1) General Aviation Facilities

Santa Elena is still basically a general aviation airport with occasional commercial flights. The majority of the flying activities comes from private and charger flights. That is why it is not necessary to provide a separate facility for the general aviation customer, who will use the main terminal.

2) Parking Lot

The existing parking lot has a capacity for 118 cars, as noted in Chapter 9.2.3. The forecast peak hour passengers is 140 in the year 1995. Assuming the vehicle-passenger ratio of 0.84 and the rate of vehicles which use the parking lot to be 0.6, the required parking spaces in 1995 is estimated to be 71 cars (= 140 x 0.84 x 0.6). Consequently, no expansion of the present parking lot appears to be required in the year 1995 for the use of passengers. With regards to the parking space for the airport personnel, the requirements would still be minimal; therefore, no work is required. It is additionally noted that the access road situation presents no problem at Santa Elena.

10.4 Airport and Aviation Support Improvements

10.4.1 Airport Support Facilities

It would be more desirable that the control tower in Santa Elena be relocated in the short-term phase. However, realization of this work will be postponed until the long-term plan principally for financial reasons. It is also considered as more feasible that the services of equipment maintenance at Santa Elena be contracted out in the short-term improvement period. On the other hand, CFR facilities, fuel farm and electrical facilities are proposed to be improved in the sort-term phase as explained below.

The aircraft movements, estimated and applied as parameters for the preliminary design of these facilities, are summarized as follows:

Forecast Aircraft Movements at Santa Elena

			1995	2005
Annual Movements	:	Domestic	7,225	10,625
		International	1,275	1,875
		Total	8,500	12,500
Busiest 3 months	:	B-737 Type	319	469
		DNC-6 Type	1,806	2,656
Weekly Movements	:	Domestic	139	204
		International	25	36

1) CFR Facilities and Building

On the basis of forecast aircraft movements during the period of 3 busiest months of year, Santa Elena is classified into the Category-5 airport for planning of the CFR facilities. The equipment needed for the airport of this Category is 1-rapid intervention vehicle and 1-major vehicle. The minimum amount of extinguishing agents is 5,400 lit of water, 3,000 discharge rate foam solution per minute, and 180 kg of dry chemical powders. In accordance with this requirement, it is proposed that Santa Elena airport will be equipped with the following:

CFR Vehicles to be Supplied for Santa Elena

Vehicle	Q'ty	Specifications		
Rapid intervention vehicle	1	Water tank cap.	:	1,200 l
		Foam tank cap.	:	100 l
		Dry chemical cap.	:	135 kg
		Foam monitor	:	1,000 l/min.
Major vehicle	1	Water tank cap.	:	4,000 l
		Foam tan cap.	:	480 l
		Dry chemical cap.	:	135 kg
		Foam monitor	:	2,000 l/min.

Santa Elena airport would not become a 24-hours airport until the design year 2005. The CFR station will therefore be manned during the daytime only. The required

minimum number of personnel is estimated to be a fireman and a driver for rapid intervention vehicle, 3 firemen and a driver for major vehicle, a station chief, watchman, service boy and a stand-by, totaling 10 personnel. Based on the number of vehicles and personnel, the service space requirements have been estimated to be about 390 m^2, as shown in Table 10.1. A layout of the CFR building is illustrated in Drawing 10-3.

2) Fuel Farm

There is no fuel storage at present for commercial flights at Santa Elena, as noted in Chapter 9.2.2. With the eventual expansion of the traffic, there will be a need to install a fuel supply system. Such a plan would become more realistic when the road CA-13 is improved as programmed.

The fuel supply facilities will be constructed and operated by a private oil company. On the basis of the forecast airplane movements per week noted before, the required storage capacities are estimated for the year 1995, by assuming the air routes for B-737 type aircraft to be Santa Elena - Mexico (1,100 km in distance) and DHC-6 type aircraft to be Santa Elena - La Aurora (260 km), as follows:

B-737 type
$(0.004D + 0.75) \times (M/2)$
$= (0.004 \times 1{,}110 \text{ km} + 0.75) \times (25/2)$
$= 66.3$ kl

DHC-6 type
$(0.001D + 0.60) \times (M/2)$
$= (0.001 \times 260 \text{ km} + 0.6) \times 139/2$
$= 59.8$ kl

where: D = air route distance
M = aircraft movement per week

Thus, the storage requirements in 1995 is estimated to be 126.1 kl (= 66.3 + 59.8). Assuming three upright cylindrical steel tanks, each having a storage capacity of 50 kl (3.9 m dia x 6.2 m height), required land for fuel farm will be about 2,600 m^2.

3) Secondary Power Supply System

As noted in Chapter 9.3.1, the frequent power failures are serious problems at Santa Elena, and installation of a secondary power supply system is urgently required. It is therefore proposed to procure and install a diesel engine generator for the airport complex and a small generator for the VHF receiving station, as an "Emergency Improvement" program. The capacity of generator for the VHF station will be 7.5 kVA. The generator for the airport complex will be 250 kVA, as determined for the following power land estimate:

Station	Power Load (kVA)
Control Tower Equipment	64.9
Receiving Station	10.8
Radionavaids	28.5
Meteorological Equipment	11.0
CIQ	7.0
Airfield Lighting	162.5
Misc.	50.0
Total	334.7
Essential Demand Load: (about 75%)	250.0 kVA

10.4.2 Aviation Support Facilities

In view of the safe operation of the airport, as well in the light of functions to serve as an alternate airport to La Aurora, it is proposed to install VOR/ATIS and PAPI at Santa Elena in the short-term improvements.

1) VOR/ATIS (Automatic Terminal Information Service)

This is a system to transmit information on airport weather, approach procedures and NOTAMs, etc. to pilots, and it is accomplished by addition of a voice function (or data) transmission to the existing VOR equipment.

2) PAPI (Precision Approach Path Indicator)

At present, Santa Elena airport has a VASIS (Visual Approach Slope Indicator System) in operation. In accordance with the ICAO recommendations, it is proposed to install PAPI in the short-term improvement plan.

10.5 Airspace Operations

Santa Elena airport has no Standard Instrument Departure Procedures (SIDs) nor Standard Terminal Arrival Routes (STARs) established properly. In conjunction with the establishment of an ATS route between Santa Elena and La Aurora, as proposed in Chapter 10.6, it is proposed to establish SIDs and STARs for Santa Elena.

There are no prominent obstructions observed in the area around the airport. However, the following restrictions near the airport have been taken into account in formulating the procedures for SIDs and STARs:

Restricted Area Near Santa Elena Airport

Name of Area	Location	Size of the Area	Restricted Altitude
ALFA :	13 NM due Northwest to the corner of the Area	10 NM x 8 NM	10,000 ft - 5,000 ft
BRAVO :	17 NM due Northeast to the corner of the Area	15 NM x 10 NM	10,000 ft - 5,000 ft

As a result, procedures for SIDs and STARs for Santa Elena airport are proposed to be established as shown in Figures 10-2 thru 10-5.

10.6 Air Route Between Santa Elena and La Aurora

In view of the future traffic increase at Santa Elena airport, a route with the protected airspace between Santa Elena and La Aurora is proposed to be established. This is particularly important when Santa Elena comes to play a role as an alternate airport to La Aurora. The establishment of an ATS route for exclusive use by flights between Santa Elena and La Aurora will be made as proposed in Figure 10-6.

In the airspace beyond Coban Intersection which is under the jurisdiction of Central American ACC, aircraft fly at VMC altitude separation of 500 ft inbetween low IFR altitude separation of 1,000 ft on the Route A-770. The separation between Route A-770 and Route R-630 which uses RAB VOR as the element Navaid, is 33 degree. Inbetween these routes, RAB radial 016 can be established as a route. Track separation between aircrafts will follow the ICAO rules. Tracks are separated by a minimum value appropriate to the navigation aid, or by the method employed as follows:

a) VOR: at least 15 degrees and at a distance of 28 km (15 NM) or more from the facility
b) NDB: at least 30 degrees and at a distance of 28 km (15 NM) or more from the facility
c) DR (Dead Reckoning): tracks diverging by at least 45 degrees and at a distance of 28 km (15 NM) or more from the point of intersection of the tracks, this point being determined either visually or by reference to a navigational aid

These specifications are so set as to establish a lateral separation between 2 aircraft using the same navaids in the case of;

VOR: 4 NM NDB: 9 NM DR: 15 NM

Since the proposed route using RAB VOR is 10 NM in width (5 NM on both sides of the route centerline) and set at 16 degrees separation from Route A-770 and 17 degrees from Route R-630, track separation is established at a distance of 17 NM from RAB VOR.

On this track, RAB R-016, a compulsory fix will be established within La Aurora TMA at 35 NM distance from RAB in the same manner as COBAN and MINAS, and the

RAB R-016 will be extended straight beyond the TMA boundary so as to easily intersect the radial from FLO VOR, in view of the receptionability of FLO VOR. Over this intersection a compulsory reporting point will be provided.

In order to provide the protected airspace for a proposed air route separated from the existing routes, a route width of 5 NM is better provided on both sides of the route centerline. Thus, the radial route direction from FLO VOR is so recommended as to provide the separation from the Routes A-770 and R-630. The proposed route distance is estimated to be 160 NM.

Along this route, the following specifications should be defined and promulgated in AIP:

a. MEA (Minimum Enroute Altitude):

11,000 ft between RAB VOR (RNB NDB) and LA ISLA (tentative name)
3,000 ft between FLO VOR (FRS NDB) and LA ISLA

b. MCA (Minimum Crossing Altitude):

8,000 ft or above at the fix 40 NM from RAB VOR/DME
11,000 ft at the fix 26 NM from RAB VOR/DME

c. MRA (Minimum Reception Altitude):

On the portion between FLO (FRS) and LA ISLA at 3,000 ft, signals of FLO (FRS) are assumably receivable at LA ISLA, and the portion between RAB (RNB) and LA ISLA at 8,000 ft or above, signals of RAB (RNB) are assumably receivable. However, a flight check is needed.

d. COP (Change Over Point): LA ISLA

Further details of the air route planning between La Aurora and Santa Elena are explained in Appendix-K.

10.7 Airport Administration

In line with the airport traffic increase and the implementation of the proposed improvements at Santa Elena, an increased number of airport administration staff will be required. Particular attention will be paid to the need to incorporate a qualified approach controller when instrument approach procedures are introduced.

It is estimated that the required number of staff in Santa Elena airport would reach about 110 persons in the short-term improvement stage, as shown in Table 10.2. An organization for the airport administration is also shown in Figure 10-7. The organizational structure is proposed to be strengthened in the following manner:

a) General Affairs Division will be newly established, and the Division will be in charge of Personnel Affairs, Accounting, Security, and Statistics.

b) Telecommunication Division will be newly established for Aeronautical Mobile Services (AMS) and Navigational Aids, in due consideration of the importance of these fields.

c) Air Traffic Services Division will be reinforced by establishing a new position for Approach Controllers.

d) Crash, Fire and Rescue (CFR facilities) will be newly established.

It is also recommended that the operational hour of Santa Elena airport will be extended to 07:00 - 19:00 in line with the tourism attraction and development.

XI. EVALUATION OF SHORT-TERM IMPROVEMENTS OF SANTA ELENA

11.1 Schedule and Estimated Costs

The short-term improvements of Santa Elena airport proposed in the foregoing Chapter X involve relatively small works, when compared with the improvements of La Aurora. Prior to the economic and financial evaluation of the proposed Santa Elena improvements, a tentative schedule for implementation and the estimated costs of the recommended works are discussed herein.

11.1.1 Implementation Schedule

The traffic forecast and studies for improvements in the foregoing Chapters IX and X have been made with reference to the target year of the short-term improvements, 1995. In the case of Santa Elena airport, the traffic demands in the early 1990's will not be so acute, except for the possibility of a boom in travel to Tikal in 1992, the 500 year anniversary of the discovery of the new continent and Mayan civilization.

In view of the nature and volume of works for the Santa Elena improvements, consideration was given to the execution of the improvement works together with the La Aurora improvements. While it might be possible to schedule the execution of works for 1991 when La Aurora works are scheduled to start, it appears more desirable that the major improvements of Santa Elena be scheduled for execution in 1993. It is because the Santa Elena improvement works will be executed in a more economical manner if they are implemented after the programed CA-13 road improvements are completed. A proposed implementation schedule is shown in Figure 11-1.

Notwithstanding such a schedule, it is recommended that the installation of the secondary power supply systems be executed at the earliest possible time, as an "Emergency Program", unless they are installed by DGAC by means of separate arrangements. As noted in Chapter 10.4.1, the frequent power failures are serious

problems at Santa Elena and installation of emergency generators are urgently required for safe operations of the airport.

11.1.2 Estimated Costs

The construction and installation costs of the proposed Santa Elena improvements have been estimated on the same basis as La Aurora improvements, as explained in Chapter 6.2.

The estimated financial costs of the improvement works are shown in Table 11-1 and summarized below. The detailed estimates are presented in Appendix-L.

Summary of Financial Costs, Santa Elena

		Foreign Currency (US$ 10^3)	Local Currency (US$ 10^3 equiv.)	Total (US$ 10^3 equiv.)
1)	Civil Works, including repair of runway-apron	64	574	638
2)	Building Works	39	349	388
3)	Navaids, Telecom. and Airfield Lighting	321	16	337
4)	Power Supply System	911	101	1,012
5)	Special Equipment	804	25	829
6)	Engineering and Administration	230	26	256
	Sub-Total	(2,369)	(1,091)	(3,460)
7)	Physical contingencies	95	43	138
	Sub-Total	(2,464)	(1,134)	(3,598)
8)	Price Contingencies	301	523	824
9)	Interest during Construction	48	68	116
	TOTAL	2,813	1,725	4,538

Disbursement of costs is primarily scheduled for 1993, except for the costs of engineering and administration. The disbursement schedule is programed as follows:

Disbursement Schedule, Santa Elena

(US$ 10^3 equiv.)

	1991		1992		1993		Total		
	Foreign	Local	Foreign	Local	Foreign	Local	Foreign	Local	Total
Direct Const. Costs	96	10	72	8	2,296	1,116	2,464	1,134	3,598
Price Contingency	6	2	7	3	288	518	301	523	824
Interest during Const.	1	-	4	1	43	67	48	68	116
TOTAL	103	12	83	12	2,627	1,701	2,813	1,725	4,538
	(115)		(95)		(4,328)				

11.2 Economic Evaluation

11.2.1 Economic Cost and Approach to Evaluation

The financial costs estimated for the Santa Elena improvements are converted into economic costs, by applying a shadow wage for unskilled labor cost and by eliminating the transfer payments in the local currency portion, as noted in Chapter 6.3.1. The economic costs are estimated as summarized below.

Economic Cost, Santa Elena

	1991	1992	1993	Total
Direct Const. Cost (Financial)	106	80	3,412	3,598
Shadow Wage	-5	-5	-200	-210
Transfer Payment	-1	-1	-84	-86
Total Economic Cost	100	74	3,128	3,302

As noted in Chapter 8.2.1, Santa Elena is the air gateway to the Tikal area and the upgrading of the Santa Elena airport is evaluated within the context of an Integrated Area Development Program. In addition to the economic cost estimated at US$3.3 million for the Santa Elena airport, various costs would be required for such an Integrated Area Development. For instance, investments in constructing a required 40 additional hotel rooms would amount to about US$2 million as noted in Chapter 8.2.1. Restaurants, athletic and recreational facilities, shopping areas, etc. will require additional economic costs. Potable water and local transport might also be necessary. All the economic costs of these facilities, including the Santa Elena airport improvements and added hotel rooms, would reach in the order of US$10 - 15 million by 1995.

This study on the Santa Elena airport improvements has not been intended for formulating, costing, scheduling and economically evaluating the required Integrated Area Development Program. Only a preliminary evaluation could therefore be made to indicate the likely prospects for justification of the proposed improvements at Santa Elena.

11.2.2 Benefit of Integrated Area Development

The major benefit of a short-term Integrated Area Development Program will be, in all probability, a rise in tourism. Tourists will come by air and by road. They will be attracted to Guatemala by the development and promotion of the Tikal area. They are also almost certain to visit Guatemala City as well.

As noted in Chapter 8.2.1, the number of passengers anticipated at Santa Elena in 1995--assuming the timely availability of all the required elements in the short-term Integrated Area Program--is 130,000, some 30,000 above the level of 1988. Since individuals are counted as entering and as departing passengers, the 30,000 increase in air travellers represent 15,000 added visits or trips to Tikal and Santa Elena area.

The benefits expected in 1995 from the forecast rise in air travel to Santa Elena can be estimated in terms of the anticipated increase in national income. While these passengers are likely to spend two nights in the Tikal area, their total stay in Guatemala may be put at 7 days. It appears logical to reason that these 15,000 additional visits to Tikal will be overwhelmingly touristic in character and were induced by the new

developments in the Tikal area--including the proposed improvements to Santa Elena--to spend a one week vacation in Guatemala.

With an average daily expenditure of US$80--a consecutive estimate since it includes air travel to and from Santa Elena--the total spending generated by these 15,000 additional visits would be about $8.4 million. And with an estimated figure of 60% to represent the increase in value added--or net income created per dollar of added spending--the income increase in 1995 would be $5 million. And this figure would rise in succeeded years by 4% annually, in line with the Study Team forecast for air passengers at Santa Elena airport. It would reach US$7.4 million in 2005 and US$10.5 million in 2014. The total volume of these benefits over the period 1995 - 2014 is almost US$150 million.

It is assumed that more than 25% of the overall benefits estimated above will accrue to the area directly tributary to the Santa Elena area (two days spent in Tikal out of 7 days spent in Guatemala). It is therefore estimated that the benefits accruing to the Santa Elena tributary area would amount to no less than US$1.25 million in 1995, US$1.85 million in 2005 and US$2.6 million in 2014.

11.2.3 Economic Feasibility

The benefits directly tributary to the Santa Elena area as estimated above are converted into the present worth at the discount rate of 12%. The present worth of the benefits is calculated to be US$12.1 million.

On the other hand, the costs required for the various components of the short-term Integrated Area Development by 1995 are estimated to be US$10 - 15 million as noted above. Using an estimated average cost of US$12.5 million and an assumed operation and maintenance cost at 3% of the construction cost of these facilities, the present worth of this stream of costs, calculated at the discount rate of 12%, amounts to US$11 million.

When the present worth of these costs are compared with that of the benefits, it indicates that the investments in the short-term Integrated Area Development Program, including the short-term Santa Elena airport improvements, can be justified entirely in terms of benefits which will remain in the local area.

11.3 Financial Evaluation

The discussion in Chapter 11.2 cast the economic evaluation of the proposed short-term improvements for Santa Elena in the context of an Integrated Area development Plan for the Santa Elena tributary area. The economic benefits were counted therein by the benefits that would be generated by the overall integrated program. The situation is different in the financial evaluation. The review of financial performance of Santa Elena improvements must be undertaken in a somewhat isolated manner.

Unfortunately, the financial information available for Santa Elena is scant. Moreover, there are features of the Santa Elena financial situation which are difficult to follow. For example, the domestic flights pay Santa Elena landing charges at La Aurora but a separate account for such revenues is unavailable in La Aurora financial data. Under such circumstances, the initial analytical effort involved preparing a normalized 1988 financial statement for Santa Elena. It will then be compared with estimated normalized financial flows after the implementation of the proposed improvements.

11.3.1 Normalized 1988 Conditions

The attempt to assess a normalized 1988 financial statement is made on the following conditions:

a) Landing Fee Revenue, Commercial Aircraft: The tower logs indicate 98 international operation (49 landings). Average aircraft weight is assumed to be 1,750 kg for international and 6,000 kg for domestic operations. The landing charge of Q.0.002/kg is the same as the La Aurora charge.

b) Other Aircraft: Based on tower data, other landings were estimated to be 2,644. Average plane weight is taken as 20,000 kg.

c) International Departure Tax: Based on Santa Elena data, it was estimated that there were 318 departing international passengers.

d) Terminal Space Rental: Based on data supplied by Santa Elena authorities, it was determined that rental income was Q.4,179.30 from Building A, Q.2,214 from Building B, and Q.1,800 from the Cafeteria in Building B.

e) Estimated O&M Costs: an arithmetic average of O&M outlays for 1987 and 1988 was applied.

The Table 11.2 indicates the normalized financial statement for Santa Elena in 1988. It reveals that Santa Elena is operated at a deficit of about Q.81,000. Assuming that desirable O&M costs are substantially higher than actual outlays, the deficit could be much higher. The evidence is indisputable that the very modest scope of present airport operations at Santa Elena creates a minimum overhead cost requirement for O&M outlays that cannot be covered by revenues. And the situation is further aggravated if the airport users either do not pay appropriate fees or pay them to the account of La Aurora.

11.3.2 Financial Projections

The revenue potential of Santa Elena after the completion of the proposed improvements is estimated on the basis of the following:

a) It is assumed that Santa Elena airport can anticipate a 4% average annual rate of growth--in passenger flows and aircraft operations--over the entire span of the projections. It is further predicted that the tariff changes discussed in Section 6.4 with respect to La Aurora will--with the single exception of space rental fees in the terminal--be applied to Santa Elena.

b) Therefore, landing fee revenues from international and domestic flights, passenger departure tax revenues and car rental and car parking revenues are projected at a 4% growth pattern plus the 1994 tariff increases specified for La Aurora. Other aircraft landings are not expected to rise, and revenues from the activity will only rise to the extent of the increase in landing fees. Terminal rental space will not increase and the quality of the space will improve to the extent that a 50% increase in rental income is anticipated.

c) O&M costs are expected to rise to Q.500,000 per year after 1994. This is in line with Santa Elena requests for O&M funds.

On the other hand, the debt obligations that would be incurred if the $4.5 million of financial costs required for implementation of the short term plan for Santa Elena were borrowed under the same guidelines set forth in Chapter 6.4.1 for La Aurora, are estimated to be about $210,000 in 1993 - 2000 and $253,000 thereafter, as shown in Table 11.3.

As a result, an isolated look at the Santa Elena finances can be indicated in the pro-forma financial statement as shown in Table 11.4. Although no claim is made that the financial statement has a high degree of precision, certain judgements and observations can be drawn from the normalized financial projections.

a) Taking into account debt service obligations, Santa Elena will remain in a deficit position throughout the entire period of the financial projections. Despite a gradual reduction in this aspect of its deficit, the financial shortfall will be in the range of $270,000 - $220,000.

b) Taking into account only the ability to cover required O&M outlays, the data show that by 2010 total traffic at the Santa Elena will grow to the point that total revenues are likely to exceed the Q.500,000 outlay for O&M.

c) From whichever perspective the deficit is viewed--whether before or after debt service obligations are taken into account--Santa Elena will require extended financial assistance.

11.3.3 Consolidated Financial Statement

The purpose of the financial projections presented above was to indicate the financial viability in the event that the Santa Elena improvements were considered apart from the Integrated Development Plan and apart from the financial performance of La Aurora. The effects of combined implementation of the short-term improvements for La Aurora and Santa Elena airports are envisaged, like the serviceability of Santa Elena as an alternate airport to La Aurora. Therefore, a consolidated financial statement for La Aurora

and Santa Elena can be prepared as a useful and productive analytical tool. Such a consolidated statement will also permit an overall evaluation of the Guatemalan air transport sector.

Table 11.5, based on such a consolidated financial approach, compares the surplus generated by La Aurora over the period 1991 - 2020 with the deficit incurred by Santa Elena over the same span. The Table also shows the consolidated surplus earned by combining the financial performance of the two airports. It is clearly indicated that on a consolidated basis the investments in the air transport sector are financially viable and self-liquidating. The air transport sector is capable of meeting its required level of O&M expenses, its required level of capital replacement outlays, its entire level of debt service incurred and--in addition--creating a substantial surplus over and beyond these financial commitments. Such a consolidated surplus will exceed US$11 million in 1996 and US$13 million in 1999.

XII. FURTHER LONG-TERM IMPROVEMENT OF SANTA ELENA

12.1 General

The long-term improvements of Santa Elena airport had been formulated as a master plan to satisfy the anticipated traffic demand in the year 2005. As noted in Chapter 8.2.1, the annual air passengers at Santa Elena would reach nearly 200,000 in the target year. If the Integrated Area Development Programs are implemented at an accelerated rate in the Santa Elena area as well as in Tikal and other yet unexploited ruins in the region, the traffic would be further increased in the early 2000's. To meet the requirements of increased traffic, additional investments will be required for the expansion of airside infrastructures, terminal areas, airport and aviation support facilities.

By early 2000's, operations of Santa Elena airport will pass 20 years since its construction in 1981, and renovation of various equipment and facilities installed in the airport would also become necessary. Such a renovation is to be programmed in the light of standards and technologies up to date. For instance, MLS will be envisaged for installation in Santa Elena in the long-term improvement program.

With the unpredictable nature of economic situations in the Department of Petén, as well as in the country as a whole, it is recommended that the air traffic forecast and the progress in the Integrated Area Development be reviewed periodically or at least after the completion of the short-term improvements. Such a review would indicate the appropriateness of additional investments in further improvements of Santa Elena airport.

12.2 Airfield Expansion

12.2.1 Taxiway Improvement

The concrete-paved existing runway will continue to be serviceable in the long-term stage, with proper maintenance works to be set forth in the short-term phase. However, the existing taxiways which are not proposed for improvements in the short-term phase, will not be adequate for safe operations of the increased traffic. It is

proposed that the parallel taxiway, rapid-exit taxiways and conventional exit taxiways be properly expanded in the long-term improvements.

The parallel taxiway, which runs for about 188 m between Runway 10 end and the apron, is planned to be extended for the entire length of the runway (3,000 m). The separation distance between the centerlines of runway and parallel taxiway should be 180 m at minimum in conformity with the ICAO standards. The parallel taxiway will be designed to be 23 m in width with 7.5 m shoulders on both sides.

The geotechnical conditions along the possible alignment of the parallel taxiway have been investigated in the course of this Study. As shown in detail in Appendix-C, the CBR values in the alignment area are classified into two groups, low value no more than 1% and around 10%. The former group shows a swelling value as high as 11%, and the later group about 5%. The test results indicate that soils are sensitive to swelling, and it will be recommendable to design sub-drains in the subgrade layer in the construction of the parallel taxiway.

A pair of rapid-exit taxiways are proposed to be provided to promote safer and more efficient operation, as well as to increase runway-taxiway capacity. Such rapid-exit taxiways are particularly important when mixed operations of small aircraft and jets are envisaged. In addition, two conventional exit taxiways are proposed to be provided, as shown in Drawing 12-1.

12.2.2 Apron Expansion

As noted in Chapter 8.3.2, the aircraft mix in peak hour operation at Santa Elena is anticipated to be 2 small jets, 2 STOLs and 12 small chartered aircraft. To meet the requirements of such operations, the existing apron of about 18,900 m2 will not be sufficient and it is proposed to be expanded to the east of the existing apron. The required area of expansion will be about 4,500 m2, and the apron will have a total area of 23,400 m2 in the long-term improvement phase. A layout of the proposed apron expansion is illustrated in Drawing 12-1.

12.3 Terminal Area Improvements

12.3.1 Passenger Terminal Facility

Originally the concept for the improvements was to propose a new terminal for the year 2005, but a more thorough analysis reveals that such new facilities are not needed. Some of the reasons can be summarized as follows:

- With a few exceptions, the 2005 requirements are still relatively close to the existing capacity.

- The existing terminal area is located near the Runway 10 threshold, which is not a desirable location for taxiing aircraft. It is anticipated that eventually the terminal area will have to be moved to a more central location. However, such a relocation will have to await the decision to build a new apron.

- To build a new terminal building on the existing apron would not only be wasteful because of its relative short life span, but also would require some degree of interference with the existing operation of an already small facility. Further, there are no vacant sites on the existing apron to build a new building.

If a new facility is not built, the solution will then consist in improving the existing building with either interior modifications or small additions. Some of these modifications are shown in Drawing 12-2 and are the following:

a) New Departure Lounge and Departure Hall: The open patios between the two buildings will be enclosed to form a new departure lounge, and an adjacent new departure hall will be created.

b) Expansion of Arrival/Greeting Area: A new extension will be built north of the building to bring that area up to the requirements as shown in the Table of Comparative Space Analysis in Chapter 10.3.1. That new space will also be used for baggage revision, when needed, and for some customs offices.

c) Additional Concession Spaces: Secondary spaces for concessions and offices will be built on an as-needed basis.

12.3.2 Cargo Terminal Facilities

By the year 2005 a separate cargo building would be built, and is shown in Drawing 12-1.

Cargo traffic for Santa Elena is still at a small scale, and will likely continue to be as such in the future. The projection for 2005 are for an annual volume of 1,335 tons, of which 475 tons are inbound cargo and 860 tons are outbound. The inbound cargo make-up will be mostly light items, such as emergency spare parts, small motorcycles, pharmaceuticals and special food products, etc. The outbound products will be ornamental flowers and various handicrafts items. This cargo, even a part earmarked for overseas, can be assumed to go through Guatemala City first. Therefore, the cargo traffic can be assumed to be all domestic, not requiring customs inspection and clearance, except for standard security checks.

Considering the small volume of cargo involved, it is possible to compute a storage space requirement based on the total volume. A flexible separation inside the building will separate inbound from outbound cargo. The criteria previously applied to small cargo at La Aurora will be used. The required storage space is calculated to be 267 m^2 (= 1,335 t/5 t). Without the need for segregated international cargo, a single space will be sufficient, with flexible separation.

It is recommended that a separate cargo building be provided for the following reasons:

- The available space in the passenger terminal is slightly below the requirements for the year 2005, and no extra space is available for cargo use.

- Possibility of expansion: Some unforeseen circumstances may create a sudden boom in cargo traffic, and it would be desirable to envisage possibility for expansion. The expansion from a location inside the passenger terminal will be difficult.

- Clearer separation of functions would be desirable, because noise and movements of a cargo operation are non-compatible with the operation of a passenger terminal

For these reasons, a new cargo terminal building will be planned in the west end of the apron, as indicated in the Drawing 12-1. There will be no need to plan a cargo apron, since it is not expected that there will be dedicated cargo flights, even by the year 2005. The building will have an area of 300 m^2 (10 x 30 m), in order to accommodate a small office area inside, with controlling view of the storage area. It is however advisable to have a work area on the apron side, in front of the building.

12.4 Airport and Aviation Support Improvement

12.4.1 Control Tower

As noted in Chapter 9.3.1, the existing control tower design is totally inadequate and has defects from ATC's point of view. It is not considered as feasible to improve these defects at the present tower site. Consequently, it is planned that the tower will be renewed under the long-term improvements for Santa Elena.

1) Site and Height of New Control Tower

A suitable site will be found in the area closest to the mid-portion of the aerodrome compound off the runway. The tower will be sited at the eastern edge of the vacant area, about 370 m from the runway centerline, so as not to infringe on the obstruction limitation surfaces.

The tower height is calculated on the basis of the following parameters::

Distance from proposed site to runway end:	
Runway 10 End	800 m
Runway 28 End	2,325 m
Elevation of runway end:	
Runway 10 End	122.78 m
Runway 28 End	128.88 m
Proposed site elevation:	121 m
Distance from runway center to tower:	370 m

The formula to determine the minimum eye level elevation in the cab is as follows:

$$Ee = Eas + D \tan (35 \text{ min.} + Gs)$$

where:

Ee = Eye level elevation

Eas = Average elevation for selection of airport traffic surface in question

D = Distance from proposed tower site to section of airport traffic surface in question.

Gs = Angular slope of airport traffic surface measured from horizontal and in direction of proposed tower site.

Taking the higher elevation, the eye level elevation (Ee) is estimated to be about 23.7 m at minimum. Consequently, the tower height is approximately 26 m at minimum. From an operational point of view, it is desirable that the tower height be higher than the minimum. A height of 28 m is recommended, which is equivalent to an 8 story-building. The proposed tower height will not infringe on the transitional surface.

2) Layout of Tower Shaft

The new tower is designed to have 8 floors with VFR control Cab atop the shaft. There will be 2 extra floors reserved for the future functional expendability. Clearances between each story can be adjusted, considering the functions of each facility, in order to accommodate 8 stories at the tower height of 28 m. A layout of the control tower is shown in Drawing 12-3. Installation of facilities is planned as summarized hereunder.

Story	Facilities (Room)	Floor	Space (m^2)
(8)	VFR Control Cab:	Atop the tower Shaft	32
(7)	Floor reserved for	Beneath the cab future Radar Room:	"
(6)	Brief and Break Rooms: floor	Beneath the reserved	"
(5)	Floor reserved for Radar Equipment Room:	Beneath the Briefing & Break Rooms	"
(4)	Computer Room:	Beneath the Radar Equipment Room	"
(3)	Communication Equipment Room:	Beneath the Computer Room	"
(2)	Meeting Room and Cafeteria:	Beneath the Communi-cation Equipment Room	"
(1)	ATS Offices	On the Ground Floor	"

12.4.2 Other Airport Support Facilities

Requirements for expansion of parking lot, CFR facilities, fuel farm and electrical facilities have been reviewed and the programs for long-term improvements have been defined as follows:

1) Parking Lot

The peak hour passengers in 2005 is estimated to be 200. The same computation as was made in the short-term plan gives the following requirement of parking space:

$$V_2 = 200 \times 0.84 \times 0.6 = 101 \text{ cars} < 118 \text{ cars (existing)}$$

No expansion of the existing parking lots is yet required even in the year 2005 for the use of passengers.

2) CFR Building

As the airport category in the design year 2005 remains the same as the short-term plan target year, no expansion of the CFR building and equipment would be required. The vehicles furnished in the short-term plan would still be serviceable at this stage.

3) Fuel Farm

The required fuel storage capacity in 2005 is estimated to be about 183 kl. One additional tank having 50 kl (3.9 m dia x 6.2 m height) storage capacity to the existing tanks will be required.

4) Electrical Facilities

Power demand for the proposed airport facilities is estimated to be around 600 kVA as follows:

Control tower	40 kVA
Terminal buildings	300
CFR facilities	100
Pump station	100
Radionavaids	25
Visual navaids	160
Miscellaneous	20
Total	745 kVA

$$\frac{745 \text{ kVA x load factor}}{\text{Diversity factor}} = \frac{745 \text{ kVA x } 0.8}{1.05}$$

= 564 kVA (say 600 kVA)

In addition to the lighting and general electric services, the passenger terminal building will be furnished with the following passenger service electric facilities in the year 2005:

a) Flight Information Display System (F.I.D.S.): Given the still relatively light level of traffic in 2005, and the open physical layout of the building, only the very basic system of F.I.D.S. will be required, that is a system

made up of video monitors which are manually activated by an operator on a keyboard. No Central Processing Unit will be required. No Gate Boards will be required either, since a single space Departure Lounge System is used with individual doors acting as gates.

b) CCTV Security System: No Closed Circuit TV System is forecast, because of the open layout of the building.

c) Telephone and Intercom System: The telephone system will be a standard company - installed PABX System; in addition, the airlines can require their own individual lines.

d) Paging System: The 1995 Paging system will be expanded to meet the new requirements of 2005. No zoning is required because of the open plan.

12.4.3 Aviation Support Improvements

Through the long-term improvements, it is envisaged that Santa Elena will be graded up to the precision approach runway Category-I. To this end, it is proposed to install the following facilities:

1) MLS (Microwave Landing System)

MLS is scheduled to be globally adopted in 1998, and it is planned to install MLS at Santa Elena. ILS could be an alternative measure if and when the installation of an airborn MLS receiver is delayed worldwide.

2) Precision Approach Lighting System

In order to enhance Santa Elena to a Category-I airport, precision approach lighting should be installed. It is proposed that lighting row of 900 m in length be installed on the Runway 10 (Refer to Drawing 12-4).

3) Other Navaids and Telecommunication Facilities

Some facilities for radionavaids, visual navaids and telecommunications will have to be renewed by the time of implementing the long-term improvements, since their life period will expire in the early 2000's. A list of equipment and facilities to be procured and installed in this stage are presented in Appendix-I, Section I.4.

12.5 Estimated Costs and Economic Prospects

12.5.1 Estimated Costs

The long-term improvements of Santa Elena--in response to the augmented demand expected by 2005--involve a major expansion and modernization of the airport, beyond the recommended changes called for in the short-term plan. The direct construction and installation costs of the proposed expansion have been estimated on the same conditions as applied in the short-term improvements. That is, the costs are expressed at 1989 prices.

The estimated financial costs of the expansion works are shown in Table 12.1 and summarized below.

Summary of Financial Cost, Santa Elena - Long Term

	Foreign Currency (US$ 10^3)	Local Currency (US$ 10^3 equiv.)	Total (US$ 10^3 equiv.)
1) Civil Works, including runway, apron, drainage	583	5,243	5,826
2) Building Works, including terminal, passenger service equip.	953	532	1,485
3) Electric Works, including navaids, telecom., lighting, power supply, meteo. observ.	8,919	522	9,441
4) Engineering and Administration	1,206	134	1,340
Sub-Total	(11,661)	(6,431)	(18,092)
5) Physical Contingency	466	257	723
TOTAL	12,127	6,688	18,815

Disbursement of costs is provisionally scheduled as follows:

(US$ 10^3)

	1st Year	2nd Year	3rd Year	4th Year	Total
Direct Construction Cost					
Foreign Currency	501	251	5,242	6,133	12,127
Local Currency	56	28	3,034	3,570	6,688
Total	552	279	8,276	9,703	18,815

Since the implementation schedule of the expansion works cannot now be foreseen, such financial costs as price contingencies and interest during construction are not estimated.

12.5.2 Economic Prospects

Looking to the airport and regional developmental requirements of 2005, the air travel passenger forecast is expected to rise from the 1995 level of 130,000 to 200,000 by 2005. This 70,000 passenger increase represents an additional 35,000 trips over the number anticipated for 1995. Just as the Santa Elena facilities need substantial modernization and expansion to accommodate this higher demand, so other components of the integrated program must be enlarged to accommodate this increased number of visitors.

The same spending patterns for increased visitors to Santa Elena set forth in Chapter 11.2.2 can be applied to the long-term analysis. With 35,000 added visits times an estimated daily outlay of $80 times seven days, the total new spending by visitors will be almost $20 million in 2005. Applying a value added percentage of 60% gives an income increase of about $12 million.

A significant portion of the benefits of increased visits will remain in the Santa Elena tributary area since 2 days of the anticipated newly-generated 7 day visits will be spent near Tikal. It is assumed that about 25% of total benefits can reasonably be expected to accrue to the tributary area. It is therefore estimated that the benefits

anticipated to remain in Santa Elena area would amount to US$3 million in 2005, US$3.6 million in 2010 and US$4.4 million in 2015.

If the above estimated benefits for the Santa Elena tributary area are compared with the costs of the Santa Elena airport improvements and investments in hotel rooms, etc., it appears that the proposed long-term improvements of Santa Elena can be economically justified. When the full sweep of benefits created in Guatemala are taken into account, it is obvious that the Integrated Development Program--which incorporates the Santa Elena airport improvements--has a justification that can be described as vigorous.

PART 4

RECOMMENDATIONS

XIII. RECOMMENDATIONS ON PROJECT IMPLEMENTATION

13.1 Implementation of Emergency Programs

La Aurora airport, as explained in Chapter 4.4.5, has a dangerously high potential for a serious accident due to various deficiencies and out of date radars (ASR/SSR) that have not been functioning properly. Further, CFR facilities are not in adequate operating condition for emergencies. The renovation of this equipment is critically needed for safe operations at La Aurora. On the other hand, Santa Elena airport is in urgent need of secondary power systems, because all control tower equipment fail and the receiving station stops completely with power failures which are frequent.

Under such situations, it is recommended that the renovation of the following facilities be implemented as an "Emergency Program":

a) Renovation of radar systems at La Aurora, including installation of ASR/SSR equipment.
b) Renovation of CFR facilities at La Aurora, including installation of one rapid intervention vehicle and two major vehicles.
c) Renovation of secondary power systems at Santa Elena, including 250 kVA generator for airport complex and 7.5 kVA generator for VHF station.

Total costs of the Emergency Programs are estimated to be US$10,122,000 equivalent. (In the event that a separate arrangement by DGAC with a French proposal is realized, the emergency installation of the CFR facilities and the secondary power systems could be precluded, and the total costs would be reduced to US$7,959,000 equivalent.)

It is recommended that the Government authorities recognize the urgency of these specific requirements and take immediate actions to raise funds for procurement and installation of the equipment scheduled as the "Emergency Program".

It is also recommended that, until the new radar system is introduced, the positive control of aircraft be refrained from at any peak hour service, depending on the traffic

situations, and only advisory service or monitoring be executed for aircraft movements, in order to prevent a likely near-miss or collision in the air.

Throughout this Study, emphasis has been placed on that it is better, on all counts, to prevent the first accident rather than the second.

13.2 Implementation of Short-Term Improvements

It has been demonstrated in the course of the Study that the proposed short-term improvements of La Aurora airport are technically sound, economically feasible and financially viable. The economic internal rate of return (EIRR) of La Aurora short-term improvements is as high as 56% in a 20 year analysis period. Even in the case of a low traffic forecast, the EIRR is 37%. The financial internal rate of return is calculated to be 16%. The proposed improvements would generate a consistent revenue surplus of about US$14 million per year after all borrowing costs have been fully covered. The project is a most encouraging and profitable development in the public sector development programs.

On the other hand, it has been revealed that the proposed short-term improvements of Santa Elena airport are economically feasible but their financial viability is marginal. It is due mainly to the low traffic at Santa Elena. However, safe operations should also be secured at Santa Elena. Besides, Santa Elena could become serviceable as an alternate airport to La Aurora when properly improved.

Under such circumstances, it is recommended that the short-term improvements at La Aurora and Santa Elena airports be taken up as a package program and be implemented at the same time. For the implementation of improvements at both airports in the short term, the following recommendations are presented:

1) It is recommended that the Government authorities take necessary actions to raise funds for the implementation of the short-term improvement programs of La Aurora and Santa Elena. According to the financial cost estimates, the necessary amount of funds is estimated as follows:

		(US$ 10^3)
	External Funds	Local Funds
La Aurora short-term improvements	52,876	9,331
Santa Elena short-term improvements	3,857	681
Total Funds Requirements	56,733	10,012

In the event that the proposed Emergency Programs are realized as proposed above under separate financial arrangements, the requirements for the external fund could be reduced to about US$46,915,000 equivalent.

For the external fund requirements, it is recommended that the Government authorities seek external loans on concessional terms. It is also recommended that they take measures necessary for guaranteeing the borrowing needed to cover the fund requirements in local currency.

2) It is recommended that DGAC and the Ministry of Communications, Transports and Public Works (MCTPW) initiate a detailed study on the improvements of tariff structures to be newly applied at the completion of the short-term improvements at La Aurora and Santa Elena. The pattern of tariff structures applied in this Study, as well as the financial evaluation as a whole, could be referred to in making decisions on the establishment of new tariff structures.

3) It is also recommended that DGAC and MCTPW initiate the detailed study on the establishment of Guatemala International Airport Authority (GIAA) by referring to the suggestions made in the Study (Refer to Chapter 5.8.3). It is believed that GIAA can manage the airport operations in a more efficient way, both technically and financially. As revealed in this Study, GIAA could be a self-financing authority. It will also be possible that GIAA will practically act as the executing agency for the proposed short-term improvements.

4) In the event that separate arrangements are made by DGAC, MCTPW and the Ministry of Finance for the realization of some part of La Aurora improvements, it is recommended that DGAC refer to the short- and long-term improvements, proposed in this Study in order to maintain a well coordinated and balanced implementation of the

improvements. Incompletely planned arrangements could cause unnecessary investments before and after the implementation of the proposed improvements.

5) The proposed improvements in airspace operations, such as the establishment of SIDs and STARs at La Aurora and Santa Elena airports, as well as the establishment of an ATS route between La Aurora and Santa Elena, can be realized without any financial requirement. Even in the case that the realization of the proposed short-term improvements is delayed for some reasons, it is recommended that SIDs, STARs and ATS route be established as early as possible, by referring to the suggestions made in this Study (Refer to Chapter 5.6, Chapter 10.5 and Appendix-K). In the event that DGAC is unable to establish such procedures, it might be possible to count on advisory services under any foreign technical cooperation program.

6) The proposed improvements of Santa Elena airport are programmed in the framework of an Integrated Area Development Program in the Tikal - Santa Elena area in the Department of Petén. In this relation, it is recommended that DGAC and MCTPW provide all the details on the recommended short-term improvements to Santa Elena airport to whichever government agencies have responsibility for regional development in the Petén. Airport officials should also remain fully informed of the details and implementation prospects for the other components in the integrated program. They should strive to move ahead with construction of the recommended short-term improvements for Santa Elena at a pace and on a schedule that harmonizes with the other components of the short-term Integrated Development Plan for the area.

13.3 Implementation of Long-Term Improvements

This Study has revealed that it is technically possible to further expand La Aurora airport in the long term, to satisfy the traffic demand anticipated for the year 2005, only on the condition that a concession of the land presently used as a horse racetrack is granted to DGAC or GIAA. Such an expansion is preliminarily evaluated as economically feasible. On the other hand, some improvement works of Santa Elena airport will become necessary with the increased traffic in the early 2000's.

The following recommendations are presented with respect to the long-term improvements at La Aurora and Santa Elena airports:

1) It is recommended that air traffic forecasts be periodically made for La Aurora and Santa Elena, during the period following implementation of the short-term improvements. Such updated traffic forecasts should be compared with the forecast made in this Study. The updated forecast would make it possible to prepare more detailed programs on the extent and schedule for improvements. Decisions on the implementation of the long-term improvements, both at La Aurora and Santa Elena, could then be made in a more efficient and timely manner.

2) For the expansion of La Aurora airport in the long terms, it is indispensable to obtain a concession for the use of the land presently used as a horse racetrack and annex it to the airport command. It is recommended that the Government authorities recognize the high economic and financial benefits to accrue from the expansion of the airport complex. A concession of the property should be made to DGAC or GIAA by the time decisions must be made on the implementation of the long-term improvements.

3) Preparation of a master plan for the development of the transportation sector, as contemplated by MCTPW, will be of great significance in deciding the programs for the long-term improvements of La Aurora and Santa Elena airports. It is recommended that the long-term improvements proposed in this Study be referred to in the preparation of such a sectoral master plan.

XIV. RECOMMENDATIONS ON CIVIL AVIATION MANAGEMENT

Through the execution of this Study, the Study Team observed and took note of various suggestions which, if implemented, will contribute to the better management of civil aviation in Guatemala. Major suggestions and recommendations are presented in a summarized form hereunder.

1) As the review and analysis of this Study became more intensive and more detailed, it was discovered that there were inconsistencies and omissions in the data on airport operations. To illustrate, significant difference were discovered in the data on commercial aircraft operations at La Aurora in 1988. There appear to be some inconsistencies or--at a minimum--some lack of clarity with respect to the number of international air passengers at both La Aurora and Santa Elena. These data deficiencies are not the fault of DGAC personnel. On the contrary, the staff is well trained and diligent. The problems were due to understaffing within certain sections of DGAC, inadequate availability of personal computers for record keeping, data review and analysis and, also, unclear and imprecise channels for routing basic data on passenger flows and aircraft operations from the data generating sources to DGAC statistical personnel. The abundant source and stream of information does not flow regularly and consistently to the Planning and Statistical Section within DGAC.

It is, therefore, recommended that there be an appropriate increase in DGAC planning and statistical personnel plus the acquisition of several personal computers to improve the scope and quality of the statistical data on air transport activities.

2) The air traffic forecast should be consistently updated for the better management and planning of civil aviation. It is recommended that the forecast be updated at least every two years. Assuredly, the reinforcement of the Planning and Statistical Section recommended above would facilitate such updating of the traffic forecast. This updating should be carried out on a regular basis, and the in-depth forecast should be made separately in programing the expansion of airport facilities as previously recommended in Chapter 13.3.

3) La Aurora airport has a number of obstructions in the obstacle limitation surface, including the artificially constructed tall buildings. They are seriously hampering the safe operations of aircraft in and around the airport. Further increase in obstructions should be severely limited. In this connection, it is recommended that regulations to legally protect the obstacle limitation surface be enacted and promulgated as early as possible.

4) La Aurora airport is located close to the urban areas, and noise is the major environmental consideration associated with the airport operations. Due to the limited length of the runway, it appears difficult to modify aircraft operating procedures to reduce engine power settings on take-off and landing or to apply steeper take-off and reduced flap setting landing approach. Alternative countermeasures to reduce the noise level would be to introduce aircraft with less engine noise level, to plan noise sensitive installations to be built in the lower noise level areas, and to prohibit the midnight aircraft operations. It is recommended that AVIATECA and other airlines be directed to introduce newer types of aircraft with less engine noise level, such as B-737, B-757, B-767, A-310, A-320, MD-80 series, etc. It is also recommended that the Municipal authorities be directed to build noise sensitive installations in the lower noise level areas by referring to the noise contours prepared in this Study.

5) Airport security is the increasing concern in recent years. Severer restrictions are recommended by ICAO, and are being applied by US and other government authorities. Some of the measures proposed to be taken for improvement of the airport security in La Aurora terminal area (Refer to Chapter 5.3.4) could be implemented with minimum costs. It is desirable that the ICAO recommendations be respected and appropriate measures be taken to improve the airport security at La Aurora, regardless of the implementation schedule of the proposed short-term improvements.

6) La Aurora airport has been heavily used by general aviation, and a proportionately large area is occupied by facilities for general aviation within the airport complex. Further expansion in this sector will aggravate the airport operations and will make it difficult and costly to realize the short-term and long-term improvements at La Aurora. It is therefore recommended that any further expansion of the general aviation area, particularly the hangar area, be limited to the boundary of the present location to avoid the worsening of the present violation of runway strip and clearance distance from taxiways. It will also facilitate any relocation process which may take place in the future.

7) It is observed that maintenance work has not been satisfactorily executed at both La Aurora and Santa Elena. It might be attributable to the shortage in budget and equipment. It should be noted that a lack of proper maintenance work would result in higher costs for repair activities. The case of Santa Elena runway cracks demonstrates this clearly. Since the maintenance work, with respect to the cracks and deteriorated concrete slab joints, has not been properly executed, the water infiltration into the subbase has made it necessary to execute the repair by asphalt overlay or replacement of concrete slab and subbase at high costs. It is recommended that appropriate budgetary arrangements be made to ensure execution of the minimum maintenance work at La Aurora and Santa Elena airports.

8) To their credit, DGAC staff have long been working for the operation of civil aviation in Guatemala. Such continued efforts are quite important to accumulating professional knowledge in DGAC. In this context, too, the short-term plan for La Aurora improvements proposes to set up an Aeronautical Training Center or ATC Training Course by making use of a floor in the proposed control tower, as noted in Chapter 5.4.1. Training of operational personnel for aeronautical traffic services is particularly important for the safe operation of aerodromes, as well as the sustainability of the improvement works. It is recommended that continued efforts be made by DGAC to maintain trained professionals and to make use of every opportunity for the training of its staff.

TABLES

List of Tables

Table 1.1 Experts Participated in The Study

Group	Name	Position
MCTPW	Francisco Godoy Arriaza	Vice-Ministro de Transportes
DGAC	Luis Rolando Girón	Director General
	José Luis Matta	Ex-Sub-Director General
	Natzúl Méndez	Sub-Director General
	Arnoldo Pernillo	Jefe, Dpto. Infrastructuras
	José Arturo Mérida	Jefe, Dpto. Maintenimiento
	Enrique Godoy Arriaza	Jefe, Dpto. Transporte Aéreo
	Leovigildo Bernal Romero	Jefe, Dpto. Telecommunicaciones
	Elio Hernández López	Jefe, Dpto. Electricidad
	Juan Luis Muñoz	Jefe, Dpto. Operaciones
	Carlos Enrique Urizar	Servicios de Tránsito Aéreo
	Carlos Eduardo Estrada	Sección de Estadística
	Victor Hugo Rivas	Eucardado Estadística
	Blanca Lilia Méndez	Asuntos Internacionales
	Manola A. de López	Sección de Planificación
	Héctor López de León	Sección de Tránsito Aéreo
JICA Advisory Committee	Akira Nakamura	Chief of Committee, MOT
	Norio Niino	Member, MOT
	Masatoshi Miyamoto	Member, MOT
	Tsuyoshi Okuma	Member, MOT
	Yuichi Sasaoka	JICA
JICA Study Team	Shoichiro Maeda	Team Leader (Nippon Koei)
	Hisaaki Hata	Civil Engineer (Nippon Koei)
	Naoyoshi Tsuruyama	Civil Engineer (Nippon Koei)
	Howard Gary	Economist (Airways)
	Max Bonnefil	Arq. Planner (Airways)
	Shinya Ohsumi	Architect (Nippon Koei)
	Takehiko Tokue	Electrical Engineer (Nippon Koei)
	Hajime Koizumi	Coordinator (Nippon Koei)

Table 4.1 Existing Condition of Airside Infrastructures, La Aurora

Item	Description	Remarks
Aerodrome/City	LA AURORA/Guatemala	
Coordinates	14.34.52 N, 90.31.40 W	
Elevation	1,509.0 m	
Operation hours	24 hours	Substantially 06:00 - 21:00
Aerodrome operator	DGAC	
Runway Strip	3,107 m x 50 m	Expansion of width to 300 m required.
Runway	(01 - 19) 2,987 m x 60 m	Expansion impractical.
Runway slope (effective)	0.98%	Improvement by Overlay required.
Runway surface	Asphalt Concrete	Overlay required.
Runway strength	PCN 46	Overlay required.
Taxiway	P/T 2,987 m x 23 m	Relocation required for 180 m separation.
	E/T	Improvement required.
Apron	69,000 m^2	Expansion required.
(berth)	6: B-727 type	
Apron surface	Cement Concrete	Partial improvement.
Apron strength	PCN 40	
Cargo apron	8,100 m^2	Expansion or relocation required.
(berth)	2: Small jets	

Table 4.2 Maximum Take-Off Weight at La Aurora

AIRCRAFT	DESTIONATION (DISTANCE)				
	SAN JOSE (463 NM)	MEXICO CITY (571 NM)	MIAMI (886 NM)	ATLANTA (1,292 NM)	LOS ANGELES (1,905 NM)
B737-200	100%	97%	87%	75%	55%
MD87	100	100	100	91	74
A300-B4	100	100	100	100	73
B767-200	92	78	67	65	47
DC-10-40	100	100	100	92	72
B747-SP	100	100	100	100	100

Note = Expressed in % of $\frac{\text{Maximum Take-Off Weight}}{\text{Structural Payload}}$

Table 4.3 DGAC Personnel (1989)

	Technical	Operational	Admin.	Others*	Total
Directorate	3	5	1	2	11
Legal adviser	2	-	3	-	5
General secretary	-	-	3	2	5
Statistics	-	-	7	-	7
Accounting	-	-	9	-	9
Procurement	-	1	4	-	5
Personal affair	1	8	7	1	17
Air Transport	1	-	2	-	3
Air Traffic	38	2	2	2	44
Operations	1	-	-	1	2
Air Navigation	2	3	2	2	9
Radionavigations	33	-	1	3	37
Licensing	-	-	-	2	2
Aviation medic.	1	1	-	-	2
Information service (AIS)	12	-	-	1	13
Engineering	4	-	4	3	11
Maintenance	8	50	6	21	85
CFR	-	13	-	1	14
ASNA installation	-	-	-	15	15
Workshop	-	33	2	9	44
La Aurora terminal	15	125	9	16	165
Santa Elena	20	44	6	12	82
Puerto Barrios	3	13	1	1	18
Poputun	2	4	-	1	7
San Jose	2	2	-	3	7
Other airstrips	3	3	-	5	11
Total	151	307	69	103	630

Note: * Others include short-term employees or vacancies.

Table 5.1 Design Standards and Processing Times

Facility		Standards
- Check-in Hall		
• International	=	1.75 m^2./PAX
• Domestic	=	1.30 m^2/PAX
• Well wishers	=	1.0 m^2/PAX
- Check-in Counters		
• Airline work area	=	Length x 2.3 m
• Passenger front area	=	1.30 m^2/PAX (or 0.80 m width)
• Processing time	=	1.5 to 2.0 min./PAX
• Passenger flow	=	50% of Peak PAX processed in 20 min.
• Max. individual queuing	=	4.5 to 5.0 m (when used)
- Departure Hall		
• Passengers	=	1.30 m^2/PAX
• Well wishers	=	1.0 m^2/visitors
- Emigration (Passport Control Departing)		
• Area	=	1.50 m^2/PAX in line
• Processing time	=	45 sec./1.5 min/PAX
(The existing procedure at La Aurora differentiates between foreigners and locals, whose names are verified in a book.).		
- Security (X-Ray) Processing Time	=	45 sec. to 1.0 min/PAX
- Security Area	=	Flexible according to design
- Departure Lounges		
• With seating	=	1.75 m^2/PAX
• Without seating	=	1.3 m^2/PAX
- Baggage Claim		
• Domestic	=	1.50 m^2/PAX
• International	=	2.0 to 2.5 m^2/PAX
• Average loading rate of belts	=	20 bags/min.
• Length of belt (average)	=	0.80 M/PAX
- Immigration (Arrival) (Arrival Passport control)	=	Same as Emigration

(cont'd)

Facility		Standards
- Customs Inspection		
• Area	=	3.0 m^2/PAX, intern 2.0 m^2/PAX, domestic
• Processing time	=	2.5 min./PAX
- Baggage Per Passenger		
• Domestic	=	2.0/PAX
• International	=	2.5 to 3.0/PAX
- Arrival Curbside Meeting Area		
• Area	=	2.50 to 3.0 m^2/PAX
• Curb length	=	0.1 to 0.2 m/Annual PAX (1,000)
- Visitor/Passenger Ratio		
• Domestic	=	1.75 to 2.0
• International	=	1.50 to 1.75

Note: Unlike some other criteria for which recommended standards were applied, even when they differ from observed occurrences, the visitor to passenger ratio is a local phenomenon which must be taken into consideration. Head counts were taken during the morning "departure surge" at the passenger entrance on the 3rd floor; at the same time, total number of departure passengers was compiled for that same day. It indicated a 2.11 VIS/PAX ratio for both international and domestic departures combined. However, that ratio had to be reduced slightly since some airline employees also used that entrance.

Table 5.2 Comparative Space Analysis for International Passenger Terminal

TERMINAL FUNCTION	EXISTING	1988 REQ'D	1995 REQ'D	2005 REQ'D
INTERNATIONAL				
- Check-in Area (m^2)	1,089	983	1,481	2,882
- Ticketing Agents	24	22	32	64
- Departure Hall (m^2)	564	601	905	1,762
- Emigration Agents	10	10	16	31
- Emigration Area (m^2)	393	338	520	1,014
- Holding (Dep.) Lounges (m^2)	886	1,031	1,466	2,640
- Intern. Transit Lounges	-	-	500	750
- No. of Gates Req'd	7	-	9	14
- Immigration Agents	8	14	20	36
- Immigration Area	244	364	520	936
- Baggage Claim Belts	2	3	4	7
- Total Length of Belt	64	(86) 130	(118) 177	(222) 333
- Baggage Claim Area (m^2)	1,503*	650	924	1,664
- Customs	-*	741	1,053	1,896
- Customs Agents		8	12	21
- Arrival Greeting Area	640	1,050	1,492	2,686
TOTAL FUNCTIONAL AREAS	5,319	5,758	8,361	15,480
ANCILLARY FUNCTIONS				
Airport Administration	1,052	-	1,052	1,452
Airline Offices	1,553	-	1,786	2,054
Apron Service Offices	1,980	-	1,980	2,277
Airline Cargo Offices	797	-	-	-
Cafeteria & Snacks	791	-	910	1,046
Shops and Concessions	1,694	-	1,694	1,945
Vertical/Horizontal Pure Circulation	2,854	-	3,000	5,160
Toilets	144	-	400	600
Functional Circulation & Others	5,885	-	7,500	12,000
Total Ancillary	16,750	-	18,322	26,534
Total International	22,069	-	26,683	42,014

* This function has been combined with customs for the existing conditions since those two spaces blend together and cannot be differentiated.

Table 5.3 Space Requirements for Domestic Traffic at La Aurora

(m^2)

TERMINAL FUNCTION	1988	1995	2005
Check in Hall		250	358
Ticketing Agents			
Departure Hall		166	238
Holding Rooms		142	202
Baggage Claim		121	173
TOTAL FUNCTIONAL SPACES	193	679	971
Circulation & Services		350	700
TOTAL REQUIRED SPACE		1,029	1,671

Table 5.4 Cargo Facility Space Requirements at La Aurora

(m^2)

Space Description	1995	2005
Outbound:		
Heavy Cargo Storage	217	329
Light Cargo Storage	2,340	4,140
Subtotal Outbound Storage (1)	2,557	4,469
Inbound:		
Heavy Cargo Storage	286	514
Light Cargo Storage	1,454	2,618
Subtotal Inbound Storage (2)	1,740	3,132
Total storage Area (1+2)	4,297	7,601
Cargo Revision Area (Inbound)	821	1,479
Cargo conditioning (Outbound)	1,425	2,520
Independent Cargo Agents	250	400
Administrative Area	-	600
Circulation/Services	-	500
Total Area	6,793	13,100

Table 5.5 Repair Equipment to be Supplied

Item	Equipment
1)	Lifting and moving equipment: Hydraulic jacks, adjustable stands, hand trucks, chain blocks
2)	Compressed air equipment: Air compressors, air valves, hose, regulators, air spray guns, engine cleaning guns, air blow guns
3)	Lubrication equipment: Automatic grease pumps, grease hand pumps, extension pipes, hoses, coupling, oil measures, drum pumps, drum openers, drum carriers, pistol oilers
4)	Painting equipment: Paint stirrers, air compressors, spray guns, heaters for baked painting
5)	Metal forging equipment: Metal forge w/cone fire, aspirator and ventilator, swage blocks, anvils, tongues, hammers, vises, files
6)	Welding equipment: Arc welders, welding tool sets
7)	Oxy-acetylene cutting/welding equipment: Acetylene generators, oxygen containers, welding/cutting tools
8)	Washing equipment: High-pressure car washers, parts washers
9)	Engine reconditioning equipment: Nozzle testers, compression gauges for diesel engine, special service tool sets for injection pump, cylinder gauges, lapping compound, vacuum gauges, plug service sets, timing lights, plug wrench sets, valve refacers, hydraulic presses, engine overhand revolving stands, valve seat grinders, piston ring tools, differential overhaul stands
10)	Electric equipment: Electric drills, electric bench drills, electric bench grinders, electric portable grinders, commutator mica cutters and lathes, screw drivers, soldering sets, plier sets, plug gap gauges, plastic hammers, hydrometers, battery filters, tachometers, volt-ampere meters, measures

(Cont'd)

Item	Equipment
11)	Battery chargers
12)	Body-fender repair equipment: Body-fender tool sets, body-fender jack set, tinner shears, hacksaws, torch lamps, C-lamps, vises
13)	Truck overhaul and tire service equipment: Hand hydraulic presses, pressure gauges, tire levers, wheel dolleys, tire bead breakers, valve repair tools, hot patches, clamps,
14)	Machinist tools Calipers, micrometer calipers, chisel and punch sets, divider springs, file sets, goggles, gauges, dial indicators, V-blocks, surface plates etc.

Table 5.6 Number of Daily Flights at La Aurora Applied for WECPNL Noise Level

Year	Aircraft	Time			Total
		07:00-19:00	19:00-22:00	22:00-07:00	
1988	DC10 (LJ)	1.00	0.00	0.00	1.00
	A300 (MJ)	6.00	2.00	2.00	10.00
	B727 (SJ)	37.00	7.00	5.00	49.00
	DHC (TP)	0.00	0.00	0.00	0.00
	TOTAL	44.00	9.00	7.00	60.00
1995	DC10 (LJ)	1.61	0.18	0.21	2.00
	A300 (MJ)	12.86	1.43	1.71	16.00
	B727 (SJ)	83.62	9.26	11.12	104.00
	DHC (TP)	27.33	3.03	3.64	34.00
	TOTAL	125.42	13.90	16.68	156.00
2005	DC10 (LJ)	4.82	0.54	0.64	6.00
	A300 (MJ)	32.16	3.55	4.29	40.00
	B727 (SJ)	115.77	12.82	15.41	144.00
	DHC (TP)	25.73	2.84	3.43	32.00
	TOTAL	178.48	19.75	23.77	222.00

Note: LJ: Large Jet, MJ: Medium Jet, SJ: Small Jet, TP: Turbo-Prop

Table 5.7 Outline of Noise Abatement Operating Procedures

	Production	Outline of system	Effect	Actual Use in Japan	Applicability for La Aurora
Takeoff System	Steepest Climb	In normal take-off, upon reaching a safe altitude, aircraft slow down the climb rate and accelerate the speed. Under the dooming system, however, the aircraft continue zooming until reaching an altitude of 1,000 m to reduce noises.	In the case of B727, the noise level is -1.5 to -3 dB(A) at a point 5 to 3 km away from the starting point of taxiing.	The system is employed by jet planes at almost all airports, except where the cutback climb-system is used.	Applicable. Present take-off climb rate (154 ft/nm, relatively high) is similar to this system.
	Thrust Cutback Climb	Upon reaching a safe altitude after take-off, aircraft fly over residential areas adjacent to the airport at a low noise level by throttling down engine thrust to 3 maximum extent permissible in terms of safety. After passing the residential areas, the aircraft increase engine thrust and return to normal climb.	With B727 and B737, the noise level in the cutback zone is -5 to -10 dB(A).	The system is used by B727, B737 and DC-9 at Fukuoka and Kumamoto Airports.	Not applicable. Climb rate of this procedure is low that aircraft cannot reach a given altitude to fly over existing mountains around the airport with a proper vertical separation.
Landing System	Delayed Approach System	This system involve delaying the lowering of under-carriage and flaps as much as practically possible during approach to runway. When approaching with under-carriage and flaps kept in flight condition, aircraft receive smaller air resistance which decrease necessary thrust and in turn reduce engine noises.	Noise level -2 to -3 dB(A).	This system is adopted by jet aircraft at nearly all airports.	Applicable. However, this procedure concentrate noise in the area under final segment.
	Reduced Flap Setting	Until touchdown, aircraft navigate with as low flap angle as possible so as to lessen air resistance and thus decrease engine thrust with a resulting noise reduction. This system, however, involve higher touchdown speed and thus limit in terms of safety.	Noise level -2 to -3 dB(A)./	All jetliners except DC-8 and A-300 use this landing system at almost all airports.	Not applicable. Present runway length is short at high elevation (5,000 ft).

(Cont'd)

	Production	Outline of system	Effect	Actual Use in Japan	Applicability for La Aurora
Other Systems	Preferential Runway	When no dwelling houses are located near one end of the runway, landing and take-off are executed in that direction whenever possible.	Highly effective in preventing noise pollution.	This system is used at airports of Tokyo International, Kochi, Sendai, Hiroshima and Matsuyama.	Not applicable. There are houses all way around airport, since airport is already surrounded by residents.
	Preferential Route	Aircraft fly a path clear of dwelling houses by circling.	Highly effective in preventive noise pollution.	This system is used at airports of Tokyo International, New Tokyo International, Osaka International, Fukuoka, Nagoya and Sendai.	Applicable. Only in West Quadrant under VFR. Not applicable in IMC.

Table 5.8 Profile of Staffing for GIAA (La Aurora, Short-Term)

Department		Division	Section	Nos. of Staff
Administration	:	Administrator		1
		Sub-Administrator		1
		Auditor		1
		Inspector Director		1
		Councilor		1
		General Secretary		4
Operation & Safety	:	Directorate		6
		Telecom. & Navaids:		2
			Radar	19
			Communication	19
			Navaids	16
			Visual Navaids	16
		CFR:		1
			Operational	27
		Ramp & Marshal:		1
			Ramp	15
			Marshal	12
			Fuel Control	2
		Security:		1
			Terminal	24
			Airport Compound	18
Maintenance	:	Directorate		4
		Civil Engineering:		1
			Pavement	5
			Civil Work	6
			Machinery	4
			Equipment	25
			Water Supply & Waste	4
		Architecture:		1
			Terminal	2
			General	3
		Electric & Mechanic:		1
			Electric	18
			Mechanic	4
		Auto-Mechanic:		1
			Automobile	32
			Mechanic	8

(Cont'd)

Department		Division	Section	Nos. of Staff
Planning & Statistic	:	Directorate		3
		Planning:		1
			Planner	2
			Drawing	3
		Statistics		1
			Statistic	3
			Computer	2
			Economic	2
Accounting	:	Directorate:		3
		Accounting		6
		Finance:		1
			Budget/Revenue	3
			Purchase/Supply	3
			Store & Inventory	2
		Concession:		1
			General Aviation	2
			Terminal Complex	2
			parking & Others	4
General Affairs	:	Directorate		6
		Personnel:		1
			Personnel	8
			Welfare	2
		Public Relations:		1
			Public Relations	2
			Environments	2
		Auxiliary Services:		1
			General Services	76
			Baggages	28
		Airport Services		19
Total				497

Table 6.1 Estimated Financial Cost (La Aurora, Short-Term)

		Foreign Currency (US$ 10^3)	Local Currency (US$ 10^3 equiv.)	Total (US$ 10^3 equiv.)
A)	Civil Works:			
	1. Runway, Taxiway and Apron	536	4,826	5,362
	2. Airfield Drainage System	9	82	91
	3. Access Road and Parking	24	220	244
	(Sub-total)	(569)	(5,128)	(5,697)
B)	Building Works:			
	4. Buildings	540	4,863	5,403
	5. Passenger Service Equip.	6,491	721	7,212
	6. Sewage Disposal	43	100	143
	(Sub-total)	(7,074)	(5,684)	(12,758)
C)	Electrical Works:			
	7. Navaids, Telecommunic.	10,278	318	10,596
	8. Airfield Lighting	5,240	394	5,634
	9. Power Supply	5,654	628	6,282
	10. Meteo Observation	1,071	33	1,104
	11. Special Equip.	2,439	278	2,717
	(Sub-total)	(24,682)	(1,651)	(26,333)
D)	Engineering and Administration	3,225	358	3,583
	(Total: A, B, C, D)	(35,550)	(12,821)	(48,371)
E)	Physical Contingencies	1,423	513	1,936
	(Total: A, B, C, D, E)	(36,973)	(13,334)	(50,307)
F)	Price Contingencies	3,831	5,058	8,889
G)	Interest during Construction	1,372	1,639	3,011
	TOTAL	42,176	20,031	62,207

Table 6.2 Estimated Economic Cost (La Aurora, Short-Term)

(US$ 10^3 equiv.)

Year		Constr. Cost	Unskilled Labor Adjustment	Transfer Payment	O&M	Replmt. Costs	Total Econ. Costs
Year 1	(1991)	1,491	81	6			1,404
Year 2	(1992)	30,231	1,632	337			28,262
Year 3	(1993)	18,588	1,004	187			17,397
Year 4	(1994)				1,500		1,500
Year 5	(1995)				1,500		1,500
Year 6	(1996)				1,500		1,500
Year 7	(1997)				1,500		1,500
Year 8	(1998)				3,000		3,000
Year 9	(1990)				1,500		1,500
Year 10	(2000)				1,500		1,500
Year 11	(2001)				1,500		1,500
Year 12	(2002)				1,500		1,500
Year 13	(2003)				3,000		3,000
Year 14	(2004)				1,500		1,500
Year 15	(2005)				1,500	663	2,163
Year 16	(2006)				1,500	663	2,163
Year 17	(2007)				1,500		1,500
Year 18	(2008)				3,000		3,000
Year 19	(2009)				1,500		1,500
Year 20	(2010)				1,500	2,304	3,804

Table 6.3 Estimate of Rejected Passengers and Benefit due to Terminal Expansion (La Aurora, Short-Term)

Years	Forecast Passenger Traffic (prs.)	Rejected Passengers (prs.)	Cancelled Trips (prs.)	Value of Benefits (US$ 10^3)	Low Forecast Value of Benefits (US$ 10^3)
1988	754,876				
1989	808,000				
1990	865,000				
1991	925,000				
1992	990,000				
1003	1,060,000				
1994	1,134,000				
1995	1,214,000	74,000	37,000	18,500	
1996	1,305,000	165,000	82,500	41,250	
1997	1,403,000	263,000	131,500	65,750	13,250
1998	1,508,000	368,000	184,000	92,000	29,875
1999	1,620,000	480,000	240,000	120,000	46,500
2000	1,742,000	602,000	301,000	150,500	63,125
2001	1,872,000	612,000	306,000	153,000	79,750
2002	2,013,000	612,000	306,000	153,000	96,375
2003	2,164,000	612,000	306,000	153,000	113,000
2004	2,326,000	612,000	306,000	153,000	129,625
2005	2,500,000	612,000	306,000	153,000	146,250
2006	2,679,000	612,000	306,000	153,000	153,000
2007	2,862,000	612,000	306,000	153,000	153,000
2008	3,078,000	612,000	306,000	153,000	153,000
2009	3,300,000	612,000	306,000	153,000	153,000
2010	3,536,000	612,000	306,000	153,000	153,000

Note: Rejected passengers between 1995 and 2000 are all forecast passengers in excess of estimated capacity of existing terminal of 1,140,000. Number of rejected passengers held constant beginning in 2001 since the improved terminal, based on design standards in the short-term plan, will be operating at capacity levels--1,752,000 passengers per year--beginning in 2001. Therefore, rejected passengers level off at 612,000 (1,752,000 less 1,140,000 equals 612,000).

Table 6.4 Costs and Benefits Flow (La Aurora, Short-Term)

Years		Project Costs (See Table 6.2)	Project Benefits "Best Traffic" Forecast (See Table 6.3)	Project Benefits "Low Traffic" Forecast (See Table 6.3)
Year 1	(1991)	1,404		
Year 2	(1992)	28,262		
Year 3	(1993)	17,397		
Year 4	(1994)	1,500		
Year 5	(1995)	1,500	18,500	
Year 6	(1996)	1,500	41,250	
Year 7	(1997)	1,500	65,750	13,250
Year 8	(1998)	3,000	92,000	29,875
Year 9	(1999)	1,500	120,000	46,500
Year 10	(2000)	1,500	150,500	63,125
Year 11	(2001)	1,500	153,000	79,750
Year 12	(2002)	1,500	153,000	96,375
Year 13	(2003)	3,000	153,000	113,000
Year 14	(2004)	1,500	153,000	129,625
Yera 15	(2005)	1,500	153,000	146,250
Year 16	(2006)	2,163	153,000	153,000
Year 17	(2007)	2,163	153,000	153,000
Year 18	(2008)	3,000	153,000	153,000
Year 19	(2009)	1,500	153,000	153,000
Year 20	(2010)	3,804	153,000	153,000
EIRR	(20 year analysis period)		(56%)	(37%)
EIRR	(10 year analysis period)		(50%)	(17%)

Table 6.5 Costs and Benefits (Sensitivity Analysis)
(Benefits estimated at 20% lower)

Years		Project Costs (Ref. Table 6.2)	Project Benefits
Year 1	(1991)	1,404	
Year 2	(1992)	28,262	
Year 3	(1993)	17,397	
Year 4	(1994)	1,500	
Year 5	(1995)	1,500	14,800
Year 6	(1996)	1,500	33,000
Year 7	(1997)	1,500	52,600
Year 8	(1998)	3,000	73,600
Year 9	(1999)	1,500	96,000
Year 10	(2000)	1,500	120,400
Year 11	(2001)	1,500	120,400
Year 12	(2002)	1,500	120,400
Year 13	(2003)	3,000	120,400
Year 14	(2004)	1,500	120,400
Yera 15	(2005)	1,500	120,400
Year 16	(2006)	2,163	120,400
Year 17	(2007)	2,163	120,400
Year 18	(2008)	3,000	120,400
Year 19	(2009)	1,500	120,400
Year 20	(2010)	3,804	120,400

EIRR	(20 year analysis period)	50%
EIRR	(10 year analysis period)	43%

Table 6.6 Repayment Obligations (La Aurora, Short-Term)

Year		Interest & Amortization External Loan /1	Interest & Amortization Local Loan /2	Total Payment
Year 1	(1991)	47,328	1,370,000	1,417,328
Year 2	(1992)	1,086,485	"	2,456,485
Year 3	(1993)	1,533,230	"	2,903,230
Year 4	(1994)	"	"	"
Year 5	(1995)	"	"	"
Year 6	(1996)	"	"	"
Year 7	(1997)	"	"	"
Year 8	(1998)	"	"	"
Year 9	(1999)	"	"	"
Year 10	(2000)	"	"	"
Year 11	(2001)	3,500,000		3,500,000
Year 12	(2002)	"		"
Year 13	(2003)	"		"
Year 14	(2004)	"		"
Year 15	(2005)	"		"
Year 16	(2006)	"		"
Year 17	(2007)	"		"
Year 18	(2008)	"		"
Year 19	(2009)	"		"
Year 20	(2010)	"		"
Year 21	(2011)	"		"
Year 22	(2012)	"		"
Year 23	(2013)	"		"
Year 24	(2014)	"		"
Year 25	(2015)	"		"
Year 26	(2016)	"		"
Year 27	(2017)	"		"
Year 28	(2018)	"		"
Year 29	(2019)	"		"
Year 30	(2020)	3,500,000		3,500,000

Note: /1 External Borrowing of US$52,870,000; Interest Rate at 2.9%; Grace Period of 10 years

/2 Local Borrowing of US$9,330,000 equiv.; Interest Rate of 8%; 10 year repayment period

Table 6.7 Airport Tariff in Central America

(US$)

	Landing Fee (78,000 kg Aircraft)	International & Departure Tax
Guatemala	57.78	7.19
El Salvador	57.78	10.00
Honduras	175.00	10.00
Nicaragua	181.50	10.00
Costa Rica	49.57	10.00
Panama	179.40	15.00

Table 6.8 Estimated Landing Fee Revenues (La Aurora, Short-Term)

Year	Tariff (Q/kg)	Commercial Landings	Other Landings	Total Landings	Total Landing Fee (Q)
1988	0.002	7,100	12,700	19,800	2,123,600
1991	0.002	11,204	10,500	21,704	2,587,746
1992	0.002	11,778	"	22,278	2,677,290
1993	0.002	12,352	"	22,852	2,766,834
1994	0.006	12,926	"	23,426	8,569,134
1995	0.006	13,500	"	24,000	8,838,000
1996	0.006	15,600	"	26,100	9,820,800
1997	0.006	16,650	"	27,150	10,312,200
1998	0.006	17,700	"	28,200	10,803,600
1999	0.006	"	"	"	"
2000	0.006	"	"	"	"
2001	0.006	"	"	"	"
2002	0.006	"	"	"	"
2003	0.006	"	"	"	"
2004	0.006	"	"	"	"
2005	0.006	"	"	"	"
2006	0.006	"	"	"	"
2007	0.006	"	"	"	"
2008	0.006	"	"	"	"
2009	0.006	"	"	"	"
2010	0.006	"	"	"	"
2011	0.006	"	"	"	"
2012	0.006	"	"	"	"
2013	0.006	"	"	"	"
2014	0.006	"	"	"	"
2015	0.006	"	"	"	"
2016	0.006	"	"	"	"
2017	0.006	"	"	"	"
2018	0.006	"	"	"	"
2019	0.006	"	"	"	"
2020	0.006	17,700	10,500	28,200	10,803,600

Table 6.9 International Departure Tax Revenue (La Aurora, Short-Term)

Year	Tariff (Q/Dep.)	Departing International Passenger	Total Inter'l Dept. Revenue (Q)
1988	20	350,000	7,000,000
1991	"	475,822	9,516,430
1992	"	508,617	10,172,330
1993	"	541,411	10,828,220
1994	40	574,205	22,968,200
1995	"	607,000	24,280,000
1996	"	735,600	29,424,000
1997	"	799,900	31,996,000
1998	"	864,200	34,568,000
1999	"	876,000	35,040,000
2000	"	"	"
2001	"	"	"
2002	"	"	"
2003	"	"	"
2004	"	"	"
2005	"	"	"
2006	"	"	"
2007	"	"	"
2008	"	"	"
2009	"	"	"
2010	"	"	"
2011	"	"	"
2012	"	"	"
2013	"	"	"
2014	"	"	"
2015	"	"	"
2016	"	"	"
2017	"	"	"
2018	"	"	"
2019	"	"	"
2020	40	876,000	35,040,000

Table 6.10 Petroleum Revenues (La Aurora, Short-Term)

Year	Tariff (Q/gal.)	Volume of Gas Sold	Total Pet. Revenue
1988	0.35	1,256,308	439,708
1991	"	1,560,613	546,215
1992	"	1,640,569	574,199
1993	"	1,720,525	602,184
1994	"	1,800,481	630,168
1995	"	1,880,507	685,177
1996	"	2,173,030	760,561
1997	"	2,319,292	811,752
1998	"	2,465,554	862,944
1999	"	"	"
2000	"	"	"
2001	"	"	"
2002	"	"	"
2003	"	"	"
2004	"	"	"
2005	"	"	"
2006	"	"	"
2007	"	"	"
2008	"	"	"
2009	"	"	"
2010	"	"	"
2011	"	"	"
2012	"	"	"
2013	"	"	"
2014	"	"	"
2015	"	"	"
2016	"	"	"
2017	"	"	"
2018	"	"	"
2019	"	"	"
2020	0.35	2,465,554	862,944

Table 6.11 Financial Statement (La Aurora, Short-Term)

(Q 1,000; US$1,000)

Item / Year	Landing Fee Revenue (Q)	Departure Tax (Q)	Space Rental (Q)	Petroleum revenues (Q)	Other Revenues (Q)	Total Revenues (Q)	Total Revenues (US$)	O&M Cost (US$)	Net Revenue (US$)	Repayment (US$)	Surplus (US$)
1991	2,587.7	9,516.4	31.6	546.2	1,268.2	11,362.4	4,087.2	550.0	3,537.2	1,417.3	2,119.9
1992	2,677.3	10,172.3	31.6	574.2	1,345.5	14,800.9	4,114.7	700.0	3,414.7	2,456.5	958.2
1993	2,766.8	10,828.2	31.6	602.2	1,422.9	15,651.7	5,630.1	900.0	4,730.1	2,903.2	1,826.9
1994	8,569.1	22,968.2	63.2	630.2	3,286.1	35,516.8	12,775.8	1,500.0	11,275.8	2,903.2	8,372.6
1995	8,838.0	24,280.0	63.2	685.2	3,449.8	37,316.2	13,423.1	1,500.0	11,923.1	2,903.2	9,019.9
1996	9,820.8	29,424.0	63.2	760.6	4,082.9	44,151.5	15,881.8	1,500.0	14,381.8	2,903.2	11,478.6
1997	10,312.2	31,996.0	63.2	811.8	4,399.5	47,582.7	17,116.1	1,500.0	15,616.1	2,903.2	12,712.9
1998	10,803.6	34,568.0	63.2	862.9	4,716.1	51,013.8	18,350.3	3,000.0	15,350.3	2,903.2	12,447.1
1999	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	1,500.0	17,037.1	2,903.2	14,133.9
2000	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	1,500.0	17,037.1	2,903.2	14,133.9
2001	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	1,500.0	17,037.1	3,500.0	13,537.1
2002	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	1,500.0	17,037.1	3,500.0	13,537.1
2003	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	3,000.0	15,537.1	3,500.0	12,037.1
2004	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	1,500.0	17,037.1	3,500.0	13,537.1
2005	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	1,500.0	17,037.1	3,500.0	13,537.1
2006	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	2,613.0	16,374.1	3,500.0	12,874.1
2007	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	2,613.0	16,374.1	3,500.0	12,874.1
2008	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	3,000.0	15,537.1	3,500.0	12,037.1
2009	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	1,500.0	17,037.1	3,500.0	13,537.1
2010	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	3,804.0	14,733.1	3,500.0	11,233.1
2011	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	3,804.0	14,733.1	3,500.0	11,233.1
2012	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	1,500.0	17,037.1	3,500.0	13,537.1
2013	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	3,000.0	15,537.1	3,500.0	12,037.1
2014	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	12,360.0	6,177.1	3,500.0	2,677.1
2015	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	12,360.0	6,177.1	3,500.0	2,677.1
2016	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	1,500.0	17,037.1	3,500.0	13,537.1
2017	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	1,500.0	17,037.1	3,500.0	13,537.1
2018	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	3,000.0	15,537.1	3,500.0	12,037.1
2019	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	1,500.0	17,037.1	3,500.0	13,537.1
2020	10,803.6	35,040.0	63.2	862.9	4,763.3	51,533.0	18,537.1	1,500.0	17,037.1	3,500.0	13,537.1

Table 6.12 Financial Outflows and Inflows (La Aurora, Short-Term)

(US$ 10^3)

Years		Financial Outflows	Incremental Financial Inflows (1)
Year 1	(1991)	1,632	
Year 2	(1992)	35,833	
Year 3	(1993)	24,742	
Year 4	(1994)	1,500	9,800
Year 5	(1995)	1,500	10,400
Year 6	(1996)	1,500	12,900
Year 7	(1997)	1,500	14,100
Year 8	(1998)	3,000	15,300
Year 9	(1999)	1,500	15,400 (2)
Year 10	(2000)	1,500	"
Year 11	(2001)	1,500	"
Year 12	(2002)	1,500	"
Year 13	(2003)	3,000	"
Year 14	(2004)	1,500	"
Year 15	(2005)	1,500	"
Year 16	(2006)	2,163	"
Year 17	(2007)	2,163	"
Year 18	(2008)	3,000	"
Year 19	(2009)	1,500	"
Year 20	(2010)	3,804	15,400

(1) Based on the data in the normalized financial table, it has been estimated that net revenue potential of the unimproved airport is $3 million a year. While it can generate total revenues of over $5 million, it is apparent that O&M outlays of about $2 - 3 million a year will be needed to keep the existing airport operating for 20 years. Therefore, $3 million has been subtracted from the total revenue indicated for the improved airport in the prior table.

(2) Net financial Inflows level off beginning in 1999 as capacity of short-term improvements to La Aurora is reached.

Table 6.13 Financial Outflows and Inflows at Reduced Revenue
(La Aurora, Short-Term)

(US$ 10^3)

Years		Financial Outflows	Incremental Financial Inflows (1)
Year 1	(1991)	1,632	
Year 2	(1992)	35,833	
Year 3	(1993)	24,742	
Year 4	(1994)	1,500	7,840
Year 5	(1995)	1,500	8,320
Year 6	(1996)	1,500	10,320
Year 7	(1997)	1,500	11,280
Year 8	(1998)	3,000	12,240
Year 9	(1999)	1,500	12,320
Year 10	(2000)	1,500	"
Year 11	(2001)	1,500	"
Year 12	(2002)	1,500	"
Year 13	(2003)	3,000	"
Year 14	(2004)	1,500	"
Year 15	(2005)	1,500	"
Year 16	(2006)	2,163	"
Year 17	(2007)	2,163	"
Year 18	(2008)	3,000	"
Year 19	(2009)	1,500	"
Year 20	(2010)	3,804	12,320

(1) Based on 20% reduction in incremental financial inflows

Table 7.1 Service Space Requirements for CFR Building (La Aurora)

Room	Occupants	Required Floor Area (m^2)	
1) Vehicle storage space	RIV x 1 MV x 2 Extra x 1	4^m x 14^m(for one vehicle) x 4 ea =	224
2) Vehicle-related service room			
- Extinguishing agent storage	Dry chemical 450 kg		20
- Tool and parts storage			50
- Battery room			20
3) Office			
- Station chief room	1		12
- Asst. station chief room	1		12
- Observation room	1		16
- Toilet & shower			6
4) Fireman's room			
- Break room	13	13^P x 4^{m2} =	52
- Dining and kitchen	14	14^P x 4^{m2} =	56
- Toilet & shower		16^{m2} (toilet) + 12^{m2} (shower) =	28
- Locker room			20
5) Others			
- General storage			6
- Machine room			6
Sub-total			528 m^2
6) Circulation		15% of above	79 m^2
Total			607 m^2

Table 7.2 Service Space Requirement for Maintenance Shop (La Aurora)

	Room	Floor Area (m^2)
1)	Maintenance bay	60 m^2 x 4 (no. of bays) = 240
2)	Machine tool room	24
3)	Hydraulic press room	36
4)	Hydraulic equipment room	60
5)	Transmission overhaul room	60
6)	Tool room	50
7)	Fuel inspection tester room	10
8)	Engine overhaul room	60
9)	Electric parts repair room	30
10)	Storage	90
11)	Welding bay	60
12)	Office	20
13)	Section chief room	16
14)	Battery room	24
15)	Toilet and shower	24
16)	Circulation 10% of above	80
	Total	884 m^2

Table 7.3 Estimated Financial Cost (La Aurora - Long Term)

	Foreign Currency (US$ 10^3)	Local Currency (US$$10^3$ equiv.)	Total (US$ 10^3 equiv.)
A) Civil Works:			
1. Runway, Taxiway and Apron	1,641	14,766	16,407
2. Airfield Drainage System	19	168	187
3. Access Road and Parking	461	4,148	4,609
(Sub-total)	(2,121)	(19,082)	(21,203)
B) Building Works:			
4. Buildings	698	6,279	6,977
5. Passenger Service Equipment	4,179	464	4,643
6. Sewage Disposal	21	50	71
(Sub-total)	(4,898)	(6,793)	(11,691)
C) Electrical Works:			
7. NAVAIDS and Telecomm. System	9,569	296	9,865
8. Airfield Lighting	1,748	132	1,880
9. Power Supply	129	14	143
10. Meteo. Observation	403	12	415
11. Special Equipment	117	4	121
(Sub-total)	(11,966)	(458)	(12,424)
D) Engineering and Administration	3,262	363	3,625
(Total: A, B, C, D)	(22,247)	(26,696)	(48,943)
E) Land Acquisition	-	9,000	9,000
F) Physical Contingencies	890	1,428	2,318
Total	23,137	37,124	60,261

Table 7.4 Rejected Passengers and Estimated Benefit (La Aurora - Long Term)

(US$ 10^3)

Year	Forecast Passenger Traffic	Rejected Passengers (1)	Estimated Benefits (3)
1988	754,876		
1989	808,000		
1990	865,000		
1991	925,000		
1992	990,000		
1993	1,060,000		
1994	1,134,000		
1995	1,214,000		
1996	1,305,000		
1997	1,403,000		
1998	1,508,000		
1999	1,620,000		
2000	1,742,000		
2001	1,872,000	120,000	30,000
2002	2,013,000	261,000	65,250
2003	2,164,000	412,000	103,000
2004	2,326,000	574,000	143,500
2005	2,500,000	740,000	185,000
2006	2,679,000	927,000	231,750
2007	2,872,000	1,120,000	280,000
2008	3,078,000	1,326,000	331,500
2009	3,300,000	1,540,000	385,000
2010	3,536,000	1,784,000 (2)	446,000
2011	3,790,000	1,784,000	446,000
2012	4,062,000	1,784,000	446,000
2013	4,354,000	1,784,000	446,000
2014	4,666,000	1,784,000	446,000
2015	5,000,000	1,784,000	446,000

Note:
(1) Capacity of terminal after short term improvement is 1,752,000 per year. Rejection starts when that passenger level is reached.

(2) Long-term terminal improvement will meet passenger demand through 2009, thereafter rejection takes place.

(3) Benefit calculations based on assumed $500 airfare.

Table 10.1 CFR Service Space Requirements for Santa Elena

	Room	Occupants	Required Floor Area (m^2)	
1)	Vehicle storage	R1V x 1 MV x 1 Extra x 1	4^m x 12^m (for one vehicle) x 3^{ea} =	144
2)	Vehicle-related service room			
	- Extinguishing agent storage	Dry chemical 180 kg		10
	- Tool and parts storage			30
	- Battery room			20
3)	Office			
	- Station chief room	1		12
	- Observation room	1		10
	- Toilet			6
4)	Fireman's room			
	- Break room	8	8^p x 4^{m2}	32
	- Dining & kitchen	9	9^p x 4^{m2}	36
	- Toilet & shower			20
	- Locker room			10
5)	Others			
	- General storage			6
	- Others			6
6)	Circulation		Sub-total	342
			15% of above	50
	Total			392 m^2

Table 10.2 Number of Staff for Santa Elena Airport Administration

Discipline	1988 (present)	Estimated Number of Staff	
		1995	2005
Administrator	1	1	1
Sub-Administrator	0	0	1
Secretary	2	2	3
General Affairs	0	1	1
Personnel Affairs	1	2	2
Dispensary	1	2	2
Accounting	2	3	4
Store	1	2	3
Security	1	1	1
Guardmen	6 x 2	7 x 2	9 x 2
Maintenance	1	1	1
Cleaning	38	1 + 8 x 5	1 + 9 x 5
Plumbing	1	2	3
Carpentry	1	2	3
Workshop	1	2	3
Electricity	3	4	6
Operations	1	1	1
Teletypewriter	0	1	2
Ramp	1	2	3
Flight Plan	0	1	1
Telecommunications	1	1	1
Aeronautical Mobile Services	0	2	2
Navigational Aids	0	2	2
Air Traffic Services	1	1	1
Approach Control	0	3	3
Aerodrome control	6	9	12
Crash, Fire and Rescue	0	1+ 8	1 + 8
Total	76	112	135

Table 11.1 Estimated Financial Cost (Santa Elena, Short Term)

	Foreign Currency (US$ 10^3)	Local Currency (US$$10^3$ equiv.)	Total (US$ 10^3 equiv.)
A) Civil Works:			
1. Runway, Taxiway and Apron	64	574	638
(Sub-total)	(64)	(574)	(638)
B) Building Works:			
2. Buildings	39	349	388
(Sub-total)	(39)	(349)	(388)
C) Electrical Works:			
3. NAVAIDS and Telecomm System	188	6	194
4. Airfield Lighting	133	10	143
5. Power Supply	911	101	1,012
6. Special Equipment	804	25	829
(Sub-total)	(2,036)	(142)	(2,178)
D) Engineering and Administration	230	26	256
(Total: A, B, C, D)	(2,369)	(1,091)	(3,460)
E) Physical Contingencies	95	43	138
(Total: A, B, C, D, E)	(2,464)	(1,134)	(3,598)
F) Price Contingencies	301	523	824
G) Interest during Construction	48	68	116
Total	2,813	1,665	4,538

Table 11.2 Normalized Financial Statement, Santa Elena (1988)

(Q)

Item	Amount
Revenue	
Commercial Landings, International	171
Commercial Landings, Domestic	20,664
Landings, Others	105,760
International Departure Tax	6,360
Terminal Space Rental	8,194
Car Rental and Car Parking	1,896
Total Revenues	143,045
Operating and Maintenance Costs	224,441
(Deficit)	(81,395)

Table 11.3 Repayment Obligations (Santa Elena, Short-Term)

(US$ 10^3)

Year		Interest & Amortization /1	Interest & Amortization /2	Total Payment
1	(1991)	3	99	102
2	(1992)	6	99	105
3	(1993)	111	99	210
4	(1994)	"	"	"
5	(1995)	"	"	"
6	(1996)	"	"	"
7	(1997)	"	"	"
8	(1998)	"	"	"
9	(1999)	"	"	"
10	(2000)	"	"	"
11	(2001)	253		253
12	(2002)	"		"
13	(2003)	"		"
14	(2004)	"		"
15	(2005)	"		"
16	(2006)	"		"
17	(2007)	"		"
18	(2008)	"		"
19	(2009)	"		"
20	(2010)	"		"
21	(2011)	"		"
22	(2012)	"		"
23	(2013)	"		"
24	(2014)	"		"
25	(2015)	"		"
26	(2016)	"		"
27	(2017)	"		"
28	(2018)	"		"
29	(2019)	"		"
30	(2020)	253		253

Note: /1 External loan amount: $3,825,000, interest rate at 2.9%.
/2 Local loan amount: $675,000 equiv., interest rate at 8%.

Table 11.4 Financial Statement (Santa Elena, Short-Term)

(Q 1,000; US$ 1,000)

Item / Year	Commercial Landings, International (Q)	Commercial Landings, Domestic (Q)	Landings, Others (Q)	Departure Tax (Q)	Space Rental (Q)	Parking (Q)	Total Revenues (Q)	O&M Cost (Q)	Surplus/ Deficit (Q)	Surplus/ Deficit (US$)	Repayment (US$)	Surplus/ Deficit (US$)	Consolidated with La Aurora (US$)
1991	0.2	23.2	105.8	7.5	8.2	2.1	147.0	224.4	-77.4	-27.8	102.0	-129.8	175.9
1992	0.2	24.2	105.8	7.4	8.2	2.3	148.0	224.4	-76.5	-27.5	105.0	-132.5	1,849.1
1993	0.2	25.1	105.8	7.7	8.2	2.3	149.3	224.4	-75.1	-27.0	210.0	-237.0	1,589.9
1994	0.6	75.4	317.3	15.5	12.3	2.4	423.5	500.0	-76.5	-27.5	210.0	-237.5	8,135.1
1995	0.7	78.4	317.3	16.1	12.3	2.5	427.3	500.0	-72.7	-26.2	210.0	-236.2	8,792.7
1996	0.7	81.6	317.3	16.7	12.3	2.6	431.2	500.0	-68.8	-24.8	210.0	-234.8	11,243.8
1997	0.7	84.8	317.3	17.4	12.3	2.7	435.2	500.0	-64.8	-23.3	210.0	-233.3	12,379.5
1998	0.7	88.2	317.3	18.1	12.3	2.8	439.5	500.0	-60.5	-21.8	210.0	-231.8	12,132.2
1999	0.8	91.8	317.3	18.8	12.3	2.9	443.8	500.0	-56.2	-20.2	210.0	-230.2	13,810.5
2000	0.8	95.4	317.3	19.6	12.3	3.0	448.4	500.0	-51.6	-18.6	210.0	-228.6	13,812.2
2001	0.8	99.3	317.3	20.4	12.3	3.2	453.2	500.0	-46.8	-16.8	253.0	-269.8	13,174.1
2002	0.9	103.2	317.3	21.2	12.3	3.3	458.1	500.0	-41.9	-15.1	253.0	-268.1	13,175.9
2003	0.9	107.4	317.3	22.0	12.3	3.4	463.3	500.0	-36.7	-13.2	253.0	-266.2	11,677.7
2004	0.9	111.6	317.3	22.9	12.3	3.6	468.6	500.0	-31.4	-11.3	253.0	-264.3	13,179.7
2005	1.0	116.1	317.3	23.8	12.3	3.7	474.2	500.0	-25.8	-9.3	253.0	-262.3	13,181.7
2006	1.0	120.8	317.3	24.8	12.3	3.8	479.9	500.0	-20.1	-7.2	253.0	-260.2	12,520.7
2007	1.0	125.6	317.3	25.8	12.3	4.0	486.0	500.0	-14.0	-5.0	253.0	-258.0	12,522.9
2008	1.1	130.6	317.3	26.8	12.3	4.2	492.2	500.0	-7.8	-2.8	253.0	-255.8	11,688.1
2009	1.1	135.8	317.3	27.9	12.3	4.3	498.7	500.0	-1.3	-0.5	253.0	-253.5	13,190.5
2010	1.2	141.3	317.3	29.0	12.3	4.5	505.5	500.0	5.5	2.0	253.0	-251.0	10,888.9
2011	1.2	146.9	317.3	30.1	12.3	4.7	512.5	500.0	12.5	4.5	253.0	-248.5	10,891.5
2012	1.3	152.8	317.3	31.4	12.3	4.9	519.8	500.0	19.8	7.1	253.0	-245.9	13,198.1
2013	1.3	158.9	317.3	32.6	12.3	5.1	527.5	500.0	27.5	9.9	253.0	-243.1	11,700.8
2014	1.4	165.3	317.3	33.9	12.3	5.3	535.4	500.0	35.4	12.7	253.0	-240.3	2,343.7
2015	1.4	171.9	317.3	35.3	12.3	5.5	543.6	500.0	43.6	15.7	253.0	-237.3	2,346.6
2016	1.5	178.7	317.3	36.7	12.3	5.7	552.2	500.0	52.2	18.8	253.0	-234.2	13,209.7
2017	1.5	185.9	317.3	38.1	12.3	5.9	561.1	500.0	61.1	22.0	253.0	-231.0	13,212.9
2018	1.6	193.3	317.3	40.0	12.3	6.1	570.3	500.0	70.3	25.3	253.0	-227.7	11,716.2
2019	1.7	201.1	317.3	41.3	12.3	6.4	580.0	500.0	80.0	28.8	253.0	-224.2	13,219.7
2020	1.7	209.1	317.3	42.9	12.3	6.7	590.0	500.0	90.0	32.4	253.0	-220.6	13,223.2

Table 11.5 Consolidated Statement of La Aurora and Santa Elena
(Short-Term Improvement)

(US$)

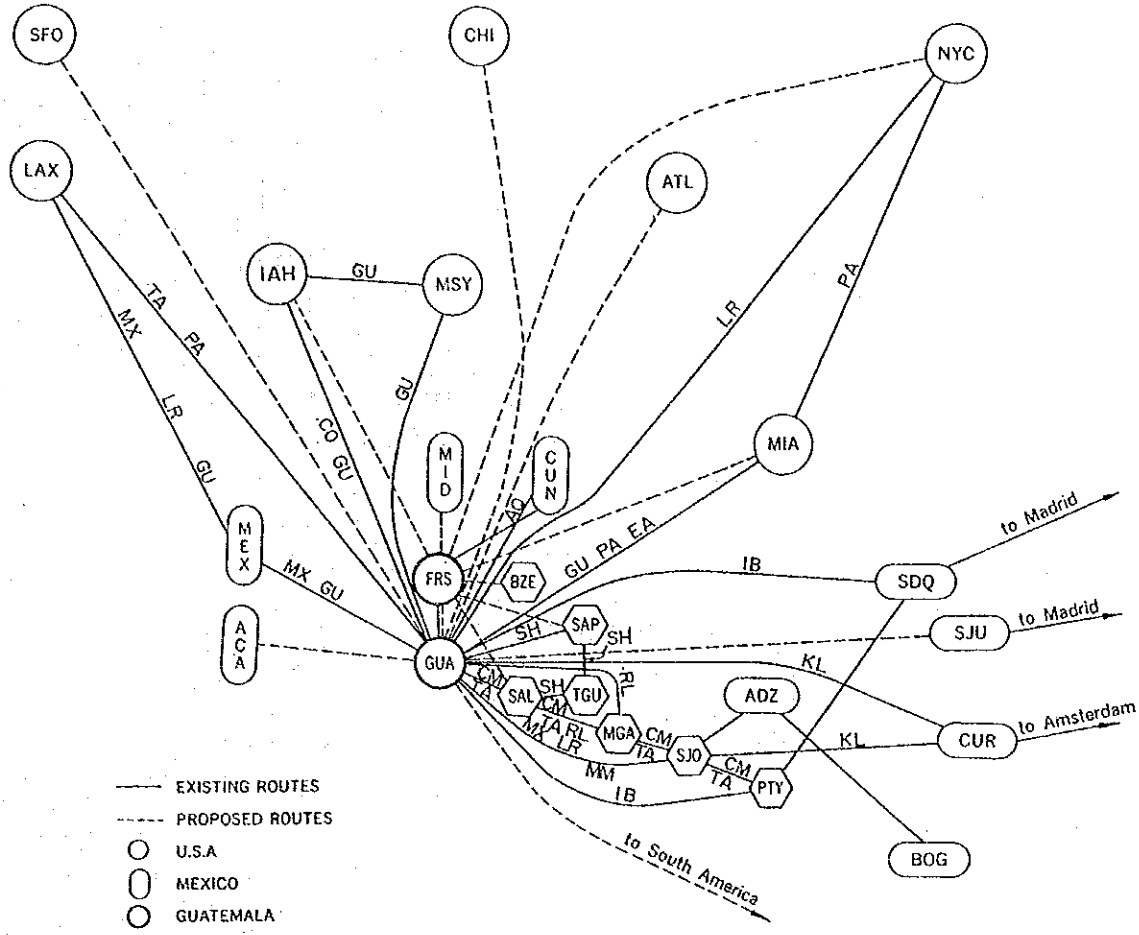
Year		La Aurora Surplus	Santa Elena (Deficit)	Consolidated Surplus
1	(1991)	305,732	(129,848)	175,884
2	(1992)	1,981,637	(132,501)	1,849,136
3	(1993)	1,826,829	(237,012)	1,589,817
4	(1994)	8,372,606	(237,519)	8,135,087
5	(1995)	9,028,852	(236,168)	8,792,684
6	(1996)	11,478,607	(234,762)	11,243,845
7	(1997)	12,612,841	(233,301)	12,379,540
8	(1998)	12,363,952	(231,780)	12,132,172
9	(1999)	14,040,714	(230,199)	13,810,515
10	(2000)	14,040,714	(288,555)	13,752,159
11	(2001)	13,443,944	(269,845)	13,174,099
12	(2002)	13,443,944	(268,067)	13,175,877
13	(2003)	11,943,944	(266,217)	11,677,727
14	(2004)	13,443,944	(264,294)	13,179,650
15	(2005)	13,443,944	(262,293)	13,181,651
16	(2006)	12,780,944	(260,213)	12,520,731
17	(2007)	12,780,944	(258,049)	12,522,895
18	(2008)	11,943,944	(255,799)	11,688,145
19	(2009)	13,443,944	(253,458)	13,190,486
20	(2010)	11,139,944	(251,025)	10,888,919
21	(2011)	11,139,944	(248,494)	10,891,450
22	(2012)	13,443,944	(245,861)	13,198,083
23	(2013)	11,943,944	(243,124)	11,700,820
24	(2014)	2,583,944	(240,276)	2,343,668
25	(2015)	2,583,944	(237,314)	2,346,630
26	(2016)	13,443,944	(234,235)	13,209,709
27	(2017)	13,443,944	(231,032)	13,212,912
28	(2018)	11,943,944	(227,702)	11,716,242
29	(2019)	13,443,944	(224,237)	13,219,707
30	(2020)	13,443,944	(220,635)	13,223,309

Table 12.1 Estimated Financial Cost (Santa Elena, Long Term)

	Foreign Currency (US$ 10^3)	Local Currency (US$$10^3$ equiv.)	Total (US$ 10^3 equiv.)
A) Civil Works:			
1. Runway, Taxiway and Apron	553	4,976	5,529
2. Airfield Drainage System	30	267	297
(Sub-total)	(583)	(5,243)	(5,826)
B) Building Works:			
3. Buildings	48	431	479
4. Passenger Service Equipment	905	102	1,006
(Sub-total)	(953)	(532)	(1,485)
C) Electrical Works:			
5. NAVAIDS and Telecomm System	3,748	116	3,864
6. Airfield Lighting	3,632	273	3,905
7. Power Supply	1,061	118	1,179
8. Meteo Observation	394	12	406
9. Special Equipment	84	3	87
(Sub-total)	(8,919)	(522)	(9,441)
D) Engineering and Administration	1,206	134	1,340
(Total: A, B, C, D)	(11,661)	(6,431)	(18,092)
E) Physical Contingencies	464	257	723
Total	12,127	6,688	18,815

FIGURES

List of Figures

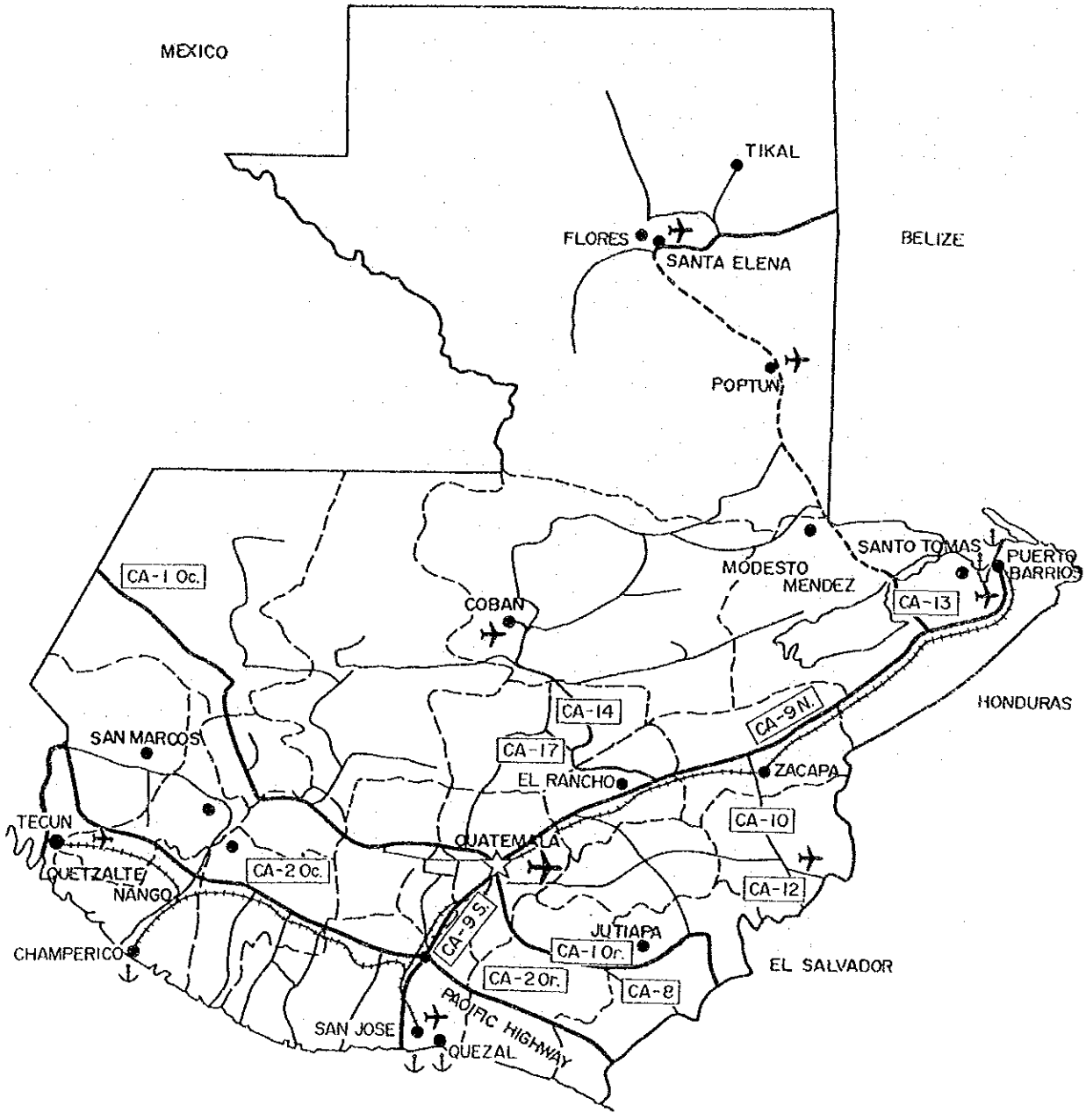


AIRLINE CODE	NAME OF AIRLINE	COUNTRY
AQ	Aeroquetzal	GUATEMALA
CM	COPA (Compania Panamena de Aviacion, S.A.)	PANAMA
CO	Continental Airlines (Air Micronesia)	U.S.A.
EA	Eastern Airlines	U.S.A.
GU	AVIATECA (Empresa Guatemalteca de Aviacion Aviateca)	GUATEMALA
IB	Iberia (Lineas Aereas de Espana, S.A.)	SPAIN
KL	KLM (Royal Dutch Airlines)	NETHERLANDS
LR	LACSA (Lineas Aereas Constarricenses, S.A.)	COSTA RICA
MM	SAM (Sociedad Aeronautica de Medellin)	COLOMBIA
MX	Mexicana (Compania Mexicana de Aviacion, S.A.)	MEXICO
PA	Pan American World Airways	U.S.A.
RL	AERONICA (Aerolineas Nicaraguenses, S.A.)	NICARAGUA
SH	SAHSA (Servicio Aero de Honduras, S.A.)	HONDURAS
TA	Taca International Airlines	EL SALVADOR

AERODROME CODE	NAME OF AIRPORT	COUNTRY
ACA	Acapulco	Mexico
ADZ	San Andres Island	Colombia
ATL	Atlanta	U.S.A.
BOG	Bogota	Colombia
BZE	Belize	Belize
CHI	Chicago	U.S.A.
CUN	Cancun	Mexico
CUR	Curacao	Netherlands, Antilles
FRS	Flores(Santa Elena)	Guatemala
IAH	Houston	U.S.A.
LAX	Los Angeles	U.S.A.
MEX	Mexico City	Mexico
MGA	Managua	Nicaragua
MIA	Miami	U.S.A.
MID	Merida	Mexico
MSY	New Orleans	U.S.A.
NYC	New York	U.S.A.
PTY	Panama City	Panama
SAL	San Salvador	El Salvador
SAP	San Pedro Sula	Honduras
SDQ	Santo Domingo	Dominican Rep.
SFO	San Francisco	U.S.A.
SJO	San Jose	Costa Rica
SJU	San Juan	U.S.A.
TGU	Tegucigalpa	Honduras

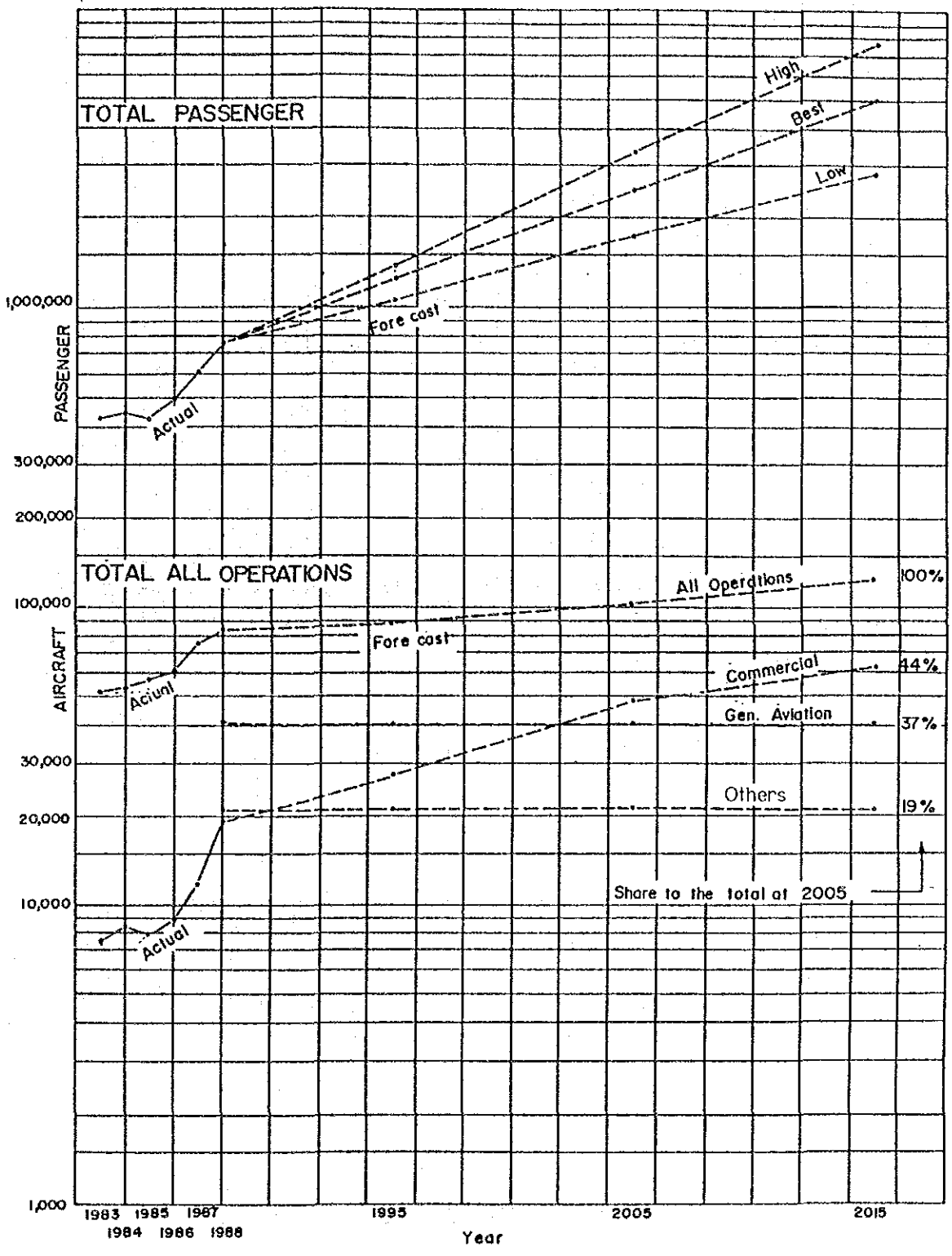
INTERNATIONAL AIR ROUTES, GUATEMALA

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS | Figure 2 — 1



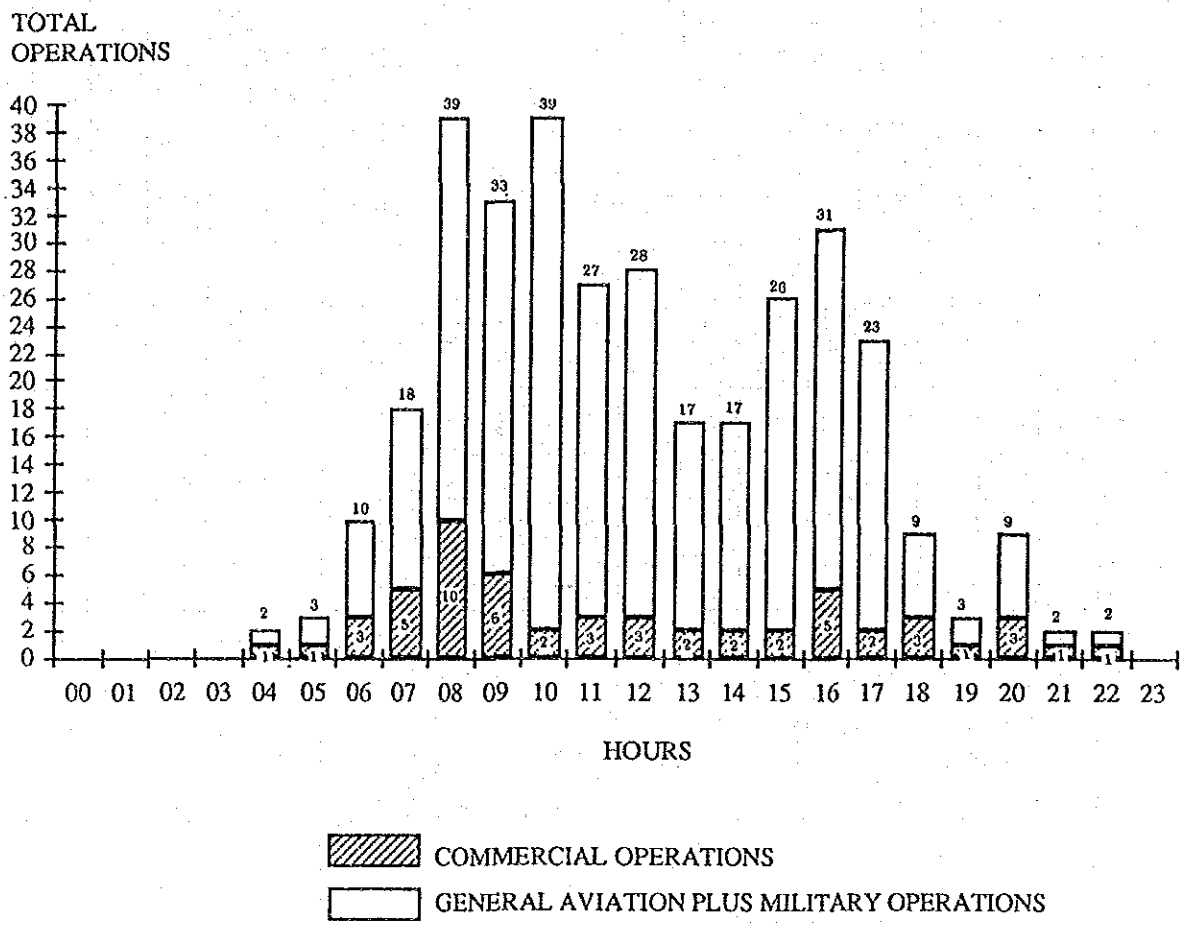
MAJOR TRANSPORTATION NETWORK IN GUATEMALA

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 2 — 2



AIR TRAFFIC DEMAND FORECASTS

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 3 — 1

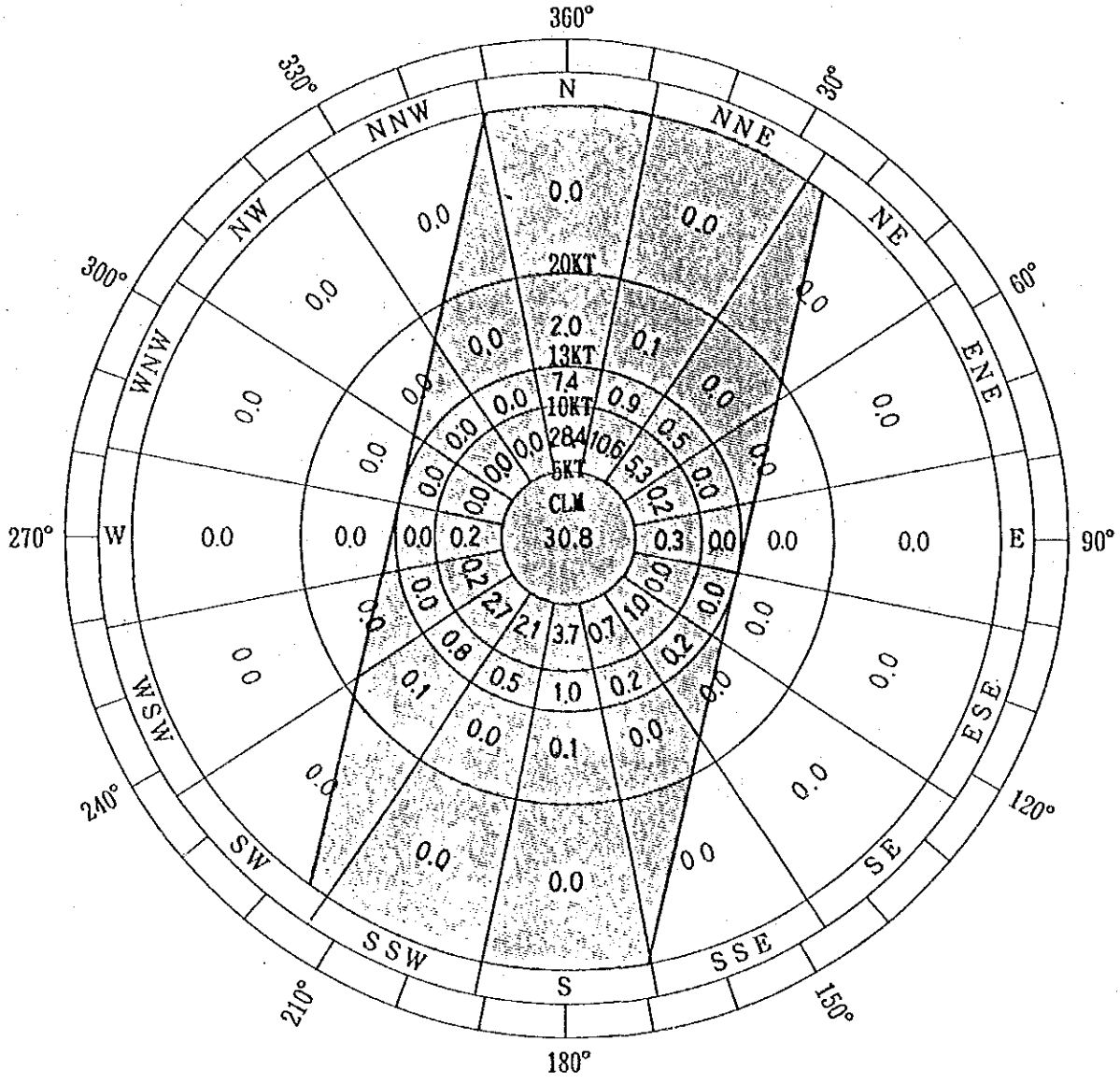


Hours	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Commercial Operations	0	0	0	0	1	1	3	5	10	6	2	3	3	2	2	2	5	2	3	1	3	1	1	0
Gneral Aviation and Other Operations	0	0	0	0	1	2	7	13	29	27	37	24	25	15	15	24	26	21	6	2	6	1	1	0
Total Operations	0	0	0	0	2	3	10	18	39	33	39	27	28	17	17	26	31	23	9	3	9	2	2	0

(DECEMBER 15, 1988)

HOURLY AIRCRAFT OPERATIONS

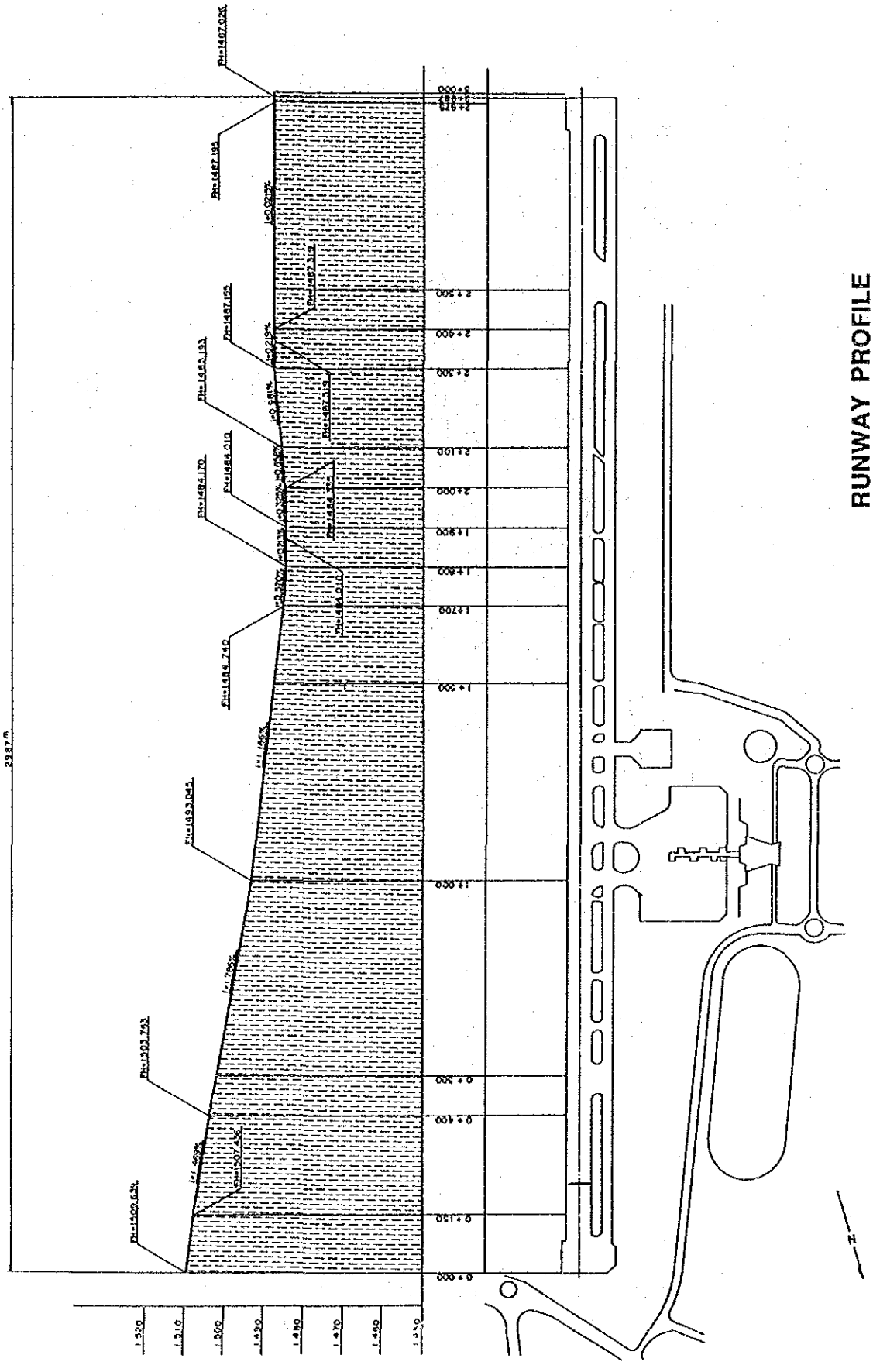
DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 3 — 2



WIND COVERAGE: 100 %

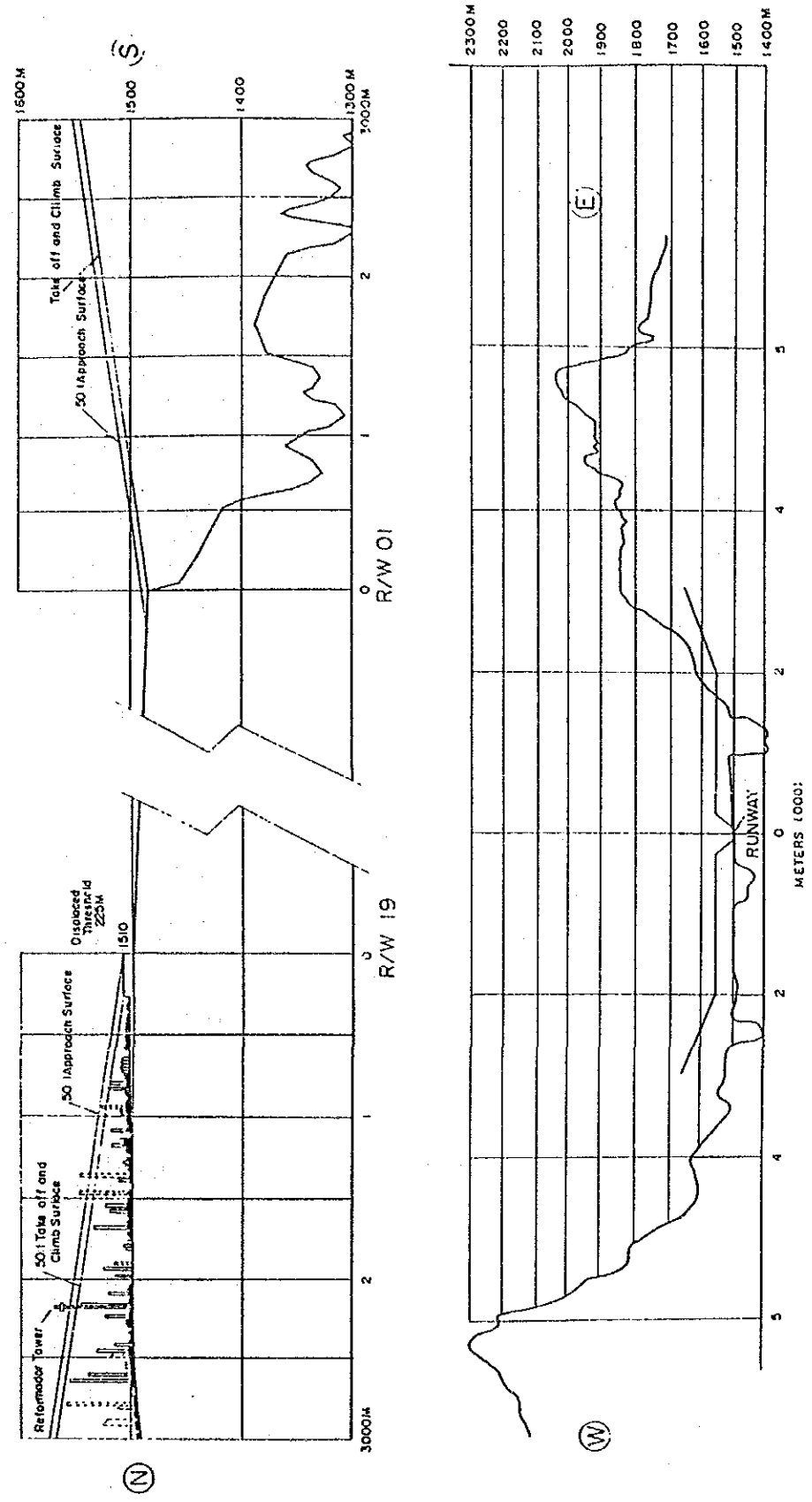
WIND ROSE AT LA AURORA AIRPORT

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 4 — 1



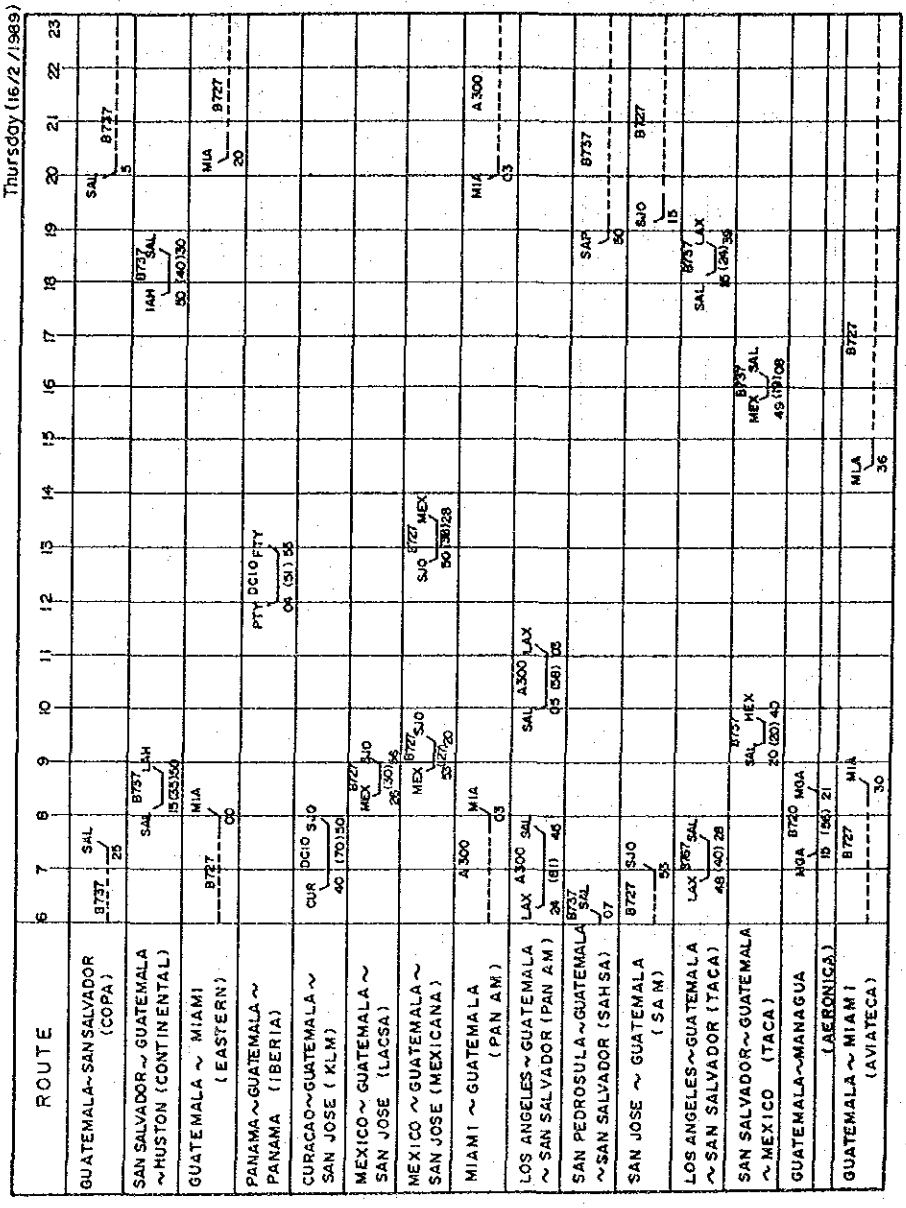
DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS

Figure 4 — 2



EXISTING OBSTACLES, LA AURORA AIRPORT

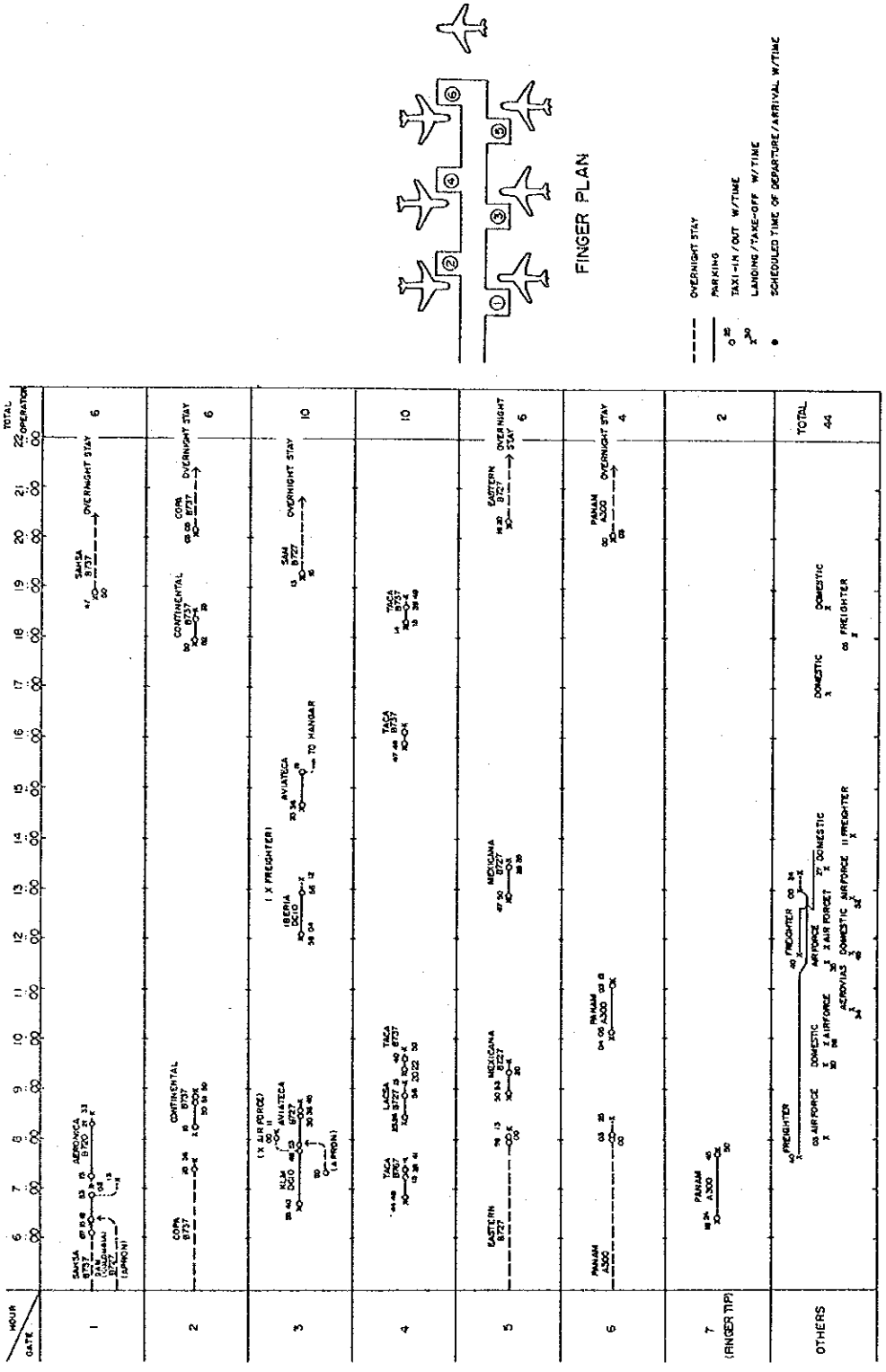
DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS | Figure 4 — 3



ACTUAL FLIGHT DATA AT LA AURORA AIRPORT

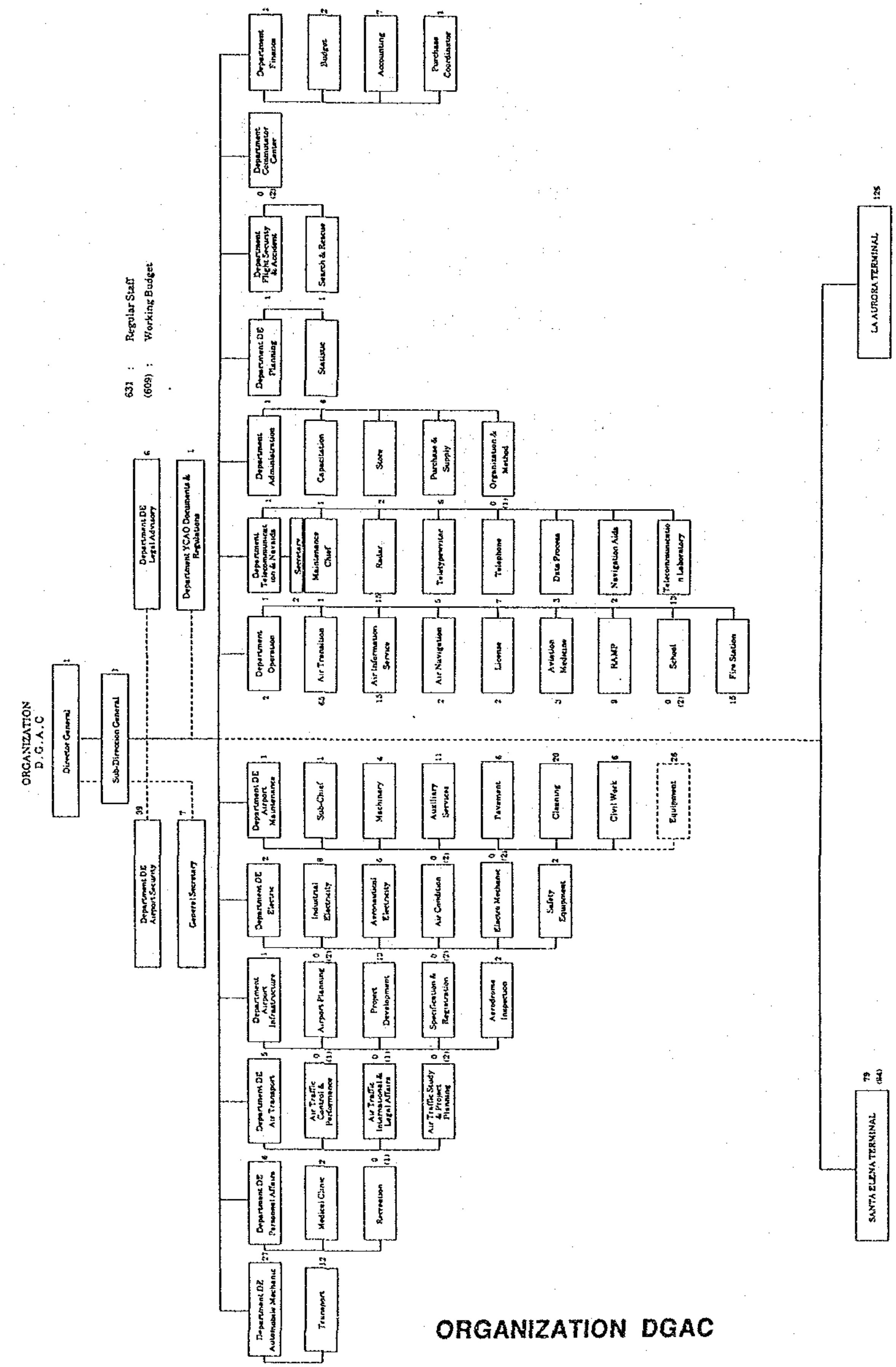
DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS

Figure 4 — 4



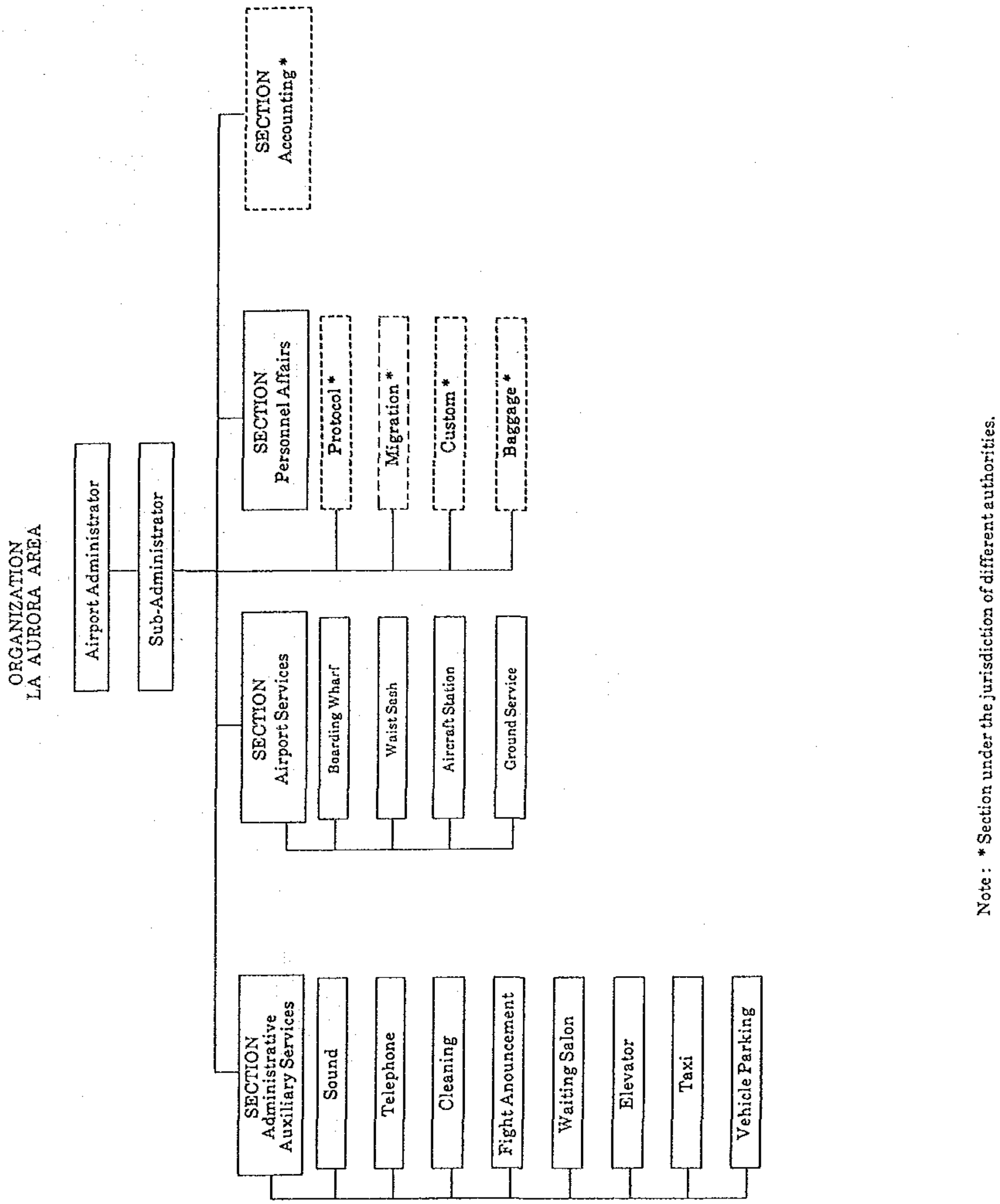
AIR TRAFFIC OPERATION IN RAMP

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 4 — 5



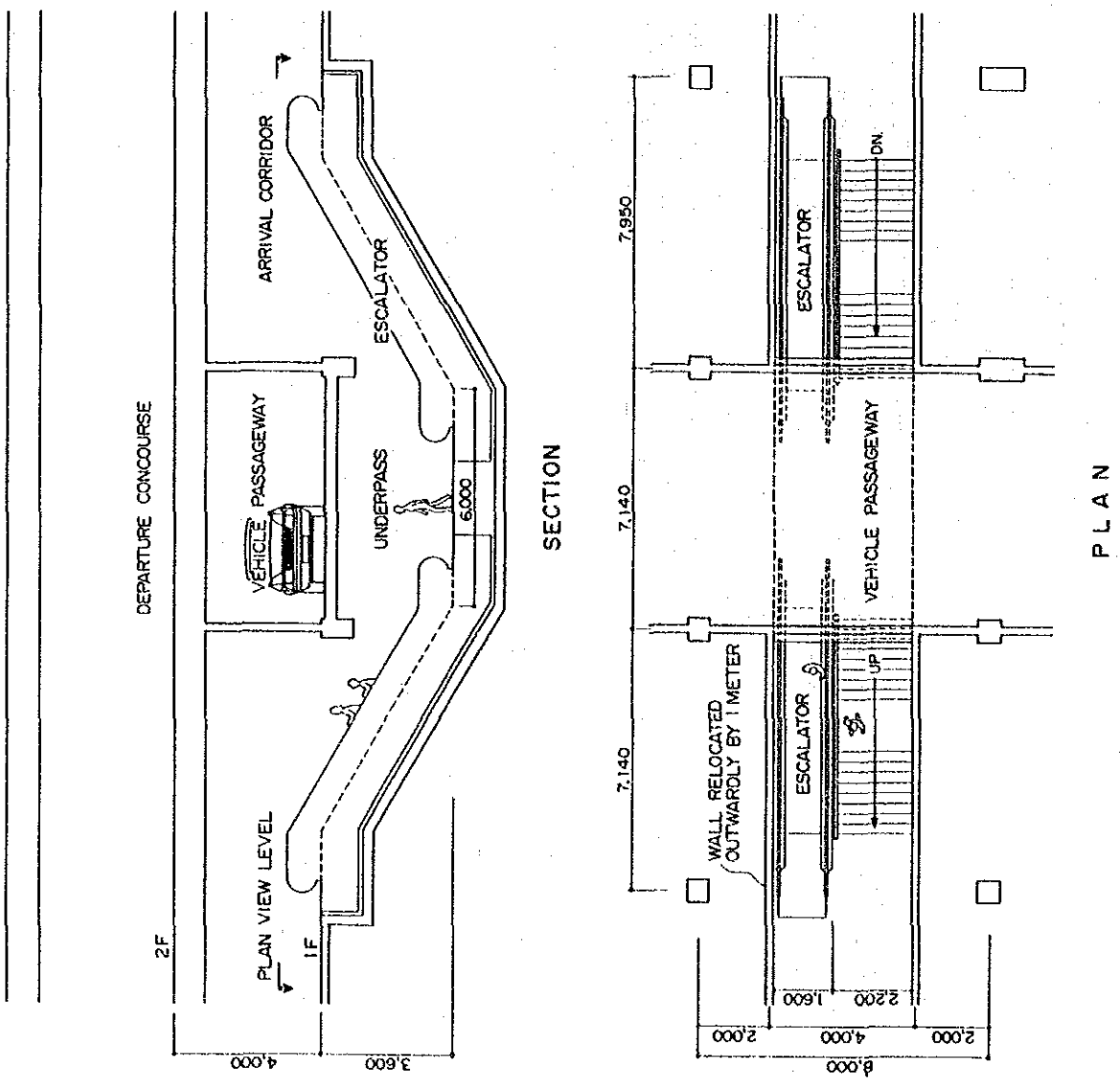
ORGANIZATION DGAC

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 4 — 6



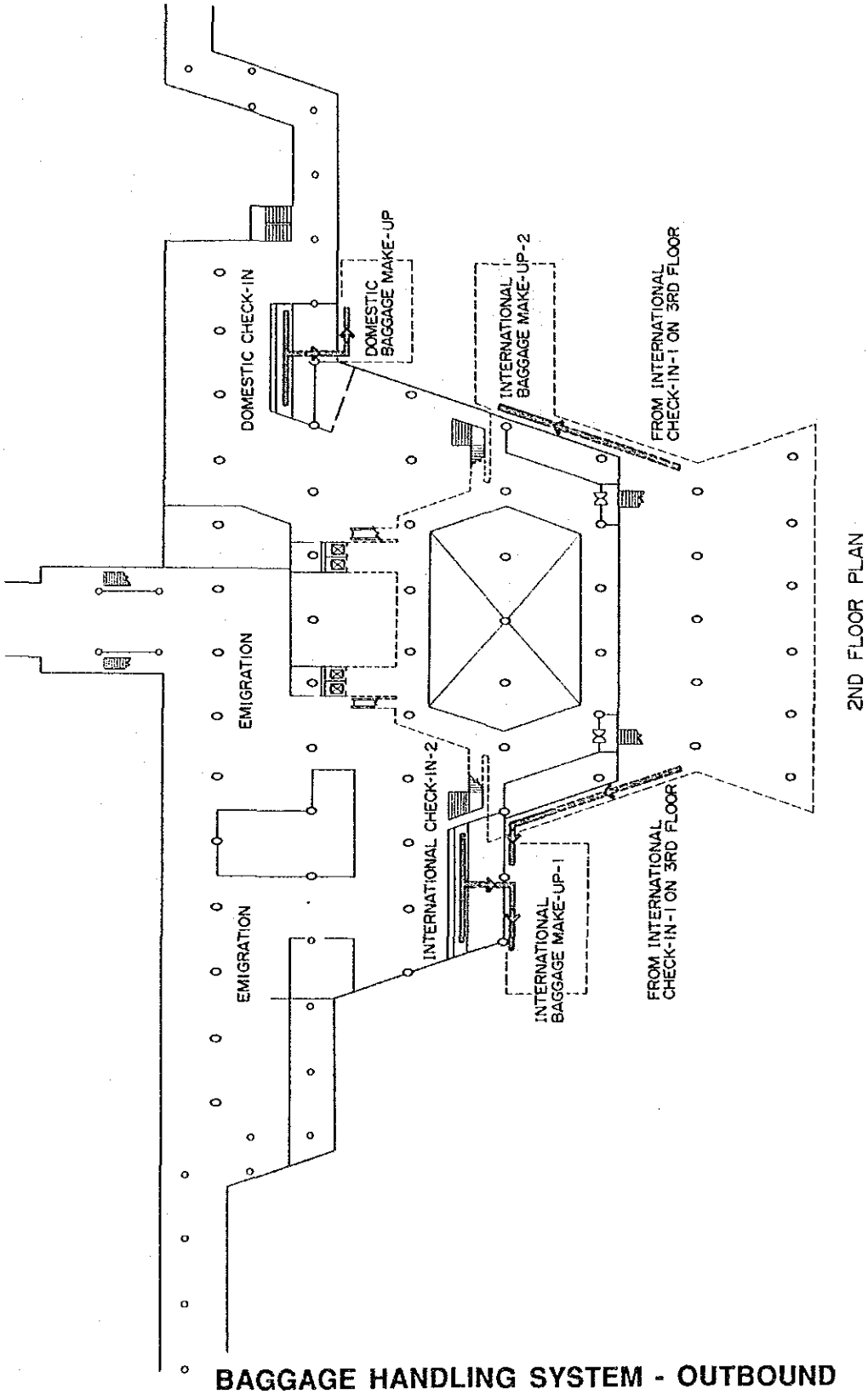
ORGANIZATION, LA AURORA AREA

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS | Figure 4 — 7



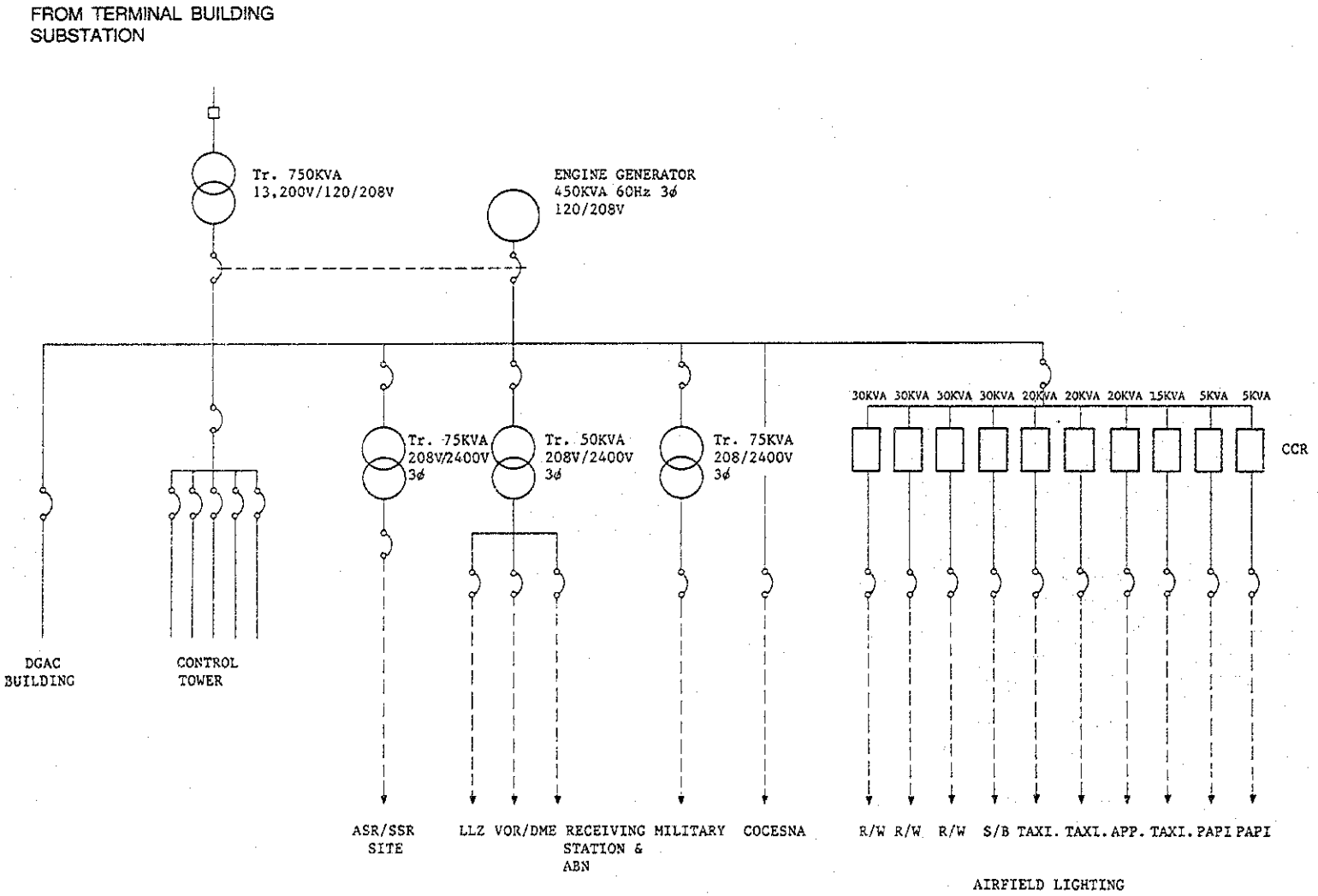
VEHICLE PASSAGEWAY & PASSENGER UNDERPASS

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 — 1



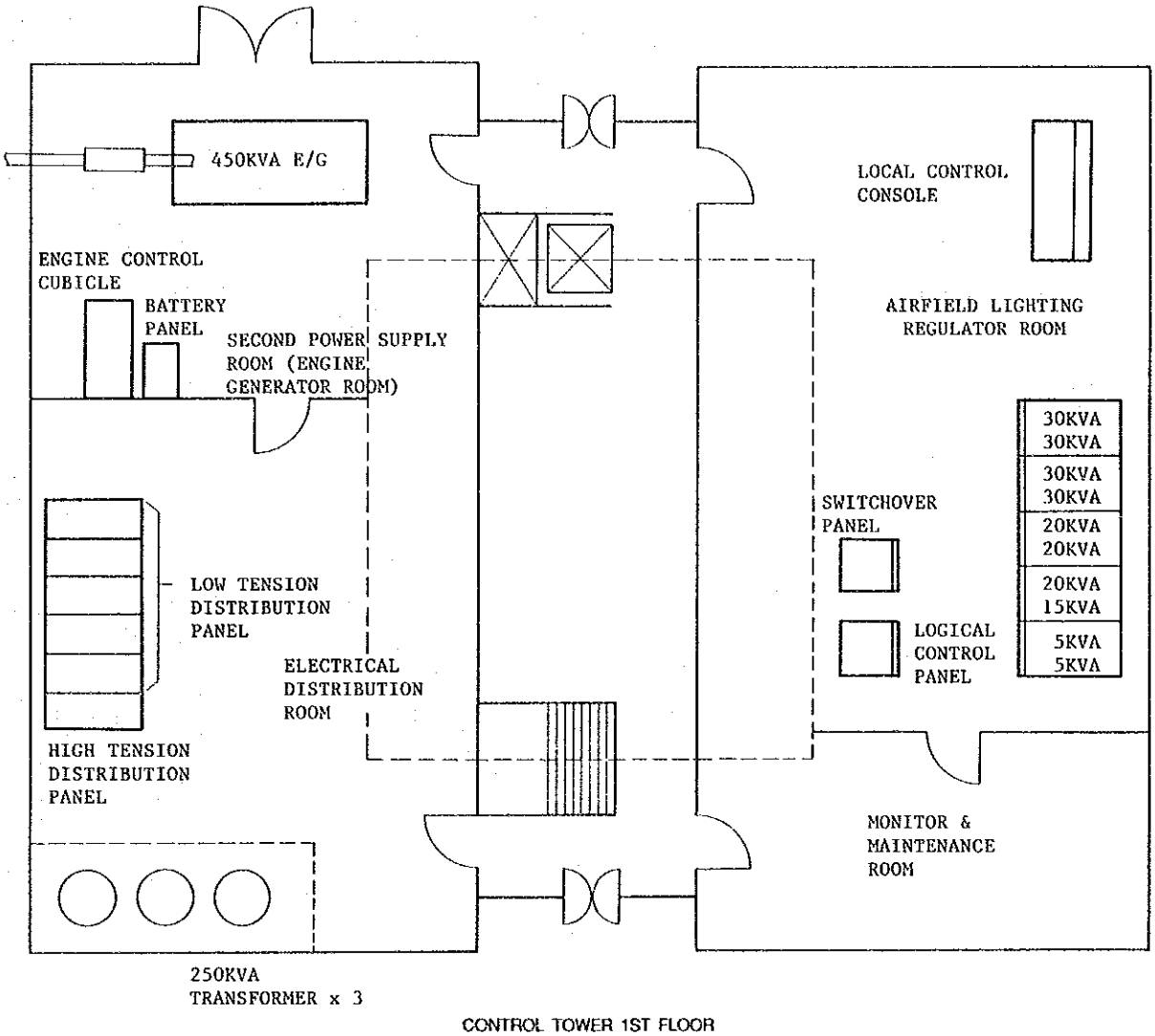
BAGGAGE HANDLING SYSTEM - OUTBOUND

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 -- 2



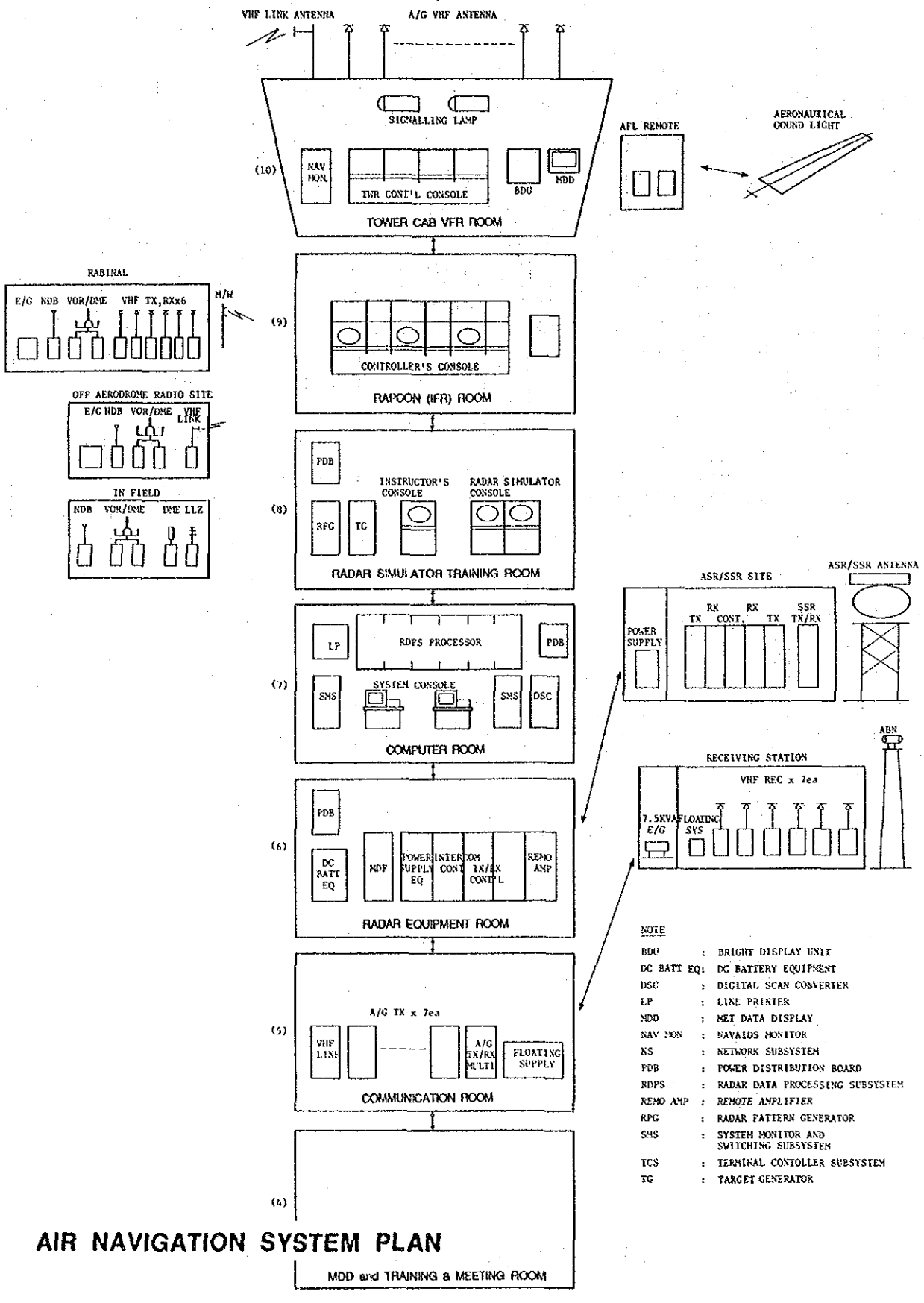
ELECTRIC POWER BLOCK DIAGRAM

Figure 5 – 3



POWER SUPPLY ROOM EQUIPMENT LAYOUT

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 — 4

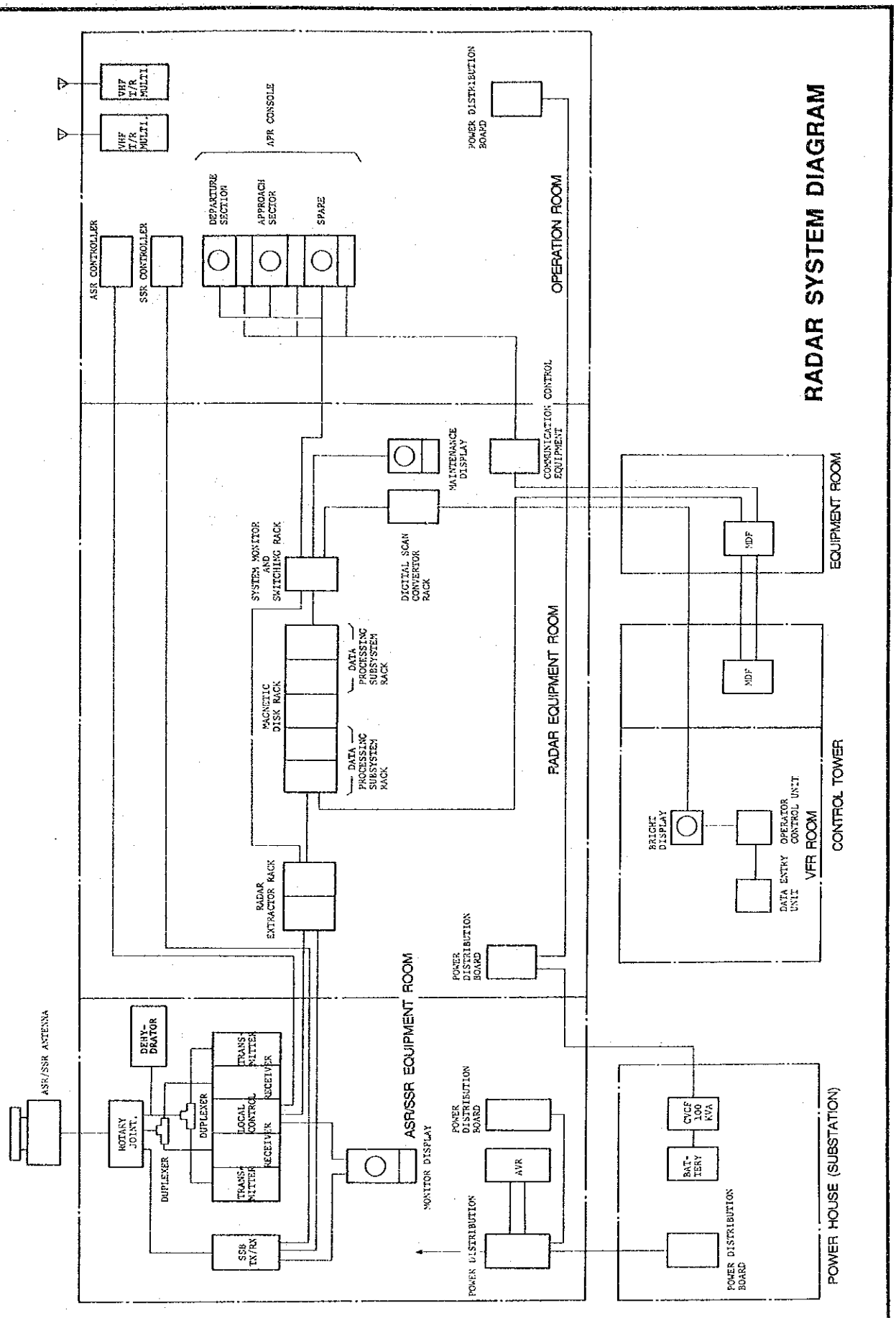


NOTE

BDU	:	BRIGHT DISPLAY UNIT
DC BATT EQ	:	DC BATTERY EQUIPMENT
DSC	:	DIGITAL SCAN COSVERTER
LP	:	LINE PRINTER
MDD	:	MET DATA DISPLAY
NAV MON	:	NAVAIDS MONITOR
NS	:	NETWORK SUBSYSTEM
PDB	:	POWER DISTRIBUTION BOARD
RDPS	:	RADAR DATA PROCESSING SUBSYSTEM
REMO AMP	:	REMOTE AMPLIFIER
RPG	:	RADAR PATTERN GENERATOR
SMS	:	SYSTEM MONITOR AND SWITCHING SUBSYSTEM
TCS	:	TERMINAL CONTOLLER SUBSYSTEM
TG	:	TARGET GENERATOR

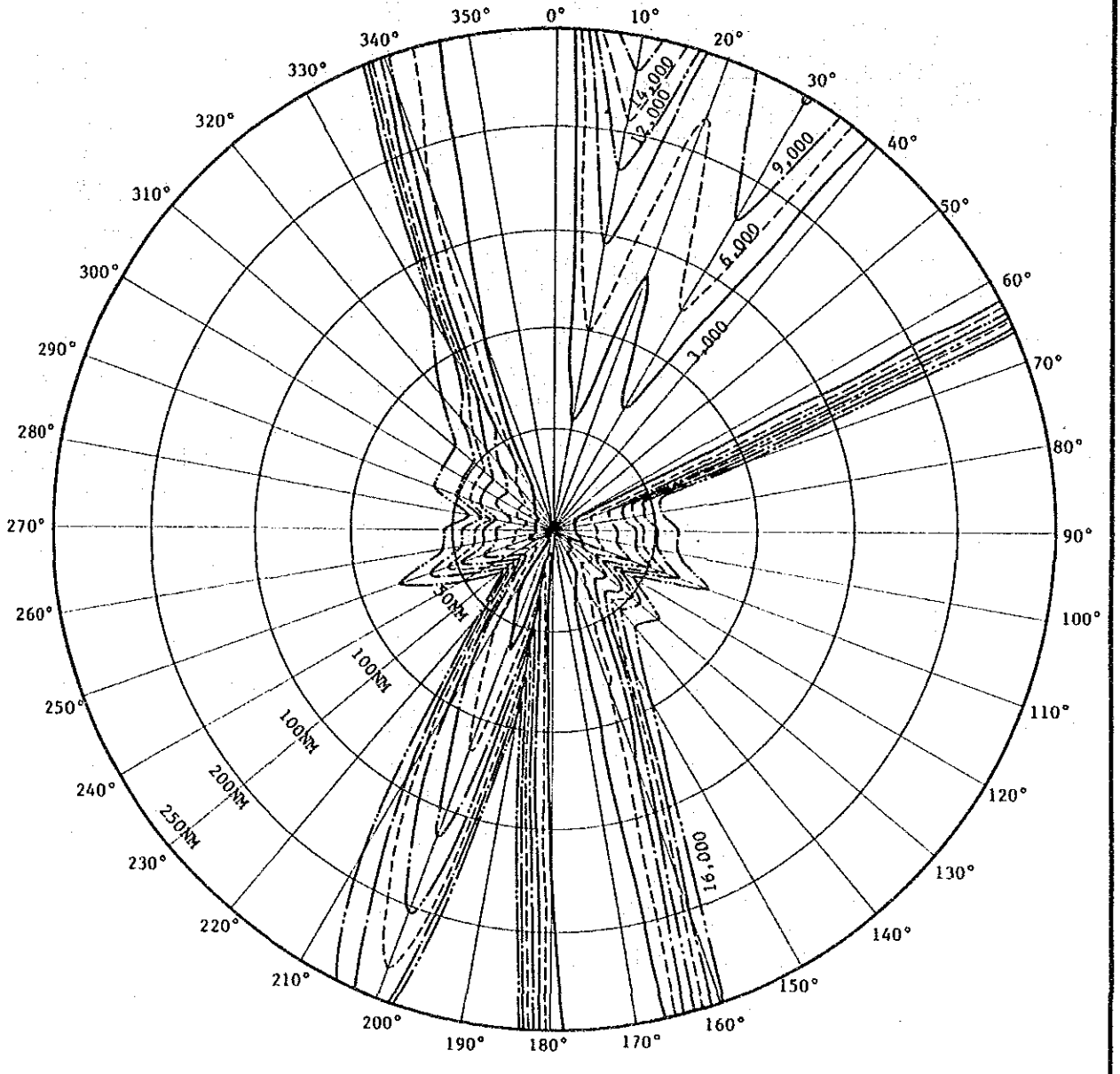
AIR NAVIGATION SYSTEM PLAN

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS | Figure 5 — 5



DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS

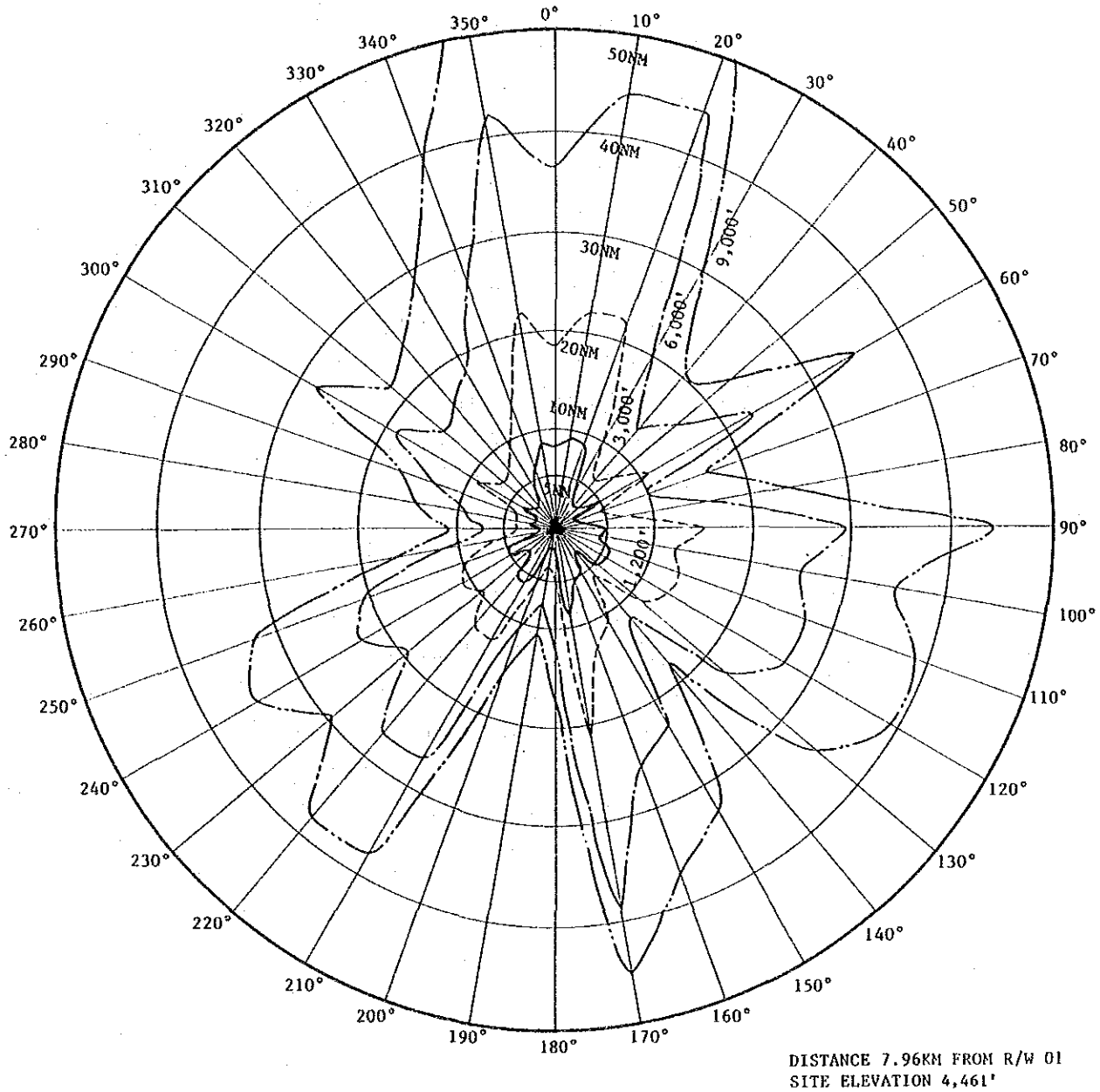
Figure 5 — 6



SITE ELEVATION 4,963'

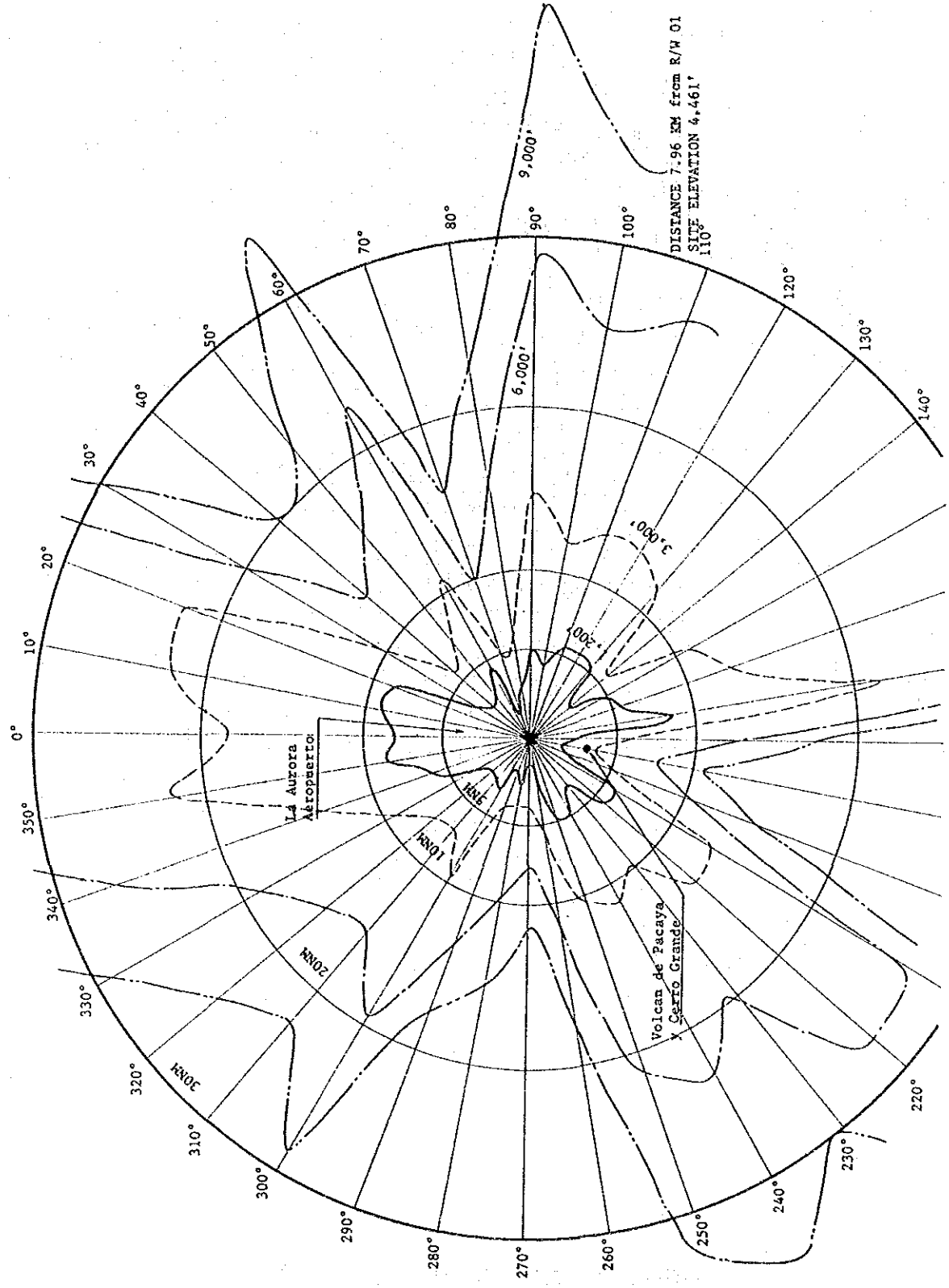
ASR/SSR COVERAGE CHART

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 — 7



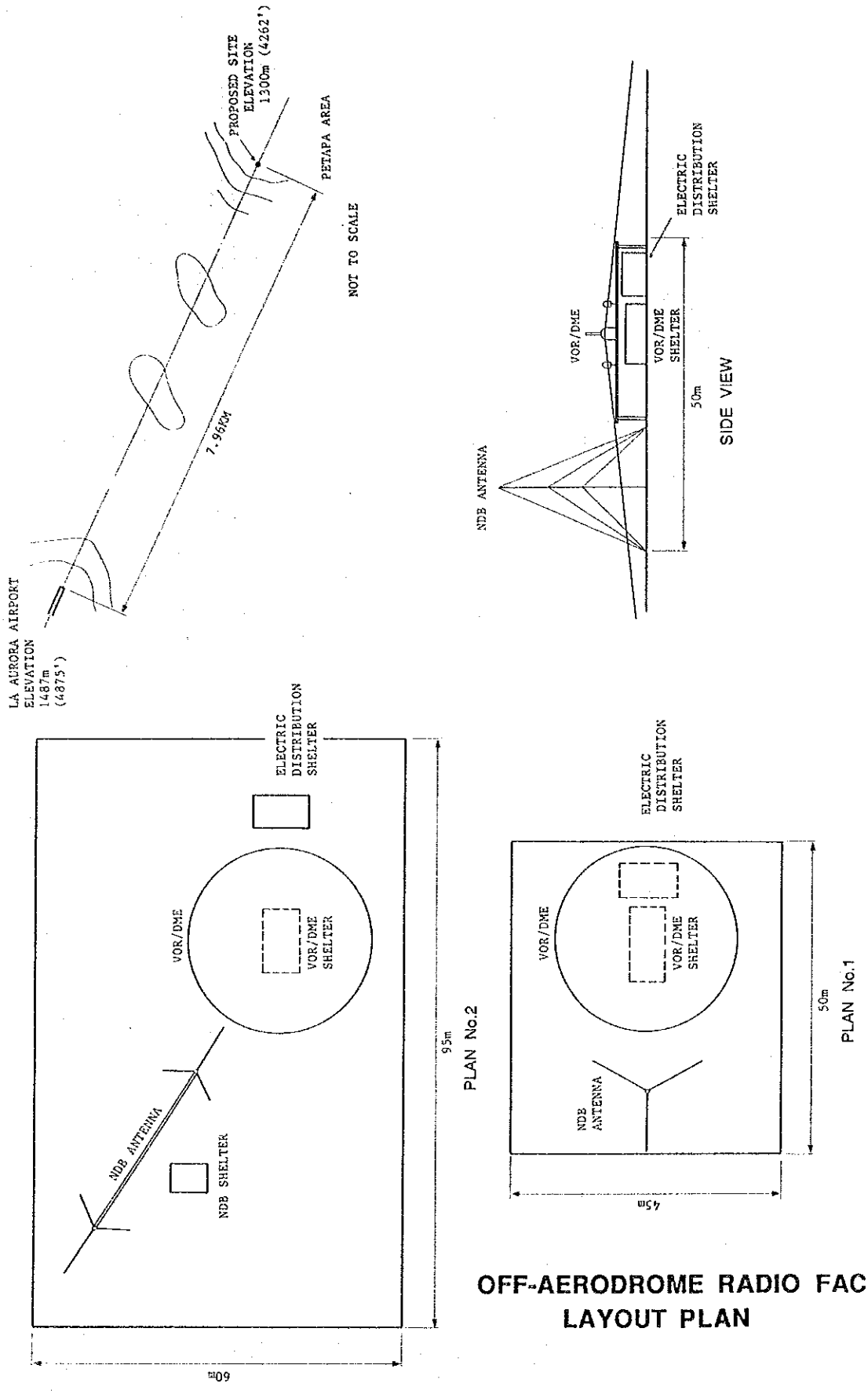
OFF-AERODROME RADIO FACILITY,
VOR COVERAGE CHART NO. 1

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 — 8



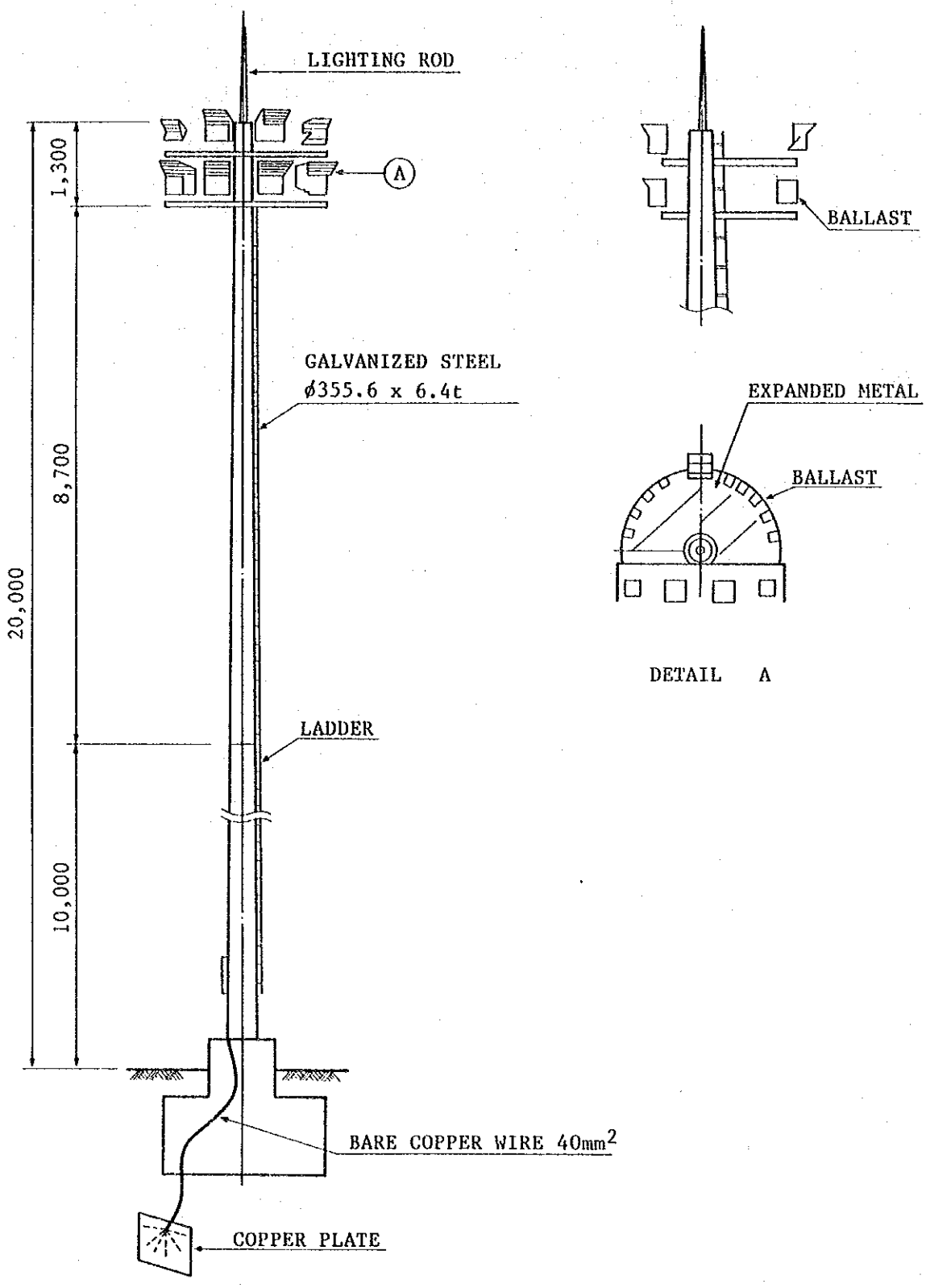
OFF-AERODROME RADIO FACILITY,
VOR COVERAGE CHART NO. 2

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 — 9



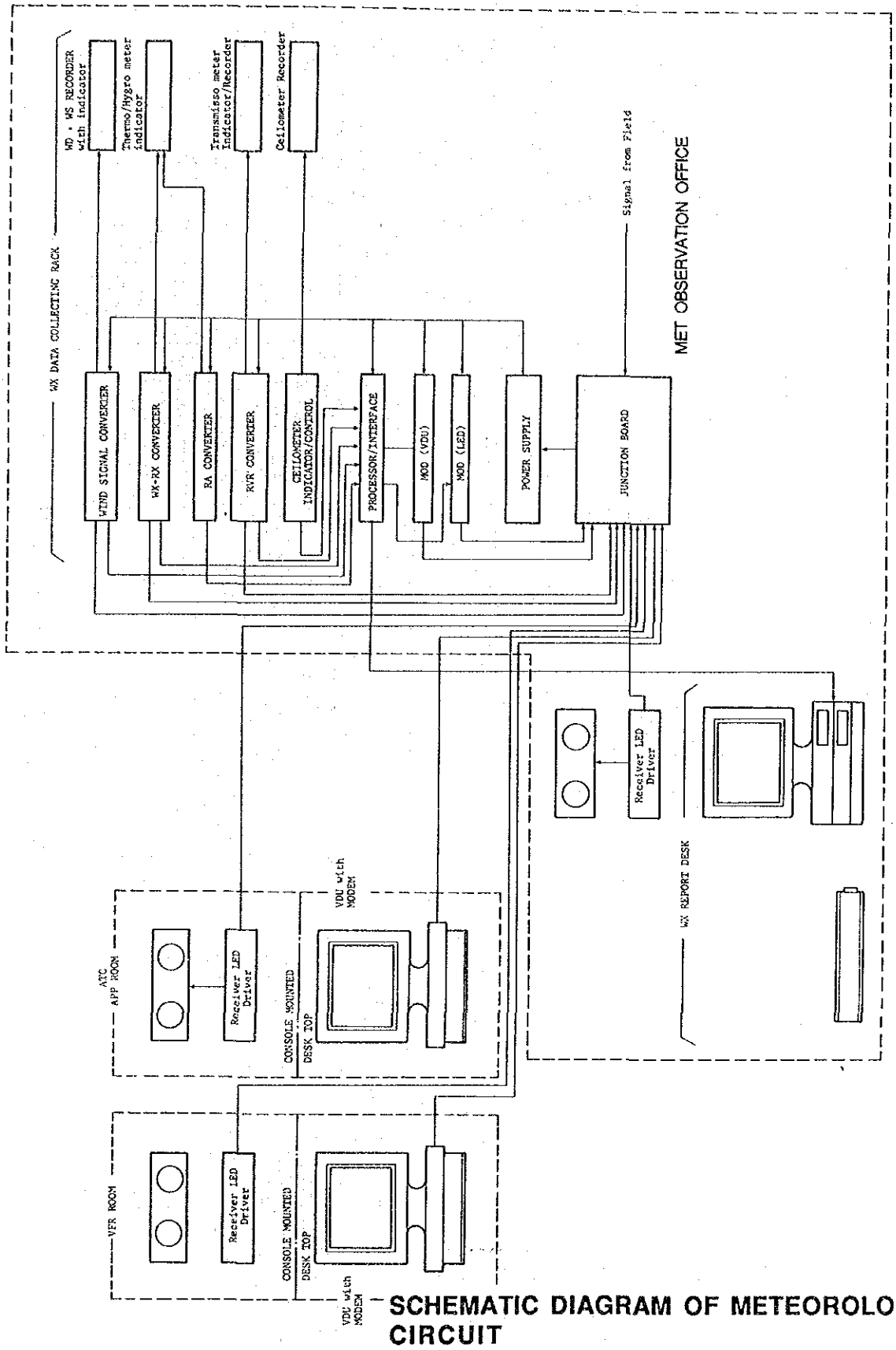
OFF-AERODROME RADIO FACILITY, LAYOUT PLAN

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 — 10



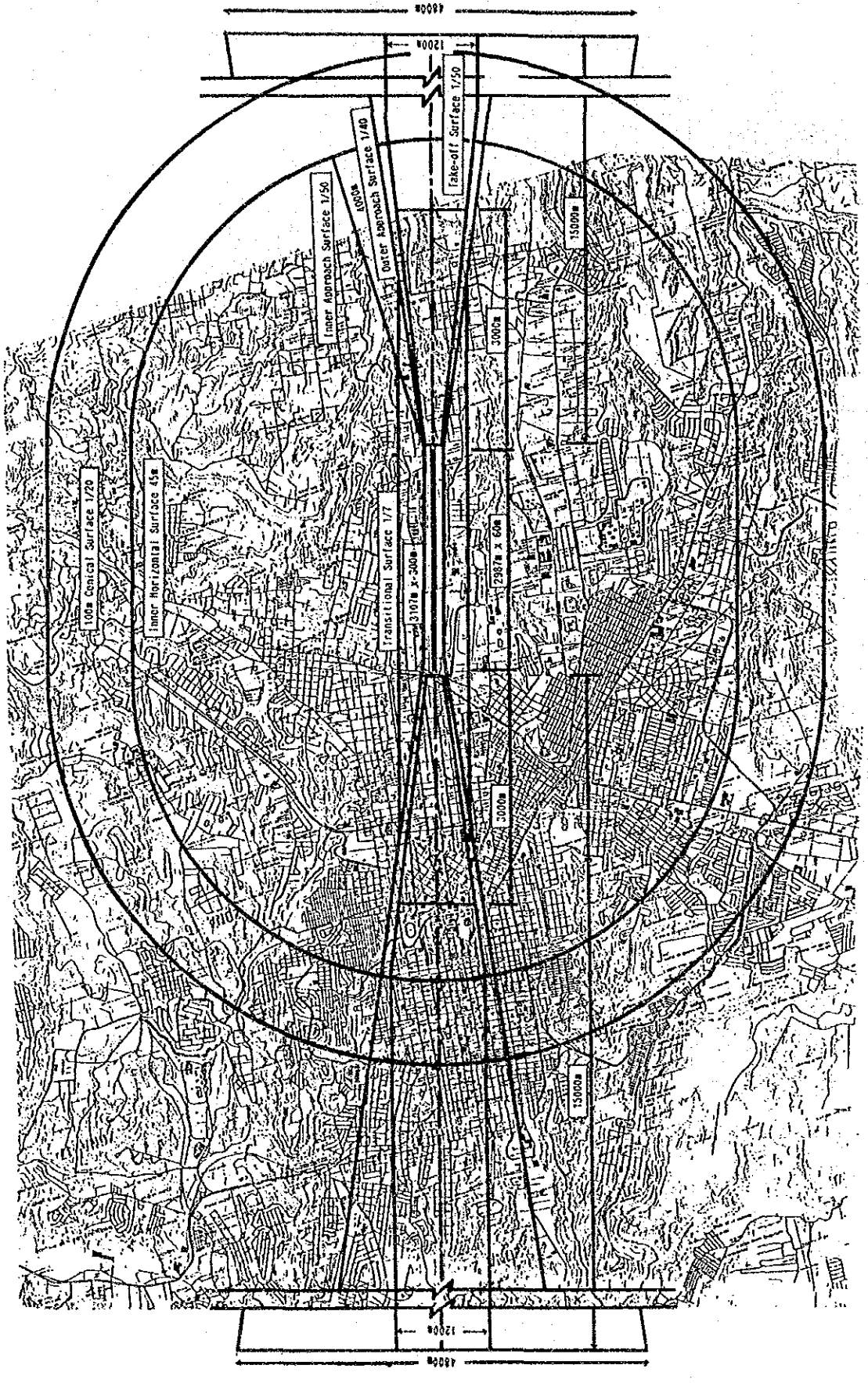
TYPICAL APRON FLOOD LIGHTING POLE

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 — 11

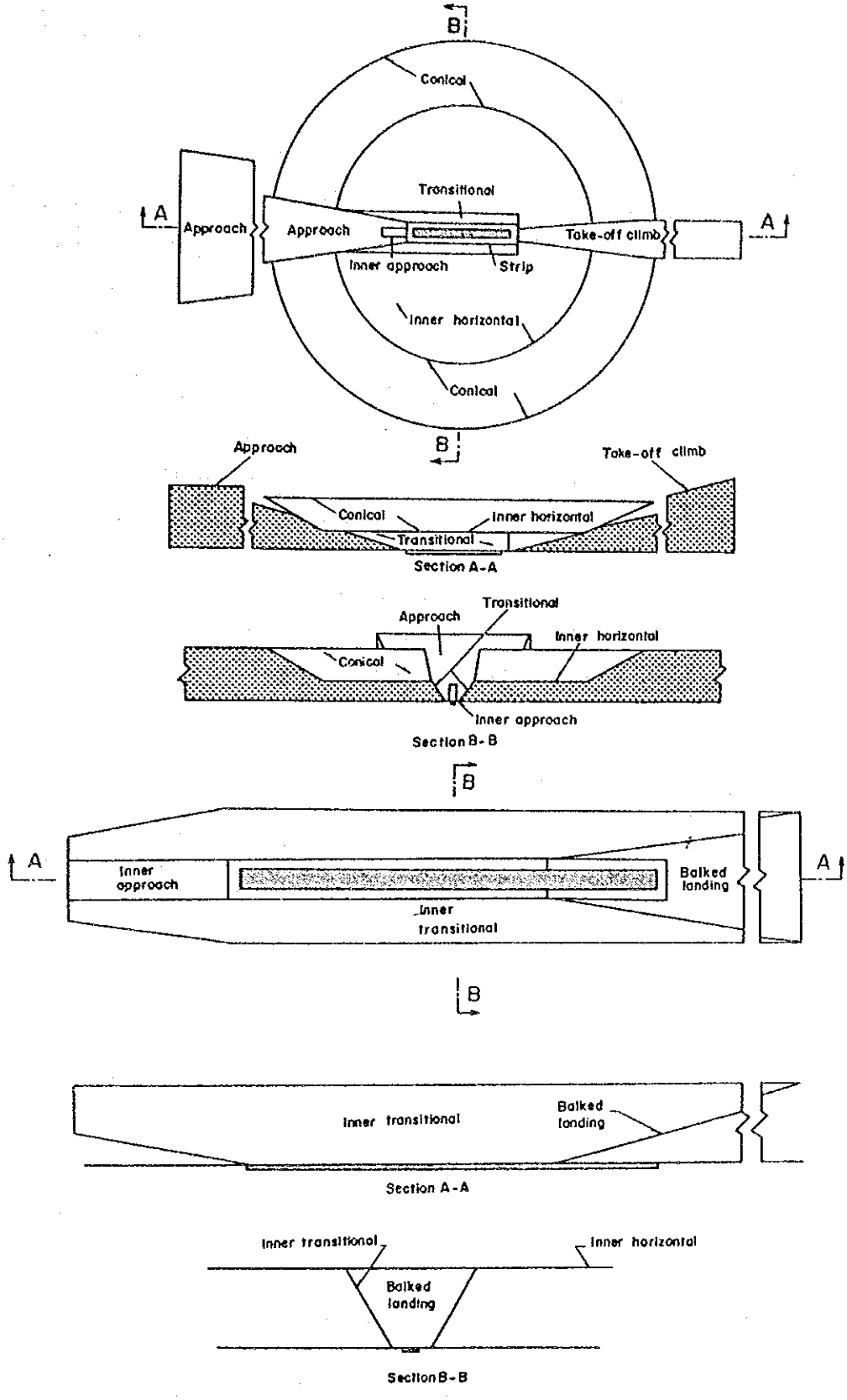


SCHEMATIC DIAGRAM OF METEOROLOGICAL CIRCUIT

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 — 12

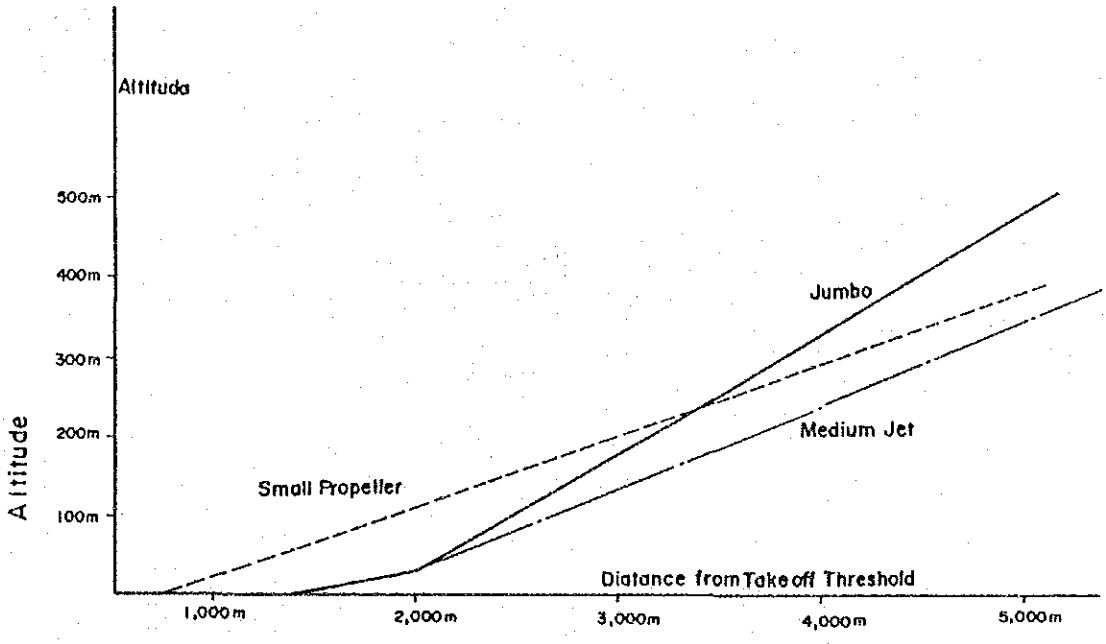


DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS | Figure 5 — 13

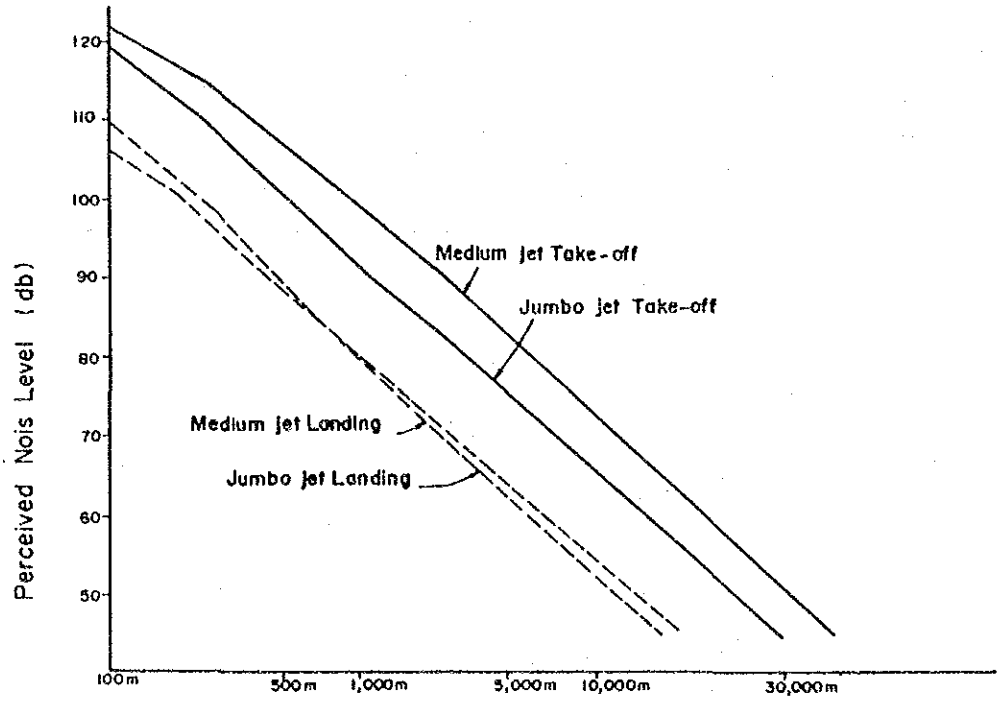


OBSTACLE LIMITATION SURFACE

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 — 14



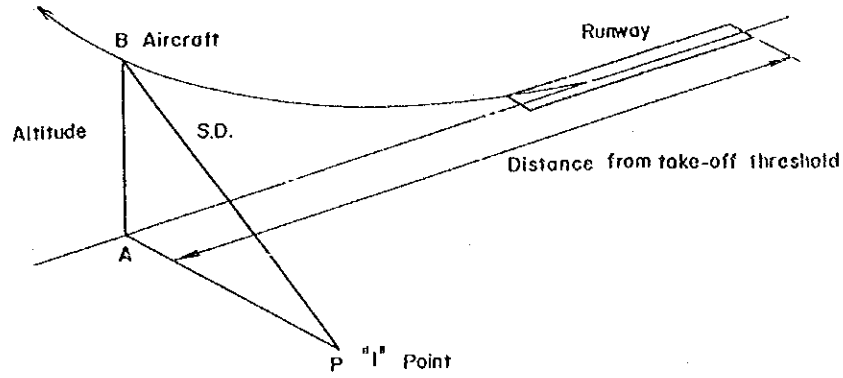
TAKE OFF PROFILE



PNL AND DISTANCE FROM AIRCRAFT

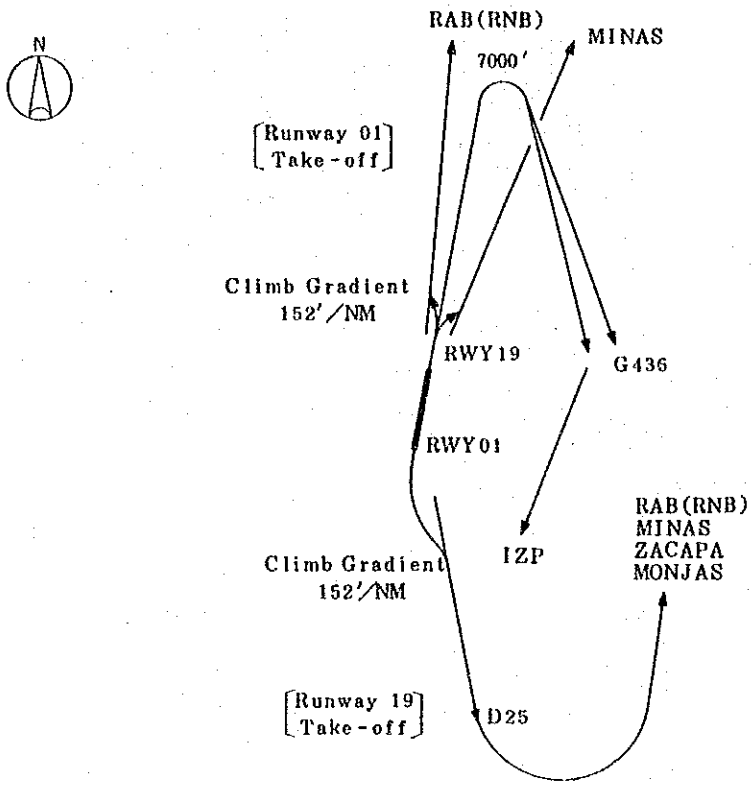
DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 — 15

Slant Distance (S.D.) = $\sqrt{AP^2 + AB^2}$

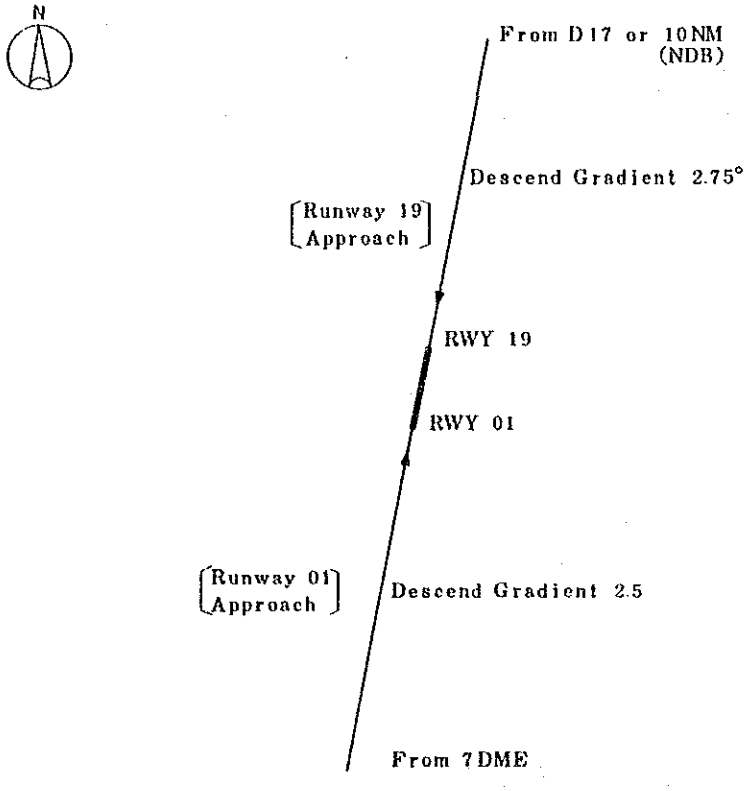


SLANT DISTANCE

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 — 16

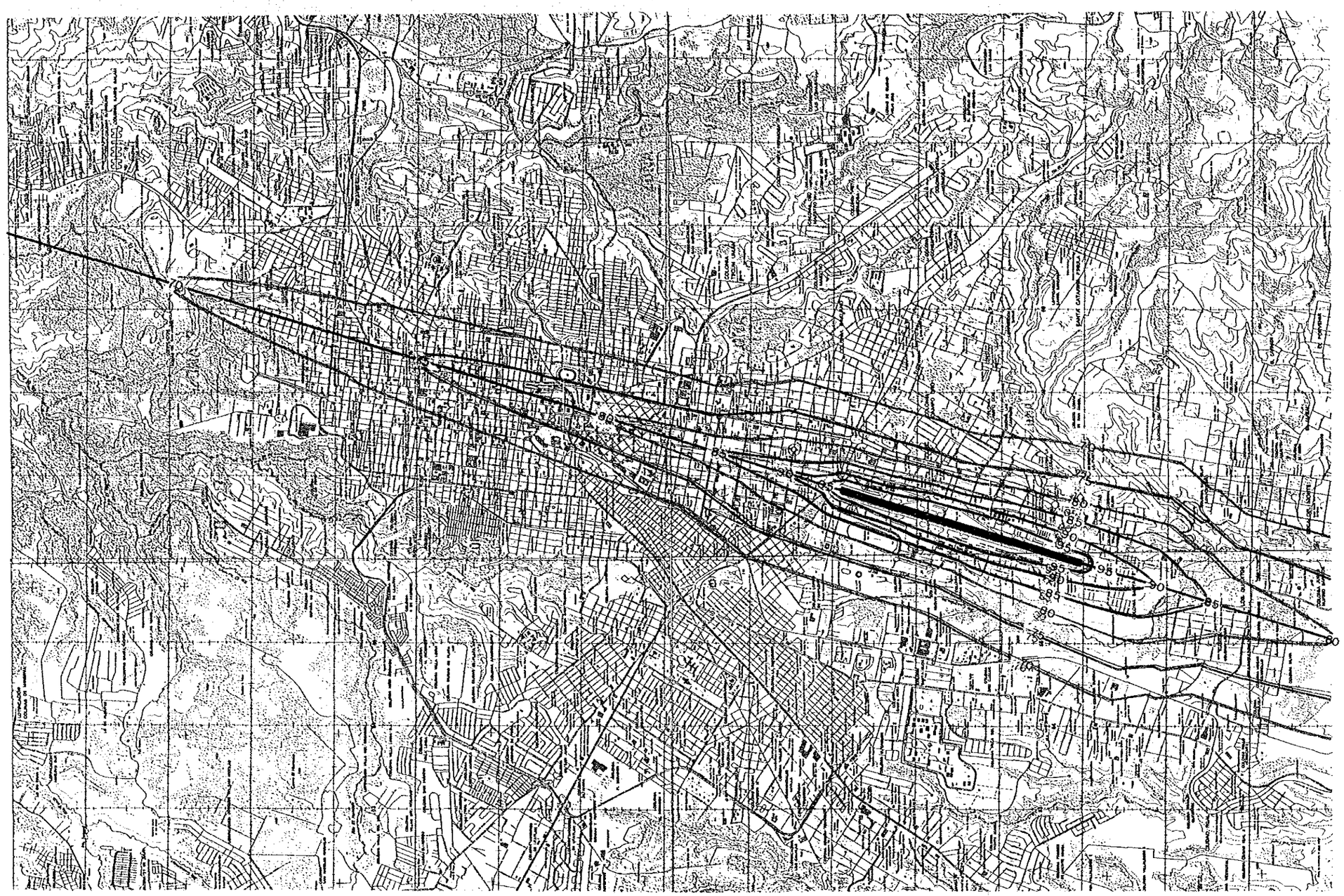


TRAFFIC PATTERN FOR NOISE CONTOUR CALCULATION



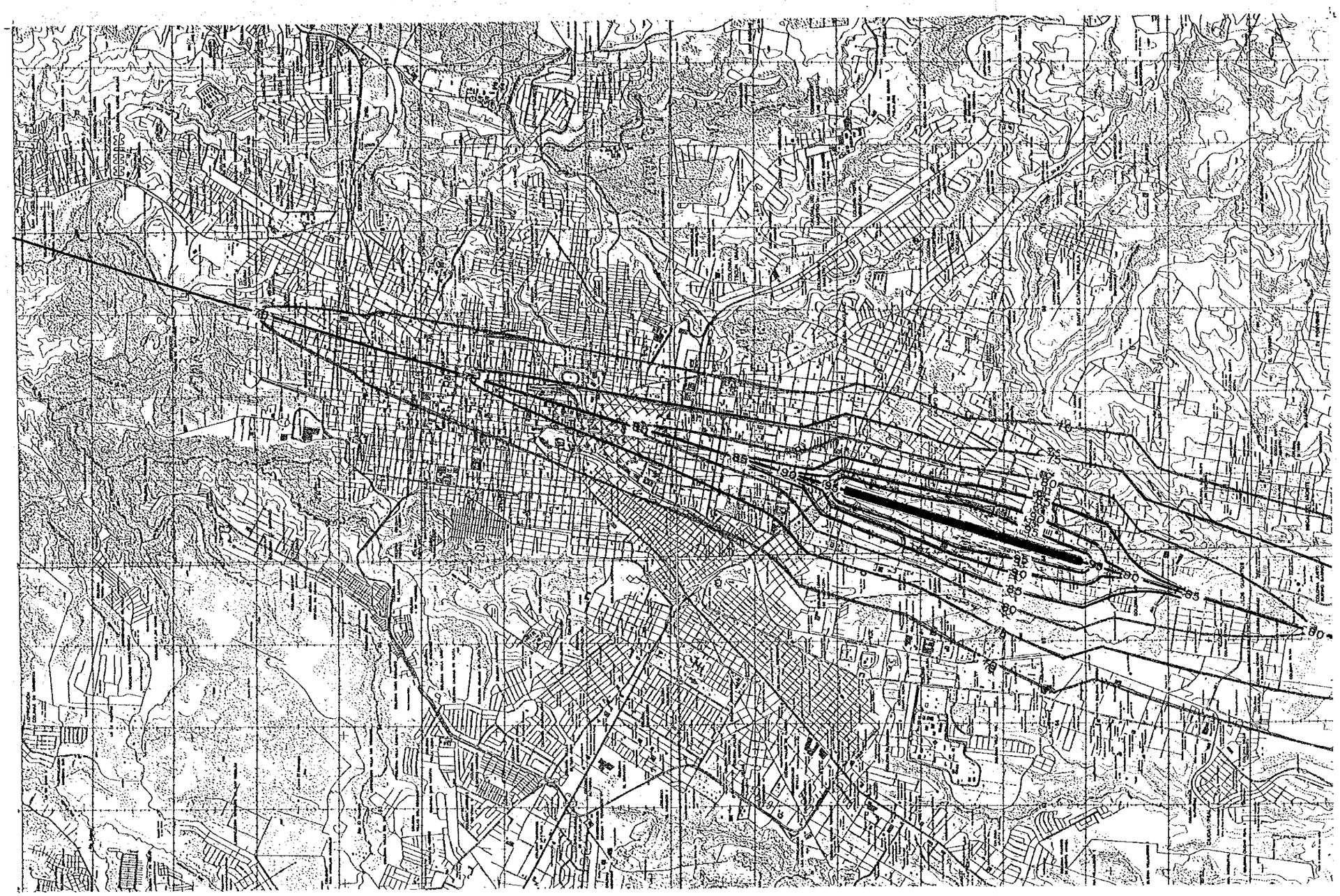
TRAFFIC PATTERN FOR NOISE CONTOUR CALCULATION

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5 — 17



NOISE EXPOSURE ZONES BY WECPNL
(YEAR 1988)

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5—18



NOISE EXPOSURE ZONES BY WECPNL
(YEAR 1995)

DEVELOPMENT PROJECT OF LA AURORA AND SANTA ELENA AIRPORTS	Figure 5—19

PROPOSED PROFILE OF ORGANIZATION, GUATEMALA INTERNATIONAL AIRPORT AUTHORITY (GIAA)

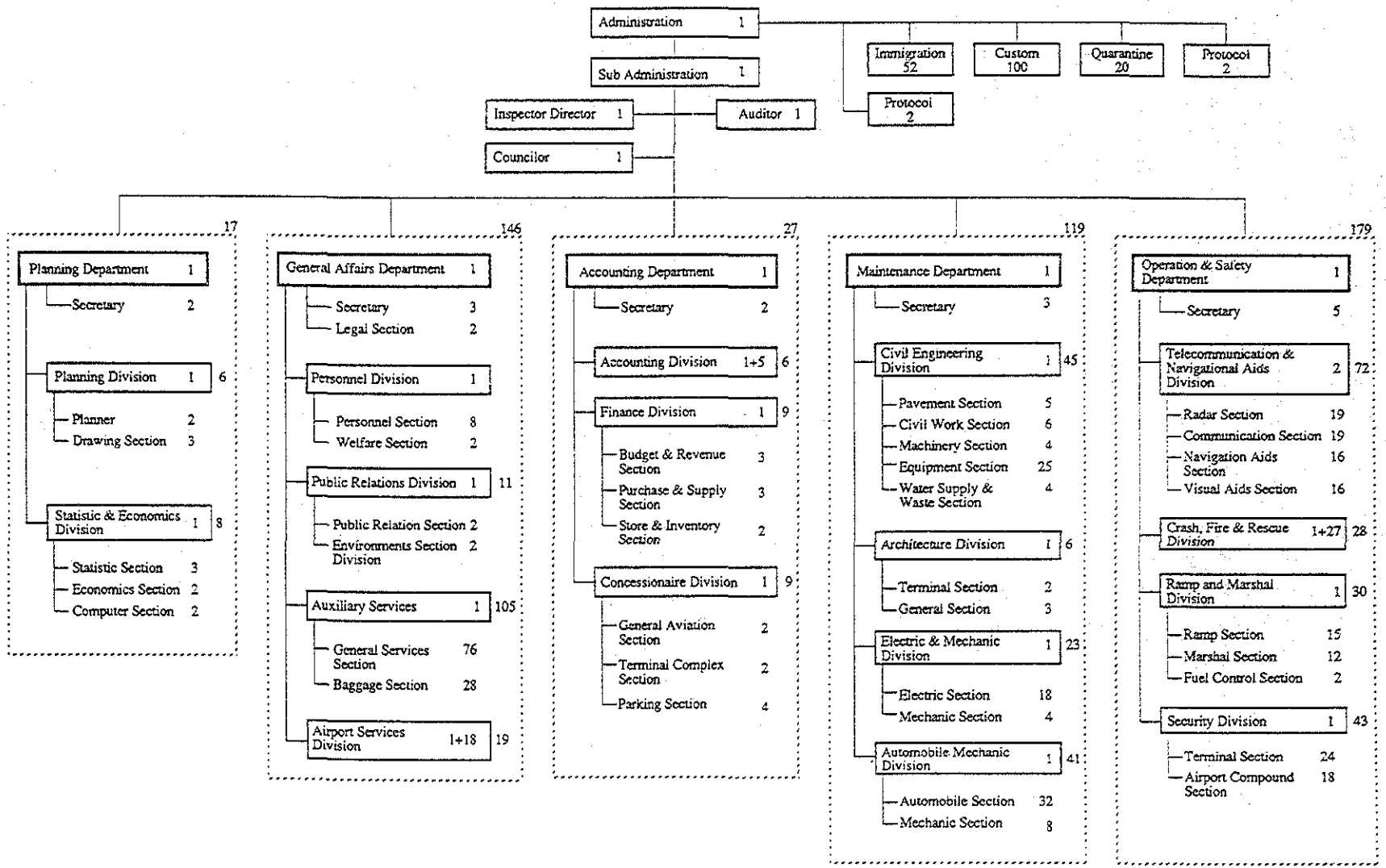


Figure 5 — 20