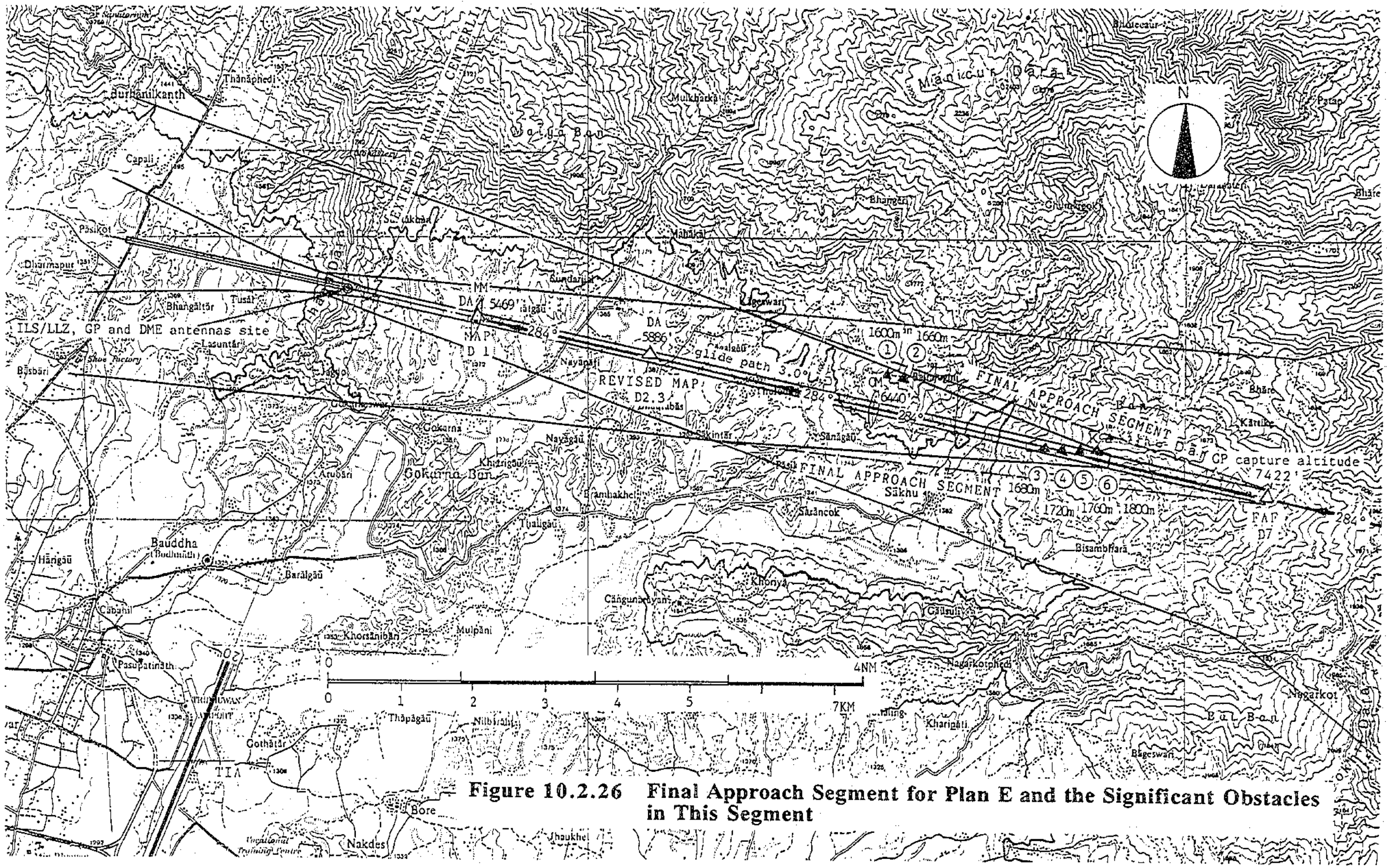


Figure 10.2.26 Final Approach Segment for Plan E and the Significant Obstacles in This Segment

Table 10.2.9 The Relationship between the Obstacles and the OAS in the Final Approach Segment of Plan E

OBSTACLES NR	HEIGHT AMSL m	LOCATIONS EXPRESSED BY X AND Y COORDINATES m	OAS CONCERNED	HEIGHT OF OAS AMSL AT OBSTACLE'S LOCATION m	PENETRATION Yes/No	REMARKS
1	1,600	x = 7,600 y = 450	X	1,848 (1)	No	
2	1,660	x = 7,900 y = 450	X	1,857 (1)	No	
3	1,680	x = 9,850 y = -	W	1,842 (2)	No	
4	1,720	x = 10,100 y = -	W	1,849 (2)	No	
5	1,760	x = 10,250 y = -	W	1,854 (2)	No	
6	1,800	x = 10,450 y = -	W	1,859 (2)	No	

Note :
1. The elevation of GP antenna is assumed as 1,570 m / 5,150 feet.
2. The values indicated by (1) and (2) are obtained by the following formulas:

$X = 0.027986x + 0.184514y - 16.91$ m + 1,570 m (GP elevation)
$Y = 0.0285x - 8.01$ m + 1,570 m (GP elevation)

d) Missed Approach Area

The Missed Approach Point (MAP) is the same as the decision point.

The missed approach course, from MAP to the existing LW Locator with a climbing direction of 270 degrees, was studied.

Figure 10.2.27 shows the critical area of the missed approach area for a course of 270 degrees.

There are many obstacles in the missed approach area. Table 10.2.10 shows the relationship between the obstacles and the OAS for the missed approach area. The obstacles Nrs. 6, 7, 8 and 10 indicated in Figure 10.2.27 project above the OAS.

To ensure the safe climbing in the missed approach area, sufficient clearance between the obstacles and the OAS must be maintained. Accordingly, the decision altitude and the MAP shall be corrected based on the most influential obstacle to the OAS. The obstacle, NR.7 indicated in Figure 10.2.27, is the most influential against the OAS.

As a result of study of the DA and MAP, the following corrections should be made to clear the obstacles.

New DA	: 5,889 feet
New MAP	: ILS/DME D 2.3
New flight visibility	: 7,000 m
New missed approach course	: 271°

However, the new landing minima stated above are too severe for aircraft operations.

e) Re-examination of the Missed Approach Course

The missed approach course from the MAP to the LW Locator which was studied in the preceding paragraph is considered to have practical difficulties for aircraft operations.

To avoid the mountains in the vicinity of the airport and to establish a reliable and efficient missed approach course, a new VOR/DME is required in the neighborhood point of KTM R-328 D7.4 for the exclusive use of the missed approach procedure.

Figure 10.2.28 shows the revised missed approach course using the proposed new VOR/DME.

The new missed approach procedure will be constructed as follows:

" At DA (ILS/DME D1), climb via R-104 of new VOR/DME to new VOR/DME, cross new VOR/DME at 7,000' or above, then left turn climb via R-275 of new VOR/DME to D8 and hold at 9,500'."

Table 10.2.11 shows the relationship between the obstacles and the OAS for the revised missed approach area and indicates that no obstacle projects above the OAS.

f) Holding Procedure after Missed Approach

Figure 10.2.29 shows the holding procedure after missed approach. The holding point was planned at point new VOR/DME R-275, D8.

MHA 9,500 feet will clear all obstacles within the holding area.

Figure 10.2.27 Enlarged Chart for the Relationship between the obstacles and the Missed Approach Area for the Approach Procedure Alternative to the IGS Approach for Runway 20

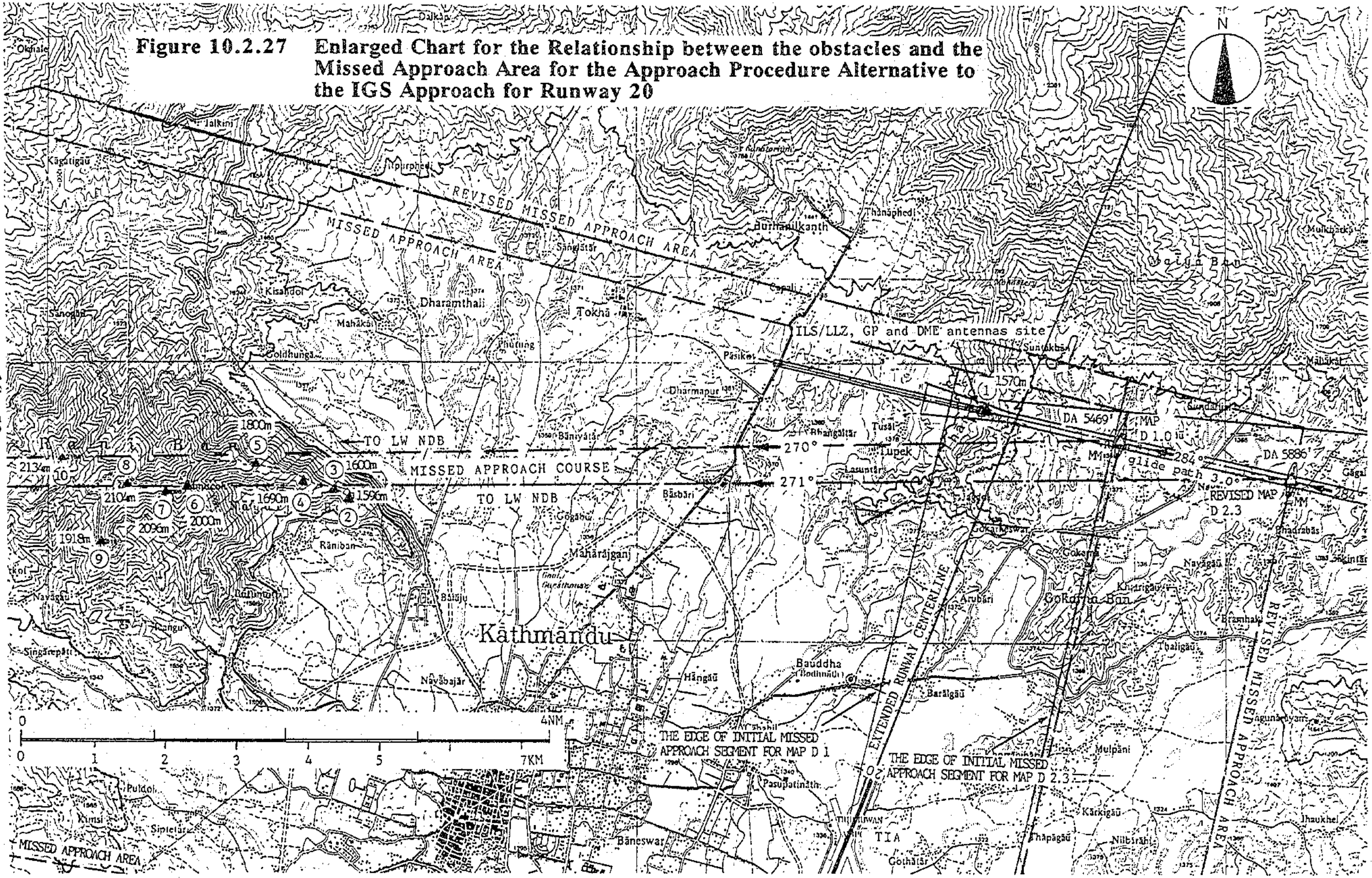


Table 10.2.10 The Relationship between the Obstacles and the OAS in the Missed Approach Area of Plan E

OBSTACLES				DISTANCE BETWEEN EDGE OF I.M.A.A. AND OBSTACLES	HEIGHT OF OAS AMSL AT OBSTACLE'S LOCATION	PENETRATION	REMARKS
NR	HEIGHT AMSL m	LOCATIONS EXPRESSED BY X AND Y COORDINATES m	OAS CONCERNED	m	m	Yes/No	
A	B	C	D	E	F	G	H
1	1,570	x = - y = -	Z	0	1,637	No	
2	1,596	x = 9,000 y = -	Z	8,300	1,844	No	
3	1,600	x = 9,200 y = -	Z	8,500	1,849	No	
4	1,690	x = 9,600 y = -	Z	8,900	1,859	No	
5	1,800	x = 10,200 y = -	Z	9,500	1,874	No	
6	2,000	x = 11,200 y = -	Z	10,500	1,899	Yes	
7	2,096	x = 11,500 y = -	Z	10,800	1,907	Yes	
8	2,104	x = 12,000 y = -	Z	11,300	1,919	Yes	
9	1,918	x = 12,500 y = -	Z	11,800	1,932	No	
10	2,134	x = 12,900 y = -	Z	12,200	1,942	Yes	

Note :
1. I.M.A.A. stands for Initial Missed Approach Area.
2. The values of column F are obtained by the following formula.
   F = E/40 + 1,667 (DA) - 30 (m)
3. The altitude at D1 (DA) on the final approach course will be 1,667 m/5,468 feet.
   (1 nm · tan θ+ GP Antenna Elevation)
4. MAP is assumed to be D1 LLZ/DME, and the missed approach course is 270 degrees.

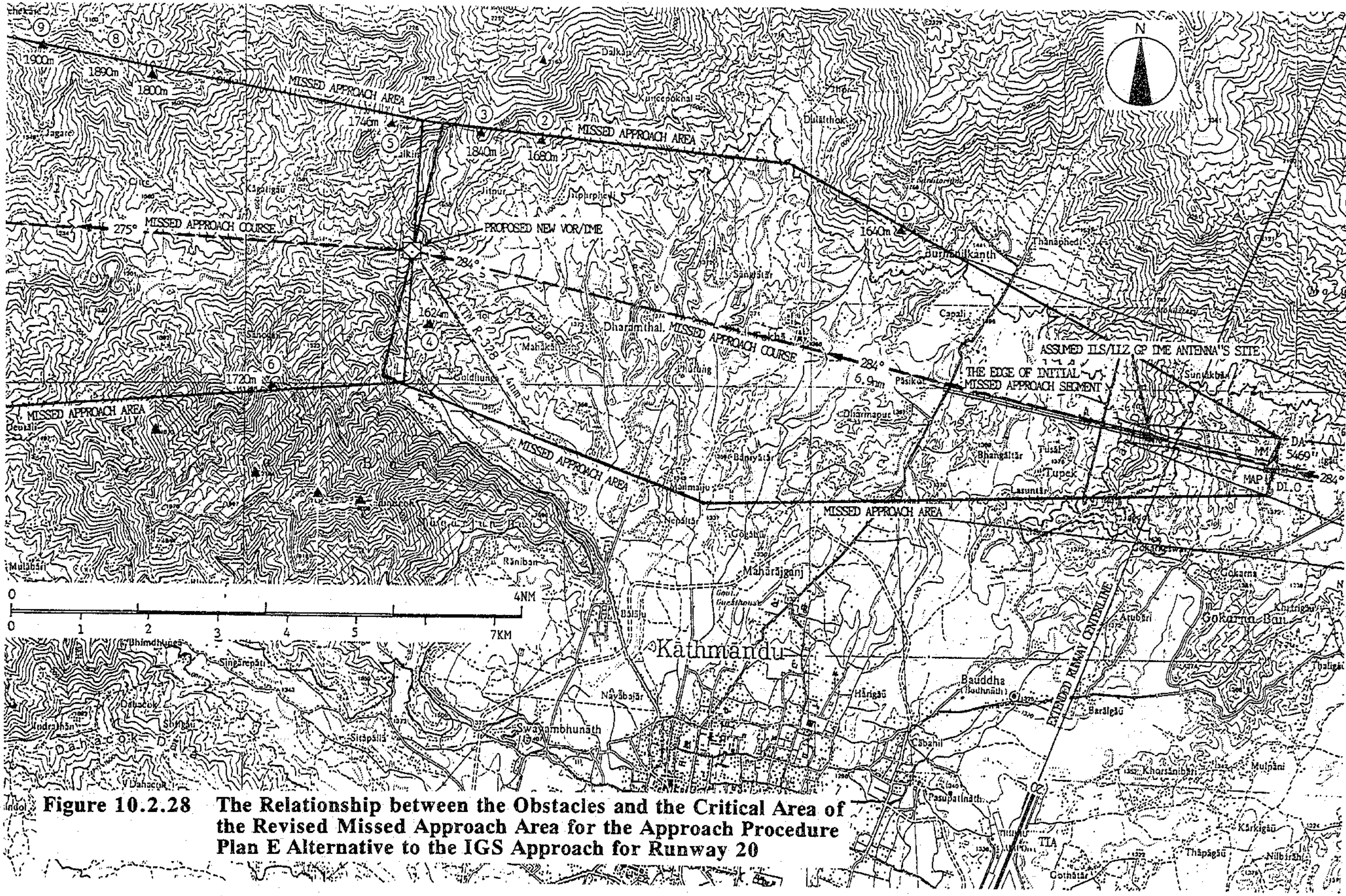


Figure 10.2.28 The Relationship between the Obstacles and the Critical Area of the Revised Missed Approach Area for the Approach Procedure Plan E Alternative to the IGS Approach for Runway 20

Table 10.2.11 The Relationship between the Obstacles and the OAS for the Revised Missed Approach Area of Plan E

OBSTACLES				DISTANCE BETWEEN EDGE OF I.M.A.A. AND OBSTACLES	HEIGHT OF OAS AMSL AT OBSTACLE'S LOCATION	PENETRATION	REMARKS
NR	HEIGHT AMSL	LOCATIONS EXPRESSED BY X AND Y COORDINATES	OAS CONCERNED				
	m	m		m	m	Yes/No	
A	B	C	D	E	F	G	H
1	1,640	x = 4,600 y = -	Z	3,600	1,727	No	
2	1,680	x = 9,700 y = -	Z	8,900	1,859	No	
3	1,840	x = 10,500 y = -	Z	9,700	1,879	No	
4	1,624	x = 10,500 y = -	Z	9,800	1,882	No	
5	1,746	x = 11,800 y = -	Z	11,000	1,912	No	
6	1,720	x = 12,700 y = -	Z	11,800	1,932	No	
7	1,800	x = 15,300 y = -	Z	14,500	1,999	No	
8	1,890	x = 15,900 y = -	Z	15,100	2,014	No	
9	1,900	x = 17,000 y = -	Z	16,100	2,039	No	

Note : 1. I.M.A.A. stands for Initial Missed Approach Area.

2. The values of column F are obtained by the following formula.
$F = E/40 + 1,667\ (DA) - 30\ (m)$

3. The edge of I.M.A.A. is 1.35 nm (= 0.85 nm + 0.5 nm) from MAP.

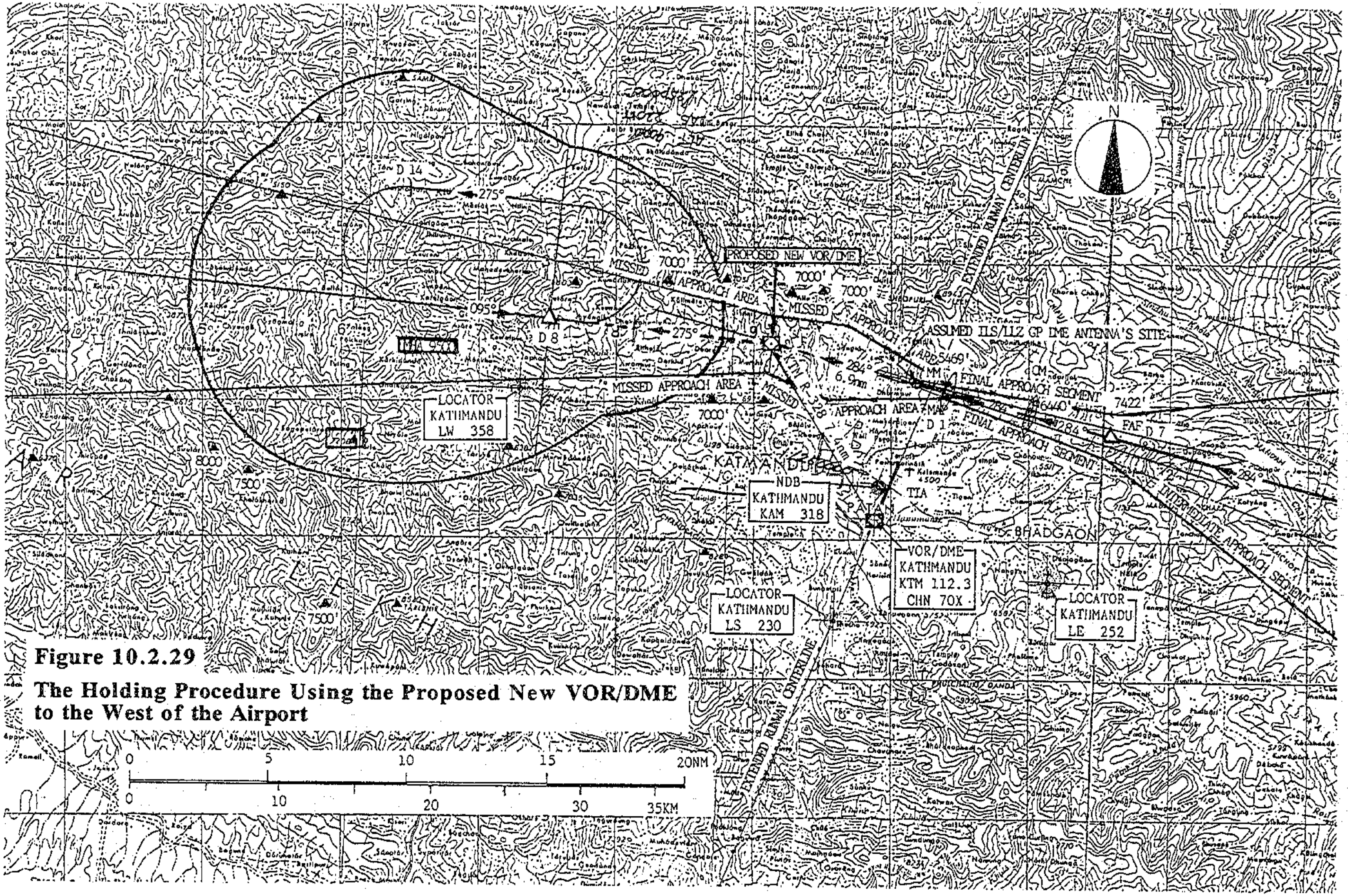


Figure 10.2.29

The Holding Procedure Using the Proposed New VOR/DME to the West of the Airport

(5) The Study of an Alternative Plan to Plan F

To reduce the intersecting angle between the final approach course and the extended runway centerline, an alternative Plan F was studied with the following assumptions.

a) The elevation of Runway 20 threshold : 4,313'/1,314 m

b) The elevation of ILS/LLZ, GP and DME antenna's sites : 4,757'/1,450 m
(these antenna's sites are assumed on the top of the hill, 1,450 m/4,757' AMSL, located approximately at point 358°T and 3,700 m from the Runway 20 threshold as shown in Figure 10.2.30)

c) Angle of GP : 3.0 degrees

(6) The Outline of Plan F

The outline of Plan F is as follows:

a) Fixes

Fixes	Locations
IAF	KTM VOR/DME R-126 D18
I F	KTM VOR/DME R-083 D18 ILS/DME D17
FAF	ILS/DME D8
MAP	ILS/DME D2

b) MEAs

Segments	MEA
Initial Approach	
from KTM VOR/DME R-126 to KTM VOR/DME R-110 D18	11,000'
from KTM VOR/DME R-110 to IF	10,000'
Intermediate Approach	
from IF to ILS/DME D12	8,500'
from ILS/DME D12 to FAF	7,300'

c) Approach Courses

Segments	Courses
Initial Approach	KTM VOR/DME 18 DME ARC
Intermediate Approach	276°
Final Approach	276°
Missed Approach	290° / 275°

(7) The Study of Plan F

Figure 10.2.31 shows Plan F.

a) The Initial Holding Procedure

The initial holding procedure is the same as that of Plan E. MHA of 11,000' will clear all obstacles within the holding area.

b) Initial and Intermediate Approach Segments

The initial approach segment was constructed by the KTM VOR/DME 18 DME ARC. The distance between the IAF and IF will be 13 nm.

MEAs for initial and intermediate approach segments are the same as those of Plan E.

All MEAs are included with consideration of the MOCA (Minimum Obstacle Clearance Altitude) and MRA (Minimum Reception Altitude) requirements.

c) Final Approach segment

Figure 10.2.32 shows the enlarged chart of the final approach segment with an inbound course of 276°.

All obstacles in the final approach segment do not project above the OAS for this segment as studied in Table 10.2.12.

The FAF was planned at a point 8 nm from the assumed GP antenna site on the final approach course. The GP capture altitude at FAF will be 7,360 feet.

Decision point was planned at a point ILS/DME D2 on the final approach course.

The decision altitude and flight visibility which are studied based on the final approach segment will be 5,393 feet and 4,800 m respectively.

d) The missed approach point is the same as the decision point. Figure 10.2.33 shows the missed approach area using the proposed new VOR/DME.

Table 10.2.13 shows the relationship between the obstacles and OAS for the missed approach area. This table indicates that no obstacles project above the OAS.

The following missed approach procedure will be applicable.

"At DA, right turn climb via R-110 of new VOR/DME to new VOR/DME, cross new VOR/DME at 7,000' or above, then turn left climb via R-275 of new VOR/DME to D8 and hold at 9,500'."

e) Holding Procedure after a Missed Approach

The holding procedure after missed approach is same as that of Plan E as shown in Figure 10.2.29.

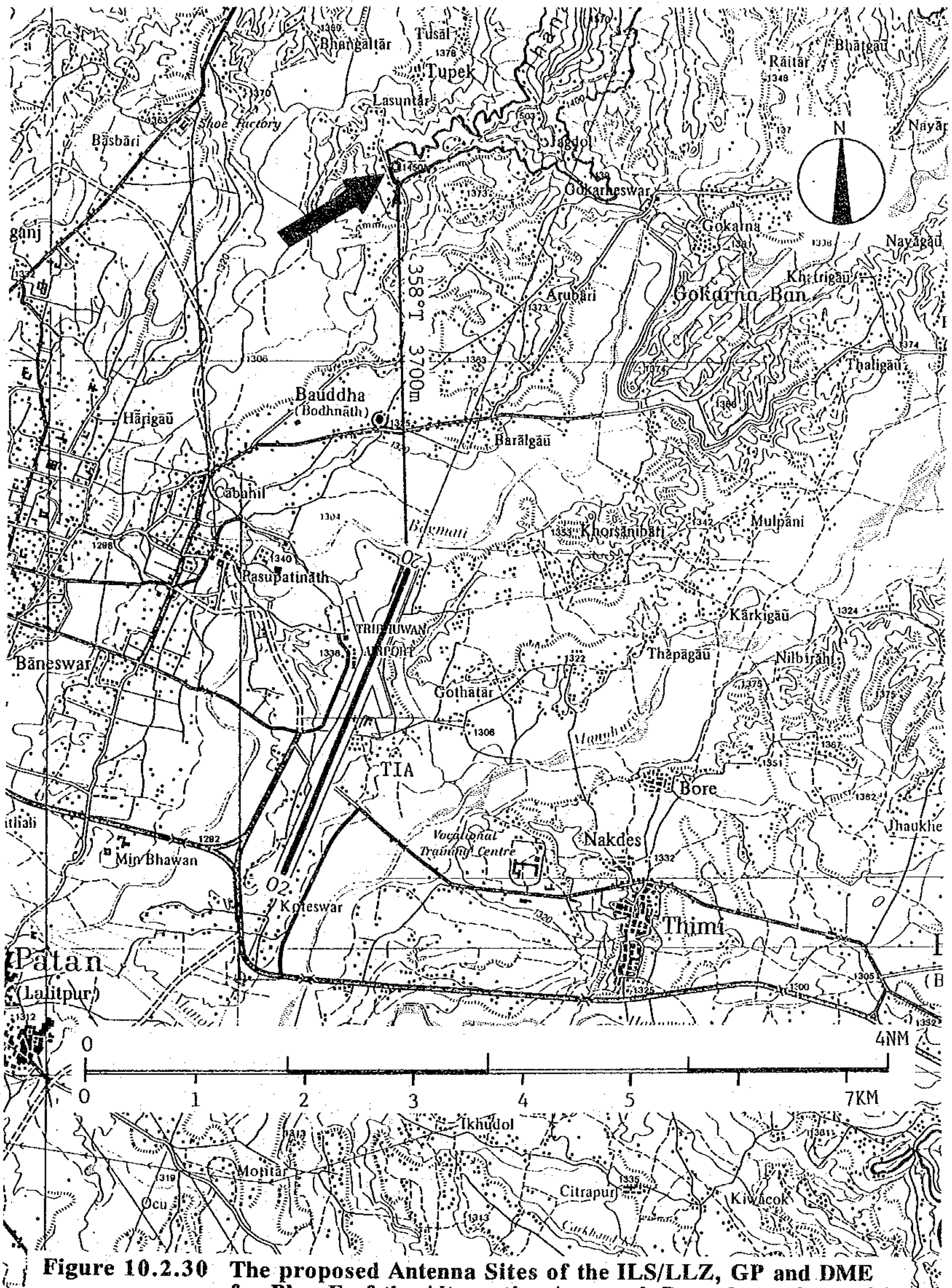


Figure 10.2.30 The proposed Antenna Sites of the ILS/LLZ, GP and DME for Plan F of the Alternative Approach Procedure of the IGS Approach for Runway 20

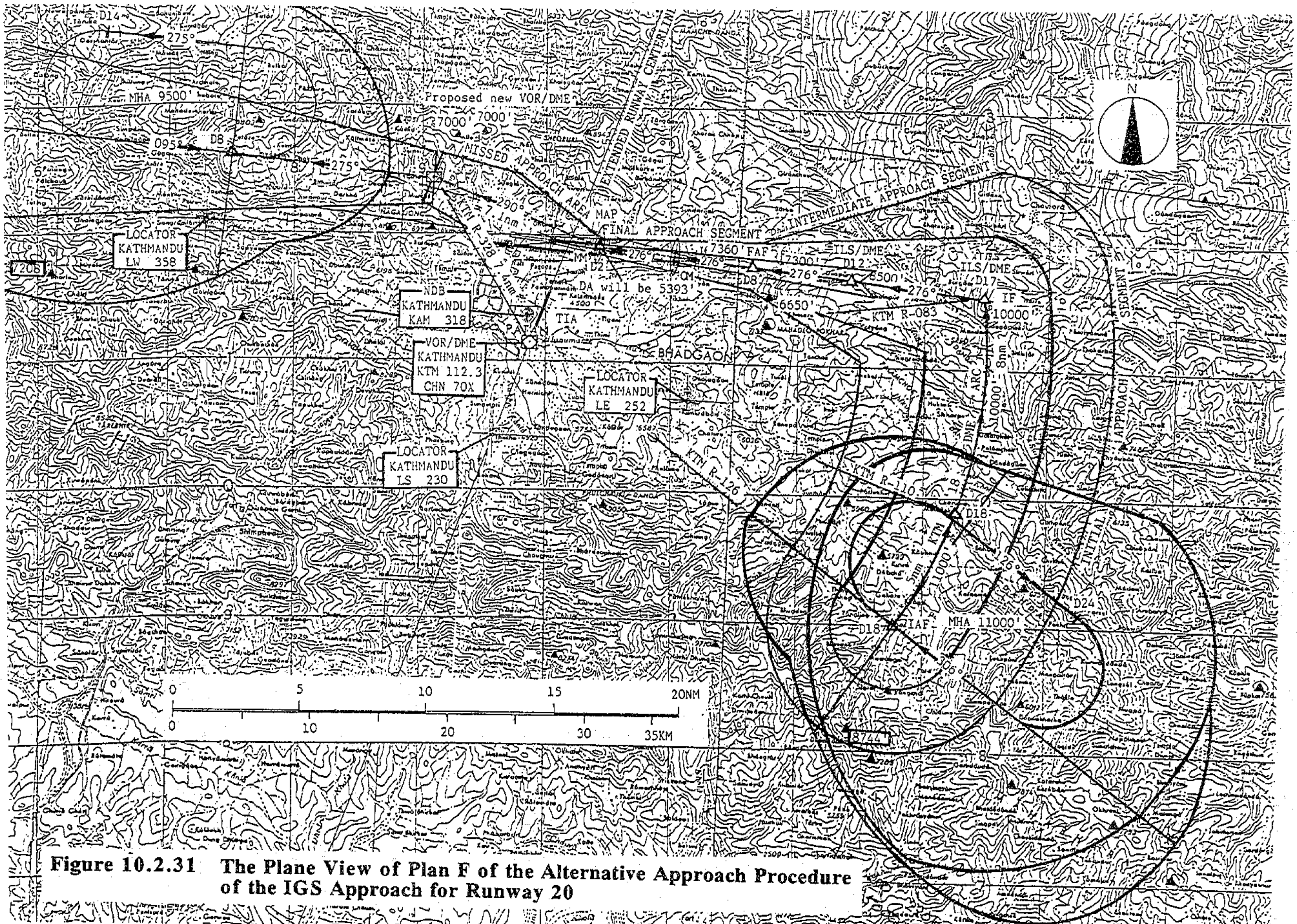


Figure 10.2.31 The Plane View of Plan F of the Alternative Approach Procedure of the IGS Approach for Runway 20

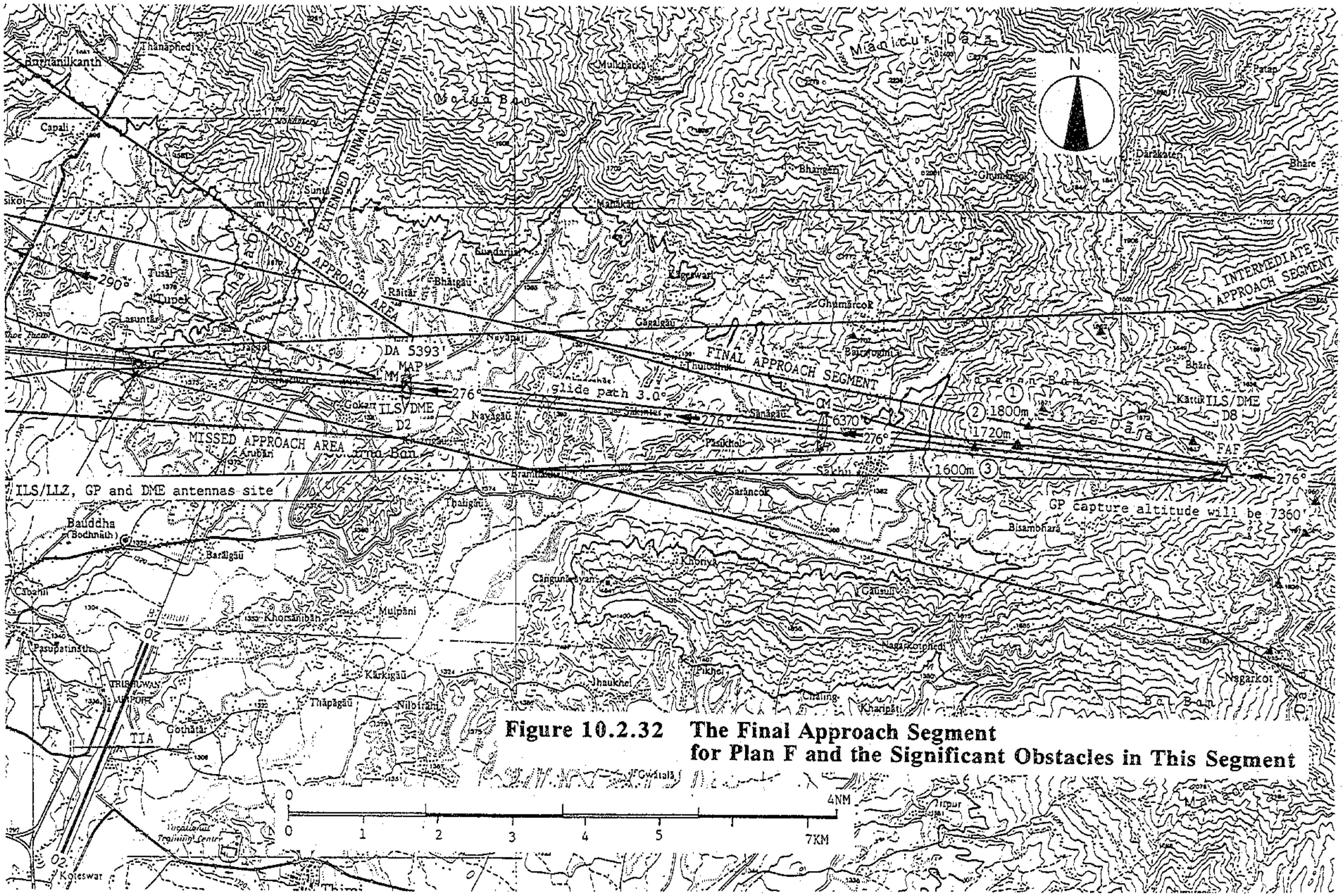


Figure 10.2.32 The Final Approach Segment for Plan F and the Significant Obstacles in This Segment

Table 10.2.12 The Relationship between the Obstacles and the OAS in the Final Approach Segment of Plan F

OBSTACLES				HEIGHT OF OAS AMSL AT OBSTACLE'S LOCATION	PENETRATION	REMARKS
NR	HEIGHT AMSL	LOCATIONS EXPRESSED BY X AND Y COORDINATES	OAS CONCERNED			
	m	m		m	Yes/No	
1	1,800	x = 12,100 y = 250	X	(1) 1,817	No	
2	1,720	x = 11,900 y = -	W	(2) 1,775	No	
3	1,600	x = 11,300 y = -	W	(2) 1,764	No	

Note :
1. The elevation of GP antenna site is assumed as 1,450 m/4,757'.
2. The values indicated by (1) and (2) are obtained by the following formulas.

X = 0.027986x + 0.184514y - 16.91 m + 1,450 m (GP elevation)
Y = 0.0285x - 8.01 m + 1,450 m (GP elevation)

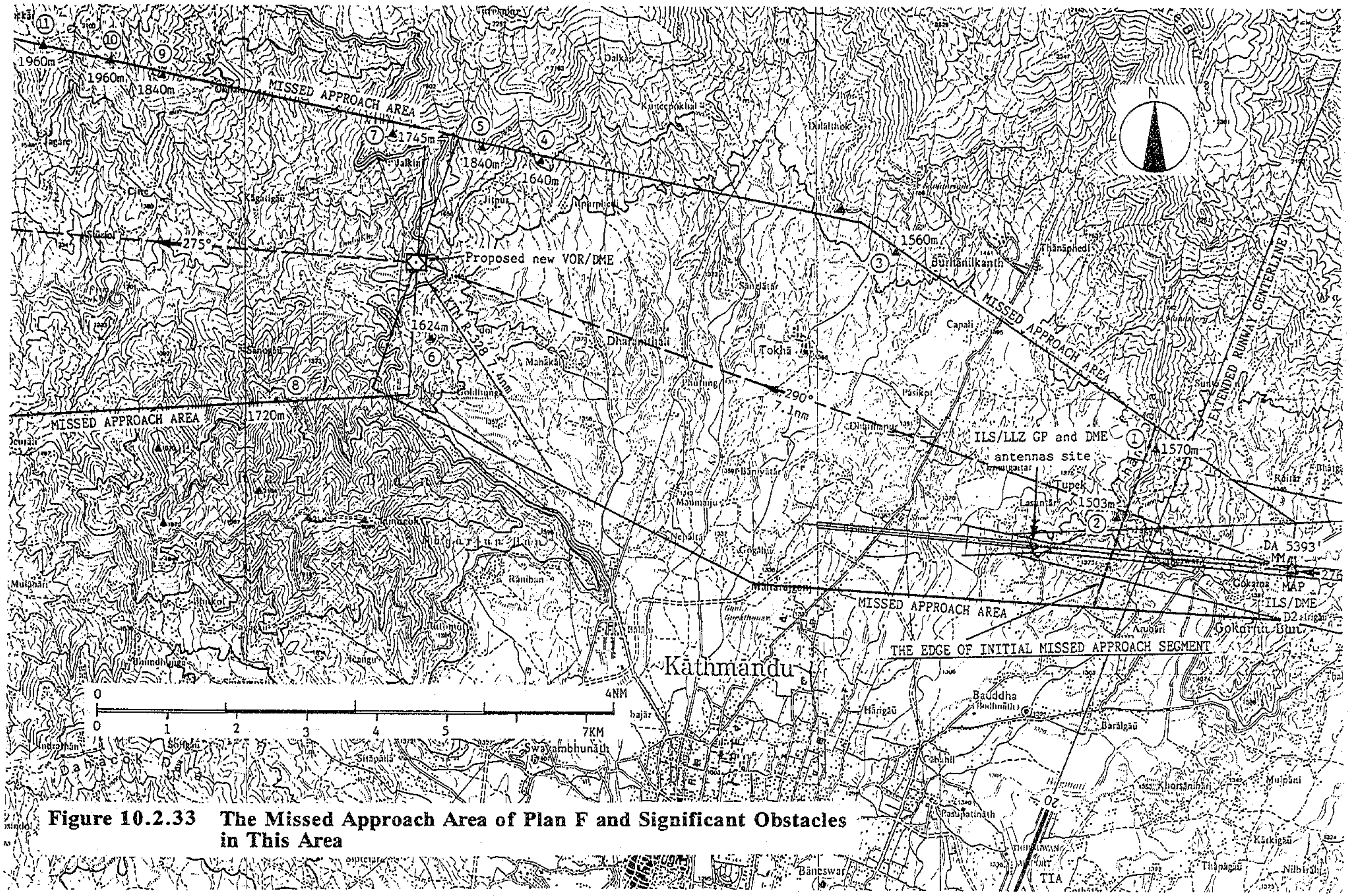


Figure 10.2.33 The Missed Approach Area of Plan F and Significant Obstacles in This Area

Table 10.2.13 The Relationship between the Obstacles and the OAS in the Missed Approach Area of Plan F

OBSTACLES NR	HEIGHT AMSL m	LOCATIONS EXPRESSED BY X AND Y COORDINATES m	OAS CONCERNED	DISATANCE BETWEEN EDGE OF I.M.A.A. AND OBSTACLES m	HEIGHT OF OAS AMSL AT OBSTACLE'S LOCATION m	PENETRATION Yes/No	REMARKS
A	B	C	D	E	F	G	H
1	1,570	x = 2,500 y = -	Z	0	1,613	No	
2	1,503	x = 2,500 y = -	Z	0	1,613	No	
3	1,560	x = 7,000 y = -	Z	4,500	1,725	No	
4	1,640	x = 12,000 y = -	Z	9,500	1,850	No	
5	1,840	x = 12,900 y = -	Z	10,400	1,873	No	
6	1,624	x = 12,600 y = -	Z	10,100	1,865	No	
7	1,745	x = 14,100 y = -	Z	11,600	1,903	No	
8	1,720	x = 14,300 y = -	Z	11,800	1,908	No	
9	1,840	x = 17,500 y = -	Z	15,000	1,988	No	
10	1,960	x = 18,200 y = -	Z	15,700	2,005	No	
11	1,960	x = 19,200 y = -	Z	16,700	2,030	No	

Note :
1. I.M.A.A. stands for Initial Missed Approach Area.
2. The values of column F are obtained by the following formula.
   F = E/40 + 1,667 (DA) - 30 (m), DA = 1,643 m
3. The degree of I.M.A.A. is 1.35 nm (= 0.85 nm + 0.5 nm) from MAP.

(8) The Evaluation of the Approach Procedure Alternatives to the IGS Approach for Runway 20

The two approach procedures, Plans E and F, were studied in this section.

It is considered that both plans basically have the possibility to make safe aircraft operations. Particularly, Plan F has the following advantages compared with Plan E.

a) The lower landing minima

b) The smaller intersecting angle with the final approach course and the extended runway centerline

Accordingly, it is considered that Plan F has the highest possibility as the approach procedure alternative to an IGS approach for Runway 20 based on the synthesized studies.

To promote the execution of safe operations by Plan F, the following existing and new navigational and ground aids would be required.

a) ILS/LLZ, GP, DME, MM and OM, and existing KTM VOR/DME

The antenna sites for the ILS components particularly the LLZ, GP and DME should have the capabilities to ensure the facility performs sufficiently.

b) A new VOR/DME on the west of the airport

c) An approach lighting system for Runway 20

d) A runway lead-in lighting system with sequenced flashing lights to define the turning and visual approach course

PANS-OPS describes the range of the final approach speed at 2,000 feet altitude based on a temperature of ISA + 15°C for each aircraft category as shown in the left column. Based on these values, speeds at 5,000 feet altitude were calculated as shown in the right column respectively in Table 10.2.14.

Table 10.2.14 Range of Final Approach Speeds at 2,000 and 5,000 feet

Aircraft Category	Range of Final Approach Speed at 2,000 feet Altitude Described in PANS-OPS (kt)	Range of Final Approach Speed at 5,000 feet Altitude (kt)
A	70/100	73/104
B	85/130	89/136
C	115/160	120/167
D	130/185	136/194

Table 10.2.15 shows the radius of turn for each range of final approach speeds for each category.

Table 10.2.15 The Radius of Turn at Maximum and Minimum Final Approach Speeds at 5,000 feet Altitude

Aircraft Category	Maximum and minimum Final Approach Speed at 5,000 feet Altitude (kt)	Radius of Turn (Nm)
A	73	0.2
	104	0.4
B	89	0.3
	136	0.7
C	120	0.6
	167	1.13
D	136	0.7
	194	1.5

Figure 10.2.34 shows the visual turning courses from the DA point to the extended runway centerline for aircraft categories C and D.

The examination for the installation of runway lead-in lighting systems with sequenced flashing lights will be further studied taking into account this figure and the practical data for turning which will be given by the operators.

e) Installation of High Intensity Obstacle Lights on the top of hills located along the turning and visual approach course.

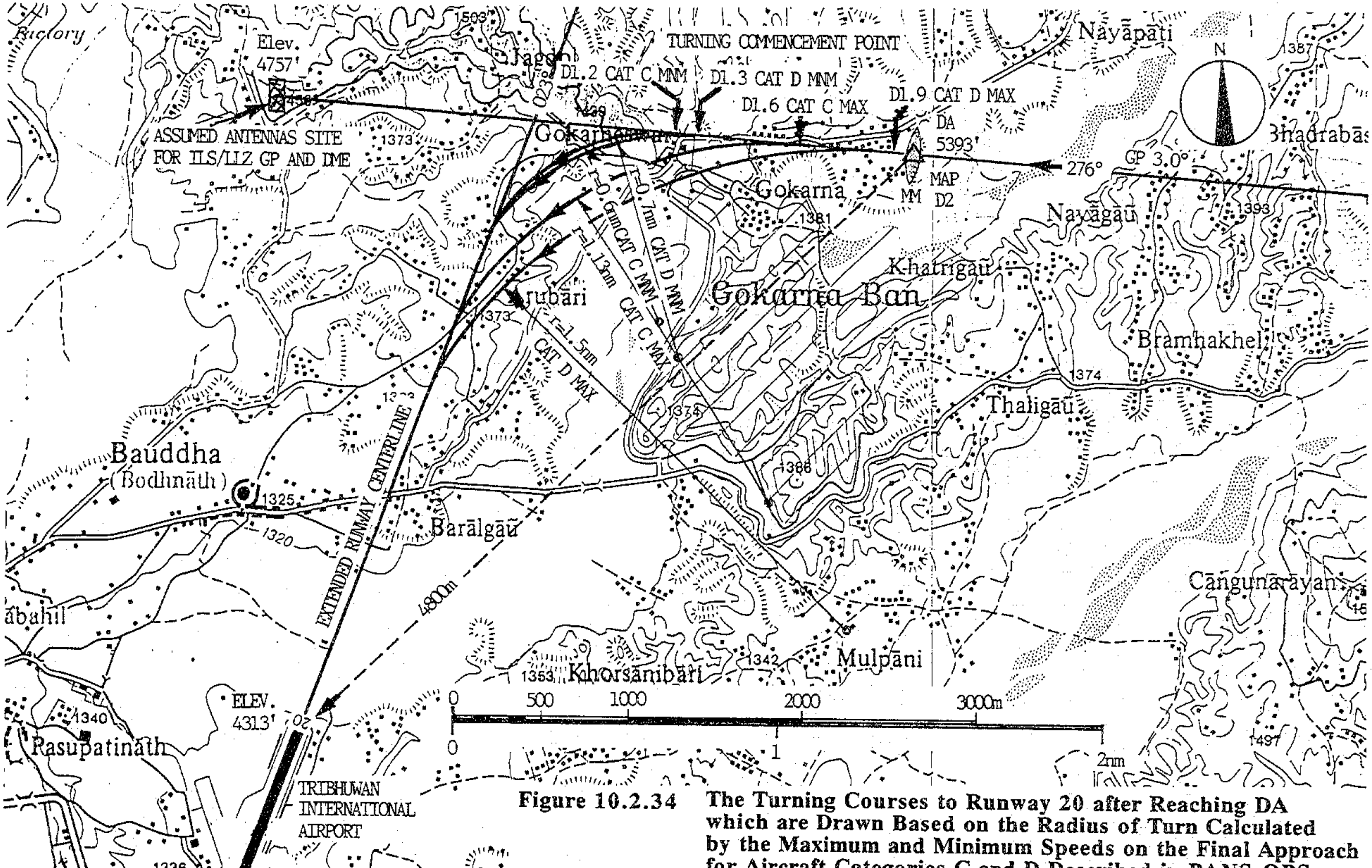


Figure 10.2.34 **The Turning Courses to Runway 20 after Reaching DA which are Drawn Based on the Radius of Turn Calculated by the Maximum and Minimum Speeds on the Final Approach for Aircraft Categories C and D Described in PANS-OPS**

10.2.5 Study of the Radar System

Air Traffic Control is usually expected to be supported by a radar system in modern airports. Particularly at TIA, there would have been the possibility of preventing recent aircraft accidents in the Kathmandu terminal area, if a radar service had been provided to monitor the aircraft's position. A terminal radar system consisting of ASR/SSR is therefore selected as the most important element in the air safety improvement plan.

At first, the operation of the radar system at Tribhuvan International Airport intends to only monitor approaching aircraft, as it will take time for the controllers to become familiar with the newly-introduced equipment and system. After the familiarization period is over, it will transfer to full scale control of the Kathmandu terminal control airspace.

(1) Objectives of the radar approach control service

Through a study and close analysis of investigation reports on recent aircraft accidents, the approaching aircraft's pilot risks collision with the mountains around the Kathmandu valley if he loses his position, heading or altitude. A radar approach control service at Kathmandu TMA will be able to advise the aircraft even if he takes a wrong course.

In order to provide a complete radar approach control service (radar vectoring), adequate knowledge and sufficient skills on radar control and maintenance technology are requisite. It is assumed that enough time will be spent to achieve the necessary requirements.

The objective of the radar approach control service at Kathmandu TMA is therefore defined to provide a radar advice service for approaching and/or departing aircraft in the initial stage.

The final target is the approach control itself.

(2) Approach routes in Kathmandu TMA

The existing Sierra instrument approach procedure, that is familiar to most international airlines, will be maintained after the commission of the radar system due to;

- An approach turn is not required to align the aircraft to the runway axis on the final approach segment because of the straight in approach
- Less obstacles comparatively on the approach course
- Some navigation aid facilities have been provided
- Easy to change procedures from radar control to procedural control whenever this is required due to some radar failure.

As studied previously, two east and west additional routes to the current Sierra Approach are planned to be introduced to solve the concentration and the congestion of the traffic around Simara at present and in future.

(3) Required Coverage for the Terminal Radar

The terminal radar must cover all of the approaching and arriving routes for its purpose. Therefore, Kathmandu terminal radar should cover the Sierra Approach route and the new approach routes, which are planned for the restructure of the airspace use.

(4) Radar System

i) site of radar

Because of severe topographical condition of the Kathmandu Valley, there was no fully satisfactory site to cover the requirement of the radar performance. The airport site is most desirable for final approach control, but the radar is estimated to cover only within the valley. On the other hand, a radar on the top of a mountain can perform well above the altitude of the radar site but this cannot cover inside the valley, where TIA lies, due to the characteristics of the radio.

As the result of this study, the following both sites are necessary to satisfy the required radar coverage for terminal radar control.

- ASR/SSR at TIA
- An additional radar on the top of a mountain (such as Mt. Phulchouki)

ii) Radar configuration

a. To monitor and control all of arriving aircraft to an airport, it is necessary to install ASR/SSR at an airport, because of thicker traffic and handling aircraft without an equipped transponder .

b. As for an additional radar at a mountain top, there are two kind of systems; ASR/SSR or SSR.

Due to the current PANS-RAC (1985) of ICAO, SSR information without primary radar information shall not normally be used for the provision of separation to aircraft except as specified by Regional Air Navigation Agreements. Nevertheless, ICAO is on the way to revise the status of radar control by SSR to be more positive, based on the technology development and the advanced reliability of SSR equipment.

Mt. Phulchouki was selected as the best site when compared with other mountain sites. However , the area is quite limited for the construction of a structure, so that it would be difficult to construct both an ASR and SSR on this site. And at the altitude of SSR coverage (more than 9,000 ft), there will be less altitude change of approaching aircraft than at the lower altitude. And at this kind of altitude, as most of bigger aircraft are equipped with a Transponder, it is thought that it will be able to provide the separation by SSR , with the regular check of the SSR wave accuracy in the case of terminal radar control.

c. Considering these conditions totally, SSR is planned for an additional radar on a mountain top of Mt. Phulchouki.

Figure 10.2.35 shows the concept system diagram, and Figure 10.2.36 is the combined line of sight coverage boundary of this radar system.

(5) Required Procedure of SSR Operation

According to the current PANS-RAC, it is required that this terminal radar system should be specified by Regional Air Navigation Agreements, after the authorization of the Nepal government and establishing the operation criteria.

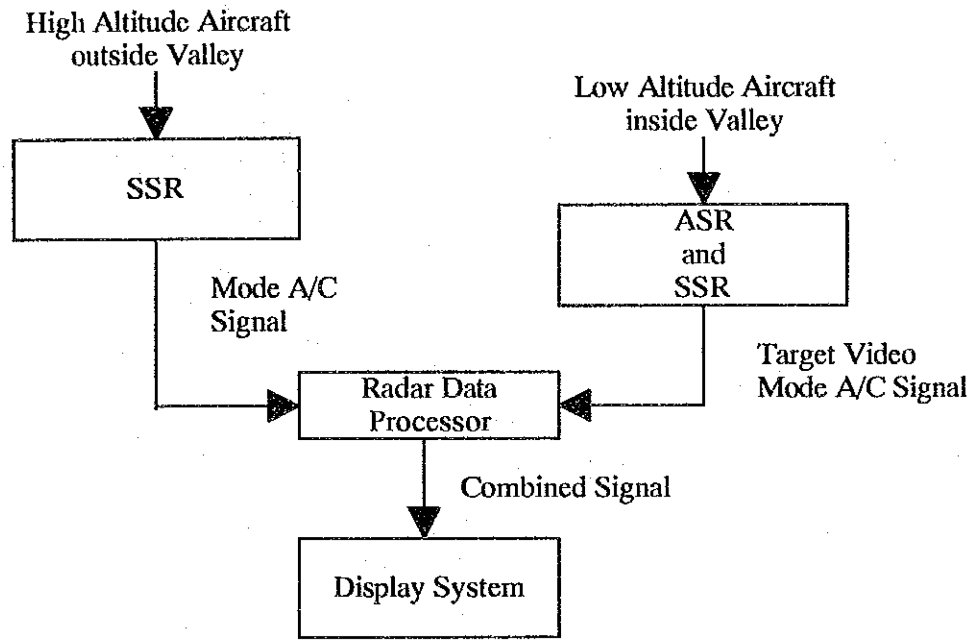


Figure 10.2.35 Conceptual System Diagram

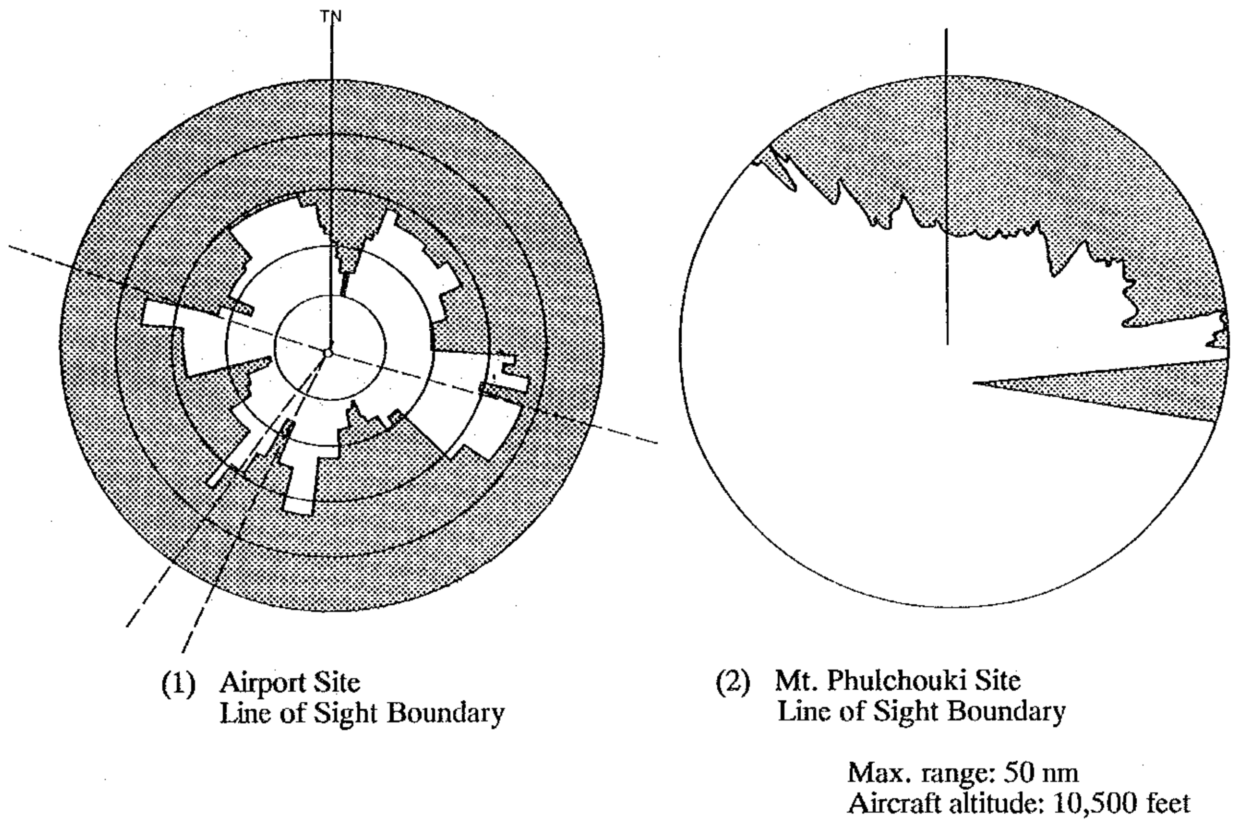


Figure 10.2.36 Combined Line of Sight Coverage Boundary

(6) Transition program for the radar vector service

The terminal radar service at Kathmandu TMA will be initiated by a radar monitoring service, and accordingly, the air safety at TIA will advance greatly with this monitoring service. The service will change to a radar vector service in the future. When the transition takes place, air safety under radar control will depend upon only the radar controller's and the maintenance technician's skill.
Therefore the transition in the radar operations mode shall be done subject to the following requisite conditions.

- An adequate number of controllers and maintenance technicians who have sufficient experience, skill and knowledge
- Complete radar coverage
- Establishment of radar operation procedures based on ICAO PANS-RAC (Rules of the Air and Air Traffic Services)

In order to fulfill the conditions mentioned above, controller's training should be planned based upon ICAO Annex-1 and on-the-job training should aim at radar vector control. Since few cases have been reported, to estimate the transition period from monitoring operations to vectoring as a whole system is not easy because it depends on many conditions there. However, the following should be taken into account before the commencement of the radar vector service.

- Controllers experience by radar monitoring:	6 months
- Establishment of operation procedures:	1 year
- Establishment of rating system for the controllers and maintenance technicians:	1 year
- Preparations of issuing NOTAM:	6 months

10.3 Air Safety Improvement Plan

10.3.1 Phased Improvement

As mentioned in 7.1.2. the plan is phased into three (3), taking into account necessity, urgency and also technical innovation.

(1) Urgent Improvement Plan

Improvement plan consisting of the most urgent programs to improve the current condition of TIA which are planned to prevent aircraft accidents from happening again.

Therefore, this plan is required to be executed as soon as possible.

(2) Short-term Improvement Plan

Improvement plan consisting of highly necessary and urgent programs, aiming at the year 2003

The programs of the Urgent Improvement Plan are selected in this plan. This plan is the first stage of the Modernization Plan.

(3) Long-term Improvement Plan

This is the second stage of the Modernization Plan aiming at the year 2010, which consists of low urgent programs and the provision for technical innovation in the future.

10.3.2 Air Safety Improvement Plan

(1) Urgent Improvement Plan

At a modern airport, the following radio navigation aids are required to be installed.

- ILS
- VOR
- DME
- Radar (ASR and SSR)

As a result of the study, installation of ILS is difficult due to the geographical features along the approach path. Thus, an alternative guidance system of a Localizer with a collocated DME is selected instead of ILS.

Referring to the recent accidents, a radar system is the most necessary equipment, so as to monitor and control aircraft movements.

The plan consists of the following programs;

- Installation and operation of an Aerodrome Surveillance Radar (ASR) supported by a Secondary Surveillance Radar (SSR) at TIA for approach monitoring and approach control

- Installation of an additional SSR to complement the ASR/SSR coverage at TIA for aircraft surveillance

- Improvement of the communication system for radar operations

- Installation of Localizer type Directional Aids (LDA) with collocated Distance Measuring Equipment (DME)

- Improvement of CATC, including buildings and equipment for practical training

- Establishment of a skill evaluation, rating and licensing institution for air traffic controllers to conform to the ICAO recommendations

- Establishment of technical skill evaluations for maintenance staff

(2) Short-Term Improvement Plan

The Plan consists of the following programs:

- Extension of ATIS coverage

- Replacement and rearrangement of the current meteorological observation equipment with an automatic system

- Replacement of the current Semi-automatic Message Switching System (MSS) with an Automatic Message Switching System

- Communications network improvement for domestic teletype network and international AFTN at the same time

- Packet switching with open system interconnection (OSI) model

- Optimum frequency allocation for HF fixed and mobile services and replacement of antenna with a suitable antenna system

- Replacement of East and South Locators

- Establishment of an ATS direct speech circuit between Kathmandu and domestic major airports/international airports by means of a communication satellite microwave radio link

- Establishment of a domestic teletype network by means of a satellite microwave radio link instead of the existing HF point to point communications

- Replacement of the Locators of NDB

- Establishment of maintenance management planning and spare parts control

(3) Long-term Improvement Plan

The long-term improvement mainly consists of regular replacement of the existing systems and the future systems which have been innovated to increase air safety.

The Special Committee on Future Air Navigation Systems (FANS) has been studied and assessed by ICAO since 1983 and submitted as a final report that comprises of the global concept of the future Communication, Navigation and Surveillance (CNS) system in May 1988. The outline of the proposed system is shown in Table 10.3.1.

Modern technology has been applied to the CNS system which is expected to overcome the topographical restraints of TIA.

The plan consists of the following programs;

- Replacement of the existing system, such as HF, VHF transmitter/receiver, ATS console and VOR/DME due to their age
- Provision for en-route air traffic control due to air route re-structuring at the time of increased traffic volume
- Provision for a Microwave Landing System (MLS)
- Provision for an Aeronautical Mobile Satellite Service (AMSS), Automatic Dependent Surveillance (ADS) and Global Positioning System (GPS)

Table 10.3.1 The Future CNS Evolution

Type of airspace	Current			Proposed		
	Communications	Navigation	Surveillance	Communications	Navigation	Surveillance
Oceanic/continental en-route airspace with low traffic density (Note 4)	VHF voice HF voice	OMEGA/LORAN-C NDB VOR/DME Barometric altitude INS/IRS	Primary radar/SSR Voice position reports	VHF voice/data AMSS data/voice HF over poles only (Note 5)	RNAV/RNPC GNSS Barometric altitude High altitude GNSS altimetry (Note 2) INS/IRS	ADS
Continental airspace with high density traffic	VHF voice	OMEGA/LORAN-C NDB VOR/DME Barometric altitude INS/IRS	Primary radar SSR Mode A/C	VHF voice/data AMSS data/voice SSR Mode S data link	RNAV/RNPC GNSS Barometric altitude High altitude GNSS altimetry (Note 2) VOR/DME (Note 6) INS/IRS	SSR Mode A/C or SSR Mode S ADS
Oceanic airspace with high density traffic	HF voice	MNPS OMEGA/LORAN-C Barometric altitude INS/IRS	Voice position reports	AMSS data/voice	RNAV/RNPC GNSS Barometric altitude High altitude GNSS altimetry (Note 2) INS/IRS	ADS
Terminal areas with high density traffic	VHF voice	NDB VOR/DME ILS Barometric altitude INS/IRS	Primary radar SSR Mode A/C	VHF voice/data SSR Mode S data link	RNAV/RNPC GNSS MLS NDB (Note 3) VOR/DME (Note 6) Barometric altitude INS/IRS	SSR Mode A/C or SSR Mode S ADS (Note 1)

AMSS - aeronautical mobile-satellite service
MNPS - minimum navigation performance specifications
RNAV/RNPC - area navigation/required navigation performance capability
GNSS - global navigation satellite system
ADS - automatic dependent surveillance
INS/IRS - inertial navigation system/inertial reference system

Note 1 - The need for primary radar is reduced.
Note 2 - To be used where barometric altimetry is not functional.
Note 3 - NDB will be progressively withdrawn.
Note 4 - Includes low-altitude, off-shore and remote areas.
Note 5 - Until such time as satellite communication is available.
Note 6 - VOR/DME will be progressively withdrawn.

10.3.3 Human Resources Development Plan

(1) General

In order to cope with the increasing training demands created by the introduction of new equipment at Kathmandu, it is required to establish a suitable human resources development plan which, together with technical assistance by international experts, plays an important role in determining the quality and the reliability of the service.

The human resources development plan is mentioned briefly in this chapter. The detailed training plan for the Urgent Project is described in chapter 14.

(2) Consideration

The following should be taken into consideration in the process of planning of the human resources development

- Required training lead time
- Lack of suitable training facilities in Nepal
- No experience of the radar nor LLZ/DME operations in Nepal

(3) Basic Policies

The following are the basic policies of the human resources development plan.

- Training along with technical assistance by international experts will be planned in accordance with the progress of the project.
- Trainees will be selected exclusively from experienced personnel.
- The training of instructors and personnel in charge of airspace management will be planned at an early stage of the Preparation phase.

(4) Planning Phases

The planning is generally considered in the following four phases.

I. Preparation Phase (~ facility accomplishment)
In this phase, initial preparations for the introduction of the new services at TIA will be conducted. Major training in this phase will be:

- Airspace adjustment and approach procedures
- Approach radar control training
- Training required for the introduction of LLZ/DME
- Training for instructors
- Basic theoretical training
- Vendor training
- Maintenance training

II. Hand-over phase (facility accomplishment ~ hand-over)

In this phase, facility hand-over field training will be conducted by the equipment manufacturer at TIA and at the new CATC Kathmandu. Major training in this phase will be :

- Facility hand-over field training

III. Familiarization Phase (hand-over ~ commencement of operation)

In this phase, familiarization training will be conducted at TIA and the new CATC using the equipment provided under the project. Additional international experts may be required.

Major training in this phase will be:

- simulator training
- Laboratory training
- Practical training
- Familiarization training

IV. Operation phase (operation ~ Localization)

In this phase, operations will commence at TIA. Training for backup personnel and for refresher causes will be conducted at the new CATC.

Major training in this phase will be:

- Simulator and OJT training
- Training for backup personnel
- management training

(5) Technical Assistance by International Experts

International experts (training instructors) in the field of ATC operations, radar maintenance, NAVAIDS maintenance, and computer maintenance will be required in order to assist the Nepal DCA in its efforts to become self-sustaining for the required services.

The experts will work together with their Nepalese counterparts to give advice, coordinate and supervise the training required for the introduction of new services at TIA.

(6) Fellowship Training

Since many training courses will not be available in Nepal for radar control, radar maintenance, localize maintenance and computer maintenance until the completion of the new CATC Kathmandu, it will be necessary for the DCA to arrange fellowship overseas training and request the fund required from an international body.

(7) Training Program

On-the-job training program should be established for each person individually.

a) On-the-job training

Training records should be maintained with a record of training items, duration, results of examinations, etc. as part of a personal history.

b) Basic refresher training

Improvement of training facilities is required. This plan should include:

- Construction of a training building.
- Replacement of training laboratory equipment.
- Printing and reproducing facility.
- Fulfillment of a sufficient number of instructors.

10.3.4 Project Cost Estimation

(1) Urgent improvement plan

	(thousand dollar)
- ASR/SSR and training facility	27,000
- LDA or LLZ/DME	3,000
- Additional SSR	3,500

(2) Short term development plan

- CGL	60
- MSS	3,200
- AMOS	1,100
- ATIS	70
- CSAT	3,000
- Locators	700

(3) Long term development plan

- SSR (en-route)	5,000

10.3.5 Study of Urgent Improvement Plan

(1) Operation and Maintenance Plan

1) Organization of ATC and radio engineering

Working time of the ATC controllers and radio maintenance engineers/ technicians is based on a two-shift working schedule, recently.

The morning team (shift morning) is on duty from 06:00, 06:20, 07:00 to 12:30, and the following day time team (shift day) from 12:00 to 17:30, 18:00.

The shift working time is sometimes changed depending on the season or air traffic conditions.

2) Working schedule of ATC controllers

One shift crew on-duty consists of twelve (12) ATC controllers. Some controllers, on duty for day time work, are assigned overtime work until the end of the last flight, usually.

The shift team, will be arranged to three shift teams by the end of this year so as to improve the overtime work situation. This third team probably will be in charge of the night time duty instead of transferring overtime work to the day crew.

3) Working schedule of radio engineers/technicians

Working fields maintained by radio engineers and technicians consist of two different fields. One is the radio facilities maintenance, such as radio navigation aids and communication systems. The other one is facilitation maintenance such as airport security system, information system, public announcement system and telephone system.

Technical team consists of one ordinary daytime work team, which is in charge of management of the maintenance section or maintenance work for required high level technique, and the two other teams in charge of morning time and day time shift work.

Technical skill of the team members are as follows:

Ordinary daytime work team

Chief radio engineer	1
Supervisor	3
General Maintenance Officer	4

Shift work teams

General Maintenance Officer	5
General Maintenance Non-Officer	4
Line Technician	1
Non-skilled	2

A duty officer is assigned in addition to the teams mentioned above. Some of the half day shift team is in charge of overtime work. The third shift work team is planned to improve the overtime work conditions.

4) Improvement program for radar operator and technical maintenance

Department of Civil Aviation (DCA) has an improvement program for ATC controllers and technical staff for TIA.

Number of total controllers and technical staff including candidates for radar operators and radar maintenance technicians are estimated as follows:

ATC controller

Present	24
End of 1993	38 (3 shift work)
End of 1994	50

Radio maintenance, technical

Present	36
End of 1993	48 (3 shift work)

Required controllers and maintenance engineers, technicians for radar operation are estimated as follows:

Operation	-	operation	:	6	(2 per 1 shift)
	-	supervisor	:	3	(1 per 1 shift)
	-	TIA instructor	:	3	
	-	CATC instructor	:	2	
	-	DCA staff	:	2	
		TOTAL	:	16	
Maintenance	-	radar head	:	6	(2 per 1 shift)
	-	processor	:	6	(2 per 1 shift)
	-	TIA instructor	:	3	
	-	CATC instructor	:	2	(1 for radar head, 1 for processor)
	-	DCA staff	:	3	
		TOTAL	:	20	

Human Resources Development Plan for Urgent Project is explained in Chapter 20.

(2) Training Requirement

Since Radar System is being introduced to Nepal, it is essential to have the training for controllers and maintenance technicians. Therefore, there should be provision for training program for the controllers and technicians personnel.

The training for both the controllers and the maintenance technicians should be provided during the project implementation.

(3) Technical Cooperation

As Nepalese ATC System is entering into Radar Controlling System. It is essential to have technical cooperation and transfer of technology form developed countries for developing training plan, airspace planning, controlling technical, maintenance personnel training plan, etc.

DCA expects to have overseas training for operation and maintenance personnel as follows:

1) Nepalese experts in ATC & Maintenance personnel will be selected for management, training and field operation to work with overseas experts for developing management, training manuals and airspace planning.

2) Those group experts, which are composed of Nepalese and overseas expert, work together abroad and in Nepal for transfer of technology and development of radar system operation.

3) At least 12 personnel from ATC/Maintenance will be sent overseas in Basic Radar Training as the first group during construction phase.

4) Second 12 personnel from ATC/Maintenance will be sent overseas during the commissioning phase.

(4) Improvement Training Facility

In spite of man power source depending on activity of Civil Aviation Training Center, facilities of the center is insufficient in terms of quantity and quality. Particularly, the building and equipment of laboratory should be improved immediately.

Requirement facilities as Urgent Improvement Plan are as follows:

- Construction of Training Building 1,700 m^2
- Equipment laboratory

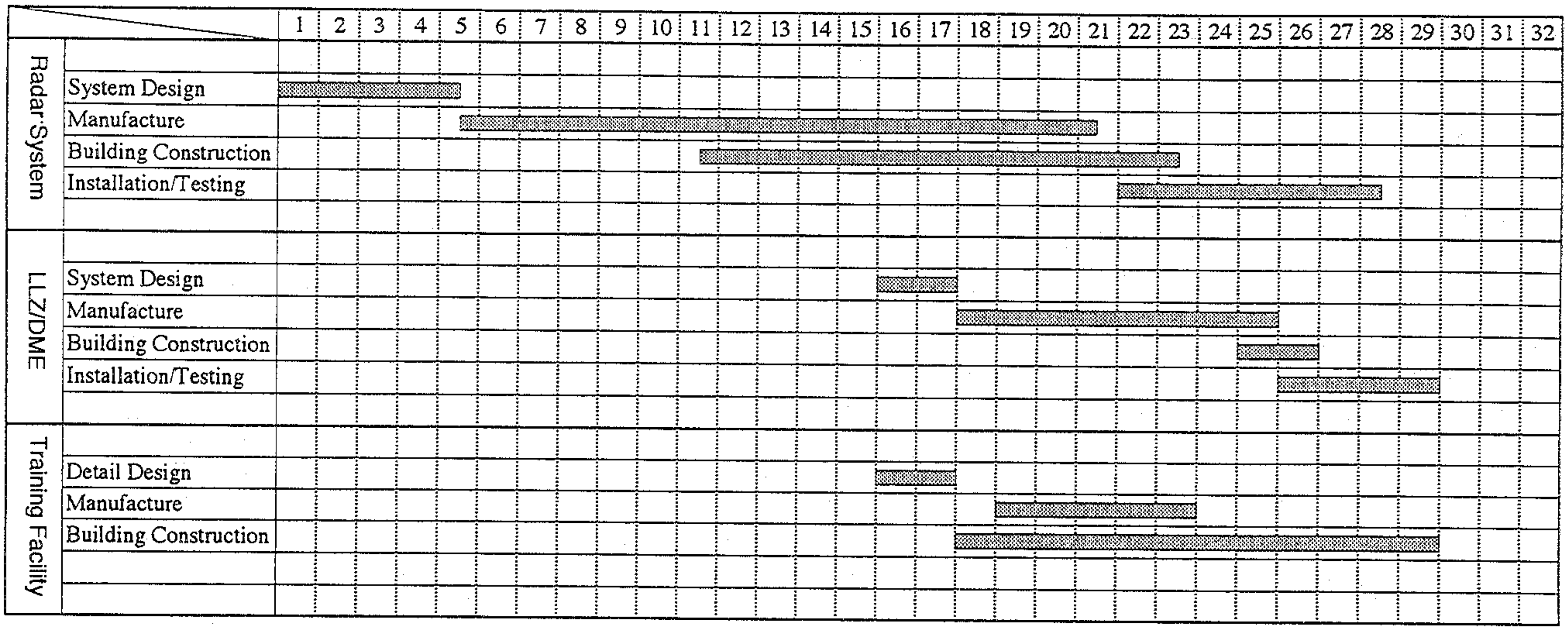
Some of the training equipment will be relocated to the new building after construction is implemented.

(5) Project Implementation Plan

Project implementation is categorized for working items, such as manufacture of equipment, installation and testing, building construction and training.

Required duration for implementation of the working items are estimated and evaluated. Critical items for the project implementation is identified and controlled as critical items until completion of the project.

Project implementation schedule is shown in Figure 10.3.1.



Remark : The program may be reviewed and rearranged when initiating the program implementation.

Figure 10.3.1 Implementation Program for Urgent Improvement Plan

PART B-3 OVERALL AIRPORT MODERNIZATION PLAN

CHAPTER 11

AIRPORT MODERNIZATION PLAN

CHAPTER 11 AIRPORT MODERNIZATION PLAN

11.1 General

Based on the Ground Facilities Improvement Plan and the Air Safety Improvement Plan described in Chapter 7 and 10 respectively, the Airport Modernization Plan for Tribhuvan International Airport is established. Major work items to be included in the Airport Modernization Plan are summarized in the following section.

11.2 Scope of Airport Modernization Plan

11.2.1 Urgent Plan

(1) Air Safety Improvement Plan

a) It is necessary for safe operations to recognize the aircraft's position by a reliable means when flying above the high mountains around the airport.

At present, an aircraft's position is recognized only by a position report with radio communication. This means, when a pilot misses his position or altitude, this may cause a dangerous situation to the aircraft. However, the existing communication system is restricted in performance due to the mountainous terrain surrounding the airport.

In order to overcome the present deficiencies, it is recommended to install and operate ASR/SSRs for approach monitoring and approach control. Furthermore, an additional SSR is required to complement the ASR/SSR coverage. This will be effective for aircraft safety immediately without any change in the current flight procedures.

Construction of a radar operations building and training facilities for radar controllers and maintenance technicians are required for the operation of a radar system.

b) Performance of the existing radio navigation aids of the airport is limited due to the mountainous terrain around the airport. To operate aircraft safely in such conditions, installation of LLZ/DME or Localizer type Direction Aids (LDA)/DME are effective since they are useful to reduce the work load of pilots who must maintain the correct direction of aircraft.

c) Training Facilities of CATC shall be developed so as to improve the usage of manpower.

11.2.2 Short-Term Modernization (Target Year 2003)

(1) Air Safety Improvement Plan

Circling Guidance Light (CGL) is recommended to be installed to enhance the safety level of visual aids.

(2) Ground Facilities Improvement Plan

a) Expansion of Facilities in accordance with passenger and cargo demand increases

In comparison with the future demand of the year 2003, it is necessary to develop the existing passenger loading apron, the international and domestic passenger terminal buildings, the cargo terminal building and the car parks. As the apron expansion is in progress, other development works shall be planned to be implemented.

Since the expansion of the existing international passenger terminal building is limited by the existence of the operation/airline building and other facilities and also the planned larger type aircraft will not be clear from the future transitional surface, a new international passenger terminal building is planned. It was decided to accommodate B747 class aircraft in a nose-in configuration in front of the building.

A new domestic passenger terminal building shall be provided by converting the current international passenger terminal building to utilize the existing facilities fully, since the existing domestic passenger terminal building is so deficient in capacity and so superannuated for the smooth handling of passengers.

The existing cargo terminal buildings are separated into three buildings at different places. Capacity is far below the requirement and each building is old. A new cargo terminal building shall be constructed along side of the apron, keeping sufficient space to handle the cargo volume efficiently in future.

b) Improvement of Safety

In order to ensure safe airport operations, the following points shall be developed Aircraft maintenance area and hangars are required to be relocated to cope with the need for handling larger aircraft and to implement the terminal development.

Security fencing surrounding the operation areas is planned in order to prevent intrusion by unauthorized persons to those areas.

The perimeter road and service road shall be constructed so as to serve the various airport activities such as maintenance and operation.

An isolated apron shall be constructed for aircraft to prevent unlawful interference or their isolation from normal airport activities and facilities.

11.2.3 Long-Term Modernization (Target Year 2010)

(1) Air Safety Improvement Plan

Installation of en-route SSR shall be studied based on rearrangement of the air routes when traffic volume increases.

A Runway Lead-in Lighting System to RWY 20 shall be provided to secure safety for aircraft approaching along side the mountains.

(2) Ground Facilities Improvement Plan

a) Expansion of Facilities in accordance with demand increase

The international terminal building shall be further expanded in accordance with the increase in passenger traffic demand. The cargo terminal building shall be also expanded in accordance with the increase in cargo demand.

b) Improvement of Safety

The fire station shall be relocated to a new site for short and direct access to the main runway.

11.2.4 Ultimate Modernization Plan (beyond Year 2010)

(1) Ground Facilities Improvement Plan

a) Expansion of Facilities in accordance with demand increase

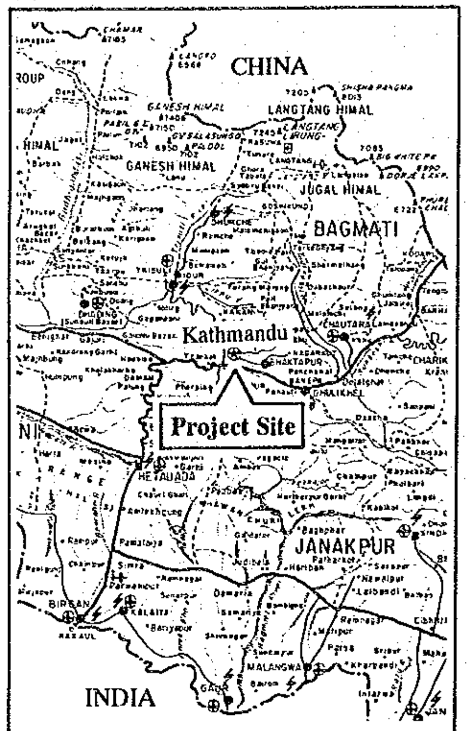
The passenger terminal building and cargo terminal building shall be expanded in accordance with the increase in demand.

b) Improvement of facilities in accordance with international standards

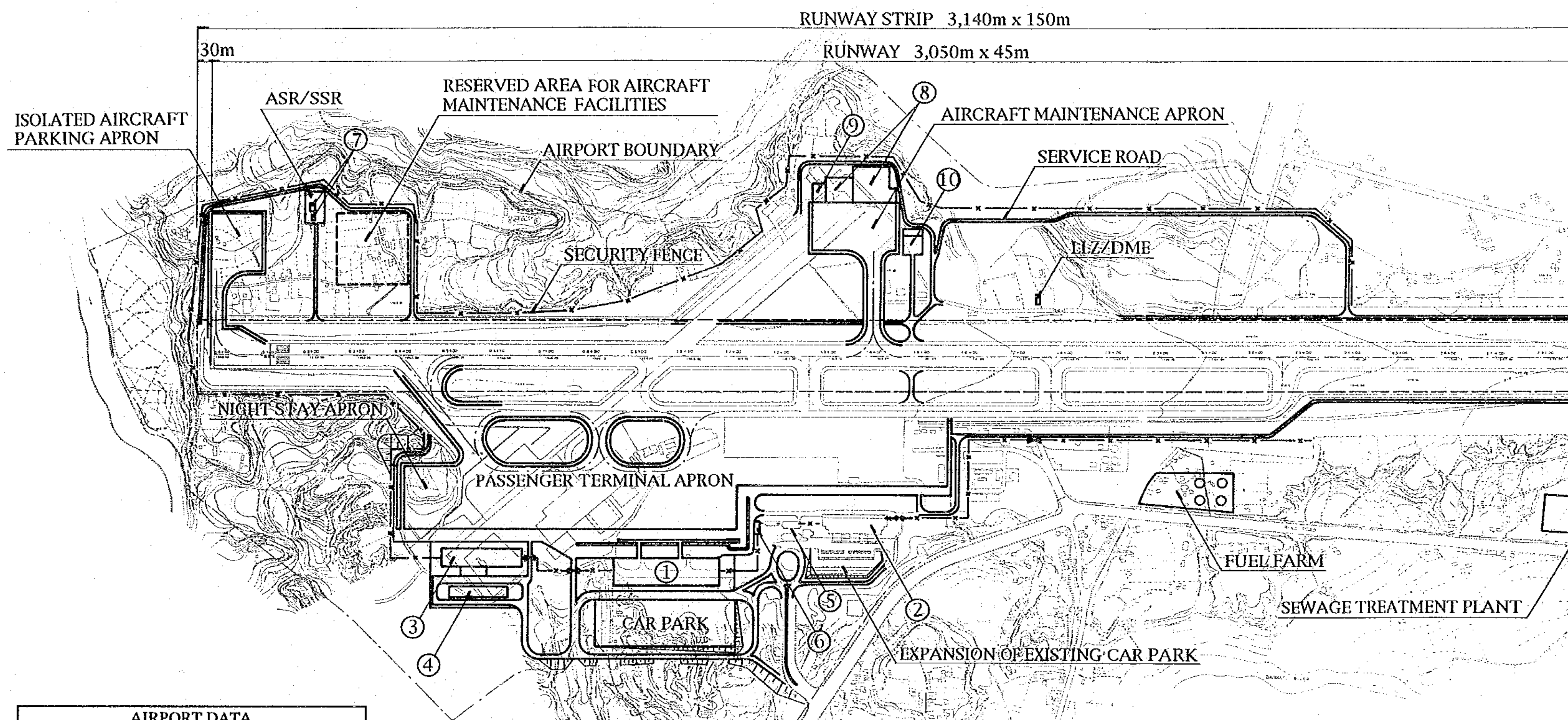
Present width of the runway strip and separation distance between the runway and the parallel taxiway are less than the recommendation of ICAO. The width of the runway strip shall be expanded and the parallel taxiway shall be shifted so as to keep minimum separation distance from the runway in accordance with ICAO recommendations.

11.3 Layout Plan for Airport Modernization Master Plan

Figure 11.3.1 shows the Airport Modernization Master Plan for Tribhuvan International Airport for the target year 2010. Together with the Master Plan for 2010, the ultimate plan beyond year 2010 is also indicated in Figure 11.3.2.



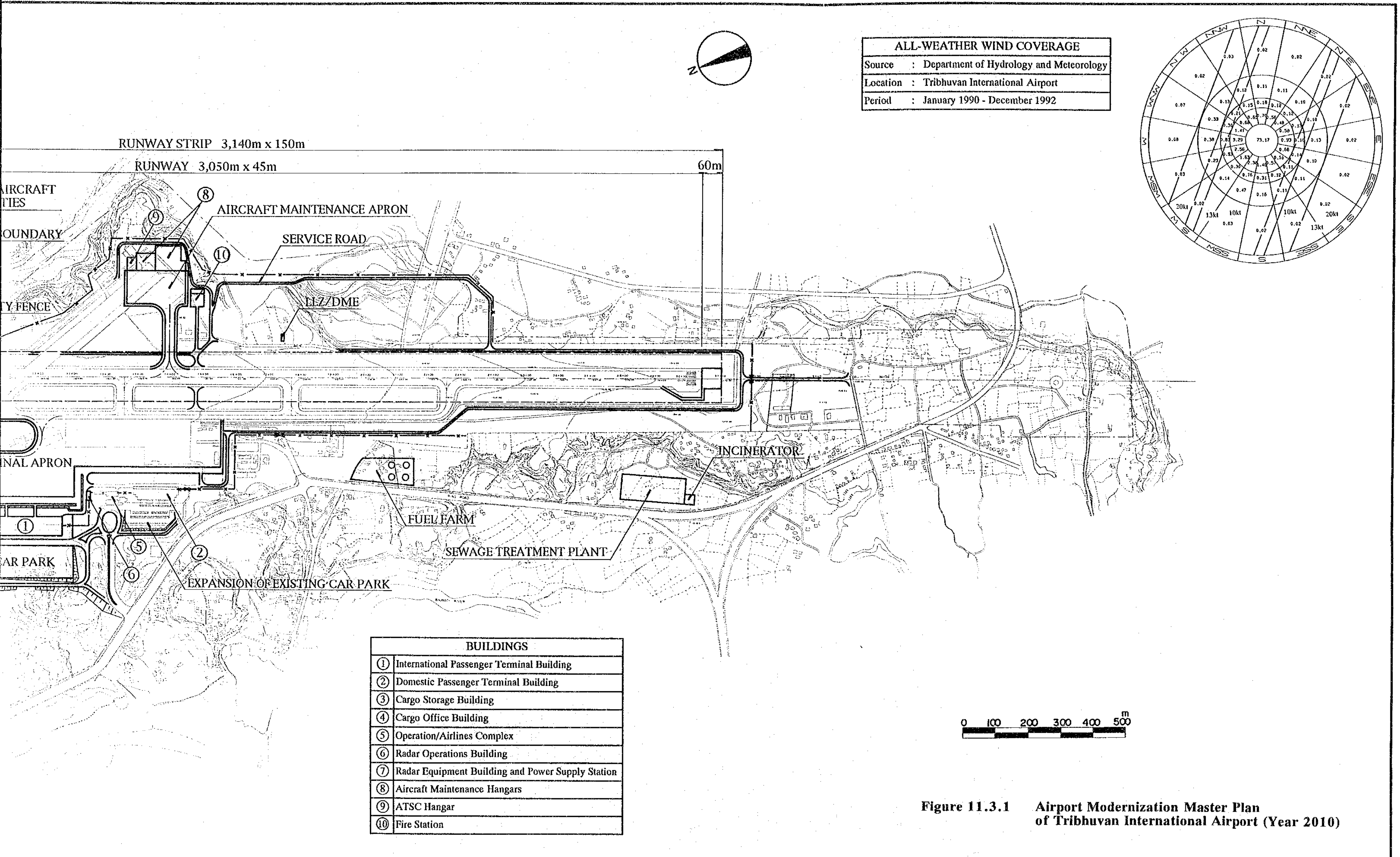
AIRPORT VICINITY MAP



RUNWAY DATA		
Runway Orientating		02/20
Effective Gradient		0.77%
Wind Coverage (Cross Wind)		98.40% (13kt)
		99.73% (20 kt)
Instrument Runway		Yes (RWY 02, 20)
Pavement Strength		PCN 54/F/A/W/T
Approach Surface		1:50
Navigation Aids	RWY 02	DVOR/DME
	RWY 20	DVOR/DME
Visual Aids	RWY 02	SALS
	RWY 20	-

AIRPORT DATA	
Elevation	1,338 m (4,390 ft.) AMSL
Reference Point (ARP)	27°41'47"N 85°21'42"E
Reference Temperature	27.8 °C (AIP Nepal)
Magnetic Variation	1°00'W (May 1980)
Airport and Terminal Navigation Aids	DVOR/DME, NDB, ASR/SSR, Locator, Fan Marker Beacon
Fire Protection	Category - 5

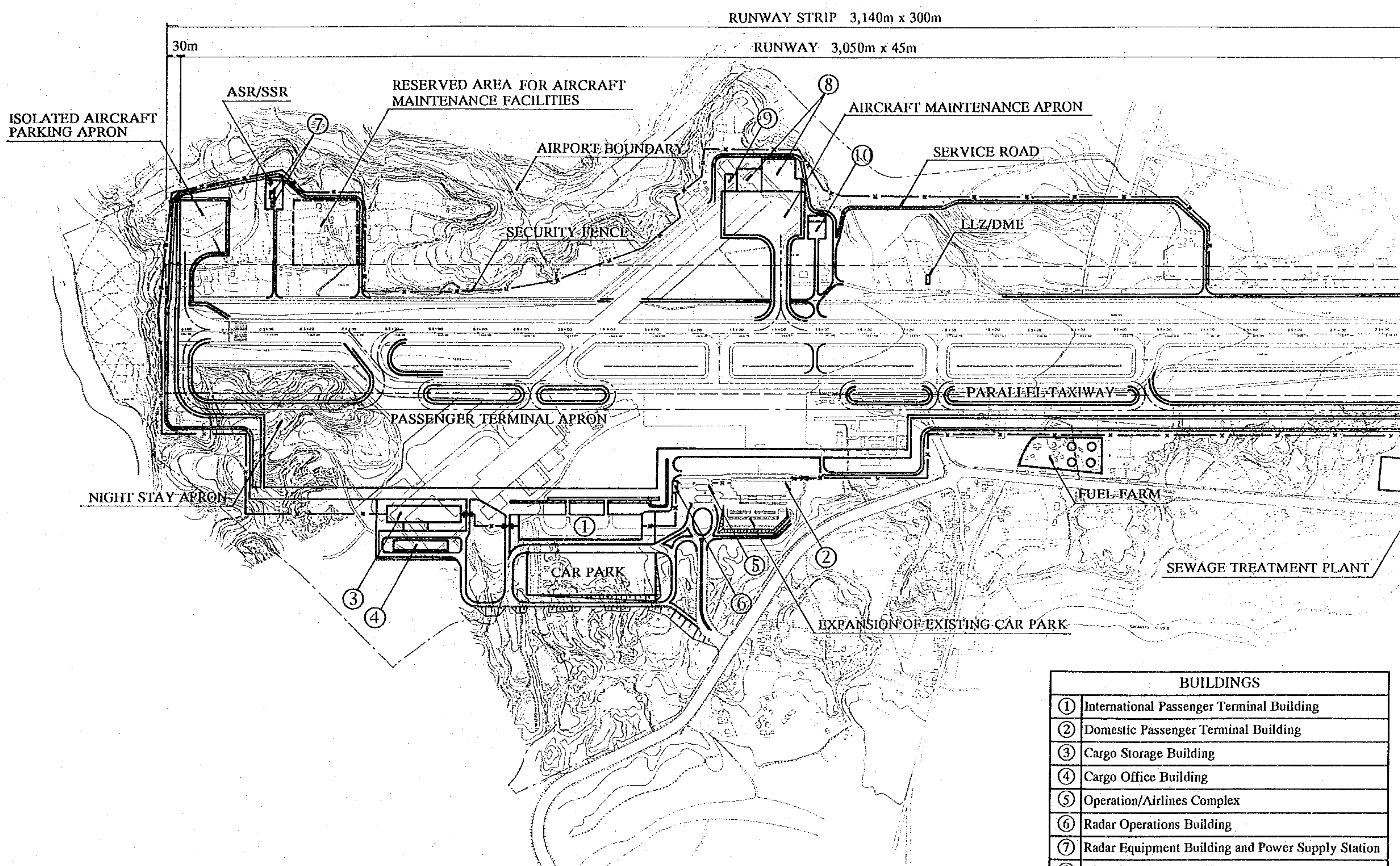
BUILDINGS	
①	International Passenger Terminal Building
②	Domestic Passenger Terminal Building
③	Cargo Storage Building
④	Cargo Office Building
⑤	Operation/Airlines Complex
⑥	Radar Operations Building
⑦	Radar Equipment Building and Power Supply Station
⑧	Aircraft Maintenance Hangars
⑨	ATSC Hangar
⑩	Fire Station



ALL-WEATHER WIND COVERAGE	
Source	: Department of Hydrology and Meteorology
Location	: Tribhuvan International Airport
Period	: January 1990 - December 1992

BUILDINGS	
①	International Passenger Terminal Building
②	Domestic Passenger Terminal Building
③	Cargo Storage Building
④	Cargo Office Building
⑤	Operation/Airlines Complex
⑥	Radar Operations Building
⑦	Radar Equipment Building and Power Supply Station
⑧	Aircraft Maintenance Hangars
⑨	ATSC Hangar
⑩	Fire Station

Figure 11.3.1 Airport Modernization Master Plan of Tribhuvan International Airport (Year 2010)



BUILDINGS	
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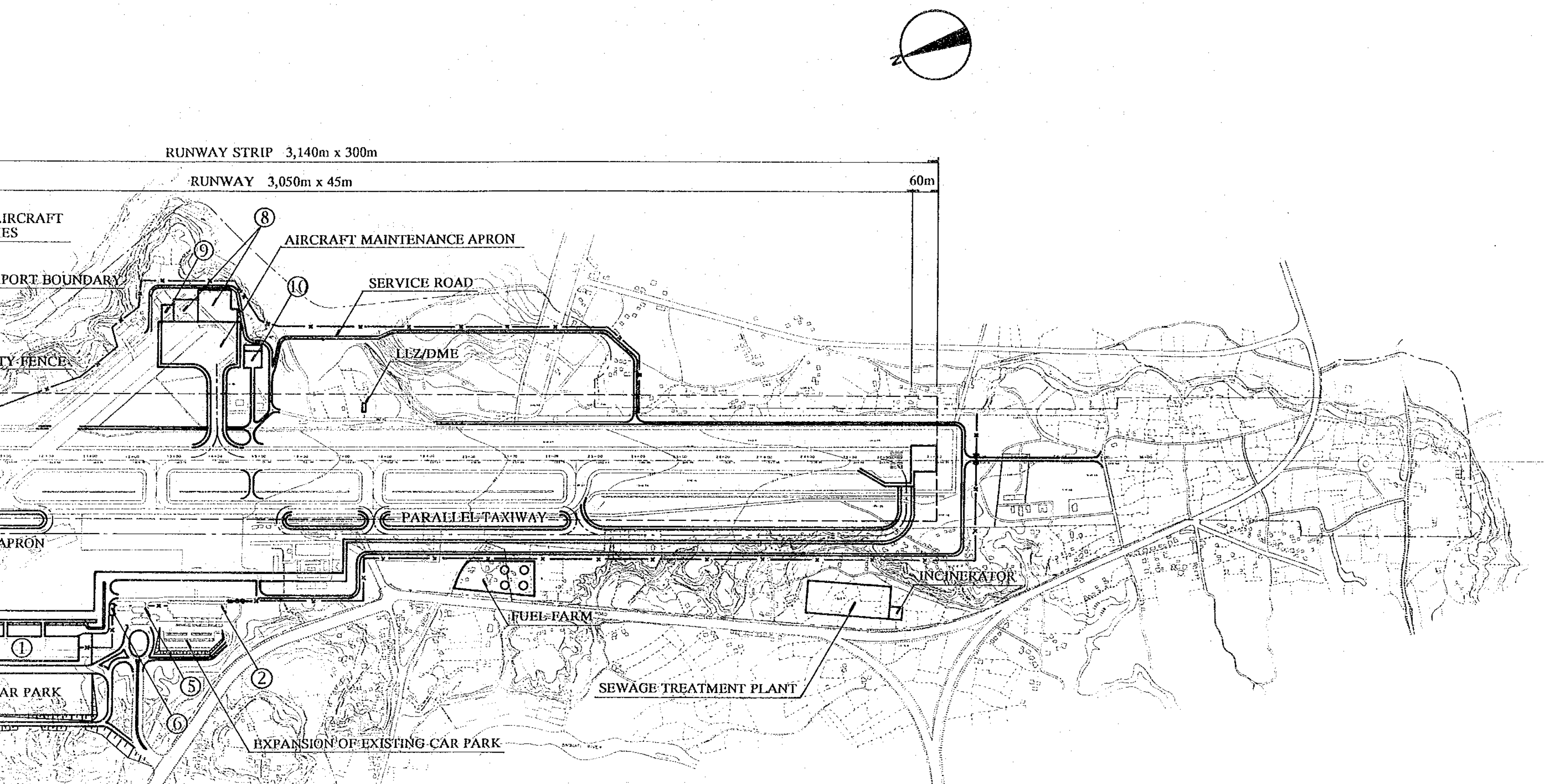
⑩	Fire Station



BUILDINGS	
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⑤	Operation/Airlines Complex
⑥	Radar Operations Building
⑦	Radar Equipment Building and Power Supply Station
⑧	Aircraft Maintenance Hangars
⑨	ATSC Hangar
⑩	Fire Station

Figure 11.3.2 Ultimate Layout Plan of Tribhuvan International Airport (Beyond Year 2010)

CHAPTER 12

INITIAL ENVIRONMENTAL EXAMINATION

CHAPTER 12 INITIAL ENVIRONMENT EXAMINATION

12.1 Purpose

The purpose is to examine the environmental impact which might be caused by the Airport Modernization Plan, and to select items of the environmental estimation and the evaluation for Environmental Impact Assessment, which is carried out in Chapter 16.

12.2 Contents of Study

(1) At first, the environmental conditions around the project site are made clear how far they are concerned or not, through the site investigation and data analysis.

(2) The next stage is "screening". Screening is to identify whether the project is necessary to be applied for environmental consideration or not. This will be done on the format through estimation the project and the environmental conditions comparatively.

(3) The last stage is "scoping". Scoping is to select the major environmental items which may be expected to cause impact on the surrounding area of the airport after the implementation of the project. This will be performed by means of a check list method.

12.3 Initial Environment Examination

(1) Name of the Project

The Study of Tribhuvan International Airport Modernization Plan in Nepal

(2) The Main Agency

Department of Civil Aviation, Ministry of Tourism and Civil Aviation, His Majesty's Government of Nepal

(3) Outline of the Project

Item	Content
Name of the Project	The study of Tribhuvan International Airport Modernization Plan in Nepal.
Background	The promotion of air traffic safety and the improvement of airport facilities that have been needed since the plane crash in 1992.
Purpose	The Master Plan will be completed by 2010, and the short period Modernization plan will be studied by 2003.
Location	The site is 7km eastward from the center of Kathmandu city.
Main Agency	Ministry of Tourism, Department of Civil Aviation, His Majesty's Government of Nepal.
Benefiters	People in Nepal and visitors
Type of the work	Renewal / improvement
Character of the Airport	International / Domestic
Size	Area : 320 ha
Other Facilities	Terminal building / facilities for lighting, radio and fuel storage
The Number of users / Type of plane	Visitors : 2,490,000 passengers (2010) /year Freight : 53,500 ton (2010) /year Maximum Type of Aircraft : B-747
The Number of taking off and landing aircraft	112 flights / per day
Other Special matters	None

(4) Environmental Condition of the Project Site.

1) Urgent Improvement plan

SOCIAL ENVIRONMENT	
Item	Condition
Population (residents,former inhabitants, area division)	There are many houses on the east, south and west sides of the Airport.
Land Use (city, village, historic spot, scenic spot, factory, school, hospital, tourist facility, natural park, preservation area)	There are farm villages on the east side of the airport. Both commercial and agricultural activities can be seen on the south and west sides. There are several small schools on the south side. The golf course can be seen on the site of Airport. Grassland is used for grazing of goats.
Economic and Traffic (commerce agriculture, bus terminal)	A ring road exists from the south side to the west side of the Airport. Traffic is heavy. There are small stores and street stalls on the south and west side. Commerce is relatively active.
NATURAL ENVIRONMENT	
Item	Condition
Topography, Geology (dislocation, slope, soft ground, land subsidence, ground water)	To the north of the Airport ,there is a steep slope. There are two wells on the site of the Airport. About 160tons of water is used per day. (240tons is needed. The remainder comes from the public supply.)
Rave animals and plants (rare species, special species, decrease of the place for extinct species, rare plants and animals)	Almost all the land is paddy around the Airport. There are no habitat for the rare animals and plants.
POLLUTION	
Item	Condition
Occurrence of complaints (pollution)	It is considered that private houses and schools may receive impact from aircraft noise, but there is no complaint about this matter so far.
Counter measures (law and compensation)	Law and standards concerned with Environment are under study now. Environmental Guidelines were made in 1992.
Special Items	None

2) Modernization Plans

SOCIAL ENVIRONMENT	
Item	Condition
Population (residents, former inhabitants, area division)	There are many houses on the east, south and west sides of the Airport. When the ring road is moved into these areas, many of the population will have to move to other places. This will cause community division.
Land Use (city, village, historic spot, scenic spot, factories, school, hospital, tourist facility, natural park, preservation area)	There are farm villages on the east side of the airport. Both commercial and agricultural activities can be seen on the south and west sides. There are several small schools on the south side. The golf course can be seen on the site of airport. Grassland is used for grazing of goats. part of the farmland will be lost when the ring road is moved.
Economic and Traffic (commerce, agriculture, bus terminal, etc.)	The ring road exists from the south side to the west side of the airport. Traffic is heavy. There are small stores and street stalls on the south and west sides. Commerce is relatively active.
NATURAL ENVIRONMENT	
Item	Condition
Topography, Geology (dislocation, slope, soft ground, land subsidence, ground water)	To the north of the airport ,there is a steep slope. There are two wells on the site of the airport. About 160tons water is used per day. (240tons is needed. The deficit comes from the public water supply.) A lot of earth works will be done around this area for filling for the airport facilities and buildings. Also, when the ring road is moved, a lot of earth works will be performed. (about 50 meters).
Animals and plants (rare species, special species, decrease of habitat for , rare plants and animals)	Almost all the land is paddy field around the Airport. There are no surroundings for rare animals and plants. The locations where much soil is taken away need to be examined from the point of environmental problem.
POLLUTION	
Item	Condition
Occurrence of Complaints (pollution)	It is considered that private houses and schools may receive impact from aircraft noise, but there have been no complaints so far.
Counter measures (Law and Compensation)	Laws and standards concerned with the environment are under study now. The Environmental Guidelines were made in 1992.
Special Items	None

(5) Screening

1) Urgent Improvement plan

Social environmental items		Content	Estimation result
1.	Resident's movement	Displacements to acquire the site	~~Yes~~/N o/~~Not clear~~
2.	Economic Activity	Damage to production opportunities, increases in earning differentials and unemployment	~~Yes~~/N o/~~Not clear~~
3.	Traffic and Living Facilities	Impact to the present traffic conditions, schools and hospital from traffic jams or accidents	~~Yes~~/N o/~~Not clear~~
4.	Division of Area	Division of Areas by traffic re-routing	~~Yes~~/N o/~~Not clear~~
5.	Increase of population	Change of community by the increase of population	~~Yes~~/N o/~~Not clear~~
6.	Historical spot and cultural heritage	Loss of the sights, ruins, temples or their loss of value	~~Yes~~/N o/~~Not clear~~
7.	Water supply and Community use of forest	Prevention of the right of fishery, water supply and community use of forests	~~Yes~~/N o/~~Not clear~~
8.	Public Sanitation	Detrimental public sanitation such as the occurrence of garbage or injurious insects	~~Yes~~/N o/~~Not clear~~
9.	Waste	Occurrence of waste from the construction waste soil, waste oil such as	~~Yes~~/N o/~~Not clear~~
10.	Risk	Increase in danger such as from ground collapse and Airplane accidents	~~Yes~~/N o/~~Not clear~~
Natural Environmental items		Content	Estimation result
11.	Geology. Topography	Detrimental charges to natural features of ground by digging, cutting and filling of earth	~~Yes~~/N o/~~Not clear~~
12.	Earth Erosion	Erosion from rainwater after reclaiming and deforestation	~~Yes~~/N o/~~Not clear~~
13.	Underground Waste	Drying up the source of water by over pumping , and water pollution	~~Yes~~/N o/~~Not clear~~
14.	Quantity of water of lake, swamp and river	Change of water quantity and river bed by reclaiming or drainage	~~Yes~~/N o/~~Not clear~~
15.	Animal and plants	Decrease of habitat for rare, special and endangered species	~~Yes~~/N o/~~Not clear~~
16.	Coast and Ocean	Coastal erosion and piles from reclamation site and by changes to ocean currents	~~Yes~~/N o/~~Not clear~~

(continued)

Natural Environmental items		Content	Estimation result
17.	Meteorology	Change of temperature and wind by the large scale-construction and/or the very tall buildings	~~Yes~~/No/~~Not clear~~
18.	Natural view	Lack of harmony with other buildings	~~Yes~~/No/~~Not clear~~
19.	Field Recreation	Loss of international tourist sites	~~Yes~~/No/~~Not clear~~
Pollution items		Contents	Estimation result
20.	Air pollution	Air pollution by exhaust and harmful gases from cars and planes	~~Yes~~/No/~~Not clear~~
21.	Water pollution	Water pollution by earth and sand from construction and waste water from factories	~~Yes~~/No/~~Not clear~~
22.	Earth pollution	Earth pollution by dust or asphalt emulsion	~~Yes~~/No/~~Not clear~~
23.	Noise and vibration	Occurrence of noise and vibration from cars, planes and factories	~~Yes~~/No/~~Not clear~~
24.	Land subsidence	Land subsidence from the change of ground surface or decrease of underground water	~~Yes~~/No/~~Not clear~~
25.	Bad smells	Bad smells from exhaust and general waste	~~Yes~~/No/~~Not clear~~
26.	Radio Waves	Detrimental effect to radio waves by the taking off and landing of airplanes	~~Yes~~/No/~~Not clear~~
27.	Sunlight	Decrease of sunlight because of high buildings	~~Yes~~/No/~~Not clear~~
Total estimation :		Does this modernization plan need Environmental Impact Assessment (EIA) ?	~~Yes~~/No