

2.4.2 LAND TRANSPORT

Half the tourists coming to Phuket use any land transportation. The highway network, bus transport and railway connections are major issues in this section.

1) HIGHWAY NETWORK

National highways and provincial highways in Southern Region have generally been maintained in a good condition due to the government's continuous effort. However, some problems still remain in forming a favorable network. The 6th Five-Year Plan has committed several projects to solve some of these problems as shown in Table 2-4-6 and Figs. 2-4-3 and 2-4-4.

The notable projects in relevant areas are:

- a. Improvement of Provincial Highway Route 4040:
This is to greatly improve the accessibility to another new economic growth pole in the East coast, Surat Thani. This highway is to be improved with 48.2 km long and a F2 standard in 1989, financed by the OECF loan. This will function as a part of the East-West Link Highway connecting between Phuket and Surat Thani, which has been proposed in the Upper South Development Study (JICA).
- b. Construction of the New Phuket Bridge and Route 413 (No.A5-A7)
This project will change the image of the Phuket Gateway. A new bridge with 4 lanes is planned to the existing one which has been assessed to have a structural problem, and a new road, Route 413, related to this new bridge, will be aligned so as to shorten the existing highway route 401. Since this project is located quite near the existing bridge, no great impact on the highway network structure in Phuket can be expected, but it would be a fact that the development potential of the surrounding area will become greater.
- c. Construction of Highway Route 4022:
The Phuket Deep-Sea Port is scheduled to be open for service in 1989. In order to support the port activities, a good access to the port area without passing through Phuket Town has been expected. A new link, connecting the 402 By-Pass and Route 4023, with 6.7 km of F1 and 3 standard road is to be constructed for this purpose, financed by the IBRD loan.

To exploit the tourism potential of areas located along the coastal areas, a number of highway improvement projects have been planned. The following are noted especially for Phuket tourism.

- d. Construction of a Phuket West Coast Link, Route 4233:
This Phuket West Coast Link has a total length of 41 km between Rawai Beach and Surin Beach. Out of the whole link, some segments have been completed or are under construction financed by MOI or local governments. The segments planned by DOH have a total of 29 km long with 5.5 m wide (design standard, F4), not including the following four segments:

Surin - Kamala (1km);
Patong Area (3.2km);
Karon - Kata (4.4km); and
Promtep - Rawai (3.6km).

The development of this road aims exclusively at promoting the potential tourism areas/beaches. TAT has approved that this project is important for tourism development in Phuket, and that this project will be commenced in 1989, using the OECF loan. Since this road is to run in the coastal forest areas, a critical erosion problem is likely to take place while it is being constructed. Special attention needs to be paid to this environmental problem. An environmental impact study is now under-way as of August, 1988.

- e. Improvement of Access Roads to Tourism Beaches:
A number of improvement projects of the existing local roads have been committed in the 6th Five Year Plan in Greater Phuket. Those are quite important in the meaning of incorporating the tourism development into the local economies as well as of facilitating the local people's activities.

In Phuket Island, several projects for improvement of access roads to the major beaches from the Phuket Town are being implemented or have been committed, namely, Provincial Highway Routes 4020, 4024, and 4028. The improvement of Route 4025 (between Route 401 and Surin Beach) has almost been completed.

In Phang Nga, Route 4144 from the crossing point of Route 4 to the Phang Nga Bay is due to be improved with a F2 Standard. Finished this improvement, the Phang Nga Bay tourism area will have a greater development.

In Krabi, Route 4034 is to be improved with a long segment, 25.2 km, so that the coastal tourism areas may be more accessible.

All these projects are expected to contribute greatly to boosting regional socio-economic as well as tourism activities. If all the projects are completed on schedule, major problems on the highway network would almost all be resolved, except for several aspects.

The following are recommended in order to strengthen the highway network for both tourism and regional development.

● East-West Link Highway Connecting Between Phuket and Surat Thani

● New Phuket Bridge

● Highway Route 4022

● Phuket West Coast Link Road Connecting Between Rawai and Surin Beaches

● Environmental Impact Study

● Roads in Phuket

● Roads in Phang Nga

● Roads in Krabi

● Access Road to Phuket Airport

- East-West Link Highway Development:
A more functional primary highway network system, integrated with international and inter-regional transport.

For this purpose, a 206 km long West-East Highway Link (Surat Thani-Phuket) with a high design standard is recommended to be developed, as proposed by the JICA Upper South Development Study (1985). The improvement of Route 4040, which has been committed in the 6th Plan, will be a significant part of this link.
- Inter-Modal Transport System Development:
A smooth connection between one transportation mode and another is required. For this, the access road to Phuket International Airport, Route 4026, and the junction with Route 401 are recommended to be improved with attention to the landscape to promote a "Sense of Arrival".
- Environmental Protection of Phuket West Coastal Link:
The Phuket West Coast Link (41km) should be a scenic drive perfectly protected from any natural erosion. A special project for preserving the roadside environment is highly recommended from an environmental point of view. This project is also recommended in Section 2.3.5. ENVIRONMENTAL CONSIDERATION in this volume.
- Facilitating Local Roads Improvement Work:
A prompt responsive system to improvement of local roads, whenever damages take place, is necessary to keep tourism areas in a favorable condition. An administrative and budgetary system should be arranged for this purpose.

2) BUS TRANSPORT

It is assumed that fixed route buses cater to about 22% of the total tourist passengers to Phuket. Bus transportation has played a significant role in the whole transport system. The fixed route bus services for inter-city network are as shown in Table 2-4-7. Along with an increase in the accommodation capacity in Greater Phuket, the carrying capacity of bus transport will also need to be expanded to almost twice as much as that at present in 2001.

In line with this, there are three issues to be tackled in terms of improvement of the bus transport system, referring to basic requirements of tourists, i.e., safety, time conservation and comfort.

● Safty, Time Conservation and Comfort

a. Safety:

Bus accidents often take place mainly because of drivers' careless mistakes. The LTD study shows that bus transport is thought to be three times as dangerous as car/taxi transport. A long haul drive with 890 km or 14 hours from Bangkok is more likely to be susceptible to road traffic accidents. Buses should ensure a reliable and safe transportation. For this, two action program should be taken promptly by relevant authorities:

- Provision of a passenger insurance system;
- Improvement of a safe operation system including an appropriate drivers management program and a coach inspection institution .

b. Travel Time Conservation:

The highway improvement is associated with this goal of bus operations. As argued in the preceding section, if the East-West Highway Link (Surat Thani-Phuket) is developed, the travel hours between Bangkok and Phuket will be reduced by 2 hours.

c. Comfort:

Tourists always want more comfortable travels. It is recommended that even for the fixed route buses, more luxurious coaches be operated. An institutional arrangement for this would be necessary.

3) RAILWAY CONNECTION

The Phuket Line diverting at Surat Thani and running to the Phuket Deep-Sea Port is a historic idea, which has been proposed by several studies. The State Railway of Thailand is now conducting a feasibility study of this project in collaboration with a Canadian group. It has broadly been recognized that the Phuket Line is inherently desired and necessary, but this project is still questionable in terms of both its economic and financial feasibility.

Now, this study cannot make any mention on this project because such a huge amount of investment cannot be justified only from a tourism point of view. The function of the Phuket deep-sea port would be paramount. Instead, establishment of a smooth connection/transfer system between rail and bus at Surat Thani Station is recommended in order to attract international tourists using the forthcoming "Orient Express Asia" and passengers of the southern line from Bangkok. A joint promotion of railway and coach should be encouraged, inviting private sector's participation. The East-West Highway Link is significant for this purpose as well.

● Feasibility Study by SRT

● "Orient Express Asia"

4) IMPLEMENTATION OF HIGHWAY DEVELOPMENT

A special budget package should be allocated to the development of the East-West Linking between Surat Thani and Phuket, including the construction of the New Phuket Bridge as proposed in the JICA Upper-South Sub-Regional Development Study (1985). Excluding some parts of the link which have been committed to be improved during The Sixth Five-year Plan, the additional costs for this project are estimated to be about 1,447 million Baht in 1988 prices. This project is recommended to be commenced in Phase II (1992-1996) with the improvement of National Highway No. 402 and parts of the New Phuket Bridge, and the development of the 401 By-Pass running through the mountainous areas is to be carried out in Phase III (1997-2001).

Emphasis should also be placed on the development/improvement of local roads accessing the major tourism potential areas. The project budget of about 90 million Baht (in 1988 prices) for roads with a total length of around 50km needs to be allocated during each phase, Phase II and Phase III.

A recommended highways development schedule is shown in Section 2.7 PLAN AND PROJECTS TO BE IMPLEMENTED in this volume.

FIG. 2-4-3 ROAD PROJECTS ON GREATER PHUKET

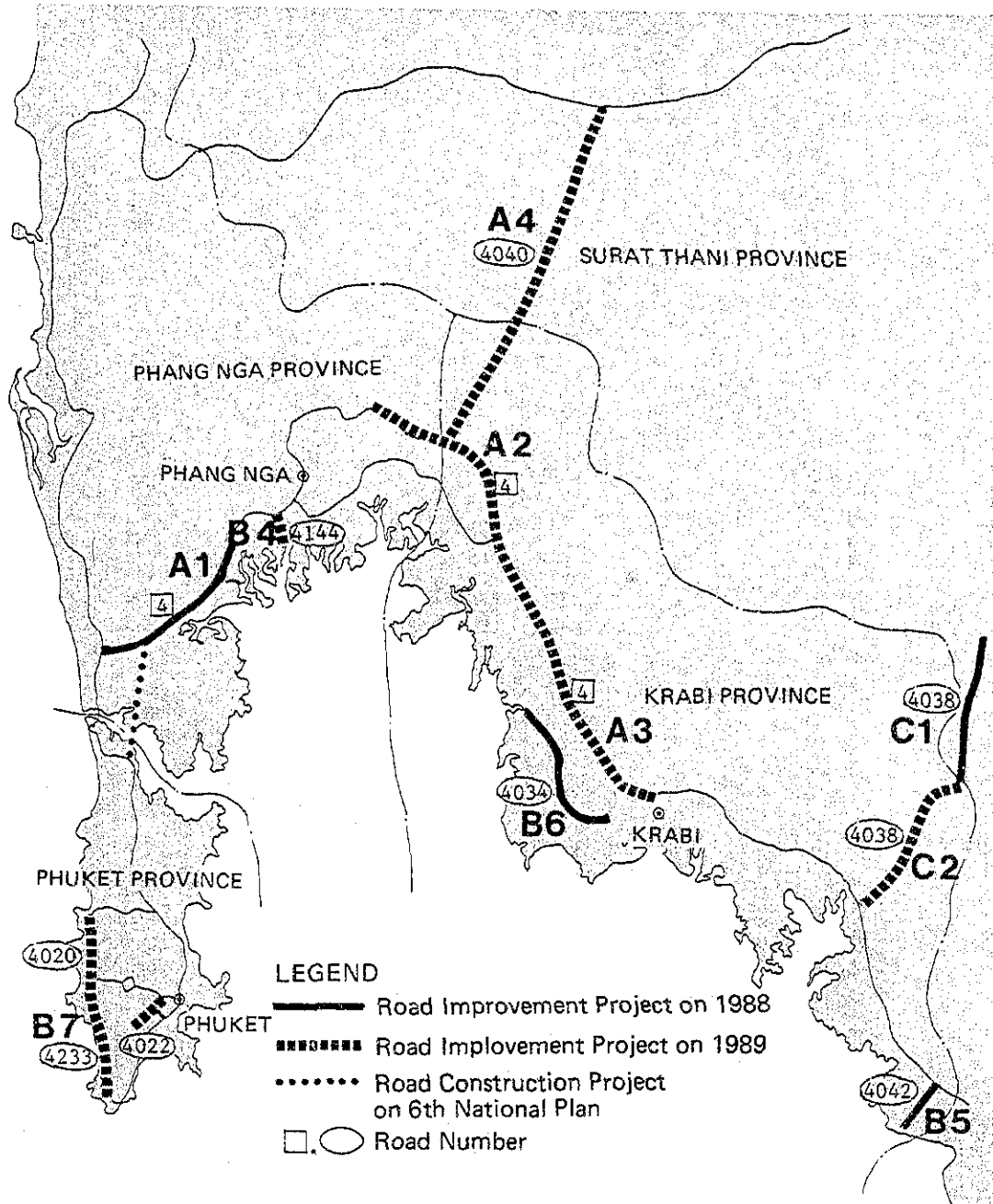


FIG. 2-4-4 ROAD PROJECTS ON PHUKET PROVINCE

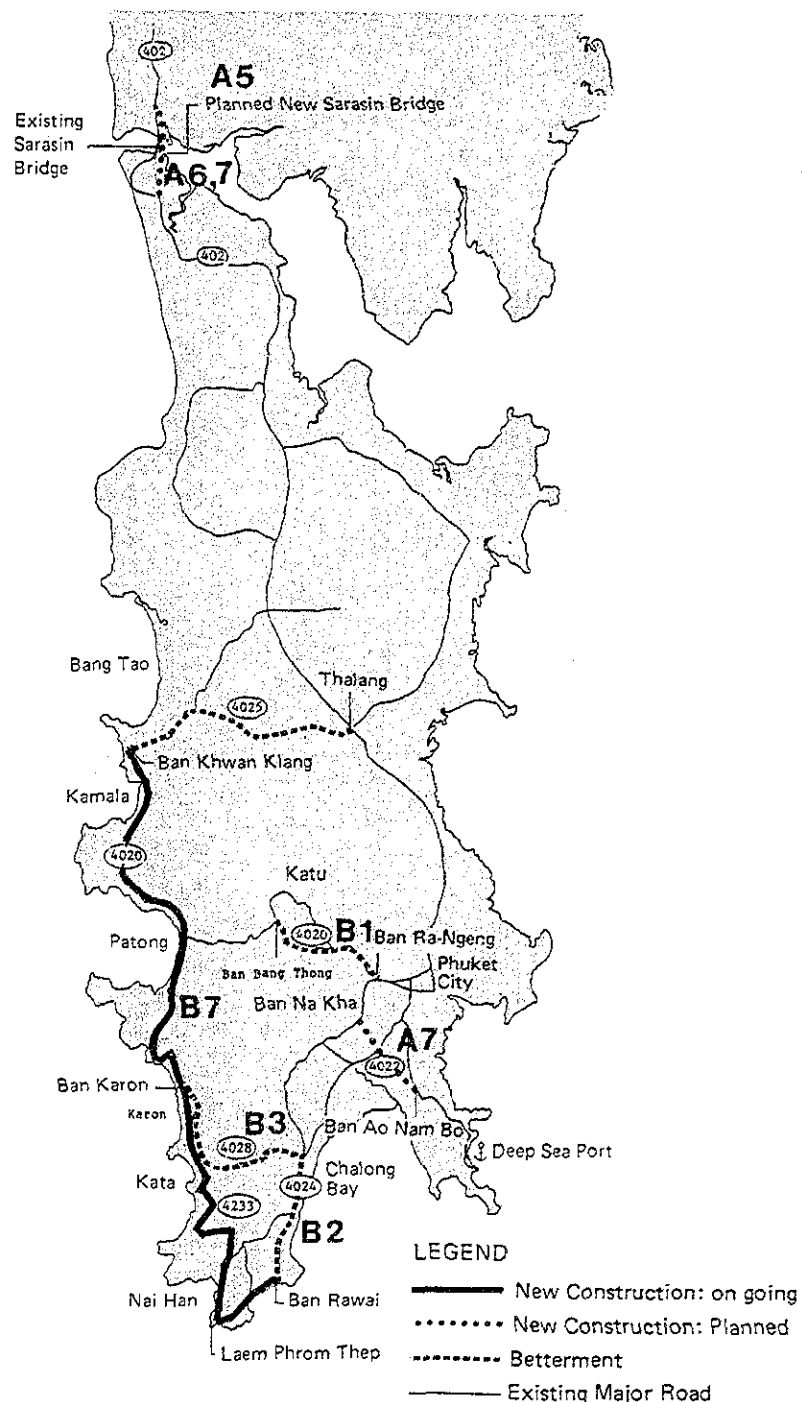


TABLE 2-4-6 NATIONAL AND PROVINCIAL HIGHWAY PROJECTS IN THE 6TH FIVE YEAR PLAN

Ref. No.	Highway Route #	Segment	Standard	Length (km)	Cost (mill. B)	Year	Province	Finance Supported
A. For Improvement Major Highway Network								
Improvement:								
A 1	4	Kok Loi - Takua Tung	P2	19.9	29.2	1988	Phang Nga	
A 2	4	Ban Kiang - Tab Pud	P3	30.5	50	1989	Phang Nga	ADB
A 3	4	Krabi - Ban Kiang	P3	30	49	1989	Krabi	ADB
A 4	4040	Phanon - Tab Pud	F2	48.2	117	1989	SRT, PNG	CECF
New Construction:								
A 5	413	New Phuket Bridge	S1	0.8	290	1991	Phuket	
A 6	413	Ta Yu Village	S2	15	60	*	Phuket	
A 7	4022	402 By-pass-4023	F1&3	6.7	21.2	1989	Phuket	IBRD
B. For Facilitating Tourism Areas								
Improvement:								
B 1	4020	Phuket - Katu I/S	F2	6.5	12.5	1989	Phuket	
B 2	4024	Chalong - Rawai	F3	5.5	10	U/C	Phuket	
B 3	4028	Chalong - Karon	F4	8.6	5.2	U/C	Phuket	
B 4	4144	Rt. #4 - Phang Nga Bay	F2	3.8	6	1989	Phang Nga	
B 5	4042	Rt. # 4 - Bor Muang	F4	13.2	28	1988	Krabi	
B 6	4034	Krabi - Kao Tong	F4	25.2	47	1988	Krabi	IBRD
New Construction:								
B 7	4233	Rawai - Surin Beach	F4	20.9	133	1989	Phuket	CECF
C. Facilitating Local Activities								
Improvement:								
C 1	4038	Lamtab - Tung Yai	F4	26.8	47	1988	Krabi	IBRD
C 2	4038	Klong Tom - Lamtab	F4	27	47	1989	Krabi	IBRD

Notes: Reference No. is referred to Figs. 2-4-3 and 2-4-4

TABLE 2-4-7 FIXED ROUTE BUS SERVICES FOR INTER-CITY NETWORK

No.	Route	Distance (km)	Category -Standard	Fare (Baht)	Duration (hrs)	No. of Services	
						to	from
1.	Bangkok-Phuket	891	II-1	299	14	8-10	8-10
			II-3	165	15	8-10	8-10
2.	Bangkok-Phang Nga	815	II-1	274	13	2-1	2-1
			II-3	161	14	3-2	3-2
3.	Bangkok-Krabi	867	II-1	290	13.5	2-1	2-1
			II-3	161	14.5	4-3	4-3
4.	Phuket-Phang Nga	87	III-3	22	2	5	5
5.	Phuket-Krabi	176	III-3	38	4	3	3
6.	Phuket-Surat Thani	287	III-3	61	6	8	8
7.	Phuket-Hat Yai	466	III-1, 2	154	8	2	2
			III-3	91	8	4	4
8.	Phuket-Trang	312	III-3	62	6	8	8
9.	Phuket-Nakhon Si Thammarat	336	III-3	75	8	6	6

Source : LTD

2.4.3 SEA NETWORK

The objective of the development of sea transport network systems may be twofold: 1) to make full use of the location advantages of Greater Phuket to attract international tourists by sea, and 2) to incorporate the dispersed tourism assets and resources into the entire Greater Phuket tourism development, thereby extending the area of tourism interest.

1) AS AN INTERNATIONAL CRUISE DESTINATION

According to immigration statistics, about 11 thousand international passengers came into Phuket by ship in 1987. Although the percentage of ship passengers is only 1.4% and they are mostly from Malaysia (Penang) so far, it is anticipated that international cruisers and yachts from European countries, Australia and Japan would occasionally stop at Phuket as the marine activities get more popular. If a well-developed facility is provided to accommodate these cruisers, Phuket will become an outstanding destination of international cruising activities. Phuket has to have a fully equipped tourist port. The Andaman circuit of Singapore-Kuala Lumpur-Penang-Phuket would be a fascinating international sea route.

The Phuket deep-sea port may provide a berth for occasional moorage of tourists ship for the time being, however, this port is expected to function as a cargo distribution and industrial port in the medium and long run. An exclusively tourism or marine recreational port, namely "Phuket Marine Center", is recommended to be developed in Phuket Island.

2) NAUTICAL CIRCUIT DEVELOPMENT

A nautical circuit system is planned in order to provide a wide variety of sea excursions, as shown in Fig. 2-4-5. This includes the development of tourist ports/jetties classified into the three categories as follows:

- a. Primary port, as a focal point of the Phuket resort, with yacht harbor, tourist boats moorage, accommodation, recreation, logistic, medical, information, navigational aids, immigration branch office, stores and repairing workshop, and car parking facilities at Chalong Bay. This is named "Phuket Marine Center".
- b. Secondary Ports, as sea excursion centers, with information, fuel station, tourist boat moorage, ship repairing workshop, terminal building, and car parking facility at three locations: the coastal area nearby the Phuket International Airport, the Phang Nga Bay, and the Krabi Town Port; and
- c. Stop-over ports, with a landing jetty and small-scale terminal building at 15 tourism spots.

High-speed tourist boats such as "Hovercrafts" or "Hydrofoils" are recommended to be introduced for the major sea transport links such as a Similan - Phuket (Marine Center/Phuket Airport) - Phi Phi link. This could provide an easy access to these remote but greatly attractive tourism spots. For example, by Hovercraft with a cruising speed of 80km/h, it will take:

Similan - Marine Center (Chalong) : about 2 hours;
Marine Center (Chalong) - Phi Phi : about 40 minutes.

It is recommended that the public sector should initiate this transport service in collaboration with the private sector, because of the huge initial investment required and the monopolistic nature of the business.

3) IMPLEMENTATION

The total costs for the ports/jetties development proposed above are estimated to be approximately 628.7 million Baht in 1988 prices, including one primary, three secondary and fifteen stop-over ports, as shown below: (The detail information, Section 2.7)

- a. Primary Ports (Phuket Marine Center): 134.6 million Baht
- b. Secondary Ports: 117.6 million Bahts for 3 locations
(39.2 million Bahts per location on the average).
- c. Stop over ports: 36.5 million Bahts for 15 locations
(25.1 million Bahts per location on the average).

These may be developed step by step during the terms of Phase II and Phase III. Special emphasis should be given to the development of the primary port, Phuket Marine Center, as a focal project. This project is thought to be a good model to introduce a public and private coordination project system in tourism development. A more detailed proposal for this project is made in Section 3.2 and its financial evaluation analysis is carried at in Section 4.3.

● International Cruiser

● Phuket Deep-Sea Port

● Marine Center

● Sea Excursion Center

● "Hovercraft/Hydrofoil"

● Initial Investment by Public Sector

FIG. 2-4-5 SEA TRANSPORT SYSTEM

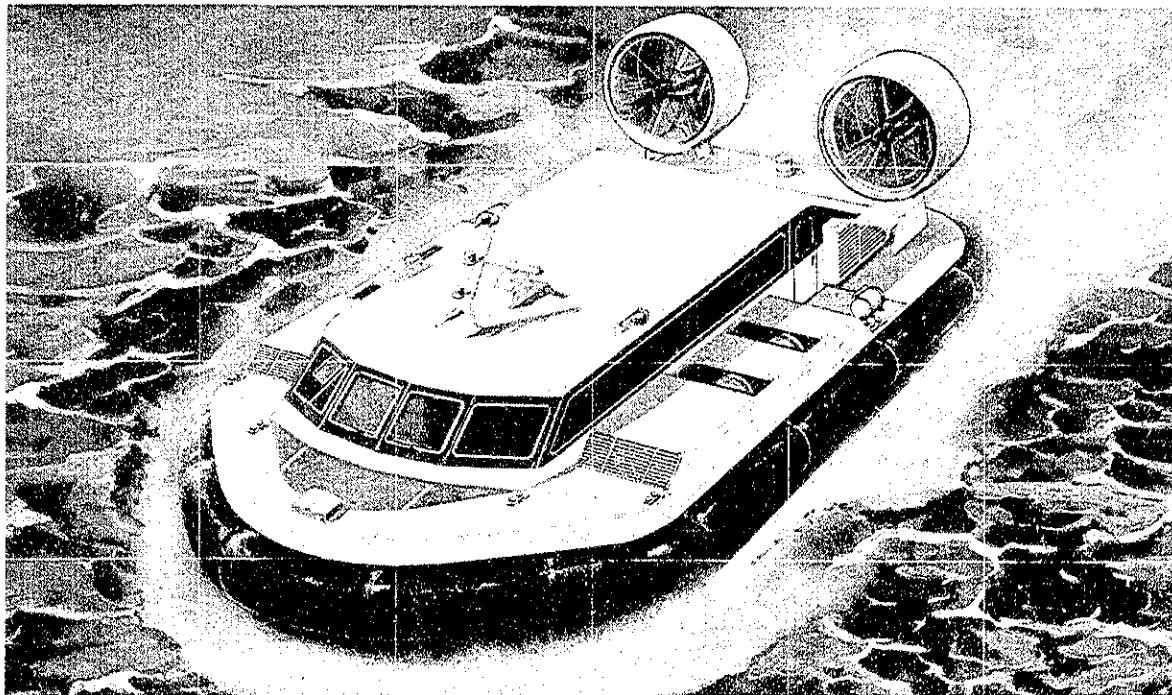
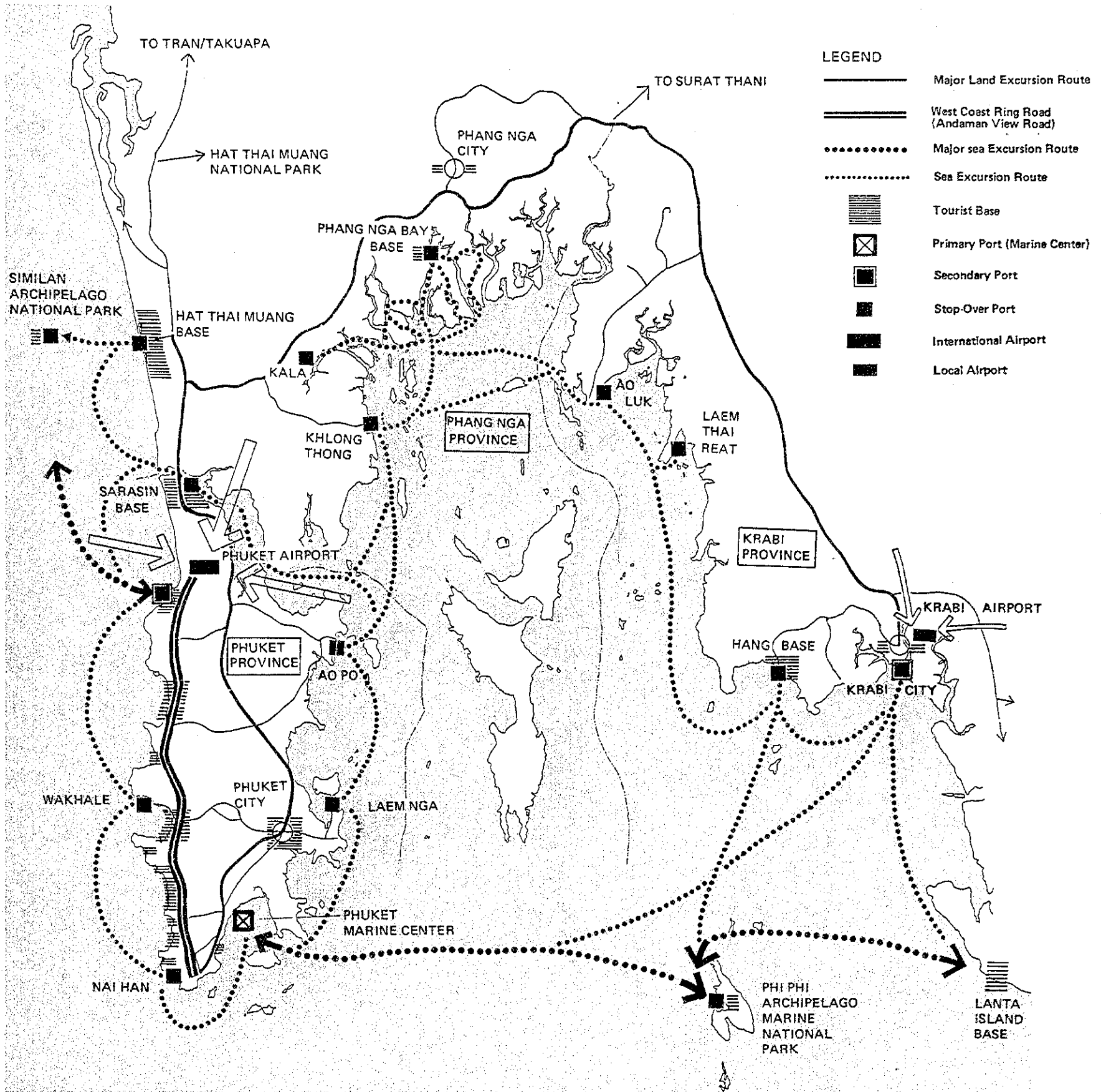


Illustration of Hovercraft

2.4.4 WATER SUPPLY

1) WATER PROBLEMS ON PHUKET ISLAND

"Water" is one of the most critical factors for not only tourism development, but also regional development on Phuket Island as a whole. The water problem in Phuket Island is mainly due to lack of a comprehensively planned system to provide water for the whole island. Because of this, a water shortage often takes place in the dry season in several areas, but not in the whole area.

There are two typical ideas to mitigate the water problem in Phuket Island, i.e., one is the idea that the water is supplied by transmission pipelines from Phang Nga where a large scale dam is constructed. The other is the idea that the water is supplied in a self-sustainable manner within Phuket Island. Each idea has both merits and demerits.

This study pursues the possibility of the latter idea, as one of alternative solutions. It is found that there is no problem in the total volume of water that the island can catch and store even in the dry season. Because of this finding, it is recommended that a water management and supply system be provided to meet the demand in the long run in a self-sustainable manner within Phuket Island.

The following are findings on the water problems in Phuket Island:

- a. Although the annual precipitation accounts for more than about 2,300 mm on the average, which is considered sufficient, there are some difficulties in storing the water in the island due to the configuration of the mountains in the central area of the island;
- b. There are no large rivers suitable for water in-take in Phuket Island;
- c. There are no potential underground water resources from a hydro-geological point of view;
- d. The existing water supply system of Phuket Municipality has a limited capacity to satisfy future water supply. It is foreseen that that facility will face a shortage in water supply after 1997. Moreover, as most of the facility is already dilapidated, the distribution pipe-lines need to be replaced soon;
- e. The administrative management system of water supply facilities has not efficiently functioned because of a lack of coordination between PWA and Phuket Municipality. For instance, the Ban Wat reservoir and the purification plant exist and are being operated, however, there exist difficulties in providing water to Phuket Town. Under such conditions, formation of an efficient service network system is strongly needed. A definite allocation of administrative responsibility is essential.

2) WATER DEMAND ESTIMATE

Residential and tourism water demands were estimated, based on the following premises:

- a. From a geological and engineering point of view, it is proposed that the comprehensive water supply system in Phuket Island consist of three separate sub-systems: one is the system serving the northern part of the island, another is the Phuket Municipal system, and the other is the one serving the southern part. The later two sub-systems are integrated into one as the southern system. The dividing line between the north and the south is the edge of the mountains, Kao Phanthur, at located almost in mid-island, as shown in Fig. 2-4-6.
- b. Service areas should cover the whole island with special attention to potential tourism beaches. Water for residential use is served in every Ampho. Division of the service areas is as shown in Fig. 2-4-6.
- c. Population and hotels to be served are assumed to be as shown in Tables 2-4-8 and 2-4-9 respectively. The future population is assumed, based on the DTCP's framework, and the number of hotels are derived from the framework estimated in this study.
- d. The connective ratios of residential water are assumed as shown in Table 2-4-8. Based on the data provided by Phuket Municipality, the present ratio is almost 60% to 65% in terms of percentage of households. For a planning framework, it is assumed that the ratios will increase step by step and will reach 80% in 2001 in the Phuket municipal area and 70% in the other areas.
- e. Unit demand of water supply is assumed as shown in Table 2-4-10. This is a critical factor for estimating future demand. Based on the results of a survey of hotels carried out in the stream of this study, the unit water demand of hotels was determined to be 1.4 liter/day for high class hotel room and 1.1 liter/day for low class hotel room, in terms of water demand per hotel room. The residential use is assumed to increase gradually year by year in response to upgrading of its standard of living.

Based on the above premises, it is estimated that in 2011 the water demand of the whole island will be 44,330 cbc.m. per day on the average, and 69,360 cbc.m. per day at a maximum level, as shown in Table 2-4-11.

Since it has been recognized in this study that the hotel construction activities should be controlled beyond 2001, the increase rates in the water demand for tourism go down from 2001 up to 2011. This result is based on the recommended policy.

Basically, it has to be understood that this estimate is subject to changes if different premises regarding service areas and population to be served are made. An adjustment with relevant agencies and the on-going studies is required for this regard.

- Supplied From Phang Nga
- Self-Sustained within Phuket

- Water Supply in Phuket Municipality

- PWA and Phuket Municipality

- Three Separate Sub-Systems

- Connective Ratio

- Require Further Studies

TABLE 2-4-8 SERVED POPULATION ESTIMATES

Area	Year	Year					
		1988	1991	1996	2001	2006	2011
Phuket North	House Connection (%)	60	63	66	70	73	75
	3)	6,130	6,930	7,854	8,890	9,709	10,425
	8)	16,404	18,585	21,120	23,800	26,134	27,900
	4)	4,957	5,607	6,402	7,210	7,957	8,475
Total		27,491	31,122	35,376	39,900	43,800	46,800
Phuket South	House Connection (%)	60	63	66	70	73	75
	4)	2,479	2,835	3,234	3,640	4,015	4,275
	2)	3,911	4,536	5,148	5,810	6,424	6,825
	7)	11,859	13,419	15,246	17,220	18,907	20,175
	5)	7,322	8,253	9,372	10,570	11,607	12,450
	6)	5,957	6,741	7,656	8,610	9,417	10,125
Sub-Total		31,528	35,784	40,656	45,850	50,370	53,850
Town	House Connection (%)	65	70	75	80	85	90
TCP's Planning framework	1)	34,678	40,460	47,100	53,200	59,500	65,520
	Total	66,206	76,244	87,756	99,050	109,870	119,370
Grand Total		93,697	107,366	123,132	138,950	153,670	166,170

Notes: Unit ; person
Area Codes are referred to Fig. 2.4.6
Source: Based on D

TABLE 2-4-9 NUMBER OF HOTEL ROOMS

Area	Year	Unit: room														
		1988			1991 (Phase I)			1996 (Phase II)			2001 (Phase III)			2011		
		High	Low	Total	High	Low	Total	High	Low	Total	High	Low	Total	High	Low	Total
Phuket North		402	11	413	2,078	11	2,089	4,472	255	4,727	5,618	300	5,918	5,618	300	5,918
Phuket South		3,764	1,989	5,753	6,770	3,824	10,594	7,387	4,058	11,445	8,034	4,469	12,503	8,034	4,469	12,503
Phuket Town		430	1,034	1,464	853	1,034	1,887	853	1,034	1,887	879	1,034	1,913	879	1,034	1,913
Others		126	183	309	126	183	309	126	183	309	126	183	309	126	183	309
Total		4,722	3,217	7,939	9,827	5,052	14,879	12,836	5,530	18,366	14,657	5,986	20,643	14,657	5,986	20,643

TABLE 2-4-10 UNIT DEMAND OF WATER SUPPLY

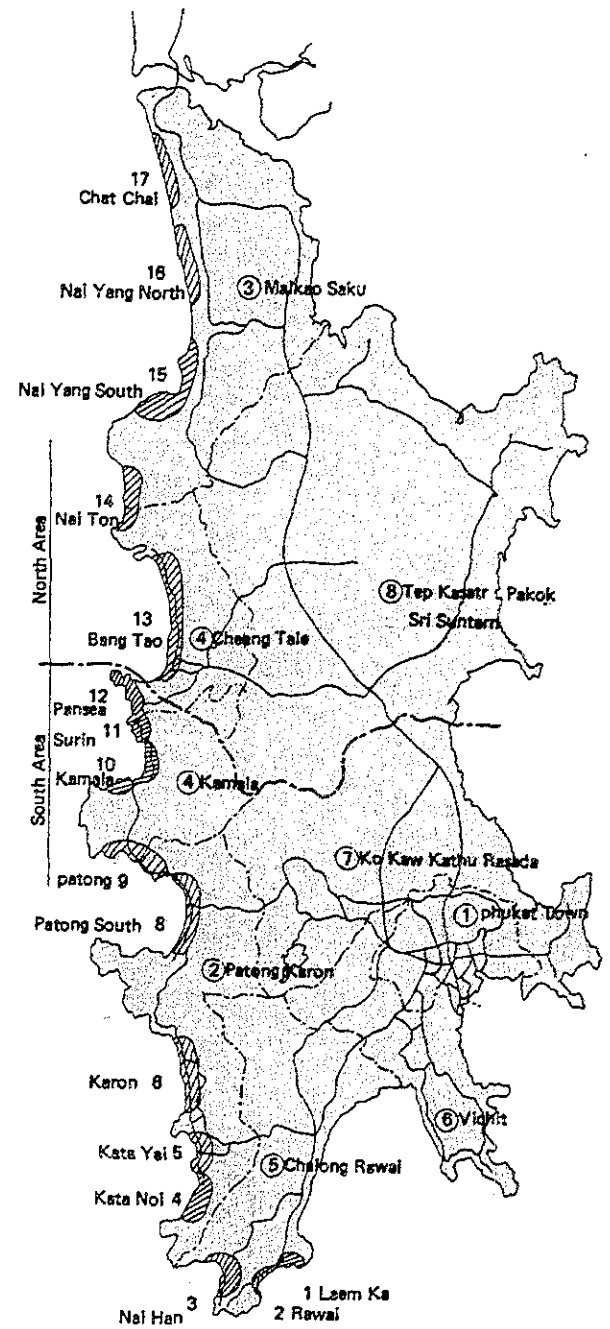
Item	Unit	Year											
		1988		1991		1996		2001		2006		2011	
		Daily Max.	Daily Ave.	Daily Max.	Daily Ave.	Daily Max.	Daily Ave.	Daily Max.	Daily Ave.	Daily Max.	Daily Ave.	Daily Max.	Daily Ave.
Hotel (High)	cbc.m. Per Room	1.4		1.4		1.4		1.4		1.4		1.4	
	Per day		0.94		0.94		0.94		0.94		0.94		0.94
Hotel (Low)	cbc.m. Per Room	1.1		1.1		1.1		1.1		1.1		1.1	
	Per day		0.74		0.74		0.74		0.74		0.74		0.74
Resident	liters Per	200		200		210		210		220		220	
	Person per day		130		130		140		140		150		150
Air Port	liters Per	15		15		15		15		15		15	
	Person		15		15		15		15		15		15

Notes: Daily Max./Daily Ave. = 1.5

TABLE 2-4-11 WATER DEMAND OF WHOLE PHUKET

Area	Year	Year					
		1988	1991	1996	2001	2006	2011
Phuket North	Max.	6,312	9,536	14,589	17,268	18,526	19,186
	Ave.	4,053	5,828	8,740	10,267	11,251	11,701
Phuket South	South Max.	16,763	24,642	27,844	30,892	32,344	33,110
	Ave.	10,855	15,347	17,652	19,663	20,800	21,322
	Town Max.	8,875	10,643	12,472	13,825	15,743	17,067
	Ave.	5,585	6,655	8,019	8,927	10,404	11,307
	Total Max.	25,638	35,285	40,316	44,717	48,087	50,177
	Ave.	16,440	22,002	25,671	28,590	31,204	32,629
Grand Total	Max.	31,950	43,821	54,905	61,985	66,613	69,363
	Ave.	20,493	27,830	34,411	38,857	42,455	44,330

FIG. 2-4-6 DIVISION OF SERVED AREAS



3) WATER RESOURCES

● Ban Wat Dam(RID) and Municipality

At present, there are two water sources: one is the Ban Wat Dam under the management of RID and the other is the water source provided by six small/medium scale reservoirs being managed by Phuket Municipality. Their annual possible supply water capacities are:

- Ban Wat Dam : 4,270,000 cbc.m./year;
- Phuket Municipal reservoirs : 3,003,000 cbc.m./year;
- Total : 7,273,000 cbc.m./year (=19,900 cbc.m./day)

Thus, the total supply capacity of the existing facilities accounts for about 19,900 cbc.m./day. Compared with the demand projected for 2001, 38,900 cbc.m./day, this is equivalent to only half of the demand. Obviously, much effort should be made to develop new water resources to recover the deficit.

● 7 Possible Dam Sites

Water resources are dependent upon construction of new reservoirs. RID has selected 7 possible locations for the dam sites, including the existing Ban Wat Dam, as shown in Table 2-4-12 and Fig. 2-4-7. The available amount of water at each potential dam is estimated based on the catchment area and the precipitation data.

● 3 Priority Dams

Assessing the efficiency of development, the water potential and technical/engineering aspects of each dam, out of the 7 dam sites, 3 sites with a total available capacity of 9.1 cbc.m./year are recommended to be constructed with high priority. This is equivalent to about 24,900 cbc.m./day.

- To serve the northern part,
Ban Nio Dam : 4.4 mill. cbc.m./year;
- To serve the southern part,
Ban Tho Sung Dam : 2.7 " ;
Pak Bang Dam : 2.6 " ;

A desirable schedule regarding the water balance between supply and demand is proposed as shown in Figs 2-4-8 and 2-4-9.

An important premise underlying the above conclusion is that the existing Phuket municipal facility will be improved and fully utilized, and that the amount of deficit in the municipal area will be covered by the Ban Wat facility.

4) PURIFICATION PLANTS AND DISTRIBUTION FACILITIES DEVELOPMENT

The two existing water purification plants are:

a. Ban Wat Plant under PWA's Management:

- Supply capacity : 24,000 cbc.m./day;
- Operating (as of Aug. 1988) : 16,000 cbc.m./day;
- Distribution pipe : 200ø - 500ø

b. Phuket Plant under Phuket Municipality's Management:

- Existing supply capacity: 9,800 cbc.m./day;
- Additional capacity planned: 6,000 cbc.m./day;
- Forthcoming total capacity : 15,800 bc.m./day

As shown in Table 2-4-13, the deficit in water supply in 2011 is anticipated to be about 37,600 cbc.m./day unless the planned expansion of the Phuket municipal facility is undertaken, and unless the remaining capacity of the Ban Wat plant is used efficiently. Even given that these conditions are satisfied, a deficit of about 38,000 cbc.m./day will take place in 2011.

For water supply facilities development, two new water purification plants are required to be developed, that is, the one has to have a treatment capacity of 20,000 cbc.m./day, located nearby the Ban Nio Dam, to service the northern part. The other is with 20,000 cbc.m./day capacity, located nearby the Ban Tho Sung Dam, to service for the southern part. This plant will be connected with the second dam, the Pak Bang Dam, with transmission pipe-lines and a pump. These two water supply systems, taking into the water levels, are conceptually proposed as shown in Fig. 2-4-10, and the area distribution systems are also proposed as shown in Fig. 2-4-11. In these proposed systems, the deficit for Phuket Town is to be covered by the existing Ban Wat Plant.

● Ban Nio Dam (North) Ban Tho Sung Dam (South)

5) RECOMMENDATIONS ON PHUKET WATER SUPPLY SYSTEM DEVELOPMENT

The following are recommended in order to solve the chronic water problems on Phuket Island.

- a. A water supply pipe-line system from the Ban Wat should be extended to the Karon/Kata areas in accordance with the existing program.
- b. A water supply system for the whole island is proposed (tentatively) as shown in Fig. 2-4-11. The construction of the dams are recommended to be started as soon as possible with a priority order of:
 - Ban Nio Dam;
 - Ban Nam Tok Dam; and
 - Pak Bang Dam.

TABLE 2-4-12 POSSIBLE DAM SITES IN PHUKET ISLAND

		Catchment Area(sq.km)	1/ Dam Capacity (mcm/yr)	2/ Estimated Availability (mcm/yr)
1	Ban Wad (Existing)	4.9	8.5	4.3
2	Ao Yon	2.1	1.5	1.1
3	Katha	5.4	4.7	3.2
4	Pak Bang	5.0 (2.3)	2.6	2.0
5	Ban Nieo	9.4 (5.1)	4.5	4.4
6	Che Tra	7.3	4.0	3.7
7	Ban Tho Sung	4.6 (3.1)	4.2	2.7

Notes: 1/ Based on the RID data.
 2/ estimated, taking into account the catchment area, precipitation, and evaporation.
 mcm/yr: stands for the unit of million cbc.m/year.

TABLE 2-4-13 BALANCE BETWEEN WATER DEMAND AND TREATED WATER SUPPLY IN PHUKET

	Demand in 2011 (A)	Capacity Being operated (B)	Forthcoming Capacity (C)	1/ Deficit (C - A)
North-Phuket	19,200	-	-	19,200
Southern-Phuket	33,100	16,000	16,000	17,100
Phuket Town	17,100	9,800	15,800	1,300
Total	69,400	24,800	31,800	37,600

Notes: 1/ Forthcoming capacity includes the additional capacity planned by Phuket Municipality and the remaining capacity of Bang Wat Plant.

FIG. 2-4-7 SELECTED POTENTIAL WATER RESOURCES

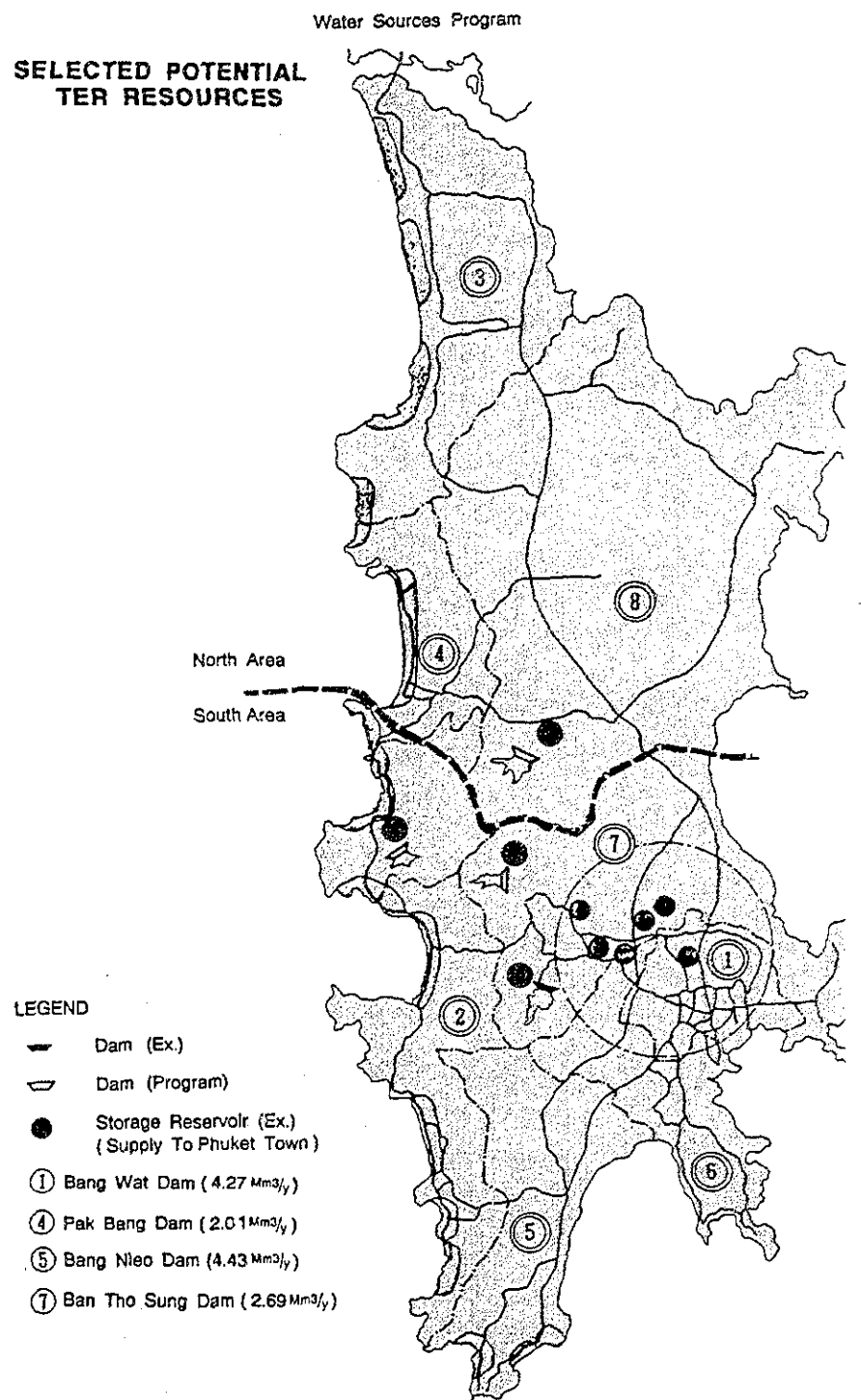


FIG. 2-4-8 WATER DEMAND AND SUPPLY IN PHUKET - NORTHERN AREA

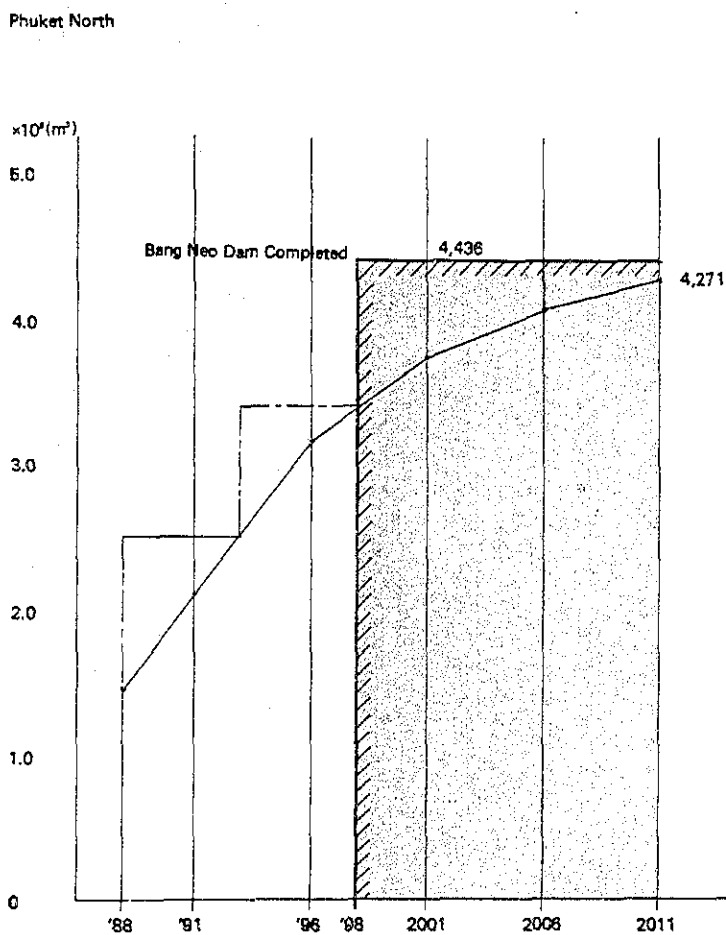
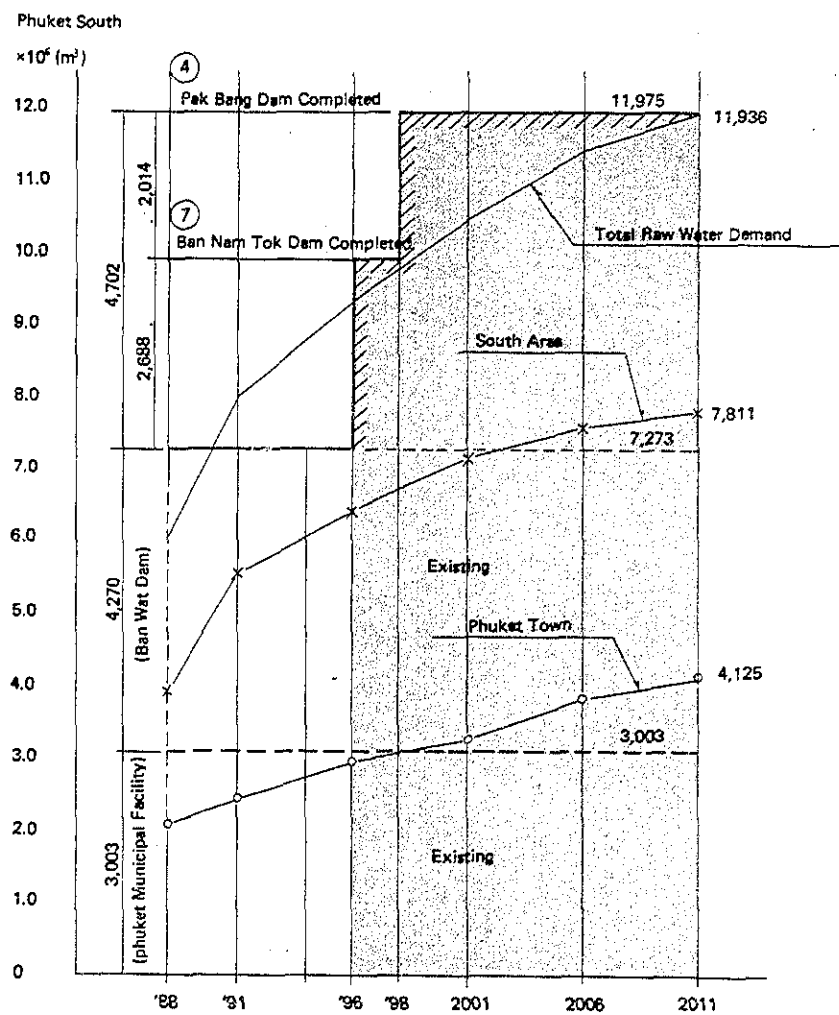


FIG. 2-4-9 WATER DEMAND AND SUPPLY IN PHUKET - SOUTHERN AREA



● Use of Ex-Tin Mining Ponds

c. During the construction period of the above dams (5 to 10 years), the water supply in the northern part is critical. Temporarily, the ex-tin mining ponds are recommended to be utilized as water reservoirs located along Route 4025 in Ban Tha Rua Noi area. For this purpose, a water quality check of heavy metal content be needed. A purification plant and a supply system should be constructed at the same time. After the completion of the Ban Nieo Dam, the raw water will be taken from that dam.

● Possibility of Underground Water

d. Utilization of underground water is thought to be limited. Water from shallow wells is normally used by most hotels and residents, but there is a problem in quality because of high iron content. The hydro-geologic study (Department of Mineral resources) shows that there are three areas where deep-well water may be possibly taken at 20 to 30 cbc.m/hour, but this has yet been proved. A testing survey is recommended to be carried out soon, since the underground water should be utilized by villages as a supplementary supply source.

e. A well-functioning administrative system responsible for managing the comprehensive water supply system should be established as soon as possible.

6) IMPLEMENTATION OF PHUKET WATER SUPPLY SYSTEM DEVELOPMENT

A recommended time-schedule of the water supply system development proposed in this study is as shown in Section 2.7 PLANS AND PROJECTS TO BE IMPLEMENTED in this volume. Since it takes a long time to construct the dams, the action should be taken as soon as possible, otherwise the tourism potential would be depressed due to this critical constraint.

The total project costs are estimated to be 2.2 Billion Baht at 1988 prices, which is equivalent to about 87 Million US\$, including engineering fees and administrative costs. As shown in Section 2.7, the result of the feasibility study from a financial point of view shows that governmental subsidies are indispensable in order to make this project feasible. A further study is also required in depth in this aspect.

7) WATER PROBLEMS IN THE PHANG NGA WEST TOURISM AREA

No serious problems are found out in the Phang Nga western coastal areas with new tourism development potentials in terms of water resources. Since these areas have huge mountainous areas in the hinterland, the surface and underground water may be abundant.

A number of potential sites for reservoirs for irrigation purposes have been identified by RID: two locations of medium-scale reservoirs with a capacity of about 2.5 million cbc.m and ten small-scale reservoirs with 300 thousand cbc.m (estimate). By partially converting the water, a certain amount of raw water for the tourism purpose could be ensured. A governmental coordination is highly required regarding this aspect.

FIG. 2-4-10 CONCEPT ON WATER SUPPLY SYSTEM DEVELOPMENT

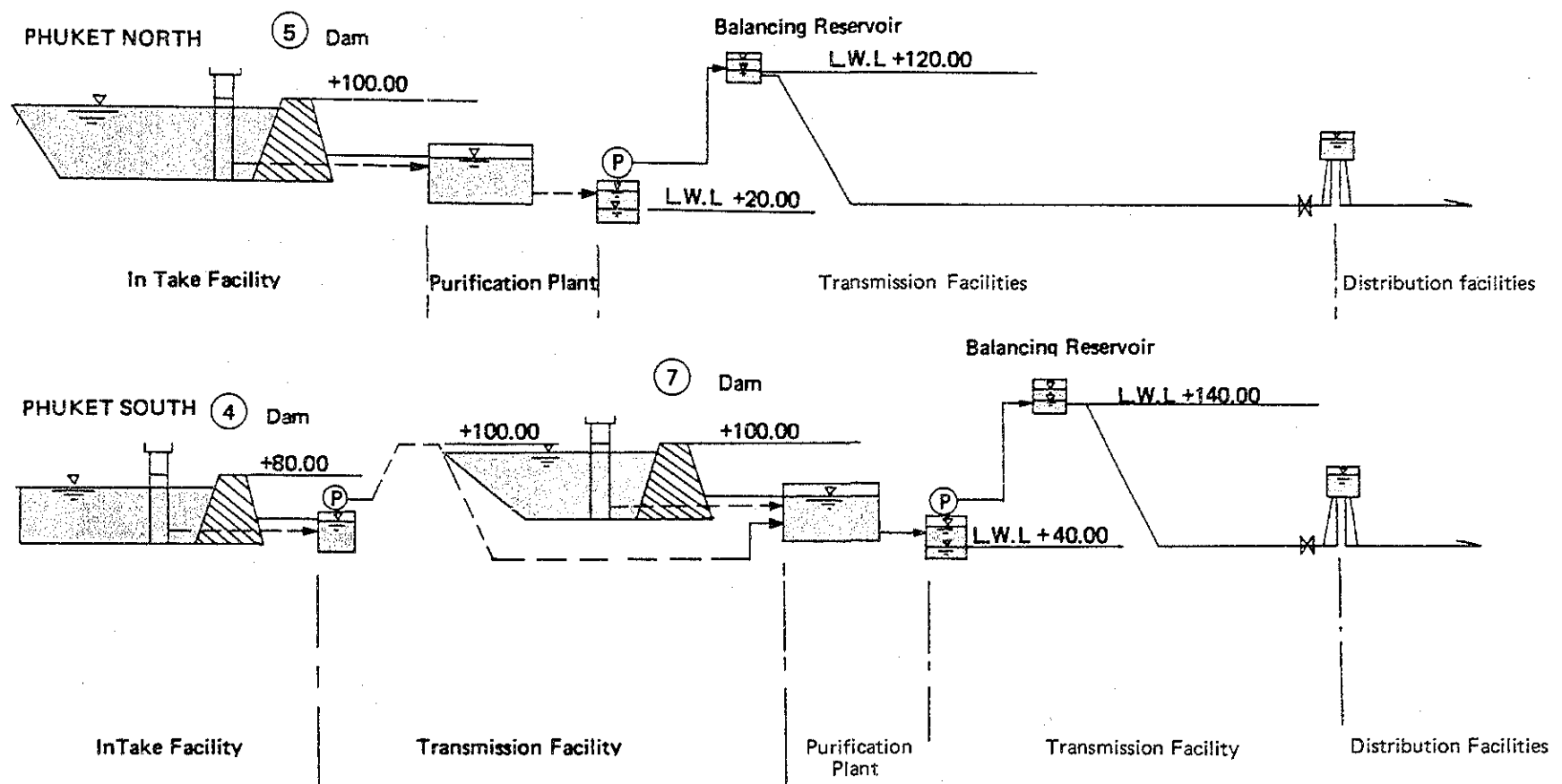
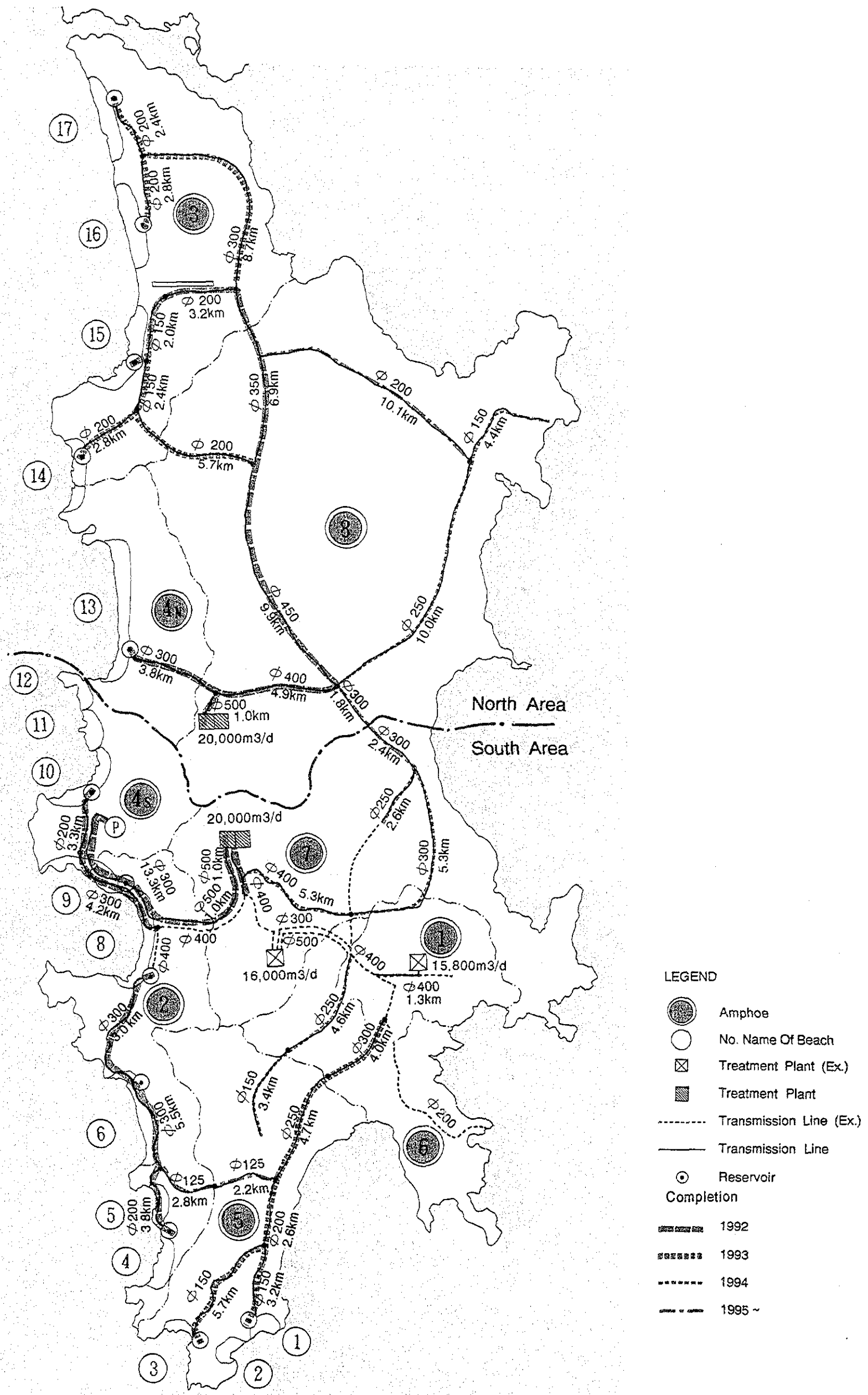


FIG. 2-4-11 WATER DISTRIBUTION SYSTEM IN PHUKET ISLAND

Transmission Conduits



- LEGEND
- Amphoe
 - No. Name Of Beach
 - Treatment Plant (Ex.)
 - Treatment Plant
 - Transmission Line (Ex.)
 - Transmission Line
 - Reservoir
 - Completion
 - 1992
 - 1993
 - 1994
 - 1995 ~

2.4.5 SEWAGE

1) NEED FOR CENTRALIZED SEWERAGE SYSTEM

The backwardness of the sanitary facilities is one of the crucial constraints on Phuket becoming an outstanding international resort. Sewage treatment systems should be developed with much emphasis, associated with environmental policies. At the present, hotels treat the sewage individually, and no centralized sewage treatment facilities are available in Phuket, except for Patong Beach. In order to ensure that the beach and the surroundings will not be polluted by discharge of waste water, adequate sewerage systems should be introduced.

● Patong Sewage Treatment Plant

The Patong sewage treatment plant with a treatment capacity of 2,500 cbc.m/day is to start its operation in the end of 1988. This plant was designed to use an oxidation ditch process with a separate system on a basis of 2,600 hotel-rooms and a population of 6,470. The capacity of the facility will be expanded to be 4,000 cbc.m/day in the second phase, as shown in Fig. 2-4-12. This system was constructed by PWD's financing and is to be transferred to the local administration, Patong Sanitary District, for its maintenance. It is expected that the same kind of system will be developed in every tourism area.

● "Treatment Service Zone"

For planning, it is recommended to designate "treatment service zone" where a centralized treatment system may serve, in accordance with the land use plan prepared by the DTCP and to be enacted by law. 7 zones are pointed out in Phuket Island as shown in Fig. 2-4-13. These are:

- Zone A : Phuket Town including Katu district;
- B : Patong;
- C : Karon/Kata;
- D : Chalong
- E : Ban Thao;
- F : Mai Khao/Airport; and
- G : Deep-Sea Port.

From a physical planning point of view, such an urban infrastructure is desired to be developed before the urbanization takes place. However, taking into account the economy of scale and the efficiency of the facility, a centralized system like the Patong system should be developed when the tributary population density reaches more than 30-40 persons per hectare. Until then, an individual treatment system shall be enforced in accordance with the NEB regulations.

● Centralized Treatment System in Two Zones

In this sense, the zones to be given higher priority to develop the centralized treatment systems are:

- Zone A : Phuket Town/Katu;
- Zone C : Karon/Kata;

From an environmental point of view, attention should be paid to the following aspects. Some of them are discussed in Section 2.3.5 ENVIRONMENTAL CONSIDERATION.

● NEB Regulation of Sea Water Quality

1) The existing environmental regulation of sea water quality (NEB), which has been applied only for the Karon/Kata beaches due to protect coral, should be in effect in the other beaches in the Greater Phuket area. On the other hand, in order to keep the designated standard in which the SS shall be less than 10 mg/l, a filtration process is necessary in addition to normal treatment. Direct discharge of the effluent must not absolutely be allowed.

● D Rank Standard

2) There is no standard for hotels effluent and the domestic effluent standard has been applied to resorts by NEB so far. Some regulation on effluent of hotels and equivalent facilities should be established as soon as possible. Until then, it is recommended that the strict standard with D rank (BOD<20 mg/l; ss<30 mg/l) should be applied to all areas, regardless of number of rooms.

● Monitoring System

3) A well-organized monitoring system is necessary to check whether or not the standard has been kept. At the same time, a training program should be prepared to train environmental specialists capable of assessing the environmental factors both qualitatively and quantitatively at local level.

● Required Institutional Arrangements

Financial and institutional arrangements are quite significant. Since this facility is recognized as a sort of social capital, this facility may be justified, even if the project cost is not likely to be recovered. However, under a limited budget condition, this development may not be given high priority, because it is difficult to explicitly evaluate what would otherwise be lost. To avoid this, the following institutional arrangement is suggested:

- 4) The funds for the project shall be provided by an organization newly established for facilitating the development of sewage treatment systems in urban/specific tourism areas at the national level. The organization shall collect the necessary funds by issuing bonds.
- 5) The development project is planned in such a way that the costs of interest and maintenance shall be recovered with a benefit principle, i.e, a levy system that the charge is imposed in proportion to the benefit. However, the beneficial rate shall not be more than the rate of water supplied by the public system.
- 6) Another problem is the training of personnel who can properly manage the facility at the local government level. Mechanical engineers, technicians and administrative persons are necessary (5-6 persons/plant). The national organization proposed above should be responsible for personnel training and producing the required number of capable persons at local level.

2) IMPLEMENTATION

As mentioned above, an urgent action should be taken for developing the centralized sewage treatment systems in two priority zones, i.e., Karon/Kata and Phuket Town.

Fig. 2-4-14 shows a preliminary design of the system in the Karon/Kata zone. This consists of two sub-systems. One is provide for Karon and the other for Kata district.

On the other hand, a larger scale centralized system needs to be developed for the Phuket Town, including Katu district. Fig. 2-4-15 shows a preliminary proposal for this project. A more thoughtful and detailed study is required.

The detail information of the implementation schedule and costs of the sewage projects is shown in Section 2.7 PLANS AND PROJECTS TO BE IMPLEMENTED in this volume.

FIG. 2-4-13 SEWAGE TREATMENT SERVICE ZONE

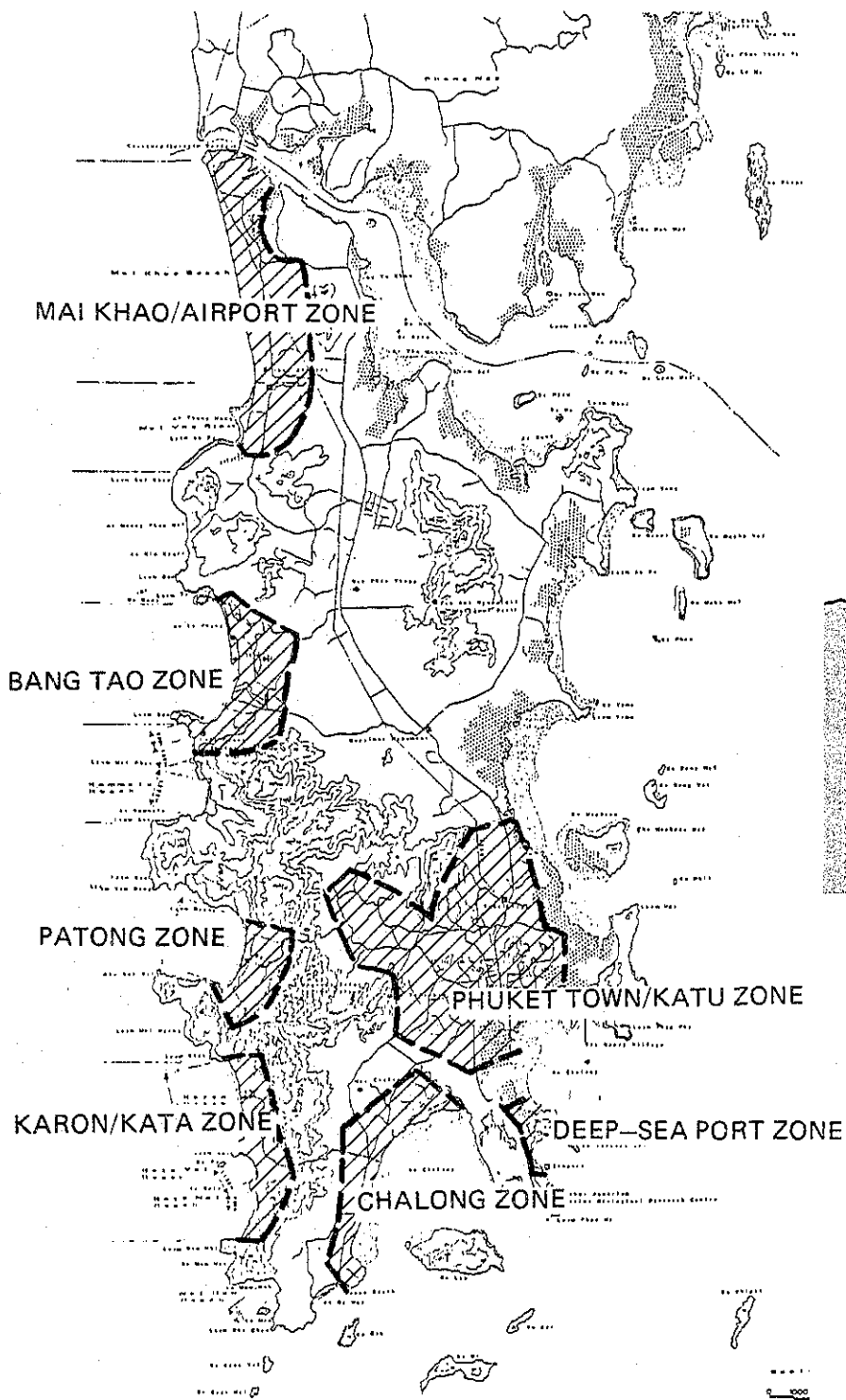


FIG. 2-4-12 PATONG SEWAGE TREATMENT SYSTEM AND PHASES

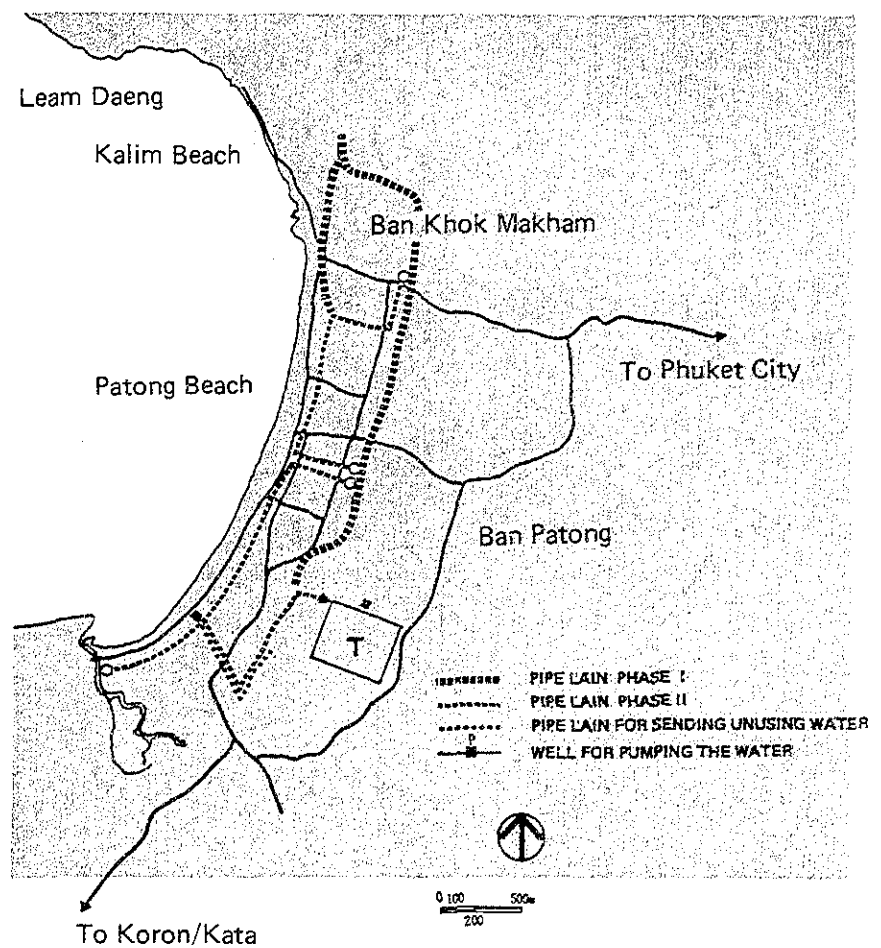
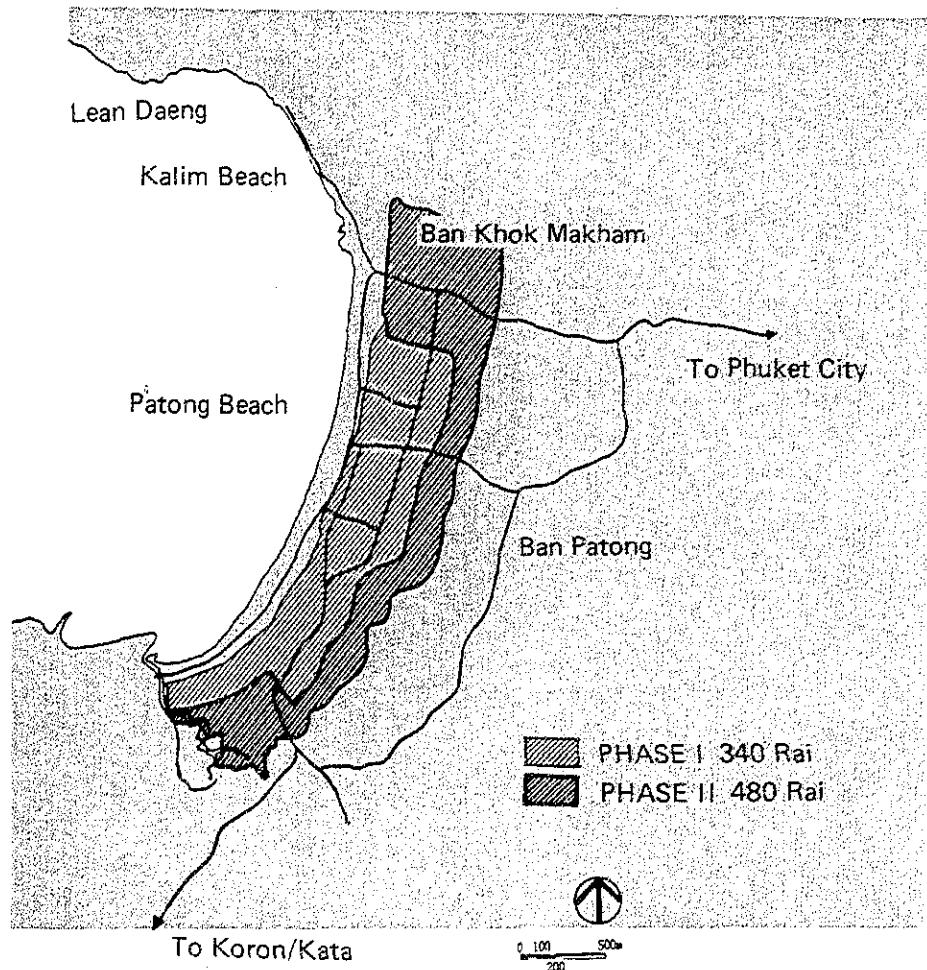


FIG. 2-4-14 SEWAGE TREATMENT SYSTEM DEVELOPMENT IN KARON/KATA ZONE

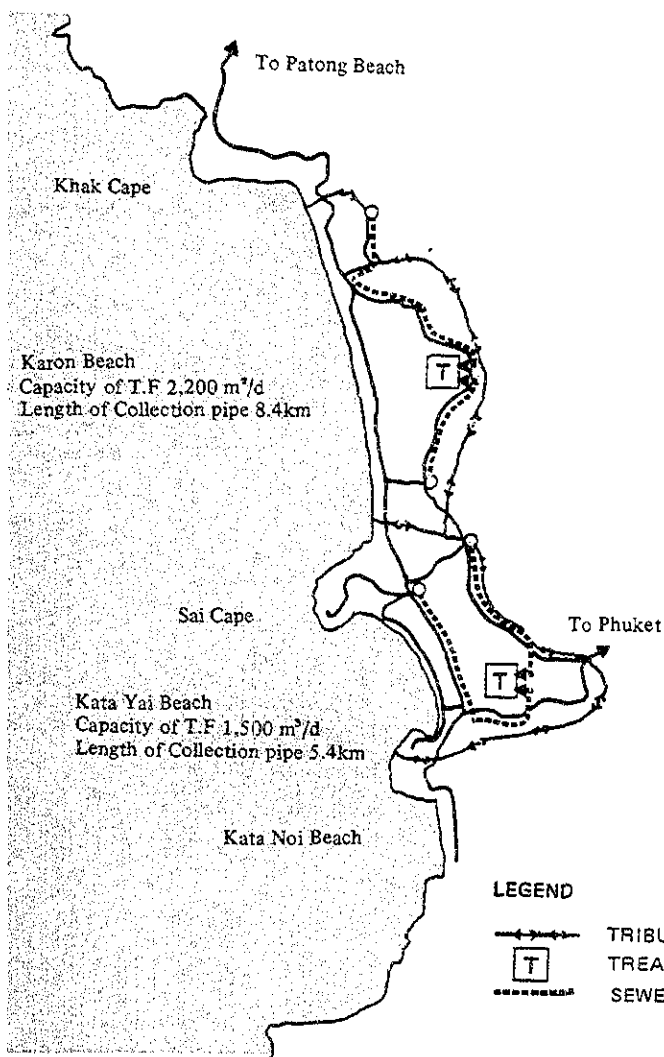
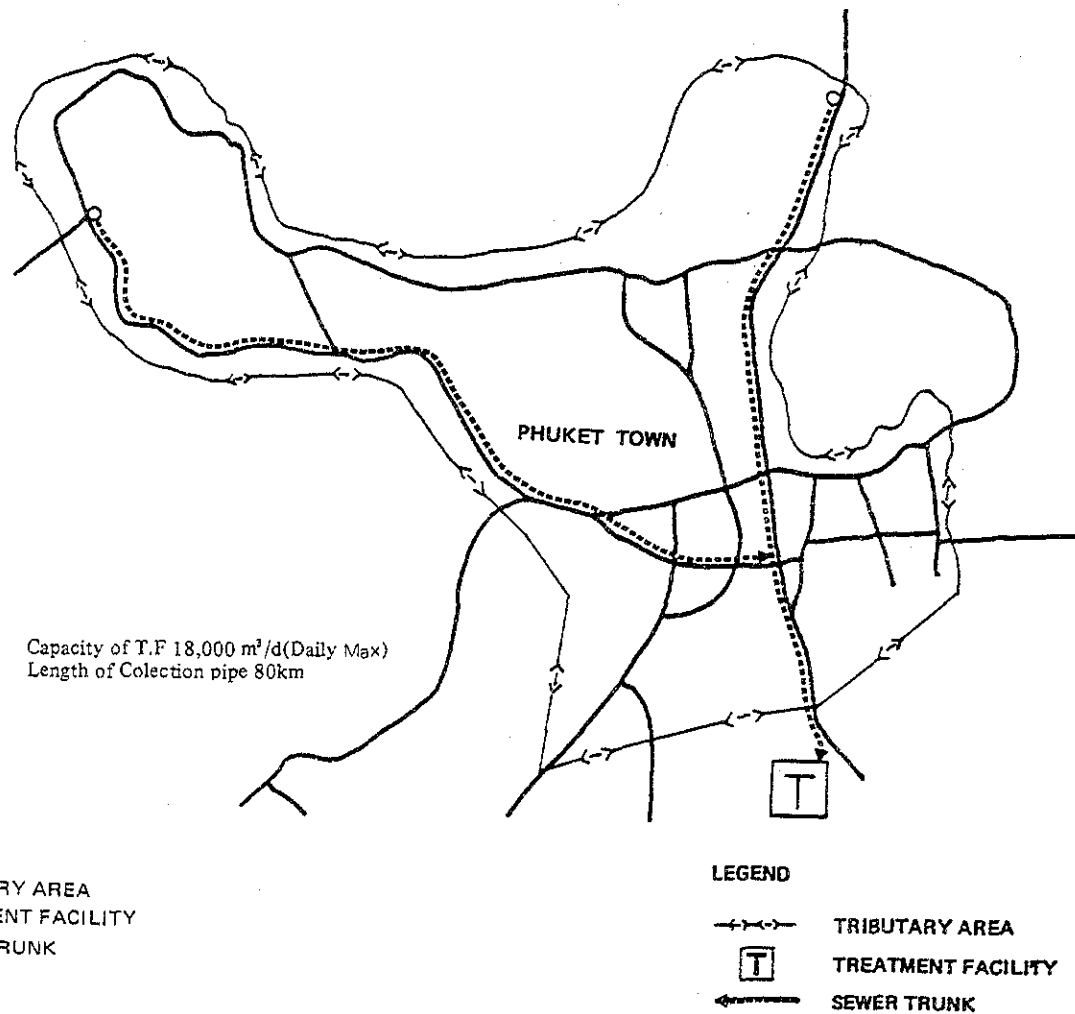


FIG. 2-4-15 SEWAGE TREATMENT SYSTEM DEVELOPMENT IN PHUKET TOWN ZONE



2.4.6 SOLID WASTE

1) NEED FOR SOLID WASTE MANAGEMENT SYSTEM

At present, three organizations take care of the solid waste management: 1) Municipality; 2) Sanitary district; and 3) Provincial Government, Public Works Department. A serious problem has been taking place in Phuket Province. It has the following 3 aspects:

- a) Limited capacity of the existing dumping site;
- b) Illegal dumping activities; and
- c) Inefficient solid waste management system.

As for the problem a) above, at present, there is only one dumping site with a sanitary land fill system in the Sapanhin area, at the southern end of the Phuket municipality. All solid waste collected by all organizations is dumped there. However, this will spatially be full in coming 5 to 7 years. A new dumping site should be prepared.

A few candidate sites have been considered by the local government. Those are the areas of ex-tin mining land with 100 rai sufficient enough to use for 20 years. Those candidate areas are located in the central part of Phuket Island, as shown in Fig. 2-4-16.

Development of an incineration plant is not recommended here, because the collected solid waste is so wet in nature. A conventional sanitary land-fill system with a protection system against environmental pollution and diseconomies is assessed to be more suitable than an incineration plant system.

In order to solve problems b) and c), a centralized management system is recommended to be introduced in such a way that an organization shall be responsible for collecting work in the whole provincial area and managing the legally designated dumping site in a proper manner. This would lead to a more efficient utilization of equipment and collecting trucks. This centralized management system will also contribute to mitigating the illegal dumping activities, because this system will be able to provide a centralized control/patrol system over the island. Given some public subsidies, this organization (namely, e.g., the Phuket Solid Waste Management Company) may involve the private sector's participation.

2) ESTIMATE OF SOLID WASTE GENERATION AND LANDFILL SITE

The following premises are assumed for estimating the amount of solid waste generated and treated at the new landfill site:

- a. In calculating the amount of solid waste to be managed, it is assumed that the present landfill site will be used until 1995. Then, the amount of solid waste to be generated from 1996 is calculated here.

● **Dumping Site at Sapanhin**

● **Conventional Sanitary Land-Fill System**

● **Centralized Management System**

b. The generation rate and unit weight are assumed as follows:

	Generation rate	Unit weight (t/cbc.m.)
From tourism activities	8.0 kg/room/day	0.45
From daily living	0.75 - 1.05 kg/person/day	0.30

The result of the estimate shows that the cumulative volume in 2011 will account for about 3.7 million cbc. m., including covering soil, as shown in Section 2.7 PLANS AND PROJECTS TO BE IMPLEMENTED.

From this total volume of waste and covering soil, the required size of landfill site is calculated to be 374,000 sq.m., assuming that the filling height is 10 meters. The shape of land could be rectangular with sides of 600 meter by 630 meters. Including the area for a maintenance road, water treatment plant and miscellaneous facilities, the site area is determined to be 420,000 sq.m.

● Size of Landfill Site

Location of the disposal site is decided to be Site "A" in Fig. 2-4-17 after discussion with the officers of related agencies and site reconnaissance. The main reasons for selection are as follows:

● Recommended Site

- General agreement has been obtained among the related agencies on selection of this area as a dumping site;
- The site is remote from the city center and resorts, thus, it does not disturb the scenic view of residents and tourists;
- Since it is located at the center of Phuket Island, it is convenient for collection and dumping;
- There are large mining ponds around this area. They seem to be appropriate for this type of land use, because of its size, shape and land characteristics.

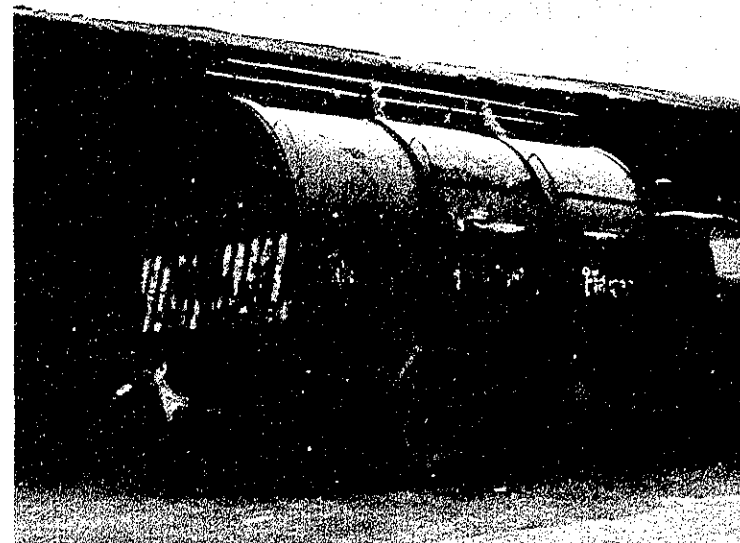
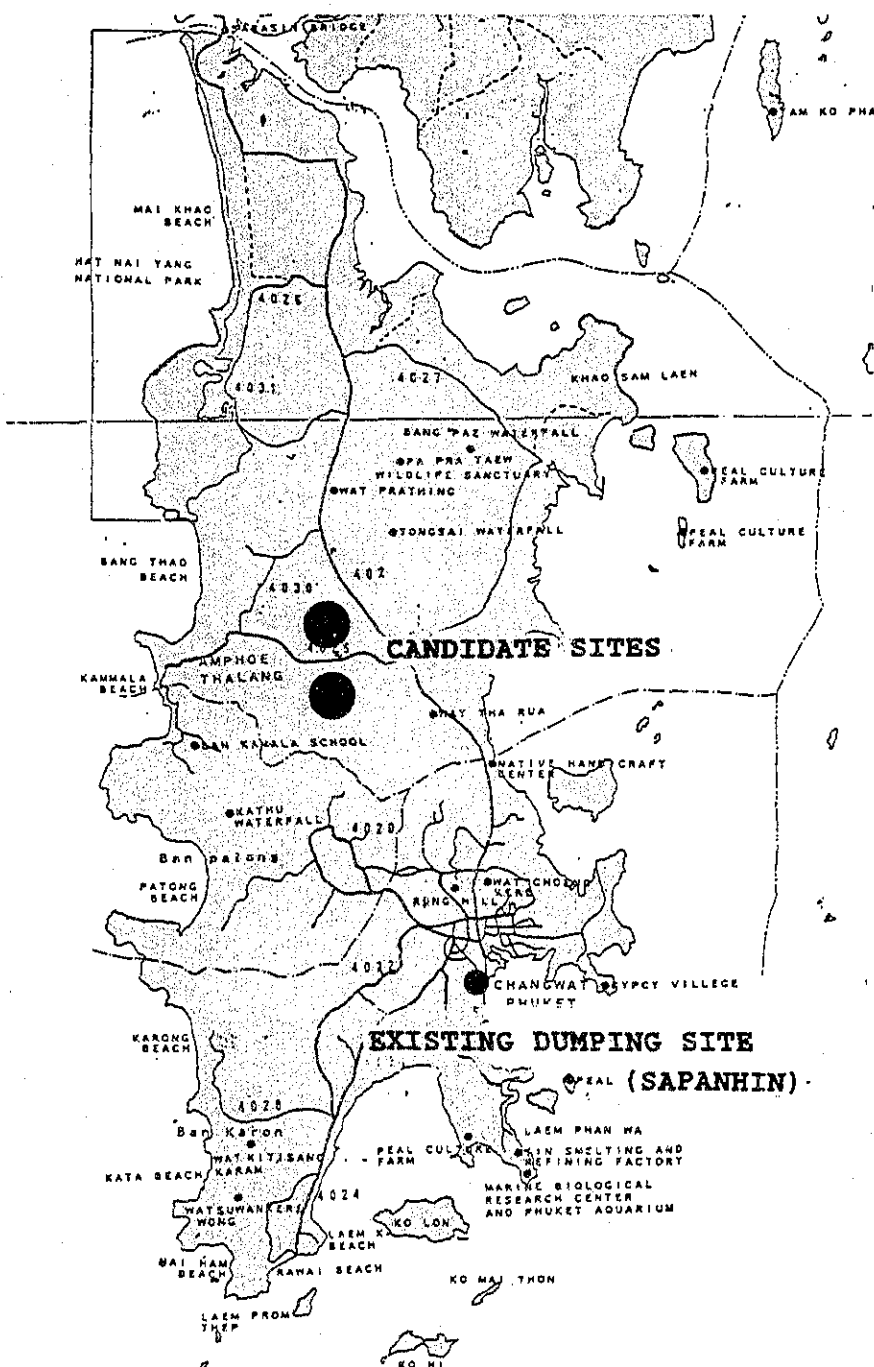
3) RECOMMENDED DISPOSAL METHOD

a. Landfill method

After a preliminary study of the waste characteristics, climate and surrounding conditions, the sanitary landfill method as shown in Fig. 2-4-17 is selected for dumping, because it suits the requirement for stabilization of waste and maintaining the good environment.

The water sealing layer works to prevent the leachate from penetrating into the ground and contaminating groundwater is necessary. Rain water is collected by the rain drains and drain pipes, then drained into water collecting pit and further to leachate treatment plant.

FIG. 2-4-16 SOLID WASTE DUMPING SITES



Present Collection Truck



Sapanhin Dumping Site

b. Water treatment plant

As the leachate from the landfill contains high level of BOD, it should be treated before discharge. The effluent should comply with the permissible discharge standard of 20 ppm.

The capacity of the plant should be 390 cbc.m./day in 2001 and 1,260 cbc.m./day in 2011. These are calculated by following formulae:

- in 2001 : 13 (ha) X 30 (cbc.m./ha/day) = 390 (cbc.m./day)
- in 2011 : 42 (ha) X 30 (cbc.m./ha/day) = 1,260 (cbc.m./day)

c. Collection and maintenance

Numbers of collection trucks should be obtained, based on the waste amount generated in whole Phuket Island. It is assumed that waste will be collected daily by 4-ton compactor trucks, which can actually carry only 2.8 tons of waste. Average collection time is assumed to be 3 times a day.

Based on these assumptions, the required numbers of collection trucks is estimated to be 30 vehicles in 1996, 35 vehicles in 2001 and 42 vehicles in 2011. After dumping waste at the site, bulldozing and leveling is needed for laying the covering soil. For this purpose, 2 bulldozers are planned to be purchased, each in 1996, 2001, 2006 and 2011.

4) IMPLEMENTATION

Assuming that the landfill site at Sapanhin will last until the end of 1995, the development of the new site should be commenced at the beginning of 1994 in order to complete the site preparation for dumping from 1996. The project span was set for 18 years until 2011 as shown in Fig. 2-4-19. This project contains not only construction of the landfill site with attention to the environment, but also procurement of a number of compactor trucks and bulldozers.

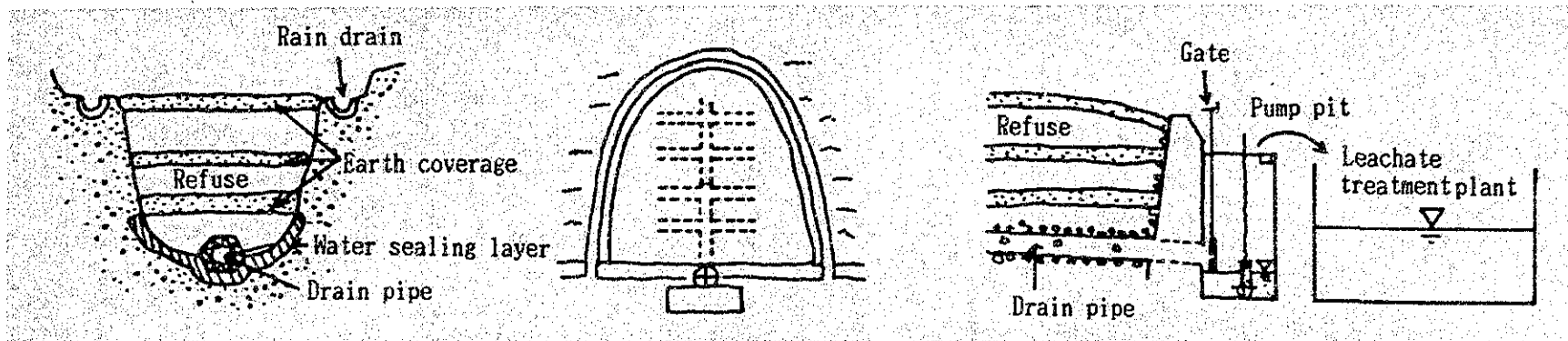
The project cost is estimated to be around 1,282 million Baht in 1988 prices, of which about 1,210 million Baht is for construction of the landfill site and the remaining 72 million Baht, for the procurement. An investment schedule is proposed as shown in Section 2.7 PLANS AND PROJECTS TO BE IMPLEMENTED.

TABLE 2-4-14 ESTIMATE OF WASTE GENERATION

	Year			
	1996	2001	2006	2011
Population	178,000	189,000	199,000	207,000
Unit rate (kg/cap/day)	0.75	0.85	0.95	1.05
Daily amount (t/day)	133.5	160.7	189.1	217.4
Annual amount (1,000t/year)	49	59	69	79
Cumulative amount (1,000t)	49	324	713	1,088
Volume (1,000cbc.m)*1	160	1,080	2,380	3,630
Hotel room	18,636	20,643	20,643	20,643
Occupied room*2	13,980	15,480	15,480	15,480
Unit rate (kg/room/day)	8	8	8	8
Daily amount (t/day)	111.8	123.8	123.8	123.8
Annual amount (1,000t/year)	41	45	45	45
Cumulative amount (1,000t)	41	258	483	708
Volume (1,000cbc.m)*3	90	570	1,070	1,570
Total daily amount (t/day)	245.3	284.5	312.9	341.2
Total annual amount (1,000t/year)	90	104	114	124
Total waste volume (1,000cbc.m)		1,650	3,450	5,200
After compaction (1,000cbc.m)*4		990	2,070	3,120
Covering soil (1,000cbc.m)*5		200	410	620
Total volume (1,000cbc.m)		1,190	2,480	3,740

- Notes: *1 Cumulative amount/0.3 = Volume
- *2 Occupation rate is 0.75
- *3 Cumulative amount/0.45 = Volume
- *4 Total waste volume X 0.6 = After compaction
- *5 Covering soil is 20% of waste volume after compaction

FIG. 2-4-17 SANITARY LANDFILL METHOD AND STRUCTURE OF FACILITIES



2.4.7 OTHER UTILITIES

1) ELECTRICITY SUPPLY

a. Current Situation

The Phuket Office serves only for Phuket, while Phang Nga is within the service area of another office.

At present, Phuket has two substations with a combined capacity of 80 mega watts. However, only 35 mega watts can be supplied due to the small capacity of the cables, requiring, the installation of larger capacity cables boost supply capacity. This is not a problem at present, because the supply volume of 35 mega watts is enough for the present demands.

At present, radio junctions on Phuket are being improved, and in 1989, six junction networks will be completed. They are (1) Phuket Town, (2) Chalong (to Karon and Kata), (3) Patong, (4) Thalang, (5) Phuket Airport and (6) Phon Wa. With the completion of the junction networks, timely services will be available for subscribers.

The number of junctions will be increased in response to growing demand, although there are no specific plans for any increase at present.

b. Recommendations

The present substations will meet demands for the next 10 years, so the future outlook depends very much on the growth in demand attendant upon the arrival of new, of large subscribers, such as hotels and factories, making it impossible to work out concrete future plans. Thus, while the Phuket office stands ready to expand substations when demands grows, a development program is necessary, that will give full consideration to the hotel accommodation development framework in our program.

2) TELE-COMMUNICATION

A well-functioning tele-communication network system is required for people's living, business and tourism activities, and Greater Phuket is to become an outstanding international tourism destination, the demand for international tele-communications will surely increase. Special emphasis should be placed on the improvement of this indispensable infrastructure development in a planned manner.

a. Current situation and existing plans

TOT is responsible for the domestic system, while the Communications Authority of Thailand (CAT), is responsible for the international system. Both systems are under the administration of MOTC.

- Domestic System:

As of July, 1988, there are three exchange stations with a total capacity of about 7,600 lines in Phuket. In Phang Nga, two stations with 1,600 lines and one station with 2,000 lines in Krabi, as shown in Table 2-4-15. The current utilization rates are 89.6% in Phuket, 85.2% in Phang Nga and 72.9% in Krabi. Thus, the existing facilities in Phuket are reaching saturation point.

During the 6th National Plan, up to 1991, the line capacities are to be increased at an of 10% annual rate. The increase will take Phuket up to about 8,000, as shown in Fig. 2-4-18. On the other hand, regarding up-grading the system, the integrated services digital network (ISDN) system is to be applied for responding to a digitalized control.

- International System:

Table 2-4-16 shows the current situation of international tele-communication activities in Greater Phuket in 1987. As seen from this table, the number of international calls in Phuket accounted for about 11 thousand which is a considerably greater than domestic telex traffic at 79 thousand. Thus, the demand for international communication is currently significant.

At present, international calls are made via submarine cables or integrate V. Three projects now under-way to up-grade the international tele-communication system are: 1) the Public Data Communication Switching System Project; 2) Procurement; Telex Subscriber ject. Out of these, the Cellular Radio Integrated Data and Voice Communication System is to be open in service in Phuket in 1989, Phang Nga in 1999, and Krabi in 1992. The Fifth Plan requires that the international tele-communication system be strengthened to respond to growth in demand. This is expected to be available on schedule.

b. Future Tele-communications Development

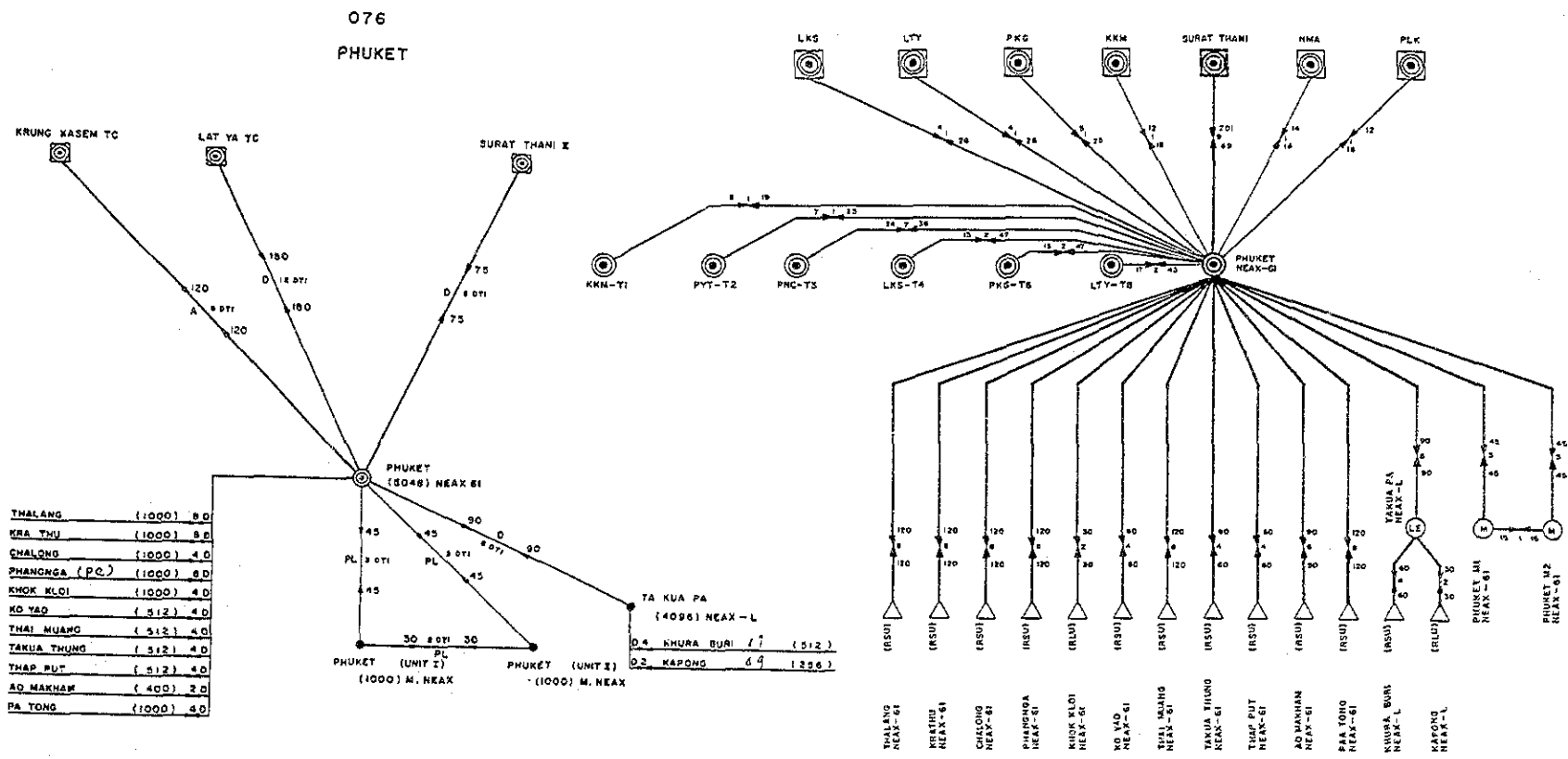
The major subscribers in the tourism sector are hotels, and an increase in the number of lines is one of their basic requirements. The future demand for tele-communications lines in the tourism sector can be estimated on the premise that one hotel requires at least 5 lines on the average. The result, as shown in Table 2-4-17, indicates that a total of about 1,600 additional lines will be required in 2001 by hotels alone, and if residential the demands for tele-communication lines is included, about 19 thousand additional lines will be needed in Phuket Island. This means is an 11.1 % growth rate per annum; quite a considerable figure, and one which means that special emphasis to be given to the development in Phuket.

Facilities for tele-communication services are also required for the tourism development in the Phang Nga west coast area, where a capacity of about 400 lines will be necessary only for this large-scale tourism development with 4,000 hotel rooms. A new exchange station might be required to meet this demand.

The convenience of international calls is essential and the new system is expected to be developed on schedule.

FIG. 2-4-18 TELE-COMMUNICATION ACTIVITIES

PLANNED AS AT AUGUST 1987



LEGEND:

- X (Y) - TRUNKS CALCULATED FROM ACTUAL DEMAND (IN DTI MULTIPLES)
- Y - TRUNKS CALCULATED FROM ACTUAL SWITCH SIZE (IN DTI MULTIPLES)
- Final choice routes.
- Direct, high usage routes as demanded by traffic.
- A - INCOMING AND OUTGOING TRUNKS (DIGITAL)
- B - DTI'S (DIGITAL ROUTES)
- C - INCOMING AND OUTGOING TRUNKS (ANALOGUE)

TABLE 2.4.15 CURRENT SITUATION OF DOMESTIC TELE-COMMUNICATION FACILITIES IN GREATER PHUKET

	Capacity (lines)	Occupied (lines)	Rate (%)
Phuket:	7,600	6,808	89.6%
Phuket	6,000	5,644	
Thalang	400	371	
Katu	600	525	
Makham	600	268	
Phang Nga:	1,600	1,363	85.2%
Takuapa	1,000	797	
Phang Nga	600	566	
Krabi	2,000	1,458	72.9%

Source: TOT

TABLE 2-4-16 TELE-COMMUNICATION ACTIVITIES

		Phuket	Phang Nga	Krabi
International Telephone	Calls	11,175	125	722
	Mins	54,303	733,839	
Telegraph Services	Calls	60,108	41,159	32,118
Domestic Telex Services	Calls	78,791	1,712	821
	Mins	164,423	3,935	1,650

Source: CAT

TABLE 2-4-17 DEMAND FOR TELE-COMMUNICATION LINES IN PHUKET

	1988	1991	1996	Increase b/w 2001 1988-2000	
For Residents					
A. Population	151716	164000	178000	189000	37,284
B. Service Level (lines/100 people)	4.7	5.8	8.6	13.0	
C. No. of Lines Required	7,100	9,450	15,219	24,511	17,411
For Hotels					
D. No. of Hotel Rooms	7,939	14,879	18,636	20,643	12,704
E. No. of Hotels	99	186	233	258	159
F. No. of Tele-Comm. Lines Required	500	1,238	1,876	2,078	1,578
Total Number of Lines Required (C+F)	7,600	10,688	17,095	26,589	18,989
Annual Growth Rate (%)		12.0%	9.8%	9.2%	

3) FIRE-FIGHTING SYSTEM

In order to establish a fire-fighting system, the following measures are recommended to be taken into account:

a. Development of a "Zone Defense System":

Since it has been proved that the probability of fire simultaneous occurrence is stochastically low in communities with less than 20,000 population, one of criteria of an efficient zone defense system may be that one zone should, at least, not be more than this size of community (COM) calculated by using the following formula:

$$\text{COM} = \text{NOH} \times 2 + \text{NOE} + \text{POL}$$

where COM; community size;
NOH; number of accommodation rooms;
NOE; number of employment;
POL; number of population.

Another criterion is a travel time: a zone extends to areas where a fire engine will be able to reach in at least 20 minutes if an emergency takes place.

Each zone should have one fire station with two fire engines and one pumping car.

b. Installation of Hydrants:

Together with development of water pipe lines, hydrants should be installed at an interval of 100 to 150 meter along the major pipe lines in densely built-up areas.

c. Utilization of Pool Water:

The water stored in a 15m x 14m x 1m is sufficient swimming pool for 2 to 3 hours extinguishing activity. This will contribute greatly to early extinction. Important is the building layout and the accessibility to the pool which allow fire-fighting crews to use the water for their extinguishing activities in the case of an emergency. The building code should cover this requirement.

● "Zone Defense System"

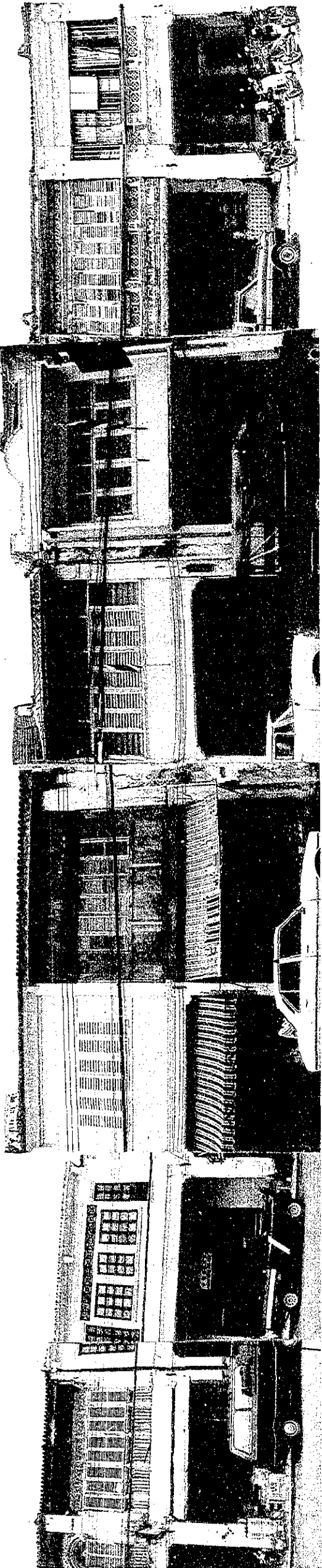
4) DRAINAGE

In order not only to promote the town tourism, but also to boost the Phuket urban social and economic activities, seasonal flooding problems in Phuket Town should be eliminated with much emphasis as soon as possible. Phuket town is inherently susceptible to flooding when it has intensively heavy rain at high-tide in the rainy season, because of its low level above the sea. The JICA Upper-South Development Study (1985) proposed measures to solve this problem as follows:

- to separate the urban area drainage system from that in the mountainous area;
- to prepare a diversion canal to drain out the water from mountains directly to the western sea;
- to develop two canals and three pumping stations besides enlargement of draining capacities of the existing canals in the urban area.

Although it has been recognized in this study that the flood mitigation project may be one of the essential projects for tourism development as well, since the most appropriate measures should be explored, based on a further study, as recommended by the JICA Upper-South Study, especially from an engineering point of view, this project is not listed up in the tourism development program proposed in this study. A more broad argument is necessary in terms of investment efficiency, cost performance.

Regarding the other beach resort areas, no serious problems are taking place so far, except for Patong, because the western coastal beaches are generally narrow plains and has a configuration suitable for a comparatively easy drain. Patong Beach, particularly in the inland areas where a number of buildings are under construction, have occasionally faced a flooding problem. Associated with the road development, the open channel (ditch) drainage system for storm water drainage should be developed in a planned manner. A more detailed study is also required for this development.



2.5 CULTURAL TOURISM DEVELOPMENT

2.5.1 TOWN TOURISM

Phuket Town tourism development should be undertaken as a package with a view to strengthening its cultural assets. The town, with its tropical atmosphere, is attractive enough and provides many tourism features. By developing the historic area as one tourism resource, the tourism patterns at Phuket could be further diversified and this could attract more international tourists, particularly Asian tourists who favor shopping, sightseeing and cultural performances.

In the central part of Phuket town, centering on Thalang road, there are a number of unique buildings which were built in the 19th century, the most prosperous era. This is a rare example in Thailand where these historically valuable cultural assets still remain in use. The Fine Art Department has completed a basic survey of these architecturally historic buildings.

1) HISTORICAL AND ARCHITECTURAL SIGNIFICANCE

Despite differences of style, architecture in Phuket expresses the value of elaborate craftsmanship and design which can not be duplicated by today's construction. Consequently, they are worth saving and preserving regardless of what their present condition is. Undoubtedly, the buildings themselves are the best examples of past architectural and interior design of this period in Thai history.

These architectural examples, which are still in use by the descendents of the original owners, are not only places of residence, but are also ancestral homes, thereby providing the incentives of both pride and preservation of the family heritage.

Set among high-rise buildings, the luxurious accommodations and modern shopping centers, are the visible historic buildings. Apparently ethnic identity was expressed in the owners selection and preference for styles which blended local with Chinese elements. Thus, all of these buildings can be appreciated for their individual artistic value.

The significance of Phuket's history lies in its economic development which was a result of the tin mining industry. The economic advantages were to have far-reaching effects on the individuals in the community, the consequences of which are reflected in the grandeur of the architecture and in the raised standard of living still evident today.

Not only Thais, but also Chinese, Malaysians and Westerners prospered in business and contributed to the town's success. The town itself, therefore is not a creation of one single ethnic group but is the result of a blending of international tastes and cultures.

2) PRESERVATION OF PHUKET TOWN CENTRE AS A HISTORIC CONSERVATION DISTRICT

Throughout its history, Phuket has enjoyed a relatively high standard of living, based on an economy of rubber cultivation and tin mining. Many old buildings, which are of a distinctive mixture of Chinese, Thai, and Western architectural elements reflecting the prosperity and cultural exuberance of past days, line the streets of the town's central area.

It is rare for a town in Thailand to have most of its historic buildings still concentrated in one area. This arrangement not only creates a valuable cultural heritage, it is very convenient for the purposes of restoring both the buildings themselves and the overall atmosphere of former times. However, unless measures are taken to preserve them, the buildings, which for practical reasons will eventually be unable to meet the needs of their owners, will inevitably fall into disrepair and eventually deteriorate completely.

As a tourist attraction, these historic buildings have considerable potential. With careful attention to detail in their restoration and a unified approach to the re-creation of the area as a whole, Phuket will be able to reclaim its past dignity and tourists will be charmed by the ambience created by a return to life as it once was one hundred years ago.

Reasons for establishing the historic district as a means of preserving the cultural heritage can be described as follows:

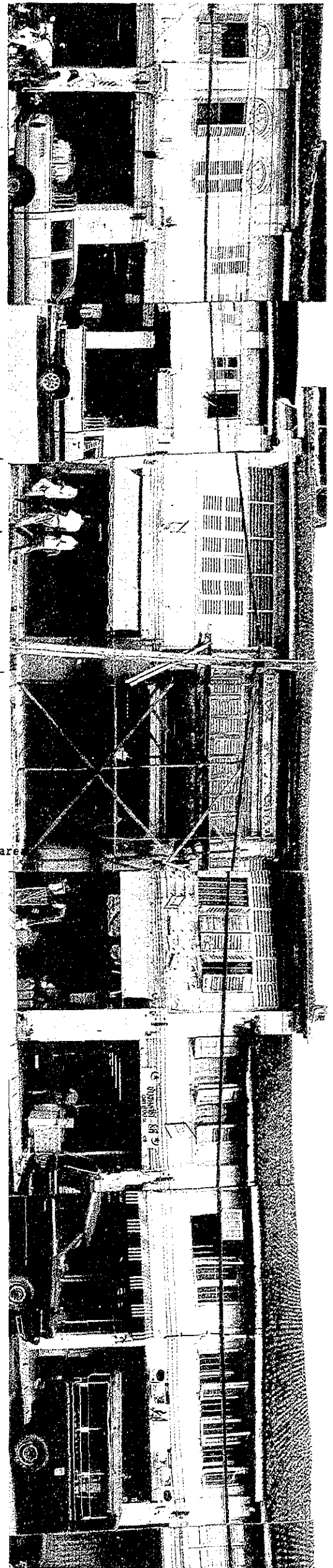
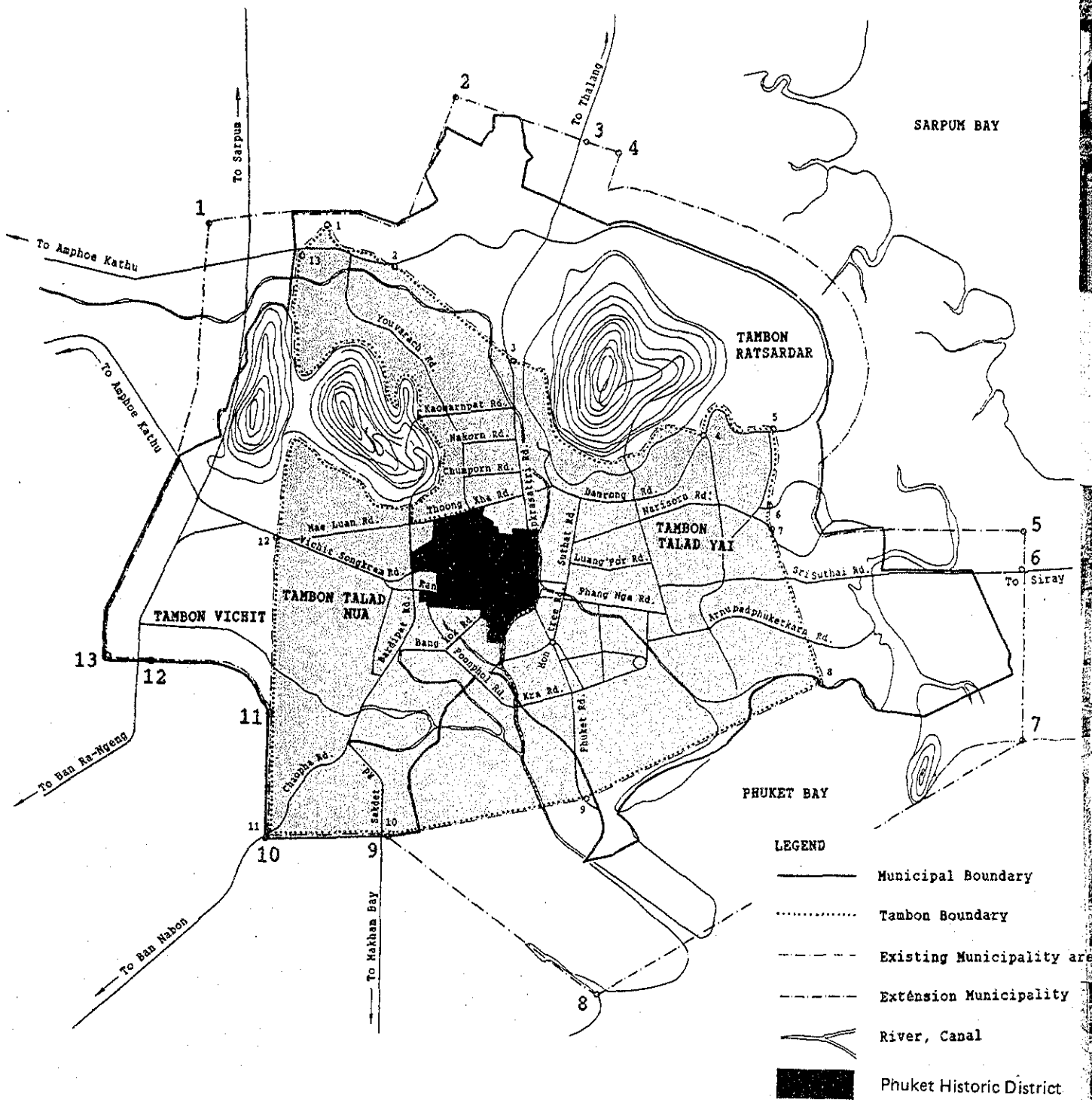
- a. Primarily to protect the architectural, historic, social, and cultural value of the town from further encroachments
- b. To preserve and enhance the value of the existing significant buildings
- c. To control or prohibit specific threats through means of special city ordinances
- d. To utilize the area in the most beneficial way compatible with modern life.

3) PROPOSED HISTORIC DISTRICT BOUNDARIES

It is proposed to establish a district with a defined boundary for the purpose of preserving the area as a tourism attraction in addition to retaining its cultural value.

The historic area designates the concentration of significant buildings. Boundaries are determined by streets lines. The defined area includes a selective buffer zone as a means of protecting the area.

FIG. 2-5-1 PHUKET HISTORIC DISTRICT AND ADMINISTRATIVE BOUNDARY



4) RESOURCE CATEGORIES

The proposed district is a multiple resource district. Many architectural styles of various types temples, shrines, schools, commercial buildings, offices, houses and parks are blended together. Although not all of the buildings have architecture which merits preservation, they are within the controlled zone. A program to enhance the historic beauty and cultural value needs to be considered.

Resources can be divided into 4 levels:

- a. **Primary Historic Significance**
A building or site that exemplifies the cultural history of the district, embodies distinctive architectural qualities, or otherwise has a high aesthetic or social value. These are essential to the future of the district and must be maintained.
- b. **Secondary Historic Significance**
A building or site that is of lesser historic or architectural value than the above category, but nevertheless has cultural, social, or aesthetic value. These sites are also of importance to the future of the district and should be retained.
- c. **Other Buildings Compatible with District Character**
Buildings within conservation district which do not meet high historic criteria, but by virtue of their style, scale, materials, etc. are compatible with the dominant architectural character of the district. These buildings, while of little architectural significance of their own, contribute to the overall character of the district and should be retained unless other development of greater benefit to the district.
- d. **Buildings Not Compatible with District Character**
Buildings within the conservation district which, by virtue of their style, scale, and materials are not compatible with the overall character of the district. These buildings can not contribute through their own significance to a desirable atmosphere, and should be re-evaluated and a program for their development or their sites should be planned and considered.

FIG. 2-5-2 PHUKET HISTORIC DISTRICT - EXISTING LAND USE

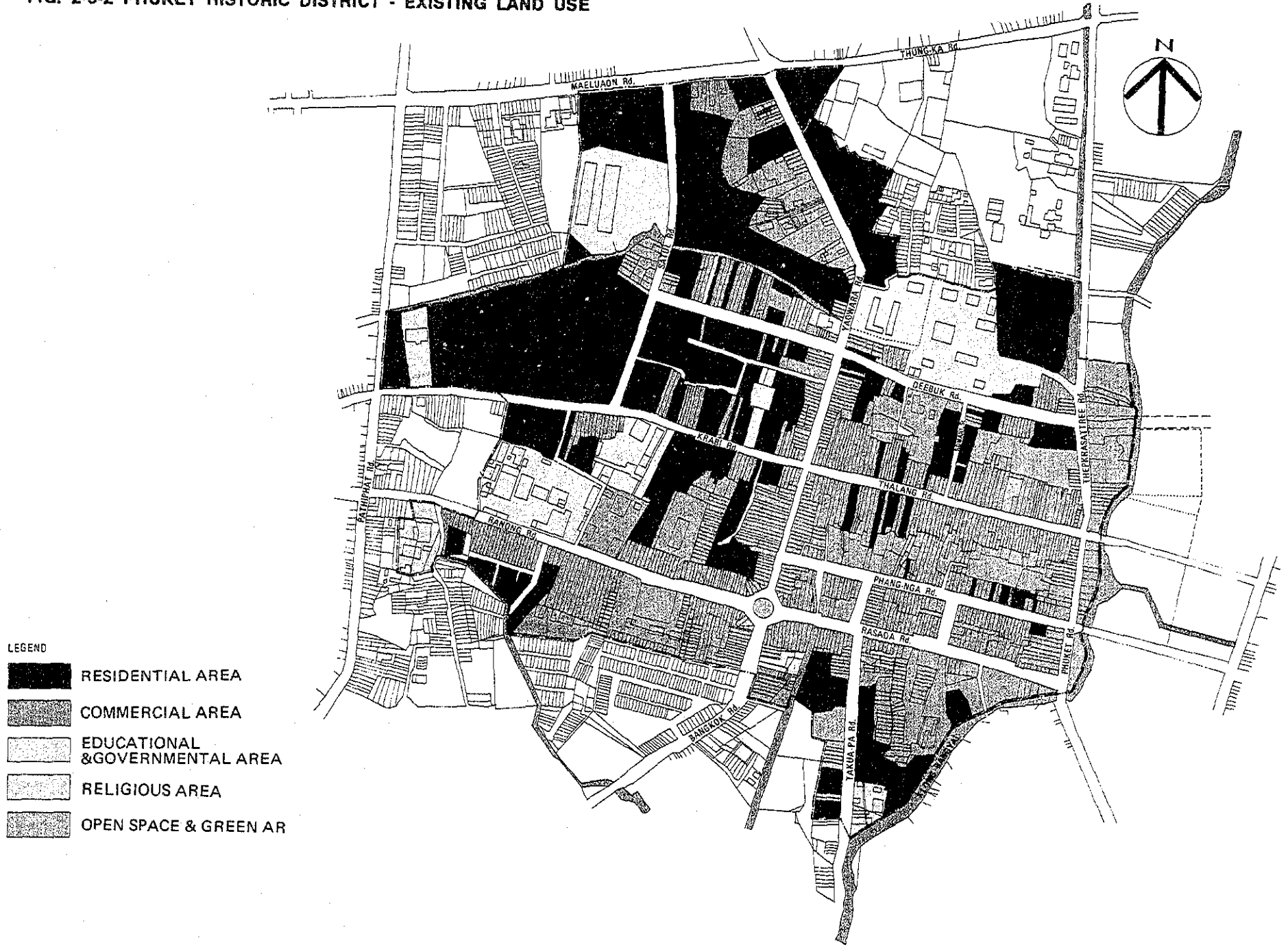
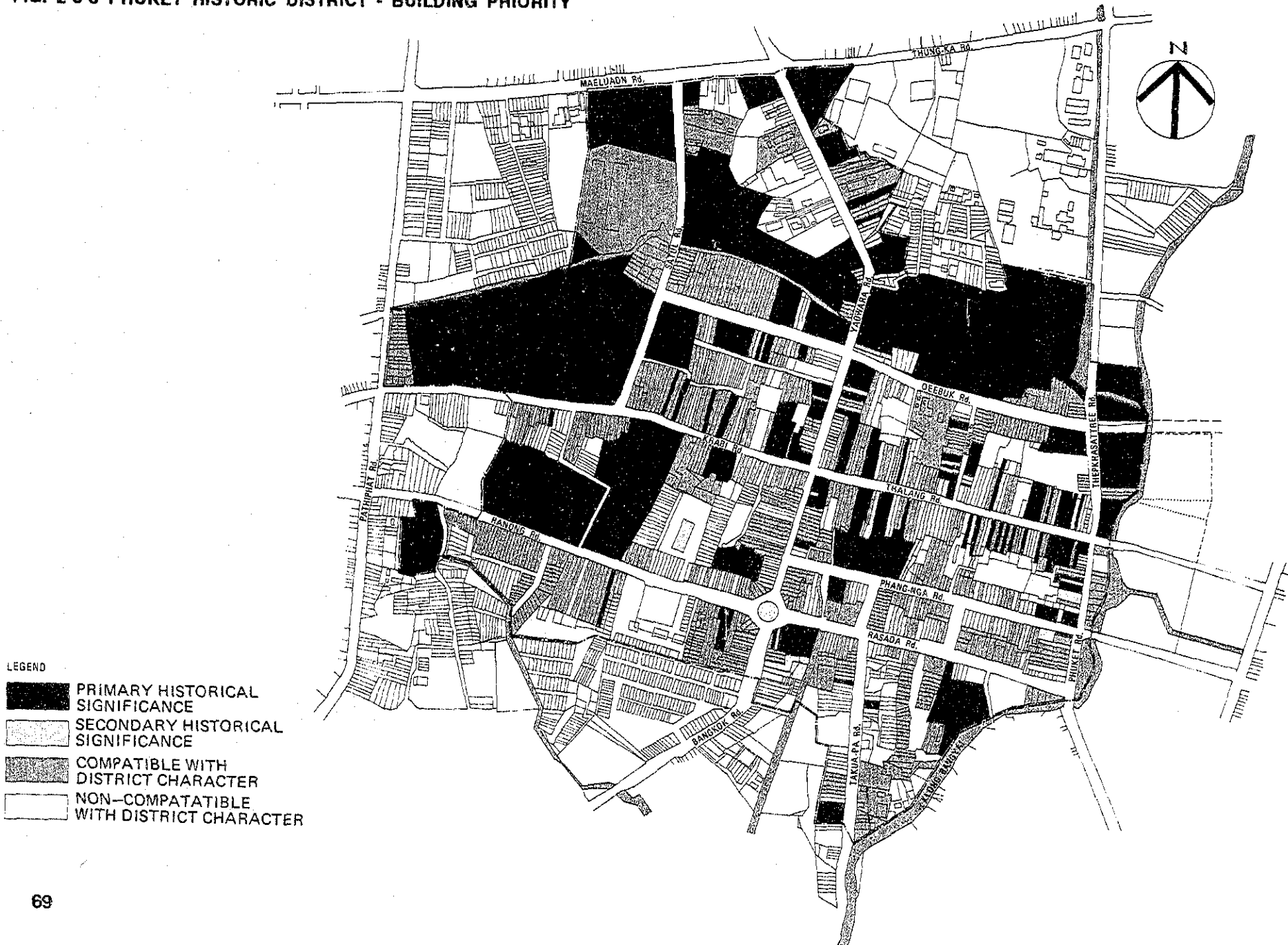


FIG. 2-5-3 PHUKET HISTORIC DISTRICT - BUILDING PRIORITY



5) CONSERVATION PROJECT FOR PHUKET HISTORIC DISTRICT

The Phuket Conservation Planning Project is proposed as a control zone for preservation. The projects can be classified into the following implementation phases:

PHASE 1: Priority I - PILOT PROJECT

The area selected will contain the most significant buildings, tourism potential and feasibility for conservation development. The buildings located mainly along Thalang road are considered.

- Theme : " Pedestrian Mall "
- Job/program : a. Facade restoration
 b. New infrastructure development and parking
 c. New pavements and landscape improvement
 d. New proposed activities and land use
 e. Signs and tourism promotion

PHASE II : Priority II

This phase will cover the area that features significant buildings, but which is not yet ready for conservation development.

- Theme : " District Beautification "
- Job/programs : a. Restoration of buildings
 b. Infrastructure improvement and landscape development in other selected streets

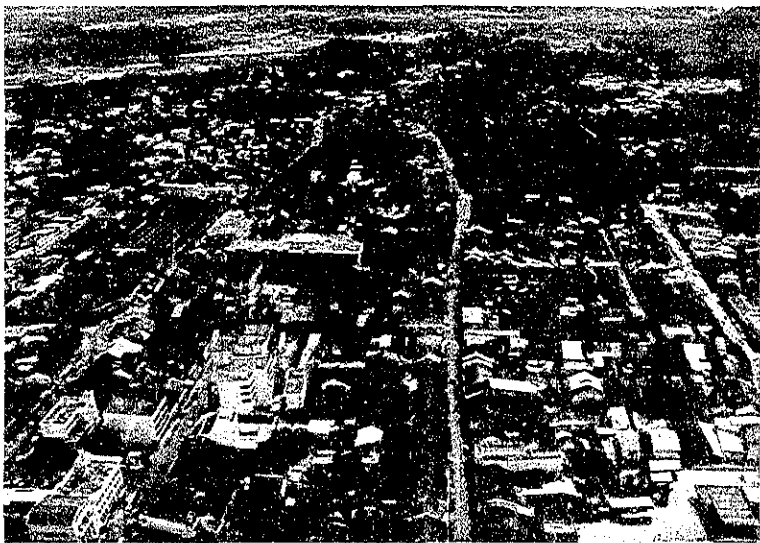
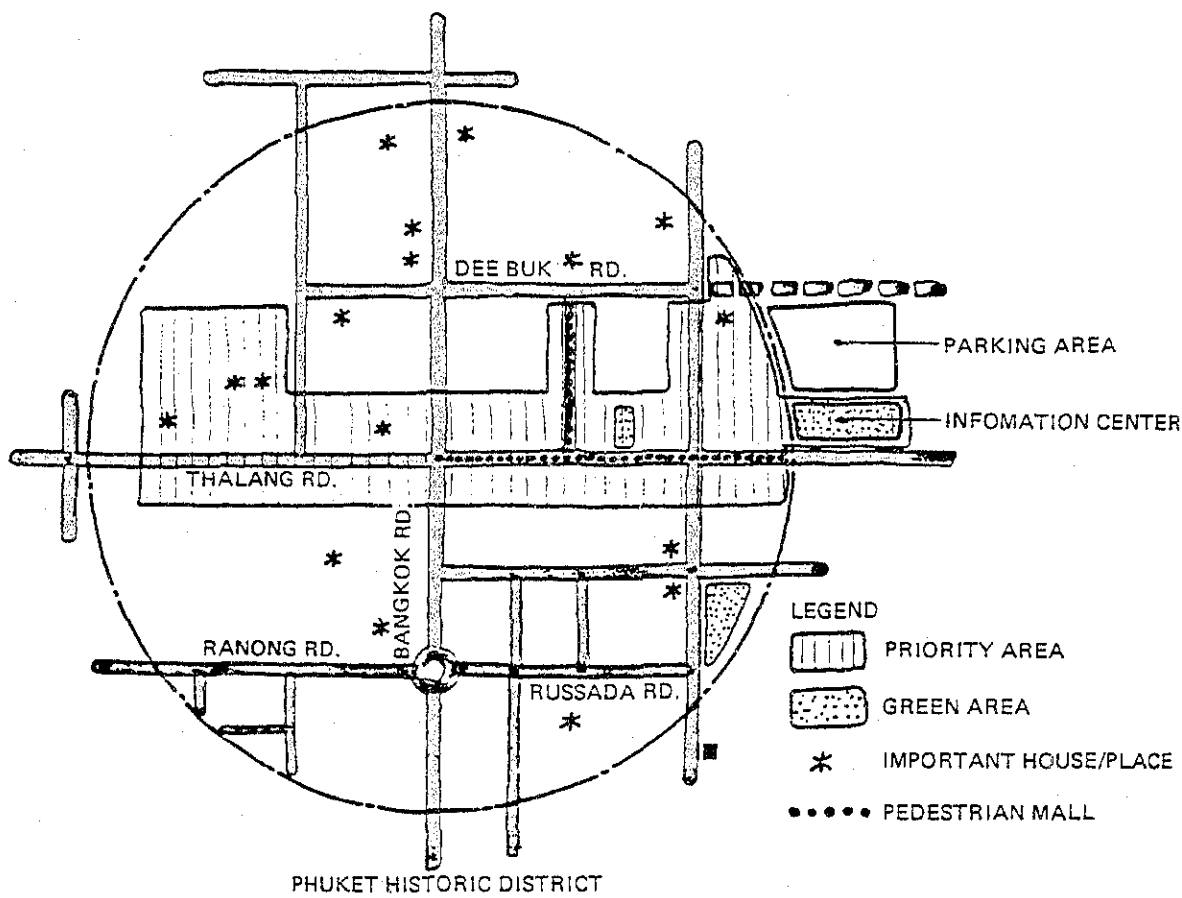
PHASE III : Priority III

Those buildings in the historic boundaries which are not compatible with the character of the district will be determined and a program will be set up to improve or alter them.

New projects on non-compatible plots of land will be encouraged

- Theme : " Old & New Lives in the Historic District "

FIG. 2-5-6 CONCEPT OF HISTORIC DISTRICT



Phuket Town Historic District

FIG. 2-5-4 PHUKET HISTORIC DISTRICT - PROPOSED PLANNING

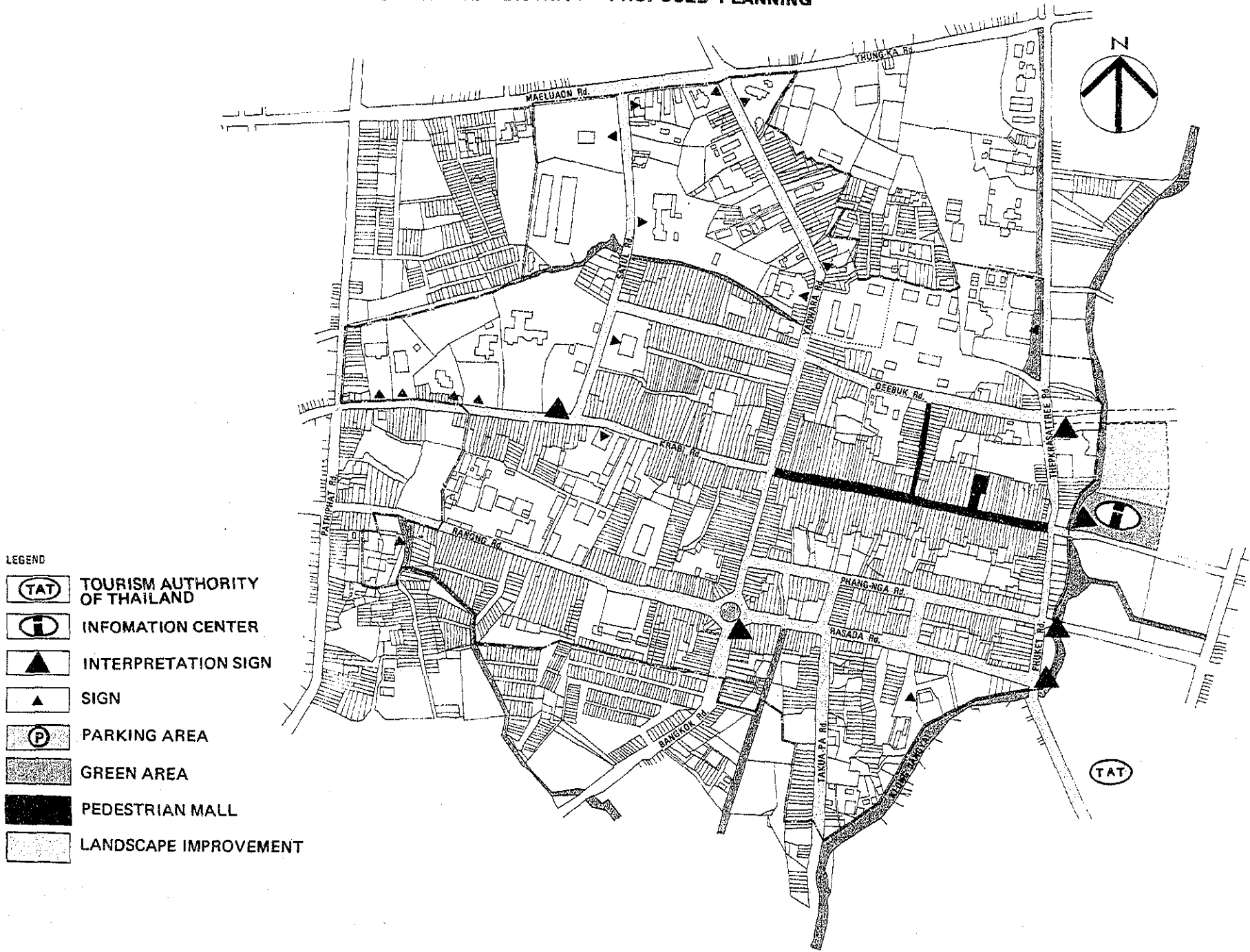


FIG. 2-5-5 PHUKET HISTORIC DISTRICT - STATE OF IMPLEMENTATION

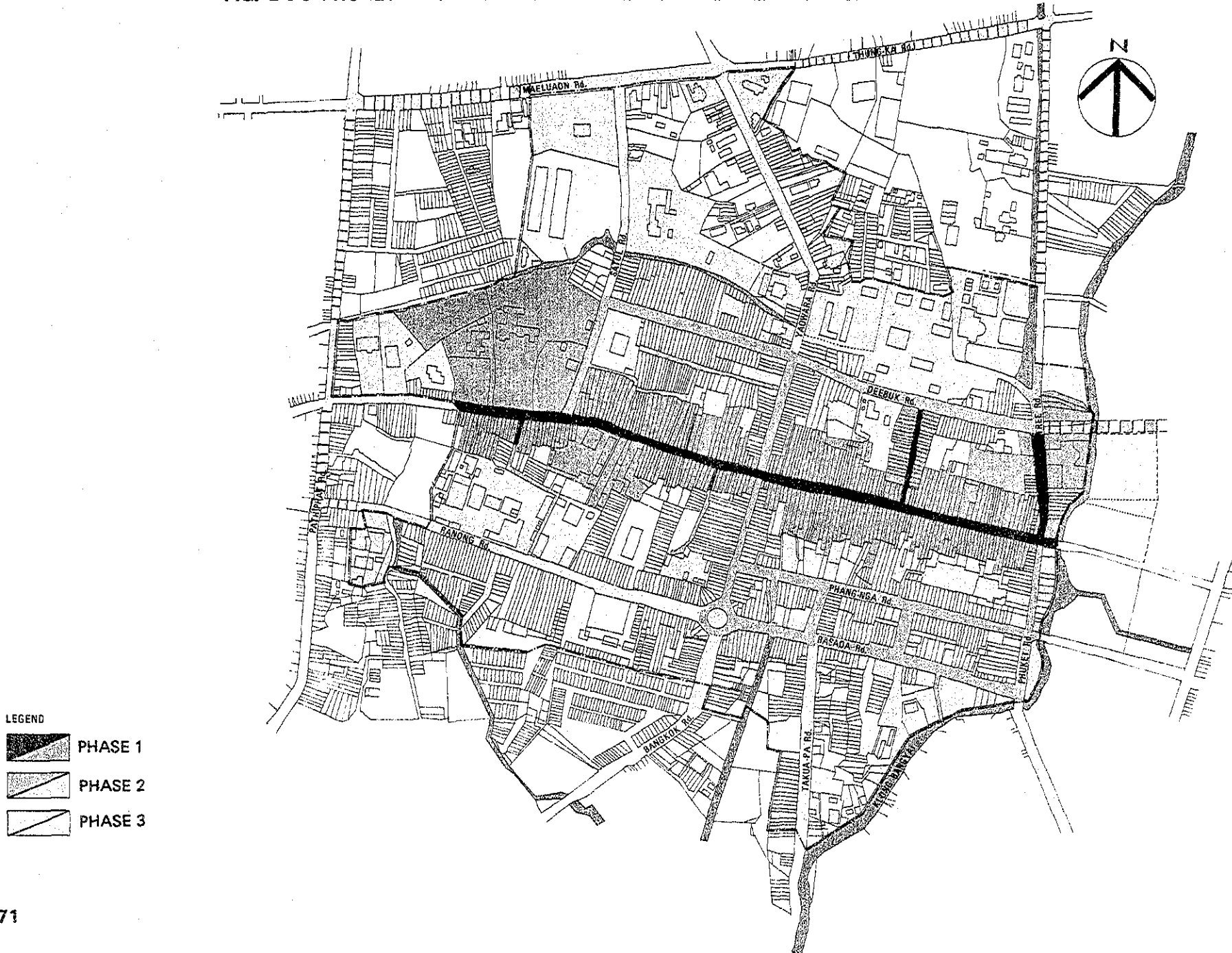


FIG. 2-5-7 PROPOSED PRIORITY PROJECT - PEDESTRIAN MALL

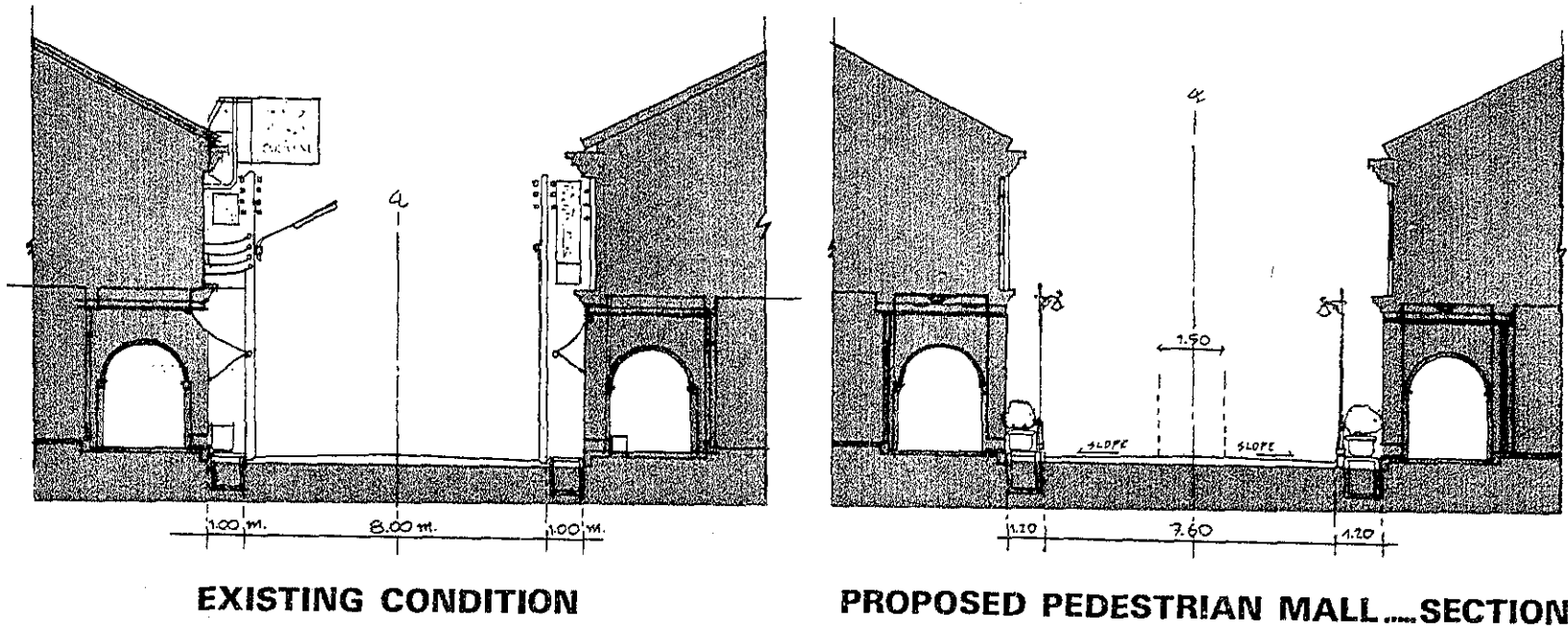


FIG. 2-5-8 PROPOSED PEDESTRIAN MALL



PROPOSED PEDESTRIAN MALL

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