

(2) Possibility of the Establishment of Precision Approach Procedures

The possibility of the establishment of Precision Approach Procedures for Alternative 2 is studied for both runways 09/27 based on the following assumptions:

Threshold - localizer distance : 3,600 m  
 GP angle : 3.0° for Runway 09, 3.2° for Runway 27  
 Approach Category : CAT I

a. Runaway 27

**Figure 10.2.9** shows the OAS for Runaway 27. The obstacles located within the OAS were checked as shown in **Table 10.2.3**.

On Alternative 2 Planning, the hills which are located on the both sides of runway 09/27 are planned to be cut off so as to clear the transitional surfaces. So, the heights above the threshold of obstacles indicated by "\*" in **Table 10.2.3** are assumed the decreased height.

The obstacles indicated No. 9 is considered as critical obstacle to decide the OCH/A.

**Table 10.2.3 Assessment of Obstacles within OAS for Runway 27 of Alternative 2 at Phuket International Airport**

Airport : Phuket Runway 27 Threshold Elevation : 27.5 m  
ILS Inbound Course : 264°33'40"T VAR : 0°51' W  
OAS LLZ - THR Distance : 3,600 m, GP : 3.2°, CAT I

No.	Elevation of Obstacle (m) (+15 : Trees)	Height above Threshold of Obstacle	Distance of		Surface Concerned	Height of Surface at Obstacle (m)	Remarks
			X (m)	Y (m)			
1	127.2+15	114.7	3910	300	x SFC	160.7	OK
2	79.6+15	67.1	3460	490	x	184.7	OK
3	108+15	87.5	3710	290	x	152.6	OK
4*	116.2+15	48.1	-1760	560	y	56.8	OK
5*	113	18.1	-1535	360	y	17.3	NO
6*	100+15	35.2	-1620	460	y	40.0	OK
7*	60+15	20.4	-1875	380	z	24.3	OK
8	69.3+15	56.8	-1640	490	y	44.0	NO
9	108.3+15	95.8	-1490	780	y	114.3	OK
10*	64.5+15	17.2	-880	300	y	21.1	OK

$$W = 0.030340x - 7.38$$

$$Y = 0.026881x + 0.228134y - 23.61$$

$$X = 0.030628x + 0.198685y - 18.63$$

$$Z = -0.025x - 22.5$$

**Table 10.2.4 OCH/A for Precision Approach Category I to Runway 27**

Approach category	OCH/A (ft)
A	214/308
B	226/310
C	234/318
D	245/329

b. Runway 09

**Figure 10.2.10** shows the OAS for Runway 09. The obstacles located within the OAS were checked as shown in **Table 10.2.5**.

The obstacles indicated No. 9 is considered as the critical obstacle to decide the OCH/A.

**Table 10.2.6** shows the results of calculations for OCH/A for the Precision Approach Category I to Runway 09.



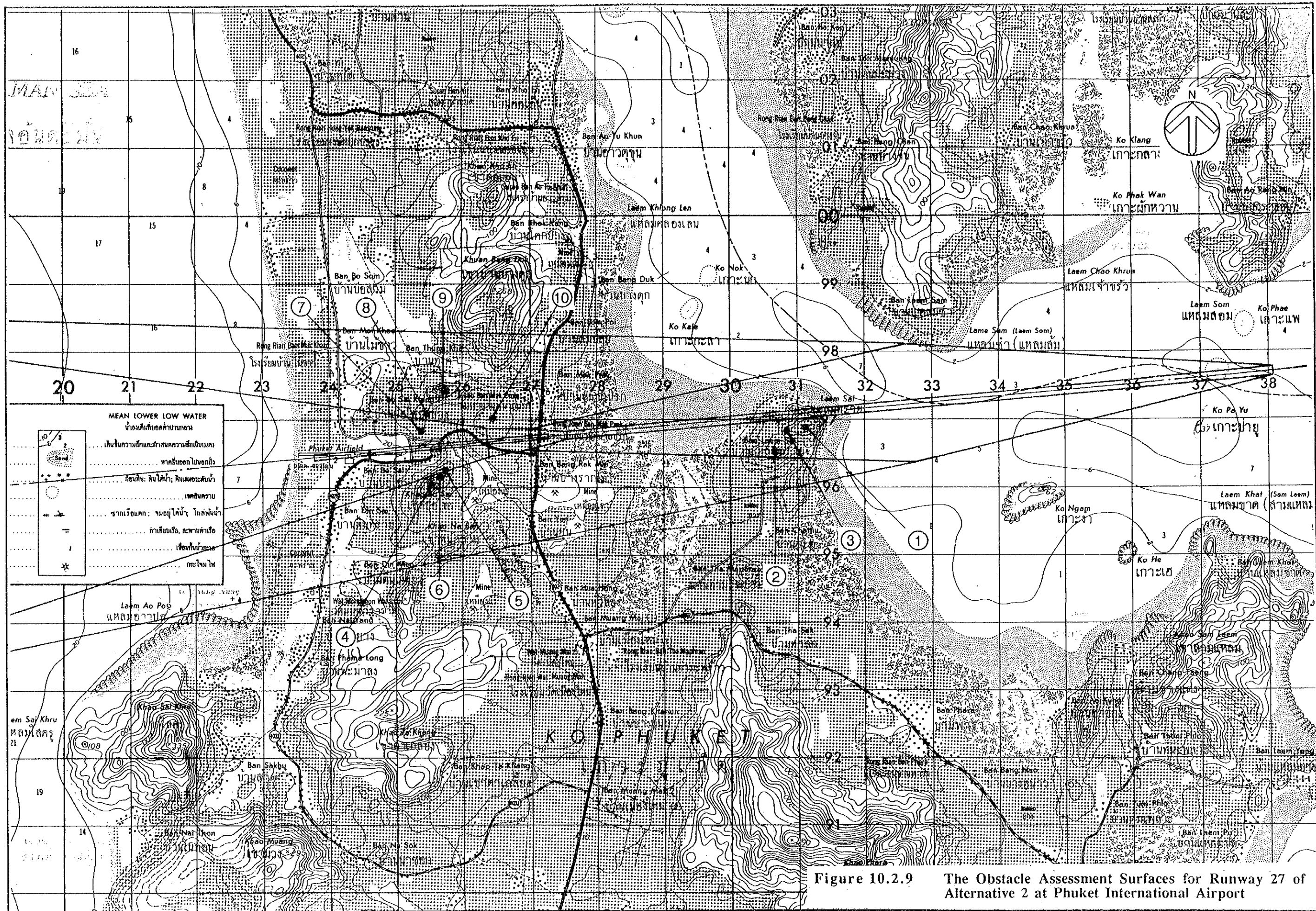
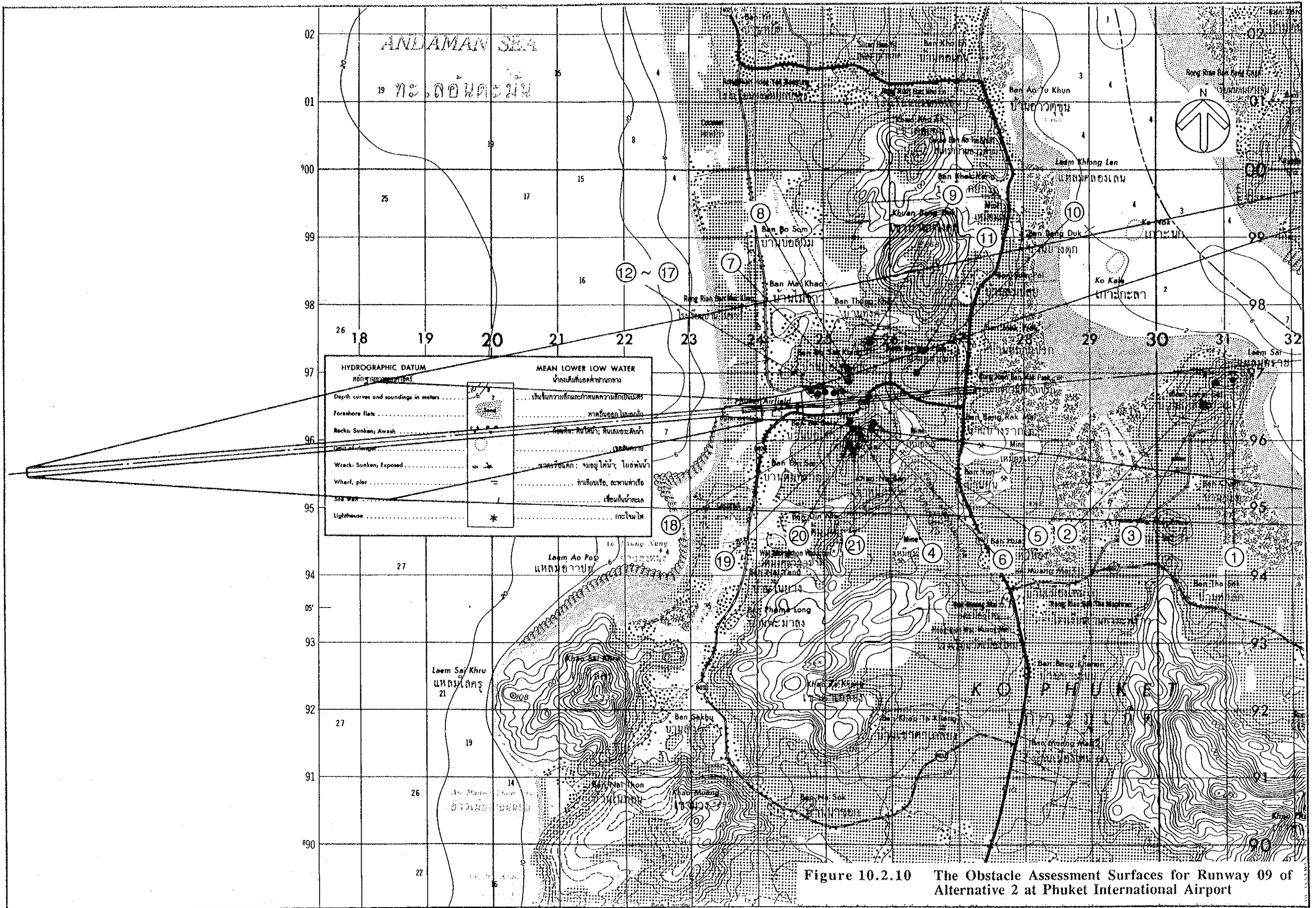


Figure 10.2.9 The Obstacle Assessment Surfaces for Runway 27 of Alternative 2 at Phuket International Airport





**Table 10.2.5 Assessment of Obstacles within OAS for Runway 27 of Alternative 2 at Phuket International Airport**

Airport : Phuket Runway 09 Threshold Elevation : 6,245 m  
 ILS Inbound Course : 084°33'40''T VAR : 0°51' W  
 OAS LLZ - THR Distance : 3,600 m, GP : 3.0°, CAT I

No.	Elevation of Obstacle (m) (+15 : Trees)	Height above Threshold of Obstacle	Distance of		Surface Concerned	Height of Surface at Obstacle (m)	Remarks
			X (m)	Y (m)			
1	127.2+15	135.9	7410	300	z SFC	162.7	OK
2	79.6+15	88.4	6960	490	z	151.5	OK
3	100+15	108.8	7120	290	z	157.2	OK
4*	116.2+15	69.4	-1740	560	y	56.2	NO ha=31.6m
5*	113	39.4	-1965	360	z	26.6	NO (TWR) ha=8.3m
6*	100+15	56.5	-1880	470	y	33.2	NO ha=20.9m
7*	60+15	41.7	-1625	380	y	20.0	NO ha=15.4m
8	69.3+15	78.1	-1860	490	y	38.0	NO ha=35.3m
9	108.3+15	117.1	-2010	780	y	97.2	NO ha=58.3m
10*	64.5+15	38.5	-2620	300	z	43	OK
11	63.0+15	71.8	-2815	640	z	48.8	NO ha=15.6m
12	10+15	18.8	-1030	285	y	14.1	NO ha=10.1m
13	10+15	18.8	-1100	190	z	5	NO
14	20+15	28.8	-1200	380	y	30.5	OK
15	20+15	38.8	-1310	270	z	10.2	NO ha=18.6m
16	30+15	48.8	-1490	310	z	14.75	NO ha=22.2m
17*	40+15	28.8	-1570	290	z	16.75	NO ha=7.8m
18	30+15	38.8	-1610	320	z	17.75	NO ha=13.7m
19	40+15	48.8	-1620	415	y	27.7	NO ha=20.1m
20	50+15	58.8	-1550	530	y	54.5	NO ha=27.8m
21*	60+15	65.1	-1585	530	y	53.5	NO ha=31.3m

$W = 0.0285x - 8.01$

$Y = 0.024733x + 0.216946y - 22.21$

$X = 0.028466x + 0.1187680y - 17.20$

$Z = 0.025x - 22.5$

**Table 10.2.6 OCH/A for Precision Approach Category I to Runway 09**

Approach category	OCH/A (ft)
A	321/342
B	333/354
C	341/362
D	352/373

### 10.3 NEW AIRPORT

In this section, the possible site I-3 for new airport, is subject to be studied.

(1) Obstacle Limitation Surfaces

Obstacle limitation surfaces for possible site of I-3 are already studied in Chapter 8.

(2) Possibility of the Establishment of Precision Approach Category I Procedures

The conditions of the study for new airport site I-3 are assumed as follows:

- ICAO Aerodrome reference code : 4E
- Elevation of east end of Landing Strip : 3.6 m AMSL
- Elevation of west end of Landing Strip : 3.6 m AMSL
- Elevation of east end of Runway Threshold : 3.6 m AMSL
- Elevation of west end of Runway Threshold : 3.6 m AMSL
- Highest elevation of the Runway : 8.8 m AMSL
- Dimensions of landing strip : 3,620 m x 300 m
- Elevation of Inner Horizontal Surface : 53.8 m AMSL
- Threshold-localizer distance for both Runway : 3,600 m
- GP angle : 3.0° for both runways

There are no obstacles which affect aircraft operations on the final approach areas for both runways of possible site selection of I-3. However, this site has high mountains in the northern and southern directions.

**Figure 10.3.1** shows the relationship between the circling area for each approach category aircraft and mountains near the site.

If aircraft intend to make a circling approach to land on the opposite side after straight-in approach, very high OCH/A will be forced as shown in **Table 10.3.1**. So, precision approach procedures for both runways were studied.

**Table 10.3.1 The Study of OCA and Visibilities for Circling Approach for I-3 Site**

Approach category	OCA (ft)	VIS (m)
A	1,140	1,900
B	1,620	2,800
C	2,100	3,700
D	2,160	4,600





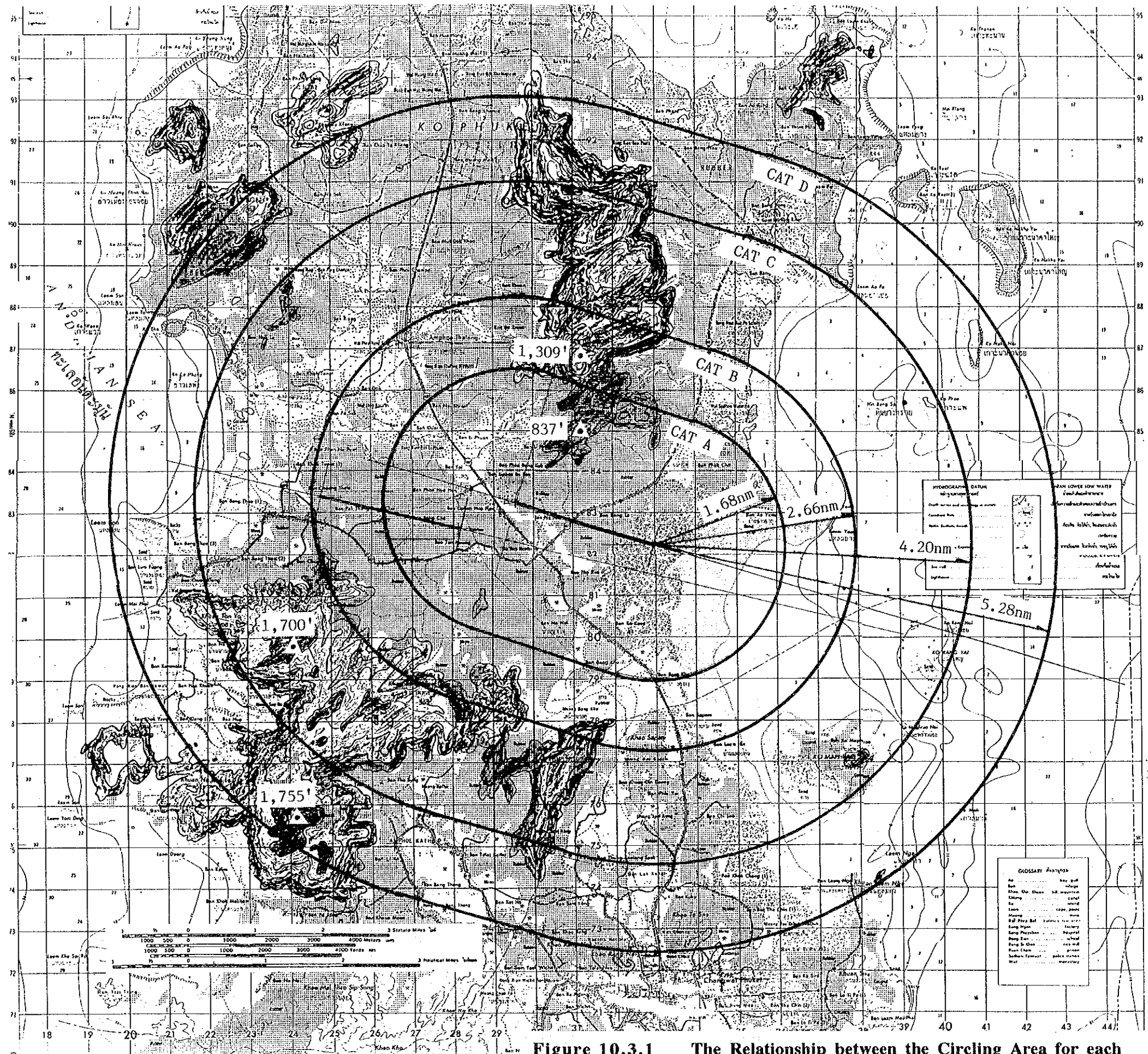


Figure 10.3.1 The Relationship between the Circling Area for each Approach Category Aircraft and Mountains near the I-3 Site



a. Landing from the west

**Figure 10.3.2** shows the OAS for the landing from the west. The obstacles located within the OAS were analyzed as shown in **Table 10.3.2**.

No obstacles project above the OAS. Therefore, Precision Approach Category I Procedure can be established successfully.

**Table 10.3.2 Assessment of Obstacles within OAS for West Side of I-3**

Airport: Phuket                      Landing from West                      Threshold Elevation : 3.6 m  
ILS Inbound Course : 106°T                      VAR : 0°51' W  
OAS LLZ - THR Distance : 3,600 m, GP : 3.0°, CAT I

No.	Elevation of Obstacle (m) (+15 : Trees)	Height above Threshold of Obstacle	Distance of		Surface Concerned	Height of Surface at Obstacle (m)	Remarks
			X (m)	Y (m)			
1	10+15	21.4	-2600	1150	y SFC	162.9	OK
2	15+15	26.4	-1280	480	y	50.26	OK
3	50+15	61.4	-600	890	y	156	OK
4	100+15	111.4	-600	1020	y	184.2	OK
5	100+15	111.4	-1440	1510	y	269.7	OK
6	31.3+15	42.7	330	710	y	139.9	OK
7	49.4+15	60.8	2910	520	x	163.2	OK

$$W = 0.0285x - 8.01$$

$$Y = 0.024733x + 0.216946y - 22.21$$

$$X = 0.028466x + 0.1187680y - 17.20$$

$$Z = 0.025x - 22.5$$

b. Landing from the east

**Figure 10.3.3** shows the OAS for the landing from the east. The obstacles located within the OAS were analyzed as shown in **Table 10.3.3**.

No obstacles project above the OAS. Therefore, Precision Approach Category I Procedure for landing from the east will be established in good conditions same as for landing from the west.

**Table 10.3.3 Assessment of Obstacles within OAS for East Side of I-3**

Airport : Phuket                      Landing from East                      Threshold Elevation : 3.6 m  
ILS Inbound Course : 286°T                      VAR : 0°51' W  
OAS LLZ - THR Distance : 3,600 m, GP : 3.0°, CAT I

No.	Elevation of Obstacle (m) (+15 : Trees)	Height above Threshold of Obstacle	Distance of		Surface Concerned	Height of Surface at Obstacle (m)	Remarks
			X (m)	Y (m)			
1	10+15	21.4	-880	1150	Y	205.5	OK
2	15+15	26.4	-2240	480	Z	33.5	OK
3	50+15	61.4	-2920	890	Y	98.6	OK
4	100+15	111.4	-2920	1020	Y	126.8	OK
5	100+15	111.4	-2090	1510	Y	253.6	OK
6	31.3+15	42.7	-3820	710	Z	73.0	OK
7	49.4+15	60.8	-6440	520	Z	138.5	OK
8	100+15	111.4	-7660	2310	Y	289.4	OK

$$W = 0.0285x - 8.01$$

$$Y = 0.024733x + 0.216946y - 22.21$$

$$X = 0.028466x + 0.1187680y - 17.20$$

$$Z = 0.025x - 22.5$$



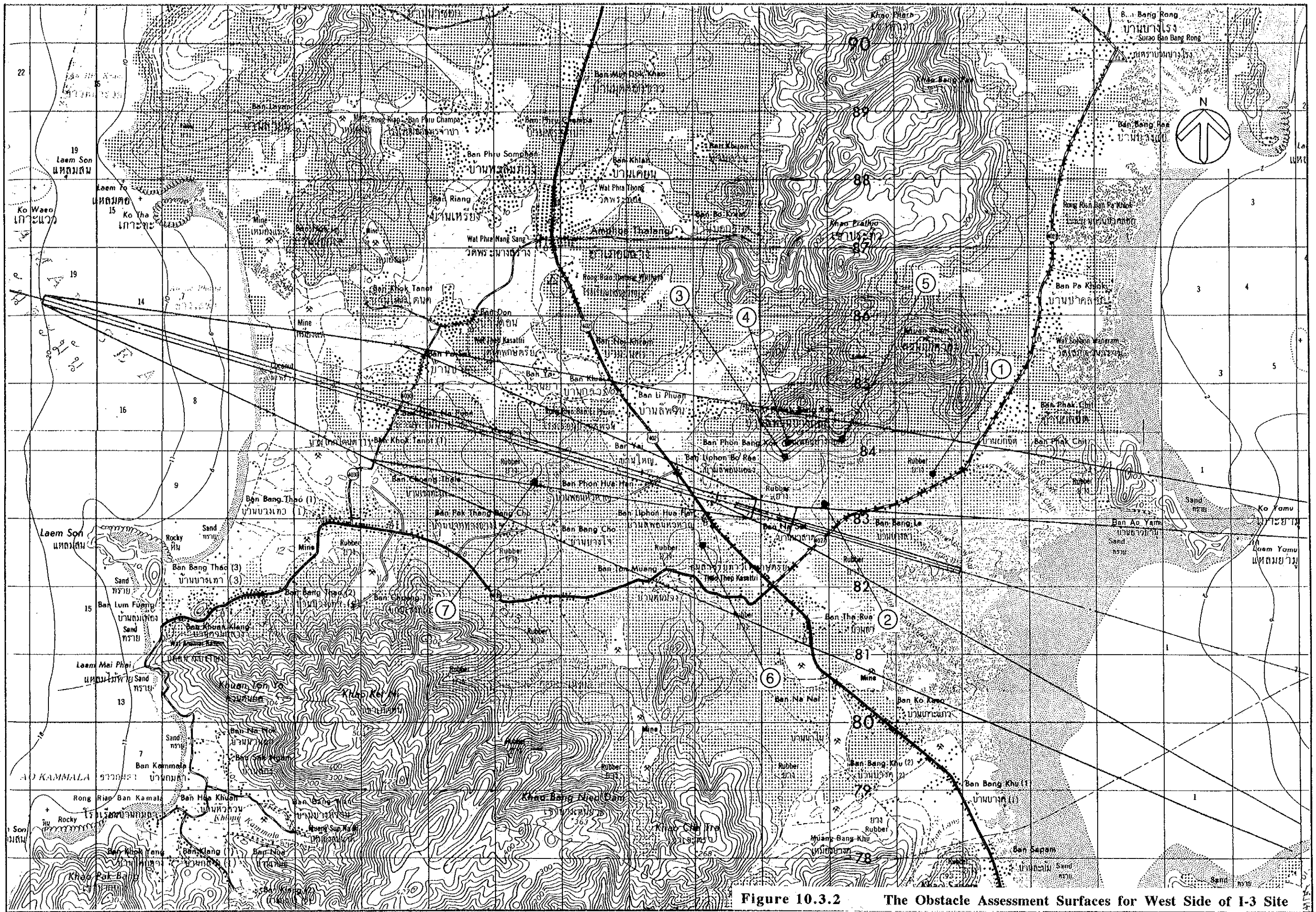


Figure 10.3.2 The Obstacle Assessment Surfaces for West Side of I-3 Site







# CHAPTER 11

## ENVIRONMENTAL CONSIDERATIONS



## 11.1 GENERAL

Environmental considerations play an important role in the development planning and need from the viewpoint of short and long-term and micro and macro areas.

In Thailand the development needs to achieve economic growth, but it is necessary that the development will be carried out on a continuing basis.

This chapter provides the materials in order to establish optimum master plan development in selecting the airport site.

At first a general investigation was carried out at the existing airport and the nine new airport sites. Field reconnaissance carried out at the existing airport and new two airport sites will be selected from the nine proposed sites.

The evaluation and recommendation will be provided on the viewpoint of environmental consideration to close this section.

## 11.2 EXISTING CONDITIONS IN PHUKET

### 11.2.1 Social Environments

The residential area of most of people on Phuket Island is concentrated in the flat area around Thalang Town and Phuket Town because of the mountainous terrain of Phuket Island. Majority of nationality of the people is Thai and there are some Chinese, Indian and Sea Gypsy as a minority. There are Sea Gypsy living at Tha Chat Chai at the north end of island, Ban Laem Tukkae of Siray Island at the east part of Phuket Town and Ban Rawai at Rawai Beach, and there are other people who are mainly living in the town area.

The majority of religions are Thai-Buddhist and Chinese-Buddhist and there are a small number of Muslim and Christian people. Therefore, there are Buddhist temples, Chinese temples, Mosques and Churches spread around the island.

Of the cultural properties in Phuket Island, there are 4 antique monuments, objects of art, 10 archeologic objects designated as cultural properties and 12 antique monuments, objects of art now under survey. (Table 11.2.1)

Cultural properties in Phuket, Thalang Town is located in the center of Phuket. It is necessary to pay attention to the historical points in old Phuket, which were developed in Thalang Town by the tin mining industry and the exporting port was established at Bang Thao Bay and Sapana Bay. Due to the frequent attacks by the Burmese, the location of Thalang Town was forced to relocate many times.

According to the information from Thalang National Museum and experts at Phuket Teacher's College, there is little possibility to discover the cultural properties without the existing properties. However, a careful survey to conserve cultural properties in Phuket will be required when the project implementation program is decided.

**Table 11.2.1 Cultural Properties in Phuket (1)**

No.	Item	Location	Description
1.	Phuket City Hall Building	Muang Municipality, Muang District	
2.	Phuket Court Building	Muang Municipality, Muang District	
3.	Ban Prayapishitsongkram	T. Srisuntorn, Thalang District	Area about 5,224 m <sup>2</sup>
4.	Wat Thalang Pranangsang	T. Thepkasattree, Thalang District	1. Ruined House of Prayapshitsongkram 2. Stack of bricks ruins 3. Building ruins 4. Soil wall 5. Pond 6. The center of the city area of about 37,272 m <sup>2</sup>
5.	Phuket Post Office	Montri Rd., T. Talad Yai, Muang District	
6.	Ko Kaew Pitsadam	Moo 3, Ban Ko Kaew Pitsadam, T. Rawai, Muang District	
7.	Wat Chalong (Wat Chaitharam)	Moo 6, Ban Chalong, T. Chalong, Muang District	
8.	Sanamchai	Narissorn Rd., T. Talad Yai, Muang District	
9.	Phud Choo Spirit House	Ranong Rd., T. Talad Nuea, Muang District	
10.	Pra Aram Sakornket Cemetery	Moo 3, Ban Kookoo, T. Rassada, Thalang District	
11.	Ban Praya Bangrong	Moo 3 T. Pa Kloak, Thalang District	
12.	New City Center	Moo 6, T. Thepkasattree, Thalang District	
13.	Wat Thepkasattree	Moo 4, Ban Doan, T. Thepkassattree, Thalang District	
14.	Koke Phama	Moo 4, Ban Doan, T. Thepkassattree, Thalang District	
15.	Ban Tao Thepkasattree	Moo 1, Ban Takien, T. Thepkasattree, Thalang District	
16.	Tha Rue City Center	Moo 3, Ban Tha Ruea, T. Srisunthorn, Thalang District	

**Table 11.2.1 Cultural Properties in Phuket (2)**

No.	Item	Latitude	Longitude	Location
1.	Krathoo Mine	07° 55' 20"N	098° 20' 20"E	T. Krathoo, Krathoo District
2.	Kamala Beach	07° 57' 11"N	098° 17' 08"E	Kamala, Krathoo District
3.	New City of Thalang	08° 58' 28"N	098° 22' 21"E	Port, Moo 3, T. Srisuntorn, Thalang District
4.	Old City of Thalang	08° 00' 49"N	098° 19' 30"E	Ban Doan, T. Thepkasattree Thalang District
5.	Wat Nanai (Wat Prathong)	08° 01' 58"N	098° 20' 25"E	Ban Takien, T. Thepkasattree Thalang District
6.	Wat Prathong (Wat Nanai)	08° 01' 58"N	098° 20' 25"E	Ban Takien, T. Thepkasattree Thalang District
7.	New City	08° 05' 11"N	098° 20' 42"E	Ban Muang Mai 1, T. Thepkasattree Thalang District
8.	Wat Chalong	08° 50' 42"N	098° 20' 21"E	T. Tha Chalong, Muang District
9.	Wat Klang (Wat Mongkolnimitr)	08° 53' 05"N	098° 23' 30"E	Muang District
10.	Wat Mongkolnimitr (Wat Klang)	08° 53' 05"N	098° 23' 30"E	Muang District

Route 402 is the primary access road to Phuket Town and the road network in Phuket Island are formed by a network of secondary roads branched off from Route 402. Hospitals are located within the town area, but schools are distributed throughout the island.

There are many resort facilities at Nai Yang National Park, Khoo Phra Taew Wildlife Park and Sirinart National Park which is presently planned. Also, there are many resort beaches at the west coast such as Patong, Karon, Kata Beach, etc. In these beaches there are many accommodations of hotels and bungalows which have been constructed for the development of the sea resort area.

There are five types of land use in Phuket; urban lands, mining areas, agricultural lands, forested areas, and coastal ecosystems. Agricultural and forested areas was 70 % of Phuket in 1985. But these types, especially forested lands including mangrove forest, are changing to urbanized areas.

### 11.2.2 Natural Environment

There are many forest areas excluding the area in Phuket Town and Thalang Town because the terrain is in the hilly areas which is the principal geographical feature.

Most of the forests were planted by the owners of rubber and coconut trees, and natural forests are preserved at the designated area such as the national parks, reservation forests, etc. The precious ecological systems in Phuket Island are the mangrove forests and coral reefs, and most of mangrove forests can be found around the east coastal areas. However, most of the area occupied by mangrove forests in Phuket Island are used to develop ponds for the cultivation of fish or shrimp, and land reclamation for industrial and residential estates surrounding the town.

The protected areas in Phuket is shown in **Figure 11.2.1**(Data source is in 1967),there are one national park, one wildlife park and 15 forest reserve areas. But these areas, especially mangrove forest in forest reserve areas, are changing to other land use; fish or shrimp pond etc.

Therefore, the remaining mangrove forests in Phuket Island is recommended to be preserved to arrest further loss of the trees. The coral reefs are limited to be retained at Nai Yang National Park and other west coastal areas, but the conditions for their preservation is fastly deteriorating.

### 11.2.3 Pollution

The main environmental problem at Phuket Island seems to be the handling of drainage and waste disposal systems. The water pollution is caused by the sewerage from Phuket Town, factories, and the resort area such as Pathong Area. The treatment of sewerage is mostly discharged raw directly to the river or sea except for some big hotels. The maintaining of portable water is the other problem.

In Phuket Town, waste disposal was collected by an agent but the treatment was abandoned and dumped at some points.

Accordingly, the establishment of a basic treatment procedure of sewerage and waste disposal generated from resort facilities must be established and legislated urgently because of the sharp increase of tourists expected by the implementation of the airport development.

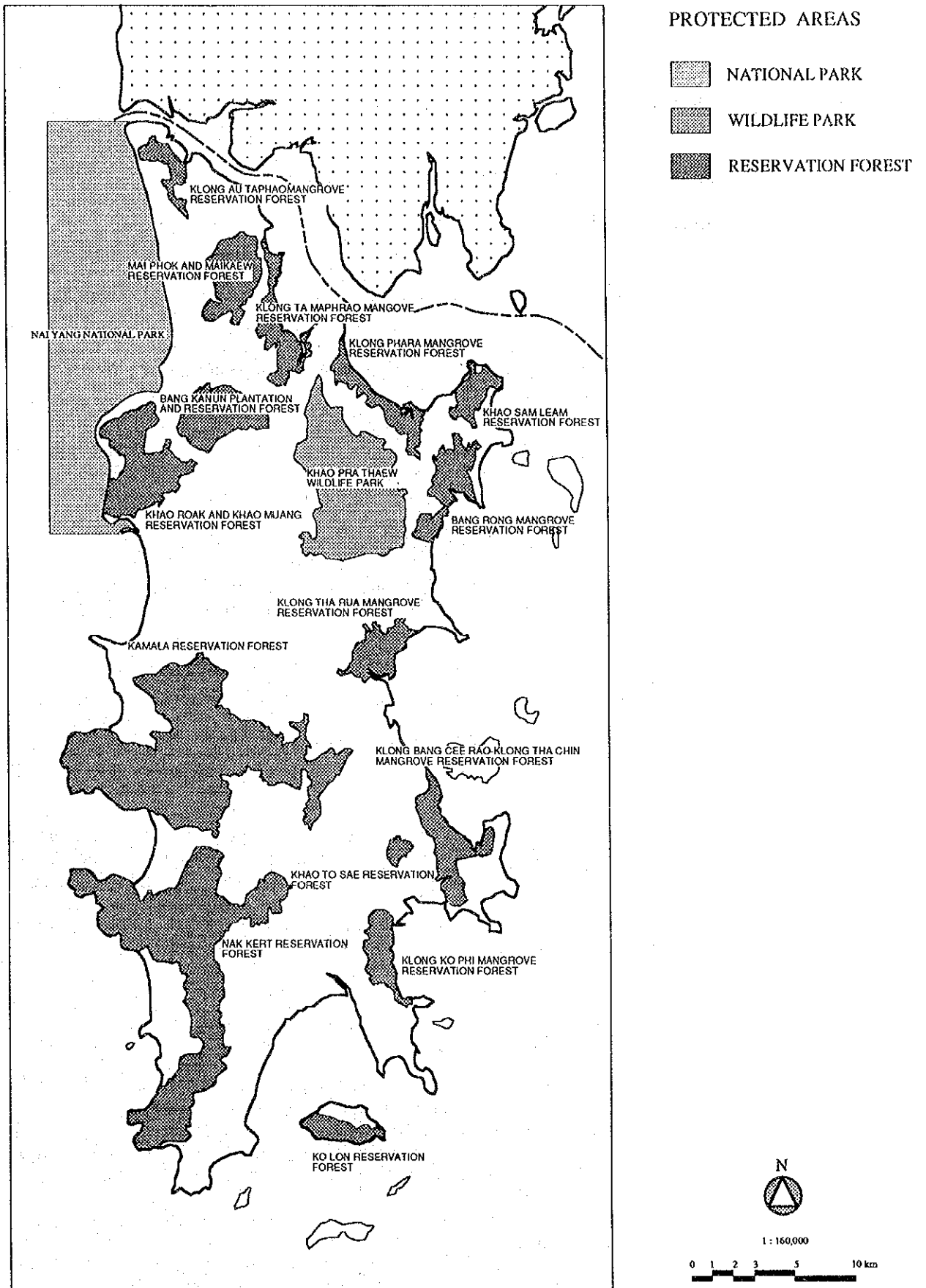


Figure 11.2.1 Protected Areas in Phuket



## 11.3 EXISTING CONDITION AT AIRPORT SITES

### 11.3.1 General Investigation

#### (1) Existing Airport

##### a. Land Use

The airport is located at the northern part of Phuket Island and faces the Andaman Sea and was developed on the east side. Around the center portion of the airport property, there are moderately high hills on the north and south sides, and Route 4026 is running around the south side of the airport, and Route 402 is on the east side.

The land at the north side of the airport is a acasuarina forest, with coconut and rubber plantations running along the west coastal line, and the west side is the marine resort area of the National Park. There are no residential houses along the road at the northern side.

There are small villages such as Ban Bang Rak Mai along Route 402 on the east side, and there are fish or shrimp culture ponds by converting of mining ponds and development of rubber plantations surrounding these villages. Eastern part of these areas and along the sea-shore, there are mangrove forests.

At the southern part, there is the Nai Yang National Park, along Route 4026 with small villages, and hills covered by forests and golf courses.

At the northern part of Nai Yang National Park facing the Airport, there is the main area with the facilities of headquarters, bungalows and visitors center.

The golf course at the southeast side of the airport is now being developed for the construction of 36 hole golf course, condominiums and hotel. For Phase 1, an 18 hole golf course was already opened on December 1991 and the part at the foot of hills at the south side of the airport where the control tower is located is now being developed for the construction of condominiums. See **Figure 11.3.1**.

##### b. Environmental Conditions

###### (a) Social Environment

There are no existing public facilities such as schools, hospitals, churches or temples or mosques nor cultural properties around the existing airport due to the existence of small scattered villages. Also there are no remarkable socio-economic activities. Accordingly waste disposal and sanitation problems have not surfaced.

The traffic on Routes 402 and 4026 which are the access roads to the airport, do not affect the surroundings due to the current traffic volume. However, the construction of the airport has interrupted the road along the west coast line. These projects are taking place even with the communities in this area and the community may have to be split in half.

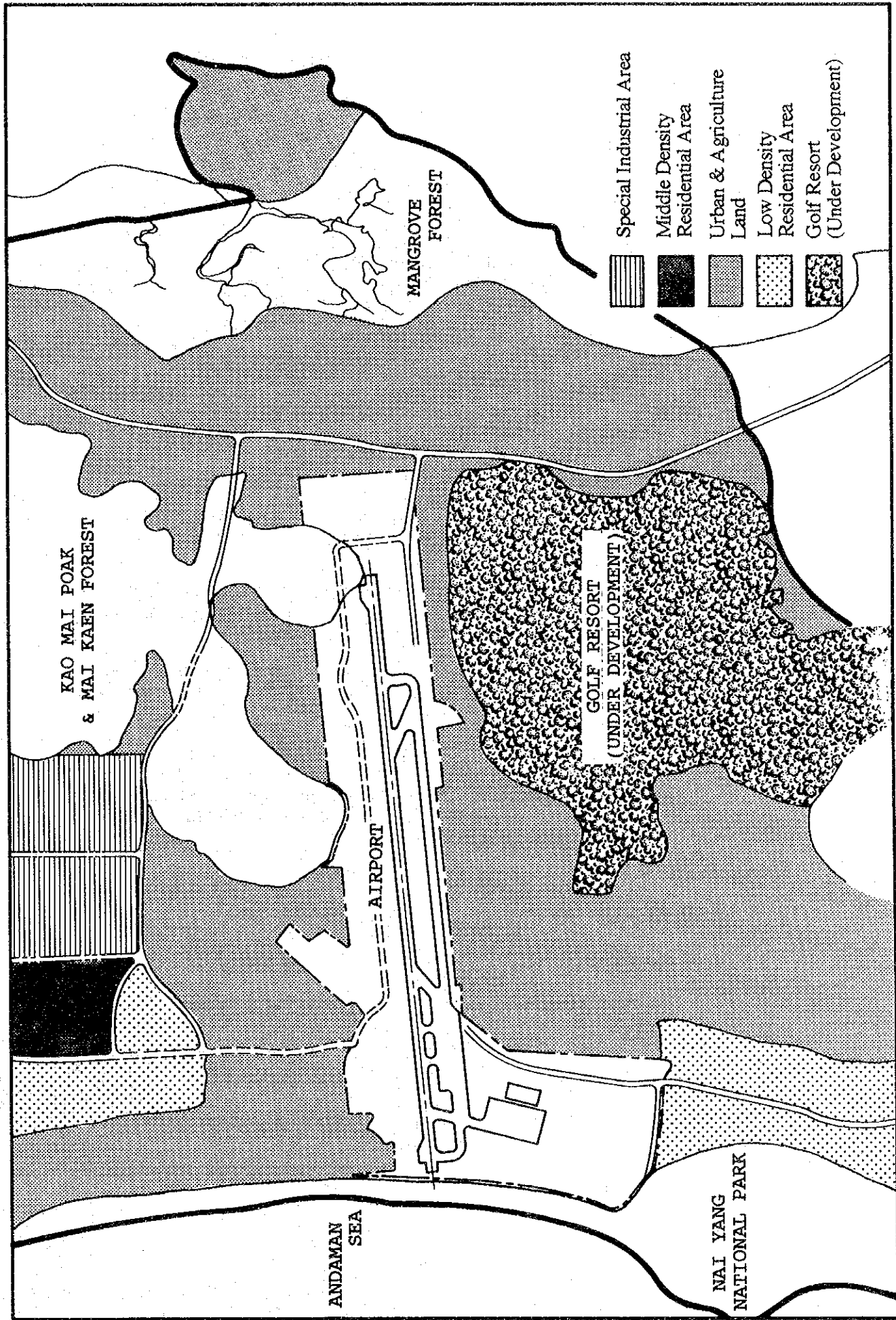


Figure 11.3.1 Land Use Surrounding the Airport

(b) Natural Environment

There are hills on the flat area facing the sea-shore. These areas are covered with rubber and coconut plantations. Since the mangrove forests at the eastern part of the airport are now being developed into ponds for fish or shrimp cultivation, the area covered by mangrove forests has been reduced and the situation for plant life and vegetation is deteriorating. Around the western coast area, sea erosion has occurred because of the steep slope and narrow back space of the beach, and some forests along the sea shore have been damaged by this erosion.

(c) Pollution

The existence of airport and road network will be considered the source of environmental pollution surrounding the airport area.

Air pollution will be caused by the exhaust gas from aircrafts and vehicles on the roads. The volume of the gas emission is expected to be small because of the small volume of traffic at the present time.

The water pollution will be generated by the sewerage discharged from the airport facilities and surface drainage of runways, taxiways and apron during rainfalls.

Actually, the sewerage is treated at the oxidation pond located at the east side of Apron C and some surface drainage seems to be discharged due to the present traffic volume.

Accordingly, it is considered that there is very little air and water pollution around the airport caused by the airport facilities and no major problems are reported.

Noise problem around the airport does not seem to have occurred. However, it is assumed that the noise problems for the planned condominiums at the golf course, which is now under construction at the south east side of airport, will occur in the near future.

(2) New Airport Sites

Nine possible sites for the new airport are as shown on **Figure 11.3.2** and have been selected by the study of the map, based on the settled condition. This section explains the outline of each possible site and mentions roughly the suitability for the new airport construction.

a. Site I-1

Site I-1 is located at the south part of the central plain of Phuket Island. Runway orientation will be oriented east-west. West side of the site is near Bang Thao beach, where new hotel developments are in progress. This area is generally utilized as paddy fields and rubber plantations. There is a small village running along the road close to the south edge of the site. Terrain is relatively flat at this site with maximum level difference of about 20 meter.

Two resort hotels were confirmed on Ban Thao beach through the site survey. Many developments are on-going in addition to these hotels and they are considerably big projects. The Muslim villages are located adjacent to the site. Therefore, the problems of resettlement and aircraft noise for the hotels and villages will occur. However, there will be no problems from the construction aspects and natural environmental aspects. Therefore, on the whole, the airport development at this site will be possible.

b. Site I-2

Site I-2 is located at the northern end of Phuket Island, near to Khlong Tha Nun Strait. Runway orientation will be limited to the east-southeast to west-northwest direction. This area is generally utilized as rubber plantations. The length of the site is limited by the river and coast at the western and eastern ends of the site. A small village is found at the east side of the site near to the coast. This area is generally utilized by rubber plantations. Sarasin Bridge crosses over Khlong Tha Num Strait at the gateway of Phuket Island from Phang-Nga by land transportation. A hill (80 meter in height) in the east portion of the site must be lowered by cutting, and power distribution line will have to be detoured to outside of site.

The Royal Park Project emerged during the site survey adjacent to the west side of the site. Space for the approach light system will be needed in this Park.

There is a mangrove reservation forest in good condition adjacent to the site. Therefore the airport development at this site should be carefully studied from the viewpoint of preservation of the natural environmental aspect.

c. Site I-3

Site I-3 is located at the eastern part of the central plain of Phuket Island. Runway orientation will be limited to the southeast-northwest direction. This area is generally utilized as rubber plantation, tin mining and housing along the road (Primary Route 402). The site will require diversion of the road and small reclamation at the south-east portion of the site.

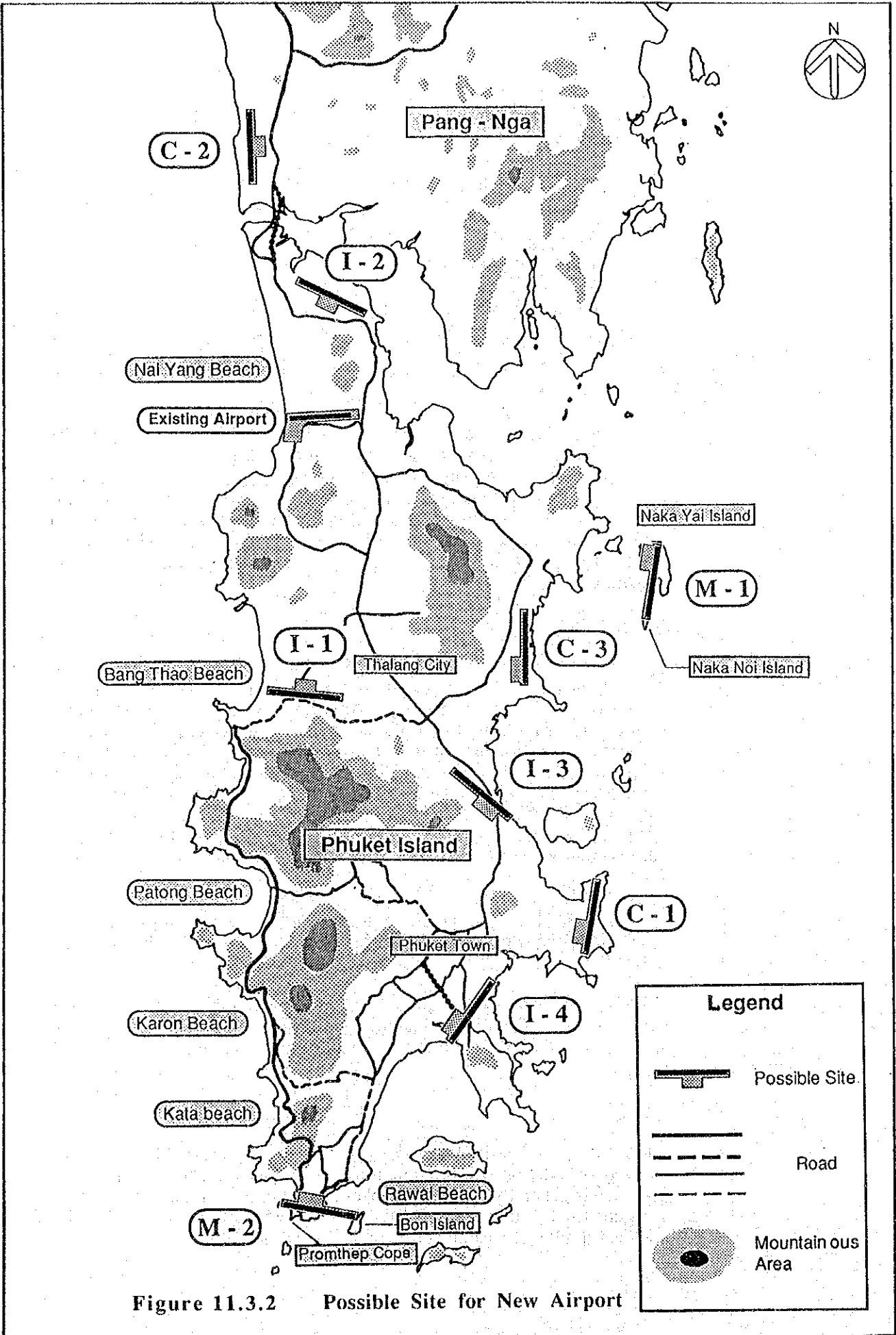


Figure 11.3.2 Possible Site for New Airport

The terrain is generally flat. The north-western approach surface can be established only when the second section is extended to clear the mountain.

The mangrove forest, that is in better condition in Phuket Island, is located near this site.

The community will be split in two by the crossing of the main road (Route 4027). But this problem can be settled by construction of a new road. Therefore the airport development at this site will be relatively good from the natural environmental aspect.

d. Site I-4

Site I-4 is located south-east of Phuket Island, 4 km south from Phuket Town. Runway orientation will be limited in the northeast-southwest direction. South-west portion of this area is generally utilized for agriculture, while the north-east portion is used for an industrial area. The site divides the peninsula of the Island where deep sea port is located. Terrain is flat and mangrove forests indicated on the topographic map (scale 1:50,000) do not exist because of the development around the area. Several tall buildings were found in the site survey in Phuket Town which penetrate the assumed horizontal surface.

This site is located in a mangrove forest area, and resettlement and aircraft noise problem will occur when the project is implemented by this site. Especially noise will be a big problem because Phuket Town will continue to grow in the future. Therefore, this site is not recommendable for airport development.

e. Site M-1

Site M-1 is located off-shore at the north-east of Phuket Island, Nakha Yai and Naka Noi Islands in Phang-Nga Bay. Runway orientation will be limited to the north-south direction. This site consists of two small islands and will require land reclamation between the islands in relatively shallow sea less than 5 meter in depth. The condition of the reclamation will be good because of the sandy bottom, shallow depth and calm seas. Fill material will be transported from outside since the islands are not massive. Top of Phanak Island will penetrate the approach surface by 60 meter, at a point of 14 km from the runway end. The second section of the approach surface will have to be extended to clear that obstruction.

The aircraft noise problem will not occur at this site because of the existence of the sea, but on the natural environment and water pollution problem there will cause some problems because this site is located in the sea. Pearl cultivating operation is confirmed at Nakha Yai Island, and resort facilities were observed by field survey. Therefore, resettlement of these facilities will be required. On the whole this site is not recommended for airport development.

f. Site M-2

Site M-2 is located at the southern end of Phuket Island, partly offshore of the coast. Runway orientation will be limited to east-west. This site consists of the tip of Phuket main island and two small islands (Man and

Bon Islands in the west and east portions respectively), and land reclamation between the islands will be required.

It became obvious by the field survey that this site was not realistic. First, construction conditions will be very severe since the terrain is hilly, the soil is mostly rocky, and the sea is rough. Secondly, the site interrupts the coastal tides and damages natural environment of Rawai Beach. The current flow in the Chalong Bay will be changed, and natural habitation in the bay and surroundings will be destroyed. Moreover, this site is located near the scenic point famous for its beautiful sunset, Prom Thep Cape in the site. Therefore, this site does not seem to be suitable for airport development.

g. Site C-1

Site C-1 is located at the south-east of Phuket Island, 4 km east from Phuket Town on the coast of a peninsula. Runway orientation limited in the north-south direction. This area is generally utilized by plantations. Some development of new housing complex is expanding closely to the site. There are two hills of 130 and 200 meter in height, in the north and south portion of the site. Length of the site is limited on both sides by the coast line. Construction on this site requires much larger scale of earth work than the others. The site is very close to Phuket Town, and new residential area under construction was observed at west side of the site.

On social environmental aspect there will be few problems. However, excavation and embankment on a large scale civil works will have an impact on topography and aesthetics matters, and aircraft noise problems will occur because this site is located near Phuket Town. Therefore, this site does not seem to be suitable for airport development.

h. Site C-2

Site C-2 is located on the opposite shore of Phuket Island, along west coast of Phang-Nga Province. Runway orientation will be limited to the north-south direction. This area is generally utilized by plantations and agricultural villages. Terrain is almost flat. A power distribution line runs through the site. Tourism development plan exists in this coastal area which will be under assumed approach surface. Therefore, this site is not suitable to be selected. However, except for this matter there is no significant disadvantage for airport development at this site.

i. Site C-3

Site C-3 is located east of the central part of the island, along the coast of Phang-Nga Bay. Runway orientation will be limited to the north-south direction. This area is generally utilized by rubber plantations. Mangrove forests shown in the topographic map (scale 1:50,000) is not a good condition because of development around the area. Terrain is relatively uneven in the south portion of the site, with a 40 meter hill to be cut. A hill located 6 km north from runway end seems to penetrate the approach surface by 10 meters.

This site is located at a lowland along the seashore line, therefore it will be necessary to provide measures for the high waves need to be considered. Therefore, the airport development at this site will not be optimum from the viewpoint of natural environmental aspect mainly.

11.3.2 Field Reconnaissance

(1) Study Area

The reconnaissance was carried out at three sites (Figure 11.3.3). The study areas encompassed the given sites *plus* their vicinities as defined below:

Study Area at Site A : The existing Phuket airport site and its vicinity including the coastal zone.

Study Area at Site B : I-1 site near Bang Tao Beach, approximately 12 kilometers south of existing airport, and its vicinity.

Study Area at Site C : I-3 site after shifting to the north as explained in section 8.5.1 (2), east of I-1 site, and its vicinity.

The study areas at sites A and C are extended to cover the mangrove forest areas at their eastern ends. The study area for the marine ecology lies along the coast at the western end of site A, and extends approximately 1 kilometer into the sea.

(2) Study Periods

Table 11.3.1 displays the schedule of the study. The study was divided into 2 parts. The first part of the study was conducted during late September and early October, representing the rainy season of Phuket island. The second part of the study was conducted during late November, representing the dry season.

**Table 11.3.1 Study Periods**

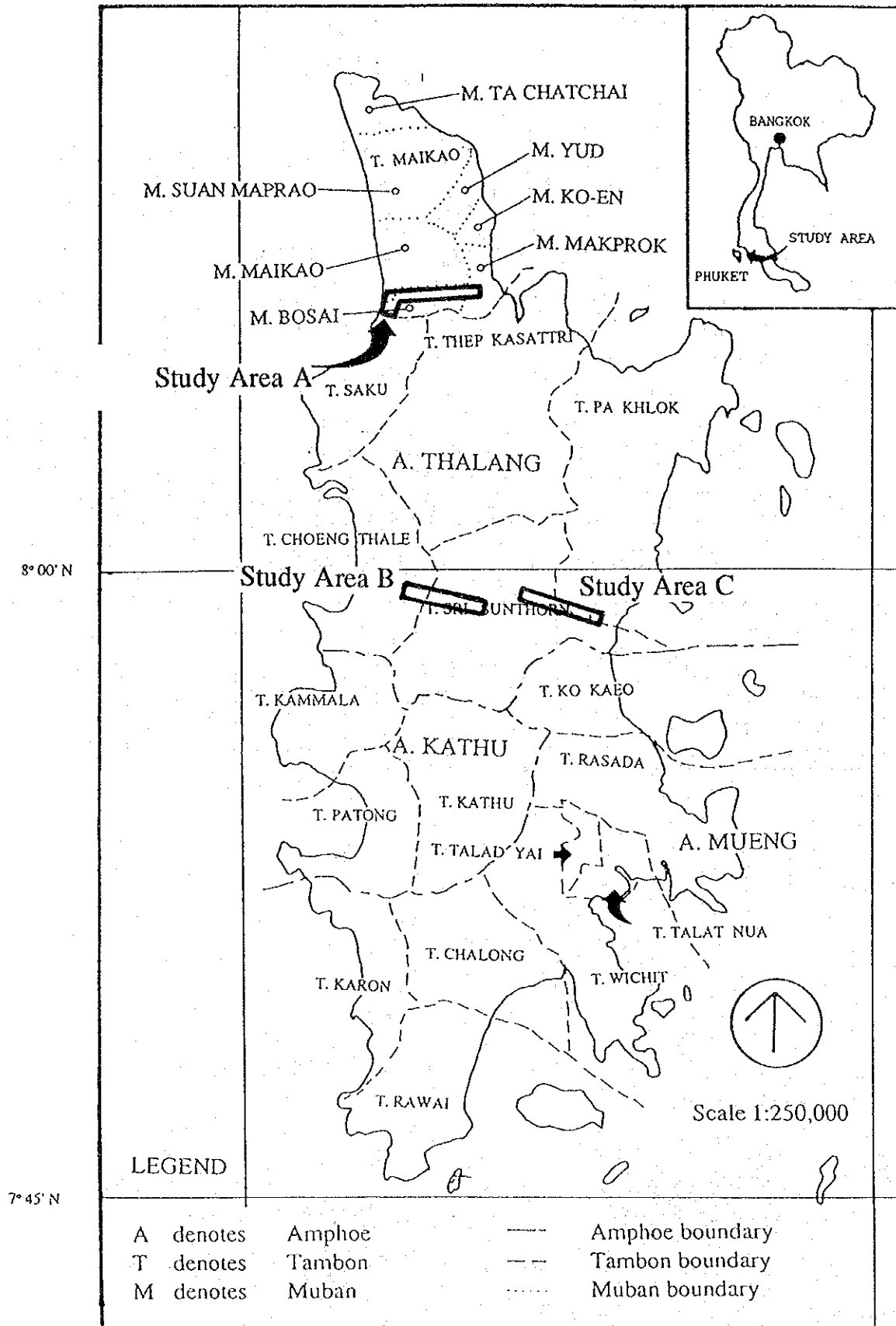
Work	Sep.	Oct.	Nov.	Dec.
Data collection	▒▒▒▒▒▒▒▒			
Field reconnaissance		▒▒	▒▒	
Data analysis		▒▒▒▒▒▒		▒▒▒▒



Figure 11.3.3 Study Area

98° 15' E

98° 30' E



### (3) Results

#### a. Land Use

Land use maps of the three study areas are shown in **Figure 11.3.4 - 11.3.6**. The information on these maps were extracted from the latest possible LANDSAT TM satellite images (March, 1992). Ground condition survey was conducted during two field visits to verify the information obtained from the satellite image. The results are self-explanatory. **Tables 11.3.2 - 11.3.4** lists areas of different land use types within the three study area boundaries.

It is noted that medium- to long-term pictures, and not the short-term one, is presented herein. Young rubber plantation with pineapple plants appeared during the time of survey as a pineapple field, for example, was interpreted as rubber plantation on the pictures. This was done because the whole area would become rubber plantation without pineapple plants within a few years, before the project materializes. In flora and bird studies, however, these differences were significant; therefore explicitly identified and were treated differently.

In the following, the specific information on socio-economic settings of Site A and its vicinities are given.

This area spans over three Mubans: Muban Bosai, Muban Maikao, and Muban Makprok, all in Tambon Maikao (**Figure 11.3.7**). Over 80% of the study area is in Muban Bosai; while a minor portion on the west is in Muban Maikao and another minor portion on the east is in Muban Makprok. As a whole, Tambon Maikao consists of 7 Mubans: (1) Muban Makprok; (2) Muban Ko-en; (3) Muban Suan Maprao; (4) Muban Maikao; (5) Muban Ta Chatchai; (6) Muban Bosai; and (7) Muban Yud.

As of mid-1992, Tambon Maikao had a population of 6,515 including 3,356 males (accounting for 51.5%) and 3,159 females (accounting for 48.5%). There were altogether 1,143 households averaging 5.7 persons per household (**Table 11.3.5**) (Office of Public Health of Changwat Phuket, 1992).

The majority of the population in Tambon Maikao are Buddhists (57.8%) and the rest are Muslims. There are three Buddhist temples and four Muslim mosques in the Tambon. Most people are engaged in the agricultural sector, particularly in planting para rubber, coconut, and other fruit-trees. Next come common laborers, livestock farming, commerce, and fisheries.

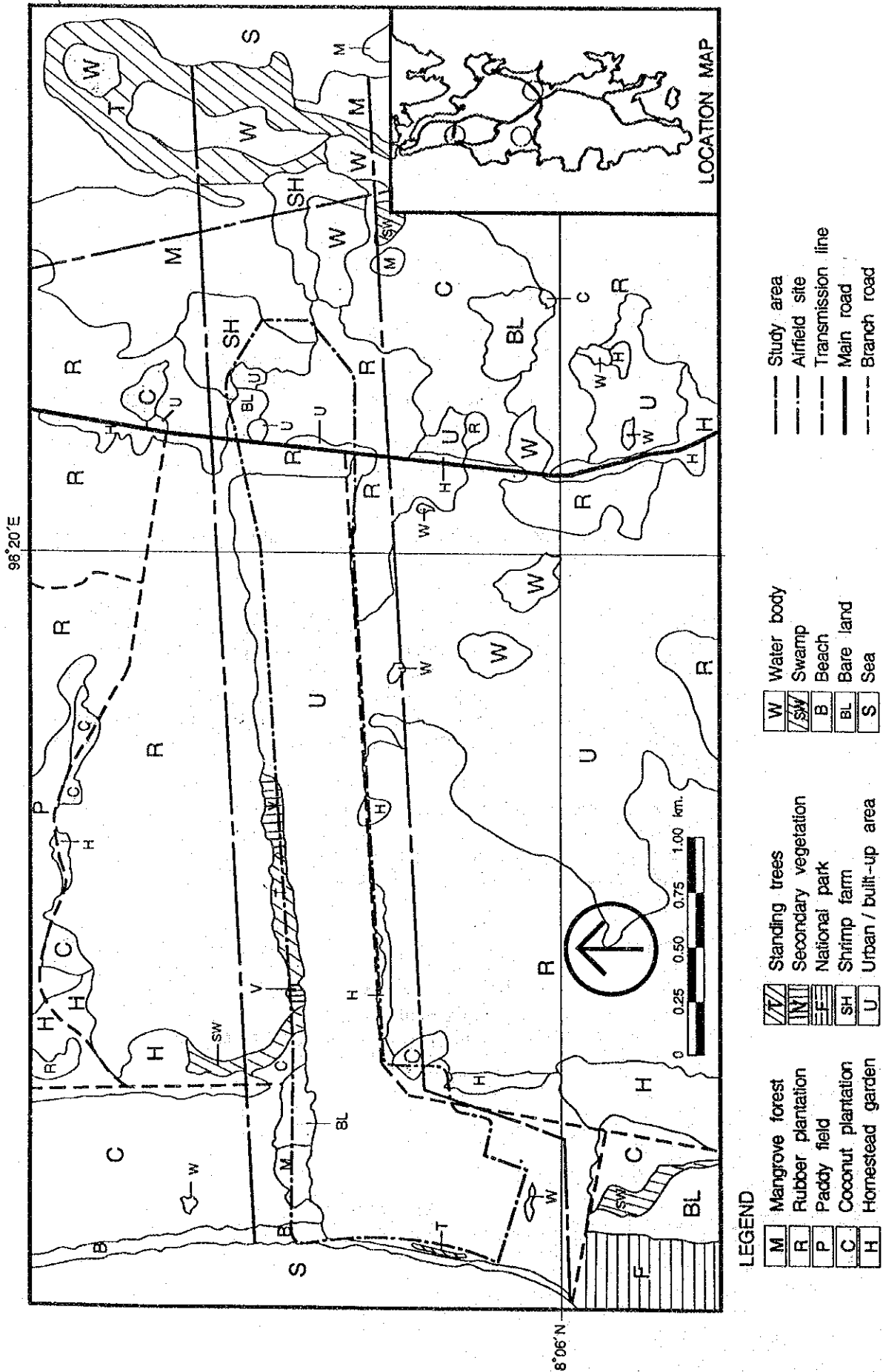
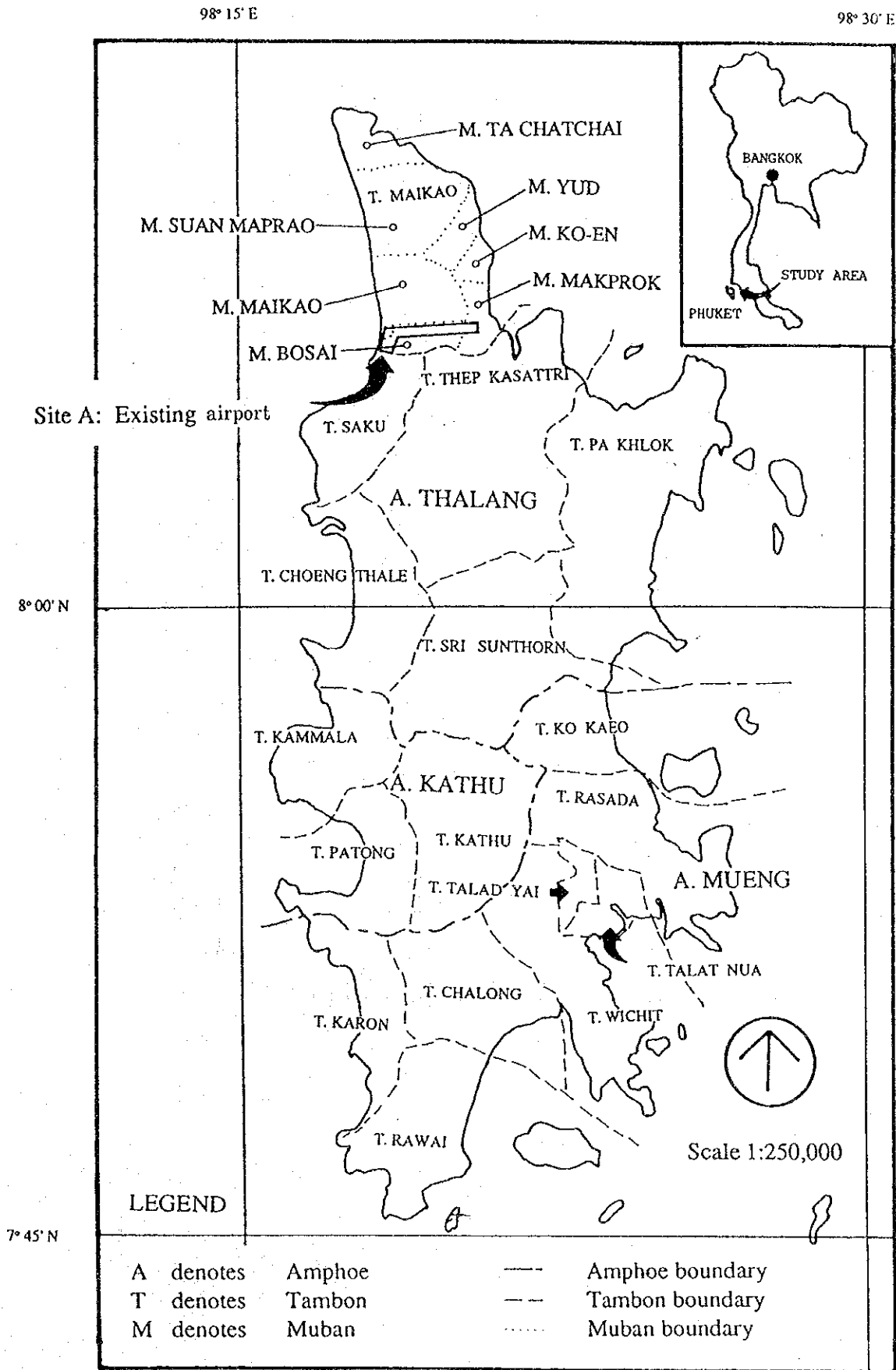


Figure 11.3.4 Land Use Map at Site A





Figure 11.3.7 Political Boundaries around Site A and its Vicinities



**Table 11.3.2 Land Use Pattern at Site A**

Land Use	Hectare	%
Mangrove forest	34.34	6.97
Rubber plantation	114.62	23.27
Coconut plantation	24.18	4.91
Homestead garden	7.58	1.54
Casuarina forest	0.79	0.16
Standing trees	18.92	3.84
Secondary vegetation	3.75	0.76
Forest plantation	3.96	0.80
Shrimp farm	26.68	5.42
Urban/built-up area	219.44	44.54
Water body	24.94	5.06
Swamp	3.12	0.63
Beach	2.99	0.61
Bare land	7.31	1.48
<b>Total</b>	<b>492.62</b>	<b>100</b>

Notes: Only the area within the study area is counted.

**Table 11.3.3 Land Use Pattern at Site B**

Land Use	Hectare	%
Rubber plantation	292.46	68.09
Homestead garden	7.92	1.84
Urban/built-up area	6.65	1.55
Water body	16.50	3.84
Post-mined land	106.06	24.69
<b>Total</b>	<b>429.59</b>	<b>100</b>

Notes: Only the area within the study area is counted.

**Table 11.3.4 Land Use Pattern at Site C**

Land Use	Hectare	%
Mangrove forest	150.77	23.02
Rubber plantation	356.11	54.37
Paddy field	35.94	5.49
Coconut plantation	8.73	1.33
Homestead garden	25.08	3.83
Shrimp farm	45.92	7.01
Urban/built-up area	9.29	1.42
Bare land	20.36	3.11
Abandoned paddy field	2.73	0.42
<b>Total</b>	<b>654.93</b>	<b>100</b>

Notes: Only the area within the study area is counted.

**Table 11.3.5 Population of Tambon Maikao**

Muban	Number of		Population		Total
	Household	Family	Males	Female	
Muban Makprok	236	244	503	498	1,001
Muban Ko-en	175	198	547	523	1,070
Muban Suan Maprao	179	189	686	605	1,291
Muban Maikao	225	263	519	563	1,082
Muban Ta Chatchai	160	169	698	586	1,284
Muban Bosai	84	90	144	157	301
Muban Yud	84	90	259	227	486
<b>Total</b>	<b>1,143</b>	<b>1,243</b>	<b>3,356</b>	<b>3,159</b>	<b>6,515</b>

Source: Office of Public Health of Changwat Phuket, 1992



b. Flora

(a) Methodology

In the rainy season, general studies were conducted at the three sites. In addition, specific studies were conducted on sites A and C. The specific study was repeated at site A during the dry season.

① General Study

The land use maps prepared earlier were used to facilitate the reconnaissance. Two zones were excluded from the general study: the para rubber plantation and the mangrove forests. As for the former, the investigator only walked through different parts, sufficiently covering total area, to confirm the homogeneity of the plantation. The latter, on the other hand, was set aside for specific detailed studies only.

In other zones, a transect method was applied. For each zone, the transect lines were drawn in parallel, at approximately 50 meter intervals. The investigator walked along each transect line, from one end of the boundary to the other, recording all significant species found within the area. Abundance of each species was assessed in qualitative scales: rare, quite rare, common, highly common, and highly abundant. This was done by estimating the density of each species, but without detailed computation.

② Specific Study

To comply with the contract three sub-areas within site A were selected for the specific studies: A1, A2, A3, (**Figure 11.3.8**). Besides, the mangrove zone at site C, jointly considered to be vulnerable area, was also studied in detail. Four sub-areas were selected within site C for the specific studies: C1, C2, C3, C4 (**Figure 11.3.10**)

After the sub-areas were selected, sampling plots were laid on these areas. One 25 x 25 square meter plot was used in the sub-area A3 which appeared to be more homogeneous than others. Two 10 x 10 square meter plots were used in other sub-areas. The plants with 5 centimeters in girth and above were recorded, measured, and tabulated. The data was subsequently used for determining the relative densities and relative dominance of each species. They were computed as follows: