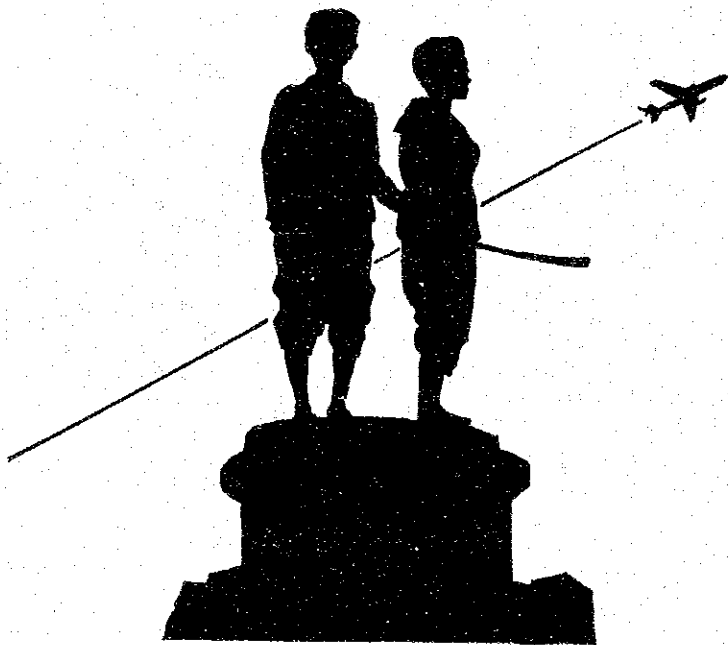


JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
AIRPORTS AUTHORITY OF THAILAND
THE KINGDOM OF THAILAND

*The Study on Phuket International Airport
Development Plan
in the Kingdom of Thailand*



**FINAL REPORT
VOLUME I: SUMMARY**

OCTOBER 1993

PACIFIC CONSULTANTS INTERNATIONAL
PASCO INTERNATIONAL INC.

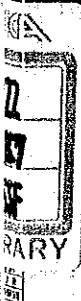
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THE STUDY ON PHUKET INTERNATIONAL AIRPORT
DEVELOPMENT PLAN IN THE KINGDOM OF THAILAND

FINAL REPORT
VOLUME I: SUMMARY

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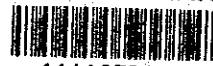
NOTE

The following exchange rate was adopted throughout this report :

US\$ 1.00 = Baht 25.0 = Yen 110 (February, 1993)

Baht 1.0 = Yen 4.4

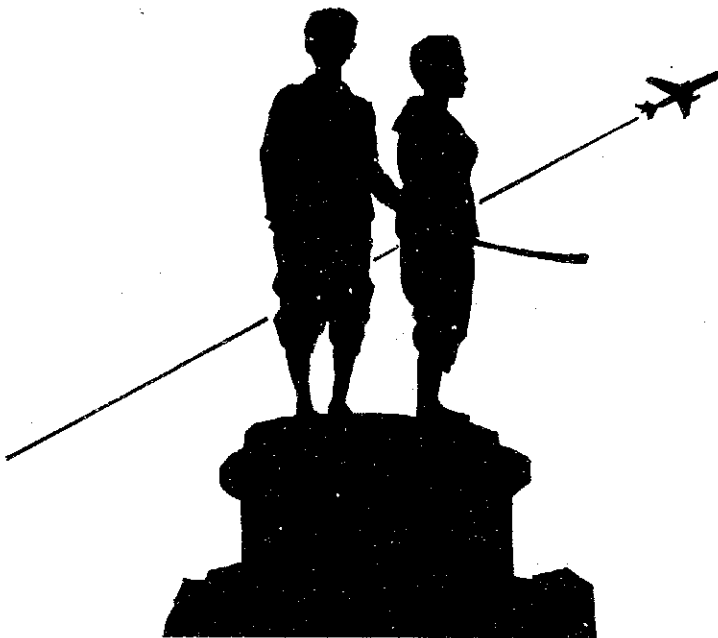
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THE KINGDOM OF THAILAND

*The Study on Phuket International Airport
Development Plan
in the Kingdom of Thailand*



FINAL REPORT
VOLUME I:SUMMARY

OCTOBER 1993

PACIFIC CONSULTANTS INTERNATIONAL
PASCO INTERNATIONAL INC.

国際協力事業団

25940

PREFACE

In response to a request from the Government of the Kingdom of Thailand, the Government of Japan decided to conduct the Study on Phuket International Airport Development Plan in the Kingdom of Thailand, and entrusted the study to the Japan International Cooperation Agency (JICA) .


JICA sent to Thailand a study team headed by Mr. Yoshiya Niinomi, Pacific Consultants International, four times between August 1992 and August 1993.

The team held discussions with the officials concerned of the Government of Thailand, and conducted field surveys at the study area. After the team returned to Japan, further studies were accomplished and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between the two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Thailand for their close cooperation extended to the Study Team.

October 1993



Kensuke Yanagiya

President
Japan International Cooperation Agency

October 1993

Mr. Kensuke Yanagiya
President
Japan International Cooperation Agency
Tokyo, Japan

Dear Mr. Yanagiya

Letter of Transmittal

We are pleased to submit to you the final report on the Study on Phuket International Airport Development Plan in the Kingdom of Thailand.

This study has been conducted by Pacific Consultants International in association with Pasco International Inc. based on a contract with JICA, from August 1992 to October 1993. Throughout the study, we have taken into full consideration the present situation of Phuket International Airport and have recommended that the Government of Thailand implement this project as a top priority.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, and the Ministry of Transport in Japan. We also wish to express our deep gratitude to the officials concerned of Airports Authority of Thailand (AAT) and other authorities concerned of the Kingdom of Thailand for their close cooperation and assistance during our study.

Finally, we hope that this report will be effectively used for the development of Phuket International Airport.

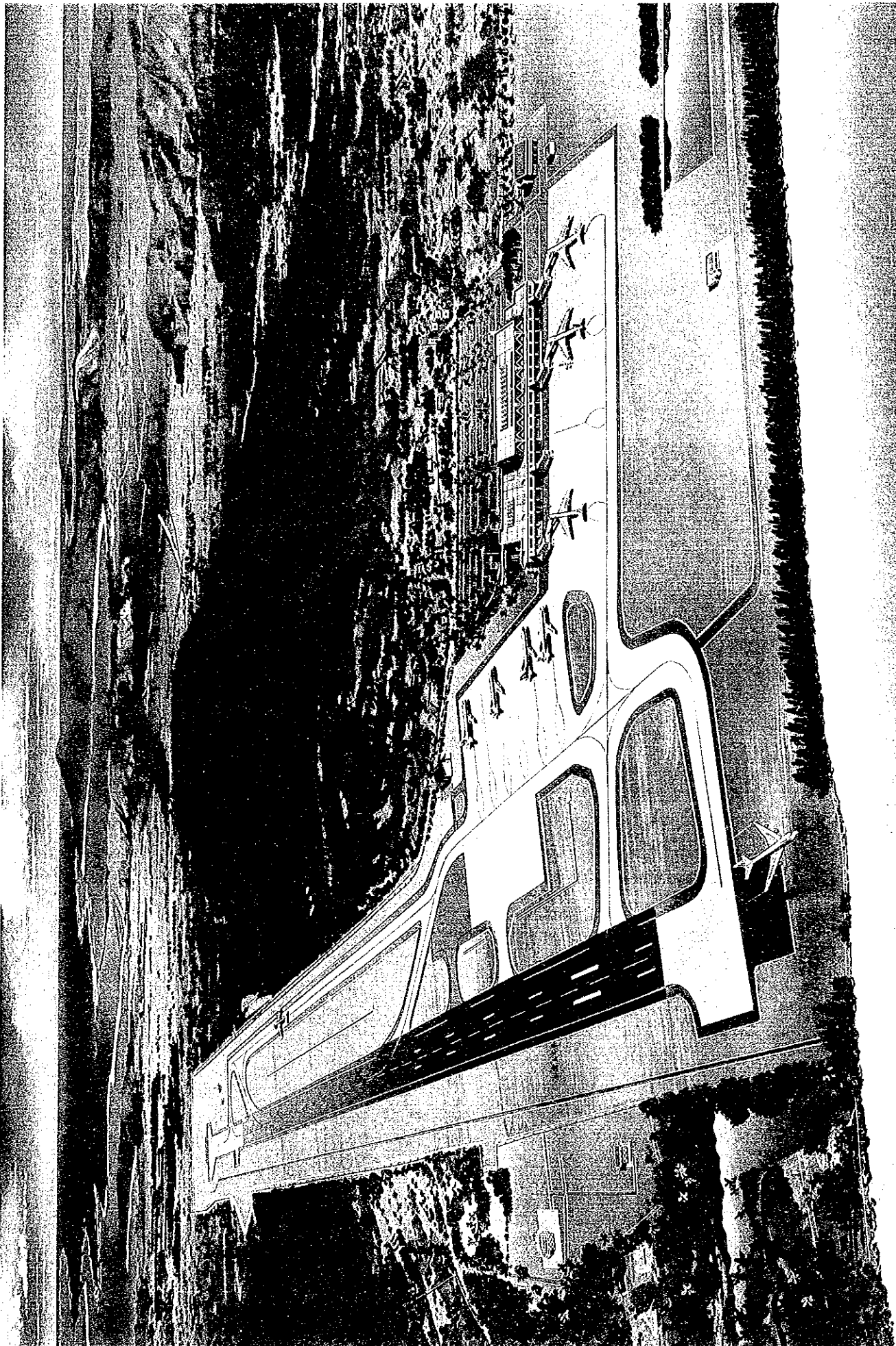
Very truly yours,


YOSHIYA NIINOMI

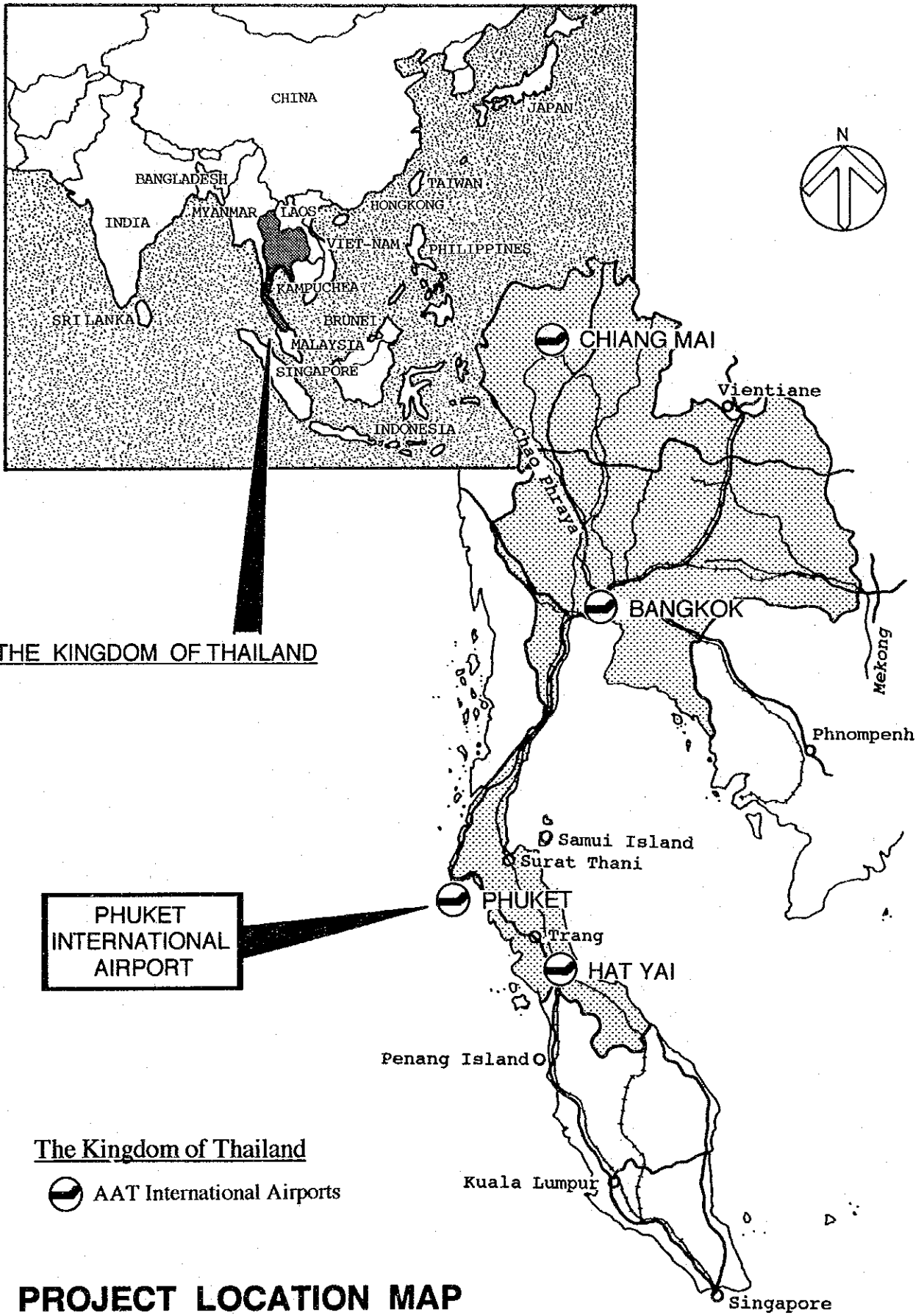
Team Leader

Phuket International Airport Development Plan

Pacific Consultants International in Association
with Pasco International Inc.



PHUKET INTERNATIONAL AIRPORT SHORT-TERM DEVELOPMENT PLAN



THE KINGDOM OF THAILAND

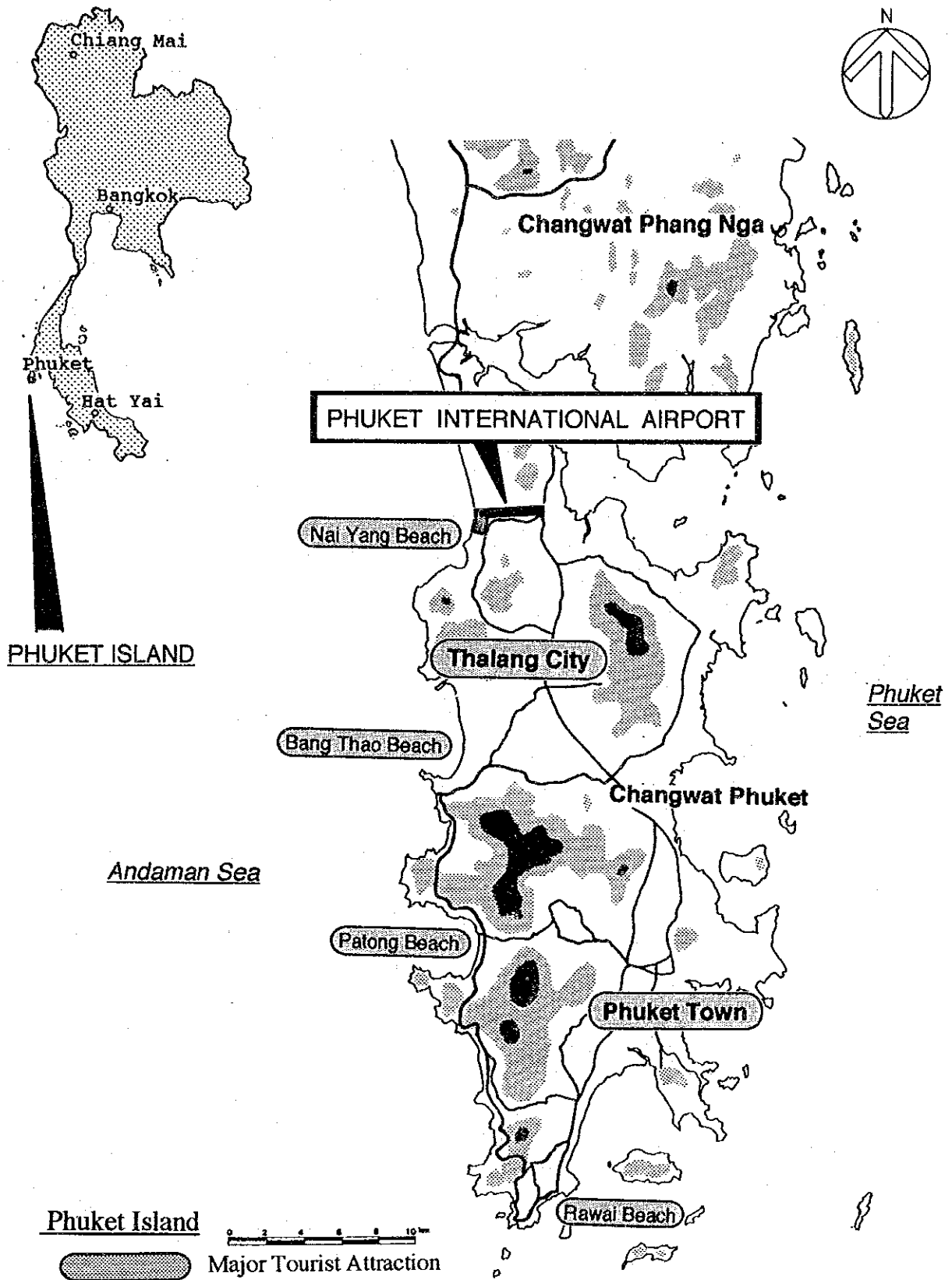
**PHUKET
INTERNATIONAL
AIRPORT**

The Kingdom of Thailand

⊖ AAT International Airports

PROJECT LOCATION MAP

(1)



PROJECT LOCATION MAP

(2)

The Kingdom of Thailand
The Study on
Phuket International Airport Development Plan
Synopsis

(1) Background and Objective of the Study

Phuket Island is an island with an area of 543 sq.km situated on the west coast of Malay Peninsula in southern Thailand. It is well known as one of the famous marine resorts not only in Thailand but also in Southeast Asia due to the abundance of nature especially with the beautiful sea.

Phuket International Airport is the gateway to this resort island, and it is located in the northern part of the island. There are many air routes operated from Phuket International Airport; domestic routes to Bangkok and other cities in Thailand, and international routes to major cities in Asia such as Singapore, Hongkong and Tokyo. Charter flights from Europe are also operated in the tourist season.

The total number of passengers to/from Phuket International Airport was 2 million in 1992; 1.3 million in domestic routes and 700 thousand in international routes. Annual growth rate of passengers in these ten years amounts to 25% for domestic and 30% for international passengers. According to the results of the demand forecast in our Study, the passenger demand is expected to continue increasing to reach 3.8 million in 2000 and 6.8 million in 2010.

In order to cope with the increasing demand, the Government of Thailand and Airports Authority of Thailand have carried out several development works since 1987 such as runway extension to 3,000 m and construction of a new passenger terminal building.

However, the necessity of airport development for safety of aircraft operation has been recognized in terms of the problems regarding the facilities which are not in compliance with international standards sufficiently such as the width of the runway strip and separation distance between the runway and the parallel taxiway. Another serious problem is regarding the terrain conditions surrounding the airport such as the existence of obstructions intruding on the obstacle limitation surfaces stipulated in ICAO standards.

The objectives of the Study are to formulate a Master Plan for long-term development of Phuket International Airport for the target year 2010 and to study the feasibility of a short-term development plan for the existing airport to be formulated within the framework of the Master Plan.

(2) Airport Master Plan for Long-Term Development

Three alternative plans including a new airport alternative described below were studied for the Phuket International Airport development for the year 2010.

- (1) Alternative-1: Expansion of the existing airport where the facilities will be expanded so as to cope with the demand in the target year

- (2) Alternative-2: Upgrading of the existing airport where the facilities will be improved so as to comply with international standards in addition to the expansion works included in Alternative-1
- (3) Alternative-3: Construction of a New Airport which will be constructed with the same capacity and same grade as Alternative-2 to replace the existing airport

Through the comparative studies of these three alternatives, Alternative-3 was selected as an optimum development plan due to the following reasons;

- The new airport shall be developed with an ideal layout of facilities and with expansibility in the future.
- The new airport shall be developed in compliance with international standards.
- There are some difficulties for future development at the existing airport such as land acquisition and large-scale earthwork.

Outline of a new airport of the selected alternative is summarized as follows:

Annual passengers:	6.8 million
	international: 3.1million
	domestic: 3.7million
Target aircraft operated:	B747 class
Major facilities:	
Runway	3,500 m x 45 m
Runway strip	3,620 m x 300 m
Taxiway	Parallel taxiway and Exit taxiways
Apron	B747 class x 4 spots
	B777 class x 3 spots
	A300 class x 2 spots
	Small aircraft x 2 spots
Passenger terminal building	Floor area: 47,000 sq.m
	Two-level, reinforced concrete
Cargo terminal building	Floor area: 1,400 sq.m
Air navigation systems	ILS(Cat-I) or MLS, VOR/DME, NDB, Approach lighting system (Cat-I), etc.
Fuel supply system	Fuel storage and apron hydrant system

(3) Short-term Development Plan

In the framework of the airport master plan, a new airport will be constructed for the long-term development of Phuket International Airport. Therefore, development of the existing airport shall be minimized only to cope with the increase of traffic demand until completion of the new airport.

The scope of the short-term development plan at the existing airport for the target year 2000 are summarized as shown below:

Runway:	Pavement overlay for structure strengthening (Length:2,280m, Average overlay thickness: 12.7cm)
Passenger Terminal Building:	Expansion (6,980 sq.m)
Road and Car Park:	Expansion of parking slots (420 slots)
Utilities:	Installation of power generator, incinerator and telephone exchanger, and construction of deep water wells
Others:	Construction of additional security fence (L = 800 m)

(4) Implementation Schedule and Project Cost of Short-Term Development Plan

Implementation schedule of the Short-term Development Plan is summarized as follows:

Financial arrangement:	First quarter of 1994
Basic and detailed design:	Second to fourth quarter of 1994
Tendering:	1995
Commencement of construction works:	Beginning of 1996
Completion of construction works:	End of 1997

Project cost of the Short-Term Development Plan is as listed below:

<u>Items</u>	<u>Cost (in Million Baht)</u>		
	Local Portion	Foreign Portion	Total
Civil works:	51	77	128
Architectural works:	81	145	226
Airport utilities:	24	33	57
Physical contingency:	16	25	41
Engineering services:	4	41	45
Total:	176	321	497

(5) Evaluation of Short-Term Development Plan

Short-term development plan is evaluated from technical, economic and environmental viewpoints.

From the technical points of view, it is evaluated that the project has no technical problems since the preliminary design has been prepared in accordance with the

technical requirements and design standards such as ICAO standards for safe and efficient operation of the traffic in the airport.

From the economic point of view, the EIRR and NPV of the Project have been estimated at 25.96 % and 295.67 million Baht respectively which are high enough to justify the Project, while the FIRR has been estimated at 12.03 % using a discount rate of 12 %. Therefore, the financial arrangement of capital costs should be considered under subsidized conditions. Increase in regional incomes through the tourist expenditures by the incremental international passengers is essential to the continuous development of the tourism sector in Phuket.

From the environmental point of view, no significant impact is evaluated to the environment surrounding the airport judging from the work items and scale of works of the short-term development works.

(6) Recommendations

- 1) National and regional consensus for the project implementation should be obtained.
- 2) The preparatory and coordination works with organizations concerned are advisable to be undertaken as soon as possible.
- 3) Financial arrangement for project implementation should be prepared.
- 4) A separate study should be carried out for selection of a new airport site in full compliance with ICAO and other international standards in Phuket Island including in the sea or on the adjacent mainland, since such a site has not been found in our study area.

Especially in case of a new site in the sea, following items should be studied in detail:

- Meteorological conditions such as wind direction and velocity
- Marine conditions such as tidal current, wave height, etc.
- Environmental conditions in the reclamation area

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1. BACKGROUND AND OBJECTIVES OF THE STUDY

The Kingdom of Thailand is located in the center of the Indochina Peninsula, and shares its borders with Myanmar to the west and a part to the north, Kampuchea and Laos to the south and east divided by the Mekong River, and Malaysia to the South. The country has an area of 513,115 sq.kms and had a population of 52 million in 1991.

Phuket which is located in the Southern Region is one of the famous resort areas in South East Asia. Tourism industry in Thailand has played an important role for the acquisition of foreign currency from the beginning of 1980, and the annual average growth rate of foreign tourists was about 20 % up to 1991 before the start of the Gulf War.

Phuket International Airport is one of the five international airports in Thailand and is situated in the northern part of Phuket Island. The traffic volume of passengers and aircraft movement in 1992 was 2.0 million and 18,844, and the annual average growth rates during the period from 1982 and 1992 was 26.4 and 17% respectively. The development of the airport is required in order to cope with the sharply increasing demand of passenger traffic as mentioned above. However, the airport has many difficulties and constraints for further development. Furthermore, decentralization of international flights from Bangkok International Airport to other airports including Phuket Airport is required due to the saturated condition of current facilities.

In consideration of the above mentioned circumstances, the Government of Thailand is now considering Phuket International Airport as one of the promising alternative airports to Bangkok International Airport. The Government, therefore, has assigned a high priority to the airport for development, and AAT has executed the development to cope with the increased traffic demand based on the government policy.

Based on these circumstances, the Government of Thailand requested the Government of Japan to conduct the Study on Phuket International Airport Development Plan. In response to the request, the Japan International Cooperation Agency (JICA), the official agency responsible for implementing technical cooperation programmes of the Government of Japan, was entrusted to undertake the study in close coordination with Airports authority of Thailand (AAT), the official Thai counterpart agency corresponding to JICA.

The objectives of the Study agreed upon between the two parties are as follows:

- Establishment of a long-term master plan for the development of Phuket International Airport targeted for the year 2010,
- Implementation of a feasibility study for the short-term development plan targeted for the year 2000,
- Implementation of technology transfer during the Study.

2. FUTURE AIR TRAFFIC DEMANDS AND PROBLEMS OF THE EXISTING AIRPORT

2.1 OUTLINE OF THE EXISTING PHUKET INTERNATIONAL AIRPORT

Phuket International Airport, located at the north end of Phuket Island, about 32 km from Phuket town, is operated by the Airports Authority of Thailand. No military or privately-owned aircraft are based at the airport; there are very few non-commercial operations.

Airline service is provided primarily by Thai Airways International to Bangkok, Singapore, Tokyo, Perth, and feeder services to Chiang Mai, Trang, Hat Yai and Surat Thani. International scheduled service is also provided by the other foreign carriers. Various charter carriers come to the airport in the high season. The most common aircraft is Airbus A-300 and the largest aircraft is Boeing B-767.

The airport served approximately 2.01 million passengers in 1992. Growth during recent years has increased very sharply, with passenger traffic increase of 30-50% per year over the past four years and aircraft movements increased about 20% per year over the same period.

Major facilities of the airport are summarized below :

- Runway : 3,000 m
- Taxiways :
 - Partial parallel taxiway
 - 2 rapid exit taxiways
 - Connecting taxiways to the aprons
- Aprons :
 - 4 aircraft stands for airbus (Apron C)
 - 6 aircraft stands for airbus
- Buildings :
 - Passenger terminal building
 - Cargo terminal building
 - Control tower
 - Fire station
- Navigation aids :
 - ILS (GP, offset LLZ, M/M)
 - VOR/DME
 - NDB
 - SALS

The existing airport layout plan is shown in **Figure 1**.

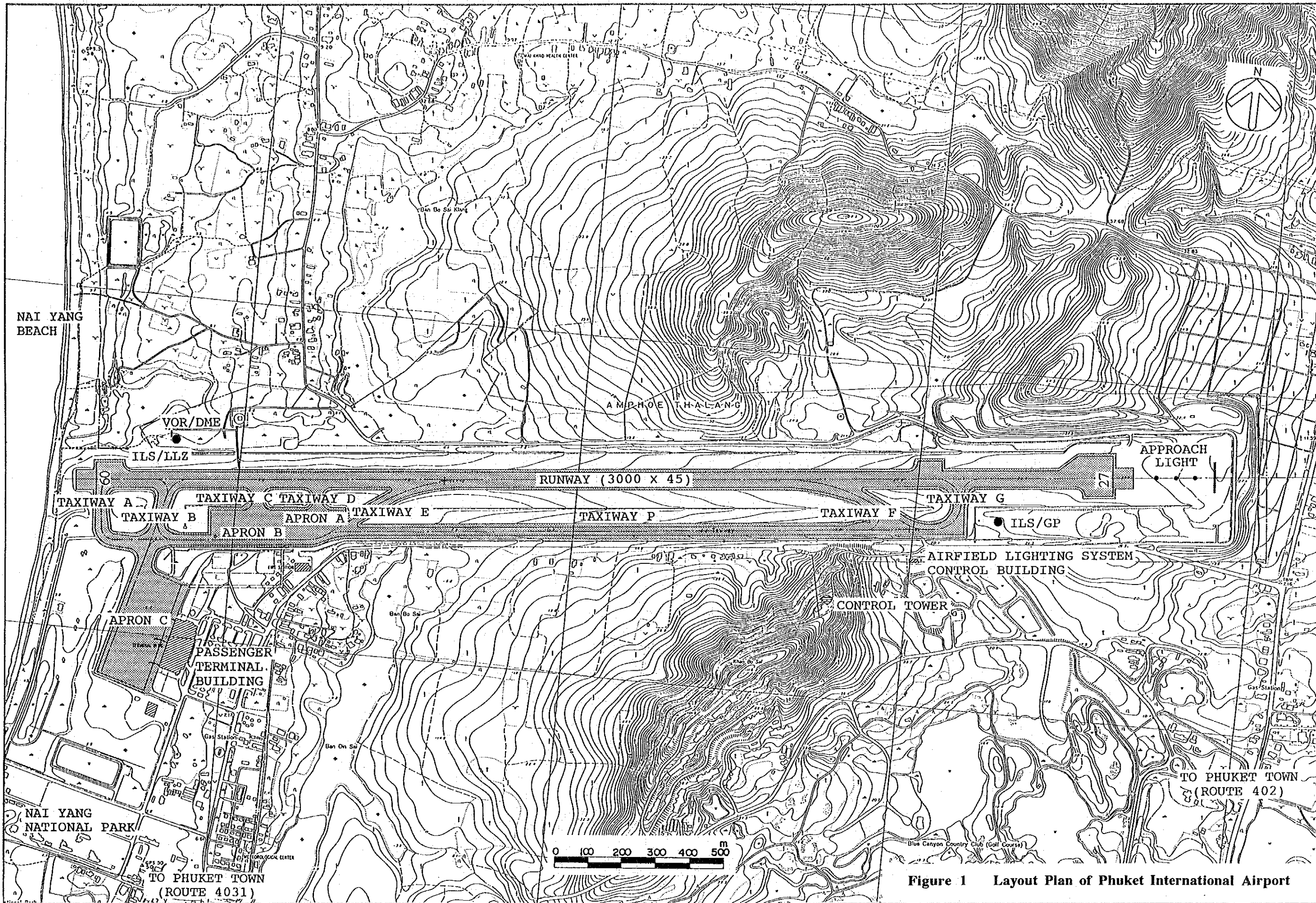


Figure 1 Layout Plan of Phuket International Airport

2.2 AIR TRAFFIC DEMAND FORECAST

The air traffic demands for Phuket International Airport, which are the principal planning factors for airport facilities, have been forecasted up to the year of 2010 covering the following categories:

- a) International Passengers
- b) Domestic Passengers
- c) International Freight
- d) Domestic Freight
- e) Aircraft Movements

Economic framework of the country and Phuket Changwat which have been estimated based on the National Development Plan, population projection, sectoral master plan, etc. are applied as independent variables to indicate future demand in the forecast.

Air Passenger Demand Forecast

In Phuket International Airport, the share of foreigners in total air passengers are very high, which is estimated at 77 % as shown below, and their purpose of travel is to spend their holidays in Phuket.

a) International Passengers (Foreigner)	35%
b) International Passengers (Thai)	0%
c) Domestic Passengers (Foreigner)	42%
d) Domestic Passengers (Thai)	23%

Therefore the future passenger demand for Phuket International Airport has been separately projected not in terms of international passengers and domestic passengers but in terms of foreign passengers and Thai passengers.

Firstly the future traffic demand for international passengers from/to Thailand has been projected in order to assume the growth model of foreign passengers in Thailand by econometric model using the GDPs of respective market segments as independent variables.

Secondly demand of domestic passengers for the whole country has been prepared using the multiple liner model with the GDP of Thailand and the number of international passengers from/to Thailand as independent variables..

Thirdly demand of foreign passengers from/to Phuket (for both international and domestic passengers) by market segments has been projected based on the growth model of demand forecasts for foreign international passengers from/to Thailand.

Fourthly demand of Thai domestic passengers from/to Phuket has been projected based on the demand of domestic passengers in the whole of Thailand.

Finally the total future traffic of air passengers from/to Phuket International Airport has been projected in terms of foreign passengers and Thai passengers. Total demand of air passengers has been allocated to international passengers and domestic passengers. The passenger demand has been broken down into the demand by route. Opening of new international routes to/from several countries have been considered in accordance with the increase of passenger demand. Therefore, some of the domestic passengers on the Bangkok route has been converted to the international passengers on the direct route to/from their countries.

Air Freight Demand Forecast

The future demand for international freights and domestic freights in whole Thailand has been estimated by an econometric model using the GDP of Thailand as an independent variable and then allocated to Phuket International Airport based on the change in the share of GPP of Phuket Changwat in the GDP of the country.

The results of demand forecast are shown in **Table 1**.

Table 1 Results of Demand Forecast

	1995	2000	2005	2010
International Passengers (thousand)	1,093	1,749	2,360	3,105
Domestic Passengers (thousand)	1,492	2,039	2,783	3,701
Total Passengers (thousand)	2,585	3,788	5,143	6,806
International Freight (tons)	1,544	2,370	3,307	4,615
Domestic Freight (tons)	4,581	7,262	10,314	14,574
Total Freight (tons)	6,125	9,632	13,621	19,189
International Aircraft Movement	6,500	9,000	11,000	14,400
Domestic Aircraft Movement	6,100	8,400	11,400	15,300
Total Aircraft Movement	12,600	17,400	22,400	29,700

Table 2 shows the forecasted passengers by routes for the years 2000 and 2010. Air traffic demand of passengers and aircraft movements including the peak hour forecast are summarized in **Table 3**.

Table 2 Annual Passengers by Route

Route	1991	2000	2010
Bangkok	1,106,800	1,850,300	3,351,900
Chiang Mai	40,500	73,300	135,400
Hat Yai	35,400	63,800	117,700
Surat Thani	7,000	12,800	23,700
Trang	1,800	3,000	5,600
Samui	19,500	36,000	66,600
Domestic Routes	1,211,000	2,039,200	3,700,900
Singapore	176,800	507,300	898,100
Taipei	77,800	228,700	404,900
Hong Kong	61,900	182,100	322,700
Penang	49,600	143,800	254,700
Kaohsiung	38,900	114,500	202,900
Kuala Lumpur	30,000	81,100	143,200
Tokyo	21,200	61,000	92,600
Langkawi	7,000	20,500	36,400
Fukuoka	3,500	10,200	15,400
Perth	3,500	13,800	24,900
London	–	87,100	160,200
Frankfurt	21,200	59,000	108,500
Munich	14,100	39,300	72,300
Paris	–	31,700	58,300
Zurich	–	30,900	56,800
Amsterdam	10,600	29,500	54,200
Stockholm	8,800	24,600	45,200
Vienna	8,800	24,600	45,200
Copenhagen	7,100	19,700	36,200
Milan	7,100	19,700	36,200
Rome	7,100	19,700	36,200
International Route	555,000	1,748,800	3,105,100
Total	1,766,000	3,788,000	6,806,000

Table 3 Summary of Air Traffic Demand Forecast

Item		Year				
		Present	Future Requirement			
			1992	1995	2000	2005
1. Annual Passengers (thousand)						
- International	no.	643	1,093	1,749	2,360	3,105
- Domestic	no.	1,272	1,492	2,039	2,783	3,701
- Total	no.	1,915	2,585	3,788	5,143	6,806
2. Annual Cargo						
- International	ton	1,028	1544	2370	3307	4615
- Domestic	ton	2,096	4,581	7,262	10,314	14,574
- Total	ton	3,124	6,125	9,632	13,621	19,189
3. Annual Aircraft Movements		a				
- International	no.	7,662	6,500	9,000	11,000	14,400
- Domestic	no.	9,320	6,100	8,400	11,400	15,300
- Total	no.	16,982	12,600	17,400	22,400	29,700
4. Typical Week Passengers						
- International	no.	17,700	26,000	43,300	56,400	76,900
- Domestic	no.	29,000	33,500	45,800	62,500	83,100
- Total	no.	46,700	59,500	89,100	118,900	160,000
5. Typical Week Aircraft Movements		b				
International	no.	142	160	224	276	356
- B-747-400 class		-	-	44	98	158
- 777 / A-330 class		-	30	42	24	20
- 767 / A-300 class		88	96	80	122	136
- B-737 class		54	34	58	32	42
Domestic	no.	230	138	190	256	344
- 777 / A-330 class		-	96	132	180	238
- 767 / A-300 class		144	6	10	12	18
- B-737 class		56	10	14	18	26
- ATR-42 class		30	26	34	46	62
Total	no.	372	298	414	532	700
6. Peak Hour Passengers (both-way)		b				
- International	no.	400	600	900	1,100	1,500
- Domestic	no.	700	900	1,100	1,400	1,700
- Total	no.	1,100	1,500	2,000	2,500	3,200
7. Peak Hour Aircraft Movements (both-way)		b				
- International	no.	3	4	5	6	7
- Domestic	no.	5	4	5	6	7
- Total	no.	8	8	10	12	14

Note : a : as of 1991; including non-scheduled flights

b : calculated figure based on 1992/1993 winter schedule

2.3 AIRPORT FACILITY REQUIREMENTS

The facility requirements are estimated basically in compliance with the relevant standards and recommended practices of International Civil Aviation Organization (ICAO), those of Federal Aviation Administration (FAA) of the United States, Japan Civil Aviation Bureau (JCAB) and International Air Transport Association (IATA) are also referred to in areas where the ICAO does not cover or more practical planning is possible by using these standards. The facility requirements for Phuket International Airport are established for a period from 1995 to 2010 at five year intervals, and the results are summarized in **Table 4**.

Table 4 Summary of Airport Facility Requirements

Item		Year				
		Present	Future Requirement			
		1993	1995	2000	2005	2010
1. ICAO Aerodrome Reference Code		4D	4E	4E	4E	4E
2. Runway						
- length	m	3,000	3,000	3,000	3,500	3,500
- Width	m	45	45	45	45	45
3. Runway Strip						
- Length	m	3,240	3,120	3,120	3,620	3,620
- Width	m	150	300	300	300	300
4. Taxiway						
- System		4 Exit	Parallel Full	Parallel Full	Parallel Full	Parallel Full
- Width	m	23.0	23.0	23.0	23.0	23.0
5. Apron						
- B-747-400 class	no.		0	2	3	4
- 777 / MD-11 class	no.		3	2	2	3
- 767 / A-300 class	no.	4	2	2	2	3
- Small jet / Propeller	no.	6	1	1	1	1
6. Passenger Terminal Building						
- International	sq. m	12,361	12,000	18,000	22,000	30,000
- Domestic	sq. m	11,494	9,000	11,000	14,000	17,000
- Total	sq. m	23,855	21,000	29,000	36,000	47,000
7. Cargo Terminal Building						
- International	sq. m		110	170	240	330
- Domestic	sq. m		330	520	740	1,040
- Total	sq. m	1,100	440	690	980	1,370
8. Administration/Operations Building						
- AAT	sq. m	(in Pax Bldg.)	4,500	4,500	4,500	4,500
- Control Tower	sq. m	1,092				
9. Carpark						
- Parking Slots	no.	190	450	600	750	960
- Area	sq. m	5,700	15,800	21,000	26,300	33,600
10. Passenger Building Curb						
- International	m		80	120	140	200
- Domestic	m		120	140	180	220
- Total Length	m	140	200	260	320	420
11. Air Navigation Systems						
- Operational Category		Precision (ILS, NDB, VOR/DME)	Precision (ILS, NDB, VOR/DME)	Precision (MLS, NDB, VOR/DME)	Precision (MLS, NDB, VOR/DME)	Precision (MLS, NDB, VOR/DME)
12. Rescue and Fire Fighting						
- Level of Protection		Category-8	Category-8	Category-8	Category-8	Category-8
- Fire Station	sq. m	984	450	450	450	450
13. Airport Utilities						
- Power Supply	KVA	50,000	3,100	4,100	4,900	6,300
- Water Supply	ton/day	300	260	340	410	520
- Sewage Disposal	ton/day	250	260	340	410	520
- Solid Waste Disposal	kg/day	none	2,200	2,800	3,300	4,100
14. Fuel Supply Facility						
- Tank Capacity (JET A1)	KL	538	1,600	2,200	3,100	4,000
- Fuel Depot Area	sq. m	48,000	10,400	10,400	10,400	10,400

2.4 EVALUATION OF EXISTING AIRPORT

The evaluation is based on the findings of site investigation at the airport, and data and information collected through the field surveys.

Figure 2 illustrates the summary of the evaluation which compares the capacity of existing facilities with the requirements. Major problems of the existing airport are identified as follows :

(1) Problems in terms of Safety

- There are the hills adjacent to the runway on both sides which infringe upon the transitional and inner horizontal surfaces defined by ICAO. The hill 4 km east of the Runway 27 threshold is the obstacle infringing on the approach surface. Due to this hill, angle of glide slope of ILS for Runway 27 is set at 3.2 degree which is more than the standard glide angle.
- The width of the existing runway strip is 150 m which is much less than the 300m recommended by ICAO for a non-precision approach runway of code number 4.
- The separation distance between the runway and the taxiway is 150 m which is below the ICAO's recommendation for the current aerodrome reference code D. Strength of runway pavement is not sufficient for B747 class aircraft operation anticipated in 2000.

(2) Problems in terms of Capacity

- The capacity of the passenger terminal building and car park is not sufficient for future demand in 2000 and after.
- Strength for existing pavement is not sufficient for B747 class aircraft which is expected to be operated in 2000.

Figure 2 Summary of Evaluation for Existing Facilities

No.	Facilities	Year	1992	1995	2000	2005	2010	Remarks
1	Runway * Number * Length * Width							A single runway can handle aircraft movement up to 2010. A 3,500m long runway will be required when B747 direct flights to Europe are operated. A 45m wide runway is adequate for aircraft up to B747.
2	Runway Strip * Length * Width							The length of the strip should be extended when the runway is extended. A 300m wide strip is recommendable in compliance with international standard.
3	Obstacle Limitation Surfaces - Approach surface - Transitional Surface		X	X				The hill intruding upon the surface is an obstruction The hills both sides of the runway are obstructions.
4	Taxiway * Separation Distance		X					The existing distance of 150 m is not sufficient for operation of A 300 class or larger aircraft.
5	Apron * Aircraft Loading							Parking space will become short after 2005 even though the apron expansion now under construction is completed.
6	Airfield Pavement * Strength							The strengthening of the existing pavement is required for operations of B777/A330 or larger class aircraft. Passenger terminal building should be expanded after 1995.
7	Passenger Terminal Building - International - Domestic							
8	Cargo Terminal Building							Cargo terminal building is planned to be expanded by AAT.
9	Administration and Operation Building - AAT Office - Control Tower		X	X				A separated administration building for AAT is ideal. The tower is located at unsuitable site.
10	Car Park		X					Parking space is not enough during peak hours.
11	Passenger Building Curb							Passenger building curb should be expanded together with PTB expansion. Life span of NDB will end soon.
12	Air Navigation System - Radio Navigation Aids - Air Traffic Control System - Aeronautical Communication System - Airfield Lighting System - Meteorological Observation System							Secondary surveillance radar should be provided to the existing ASR facility. System is adequate and maintained well. Approach lighting system is to be rebuilt at the same time of runway extension Power supply for the system should be enhanced (system itself has no problem). Present level of protection of Category-8 is enough up to 2010.
13	Rescue and Fire Fighting - Level of Protection - Fire Station							The building is large enough up to 2010.
14	Airport Utilities - Power Supply - Water Supply - Sewage Disposal - Solid Waste Disposal							The capacity of emergency generator for Passenger Terminal Building is inadequate. The capacity of deep well will be a problem. The capacity of oxidation pond is enough. No incinerator is available at the airport. Storage capacity of the fuel tanks is below requirements.
15	Aviation Fuel Supply		X					

Note: " X indicates facility reached its capacity or is not adequate.

3. AIRPORT MASTER PLAN AND SCOPE OF THE SHORT-TERM DEVELOPMENT PLAN

3.1 PHASES OF THE AIRPORT DEVELOPMENT

The phases of the airport development is set forth as follows:

Short-term development : Design target year 2000

Long-term development : Design target year 2010

3.2 BASIC POLICY FOR AIRPORT DEVELOPMENT

Three development alternatives as explained below are prepared for the long term development. Two alternatives are established for the existing airport development in consideration of two different concepts for development i.e. expansion and upgrading. In consideration of fundamentally different measure for the existing problem, one alternative for a new airport development will be established.

Alternative-1 : Expansion of the existing airport

In order to cope with the traffic demand of the target year, the facilities of the existing airport will be expanded and will have sufficient capacity for the future increasing traffic demand.

Alternative-2 : Upgrading of the existing airport

For further development of the airport in compliance with the international standard in addition to the development of Alternative-1, the existing airport will be improved in compliance with the ICAO standards and recommendations taking into consideration the cost and benefit of each work item.

Alternative-3 : New airport development

Due to the constraint of the existing airport for future development, another alternative will be established instead of the upgrading or expansion of the existing airport by the new airport construction. The new airport shall be planned in compliance with the ICAO standards and recommendations in order to be free from the various constraint experienced at the existing airport. For the completion of a new airport, it is considered to take many years, and for this reason short-term development will be temporarily required at the existing airport.

3.3 SELECTION OF NEW AIRPORT SITE

3.3.1 Requirements for New Airport Sites

The basic requirements of the airport for the study are as follows :

- Runway : 3,500 x 45 m
- Runway strip : 3,620 x 300 m
- A full parallel taxiway
- Apron
- Terminal building
- Car park
- Navigation aids

The basic shape of the airport property is as follows :

- A rectangular area of 3,720 x 400 m for the strip
- A rectangular area of 1,000 x 500 m for the terminal
- Spaces required for installation of ILS/LLZ and GP
- Spaces required for installation of 900 m long ALS

Following requirements of ICAO obstacle limitation surfaces for precision approach runways with the code number of 4 are taken into consideration :

- Approach surfaces to both directions
- Transitional surfaces in both sides
- Inner horizontal surface

3.3.2 The Process for Selection of a Suitable Site for the Airport

Nine sites as shown in **Figure 3** were studied by placing emphasis on aircraft operation and the environment. Through the field study, location of sites I-1 and I-3 were slightly changed in order to avoid the resort area and a newly constructed road. Site I-3 was changed by moving it closer to Site I-1

Table 5 shows the comparative evaluation of the nine possible new airport sites.

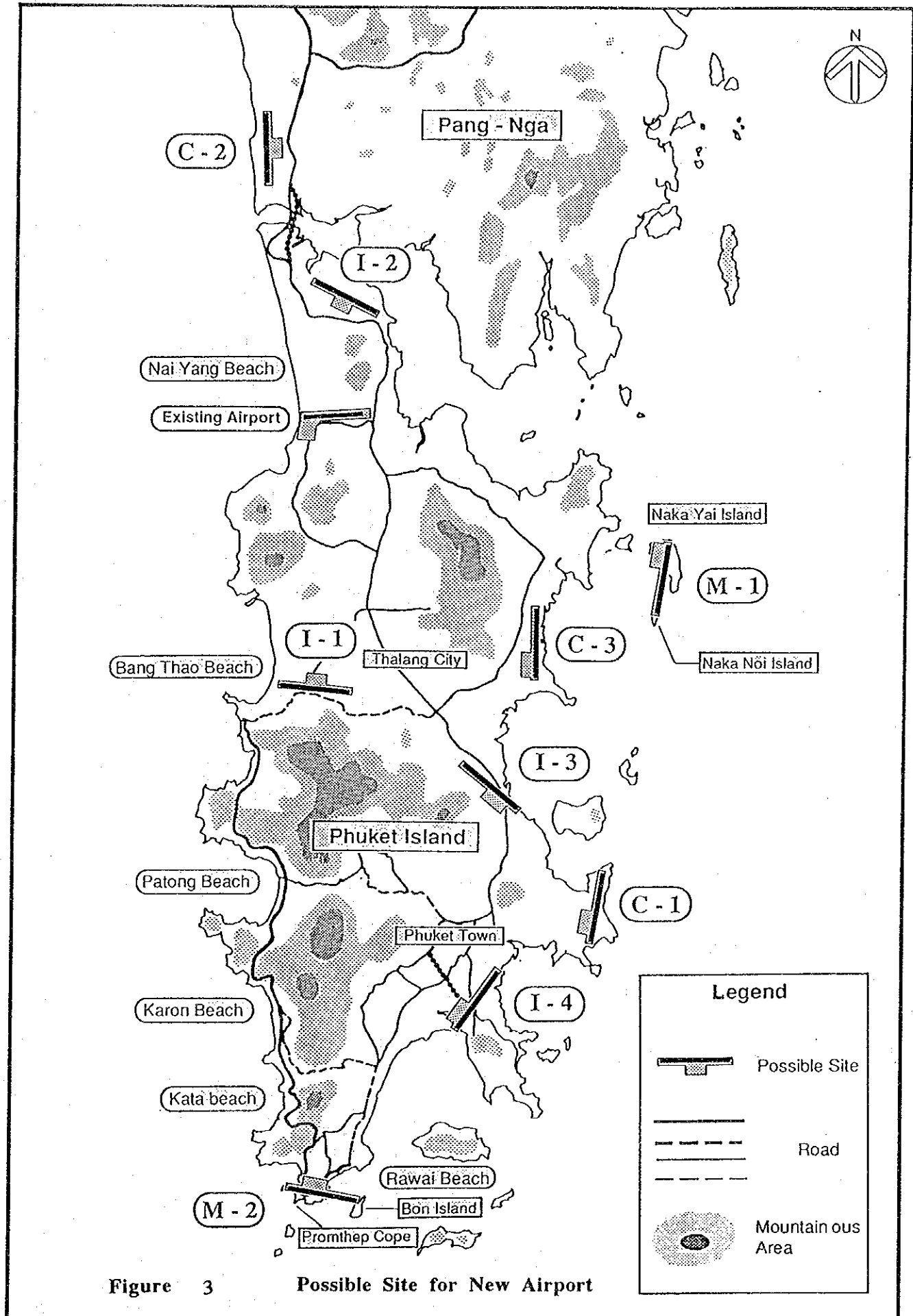


Figure 3 Possible Site for New Airport

Table 5 Evaluation of Airport Sites

Evaluation
 A : Excellent
 B : Fair
 C : Poor

Alt. No.	INLAND				MARINE		COAST			REMARKS
	I-1	I-2	I-3	I-4	M-1	M-2	C-1	C-2	C-3	
1 Site Condition										
- Location	Central plain of the Island, near to Bang Thach beach	Northern end of the Island, near Khlong Tha Nun strait	East end of the central plain of the Island, 10 km north of Phuket Town	South-east of the Island, 4km south of Phuket Town	North-east offshore of the Island, Nakha Yai and Naka Noi Islands in Phang Nga Bay N - S	South end of the Island, Partly off shore of the coast, and Man and Bon Islands E - W	South-east of the Island, 4km east of Phuket Town, Coast of a cape N - S	Opposite shore of Phuket Island, West coast of Mafay Pen. N - S	East of the central part of the Island, Along the coast of Phang Nga Bay N - S	
- Runway orientation	E - W	SEE - NWW	E - W	NE - SW						
- Surrounding condition	Rice field, plantation area, village and abandoned mine on flat terrain	Rubber plantation area and village on flat hill	Swampy area and relatively flat terrain	Plantation and mangrove area	Two small islands in relatively shallow sea	Rocky cape and small island	Plantation area between 200 and 130 meter high hills	Plantation area along undeveloped beach, and village	Plantation and mangrove area	
2 Airport Development Aspect										
- Extensibility of runway	A Extensible, One side	C Poor	B Partial reclamation	C Reclamation	C Large reclamation	C Large reclamation	C Poor	A Good	C Partial reclamation	
- Extensibility of terminal	A Expansible	A Expansible	A Expansible	A Expansible	B Reat Is. can be used	C Large scale earth work	C Large scale earth work	A Expansible	A Expansible	
- Accessibility	A	B	A	B	B	C	C	B	C	
Distance from Phuket Town	27 km	43 km	13 km	6 km	37 km	14 km	4 km	55 km	24 km	
Main access route	B Routes 402 & 4025	B Route 402	A Route 402	A Routes 4021 & 4023	B Route 402 & 4027	B Routes 4021 & 4024	A Existing road	C Route 402	C Routes 402 & 4027	
New access road	3.3km	0.8km	0.2km	0.3km	7.2km	1.5km	3.0km	0.5km	1.0km	
Special access way	None	None	None	None	Marine access	Marine access	Marine access	None	None	
3 Construction Aspect										
- Special civil work required	A None	A None	A B Rerouting of Route 4027	C Long rerouting of Route 4023	C New access road includes 1,000m and	C Large scale earth work for site preparation	C Large scale earth work for site preparation	A None	A B Detour of river	
- Need for land reclamation	A None	A None	A None	C Partly Swampy Area	C Large Scale	C Large Scale	A None	A None	A None	
- Availability of utilities (Elec., tel., etc.)	A No problem	A No problem	A No problem	A No problem	C Problematic	B Problematic	A No problem	A No problem	A No problem	
4 Aircraft Operational Aspect										
- Obstacle Limitation Surface										
Approach *	A Clear	A Clear	A Clear	A Clear	C Island on N (60m)	A Clear	A Clear	A Clear	C Hill on N (10m)	*Figure in () shows obstacle height above surface
Horizontal *	B Hill on N (160m)	A Hill on NNE (30m)	B Mountain on N (340m)	B Mountain on N (140m)	B Hill on W (30m)	A Hill on N (300m)	B Island on W (160m)	B Hill on E (10m)	C Mountain on W (440m)	
Transitional	C Mountain on S (450m)	A Mountain on SSW (220m)	C Mountain on S (80m)	C Hill on SE (180m)	A Clear	A Clear	A Clear	A Clear	C Terrain on E	
- Establishment of OPS procedure	A Clear	A Clear	A Clear	A Clear	A No problem	A No problem	B Possible	A No problem	C Problematic	
- Wind Coverage	B Possible	A No problem	B Possible	C Problematic	B Possible	A Good	B Possible	A No problem	B Possible	
	A Good	A Good	A Good	A Good				B Possible	B Possible	
5 Environmental Impact										
(Detailed evaluation is shown in Table 11.4.2)										
- Social Environment	B Fair	B Fair	A Few	B Fair	B Fair	C Significant	B Fair	B Fair	B Fair	
- Natural Environment	A A Few	B B Fair	A B Fair	C B Fair	B B Fair	C C Significant	B B Fair	A A Few	B B Fair	
- Quality of Life	B Fair	B Fair	B Fair	C Significant	A Few	A Few	B Fair	A Few	B Fair	
Comprehensive Evaluation	(A)	B	(A)	C	B	C	C	B	C	
Remarks (Main Disadvantages)		- Royal Park		- Noise Pollution to Phuket Town	- Wind coverage - Environment Problems	- Environment Problems	- Large Scale Earth Work	- Wind coverage - Tourism Development	- Obstacles (Hill and Mountain)	

◊ : priority evaluation items

Bold letters indicate the decisive points of disadvantages

3.3.3 Selection of A New Airport Site

In making the selection of the new airport, safe aircraft operation will be of prime consideration, with the least impact on the environment, with construction conditions, convenience of access, future expandability and cost of construction next in line. For the new Phuket Airport, when the two alternate sites are compared, the problem of environment will make the big difference with other matters following.

In the selection of the best suited site for the new airport, Site I-3 is considered to be the most suitable site from the following reasons: (i) it will be easier to obtain local cooperation and the minimum adverse impact will be made to the adjacent areas if the correct precautionary measures are taken in advance, (ii) countermeasures can be taken technically for the preservation of mangrove forests around the new airport site, and (iii) the airport with the scope desired can be constructed.

It is noted that Site I-3 and other sites in the island are not fully in compliance with ICAO recommendations since inner horizontal surfaces are not established due to the existence of the obstructions.

A new airport site completely free from obstructions for approach, transitional and horizontal surfaces recommended by ICAO could not be found in Phuket Island due to the mountainous terrain of the Island. Therefore, an ideal site for a new airport fully in compliance with international standards may be found in Phuket Island including in the sea or on the adjacent mainland by an additional and separate study, if necessary.

3.4 ALTERNATIVE STUDY ON AIRPORT MASTER PLAN

3.4.1 Airport Development Alternatives

Work items to be included in each alternative are summarized as shown in the following **Table 6**. Layout plans of each alternative are shown in **Figures 4 to 6**.

Table 6 Work Items for Alternatives-1, 2 and 3

Facilities		Problems at existing airport	Alt-1	Countermeasures		
				Alt-2	Alt-3	
Runway	Length	Not sufficient for the required length	Extension to 3,500m	Extension to 3,500m	New construction (3,500m)	
	Pavement	Not sufficient for B747/MD11 class aircraft	Overlay for strengthening	Overlay for strengthening	New construction (>PCN67)	
Runway Strip	Width	Existing width of 150m is below ICAO recommendation (300 m)	Same as Existing (150m) ◇	Expansion to 300 m ◆	New construction (300 m) ◆	
Parallel Taxiway	Separation distance with runway	Existing separation 150m is below ICAO recommendation (182.5 m)	Same as Existing (150 m) ◇	To be increased to 182.5 m ◆	New construction (182.5m) ◆	
	Length	Shorter than runway length	To be extended to R/W27 threshold	To be extended to R/W27 threshold	New construction	
	Pavement	Not sufficient for B747/MD11 class aircraft	Overlay	Overlay	New construction	
Apron	Number of aircraft stands	Not sufficient to meet requirement	Expansion	Expansion	New construction	
Passenger Terminal Bldg	Total floor area	Not sufficient to meet requirement	Expansion	Expansion	New construction	
Cargo Terminal Building	Total floor area	Not sufficient to meet requirement	Expansion	Expansion	New construction	
Car Park	Number of parking lots	Not sufficient to meet requirement	Expansion	Expansion	New construction	
Control Tower	Visibility	Parking Aircraft is not visible from VFR room	No relocation	Relocation	New construction	
Air Navigation System	ILS	Offset localizer	Same as existing	ILS approach to be established in the both directions of the runway	ILS approach to be established in the both directions of the runway	
		Middle marker site is close to the runway threshold.	Relocation to a suitable site	Relocation to a suitable site	New installation	
	Approach Lighting System	Insufficient configuration (length = 300 m)	Extension to ICAO standard configuration(900 m) ◆	Extension to ICAO standard configuration(900 m) ◆	New installation (900 m) ◆	
Obstacle Clearance Surfaces	Approach Surface (East)	Hill intrudes approach surface. Glide slope is set at 3.2 deg.	Hill is to be cut ◆	Hill is to be cut ◆	No obstruction ◆	
	Approach Surface (West)	No obstruction	---	---	---	
	Transitional surfaces (North)	Hills are intruding.	No cutting ◇	Hills are to be cut. ◆	No obstruction ◆	
	Transitional surfaces (South)	Hills and Control Tower are intruding.	No cutting ◇	Hills are to be cut and Control Tower to be relocated ◆	No obstruction ◆	
	Inner Horizontal Surface (North)	Hills are intruding.	No cutting ◇	No cutting ◇	No cutting ◇	
Inner Horizontal Surface (South)	Hills are intruding.	No cutting ◇	No cutting ◇	No cutting ◇		

Key to Symbol : ◆ Compliance with international standard

◇ Not compliance with international standard

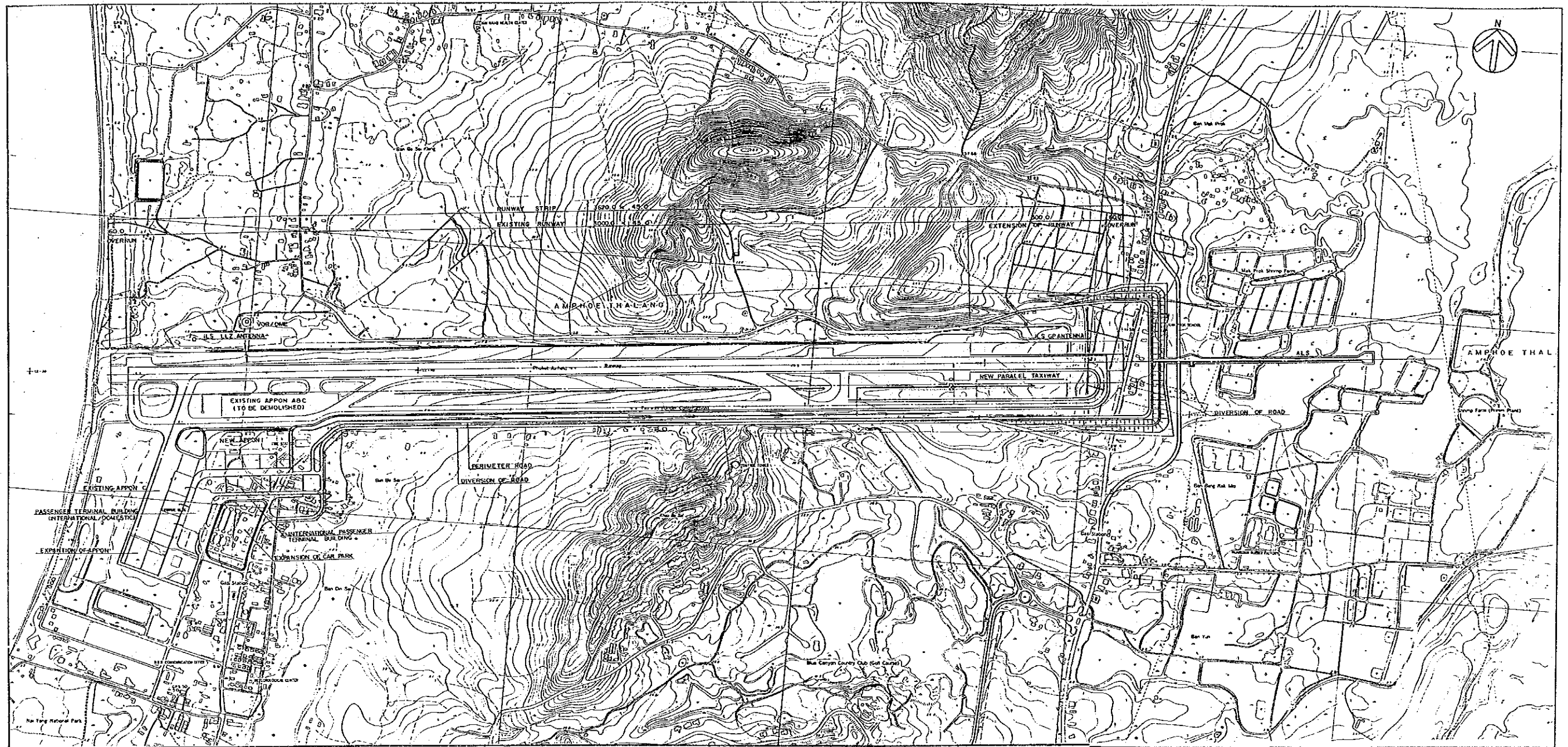


Figure 4 Layout Plan of Alternative-1 (S = 1 : 15,000)

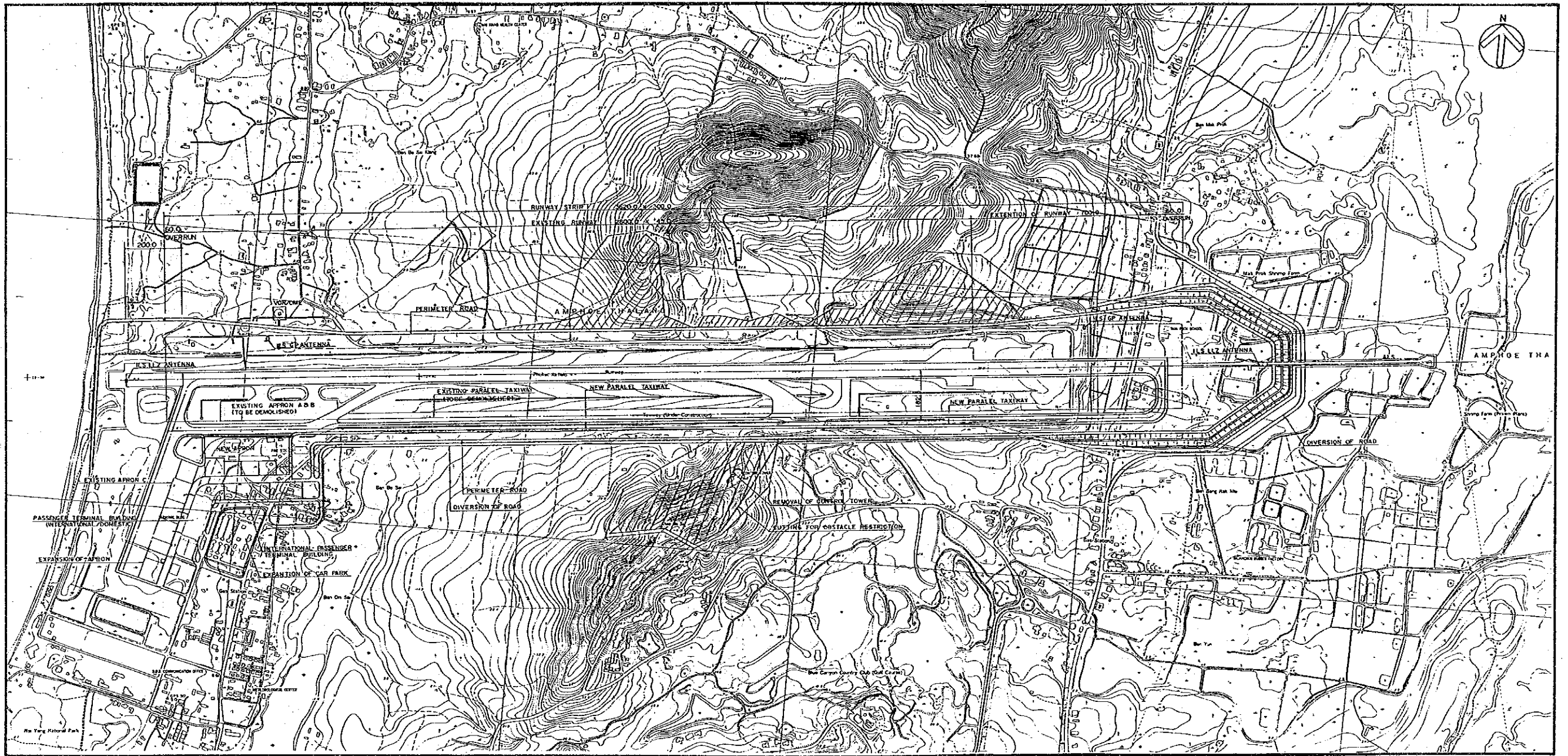


Figure 5 Layout Plan of Alternative-2 (S = 1 : 15,000)

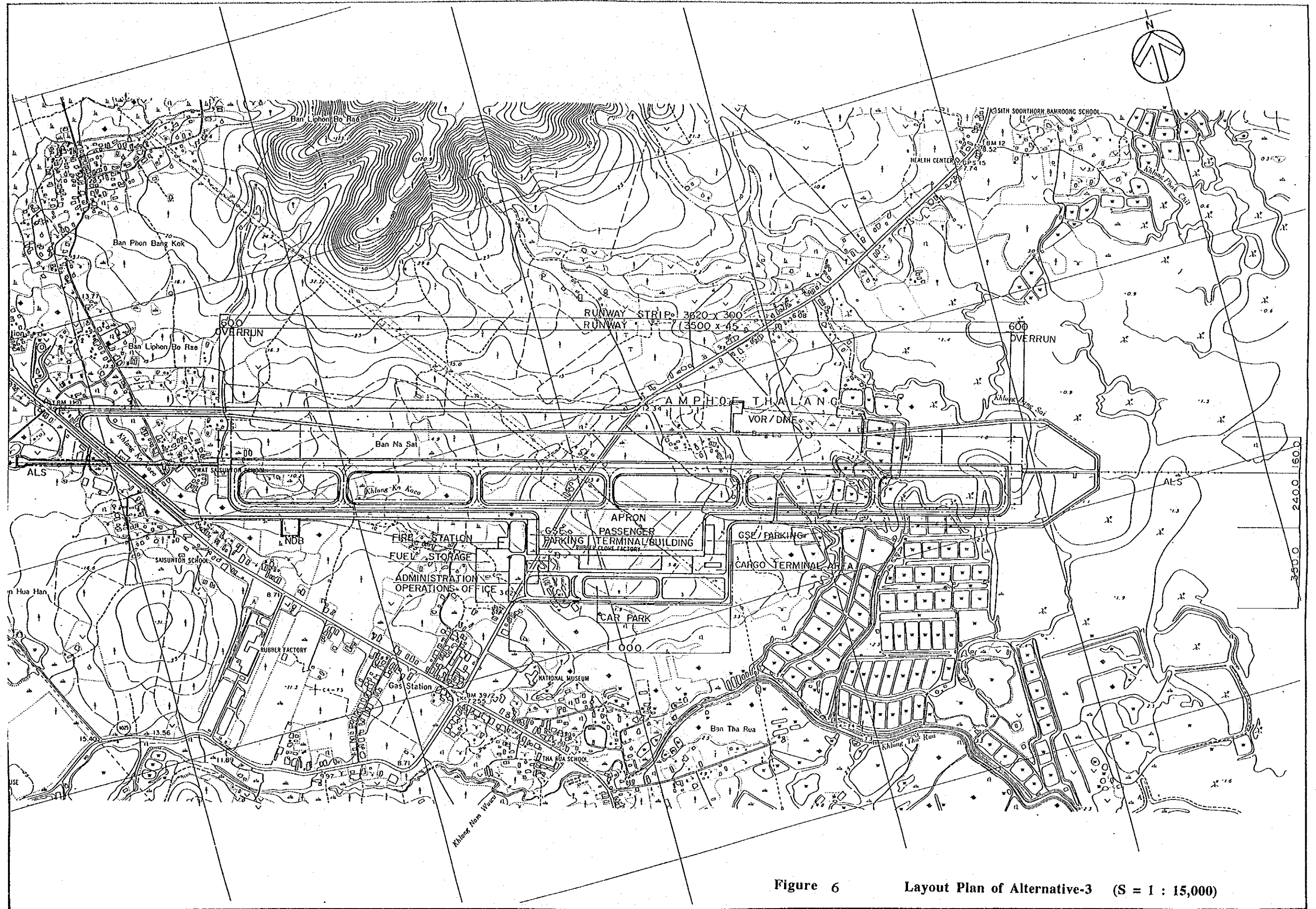


Figure 6 Layout Plan of Alternative-3 (S = 1 : 15,000)

3.4.2 Selection of Optimum Alternatives

(1) Comparison of the Three Alternatives

Alternative-1 is the concept where the airport will be improved in accordance with increase of traffic demand. Current problems such as runway strip width, separation distance between the runway and parallel taxiway, and obstructions penetrating upon the transitional and horizontal surfaces will not be resolved. ILS localizer will still be offset. However, construction cost is the lowest among the three alternatives and impact to the environment is minimum.

Alternative-2 is the concept where the airport will be upgraded to the international standard level as much as possible in addition to the improvements included in Alternative-1. Some constraints to the operation such as obstructions for the transitional surface will be relieved by much more civil works than Alternative-1. However, some constraints such as the obstructions for the horizontal surface are still remaining. Project cost is larger than Alternative-1 but smaller than Alternative-3 for new airport construction.

Alternative-3 is a new airport concept. In Alternative-2, the existing airport will be improved to the international standard levels. In Alternative-3, the same level of the facilities will be developed at the new airport site. In comparison with the existing airport site, there are no obstructions penetrating on the approach and transitional surfaces. There are still hills penetrating the horizontal surface. Major facilities such as the runway, taxiway, apron and terminal facilities will be located in accordance with international standards with sufficient future expansion space. On the other hand, land acquisition of about 280 ha will be necessary and the existing road and power transmission lines are to be diverted.

From the viewpoint of air space use, each alternative is outlined as follows:

For Alternative-1, obstructions are intruding upon the inner horizontal surface, conical surface and transitional surface. The hill intruding upon the Runway 27 approach surface is planned to be lowered. The study of Obstacle Assessment Surface (OAS) for establishment of a precision approach procedure for Runway 27 has proved that some obstacles project above the OASs. The hill south of the runway is the most critical obstacle for decision of the OCH/A (obstacle clearance height/altitude).

For Alternative-2, obstructions are intruding upon the same surfaces as Alternative-1. However, the hills that project above the transitional surface on the both sides of the runway are planned to be lowered. The study of OAS shows that the hill on the north side of the runway is a critical obstacle to decide the OCH/A.

For Alternative-3, there are obstructions in the inner horizontal surface and conical surface. The study of OAS indicates that no obstacles project above the OAS for precision approach procedure from both directions of the runway.

From the environmental point of view, three alternatives are described as follows:

In Alternatives-1 and 2, the east side of this area is located in the mangrove forest. But this forest is not in good condition, and the forest has been changed into other land use, mainly into ponds for fish, prawn or shrimp. Therefore no problems will be anticipated.

In Alternative-3, the land use surrounding this area is mainly rubber plantations, and the east side of this area is used as a fish or shrimp pond. There are some Muslims residing in this area. But the east side of this area may include the Klong Tha Rua mangrove reservation forest. Therefore detail reconnaissance on rights of common will be required in the feasibility study stage.

(2) Selection of Optimum Alternative

It is considered that Phuket International Airport will not only be expanded in accordance with future increase of traffic demand but also be upgraded so as to meet international standards so as to ensure safe aircraft operations by the release from current constraints. Alternative - 1 was thus eliminated.

However, there are some difficulties in establishment of inner horizontal surfaces of Obstruction Limitation Surfaces stipulated in Annex 14 of ICAO due to the mountainous terrain of the Island. Therefore, Alternatives-2 and 3 are selected as adequate alternatives in compliance with international standards as much as possible.

In the comparative study between the above two alternatives, the construction cost of Alternative-2 is lower than Alternative-3, and the existing facilities can be utilized effectively in Alternative-2.

Although these advantages are expected in Alternative-2, Alternative-3 is selected as the best alternative for Airport Master Plan in this Study for the following reasons:

- In comparison between Alternatives-2 and 3, there are no significant differences in the difficulties in land acquisition* and environmental conditions, however, Alternative-3 is slightly better in the constraints of the surrounding terrain.

Accordingly it is considered that the ability of the better layout of the airport will be regarded as the more important factor for the long-term development of the airport in order to secure efficient and safe operation for the increasing air traffic and to keep the future expansibility for further development.

- An ideal airport is expected to be developed at the new site to meet satisfactorily with international standards as much as possible by the airport authority and persons concerned.
- There are some difficulties expected for further development of the existing airport. For example, land acquisition and cutting of mountainous areas around the existing airport is very difficult since there are many laws and governmental organizations concerned.

Consequently, Alternative-3 is selected as the most preferable alternative for Airport Master Plan in this Study, judging from the future expansibility and pursuit of an ideal airport.

The new airport site for the Study is not fully in compliance with international standards. Therefore, the further detailed survey for the site selection will be required for the implementation of a new airport construction in the Island including in the sea or on the adjacent mainland.

* : Although land acquisition area for a new airport is larger than that in the existing airport, there are not so much difference in the acquisition procedures between both cases since, for a new airport, procedures can be made for a whole area at one time.

3.5 AIRPORT MASTER PLAN

Figure 7 shows the selected master plan for Phuket International Airport for the target year 2010.

There are not too many limitations on the layout plan in the new airport development. Each facility can be laid out better than those in the existing airport.

- Runway : 3,500 m long, 45 m wide, single runway
- Runway Strip: 300 m wide strip
- Taxiway : One full parallel taxiway
- Apron (11 aircraft stands in linear concept)
- Passenger Terminal Building (47,000 sq.m in floor area)
- Cargo Terminal Building (1,400 sq.m in floor area)
- Air Navigation System:
Category-I ILS or MLS, Terminal VOR/DME, NDB
Category-I ALS
PAPI s

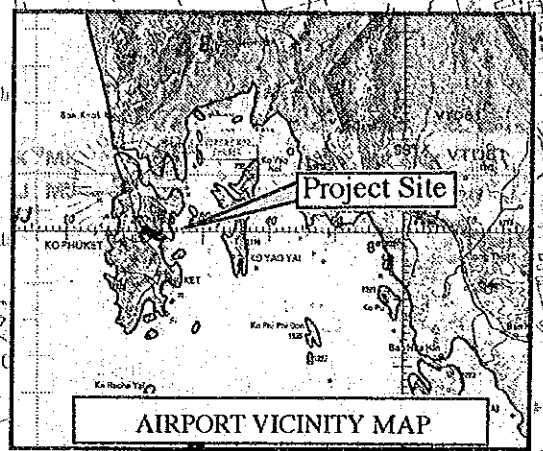
3.6 SCOPE OF THE SHORT-TERM DEVELOPMENT PLAN

Work items of the short-term development are listed in Table 7.

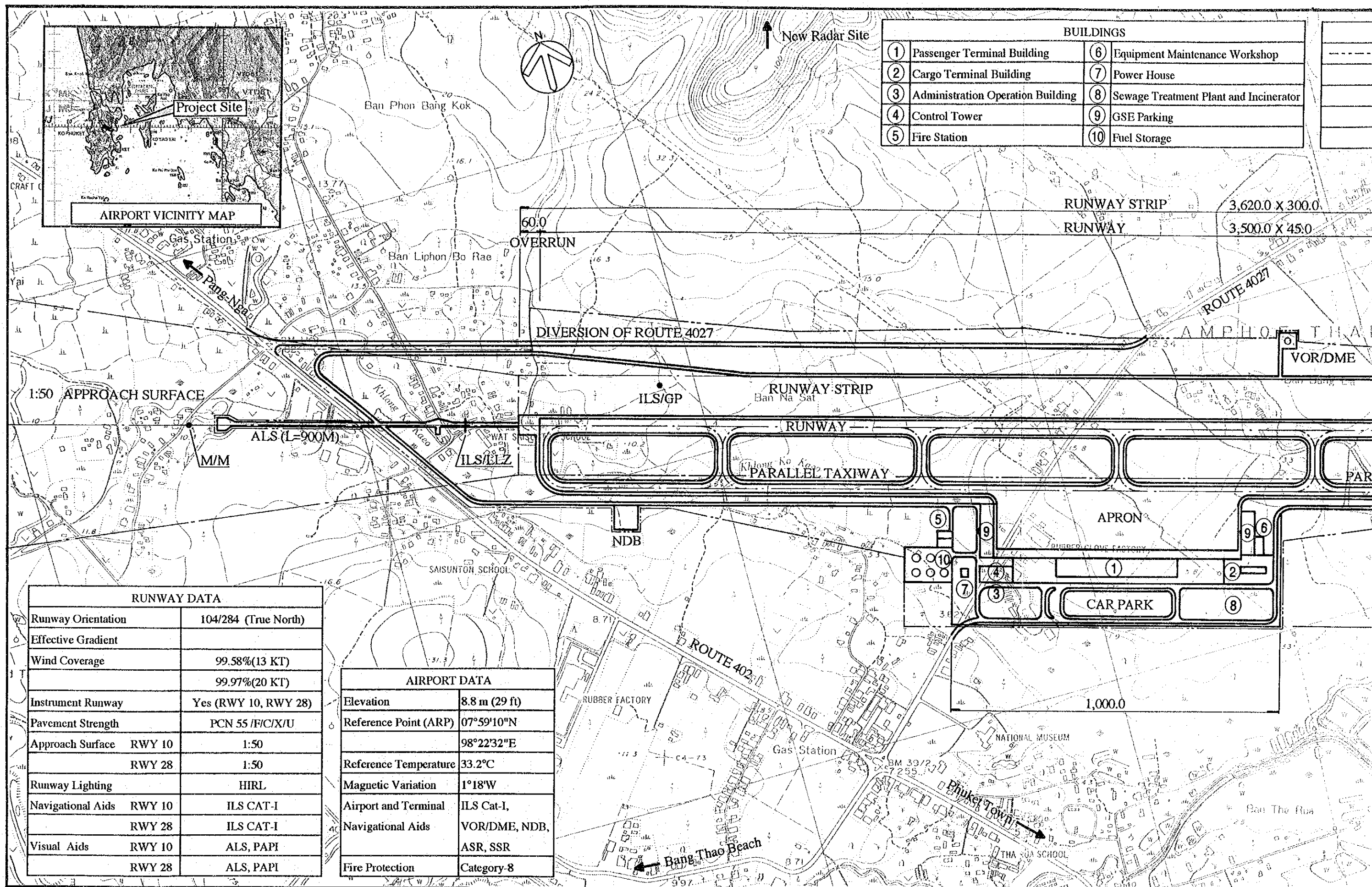
Work items for the short-term development are selected through the comparison between the existing capacity and the requirement in the year 2000, and the facilities which will not have sufficient capacity in the year 2000 will be expanded in the short-term development plan.

Table 7 Construction Work Items

A. Civil Works	
1) Runway Overlay	Construction section : STA 1110 to STA 3390 m (L = 2280 m) Minimum overlay thickness : 7.5 cm Average overlay thickness : 12.7 cm
2) Expansion of the Car Park	Number of parking slots : 420 cars
3) Miscellaneous Work	Construction of the additional security fence : L = 800 m
B. Architectural Works	
1) Expansion of Passenger Terminal Building	Floor area = 6,980 sq.m
C. Utilities	
1) Installation of Power Generator	
2) Construction of New Deep Water Well	
3) Installation of Incinerator	
4) Installation of Telephone Exchange	



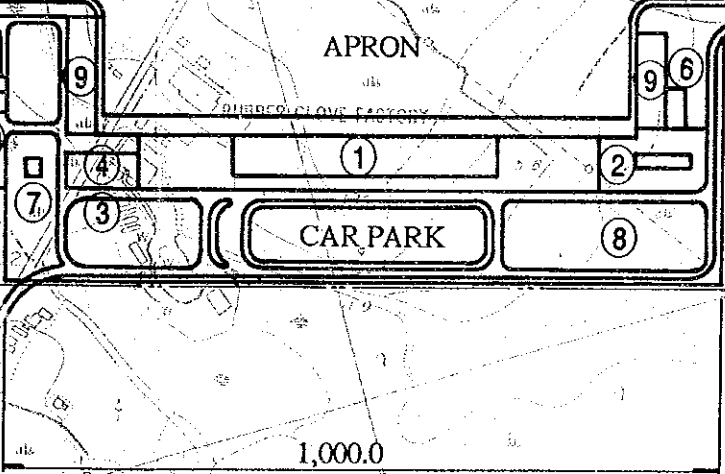
BUILDINGS	
① Passenger Terminal Building	⑥ Equipment Maintenance Workshop
② Cargo Terminal Building	⑦ Power House
③ Administration Operation Building	⑧ Sewage Treatment Plant and Incinerator
④ Control Tower	⑨ GSE Parking
⑤ Fire Station	⑩ Fuel Storage



RUNWAY DATA	
Runway Orientation	104/284 (True North)
Effective Gradient	
Wind Coverage	99.58%(13 KT) 99.97%(20 KT)
Instrument Runway	Yes (RWY 10, RWY 28)
Pavement Strength	PCN 55 /F/C/X/U
Approach Surface	RWY 10: 1:50 RWY 28: 1:50
Runway Lighting	HIRL
Navigational Aids	RWY 10: ILS CAT-I RWY 28: ILS CAT-I
Visual Aids	RWY 10: ALS, PAPI RWY 28: ALS, PAPI

AIRPORT DATA	
Elevation	8.8 m (29 ft)
Reference Point (ARP)	07°59'10"N 98°22'32"E
Reference Temperature	33.2°C
Magnetic Variation	1°18'W
Airport and Terminal	ILS Cat-I,
Navigational Aids	VOR/DME, NDB,
Fire Protection	ASR, SSR Category-8

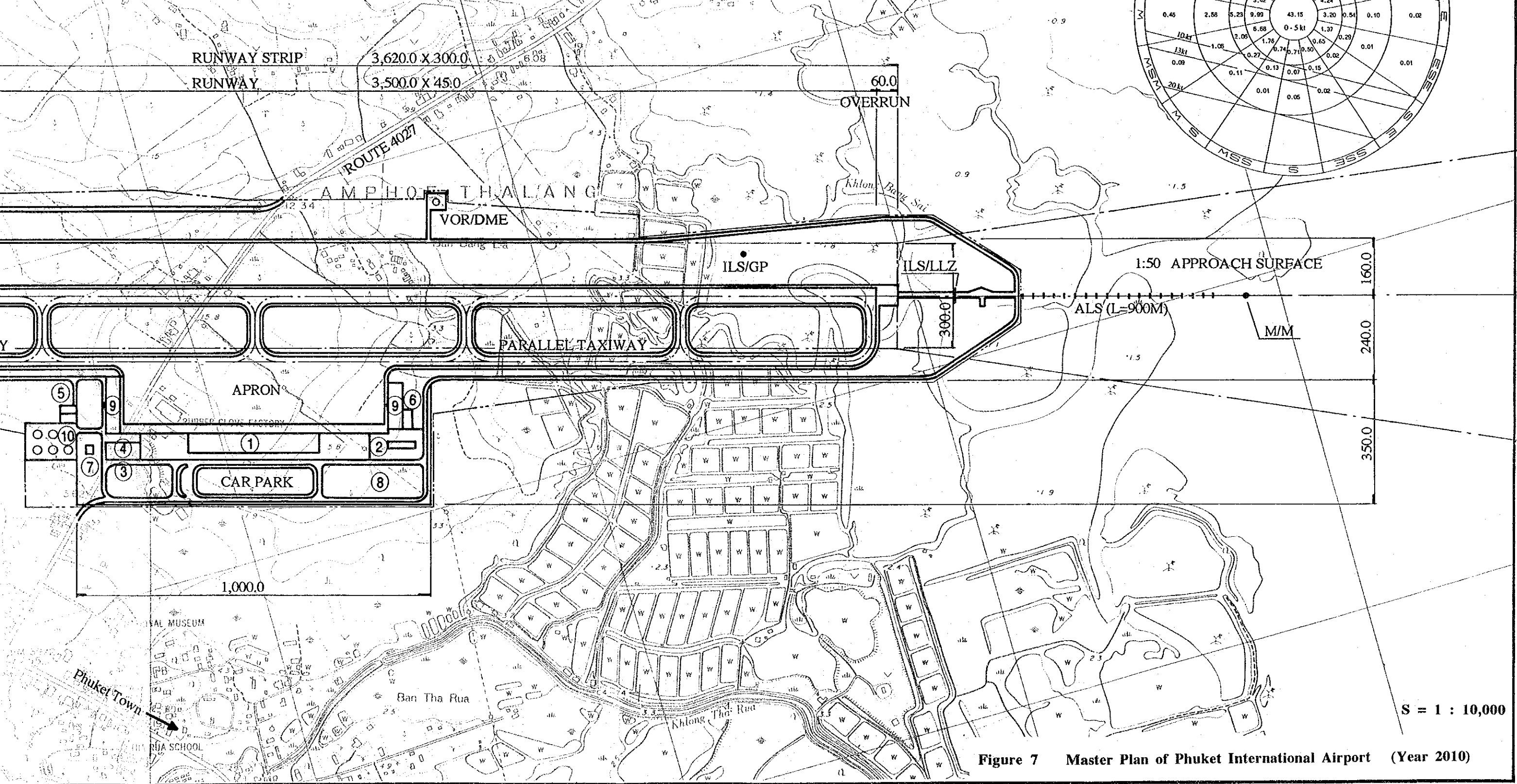
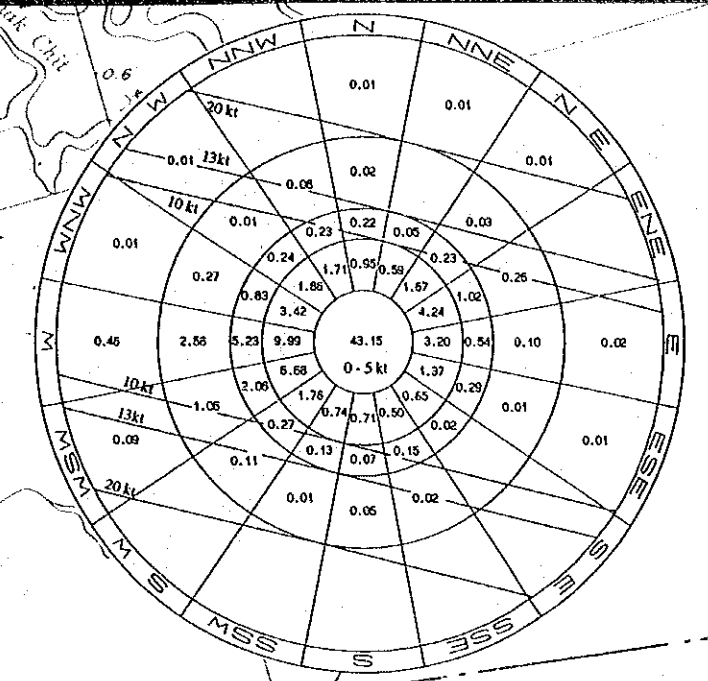
RUNWAY STRIP	3,620.0 X 300.0
RUNWAY	3,500.0 X 45.0



BUILDINGS	
① Passenger Terminal Building	⑥ Equipment Maintenance Workshop
② Cargo Terminal Building	⑦ Power House
③ Administration Operation Building	⑧ Sewage Treatment Plant and Incinerator
④ Control Tower	⑨ GSE Parking
⑤ Fire Station	⑩ Fuel Storage

LEGEND	
-----	Property Line

ALL-WEATHER WIND COVERAGE	
Source	: Meteorological Department
Location	: Phuket International Airport
Period	: August 1989 - July 1992
Runway Orientation	: N 104° E



S = 1 : 10,000

Figure 7 Master Plan of Phuket International Airport (Year 2010)

4. FEASIBILITY STUDY ON THE SHORT-TERM DEVELOPMENT PLAN

4.1 PRELIMINARY DESIGN

The airport layout plan and terminal area layout plan in the short-term development plan are shown in **Figures 8** and **9** respectively.

4.1.1 Civil Works

The length and width of the **runway** in the short-term development plan will remain the same as the existing condition, i.e., 3,000 m long and 45 m wide. The runway was designed to have 12.7 cm thick pavement overlay and profile that satisfies the ICAO recommendation.

Car park will be expanded to accommodate a total of 600 cars. **New terminal roads** will be constructed for vehicle circulation in accordance with the expansion of car park. Passenger building curb will be extended by approximately to twice its present length in front of the expanded passenger terminal building.

Drainage facilities will be extended so as to handle the rain water from the expanded car park area. In the curb side, new construction of flexible pavement is planned in the carpark and terminal road.

Construction of the additional **security fence** is planned in front of the area from VOR/DME to ILS/LLZ, adjacent to the runway strip.

4.1.2 Architectural Works

The international facilities and a part of the domestic facilities of the existing passenger terminal building will be expanded to meet the demand of the year 2000.

The design principles are summarized as follows:

- a) To keep the 2-level concept of the existing terminal building as it is.
- b) To keep the bus transportation system between remote aircraft parking spot and terminal building as it is.
- c) To keep the common use passenger handling facilities, such as check-in counter and gates for domestic and international passengers of the existing terminal as it is.
- d) To keep the existing building operable with minimum restrictions during the renovation work period.
- e) To utilize the existing building frames or facilities as much as possible.

An expansion plan has resulted through the alternative comparison study for layout planning. That is five spans of expansion to the north (international), small portion to the south (domestic) of two storied building and small renovation of the existing building. Total floor area of the expansion is 6,980 sq.m.

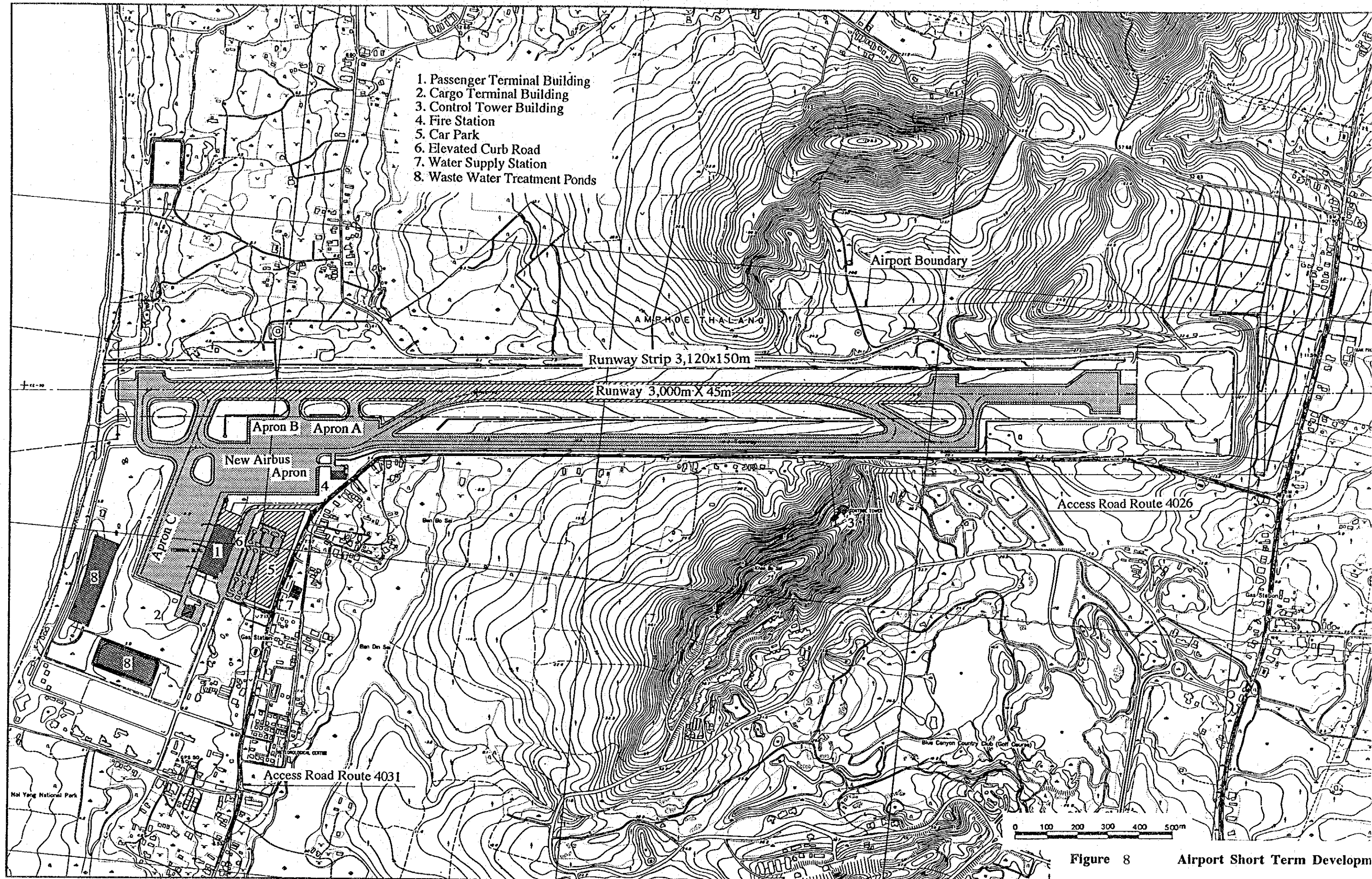


Figure 8 Airport Short Term Development