APPENDIX H

RURAL ROAD

APPENDIX H RURAL ROAD

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APPENDIX H RURAL ROAD

1. THE PRESENT CONDITION OF THE ROADS

The Baguio-Bontoc national road passes through the central area of La Trinidad city where the Study area comprises, provincial roads and barangay road branching off from the national road to communicate with each peripheral villages (see Fig. H.1.1).

The Study area, which is located in the Central Cordillera mountains, is composed of three (3) zones, i.e. Zone I, II and III. Zone I is located in the flat land called the Trinidad Valley, whereas the Zone II and III are located in the steep mountainous area. In Zone I, national and provincial loop roads are laid out around the agricultural land of some 200 has. in area distributed in the center of the Trinidad basin, so that the road maintenance and improvement have properly advanced. On the contrary, in Zone II and III, most of the roads are constructed along the ridge on the side of the mountains, and connecting roads with villages are scarce. Verification and inventory data of the provincial and barangay roads are summarized in Table H.1.1 and H.1.2.

(1) Zone I

Zone I situated in a flat area, an urbanization is well advanced and road rehabilitation and maintenance are also well executed. The Baguio-Bontoc national road passes through the center of La Trinidad city. national (Pico-Puguis) and provincial (Puguis-Poblacion) loop roads with 2-lanes, 6 meters width are laid out around the agricultural land of some 200 ha in area distributed in the center of the Trinidad basin, and thus, the road maintenance and improvement are well in progress. Main public buildings in Zone I are Provincial office, Mayor's office, Benguet State University, General hospital, which are located along the national road. The majority of residences has been built along the loop road, each barangay is communicated by that road.

(2) Zone II

The national road passes at the southern boundary of Zone II, the provincial roads and barangay roads are branching off from the national road to communicate with each barangays. Most of the roads are constructed along the ridge on the side of the mountains, the steep road with gradients more than 15 percent is 2.1 kms (17 percent) out of the total road length. The loop road are constructed in Cruz, Alapang and south of Bahong contiguous to the national road. The total area 310 ha of agricultural land is expanded in the sloped land, roads for agricultural transportation in agricultural land and communication roads between barangays are very scarce.

Two (2) roads Camp Dangwa-Alno route and Camp Dangwa-Sadag route shown below are the main roads in Zone II, descend steeply toward the north.

a) Camp Dangwa to Alno route

The Camp Dangwa-Alno route leads to Tuel and Pangablan city in the Municipality of Tublay contiguous to the north of the Municipality of La Trinidad. The road is well maintained with the road width of 4.5 meters, there are many automobile traffic for transportation of farm products. As the result of the traffic volume survey in September 1987, some 100 trucks were marked at the intersection on the national road.

b) Camp Dangwa to Sadag route

Camp Dangwa to Sadag route was constructed along the ridge of the mountains, comes to the end at Sadag. The road width is about three (3) meters, 60 percent of the total agricultural lands in the Project area is located along this road.

c) Tomay-Bahong Proper route

Tomay-Bahong Proper route is forming a loop road with Camp Dangwa-Sadag route in the north of Bahong. The daily traffic volume attained 30 - 60 vehicles.

d) Samuyao-Alapang route

Samuyao-Alapang route is forming a loop road with Cruz-Samuyao road in Alapang.

e) Cruz-Samuyao-Peril route

Land slide is occurring in the section between Cruz and Samuyao, the slope is very steep. The road width between Samuyao and Peril is some 4 - 5 meters, and the route comes to the end at Peril.

(3) Zone III

Zone III (Bineng) is located at three (3) kms from the north of Zone I. Two (2) roads, Capitol-Bineng Proper-Yapos route and Buyagan-Wangal-Yapos route connect with Zone I and Zone III (Bineng). Capitol-Bineng Proper-Yapos route is shorter than Buyagan-Wangal-Banenbeng route, thus, the former is well used. The roads are constructed along the side of the mountains, the road width excluding shoulder ranges 2.5 - 3.5 meters. Gradients of the road is generally very steep, the section with the gradients of more than 15 percent is 1.85 kms (30 percent) out of the total length of 6.4 km. In addition to the mentioned above, the road surface pavement with calcareous stone causes wheel slip on the road and consequent traffic inexpediency. The daily traffic volume was attained some 30 vehicles caused by a bad condition of the road. The road connecting between Bineng to Boleweng is also in bad condition, the section with the gradients of more than 15 percent is 1.2 kms (46 percent) out of the total length of 2.6 km.

The survey results of the existing road gradient are shown in Table H.1.3.

2. DEVELOPMENT PLAN OF THE RURAL ROADS

2.1 Basic Concept

The purposes of the development plan of rural roads are as follows :

1) realization of highly productive agriculture
2) activation of the regional economy
3) improvement of social capital
4) improvement of conditions for settlement

As for realization of highly productive agriculture mentioned above, the followings are enumerated in detail :

a) Saving of vehicle operation cost

- introduction of transportation vehicle with road rehabilitation and new construction
- speed up with road maintenance
- shortening of transportation range

b) Laborsaving for farming practice

c) Improvement of farm production

- lightening of farm products damage with road widening and pavement
- prevention farm products from a dust cause by traffic

Increment of land use value, increase of farm products variety and extension of market would be expected, moreover, activation of social activity and increased demand of employment, materials would be accelerated.

2.2. Field Survey

2.2.1 The basic data for the road planning

The basic data for the road planning are enumerated below :

(1) Temperature

- Monthly mean temperature

(Unit : °C)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
16.8	17.2	18.6	19.9	20.2	20.6	20.1	19.9	19.8	19.6	18.9	17.6	19.1

BSU PAGASA 1977-1987

- Monthly maximum temperature

(Unit : °C)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
22.2	23.0	24.5	25.0	24.4	24.4	23.6	23.5	23.6	23.8	23.8	23.0	25.0

BSU PAGASA 1977-1987

- Monthly minimum temperature

(Unit : °C)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
11.3	11.3	12.7	14.8	15.8	16.8	17.0	16.8	16.2	15.5	14.3	12.6	11.3

BSU PAGASA 1977-1987

The monthly mean temperature ranges between 16.8 and 20.6 °C, and the variation in maximum and minimum temperature ranges within 14 °C.

(2) Rainfall

- Annual mean rainfall 3,575 mm (BSU PAGASA 1977-1987)
- Annual maximum rainfall 4,524 mm (- ditto -)

- Monthly mean rainfall

(Unit : mm)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
13.6	7.5	28.1	89.6	404.4	434.2	652.9	950.4	554.5	243.2	169.9	27.0	3,575.3

BSU PAGASA 1977-1987

- Monthly mean rainy days

(Unit : days)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
3	2	4	10	19	22	25	29	24	17	10	4	169

BSU PAGASA 1977-1987

- Maximum monthly daily (hourly) rainfall

	Maximum Daily Rainfall	Year	Maximum Hourly Rainfall	Year
1.	979.4	1967	113.4	1974
2.	781.4	1974	109.1	1980
3.	730.3	1980	78.2	1964
4.	709.6	1986	74.4	1951
5.	649.7	1968	72.0	1978

2.2.2 Land use

The land use in Project area is classified into five categories i.e., upland crop field, lowland rice field, resident/commercial area, forest/grass land and others. The areas in each Zone are estimated as shown below :

(Unit : ha)

Land use	Zone I	Zone II	Zone III	Total
1. Agricultural land				
Upland field	210	310	60	580
Lowland field	0	6	40	46
2. Swamp	4	0	0	4
3. Residential/Commercial	67	30	5	102
4. Forest/grass	0	264	295	559
5. Others	9	70	50	129
Total	290	680	450	1,420

The details are shown in Appendix B 2.5 and 2.6 .

Zone I is characterized by large occupation ratios of upland crop fields (73 percent) and resident/commercial area (23 percent). The occupation in Zone II is upland crop fields (46 percent), residential/commercial areas (4 percent) and the rest is mostly forest and grass land. Agricultural land in Zone III occupies 21 percent of the total area, and the rest is mostly forest and grass land on steep slope.

Gradual slopes have been reclaimed with effective erosion control, terracing, the rest i. e., forest and grass land on steep slope is not suitable for agricultural land exclusive of proceeding to the orcharding.

In Zone I, residential and commercial areas are densely congested along the road, and have a marked tendency to increase in population. Meanwhile, in Zone II and Zone III, majority of the residences are built up along the road, few residences are studding in the agricultural land.

2.2.3 Socio-economic

(1) Population

The population in each Zone is shown as below :

	Population			Population growth rate (%)		
Zone	1975	1980	1985	1975-1980	1980-1985	1975-19885
Zone I	10,052	13,126	14,028	5.5	1.3	3.4
Zone II	4,020	4,660	6,339	3.0	6.3	4.7
Zone III	1,263	1,478	1,611	3.2	1.7	2.5
Total	15,335	19,264	21,978	4.7	2.7	3.7

(2) The working population by industry

The rate occupied with agriculture in each Zone is as below :

Zone	Rate (%)
Zone I	24.1
Zone II	55.2
Zone III	68.5

The table shows that the inhabitants in Zone II, III are occupied mainly with agriculture. The rests are occupied with commerce and industry.

2.3 Development Plan of the Rural Roads

2.3.1 Route alignment

Rehabilitation and new construction of roads in the Project area will be designed by taking consideration of harmony with the natural conditions, dimensions and configurations of the beneficial areas, layout and the structure of the existing roads and conditions and density of traffic. Basically, the scheme aims to improve synthetically the regional agricultural productivity and to accelerate the activation of social activity be forming a road network. The routes of the rehabilitation and new construction roads are shown in Fig. H.2.1.

(1) Zone I

In Zone I situated in a flat area, urbanization is well advanced and road rehabilitation and maintenance are also well executed. The national road from Baguio to Bontok forming a part of loop road is a two-lane road with concrete pavement, its traffic volume marked 7,300 vehicles per day including that of big buses and trucks. Loop road consists of national road and provincial road section. Loop road also has two-lane, and its maintenance and improvement with concrete pavement are well in progress. The majority of residences has been built along the loop road, each barangay is communicated by that loop road. For these reason, a development plan concerning to the road rehabilitation and new construction in Zone I is not schemed.

(2) Zone II

The loop road was constructed in Cruz, Alapang and south of Bahong contiguous to the national road. While, the roads in Peril (Alapang), Alno, Sadag (Bahong) located away from the national road are constructed on the ridge and the side of mountains, and farm to market roads and communication roads between barangays are very scarce. Thus, rehabilitation works of existing roads and construction of new roads to form a road network are planned in order to improve an agricultural productivity and to accelerate regional social activities. The routes of the construction roads are shown in Fig.H.2.2.

The traffic volume on the main roads, Camp Dangwa-Alno route and Camp Dangwa -Sadag route marked 100 - 150 vehicles and 800 pedestrians per day.

(3) Zone III

Zone III (Bineng) is located three (3) kms of the distance to the north of Zone I. The Balili river cuts off a place from communication between Zone III and Zone II. A maintenance condition of the road between the Capitol and Bineng is very poor, This is a serious obstacle to traffic communication and regional development. The traffic volume of Capitol-Bineng route marked 30 vehicles per day.

Thus, the scheme should comprise a rehabilitation works for this road as well as the road between Bineng and Boleweng located to the north of Bineng. In addition to this, the new road which connects each road stretching down the Bineng plateau are planned The route of the construction road is shown in Fig. H.2.3.

The total length to be rehabilitated or new constructed is shown as follows :

	Existing road length	Construction road length	Total length
Zone II	13,900 m	5,000 m	18,900 m
Zone III	8,700 m	2,800 m	11,500 m

The details is below :

- The rehabilitation roads 9 routes Total length 22.6 km

Route				Length
1. Zone II		7 routes	Total length	13.9 km
1)	Samuyao-Peril route			2.0 km
2)	Samuyao-Alapang route			1.1 km
3)	Camp Dangwa-Alno route			3.8 km
4)	Camp Dangwa-Bahong Proper-Sadag route			3.4 km
5)	Tomay-Bahong Proper route			1.3 km
6)	Camp Dangwa-Mae-Bahong route			0.7 km
7)	West Alno-East Alno route			1.6 km
2. Zone III		2 routes	Total length	8.7 km
1)	Capitol-Bineng Proper-Yapos route			6.2 km
2)	Bineng Proper-Boleweng route			2.5 km

- New construction roads 5 routes Total length 7.8 km

Route				Length
1. Zone II		4 routes	Total length	5.0 km
1)	North Sadag-East Alno route			1.5 km
2)	Sadag-East Alno route			1.6 km
3)	North Bahong-Alapang Proper route			0.9 km
4)	East Alno-Peril route			1.0 km
2. Zone III		1 route	Total length	2.8 km
1)	Boleweng-Lower Bineng route			2.8 km

2.3.2 Preliminary design of the rural roads

(1) Basic design criteria

A standard road section is determined in consideration of the following factors :

1) Traffic volume estimated at the Project target year (10 years after)

2) Type of design vehicles

3) Design speed

a. Design daily traffic volume

Daily design traffic volume of the rehabilitated roads and newly constructed roads at the Project target year is estimated to be 150 - 500 vehicles per day on the assumption that an yearly increase rate of vehicles is estimated as 5 percent against the present traffic volume of 100 - 300 vehicles per day.

b. Type of design vehicles

Design vehicles are as follows :

Vehicle	Vehicle width
Passenger car	1.7 m
Truck (below 2 ton)	2.0 m
Jeepney	2.0 m

Design vehicles were determined taking account of the result of the traffic volume survey.

c. Design speed

Design speed is set as the maximum safe speed that can be maintained over a specified section of road where conditions are so favorable.

As for the development plan, the design speed is to be designed for a speed of 30 kms per hour. If necessary, due to a topographic condition, in very difficult or steep terrain, it might be useful to reduce the speed to a minimum of 20 kms per hour.

(2) Standard section of the roads

In consideration of the basic criteria as above-stated, the following dimensions are derived for a road standard section :

a. Lane width

The lane width is determined on the basis of the design traffic volume taking account of the design vehicle type.

1) In case by design traffic volume

Design traffic volume and the lane width are given below :

Traffic volume (vehicle/day)	Lane width (m)
over 4000	6.5
4000 to 1500	6.0
1500 to 500	5.5
less than 500	5.0 - 2.5

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2) In case by type of the design vehicles

The lane width is determined by the sum of a vehicle width and 0.3 meter wide of clearance on either side.

3) Lane width

The lane width of 3 meters is given in consideration of as following :

1) Existing road ranges from two (2) to three (3) meters width.

2) Heavy vehicle is not considered as the design vehicle.

3) Design daily traffic volume is estimated less than 500 vehicles.

In consideration of above-stated, the following dimensions are derived for a road standard section ;

a) Lane width : 3.0 m
b) Shoulder : 0.5 meters for each side of the road
c) Soft shoulder : 0.5 meters guarding the top of slope against collapse.

The road width 4.0 meters including shoulders are required to the passing or stopping of vehicles, refuge of pedestrians, protection of facilities laying underground and securing of sight distance.

Widening at sharp curves is desirable due to the fact that, same radius at the front wheel. The following widening should be applied on the inside edge.

Radius	Widening
40 - 80 m	0.6 m
over 60 m	0.3 m
less than 40 m	0.6 - 1.0 m

In due regard to the fact that the Project area has a seasonal heavy rainfall, the lane and shoulder parts of the roads shall be paved with concrete or gravel in principals.

(3) Vertical alignment of the roads

Vertical alignment of the existing roads shall not be changed in consideration of the topographical restriction and the increase of a large amount of construction cost involved. The maximum gradient of the roads shall be designed at 8 percent for a newly constructed road.

(4) Pavement and drainage facilities

As the Project area has heavy seasonal rainfall, a severe road surface erosion by rainfall occurs on the steep roads. Therefore, the lanes of the roads rehabilitated shall be paved with concrete and appropriate drainage facilities such as a gutter shall be installed.

In case that the installation of the gutter will cause any disadvantages or difficulties for the Project, a waterway road having a function of waterway for drainage shall be allowed for.

As for the newly constructed roads, the drainage facilities such as gutters shall also be involved, and the roads shall be paved with gravel.

Adequate openings across the road shall be made for the passage of surface water. The capacity of opening i.e. pipe culverts and box culverts is calculated by the Talbot's Formula for expediency. Table H.2.1 and Table H.2.2 show the required sizes of pipe and box culverts necessary for corresponding drainage area.

Table H.1.1 Provincial Road Verification and Inventory (1/2)

As of Date : November 5, 1976

Municipality of La Trinidad

	Name of Road	Verified Length and Width								Total Length	Shoulders	
		Concrete		Asphalt		Gravel		Earth				
		Length (km)	Ave. Width (m)	Length (km)	Ave. Width (m)	Length (km)	Ave. Width (m)	Length (km)	Ave. Width (m)	(km)	Type	Width (m)
1.	Alno-Pangablan Road Km. 260.086-262.435	-	-	-	-	0.860	2.9	1.489	2.9	2.349	Earth	0.5
2.	Camp Dangwa-Alno-Tuel-Balway Road Km. 256.910-265.460	-	-	0.240	3.2	5.505	3.3	2.805	2.9	8.550	Earth	0.5-1.5
3.	Bayan Park-Ambiong-Lubas-Tawang-Tomay Road Km. 253.385-250.985	0.230	3.0	0.050	3.0	0.925	3.0	5.795	2.9	7.000	Earth	1.0
4.	Beckel-Balangabang Road Km. 255.425-259.825	-	-	0.100	3.0	0.660	3.2	3.640	2.8	4.400	Earth	1.0-1.8
5.	Buyagan-Wangal-Banengbeng Road Km. 257.389-263.389	0.070	3.0	-	-	3.000	2.8	2.930	2.8	6.000	Earth	0.5-0.8
6.	Camp Dangwa-Bahong-Sadag Road Km. 257.830-272.145	-	-	0.559	3.0	0.500	2.8	6.117	2.8	7.176	Earth	0.5-1.0

Table.H.1.1 Provincial Road Verification and Inventory (2/2)

As of Date : November 5, 1976

Municipality of La Trinidad

	Name of Road	Verified Length and Width								Total Length	Shoulders	
		Concrete		Asphalt		Gravel		Earth				
		Length (km)	Ave.Width (m)	Length (km)	Ave.Width (m)	Length (km)	Ave.Width (m)	Length (km)	Ave.Width (m)	(km)	Type	Width (m)
7.	Km. 12 (shilan)-Pagal-Talingting Road Km. 260.195-262.700	-	-	-	-	0.805	3.0	1.700	3.0	2.505	Earth	0.5
8.	Km. 12 (shilan)-Sagpawa Road Km. 260.640-262.540	-	-	-	-	1.500	3.0	0.400	2.8	1.900	Earth	0.8-1.0
9.	La Trinidad Capitol-Bineng-Boleweng Road Km. 256.200-263.000	0.135	5.0	0.065	3.9	2.100	2.8	4.500	2.8	6.800	Earth	0.45-0.55
10.	Pico-Stockfarm Road Km. 256.152-258.496	1.277	6.0	1.067	3.5	-	-	-	-	2.344	Earth	0.5
11.	Suyoc-Shelan Road	-	-	-	-	4.320	3.0	1.400	3.0	5.720	Earth	1.0-1.5
12.	Suyoc-Beckel Road Km. 254.460-254.960	-	-	-	-	-	-	0.500	3.0	0.500	Earth	1.0
	Total	1.712	5.4	2.081	3.3	20.175	3.0	31.276	2.6	55.244		

Table H.1.2 Barangay Road Verification and Inventory (1/5)

As of Date : April 30, 1987

Municipality of La Trinidad

	Name of Road / Barangay	Verified Length and Width: Gravel Length (km)	Gravel Ave. Width (m)	Earth Length (km)	Earth Ave. Width (m)	Trail Length (km)	Trail Ave. Width (m)	Others Length (km)	Others Length (m)	Total Actual Length (km)	Remarks
1.	Lubas-Lamut	-	-	1.430	3.1	-	-	-	-	1.430	
	Barangay Lubas										
2.	Pines-Park-Lubas	0.125	3.0	1.109	3.0	-	-	concrete		1.380	Tire Path
	Barangay Lubas							0.146	0.60		
3.	Ambiong-Proper-Botiwtiw	0.640	3.0	0.240	3.0	-	-	-	-	0.880	
	Barangay Ambiong										
4.	Lamut-Linusod	-	-	0.690	3.0	0.400	1.500	-	-	1.090	
	Barangay Beckel										
5.	Obulan-Cemetery	0.030	3.0	0.225	3.1	0.450	0.500	-	-	0.705	
	Barangay Beckel										
6.	Ubulan-Pagal	0.291	2.7	0.620	2.7	-	-	concrete		1.053	
	Barangay Beckel							(0.142)	(3.0)		
7.	Balangbang-Timoy	-	-	1.267	3.1	-	-	concrete		1.540	
	Barangay Beckel							(0.273)	(0.90)		
8.	Lamut Elementary School	0.100	2.7	0.299	2.9	-	-	-	-	0.399	
	Barangay Ambiong										

Table H.1.2 Barangay Road Verification and Inventory (2/5)

As of Date : April 30, 1987

Municipality of La Trinidad

	Name of Road	Verified Length and Width								Total Actual Length	Remarks
		Gravel		Earth		Trail		Others			
	Barangay	Length (km)	Ave.Width (m)	Length (km)	Ave.Width (m)	Length (km)	Ave.Width (m)	Length (km)	Length (m)	(km)	
9.	Long-Balite-Pinsao	0.762	3.4	0.830	3.4	-	-	-	-	1.592	
	Barangay Puguis										
10.	Longlong-Timoy	0.055	3.0	0.337	3.1	-	-	-	-	0.392	
	Barangay Puguis										
11.	Longlong-Talingoroy	0.145	2.8	1.635	2.8	-	-	-	-	1.780	
	Barangay Wangal										
12.	Wangal River School	0.227	3.0	-	-	-	-	concrete		0.300	
	Barangay Wangal							(0.073)	(0.65)		
13.	Clinton-Gayasey	0.225	3.0	0.252	3.0	1.080	0.5	-	-	1.557	
	Barangay Wangal										
14.	Cabanao-Aponan	0.420	3.0	0.100	3.0	-	-	-	-	0.520	
	Barangay Shilan										
15.	Pagal-Pasnaan	0.350	3.0	-	-	-	-	-	-	0.350	
	Barangay Shilan										
16.	Sagpawe-Bangao	0.06	2.7	0.480	3.1	-	-	-	-	0.540	
	Barangay Shilan										

Table H.1.2 Barangay Road Verification and Inventory (3/5)

As of Date : April 30, 1987

Municipality of La Trinidad

	Name of Road / Barangay	Verified Length and Width								Total Actual Length	Remarks
		Gravel		Earth		Trail		Others			
		Length (km)	Ave. Width (m)	Length (km)	Ave. Width (m)	Length (km)	Ave. Width (m)	Length (km)	Length (m)	(km)	
17.	Sagpawe-Suyok	0.060	2.7	0.440	3.2	-	-	-	-	0.500	
	Barangay Shilan										
18.	Balangbang-Balukas	0.125	3.1	1.900	3.1	-	-	concrete		2.050	Tire Path
	Barangay Beckel							(0.025)	(0.40)		
19.	Ampasil-Stockfarm	0.235	3.0	0.802	3.0	-	-	-	-	1.037	
	Barangay Puguis										
20.	Balangbang-Sagpawe-Shilan	-	-	0.060	2.7	0.400	0.50	-	-	0.460	
	Barangay Shilan										
21.	Jappa-Connet	2.820	3.2	-	-	-	-	-	-	2.820	
	Barangay Shilan										
22.	Shilan-Jappa	0.179	3.1	0.862	3.1	-	-	concrete		1.078	Tire Path
	Barangay Shilan							(0.037)	(0.65)		
23.	Shilan-Sablang	-	-	0.460	3.1	-	-	-	-	0.460	
	Barangay Shilan										
24.	Balangbang-Balukas	0.300	3.1	1.600	3.2	-	-	-	-	1.900	
	Barangay Shilan										

Table H.1.2 Barangay Road Verification and Inventory (4/5)

As of Date : April 30, 1987

Municipality of La Trinidad

	Name of Road	Verified Length and Width								Total Actual Length	Remarks
		Gravel		Earth		Trail		Others			
	Barangay	Length (km)	Ave.Width (m)	Length (km)	Ave.Width (m)	Length (km)	Ave.Width (m)	Length (km)	Length (m)	(km)	
25.	Tomay Bahong	1.832	3.1	-	-	-	-	concrete		2.040	
	Barangay Bahong							(0.208)	(3.0)		
26.	Cruz-Tawang	0.200	2.5	-	-	0.272	1.0	-	-	0.472	
	Barangay Cruz										
27.	Cruz-Samuyao-Peril	0.156	3.0	-	-	-	-	concrete		0.240	Tire Path
	Barangay Cruz							(0.084)	(0.600)		
28.	Buyagan-Wangal-Cemetery Barangay Wangal	0.04	3.1	0.700	3.1	-	-	-	-	0.740	
29.	Little Wangal	0.380	2.8	0.640	3.0	-	-	concrete		1.070	
	Barangay Wangal							(0.050)	(3.0)		
30.	Bahong-Gold River-Beckel Barangay Beckel	-	-	2.040	3.2	-	-	-	-	2.040	
31.	Camp Holmes-Mae-Bahong Barangay Bahong	1.020	3.0	0.100	3.0	-	-	-	-	0.120	
32.	Baguio-Bontoc Rd.-Swamp-Betag Barangay Betag	0.520	3.0	0.140	3.0	-	-	-	-	0.660	

Table H.1.2 Barangay Road Verification and Inventory (5/5)

As of Date : April 30, 1987

Municipality of La Trinidad

	Name of Road / Barangay	Verified Length and Width: Gravel Length (km)	Gravel Ave.Width (m)	Earth Length (km)	Earth Ave.Width (m)	Trail Length (km)	Trail Ave.Width (m)	Others Length (km)	Others Length (m)	Total Actual Length (km)	Remarks
33.	Halsema-Sungkian-Tpmay-Bahong Barangay Bahong	0.252	3.1	0.092	2.70	-	-	concrete (0.008) concrete (0.168)	 (3.30) (0.80)	0.520	Tire Path
34.	Alapang-Samyao Barangay Alapang	0.290	2.8	0.761	3.0	-	-	-	-	1.051	
35.	Pico-Bayabas Barangay Pico	0.468	0.4	0.051	0.4	-	-	0.074	0.4	0.593	
36.	Pico-Cemetery Barangay Pico	0.03	2.6	0.140	2.7	0.07	0.75	concrete pav't. (0.090)	 (2.6)	0.33	Length included in the total road length.
		Note: The verified length in Pico-Cemetery is within the private property.									
37.	Cruz-Samuyao-Peril-Onasan Barangay Alapang	1.596	3.0	0.210	3.0	-	-	concrete (0.084)	 (0.6)	1.890	Tire Path
38.	Cruz-Tawang Barangay Tawang	0.080	2.5	0.420	3.0	0.20	0.50	-	-	0.700	
39.	Ambiong Proper Tiptop Barangay Ambiong	0.765	2.8	1.825	3.2	-	-	-	-	2.590	
	TOTAL	14.778	3.0	22.757	3.1	2.872	0.7	1.462	-	41.869	

Table H.1.3 Survey Results of the Existing Road Grade

(Unit: m)

No.	Road	Grade (%)							Total length
		0.0-4.9	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	25.0-29.9	30.0-	
1	Buyagan - Upper Wangal	400	200	530	70	100	0	0	1300
2	Buyagan - Lower Wangal	370	960	740	140	50	0	0	2260
3	Capitol - Bineng - Yapos	1600	1250	1650	1550	100	100	100	6350
4	Bineng - Boleweng	700	350	350	500	600	100	0	2600
5	Cruz - Peril	500	500	450	200	100	0	200	1950
6	Samuyao - Alapang	450	250	200	150	0	0	0	1050
7	Camp Dangwa - Alno	1500	1300	950	200	0	50	0	4000
8	Camp Dangwa - Sadag	950	550	750	750	350	0	0	3350
9	Tomay - Bahong Proper	200	500	200	350	0	0	50	1300
10	Camp Dangwa - Mae Bahong	400	200	50	50	0	0	0	700
11	West Alno - East Alno	500	350	150	350	300	0	0	1650
	Total	7570	6410	6020	4310	1600	250	350	26510

Table H.2.1 Hectares Drained by Culverts of Various Diameters
Talbot's Formula

Diameter of Culvert (inches)	Area of Waterway Opening (sq.feet)	Mountainous Country C = 1 (ha)	Rolling Country C = 1/3 (ha)	Level Country C = 1/5 (ha)
12	0.785	0.304	1.215	2.429
18	1.767	0.810	3.644	7.287
24	3.142	2.024	8.097	15.789
30	4.909	3.239	14.575	28.745
36	7.068	5.668	23.887	46.964
42	9.621	8.097	36.032	70.850
48	12.566	11.741	51.012	101.215
60	19.635	21.457	93.715	183.401

Talbot's Formula :

$A = C\,\sqrt[4]{M^3} = C\,(M^3)^{1/4}$ $\quad M = \{ (A/C)^4 \}^{1/3}$

Where : A = Required Area of Waterway in Square Feet

M = Area Drained in Acres (1ha. = 2.471 acres)

C = Coefficient

Table H.2.2 Hectares Drained by Std. Box Culverts of Various Sizes Computed by Talbot's Formula

Span (feet)	Height (feet)	Area of Waterway Opening (sq.feet)	Hectares Drained for Various Terrains: Mountainous Country C = 1	Rolling Country C = 1/3	Level Country C = 1/5
	3	12	11.117	48.103	95.053
4	4	16	16.136	70.597	139.501
	6	24	28.016	121.219	239.532
	3	15	14.970	64.774	129.996
5	4	20	21.970	95.060	187.842
	5	25	29.583	128.001	252.989
	6	30	37.721	163.212	322.512
	3	18	18.826	81.455	160.957
	4	24	28.016	121.219	239.532
6	5	30	37.721	163.212	322.512
	6	36	48.106	208.143	411.298
	7	42	59.335	256.729	507.306
	6	48	70.596	305.455	603.590
8	7	56	86.705	375.155	741.319
	8	64	103.602	448.264	884.785
	7	70	116.726	505.050	997.996
10	8	80	139.502	603.598	1,192.730
	9	90	163.224	706.238	1,395.551
	10	100	187.843	812.757	1,606.035

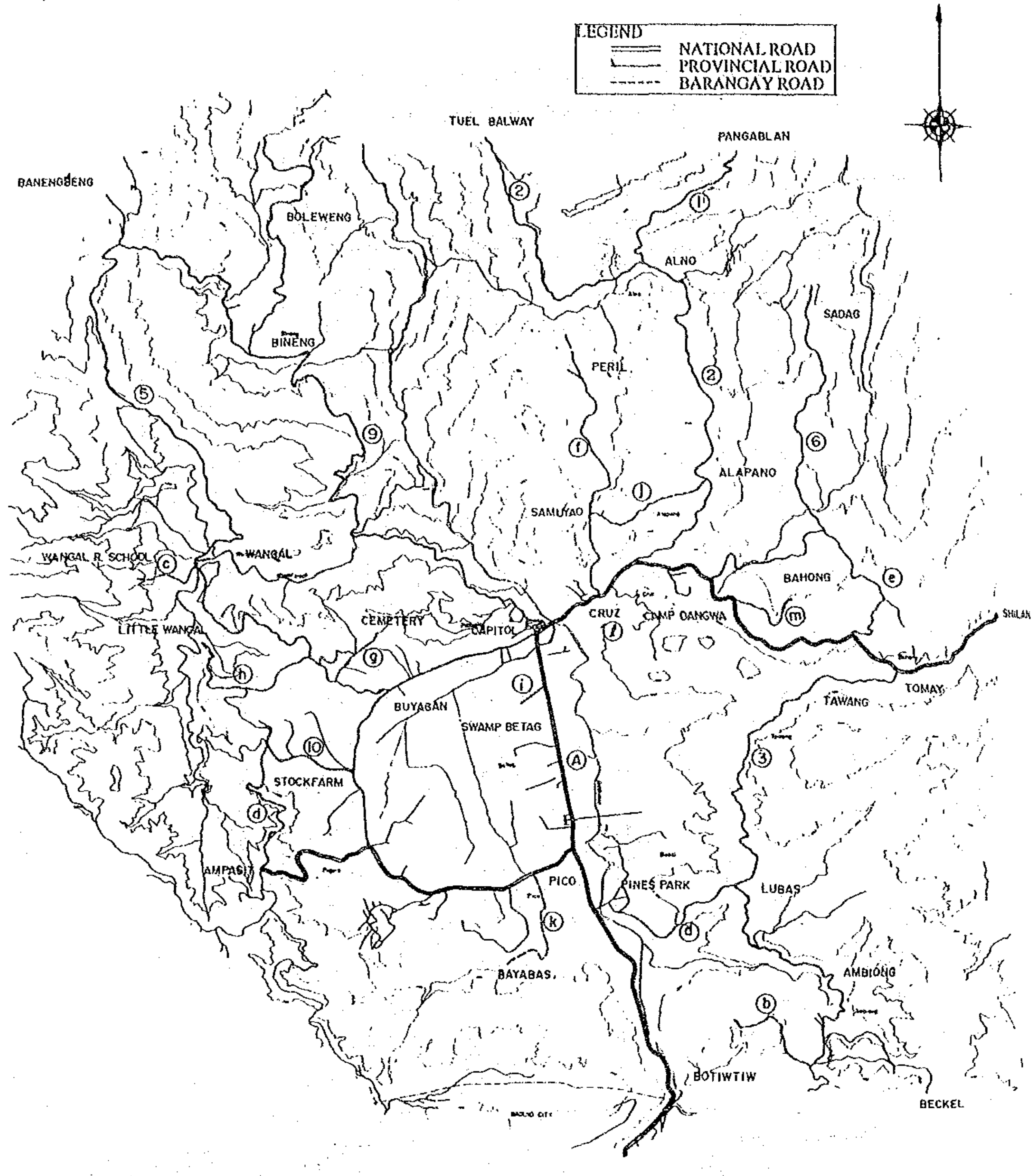
Talbot's Formula :

$A = C\sqrt[4]{M^3}$

Where : A = Area of Waterway in Square Feet

M = Area of Drained in Acres (1ha. = 2.471 acres)

C = Coefficient of Terrain



A NATIONAL ROAD

PROVINCIAL ROAD	
1.	ALNO-PANGABLAN
2.	CAMP DANGWA-ALNO-TUEL-BALWAY
3.	BAYAN PARK-AMBIONG-LUBAS-TAWANG-TOMAY
4.	BECKEL-BALANGBANG
5.	BUYAGAN-WANGAL-BANENGBENG
6.	CAMP DANGWA-BAHONG-SADAG
7.	KM 12(SHILAN)-PAGAL-TALINGTING
8.	KM 12(SHILAN)-SAGPAWA
9.	LA TRINIDAD-CAPITOL-BINENG-BOLEWENG
10.	PICO-STOCKFARM
11.	SUYOC-SHILAN
12.	SUYOC-BECKEL

BARANGAY ROAD	
a.	PINES PARK-LUBAS
b.	AMBIONG PROPER-BOTIWTIW
c.	WANGAL RIVER SCHOOL
d.	AMPASIT-STOCKFARM
e.	TOMAY-BAHONG
f.	CRUZ-SAMYAO-PERIL
g.	BUYAGAN-WANGAL CEMETERY
h.	LITTLE WANGAL
i.	SWAMP BETAG
j.	ALAPANO-SAMYAO
k.	PICO-BAYABAS
l.	CRUZ-TAWANG
m.	CAMP DANGWA-MAE BAHONG

0 500 1000m
SCALE 1 : 30 000

Fig. H.1.1 Existing Road Networks

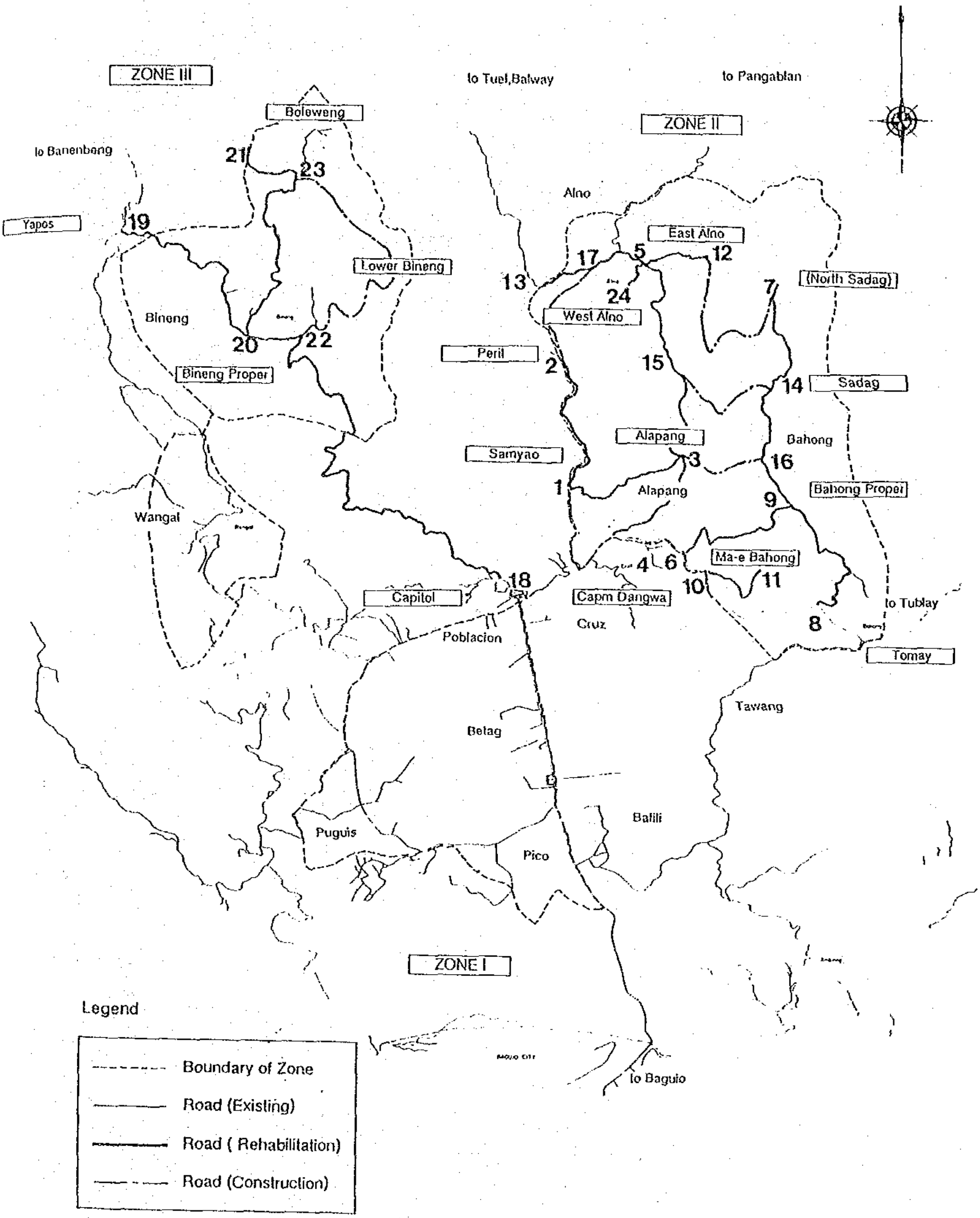


Fig. H.2.1 Plan of Road Rehabilitation and Construction

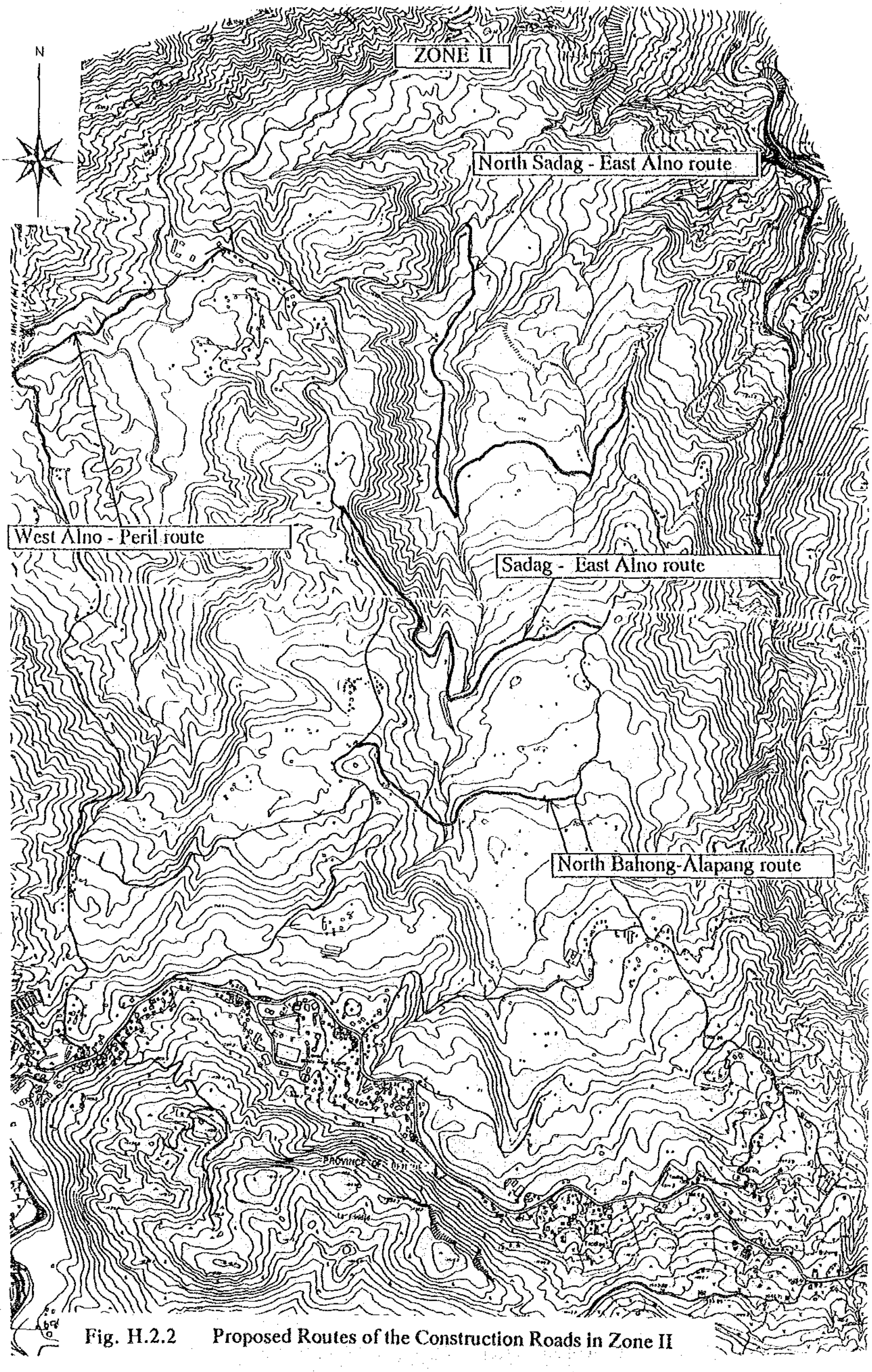


Fig. H.2.2 Proposed Routes of the Construction Roads in Zone II

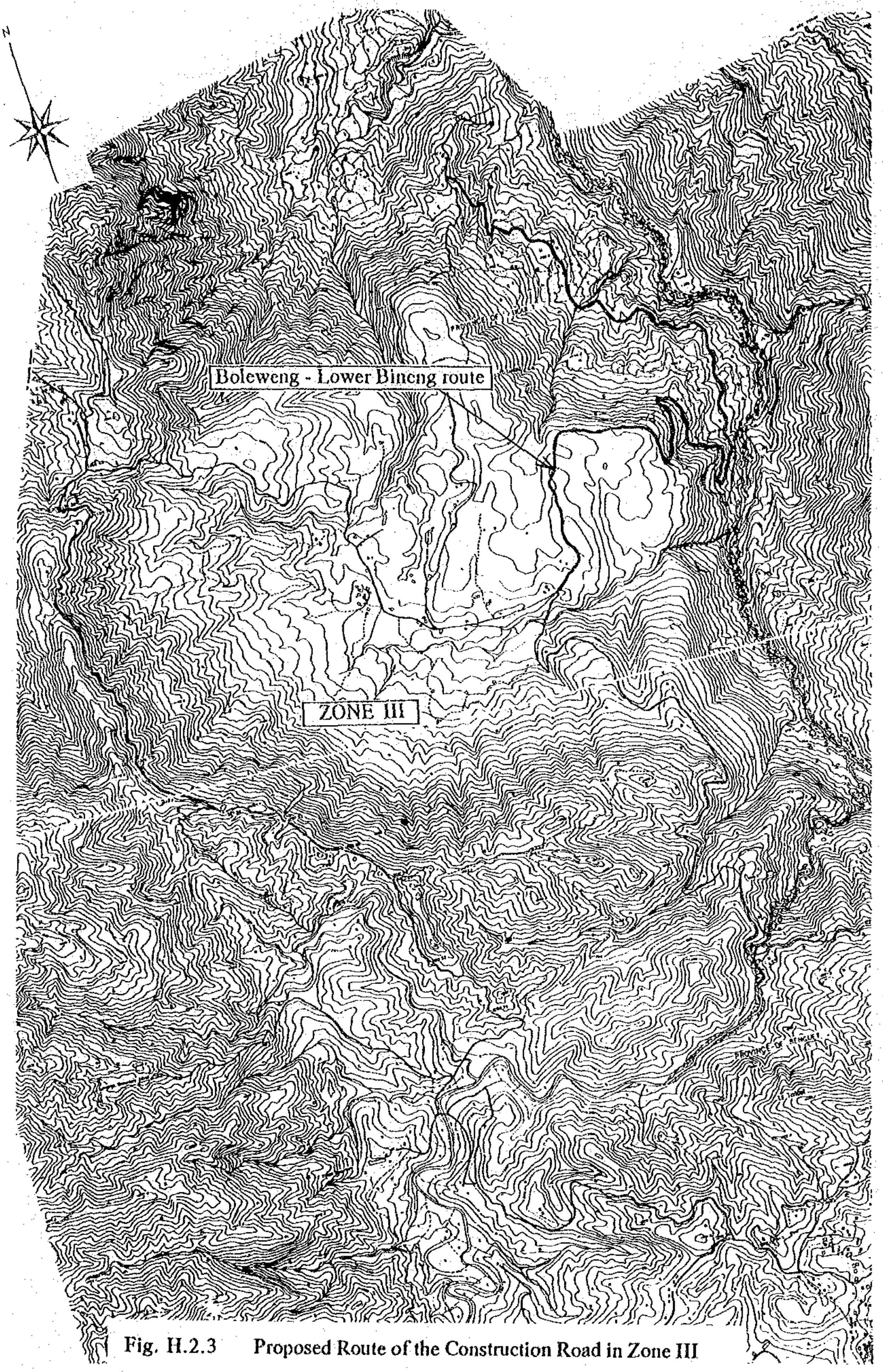
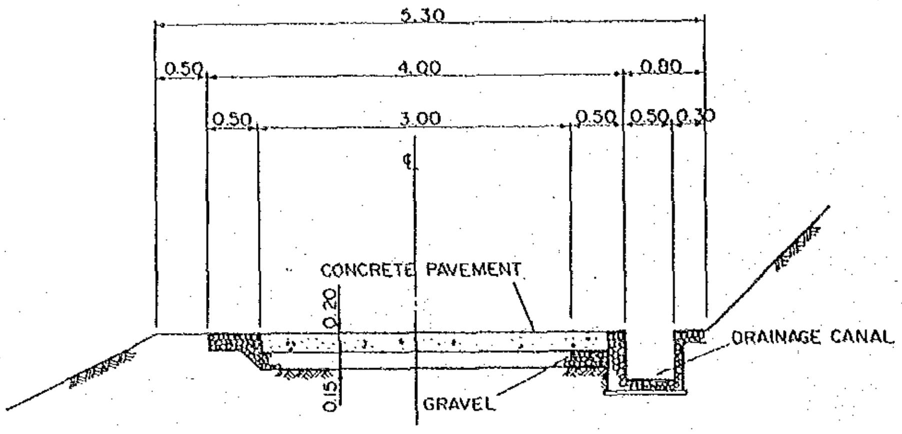
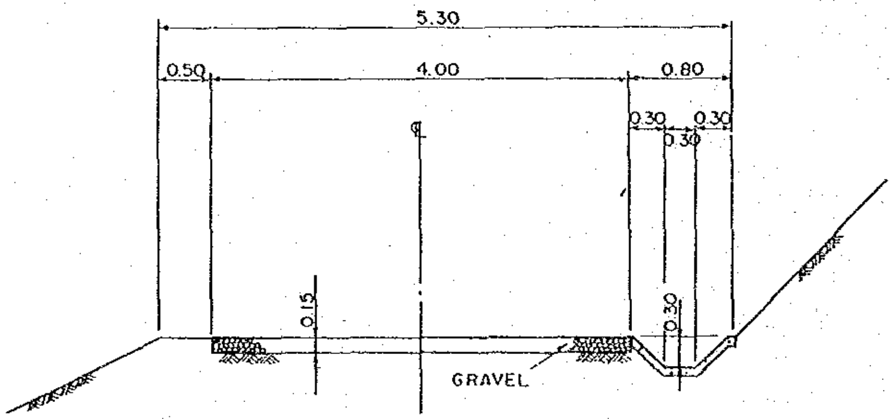


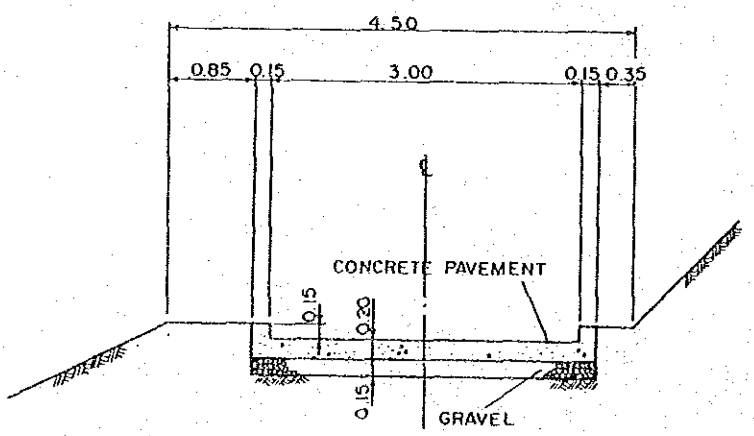
Fig. H.2.3 Proposed Route of the Construction Road in Zone III



STANDARD SECTION



STANDARD SECTION
NEW CONSTRUCTION ROAD
SCALE 1:50



STANDARD SECTION
WATERWAY ROAD

Fig. H.2.4 Standard Section of the Road

APPENDIX I

DRINKING AND DOMESTIC WATER SUPPLY

APPENDIX I DRINKING AND DOMESTIC WATER SUPPLY

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APPENDIX I DRINKING AND DOMESTIC WATER SUPPLY

1. PRESENT CONDITIONS

1.1 General

Water sources in the Municipality of La Trinidad can not meet the needs for the water development now and future. The Balili river is not suitable for the water source from the viewpoint of water quality. The domestic water supply sources (see table below) are public springs serving 1,170; water works serving 1,221; private shallow well serving 154; private deep well serving 976; public shallow well serving 181; public deep well serving 491 and stream flow serving 1,967 families. Only 20 percent of the total families are supplied from the waterworks system; the remaining 80 percent are still in want of a continuous and safe water supply. Domestic water sources of La Trinidad Municipality in 1985 are summarized as follows:

Type	Family served	%
Waterworks *	1,221	19.8
Public Deep Well	491	8.0
Public Shallow well	181	2.9
Private Deep Well	976	15.8
Private Shallow Well	154	2.5
Public spring	1,170	19.0
Stream Flow	1,967	32.0
Total	6,160	100.0

Source : RHU La Trinidad 1985
* La Trinidad Water District

Water consumption as well as the capacity of sources can not be quantified in as much as the residents have different water sources.

In addition to the scarce water sources, its potability is one factor which needs immediate attention. The majority of the water sources are open springs which are open to waterborne viruses/organisms which affect the respiratory tract and gastro-intestinal parts of the human body, so that adequate water treatment is required. Ingenious water treatment being practiced by a minority of the residents is boiling the water before drinking. The majority take the risk of drinking directly from the source. There is a vital need to develop water sources so as to deliver to the homes potable drinking water.

1.2 Water supply in the Study Area

The water supply system is well equipped in Zone I. The production, however, can not be relied upon to adequately support the needs for increasing water consumption. An 80 lit./capita-day of the water consumption is supplied to the service area including 20 percent of the system losses. Whereas 110 lit./capita-day of the water consumption is required. In addition to the above-mentioned, water supply to the high elevation area, Barangay Cruz, Alapang, is not attained because of the lack of the water capacity and pressure in the dry season.

Meanwhile, Zone II and Zone III areas are out of the service area by LTWD, so that the majority of inhabitants secure the water from springs and ground water. As the land of Zone II and Zone III descends steeply forward the north, only few springs in low elevation area provide a stable water through out the year. Nevertheless, springs in the high elevation area have no water yield in the dry season because of the drawdown of the ground water surface.

1.3 Water supply by La Trinidad Water District

1.3.1 Water supply system

LTWD (La Trinidad Water District) is operating three (3) water sources, deep well located in BSU compound and intake weirs in Ampasit and Lubas area. Daily production of water sources and the number of service connection are as follows :

a) Production

- Deep well	760 lit./min.
- Ampasit intake weir	150 lit./min. (average)
- Lubas intake weir	340 lit./min. (average)
Total	1,250 lit./min.

b) Service connection : 1,756 nos. (as of 31 May 1987)

1.3.2 Service area and water consumption

LTWD is supplying potable water to the built-up area along the National and Provincial roads, and Barangay Balili shown in Fig. I.1.1 and Fig. I.1.2. Water sources do not meet the increasing water consumption.

In respect to the above, LTWD has the ten year development plan (1983 to 1993) shown below :

Objectives :

1) To properly handle and maintain new tools and equipments including relevant technique on the new and existing water supply systems,

2) To minimize a water loss,

3) To maintain good relations between LTWD and consumers,

4) To construct administration building,

5) To develop another deep wells and water reservoirs to supplement the increasing water demand, and

6) To supply clean and good drinking water.

Implementation :

1) To conduct seminars for technical personnel on handling and operating tools, machineries and equipment,

2) To maximize a collection efficiency to fund necessary projects for the improvement of the facilities,

3) To maintain and improve the water shed areas and construct filtration tanks and basin to supplement other water sources, and

4) To constantly check and maintain the deep wells, pumps, machines and equipment.

Based on the above, LTWD has estimated the total production required below:

		1987	1988	1989	1990	1991	1992	1993
1.	Total population (service/expansion area) 4% incr/yr	21,846	22,720	23,629	24,574	25,557	26,580	27,642
2.	No. of projected service connections (20 conn/mo)	2,000	2,300	2,540	2,780	3,020	3,260	3,500
3.	Percent area supplied (6.5 members/household)	60%	66%	71%	74%	78%	81%	83%
4.	Water demand (ave gpm)							
	a. Customers (100/pcpd)	242.0	278.0	308.0	337.0	367.0	397.0	427.0
	b. Fire provisions (10%)	24.2	27.8	30.8	33.7	36.7	39.7	42.7
	c. Allowable loss (20%)	48.4	55.6	61.6	67.4	73.4	79.4	85.4
	d. Other contingencies (10%)	24.2	27.8	30.8	33.7	36.7	39.7	42.7
Total production (Req'd gpm)		338.8	389.2	431.2	475.8	513.8	555.8	597.8
Required(cu.m./mo)		57,288	65,810	72,912	80,455	86,879	93,981	101,085

1.3.3 Operation and maintenance by LTWD

The operation and maintenance of the water supply facilities executed by the LTWD are :

1) flushing of hydrants,
2) improvement of deepwell facilities,
3) inspection and maintenance of intake facilities, chlorination facilities and pipelines, and
4) extension of pipeline.

Operation and maintenance cost of LTWD in 1987 is given below :

Items	O & M cost
Chlorination	44,400₱
Pumping up expense	457,200₱
Maintenance of existing facilities	207,400₱
New construction	223,200₱
Total	932,200₱

Organization chart is shown in Fig. I.1.3. Water rates of Baguio Water District and La Trinidad Water District are shown in Table I.1.2. and Table I.1.3.

1.3.4 Development of water sources and water supply facilities

To maintain the constant yield of the spring and to maximize a delivery and supply of water, the following should be considered :

1) preservation of Lubas, Ampasit and the Wangal river watershed,

2) drilling of additional deepwells,and

3) enlarging and improvement of the present intake facilities and the replacement of the existing pipeline.

   To meet rapid increasing water demand, deepwells located in the BSU compound around,the Buyagan-Pico loop road or beyond the Camp Dangwa would be recommended.

2. DEVELOPMENT PLAN

2.1 Basic Concept

The majority of the inhabitants in the Project area secure the household water from springs and deepwells. Yield of springs and deep wells becomes to decrease in the dry season to impede the daily life.

Thus, there should be an urgent needs to develop the domestic water supply system in the area from the viewpoint of basic human needs.

2.2 Design Terms

2.2.1 General

Development plan for drinking and domestic water supply should be designed with regards for:

1) development level in accordance with that of the adjacent areas,

2) functional stability of the systems,

3) operational easiness of the facilities, and

4) effective use of the water.

2.2.2 Design terms

(1) Service area

Service areas consist of Zone II and Zone III except LTWD service area. The proposed areas are shown in Fig. I.2.1.

(2) Target year

Water demand has been set as of a decade after. Therefore, the target year is designed at the 1988.

(3) Service population

Total service population has been estimated at 11,000 persons with annual growth rate of 6 percent on the target year 1988. The present population data are indicated on Table I.2.1. Detailed service population is given in Table I.2.2.

(4) Water use

The domestic water includes miscellaneous water for agriculture use, such as livestock use, crop washing water and water for spraying fungicide.

(5) Water consumption

a. Mean daily water consumption (Mean D.W.C)

1) Drinking and domestic water supply

	Water consumption	Remarks
- Residences	120 lit./capita-day	including 20% loss
- School	24 lit./capita-day	- ditto -
- Clinic, public facilities	1,000 lit./capita-day	- ditto -

The water consumption for potable and household water has been estimated, referring from LTWD's criteria, at 120 lit./capita-day including 20 percent loss in consideration of the present water consumption.

2) Miscellaneous water use for agriculture

— Livestock use

Livestock	Water consumption	Remarks
Cattle	30 lit./no-day	including 20% loss
Pig	15 lit./no-day	- ditto -
Domestic fowl	0.5 lit./no-day	- ditto -

— Crop washing water : 500 lit./10 a. including 20% loss.

— Water for spraying fungicides : 500 lit./10 a. including 20% loss.

b. Maximum daily water consumption (Max. D. W. C)

Maximum daily water consumption is estimated on the basis of the mean daily water consumption (Mean D. W. C.)

1) Drinking and domestic water	Mean D.W.C. x 120%
2) Miscellaneous water use for agriculture	
- Livestock	Mean D.W.C. x 150%
- Crop washing water	Mean D.W.C. x 150%
- Water for spraying fungicide	Mean D.W.C. x 150%

Based on the above, total water consumption is estimated as follows :

Items	Average water Consumption (cu.m/day)	Maximum water Consumption (cu.m/day)
1. Drinking, domestic water	1,500	1,800
2. Miscellaneous water use		
- Livestock	40	60
- Washing (Spraying) water	130	200
Total	1,670	2,060

The detailed results of each water consumption have been estimated in Table I.2.3 through Table I.2.10.

2.3 Proposed Facilities

2.3.1 Flow chart of the water supply facilities

Flow chart of the water supply facilities is shown in Fig I.2.6. The flow chart shows the process of producing potable water including water purification facilities

2.3.2 Proposed facilities

(1) Water source

Deep wells are adopted as the water source because of their steady characteristics of ground water in terms of quantity and quality. Almost all creek water in the Project area has been distinguishably contaminated by bacillus. BOD and COD of the creeks water show the value of 2 to 6, and these figures are higher than that of the springs and wells water of 0 to 5. In addition to the above, springs and wells water becomes turbid and muddy even at the slight rainfall.

(2) Pumping facilities

Six (6) deepwells in Zone II and one (1) deepwell in Zone III have been designed based on the topography, geology, the pumping test result and so on. The depth of deep wells are designed at 70 to 120 m. The submersible pump is available for deep well.

(3) Service area

Six (6) service areas in Zone II and one (1) service area in Zone III have been proposed in consideration of the production capacity of the deep wells. The service areas are below:

Service Areas	Barangays
Area II-1	Bahong, Tawang
Area II-2	Bahong, Tawang
Area II-3	Bahong
Area II-4	Bahong
Area II-5	Alapang, Alno
Area II-6	Alno
Area III-1	Bineng

* Location is indicated in Fig. I.2.2 and Fig. I.2.3.

(4) Water conduit facilities

Pipeline has been introduced for the water conduit facilities taking account of the topographic conditions, the conveyance effective use and potability.

(5) Water purification facilities

Water purification system has been selected in relation to the quality of water source, volume of water required and easiness of operation and maintenance of the facilities.

Selection of Water Purification System

System	Water quality	Sedimentation pond	Remarks
Chlorine disinfection system	colitis germs (100 ml MPN)<50 common germ (1 ml)<500	- no need -	
Slow filtration system	colitis germs (100 ml MPN)<1,000 Bod<2 ppm turbidity<10	- no need -	Max turbidity<10
		- normal	Max turbidity<10 to 30
		- chemical	Max turbidity>30
Rapid filtration system	more than the above system coagulation setting basin	- chemical	Max turbidity=10
		- high rate	Max turbidity<1,000

The water purification methods operated in Baguio Water District (BWD) and LTWD are enumerated in Table I.2.9. The chlorination for each deep well and the filtration system in case that the water is turbid and muddy is adopted as the water purification facilities. Slow filtration system is available for water purification. Its capacity is estimated at less than 5 m/day in terms of the filtration velocity. Potable water standard provided by Baguio Water District is shown in Table I.2.10.

(6) Water distribution facilities

a. Volume of water distribution

Maximum hourly water consumption for drinking and domestic water use and miscellaneous use for agriculture are calculated using the equation as below :

— Drinking and domestic water use

Maximum hourly water consumption (max. H.W.C)
= 3 (coefficient) x Max.D.W.C.

— Miscellaneous use for agriculture

1) Livestock : Max. D. W. C.x 1/24 x 150%
2) Crop washing : Max. D. W. C.x 1/24 x 150%
3) Spraying fungicide : Max. D. W. C x 1/24 x 300%

b. Distributing tank

Capacity of distributing tank is determined by the following criteria.

— Capacity for drinking and domestic water

Population	Capacity
More than 5,000	Max. D. W. C x 1/24 x 8 hrs.
3,000 to 5,000	Max. D. W. C x 1/24 x 9 hrs.
2,000 to 2,000	Max. D. W. C x 1/24 x 10 hrs.
1,000 to 2,000	Max. D. W. C x 1/24 x 12 hrs.
500 to 1,000	Max. D. W. C x 1/24 x 14 hrs.
300 to 500	Max. D. W. C x 1/24 x 16 hrs.
100 to 300	Max. D. W. C x 1/24 x 18 hrs.
less than 100	Max. D. W. C x 1/24 x 20 hrs.

— Capacity for miscellaneous water use for agriculture

1)	Livestock	Max. D.W.C x 1/24 x 8
2)	Crop washing water	neglect
3)	Spraying fungicide	Max. D.W.C x 1/24 x (16 to 18)

The water supply facilities are illustrated by diagrams on Fig. I.2.4 and Fig. I.2.5.

The salient features of water supply facilities are summarized hereunder:

1.	Deep well	
	Number of deep well	7 nos.
	Casing pipe diameter	200 mm
	Well depth	70 mm(average)
2.	Pump (7 nos)	
	Pump type	Submersible pump
	Design discharge	200 lit./min. (average)
	Total head	70 - 100 m
	Required motor output	7.5 Kw
3.	Water conduit pipe	
	Pipe diameter	3" diameter
4.	Water purification facilities	7 nos.
	Water treatment method	Chlorination
	Filtration basin	as the need arises
5.	Distributing reservoir	7 nos. 150 cu.m. each
6.	Distributing pipe	
	Diameter	100 - 150 mm
7.	Common water faucet	

Table I.1.1 Water Supply Facilities (La Trinidad Water District)

MOTORS				
Location	HP Rating	Type	Hours operation	Remarks
a. Balili 1 (Old)	50	Belted close coupled		Not being utilizes due to low effeciency
	7.5	Belted close coupled	6	Used on seasonal months only
b. Balili 2 (Deep wall)	30	Submersible	20	
c. Cruz	5	Centrifugal		-
	7.5	Centrifugal	10	

PUMPS				
Location	Discharge (GPM)		Type	Hours operation
a. Balili 1 (Old)	-	-	Belted close coup	-
	100	130	Belted close coup	6
b. Balili 2 (Deep well)	200	304	Submersible	20
c. Cruz	50	150	Centrifugal	-
	100	150	Centrifugal	10

RESERVOIRS				
Location	Capacity (cum	Utilization	Construction	Remarks
a. Lubas	104.78	Storage/Distribution	1927	
b. Balili 1 (Old)	11.47	Sump tank	1977	
	89.26	Storage/Distribution	1977	
c. Cruz	250	Storage/Distribution	1982	
d. Ampasit	18.71	Storage/Distribution	1958	

Table I.1.2 Water Rates of Baguio Water District

Classification	Code	Meter Size	Minimum Charge 0 - 10 cu.m	1-20	1-30	1-31 above
Residential A/ Government	1-2	1/2"	36.00	3.60/cu.m.	3.65/cu.m.	3.75/cu.m.
	1-3	3/4"	57.75			
	1-4	1"	116.00			
	1-5	11/2"	290.70			
	1-6	2"	727.50			
	1-7	3"	1,309.90			
Residential B	1-2B	1/2"	44.50	4.45/cu.m.	4.50/cu.m.	4.60/cu.m.
	1-3B	3/4"	71.20			
	1-4B	1"	142.90			
	1-5B	11/2"	357.90			
	1-6B	2"	895.50			
	1-7B	2"	1,612.30			
Commercial A	3-2A	1/2"	72.50	7.25/cu.m.	7.25/cu.m.	7.55/cu.m.
	3-3A	3/4"	116.00			
	3-4A	1"	232.50			
	3-5A	11/2"	581.90			
	3-6A	2"	1,455.50			
	3-7A	3"	2,620.30			
Commercial B	3-2	1/2"	72.50	4.5/cu.m.	4.5/cu.m.	4.60/cu.m.
	3-3	3/4"	116.00			
	3-4	1"	232.50			
	3-5	11/2"	581.90			
	3-6	2"	1,455.50			
	3-7	3"	2,620.30			

Wholesale - P11.15/cu.m.

Water delivery : Residential - P4.00/drum
Commercial - P6.00/drum

Table I.1.3 Water Rates of La Trinidad Water District

	Commodity Charge			
	Min. Charge	11 - 20 cu.m.	21 - 30 cu.m.	31 - Over
Residential	P58.20/cu.m.	P3.45/cu.m.	P5.05/cu.m.	P7.05/cu.m.
Commercial	P116.40/cu.m.	P6.90/cu.m.	P10.10/cu.m.	P14.10/cu.m.

Table I.2.1 Barangay Population

Barangay	Year		
	1975	1980	1985
Alapang	938	1,058	1,697
Alno	954	886	1,043
Bahong	1,490	1,514	2,010
Bineng	590	669	718
Tawang	638	1,202	1,589
Total	4,610	5,329	7,057

Popuration growth rate 1975-1985 4.3(%)
1980-1985 5.8(%)

Table I.2.2 Designed Population

Area	Year	
	1988	1998
Area II-1	950	1,700
Area II-2	950	1,700
Area II-3	1,000	1,790
Area II-4	600	1,070
Area II-5	950	1,700
Area II-6	900	1,610
Area III-1	780	1,400
Total	6,130	10,970

Table I.2.3 Water Consumption

Area	Water supply	Mean daily water supply (cu.m/day)	Max. daily water supply (cu.m/day)
Area II-1	Drinking & Domestic	221	265.2
	Livestok	4.5	6.8
	Washing & Spraying	17.0	25.5
	Total	242.5	297.5
Area II-2	Drinking & Domestic	242.6	291.1
	Livestok	4.5	6.8
	Washing & Spraying	17.0	25.5
	Total	264.1	323.4
Area II-3	Drinking & Domestic	232.8	279.4
	Livestok	7.9	12.0
	Washing & Spraying	17.0	25.5
	Total	257.7	316.9
Area II-4	Drinking & Domestic	138.9	166.7
	Livestok	4.7	7.1
	Washing & Spraying	21.7	32.6
	Total	165.3	206.4
Area II-5	Drinking & Domestic	244.8	293.8
	Livestok	7.3	11.0
	Washing & Spraying	15.7	23.6
	Total	267.8	328.4
Area II-6	Drinking & Domestic	217.1	260.5
	Livestok	7.1	10.7
	Washing & Spraying	18.3	27.5
	Total	242.5	298.7
Area III-1	Drinking & Domestic	187.5	225.0
	Livestok	6.1	9.3
	Washing & Spraying	26.7	40.1
	Total	220.3	274.4
Total	Drinking & Domestic	1484.7	1518.4
	Livestok	42.1	63.7
	Washing & Spraying	133.4	200.3
	Total	1660.2	2045.7

Table I.2.4 Mean of Water Consumption

Area	Design population for water consumption (housing) Mean daily consumption Max. daily consumption	Design population for water consumption (school) Mean daily consumption Max. daily consumption	Medical,Community water consumption Mean daily consumption Max. daily consumption	Total Mean daily consumption Max. daily consumption
Area II-1	1,700.0	-	3.4 nos	
	204.0	-	17.0	221.0
	244.8	-	20.4	265.2
Area II-2	1,700.0	900.0	3.4 nos	
	204.0	21.6	17.0	242.6
	244.8	25.9	20.4	291.1
Area II-3	1,790.0	-	3.6 nos	
	214.8	-	18.0	232.8
	257.8	-	21.6	279.4
Area II-4	1,070.0	-	2.1 nos	
	128.4	-	10.5	138.9
	154.1	-	12.6	166.7
Area II-5	1,700.0	990.0	3.4 nos	
	204.0	23.8	17.0	244.8
	244.8	28.6	20.4	293.8
Area II-6	1,610.0	330.0	3.2 nos	
	193.2	7.9	16.0	217.1
	231.8	9.5	19.2	260.5
Area III-1	1,400.0	230.0	2.8 nos	
	168.0	5.5	14.0	187.5
	201.6	6.6	16.8	225.0
Total	10,970.0	2,450.0	21.9 nos	
	1,316.4	58.8	109.5	1,484.7
	1,579.7	70.6	131.4	1,781.7

Unit : Mean daily consumption (cu.m/day)

Max. daily consumption (cu.m/day)

Table I.2.5 Water Consumption for Livestock

Area	Mean daily water consumption				Max. daily water consumption			
	Cattle	Swine	Fowl	Total	Cattle	Swine	Fowl	Total
Area II-1	1.5	2.6	0.4	4.5	2.3	3.9	0.6	6.8
Area II-2	1.5	2.6	0.4	4.5	2.3	3.9	0.6	6.8
Area II-3	2.7	4.5	0.7	7.9	4.1	6.8	1.1	12
Area II-4	1.6	2.7	0.4	4.7	2.4	4.1	0.6	7.1
Area II-5	2.5	4.2	0.6	7.3	3.8	6.3	0.9	11
Area II-6	2.4	4.1	0.6	7.1	3.6	6.2	0.9	10.7
Area III-1	2.1	3.5	0.5	6.1	3.2	5.3	0.8	9.3
Total	14.3	24.2	3.6	42.1	21.7	36.5	5.5	63.7

Table I.2.6 Water Consumption for Cattle

Area	No. of cattle	No. of farmhouse	Water consumption (lit./nos.day)	Mean daily water consumption (cu.m/day)	Max. daily water consumption (cu.m/day)
Area II-1	0.3	170	30.0	1.5	2.3
Area II-2	0.3	170	30.0	1.5	2.3
Area II-3	0.3	300	30.0	2.7	4.1
Area II-4	0.3	180	30.0	1.6	2.4
Area II-5	0.3	280	30.0	2.5	3.8
Area II-6	0.3	270	30.0	2.4	3.6
Area III-1	0.3	230	30.0	2.1	3.2
Total		1600		14.3	21.7

Table I.2.7 Water Consumption for Swine

Area	No. of swine	No. of farmhouse	Water consumption (lit./nos.day)	Mean daily water consumption (cu.m/day)	Max. daily water consumption (cu.m/day)
Area II-1	1.0	170	15.0	2.6	3.9
Area II-2	1.0	170	15.0	2.6	3.9
Area II-3	1.0	300	15.0	4.5	6.8
Area II-4	1.0	180	15.0	2.7	4.1
Area II-5	1.0	280	15.0	4.2	6.3
Area II-6	1.0	270	15.0	4.1	6.2
Area III-1	1.0	230	15.0	3.5	5.3
Total		1600		24.2	36.5

Table I.2.8 Water Consumrtion for Domestic Fowl

Area	No. of swine	No. of farmhouse	Water consumption (lit./nos.day)	Mean daily water consumption (cu.m/day)	Max. daily water consumption (cu.m/day)
Area II-1	4.5	170	0.5	0.4	0.6
Area II-2	4.5	170	0.5	0.4	0.6
Area II-3	4.5	300	0.5	0.7	1.1
Area II-4	4.5	180	0.5	0.4	0.6
Area II-5	4.5	280	0.5	0.6	0.9
Area II-6	4.5	270	0.5	0.6	0.9
Area III-1	4.5	230	0.5	0.5	0.8
Total		1600		3.6	5.5

Table I.2.9 Water Consumption for Washing and Spraying Fungicide

Area	Farm area (ha)	Mean daily water consumpti (cu.m/day)	Max. daily water consumption (cu.m/day)
Area II-1	51	17.0	25.5
Area II-2	51	17.0	25.5
Area II-3	51	17.0	25.5
Area II-4	65	21.7	32.6
Area II-5	47	15.7	23.6
Area II-6	55	18.3	27.5
Area III-1	80	26.7	40.1
Total	400	133.4	200.3

Mean daily water consumption = Farm area/15days x 5.0 cu.m/ha.day

Table I.2.10 Max. Hourly Water Consumption

No.	1	2	3	4	*5	*6	1+6
Area	Drinking and Domestic water (cu.m/hr)	Livestock water (cu.m/hr)	Spraying fungicide (cu.m/hr)	Washing (cu.m/hr)	(cu.m/hr)	(cu.m/hr)	Max. hourly water consumption (cu.m/hr)
Area II-1	33.2	0.4	3.2	1.1	3.2	3.6	36.8
Area II-2	36.4	0.4	3.2	1.1	3.2	3.6	40.0
Area II-3	34.9	0.8	3.2	1.1	3.2	3.9	38.8
Area II-4	20.8	0.4	4.1	1.4	4.1	4.5	25.3
Area II-5	36.7	0.7	3.0	1.0	3.0	3.6	40.3
Area II-6	32.6	0.7	3.4	1.1	3.4	4.1	36.7
Area III-1	28.1	0.6	5.0	1.7	5.0	5.6	33.7

Value of *5 is the biggest water consumption among No.2 - No. 4.

Value of *6 means the 1.5 hr. water consumption of total amount of max. hourly water consumption on No.2 - No. 4.

Table I.2.11 Water Sources and Purification Facilities Operated by Water District

BAGUIO WATER DISTRICT
Baguio City

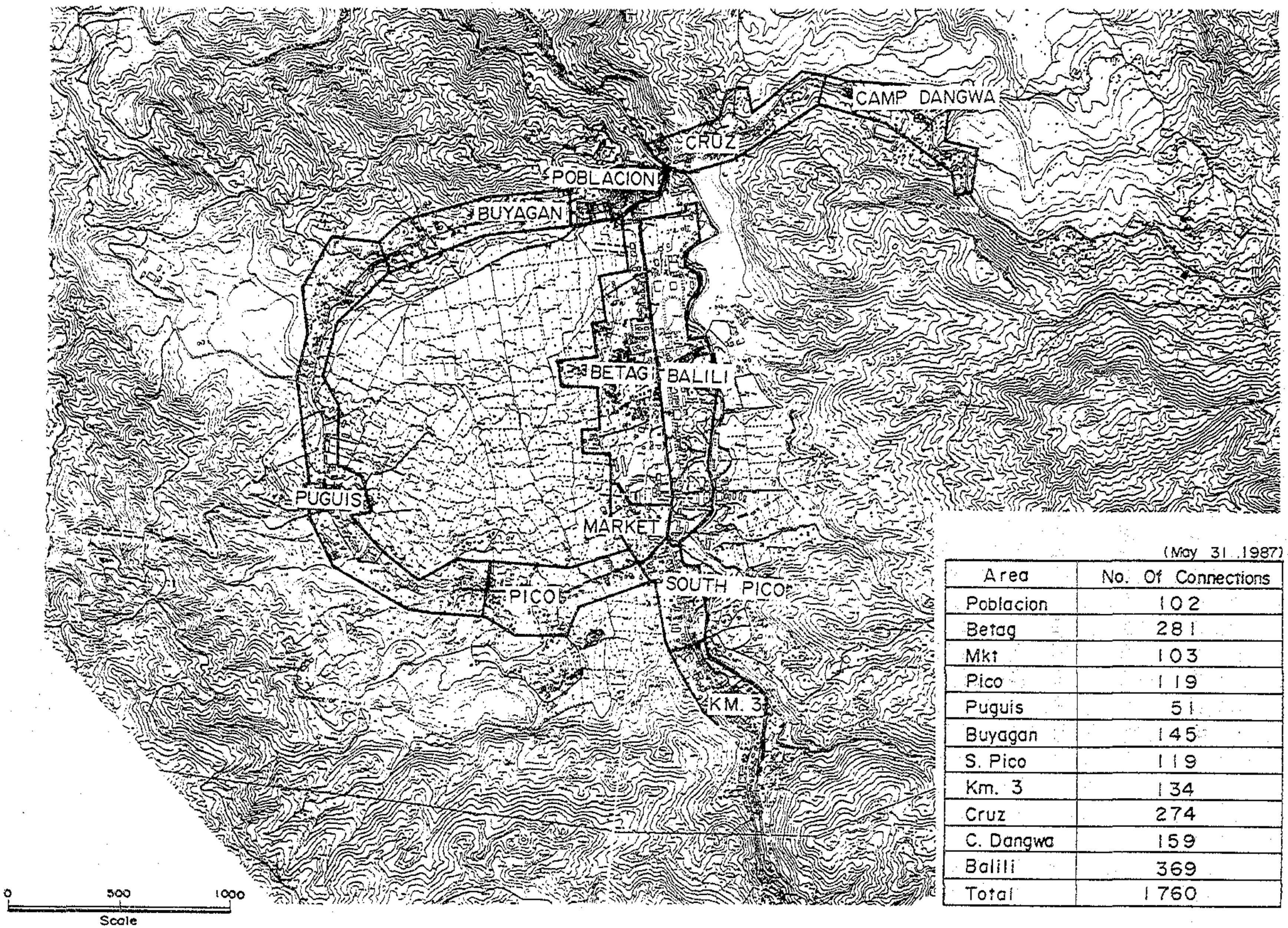
Water Sources	Water Purification
Deepwells	
1. Amparo 1	Gas Chlorination
2. Amparo 2	Gas Chlorination
3. Milo	Gas Chlorination
4. Harrison	Gas Chlorination
5. MRR	Gas Chlorination
6. Market	Gas Chlorination
7. Athletic Bowl	Gas Chlorination
8. Camp 8	Aeration, Sand Filtration, Chlorination
9. Labsan	Gas Chlorinatio
10. Cabinet	Gas Chlorination
11. Happy Glenn	Gas Chlorination
12. P. Burgos	Gas Chlorination
13. Skating Rink	Gas Chlorination
14. Kisad	Gas Chlorination
15. Ramsey	Gas Chlorination
16. Palos	Gas Chlorination
17. Riverwell	Gas Chlorination
18. M.Roxas	Gas Chlorination
19. Evangelista	Gas Chlorination
20. Idisan	Gas Chlorination
21. Ambiong	Gas Chlorination
22. Amsing	Gas Chlorination
23. Pacdal	Gas Chlorination
24. Gibraltar	Gas Chlorination
25. Teachers Camp	Gas Chlorination
26. Ferguson	Gas Chlorination
27. Guisad	Gas Chlorination
28. Easter	Gas Chlorination
29. Buyog	Gas Chlorination
Open Sources (Rainy Season)	
1. Amliang	Gas Chlorination
2. Lamut Spring	Gas Chlorination
3. Idisan Spring	Gas Chlorination
4. Amsing Spring	Gas Chlorination
Boosters	
1. Military Cut Off	
2. Bonifacio	
3. DPWH	
4. Upper Quezon Hill	
5. City Camp	
6. Stage I	
7. Phil-Am	

LA TRINIDAD WATER DISTRICT
La Trinidad City

Water Sources	Water Purification
Deepwells	
1. LTWD Well	Gas Chlorination
Open Sources	
1. Lubas Spring	
2. Ampasit	
Boosters	
1. Tawang	

Table I.2.12 Potable Water Standard (Baguio Water District)

Allowable colon bacillus	:	2.2 count per 100 ml
Allowable chlorine residential	:	0.2 - 1.0 mg/lit.
Permissible limit for chemical substances		
Total solids	:	500 mg/lit.
Iron (Fe)	:	0.3 mg/lit.
Manganese (Mn)	:	0.1 mg/lit.
Copper (Cu)	:	1.0 mg/lit.
Zinc (Zn)	:	5.0 mg/lit.
Calcium (Ca)	:	75.0 mg/lit.
Magnesium (Mg)	:	50.0 mg/lit.
Sulfate (SO4)	:	200.0 mg/lit.
Chloride (Cl)	:	200.0 mg/lit.
pH range	:	7.0 - 8.5
Bacteriocidal examination of water	:	Multiple fermentation tube technic



(May 31 .1987)

Area	No. Of Connections
Poblacion	102
Betag	281
Mkt	103
Pico	119
Puguis	51
Buyagan	145
S. Pico	119
Km. 3	134
Cruz	274
C. Dangwa	159
Balili	369
Total	1760

Fig. I.1.1 Water Supply Area (La Trinidad Water District)

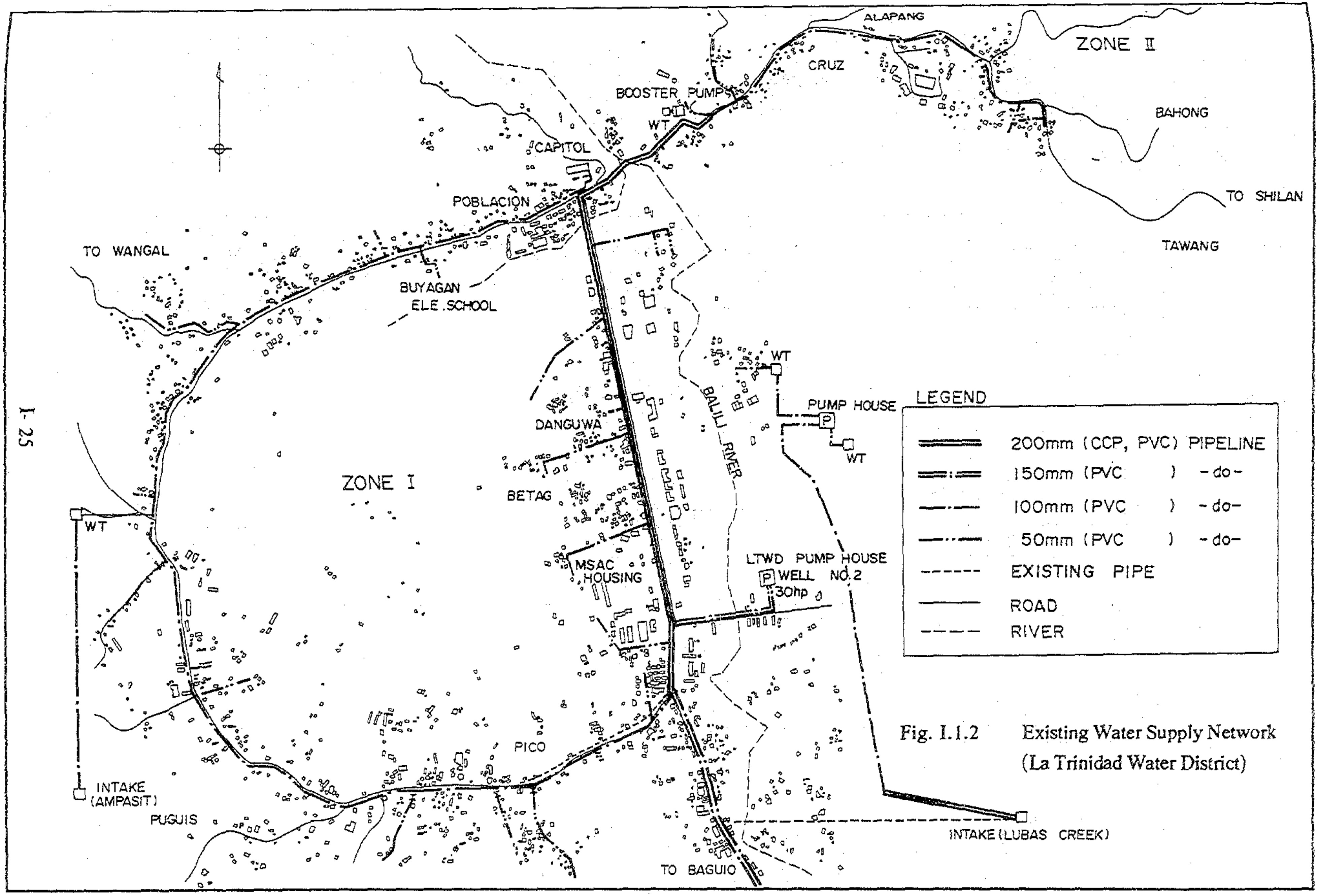


Fig. I.1.2 Existing Water Supply Network (La Trinidad Water District)

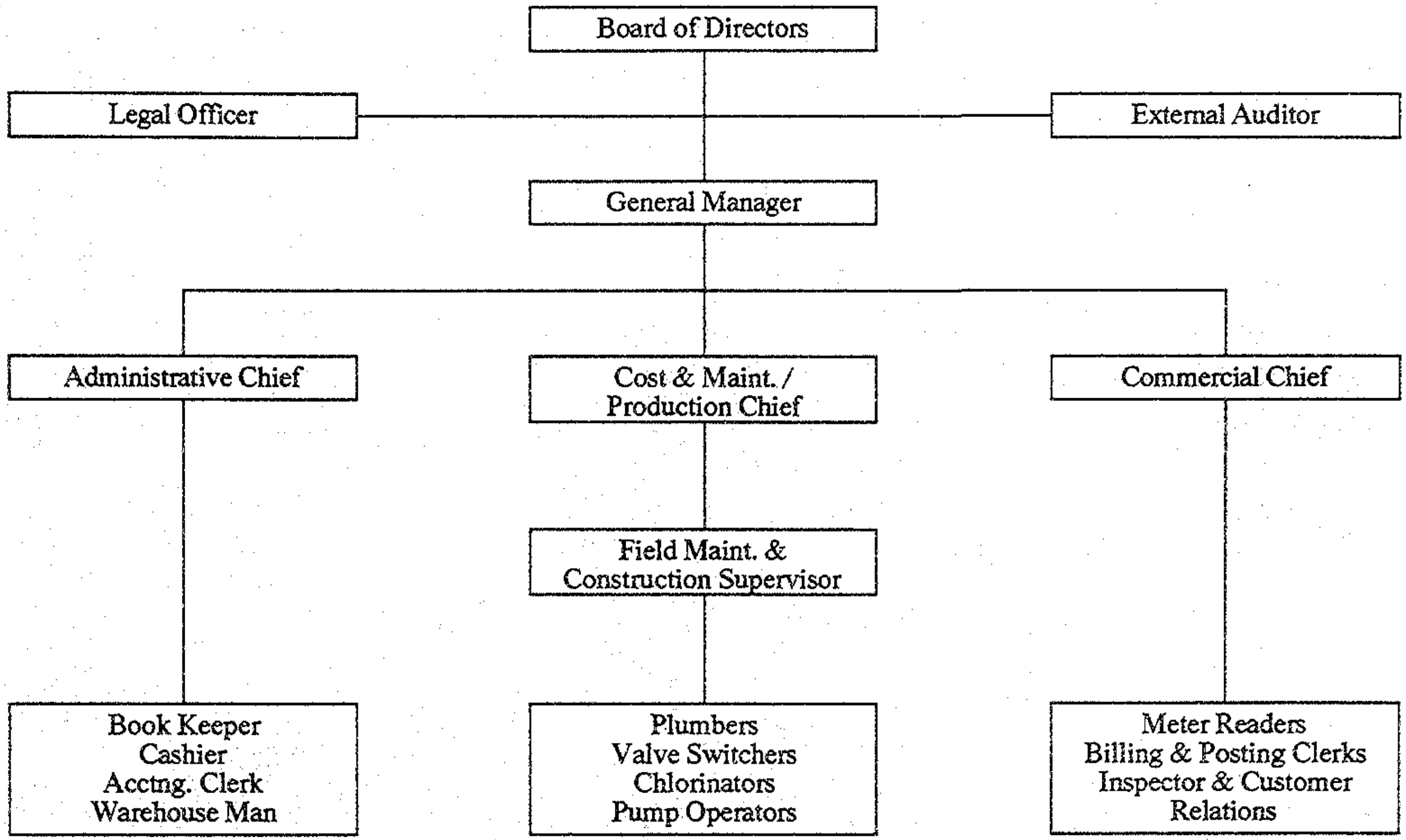


Fig. I.1.3 La Trinidad Water District Organization Chart

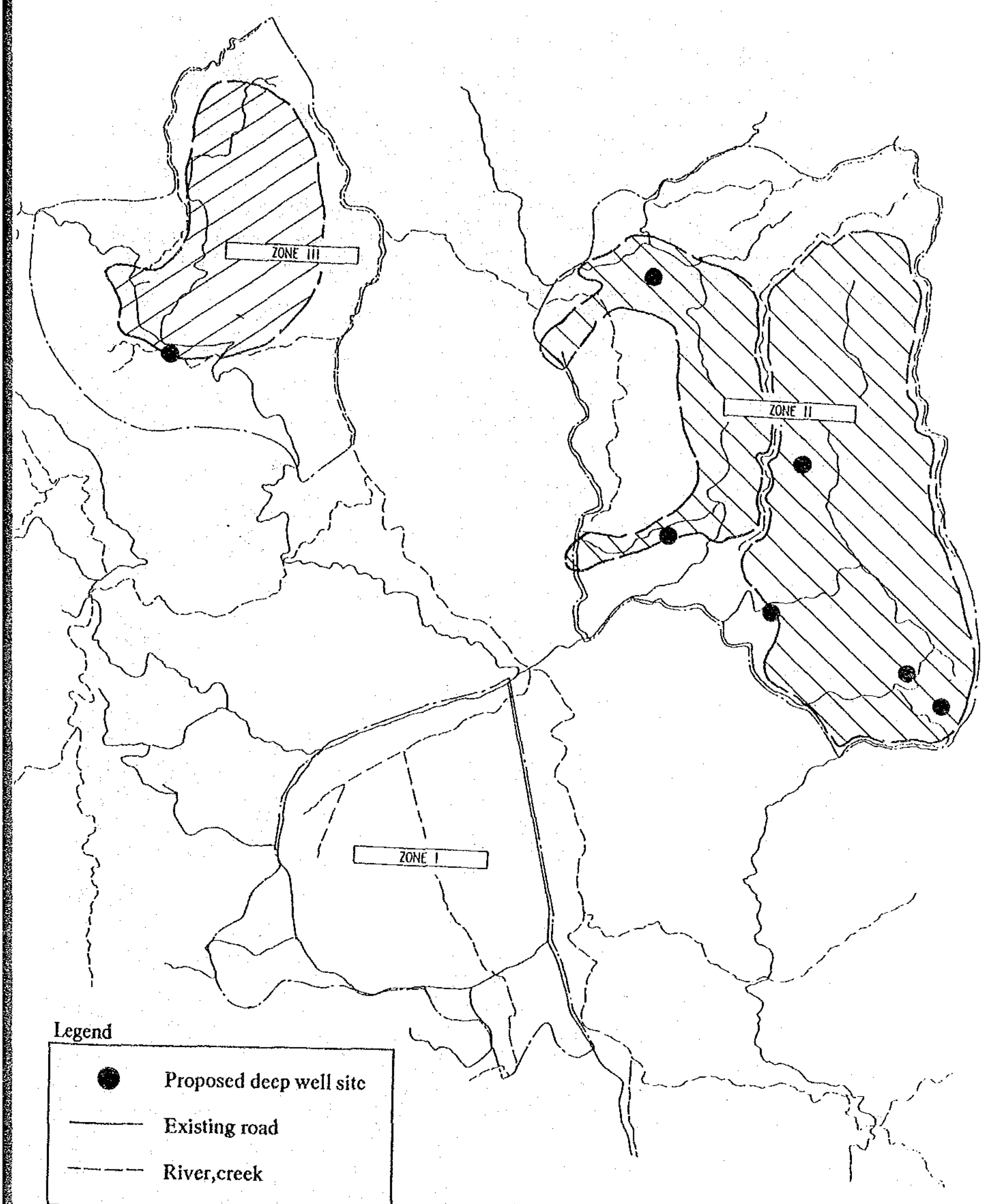


Fig. I.2.1 Water Supply Area

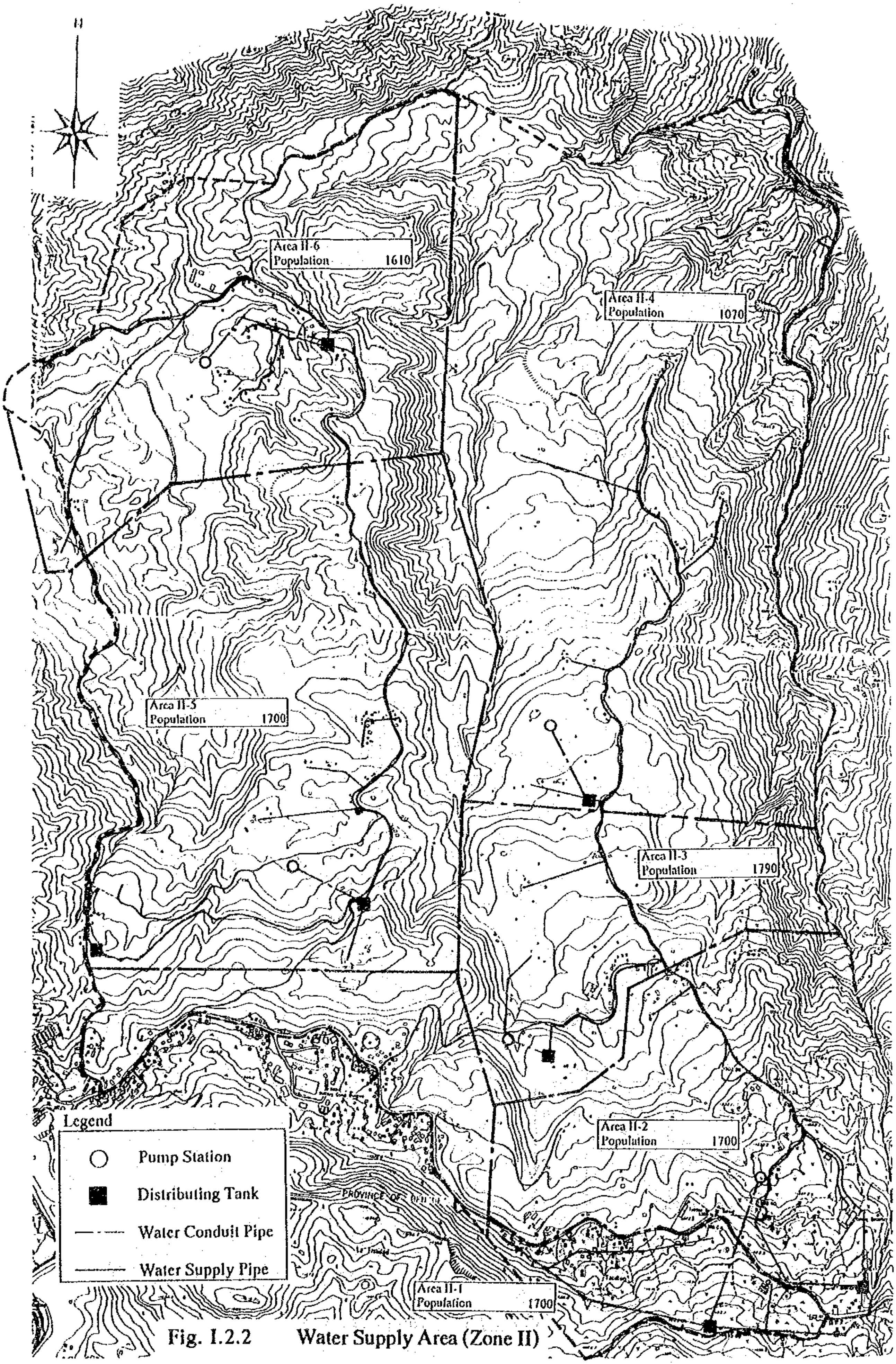


Fig. I.2.2 Water Supply Area (Zone II)

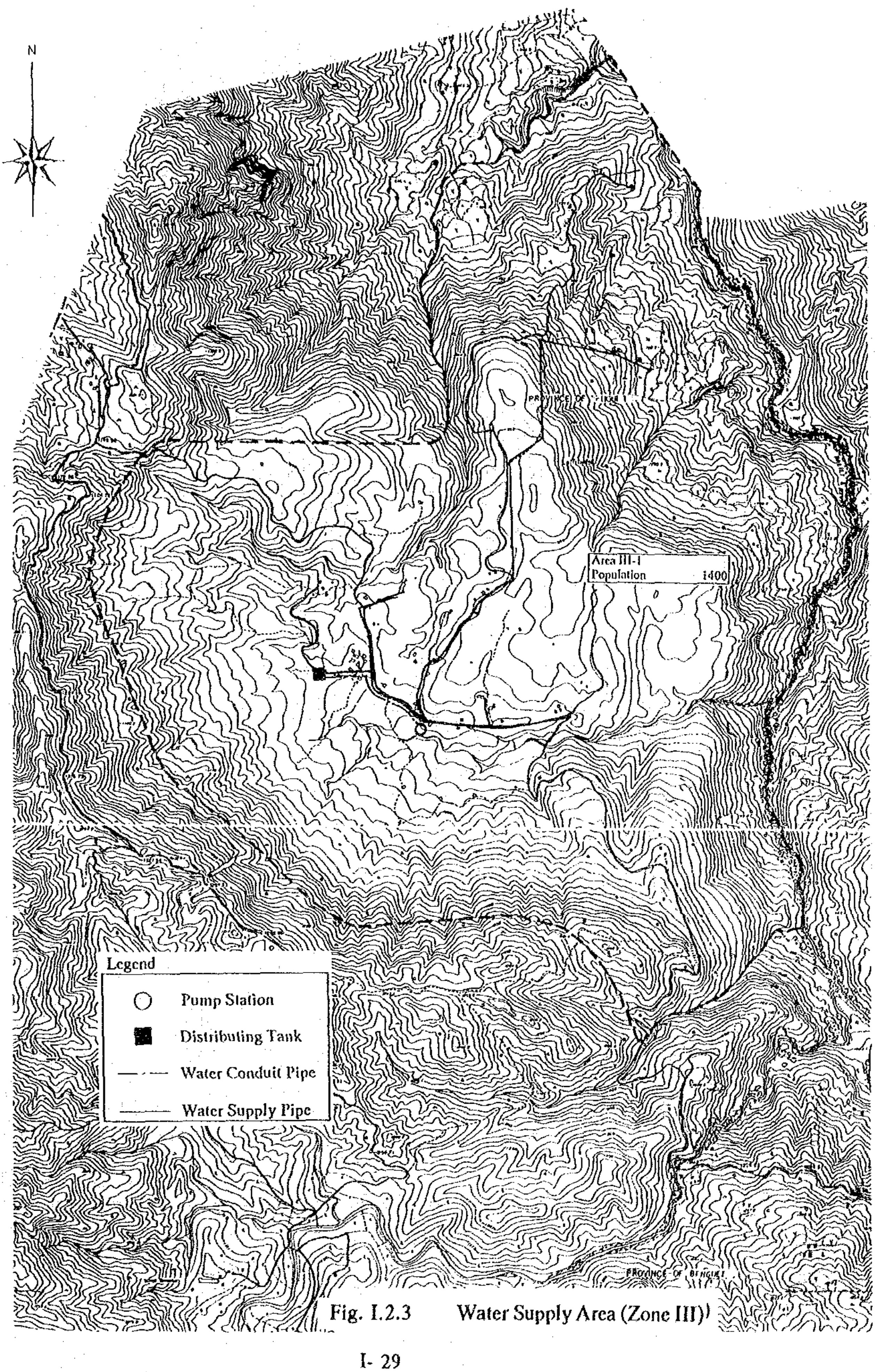


Fig. I.2.3 Water Supply Area (Zone III)

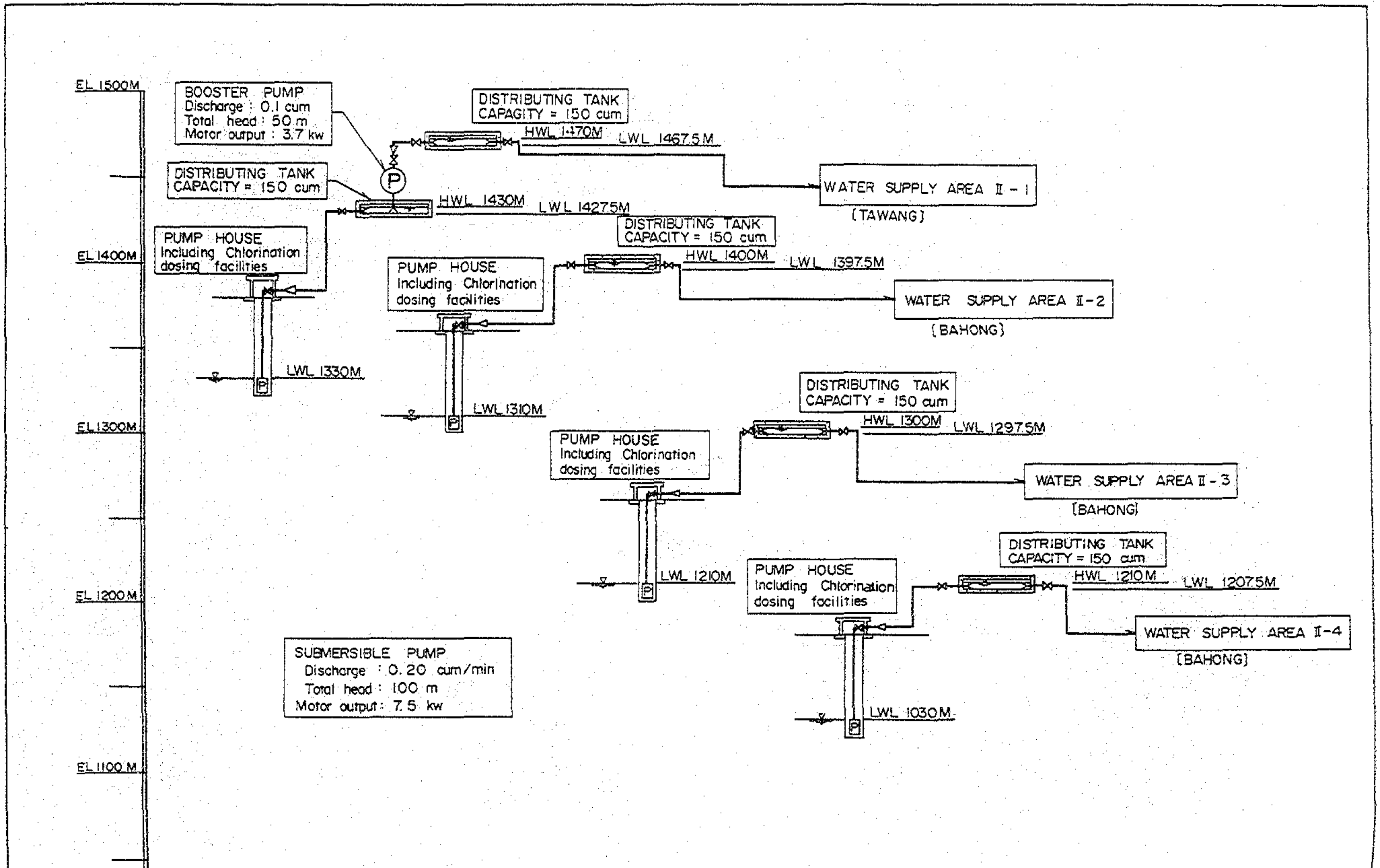


Fig. I.2.4 Plan of Water Supply Facilities (Zone II) (1/2)

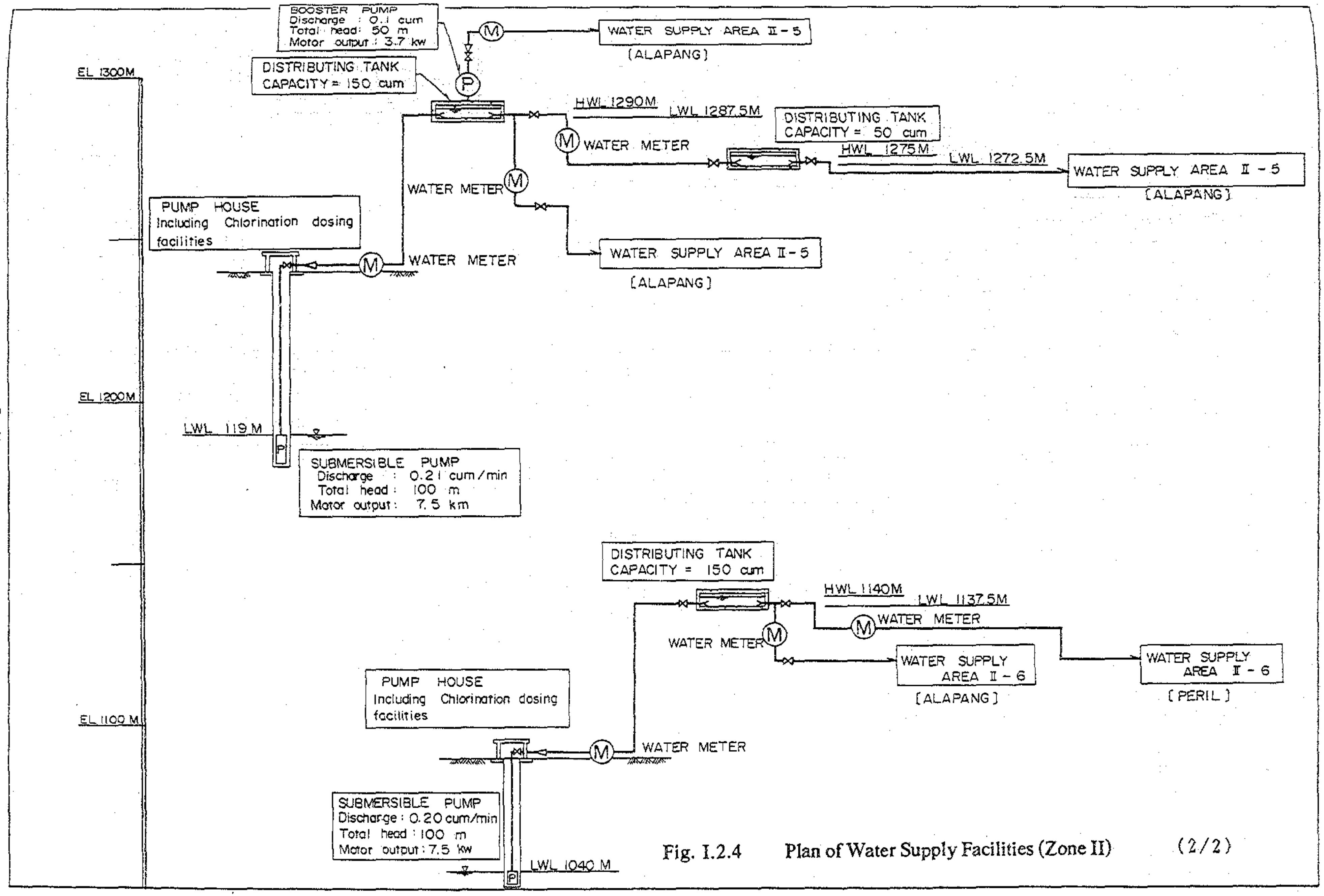


Fig. I.2.4 Plan of Water Supply Facilities (Zone II) (2/2)

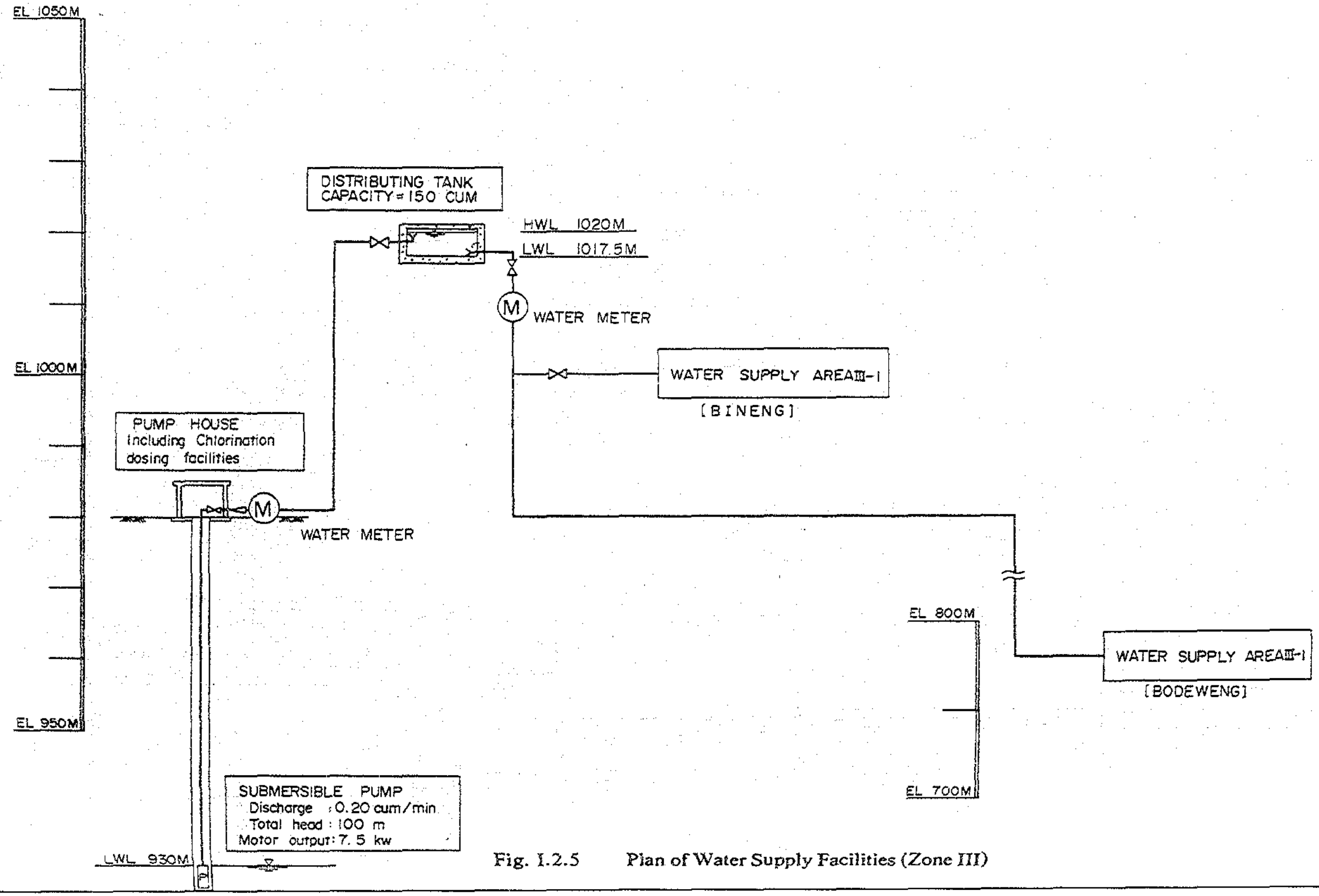


Fig. I.2.5 Plan of Water Supply Facilities (Zone III)

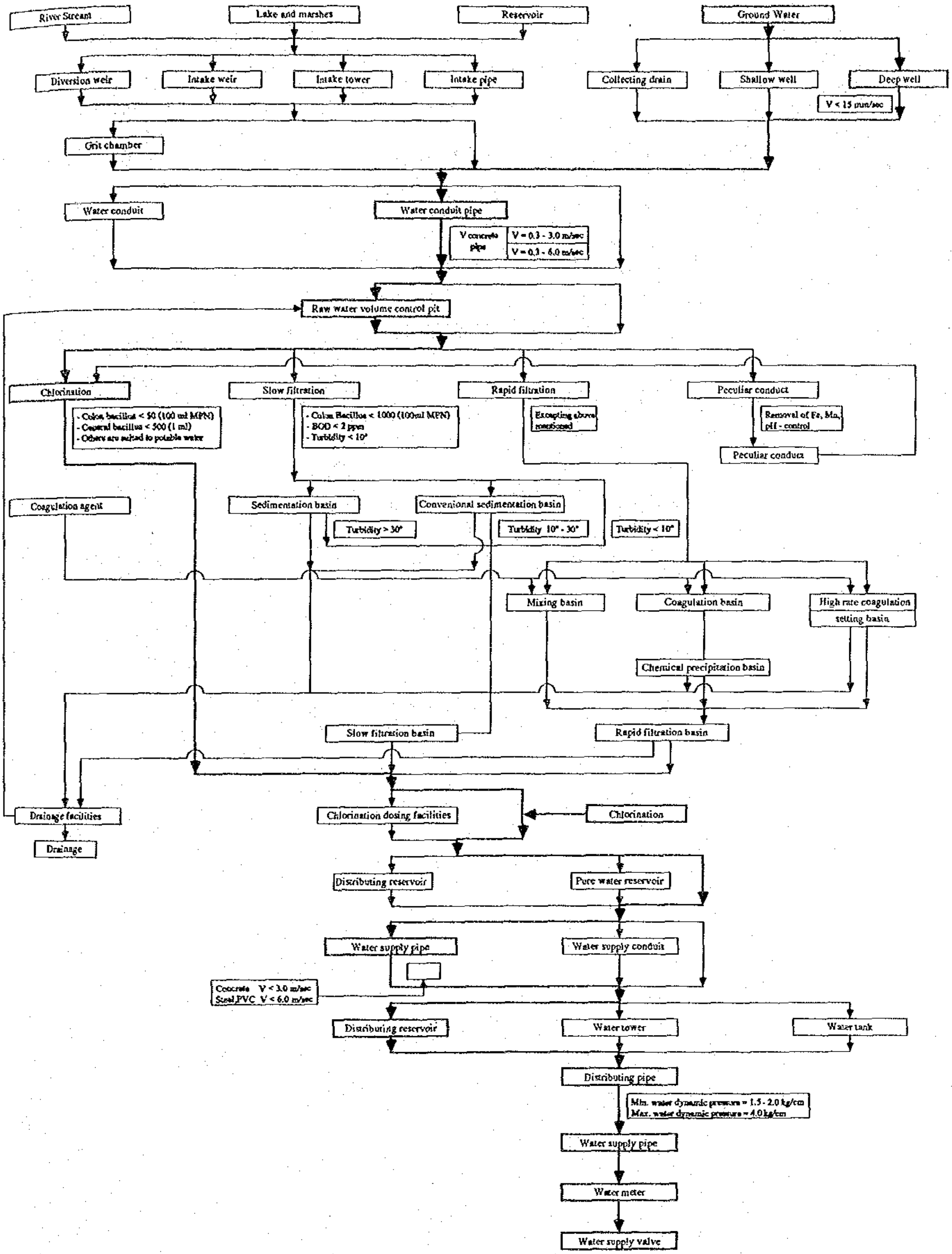


Fig. I.2.6 Flow Sheet of Drinking Water Supply
Water Source - Deep Well

APPENDIX J

CONSTRUCTION PLAN AND COST ESTIMATE

APPENDIX J CONSTRUCTION PLAN AND COST ESTIMATE

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APPENDIX J CONSTRUCTION PLAN AND COST ESTIMATE

1. CONSTRUCTION PLAN

1.1 General

The constructions of the Project are given below :

1) Irrigation facilities

Irrigation facilities consist of ponds as the water source, intake weirs, water conduit pipes, irrigation canals, and on-farm irrigation structures. Eleven (11) ponds and eight (8) intake weirs are proposed in the Project area. Intake weirs, ponds and farm are connected by pipeline.

2) Drainage improvement

Drainage improvement is applied to the Balili river, the Bolo creek, the Bayabas creek and a part of the small creeks in Zone I.

As a major cause of flood inundation is a lack of discharge capacity of the Balili river and the Bolo creek, widening of river section is proposed and bank lining is also planned so as to flow the flood smoothly. Moreover, installation of a screen at the entrance of the Dinog cave is proposed to prevent the floating matter from flowing into the cave.

3) Rural road

The rehabilitation and construction of rural roads are mainly intended to improve the agricultural and social infrastructures. Concrete pavement for the existing road and gravel pavement for the newly proposed road should be constructed to preclude the road surface from an erosion.

4) Drinking and domestic water supply facilities

Drinking and domestic water supply facilities are proposed in Zones II,III. They are composed of deep wells as a water source, water purification facilities and water distributing facilities.

5) Rural electrification

Electric power supply is proposed in Zone III. Electricity is necessary for domestic electrification. Extension of the electric wires from Zone I to Zone III is to be executed.

6) Sewerage

The sewage canals are proposed as a countermeasure against the sewage problem in Zone I. Drainage canal is lined with concrete.

7) Rural community center

Seven (7) rural community centers are selected to be constructed to promote the rural development programs. Rural community centers will be utilized for the barangay associations and council, training of agricultural management and health service.

As described above, the construction works of the Project consist of various works such as deep wells, earth, concrete and piping works. Construction site is located in the mountainous area, where annual rainfall has been recorded 3,500 - 4,000 mm. As existing road conditions are not adapted to transport of construction machineries and materials due to the rough surface and narrow road width, it is therefore extremely important to adjust the road construction schedule in consideration of the other construction schedules.

1.2 Basic Assumption of Construction Planning

1.2.1 Workable days

As for the general works such as concrete works, drilling works and piping works, etc., 25 days per month are applied for the standard workable day.

On the other hand, earth works are mostly affected by heavy rainfall. Since embankment of impervious or semi-impervious materials are controlled by moisture content, special attentions must be paid on executing earth works. Suspension days of earth works caused by rainfall are studied based on the following criteria concerning daily rainfall intensity.

Daily Rainfall Intensity (mm/day)	Suspension of Work (day)
0 - 5	0
5 - 30	1
30 - 100	2
more than 100	3

Annual mean workable days were estimated based on the daily rainfall records at BSU PAGASA for recent 11 years (1977 - 1987). The results are shown in Table J.1.1.

The results show that less than 25 days of the standard workable days concentrate in the wet season from May to October, especially, the workable days from May to September are estimated at less than 15 days.

Workable days for impervious materials were obtained from computed days in wet season and 25 days in dry season, i.e. , in total, 235 days in a year .

Workable Days

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
General works	25	25	25	25	25	25	25	25	25	25	25	25	300
Impervious Material	25	25	25	25	15	14	13	9	13	21	25	25	235

1.2.2 Earth moving plan

The construction works of the irrigation, drainage improvement and rural road include a large quantity of the earth works. The total amount of 58,000 cu.m. of the embankment materials are required. The amount of 40,000 cu.m. will mainly be obtained from the excavated materials and the rest amount of 18,000 cu.m. will be obtained from the borrow area selected around the working site.

The total amount of excavated materials, i.e., 180,000 cu.m., comprising 105,000 cu.m. from the drainage improvement construction, 75,000 cu.m. from the ponds construction, will be hauled to the spoil area. The swamp area would be available for the spoil area with the surface soil handling.

1.3 Irrigation Facilities

1.3.1 Pond construction

(1) Earth works

Stripping and surface excavation would be mainly executed by bulldozer and sub-surface and deep excavation would be executed by back-hoe shovel, drag line depending on the soil condition at the pond site. Manpower would contribute to face smoothing and compacting of the foundation of appurtenant structures.

The excavated materials excessing embankment requirement would be transported to a spoil area. In case of lacking the embankment materials, the materials would be supplemented from borrow area selected around the working site. embankment materials would be spread by bulldozer and compacted by tire roller. As for the compacting impervious materials, tamping roller would be adopted.

(2) Concrete works

Intake and spillway would be constructed by concrete or stone masonry. Concrete works would be started after completion of earth works. Concrete would be produced by portable concrete mixer and placed using bucket hanged by truck-crane.

1.3.2 Intake weirs

The construction works of intake weirs would be executed during dry season. Intake weirs are designed to be a fixed type weir made by concrete. Concrete would be produced by concrete plant or portable concrete mixer and placed using bucket hanged by truck-crane.

1.4 Drainage Improvement

The construction works for drainage improvement would be mainly executed during the dry season in consideration of magnitude of flooding in the river. The constructions consist of widening of river section and bank protection. The foundation of the river bed consists of rock, gravel and river load. The excavation of gravel and river load would be executed by bulldozer and back-hoe, while, rock materials would be broken by blasting and gathered by bulldozer. Excavated rock would be useful for riprap and so forth. Bank would be protected by retaining wall. Concrete would be produced by concrete plant and placed by concrete pump or bucket hanged by truck crane.

1.5 Rural Road

The constructions of rural road mainly consist of the excavation for road widening, concrete/gravel pavement and appurtenant structure, such as bridges, drainage culverts and so on.

Excavation works would be mainly made by bulldozer, back-hoe shovel and supplementary manpower. Excavated materials would be hauled by dump truck to a spoil area.

Pavement consists of subbase course and concrete pavement slab. Subbase course of crushed stone would be spread by bulldozer and compacted by vibratory roller and pneumatic type roller. Concrete would be produced by concrete plant, and hauled by truck mixer.

1.6 Drinking and Domestic Water Supply Facilities

The construction of drinking and domestic water supply facilities mainly consists of deep wells, slow filtration basins, distributing tanks and water conduit and supply pipe. Deep well drilling , 70-120 meters in depth, would be executed by percussion method and submersible pumps would be installed in deep well. Water conduit and supply pipes would be laid 0.6-1.0 meters below from the ground surface. Excavation for lying pipe would be made by back-hoe shovel and manpower.

1.7 Rural Electrification

Electrification is proposed in Zone III. Extension of the electric wires from Zone I to Zone III is to be executed.

1.8 Sewerage

The sewage canals would be lined with concrete. Concrete would be produced by portable mixer. Excavation would be made by back-hoe shovel and manpower.

1.9 Implementation Schedule

The implementation schedule of the Project is shown in Fig. J.1.1. The first one (1) year would be necessary for the preparatory works including tendering, survey and mapping works, detailed design works, mobilization and construction of offices and quarters. The actual construction works would be commenced from the second year. The construction works for irrigation , drainage improvement, drinking and domestic water supply facilities and rural road will need two(2) years in total.

Construction of the irrigation facilities, the drainage improvement and rural road would be executed during the dry season in consideration of the damage caused by the heavy rainfall and flooding in the river.

2. COST ESTIMATE

2.1 Basic Assumptions

The construction costs have been estimated on following assumptions:

1) Unit prices are analyzed on the basis of average price level for first half of 1988, forming the price basis prior to preparing this cost estimate.

2) Exchange rate used in the estimate is shown as follows:

US $ 1.0 = ₱ 21.0

3) Construction works is assumed to be executed within the full contract basis. The machinery and equipment required for construction works shall be provided by the contractors. Therefore, depreciation costs of machinery and equipment are considered in the estimate of the construction unit cost.

4) Import tax for construction materials, machinery and equipment shall be excluded from the cost estimate.

5) The construction cost based on unit costs shall be divided into foreign and local currency portions. Local currency portion is estimated on the basis of the current price in La Trinidad in the first of 1988 and of the data collected from the on-going projects around the project area. Foreign currency portion is estimated based on the CIF prices at Manila.

6) The physical contingency, 10 percent of the direct construction cost shall be included in the construction cost in view of preliminary nature of the estimate.

7) Price contingency shall also be taken into account at an annual escalation rate of three(3) percent for the foreign currency portion and five(5) percent for the local currency portion.

8) The associated costs to be financed by the Government, such as the costs for strengthening the extension services and facilities of the water user's association shall be not included in the estimate.

2.2 Financial Construction Cost

Financial construction cost comprises direct construction cost, land acquisition, O&M equipment, administration and engineering services, physical contingency and price contingency.

The direct construction cost consists of construction costs of irrigation facilities, sewage canals, drainage facilities, drinking and domestic water supply facilities, rehabilitation and construction of rural roads, barangay halls and electric facilities, including contractor's profit, overhead and taxes.

The total construction costs of the project are estimated at 301.5 million peso, comprising 175.2 million peso (equivalent to 58.1 percent of the total construction costs) for the foreign currency portion and 126.3 million peso (equivalent to 41.9 percent the total construction costs) for the local currency portion. The summary of the construction cost are shown in Table J.2.1. Breakdown of the cost estimate is shown in Table J.2.3 through Table J.2.11.

2.3 Annual Disbursement Schedule

The annual disbursement schedule has been established on the basis of the construction implementation schedule. Details are stated in Table J.2.2.

2.4 Annual Operation and Maintenance Costs

Annual operation and maintenance costs include salaries for project administration and staff, materials and labor costs for repair and maintenance of O&M equipment, and running costs of project facilities. The annual operation and maintenance costs are estimated at 2.2 million peso (Table J.2.12).

2.5 Replacement Cost

Some of the facilities, especially mechanical equipment have a shorter useful life than the civil constructions and are likely to require replacement at some time within the project's useful life. Table J.2.13 shows the useful life and replacement cost for the mechanical equipment.

Table J.1.1 Suspention and Workable Days by Rainfall Intensity for Impervious Materials for Pond

Year	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Total
1977	2	0	7	3	13	12	19	23	26	9	10	0	124
1978	0	1	3	1	13	17	24	25	21	12	3	3	123
1979	1	0	0	8	21	15	15	21	17	7	0	3	108
1980	0	0	2	2	16	7	19	11	21	13	5	5	101
1981	1	0	0	8	16	21	21	28	10	10	6	0	121
1982	0	2	0	9	15	15	22	22	13	7	5	2	112
1983	2	1	1	0	4	15	14	24	20	9	5	0	95
1984	1	0	3	12	25	16	17	23	16	15	1	0	129
1985	1	1	3	11	19	24	14	24	17	11	11	0	136
1986	1	2	2	3	16	15	21	23	16	9	3	2	113
1987	0	0	1	3	13	21	16	19	14	11	1	3	102
Total	9	7	22	60	171	178	202	243	191	113	50	18	1,264
Mean Suspension	1	1	2	5	16	16	18	22	17	10	5	2	115
Workable days	30	27	29	25	15	14	13	9	13	21	25	29	250

Table J.2.1 Summary of Construction Cost

Item	Foreign Currency (10^6₱)	Local Currency (10^6₱)	Total (10^6₱)
1. Construction Cost	122.5	94.6	217.1
1.1 Irrigation Facilities	35.8	32.0	67.8
1.2 Drainage Improvement	23.0	15.7	38.7
1.3 Rural Road	36.5	26.4	62.9
1.4 Drinking and Domestic Water Supply Facilities	23.8	17.3	41.1
1.5 Rural Electrification Facilities	1.0	1.0	2.0
1.6 Sewage Facilities	1.3	1.2	2.5
1.7 Rural Community Center	1.1	1.0	2.1
2. Land Aquisition	-	2.0	2.0
3. O & M Equipment	4.6	0.3	4.9
4. Administration Cost and Engineering Services	21.7	5.3	27.0
Sub- Total	148.8	102.2	251.0
5. Physical Contingency	14.7	10.2	24.9
Total	163.5	112.4	275.9
6. Price Contingency	11.7	13.9	25.6
Grand Total (Financial Cost)	175.2	126.3	301.5

(Exchange Rate : US$ 1 = ₱21.0)

Table J.2.2 Annual Disbursement Schedule of Construction Cost

(Unit : 10^6 ₱)

Item	1st year			2nd year			3rd year			TOTAL		
	F.C.	L.C	Total	F.C.	L.C	Total	F.C.	L.C	Total	F.C.	L.C	Total
1. Construction Cost	3.1	2.4	5.5	59.9	46.7	106.6	59.5	45.5	105.0	122.5	94.6	217.1
1.1 Irrigation Facilities	0.7	0.7	1.4	12.1	11.9	24.0	23.0	19.4	42.4	35.8	32.0	67.8
1.2 Drainage Improvement	0.6	0.5	1.1	12.5	8.5	21.0	9.9	6.7	16.6	23.0	15.7	38.7
1.3 Rural Road	1.0	0.7	1.7	18.6	13.5	32.1	16.9	12.2	29.1	36.5	26.4	62.9
1.4 Drinking and Domestic Water Supply Facilities	0.8	0.5	1.3	14.1	10.3	24.4	8.9	6.5	15.4	23.8	17.3	41.1
1.5 Rural Electrification Facilities	-	-	-	1.0	1.0	2.0	-	-	-	1.0	1.0	2.0
1.6 Sewage Facilities	-	-	-	1.3	1.2	2.5	-	-	-	1.3	1.2	2.5
1.7 Rural Community Center	-	-	-	0.3	0.3	0.6	0.8	0.7	1.5	1.7	1.0	2.1
2. Land Aquisition	-	2.0	2.0	-	-	-	-	-	-	-	2.0	2.0
3. O & M Equipment	4.6	0.3	4.9	-	-	-	-	-	-	4.6	0.3	4.9
4. Administration Cost and Engineering Services	10.1	2.4	12.5	5.8	1.5	7.3	5.8	1.4	7.2	21.7	5.3	27.0
Sub-Total	17.8	7.1	24.9	65.7	48.2	113.9	65.3	46.9	112.2	148.8	102.2	251.0
5. Physical Contingency	1.6	0.7	2.3	6.6	4.8	11.4	6.5	4.7	11.2	14.7	10.2	24.9
Total	19.4	7.8	27.2	72.3	53.0	125.3	71.8	51.6	123.4	163.5	112.4	275.9
6. Price Contingency	0.6	0.4	1.0	4.4	5.4	9.8	6.7	8.1	14.8	11.7	13.9	25.6
Grand-Total	20.0	8.2	28.2	76.7	58.4	135.1	78.5	59.7	138.2	175.2	126.3	301.5

Table J.2.3 Breakdown of Direct Construction Cost (1/5)

Items		Unit	Quantities	Cost (10^3 peso)		
				F/C	L/C	Total
1-1	Irrigation facilities					
A.	Zone I					
(a)	Pond construction	nos	3	1,397	687	2,084
(b)	Piping works (Lateral conduit pipe: ø 100 - 150)	m	6,600	1,928	1,670	3,598
(c)	Piping works (Delivery conduit pipe: ø 80)	m	13,400	2,212	2,908	5,120
(d)	Water tank	nos	268	541	1,327	1,868
(e)	Deep well construction	nos	3	4,737	783	5,520
(f)	Others			457	583	1,040
	Total A			**11,272**	**7,958**	**19,230**
B.	Zone II					
(a)	Pond construction	nos	8	6,341	4,044	10,385
(b)	Intake weirs	nos	6	2,468	2,392	4,860
(c)	Piping works (Intake - Pond: ø 200)	m	2,400	985	816	1,801
(d)	Piping works (Lateral conduit pipe: ø 100 - 150)	m	13,050	3,810	3,302	7,122
(e)	Piping works (Delivery conduit pipe: ø 80)	m	13,000	2,146	2,821	4,967
(f)	Water tank	nos	260	525	1,287	1,812
(g)	Improvement of the Dinog cave	Ls.	1	1,081	890	1,971
(h)	Others			2,284	2,916	5,200
	Total B			**19,640**	**18,468**	**38,108**

Table J.2.3 Breakdown of Direct Construction Cost (2/5)

Items	Unit	Quantities	Cost (10^3 peso)		
			F/C	L/C	Total
C. Zone III					
(a) Intake weir, Wangal	no	1	650	600	1,250
(b) Piping works (Lateral conduit pipe: ø 100 - 150)	m	5,400	1,576	1,367	2,943
(c) Piping works (Delivery conduit pipe: ø 80)	m	3,350	553	727	1,280
(d) Water tank	nos	67	135	332	467
(e) Bineng irrigation system					
Intake weir	no	1	325	299	624
R.C. piping	m	600	143	316	459
Energy dissipator	nos	15	95	165	260
Lining canal	m	3,800	731	988	1,719
Regulating pond	Ls.	1	280	245	525
Sub-total (e)			1,574	2,013	3,587
(f) Others			392	500	892
Total C			**4,880**	**5,539**	**10,419**
Total 1-1			**35,792**	**31,965**	**67,757**

Table J.2.3 Breakdown of Direct Construction Cost (3/5)

Items	Unit	Quantities	Cost (10^3 peso)		
			F/C	L/C	Total
1-2 Drainage improvement					
A. Zone I					
(a) Improvement of the Balili river	Ls.	1	9,756	7,288	17,044
(b) Improvement of the Bolo creek	Ls.	1	12,163	7,841	20,004
(c) Improvement of the Bayabas creek	Ls.	1	836	352	1,188
(d) Box culverts on the raod	nos	2	288	216	504
Total 1-2			**23,043**	**15,697**	**38,740**
1-3 Rural road					
A. Zone II					
(a) Rehabilitation of the raod	m	13,900	19,204	14,293	33,497
(b) Constructoin of the road	m	5,000	3,285	1,945	5,230
Total A			**22,489**	**16,238**	**38,727**
B. Zone III					
(a) Rehabilitation of the raod	m	8,700	12,138	9,013	21,151
(b) Construction of the road	m	2,800	1,840	1,189	3,029
Total B			**13,987**	**10,202**	**24,180**
Total 1-3			**36,467**	**26,440**	**62,907**

Table J.2.3 Breakdown of Direct Construction Cost (4/5)

Items	Unit	Quantities	Cost (10^3 peso)		
			F/C	L/C	Total
1-4 Drinking and domestic water supply					
A. Zone III	nos	6	20,394	14,862	35,256
B. Zone III	no	1	3,399	2,477	5,876
Total 1-4			**23,793**	**17,339**	**41,142**
1-5 Rural electrification facilities					
A. Zone III	km	6.0	994	1,006	2,000
Total 1-5			**994**	**1,006**	**2,000**
1-6 Sewage facilities					
A. Zone I	m	5,000	1,334	1,192	2,526
Total 1-6			**1,334**	**1,192**	**2,526**
1-7 Rural community center					
A. Zone I	nos	2	320	280	600
B. Zone II	nos	3	480	420	900
C. Zone III	nos	2	320	280	600
Total 1-7			**1,120**	**980**	**2,100**

Table J.2.3 Breakdown of Direct Construction Cost (5/5)

	Cost (10^6 peso)		
	F/C	L/C	Total
Grand Total	122.5	94.6	217.1
Zone I	36.0	25.1	61.1
Zone II	63.0	50.0	113.0
Zone III	23.6	19.4	43.0

Table J.2.4 Cost for Land Acquisition

Discription	Area (ha)	Unit Cost (10^3₱/ha)	Amount (10^3₱)
1. Irrigation Facilities	5.5	200	1,100
2. Drainage Improvement	1.7	200	340
3. Rural Road	1.5	400	600
Total	8.7		2,040

Table J.2.5 Procurement Cost of O & M Equipment

(Unit : 10^3 ₱)

Equipment	Foreign Currency	Local Currency	Total
I. Project Office Equipment for Implementation and O & M	2,240	120	2,360
II. O & M Equipment for Agricultural Extension Service	850	40	890
III. O & M Equipment for Garbage Disposal	1,520	80	1,600
Total	4,610	240	4,850

Table J.2.6 Procurement Cost of Project Office Equipment for Implementation and O & M

(Unit : 10^3 ₱)

Equipment	Unit Price	Quantity	Amount
Vehicles			
— 4 wheel-drive jeep	300	2	600
— 4 wheel-drive pick-up	280	1	280
— Motorcycles	20	3	60
— Spare parts (10 % of above)			94
Office Equipment			
— Photo copier	15	1	15
— Micro computer / Word processor with accessories	90	1	90
— Type writer	30	2	60
— Audio visual aid	15	1	15
— Camera with accessories	12	1	12
— Furniture	24	Various	24
— Others	10	Various	10
Observation Unit			
Metorological observation equipment		Ls.	800
Water quality test equipment		Ls.	300
Total			2,360

Table J.2.7 Procurement Cost of O & M Equipment for Agricultural Extension Service

(Unit : 10^3 ₱)

Equipment	Unit Price	Quantity	Amount
Vehicles			
— 4 wheel-drive jeep	300	1	300
— 4 wheel-drive pick-up	280	1	280
— Motorcycles	20	3	60
— Spare parts (10 % of above)			64
Office Equipment			
— Photo copier	15	1	15
— Micro computer / Word processor with accessories	90	1	90
— Audio visual aid	15	1	15
— Camera with accessories	12	1	12
— Furniture	20	Various	20
— Others	10	Various	10
Agricultural Equipment *1	24	Various	24
Total			890

Remarks
*1 : Agricultural equipment include shovel, knopsack sprayers, hoe, etc..

Table J.2.8 Procurement Cost of O & M Equipment for Garbage Disposal

(Unit : 10^3 ₱)

Equipment	Unit Price	Quantity	Amount
Garbage truck	800	2	1,600
Total			1,600

Table J.2.9 Administration and Engineering Costs

(Unit : 10^6 ₱)

Description	Foreign Currency	Local Currency	Total
I. Detailed Design Stage			
1. Administration			
1.1 Staff Salary (180 M/M)	-	0.6	0.6
1.2 Other Direct Cost	-	0.3	0.3
2. Engineering Consultant			
2.1 Remuneration			
Forign Consultant (45 M/M)	6.1	-	6.1
Local Consultant (25 M/M)	1.5	-	1.5
2.2 Direct Cost	1.7	0.8	2.5
2.3 Topo-Survey and Investigation	0.8	0.7	1.5
Sub-Total	10.1	2.4	12.5
II. Construction Stage			
1. Administration			
1.1 Staff Salary (480 M/M)	-	1.7	1.7
1.2 Other Direct Cost	-	0.8	0.8
2. Engineering Consultant			
2.1 Remuneration			
Forign Consultant (68 M/M)	9.2	-	9.2
Local Consultant (25 M/M)	1.5	-	1.5
2.2 Direct Cost	0.8	0.4	1.2
2.3 Special Equipment	0.1	-	0.1
Sub-Total	11.6	2.9	14.5
Total	21.7	5.3	27.0

Table J. 2. 10 Required Man-Months of the Project Staff

Staff	Man-Month		
	Detailed Design Stage	Construction Stage	Total
1. Managing Staff			
- General Director	12	24	36
- Senior Officer	12	48	60
2. Technical and Administrative Staff			
- Civil Engineer	12	32	44
- Agricultural Engineer	6	16	22
- Agricultural Technician	6	16	22
- Accountant & Casher	12	32	44
- Secretary, Typist & Clark	36	88	124
3. Workers and Labours			
- Driver	36	96	132
- Guardman	24	64	88
- Labour	24	64	88
Total	180	480	660

Table J. 2. 11 Required Man-Months of Consultant Engineers

Specialist	Man-Month		
	Foreign Consultant	Local Consultant	Total
I. Detailed Design Stage			
1. Project Director	1	-	1
2. Team Leader / Irrigation Engineers	8	4	12
3. Irrigation and Drainage Design Engineers	12	4	16
4. Hydrologists	3	2	5
5. Engineering Geologist	3	2	5
6. Soil Mechanic Engineers	2	2	4
7. Topo-Survey Supervisor	4	4	8
8. Cost & Specification Engineers	3	3	6
9. Metal Work Engineer	2	1	3
10. Equipment Engineer	2	1	3
11. Specialists as Required	6	2	8
12. Home Support Engineers	2	-	2
Total	48	25	73
II. Construction Supervision Stage			
1. Project Director	2	-	2
2. Team Leader / Irrigation Engineers	25	-	25
3. Design Engineers	3	3	6
4. Construction Engineers	25	20	45
5. On-farm Development Engineers	5	2	7
6. Equipment Engineers	2	-	2
7. Mechanical Engineer	2	-	2
8. Specialists as Required	2	-	2
9. Home Support Engineers	2	-	2
Total	68	25	93

Table J. 2. 12 Annual Operation and Maintenance Cost

Items		O&M Cost (1,000 pesos)
1. Project Office		
1-1	Office Expenses	50
1-2	Staff Salaries	135
2. O&M Cost for the Facilities		
2-1	Irrigation Facilities	
	Operation Cost	120
	Maintenance Cost	1,128
2-2	Drainage Facilities	
	Maintenance Cost	12
2-3	Rural Road	
	Maintenance Cost	240
2-4	Drinking and Domestic Water Supply Facilities	
	Operation Cost	385
	Maintenance Cost	76
2-5	Rural CommunityCenter	7
	Total	2,153

Table J. 2. 13 Replacement Cost

	Items		Useful life (year)	Replacement Cost (1,000 pesos)
1.	O&M Equipment			
		Garbage Disposal Trucks	10	1,600
2.	Project Facilities			
	2-1	Irrigation Facilities		
		Pump	20	990
		Vulves and Others	20	6,837
	2-2	Drainage Facilities		
		Gate	30	2,400
	2-3	Drinking and Domestic Water Supply Facilities		
		Pump	20	1,270
		Pipe, Valve and Others	20	17,200

Table J.2.14 Labors cost

No.		Unit	Cost	Component		Unit Cost	
				F(%)	L(%)	F/C (pesos)	L/C (pesos)
1	Labor	md	55.59	0	100	0	55.59
2	Foreman General	md	78.00	0	100	0	78.00
3	Carpenter	md	65.29	0	100	0	65.29
4	Head of Carpenter	md	73.76	0	100	0	73.76
5	Mason Worker	md	55.59	0	100	0	55.59
6	Head of Mason	md	73.76	0	100	0	73.76
7	Steel Worker	md	55.59	0	100	0	55.59
8	Head of Steel Worker	md	73.76	0	100	0	73.76
9	Asphalt Mix Worker	md	56.78	0	100	0	56.78
10	Driver(Light Equipment)	md	71.87	0	100	0	71.87
11	Operator(Heavy Equipment)	md	87.00	0	100	0	87.00
12	Mechanical	md	61.50	0	100	0	61.50
13	Electric Worker	md	58.37	0	100	0	58.37
14	Head of Mechanical	md	73.76	0	100	0	73.76
15	Driller	md	57.68	0	100	0	57.68
16	Blaster	md	142.00	0	100	0	142.00
17	Explosive Worker	md	72.00	0	100	0	72.00
18	Watchman	md	52.59	0	100	0	52.59
19	Janitor	md	52.59	0	100	0	52.59
20	Driver(General)	md	52.59	0	100	0	52.59

Table J.2.15 Materials Cost

NO.	Items	Unit	Cost	Component F/C (%)	Component L/C (%)	Unit Cost F/C (Pesos)	Unit Cost L/C (Pesos)
1	Aggregate						
	(a) Sand	cum	180.0	37	63	66.6	113.4
	(b) Gravel	cum	260.0	37	63	96.2	163.8
	(c) Boulder	cum	165.0	37	63	61.1	104.0
2	Sod		1.4	0	100	0.0	1.4
3	Lumber						
	(a) Form Lumber Ro	bf	8.7	0	100	0.0	8.7
	do	cum	3686.5	0	100	0.0	3686.5
	(b) Lumber KD	bf	12.0	0	100	0.0	12.0
	do	cum	5084.8	0	100	0.0	5084.8
	(c) Plywood 1/4&4*8	bf	135.0	0	100	0.0	135.0
	(d) Plywood 1/2&4*8	bf	240.0	0	100	0.0	240.0
	(e) Plywood 3/4&4*8	bf	325.0	0	100	0.0	325.0
4	Reinforced Iron Bar	kg	9.8	80	20	7.8	2.0
5	Nail,Bolt,Nut	kg	14.0	80	20	11.2	2.8
6	Hardware	kg	0.0	80	20	0.0	0.0
7	Cement(1bag=40kg)	bag	56.6	75	25	42.5	14.2
8	Fuel						
	(a) Gasoline	lit	6.6	50	50	3.3	3.3
	(b) Diesel	lit	5.6	50	50	2.8	2.8
9	Blasting						
	(a) Dynamite	kg	75.0	50	50	37.5	37.5
	(b) ANFO	kg	46.0	50	50	23.0	23.0
	(c) Detonator	pc	32.0	50	50	16.0	16.0
10	Drilling						
	(a) Rod(for Jack Hummer)	pc	632.7	100	0	632.7	0.0
	(b) Rod(for Drifter)	pc	1896.4	100	0	1896.4	0.0
	(c) Bit(for Jack Hummer)	pc	790.0	100	0	790.0	0.0
	(d) Bit(for Drifter)	pc	2015.0	100	0	2015.0	0.0
11	RC Pipe(l=1.00m)					0.0	0.0
	(a)D=150(6")	pc	45.0	57	43	25.7	19.4
	(b)D=200(8")	pc	65.0	57	43	37.1	28.0
	(c)D=250(10")	pc	75.0	57	43	42.8	32.3
	(d)D=300(12")	pc	85.0	57	43	48.5	36.6
	(e)D=350(14")	pc	100.0	57	43	57.0	43.0
	(f)D=450(18")	pc	380.0	57	43	216.6	163.4
	(g)D=600(24")	pc	480.0	57	43	273.6	206.4
	(h)D=700(28")	pc	560.0	57	43	319.2	240.8
	(i)D=800(32")	pc	640.0	57	43	364.8	275.2
	(j)D=900(36")	pc	680.0	57	43	387.6	292.4
	(k)D=1050(42")	pc	793.0	57	43	452.0	341.0
	(l)D=1200(48")	pc	1090.0	57	43	621.3	468.7
	(m)D=1350(54")	pc	1230.0	57	43	701.1	528.9
	(n)D=1500(60")	pc	1450.0	57	43	826.5	623.5

Table J.2.15 Materials Cost

NO.	Items	Unit	Cost	Component F/C (%)	Component L/C (%)	Unit Cost F/C (Pesos)	Unit Cost L/C (Pesos)
12	Cement Products					0.0	0.0
	(a) Concrete Hollow Block 6"	pc	4.2	57	43	2.4	1.8
	(b) do 4"	pc	3.7	57	43	2.1	1.6
	(c) Cement Tiles(20*20)	pc	225.0	57	43	128.3	96.8
	(f) White Cement(40kg/bag)	bag	240.0	75	25	180.0	60.0
13	Steel Plate	kg	12.0	80	20	9.6	2.4
14	H-Beam (kg/m)	kg	27.0	80	20	21.6	5.4
	(a) H-100*100*8.5 (17.6)	m	475.2	80	20	380.2	95.0
	(b) H-125*125*9.5(24.3)	m	656.1	80	20	524.9	131.2
	(c) H-150*150*10.5(32.0)	m	864.0	80	20	691.2	172.8
	(d) H-175*175*13.5(46.7)	m	1260.9	80	20	1008.7	252.2
	(e) H-300*200*12(64.2)	m	1733.4	80	20	1386.7	346.7
	(f) H-300*300*12(84.1)	m	2270.7	80	20	1816.6	454.1
	(g) H-400*400*12.5(146.0)	m	3942.0	80	20	3153.6	788.4
	(h) H-500*400*12.5(157.0)	m	4239.0	80	20	3391.2	847.8
	(i) H-500*400*6(185.0)	m	4995.0	80	20	3996.0	999.0
15	L-Beam (kg/m)	kg	21.0	80	20	16.8	4.2
	(a) L-20*20*3 (0.885)	m	18.5	80	20	14.8	3.7
	(b) L-25*25*5 (1.76)	m	37.0	80	20	29.6	7.4
	(c) L-30*30*5 (2.16)	m	45.4	80	20	36.3	9.1
	(d) L-40*40*5 (2.95)	m	62.0	80	20	49.6	12.4
	(e) L-50*50*6 (4.43)	m	93.0	80	20	74.4	18.6
	(f) L-60*60*7 (6.21)	m	130.4	80	20	104.3	26.1
	(g) L-70*70*8 (8.29)	m	174.1	80	20	139.3	34.8
16	Sheet Pile (kg/m)	kg	8.7	95	5	8.3	0.4
	(a) 256*36*5 (14.6)	m	127.0	95	5	120.7	6.4
	(b) 303*36*5 (17.0)	m	147.9	95	5	140.5	7.4
	(c) 333*75*6 (25.9)	m	225.3	95	5	214.1	11.3
	(d) 400*150*7(41.2)	m	358.4	95	5	340.5	17.9
17	Steel Pipe(SGP,l=6.00m)					0.0	0.0
	1/2"	pc	125.0	80	20	100.0	25.0
	3/4"	pc	130.0	80	20	104.0	26.0
	1"	pc	185.0	80	20	148.0	37.0
	1 1/4"	pc	238.0	80	20	190.4	47.6
	1 1/2"	pc	297.0	80	20	237.6	59.4
	2"	pc	376.0	80	20	300.8	75.2
	2 1/2"	pc	579.0	80	20	463.2	115.8
	3"	pc	710.0	80	20	568.0	142.0
	4"	pc	998.0	80	20	798.4	199.6
	5"	pc	1215.0	80	20	972.0	243.0
	6"	pc	1603.0	80	20	1282.4	320.6
	8"	pc	2438.0	80	20	1950.4	487.6

Table J.2.15 Materials Cost

NO.	Items	Unit	Cost	Component F/C (%)	Component L/C (%)	Unit Cost F/C (Pesos)	Unit Cost L/C (Pesos)
18	Small Gate (complete)					0.0	0.0
	(a) 610*355mm	asy	2050	80	20	1640.0	410.0
	(b) 610*400mm	asy	2395	80	20	1916.0	479.0
	(c) 800*500mm	asy	4146	80	20	3316.8	829.2
	(d) 800*800mm	asy	4810	80	20	3848.0	962.0
	(e) 1000*800mm	asy	4981	80	20	3984.8	996.2
	(f) 1000*1000mm	asy	11770	80	20	9416.0	2354.0
	(g) 1200*1200mm	asy	13206	80	20	10564.8	2641.2
	(h) 1400*1200mm	asy	13859	80	20	11087.2	2771.8
	(i) 1600*1400mm	asy	17368	80	20	13894.4	3473.6
	(j) 1600*1600mm	asy	18097	80	20	14477.6	3619.4
19	Electricity	kWh	2	60	40	1.2	0.8
20	Accesory of Boring Machine					0.0	0.0
	(a) Bit(Diamond) 46mm	pc	5250	100	0	5250.0	0.0
	(b) Bit(Diamond) 76mm	pc	5565	100	0	5565.0	0.0
	(c) Core Lifter	pc	635	100	0	635.0	0.0
	(d) Core Barrel	pc	19956	100	0	19956.0	0.0
	(e) Boring Rod(l=3.00m)	pc	2812	100	0	2812.0	0.0

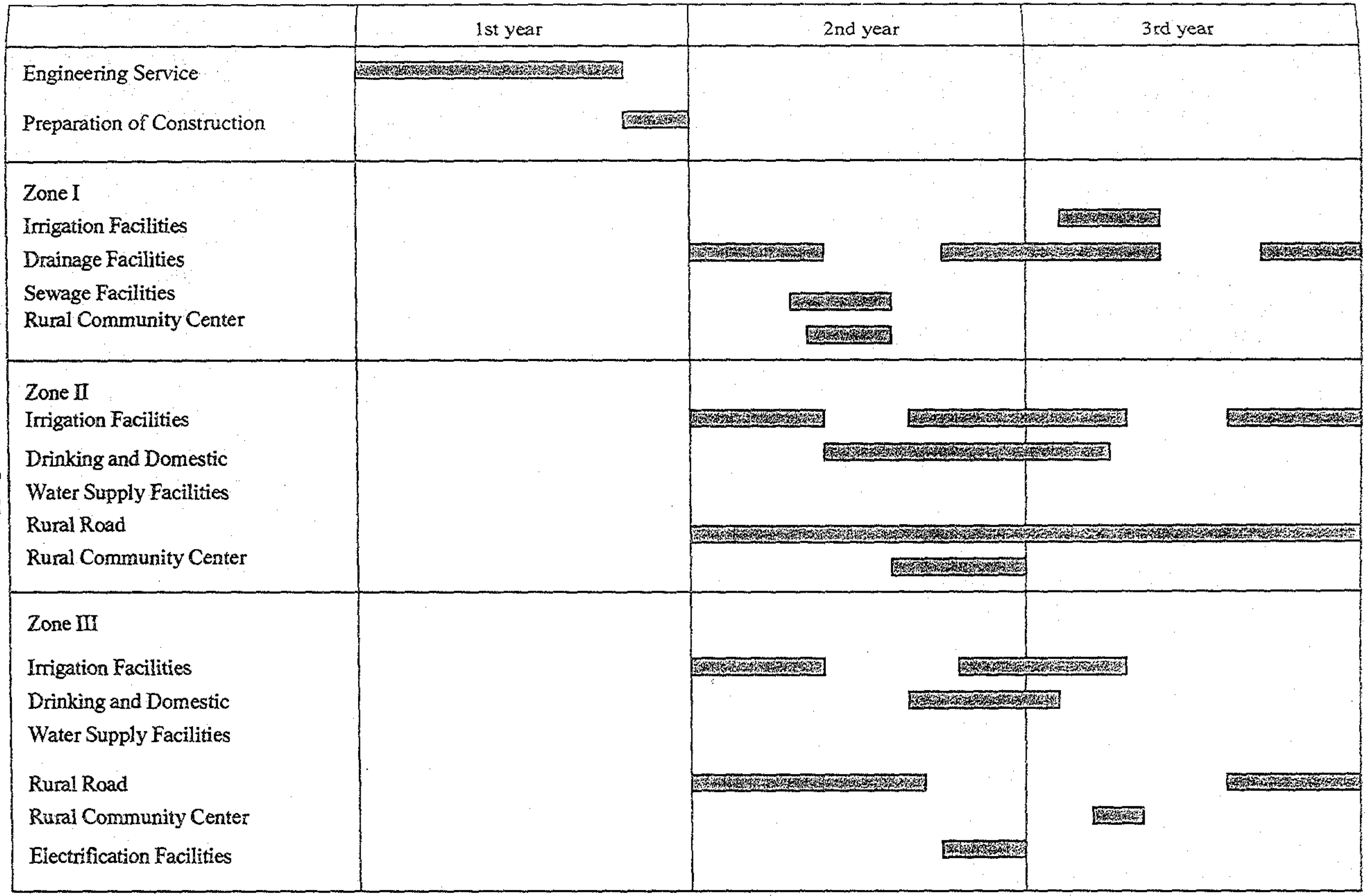

Fig. J.1.1 Implementation Schedule of the Project

APPENDIX K

PROJECT EVALUATION

APPENDIX K PROJECT EVALUATION

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APPENDIX K PROJECT EVALUATION

1. GENERAL

The Government of the Philippines considers agricultural and rural development as the highest priority among all other national medium-term development plans (1987-1992) to stabilize and improve living of farmers. Conformably the Government of the Philippines paid attention to assist highland farmers who had long been neglected from the development.

Under this situation, the feasibility study of the Highland Integrated Rural Development Project in La Trinidad, Province of Benguet, was carried out with the intention of :

(i) increasing land and labor productivities through the improvement of agricultural infrastructures ;

(ii) increasing farm income through the improvement of agricultural infrastructures and strengthening of agricultural extension services ; and

(iii) raising quality of life of farmers through income increase, upgrading and construction of rural infrastructures and improvement of access to social and cultural amenities.

The evaluation of the Project was carried out in terms of economic, financial and socio-economic aspects. The economic feasibility was evaluated by calculating the economic internal rate of return (EIRR), net present value (NPV) and benefit cost ratio (B/C). Sensitivity analyses were also carried out in order to elucidate the economic viability of the Project against the changes in the economic benefits, costs and construction period. The financial feasibility was evaluated by analyzing the effects of the Project on a typical farm budgets. The socio-economic impacts from the implementation of the Project were studied including the qualitative evaluation of the social components.

2. ECONOMIC EVALUATION

2.1 Basic Assumptions

The economic evaluation was carried out on the following basic assumptions :

(1) A conventional assessment ways will be adopted. That is the economic evaluation will be carried out on the directly productive components of the Project as : (i) irrigation ; (ii) drainage; and (iii) rural roads.

(2) The costs in the economic evaluation will be studied on directly productive components in accordance with the assumption above mentioned.

(3) From the viewpoint of national economy as a whole, the transfer payments such as contract taxes, duties, subsidies, interests and depreciations should be considered as a domestic monetary movement without direct productivity. These transfer payments should be, therefore, excluded from the economic costs.

(4) Price contingencies should be excluded from the economic costs.

(5) The construction period will be three (3) years including one (1) year for detailed design.

(6) The economic useful life of the Project will be 35 years.

(7) All prices are expressed in constant 1987 prices.

(8) An exchange rate of US$ 1.00 = ₱ 21.0 = ¥ 130.0 is used throughout the report.

2.2 Economic Factors

For evaluation of economic prices and costs, the following criteria were used. Each economic factor was studied based on the Appraisal Report on the Highland Agriculture Development Project (HADP) performed by the Asian Development Bank (ADB).

2.2.1 Economic prices for agricultural outputs and inputs

Prices of internationally traded inputs (fertilizers) were estimated on the basis of projected international market prices by the World Bank with the necessary adjustments, and are all expressed in 1987 constant value. Economic prices of all imported farm inputs except fertilizers were converted from the current market price, assuming that 90 percent of the market price consists of foreign exchange and 10 percent of local currency which is adjusted using a standard conversion factor of 0.86. Economic prices of locally produced farm inputs was also converted from the farmgate prices using a standard conversion factor. A shadow wage rate of 0.80 was used for both family and hired farm labor. All economic prices of outputs were converted into economic prices using a standard consumption conversion factor of 0.85. Financial farmgate prices of farm inputs and outputs were estimated on the basis of current farmgate prices prevailing in the Project area as of 1987.

2.2.2 Conversion factors of construction

The individual financial costs were split into four (4) categories as transfer payment, foreign exchange, unskilled labor and others in local currency.

The economic opportunity cost of unskilled construction labor might be assumed to equal that of hired farm labor of ₱ 35 /man-day. Related to the financial wage rate of ₱ 55 /man-day for construction labor, this would give a conversion factor of (₱ 35 / ₱ 55) x 0.86 (SCF) = 0.55. The conversion factors for each cost component were as follows :

	Conversion Factor
Foreign Exchange Component	1.0
Local Currency (Unskilled Labor) Component	0.55
Local Currency (Others) Component	0.86
Transfer Payment Component	0.0

2.3 Economic Benefits

2.3.1 Irrigation

The agricultural benefits are primarily derived from the increased and stabilized crop production attributable to :

(i) improved technologies and farm management practices coupled with strengthening agricultural extension system ;

(ii) reduction of flooded area and provision of irrigation water ;

(iii) guidance of extension team to minimize the variation of the crop prices ;

(iv) promotion of farmer's cooperative activities ; and

(v) reduction of transportation loss by rehabilitating of the rural roads.

The benefits are estimated as the difference of the annual net crop production values under with and without Project conditions. The net production value is defined as the difference between the gross production value and the crop production cost (for details, see APPENDIX B).

The annual incremental net production values creditable to irrigation and agricultural extension services were estimated at ₱ 17.325 million as shown in Table K.2.1. The benefits may be expected to increase linearly year by year, and to reach its full benefits about five (5) years after the completion of physical implementation. The implementation of the Project would require lands for construction. These lands presently used for agricultural production were considered in the planted area under with project conditions.

2.3.2 Drainage

The annual flood control and drainage benefits creditable to the Project were estimated at ₱ 7.335 million. This presents estimated average annual reduction in flood damages and incremental net production values of agricultural crops in Zone I as follows :

Project Component	Benefits (Million ₱)
(1) Flood Control — Average Annual Reduction in Flood Damages	1.020
(2) Drainage — Incremental Net Production Value of Agricultural Crops in Zone I	6.315
Total Benefits	7.335

(1) Flood control

Monetary estimates were made including damages to residential and non-residential houses, personal property and real property, etc.. No estimates of intangible damages such as loss of life, impairment to health, etc. were included.

Average annual reduction in flood damages was estimated as a expected value using the formula as follows :

$$I = \sum (Dn - dn) \cdot Fn$$

Where ; I = Average annual reduction in flood damages,
Dn = Estimated flood damages under without project conditions in return period (n),
dn = Estimated flood damages under with project conditions in return period (n),
Fn = Probability of flood occurrence in return period (n).

The procedures of calculation of average annual reduction in flood damages are shown in Table K.2.2, Table K.2.3 and Table K.2.4. The flood control benefits may be expected to reach its full extent just after the construction of the flood control facilities.

(2) Drainage

Through the agricultural survey and interviews under Work II, it was revealed that hardly anything is planted in flood-prone area in Zone I during the wet season, because the farmers don't want to risk losing the crops in case an unusually heavy rain comes along and floods the area.

The drainage problem is a yearly phenomenon and the solution of which would enable the farmers to plant all throughout the wet season. The additional production during this period would be a direct benefit of the drainage. The quantification of this benefit is difficult because the ultimate total incremental value of production that would accrue from the Project is a function of management decision and management capability. However, a reasonable enough estimate can be made with the use of the agricultural survey data. Based on the survey, it was estimated at ₱ 6.315 million by multiplying net return per ha. of 29,100 pesos with increase of vegetables cropping area of 217 ha. The drainage benefit may be expected to increase linearly year by year, and to reach its full benefit about five (5) years after completion of the physical implementation.

2.3.3 Rural roads

On the basis of the location of current vegetable areas, their production and the existing road network, the rural roads works would consist of the following :

(Unit : km)

Zone	Rehabilitation Roads		Construction	Total
	Provincial Roads	Barangay Roads	New Roads	
Zone II	7.2	6.7	5.0	18.9
Zone III	8.7	0	2.8	11.5
Total	15.9	6.7	7.8	30.4

Benefits due to rehabilitation of roads arise from vehicle operating cost savings (VOC savings) on agricultural and non-agricultural transport. On the other hand, benefit from opening of new roads in vegetable producing areas are obtained by substitution of head-carrying by vehicle transport. The results of the benefits accrued from rural roads are summarized as follows :

		Benefits (million ₱)
Rehabilitation	VOC Savings (Agricultural)	0.179
of Roads	VOC Savings (Non-agricultural)	1.053
Construction of New Roads	Transport Savings	0.356
Total		1.588

The rural roads benefits of agricultural transport concerned and non-agricultural transport may be expected to increase linearly year by year, and to reach its full extent about five (5) and ten (10) years after completion of physical implementation respectively.

A number of case studies undertaken in the Philippines have shown that there is a close correlation between improved roads and higher farmgate prices for agricultural commodities, as well as increased transfer of modern farming techniques through agricultural extension services. From this past experience, it is expected that the farmers, local population, and transport operators providing services in the areas will be influenced.

Many of the farmers in the less developed areas are currently farming at subsistence level and improved access is expected to increase farm incomes through the encouragement of better farming techniques and greater opportunity for marketing surpluses. The road improvements will also enable other small-scale producers to participate in the market economy stimulating trade and development in other sectors of the economy.

(1) Internal influence area

The internal influence area of a project road consists of the area directly being served by the road. In other words, the internal area is the area surrounding the road. The exact delineation of that area depends on the natural terrain boundaries, such as mountains and rivers, as well as crop areas, competing road network and the location of local market centers to/from which the farmers bring their produce and carry other goods.

In the Project area, Zone II and Zone III will be served by more than one road. Therefore, Zone II and Zone III would be split into internal influence areas according to the respective homogeneous road sections. The boundaries of the influence areas of rehabilitation and new opening rural roads are shown in Fig. K.2.2 and Fig. K.2.3 respectively. Land use patterns are also plotted on these figures, and crop type areas in each internal influence area are measured. The results are indicated in Fig. K.2.4 and Fig. K.2.5 in the form of schematic diagram.

(2) Individual traffic costs

Basic traffic costs in the Philippines are defined as the costs which would be incurred by vehicles using roads under ideal conditions. The basic traffic costs can be divided into groups as : (i) running costs; (ii) fixed costs; (iii) time costs; and (iv) accident costs. Accident costs were not taken into consideration in this study because of the low vehicle operating speed and small traffic volume in the Project area.

Individual traffic costs for specific project roads with road and traffic elements which deviate from the ideal road conditions are calculated according to the dl-system concerning running costs based on the basic traffic costs calculated by DPWH in 1982. It was no use of dt-system in this study because of low vehicle operating speed. The updated individual traffic costs of the project roads are shown in Table K.2.5.

Representative vehicles by make and model in the Project area were selected based on the results of the traffic survey as : (i) small trucks; (ii) light cars; (iii) jeeps; and (iv) jeepneys.

(3) VOC savings on agricultural transport

After farmers have harvested and packed the products, they deliver them to the market in La Trinidad and Baguio City by means of jeepney transport at present time. The road conditions in Zone II and Zone III are so bad that there are plenty of spoilage of vegetables during jeepney transport.

With implementation of the Project, provincial and barangay roads in the area will be rehabilitated with concrete pavement. In addition to the improvement of rural roads, provision of irrigation water and agricultural extension services will increase and stabilize crop production in the area. These conditions will also encourage the introduction of vehicles with higher loading capacity (2 tons truck) as partial substitution of jeepneys.

Benefits from the roads rehabilitation materialize as savings in vehicle operating costs (VOC savings), which are derived from individual traffic costs. The VOC savings were calculated under the hypothesis that a half of the produce transported on rehabilitated roads will shift from jeepneys to small trucks. The production used in the calculation was anticipated target around the five years after completion of the Project.

The results and procedures of the calculation are shown in Table K.2.6 and Table K.2.7.

The VOC savings due to the rehabilitation of rural roads were ₱ 0.163 million. This savings can be increased by 10 percent to take into account the transport of agricultural inputs. The final VOC savings was therefore ₱ 0.179 million.

(4) VOC savings on non-agricultural transport

Non-agricultural transport saving on rehabilitated roads is due to the difference in VOC between poor and good conditions road. In the following calculation it was assumed that the traffic volume will increase with the growth rate of 5 percent p.a., and the traffic volume of ten years later was used in the calculation based on the results of the traffic survey.

The results and procedures of the calculation are shown in Table K.2.8 and Table K.2.9. The VOC savings due to rehabilitation of rural roads on non-agricultural transport were estimated at ₱ 1.053 million.

(5) Transport savings from opening of new roads

The transport savings in the vegetable producing areas obtained from the opening of new roads derived from the conversion of a footpath into a passable vehicle were calculated by the reduction of head-carrying costs. The unit cost of head-carrying has been estimated at ₱ 10 - 15 /trip where the average trip consists of 1 km and 50 kg of weight to be carried. The majority of households prefer to use family labor to work in the field and hired labor for head-carrying of their produce.

In the following calculation it was assumed that moving each head load (50 kg) of produce by 1 km costs to the farmer ₱ 10. The crop production used in the calculation was anticipated target around the five years after completion of the Project.

In order to calculate the savings obtained from the opening of new roads, it has been assumed that head-carrying will be substituted by vehicle transport, jeepneys and small trucks sharing the production equally.

The results and procedures of the calculation are shown in Table K.2.10 and Table K.2.11. The transport savings were estimated at ₱ 0.324 million. This amount can be increased by 10 percent to take into account the transport of agricultural input. The total transport cost savings were ₱ 0.356 million.