The proposed conventional system covers an area of 714.6 ha (69%) with a served population of 82,499 in 2000. On the other hand, the interceptor system collects the remaining area of 316.2 ha (31%) with a population of 35,365 in 2000.

(3) Proposed Urgent Sewer Networks

The proposed urgent sewer networks consist of secondary and tertiary sewers, main sewer including siphon, and conveyance sewer. Lift/booster pump station and force main are excluded from the urgent project.

The salient features of the urgent sewer networks are shown below.

Secondary & Tertiary Sewer (ø150-300 mm)	:	126,020 m
Main Sewer	:	15,140 m
Normal Main (ø350-1,500 mm)	:	15,060 m
Siphon (ø150-450 mm)	:	80 m
Conveyance Sewer (ø1,500-1,800 mm)	:	4,390 m
Total	:	145,550 m

The proposed urgent main and conveyance sewers are shown in Fig. 1.7.

The main sewer crosses Oongan River by siphon at two (2) locations.

1.2 Sewerage Networks of Sanur Area

1.2.1 Overall Plan

The overall plan targets the year of 2010.

(1) Sewerage Service Area

The Project Area encompasses Kel. Sanur, Desa Sanur Kaja and Desa Sanur Kauh with a total administrative area of 740 ha of which the net sewerage service area covers 726 ha excluding green area (see, Fig. 1.8).

Population of the service area in 1990 and 2010 are estimated to be 17,864 and 27,800 respectively. The corresponding population densities are 24.6 person/ha and 38.3 person/ha.

(2) Alternative Study of Sewer Networks

It is difficult to convey wastewater of the service area to the treatment plant located at central Suwung Swamp Area by gravity only. Construction of a booster pump station with a force main is necessary.

The following two (2) typical sewer networks are proposed as alternatives, considering the above situations.

Alternative A: Independent collection system

This system consists of four (4) main sewers laid in parallel with the coast line. Wastewater of the service area is independently collected to the booster pump station located at a southern location of the service area. All collected wastewater is conveyed to the treatment plant by the booster pump with a force main. See, Fig. 1.9.

Alternative B: Integrated collection system

This system consists of six (6) main sewers of which four (4) main sewers are integrated into one (1) big sewer before reaching the booster pump station. The remaining two (2) main sewers independently collect wastewater to the booster pump station. The integrated four (4) main sewers cover a large portion of the service area. All collected wastewater is conveyed to the treatment plant by a booster pump with a force main. See, Fig. 1.9.

The total direct construction cost of the above two (2) Alternatives are compared as follows.

	(Unit: billion Rp., 1992 price) Construction Cost	
	A	B
Secondary & Tertiary Sewer	13.2	13.2
Main Sewer	9.4	10.1
Force Main	4.0	4.0
Booster Pump Station	2.3	2.3
Total	28.9	29.6

As evident from the above table, Alternative A is more economical. Moreover, its independent system is more advantageous in stage implementation of the Project.

Hence, Alternative A is recommended.

(3) Proposed Sewer Networks

The net sewerage service area encompasses 726 ha with a total served population of 27,800 in 2010. The service area is divided into four (4) catchment zones governed by the proposed four (4) main sewers. Each catchment zone is further divided into several sub-catchment areas governed by secondary and tertiary sewers. See, Fig. 1.10.

The main works of the proposed sewer networks are secondary and tertiary sewer, main sewer, force main and booster pump station. However, some manhole pumps are further required to minimize the earth covering depth of sewers.

Salient features of the proposed sewer networks are as follow.

Secondary & Tertiary Sewer (ø150-300 mm)	:	97,220 m
Main Sewer (ø350-800 mm)	:	10,940 m
Force Main (ø500 mm x 2 units)	:	5,160 m
Total	:	113,320 m
Booster Pump Station	:	31.7 m^3/min., 1 place
Manhole Pump	:	Total 11.58 m^3/min., 3 place

The proposed sewer networks including main sewer, force main, booster pump station and manhole pump are shown in Fig. 1.10.

1.2.2 Urgent Plan

(1) Selection of Sewerage Service Area

In the sewerage development of Sanur area, priority is given to the improvement of sanitary environments in the tourism areas located along the beach. Hence, the entire catchment zone of the main sewer (C) and part of the catchment zone of the main sewer (D) are selected as the sewerage service area of the urgent plan. The service area and served population in 2000 are 331.8 ha and 11,513 respectively. The service area is shown in Fig. 1.11.

(2) Proposed Urgent Sewer Networks

Conventional collection system is applied for the whole urgent sewerage service area. Both toilet waste and gray water are collected by a separate collection system.

The proposed urgent sewer networks consist of secondary and tertiary sewers, main sewer, force main, booster pump station and manhole pump. Their salient features are shown below.

Secondary & Tertiary Sewer (ø150-300 mm)	:	32,720 m
Main Sewer (ø350-800 mm)	:	4,310 m
Force Main (ø500 mm x 1 unit)	:	5,160 m
Total	:	42,190 m
Booster Pump Station	:	17.8 m^3/min., 1 place
Manhole Pump	:	Total 5.37 m^3/min., 2 places

The above sewer networks are shown in Fig. 1.12.

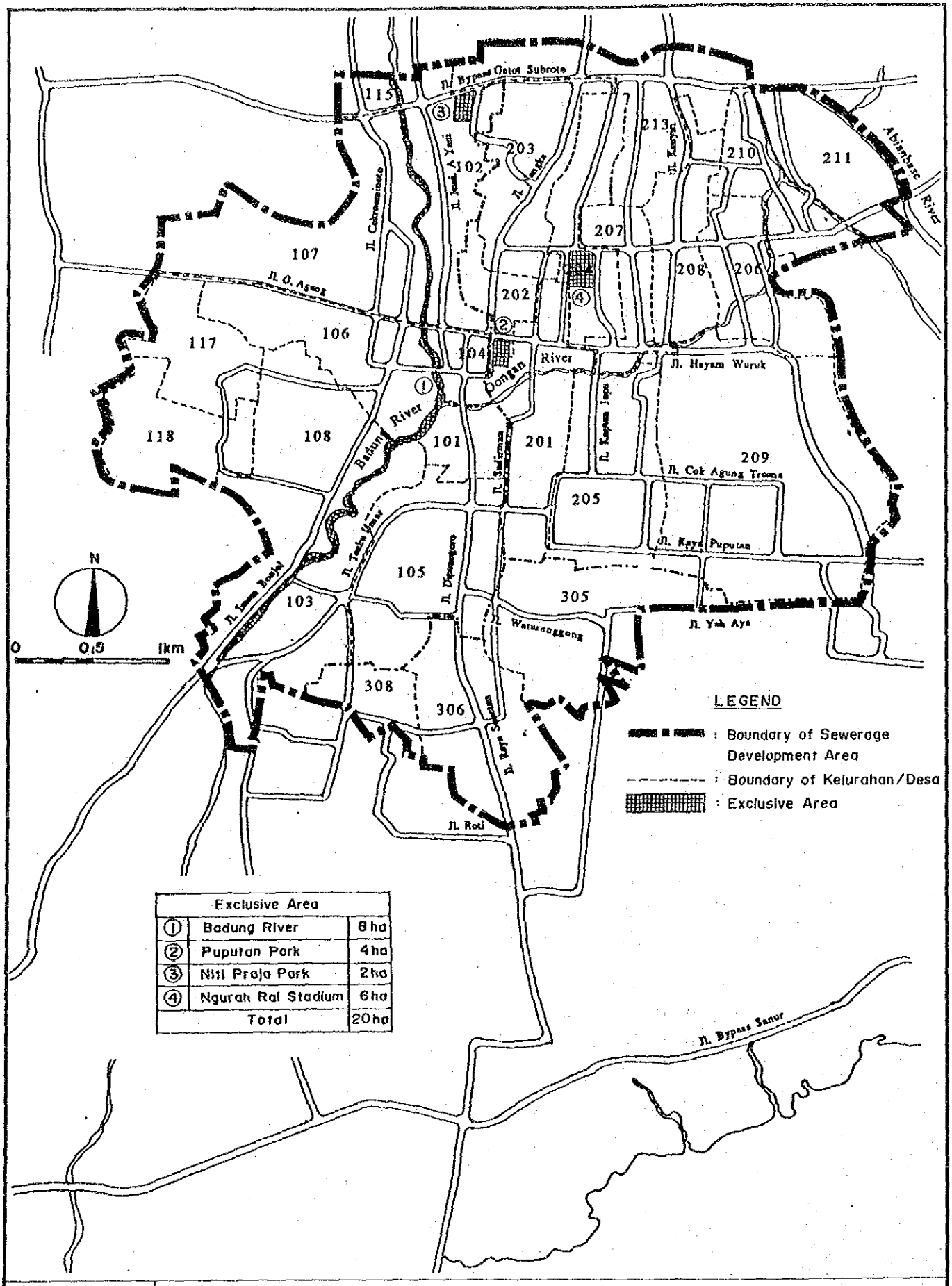
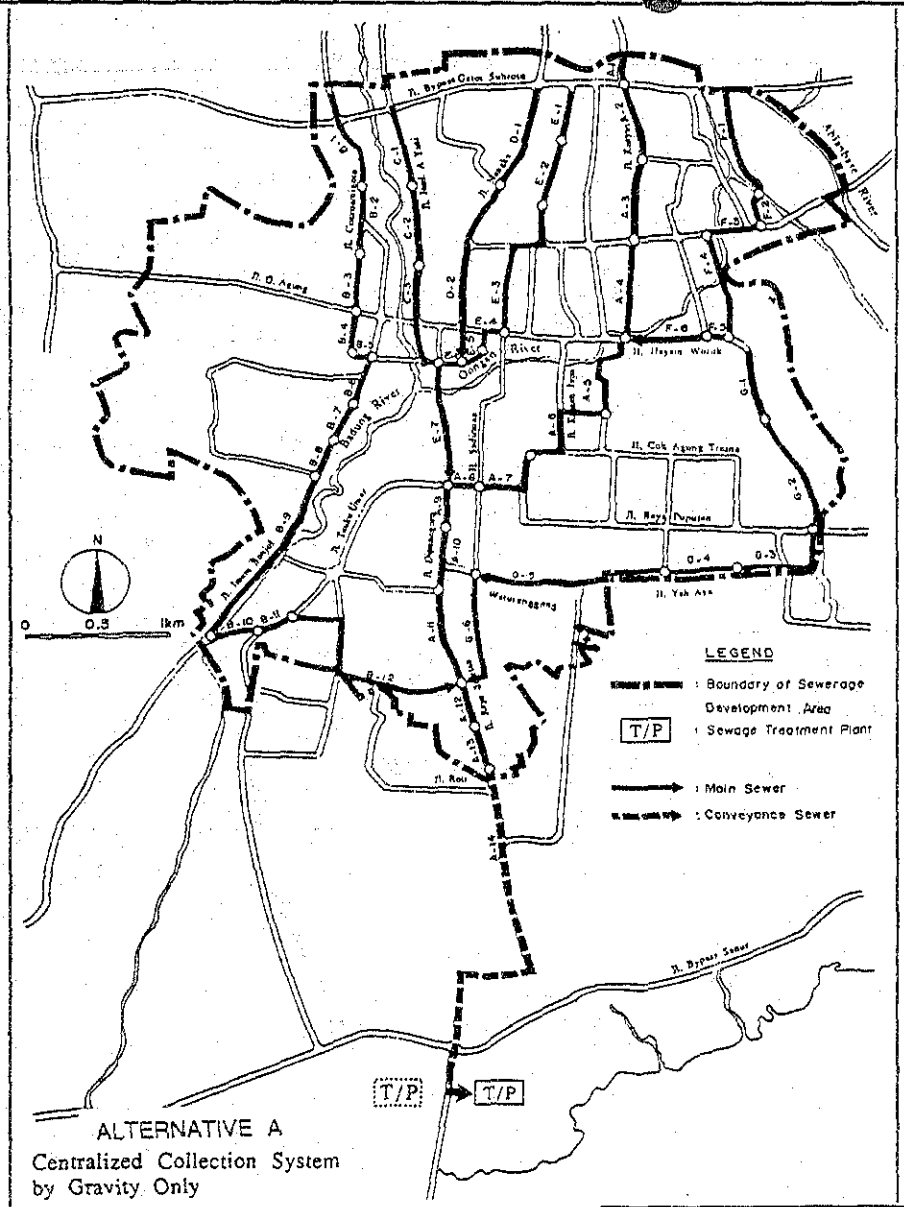
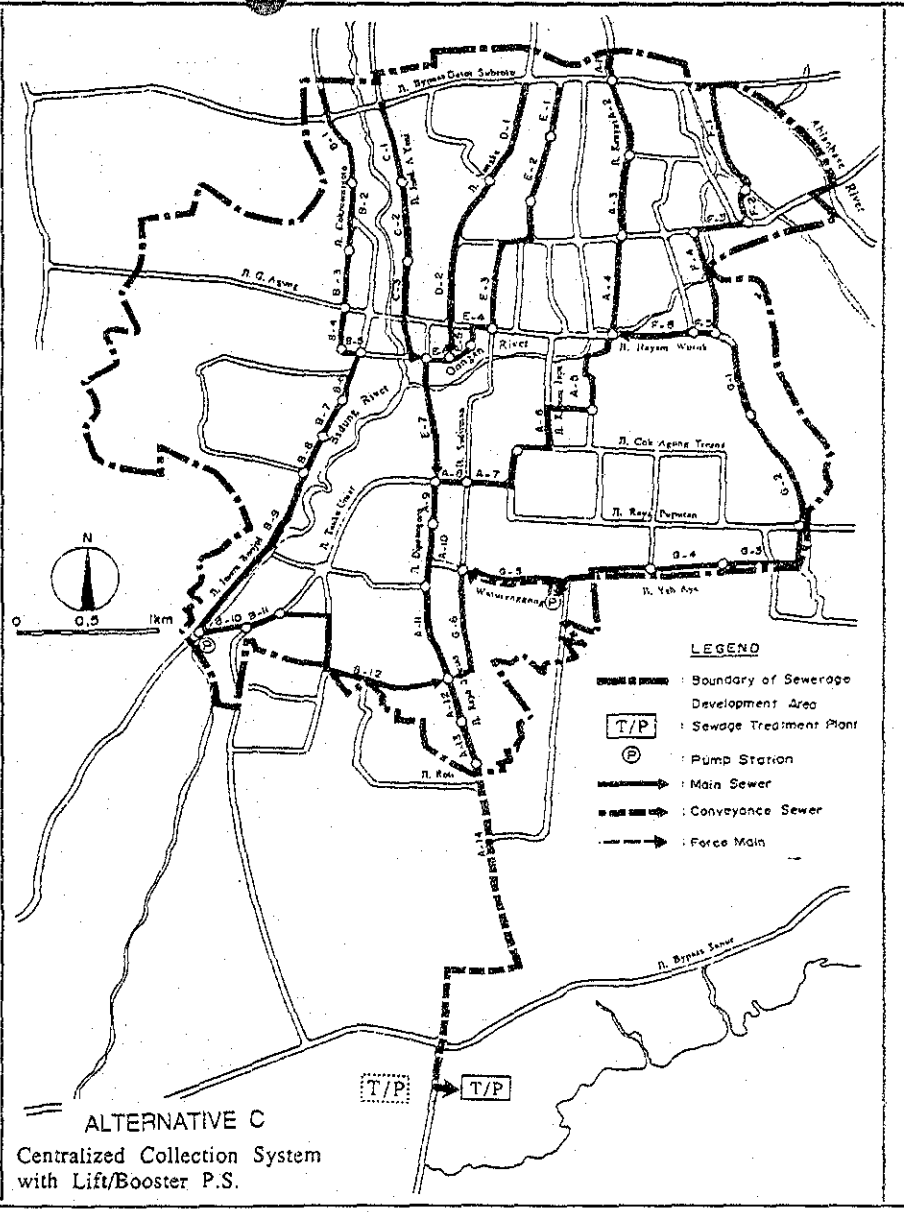


FIG. 1.1 SEWERAGE DEVELOPMENT AREA OF DENPASAR

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR



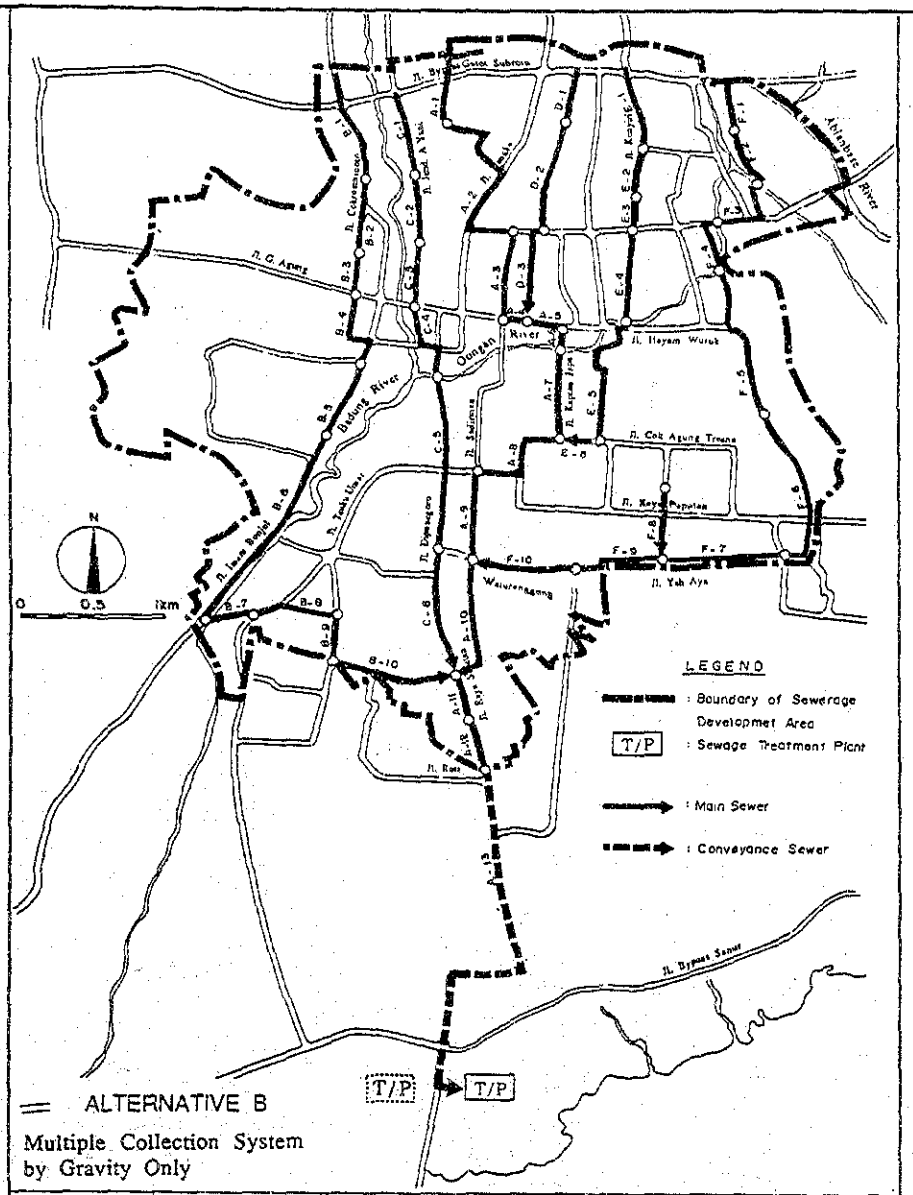
ALTERNATIVE A
Centralized Collection System
by Gravity Only



ALTERNATIVE C
Centralized Collection System
with Lift/Booster P.S.

FIG. 1.2 ALTERNATIVE A AND C

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR



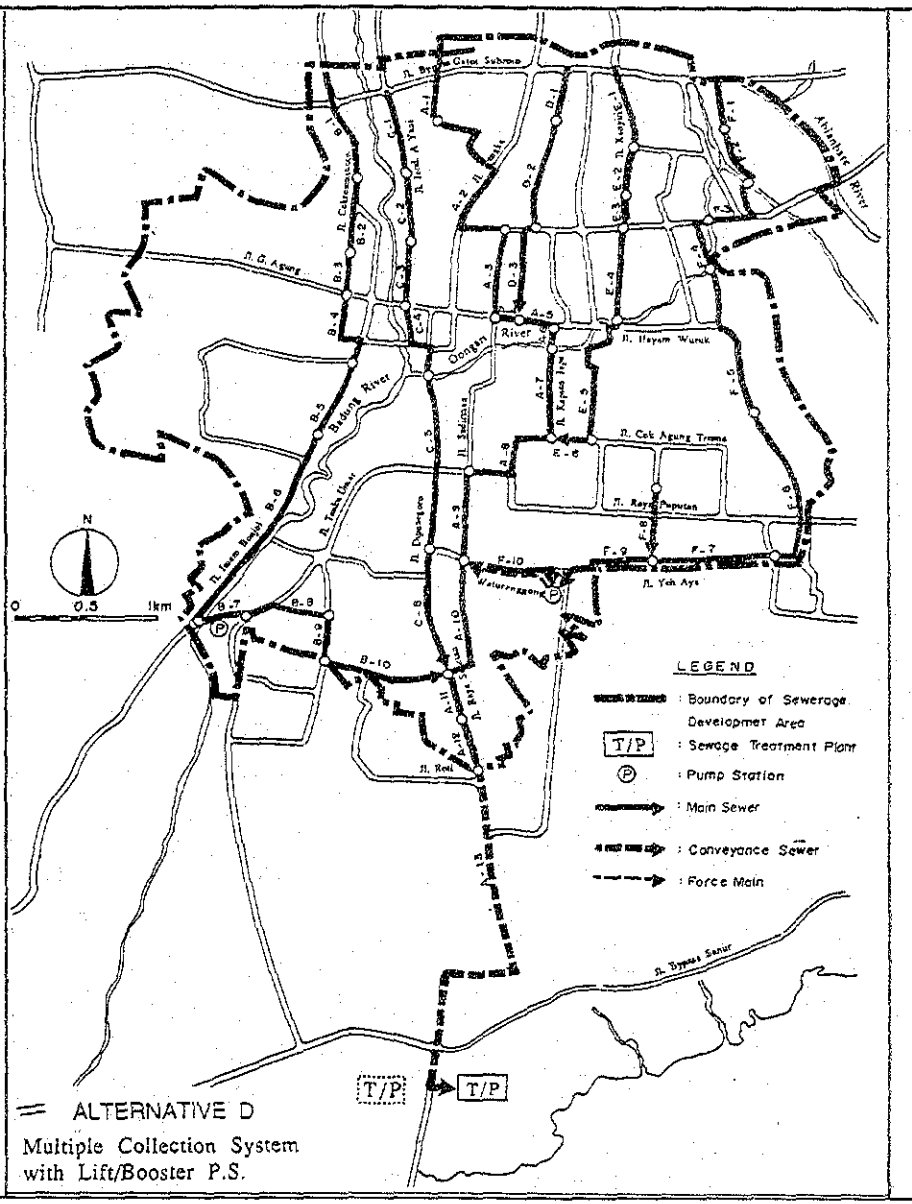


FIG. 1.3 ALTERNATIVE B AND D

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

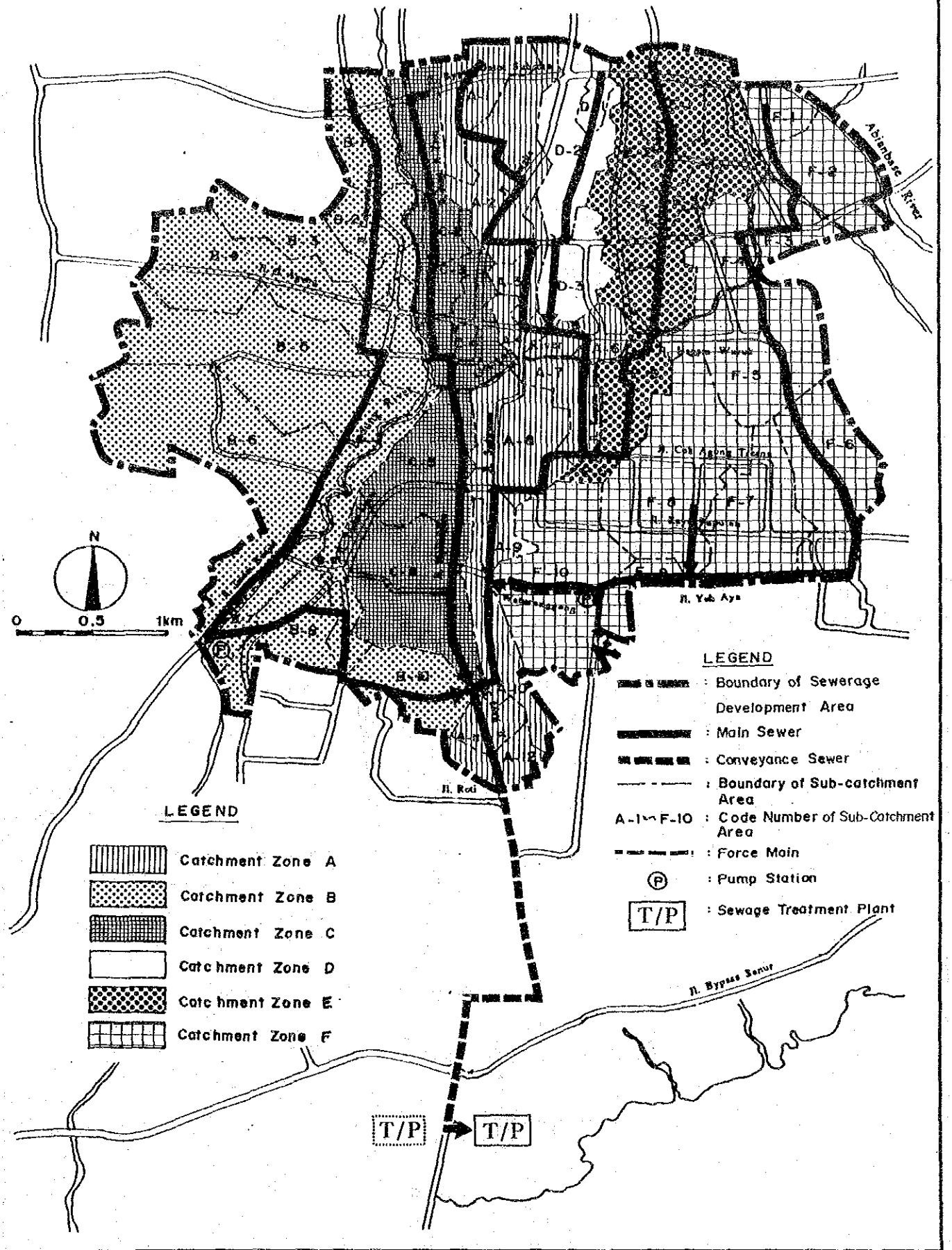


FIG. 1.4 DIVISION OF SEWERAGE SERVICE AREA

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

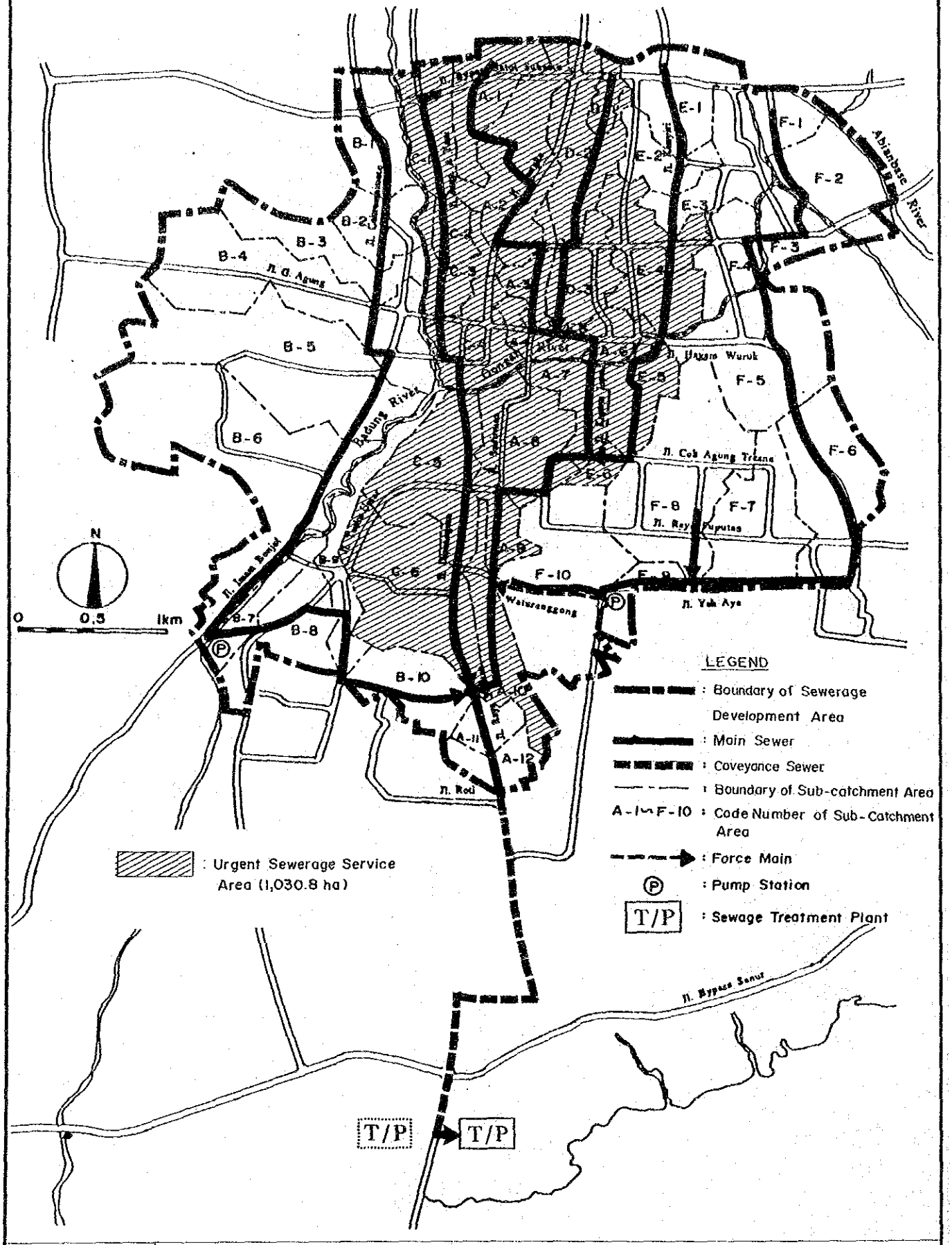


FIG. 1.5 PROPOSED URGENT SEWERAGE SERVICE AREA

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

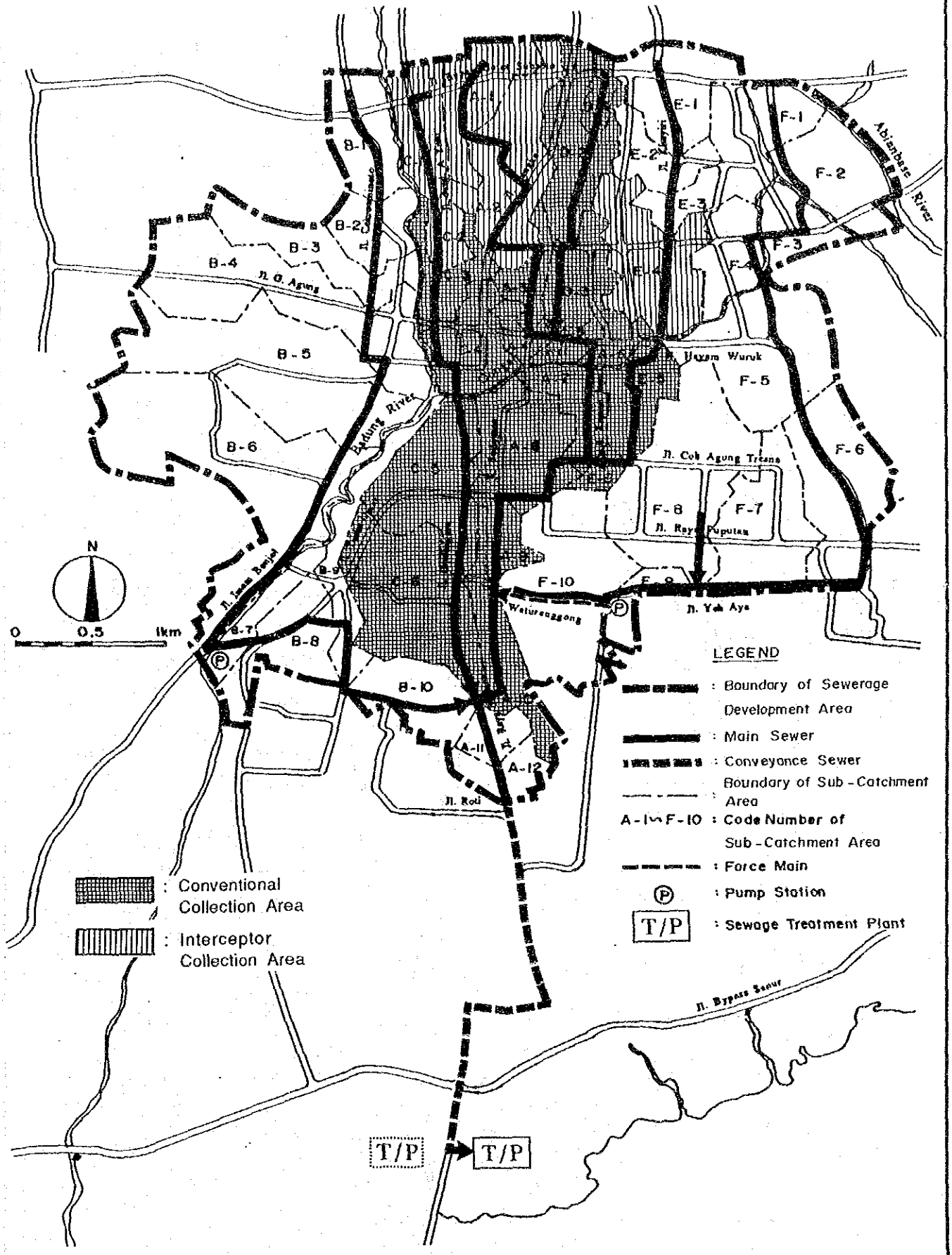


FIG. 1.6 DELINEATION OF CONVENTIONAL AND INTERCEPTOR COLLECTION SYSTEM

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

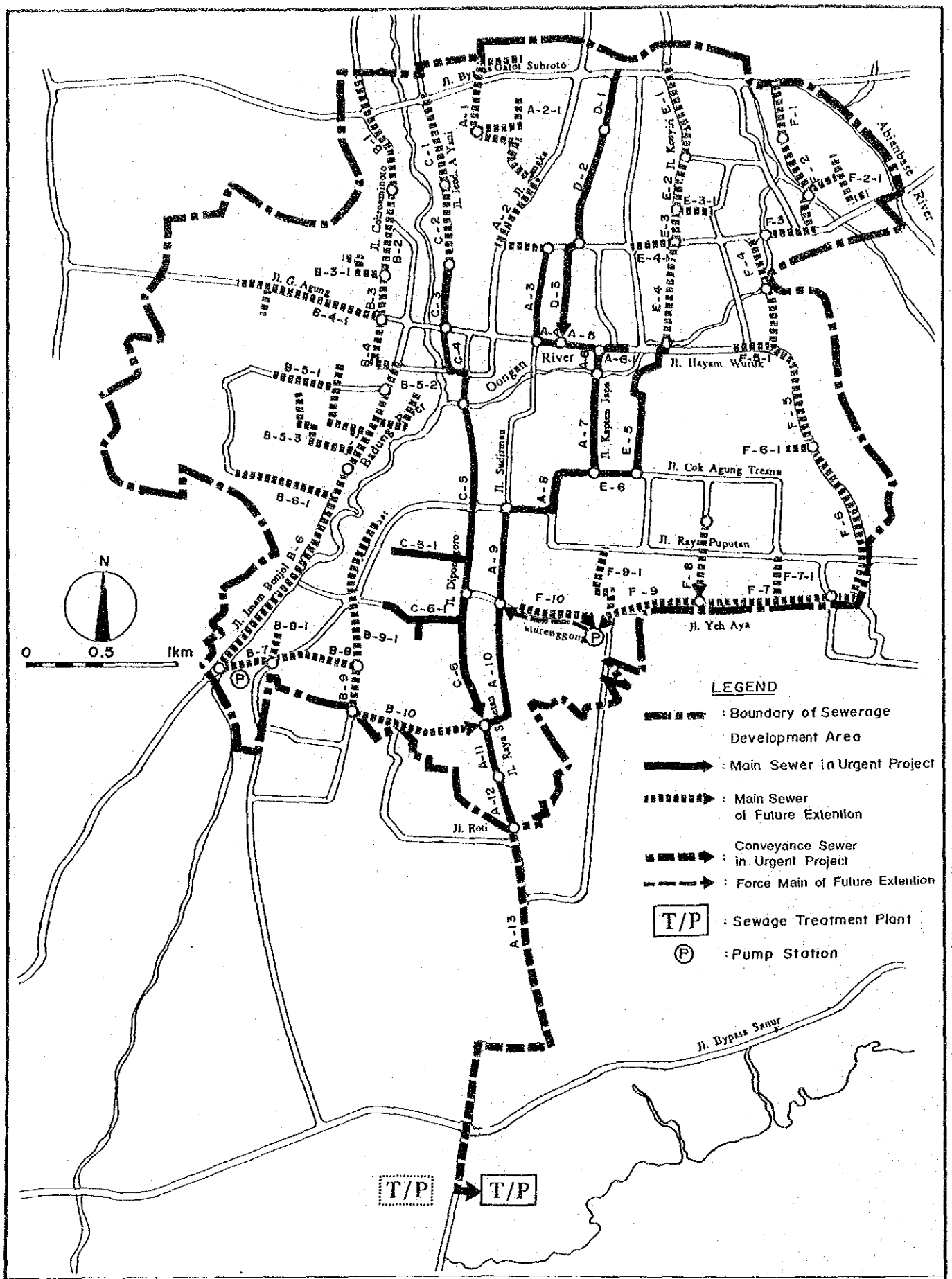


FIG. 1.7 PROPOSED URGENT MAIN AND CONVEYANCE SEWERS

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

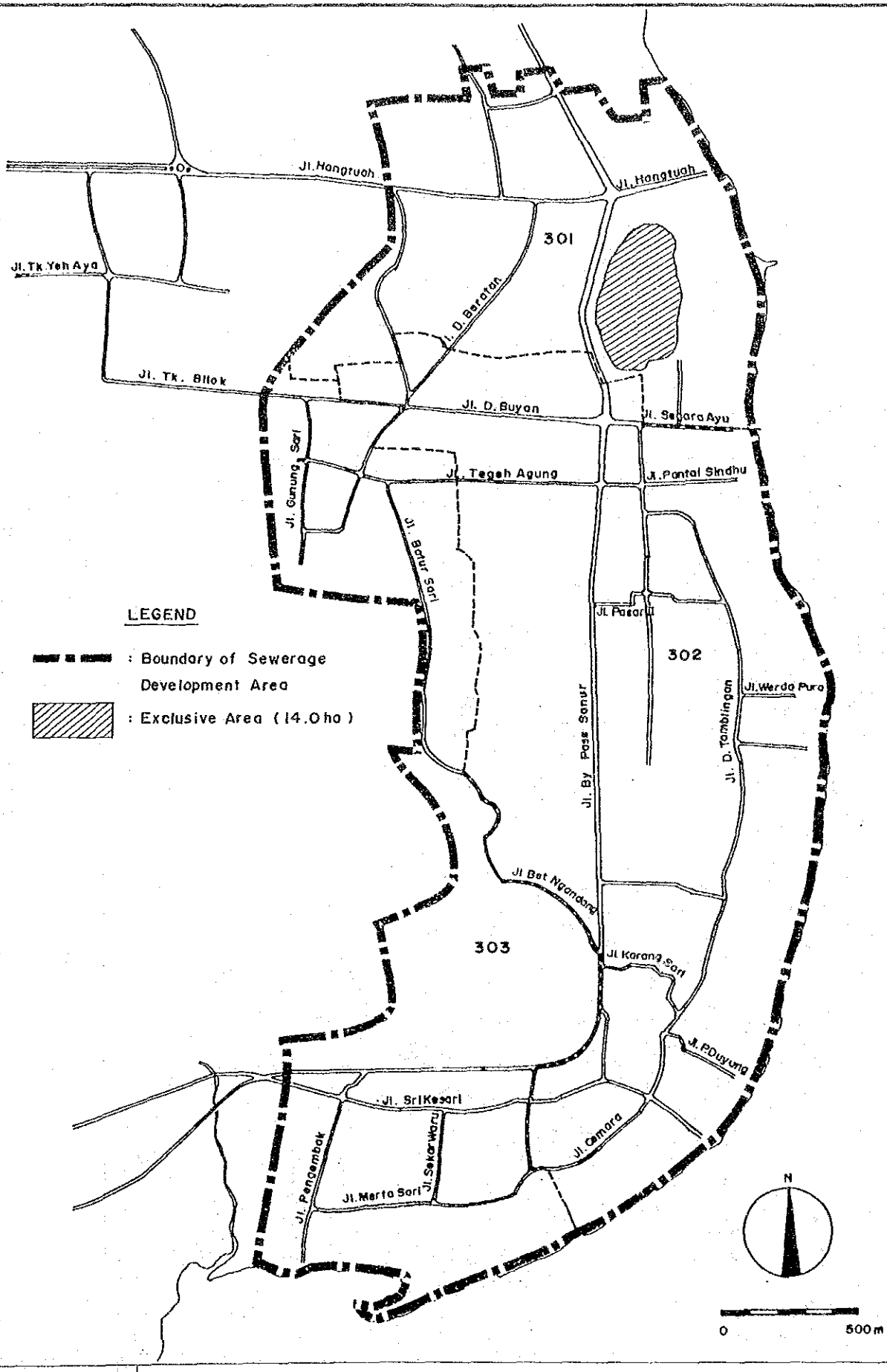
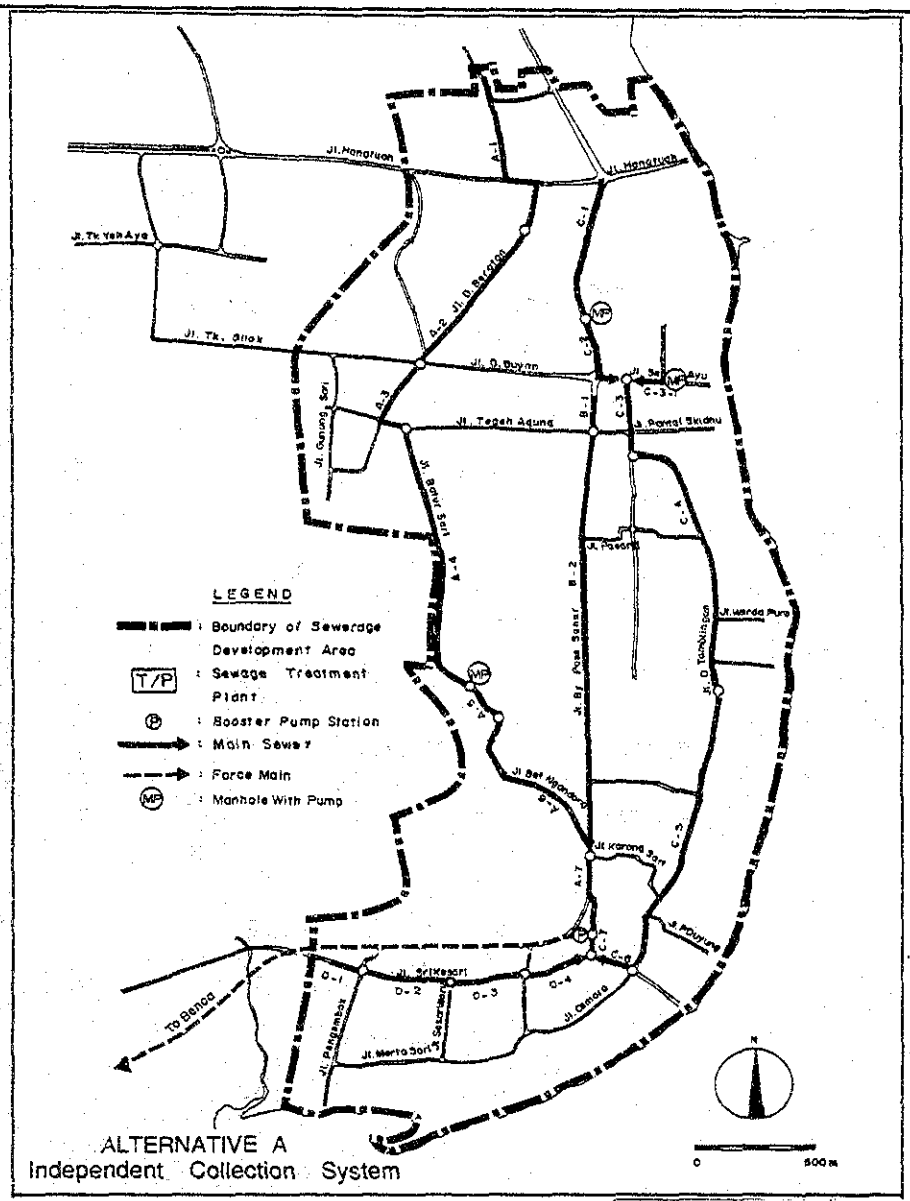
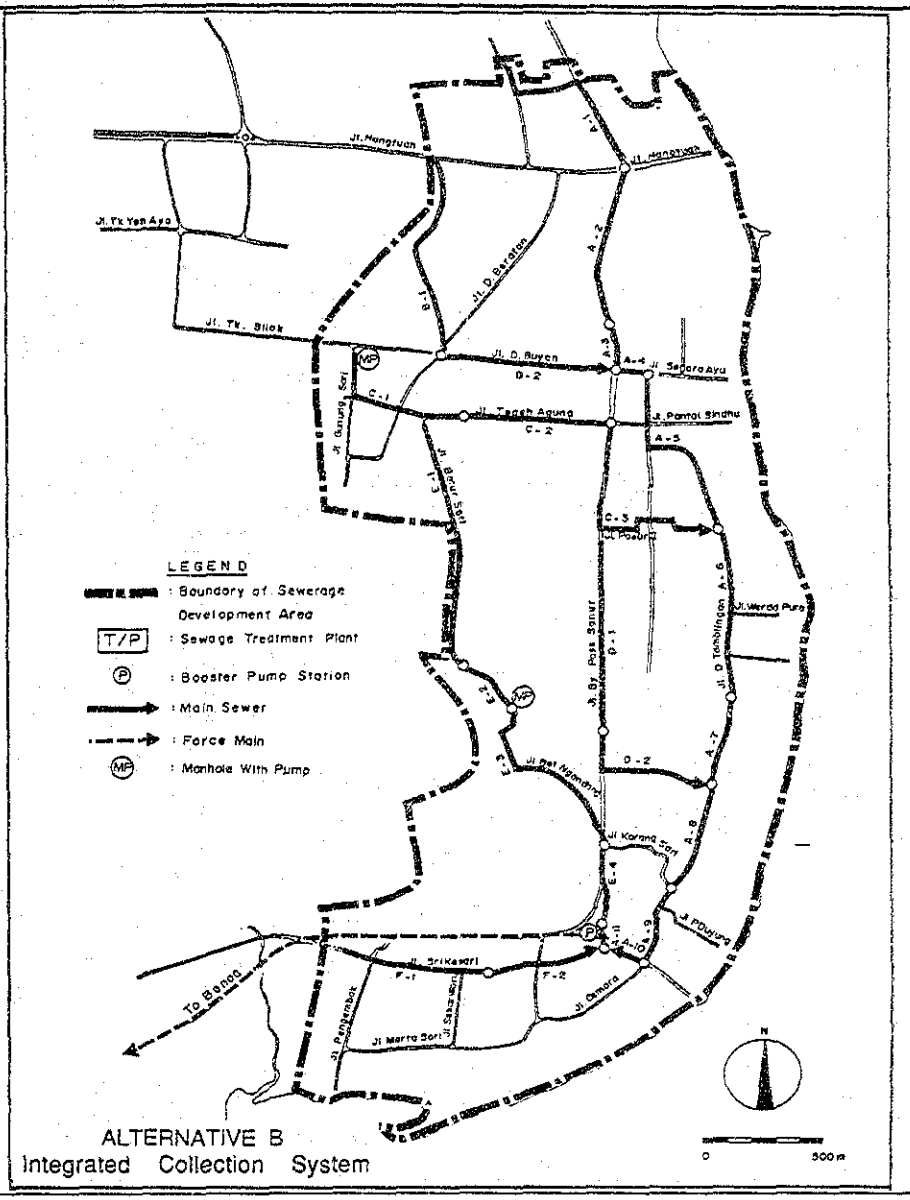


FIG. 1.8 SEWERAGE DEVELOPMENT AREA OF SANUR

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR



ALTERNATIVE A
Independent Collection System



ALTERNATIVE B
Integrated Collection System

FIG. 1.9 ALTERNATIVE A AND B

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

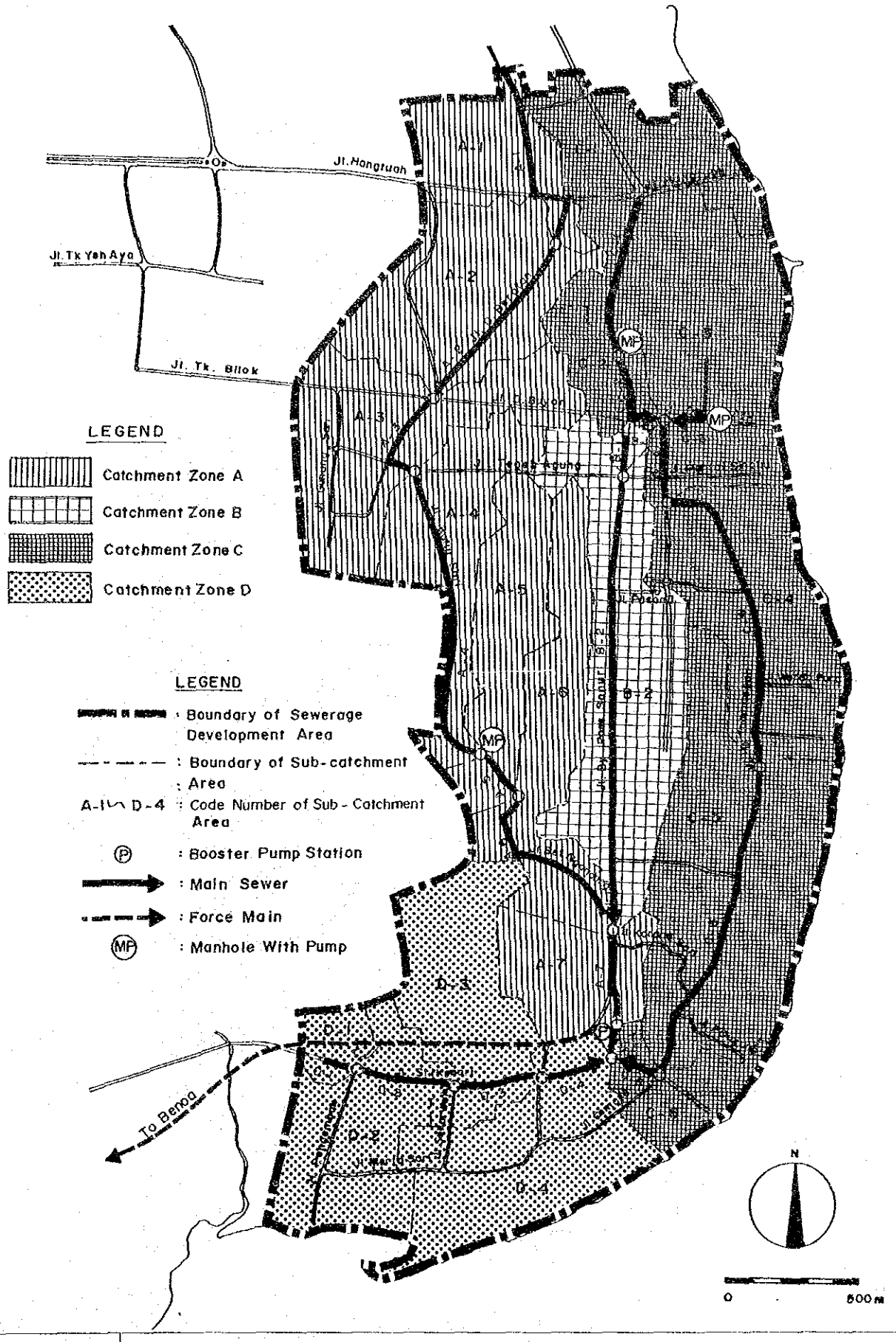


FIG. 1.10 DIVISION OF SEWERAGE SERVICE AREA

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

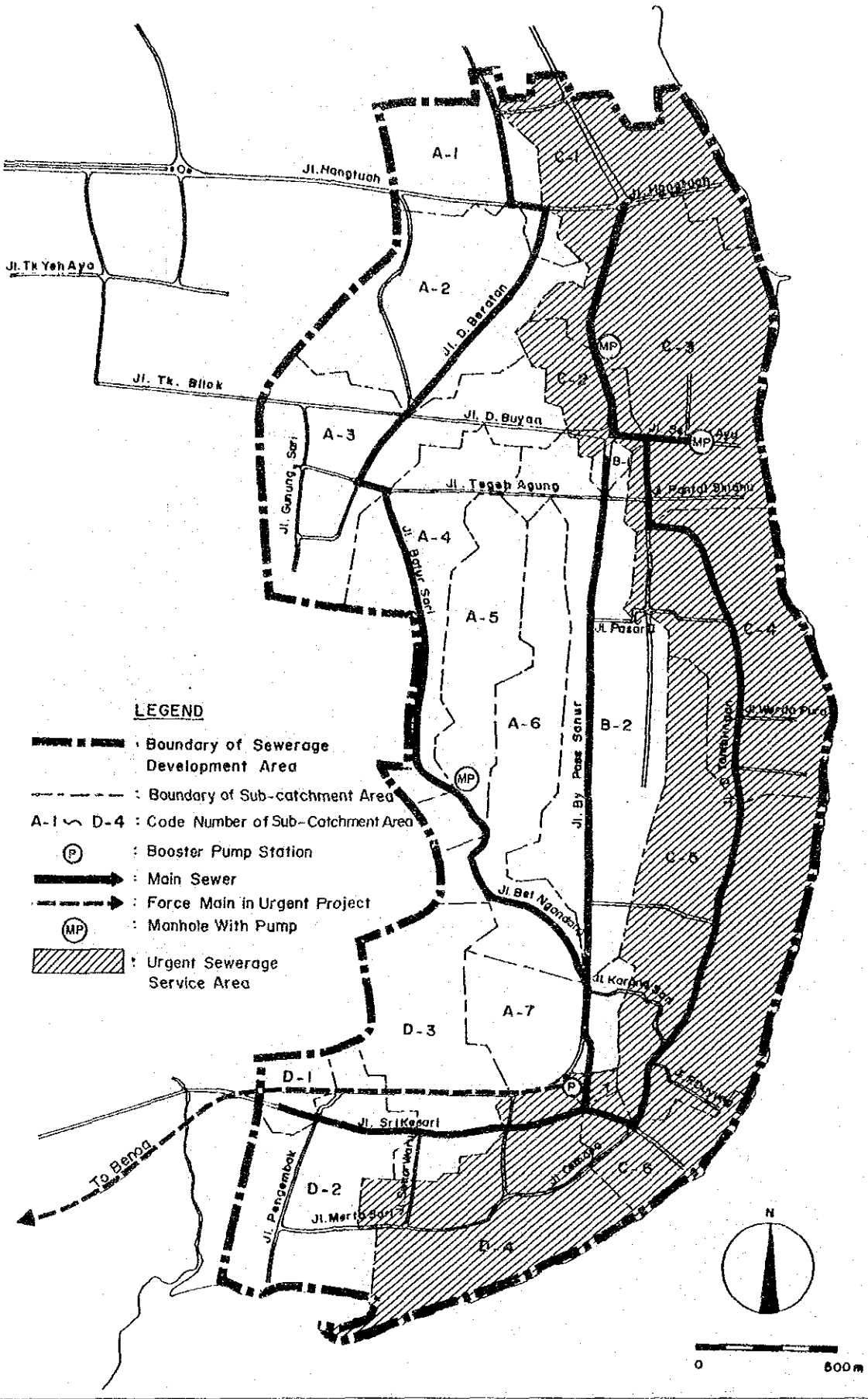


FIG. 1.11 PROPOSED URGENT SEWERAGE SERVICE AREA

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

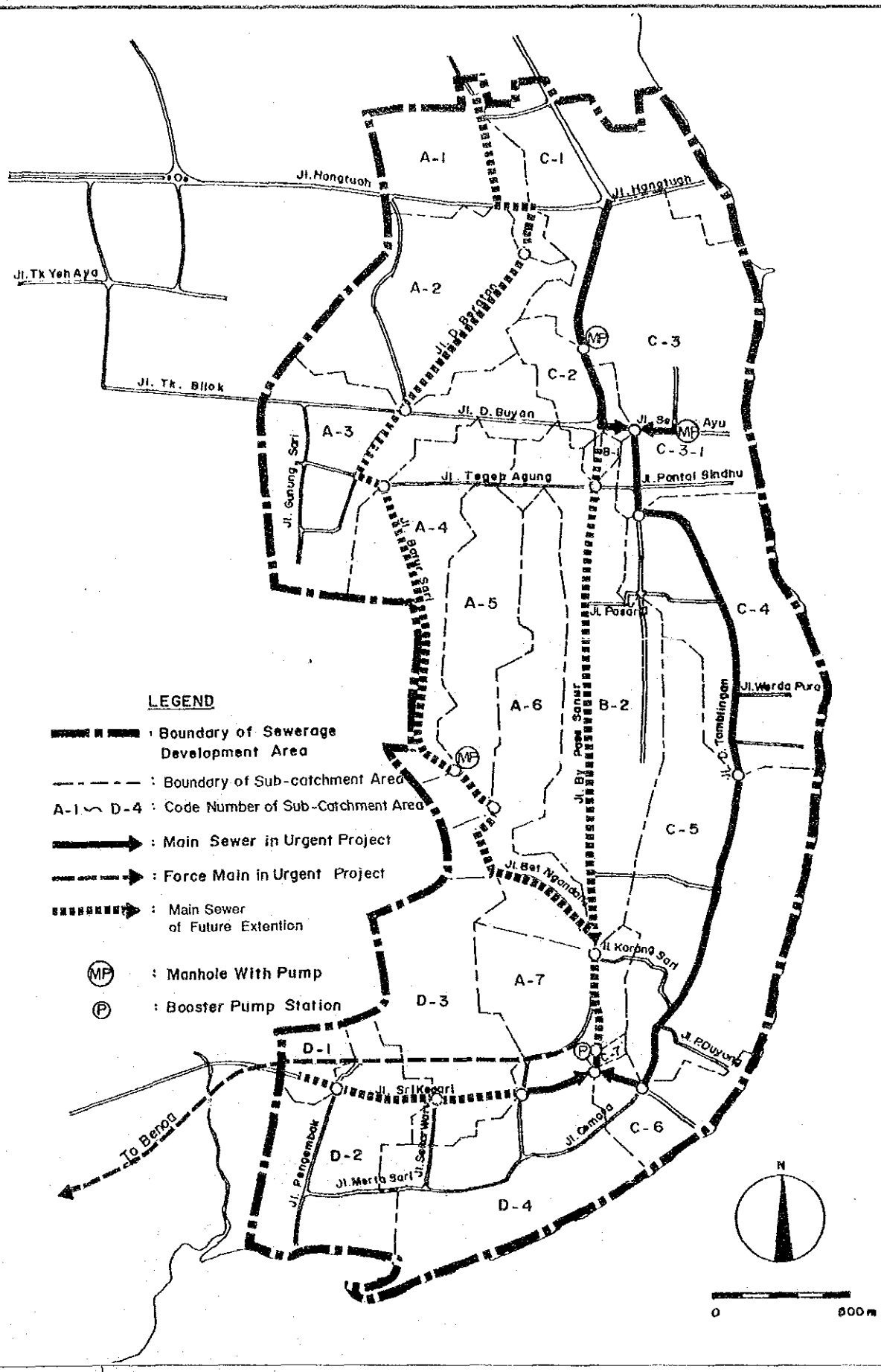


FIG. 1.12 PROPOSED URGENT SEWERAGE NETWORKS

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

CHAPTER 2 SEWAGE TREATMENT PLANT

2.1 Treatment Plant Site

2.1.1 Location

The proposed treatment plant site is swampy area located in Pessanggaran of Kelurahan Pedungan along Jl. Pelabuhan Benoa, the road leading to the Benoa Port (see, Fig. 2.1). The land is under the jurisdiction of the Ministry of Forestry, the Government of Indonesia.

The existing land use of this swampy area of treatment site is artificial shrimp culture (aquaculture) ponds, that covers an area of more than 394 ha. Mangrove forestation expands in the swampy area along the southern side of the shrimp pond area toward the Benoa Bay coast.

The required area for treatment plant, until the year 2000 is about 9.2 ha, while the total requirement of master plan until the year 2010 is about 22 ha. The site is remote from residential areas.

2.1.2 Land Elevation

The treatment plant is constructed in the existing shrimp pond area consisting of a number of small shrimp ponds. Each of the shrimp ponds are partitioned or encompassed by embankment.

The existing average crown elevation of the shrimp ponds is +0.7 m. The average bed elevation of the ponds is -1.4 m. On the other hand, high tide of the Benoa Bay is +0.5 m.

The above elevations are based on the inland survey bench mark used in this project. The high tide elevation of +0.5 m is equivalent to +1.0 m MSL.

2.2 Design Wastewater Quality and Quantity

2.2.1 Wastewater Quality

The influent wastewater quality to treatment plant is established as 190 mg/l in BOD_5, while the effluent water quality requirement is 20 mg/l as BOD_5. The design wastewater temperature is determined as 25°C.

2.2.2 Wastewater Quantity

The quantity of wastewater for treatment, influent to treatment plant, is determined with due consideration to groundwater infiltration into sewer system. Groundwater infiltration is assumed as 10% of design wastewater discharge into sewer system.

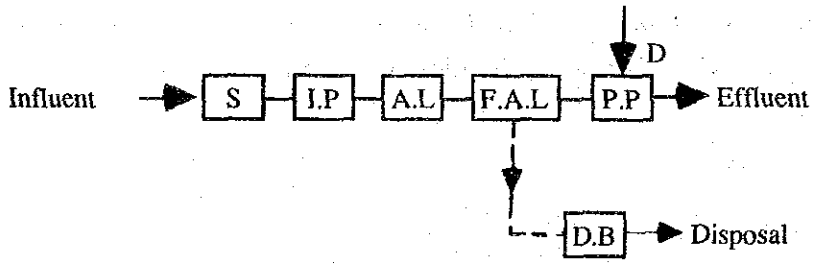
The service area will cover only portions of master plan areas in Denpasar and Sanur, until the year 2000 as the urgent project. The quantity of daily average design wastewater discharge to treatment plant are as follows.

Denpasar service area	:	34,570 m^3/d
Sanur service area	:	9,420 m^3/d
Total in the year 2000	:	43,990 m^3/d

Accordingly, the design capacity of treatment plant for this urgent project is determined as 44,000 m^3/d.

2.3 Wastewater Treatment System

Aerated lagoon system is used for treatment. The flow diagram of treatment stream is shown below.



S	:	Screen
I.P	:	Inflow Pump
A.L	:	Aerated Lagoon
F.A.L	:	Facultative Aerated Lagoon
P.P	:	Polishing Pond
D	:	Disinfection
D.B	:	Sludge Drying Bed

Two (2) parallel treatment streams each of capacity 22,000 m^3/d is used.

The layout of the treatment system distinguished between the capacity of urgent project until the year 2000, and that of master plan until the year 2010 is shown in Fig. 2.1.

The treated effluent will be discharged to the adjacent mangrove swampy area toward the Benoa Coast.

2.4 Treatment Facilities

2.4.1 Inflow Pump Station

The inflow pump station of treatment plant consists of initial bar screen followed with the pump facilities.

The design pump capacity by the year 2000 is determined as 70 $m^3/min.$, with 1 No. 50 $m^3/min.$ capacity and 1 No. 20 $m^3/min.$ capacity pumps with additional 1 No. 50 $m^3/min.$ capacity of pump as a stand by.

Pump type is vertical axial mixed flow pump.

The design hydraulic pump head is 7.4 m.
The design power of pump motor is 119.5 kW with 1 No. 84.5 kW (for 50 $m^3/min.$ capacity pump) and 1 No. 35.0 kW (for 20 $m^3/min.$ capacity pump).

The design dimension of screen preceeding the pump is as follows:
2.5 m (W) x 1.0 m (H) x 2 units.

2.4.2 Lagoon Treatment System

(1) Basic Consideration

The design high water level in the lagoon treatment system consisting of aerated lagoon, facultative aerated lagoon and polishing pond is determined as +1.0 m, which is 0.5 m higher than the high tide in Benoa Bay. Hence, the design land elevation of the treatment plant is set at +1.5 m by allowing an overall free board of 0.5 m.

In order to enhance the system reliability two parallel streams of identical treatment units with necessary interconnections will be provided. Accordingly, the system capacity per flow stream is 50% of the urgent project capacity of 44,000 m^3/d, which becomes 22,000 m^3/d.

Salient features of the lagoon treatment system are as follows.

(2) Aerated Lagoon

Capacity per stream is 22,000 m^3/d.
Detention time is 2 days.
Effective depth is 4 m.

Effective dimension selected is 150 m (L) x 75 m (W) x 4 m (D) x 2 No.

Design power rating of aerator : 75 kW x 3 units (per lagoon)
75 kW x 6 units (Total)

(3) Facultative Aerated Lagoon

Capacity per stream is 22,000 m^3/d.
Detention time is 2 days.
Effective depth is 4.0 m, with additional 0.5 m depth at base for digested sludge storage.

Effective dimension selected is 150 m (L) x 75 m (W) x 4.0 m (D) x 2 No.

Design power rating of aerator : 22 kW x 3 units (per lagoon)
22 kW x 6 units (Total)

(4) Polishing Pond

Capacity per stream is 22,000 m^3/d.
Detention time is 0.5 day.
Effective depth is 1.5 m, with additional 0.5 m at base for sludge stabilization.

Effective dimension selected is 93.25 m (L) x 78.75 m (W) x 1.5 m (D).

(5) Sludge Drying Bed

The quantity of desludging from facultative aerated lagoon was determined considering an annual per capita sludge accumulation of 35 liters in the lagoon.

The design dimension of drying bed, with a sludge spread thickness of 250 mm, is determined as : 10 m(W) x 25 m(L) x 0.25 m(D) x 22 No.

(6) Treatment Plant Area

The land area of treatment system for this urgent project is 9.2 ha, covering the areas of treatment facility (8.0 ha) and control building (1.2 ha). No green belt (buffer zone) is required since the proposed treatment plant is surrounded by the existing and planned mangrove forests.

The selected dimensions of the aerated lagoon, facultative aerated lagoon, polishing pond and sludge drying bed are shown in Fig. 2.2.

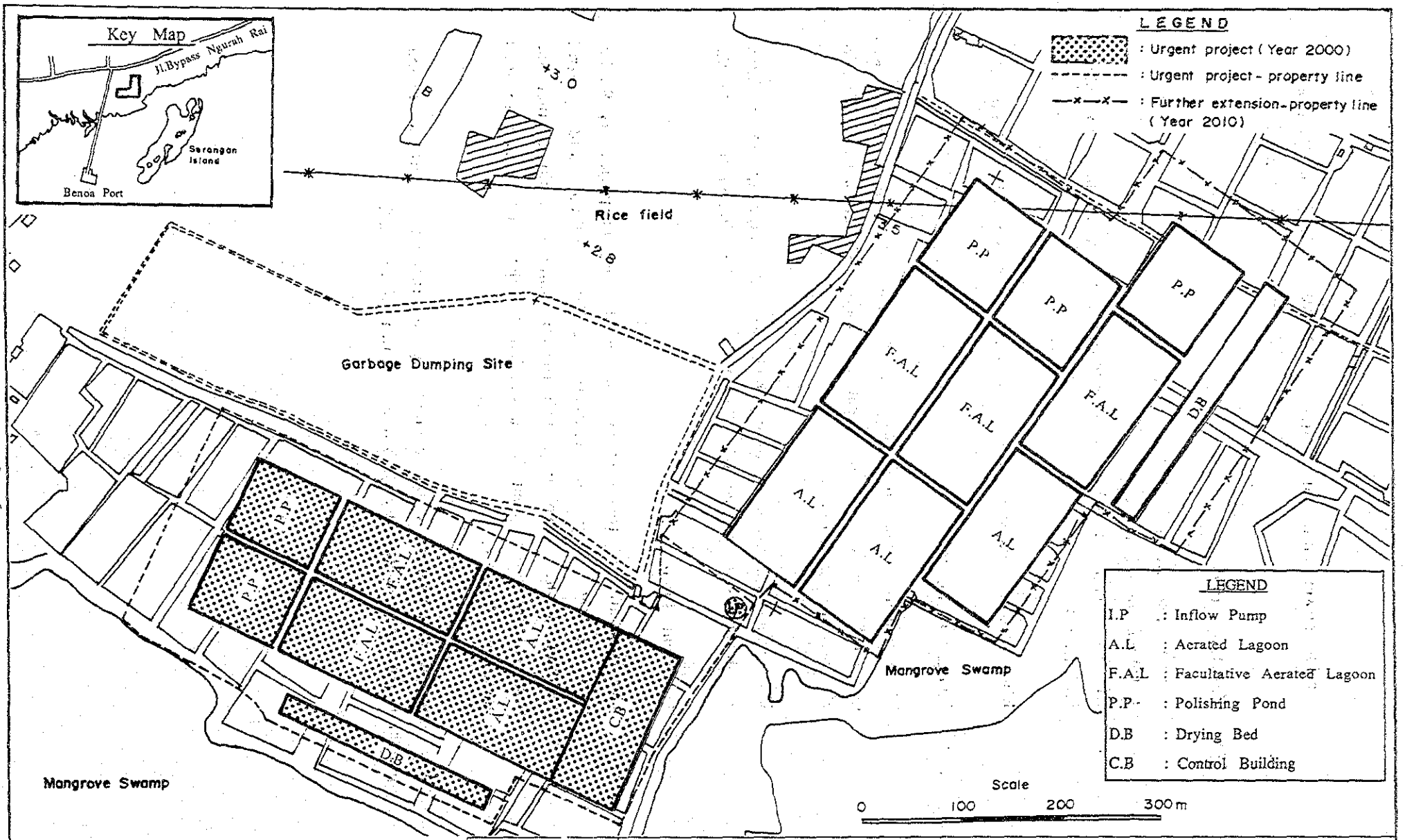


FIG. 2.1 LAYOUT OF TREATMENT PLANT

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

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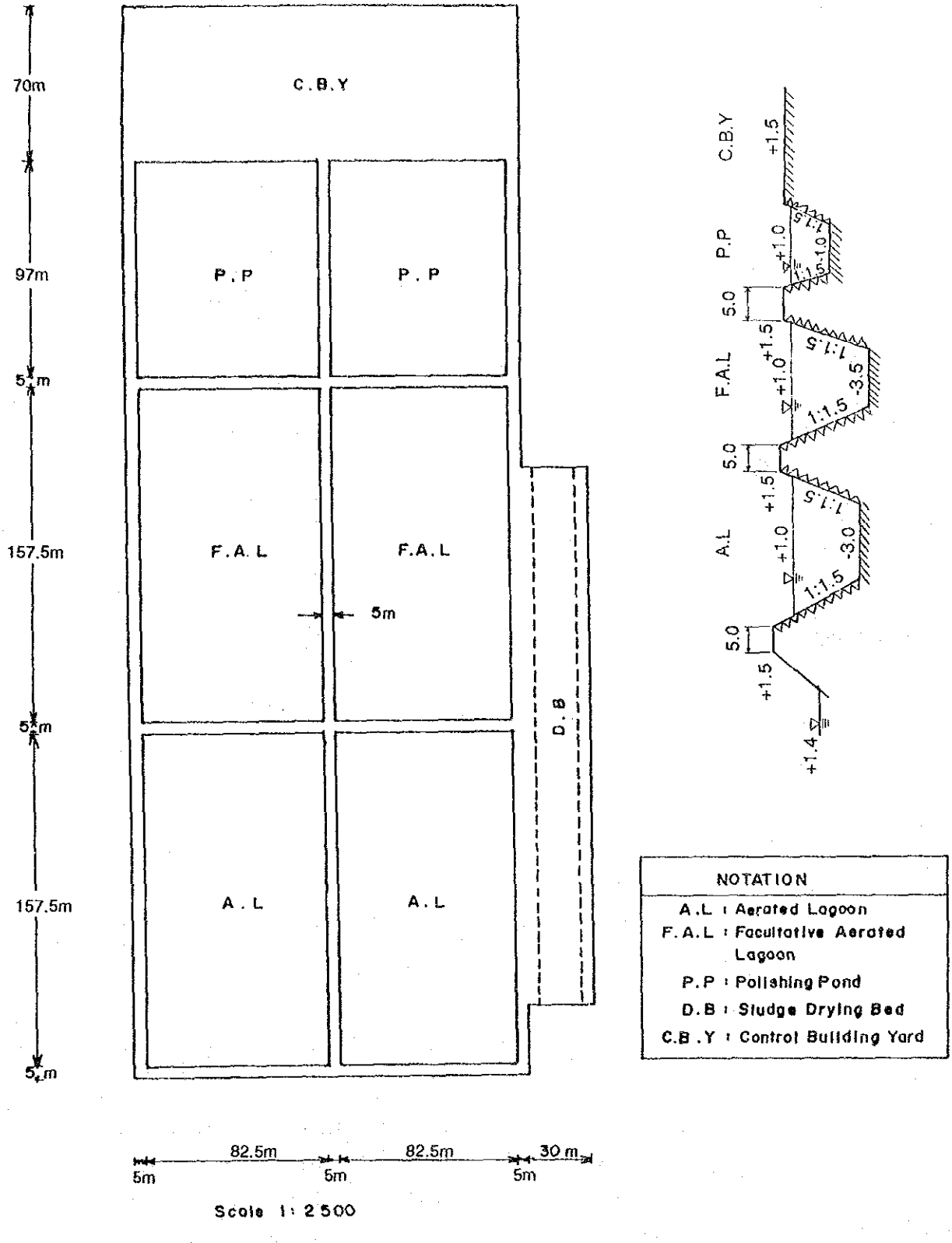


Note : All dimensions at design land elevation of treatment plant (+ 1.5 m).

FIG. 2.2 DESIGN DIMENSION OF LAGOON TREATMENT SYSTEM

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

CHAPTER 3 COST ESTIMATE AND IMPLEMENTATION PROGRAMME

3.1 Construction Plan

3.1.1 Geology and Groundwater Table

The sub-soil characteristics of the Project Area vary according to underground depth as follows.

Denpasar sewerage area : soft sandy silt to dense gravely coarse sand

Sanur sewerage area : fine beach sand to coarse beach sand. Both sands are formed from disintegrated coral and sea shell

Treatment plant site : soft clay to stiff sandy clay
The N-value is:
- Less than 10 in the shallower layer up to 11.0 m deep
- 15-20 in the layer of 12.0-22.0 m depth
- More than 20 in the deeper layer of 23.0 m and more

The Project Area is affected by shallow groundwater table as below.

A large portion of Denpasar sewerage area : < 3.0 m
Sanur sewerage area : 3.0 - 5.0 m
Treatment plant site : < 1.0 m

3.1.2 Construction Method

The maximum diameter and earth covering depth of the proposed sewer pipes are ø1800 mm and 7.0 m respectively. All the sewer pipes except the inverse siphons will be economically constructed by open trench method. For the inverse siphons crossing the Oongan River, micro tunnelling method will be applicable.

The construction of the treatment plant requires a large volume of earth work. The earth works will be conducted by an economical combination of man-power, power shovel/back hoe/drag line, bulldozer and dump truck.

The earth work volume of the treatment plant is well balanced and no soil dumping is required. However, the sewer pipe construction works will produce a residual soil of 301,000 m^3 in total. The housing development areas scattered in the Project Area are potential spoil banks of such residual soils.

3.2 Cost Estimate

3.2.1 Project Cost

The total project cost, consisting of direct construction cost, land acquisition cost, administration cost, engineering cost and physical contingency amounts to Rp. 82,400 million at 1992 price. Its break-down is shown below.

		(unit: million Rp.)
(A)	Direct Construction Cost	66,000
	1) Collection Sewer	53,800
	(1) Secondary & Tertiary	20,590
	(2) Main Sewer	18,365
	(3) Conveyance Sewer	11,558
	(4) Force Main	1,992
	(5) Booster Pump	1,295
	2) Treatment Plant	12,200
	(1) Inflow Pump	7,100
	(2) Aerated Lagoon	4,200
	(3) Other Facilities	900
(B)	Land Acquisition Cost	500
(C)	Administration Cost	1,320
(D)	Engineering Cost	7,920
(E)	Physical Contingency	6,660
	Total	82,400

The direct construction cost is further broken down as shown in Table 3.1.

3.2.2 O&M Cost

The annual O&M cost of the urgent project in 2000 is estimated at Rp. 1,194 million/year with following break-down.

		(unit: million Rp.)
(A)	Sewer Pipe	57
(B)	Booster Pump	103
(C)	Treatment Plant	849
(D)	Overhead	185
	Total	1,194

3.3 Implementation Programme

3.3.1 Implementation Schedule

The proposed urgent project will be completed within 7 years from 1994 to 2000. The detailed design will be completed within 15 months in the years of 1994 and 1995. The construction works will commence in 1996 and be completed in 2000 with a net construction period of 60 months.

The proposed implementation schedule is shown in Fig. 3.1.

3.3.2 Disbursement Schedule

The proposed disbursement schedule of the project cost is shown in Table 3.2.

Table 3.1 Break-down of Direct Construction Cost

(Sewer Pipe)

(Unit: million Rp.)

	Denpasar Area		Sanur Area		Total	
	Q'ty	Cost	Q'ty	Cost	Q'ty	Cost
Secondary & Tertiary	126,020 m	16,933.4	32,720 m	3,656.4	158,740 m	20,590
Main						
-Normal Main	13,690 m	13,737.1	4,310 m	4,221.6	18,000 m	17,959
-Inverse Siphon	80 m	406.4	—	—	80 m	406
Conveyance	4,390 m	11,557.5	—	—	4,390 m	11,558
Force Main	—	—	5,160 m	1,992.0	5,160 m	1,992
Booster/Lift Pump	—	—	17.5m^3/min.	1,295.0	17.5m^3/min.	1,295
Total		42,634.4		11,166.0		53,800

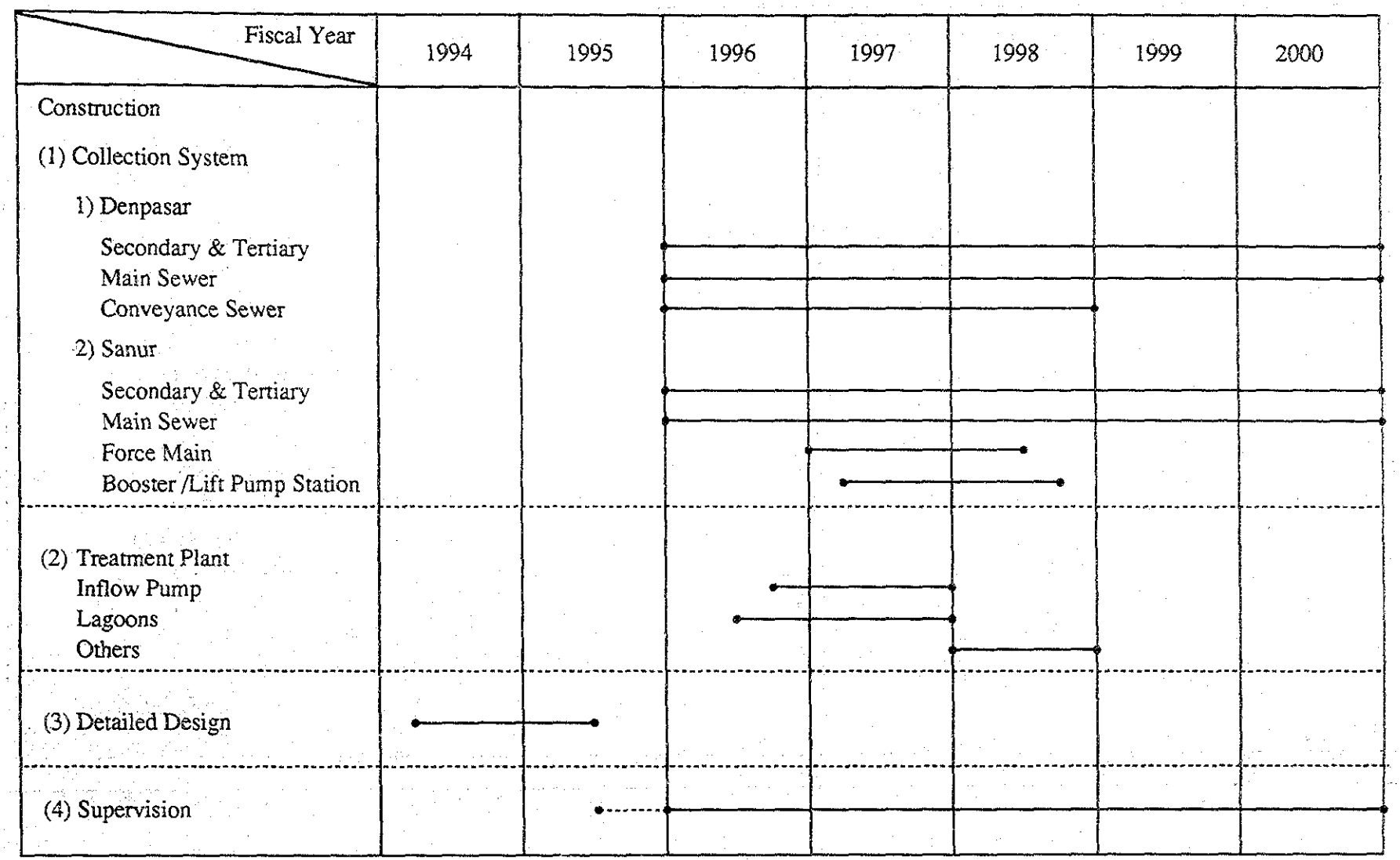
(Treatment Plant)

Work Item	Quantity	Unit Cost	Const. Cost (million Rp.)
1. Pump Station			7,100
Civil/Architecture	1 ls.		4,364
Mech./Elect. Equipment	66.0 m^3/min.		2,632
Miscellaneous Works	1 ls.		104
2. Aerated Lagoon			4,200
Excavation	89,000 m^3	7,000 Rp./m^3	623
Embankment			
Excavated Soil	89,000 m^3	8,300 Rp./m^3	739
Transported Soil	14,000 m^3	29,000 Rp./m^3	406
Slope Protection (Wet Masonry)	18,000 m^2	46,000 Rp./m^2	828
Bed Protection (Cobble Stone)	19,000 m^2	12,000 Rp./m^2	228
Drying Bed	4,900 m^2	20,000 Rp./m^2	98
Aerator			
Aerated Lagoon	75 kW x 6 units	2.0 million Rp./kW	900
Facultative Aerated Lagoon	22 kW x 6 units	2.0 million Rp./kW	264
Others			114
3. Other Facilities & Equipments			900
4. Total			12,200

Table 3.2 Disbursement Schedule of Urgent Project Cost

	1994	1995	1996	1997	1998	1999	2000	Total
(A) Direct Construction Cost			16,414	19,560	14,667	7,730	7,629	66,000
1) Collection Sewer								
(1) Denpasar								
Secondary & Tertiary			3,400	3,400	3,400	3,400	3,333	16,933
Main Sewer			2,750	2,750	3,156	2,750	2,737	14,143
Conveyance Sewer			3,850	3,850	3,858			11,558
(2) Sanur								
Secondary & Tertiary			730	730	730	730	737	3,657
Main Sewer			850	850	850	850	822	4,222
Force Main				996	996			1,992
Booster/Lift Pump Civil				518				518
Booster/Lift Pump Mech.					777			777
2) Treatment Plant								
Inflow Pump Civil			2,500	1,968				4,468
Inflow Pump Mech.			816	1,816				2,632
Aerated Lagoon Civil			1,518	1,518				3,036
Aerated Lagoon Mech.				1,164				1,164
Other Facilities					900			900
(B) Land Acquisition		100	400					500
(C) Administration Cost			328	391	293	155	153	1,320
(D) Engineering Cost	1,220	2,900	1,100	1,100	600	600	400	7,920
(E) Physical Contingency			1,640	1,960	1,470	820	770	6,660
Total	1,220	3,000	19,882	23,011	17,030	9,305	8,952	82,400

Fig. 3.1 Implementation Schedule of Urgent Project



CHAPTER 4 ECONOMIC, SOCIAL AND ENVIRONMENTAL EVALUATION

4.1 Water Pollution Abatement

The proposed urgent sewerage development project will improve the river water quality in central and southern Denpasar areas. As a result, it will also improve the sea water quality in Benoa Bay, Sanur Beach and Nusa Dua Beach.

The river water quality of the central and southern Denpasar areas under the existing, future without project and future with urgent project conditions are summarized below:

(Unit: BOD mg/ℓ)

	Range	Average
Existing (1990)	22.9 - 51.8	32.2
Future (2000) without Project	35.1 - 80.3	52.7
Future (2000) with Project	15.3 - 30.8	23.0

For water quality of each river section, see Fig. 4.1.

The average river water quality of central and southern Denpasar areas will be maintained around BOD 20 mg/ℓ.

The pollution loads to the sea from the Study Area under the existing, future without project and future with urgent project conditions are as follows :

	Pollution Load to Sea (BOD, ton/day)
Existing (1990)	10.8
Future (2000) without Project	17.2
Future (2000) with Project	11.6

The polluted sea areas with COD of more than 5 mg/ℓ under the existing, future without project and future with urgent project conditions are estimated as follows:

	Polluted Sea Area (km^2)
Existing	28.3
Future (2000) without Project	35.3
Future (2000) with Project	31.1

For regional distribution of the polluted sea area, see Fig. 4.2.

The proposed urgent project will control the sea water quality in 2000 around the existing level.

4.2 Number of Beneficiaries

Beneficiaries were classified into nine (9) types or categories, namely, households, hotels, restaurants, shops, factories, offices, educational institutions, medical institutions and religious institutions.

The urgent sewerage development project covers an area of 714.6 ha by conventional system and 316.2 ha by interceptor system for Denpasar area. For Sanur area, it encompasses 331.8 ha by conventional system only. This urgent project will be completed by 2000.

Households and hotels are the largest beneficiaries in the above service areas. The total number of households and hotels (room) in the urgent sewerage service area in 1990 are estimated to be 18,025 and 4,136 respectively. Those in 2000 are also estimated to be 22,428 and 6,812 respectively. Their break-down are shown below.

	1990		2000	
	Households	Hotels (Room)	Households	Hotels (Room)
Denpasar	16,452	991	20,392	1,203
Conventional	11,697	801	14,269	968
Interceptor	4,755	190	6,123	235
Sanur	1,573	3,145	2,036	5,609
Total	18,025	4,136	22,428	6,812

The sewerage development will be continued until 2010 to achieve the overall sewerage plan. This overall plan serves a total area of 3,389 ha by

conventional system only including 2,663 ha for Denpasar and 726 ha for Sanur.

The total number of served households and hotels (room) in the overall service area in 2010 are estimated to be 53,903 and 10,217 respectively with the following break-down.

	Households	Hotels (Room)
Denpasar	49,044	2,147
Sanur	4,859	8,070
Total	53,903	10,217

The number of beneficiaries by type in 1990, 2000 and 2010 are shown in Table 4.1(1)~4.1(3).

4.3 Reduction of Water-borne Disease

As already discussed in the Master Plan Study (refer to Appendix B Chapter 7 and Appendix F, Section 1.1) ;

(i) The annual contraction rate of water-borne diseases across the Study Area is estimated at 57.1 cases per 1,000 population.

(ii) The economic costs of a water-borne disease consist of two (2) factors, namely medical cost and the opportunity cost of time spent by a hospitalized patient. They are on average estimated at Rp.129,839 and Rp.9,873 in the above order respectively, adding up to Rp.139,712.

The population of the urgent sewerage service area in 2000 is estimated at 129,377. Supposing the above contraction rate is still applicable in 2000, the annual number of water-borne disease cases and the related economic costs in the area are estimated to be respectively 7,387 and Rp.1,032 million in the same year. This is the situation where it is assumed that the project will not be implemented.

The proposed urgent sewerage development project will greatly contribute to the reduction of these water-borne diseases and related economic costs.

4.4 Increase of Tourism Income

(1) Projection of Tourism Income

Number of tourists, tourist's expenditures and tourism income in the Feasibility Study Area (the overall sewerage plan area in Chapter 1) were estimated based on the results of the Master Plan Study. Those in 1990, 2000 and 2010 are summarized below.

(at 1990 price)

	1990	2000	2010
No. of Tourists	456,122	996,924	1,595,989
Tourist's Expenditure (million Rp.)	134,627	316,621	537,500
Tourism Income (million Rp.)	40,388	94,986	161,250

In this estimation, the gross profit ratio of the commercial businesses catering for tourists was assumed as 30% on average.

The above projected tourism income can be realized only when the state of the sea water concerned is kept clean and clear in future through the implementation of the wastewater disposal project. The annual tourism income in future is shown in Table 4.2 (see, theoretical with project).

(2) Estimation of Benefit

The above theoretical tourism income with project will be realized only in the imaginary case where sewerage services started in 1991. However, actual sewerage services are expected to partially start in 1998. Then, the actual annual tourism income with project will be estimated as shown in Column A_2 of Table 4.2.

If wastewater disposal project were not implemented and as a result the quality of sea water got deteriorated more than now, then the number of tourists coming to the F/S area would be severely affected. According to the results of the sampling questionnaire survey conducted towards tourists, 64.9% of the sampled tourists replied that they would not revisit Bali if the quality of sea water got deteriorated more.

Sea water quality of the concerned area is projected to get deteriorated to a substantial extent in 2010, if no wastewater disposal project is implemented (see, Part II, Chapter 5). It is reasonable, therefore, to assume that the number of tourists in the case of "without project" will be decreased to 35.1% of the number of tourists expected in the case of "theoretical with project".

The annual tourism income without project in future is estimated as shown in Table 4.2 by assuming that the above reduction rate of the number of tourists proportionally varies from 0% in 1990 to 64.9% in 2010.

Tourism benefits as defined as the difference of tourism income between the without project and with project work out at Rp.30,823 million in 2000 and Rp.104,651 million in 2010.

However, the above benefits can not be entirely attributed to the sewerage project. Those benefits will be realized only by the combined and concerted efforts in all related infrastructures such as road, water supply, drainage, solid waste disposal, transportation, electricity, telecommunication, etc.

According to the results of the questionnaire survey conducted by the Study Team, the contribution of sewerage system to the development of tourism comes to 35%.

Thus, tourism benefits to be produced by the sewerage development project of Denpasar and Sanur areas are estimated to be Rp.10,788 million in 2000 and Rp.36,628 million in 2010. The annual benefits are shown in Column D of Table 4.2.

4.5 Economic Analysis

(1) General

Reduction of water-borne diseases and increase of tourism income are the major two (2) benefits of the Project. Out of them, benefits of reduction of water-borne diseases were not quantitatively analysed. Benefits of the increase of tourism income were quantified on annual

basis as shown in Table 4.2. This benefit stream is used for economic analysis.

The cost stream is derived from the disbursement schedules of the Urgent and Phase II Projects by converting financial costs into economic costs on annual basis. The Urgent Project will be implemented during the period of 1994 to 2000. The Phase II Project will be conducted between 2001 and 2010 to complete the overall plan. The disbursement schedule of the Urgent Project is shown in Table 3.2 in Chapter 3. The disbursement schedule of the Phase II was prepared based on the Master Plan Study.

(2) Preconditions

In conducting economic analysis, preconditions were established as follows:

The opportunity cost of capital	:	10%
Period of project life	:	50 years
Standard conversion factor for local components of initial capital costs	:	97.4%
Durable life of (a) facilities	:	50 years
(b) pumps & aerators	:	15 years

(3) Calculation of Decision Criteria

The capital cost stream was prepared for 50 years between 1994 and 2043 in accordance with the disbursement schedule of the Urgent and Phase II Projects, and the disbursement schedule for replacement of the constructed equipment. Likewise, in accordance with the disbursement schedules the O/M cost stream was prepared.

The benefit stream is represented by tourism benefits.

Economic analysis of the Project was performed by using the cost benefit stream shown in Table 4.3.

The results are as follows:

NPV	:	Rp.42,321 million
B/C	:	1.40
EIRR	:	14.1%

The project is economically feasible. Moreover, if the reduction of water-borne diseases were quantified and added to the benefits, better results would be obtained.

4.6 Environmental Impact Assessment

(1) General

The anticipated environmental impacts due to the Project activities are mostly beneficial, as the project in itself is an environmental improvement project. Significant beneficial effects include improvements of surface water, groundwater and coastal water quality and public health. However, some negative impacts may be also expected to some extent.

The anticipated negative impacts in three (3) project stages of pre-construction, construction and operation are evaluated as follows.

(2) Pre-construction Stage

The treatment plant requires a land acquisition of 9.2 ha in the Suwung Swamp Area. No negative impact is anticipated concerning to the land acquisition since the land belongs to the Government of Indonesia and no resettlement is involved.

Though this land is used as shrimp ponds by private sector, it will be returned to the government by the end of 1992.

There are no valuable historical asset, flora and fauna in the Suwung Swamp Area.

The land area required in Sanur for booster pump station is rather small (500 m^2). Though the land belongs to the private sector, it is a

vacant land requiring no resettlement. Hence no significant impact is anticipated concerning this land acquisition.

All the sewer pipes are installed under the existing roads. No land acquisition is required.

(3) Construction Stage

(i) Vibration and noise

Vibration and noise will mainly be caused by sheet piling of sewer trenches. The impacts are assessed as less important since the sewer length with sheet piling is not long (6% of the total sewer length).

Pre-boring method will be adopted instead of conventional hammering method, if necessary, to minimize vibration and noise.

(ii) Lowering of groundwater table

Groundwater table will be temporarily lowered by dewatering of trenches during the sewer installation. However, it is considered to be limited to a small area around the construction site. The sewer installation length below ground water table is not long (4.6% of the total sewer installation length). Hence, the impacts are assessed as less important.

Sheet piling of trenches will be performed to minimize lowering of ground water table, if necessary.

(iii) Traffic Disturbance

The anticipated traffic disturbance is both due to excavation of sewer trenches as well due to transportation of construction materials and surplus excavated soil.

Though the impact due to sewer trench excavation on traffic may be significant, the impact by the transportation of soil and other materials is not expected to be significant. Surplus soil to be

generated over the construction period is estimated at less than 140 m^3/day on average.

Sewer installation and transportation of construction materials and equipment will be scheduled to avoid peak hours of daily traffic with proper work plan. Roads with heavy traffic will be avoided from the routes of project vehicle operation, as far as possible.

The one time length of sewer trench excavation will be limited in heavy traffic roads. If necessary, the work shall be scheduled to night time in order to avoid interference with traffic.

(3) Operation Stage

Odor, noise and foam nuisance due to the operation of treatment system is the anticipated potential long term impact by the project.

Odor due to aerated lagoon treatment system is considered to be minimal, because the treatment will be performed under aerobic conditions. Moreover, the treatment plant is located more than 300 m away from the nearest permanent structure, and expected to be surrounded by mangrove forestation in future.

Hence, the impacts of odor, noise and foam are considered as less important. However, water and/or chemical spraying system to the aerated lagoon may be constructed, if necessary, to minimize foam occurrence due to aerator operation.

Table 4.1(1) No. of Beneficiaries in Urgent Sewerage Service Area in 1990

	Denpasar			Sanur	Total		
	Conv.	Int.	Total	Conv.	Conv.	Int.	Total
Households	11,697	4,755	16,452	1,573	13,270	4,755	18,025
Hotels (Room)	801	190	991	3,145	3,946	190	4,136
Restaurants (Seat)	1,775	164	1,939	4,432	6,207	164	6,371
Shops	555	232	787	185	740	232	972
Factories	30	16	46	31	61	16	77
Offices	359	61	420	19	378	61	439
Educational Institutions	101	32	133	8	109	32	141
Medical Institutions	13	3	16	1	14	3	17
Religious Institutions	57	41	98	11	68	41	109

Note: Conv. : Conventional System, Int. : Interceptor System

Table 4.1(2) No. of Beneficiaries in Urgent Sewerage Service Area in 2000

	Denpasar			Sanur	Total		
	Conv.	Int.	Total	Conv.	Conv.	Int.	Total
Households	14,269	6,123	20,392	2,036	16,305	6,123	22,428
Hotels (Room)	968	235	1,203	5,609	6,577	235	6,812
Restaurants (Seat)	1,835	166	2,001	5,139	6,974	166	7,140
Shops	688	298	986	281	969	298	1,267
Factories	46	25	71	46	92	25	117
Offices	472	77	549	33	505	77	582
Educational Institutions	120	47	167	11	131	47	178
Medical Institutions	15	4	19	1	16	4	20
Religious Institutions	69	52	121	14	83	52	135

Note: Conv. : Conventional System, Int. : Interceptor System

Table 4.1(3) No. of Beneficiaries in Overall Sewerage Service Area in 2010

	Denpasar	Sanur	Total
Households	49,044	4,859	53,903
Hotels (Room)	2,147	8,070	10,217
Restaurants (Seat)	4,491	5,845	10,336
Shops	2,758	376	3,134
Factories	336	126	462
Offices	945	54	999
Educational Institutions	351	28	379
Medical Institutions	41	4	45
Religious Institutions	382	39	421

Table 4.2 Estimation of Tourism Benefits

(Unit : Rp. million)

Year	Tourism Income			Tourism Benefits	
	Theoretical With Project	With Project	Without Project	Total	Sewerage Contribution
	A 1	A 2	B	C = A2 - B	D = C x .35
1990	40,388	40,388	40,388	0	0
1991	45,050	43,588	43,588	0	0
1992	50,078	46,828	46,828	0	0
1993	55,245	49,867	49,867	0	0
1994	60,548	52,689	52,689	0	0
1995	65,982	55,276	55,276	0	0
1996	71,542	57,613	57,613	0	0
1997	77,225	59,684	59,684	0	0
1998	83,029	68,660	61,475	7,185	2,515
1999	88,950	80,291	62,972	17,319	6,062
2000	94,986	94,986	64,163	30,823	10,788
2001	101,135	101,135	65,035	36,100	12,635
2002	107,394	107,394	65,575	41,819	14,637
2003	113,762	113,762	65,772	47,990	16,797
2004	120,237	120,237	65,613	54,624	19,118
2005	126,817	126,817	65,089	61,728	21,605
2006	133,501	133,501	64,187	69,314	24,260
2007	140,288	140,288	62,898	77,390	27,087
2008	147,175	147,175	61,210	85,965	30,088
2009	154,163	154,163	59,114	95,049	33,267
2010	161,250	161,250	56,599	104,651	36,628

Source : JICA

Table 4.3 Cost Benefit Streams - Economic Analysis -

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:Rp million)

NO.	YEAR	CC	OM	CS	BF	CF
1	1994	1210	0	1210	0	-1210
2	1995	2975	0	2975	0	-2975
3	1996	19524	0	19524	0	-19524
4	1997	22630	0	22630	0	-22630
5	1998	16724	398	17122	2515	-14607
6	1999	9134	796	9930	6062	-3868
7	2000	8786	1194	9980	10788	808
8	2001	10229	1194	11423	12635	1212
9	2002	10229	1194	11423	14637	3214
10	2003	12475	1194	13669	16797	3128
11	2004	19765	1194	20959	19118	-1841
12	2005	18741	1194	19935	21605	1670
13	2006	15416	1489	16905	24260	7355
14	2007	8802	1784	10586	27087	16501
15	2008	8717	2080	10797	30088	19291
16	2009	8541	2375	10916	33267	22351
17	2010	7199	2670	9869	36628	26759
18	2011	810	2670	3480	36628	33148
19	2012	2960	2670	5630	36628	30998
20	2013	771	2670	3441	36628	33187
21	2014	0	2670	2670	36628	33958
22	2015	0	2670	2670	36628	33958
23	2016	0	2670	2670	36628	33958
24	2017	0	2670	2670	36628	33958
25	2018	0	2670	2670	36628	33958
26	2019	2738	2670	5408	36628	31220
27	2020	2685	2670	5355	36628	31273
28	2021	0	2670	2670	36628	33958
29	2022	0	2670	2670	36628	33958
30	2023	0	2670	2670	36628	33958
31	2024	1488	2670	4158	36628	32470
32	2025	2065	2670	4735	36628	31893
33	2026	810	2670	3480	36628	33148
34	2027	2960	2670	5630	36628	30998
35	2028	771	2670	3441	36628	33187
36	2029	0	2670	2670	36628	33958
37	2030	0	2670	2670	36628	33958
38	2031	0	2670	2670	36628	33958
39	2032	0	2670	2670	36628	33958
40	2033	0	2670	2670	36628	33958
41	2034	2738	2670	5408	36628	31220
42	2035	2685	2670	5355	36628	31273
43	2036	0	2670	2670	36628	33958
44	2037	0	2670	2670	36628	33958
45	2038	0	2670	2670	36628	33958
46	2039	1488	2670	4158	36628	32470
47	2040	2065	2670	4735	36628	31893
48	2041	810	2670	3480	36628	33148
49	2042	2960	2670	5630	36628	30998
50	2043	771	2670	3441	36628	33187

Source: JICA

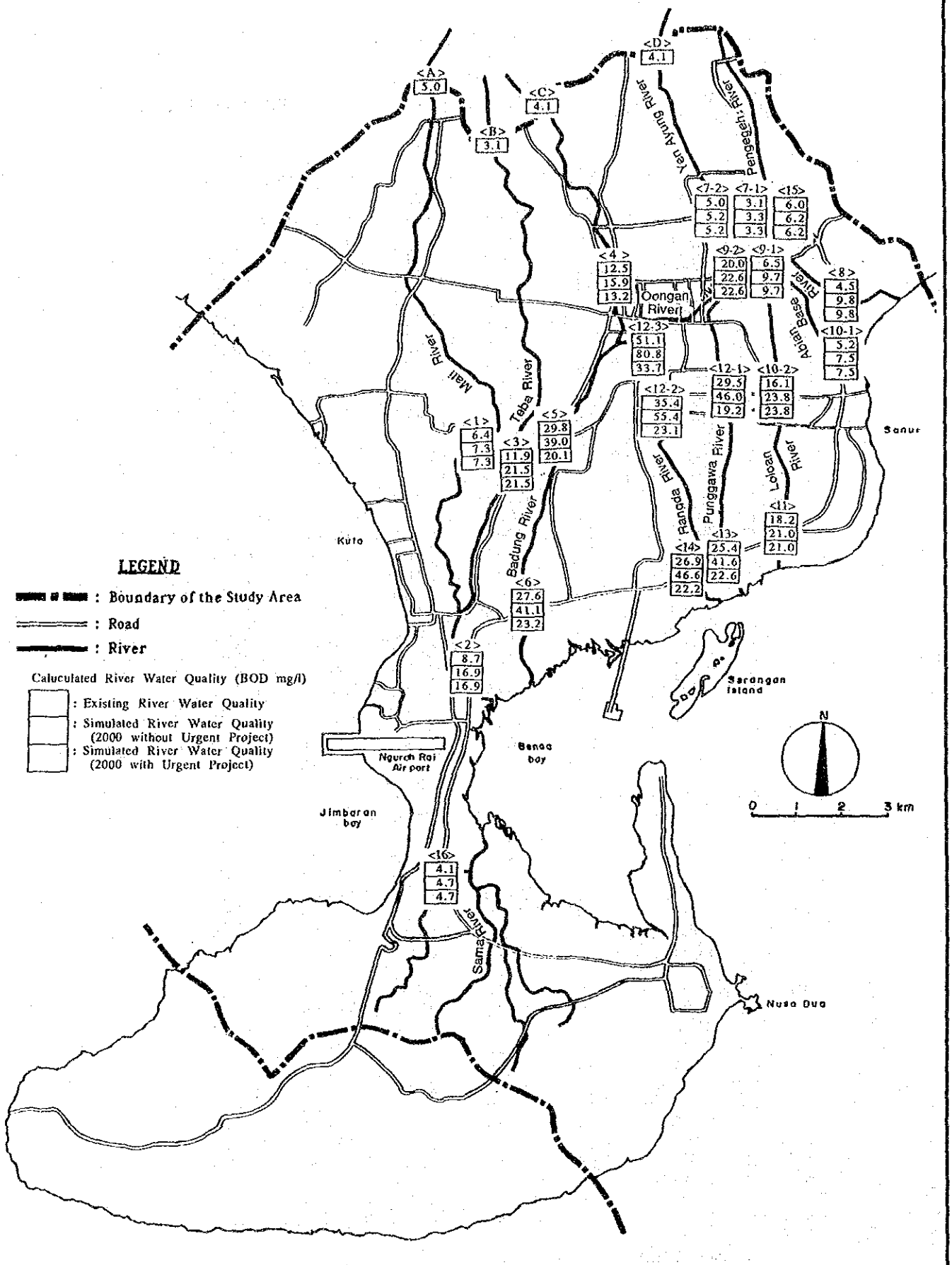


FIG. 4.1(1) SIMULATED RIVER WATER QUALITY IN 2000 (DRY SEASON)

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

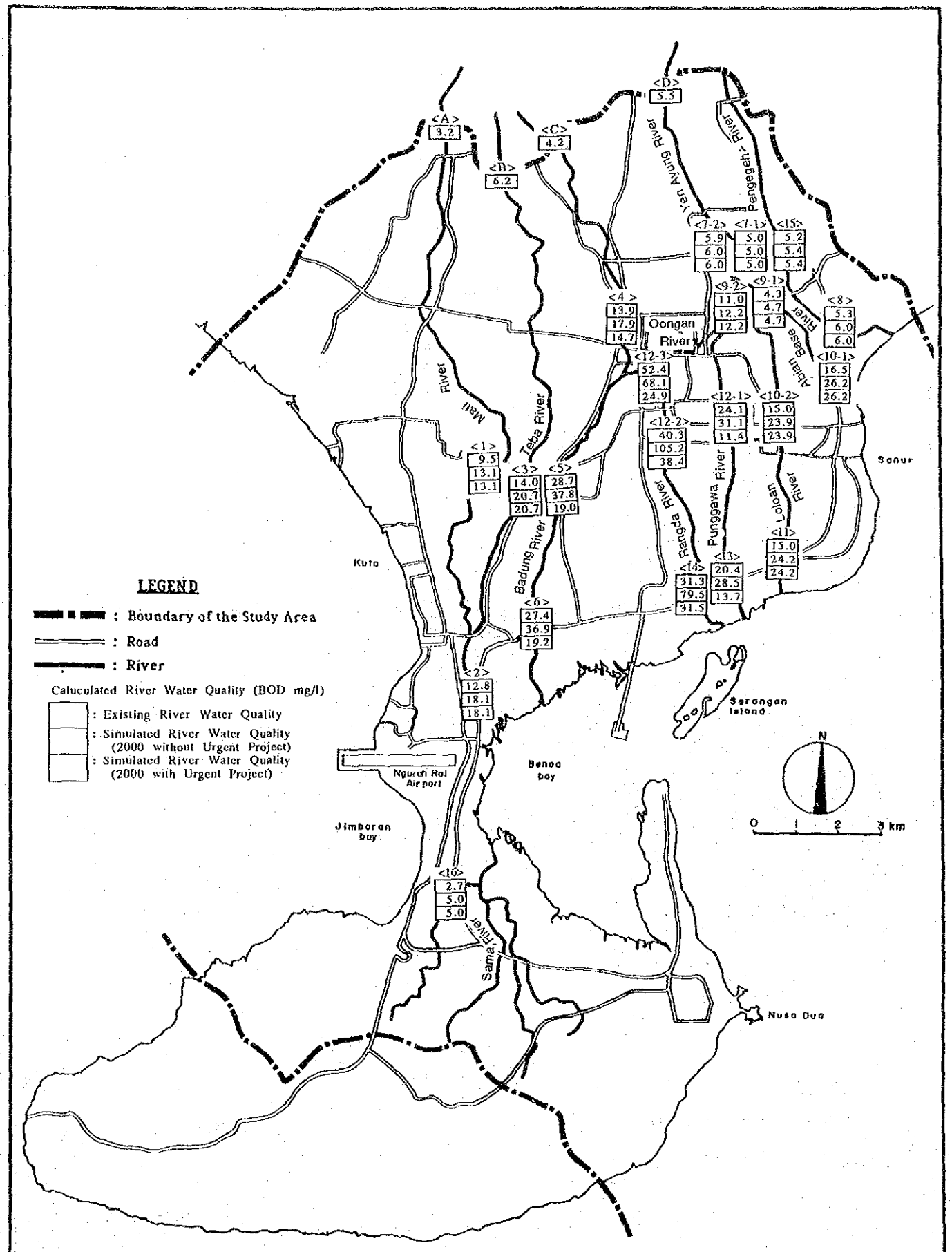


FIG. 4.1(2) SIMULATED RIVER WATER QUALITY IN 2000 (RAINY SEASON)

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

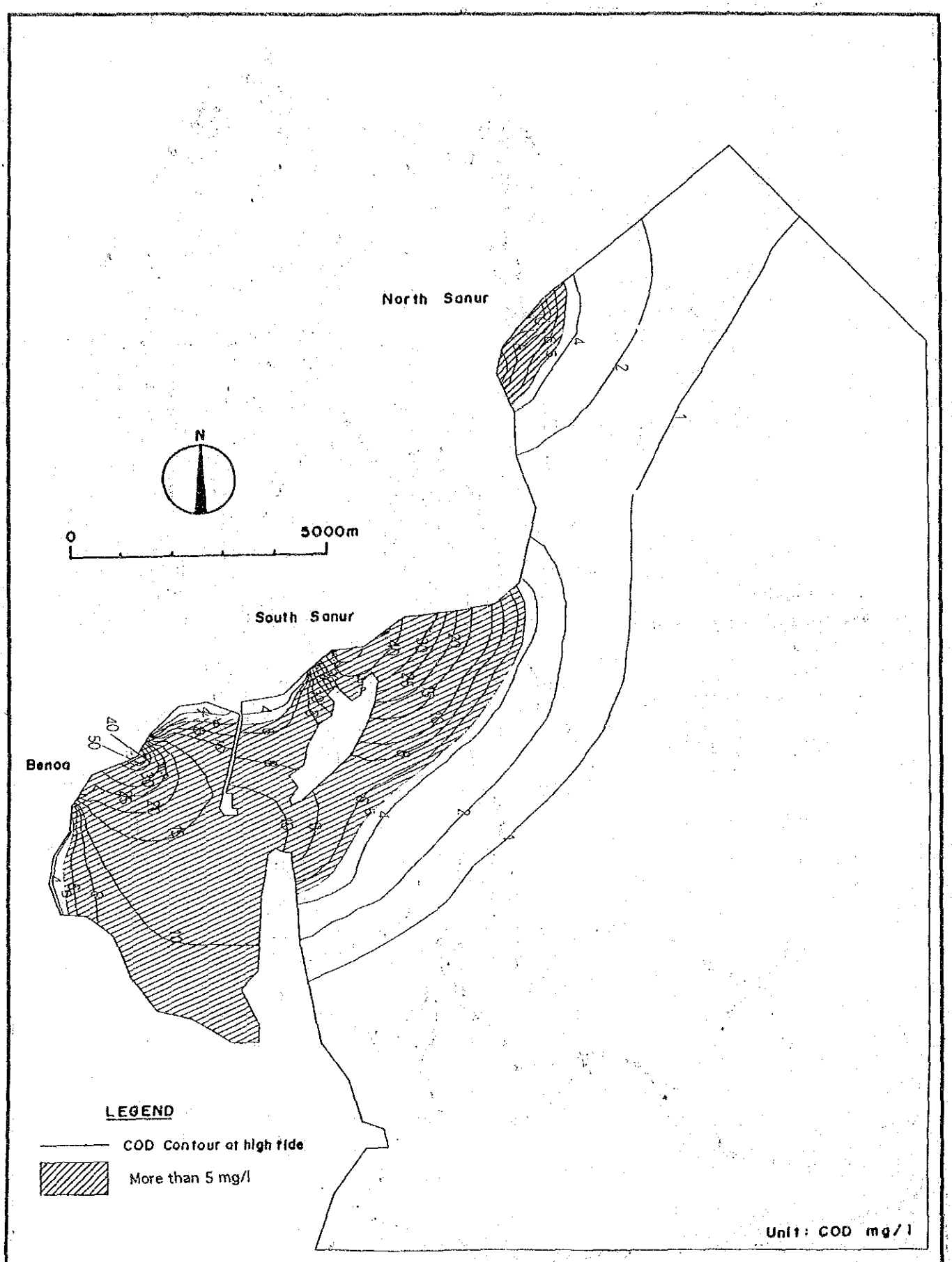


FIG. 4.2(1) COD DISTRIBUTION IN 2000 (DRY SEASON) - WITHOUT URGENT PROJECT

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

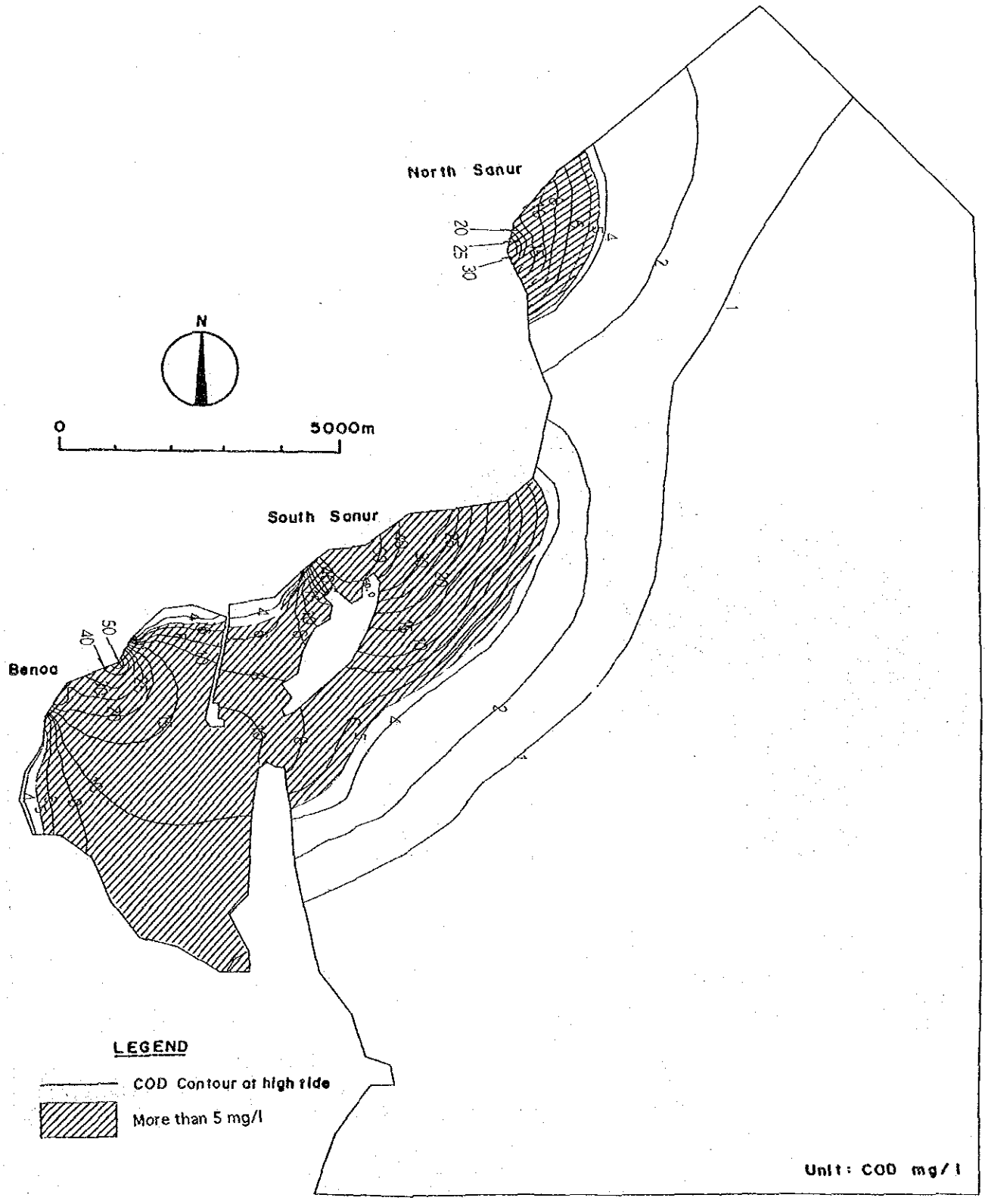


FIG. 4.2(2) COD DISTRIBUTION IN 2000 (RAINY SEASON) - WITHOUT URGENT PROJECT

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

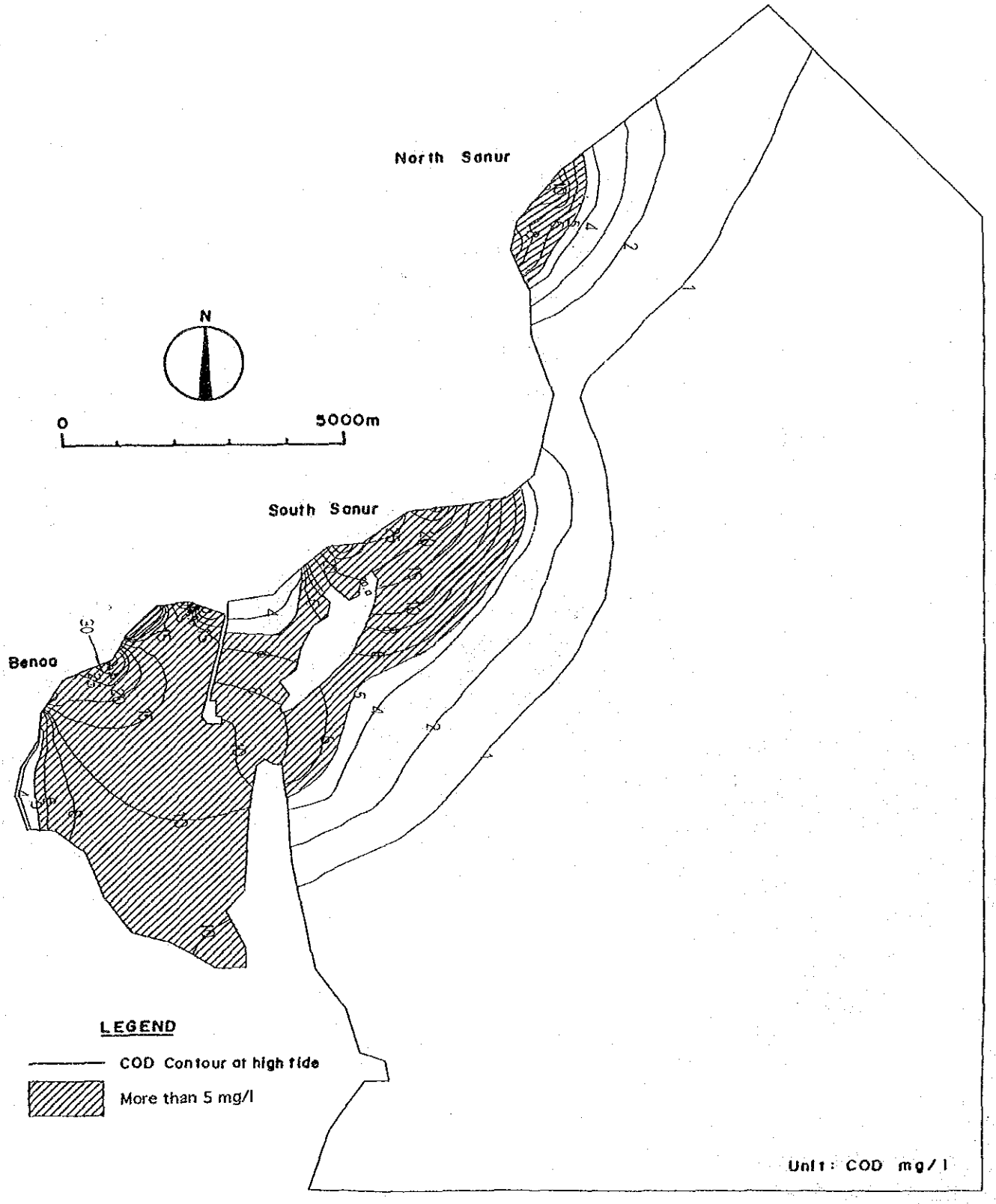


FIG. 4.2(3) COD DISTRIBUTION IN 2000 (DRY SEASON) - WITH URGENT PROJECT

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

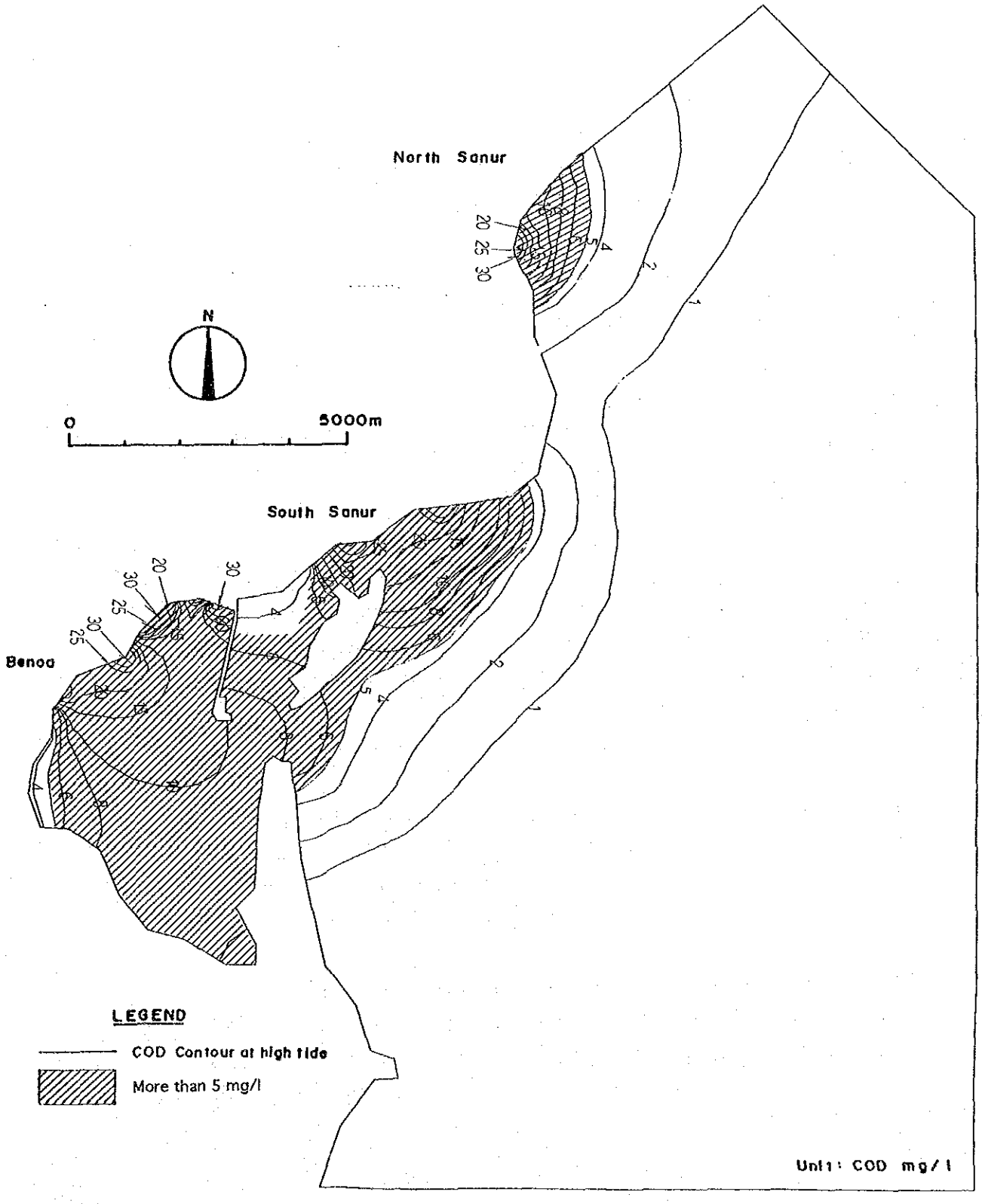


FIG. 4.2(4) COD DISTRIBUTION IN 2000 (RAINY SEASON) - WITH URGENT PROJECT

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

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Chapter 5 FINANCIAL EVALUATION

5.1 People's Willingness to Pay

Based on the results of the Master Plan Study, average unit monthly amount of willingness to pay by beneficiary in the urgent sewerage service area in 1991 were estimated. Moreover, these willingness to pay were converted into monthly amount of willingness to pay per m^2 of floor area. The results are shown below.

	Rp./household or establishment/month	Rp./m^2 of floor area
Household	2,264	14
Hotel	167,105	76
Restaurant	7,977	48
Shop	4,957	41
Factory	8,802	113
Bank	29,522	40

The total amount of annual willingness to pay in the urgent sewerage service area is estimated to be Rp.763 million in 1990 and Rp.1,314 million in 2000. In 2010, sewerage services will cover the entire overall plan area. As a result, the total amount of annual willingness to pay will reach Rp.3,582 million in 2010.

Regarding Rp.1,314 million in 2000, households are the topmost contributor with the share of 40.1% followed by hotels and shops will 34.6% and 5.1%, respectively. Areawise, the share of the Denpasar area is greater with 52.4%, that of the Sanur area being 47.6%.

It is to be noted that the annual O/M costs of the project are estimated at Rp.1,194 million and Rp.2,670 million in 2000 and 2010 respectively and, therefore, that the total annual willingness to pay in 2000 and 2010 is greater than the annual O/M costs in the respective years.

5.2 Sewerage Charges in Other Cities

(1) Jakarta

The underlying philosophy of the sewerage organization regarding cost recovery is to redeem O/M cost at the least. Based on it, official tariff of sewerage discharge services to be applied for beneficiaries with direct connections to the sewers was legalized in 1989 by the decree of the Ministry of Public Works. The tariff structure is based on the floor area of the client's house/building and the quantity/quality of wastewater.

Clients are classified into five (5) categories, i.e. Residential, Small Commercial, Large Commercial, Industry and Social Institution. Each category is further broken down to specific types of customers. Unit price per square meter is different in accordance with the nature of effluents. The unit price is Rp.28 for Residential, Rp.50 for Small Commercial, Rp.182 for Large Commercial, Rp.108 for Industry and Rp.56 for Social Institution on simple average basis.

Under the above sewerage charges, the average household will pay monthly 1.0% of household income for wastewater discharge. On the other hand, water supply charge is 4.0% of household income on average.

(2) Bandung

In Bandung most of the population had been served with water supply when sewerage was introduced. It was natural, therefore, to adopt a sewerage charge that is linked with water supply charge. Thus, sewerage service charge, which is called environmental charge in Bandung is stipulated to be 30% of water supply charge for those beneficiaries having connections. A household on average pays Rp.10,000 per month as water supply charge. Then, it pays on average Rp.3,000 per month as environmental charge.

5.3 Affordability and Contribution of Tourism Industry

(1) Basic Concept

The project is primarily economically motivated, although it has an important social role by improving public health.

Therefore, the major part of project costs will be borne by beneficiaries themselves. And the balance will be borne by the government which has an important function of maintaining a sound sanitary environment.

Firstly, the entire O/M costs will be borne by the entire beneficiaries in the sewerage service area.

Secondly, a major part of initial costs will be borne by those beneficiaries which will reap the benefits of the project more directly and more abundantly. They are the so-called tourism industry represented by hotels and restaurants.

Hotels are the prime beneficiary of the "clean, clear and beautiful seas", which will be kept that way by the project. Conversely, hotels will suffer fatal damage from polluted seas in the without case of the project.

Accordingly, hotels in the sewerage service area will bear the initial costs that are to be duly expected of them.

Moreover, the construction of sewerage in the F/S area will have effects on tourism industry more or less over the entire Master Plan Study Area by maintaining the seas clean and clear. Therefore, hotels and restaurants in the Master Plan Study Area will partake of the shouldering of initial costs.

Thirdly, the government will bear those remaining initial costs in the form of grant.

(2) Affordable Initial Cost of Hotel

Every hotels would be forced to install household package treatment plant by themselves in case of without project. The construction costs of household package treatment plant are considered as the upper limit that hotels can bear as a initial cost of the sewerage project.

The estimated construction costs of household package treatment plant per hotel room by class of hotels are as follows.

(Unit: Rp. million/room)

Classified Hotels	Non-Classified Hotels & Other Accommodations
1.97	1.41

(3) Contribution of Tourism Industry in Master Plan Study Area

As the sewerage project in the F/S area will have effects on tourism industry more or less over the entire Master Plan Study Area including the three (3) tourism centers, it is proposed that a substantial part of the remaining initial costs be borne by the tourism industry there. It will be represented by hotels and restaurants.

Now hotels and restaurants in the Master Plan Study Area are subjected to Tourism Tax which has taken effect from June 1, 1992 under the decree of the Ministry of Tourism, Post and Telecommunications. Under the tax, two (2) percent levy is imposed on the guests' bills in addition to the combined 15.5% levy of the previous service charge and development tax.

It is proposed that a fixed ratio of the revenue from Tourism Tax be appropriated for the recovery of initial costs. As the contribution of the sewerage project among various infrastructure projects in further developing tourism is considered as 35.0% (refer to Section 4.4, Increase of Tourism Income, Chapter 4), the revenue to be collected from Tourism Tax of 0.7% (2% x 35%) will be used for initial cost recovery.

5.4 Proposed Sewerage Charge

(1) Sewerage Service Charge

This charge will be applied to all types of beneficiaries located within the sewerage service areas. The charge is based on floor area and takes the form of monthly rates per m^2.

The Sewerage Service Charge was established based on the following two (2) factors.

(i) Tariff of water supply charge actually employed by PDAM. In this case, the sewerage service charge was assumed as 30% of water supply charge.

(ii) People's willingness to pay for sewerage services clarified through the sampling questionnaire survey

Also, the sewerage service charge actually being enforced in Jakarta was referred to.

The proposed Sewerage Service Charges are shown in Table 5.1 along with the above mentioned sewerage service charges and willingness to pay.

According to the proposed charge a household will pay Rp.2,684 on average per month. It corresponds to 0.935% of average monthly income.

The present value of the cumulative revenue from Sewerage Service Charge for 30 years from 1994 to 2023 discounted at 5.5% (FIRR) is calculated to be Rp.27,474 million. It is 140.5% of that of the O&M costs (Rp.19,554 million).

The Sewerage Service Charge can fully meet O&M costs. The surplus will be used to cater for replacement costs and 3.8% of initial costs.

The estimated Sewerage Service Charge revenue in 2000 comes to Rp.1,647 million. Out of it, hotels and households account for 38.0% and 31.9% respectively, combinedly reaching 69.9%. They are

followed by offices with 10.1%, shops with 4.0%, medical institutions with 3.4% and so forth.

Area wise, the Denpasar area accounts for 53.0% and the Sanur area 47.0%.

Area and type of beneficiaries wise, in the Denpasar area households will bear a major part of the charge, accounting for 52.7% of the total. They are followed by offices with 17.5%, medical institutions with 6.4%, shops with 5.7%, hotels with 3.9%, etc. In the Sanur area most of the charge will be borne by hotels with the share of 76.5%. They are followed by households with 8.5%, shops with 2.3%, offices with 1.7%, etc.

(2) Capital Works Charge

Capital Works Charge will be applied to all the existing and future hotels located within the sewerage service areas. It will be levied when a new hotel is constructed. Regarding the hotels that already exist or will be built before sewerage construction, it will be levied when sewerage is constructed.

The proposed Capital Work Charge is Rp.1.97 million/room for classified hotels and Rp.1.41 million/room for non-classified hotels (refer to Section 5.3(2)).

These are the regular rates. For those hotels which already exist or will be built before project implementation, 50% of regular rates will be applied.

The present value of the cumulative Capital Works Charge revenue for 30 years from 1994 to 2023 discounted at 5.5% (FIRR) is calculated at Rp.7,495 million. It is 5.8% of that of the initial costs (Rp.129,628).

It means that the contribution of hotels in the sewerage service area to the initial cost of the Project is not so large.

(3) Tourism Tax

This Tax will be utilized to recover capital costs of the Project along with Capital Works Charge.

Under Tourism Tax all hotels and restaurants in the Master Plan Study Area will impose 0.7% levy on the clients' bills (refer to Section 5.3(3)).

Tourism Tax for this Project will be enforced from 1998 when sewerage services start.

Tourism Tax will be collected by the government and later will be transferred to the sewerage organization as subsidy.

Tourists' expenditures on hotels and restaurants in the Master Plan Study Area in 2000 and 2010 are estimated at Rp.832,476 million and Rp.1,408,005 million respectively. As a result, the revenue from Tourism Tax of 0.7% is calculated at Rp.4,959 million in 2000 and Rp.8,388 million in 2010.

The present value of the cumulative Tourism Tax revenue for 30 years from 1994 to 2023 discounted at 5.5% (FIRR) is calculated at Rp.71,812 million. It is 55.4% of that of the initial costs (Rp.129,628 million).

It means that the contribution of Tourism Tax to the initial costs of the Project is as large as 55.4%.

5.5 Financial Analysis

Financial analysis of the sewerage organization in the form of the estimation of financial internal rate of return (FIRR) and financial statement projections for the period of thirty (30) years was performed.

The analysis was made for the proposed financial plan and three (3) alternative plans. Their financial preconditions are summarized in Table 5.2 and Table 5.3 respectively.

The results of the financial analysis are summarized below.

(1) Proposed Plan

Financial internal rate of return (FIRR) was calculated at 5.5% based on the cost benefit streams for 30 years from 1994 to 2023. The cost benefit streams are shown in Table 5.4.

The value is considered sufficient and reasonable since the sewerage organization is a public enterprise.

Projected financial statement comprised of income statement and funds statement for 30 years from 1994 to 2023 is shown in Table 5.5. As it shows, the sewerage organization will be financially sound and stable in terms of earnings as well as solvency except for a few years.

(2) Alternative Plans

FIRR was also calculated for Alternative Plans I, II and III based on cost benefit streams. The calculated FIRR are 5.4% for Alternative I, 7.8% for Alternative II and 11.1% for Alternative III. For the cost benefit streams, see Table E.5.5, E.5.6 and E.5.7 in Appendix E.

Financial statement was also projected for three (3) alternatives. The sewerage organization will also be financially sound and stable in terms of earnings as well as solvency except for a few years. For financial statement, see Table E.5.8, E.5.9 and E.5.10 in Appendix E.

Table 5.1 Proposed Sewerage Service Charge

(Unit : Rp./m^2/month)

Beneficiaries			Proposed Sewerage Service Charge	Based on Water Supply Charge	Willingness to Pay	Jakarta Sewerage Service Charge
Households			22	22	14	28
Hotels	Classified		125	150	89	224
	Others		50	143	45	60
Restaurants			50	55	48	60
Shops	Large		70	65	73	140
	Medium/Small		30	16	28	40
Factories	Large/Medium		150	201	124	170
	Small		50	33	57	40
Offices	Banks		50	60	40	40
	Other Offices	Private	50	50	-	40
		Government	30	32	-	40
Educational Institutions			20	18	-	40
Medical Institutions	Public		50	43	-	72
	Private		170	174	-	224
Religious Institutions	Hindu Temples		0.2	0.2	-	40
	Others		15	13	-	40

Source : JICA

Table 5.2 Preconditions for Financial Analysis

- Proposed Plan -

1. Financial Sources of Capital Costs

   1) Initial costs

      Loan from central government : 65%

      Grant from central/local governments : 35%

   2) Replacement costs

      To be self-financed by the sewerage organization

2. Terms of Loans from Central Government

   Annual rate of interest : 10.5%

   Repayment period : 25 years

   Grace period : 5 years

3. Cost Recovery Method (Sewerage Charges)

   (as described in Section 5.4)

4. Depreciation

   1) Depreciation periods

      Facilities : 50 years

      Pumps & aerators : 15 years

   2) Depreciable assets

      Those assets for whose acquisition capital costs will be incurred.

5. Collection Rate of Sewerage Service Charge : 90%

6. Annual Rate of Price Escalation : 9%

7. Rate of Tax on Corporate Income : 35%

Source: JICA

Table 5.3 Comparison of Preconditions Among Alternatives

Item	Proposed Plan	Alternatives		
		I	II	III
1. Cost Recovery Method				
1) Tourism Tax (Tax Rate (%))	0.7%	1%	0.35%	0.1%
2) Sewerage Service Charge	(as described in Section 5.4)			
3) Capital Works Charge	(as described in Section 5.4)			
2. Financial Sources				
1) Initial Costs				
(1) Loan from Central Government	65%	90%	1/3	15%
(2) Grant from Central/Local Governments	35%	10%	2/3	85%
2) Replacement Costs				
(1) Self-Financing	100%	100%	50%	0%
(2) Grant from Central/Local Governments	0%	0%	50%	100%

Source: JICA

Table 5.4 Cost Benefit Streams - Financial Analysis - (Proposed Plan)

CC=Capital Costs; OM=O/M Costs; CS=Costs; BF=Benefits
CF=Cash Flow (=BF - CS)

(Unit:Rp Million)

NO.	YEAR	CC	OM	CS	BF	CF
1	1994	793	0	793	0	-793
2	1995	1950	0	1950	0	-1950
3	1996	12923	0	12923	0	-12923
4	1997	14957	0	14957	0	-14957
5	1998	11070	398	11468	3696	-7772
6	1999	6048	796	6844	6118	-726
7	2000	5819	1194	7013	8502	1489
8	2001	6770	1194	7964	7578	-386
9	2002	6770	1194	7964	8098	134
10	2003	8254	1194	9448	8623	-825
11	2004	13065	1194	14259	9155	-5104
12	2005	12379	1194	13573	9691	-3882
13	2006	10199	1489	11688	10234	-1454
14	2007	5826	1784	7610	10782	3172
15	2008	5772	2080	7852	11334	3482
16	2009	5645	2375	8020	11894	3874
17	2010	4750	2670	7420	12457	5037
18	2011	816	2670	3486	11834	8348
19	2012	2980	2670	5650	11834	6184
20	2013	777	2670	3447	11834	8387
21	2014	0	2670	2670	11834	9164
22	2015	0	2670	2670	11834	9164
23	2016	0	2670	2670	11834	9164
24	2017	0	2670	2670	11834	9164
25	2018	0	2670	2670	11834	9164
26	2019	2760	2670	5430	11834	6404
27	2020	2705	2670	5375	11834	6459
28	2021	0	2670	2670	11834	9164
29	2022	0	2670	2670	11834	9164
30	2023	0	2670	2670	11834	9164

Source: JICA

Table 5.5 (1) Financial Statement - Proposed Plan -

(Unit: Rp million)

No.	1	2	3	4	5	6	7	8	9	10
Year	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Income Statement										
Sewerage Service Charge	0	0	0	0	779	1,752	2,952	3,645	4,438	5,344
Capital Works Charge	0	0	0	0	2,991	3,767	4,106	1,353	1,475	1,608
Tourism Tax	0	0	0	0	2,428	5,664	9,882	11,461	13,258	15,300
Revenue	0	0	0	0	6,198	11,184	16,941	16,459	19,171	22,252
Operation and Maintenance	0	0	0	0	667	1,455	2,379	2,593	2,827	3,081
Depreciation	0	0	259	630	863	974	1,083	1,203	1,324	1,470
Payment of Interest	0	0	0	0	0	163	597	3,743	7,660	10,736
Expenditure	0	0	259	630	1,530	2,592	4,060	7,539	11,810	15,287
Profit before Tax	0	0	-259	-630	4,667	8,592	12,881	8,920	7,360	6,965
Tax	0	0	0	0	1,634	3,007	4,508	3,122	2,576	2,438
Profit after Tax	0	0	-259	-630	3,034	5,585	8,373	5,798	4,784	4,527
Funds Statement										
Profit after Tax	0	0	-259	-630	3,034	5,585	8,373	5,798	4,784	4,527
Loans	942	2,525	18,242	23,013	18,565	11,056	11,594	14,705	16,028	21,298
Grants	507	1,360	9,823	12,392	9,996	5,953	6,243	7,918	8,630	11,468
Depreciation	0	0	259	630	863	974	1,083	1,203	1,324	1,470
Sources	1,449	3,885	28,065	35,405	32,458	23,569	27,294	29,624	30,766	38,764
Capital Works	1,449	3,885	28,065	35,405	28,561	17,010	17,837	22,622	24,658	32,766
Payment of Principal	0	0	0	0	0	26	97	603	1,291	1,931
Working Capital	0	0	0	0	3,897	6,533	9,359	6,398	4,816	4,066
Applications	1,449	3,885	28,065	35,405	32,458	23,569	27,294	29,624	30,766	38,764
Loan Liabilities	1,041	3,941	24,512	52,516	78,544	98,820	121,314	145,955	170,040	198,761
Cash Balance	0	0	0	0	3,897	10,430	19,789	26,187	31,004	35,070

Source: JICA

Table 5.5 (2) Financial Statement - Proposed Plan -

(Unit: Rp million)

No.	11	12	13	14	15	16	17	18	19	20
Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Income Statement										
Sewerage Service Charge	6,378	7,554	8,891	10,407	12,123	14,064	16,257	17,720	19,315	21,053
Capital Works Charge	1,752	1,910	2,082	2,269	2,474	2,696	2,939	0	0	0
Tourism Tax	17,618	20,247	23,225	26,596	30,406	34,710	39,568	43,129	47,010	51,241
Revenue	25,749	29,712	34,198	39,272	45,003	51,471	58,764	60,849	66,325	72,295
Operation and Maintenance	3,358	3,661	4,977	6,500	8,257	10,277	12,595	13,728	14,964	16,311
Depreciation	1,785	2,087	2,268	2,371	2,474	2,620	2,767	2,786	2,855	2,873
Payment of Interest	12,446	14,196	16,424	18,806	22,012	27,781	33,591	38,544	41,076	43,722
Expenditure	17,589	19,943	23,668	27,677	32,743	40,678	48,952	55,058	58,895	62,906
Profit before Tax	8,159	9,768	10,530	11,595	12,260	10,793	9,811	5,791	7,430	9,389
Tax	2,856	3,419	3,685	4,058	4,291	3,778	3,434	2,027	2,601	3,286
Profit after Tax	5,304	6,349	6,844	7,537	7,969	7,016	6,377	3,764	4,830	6,103
Funds Statement										
Profit after Tax	5,304	6,349	6,844	7,537	7,969	7,016	6,377	3,764	4,830	6,103
Loans	36,747	37,952	34,081	21,221	22,917	24,431	22,404	0	0	0
Grants	19,787	20,436	18,351	11,427	12,340	13,155	12,064	0	0	0
Depreciation	1,785	2,087	2,268	2,371	2,474	2,620	2,767	2,786	2,855	2,873
Sources	63,624	66,825	61,544	42,556	45,699	47,221	43,612	6,550	7,685	8,976
Capital Works	56,535	58,388	52,432	32,648	35,256	37,586	34,468	4,196	16,701	4,747
Payment of Principal	2,435	3,005	3,720	4,547	5,603	7,189	8,976	10,844	12,559	14,501
Working Capital	4,654	5,431	5,392	5,362	4,840	2,446	169	-8,490	-21,575	-10,271
Applications	63,624	66,825	61,544	42,556	45,699	47,221	43,612	6,550	7,685	8,976
Loan Liabilities	245,357	295,856	344,436	380,698	418,379	454,335	484,230	485,686	483,048	475,546
Cash Balance	39,724	45,155	50,548	55,909	60,749	63,195	63,364	54,874	33,299	23,028

Source: JICA

Table 5.5 (3) Financial Statement - Proposed Plan -

(Unit: Rp million)

No.	21	22	23	24	25	26	27	28	29	30
Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Income Statement										
Sewerage Service Charge	22,948	25,013	27,265	29,718	32,393	35,308	38,486	41,950	45,726	49,841
Capital Works Charge	0	0	0	0	0	0	0	0	0	0
Tourism Tax	55,853	60,880	66,359	72,331	78,841	85,937	93,671	102,102	111,291	121,307
Revenue	78,801	85,893	93,624	102,050	111,234	121,246	132,158	144,052	157,016	171,148
Operation and Maintenance	17,778	19,379	21,123	23,024	25,096	27,354	29,816	32,500	35,425	38,613
Depreciation	2,873	2,873	2,873	2,873	2,873	2,938	3,001	3,001	3,001	3,001
Payment of Interest	46,425	48,548	46,548	44,338	41,896	39,198	36,236	33,016	29,841	26,817
Expenditure	67,077	70,800	70,545	70,236	69,866	69,490	69,053	68,517	68,267	68,431
Profit before Tax	11,724	15,093	23,079	31,814	41,369	51,755	63,105	75,535	88,750	102,717
Tax	4,103	5,283	8,078	11,135	14,479	18,114	22,087	26,437	31,062	35,951
Profit after Tax	7,621	9,810	15,002	20,679	26,890	33,641	41,018	49,098	57,687	66,766
Funds Statement										
Profit after Tax	7,621	9,810	15,002	20,679	26,890	33,641	41,018	49,098	57,687	66,766
Loans	0	0	0	0	0	0	0	0	0	0
Grants	0	0	0	0	0	0	0	0	0	0
Depreciation	2,873	2,873	2,873	2,873	2,873	2,938	3,001	3,001	3,001	3,001
Sources	10,494	12,684	17,875	23,553	29,763	36,579	44,019	52,099	60,688	69,767
Capital Works	0	0	0	0	0	28,276	30,207	0	0	0
Payment of Principal	16,687	19,048	21,048	23,258	25,700	28,210	30,667	30,235	28,804	28,112
Working Capital	-6,193	-6,364	-3,173	295	4,063	-19,908	-16,855	21,864	31,885	41,655
Applications	10,494	12,684	17,875	23,553	29,763	36,579	44,019	52,099	60,688	69,767
Loan Liabilities	462,366	443,318	422,270	399,012	373,312	345,102	314,436	284,201	255,397	227,284
Cash Balance	16,835	10,471	7,298	7,593	11,656	-8,251	-25,106	-3,242	28,642	70,297

Source: JICA

CHAPTER 6 SEWERAGE ORGANIZATION

6.1 Required Activities for Sewerage Organization

The required activities of sewerage organization are as follows.

(i) Administration

(ii) Finance/Accounting

(iii) Public Relations

(iv) Planning

(v) Construction

(vi) O&M of Treatment Plant and Pumping Stations

(vii) O&M of Collection Systems

(viii) House Connection and Disconnection

(ix) Environmental Monitoring

6.2 Existing Organization of PDAM

The existing organization has two (2) departments of administration & financial department and technical department under director/vice directors. Each department consists of several divisions as follows.

(i) Administration & Financial Department
- Administration Division, Financial Division, Accounting Division and Customers Division

(ii) Technical Department
- Production Division, Transmission & Distribution Division, Maintenance Division and Technical Planning Division

For the organization chart, see Fig. F.2.1, Appendix F.

The total number of staff of PDAM is now 365 including 37 security staff. They are serving 26,000 customers. The number has not been increased since 1985, though the production volume has been increasing every year.

6.3 Alternatives for Sewerage Organization

Two (2) typical sewerage organizations are compared. One is Independent Organization. Another is Integration into PDAM.

(1) Independent Organization

This is discussed in analogy with the existing similar organization; Denpasar PDAM. The organization has the following functions.

(i) Control Committee

(ii) Director/Vice-Directors

(iii) Internal Audit

(iv) Administration and Financial Department
- Responsible for administration, financial affairs, accounting and customer & public relation

(v) Technical Department
- Responsible for operation of treatment plant & pumping stations, environmental monitoring, sewege collection, house connection & disconnection, maintenance of all facilities, planning and record keeping

The required staff number is assumed to be 100 in 1998 when sewerage services start. The number will increase to 370 in 2010.

The organization chart is shown in Fig. 6.1.

(2) Integration into PDAM

If a new organization for sewerage system is integrated into PDAM, some divisions can be shared for both water supply and sewerage.

Those divisions are as follows.

- Administrative division
- Financial division
- Accounting division

- Customer division
- Maintenance division
- Planning division

The integrated organization chart is shown in Fig. 6.2.

The staff number required for the management of sewerage system are estimated to be 80 in 1998 and 290 in 2010.

(3) Recommendation

The independent organization is free from undesirable habits of the old system and staff in there are highly motivated in their jobs.

However, all activities for the management of sewerage system shall be covered by its own staff and as a result, financial burdens are larger than integration into PDAM. Moreover, all staff shall be newly recruited, while they will be less experienced in the management of sewerage system.

It is recommended to integrate the new sewerage organization into the existing PDAM, considering the importance of O&M cost saving and serious shortage of sanitary engineers and technical staffs.

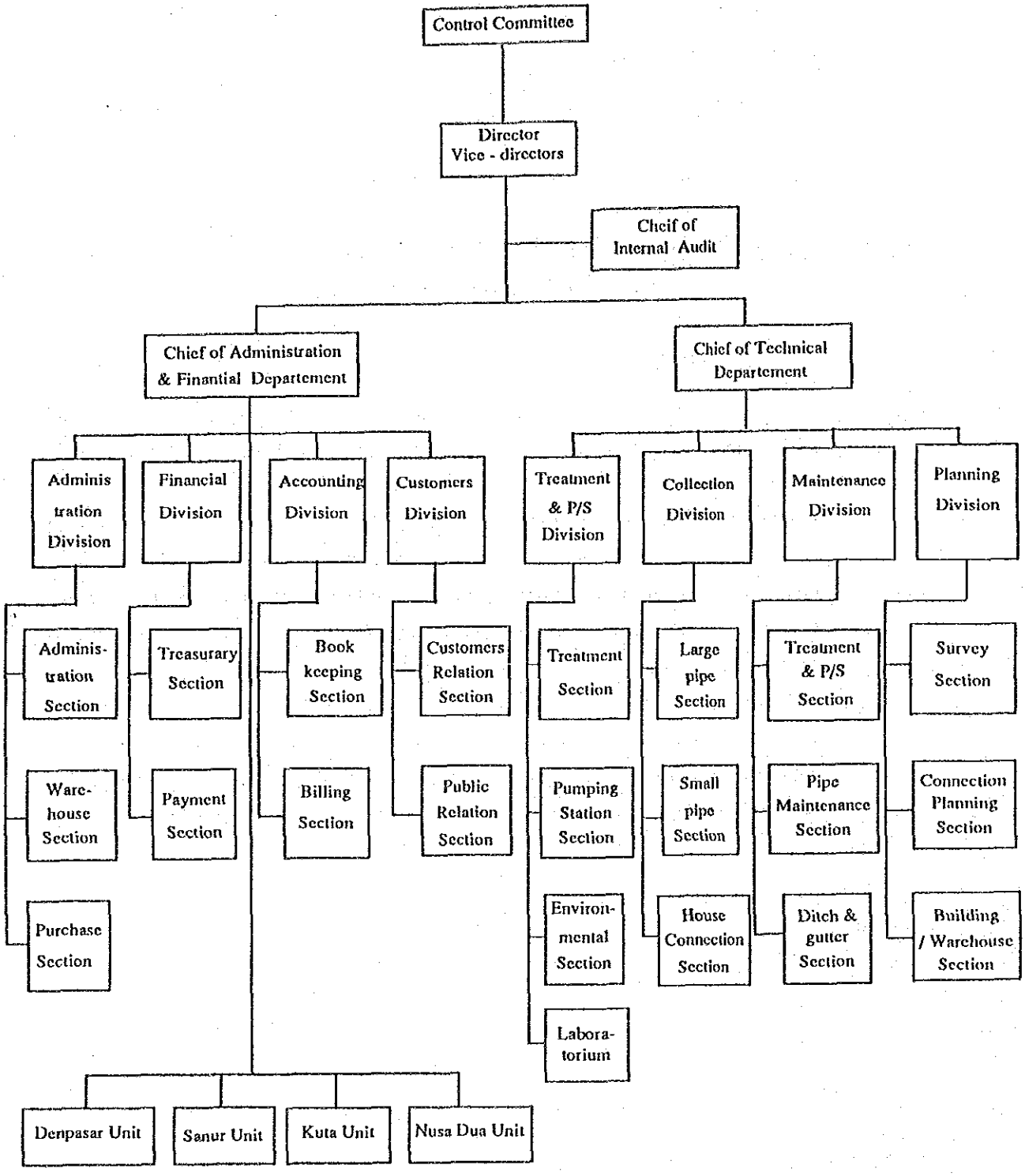
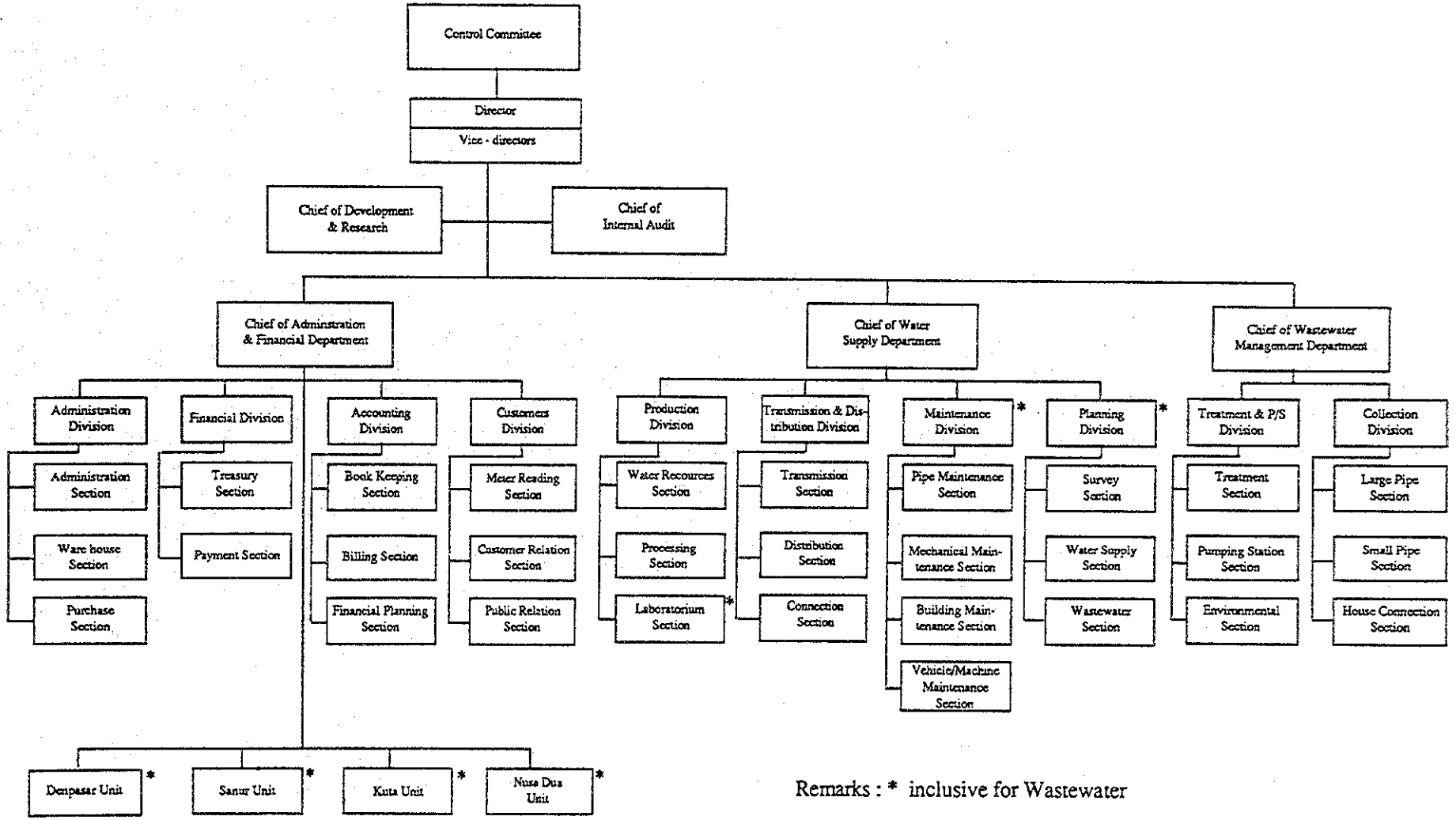


FIG. 6.1 ORGANIZATIONAL STRUCTURE OF PDAL (INDEPENDENT ALTERNATIVE)

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR



Remarks : * inclusive for Wastewater

FIG. 6.2 ORGANIZATIONAL STRUCTURE OF PDAM (INTEGRATION ALTERNATIVE

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR

JICA A.D 1993

CHAPTER 7 RECOMMENDATIONS

7.1 Immediate Project Implementation

The water quality of rivers, coastal sea and groundwater in the Project Area is much polluted due to disposal of untreated wastewater from human activities. Further aggravation of the water quality will cause fatal damages on the tourism resources and public health of the Project Area.

An immediate implementation of the Project is necessary for both development of the tourism industry and improvement of the overall sanitary environments of the Project Area.
Hence, it is recommended to commence the necessary financial procurement at the earliest.

7.2 Development of Monitoring System

Monitoring of the water quality in rivers, coastal sea and groundwater of the Project Area has been limited with respect to both area and time. Monitoring system of such water quality shall be developed for better environmental management of the Project Area.

The proposed monitoring location of the river, coastal sea and groundwater quality are shown in Fig. 7.1.

For this purpose, a laboratory with sufficient experimental equipment shall be immediately established in the Project Area in cooperation with the other related agencies.

Training of monitoring and laboratory staff is also essential and its early commencement is recommended.

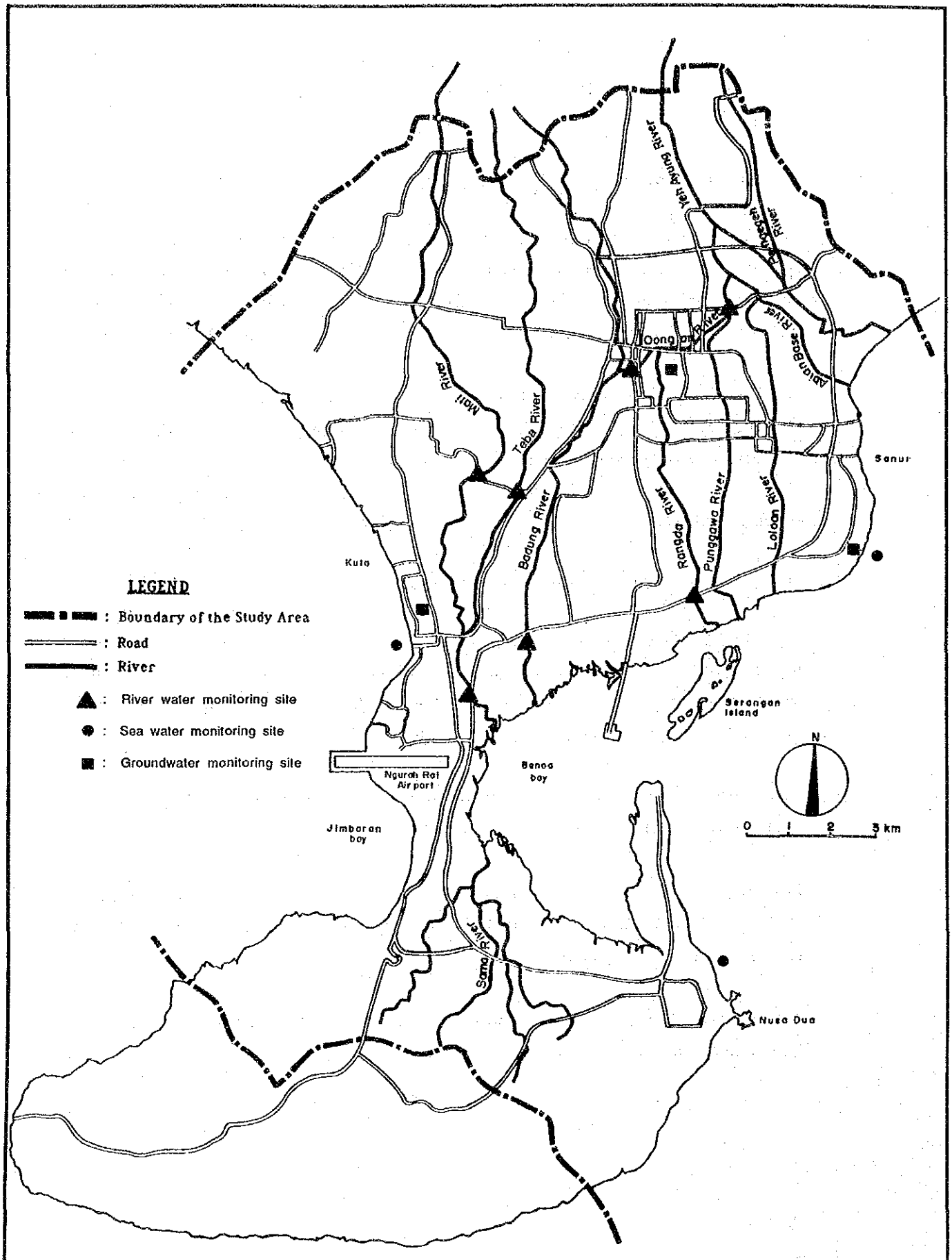


FIG. 7.1 PROPOSED MONITORING LOCATION

THE DEVELOPMENT STUDY ON WASTEWATER DISPOSAL FOR DENPASAR