社会開発調査部報告書

THE STUDY ON
TOKUA AIRPORT DEVELOPMENT PROJECT
IN
PAPUA NEW GUINEA

FINAL REPORT

-S U M M A R Y-

MARCH 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to a request from the Government of Papua New Guinea, the Government of Japan decided to conduct a study on the Development Project of Tokua Airport and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Papua New Guinea a study team headed by Mr. Shoichiro Maeda of Nippon Koei Co., Ltd. three times between May 1991 and March 1992.

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

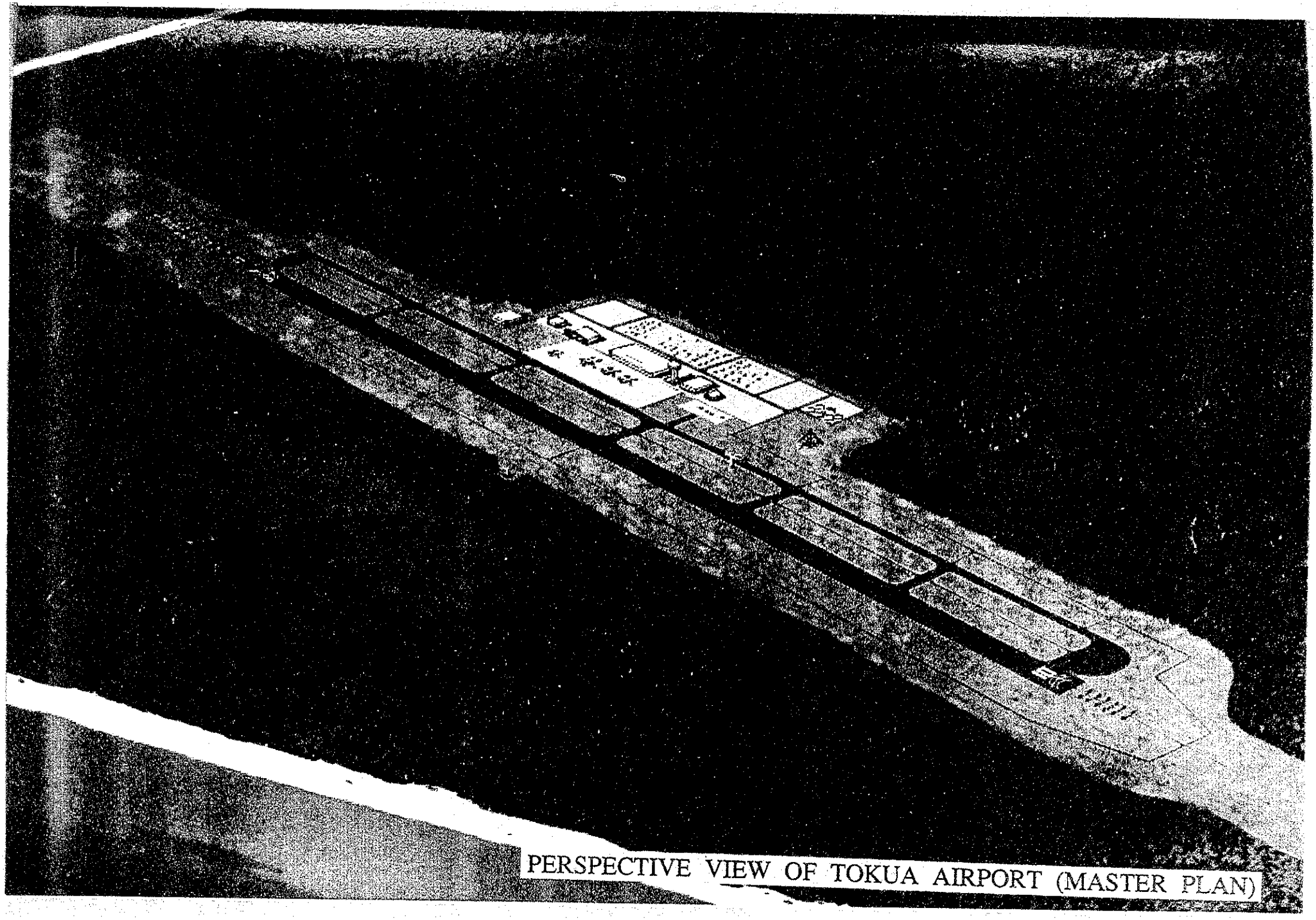
I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Papua New Guinea for their close cooperation extended to the team.

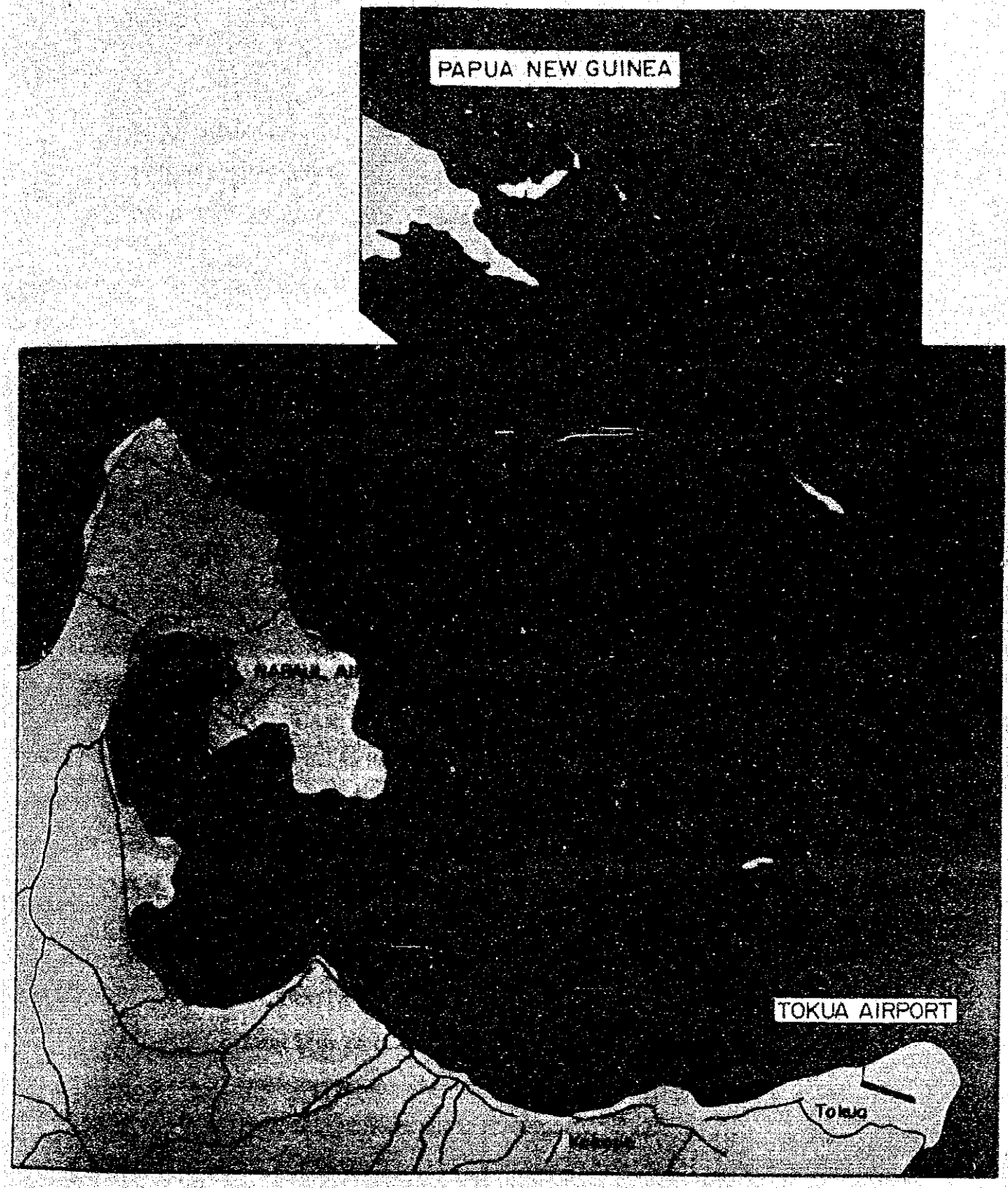
March 1992

Kensuke Yanagiya

Kensuke Yanagiya
President
Japan International Cooperation Agency



PERSPECTIVE VIEW OF TOKUA AIRPORT (MASTER PLAN)



TOKUA AIRPORT PROJECT SITE

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1. BACKGROUND AND OBJECT OF THE STUDY

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In a country which has rugged terrains and isolated islands such as Papua New Guinea, Air-transportation has played a historically important role in providing greater beneficial socio-economic activities to the people of the country. Rabaul, the capital city of East New Britain Province, being located at the center of surrounding regions, National and Provincial Government have planned and promoted to develop this area to be functioned as the hub of the eastern portion of the country.

However, due to the volcanic disaster, operational and expansion difficulties of existing Rabaul Airport, Tokua Airfield was selected to be developed as soon as possible through deliberate studies executed by the authorities concerned.

From the above-mentioned situation, the Government of Papua New Guinea (GOP) requested the Government of Japan (GOJ) to conduct the Study on Tokua Airport Development Project.

In response to the request of GOP, GOJ decided to perform the Study through its implementing agency, the Japan International Cooperation Agency (JICA).

The objectives of this study are as follows:

1) To prepare a master plan of the Tokua Airport. (Target Year 2010)

2) To determine technical, economic and financial feasibility of a short term development plan to be formulated within the framework of the master plan. (Target Year 2000)

JICA study team conducted the project survey three times between May 1991 and March 1992 and submitted reports of the respective stages as scheduled.

2. TRANSPORTATION NETWORK AND STATUS OF EXISTING AIRPORTS

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2.1 Transportation Network

1) Land Transport

For land transportation, there is no railway facilities and the road system is the sole transportation mode. The total length of roads in the nation is about 24,000 km of which only 22% are paved.

The domestic road development has not yet been constructed between the major cities and not reached sufficient level because of such factors as steep topography, tropical jungle, scarce population density, etc.

2) Marine Transport

PNG operates 13 principal ports for mainly cargo transport through inter-islands operations. Passengers are mainly carried by air transport.

3) Air Transport

In the nation, there are more than 450 runways of which 23 major airports are directly managed by the government and have historically played an important role both in the international and domestic transport.

Air Niugini, the flag carrier, operates all international routes and major domestic routes, and other scheduled airlines such as Talair, Airlink, and Islands Airways operate the domestic routes.

Total air passengers in PNG are about 2 millions annually of which 93% are domestic.

2.2 Status of Existing Airports

1) Rabaul Air Traffic

Existing Rabaul Air Traffic is as follows:

(1)	Air passengers	Year 1989	:	146,255 persons
		Annual Growth Rate	:	3.9% (1983 ~ 1989)
(2)	Air Cargo	Year 1989	:	1,455 tons
		Annual Growth Rate	:	11.5% (1983 ~ 1989)

(3) Air Lines : Air Niugini, Island Airways, Air Link

(4) Major Air Routes : Port Moresby, Lae, Kavieng, Hoskins

(5) Major Aircraft : F-28, DHC7, DHC6, EMB-1210

2) Facilities

The facilities of the existing Rabaul Airport and Tokua Airfield are compared as shown in Table-1.

3) Problems of Rabaul Airport

It is immediately necessary to develop a new airport at Tokua as the alternative airport to the existing Rabaul Airport, because Rabaul Airport has now become to have various problems especially in relation to volcanic disaster as follows:

(1) There is a high possibility of volcano eruption which would endanger the mass of people.

(2) Pressure from remaining air in the runway base material caused by the underground water level rise, when it rains, damages the surface pavement.

(3) The existing volcanoes penetrate over the approach surfaces, thus hampering aircraft IFR operations.

(4) The necessary expansion of runway for the safe operation by jet aircraft is very limited because of the deep sea existing at the both ends of the runway.

Table - 1 Comparison of Subject Airports

Items	Rabaul	Tokua
Ref. Coordinate	4°13'30"S 152°12'00"E	4°20'00"S 152°23'30"E
Height/Slope	4.0 m/0.2° longi.	9.7 m/0.82° longi.
R/W Orientation	12/30	10/28
Main Facilities		
- Runway	1,586 m x 30 m	1,720 m x 30 m
- Pav. Strength	AS/PCN 20/F/C/Z/U	WC/PCN 12/F/CZ/T
- Runway Strip	1,646 m x 90 m	1,720 m x 80 m
- Taxiway	15 m x 85 m	15 m x 135 m
- Apron	210 m x 60 m	150 m x 70 m
- Pav. Strength	AS/PCN 20/F/C/Z/U	
- Terminal Build.	880 m^2, 1F	
- Admi. Build.	DCA, 1F	
- Nav. Aid	NDB, DME, T-VASIS	NDB
- Comm.	VHF, SSB-HF	
- Wx	A set of equipments	Auto-Anemometer
- Fuel	AVIGAS, JET-A1	
Expandability	None	Sufficient
Airspace	Limited	Ample
Volcanic danger	High	Low
Equipment	Insufficient and under urgent renewal	New

3. AIR TRAFFIC DEMAND FORECAST

3. AIR TRAFFIC DEMAND FORECAST

Air traffic demand forecast was carried out with regard to the two cases of "without the Project" and "with the Project". For these cases, the traffic demand of air passengers and air cargo was forecasted concerning the domestic and international.

The target years for forecasting are year 2000 for the short term development plan and year 2010 for the master plan.

3.1 Without the Project

In this Study, the traffic forecast is done by the following methodology. For the case of "without the Project", first of all, the three levels (high, medium and low) of total air passengers (cargo) are forecasted by the forecasting models built up on the basis of time series data of total air passengers (cargo) and real GDP from 1983 to 1989 in PNG. The medium level demand forecast of total air passengers (cargo) is utilized for forecasting as "the control total".

Secondly, the generated and attracted air passengers (cargo) by 23 key airports are forecasted by the forecasting models as the temporary estimates and coordinated by the control total mentioned above as the final estimates.

For air passengers, the traffic demand of OD pairs between key airports is estimated by iteration of "Fratar Method" for the purpose of making the forecasting more accurate.

3.2 With the Project

For the case of "with the Project", the diverted traffic demand from POM to RAB for international passengers (cargo), the revealed traffic of potential demand for passengers and increased traffic demand by regional development for passengers and increased traffic demand by regional development for cargo are projected as the domestic traffic demand.

For air passengers, the diverted traffic demand is estimated on the basis of the traffic survey conducted by the Study Team with cooperation of DCA on 11th and 12th of June, 1991 at POM and RAB. The potential demand is estimated by the model based on the assumption that the number of potential passengers make a "normal distribution".

The results of forecasting are shown in Figure-1 and 2, and Table-2 and 3.

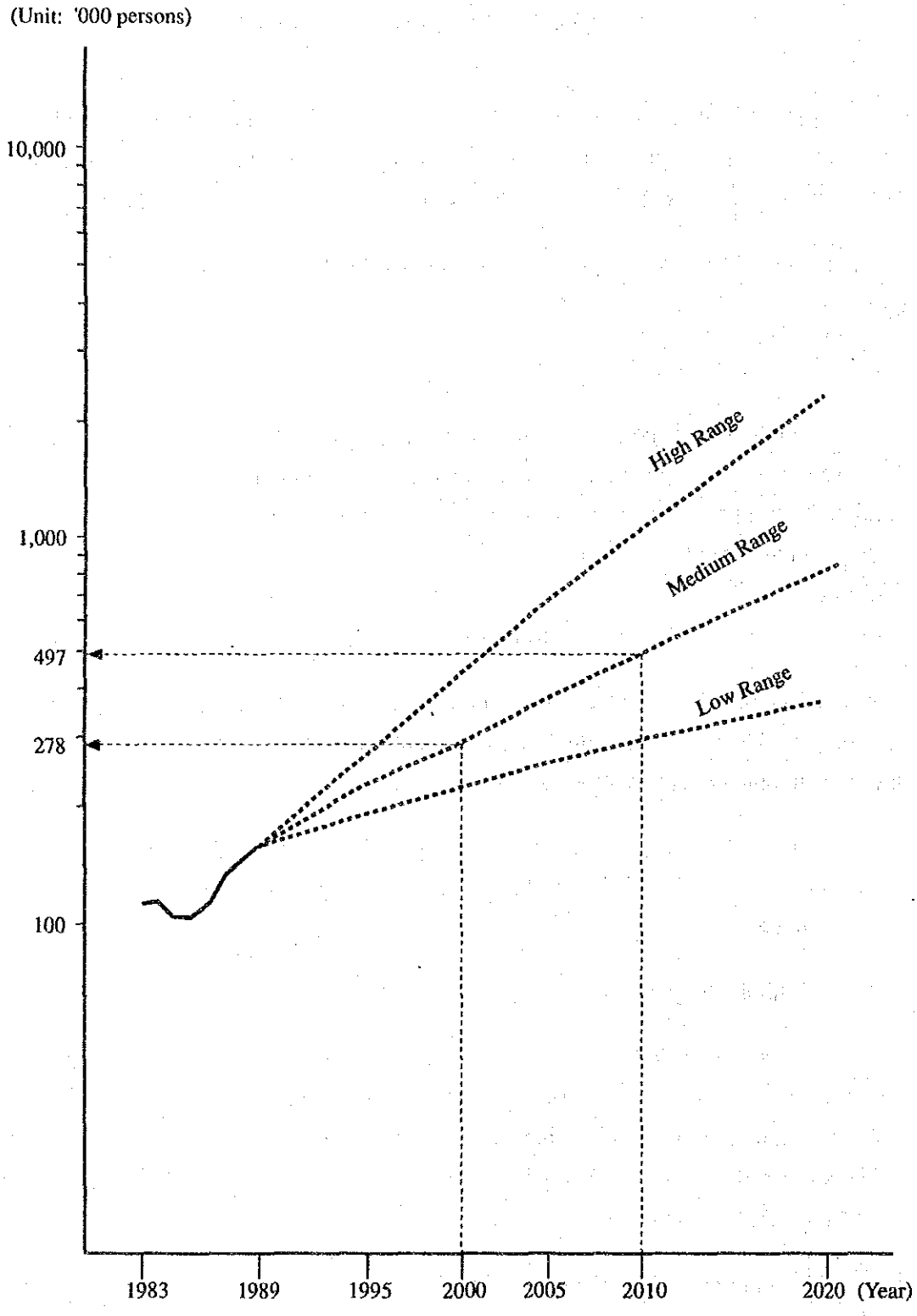


Figure -1 Projections of Air Passengers Traffic Demand
(With the Project: Tokua Airport)

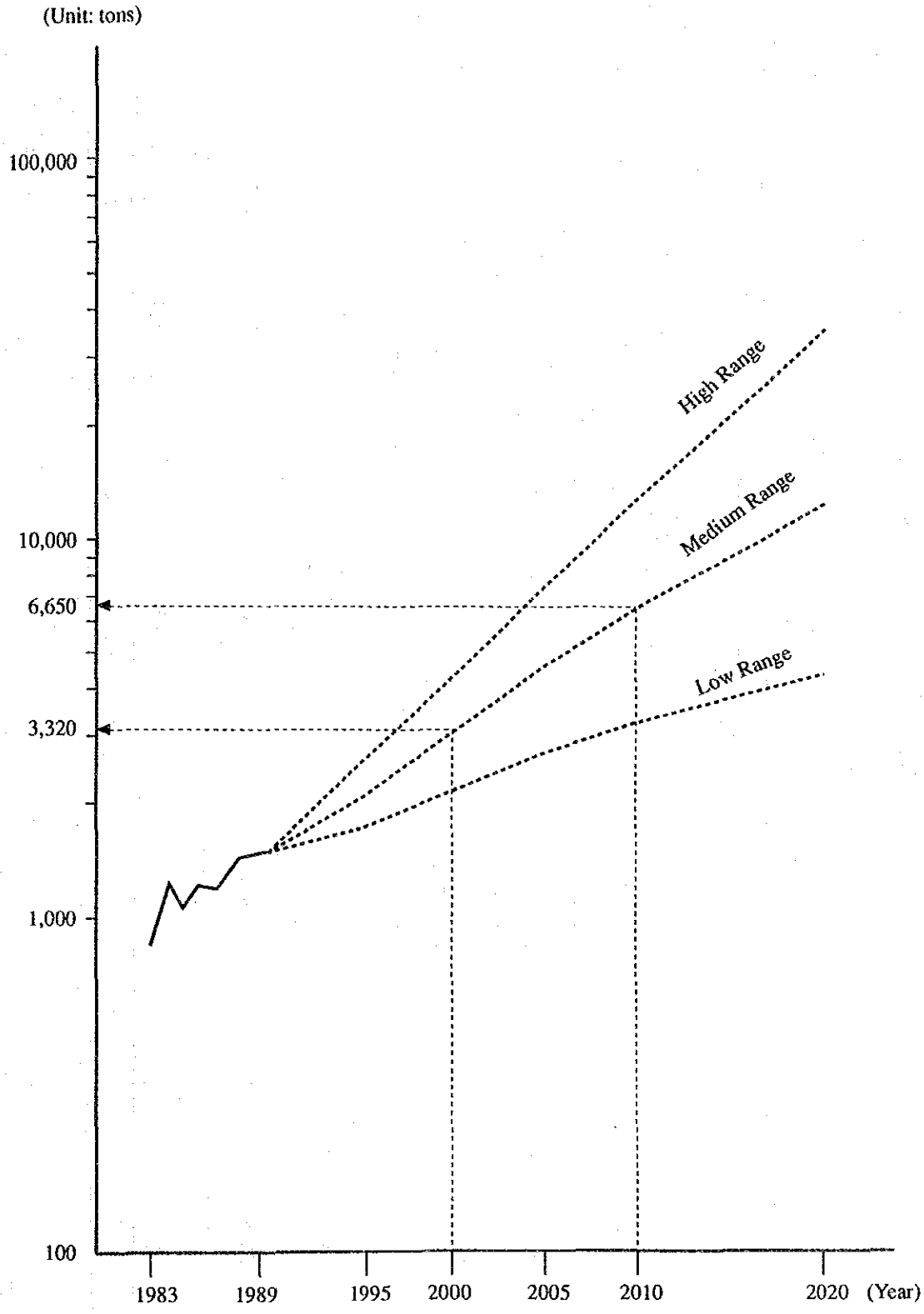


Figure -2 Projections of Air Cargo Traffic Demand
(With the Project: Tokua Airport)

Table - 2 Forecast of Passenger Traffic Demand

[Medium] (Unit: Persons)

			1995	2000	2005	2010	2020
Without	Normal Traffic		188,000	251,000	335,000	448,000	731,000
(Rabaul)	(Domestic)						
	(Potential Demand)		(20,000)	(27,000)	(37,000)	(49,000)	(80,000)
	Total		188,000	251,000	335,000	448,000	731,000
With		Domestic	188,000	233,000	310,000	414,000	660,000
(Tokua)	Normal Traffic	International		18,000	25,000	34,000	71,000
		(Diverted from POM)					
		Sub total	188,000	251,000	335,000	448,000	731,000
	Induced Traffic	Domestic	20,000	25,000	34,000	45,000	72,000
	(Revealed Traffic of Potential Demand)	International	-	2,000	3,000	4,000	8,000
		Sub total	20,000	27,000	37,000	49,000	80,000
	Total	Domestic	208,000	258,000	344,000	459,000	732,000
		International	-	20,000	28,000	38,000	79,000
		Total	208,000	278,000	372,000	497,000	811,000

Table - 3 Forecast of Freight Traffic Demand

[Medium] (Unit: Tons)

			1995	2000	2005	2010	2020
Without	Normal Traffic		2,100	3,100	4,400	6,200	11,000
(Rabaul)	(Domestic)						
	(Potential Demand)		-	-	-	-	-
	Total		2,100	3,100	4,400	6,200	11,000
With		Domestic	2,100	2,600	3,700	5,200	9,400
(Tokua)	Normal Traffic	International	-	500	700	1,000	1,700
		(Diverted from POM)					
		Sub total	2,100	3,100	4,400	6,200	11,000
	Increased Traffic	Domestic	50	70	100	150	300
	by Development	International	-	150	220	300	600
		Sub total	50	220	330	450	900
	Total	Domestic	2,150	2,670	3,800	5,350	9,700
		International	-	650	920	1,300	2,300
		Total	2,150	3,320	4,720	6,650	12,000

4. MASTER PLAN

4. MASTER PLAN

4.1 Development Policy

Based on the results of air traffic demand forecast and the viewpoint of cost/benefit, two stages of project implementation were planned to ensure the required airport functions and facilities.

Master Plan	:	Target year 2010
Short Term Development Plan	:	Target year 2000

The development policy for the airport master plan was established on the basis of the target year, air traffic demand forecasts, required airport scales and airport layout through the discussion with DCA.

1) Establishment of Required Scales

The scales required for the master plan were established as tabulated in Table-4 considering the air traffic demand forecasts. The basic scales should be identified with the international standards and recommended practices as specified by ICAO, FAA (USA) and JCAB (Japan) in due course. As a result of the study, Tokua Airport is categorized to be code number 4 and code letter E in the aerodrome reference code specified by ICAO.

2) Site Conditions

(1) Topography and Geology

Tokua site is suitable for the new airport construction site, because this site is located at the flatland with adequate airspace and the foundation of the existing airfield is sufficient to be the subbase for the future runway.

(2) Wind

Wind coverages of the orientation of existing runway in the both categories of 13 and 20 knot crosswind are more than 95 percent in conformity with ICAO standards as the result of wind analyses for one year from Jan. 1990 to Dec. 1990. However, wind

Table - 4 Required Airport Scales (Master Plan 2010)

ITEM		Master Plan (2010)
1.	Fundamental Facilities	
	Runway	3,000 m x 45 m
	Runway Strip	3,120 m x 300 m
	Taxiways	148.5 m x 30 m x 7 with H.B. 3,000 m x 23 m (Parallel)
	Main Apron	430 m x 190 m
	GA Apron	162 m x 63 m
	GSE Movements	17,900 m^2
	Others	50,000 m^2 (Airfield Road)
2.	Building	
	Passenger Terminal	8,000 m^2
	Cargo Terminal	600 m^2
	Parking Lot	7,100 m^2
	Control Tower	635 m^2 (Plus Radar Control)
	Administration Building	1,244 m^2
	CFR Building	461 m^2
	Maintenance Shop & Depot	1,298 m^2
	Fuel Farm	6,000 m^2
	Others	
3.	Operational Equipment	
	VOR	O
	DME	O
	NDB	O
	AMS	O
	AFS	O
	ALS	R/W 28 O
	SALS	R/W 10 O
	ATC Equipment	O Plus Radar Control
	ATC Radar	O
	W x Radar	O
	W x Observation Gauges and Station	Full set O
	Aerodrome Lighting	Full set O
	Runway Lighting	Full set O
	Taxiway Lighting	Full set O
	PAPI	O
	ILS (MLS)	O
	Fire Fighting Equipment	Full set O
	Work shops Equipment & Storage	Full set O
	Security equipment	Full set O
	Others	
4.	Utilities	
	Electric	O
	Water Supply	O
	Air Conditioning	O
	Telephone, etc.	Full set O
	Others	

coverage of dry season (May to Oct.) in category of 13 knot crosswind is only 90.7 percent. Optional studies of secondary runway orientation were carried out.

(3) Volcanic Activities

Rabaul region is geologically located in the midst of volcanic zone and therefore the influence of volcanic activities had been taken into consideration for the planning and design of Tokua Airport development.

However, it is considered that the influence of volcano eruption to Tokua Airport is very minor compared to Rabaul Airport.

3) Main Issues of Airport Planning

(1) Secondary Runway

The orientation of primary runway is planned to be 10 - 28. Regarding the operation for small aircraft, runway orientation with clockwise rotation to 28 through 66 degrees from the existing runway would be recommended to keep the coverage of more than 95 percent. However, from the economic viewpoint and operational problem, the secondary runway is not included in this study. However, it would become necessary to review the secondary runway for small aircraft should the traffic volume of small aircraft increase in future.

(2) Cargo Apron

Concerning the handling of cargo volume, an apron exclusively used for cargo handling is not provided, but a supplemental spot in the passenger-apron is to be utilized as a cargo apron. However, since cargo demand will increase and cargo aircraft will accordingly increase in future, cargo apron should be acquired in advance in the area adjacent to the passenger-apron.

4.2 Airport Master Plan

Airport layout plan based on the airport requirements for the master plan is shown in Figure-3.

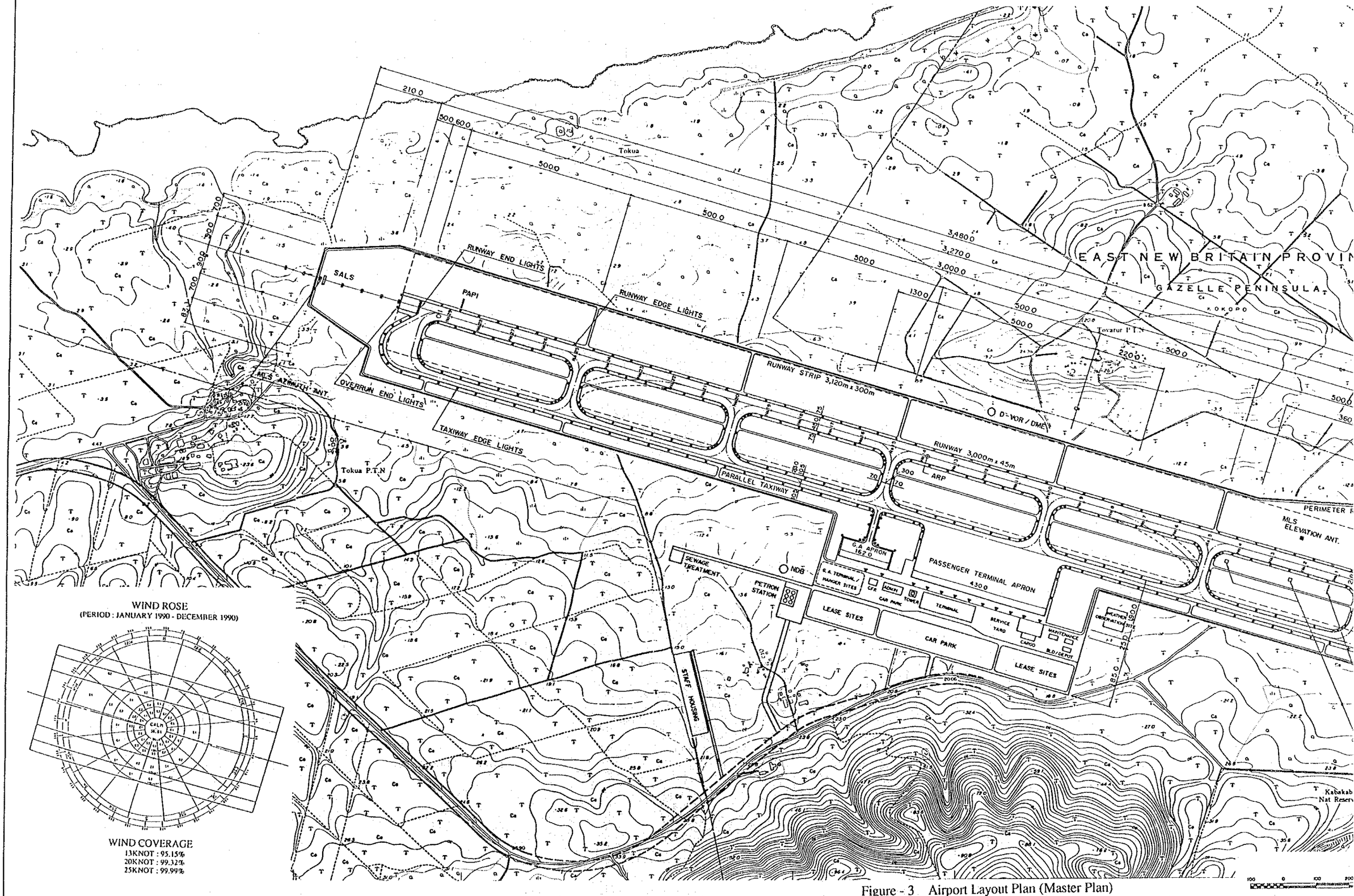
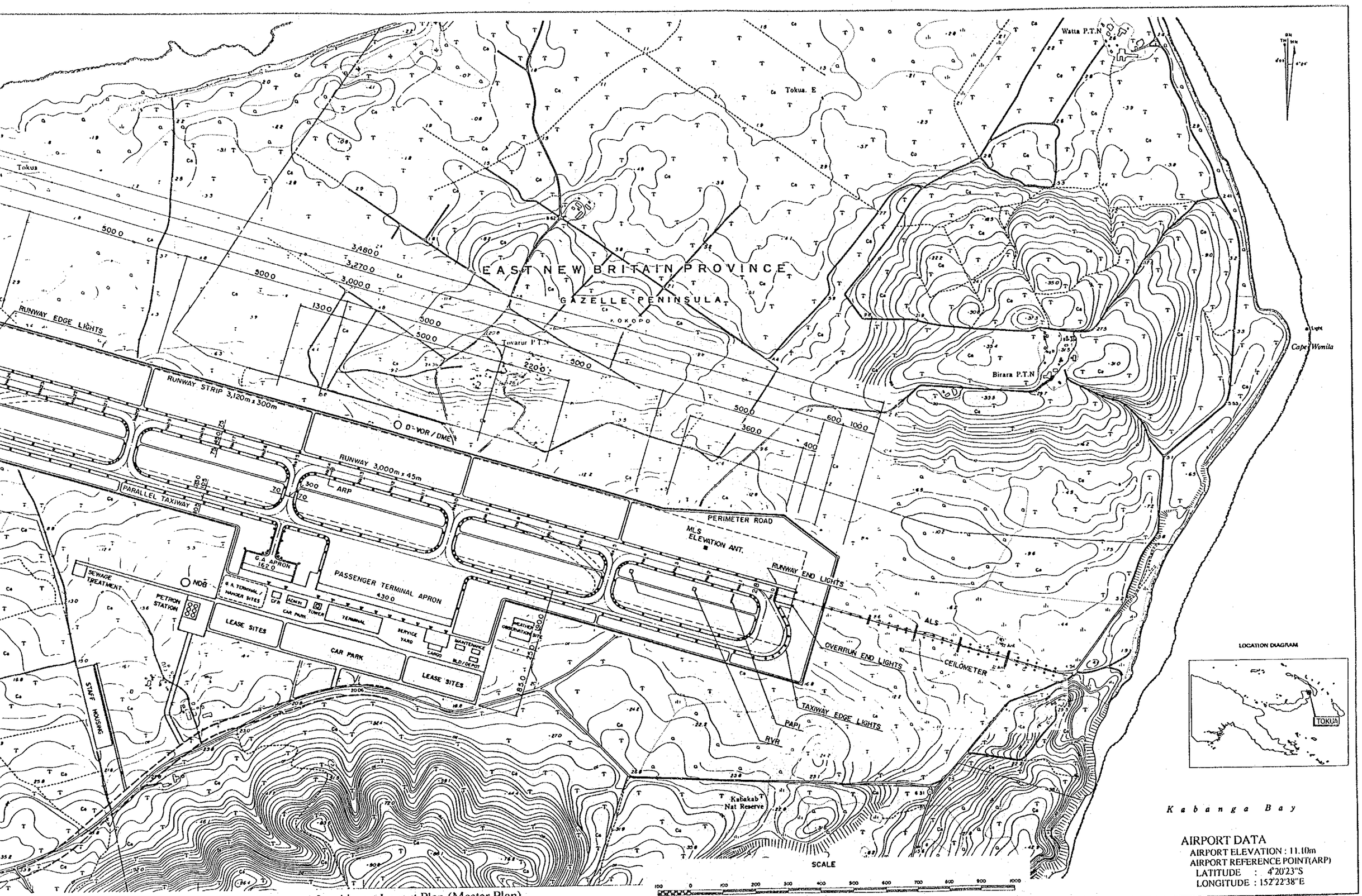


Figure - 3 Airport Layout Plan (Master Plan)



AIRPORT DATA
AIRPORT ELEVATION : 11.10m
AIRPORT REFERENCE POINT(ARP)
LATITUDE : 4°20'23"S
LONGITUDE : 152°22'38"E

Figure - 3 Airport Layout Plan (Master Plan)

The outline of the master plan is summarized as follows:

1) Fundamental Facilities

(1) A runway of 3,000 m x 45 m and a runway strip of 3,120 m x 300 m are planned to cater for B747 CAT-I operation.

(2) A parallel taxiway of 3,000 m x 23 m as well as five conventional taxiways and two holding bays are planned.

(3) Passenger terminal and general aviation aprons are planned separately. The passenger apron is planned to have a width of 430 m to park six angled aircraft running on its own power.

2) *Terminal Facilities*

A group of facilities of the terminal area to be planned and constructed for the master plan includes the following:

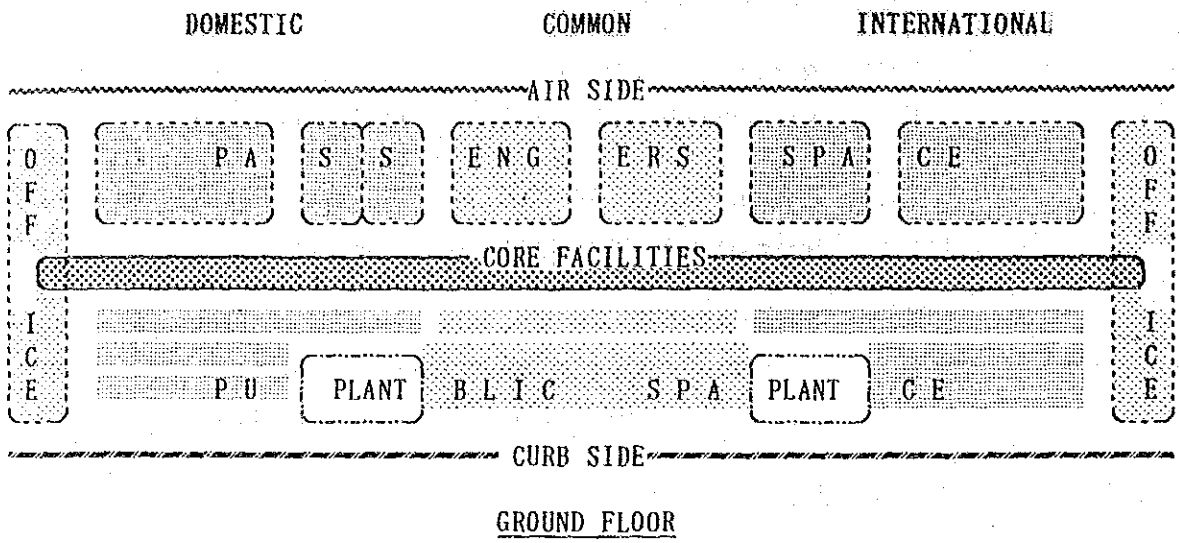
(1) Passenger terminal building
(2) Cargo terminal building
(3) Control tower
(4) Administration building
(5) CFR building
(6) Maintenance shops
(7) Fuel Farm
(8) Utilities

The total floor area of the passenger terminal building is planned to have 8,000 m^2. The points where particular attention was paid in planning and designing the passenger terminal building were in maintaining a harmonious atmosphere throughout the airport and further as follows:

(1) Application of module of human scale
(2) Block planning to clarify functional spaces
(3) Separate/common use of space between domestic and international terminal facilities
(4) Future expansion

Figure-4 and 5 show the concept of block planning and modular planning.

The floor plan of year 2010 is proposed as illustrated in Figure-6.



GROUND FLOOR

Figure - 4 Block Planning

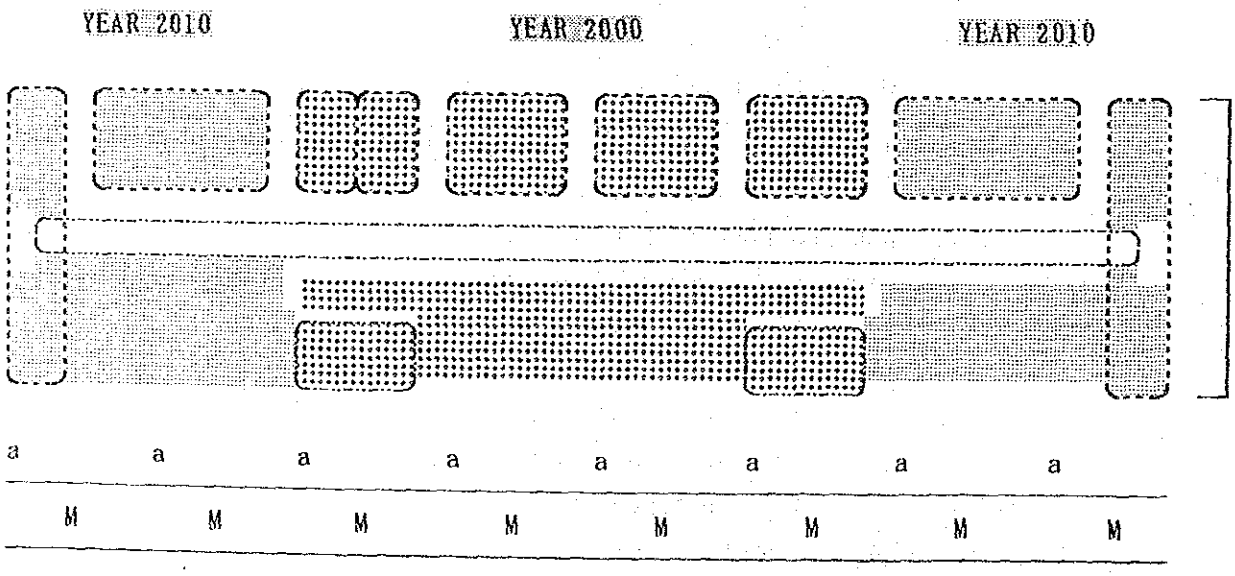


Figure - 5 Modular Planning

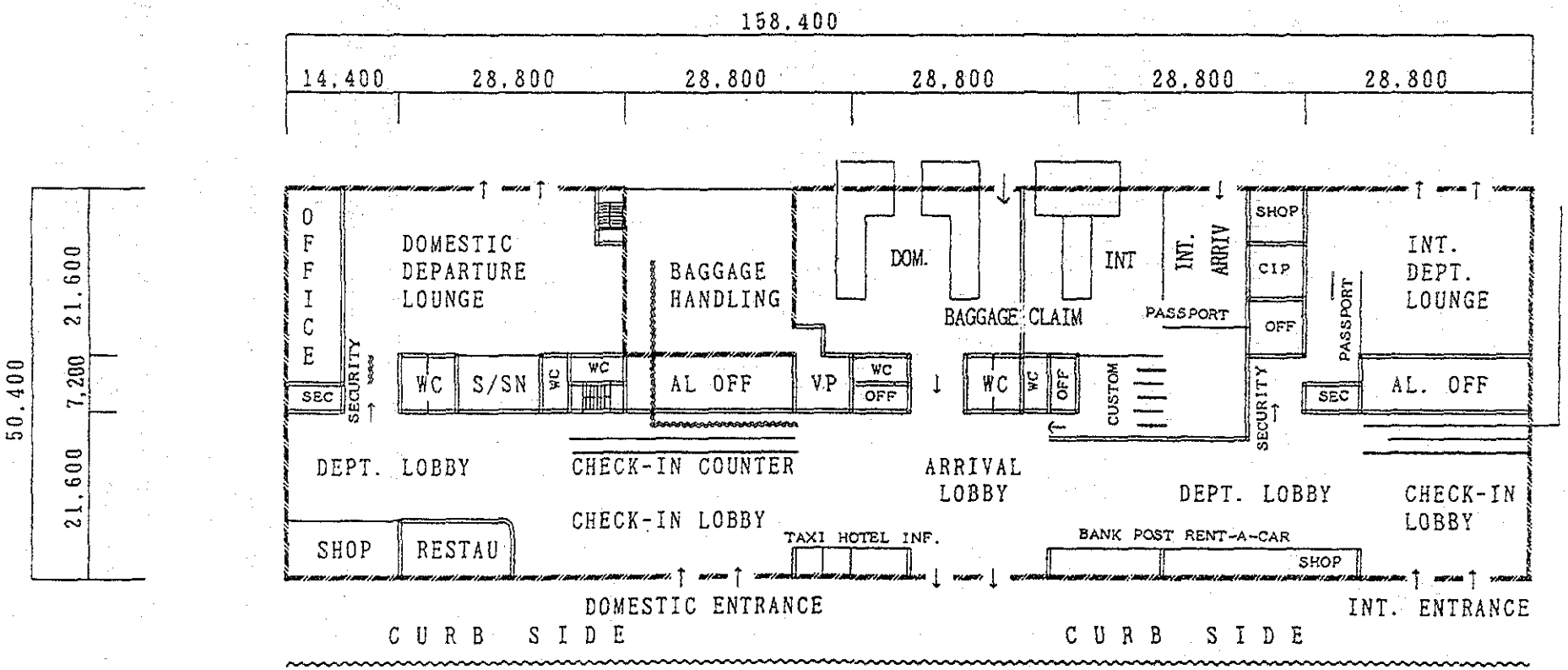


Figure - 6 Passenger Terminal Building, Year 2010

3) Operation Equipment

Fundamental aeronautical navigation facilities of NDB, DVOR, DME, and ILS (MLS) will be installed in the airport for the safe and efficient conduct of aircraft operations.

It is also preferable to provide a terminal radar data processing system (TRDPS) which is aimed to contribute in maintaining the air traffic order and a safe air transportation.

In addition to the above, aeronautical mobile service (AMS) and aeronautical fixed service (AFS) will be provided for the safety of air navigation and for the regular, efficient and economic operation of air services.

Field lighting system will be supplied for use at night or for a precision approach runway.

MET equipments will be installed at the airport, and connected with the National Met Center in POM to obtain necessary weather information for air traffic services.

Electrical power and public telephone will be connected to Tokua Airport.

4) ATC and Aircraft Operation

(1) The airspace configurations necessary for aircraft operation would scarcely have any operational problems even if the traffic increases in future.

(2) Aerodrome Control Service, Approach Control Service will be provided and Radar Control Service is also preferable to be provided.

(3) Aircraft operating procedures are set by specifying each type of naviaids and runways.

(4) Necessary numbers of air traffic controllers, maintenance staffs and equipments are assigned.

5) Airport Management

Respective staffs responsible for the airport operation are required in all government services.

6) Optimum Financial Costs

Table-5 shows the construction costs of the master plan as a result of study and discussion for some alternatives. The financial costs for construction of the master plan and the short term development plan are estimated to be approximately 150 million Kina and 68 million Kina (as mentioned later in 5.3) respectively. In the case that the traffic demand is estimated at the range of present forecast and the master plan would be implemented from the first stage of the Project, the construction will be considerably over investment.

On the other hand, for the short term development plan, the traffic demand is forecasted on the assumption that the existing aircraft will be operated in the future, and the aircraft of large size will be able to be operated with some preconditions.

Table -5 Construction Costs for the Master Plan

As of December 1991
1 Kina = 1.04 US$

Work Item		2010 Total (1000 K.)	F.C. (1000 US$.)	L.C. (1000 K)
A.	Construction Cost	136,266	75,910	63,275
1.	Civil Works	77,966	33,696	45,566
2.	Building Works	16,118	13,410	3,224
3.	Operational Facilities	22,796	17,561	5,910
4.	Utility	1,612	1,342	322
	Sub-total (Base Cost)	118,492	66,009	55,022
5.	Price Conti. *1)	11,849	6,601	5,502
6.	Physical Conti. *2)	5,925	3,300	2,751
B.	Engineering Services	13,627	7,591	6,328
1.	Base Cost *3)	11,849	6,601	5,502
2.	Price Conti. *1)	1,185	660	550
3.	Physical Conti. *2)	592	330	275
C.	Grand Total	149,892	83,501	69,603

Notes *1) 10% of base cost.
*2) 5% of the base cost.
*3) 10% of the total base cost of A.

4.3 Regional Development

A variety of cases is generally found in the world in which airport development is expected to spearhead regional development.

Taking into consideration the geological features, transportation levels and economic levels, etc. in PNG, Tokua Airport Development Project is expected to stimulate regional economy of East New Britain in a number of ways such as follows:

a) Tourism development

b) Growth of tourism-related industries

c) Air transport of agriculture products

d) Increasing role as the hub airport for the Island Region as well as in the South Pacific Region.

With local culture and historical resources, East New Britain Province has high tourism growth potential, while a number of constraints in tourism promotion are found in PNG and East New Britain Province, such as, law and order situation, high prices and limited accessibility. Tourism Development Corporation (TDC) has a policy of promoting tourism growth in selected priority areas, namely the Island Region including East New Britain Province and guide tourism related private investment concentrated in these areas.

For East New Britain Province, a step wise approach would be appropriate instead of pursuing a large scale tourism growth from the beginning.

In consideration of harmony with the natural environment, the receiving capacity of the local community and a relatively negative image toward PNG in the overseas market, a development of hotels with 200 to 300 guest rooms would be desirable by the year 2000.

In parallel with Tokua Airport Project, it will be required on the part of the central and provincial governments to first prepare a long term framework of tourism development in the region and in accordance with the framework, upgrade various infrastructure facilities and promote and introduce private investment in desirable directions.

4.4 Environment

Master plan study are carried out to take into account the consideration of environmental impacts of the project as follows:

1) Natural Environment

Regarding Tokua Airport Project, no rare or precious species in the region have been reported according to Department of Environment and Conservation.

However, necessary studies concerning impacts on precious species have been carried out and found that Tokua Airport Project would impose almost no effects on the environment. But it is recommended that suitable consideration in the implementation stage be taken to avoid negative impacts on the conditions of coral reefs which exist in the coastal area around the airport site.

2) Noise Impacts

Noise in airport surrounding areas is the major environmental consideration associated with the airport management.

In this studies, review of noise impacts is executed by the noise contours of year 2000 and 2010 taking into account the site of runway, type of aircraft, frequencies and hours of operation. As its results, aircraft noise level will not become a sensitive problem to the surrounding human residence till and beyond year 2010.

3) Social Environment

Major issues in social environmental impact include land use control and disposal of cutting trees in the aircraft landing area.

In order to create a favourable environment for residents, it will be required to prepare a land use plan of surrounding areas based on the noise contour and guide individual development in accordance with the land use plan.

And on the matter of trees disposal, the provincial government anticipates that no social problem would be created.

5. FEASIBILITY STUDY OF THE SHORT TERM DEVELOPMENT PLAN

5. FEASIBILITY STUDY OF THE SHORT TERM DEVELOPMENT PLAN

The study of the short term development plan was carried out to find a technical, economic and financial feasibility within the framework of the proposed master plan to substitute, as soon as possible, the existing Rabaul Airport which has various constraints.

5.1 Short Term Development Plan

Planning and preliminary design of the short term development plan were executed through the technical and economic optional studies. Required airport scales and airport layout plan are shown in Table-6 and Figure-7 respectively. The outline of the short term development plan is summarized as follows:

1) Fundamental Facilities

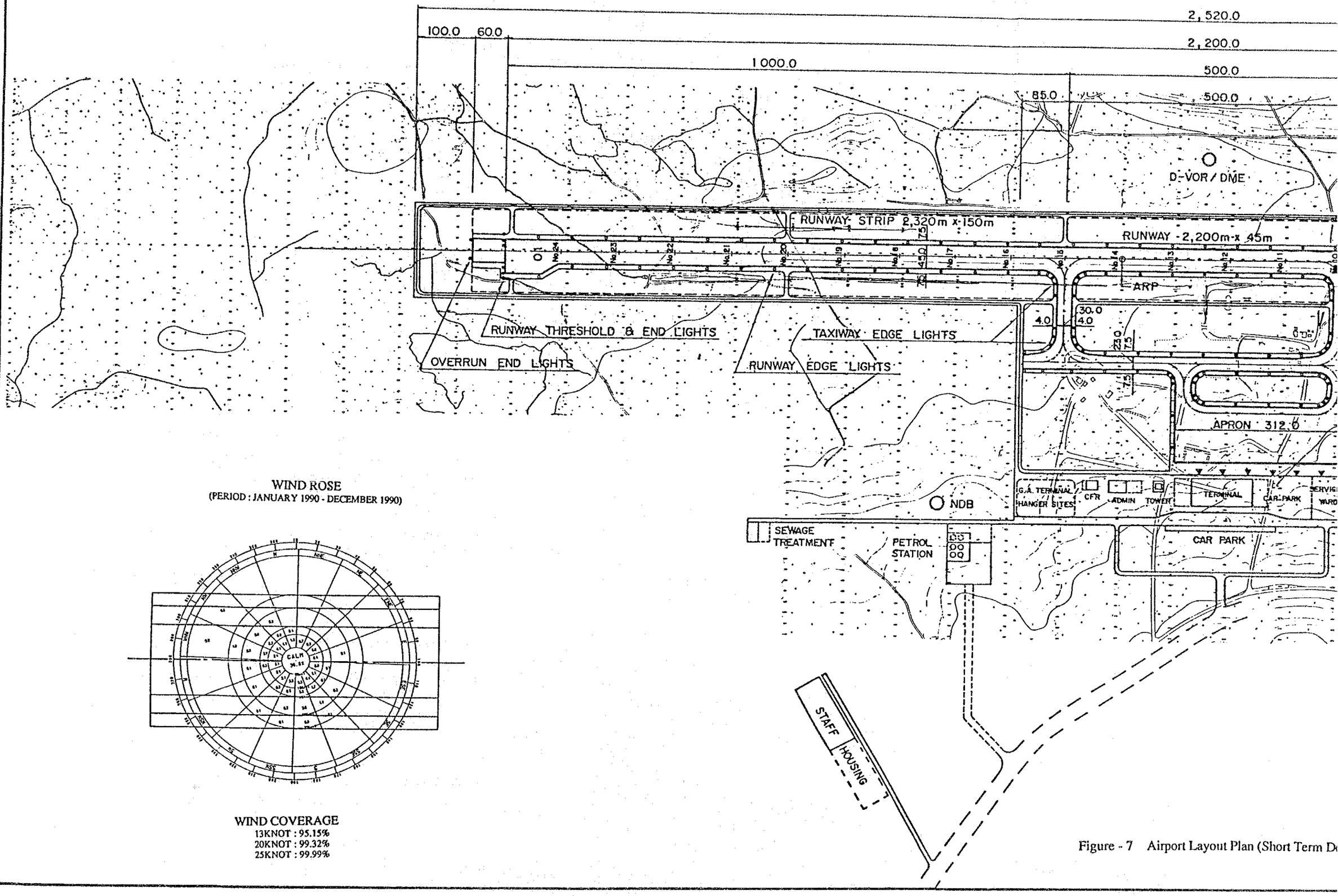
(1) A runway of 2,200 m x 45 m with turning pads at both runway end and a runway strip of 150 m in width are planned to cater for A310 non-precision runway operation. However, it is noted that this runway can be used by B747 with weight reduction penalty in limited air routes. For the safe aircraft operation, the trees existing in the runway strip of 300 m in width should be trimmed off. Pavement structure of runway is designed for asphalt pavement on the basis of A300 class aircraft, however this pavement is capable of supporting B747 when the aircraft movement is not large.

(2) A partial parallel taxiway of 650 m x 23 m, which is located with a 182.5 m separation between the centerlines of runway and proposed taxiway to accommodate large aircraft, as well as two conventional taxiways of 30 m in width are planned to meet the ICAO standards. Pavement structure of taxiways is similar to that of the runway.

(3) Passenger and general aviation aprons with 190 m in depth are planned together to park angled aircraft running on its own power. A green belt is planned between the apron and parallel taxiway from the economic viewpoint. Pavement structure of the apron is designed for asphaltic concrete pavement on the basis of A300 class aircraft, however this pavement is capable of supporting B747 when the aircraft movement is not large.

Table - 6 Required Airport Scales
(Short Term Development)

ITEM		1. Short Term (Earliest ~ 2000)
1.	Fundamental Facilities	
	Runway	2,200 m x 45 m with T.P.
	Runway Strip	2,320 m x 150 m
	Taxiways	148.5 m x 30 m x 2 650 m x 23 m (Parallel)
	Main Apron	205 m x 140 m
	GA Apron	107 m x 140 m
	GSE Movements	11,600 m^2
	Others	42,000 m^2 (Airfield Road)
2.	Building	
	Passenger Terminal	5,000 m^2
	Cargo Terminal	360 m^2
	Parking Lot	5,200 m^2
	Control Tower	635 m^2 (Aerodrome only)
	Administration Building	778 m^2
	CFR Building	381 m^2
	Maintenance Shop & Depot	924 m^2
	Fuel Farm	4,000 m^2
	Others	
3.	Operational Equipment	
	VOR	O
	DME	O
	NDB	O
	AMS	O
	AFS	O
	ALS	–
	SALS	R/W 28 O
	ATC Equipment	O Aerodrome and Approach Control
	ATC Radar	–
	W x Radar	–
	W x Observation Gauges and Station	set O
	Aerodrome Lighting	set O
	Runway Lighting	set O
	Taxiway Lighting	set O
	PAPI	O
	ILS (MLS)	–
	Fire Fighting Equipment	set O
	Work shops Equipment & Storage	set O
	Security equipment	set O
	Others	
4.	Utilities	
	Electric	O
	Water Supply	O
	Air Conditioning	O
	Telephone, etc.	set O
	Others	



WIND ROSE
(PERIOD : JANUARY 1990 - DECEMBER 1990)

WIND COVERAGE
13KNOT : 95.15%
20KNOT : 99.32%
25KNOT : 99.99%

Figure - 7 Airport Layout Plan (Short Term De

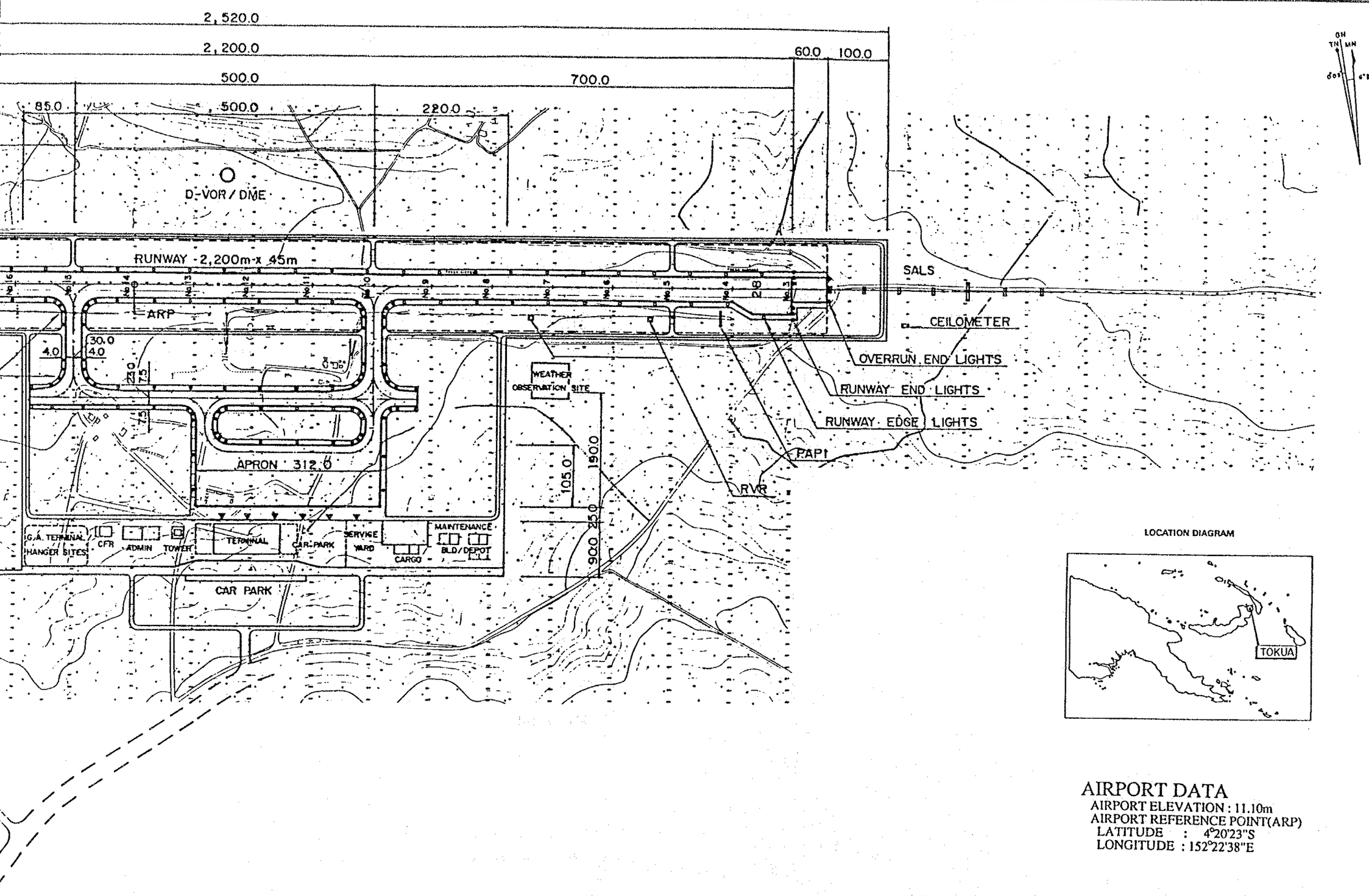


Figure - 7 Airport Layout Plan (Short Term Development)

(4) Site preparation and drainage system of the airport are designed to take into account the environmental and economic points.

2) Terminal Facilities

Facilities of the terminal area for the short term development are planned and designed as a preliminary step towards the master plan of year 2010. Accordingly, all the buildings are planned and designed in consideration of future extension except the control tower which will be built in a complete form at the beginning.

A proposed floor plan of the passenger terminal building of year 2000, with a floor area of 5,000 m^2, is illustrated in Figure-8. Passenger terminal building in this stage is designed to be more functional, easier to use and more efficient to use the space, and less troublesome to extend for year 2010.

The layout of land side facilities are shown in Figure-9.

3) Operation Equipment

D-VOR/DME and NDB will be provided in the short term development. VHF air-ground radios and AFTN circuit through public telephone line will be installed with HF back-up for main AFTN. Therefore public telephone line will be connected to Tokua Airport at this stage.

Major parts of the airfield lighting are expected to be introduced in this stage. And the basic instrument of meteorological facilities such as anemometer will be installed.

4) ATC and aircraft operation

(1)	Aerodrome Control	10 NM TOK, below 3,000 feet
(2)	Approach Control	60 NM TOK, below 15,000 feet
(3)	Area Control	15,000 feet ~ FL245

5) Airport Management

Reasonable numbers of staff should be assigned to cope with the requirement for the short term development and actual work volumes.

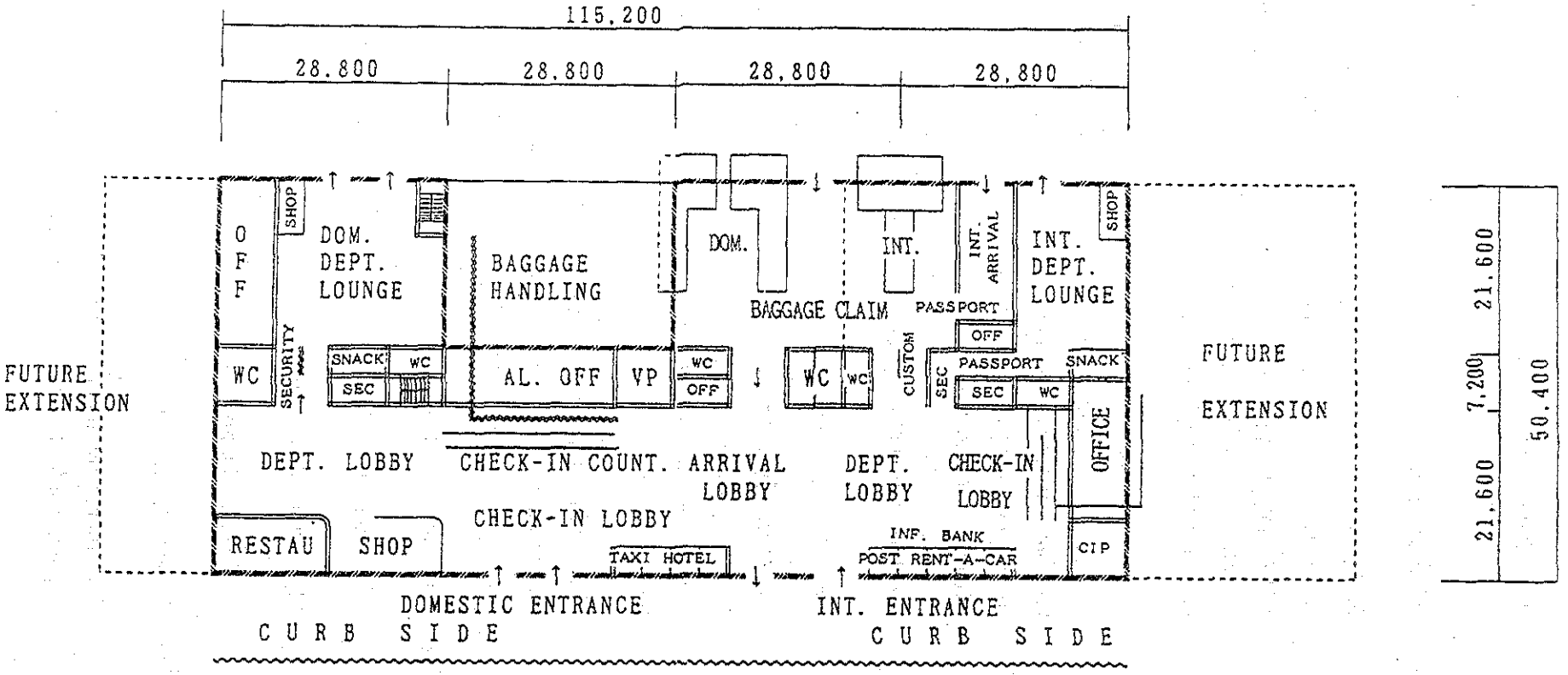


Figure - 8 Passenger Terminal Building, Year 2000

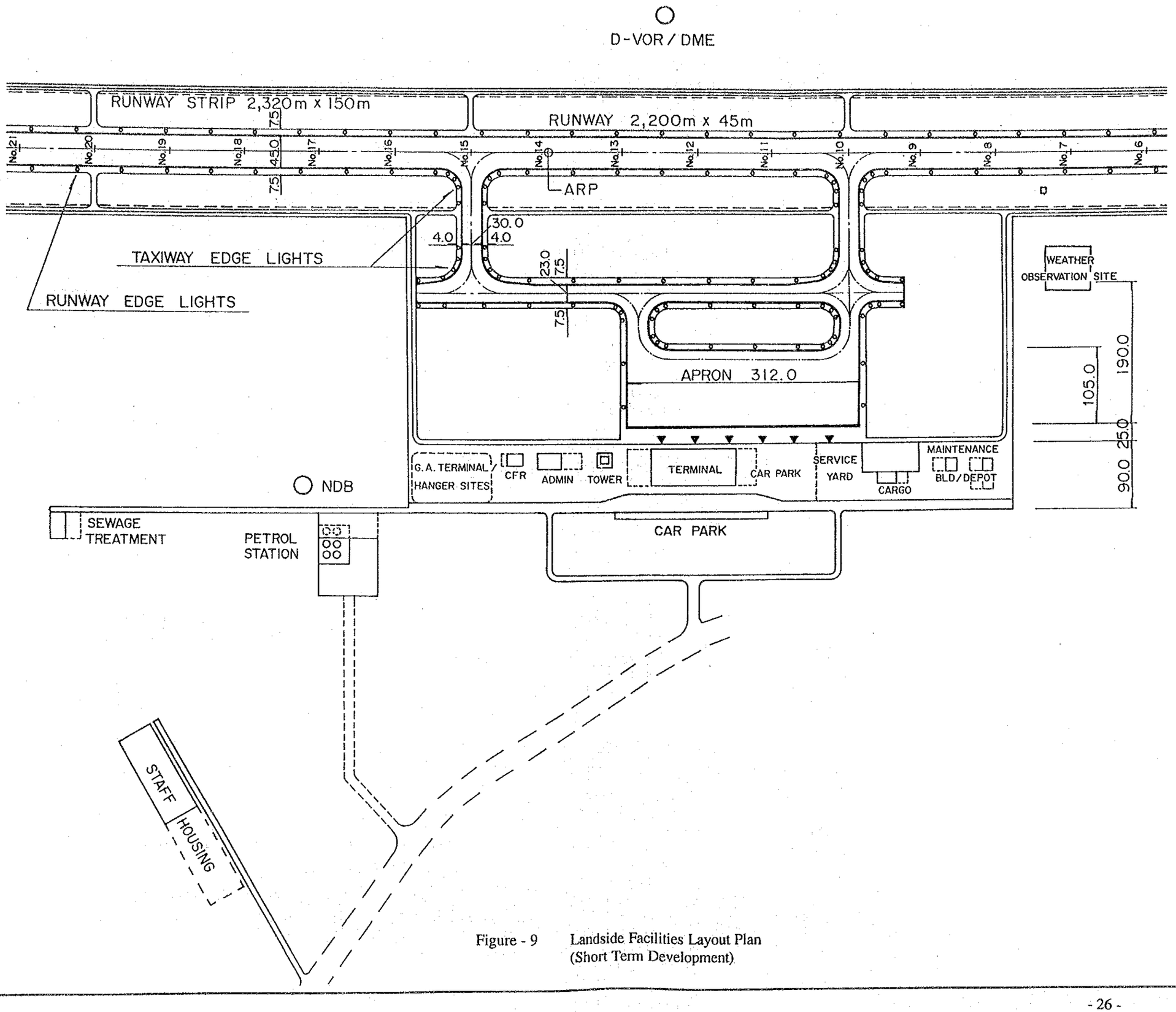


Figure - 9 Landside Facilities Layout Plan
(Short Term Development)

5.2 Implementation Schedule and Cost Estimates

1) Implementation Schedule

Implementation schedule of the short term development plan is estimated as shown in Table-7.

Table - 7 Time Schedule

Items \ Year	1 (1993)	2 (1994)	3 (1995)	4 (1996)	5 (1997)
Detailed Design	———	———			
Negotiation/Bidding		———			
Construction					
(1) Civil Works		———	———	———	———
(2) Buildings			———	———	———
(3) Equipments				———	———
Flight Check					———
Airport Opening					→

2) Cost Estimates

The project cost for the short term development plan was estimated at approximately 68 million Kina (Refer to Table-8).

5.3 Financial and Economic Evaluations

1) Financial Evaluation

(1) Financial Cost

Financial costs of the project for financial evaluation is based on the cost estimates in 5.2 2) mentioned above.

(2) Financial Benefit

Financial benefit is composed of net increase of revenues paid for aviation charges such as charges for use of airport facilities by aircraft (ex. landing charges), and by passengers and charges for navigations etc. The net increase of these charges is estimated by

Table - 8 Annual Disbursement Schedule (Financial Cost)

As of December 1991
1 Kina = 1.04 US$

Work Item	Total			1995		1996		1997	
	Total (1000 K.)	F.C. (1000 US$.)	L.C. (1000 K.)	F.C. (1000 US$.)	L.C. (1000 K.)	F.C. (1000 US$.)	L.C. (1000 K.)	F.C. (1000 US$.)	L.C. (1000 K.)
A. Construction Cost	62,240	33,003	30,507	1,264	3,622	12,864	13,487	18,874	13,398
1. Civil Works	32,349	14,894	18,028	1,204	2,862	7,447	9,014	6,243	6,152
2. Building Works	10,500	8,376	2,100	0	0	4,368	1,050	4,368	1,050
3. Operational Facilities	8,992	6,928	2,331	0	0	0	0	6,928	2,331
4. Utility	1,050	874	210	0	0	437	105	437	105
Sub-total (Base Cost)	52,891	31,431	22,669	1,204	2,862	12,252	10,169	17,975	9,638
5. Price Conti. *1)	6,704	0	6,704	0	617	0	2,810	0	3,278
6. Physical Conti. *2)	2,645	1,572	1,133	60	143	613	508	899	482
B. Engineering Services	6,052	3,300	2,879	126	362	1,286	1,287	1,887	1,230
1. Base Cost *3)	5,289	3,143	2,267	120	286	1,225	1,017	1,798	964
2. Price Conti. *1)	489	0	489	0	62	0	219	0	208
3. Physical Conti. *2)	275	157	124	6	14	61	51	90	59
C. Grand Total	68,292	36,303	33,386	1,391	3,984	14,151	14,774	20,762	14,628

Notes *1) Average growth rates per annum are 0% for F.C. and 5% for L.C. respectively.
*2) 5% of base cost.
*3) 10% of the total base cost of A.

deducting the charges in case of "without the Project" from them in case of "with the Project".

(3) Financial Feasibility of the Project

On the basis of annual cash flow of financial costs and benefits, the project is evaluated from the financial viewpoint by figuring out the financial viability in terms of internal rate of return (IRR), benefit-cost ratio (B/C), and the net present value (NPV).

By reviewing the present charging system for aviation, the Study Team considers that the present level of charges is considerably low comparing with neighbouring countries. Therefore, the calculation in this Study was carried out by assuming that the level of all charges will have gone up to six times of the present level because the revenues of passenger fare of 10% for Rabaul Airport in 1989 become equal to sixfold of present level of aviation charges, by taking account of the fact that the examples of the share of aviation charges in foreign countries in revenues of passenger fare have been more than 10%.
The indices for the financial feasibility of the Project are thus figured out as follows:

- FIRR : 3.1%
- B/C : 0.32
- NPV : -34,204 thousand Kina

From the results of above calculation, it proves to be clear that FIRR is less than 15% as the average interest rate for loan in PNG, and the benefits are less than the costs when they are discounted by 15%.

(4) Estimates of Financial Statements

On the assumption that Tokua Airport will be operated independently from the financial viewpoint, the financial statements such as profit and loss statement, repayment schedule, and money flow table are estimated. This estimation is based on the conditions such as the sixfold aviation charges of the present level, the low average interest rate for loan, 2.7% for construction, to make the Project feasible (less than 3.1% of FIRR), the average

life time of assets as 30 year, the average interest rate, 10%, of deposit for the depreciation allowance and positive money surplus, the average interest rate, 15%, of loan for the negative money surplus, and the growth rate of administration cost as 3% per annum etc. after opening of the airport.
From these financial statements, the followings are pointed out:

a) Net profit and surplus will be changed into positive after the twelfth year of the project life (2006). The accumulated surplus will be positive in the nineteenth year of the project life (2013).

b) The funds will be changed into the surplus after the fourteenth year (2008) on the assumption that the level of air navigation charges will be raised up to six times of the present level.

(5) Overall Financial Evaluation

On the basis of the results mentioned above, the overall financial evaluation is as follows:

a) Judging from the estimates of FIRR, NPV and B/C ratio as the indices for evaluation and profitability by financial statements on the basis of present conditions for operation of airport, the financial feasibility can not be expected.

b) In PNG, the passenger fare is expensive but the aviation charges such as landing charges are cheap with comparison to the neighboring countries. Besides, the payment ratio for aviation charges by air line companies is too low by comparison with the air line companies abroad. On the basis of the present level of charges and the present average interest rate for loan (15%), it is not sufficient to recover not only the annual operating costs but the total Project costs including the construction cost.

c) On the assumption that the present aviation charges will be raised up to reasonable level and loan with a low interest rate (example: 2.7%) will be applied, it is possible that the annual deficit will be changed into positive figure and the

cost of the Project will be recovered in the long term and then the Project can be expected to be financially feasible. This means that it is necessary to consider policies such as governmental subsidies and/or loan with low interest rate by laying stress on social and public necessity.

2) Economic Evaluation

(1) Economic Cost

Financial costs for the project evaluation are converted into the economic costs, by taking account of shadow wage rate, 0.90, for unskilled labor for local portion currency and transfer payment such as taxes and duties, 10% of total financial costs.

(2) Economic Benefit

The economic benefits of this Project comprise efficiency of fuel consumption for navigation, expenditure by foreign tourists, and passengers' benefit by willingness to pay, etc.

(3) Economic Feasibility of the Project

The Project is evaluated from the economic viewpoint by figuring out the economic viability in terms of internal rate of return (IRR), B/C, and NPV on the basis of annual cash flow of economic costs and benefits.
The economic viability of the Project is thus figured out as follows:

- EIRR : 18.5%
- B/C : 1.24
- NPV : 10,772 thousand Kina

From the results of above calculation, it proves to be clear that EIRR is more than 15% as an opportunity cost of capital and the benefits are more than the costs when they are discounted by 15%.

(4) Sensitivity Analysis

Sensitivity analysis for the Project is carried out for the Project to identify the sensitivity of economic viability with regard to EIRR by changing the construction cost and benefit. All of EIRRs estimated are more than 15% as an opportunity cost of capital.

It can be concluded from above economic analyses that the Project has high economic feasibility and is to be implemented in the earliest future.

6. CONCLUSION AND RECOMMENDATION

6. CONCLUSION AND RECOMMENDATION

This project can not be assumed financially feasible, should the loan rate be based on the present domestic average loan interest rate of approximately 15%.

In order to have the project be financially feasible, it is essentially required for the Government to consider to introduce low interest rate loans and/or governmental subsidies.

However, the subject project is considered to be feasible from the economic, technical and environmental point of view. Besides, the existing Rabaul Airport being located in the midst of active volcanoes should be relocated as soon as possible to the Tokua site in order to maintain the safety of operation and to avoid volcanic disasters which would surely result in the suspension of airport function and the paralysis of transportation in the region.

Furthermore, the requirement for an early development of Tokua Airport which is considered to be the most optimum site should be stressed to also cope with the increasing air traffic demand envisaged for the very near future.

We, therefore, wish to strongly recommend the earliest realization of this Airport Project.