To the Graduate Council:

I am submitting herewith a thesis written by Randall S. Curtis entitled "An Access and Distribution System Plan for the Metropolitan Nashville Airport." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Aviation Systems.

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Thesis
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AN ACCESS AND DISTRIBUTION SYSTEM PLAN FOR THE METROPOLITAN NASHVILLE AIRPORT

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Randall S. Curtis

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ABSTRACT

The purpose of this study was to develop the conceptual framework for an access and distribution system plan for the Metropolitan Nashville Airport. Travel time measurements were to provide sufficient information to determine the operational efficiency of the existing access and distribution system and to provide a basis for recommendations to insure adequate access and distribution capabilities.

Travel time from the Metropolitan Nashville Airport was determined by actual measurements made during nonrush hour periods and supplemented by data from the Tennessee Department of Transportation. These data provided the basis for determining the accessibility of the airport within specified travel time limits.

It was determined that 63% of the existing airline passengers had access to the airport within a 30 minute travel time limit. Only 27% of the population of the defined "air trade area" of Middle Tennessee had access within the 30 minute limit. Furthermore, it was determined that the major mode of access was the private automobile.

Various alternatives were identified as means of increasing the efficiency of the existing access and distributive system. It was recommended that the Metropolitan Nashville Airport Authority create a technical coordinating committee to insure that the requirements of the access and

distribution system are coordinated and integrated with the transportation policy of Tennessee.

TABLE OF CONTENTS

SECTION	PAGE
INTRODUCTION	1
I. PURPOSE AND OBJECTIVE	4
II. BACKGROUND--THE NASHVILLE METROPOLITAN REGION	5
Population Growth	5
Economic Development	6
Summary	7
III. TERMINAL AND AIRSIDE FACILITIES	10
Airside Facilities	11
Terminal Facilities	15
Summary	19
IV. EXISTING ACCESS AND DISTRIBUTION SYSTEM FACILITIES	21
Existing Highway System Analysis	24
Intracity Mass Transit System	32
Intercity Bus Service	33
Air Commuter Service and Private Aircraft	34
Other Modes of Transportation	34
Summary	34
V. ACCESS AND DISTRIBUTION SYSTEM PLAN	36
Alternatives	36
Determination of Specific Plan of Action	39
Summary	42
LIST OF REFERENCES	45

SECTION PAGE

APPENDIX 48

VITA 53

LIST OF TABLES

TABLE		PAGE
I.	Industry Trends for Davidson County, 1965-1985	8
II.	Industry Trends for Nashville Metropolitan Region, 1965-1985	9
III.	Air Traffic Forecast for Nashville Metropolitan Airport	12
IV.	Airport Access Modes	23
V.	1974 Congested Links on Selected Major Arterial Systems	28
VI.	Federal Assistance Programs	40
VII.	Transportation Technical Committee	43
VIII.	Local Passenger Origins for Nashville Metropolitan Airport	50

LIST OF FIGURES

FIGURE		PAGE
1.	Travel Time Changes	2
2.	Nashville Metropolitan Airport--Airside Facilities	13
3.	Terminal Facilities	16
4.	Main Passenger Terminal Building Layout	17
5.	Major Highway Network--Air Trade Area	25
6.	Major Highway Network--Davidson County	26
7.	Thirty Minute Travel Limits	30
8.	Air Trade Area	52

INTRODUCTION

Air transportation has made remarkable advances since its beginning in the early part of the century and is reflected by the acceptance of air travel as a major mode of transportation. In 1975, enplanements at U.S. airports totaled more than 201 million passengers (1, p. 31).[1] The rate of growth for the past 15 to 20 years has averaged 9% (2, p. 5). Forecast indicates continued growth in the future, thus increasing the demand for air transportation and its support facilities (1, p. 31).

Air travel time per trip has decreased substantially since the first use of jet aircraft commercially in 1958. However, it is significant that total trip time has not been substantially reduced. In many cases the ground time exceeds the air time by a considerable margin. For a journey of 600-1000 nautical miles between two large metropolitan areas, ground times are almost double the air time. (See Figure 1.) A major cause is the increasing congestion of terminal and ground access facilities. Today, the air portal has begun to lose its appeal because of this congestion.

Progress made in the reduction of air travel time is being offset by the increases in ground travel time. The

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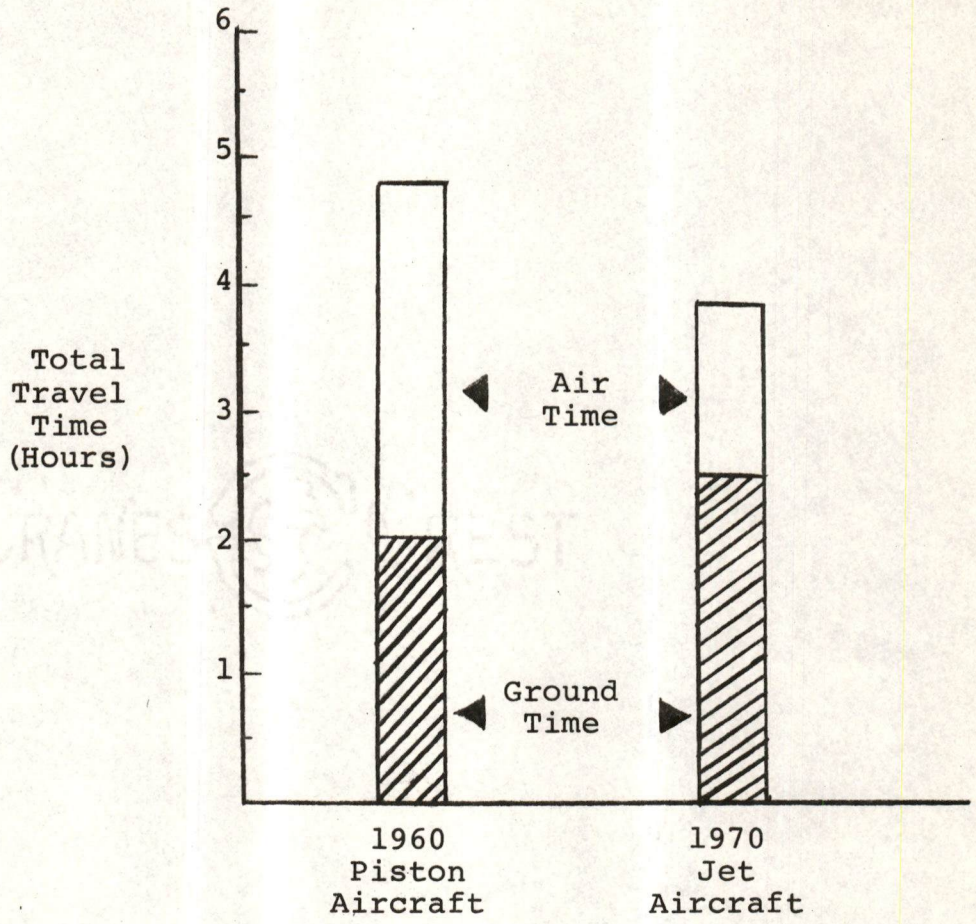
[1]Numbers in parentheses refer to similarly numbered references in the List of References.



Medium Haul: 600-1000 Nautical Miles

Figure 1. Travel time changes.

Source: Federal Aviation Administration.

air transportation system of the coming years will depend greatly upon the ability to collect and distribute passengers and freight efficiently, expeditiously, and in accord with the advances achieved by commercial aircraft. Total trip time must be the criterion for determining system effectiveness.

Airport operators are concerned about congestion. Few, however, have the detailed information to quantify the problem and respond accordingly. Many have concentrated improvements in the on-airport terminal segment, leaving off-airport consideration for others. Studies indicate that trips to and from an airport account for less than 1% of all vehicle trips in the urban region (2, p. 20). Therefore, ground transportation planners often place low priorities upon the airport needs. These facts have accounted for the "orphaned" status of the access and distribution system.

A definite need exists for a coordinated approach to increase performance of interface facilities and the access and distribution system. This need is becoming more evident day by day as the demand for air transportation increases.

I. PURPOSE AND OBJECTIVE

The purpose of this study is to develop the conceptual framework for an access and distribution system to meet future requirements of the Nashville Metropolitan Airport.

The objective is to develop this plan from a total system's viewpoint and in doing so create conceptually an access and distribution system which is coordinated, well-balanced, and integrated with the total transportation system.

For the purpose of this study, an access and distribution system is defined as the sum total of the facilities and services utilized by the airport population in traveling from the surrounding region to the airport and from the airport to the surrounding region (2, p. 8).

The airport population consists primarily of air travelers, visitors and greeters, persons who work at the airport, shippers of freight and cargo, and those providing support services (2, p. 17). Major modes of travel to and from the airport are by private auto, taxi, bus, limousine and truck (2, p. 23).

II. BACKGROUND--THE NASHVILLE METROPOLITAN REGION

The growth and development of an airport is a reflection of the vitality of the surrounding region. Billy Mitchell (4, p. 24), the famous aviation pioneer, once stated, "If you were to measure the heartbeat of a city . . . measure the pulse of its airport." A study of the demographic and socioeconomic trends of a region provides insights into the development of that community and a basis for determining transportation requirements.

The Metropolitan Planning Commission defines the Nashville Metropolitan Region as the counties of Davidson, Rutherford, Sumner, Wilson, and Williamson (5, p. 4). This region generates approximately 82% of the enplaned passengers at the Nashville Metropolitan Airport. The remaining passengers originate throughout Middle Tennessee and portions of northern Alabama and southern Kentucky (5, pp. 2-3).

Population Growth

Nashville Metropolitan Region has experienced moderate population growth since 1950. The population of Davidson County increased from approximately 321,800 in 1950 to some 448,000 in 1970, an increase of 39% for the 20 year period. The region as a whole increased at a slightly faster rate, growing from 446,600 in 1950 to some 634,900 in 1970, or an overall increase of 42% for the period. Davidson

County is the dominant population center of the region and has historically accounted for more than two-thirds of the population (5, pp. 5-12).

The Metropolitan Planning Commission forecasts the Davidson County population as growing moderately and reaching a level of 619,600 by 1990, an overall increase of 38.3% from the 1970 population. The Metropolitan Region is also expected to grow moderately to reach a level of 901,000 by 1990, an overall increase of 41.9%. As in the past, Davidson County is expected to remain the urban core of the region and to continue to account for more than two-thirds of the population (5, pp. 5-12).

Economic Development

Nashville is the second largest metropolitan area in Tennessee, the capital of the state and a major center of trade and commerce for the Mid-South Region.

A strong agricultural economy was begun by the early settlers of Nashville, providing for the development of agriculture service and market functions such as food processing, retail and wholesale trade, and textile manufacturing (5, p. 12).

The economy of Nashville has diversified since its early days as an agricultural center. Today the city is a center of manufacturing, finance, trade, education, entertainment and government. Growth in the last decade has been most rapid in durable goods manufacturing, wholesale trade, services, government and finance (5, p. 13).

Total nonagricultural employment between 1960 and 1970 increased from 160,900 to approximately 208,000 employees in Metropolitan Nashville. The growth reflected an average increase of 2.6%. In 1974, nonagricultural employment was estimated to be 228,000, or approximately a 2.4% annual increase between 1970 and 1974. The forecast range of persons engaged in nonagricultural employment through 1995 is between 290,400 and 334,200, an annual increase between 1.4 and 1.9% (5, pp. 13-19). Tables I and II show employment profiles for Davidson County and the Metropolitan Region from 1965 through 1985.

Summary

Davidson County and the Metropolitan Region are expected to experience a steady, stable growth over the next 20 years, with a continuing diversification of the economy. This is primarily because of Nashville's strategic location between the manufacturing belt of the North and the growing Southern markets and Nashville's continuing development as a regional finance, industrial and trade center as well as its function as an educational center and seat of government (5, pp. 16-18).

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TABLE I

INDUSTRY TRENDS FOR DAVIDSON COUNTY, 1965-1985

Industry	1965	% of Total	1970	% of Total	1975	% of Total	1980	% of Total	1985	% of Total
Agriculture, Forestry, Fisheries, & Mining	1,600	0.9	1,400	0.7	1,200	0.5	1,250	0.5	1,300	0.5
Construction	11,500	6.4	11,800	5.6	13,600	5.8	14,450	5.5	15,000	5.2
Manufacturing	40,300	22.4	49,300	23.5	56,100	23.7	62,850	23.9	67,050	23.3
Transportation, Communication, & Other Public Utilities	11,000	6.1	11,300	5.4	11,700	4.9	12,000	4.6	12,250	4.3
Wholesale Trade	8,700	4.8	10,800	5.2	12,550	5.3	14,250	5.4	15,950	5.5
Retail Trade	26,150	14.5	30,300	14.5	33,950	14.3	38,050	14.4	42,650	14.8
Finance, Insurance, & Real Estate	10,000	5.5	11,200	5.3	12,400	5.2	13,650	5.2	14,700	5.1
Services	42,000	23.3	49,900	23.8	58,400	24.7	65,750	25.0	73,650	25.6
Government	23,500	13.0	27,200	13.0	30,900	13.0	34,650	13.2	38,650	13.5
Other	5,550	3.1	6,200	3.0	6,000	2.6	6,100	2.3	6,300	2.2
Total	180,300	100.0	209,400	100.0	236,800	100.0	263,000	100.0	287,500	100.0

Source: Metropolitan Planning Commission.

TABLE II

INDUSTRY TRENDS FOR NASHVILLE METROPOLITAN REGION, 1965-1985

Industry	1965	% of Total	1970	% of Total	1975	% of Total	1980	% of Total	1985	% of Total
Agriculture, Forestry, Fisheries, & Mining	8,850	3.7	7,500	2.6	6,500	2.0	6,650	1.8	6,800	1.7
Construction	15,850	6.6	16,250	5.7	19,000	5.8	20,600	5.6	21,550	5.4
Manufacturing	55,900	23.1	70,000	24.7	82,000	25.2	93,200	25.5	100,200	24.9
Transportation, Communication, & Other Public Utilities	13,300	5.5	14,050	5.0	14,900	4.6	15,350	4.2	15,850	4.0
Wholesale Trade	10,400	4.3	13,300	4.7	15,650	4.8	18,000	4.9	20,250	5.0
Retail Trade	34,200	14.2	40,200	14.2	45,900	14.1	51,900	14.2	58,450	14.5
Finance, Insurance & Real Estate	12,250	5.1	13,900	4.9	15,600	4.8	17,500	4.8	19,050	4.7
Services	51,700	21.4	62,900	22.2	75,000	23.0	85,700	23.4	96,500	24.0
Government	31,700	13.1	37,300	13.1	43,250	13.2	48,900	13.3	54,800	13.6
Other	7,350	3.0	8,200	2.9	8,200	2.5	8,400	2.3	8,650	2.2
Total	241,500	100.0	283,600	100.0	326,000	100.0	366,200	100.0	402,100	100.0

Source: Metropolitan Planning Commission.

III. TERMINAL AND AIRSIDE FACILITIES

The principal role of an airport is to provide an interface between air and ground transportation. Based upon this role, airport facilities can be grouped into three functional categories consisting of airside, terminal, and access and distribution facilities.

Airside facilities consist of the aircraft operational area and include runways, taxiways, parking aprons, and various support facilities. The terminal provides the actual interface between air and ground transportation for both passengers and cargo. The access and distribution system consists of all facilities and services utilized by the airport population in traveling to and from the airport (2, p. 8).

Passenger and cargo movement at an airport follows two basic paths. Enplaning passengers and cargo arrive via the access and distribution system, move through the terminal facilities, and exit at the airside facilities. Whereas deplaning passengers arrive on the airside, move through the terminal in an opposite direction, and exit via the access and distribution system.

The three functional areas are highly dependent upon each other as a result of these movements. The failure of one area to operate efficiently can disrupt the entire airport operation resulting in costly and time consuming delays

thus reducing the effectiveness of the air transportation system.

To develop a functional access and distribution system, it is necessary to study the capacity of the terminal and airside facilities, and determine their effectiveness. The most elaborate access and distribution system would be useless if the interdependent terminal and airside facilities were not capable of adequately handling the demands placed on them by the air transportation system.

Air traffic forecasts have been made and provide the basis for determining what facilities are necessary to meet the demand (see Table III).

Airside Facilities

At the Nashville Metropolitan Airport there are three runways consisting of 2L-20R (7700'), 2R-20L (4026') and 13-31 (8000'). Runways 2L and 13 are precision instrument runways. All taxiways on the airport are 75' wide and are lighted with medium intensity lights. (See Figure 2.)

Navigation aids include airport surveillance radar (ASR), vertical approach slope indicator (VASI), a very high frequency omnidirectional range (VOR) with distance measuring equipment (DME), nondirectional beacon and Stage III radar. Also located on the airport are an FAA control tower, flight service station, and U.S. Weather Bureau station (6, pp. 1-2).

TABLE III

AIR TRAFFIC FORECAST FOR NASHVILLE METROPOLITAN AIRPORT

	(Actual) 1970	(Actual) 1975	1980	1985	1990
1. Population (Davidson Co.)	448,003	475,500	545,600	580,800	619,600
2. Annual Enplaned Passengers	653,072	848,829	1,700,000	2,600,000	3,700,000
3. Annual Scheduled Aircraft Departures	75	78	96	110	126
4. Average Passengers Enplaned Per Flight	24	30	48	65	80
5. Annual Aircraft Operations					
Air Carrier	60,282	57,183	79,000	90,000	104,000
General Aviation	111,889	126,161	151,000	187,000	248,000
Military	10,340	8,548	11,000	11,000	11,000
6. Terminal Gate Positions	14	14	16	19	24
7. Cargo Apron Positions	4	4	4	4	4
8. Annual Enplaned Mail (Tons)	3,224	4,769	6,700	8,600	11,000
9. Annual Enplaned Cargo (Tons)	10,442	13,503	39,000	73,000	132,000

Source: Metropolitan Nashville Airport Authority.

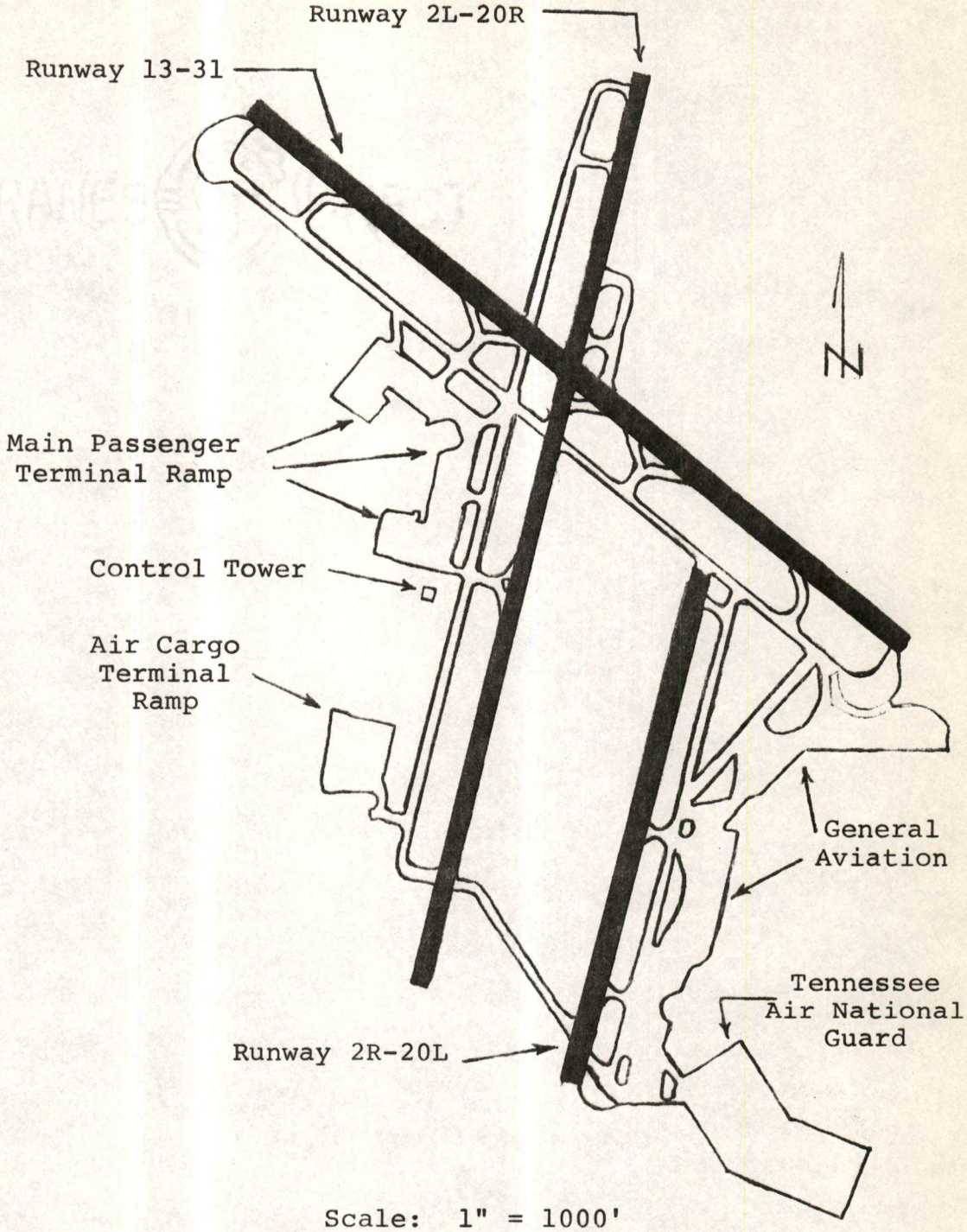

Figure 2. Nashville Metropolitan Airport--airside facilities.

Source: Metropolitan Nashville Airport Authority.

The annual capacity[1] of the existing airfield configurations is 390,000 operations (5, p. C-7). Forecasts show that the airport will exceed this capacity during the 1990's (6, p. 7). Based upon this analysis, the 1990 Master Plan Study indicated the following recommendations to insure that proper airside facilities would be available to meet the forecasted demand:

1. Extend runway 2L and 20R and associated parallel taxiway 950 feet in a southerly direction by 1980.
2. Extend runway 13-31 and its associated parallel taxiway 2000 feet by constructing a 1000 foot extension on each end by 1980.
3. Acquire approximately 970 acres of land contiguous to the airport for future development of a new ILS runway parallel to 2L-20R, and necessary parallel and connecting taxiways after 1990.
4. Acquire or control remainder of clear zone for extended runway 2L-20R.
5. Lime stabilization of taxiway 2L-20R and runway 2L-20R.

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[1]Annual capacity is defined as that level of annual operations at which the aircraft traffic demands exceed the hourly airfield capacity for 10% of the operations or 5% of the time. Hourly airfield capacity is defined as the average number of aircraft operations which the runways and taxiways can accommodate for two consecutive hours with an average delay of less than four minutes to arriving and departing aircraft (5, p. C-4).

6. Overlay and groove runway 2L-20R.
7. Raise runway 2L-20R high intensity runway lights.
8. Overlay and groove runway 13-31.
9. Overlay taxiway 13-31.
10. Install centerline and touchdown zone lights for runway 2L-20R.
11. Modify and fillet taxiway radii.
12. Construct taxiway connector and apron area when new terminal complex is developed (6, pp. 21-22).

These recommendations, when completed, would provide an airfield capacity of 600,000 annual operations (5, p. C-7). Therefore, adequate facilities would be available to meet the forecasted demand.

Terminal Facilities

The terminal building, opened in 1961, is constructed on two levels, with apron areas at a higher grade than curbside (see Figures 3 and 4). Airline ticketing and baggage claim areas are located adjacent to the curbside. At the apron level, there is a large central public lounge, adjacent restaurant and bar, and two concourses accommodating a total of 14 gates. The segment which bridges the service roadway and connects the apron and lobby areas houses various airport offices (6, p. 3).

A recently completed air cargo terminal facility increased the freight handling space by 21,000 square feet. This brings the combined total inbound and outbound cargo

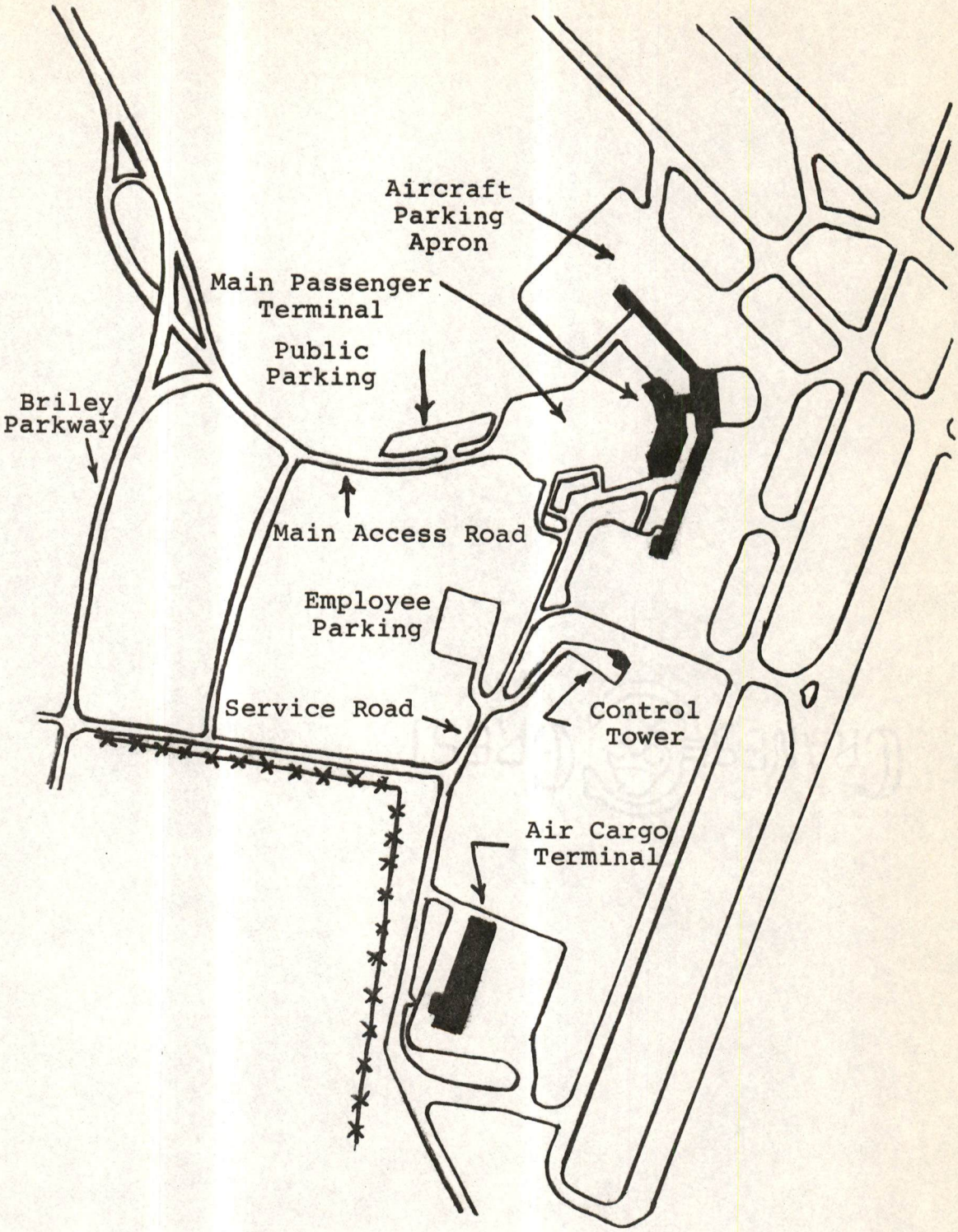

Figure 3. Terminal facilities.

Source: Metropolitan Nashville Airport Authority.

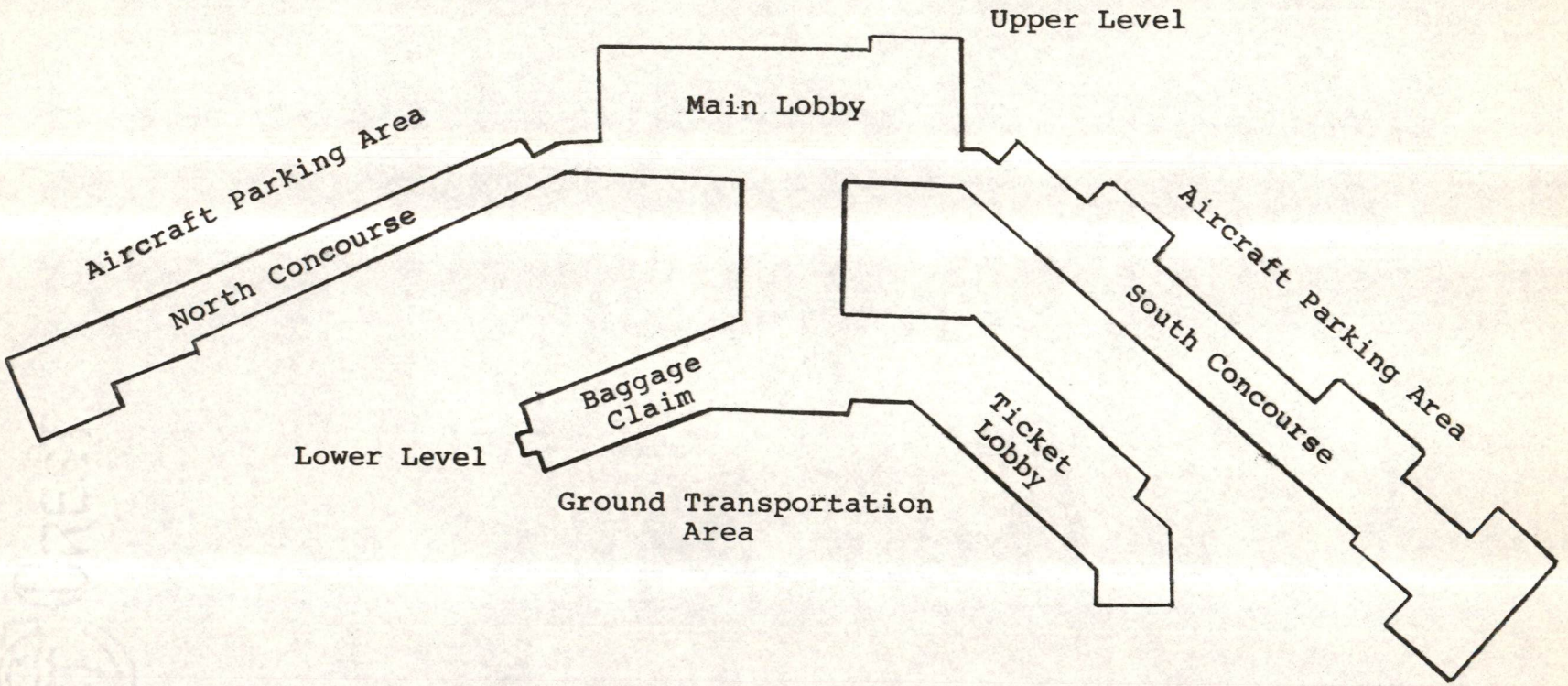

Figure 4. Main passenger terminal building layout.

Source: Metropolitan Nashville Airport Authority.

facilities to 81,000 square feet. This structure also houses the U.S. Postal Service, U.S. Customs and various freight forwarding firms (8, p. 3).

The 1990 Master Plan Study stated that the air passenger terminal was inadequate and would require expansion and major modification to meet immediate and long-range needs. This study identified major deficiencies including:

1. Minimum size holdrooms.
2. Congestion in the main lobby at peak periods.
3. Inadequate baggage claim area.
4. Inadequate queuing space in front of check-in counters.
5. Excessive walking distance between ticketing and baggage claim area, and the aircraft gates.
6. Inadequate curbside and roadway to handle peak enplaning and deplaning traffic (6, p. 3).

This study recommended the expansion of facilities by constructing either a new complex located between the existing and proposed north/south runway or the expansion of the existing terminal building (6, pp. 22-23).

The 1990 Master Plan Study was then used as a basis for undertaking a more precise, definitive examination of available terminal expansion and development alternatives. An Evaluation Team was formed in December 1973 under management of the Metropolitan Nashville Airport Authority. This team was comprised of architects, engineers, airport planners,

financial consultants and technical representatives of the various airlines (9, pp. 1-8).

The Evaluation Team reported their findings and recommendations to the Airport Authority Board of Commissioners on July 19, 1974. The recommendations were as follows:

1. The long term solution for expanding terminal facilities should be through construction of a new complex east of the present facility located between the present and proposed north/south runways.
2. Existing terminal should be upgraded and improved, maximizing use of this facility pending planning, design, and construction of the recommended new terminal complex (9, p. 18).

The airline representatives, as an integral part of the evaluation study, presented a plan for maximizing continued use of the existing terminal to accommodate a 1.8 million enplaned passenger level. They proposed that the development phase for the recommended new complex be commenced when enplaned passenger level reached 1.3 million (9, p. 16).

Summary

Airfield and terminal complex facilities play major roles in the smooth and efficient operation of the air transportation system. At the Nashville Metropolitan Airport

deficiencies within these facilities exist which impede the operational capabilities of the airport and the air transportation system. Detailed studies were undertaken to identify these deficiencies. Plans have been developed which will eliminate the deficiencies and insure adequate terminal and airside facilities in the future.

The implementation of these plans began in July of 1975, when the Airport Authority sold 16.1 million dollars of revenue bonds. The renovation of the existing terminal building began in the fall of 1975 and was scheduled for completion in early 1977. These funds are also being used for the recommended airfield improvements (8, pp. 1-2).

IV. EXISTING ACCESS AND DISTRIBUTION SYSTEM FACILITIES

The purpose of this section is to analyze the existing access and distribution system of the Nashville Metropolitan Airport and determine the capability of the system to meet both existing and future air transportation demands.

As indicated in Section III, detailed studies have been undertaken to insure that adequate terminal and airside facilities are developed to meet the air transportation needs. However, very little consideration has been given to the needs of the access and distribution system.

Access and distribution planning to date has concentrated almost entirely upon the on-airport segment and the highway system immediately adjacent to the airport. The limited scope of access planning is shown in the "Access Analysis" study included in the recently completed Airport Development Plan--Implementation (7, Appendix D). This study concentrated upon the on-airport access roads and the highway system immediately adjacent to the airport only. This analysis was made for automobile traffic only and no other mode of transportation was included (7, p. 1).

The access and distribution system does not end at the airport boundary or immediately adjacent to it. The total trip to and from the airport must be the criterion for determining system effectiveness.

At the Nashville Metropolitan Airport, airline passengers and passenger related visitors comprise approximately 58% of the airport population. The remaining 42% consists of persons employed at the airport (8, p. 8; 10, pp. 41-44).

An airline passenger survey was conducted by the Metropolitan Nashville Airport Authority in March, 1971. This survey identified the access modes used in traveling to the airport with the modal distribution as shown in Table IV (5, p. A-9).

Based upon this survey, 96.2% of the airline passengers utilize some form of highway transportation as access to the airport. In like manner, airport employees rely almost entirely upon the private automobile for travel to and from the airport. Therefore, an analysis of the existing access and distribution system is basically a study of the various modes of highway transportation.

The same passenger survey identified local passenger origins throughout the Middle Tennessee region. This region was defined as the Air Trade area and is shown in detail in the Appendix. Based upon this survey, 76.7% of the airline passengers originate in Davidson County (5, p. 1). Approximately 70% of airport employees live in Davidson County with the remainder commuting from surrounding counties (11, pp. 1-11).

TABLE IV

AIRPORT ACCESS MODES

Mode	Percentage of Total
Air Taxi	0.0
Private Plane	3.8
Rental Car	15.1
Private Car	61.7
Bus	0.9
Limousine	12.3
Taxicab	2.5
Hotel/Motel Car	3.7
	100.0%

Source: Metropolitan Nashville Airport Authority.

Existing Highway System Analysis

The Bureau of Public Roads conducted an in-depth study of highway access problems at all large and medium hub airports in the United States. They recommended that 30 minutes be considered as maximum acceptable travel time to an airport (10, p. 57).

Time to the air traveler is very important, whether it is spent in the air or traveling to and from the airport. It is a major factor in the choice of air transportation as a mode of travel. For the businessman, nonproductive travel time can be very costly. Therefore, he chooses air transportation over other modes because of the reduced travel time. At the Nashville Metropolitan Airport, 65.8% of air passengers travel for business purposes (5, p. A-11).

Figures 5 and 6 indicate the major highway network providing access and distribution in the Nashville Metropolitan Airport's Air Trade area (see the Appendix).

Several factors act as constraints upon the highway system and result in increased travel time. Speed limits increase travel times by reducing maximum operating speeds. Highway congestion, bad weather, and traffic accidents are other factors which act to further increase travel time (12, p. 4-3).

A 1974 Metropolitan Planning Commission study identified specific highways which exhibited undesirable operating speeds below 20 mph, indicative of travel time

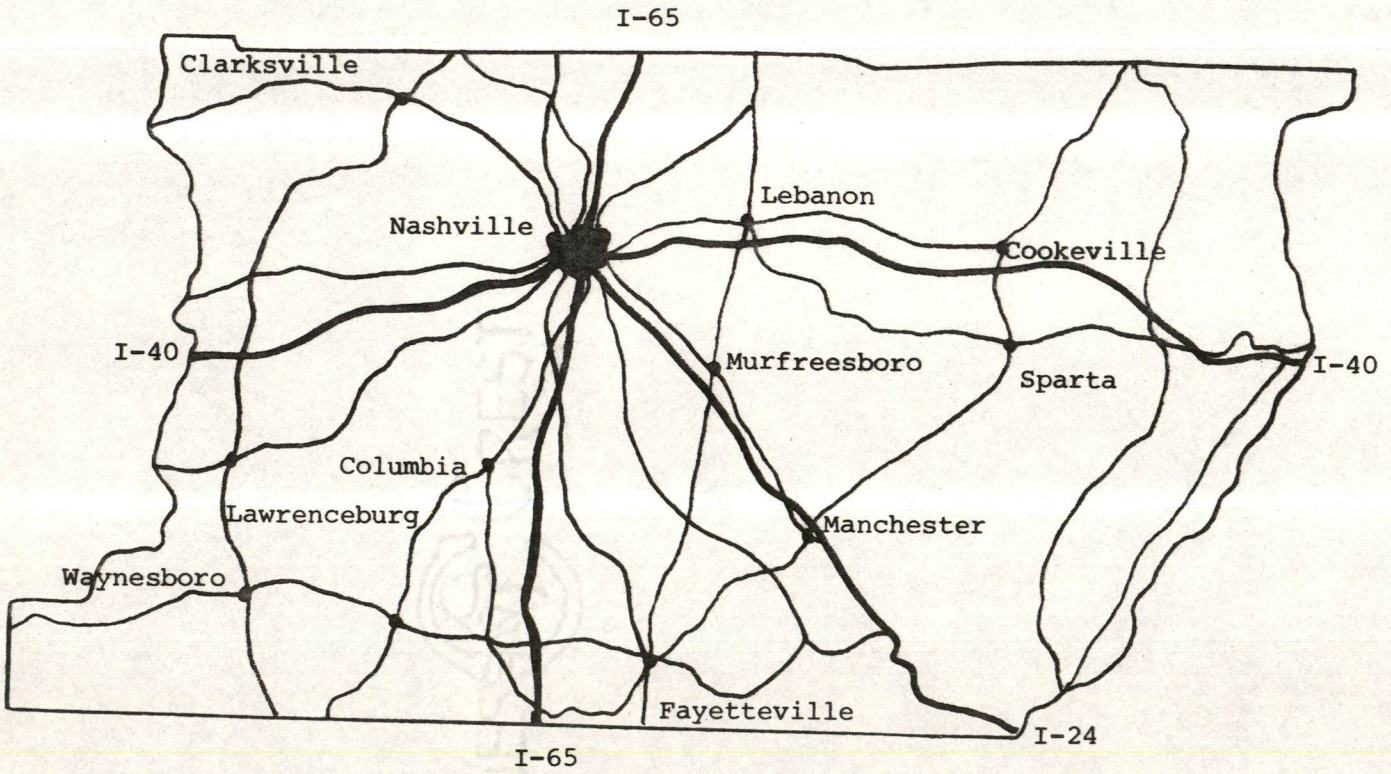

Figure 5. Major highway network--Air Trade Area.

Source: Road Atlas and Travel Guide, 1971, Rand McNally & Company, pp. 44 and 45.

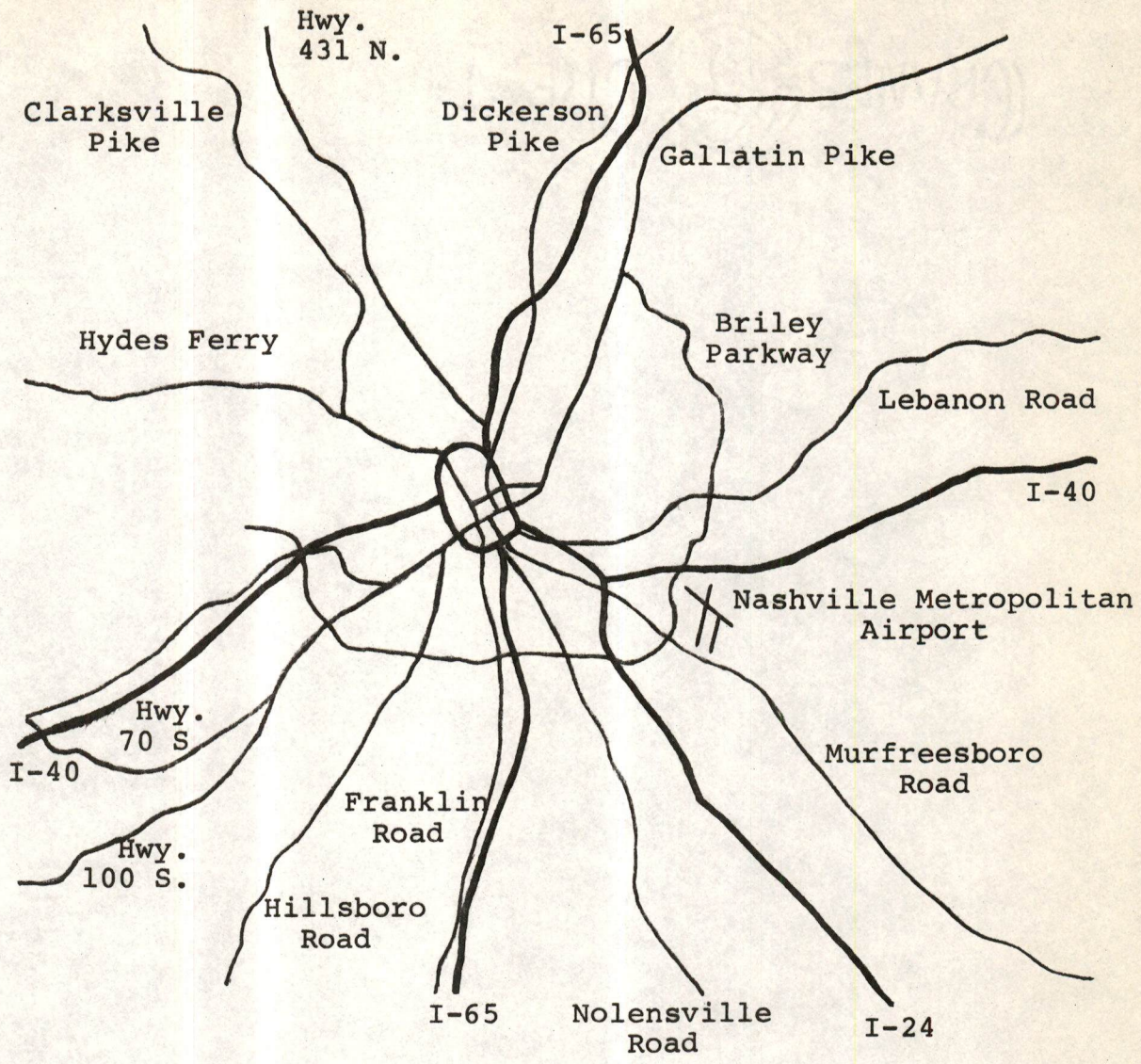

Figure 6. Major highway network--Davidson County.

Source: Road Atlas and Travel Guide, 1971, Rand McNally & Company, pp. 44 and 45.

delay and undue congestion (16, pp. 39-43). These road systems are shown in Table V.

The maximum operating speed on the highway system today is 55 mph, the national speed limit. If ideal highway conditions existed, one could travel 27.5 miles in the 30 minutes considered as acceptable travel time to and from the airport.

Based upon local passenger origins (see Appendix), approximately 87% of today's airline passengers would have access to the airport within the 30 minute time limit.

However, ideal highway conditions do not exist. An actual measurement of highway travel times during nonrush hour periods was made, the results of which are shown in Figure 7. Based upon these measurements only 63% of all airline passengers would have adequate access--a reduction of 24% from ideal conditions. Furthermore, airport trips tend to peak during rush hour traffic periods. This further reduces the effectiveness of the highway system as an adequate means of access and distribution.

The above analysis was based upon the existing passenger distribution. When one views potential air passengers, results are somewhat different. The Nashville Metropolitan Airport is the major air carrier facility serving the Middle Tennessee Region. This Air Trade Area is comprised of 38 counties with a total population of 1,230,481 people (13, pp. 17-23). If each person was considered as a potential air traveler, only 51% of the

TABLE V

1974 CONGESTED LINKS ON SELECTED MAJOR ARTERIAL SYSTEMS

Highway	Links	Average Peak Hour Operational Speeds (mph) A.M.	P.M.
Murfreesboro Pike	I-24 East to Thompson Lane	23.8	19.8
21st Avenue South	19th Ave. So. to Edgehill Ave.	16.6	13.3
	Edgehill Ave. to Blair Blvd.	17.6	11.9
Hillsboro Pike	Old Hickory Blvd. to Davidson Co. Line	15.8	33.8
8th Ave. North	Jefferson St. to Monroe St.	15.1	11.2
8th Ave. South	Chestnut St. to Wedgewood Ave.	15.6	19.1
Franklin Pike	Wedgewood Ave. to Kirkwood Ave.	16.8	15.8
Franklin Pike	Kirkwood Ave. to Thompson Lane	32.0	17.3
Franklin Pike	Thompson Lane to Caldwell Lane	15.1	21.6
Gallatin Pike	Interstate Drive to Trinity Lane	19.8	19.4
Gallatin Pike	Briley Parkway to Due West Avenue	19.8	17.6
Gallatin Pike	Due West Avenue Neely's Bend Road	18.7	15.1
Gallatin Pike	Neely's Bend Road to Old Hickory Blvd.	16.2	8.6
West End Avenue	Cherokee Avenue to Woodmont Blvd.	20.5	16.6

TABLE V (continued)

Highway	Links	Average Peak Hour Operational Speeds (mph) A.M.	P.M.
Robertson Road	Charlotte Pike to I-40 West	15.2	16.2
Woodmont Blvd.	Hillsboro Pike to Belmont Blvd.	27.4	18.0
Thompson Lane	Sidco Drive to Nolensville Pike	15.1	20.9
Thompson Lane	Nolensville Pike to I-24 East	18.4	19.8
Trinity Lane	I-65 North to Dickerson Pike	18.4	16.2
Trinity Lane	Dickerson Pike to Jones Avenue	14.8	27.7

Source: Tennessee Department of Transportation.

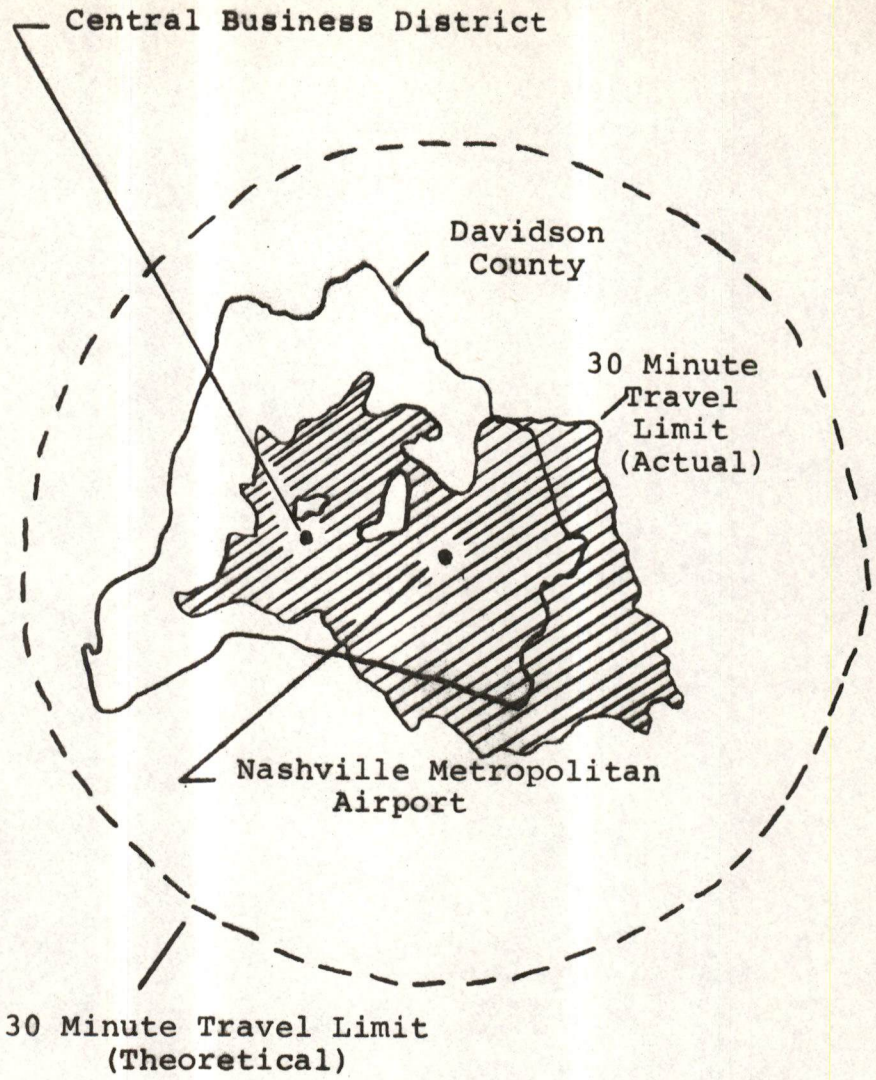

Figure 7. Thirty minute travel limits.

Source: Actual travel time measurements made by the author and supplemented with data supplied by the Tennessee Department of Transportation.

population would lie within the theoretical 27.5 mile access radius. In considering the actual travel time measurements, only 27% of the population of the air trade area would have adequate access via the highway system. Again, this is further reduced during the congested peak hour traffic periods.

Several factors today exist which act as constraints upon the development of adequate highway facilities. Some of the constraints are:

1. Increasing cost of highway construction and maintenance.
2. Increasing cost of land necessary for highway development.
3. Reluctance of the taxpayer to fund highway construction programs.
4. Increased environmental concern (noise and air pollution, and disruption of neighborhoods and the community).
5. Increasing energy consumption and cost.
6. Decreasing energy resources.
7. Increased vehicle operating cost.

Evidence of these constraints are seen in the reduction of the speed limit from 75 mph to 55 mph.

Congestion is a constraint which reduces the effectiveness of the existing highway system. As the Nashville Metropolitan Region grows, more demand is placed upon the highways. As traffic volume increases, operating speeds

decrease, with an increase in the number of accidents (12, pp. 4 and 19). A recent study commented upon the local transportation system of Nashville (18, p. 7):

> The reliance on the private automobile as a major mode of transportation and a subsequent lack of adequate public transportation services affects not only those who are not able to drive but also the commuting public. Present trends indicate a lack of transportation mode choice which results in increased peak hour congestion and thereby inhibits movement opportunities.

Intracity Mass Transit System

The local urban mass transit operation was transferred from private ownership to the Metropolitan Transit Authority in September 1973 (14, p. 8). The transit system consists of 140 buses operating on 40 routes (14, p. 6). Ridership reached a low point in 1974 of 6,612,000 revenue passengers (16, p. 72). However, since transfer to the Metro Transit Authority, the declining trend has reversed and over 7,000,000 passengers were recorded during the 1975-1976 fiscal year (14, p. 8).

The existing transit system provides limited service as a means of access and distribution for the airport. All bus routes originate from the Central Business District (CBD). Bus service to the airport is from the CBD only. Scheduled travel time is from 35 to 40 minutes, an unacceptable travel time (15, p. 15).

Passengers with a destination in other parts of the city must first travel to the CBD and then transfer to another bus for transportation to their destination.

The existing transit system operates within the highway system environment. No exclusive busways or dedicated bus lanes exist. Under this condition, the bus is one of the least effective means of highway transportation.

The Metropolitan Transit Authority is undertaking a two phase technical study program to improve the existing transit system operation. The first phase involves a short range capital improvement program for a five-year time frame. The second phase is the development of a long-range program for a 20-year period with regional and local long-range transit goals to be interrelated with the total transportation system. Dedicated bus lanes and "park and ride" terminal facilities will be given consideration in the development of this program (16, p. 73).

Intercity Bus Service

Greyhound and Continental Trailways provide intercity bus service throughout the entire Middle Tennessee Region. As with the local transit system, both companies operate from their respective bus stations located in the CBD. Even though both companies have scheduled routes which operate on the highways immediately adjacent to the airport, they do not stop at the airport. It is necessary for the traveler to find another mode of transportation to and from the airport and the downtown bus stations. This system is also characterized by excessive travel times.

Air Commuter Service and Private Aircraft

Air commuter service is provided by Aerie Airlines and Southern Airways to Clarksville, Tennessee (17, pp. 1-2). This is the only city in the Air Trade Area where such service is offered. Private aircraft is also a means of access and distribution in the Air Trade Area. However, this mode is characterized by high operating cost and limited availability.

Other Modes of Transportation

Air cargo and freight are accessible to the airport by the highway system only. This consists primarily of small delivery vans and truck transport. No form of rail or water transportation is available to the air freight terminal facilities. However, freight can be delivered to downtown river ports and rail yards. From those points, freight would have to be trucked to and from the airport on the highway system.

Summary

The major means of access and distribution to the Nashville Metropolitan Airport is via the highway system. The major mode of travel is the private automobile which was used by 61.7% of the airline passengers. The remainder consists primarily of other modes of highway transportation--taxi, bus, limousine, hotel-motel courtesy car and rental car. Based upon a 30 minute travel time maximum, 63% of existing airline passengers had adequate highway access.

Only 27% of the people living within the Air Trade Area had access to the airport within the average 30 minute travel limit.

Bus transportation is ineffective as a means of access and distribution and is characterized by excessive travel time. Private aircraft and air taxi provided very limited access to the airport.

V. ACCESS AND DISTRIBUTION SYSTEM PLAN

It has been determined that the existing access and distribution system for the Nashville Metropolitan Airport possesses characteristics which act as constraints upon the system and result in increased travel time. The purpose of this section is to identify various alternatives capable of providing adequate access and distribution facilities. Also, it is the purpose of this section to recommend a means for determining the proper course of action necessary to provide adequate facilities and a method for implementing such a program.

Alternatives

Requirements for future transportation to and from airports include increased demands not only by air passengers but also by other users of airports such as airport and airline personnel, sightseers, well-wishers, and employees of businesses located at or in the immediate vicinity of airports. The required highway investments necessary to adequately handle forecast peak-hour traffic volumes are extremely high and may result in substantial disruption and relocation in urban areas (19, p. 1).

A more efficient use of optional modes of transportation should be encouraged since the traditional response to transportation needs such as added highway corridors or additional lanes to meet insatiable peak hour demands is

being reexamined in view of public economy, neighborhood disruption and environmental concerns (20, p. 11).

Four alternatives that appear to be feasible as alternate modes of ground transportation to and from airports are:

1. Railroads and subways using separate rights-of-way.
2. Railroads and subways using common rights-of-way with other rail traffic.
3. Buses and limousines using separate highway rights-of-way.
4. Buses and limousines using existing highways and city street systems (19, p. 1).

The potential application of rail transit to the Nashville Metropolitan Airport is extremely limited. The capacity of rail transit systems range from 10,000 to 50,000 passengers per hour (12, p. 2-5). There are relatively few cities in the United States that have the density of population and airport usage to warrant consideration of rail transit facilities. New York City, with its high core density and high airport usage, forecast a rail mass transit peak ridership of only 2,500 people. In view of this, the feasibility of rail transit access to the Nashville Metropolitan Airport is remote (19, p. 3).

An alternate to rail transit is separate high speed busways. Such a busway was proposed for the Kansas City International Airport (19, pp. 16-20). The primary value of

such a system is that it is not impeded by peak hour traffic congestion as are buses using local street and highway networks. The buses may operate at speeds equivalent to those of rail transit and thus make substantial reductions in ground transportation time (19, p. 3).

Some airport planners are considering the remote air terminal concept to relieve congestion. Logic seems to indicate that movement of the parking, baggage handling, ticketing, and other passenger and cargo services from the main air terminal to off-site terminals would alleviate congestion at the main terminal and provide better service to airport users. Such a facility was developed at Van Nuys, California, and has met with considerable success (20, pp. 9-10).

Air commuter service is a potential means of access and distribution for the remote areas served by the Nashville Metropolitan Airport. Legislation is currently being formulated in Congress to aid communities in the acquisition of air commuter service by means of subsidies.

Various federal programs are available to provide financial assistance in the development and implementation of transportation programs. Unified planning encompassing transit, highways, airways and land use is available on a local level with financial assistance being provided by the Urban Mass Transit Administration (UMTA), Federal Highway Administration (FAA), and Housing and Urban Development

(HUD) (2, pp. 35 and 26). A summary of specific elements eligible for federal assistance is listed in Table VI.

Determination of Specific Plan of Action

Implementation of a specific plan of action to improve access and distribution would not only affect the airport, but the entire Middle Tennessee Region. It would necessitate the coordination and efforts of many agencies, both public and private. The complex institutional structures that exist are one of the most serious constraints upon the development of adequate access and distribution facilities.

One of the major functions of the Metropolitan Nashville Airport Authority is to encourage and promote air transportation. The Metropolitan Airport Authority Act of 1969 created the Airport Authority as a public and governmental body with the responsibility of operating airports and related facilities (22, p. 28). Based upon these functions, it is recommended that the Metropolitan Nashville Airport Authority create a technical coordinating committee with the following objectives:

1. Development of a specific plan of action designed to provide adequate access and distribution facilities for the Nashville Metropolitan Airport.
2. The coordination of such a plan with the various agencies involved with creating and implementing transportation policy in Tennessee.

TABLE VI

FEDERAL ASSISTANCE PROGRAMS

Element	Sponsor	Program
Automobile Parking	FAA	PGP (662/3%)
	UMTA	Technical Studies (Up to 100%)
	FHWA	Public Transportation (70-90%)
Pedestrian Walkways (On Airport)	FAA	ADAP (50%)
	FAA	PGP (662/3%)
	UMTA	Technical Studies (Up to 100%)
Road Links between Parking and Modal/ Intermodal Terminal	FAA (On Airport)	ADAP (50%)
	FAA	PGP (662/3%)
	UMTA	Capital Grant (80%)
	UMTA	Technical Studies (Up to 100%)
	FHWA	Public Transportation (70-90%)
	FHWA	Fringe & Corridor (70%)
	FHWA	Urban System
Bus Terminals Ramps, Shelters & Buildings	FAA (On Airport)	ADAP (50%)
	FAA	PGP (662/3%)
	UMTA	Capital Grant (80%)
	UMTA	Technical Studies (Up to 100%)
	FHWA	Public Transportation (70-90%)
	FHWA	Fringe & Corridor (70%)
	FHWA	Urban System
Rapid Rail	FAA (On Airport)	ADAP (50%)
	FAA	PGP (662/3%)
	UMTA	Capital Grant (80%)
	UMTA	Technical Studies (Up to 100%)
	FHWA	Urban Systems
	FRA	High Speed Ground
Air Terminal Land	FAA	ADAD (50%)
	FAA	PGP (662/3%)
Air Terminal Bldg.	FAA	PGP (662/3%)
Entrance Roads	FAA (On Airport)	ADAP (50%)
	FAA	PGP (662/3%)
	UMTA	Technical Studies (Up to 100%)
	FHWA	Public Transportation (70-90%)
	FHWA	Urban System
	FHWA	Special Urban Hi-Density Program

TABLE VI (continued)

Element	Sponsor	Program
Exclusive Truck Lanes	FAA	PGP (662/3%)
	FHWA	Exclusive Truck Lane
Joint Use Access Roads	FAA	PGP (662/3%)
	UMTA	Capital Grants (80%)
	UMTA	Technical Studies (Up to 100%)
	FHWA	Public Transportation (70-90%)
	FHWA	Urban System
	FHWA	Special Urban Hi-Density Program
Satellite Terminal	UMTA (Mass Transit)	Capital Grant (80%)
	UMTA (Mass Transit)	Technical Studies (Up to 100%)
	FHWA	Public Transportation (70-90%)
	FHWA	Fringe & Corridor (70%)
	FHWA	Urban System
	FHWA	Exclusive Truck Lane

Source: U.S. Department of Transportation.

The specific access and distribution requirements of the Nashville Metropolitan Airport are small when compared with the total demand for transportation in the region. Therefore, it is urged that the Metropolitan Nashville Airport Authority take the initiative to insure that adequate access and distribution facilities for the airport are coordinated and integrated with the total transportation policy for Tennessee.

The creation of a technical coordinating committee comprised of the various agencies involved in formulating Tennessee transportation policy would be the first step. The major concern of this committee would be to identify the access and distribution requirements of the airport and integrate these requirements within the transportation policy of Tennessee. The membership of the technical coordinating committee should include but not be limited to the individuals and agencies listed in Table VII.

Summary

Various alternatives were identified as means of increasing the efficiency of the existing access and distribution system. Federal assistance is available through various agencies to aid in planning and development. It was recommended that the Metropolitan Nashville Airport Authority form a technical coordinating committee to insure coordination and integration of the access and distribution requirements within the transportation policy of Tennessee.

TABLE VII

TRANSPORTATION TECHNICAL COMMITTEE

1. Metropolitan Nashville Airport Authority:
   Albert J. Huber, Executive Director
   John Fisher, Airport Planner
   Richard Morgan, Airport Engineer
   Frank Knapp, Director of Operations
   James Graham, Director Finance and Administration
   Steve Fitzhugh, Supervisor of Operations (Smyrna Airport)
   Randall S. Curtis, Administrative Assistant--Property Management

2. Tennessee Department of Transportation:
   Eddie Shaw, Commissioner
   W. H. Wilson, Administrative--Urban Transportation Planning
   Earl C. Williams, Jr., State Traffic Engineer
   Paul Edens, Deputy Director--Bureau of Planning

3. Metropolitan Planning Commission:
   Farris A. Deep, Executive Director
   Robert H. Paslay, Planning Director
   Robert C. Kurzynske, Senior Community Planner

4. Metropolitan Transit Authority:
   Dr. Ralph Hines, Executive Director
   Harvell Williams, General Manager

5. Federal Highway Administration:
   Sheldon Strickland, Planning and Research Engineer
   Robert V. Robertson, District Engineer

6. U.S. Corps of Engineers:
   E. C. Moore, Chief--Engineering Division

7. Department of Housing and Urban Development:
   Carol G. Oakes, Area Director

8. Urban Mass Transit Administration:
   Doug Campion, Region IV Representative

9. Mid-Cumberland Council of Governments:
   Marshall S. Stuart, Executive Director

10. Metropolitan Traffic and Parking Commission:
    Melton Tharp, Executive Secretary
    Francis May, Traffic Engineer

TABLE VII (continued)

11. Metropolitan Model Cities Program:
Buford Drake, Director

12. Metropolitan Development and Housing Agency:
John E. Acuff, Director of Development

13. Metropolitan Department of Finance:
Joe E. Torrence, Director

14. Metropolitan Department of Law:
Milton H. Sittion, Director

15. Public Services Commission:
John Searcy, Engineer

16. Tennessee State Planning Office:
Phillip M. Maples, Regional Director

17. Family Lines System (L&N) Railroad:
B. H. Voor, Nashville Division Engineer
Col. Hooper, Vice-President

18. Federal Aviation Administration:
John Dempsey, Chief of Airports

19. Tennessee Bureau of Aeronautics:
Jerry Hall, Chief Engineer

20. Representatives of the Nashville Airlines:
American--Henery O'Neil
Allegheny--Lou Alveridies
Braniff--Jerry Odell
Delta--Bob Miller
Eastern--Harold Gains
Ozark--Val Claxton
Piedmont--Vise Dotson
Southern--Bob Brown
Aerie--Clyde Cook

Source: Metropolitan Planning Commission.

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APPENDIX

APPENDIX

LOCAL PASSENGER ORIGINS

An airline passenger survey was conducted by the Metropolitan Nashville Airport Authority during the second and third weeks of March 1971. Of the 24,123 passengers enplaned by the airlines during this period, 3,425 (14.29% of the total) filled out the survey questionnaire. The survey results are shown in Table VIII. Based upon this data, the Air Trade Area was defined and is shown in Figure 8.

TABLE VIII

LOCAL PASSENGER ORIGINS FOR NASHVILLE METROPOLITAN AIRPORT

Origin Point	% of Total
Primary Air Trade Area (Davidson County):	
Central Nashville	25.80
South of Nashville	8.10
Southwest of Nashville	18.40
Northwest of Nashville	2.20
Northeast of Nashville	8.90
East-Southeast of Nashville	13.30
Subtotal	76.7%
Secondary Air Trade Area (Other Counties of Middle Tennessee):	
Bedford	0.50
Cannon	0.03
Cheatham	0.15
Clay	0.00
Coffee	1.20
DeKalb	0.15
Dickson	0.30
Franklin	0.34
Giles	0.41
Hardin	0.00
Hickman	0.15
Houston	0.00
Humphreys	0.61
Jackson	0.07
Lawrence	0.03
Lewis	0.03
Lincoln	0.15
Macon	0.03
Marshall	0.26
Maury	1.25
Montgomery	1.40
Moore	0.00
Overton	0.03
Perry	0.00
Pickett	0.00
Putnam	1.30
Robertson	0.61
Rutherford	2.16

TABLE VIII (continued)

Origin Point	% of Total
Smith	0.07
Stewart	0.03
Sumner	1.48
Trousdale	0.00
Warren	0.49
Wayne	0.15
White	0.23
Williamson	1.43
Wilson	0.68
Subtotal	15.6%
Other Areas:	
Southern Kentucky	5.10
Northern Alabama	0.68
East Tennessee	1.62
West Tennessee	0.34
Subtotal	7.7%
Total	100.0%

Source: Metropolitan Nashville Airport Authority.

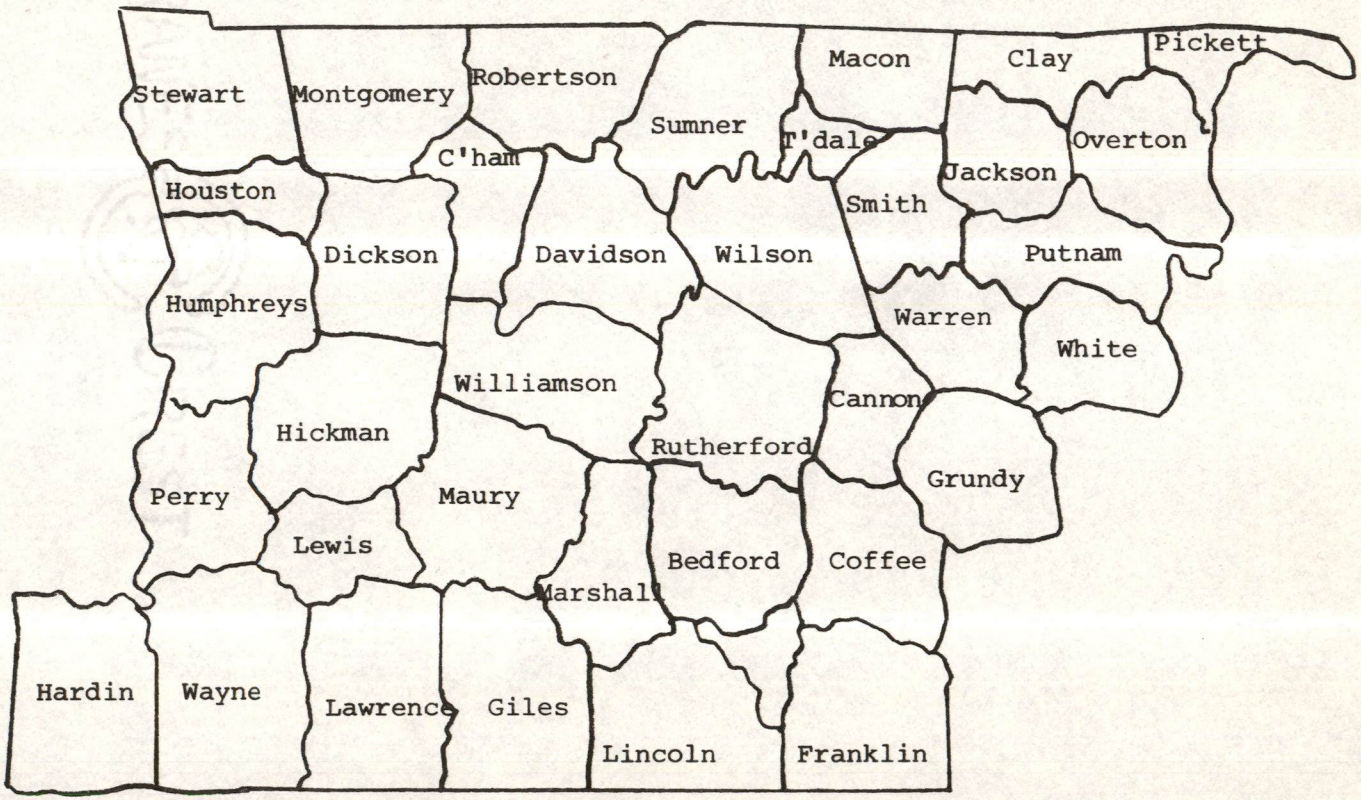

Figure 8. Air Trade Area.

Source: Metropolitan Nashville Airport Authority.

VITA

Randall S. Curtis was born in Shelbyville, Tennessee, on October 14, 1951. He attended elementary schools in that city and was graduated in 1969 from the Bedford County High School. Upon completion of studies at the Middle Tennessee State University in May 1974, he received a Bachelor of Science degree in Aerospace Technology.

He entered the Graduate School of The University of Tennessee Space Institute in the summer of 1974, and received a Master of Science degree with a major in Aviation Systems in December 1976.

Since February 1976, he has been employed by the Metropolitan Nashville Airport Authority and holds the position of Administrative Assistant. He is a member of the American Association of Airport Executives.

He is married to the former Janis Kay Amacher of Lawrenceburg, Tennessee.