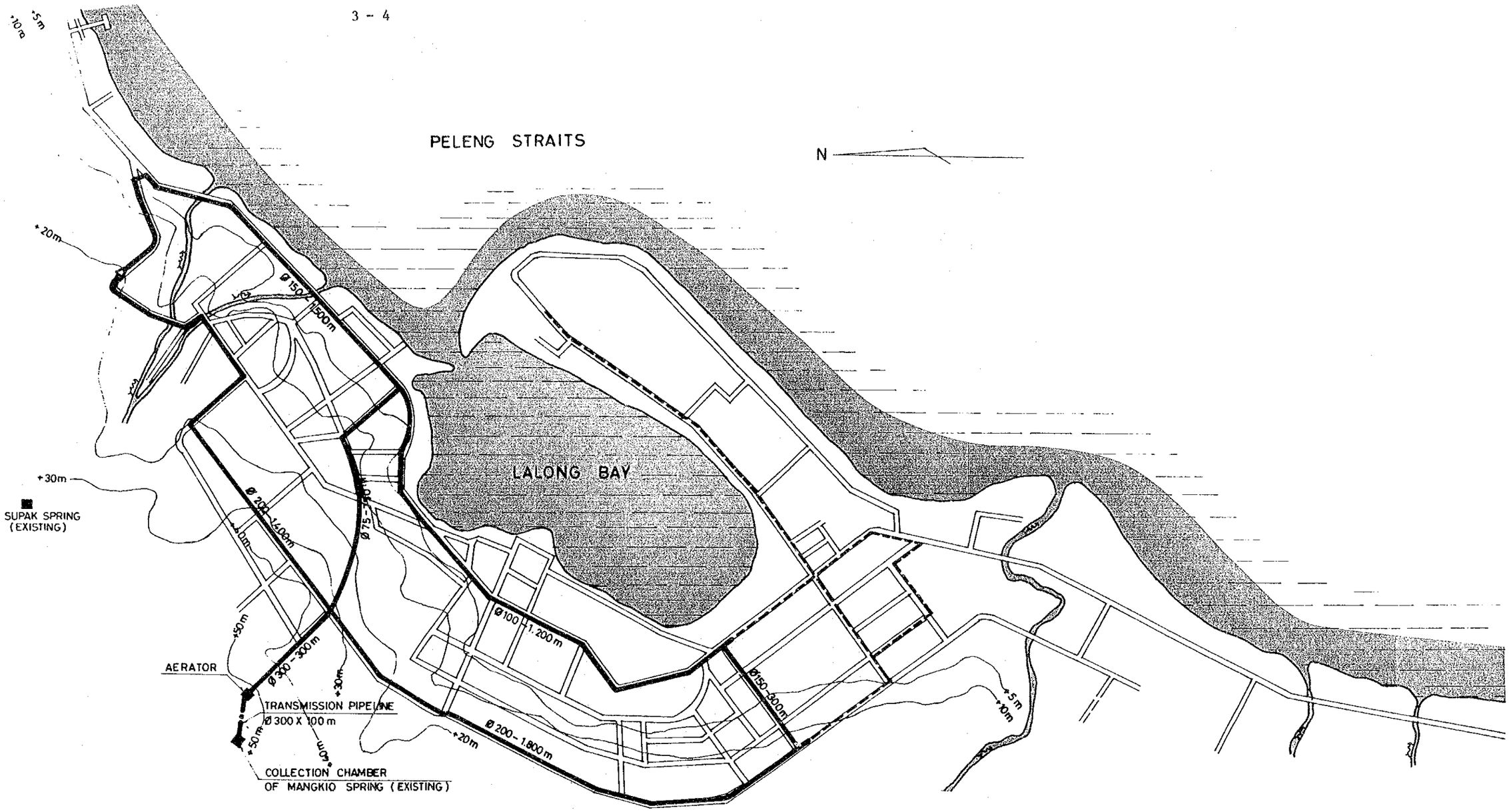
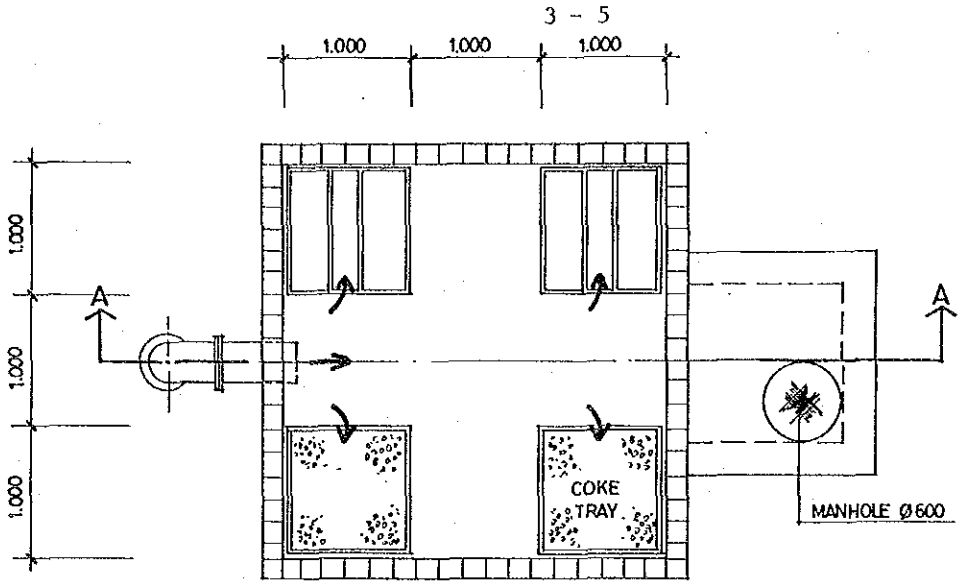


FIG. 3-2-1 PROPOSED WATER SUPPLY SYSTEM 1 : 10.000



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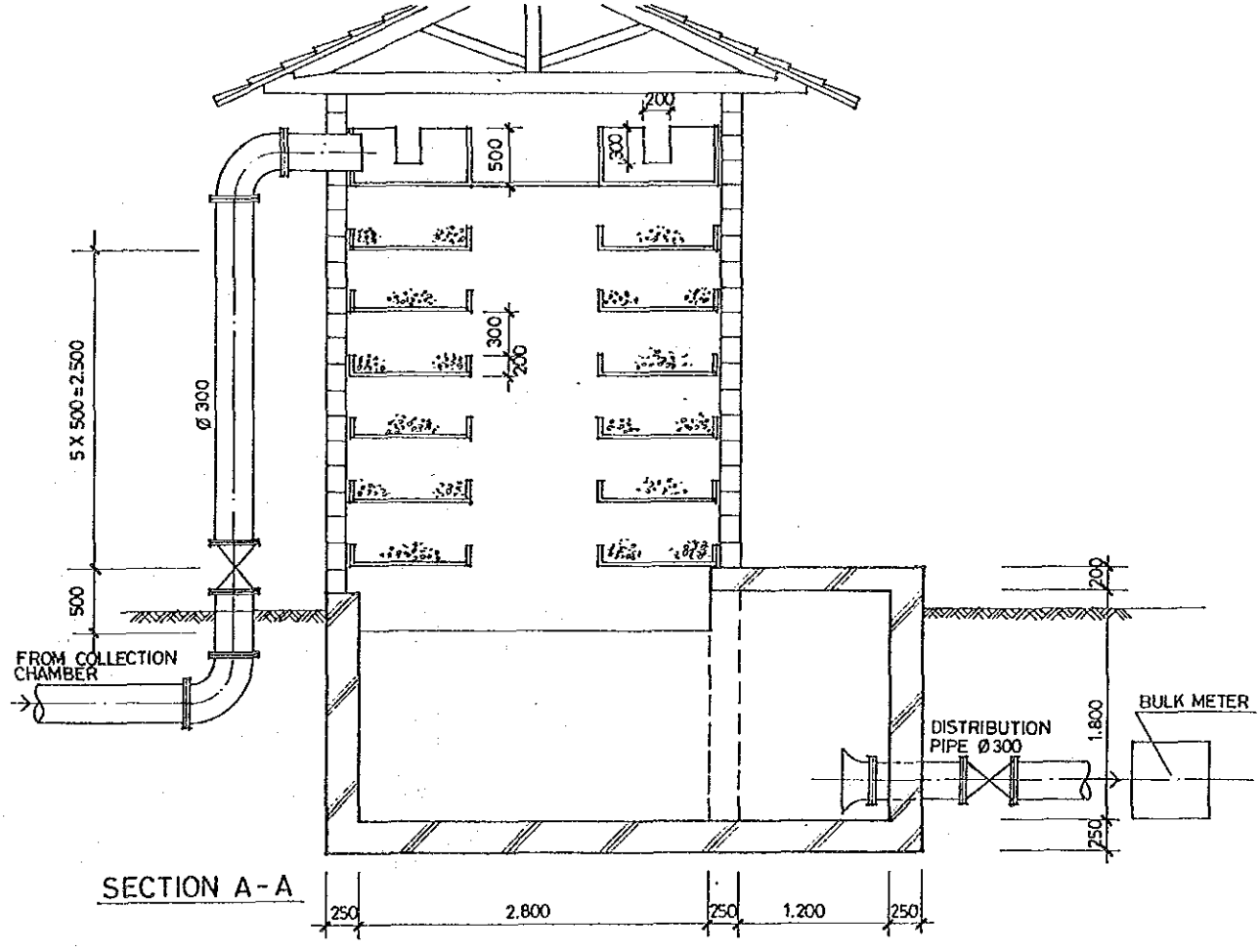
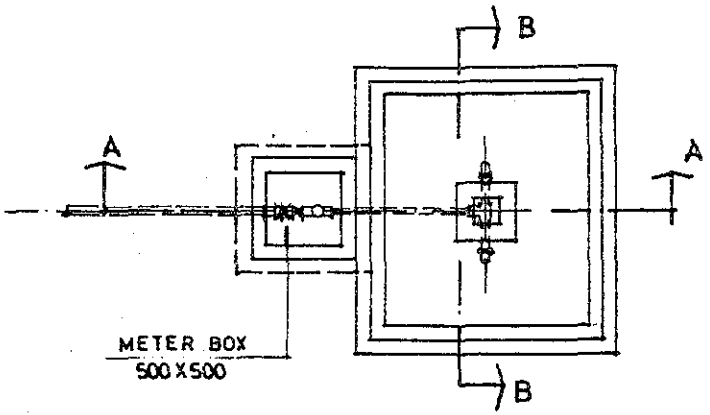


SECTION A-A

FIG. 3-2-2 COKE TRAY AERATOR 1 : 50



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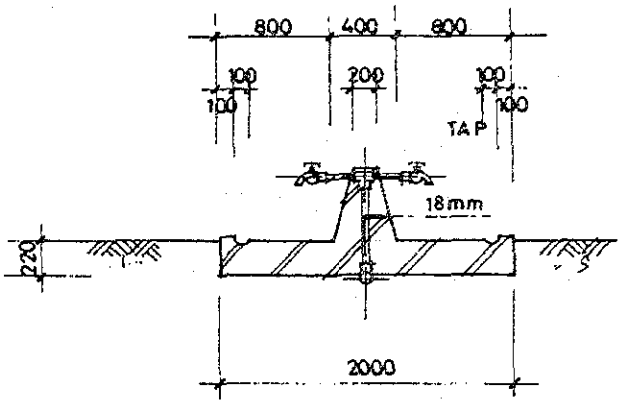
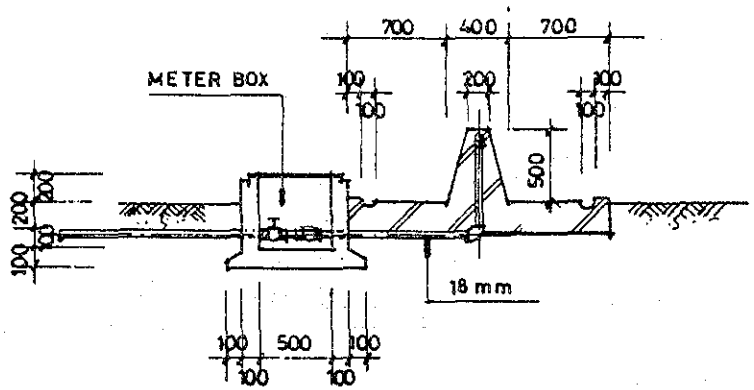


SECTION B-B



SECTION A-A

FIG. 3-2-3 TYPICAL PUBLIC HYDRANT 1 : 50

IV. REVIEW OF COST ESTIMATE AND IMPLEMENTATION SCHEDULE

4-1 General

The existing Report made a cost estimate for the construction work of the project. As this review of the said Report has proposed some revisions in work, as described in III Review of Design Criteria and Preliminary Design, a subsequent cost estimate is made as presented in the following paragraphs. In connection with the cost estimate, considerations are given to some factors which have relation to the costs, as described below. Further the implementation schedule for the project is prepared with the target of start-up of the project within 1982.

4-2 Considerations on Construction-related Matters

In view of the importance of availability of labor, materials, etc., all matters related to construction have been studied in the field. Luwuk is situated at a strategic point for sea transport, having direct connection with Manado and Ujung Pandang of Sulawesi, and Jakarta, Surabaya and others of other islands, and besides it has a good seaport. Although Luwuk is rather handicapped in land transportation, the convenient sea transportation gives more advantage than enough.

1) Contractors and Labor

With regard to contractors and suppliers, a complete list of them is provided by the central and local governments. The list covers all the specialities and capabilities so as to be selected for any type of work. Skilled labor is generally provided by the contractor recruited from other cities, and unskilled labor is available in the locality.

2) Materials

Aggregates for concrete work are locally available, and cement will be supplied by the local cement manufacturer. Pipes and fittings, both domestic and imported, are available from Jawa. The transportation charges from Jawa to Luwuk amount to about 15% in average.

4-3 Construction Cost

Table 4-3-1 shows the estimated construction costs (The breakdown of estimated construction costs is attached in Appendix D). All the unit costs employed are those as of May 1980, which are obtained from projects now under construction in Indonesia similar to the present project. For the costs in 1982, when the project is to be executed, an escalation of 15% per annum and a contingency of 20% are provided. In addition to the above, engineering cost for detailed design including some supplemental surveys, construction supervision, etc. is provided with an allowance 8% of the construction cost plus escalation and contingency. Table 4-3-2 shows the estimated project costs including all the above.

4-4 Implementation Schedule

The implementation schedule for the project is shown in Fig 4-4-1 prepared taking into consideration the target of project completion set by Cipta Karya, namely, the commissioning of the project within 1982. In preparing the schedule, all the requirements for time and procedures in financing, tendering, construction, etc. are duly considered.

It should, however, be noted that the implementation schedule has been prepared assuming that the financing for the project would be decided within this calendar year. Therefore, if not, the implementation schedule is subject to change, at a later date, according to the decision of financing by the agencies concerned.

Table 4-3-1 Estimated Construction Cost

Rupiahs 1,000

Item	Foreign Exchange	Local Currency	Total
1. Transmission Pipeline			
Ø 300 x 100 m	Rp 50.1/m 5,010	Rp 11.0/m 1,100	6,110
2. Aeration	-	lump sum 3,441	3,441
3. Distribution Pipeline			
Ø 300 x 300 m	Rp 39.1/m 11,730	Rp 12.2/m 3,660	15,390
Ø 200 x 3,200 m	Rp 23.3/m 74,560	Rp 10.4/m 33,280	107,840
Ø 150 x 1,800 m	Rp 13.1/m 23,580	Rp 8.1/m 14,580	38,160
Ø 100 x 1,200 m	Rp 6.9/m 8,280	Rp 6.7/m 8,040	16,320
Ø 75 x 750 m	Rp 4.0/m 3,000	Rp 5.0/m 3,750	6,750
4. Bulk Meter			
Ø 300 x 1 piece	4,350	900	5,250
5. Water Meter			
Ø 13 x 2,500 pieces	Rp 17.0/piece 42,500	Rp 1.7/piece 4,250	46,750
6. Public Hydrant			
Ø 18 x 33 pieces	Rp 30.0/piece 990	Rp 303.0/piece 9,999	10,989
Total Cost	174,000	83,000	257,000

Table 4-3-2 Estimated Project Cost

(1)

Rupiahs 1,000,000
U.S. Dollars 1,000

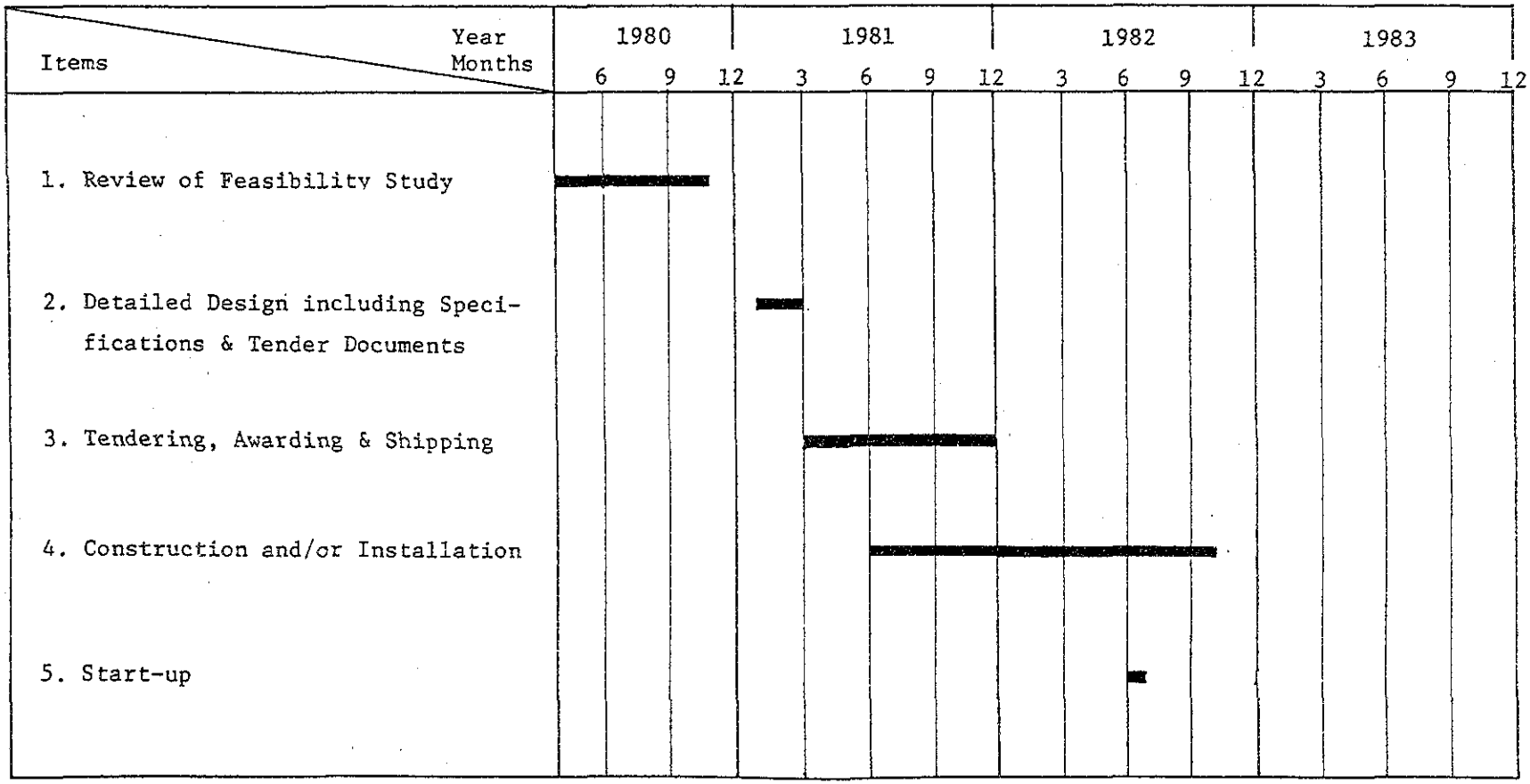
Items	Foreign Exchange	Local Currency	Total Cost
a. Construction Cost (2)	174 277	83 132	257 409
b. Escalation (3) (a x 32.25%)	56 89	27 43	83 132
c. Sub-total	230 366	110 175	340 541
d. Contingencies (c x 20%)	46 73	22 35	68 108
e. Sub-total	276 439	132 210	408 649
f. Engineering Services (e x 8%)	11 17	22 35	33 52
Total Cost of Project	287 456	154 245	441 701

Note : (1) Currency equivalent : US$ 1 = Rp. 629

(2) Construction cost is calculated based on the prices as of May 1980.

(3) The escalation is considered as 15% annually each for years of 1981 and 1982.

Fig 4-4-1 Implementation Schedule



V. REVIEW OF FINANCIAL STUDY

5-1 General

The existing Report has a detailed financial study in compliance with its engineering planning. This detailed financial study was worked out with the condition that the target year would be in 1995, and that the capital cost would be covered 50 per cent by subsidy and another 50 per cent by a loan from the central government. As the planning by the Report has been revised in the present study, the financial feasibility will be studied over again hereinafter in line with the presently proposed works and the funding conditions as described in the following sections.

The study will be conducted in the following manner, that is, firstly the fund requirements and fund sources will be described, secondly financial feasibility will be examined under the conditions that the government is to provide a full grant to the project, and finally the water tariff system to be set up will be studied together with the checking of the paying ability of the consumers.

5-2 Funding Requirement

Funds required for construction of water supply facilities are summarized in Table 4-3-2 Estimated Project Costs. Total cost necessary to implement the project is Rp. 441 million or US$ 701,000 based on the prices as of May 1980. As the construction of the facilities is considered to initiate in 1981, escalation of 15% is assumed for the years of 1981 and 1982. For contingencies, 20% is also assumed. It should be noted that in determining unit costs of goods and materials to be employed for calculation of the capital cost, local conditions of Luwuk are duly taken into consideration.

5-3 Source of Financing

As a source of financing for the present project, the Government of the Republic of Indonesia considers to receive a loan from external sources to cover the foreign component of the capital cost. The Goverment, however, intends to construct the facilities on full grant basis in accordance with the policy envisaged in PELITA III. That means that all construction cost will be borne by the Government and after construction the facilities will be turned over to the local government.

For operation and maintenance, principally the water enterprise should pay the cost by the revenue generated from water sales. However, in case the enterprise cannot afford to pay, the cost will also be met by the grant from the Government for the first 2-year operation of the facilities.

5-4 Financial Feasibility

As described in the preceding section, this project is linked with the PELITA III of the Government, and within which the Government has planned to provide water supply facilities to small and medium sized towns in Sulawesi with its policy of allocating capital costs needed for construction of the facilities in the form of grant. As this is the case, the review of financial condition of the water enterprise is focussed on whether or not the enterprise can pay the costs of operation and maintenance. The financial projection is, therefore, worked out to check the financial condition of the water enterprise with comparison of cost and revenue.

Table 5-4-1 shows projected Income Statement and Table 5-4-2 shows projected Cash Flow. The Statements indicate the financial condition of the Water Enterprise from 1983, the year of the expected operation of the facilities, and six years thereafter. The revenue of water sales are projected from the yearly water quantity of water sales times the proposed water rate which is worked out considering the costs of production and consumers ability, as described in Section 5-6. The costs of operation covers costs of personnel

Table 5-4-1 Income Statement

(Rp 1 million)

	1983	1984	1985	1986	1987	1988
Water Production (m^3/year)	919,508	1,023,314	1,127,120	1,230,926	1,334,732	1,438,538
Water Sales (m^3/year)	735,402	818,476	901,550	984,625	1,067,098	1,150,772
Percentage Sales to Production (%)	80	80	80	80	80	80
Revenue Water Sales (1)	22.9	24.9	26.9	29.0	31.0	33.0
Other Fees	6.9	0.3	0.3	0.3	0.3	0.3
Total Billing	29.8	25.2	27.2	29.3	31.3	33.3
Less Provision for Bad Debt	0.6	0.5	0.5	0.6	0.6	0.6
Total Revenue	29.2	24.7	26.7	28.7	30.7	32.7
Operation Cost	26.5	27.3	28.2	29.1	30.1	31.1
Net Income (Deficit)	2.7	(2.6)	(1.5)	(0.4)	0.6	1.6

Note : (1) Water sales are based on water rate structure

Table 5-4-2 Cash Flow

(Rp 1 million)

	1983	1984	1985	1986	1987	1988
Sources of cash						
Net income	2.7	(2.6)	(1.5)	(0.4)	0.6	1.6
Depreciation	9.9	9.9	9.9	9.9	9.9	9.9
Government grant	441					
Total	453.6	7.3	8.4	9.5	10.5	11.5
Application of cash						
Capital expenditure	441	-	-	-	-	-
Total	441	-	-	-	-	-
Net cash inflow (outflow)	12.6	7.3	8.4	9.5	10.5	11.5
Cash at beginning	-	12.6	19.9	28.3	37.8	48.3
Cash at end	12.6	19.9	28.3	37.8	48.3	59.8

salary, maintenance and operation, chemical and office operation. For Luwuk, depreciation of the constructed facilities is considered to be included in the expenditure items. Detail description of assumptions for financial projections is given in Appendix E, in the present Report.

As can be seen in the table, the revenue is equally balanced with expenditure during six years period. Considering, however, that the cost items include depreciation, the financial condition of the Enterprise is not all bad, and it can be said that the business is operational.

5-5 Water Rates

The proposed water rate to be applied to Luwuk is worked out considering the production cost and also paying ability of consumers. Table 5-5-1 shows the water rates for different consumers in accordance with uses of water. It is to be noted that the water rate has been set rather low as Rp. 20 for residential class with usage up to 15 cu m/m. This is because, i) the population served is rather high, ii) percentage of sales to production is also high as the 90 % of total population is within the served area, and iii) willingness of people to apply for connections seems to be high. Design of proposed water rate is given in Attachment I) of Appendix E.

Table 5-5-1 Water Rates

in Rp.

Block	Residential	Commercial	Industrial	Social	Public Hydrant
0 - 15 cu m/m	20	40	60	16	16
15 - 30 cu m/m	30	40	60	24	16
In excess of 30 cu m/m	60	80	100	32	16

5-6 Ability of the Consumers to Pay for Water

The average income of consumers who are expected to receive water by the present project is checked to know the ability of consumers to pay for water. According to the survey, the average monthly income of consumers is about Rp. 38,000.

According to the policy of the Central Government, water rate is recommended to be arranged under 4 % within the average monthly income of consumers. In the case of Luwuk, the average monthly income of consumers were found to be about Rp. 38,000, so it will be appropriate if the monthly payment is determined below Rp. 1,520 per month. It is believed that a consumer consisting of six persons will use about 20 cu m per month. In this case the average monthly water charge to be borne by this consumer will be Rp. 450. This means that the charge is far less than Rp.1,520 per month and is within the ability to pay for water.

VI. REVIEW OF ORGANIZATION

6-1 General

This Chapter deals with an organization to be established in Luwuk, in accordance with the water supply system proposed to be constructed for the target year 1985.

Although Luwuk has presently a water supply system, it does not have an independent organization to manage water business and to maintain and operate facilities. The present system is operated by the section of public works under the local government (Dinas Pekerjaan Umum Daerah Kabupaten Banggai Luwuk). This means that water supply activities are handled together with other general civil works activities. Because of this situation, responsibility of water supply and personnel arrangement are not necessarily clear-cut. Along the implementation of the present project, a suitable organization should be set up.

6-2 Recommended Organization

The existing Report has proposed the organization for the body of water supply enterprise for the target year of 1995 based on the principle directed by Cipta Karya as shown in Fig 6-2-1. As the target year of a fairly long term, the proposed organization is not necessarily adequate and not practical for the present project. With establishing a most suitable organization in mind, the proposed organization is reviewed so as to fit for the target year of 1985 and attain sound and efficient management of water enterprise.

The recommended structure of organization is presented in Fig 6-2-2, which was adjusted according to size of the water supply business and local features of Luwuk. As is shown in the Fig the water enterprise has two units, 1) Finance and Administration, and 2) Technical. Finance and Administration unit will be responsible for routine bookkeeping and billing and collection including meter reading. Technical unit will be responsible for maintenance and operation of water supply facilities including water treatment and distribution facilities.

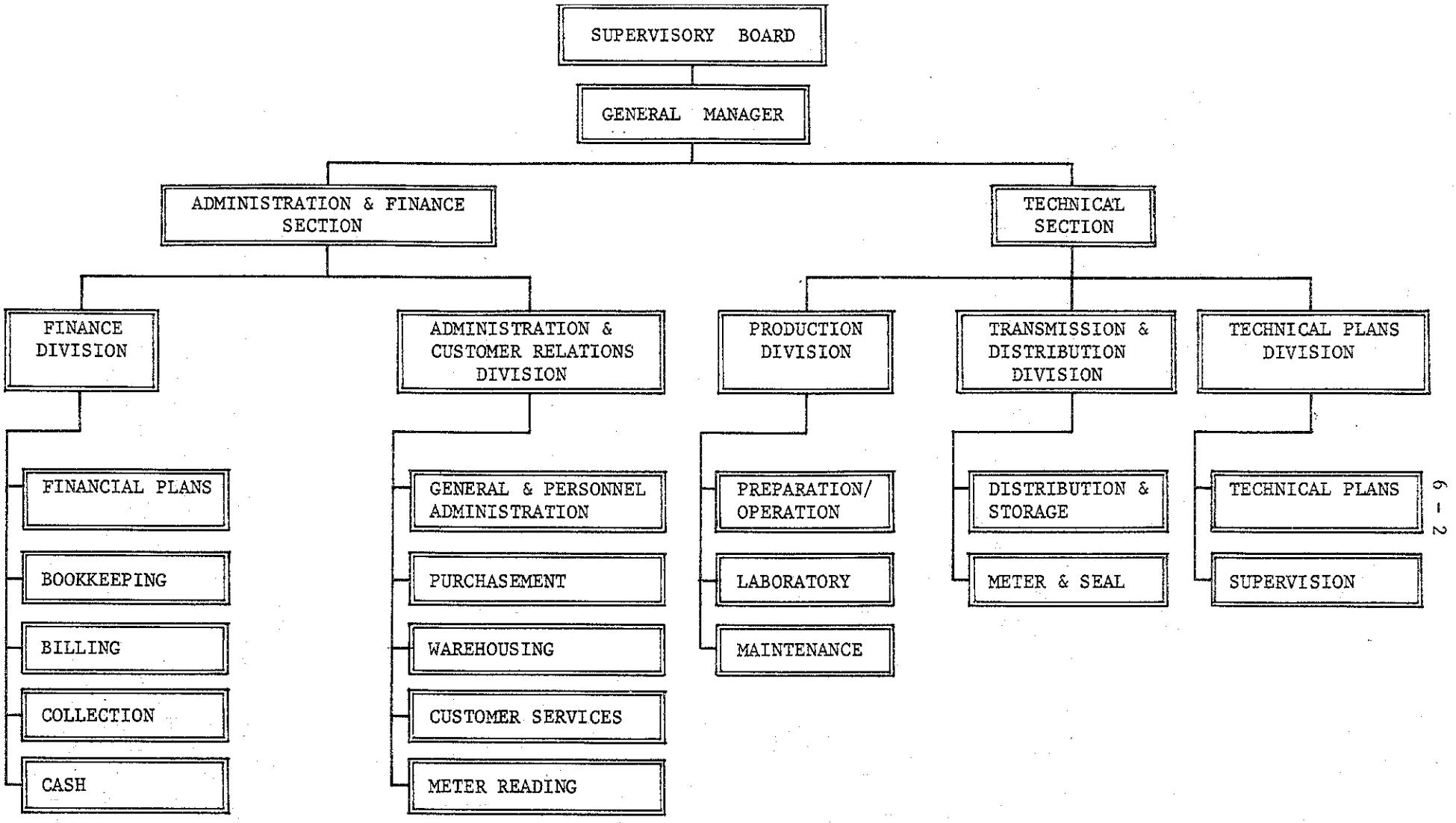


Fig 6-2-1 Organization Structure Recommended by the existing Report

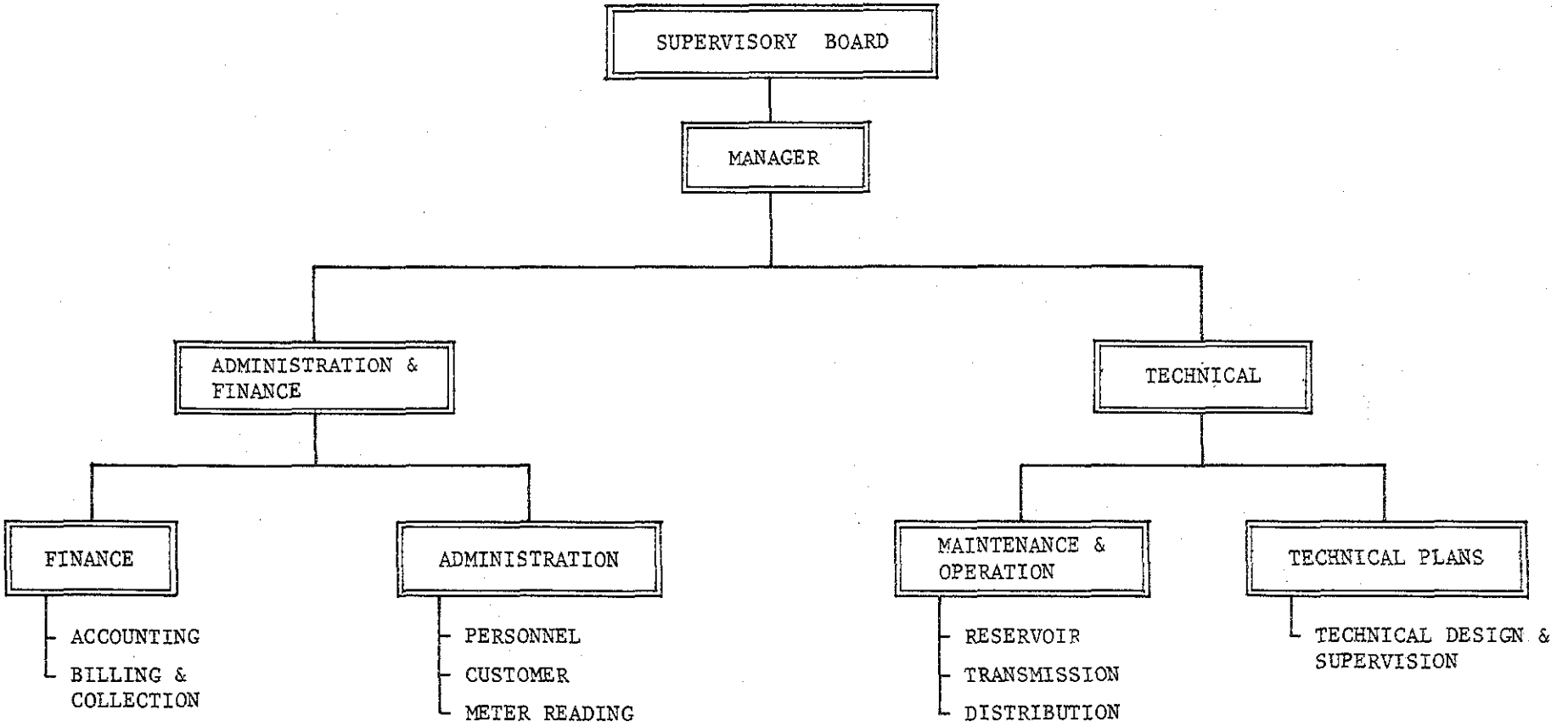


Fig 6-2-2 Proposed Organization Chart for Luwuk Water Enterprise

6-3 Staffing Schedule

Necessary number of personnel required for conducting water supply activities is studied considering the scale of Luwuk water supply and the target year of the present project. The staffing schedlue is shown in Table 6-3-1. The number of personnel is kept minimum to the extent possible.

6-4 Transient Measure in the Initial Stage of Operation

In the initial of the project operation, it is advisable for Cipta Karya to provide some experienced personnel under an appropriate organization for the purpose of breaking-in of all staff and personnel of the new organization. Along with this, Cipta Karya is also recommended to assist in employing such manpower, if possible, experienced persons for the new organization.

Table 6-3-1 Staffing Schedule for Luwuk Water Enterprise

Description	1981	1982	1983	1984	1985
Manager	1	1	1	1	1
Secretary/Typist	1	1	1	1	1
Sub-total	2	2	2	2	2
Tecnical					
Head	1	1	1	1	1
Maintenance & Operation	-	-	5	5	5
Foreman	-	-	5	5	5
Technical Plan	1	1	1	1	1
Sub-total	2	2	12	12	12
Administration & Finance					
Head	1	1	1	1	1
Accounting	-	-	2	2	2
Bookkeeping	-	-	2	2	2
Billing & Collection	-	-	3	3	3
Meter Reading	-	-	3	3	3
Sub-total	1	1	11	11	11
Total	5	5	25	25	25

VII. EVALUATION OF THE PROJECT AND RECOMMENDATIONS

7-1 Evaluation of Merits of the Project

Luwuk has a favourable natural environment with water, scenic beauty, sea transportation, etc., but from the standpoint of public health is not in a satisfactory condition. The expansion of the public water supply will become a motivation for overall improvement in not only public health but also all other public utilities including public education on the mental aspect, as described below.

1) Decrease or Elimination of Gastroenteric Diseases
As already stated, there are many incidences of gastroenteric disease in Luwuk. The major cause, among others, is believed the use of unhygienic water for drinking, cooking and washing. Although there is plenty of safe water from the springs, numerous people of Luwuk are using such unhealthy water because of insufficient water supply capacity. Once the present project is completed and all people are able to take the safe water, the gastroenteric diseases will decrease and eventually be eliminated.

2) Overall Decrease of Disease Incidences
Not only the gastroenteric disease, mentioned in 1), but other diseases can be expected to decrease, as experienced in other cities with water supply, thanks to the use of clean water for drinking, cooking, washing, etc. And this event of the water supply system installation can be made an opportunity for health improvement campaign of the public, as recommended in 7-2 6).

3) Alleviation of Hard Labor for Water Carrying
Water carrying is the task of women and children. They will be liberated from the hard labor of water carrying. And the time and energy for such work can be utilized for other useful purpose.

4) Low Construction Cost and High Percentage of Population Served
Most outstanding benefits of the present project are that the percentage of population to be served is quite high, and the construction cost is unusually inexpensive. This is attributable to the fact that the population of Luwuk is densely concentrated in the kota area, and the location of the water source is quite close to the water consuming area, in addition, the source having good water quality and a proper elevation. All these result in a low water tariff.

7-2 Recommendations

The following will be recommended to secure for the consumers as clean water as possible and to realize a healthy living environment taking advantage of the water supply facilities.

1) Metering and Thorough Maintenance
Metering must be practiced for two purposes, namely, to prevent wasteful use and to change the consumers on a fair basis. And when the revenue from the water sales is secured, thorough maintenance of all the water supply facilities can be made and should be performed. In view of the existing facilities, it is most essential.

2) Rehabilitation of Pipelines
In Luwuk there are not-working distribution pipelines due to insufficiency of the supply capacity and deterioration of pipe. When the new network of pipelines has been completed, most of the out-of-use pipelines can restore the original function with some rehabilitation work. It is, therefore, recommended to execute at an earliest possible opportunity such rehabilitation work to give the people maximum possible benefits of the project.

3) High Growth Rate of Population

In the population statistics of Luwuk, some years with abnormally high growth rates are observed. Causes for this have not been ascertained by the present study. As the growth rate, together with the distribution of increased population, is an essential factor for planning the future extension work, it is recommended to regularly review the following.

- How many population have moved in to Luwuk, and where they have settled.

By analysis of the above data, together with review of the city master plan, both future population to be served and works to be carried out will be determined.

4) Observation of the Water Quality

As far as the investigation of the Study Team and the existing data of water analysis are concerned, the water quality of the spring is safe and suited for drinking purpose. But unverified information says that the spring water gets sometimes slightly turbid. Therefore, it is recommended that regular testing of the spring water be carried out including all tests of physical, chemical and biological aspects.

5) Utilization of Surplus Water of the Springs

After taking the necessary amount of water from the spring, there is still plentiful surplus of water. It is advisable to use this water for flushing ditches in the built-up area. By doing so, the ditches may be kept clean, for the improvement of the living environment.

6) Public Education and Health Compaign

Sole improvement of drinking water, though essential, can not accomplish the target of solving all the environmental problems. To attain the objective, it is indispensable to draw the attention of the public to unhygienic conditions of domestic water, waste water, garbage, etc., and lead all the efforts of the public to elimination of such conditions.

7) Water Supply Facilities of the Supak Spring

The existing facilities of the Supak spring has been used for exclusive use of certain establishments, and they will also be used in the future, taking advantage of the location and the yield of the spring. As there is a possibility of contamination due to the exposed transmission conduit, it is recommended that the intake facilities be reformed similarly to that of the Mangkio spring.

APPENDIX A

CONSIDERATION ON

POPUALTION PROJECTION IN THE REPORT

1. General

In this text, firstly, the method employed in the existing Report will be introduced. Secondly, several kinds of equations which are all widely used for water supply planning will be presented. Each equation has parameters. These parameters will be determined employing the least mean square method. From these equations future population will be calculated so as to know the range of distribution of the projected population. Finally, some comments by the Team on the projected population in the said Report will be given.

2. Population Projection in the Existing Report

For population projection, the Report employed some common methods and projected in unique process. Hereunder, the methods employed as well as process and results of projection are introduced quoted wholly from the Report.

III. POPULATION AND SOCIAL ECONOMY

III.01. STATE OF POPULATION

III.01.01. TOTAL POPULATION

The total population of Kota Luwuk at present (1977) is 18,019 persons. Population growth of Kota Luwuk from 1968 to 1977 is shown in Table III-01.

TABLE III-01

JUMLAH PENDUDUK KOTA LUWUK

TAHUN 1968 - TAHUN 1977

TAHUN	JUMLAH PENDUDUK (ORANG)	PERTAMBAHAN %
1968	12,148	0.8
1969	12,246	0.81
1970	12,345	4.87
1971	12,946	6.46
1972	13,782	5.06
1973	14,479	5.77
1974	15,314	4.03
1975	15,922	6.12
1976	16,897	6.64
1977	18,019	

Sumber: * Kantor Kecamatan Kota Luwuk.
* Kantor Sensus & Statistik DATI II Banggai.

In the table it is known that during 1980 - 1971 a significant increase of population took place. It was caused by the expansion of kota with inclusion of kampungs Maahas and Simpong as the kota area in 1970, and since then school and university have been opened, which is enough to bring about urbanization of kota Luwuk attracting people in the neighborhood.

As is clear in the above, the population growth in the table for the years 1968 and 1969 is confusing to use it as basis for calculation of the percentage of population growth. Hence, for calculation of the percentage of population increase before 1977, the totalized population from 1970 to 1977 is adopted. By doing so, the yearly increase is calculated as 5.56% in average.

This increase is fairly high compared with that of Kabupaten Banggai, that is 2.8%. From this condition, it is concluded that in addition to the natural growth, there is an increase of population from outside districts to Kota Luwuk.

Distribution of population of kota Luwuk based on grouping by sex is shown in Table III-02.

Table III-02

DISTRIBUSI PENDUDUK KOTA LUWUK BERDASARKAN JENIS KELAMIN

	NAMA DESA	LAKI-LAKI	PEREMPUAN	JUMLAH
1.	Desa Luwuk	2,188	2,133	4,321
2.	Desa Maahas	596	593	1,189
3.	Desa Simpong	1,439	1,379	2,818
4.	Desa Kampung Baru	1,739	1,463	3,202
5.	Desa Soho	1,359	1,171	2,530
6.	Desa Bungin	2,018	1,941	3,959
	J u m l a h	9,339	8,680	18,019

* Kantor Kecamatan Kota Luwuk.

On the other hand, population of kota Luwuk based on grouping by age is shown in Table III-03.

Table III-03

JUMLAH PENDUDUK BERDASARKAN UMUR TAHUN 1977

NAMA DESA	JUMLAH PENDUDUK					
	0-4	5-14	15-24	25-54	55 KEATAS	TOTAL
Desa Luwuk	1,011	1,711	531	778	290	4,321
Desa Maahas	112	206	256	344	271	1,189
Desa Simpong	552	907	562	659	138	2,818
Desa Kampung baru	278	551	785	1,178	410	3,202
Desa Soho	291	455	587	969	228	2,530
Desa Bungin	483	926	669	1,382	499	3,959
J u m l a h	2,727	4,756	3,390	5,310	1,836	18,019

* Sumber: Kantor Sensus dan Statistik Biro Pusat statistik Luwuk.

Further, if potential labor force, namely people of age 15 to 45 is computed, the number thereof in the kota is 8,700 persons or 48.3%, where 4,239 persons do not work, 2,527 persons are wives and 1,479 persons are still in education. In the above figures there are 300 - 400 persons who have no regular livelihood.

III.01.02. PLANNING MAXIMUM DEVELOPMENT IN PROJECT AREA

In the Project area which is intended here to have a maximum development plan, the maximum area development for Kota Luwuk Master Plan up to 2000 is 410.8 ha in area, with a population density planned as 140 - 150 persons per ha, as set forth in the book of Kota Luwuk Master Plan. Land use for Kota Luwuk up to the year 2000 is as shown in Table III-04.

Table III-04
JENIS GUNA TANAH UNTUK PERKEMBANGAN
MAKSIMUM KOTA LUWUK TAHUN 2000

NO.	JENIS PENGGUNAAN TANAH	LUAS MINIMUM (Ha)	%
1.	Permukiman	320	77.9
2.	Perkantoran	6	1.5
3.	Aktivitas Ekonomi	6.24	1.5
4.	Aktivitas Agama	1.2	0.3
5.	Lapangan + Kuburan	14.83	3.6
6.	Perusahaan + Industri	22	5.3
7.	Tanah kosong yang diperuntukan	25.47	6.2
8.	Open Space + Greenbelt dan jalan - jalan	15.06	3.7
	T O T A L	410.8	100

* Sumber : "Buku Rencana Induk Kota Luwuk".

III.01.03. METHODS OF POPULATION PROJECTION

Population projection is made on the basis of data obtained from the investigation which has been already made. Calculation of the population here is necessary to know the population in the future, and to determine necessary facilities including also the water requirement. For projection of population there are various methods, in which:

- Least square
- Geometric
- Logistic growth
- Others.

A. LEAST SQUARE METHOD

Calculation of population by this method is based on the formula:

$$y = a\,x + b$$

where y = population in the year to calculate for

a = constant

b = constant

x = years to zero from the year for calculation

By the calculation, the following is obtained:

a = 743.87 and b = 14,594.44.

For the year 2000, x = 32 is obtained. So that the population of Luwuk in the year 2005 is calculated as 37,398. To be more in detail, the estimation of population of Kota Luwuk in the future years is shown in Table III-05.

TABLE III-05

PROYEKSI PENDUDUK DENGAN CARA

LEAST SQUARE.

TAHUN	JUMLAH PENDUDUK
1977	18,019 jiwa.
1978	18,314
1979	19,058
1980	19,802
1985	23,521
1990	27,240
1995	30,960
2000	34,679
2005	37,398

B. GEOMETRIC METHOD

One of the methods of population projection, which has logarithmic characteristics, is the following:

$$Pn = Po\ (1 + a)^t$$

where Pn = population in the nth year

Po = population at the beginning of calculation

a = percentage of population growth per year

t = year

Population projection with use of the geometric method is complete with taking a = 5.56, in accordance with the average population growth in Kota Luwuk, which is shown in Table III-06.

TABLE III-06

PROYEKSI PENDUDUK KOTA LUWUK

SECARA GEOMETRIC

TAHUN	JUMLAH PENDUDUK
1977	18,019
1978	19,021
1979	20,078
1980	21,195
1985	22,373
1990	23,617
1995	24,930
2000	26,316
2005	27,780

C. LOGISTIC GROWTH CURVE METHOD

This method forms one method of similarity in estimation of population projection, which is analogous to the characteristic "S" curve of bacteria growth. In this curve the growth will be divided into 3 phases, namely,

1. Accelerated growth phase,
2. Logarithmic growth phase,
3. Negative acceleration phase.

At the third summit phase, a certain saturated condition will be reached, where the growth will cease or be very slow; in this connection the necessary factor will become smaller and smaller.

This method has its basis on the concept that the growth rate of a certain area depends on functions of the possibility of extension with regard to economy or geography, because the growth will be limited by the capability of absorption of the area until the maximum condition.

The density which was planned is 150 persons per ha at the end of 2000.

The condition of population in each year before the target year is compared with that of saturated condition, which is 61,620 persons, as shown in Table III-07.

TABLE III-07

JUMLAH PENDUDUK DAN % SATURATION

TAHUN 1968 - 1977

TAHUN	JUML. PENDUDUK	% SATURATION
1968	12,148	19.71
1969	12,246	19.87
1970	12,345	20.03
1971	12,946	21.01
1972	13,782	22.36
1973	14,479	23.50
1974	15,314	24.86
1975	15,922	25.85
1976	16,897	27.42
1977	18,019	29.24

In order to get a curve of projection which is straight, data in the above is plotted on the probability paper as shown in Fig III-01, by which population projection of Kota Luwuk up to 2005 can be estimated as mentioned in Table III-08.

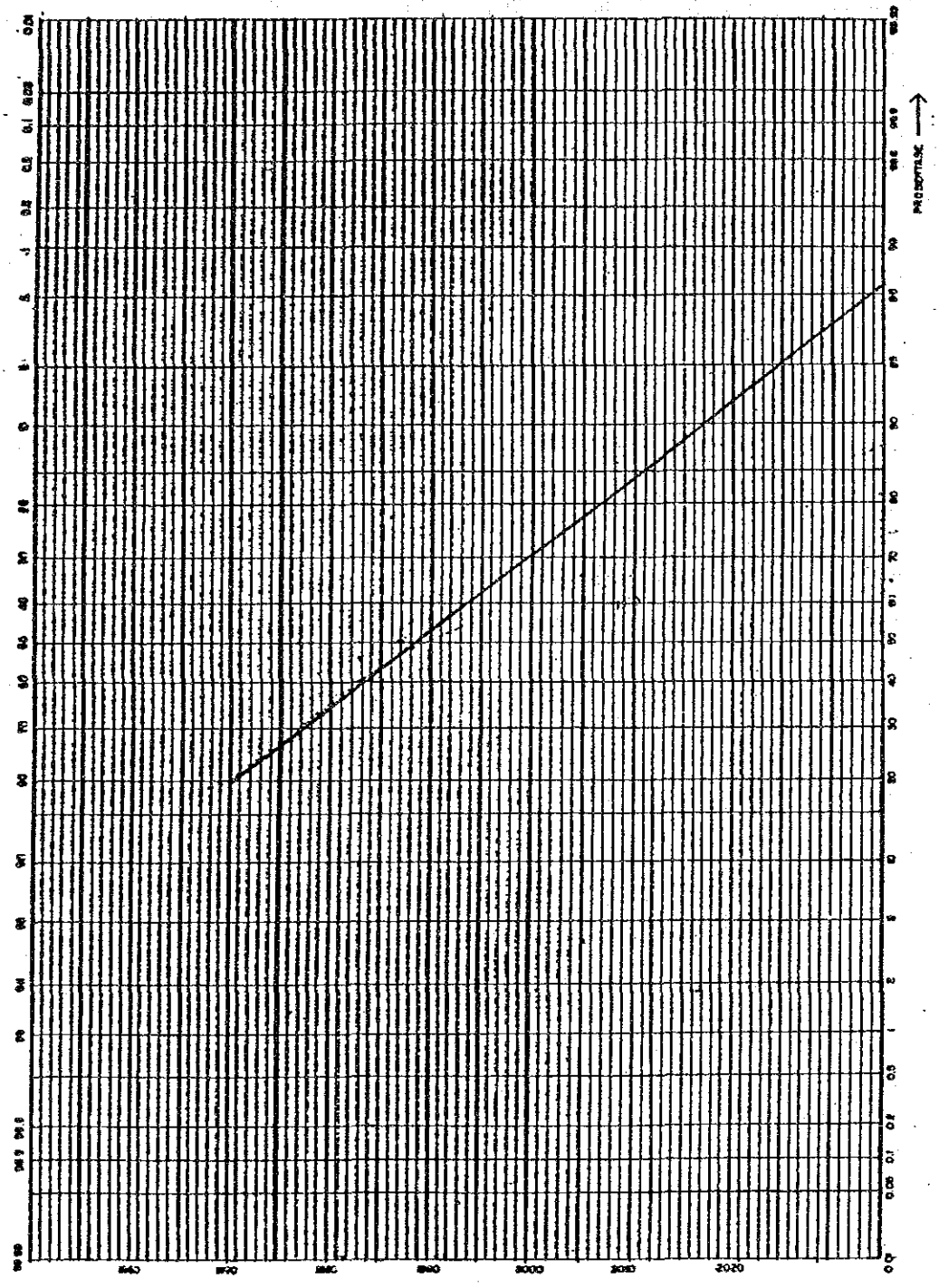
Table III-08
PROYEKSI PENDUDUK KOTA LUWUK
TH 1977 - TH 2005
(CARA LOGISTIK GROWTH)

TAHUN	% SATURATION	JUMLAH PENDUDUK
1977	29.24	18,019
1978	31.43	19,367
1979	33.25	20,489
1980	35	21,567
1985	43.33	36,700
1990	53.33	32,862
1995	63	38,821
2000	70.45	43,412
2005	78.85	48,587

The above three methods being compared, the geometric method gives highest results, the least square lowest and the log growth is in between. (Fig III-02). In order to project the population of Kota Luwuk which will be used for the present planning, a more detailed analysis is needed, not to bring about an error in optimization which is too big in the future.

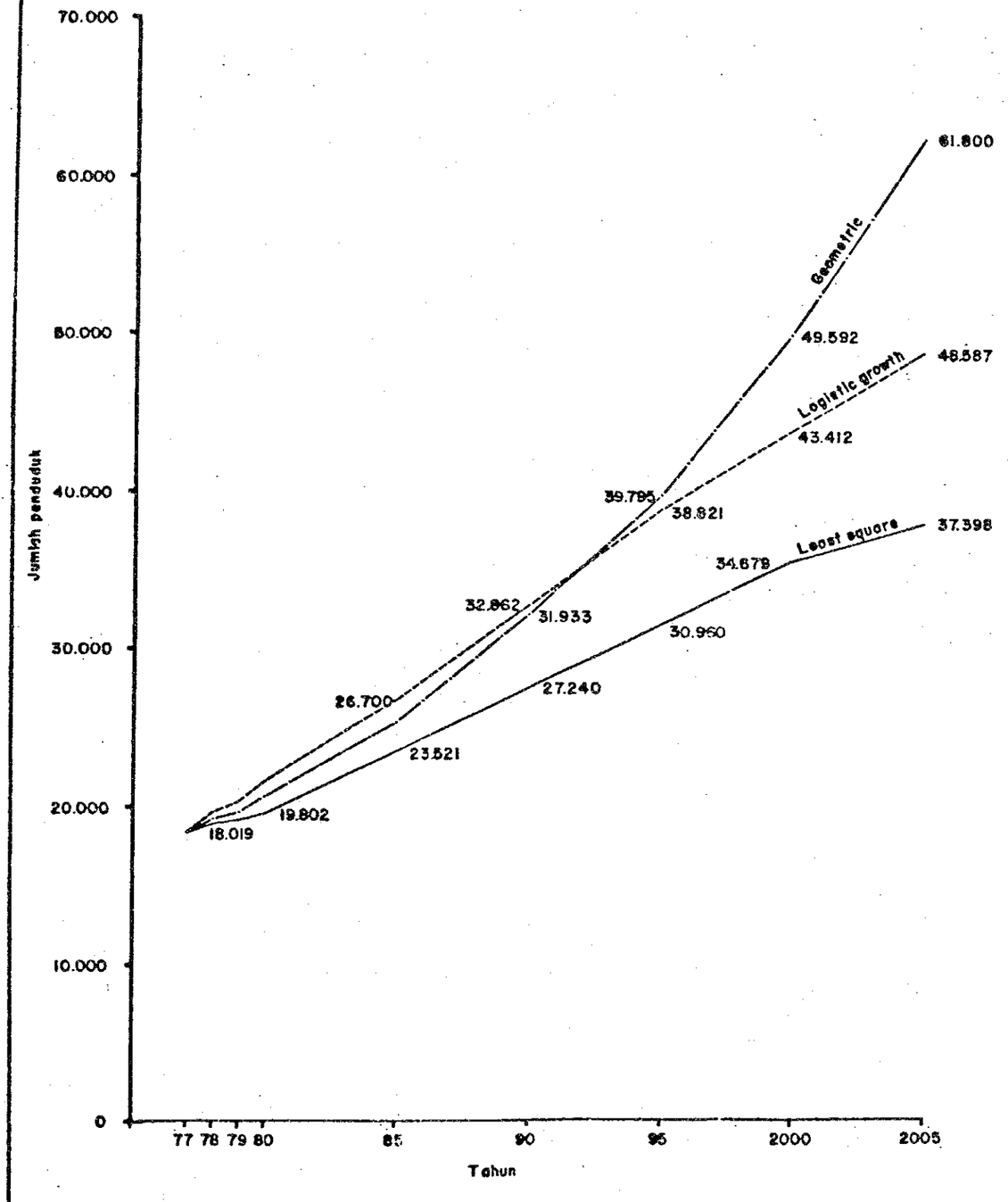
CIRIAJASA TOTAL DESIGN - CTD

LOGISTIC GROWTH CURVE



Grafik III - 01

CIRIAJASA TOTAL DESIGN - CTD



GAMBAR

GRAFIK
PROYEKSI PENDUDUK
KOTA LUWUK
1977 — 2005

KETERANGAN

NO. GAMBAR	SKALA
Grafik III - 02	

SUMBER

III.01.04. POPULATION PROJECTION OF KOTA LUWUK

If the population data until 1977 is observed, the percentage of population growth of Kota Luwuk can be calculated, which is 5.56 % per year. This growth rate is too high to be used as a criterion of population increase until the year of 2005. So the following consideration is required:

- The figure of average growth rate of the country is 2.34 % per year.
- The figure of average growth rate of Kabupaten Banggai is 2.8% per year.
- The planned saturation extent of the kota is only to reach 150 persons per ha at the end phase of the development.
- The family plan desired at the national level will be more successful in the future.

In order to project the population of Kota Luwuk until the year of 2005, which can be used as a criterion to plan the Water Supply Master Plan, two methods will be used, namely, the geometric method with percentage of growth per year that decreases up to the year 1993 and then (the years 1994 to 2005) the logistic growth will be used. To make it clear, the population projection is shown in Table III-09 and Fig III-3.

Table III-09

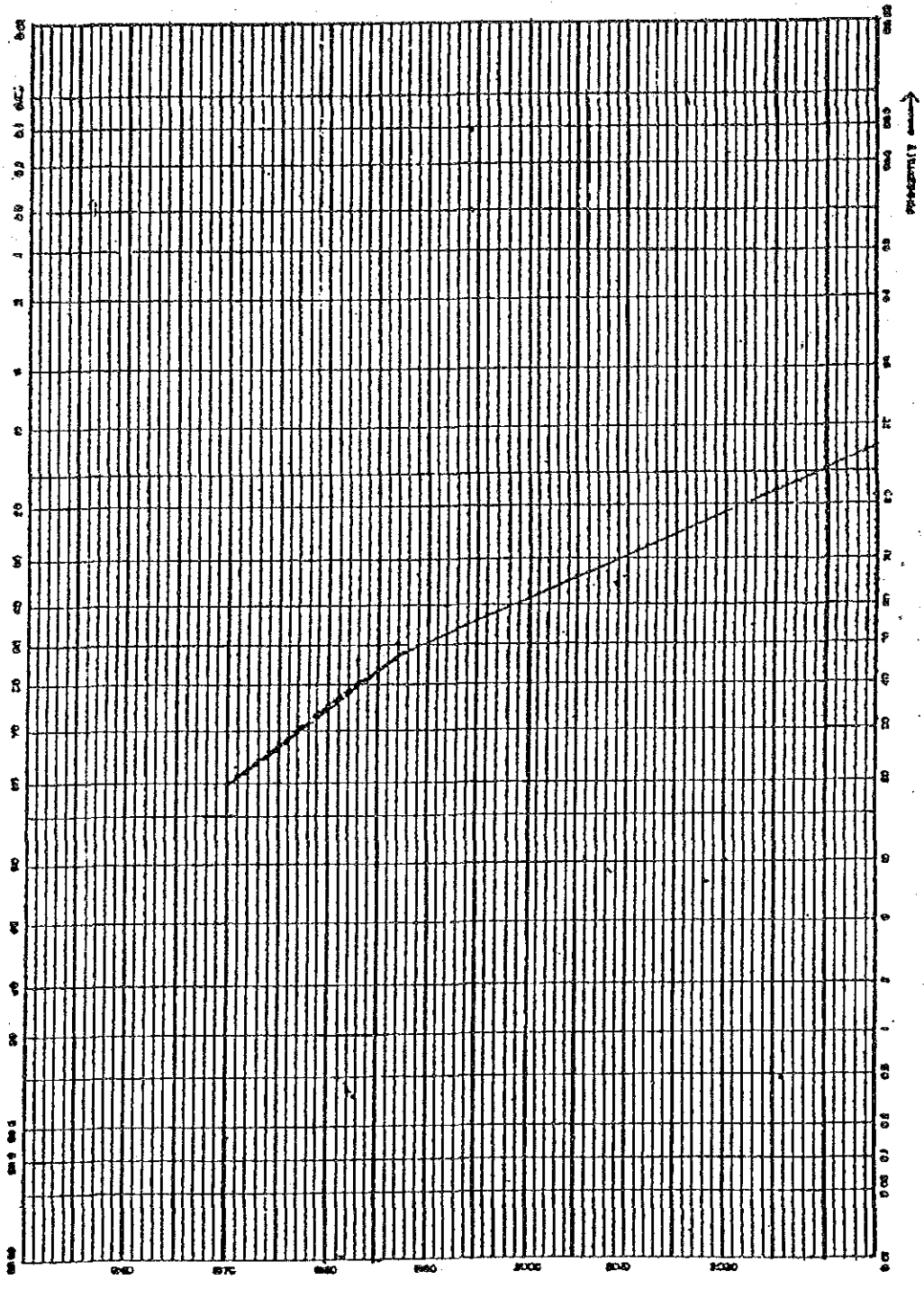
PROYEKSI PENDUDUK KOTA LUWUK

(TH 1977 s/d TH 2005)

NO.	TAHUN	JUMLAH PENDUDUK (ORANG)	% SATURASI	PROSEN PERTAMBAHAN (GEOMETRIK MEAN)
0.	1977	18,019	29.2	5.56
1.	1978	19,021	30.9	5.56
2.	1979	20,078	32.6	5.56
3.	1980	21,195	34.4	5.56
4.	1981	22,373	36.3	5.56
5.	1982	23,617	38.8	5.56
6.	1983	24,930	40.5	5.56
7.	1984	25,803	41.9	3.50
8.	1985	26,706	43.3	3.50
9.	1986	27,640	44.9	3.50
10.	1987	28,608	46.4	3.50
11.	1988	29,609	48.0	3.50
12.	1989	30,201	49.0	2.00
13.	1990	30,805	50.0	2.00
14.	1991	31,421	51.0	2.00
15.	1992	32,050	52.0	2.00
16.	1993	32,691	53.0	2.00
17.	1994	33,275	54.0	2.00
18.	1995	33,891	55.0	
19.	1996	34,507	56.0	
20.	1997	35,123	57.0	Logistik
21.	1998	35,740	58.0	Growth
22.	1999	36,356	59.0	
23.	2000	36,972	60.0	
24.	2001	37,588	61.0	
25.	2002	38,204	62.0	
26.	2003	38,821	63.0	
27.	2004	39,439	64.0	
28.	2005	40,053	65.0	

CIRIAJASA TOTAL DESIGN - CTD

PROYEKSI PENDUDUK KOTA LUWUK



Grafik III - 03

TAHUN ⟶

From Table III-09, it can be seen that by this method, if calculated in the geometric manner with mean population from 1977 up to 2005, this calculation produces the percentage of average growth rate per year, 2.89 %. The said figure is almost half of average population increase at the beginning year of projection, and approaches the figure of population increase at the kabupatan level.

3. Future Population

In the preceding section, the population projection was quoted from the existing Report. In this section, population projection, furthermore, employing several kinds of equations, will be made to know the range of distribution of future population. For the population projection, the following fundamental equations are employed. These are all commonly employed for population projection.

i) $y = ax + b$

ii) $y = K/ (1 + e^{aT+b})$

iii) $y = P_o (1 + r)$

iv) $y = ax^{0.5} + b$

v) $y = ax^2 + b$

vi) $y = ax^b + c$

where, y : population

x : term between the first year of utilized data and year to estimate population, in years

T : term between standard year to estimate population, in years

a,b,c : parameters

P_o: the latest population

e : the base of natural logarithm

Population projection by iii) and v) equations would usually give higher side results than the others when growth rate in the past is relatively high.

The future population will be calculated in the following steps. Firstly, the parameters in each equation are determined by means of the least mean square method. And then population up to the year of 2005 will be estimated based on these equations. The results of estimation using the above equations are presented in Table A - 1 and Fig A - 1 As seen in Fig, future population will increase between 20,000 to 35,000 by 1985, and the projected population by the Report is as large as the estimates based on i) and ii) equations.

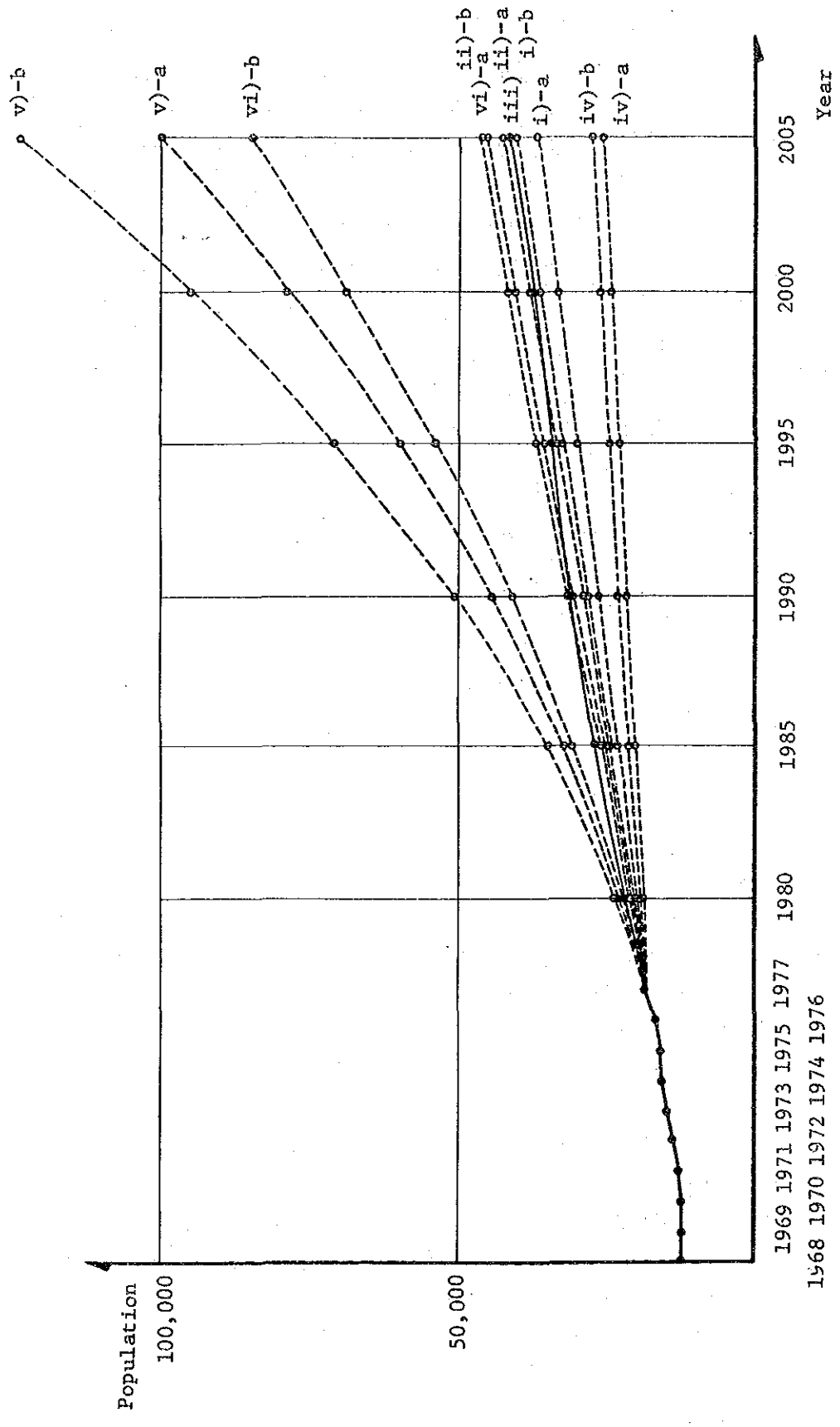


Fig A-1 Future Population

Table Future Population

	equation	1985	2005	Remarks
i)-a	$y = 10,707 + 673X$	19,460	36,290	
-b	$y = 11,388 + 794X$	20,130	39,990	
ii)-a	$y = 61,620/ (1 + e^{1.1647-0.0606T})$	19,900	42,180	
-b	$y = 61,620/ (1 + e^{1.1790-0.0703T})$	20,620	45,880	
iii)	——*	26,710	40,050	taken from the Report
iv)-a	$y = 8,200 + 2,763X^{0.5}$	18,160	25,240	
-b	$y = 8,762 + 3,043X^{0.5}$	18,850	27,020	
v)-a	$y = 12,075 + 61X^{2}$	22,320	99,640	
-b	$y = 12,787 + 85X^{2}$	23,110	123,360	
vi)-a	$y = 12,148 + 119X^{1.7764}$	21,980	84,790	
-b	$y = 12,345 + 621X^{1.1213}$	20,560	45,810	

Note: a = equation based on the population statistics in the past 10 years
b = equation based on the statistics in the past 8 years

* Refer to section 2. Population Projection in the Existing Report.

4. Considerations on the Results of Projection

The foregoing section estimated future population by several kinds of equation. Comparing the results of the above projections with the projection by the existing Report, some comments are briefly described. (Refer to Fig A - 1.)

i) In the case of short term projection, there would be no remarkable differences of population whichever equations might be employed. In 1985, the target year of this project, Luwuk will have approximately 20,000 to 35,000 population unless unexpected changes in circumstances should happen.

ii) Future projected population can roughly be grouped into two, high and low, as seen in Fig A-1.

iii) The projected population by the existing Report belongs to the low group. In the short term future, it belongs to the rather high side of low group but this tendency will be lessened in the long term future.

iv) It is advisable that this population projection including all calculation processes and assumptions should be reviewed in the near future based on the further collection and analysis of data concerned.

v) In the existing Report, some defects were found. They did not give serious results to the feasibility study but they are all very important for any study or planning. For reference, therefore, such defects are categorized as below.

- Simple miscalculation of future population,
- Insufficient understanding of the real meaning of each adopted method,
- Lack of logical description despite redundant explanation in the Report.

APPENDIX B

WATER DEMAND

BY THE EXISTING REPORT

The Report has estimated the future water demand broken down into use categories. For reference, the process of the estimation in each category will be introduced as below in the form of tables.

i) Domestic Use

(1) Domestic Use by House Taps

TABLE VII-01

Water Demand for Domestic Use

by House Taps

Year	Population	Served Population		Average Nos. of Resident	Nos. of House-connection	Consumption per Capita per Day (l/c/d)	Daily Consumption (cu m/d)
		Percentage (%)	Served Population				
1977	18,019	30	5,406	7	772	100	541
1980	21,195	40	8,478	7	1,211	100	848
1983	24,930	55	13,712	7	1,959	100	1,371
1985	26,706	60	16,024	6.5	2,465	100	1,602
1990	30,805	65	20,023	6	3,337	125	2,503
1995	33,891	70	23,724	5.5	4,313	125	2,966
2000	36,972	75	27,729	5	5,546	150	4,159
2005	40,053	80	32,042	5	6,408	150	4,805

(2) Domestic Use by Public Hydrants

TABLE VII-02

Water Demand for Domestic Use

for Public Hydrants

Year	Population	Served Population		Population Served by Each Public Hydrant	Nos. of Public Hydrants	Consumption per Capita per Day (l/c/d)	Daily Consumption (cu m/d)
		Percentage (%)	Served Population				
1977	18,019	30	5,406	250	22	30	162
1980	21,195	30	6,359	250	25	30	191
1983	24,930	30	7,479	250	30	30	224
1985	26,706	25	6,677	200	33	30	200
1990	30,805	25	7,701	200	39	30	231
1995	33,891	20	6,778	150	45	30	203
2000	36,972	20	7,394	150	49	30	222
2005	40,053	15	6,008	125	49	30	180

ii) Non-domestic Use

(1) Industrial

TABLE VII-03

Water Demand for Industrial

Year	Nos. of Industrial Facilities	Estimated Consumption per Unit (cu m/d)	Total Consumption (cu m/d)
1977	84	2.5	210
1980	89	2.5	223
1983	94	2.5	235
1985	98	3.5	343
1990	108	3.5	378
1995	119	4.5	536
2000	121	4.5	590
2005	144	5.0	720

(2) Harbour

TABLE VII-04

Water Demand for Harbour

Year	Ships per Year	Consumption per Ship	Daily Consumption per Ships (cu m/d)	Daily Consumption by Harbour (cu m/d)	Total Consumption (cu m/d)
1977	222	5	3	2	5
1980	226	5	3	2	5
1983	240	5	3.5	3	7
1985	250	7.5	5.0	3	8
1990	275	7.5	6.0	3	9
1995	303	10	8.0	4	12
2000	333	10	9.0	4	13
2005	365	10	10	5	15

(3) Schools

TABLE VII-05

Water Demand for Schools

Year	Population	Nos. of Pupils		Consumption per pupil (l/pupil/d)	Total Consumption (cu m/d)
		Percentage (%)	Nos. of Pupils		
1977	18,019	47	8,528	20	171
1980	21,195	42	8,902	20	178
1983	24,930	37	9,224	20	184
1985	26,706	35	9,347	20	187
1990	30,805	35	10,782	25	270
1995	33,891	35	11,862	25	297
2000	36,972	35	12,940	25	324
2005	40,053	35	14,019	25	350

(4) Religious Institutions

TABLE VII-06

Water Demand for Religious Institutions

Year	Population	Nos. of Prayer per Unit	Nos. of Religious Institution	Consumption per unit (cu m/unit/d)	Total Consumption (cu m/d)
1977	18,019	1,500	13	1.5	20
1980	21,195	1,000	21	1.5	32
1983	24,930	1,000	25	1.5	38
1985	26,706	1,000	27	1.5	41
1990	30,805	750	41	1.5	62
1995	33,891	750	45	1.5	68
2000	36,972	500	74	1.5	111
2005	40,053	500	80	1.5	120

(5) Markets & Shops

TABLE VII-08

Water Demand for Restaurants,

Shops & Markets

Year	Nos. of Unit	Consumption (cu m/unit/d)	Total Consumption (cu m/d)
1977	84	0.88	74
1980	85	0.88	75
1983	88	0.88	77
1985	90	1.00	90
1990	94	1.50	141
1995	98	2.0	196
2000	102	2.5	255
2005	105	3.0	315

(6) Theaters

TABLE VII-09

Water Demand for Theaters

Year	Nos. of Theaters	Consumption (cu m/unit/d)	Total Consumption (cu m/d)
1977	2	2	4
1980	2	2	4
1983	2	2	4
1985	3	3	9
1990	3	3	9
1995	4	3	12
2000	4	4	16
2005	5	4	20

(7) Hotels

TABLE VII-10

Water Demand for Hotels

Year	Nos. of Beds	Nos. of Beds per Hotel	Nos. of Hotels	Consumption (l/bed/d)	Total Consumption (cu m/d)
1977	62	16	4	150	9
1980	64	18	4	150	10
1983	66	18	4	150	12
1985	67	18	4	200	13
1990	70	20	4	200	14
1995	74	20	4	250	19
2000	78	20	4	250	20
2005	82	20	4	300	25

(8) Institutions

TABLE VII-11

Water Demand for Institutions

Year	Nos. of Office	Nos. of Office Workers per office	Consumption (l/capita/d)	Total Consumption (cu m/d)
1977	66	14	10	9
1980	70	14	10	10
1983	72	14	10	10
1985	73	14	15	15
1990	76	14	15	16
1995	79	14	15	17
2000	82	14	20	23
2005	85	14	20	24

(9) Medical Facilities

(a) Hospitals

TABLE VII-12

Water Demand for Hospitals

Year	Population	Total of Beds	Consumption (l/bed/d)	Total Consumption (cu m/d)
1977	18,019	72	250	18
1980	21,195	89	250	22
1983	24,930	117	250	29
1985	26,706	125	300	38
1990	30,805	162	300	49
1995	33,891	178	350	62
2000	36,972	195	350	68
2005	40,053	210	400	84

(b) Maternity and Clinic

TABLE VII-13

Water Demand for Maternity and Clinic

Year	Population	Nos. of Maternity	Nos. of Medical Clinic	Total Nos. of Units	Consumption (cu m/unit/d)	Total Consumption (cu m/d)
1977	18,019	2	3	5	1.5	8
1980	21,195	2	5	7	1.5	11
1983	24,930	2	8	10	1.5	15
1985	26,706	3	9	12	2.0	24
1990	30,805	3	10	13	2.0	26
1995	33,891	3	11	14	2.5	35
2000	36,972	4	12	16	2.5	40
2005	40,053	4	13	17	3.0	51

APPENDIX C

CARBON DIOXIDE REMOVAL METHOD

BY THE EXISTING REPORT

The following is the summary of the proposed removal method for the carbon dioxide by the existing report. Comments of the study team on the proposed facilities are attached at the end.

1. Terms of treatment

a. Target year : 1990

b. Water quantity for treatment: max 5,357 cu m/day (62 l/sec)

c. Treatment method : lime feeding

d. Chemical to be used : quick lime

2. Removal Facilities

a. Quick lime saturator

- Capacity : 4 tanks, Ø 1.7m x h 1.4m
- Upflow velocity: 2 cm/min
- Detention time : 1 hour

b. Mixing tank

- Objective : mixing lime with raw water
- Capacity : 2m x 2m x 1m = 4 cu m
- Mixing power : G = 300 to 500/sec

c. Implement for density measurement

- Cipallette measurement

3. Construction Cost

- Hydraulic fall facility (mixing tank)	Rp 5,000,000
- Lime saturator	Rp 4,500,000
- Implement for measurement	Rp
- Chemical storage	Rp

Note: Regarding the construction costs calculated, unit prices used are as of 1978.

4. Lime Dosage

First step phase 1 (1990) : 252 kg/d (about 28 ppm as 60 % lime)

phase 2 (1995) : 306 Kg/d

Second step (2005) : 450 Kg/d

5. Comments of the Study Team

a. A manufacturing process making slaked lime from the quick lime is not included in the above method.

b. The calculated construction costs are not proper, because unit prices in 1978 were used.

c. Operation and maintenance are much more difficult than that of the aeration method recommended by the study team.

d. One more operator than proposed may be needed for operating these facilities.

e. Electric power is usually necessary for the rapid mixing.

f. Operation costs such as operator, chemical and electric power are expensive compared with the aeration method.

APPENDIX D

BREAKDOWN OF

ESTIMATED CONSTRUCTION COST

Note:

Foreign Portion : CIF of pipe and fitting, meter, valve and pump. PVC and ACP, although locally available, are included in Foreign Portion, considering that the manufacturing capacity and experience in use are still not sufficient.

Local Portion : Cement, steel bar, gravel, sand, civil work and local transportation.

ESTIMATED CONSTRUCTION COST FOR LUWUK (in Rp.)

Items	Foreign Exchange	Local Currency	Remarks
1. Transmission Pipeline Ø 300 x 100 m DCIP	1) pipe @ 30,781/m x 100 m = 3,078,100 2) fitting 3,078,100 x 20 % = 615,620 3) valve @ 656,000/pcs x 2 pcs = 1,312,000 Total 5,005,720 @ 50,100/m	1) pipe @ 6,000/m x 100 m = 600,000 2)* local transportation 501,000 Total 1,101,000 @ 11,000/m	2)* In case of Luwuk, costs of materials x 10 %
2. Aeration	———	1) earthwork (110 cu m) = 220,000 2) concrete @ 200,000/cu m x 8 cu m = 1,600,000 3) shed @ 150,000/sq m x 9 sq m = 1,350,000 4) manhole, etc. 271,000 Total 3,441,000	
3. Distribution Pipeline - Ø 300 x 300 m DCIP	1) pipe @ 30,781/m x 300 m = 9,234,300 2) fitting 9,234,000 x 20 % = 1,846,860 3) valve @ 656,000/pcs x 1 pcs = 656,000 Total 11,737,160 @ 39,100/m	1) pipe @ 6,000/m x 300 m = 1,800,000 2) valve box @ 500,000/pcs x 1 pcs = 500,000 3) thrust block @ 50,000/pcs x 4 pcs = 200,000 4) local transportation 1,170,000 Total 3,670,000 @ 12,200/m	

Items	Foreign Exchange	Local Currency	Remarks
- Ø 200 x 3,200 m DCIP	1) pipe @ 17,395/m x 3,200 m = 55,664,000 2) fitting 55,664,000 x 20 % = 11,132,000 3) valve @ 327,148/pcs x 7 pcs = 2,290,036 4) river crossing @ 90,000/m x 60 m = 5,400,000 Total 74,486,836 @ 23,300/m	1) pipe @ 6,000/m x 3,200 m = 19,200,000 2) valve box @ 500,000/pcs x 7 pcs = 3,500,000 3) thrust block @ 50,000/pcs x 20 pcs = 1,000,000 4) river crossing @ 35,000/m x 60 m = 2,100,000 5) local transportation 7,450,000 Total 33,250,000 @ 10,400/m	
- Ø 150 x 1,800 m PVC	1) pipe @ 9,340/m x 1,800 m = 16,812,000 2) fitting 16,812,000 x 20 % = 3,362,400 3) valve @ 217,525/pcs x 7 pcs = 1,522,675 4) river crossing @ 90,000/m x 20 m = 1,800,000 Total 23,497,075 @ 13,100/m	1) pipe @ 4,000/m x 1,800 m = 7,200,000 2) valve box @ 500,000/pcs x 7 pcs = 3,500,000 3) thrust block @ 50,000/pcs x 15 pcs = 750,000 4) river crossing @ 35,000/m x 10 m = 700,000 5) local transportation 2,350,000 Total 14,500,000 @ 8,100/m	

Items	Foreign Exchange		Local Currency		Remarks
- Ø 100 x 1,200 m PVC	1) pipe @ 4,913/m x 1,200 m =	5,895,600	1) pipe @ 4,000/m x 1,200 m =	4,800,000	
	2) fitting 5,895,600 x 20 % =	1,179,120	2) valve box @ 500,000/pcs x 3 pcs =	1,500,000	
	3) valve @ 120,074/pcs x 3 pcs =	360,222	3) thrust block @ 50,000/pcs x 10 pcs =	500,000	
	4) river crossing @ 90,000/m x 10 m =	900,000	4) river crossing @ 35,000/m x 10 m =	350,000	
	Total	8,334,942	5) local transportation	830,000	
		@ 6,900/m	Total	7,980,000	
				@ 6,700/m	
- Ø 75 x 750 m PVC	1) pipe @ 3,130/m x 750 m =	2,347,500	1) pipe @ 3,500/m x 750 m =	2,625,000	
	2) fitting 2,347,500 x 20 % =	469,500	2) valve box @ 300,000/pcs x 2 pcs =	600,000	
	3) valve @ 92,750/pcs x 2 pcs =	185,500	3) thrust block @ 40,000/pcs x 5 pcs =	200,000	
	Total	3,002,500	4) local transportation	300,000	
		@ 4,000/m	Total	3,725,000	
				@ 5,000/m	
4. Bulk Meter Ø 300	1) bulk meter	4,350,000	1) meter box	500,000	
			2) local transportation	400,000	
			Total	900,000	

Items	Foreign Exchange	Local Currency	Remarks
5. Water Meter Ø 13	1) water meter @ 17,000/pcs x 2,500 pcs = 42,500,000	1) local transportation 4,250,000 @ 1,700/pcs	
6. Public Hydrant	1) meter - Ø 18 @ 30,000/pcs x 33 pcs = 990,000	1) concrete @ 300,000/pcs x 33 pcs = 9,900,000 2) local transportation 100,000 Total 10,000,000 @ 303,000/pcs	

APPENDIX E

ASSUMPTIONS FOR FINANCIAL PROJECTIONS

Financial projections are prepared on the basis of following assumptions.

1. The accounts in the financial statements conform with the generally accepted chart of accounts for water utilities. The financial statement and projections are based on an accrual system of accounting.

2. Revenues are expected from water sales and other income for installing and reconnecting service connections. Volumes of water sold are consistent with the engineering estimates of total water consumption. Other income for installing and reconnecting service connections is a service payment. Other income consists of revenues from reconnection fees and labor costs billed for installing new connections. Customers are assumed to pay for the meters, pipes and other materials used in installing the service connections.

3. The water rate, payable by the consumers, are determined, employing guidelines for setting water rates prepared by Cipta Karya, on the basis of production cost. Water rates are assumed to be minimum to generate return of the operation and maintenance cost. Depreciation for assets newly constructed is considered in the item of operation and maintenance cost. Water rates, therefore, are arranged to generate return of depreciation in addition to operation and maintenance cost. Details of water rates calculation are shown in Attachment I) Assumption for Calculation of Water Rate.

4. Two per cent of annual billings are written off as bad debts in line with assumptions of increasing water rates and number of customers.

5. Operating expense are assumed at substantially increasing levels considered necessary to operate and maintain the water supply system adequately and to provide for expanding operations. Details are given in Attachment II) Projection of Operation and Maintenance Cost.

6. Personnel costs are based on staffing requirements for the implementation of the project and on equitable salaries, and 5% increase annually. Details are given in Attachment III) Projection of Personnel Cost.

7. Annual costs of materials for repairs and maintenance cost is estimated at 0.6% of the gross value of fixed assets (project cost) in the service at 1983 and will increase 5% annually.

8. Annual office supplies expense is assumed to amount to about Rp.200 for every customer.

9. Chemical expenses are based on the chemical requirements for the volume of water to be treated and increase 5% annually. Chemical price is assumed to be Rp.1,170/kg in 1980. Details are given in Attachment IV) Projection of Chemical Cost.

10. Other operating expenses include expenditures for communications, reproduction, personnel training, board meeting, and miscellaneous items. This is estimated at 5% of total of other cash operating expenses such as personnel cost, office operating cost, and chemical cost.

11. The straight line method of calculating depreciation is used based on the estimated useful lives of the individual assets and a composite rate of 2.24% is developed. Calculation is shown in Attachment V) Calculation of Depreciation Cost.

Attachment I)

Assumption for Calculation of Water Rate

A. Percentage of Water Structure Classification*

Item	Percentage of Usage of Water		
	0 - 15 m^3/m	15 - 30 m^3/m	more than 30 m^3/m
Domestic Use	87.70	12.30	-
Office	47.00	51.81	1.19
Commercial	80.51	19.49	-
Industrial	-	-	100
Social	36.09	61.29	2.62
Hospital	54.7	4.01	41.29

Note: Residential/Government tariff includes domestic use, office, and medical facilities.
Commercial tariff includes hotel, markets.
Industrial tariff includes industrial.
Social tariff includes religious, school and domitories.
Public tariff includes public taps and public parks.
Port tariff includes harbor.

* .... Water structure classification is based on the data of monthly water consumption in Donggala.

B. Classification of Water Consumption

Luwuk

1985

m^3/day	Residential					Social		
Class of Water Consumption	Domestic	Institutional	Medical	Commercial	Industrial	Religious	Public	Harbor
	1,602	15	62	112	243	228	200	8
0 - 15 m^3/m	1,405	7	34	90	-	82	72	-
15 - 30 m^3/m	197	8	2	22	-	140	122	-
more than 30 m^3/m	-	-	26	-	243	6	6	8

1990

m^3/day	Residential					Social		
Class of Water Consumption	Domestic	Institutional	Medical	Commercial	Industrial	Religious	Public	Harbor
	2,503	16	75	164	278	332	231	9
0 - 15 m^3/m	2,195	7	41	132	-	120	83	-
15 - 30 m^3/m	308	8	3	32	-	203	141	-
more than 30 m^3/m	-	1	31	0	278	9	7	9

C. Water Sales

Item \ Year	1985	1990
Residential	1,756.5A	2,721.5A
Commercial	224A	328A
Industrial	1,215A	1,390A
Social	456.8A	600.8A
Harbor	40A	45A
Total	3,692.3A	5,085.3A

Note: Figures in each of classification show sales of water in Rupiah per cubic meter per day x "A" factor.

D. Water Sales

Water Sales \ Year	1983	1984	1985	1986	1987	1988	1989	1990
	1,144,311A		1,347,689A		1,551,067A			
		1,246,000A		1,449,378A		1,652,756A		1,856,134A

Note: Figures show sales of water in Rupiah per year x "A" factor.

E. "A" Factor based on Water Sales

	1983	1984	1985	1986	1987	1988	1989	1990
A" factor	23.18	21.95	20.94	20.10	19.40	18.82	18.33	17.92

Note: "A" Factor = $\frac{\text{Total Cost of Operation and Maintenance}}{\text{Water Sales}}$

"A" factor is determined to be Rp.20.

F. Proposed National Standard Water Rate Structure

Blocks	Residential/ Government	Commercial	Industrial	Social	Public Bath-house & Standpipes	Ports
0 - 15 m^3	1.0A	2.0A	3.0A	0.8A	0.8A	5.0A
15 - 30 m^3	1.5A	2.0A	3.0A	1.2A	0.8A	5.0A
more than 30 m^3	3.0A	4.0A	5.0A	1.6A	0.8A	5.0A

Attachment II)

Projection of Operation and Maintenance Cost

LUWUK

Operation and Maintenance Cost

(Rp. 1,000)

		1983	1984	1985	1986	1987	1988
I.	Personnel Cost	12,308	12,923	13,568	14,244	14,959	15,707
II.	Operation & Maintenance Cost						
	1. Maintenance	2,385	2,504	2,629	2,760	2,897	3,042
	2. Office Cost	462	484	507	529	551	574
	3. Chemical Cost	1,229	1,290	1,355	1,423	1,494	1,569
	(Total I & II $_{1,2,3}$)	16,384	17,201	18,059	18,956	19,901	20,892
	4. Other Expenses	264	277	291	305	321	336
	5. Depreciation	9,878	9,878	9,878	9,878	9,878	9,878
	TOTAL COST	26,526	27,356	28,228	29,139	30,100	31,106
	Water Consumption (m^3/year)	735,402	814,476	901,550	984,624	1,067,098	1,150,772
	Production Cost Ro./m^3	36.07	33.42	31.31	29.59	28.21	27.03

Attachment III)

Projection of Personnel Cost

Monthly salary of personnel according to the qualification is assumed based on information obtained from D.S.E., Cipta Karya:

	Position	Rp./month
i.	Manager	100,000.-
ii.	Head	65,000.-
iii.	Accounting Staff	50,000.-
iv.	Maintenance & Operation Staff	45,000.-
v.	Bookkeeping Staff	45,000.-
vi.	Staff of Billing & Collection	40,000.-
vii.	Meter reader	20,000.-
viii.	Secretary cum Typist	45,000.-
ix.	Foreman	15,000.-

Note :

Position	Qualification
Manager	Technical I
Head	Technical II
Technical Plan	Technical III
Maintenance & Operation Staff	Technical IV
Accounting Staff	Administration II
Staff of Billing & Collection	Administration III
Meter reader	Administration IV
Secretary cum Typist	Administration II

L U W U K

Personnel Cost

Description	1981	1982	1983	1984	1985	1986	1987	1988
Manager	1,200	1,260	1,323	1,389	1,459	1,531	1,608	1,688
Secretary/Typist	540	567	595	625	656	689	724	760
Technical								
Head	780	819	860	903	948	995	1,045	1,097
Maintenance & Operation	-	-	2,700	2,835	2,976	3,125	3,282	3,446
Foreman	-	-	900	945	992	1,041	1,094	1,149
Technical Plan	-	600	630	661	694	729	766	804
Administration & Finance								
Head	780	819	860	903	948	995	1,045	1,097
Accounting	-	-	1,200	1,260	1,323	1,389	1,458	1,531
Bookkeeping	-	-	1,080	1,134	1,191	1,250	1,312	1,378
Billing & Collection	-	-	1,440	1,512	1,589	1,667	1,750	1,838
Meter reading	-	-	720	756	794	833	875	919
TOTAL	3,300	4,065	12,308	12,923	13,568	14,244	14,959	15,707

Attachment IV)

Projection of Chemical Cost

A. Projection of Chemical Cost

i. Unit price : Rp. 1,170/kg as of 1980
(annual escalation of 5% considered)

ii. Amount of calcium hypochlorite to be used.

Item	Luwuk
Water Production (Average day 1/sec)	37.5
Dosage of Chlorite (ppm)	0.6
Period of Dosage	Daily
Use of Chlorite per Year (kg/y)	1,180

Attachment V)

Calculation of Depreciation

Asset Composition

Civil Structure

Composing ratio in the assets	85 %
Average service life	45 years
Salvage at the end of life	10 %

Pipeline

Composing ratio	15 %
Average service life	25 years
Salvage at the end of life	10 %

Composite rate of depreciation

$$\frac{1 - 0.1}{45} \times 85 + \frac{1 - 0.1}{15} \times 15 = \underline{2.24\ \%\ \text{(per annum)}}$$

REPUBLIC OF INDONESIA

FEASIBILITY STUDY FOR SMALL AND MEDIUM SIZED TOWNS WATER SUPPLY PROJECTS IN SULAWESI

FINAL REPORT

Vol. 5 : BAUBAU

NOVEMBER 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

FEASIBILITY STUDY FOR
SMALL AND MEDIUM SIZED TOWNS WATER SUPPLY PROJECT
IN SULAWESI
THE REPUBLIC OF INDONESIA

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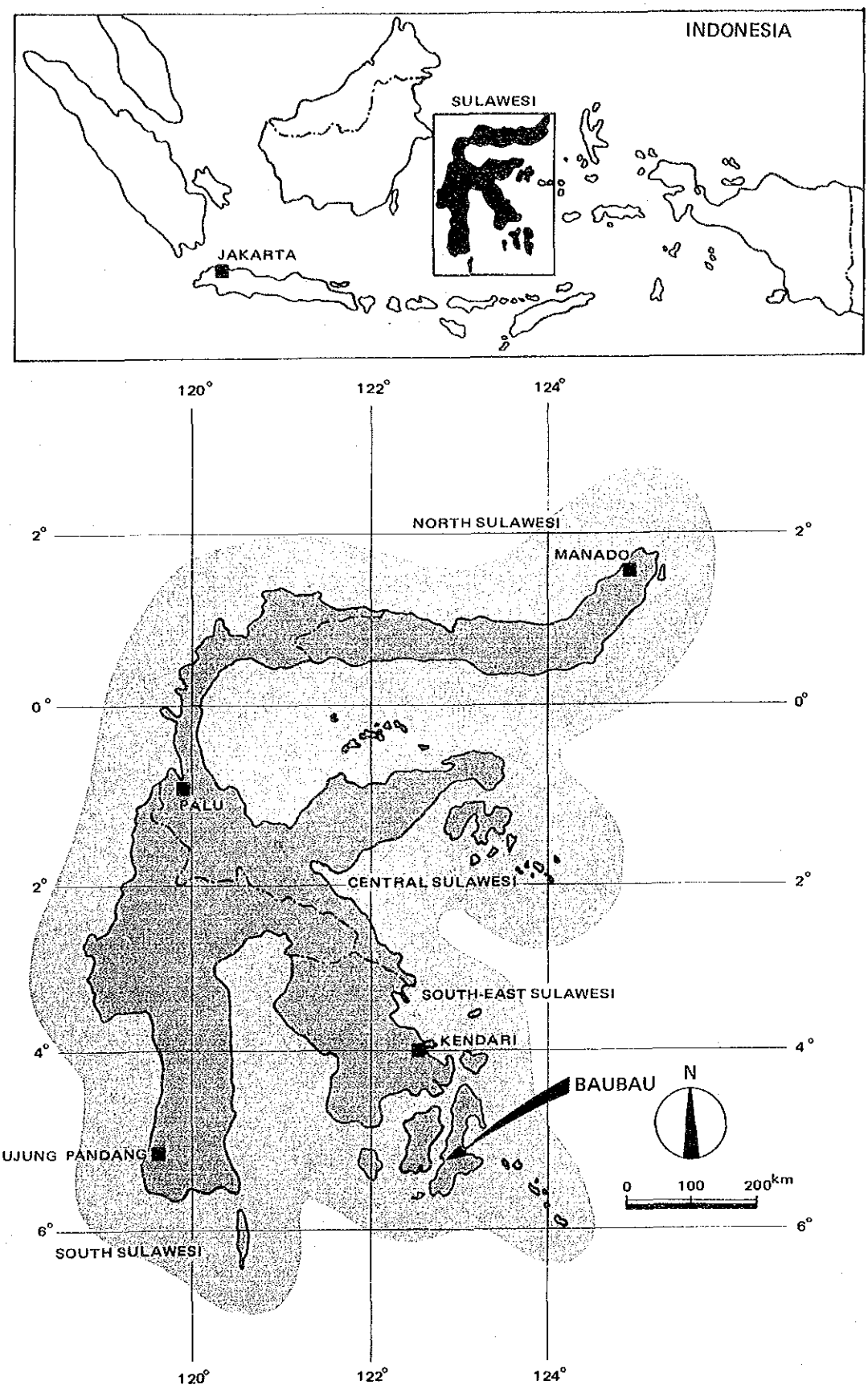
LIST OF ABBREVIATIONS

CIPTA KARYA	- the Directorate General of Housing, Building, Planning and Urban Development
DSE	- the Directorate of Sanitary Engineering, CIPTA KARYA
JICA	- the Japan International Cooperation Agency
The existing Report or the Report	- "Feasibility Study dan Master Plan Sistim Penyediaan Air Minum for Baubau" prepared by P.T. Ciriajasa Total Design
sq km	- square kilometer
kg/sq cm	- kilogram per square centimeter
ha	- hectare
%	- percentage
°C	- degree centigrade
l/sec	- liter per second
l/c/d	- liter per capita per day
cu m/d	- cubic meter per day
cu m/m	- cubic meter per month
ppm	- parts per million by weight
mg/l	- miligram per liter
pH	- potential of Hydrogen
FTU	- function turbidity unit
ACP	- asbestos cement pipe
PVC	- polyvinyl chloride pipe
CIP	- cast iron pipe
DCIP	- ductile cast iron pipe
GSP	- galvanized steel pipe
SP	- steel pipe



LOCATION MAP OF STUDY AREA

I. GENERAL

1-1 Introduction

The Government of the Republic of Indonesia intends to implement the Small and Medium Sized Towns Water Supply Projects in the frame of PELITA III, and has requested the Government of Japan to carry out a Feasibility Study for five towns in Sulawesi. In response to such request the Government of Japan decided to conduct the Feasibility Study for the projects, and the Study Team was dispatched to carry out the study, covering a period from March to August 1980, by the Japan International Cooperation Agency, the official agency responsible for implementation of the Technical Cooperation Program of the Government of Japan.

This report, the Feasibility Study for Baubau Water Supply System, has been prepared, based on review of the existing Feasibility Study Report (the existing Report) by the Directorate of Sanitary Engineering, Cipta Karya, Ministry of Public Works, and on Team's own surveys conducted during the study period for the above mentioned project. The report describes the result of review and presents a recommended system to be constructed with a target year of 1985, together with an estimated cost of the project and an implementation schedule thereof, all based on the said review.

The report also deals with necessary funds required for construction of the proposed system with potential sources of financing and financial feasibility of the project. Considerations are given to establishing a suitable organization, which will perform the operation and maintenance of the system after completion. This organization is to be established along the basic policy lines of Cipta Karya.

It is to be noted that this report does not contradict the above mentioned existing Report, but replenishes it with additional studies and analysis, on the basis of supplemental data and information. In compiling the report, quotations or reproductions from the existing Report have been