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Airport Land Expansion:
A Case Study of Memphis International Airport, Tennessee

A Thesis
Presented for the
Master of Science in Planning
Degree
The University of Tennessee, Knoxville

Junko Nishihara
May, 1995

This thesis is dedicated to
the many individuals, past and present,
who have devoted their lives to airports and
the never-ending task of helping people to
encounter the whole world

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ABSTRACT

Air traffic congestion at major airports is a severe problem in the United States. The primary solution has been to expand existing runways or build new runways. This thesis examines Memphis International Airport as the case study in the issue of airport land expansion related to runway expansion.

The history of the airport from 1929 to 1994 is reviewed, and the issues related to runway expansion, demand forecasting, land acquisition, noise compatibility programs, zoning and land use are examined. The study reveals that unpredictable and diverse events have made accurate long-range airport planning difficult, and that land was purchased when runway expansion was needed. If the demand of the airport is increasing, long-term implementation of airport land expansion will be required since the airport is surrounded by residential use. Although land use control in the vicinity of the airport has been difficult in the past, the adoption of a noise contour line by the Federal Aviation Administration in 1979 has enhanced the land use control process. Land use compatibility study will, therefore, become effective. Such study needs the support of local jurisdictions surrounding the airport in order to reflect the safety, welfare and peace of mind of the people living in the vicinity of the airport.

Runway expansions not only abate air traffic congestion, but also involve many interested parties. In order to implement an expansion plan, airport planners must consider various effects and notify all interested parties of the plan as soon as possible. In addition, planners must engage in continuing research and must be flexibile. Finally, the support of city and regional planners is necessary in airport land expansion.

TABLE OF CONTENTS

CHAPTER		PAGE
I.	INTRODUCTION	1
	1.1. Purpose	1
	1.2. Definition of Problem	1
	1.3. Inventory of Pubic Use Airports	2
	1.4. Research Questions	2
	1.5. Limitations	2
II.	BACKGROUND	3
	2.1. Classification of Airports	3
	2.2. Airport Issues	5
	2.2.1. Airport Expansion Needs	5
	2.2.2. Airspace Regulations	5
	2.2.3. Adjacent Land Development / Zoning	7
	2.2.4. Noise	8
	2.2.5. Accidents / Public Safety	11
	2.3. Decisions of Courts	12
	2.4. Roles of Federal Government	14
	2.5. Airport Planning	15
	2.5.1. Airport System Planning	16
	2.5.2. Airport Master Planning	17
	2.6. Federal Funds	18
III.	METHODOLOGY	19
	3.1. Research Method	19
	3.2. Research Procedure, An Outline	19
	3.2.1. Criteria for Selection of Airport for Case Study	19
	3.2.2. Collecting Data	20
	3.2.3. Interview Questions	20
	3.2.4. List of Interviewees	21

IV. CASE STUDY - MEMPHIS INTERNATIONAL AIRPORT 23

4.1. Introduction 23

4.2. History of Memphis Airport, A Chronology 25
4.2. 1. Memphis Municipal Airport (1925-1929) 25
4.2. 2. Radical Runways and Control Equipment (1930-1938) 27
4.2. 3. Administration Building (1938-1941) 30
4.2. 4. Military Age (1939-1946) 32
4.2. 5. Civilian Age (1946-1955) 35
4.2. 6. Toward North-South (1956-1959) 40
4.2. 7. Jet Age (1956-1968) 42
4.2. 8. Memphis International Airport and Airport Authority (1969) 48
4.2. 9. Second North-South Runway (1969-1973) 49
4.2.10. Rebuilt Runways, Expanded Terminal and Improved Access Roads (1974-1977) 50
4.2.11. Restructuring of Airline Flight Routes (1978-1986) 53
4.2.12. Plan of Third North-South Runway (1986) 58
4.2.13. Residential Buyout and Raising Funds (1986-1989) 62
4.2.14. Preparation for the Construction of the Third Runway (1989-1992) 65
4.2.15. Clearing Land for the Third Runway (1993) 69
4.2.16. Northwest Airlines and Federal Express Become Active (1994) 70

4.3. Runway Expansion 71

4.4. Demand Forecasts 75
4.4.1. Passenger Enplanement Forecast 75
4.4.2. Annual Aircraft Operation Forecast 78
4.4.3. Hourly Aircraft Operation Forecast 82

4.5. Land Acquisition (1935-1994) 85

4.6. Noise Compatibility Program of MEM (1984-1994) 92
4.6.1. Noise Exposure Maps 92
4.6.2. Property Acquisition Program 95
4.6.3. Fund Sources for Property Acquisition 96
4.6.4. Identification of Acquisition Area 97
4.6.5. Neighborhood Survey 98

4.7. Zoning 99
4.7.1. First Airport Zoning 99
4.7.2. Recommended Zoning in 1955 and Adopted Zoning in 1962 99
4.7.3. Rezoning for New Runway 18E-36E (1986-1992) 102
4.7.4. Generalized Zoning Map in Airport Study Area 103

4.8. Land Use 107
4.8.1. Residential Expansion 107
4.8.2. Existing Land Use of Memphis Airport Area 110
4.8.3. Future Land Use 113

V. FINDINGS and CONCLUSIONS 119

5.1. Findings 119

5.2. Conclusions 124

GLOSSARY 127

BIBLIOGRAPHY 129

VITA 142

LIST OF TABLES

TABLE PAGE

2.2.3.a. Summary of Land Uses Compatibility with Yearly Day-Night Average Sound Levels 8

2.2.4.a. Comparative Noise Levels of Typical Values (dBA) encountered in Daily Life and Industry 9

4.3.a. Required Runway Lengths for Take-off and Landing of Typical Aircraft at MEM 74

4.6.1.a. Estimated Land Areas, Population and Housing Units exposed to Forecast Aircraft Operations between 2001 and 2010 93

4.7.2.a. Area Comparison between Recommended Zoning and Adopted Zoning inside "Sound Boundary" 99

4.8.2.a. Existing Land Uses in Memphis Airport Area 112

LIST OF FIGURES

FIGURE		PAGE
2.2.2.a.	FAA imaginary surfaces for civil airports	6
2.2.4.a.	Examples of Outdoor Day/Night Average Sound Levels in dB Measured at Various Locations	10
2.2.4.b.	Typical Day-Night Average Sound Level (Ldn) Contours	11
4.1.a.	Location of Large Air Traffic Hubs and Memphis International Airport	24
4.2.1.a.	Three Final Candidate Sites for the Memphis Municipal Airport	26
4.2.2.a.	Memphis Municipal Airport in 1937	28
4.2.3.a.	Memphis Municipal Airport in 1939	31
4.2.5.a.	Ultimate Plan of Master Airport Plan in 1947	36
4.2.6.a.	Airport Expansion Plan in 1956	41
4.2.7.a.	A photo of Memphis Metropolitan Airport - Terminal Building in 1963	43
4.2.7.b.	Memphis Metropolitan Airport - Terminal Expansion Plan from 1970 to 1975	46
4.2.7.c.	New Airport Expansion Plan in 1969	47
4.2.10.a.	Street and road Work around Memphis Airport from 1972 to 1976	52
4.2.12.a.	2006 Airport Layout Concept Plan	59
4.3.a.	Airport layout Concept Plan - Memphis International Airport	72
4.4.1.a.	Actual Passenger Enplanements of MEM and U.S. Domestic	76
4.4.1.b.	Actual Passenger Enplanements of MEM by Airlines between 1970 and 1990	77
4.4.1.c.	Actual and Forecast of Passenger Enplanements of MEM	78
4.4.2.a.	Annual Aircraft Operations of MEM and U.S. Domestic	79
4.4.2.b.	Annual Aircraft Operations of U.S. Domestic by Activity Type	80
4.4.2.c.	Annual Aircraft Operations of MEM by Activity Type	80
4.4.3.a.	Hourly Distribution of 1,315 Average Aircraft Daily Operations of Four Busiest Days in 1993	82

4.4.3.b. Hourly Distribution of 1,315 Aircraft Operations and Hourly Capacity of MEM in 1993 84

4.5.a. Land Acquisition History of Memphis Airport 86

4.6.1.a. Noise Exposure Map with Forecast Aircraft Operation with the Planned Third North-South Runway between 2001 and 2010 94

4.6.2.a. Status History of Property Acquisition Program 95

4.6.4.a. Eligible Acquisition Areas of Charjean Park 97

4.7.2.a. Recommended Zoning in 1955 100

4.7.2.b. Existing Zoning in 1962 101

4.7.3.a. Rezoning for New Runway 18E-36E 102

4.7.4.a. Generalized Existing Zoning Map in Memphis Airport Study Area 104

4.8.1.a. Generalized Land Use in Shelby County in 1938 107

4.8.1.b. Generalized Land Use in Shelby County in 1953 108

4.8.1.c. Generalized Land Use in Shelby County in 1964 109

4.8.1.d. Generalized Land Use in Shelby County in 1975 110

4.8.2.a. Generalized Existing Land Use of Memphis Airport Area 111

4.8.3.a. Future Land Use of Memphis Airport Area as of 1990 114

4.8.3.b. Future Land Use of Memphis Airport Area as of 1993 115

4.8.3.c. Generalized Land Use Plan of DeSoto County in Airport Study Area 117

CHAPTER I

INTRODUCTION

1.1. Purpose

This thesis is proposed on the premise that research about the development of an individual airport master plan and what has happened at that airport and in the surrounding community can present some lessons for airport expansion plans elsewhere. The thesis mainly focuses on runway expansion since runway expansion is the primary means of airport land expansion.

1.2. Definition of Problem

The U.S. Federal Aviation Administration (FAA) has recently testified that 62 of the nation's top 100 airports plan new runways or runway extensions.[1] However, most airports acquire land space only for initially proposed facilities, not for future facilities. Those facilities include runways, taxiways, aprons, hangers, car parking space, operation building space, and so on. Ten or twenty years later, housing, shops, and businesses are frequently built in the vicinity of the airports, and neighbors in the vicinity of the airports often fight against the runway expansion plans.

Most public use airports have received federal funds to add or extend runways. In order to obtain the federal funds, airport design planners prepare an airport master plan, which forecasts the facility demand for five, ten and twenty years. The airport plans comply with the Federal Aviation Administration regulations. After airport expansion plans are approved by the FAA, time is required for the implementation of the plans. Therefore, they sometimes need to be amended after initial approval, because demands and surrounding environs change.

---

[1] U.S. Congress, House, (1992) pp.15, 16.

1.3. Inventory of Public Use Airports

As of June 1990, there were 17,451 civil landing areas (airports, heliports, seaplane bases etc.) in the United States. There were 3,534 airports open for public use, which also have at least one paved and lighted runway. The public airports are typically owned by cities and counties, or by semi-independent authorities formed by these jurisdictions.[2]

An analysis prepared for the FAA in 1983 indicated that ninety-seven percent of the population in the United States is within 20 miles (32.2 km) of a National Plan of Integrated Airport Systems (NPIAS) airport.[3] NPIAS is a bottom-up plan which integrates local airport master plans with state aviation system plans.

1.4. Research Questions

The primary research question is when, why, and how airport expansion has been done, and by whom.

The subsidiary questions are:

- When did airport planners start to think of airport expansion?
- Why have some city planners permitted residential development in the vicinity of their airport?
- What role did the FAA have in airport expansion?

1.5. Limitations

This study is limited to the process of land expansion of an airport. There are many other aspects of airport planning: site selection, finance and economic impact that are important, but not the focus of this thesis.

---

[2] FAA, (1990) p. 1.

[3] FAA, (1990) p. 5.

CHAPTER II

BACKGROUND

When the Wright brothers made their first successful flight in 1903, only one pilot flew from Kitty Hawk field. In 1991, Chicago O'Hare International Airport, the busiest airport in the world, performed 809,000 annual aircraft operations[1] and carried 27,827,000 annual passenger enplanements[2,3] As airports have evolved from open rural fields to airport cities, the activities of aircraft and airports have created issues in diverse fields: economics, transportation, acoustics, land use, quality of life, and others. Simultaneously, the federal government has been a great influence on airport planning because most airport expansion plans were approved by the federal government. The process of airport planning now often involves environmental impact assessment.

2.1. Classification of Airports

For the purposes of federal administration, airports in the United States are functionally classified in two ways for inclusion in the NPIAS. One classification is related to the service level of the airports and uses the following definitions:[4]

A. **Commercial Service Airports** - A public airport enplanes annually 2,500 or more passengers and receives scheduled passenger service of aircraft.

a. Primary Airports - A commercial service airport that has more than 10,000 passengers enplaned annually.

b. Other Airports - A commercial service airport that has 10,000 or fewer

---

[1] See aircraft operation in Glossary.

[2] See passenger enplanement in Glossary.

[3] FAA, Terminal Area Forecasts, (1993) pp.10, 13.

[4] FAA, NPIAS 1990-1999, (1990) pp. 5, 6 & 23.

passengers enplaned annually.

c. Reliever Airports - A commercial service airport that is intended to reduce congestion at a large air carrier airport.

B. **Reliever Airports** - A public airport in a metropolitan area which is intended to reduce congestion at a large air carrier airport by providing alternative general aviation facilities. It should have an activity level of at least 50 based aircraft, 25,000 itinerant operations, or 35,000 local operations annually.

C. **General Aviation Airports** - The criteria are as follows:

(1) A public airport enplanes annually less than 2,500 passengers. It serves a community located 30 minutes or more average ground travel time from the nearest existing or proposed plan airport and has at least ten based aircraft.

(2) A public-use heliport has at least four based rotorcraft or 800 annual itinerant operations, or 400 annual operations by air taxi rotorcraft.

The other classification involves the role of airports as its airport layout influences the aircraft it can accommodate:

A. **Basic Utility (BU) Airports** - A general aviation airport accommodates most single-engine and many of small twin-engine airplanes under 12,500 pounds (5,570 kg). It is tended to serve personal, business flight and medium-sized community.

B. **General Utility (GU) Airports** - A general aviation airport accommodates all general aviation aircraft with maximum takeoff weights of 12,500 pounds or less. It is tended to serve the fringe of metropolitan areas or large, remote communities.

C. **Transport (TR) Airports** - A general aviation airport accommodates business jet and transport type aircraft.

2.2. Airport Issues

2.2.1. Airport Expansion Needs

Airport expansion is driven by increases in the number of aircraft operations and the change of aircraft characteristics. Airport expansion of commercial service airports is required in order to increase the number of aircraft operations since air traffic congestion at major airports is a severe problem. By the year 2000, 40 major airports will be congested and incurring more than 20,000 hours of flight delay unless the capacity of the airports is increased substantially. The resulting delays in flights will cost the U.S. economy billions of dollars a year in lost productivity and undermine the Nation's ability to compete in the global economy.[5]

Expansion of general aviation airports is required in order to accommodate jet-powered aircraft. Two thousand and twenty-four of 2,432 general aviation airports in NPIAS will be upgraded from basic utility airports or general utility airports to transport type airports during 1990 through 1999.[6]

2.2.2. Airspace Regulations

In order to protect aircraft from turning in the vicinity or on takeoff or approach from obstructions, the FAA regulates imaginary or obstacle limitation surfaces to each runway in Federal Aviation Regulations (FAR) Part 77, Objects Affecting Navigable Airspace. Figure 2.2.2.a. illustrates FAA imaginary surfaces for a civil airport. Protected airspace around airports is made up of five principal imaginary surfaces;

1) **Primary surface** is longitudinally centered on a runway, extending 200 feet (61 m) beyond the threshold in each direction in the case of paved runways. The width of a primary surface ranges from 250 feet (76 m) to 1,000 feet (305 m) based on the types of approach and visibility.

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[5] U.S. Congress, House, Rep. No. 102-503, 1992, pp.1, 2.

[6] FAA, NPIAS 1990-1999, (1990).

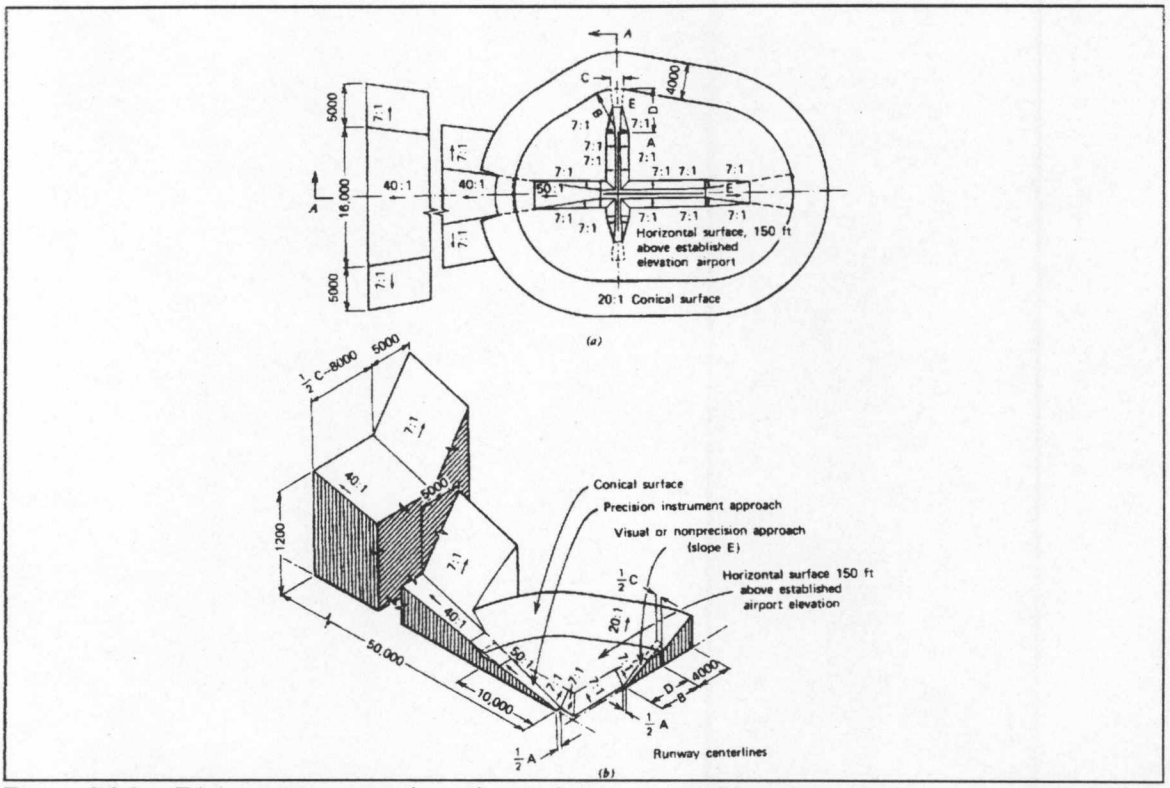


Figure 2.2.2.a. FAA imaginary surfaces for civil airports. (a) Plan view. (b) Isometric view of A-A. (Source: Ashford and Wright, Airport Engineering, 1992, p.221)

2) **Approach surface** is a surface longitudinally centered on the extended runway centerline and extending outward and upward from each end of the primary surface. It is applied to each end of each runway based upon the type of approach available or planned for that runway end.

(1) The inner edge of the approach surface is the same width as the primary surface and it expands uniformly to a width from 1,250 feet (381 m) to 16,000 feet (4,877 m) based on the types of runways and visibility.

(2) The approach surface extends for a horizontal distance from 5,000 feet (1,524 m) at a slope of 20 to 1, to 10,000 feet (3,048 m) at a slope of 50 to 1 with an additional 40,000 feet (12,192 m) at a slope of 40 to 1 based on the types of runways.

3) **Horizontal surface** is a horizontal plane 150 feet (46 m) above the established airport elevation. The perimeter of which is constructed by swinging arcs of specified radii from the center of each end of the primary surface of each runway and connecting the adjacent arcs by lines tangent to

those arcs. The radius of each arc is ranged from 5,000 feet (1,524 m) to 10,000 feet (3,048 m) based on the types of runways and visibility.

4) **Transition surfaces** are surfaces extending outward and upward at right angle to the runway centerline and the runway centerline extended at a slope of 7 to 1 from the sides of the primary and approach surfaces. Transitional surfaces for those portions of the precision approach surface beyond the limits of the conical surface, extend a distance of 5,000 feet from the edge of the approach surface.

5) **Conical surface** is a surface extending outward and upward from the periphery of the horizontal surface at a slop of 20 to 1 for a horizontal distance of 4,000 feet (1,219 m).

Primary surface and transition surfaces along a runway are normally included in the airport's property. The obstructions of horizontal surface and conical surface depend on terrain. There is no obstruction without skyscraper buildings when surroundings around airports are flat terrain. On the other hand, low buildings and trees might be obstructions in those surfaces when terrain around airports is higher than the runway. Any objects might be an obstacle to approach surface near a runway.

2.2.3. Adjacent Land Development / Zoning

In 1952, the U.S. President's Airport Commission identified community encroachment on airports as an issue and recommended establishment of effective zoning laws.[7]

The FAA recommends Airport-Land Use Compatibility with Yearly Day-night Average Sound Levels (Ldn)[8] in Federal Aviation Regulation Part 150. According to Table 2.2.3.a., all types of land use are compatible noise level less than 65 Ldn. Residential use, school, hospital, church and park are compatible with restrictions noise level beyond 65 Ldn and noncompatible noise level beyond 75 Ldn.

---

[7] The Airport and Its Neighbors, p. 17.

[8] Ldn is discussed in the next section 2.2.4 Noise.

Table 2.2.3.a. Summary of Land Uses Compatibility with Yearly Day-Night Average Sound Levels

Land Use	Yearly day-night average sound level (Ldn) in decibels (<65)	(<70)	(<75)	(>=75)
Residential	Y	R	R	N
Public Use				
School, Hospital and Church	Y	R	R	N
Transportation, Parking and Govt. Service	Y	Y	R	R
Commercial Use	Y	Y	R	R
Manufacturing and Production				
Manufacturing, General	Y	Y	R	R
Agriculture and forestry	Y	R	R	R
Mining and fishing, resource production and extraction	Y	Y	Y	Y
Recreational				
Amusement, parks, resorts and camps	Y	Y	Y	N
Golf Courses, riding stables and water recreation	Y	Y	R	R

Remarks: Y - Compatible without restrictions, R - Compatible with restrictions, N - Noncompatible
(Adapted from: 14 CFR Part 150 (1993) Appendix A. p. 64)

However, the jurisdiction of land use in the vicinity of an airport is given to a county or a city in which the airport is located. Notwithstanding that the FAA recommends compatible land use in the vicinity of the airport, some counties or cities allow incompatible land use. Zoning of most counties and cities applies to the use of land surface area but not to noise contours.

2.2.4. Noise

Concern about aircraft noise frequently constrains runway expansion plans. Large scale projects have been undertaken in a number of major cities to relocate households or soundproof dwellings.[9] The General Accounting Office has stated that beyond land use compatibility, no single solution exists to the noise problem.[10]

There are two basic schemes for quantifying the noise associated with aircraft operations. One method considers the noise generated by all aircraft over a cumulative twenty-four hour

[9] FAA, NPIAS, (1990) p.18.

[10] "Aircraft Noise: Eight Airports," (1989) p.10.

period, while the other quantifies the sound levels of single aircraft flyovers measured at various points on the ground.

The latter scheme may employ either the effective perceived noise level (EPNL) or the A-weighted sound level (dBA/dB/La). The effective perceived noise level is a single number evaluator of the subject effective of aircraft noise on human beings. EPNL consists of instantaneous perceived noise level, PNL, corrected for spectral irregularities and for duration.[11] The A-weighted sound level is the actual measured sound level filtered or weighted to reduce the influence of the low and high frequency noise which is less than 20 Hz or more than 20,000 Hz. It was designed to approximate the response of the human ear to sound.[12] The general equivalence between EPNL and dB(A) is shown below.[13]

$$\text{EPNdB} \approx \text{dB(A)} + 12$$

In order to convey the intensity and relative impact of single event noise in A-weighted level, Table 2.2.4.a describes typical dBA values on noise commonly experienced by people.

Table 2.2.4.a. Comparative Noise Levels of Typical Values (dBA) encountered in Daily Life and Industry

Description of noise	dBA
Rustling leaves	20
Room in a quiet dwelling at midnight	32
Conversational speech	60
Busy restaurant	65
Ringing alarm clock (at 2 feet)	80
Loudly reproduced or orchestral music in large room	82
Over 85 dBA, beginning of hearing damage if prolonged	
Heavy city traffic	92
Banging of steel plate	104
Jet airliner (500 feet overhead)	115

(Adapted from: FAA, Impact of Noise on People, (1977) p. 8.)

[11] Smith, Aircraft Noise, (1989) p. 301.

[12] FAA, Impact of Noise on People, (1977) p. 6.

[13] Ashford and Wright, (1992) p. 489.

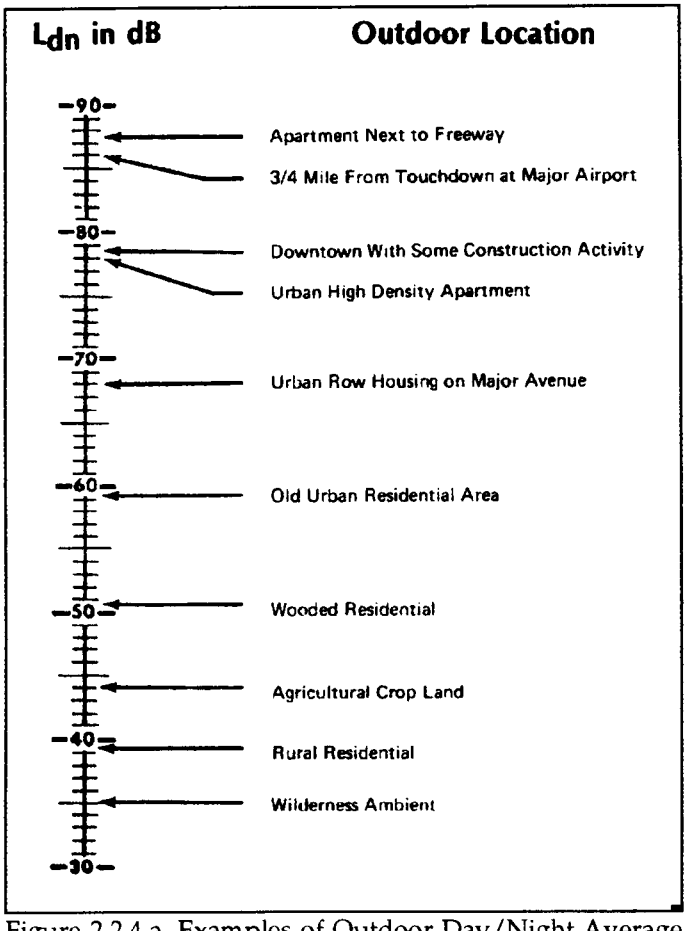


Figure 2.2.4.a. Examples of Outdoor Day/Night Average Sound Levels in dB Measured at Various Locations. (Source: FAA, Protective Noise Levels, (1978) p. 8.)

In the late 1970's, the FAA adopted the Day/Night Average Sound Level (Ldn) procedure as the preferred method of measuring cumulative noise resulting from aircraft operations.[14] Ldn is the A-weighted equivalent sound level for a 24-hour period with an additional 10 dB weighing imposed on the equivalent sound levels occurring during nighttime hours (10 pm to 7 am). [15] Figure 2.2.4.a shows examples of measured Ldn value.

A computer tool for measuring the impact of aircraft noise,known as the Integrated Noise Model (INM), was released by the FAA in January 1978. The model includes a standard data base of individual aircraft noise and performance. The data base contains representatives of commercial, general aviation, and military aircraft, which are powered by turbojet, turbofan, or propeller-driven engines. Each of these aircraft is associated with an aircraft category, a set of departure profiles for each applicable trip length, a set of approach parameters, Sound Exposure Level (SEL) versus distance curves at several thrust settings, and ENPL versus distance curves at several thrust settings. The model

[14] Ashford and Wright (1992) p. 494.

[15] FAA, Impact of Noise on People, (1977) p. 6.

gives the noise impact in terms of contours of equal noise exposure.[16] Figure 2.2.4.b. shows typical Day/Night Average Sound Level contours.

The Airport Safety and Capacity Expansion Act of 1990 provided that the noisiest aircraft of the fleet, Stage II aircraft, would have to be phased out by July 1, 1999, subject to possible exemptions to permit up to 15 percent of air carriers Stage II aircraft to operate through the year 2003. It was estimated that this phase-out of noisy aircraft would reduce the number of persons impacted by unacceptable levels of aviation noise from three million in 1990 to one million in the year 2000.[17]

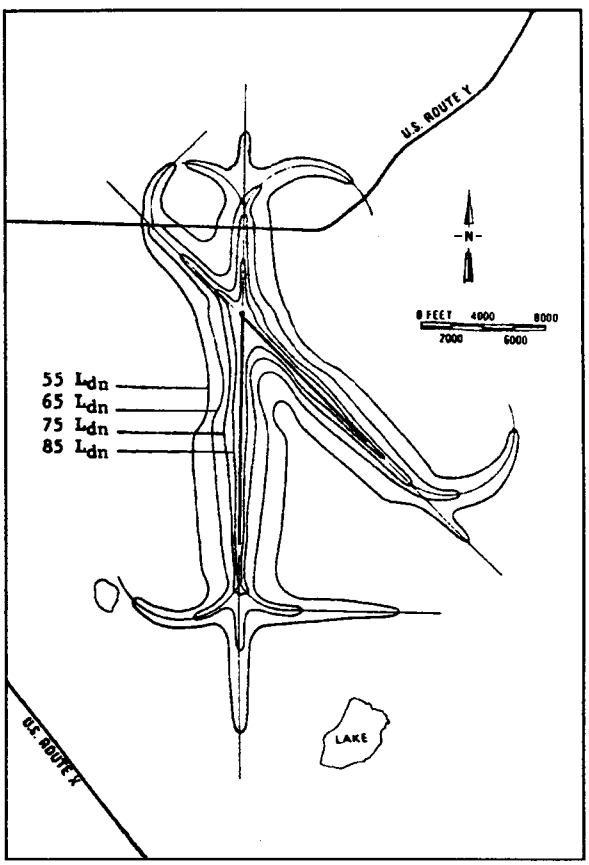


Figure 2.2.4.b Typical Day-Night Average Sound Level (Ldn) Contours. (Source: FAA, Airport-Land Use Compatibility Planning, (1977) p.Ap-3.)

2.2.5. Accidents / Public Safety

There is a well-established trend toward lower aircraft accident rates at the national level. Through a partnership program with the National Association of State Aviation Officials (NASAO) and cooperating state organizations, FAA annually funds the inspection of approximately 3,500 general aviation airports that are open to the public.[18] Runway expansion increases the size of dangerous areas. Nothing assures public safety in aircraft accidents since most of them are fatal.

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[16] Ashford and Wright, (1992) p. 496, 497.

[17] U.S. Congress, House, Rep. No. 102-503, (1992) p. 15.

[18] FAA, NPIAS, (1990) pp.18, 19.

Surveys taken during the last 25 years by the Airline Pilots Association indicate the following breakdown for the location of accidents:

En route accidents	5 %
Accidents in the airport approach areas within 15 mi of the airport	15 %
Accidents on the active runway or its overrun areas and clear zones	80 %

In addition, ALPA Accident Data Forms through January 1978 show that almost all of accidents within the critical rescue and fire fighting access area and the runway safety area occur within 500 feet (152 m) of the active runway centerline and 3,000 feet (912 m) of the runway thresholds.[19]

The FAA defines the safety area for transport airports as within 250 feet (76 m) of the active runway centerline and 1,000 feet (304 m) of the runway end, and the safety area for utility airports of airport design group I as within 60 feet (18 m) of the active runway centerline and 120 feet (36 m) of the runway end.[20]

2.3. Decisions of Courts

From early in their history, airports and individuals have been in courts. Later, their host communities have gone in courts. Courts have resolved some of the problems among them.

In 1928, in Dysart v. City of St. Louis Court, the Missouri Supreme Court concluded that an airport is analogous to a harbor, and that the acquisition and control of an airport is a city purpose within the purview of general constitutional law, notwithstanding a plaintiff's claim that a bond issue was for a "private" rather than a "public" purpose to develop certain land as a city airport.[21]

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[19] Ashford and Wright, (1992) pp. 268, 269.

[20] Ashford and Wright, (1992) pp. 243, 245.

[21] Rhyne, (1944) pp. 20-22.

On March 4, 1930, the Supreme Judicial Court of Massachusetts, in Smith v. New England Aircraft case, held that a property owner who complained of low flights over uninhabited woodlands which he owned adjoining a privately owned airport was not entitled to either injunctive relief or damage.[22]

In 1962, in Grigg v. Allegheny County case, the Supreme Court of the U.S. held that the interference with the plaintiff's property amounted to a "taking" of an air easement for which compensation must be made; and the defendant county, not the United States, was the "taker" liable to pay compensation. The noise, vibrations, and fear caused to the occupants of the plaintiff's residential property located near a runway of the airport with constant and extremely low overflights, interfered with the use of the owner's property.[23]

In the 1973, in the U.S. Supreme Court case of City of Burbank v. Lockheed Air Terminal, the Court concluded that the city airport curfew ordinance, which forbade jet aircraft from taking off at the Burbank airport between 11 p.m. and 7 a.m., was held unconstitutional under the supremacy clause since the imposition of curfews at local airports had a direct effect on congestion in navigable airspace.[24]

In 1984, in Illinois v. Federal Aviation Administration (No. 81-1317, 832 F.2d 168, D.C. Cir. Oct. 30, 1987), the District of Columbia Circuit held that the Aviation Safety and Noise Abatement Act of 1979 (ASNA) requires that Airport Noise Evaluation Process, for measuring the incremental impact of aircraft noise, be voluntary. These reasons included concern over imposing an "unnecessary cost burden on those airports with no present or anticipated noise problem," and concern that the airport certification program would not be "the proper vehicle for implementation of an airport noise abatement planning.[25]

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[22] Rhyne, (1944) pp. 84-85.

[23] 369 US 84, 7 L ed 2d 585.

[24] Hardway, (1991) pp. 35-37.

[25] ELR, v. 18, pp. 20391-20393.

2.4. Roles of Federal Government

The U.S. Federal Aviation Administration (FAA) has primary responsibility for civil aviation. By the Department of Transportation Act of 1967, the FAA replaced the former Federal Aviation Agency and was absorbed into the Department of Transportation. The Administration discharges its duties in nine principal areas[26]:

1. Safety and regulation.
2. Airspace and air traffic management.
3. Air navigation facilities.
4. Research, engineering and development.
5. Test and evaluation.
6. Airport programs.
7. Registration and recording
8. Civil aviation abroad.
9. Other programs.

The federal supporting role for airport expansion was assumed under the following series of federal statues.

In 1968, the Federal Aviation Act of 1958 was amended to require noise abatement regulations. Its principal purpose was to establish noise levels, which aircraft manufacturers cannot exceed in the development of new aircraft.[27]

The Airport and Airway Revenue Act of 1970 created the Airport and Airway Trust Fund and established a pattern of aviation excise taxes. The Airport and Airway Development Act of 1970 detailed the airport assistance programs and established a financing program for airport grants, airway hardware acquisition, research, and development.[28] The act earmarked the trust fund for only aviation development; one-third of the fund was used for air carrier airports based on the number of passenger enplanements, one-third for air carrier and general aviation reliever airports on the basis of state population and state area, and one-third was to be disbursed at the

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[26] Ashford and Wright, (1992) p. 5, 6.

[27] Horonjeff and McKelvey, (1983) p. 25.

[28] Horonjeff and McKelvey, (1983) pp. 25-26.

discretion of the Secretary of Transportation.[29]

The Airline Deregulation Act of 1978 eliminated the statutory authority for the economic regulation of the passenger airline industry in the United States.[30] The act has changed the economic and operational character of the airline industry. Four key trends are: The effect of airline price and service competition in encouraging volume; Growth of airline hub and spoke system; Merger of major airlines; and Financial pressure on many large airlines.[31]

The Airport and Airway Improvement Act of 1982 replaced the Airport Development Aid Program with the Airport Improvement Program. The Airport Improvement Program was to fund NPIAS.[32] This act continued the user tax categories outlined in the original airport development legislation with some increases in rates.[33]

The Airport Safety and Capacity Expansion Act of 1990 dealt with the three related areas which underlie the development of the aviation system: the Airport and Airway Trust Fund, Passenger Facility Charges, and Aviation Noise Policy.[34]

The Airport and Airway Safety, Capacity and Intermodal Transportation Act of 1992 established a comprehensive program to enable the nation's aviation system to meet the needs of the 1990s.[35]

2.5. Airport Planning

Airport planning is based upon a multitude of procedures and criteria for evaluating

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[29] Ashford and Wright, (1992) p. 17.

[30] Horonjeff and McKelvey, (1983) pp. 26-28.

[31] Apogee Research, (May 1987) p. 11.

[32] Ashford and Wright, (1992) pp. 18-19.

[33] Horonjeff and McKelvey, (1983) p. 28.

[34] U.S. Congress, House, Rep. No. 102-503, (1992) p. 12.

[35] U.S. Congress, House, Rep. No. 102-503, (1992) p. 11.

needs, proposing alternative concepts, ranking priorities, and justifying selected alternatives. Airport planning can be performed at either the system planning or the master planning level. An airport system plan is a representation of the aviation facilities required to meet the immediate and future needs of a metropolitan area, region, state, or country. Its overall purpose is to provide the basis for definitive and detailed airport planning, such as the airport master plan. An airport master plan is a concept of the ultimate development of an airport.[36]

2.5.1. Airport System Planning

The objectives of the system plan include the following elements[37]:

- The orderly and timely development of a system of airports adequate to meet present and future aviation needs and to promote the desired pattern of regional growth relative to industrial, employment, social, environmental, and recreational goals.
- The development of aviation to meet its role in a balanced and multimodal transportation system plan and comprehensive development plan.
- The protection and enhancement of the environment through the location and expansion of aviation facilities in a matter which avoids ecological and environmental impairment.
- The provision of the framework within which specific airport programs may be developed consistent with the short-range and long-range airport system requirements.
- The implementation of land use and airspace plans that optimize the use of these resources in an often constrained environment.
- The development of long-range fiscal plans and the establishment of priorities for airport financing within the governmental budgeting process.
- The establishment of the mechanism for the implementation of the system plan through the normal political framework, including the necessary coordination between governmental agencies, the involvement of both public and private aviation and nonaviation interests, and compatibility with the content, standards and criteria of existing legislation.

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[36] Horonjeff and McKelvey, (1983) pp. 146, 147.

[37] Ibid.

2.5.2. Airport Master Planning

The FAA requires that the airport master plan include the following elements[38]:

- Organization and Preplanning.
- Inventory of existing conditions and issues.
- Aviation demand forecasts.
- Requirements analysis and concepts development.
- Airport site selection.
- Environmental procedures and analysis.
- Simulation.
- Airport plans.
- Plan implementation.

Aviation demand forecasts are particularly important for airport master planning because they indicate the relative timing for airport investment. The FAA requires the following aviation demand elements:

Mandatory	Additional Where Appropriate
Aircraft Operations	Domestic vs. International
Itinerant	Annual Instrument Approaches
Air Carrier	IFR vs. VFR Operations
Air Taxi & Commuter (Regional)	Helicopter
General Aviation	
Military	
Local	
General Aviation	
Military	
Passenger Enplanements	Domestic vs. International
Air Carrier	General Aviation
Commuter	Helicopter
Based Aircraft	Air Cargo and Air Mail
Aircraft Mix	

Furthermore, forecasts are to be prepared in terms of levels of annual activity for five, ten and twenty years horizons. In addition, airports with peak periods of demand that far surpass the average condition may need peak load forecasts. The situation is important for airports that serve as hubs in a hub-spoke route system, or airports with high levels of international traffic.[39]

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[38] Ashford and Wright, (1992) pp. 120-123.

[39] FAA, Airport Master Plans, (June 1985) pp. 22, 23.

2.6. Federal Funds

Up to 1933, the financing of airports in the United States was carried out almost entirely by local governments and by private investors. So far, the Work Progress Administration, the Public Works Administration, the Civil Aeronautics Administration, the Federal Aviation Agency and the Federal Aviation Administration have had responsibility for the administration of federal aids to airports.[40] Now, federal grants-in aid funds a major portion of an airport's capital improvement. The ultimate share of project cost eligible for federal grant funding is as follows:

Type of Project	Large Primary Airports	All Other Airports
Individual airport planning	75%	90%
Airport development	75%	90%
Noise compatibility	80%	90%
Terminal development	75%	75%

To be eligible for grants-in-aid in the federal program, an airport must be included in the NPIAS, which acts as a guide to appropriate funding levels and priorities for five years.[41] In the financial year 1991, federal spending was $1.8 billion.[42]

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[40] Ashford and Wright, (1992) pp. 16, 17.

[41] Ashford and Moore, (1992) pp. 32, 53.

[42] U.S. Congress, House, Rep. No. 102-503, (1992) p. 33.

CHAPTER III

METHODOLOGY

3.1. Research Method

This thesis employs case study research. This method allows careful examination of the interaction of airport planners, local zoning authorities, the federal government, and the community on airport expansion. Babbie has stated that the chief strength of field research such as case studies lies in the depth of understanding the field. On the other hand, the research is qualitative rather than quantitative.[1]

3.2. Research Procedure, An Outline

The research procedure consists of the following major elements:

- Selecting an airport in the United States for the ease of study,
- Collecting data on the selected airport in books, government documents, periodicals, newspapers, and so on,
- Interviewing key persons,
- Identifying issues and describing events, and
- Summarizing the result.

3.2.1. Criteria for Selection of Airport for Case Study:

- Select an airport that is a commercial service airport,
- Select an airport with airport master plans which have been presented to the FAA,
- Select an airport that has expanded runways or new runways added within the past 10 years,

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[1] (1991) pp.305, 306.

- Select an airport in a community that has employed zoning regulations, and
- Select an airport that is reasonably accessible and available for study.

3.2.2. Collecting Data:

- Historical airport master plans,
- Historical zoning maps in the vicinity of the selected airport,
- Historical air photographs and land use surveys in the vicinity of the selected airport, and
- History of events related to the selected airport.

The history will include a detailed chronology of events in order to show the complex web of change within which major expansion decision were made.

3.2.3. Interview Questions

a) To an airport planner or manager:

- Does your airport have plans or policies to protect against community encroachment?
- How are you concerned about development in the vicinity of your airport after your airport has been built?
- Does your airport have enough space for future needs?
- Is the zoning adequate in the vicinity of your airport?
- What are some things that should be changed, added, or eliminated for runway expansion?

b) To a city planner or a local zoning authority:

- Have you participated in the project for airport master plan?
- Have you changed the comprehensive plan or zoning in the airport area after a runway has been added or expanded?

- Is there an intermodal transportation system working in your county or city working?
- What are some things that should be changed, added, or eliminated in area plans to accommodate for runway expansion?

c) To FAA staff:

- Does the airport cause some complaints in its vicinity?
- Does the airport completely satisfy the airport regulations of the FAA?
- What are some things that should be changed, added, or eliminated in plans for the area as a result of runway expansion?

d) To host community public officials such as city planners surrounding the city located the selected airport:

- What benefit and loss does runway expansion cause?
- Have you received adequate information from the airport?
- Are you informed about airport plans?
- What are some things that should be changed, added, or eliminated for runway expansion?

3.2.4. List of Interviewees

Interviewees' name and position	Interview date
a) Airport planners	
Bill Burrow, Director Development, Memphis Airport Authority	01/21/94
Robert A. Beesley, Manager Engineering, Memphis Airport Authority	01/21/94
Solomon M. Garrett Jr., Coordinator Noise Compatibility Program, Memphis Airport Authority	01/21/94

b) City planners involved in airport planning

Eugene S. Bryan, Manager — 03/10/94
Plans Development Section
Memphis and Shelby County
Office of Planning and Development

Don Jones, Senior Planner — 02/23/95
Plans Development Section
Memphis and Shelby County
Office of Planning and Development

c) FAA staff

Jerry Hall, Chief Engineer — 10/28/93
Tennessee Department of Transportation,
Office of Aeronautics

Jerry O. Bowers, Planner — 03/16/94
FAA South Region Memphis Airport District Office

d) City planners surrounding Memphis Airport

Robert L. Barber, Planner — 03/30/94
DeSoto County, Mississippi, Planning Commission

Joy G. Black, Planning Director — 04/14/94
The City of Horn Lake, Mississippi

Carl F. Allen, former Director — 08/17/94
Office of Planning Department
The City of Southaven, Mississippi

e) Aviation business

Frank H. Adams, Manager — 03/15/94
Regional Airport Operations, Federal Express

CHAPTER IV

CASE STUDY - MEMPHIS INTERNATIONAL AIRPORT

4.1. Introduction

According to the Memphis City Directory (1992), Memphis, Tennessee is the sixth largest distribution center in the United States. It is served by six railroad systems, six barge lines and eight major and three regional commuter airlines. The city has desirable and adequate space for industrial development.

Memphis Municipal Airport (MEM) was dedicated in 1929. MEM has grown from 202.5 acres in 1929 to 5,000 acres in 1994. MEM is one of early developed airports in the United States. Most public airports have received federal funds and been advised about airport expansion by the FAA. The policies of the FAA have therefore been reflected by the development process of the airport expansion. The history of MEM might be almost similar to that of other public airports. In its early years, two and three runways were crossing at the center and taxiways were surrounding them. Since the invention of jets in the 1950s, runways have been built parallel to each other and taxiways have been constructed side of each runway.

MEM has three active runways and two inactive runways. In 1992, MEM was the 37th largest airport in the United States with a total of 3,958,537 passenger enplanements.[1] MEM handles more than 265 departing flights daily. Approximately 70 percent of the flights are managed by Northwest Airlines since MEM is a major hub for that airline. Memphis is the corporate headquarters of Federal Express Corp., the pioneer in small package air cargo service. Federal Express sorts over 1 million packages each weekday night at MEM.[2] MEM has 157 base aircraft.[3]

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[1] FAA, Enplanement and All Cargo Activity- Calender Year 1992, p. VP-1.

[2] Tennessee Bureau, Memphis City Directory, (1993).

[3] FAA, Terminal Area Forecast, (1993).

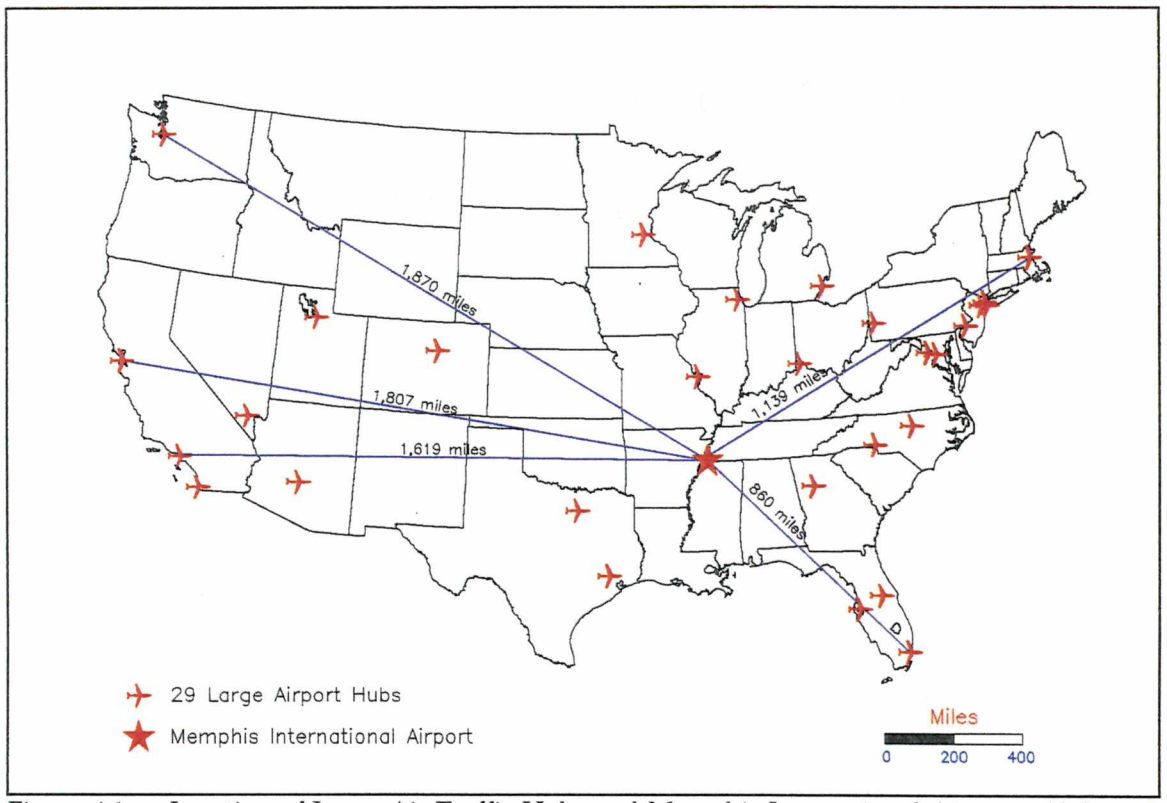


Figure 4.1.a. Location of Large Air Traffic Hubs and Memphis International Airport. (Adapted from: FAA, Terminal Area Forecasts FY1993-2005, (1993) p.13, and Delta Air Lines, Delta Worldwide Timetable,(1994).)

MEM is six miles (10 km) southeast of downtown (35°03' N and 89°59' W, elevation of 332 MSL). Geographically, MEM is located almost in the middle of large air traffic hubs in the United States, excluding Hawaii and Alaska (Figure 4.1.a.). The longest distance between MEM and the large air traffic hubs[4] on the West Coast is 1,870 miles (3,009 km) to Seattle-Tacoma International Airport in Washington State. The longest distance between MEM and large air traffic hubs on the East Coast is 1,139 miles (1,833 km) to Logan International Airport in Boston, Massachusetts.[5] In addition, the weather conditions of MEM are better than that of other airports in Tennessee. Those conditions are an advantage for MEM to be an air traffic hub.

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[4] See reliever airport in Glossary.

[5] Delta Worldwide Timetable, 1994.

MEM is a medium air traffic hub. There are three reliever airports in the vicinity of MEM: Memphis-General Dewitt Spain Airport 11 miles (18 km) northwest, Milington-Charles W. Baker Airport 16 miles (26 km) north, and Arlington Airport 24 miles (39 km) northeast.[6]

MEM has been facing a controversial issue, noise. MEM is participating in the noise mitigation programs developed under FAA's Part 150 program.[7] The FAA has agreed to purchase 1,362 houses and businesses as part of its $120 million noise abatement program. An additional 469 properties will be purchased for $40 million for the airport expansion project.[8] In 1989, 27 residents claimed increased noise and pollution at the airport damaged property values and hurt the quality of life in their neighborhoods.[9]

Surveying the history of MEM will not only provide a detailed documentation of one airport, it may suggest much about the general pattern of airport development in the United States.

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[6] National Oceanic and Atmospheric, "Memphis Sectional Aeronautical Chart", 1994.

[7] U.S. GAO, "Aircraft Noise: Eight Airports," (1989) p. 13.

[8] Hirschman, "FAA Action Boosts Plan to Construct 4th Runway," Commercial Appeal 1 Apr. 1993.

[9] Hirschman, "Thousands can Join Suit Against, Federal Judge Rules," Commercial Appeal 8 May 1993.

4.2. History of Memphis Airport, A Chronology

4.2.1. Memphis Municipal Airport (1925 - 1929)

On June 15, 1929, a few months short of the famous 1929 stock market crash, the Memphis Municipal Airport was dedicated for commercial purposes. Three final candidate sites of the airport (Figure 4.2.1.a.) were considered from among 14 sites.[11] They were: New Bry's Airport (65-acre), Mud Island and a 202.5-acre tract at Ward Farm. New Bry's airport was too small and provided little room for expansion even though it was close to downtown. Some considered Mud Island, which would have put an air-terminal right at the door of the post office, but the unpredictable Mississippi River ruled that out. At the tract in Ward Farm there were woods, but they were not thick and could be easily cleared. The tract could be expanded. Two good roads

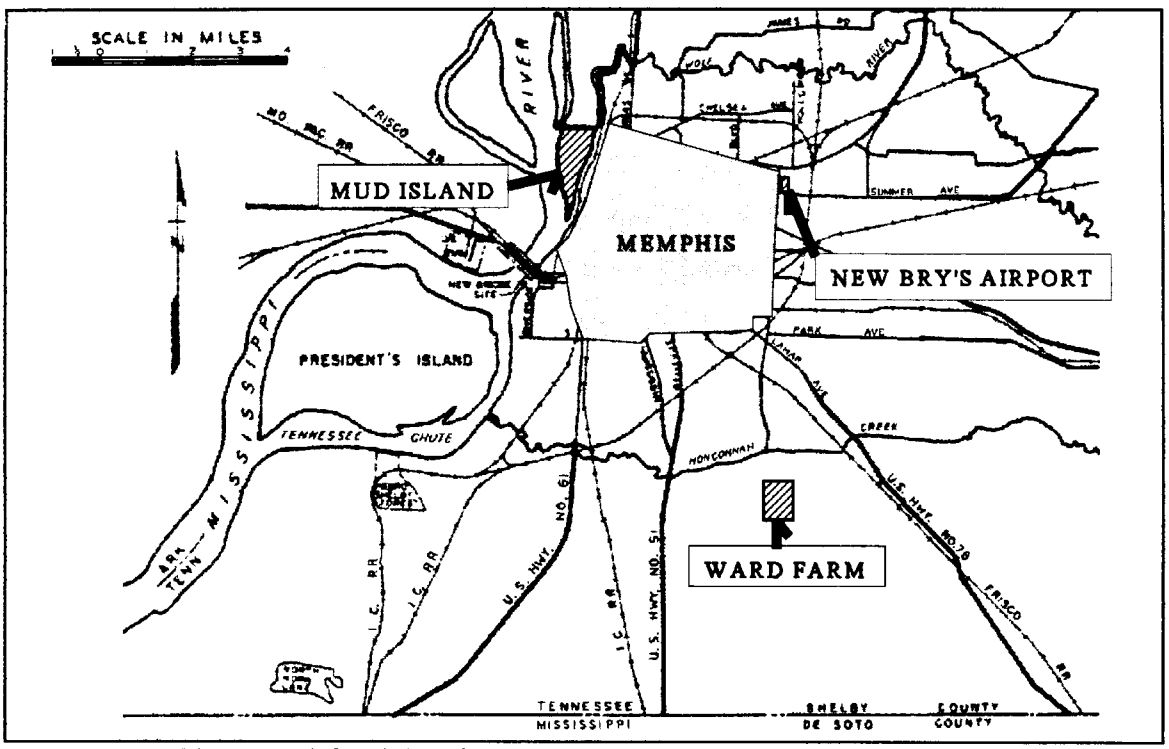


Figure 4.2.1.a. Three Final Candidate Sites for the Memphis Municipal Airport. (Base map adapted from: Memphis Municipal Airport, Master Airport Plan City of Memphis and Urban Area, 1947.)

[11] "From Sod Field Take-offs to Supersonic Landings in Fifty Years," 1929 50th Anniversary, (Memphis: Memphis-Shelby County Airport Authority, 1979).

led to it. It was located seven-and-a-half miles (12 km) from downtown and two miles (3 km) outside the corporate boundary of the City of Memphis.[12] Backed by the Memphis Aero Club of the year 1925 and a pro-aviation mayor, who appointed an airport planning commission, as promised, and further promoted in 1927 by Charles Lindbergh, the airport originally covered 202.5 acres, 2,600 feet (790 m) wide and 3,200 feet (973 m) long.[13]

A year before the dedication the City of Memphis leased the airport tract for $100 a month with an option to buy in 1936. On the basis of the lease and option, the airport commission made a lease contract with the Standard Oil Company by which the oil company built and gave the city, without cost, the hanger in exchange for the exclusive gasoline and oil privilege for 14 years.[14]

The airport consisted of three hangers and 3,000 feet (912 m) of sod field runway. One of the hangars was built by the Standard Oil company for $80,000. Another hanger was built by Curtiss-Wright, an aircraft maker, for $90,000. The last was built by Continental Airlines, later American Airways, for $40,000.[15]

The airport's operations were conducted from a white stucco building built by the Standard Oil Company. As many as15 passengers a day were using the airport.[16]

4.2.2. Radical Runways and Control Equipment (1930 - 1938)

In 1930, night flight was aided when a beacon that was seen for 50 miles (80 km) and a floodlight that turned night into day on the field were dedicated.[17]

On June 15, 1931, twelve years after the first commercial air transportation in the United

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[12] Archie Quinn, "Aviation in Memphis Has Been Slim Times," Commercial Appeal 2 Apr. 1951.

[13] Geoffrey Arend, (1988) p. 446.

[14] "City to Buy Airport if Title Approved," Press Scimitar 21 June 1935.

[15] Paul Coppock, "City to Buy Airport Improve Flying Site," Commercial Appeal 30 Jan. 1935.

[16] Geoffrey Arend, (1988) p. 446.

[17] "Airport Lights to be Dedicated Tonight," Commercial Appeal 15 Mar. 1930.

States was established between New York City and Chicago in 1919,[18] the first regularly scheduled mail and passenger line was provided to Memphis by American Airways, Inc., later American Airlines. The first batch of mail at Memphis Municipal Airport came in from Cincinnati and Louisville by the way of Nashville and the first mail flown out was carried to New Orleans.[19] one of airliners was the Ford Tri-Motor which carried 13 passengers and two crewmen, and cruised at 100 mph. The plane had the pounding noise of the three engines, a drafty cabin, and teeth-rattling vibration. Pioneer air travelers were impressed more with the speed than comfort.[20]

Between 1932 and 1937, three runways were constructed (Figure 4.2.2.a.). Those runways were in a radial shape because the shape would accommodate all wind directions for takeoff and landing.

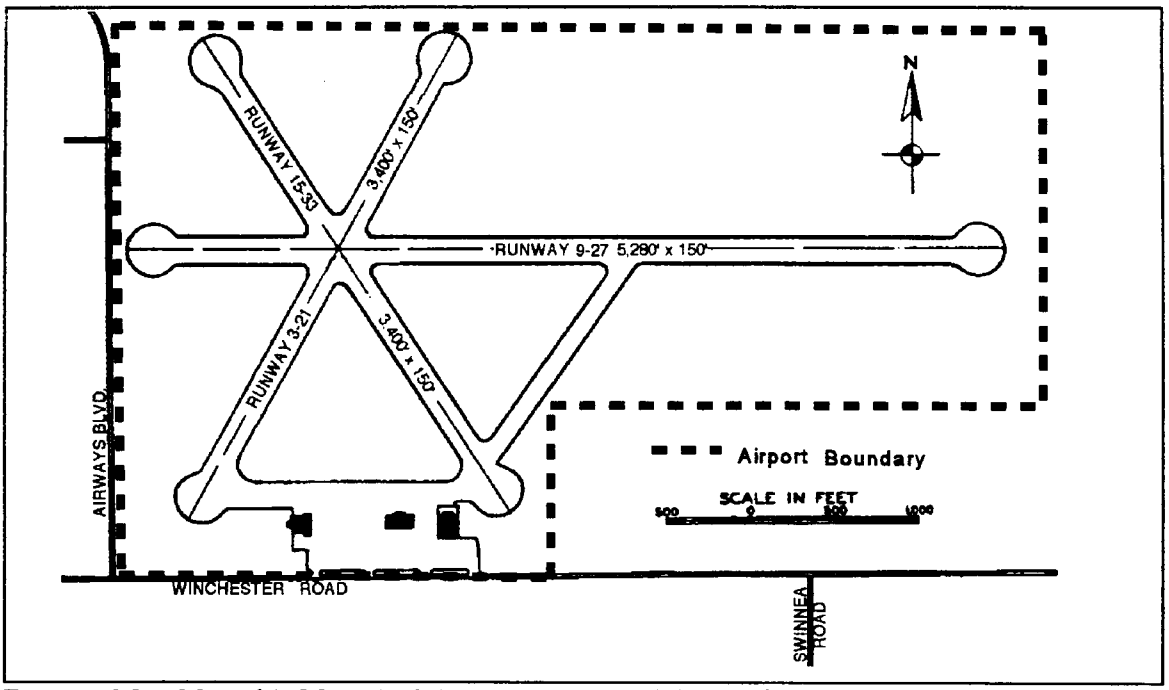


Figure 4.2.2.a. Memphis Municipal Airport in 1937. (Adapted from: "63 Acres Purchased to Enlarge Airport," Commercial Appeal 8 May 1938.)

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[18] Horonjeff, (1983) p. 15.

[19] Mermon Potter, "Memphis, Air Hub of the Nation," Commercial Appeal 8 Oct. 1939.

[20] "'Tin Goose' Alights in Memphis," Press Scimitar 6 June 1963.

In 1932, a new hard-surfaced Runway 3-21 composed of gravel and oil impregnated six inches thick. It was 3,400 feet (1,034 m) long and 100 feet (30 m) wide from the northeast to southwest corner of the field, was constructed by American Airways at a cost of $11,000.[21]

In June 1934, the Pacific Seaboard Line, later Chicago & Southern Airlines, started operating a line through Memphis and Chicago.[22]

In 1935, the original leased land, 202.5 acres, was titled to the City of Memphis for $100,000 before the expiration of the land lease on January 1, 1936. The reason was to obtain a share of Works Progress Administration (WPA) money being used for airport improvement. The WPA money could not be used to improve private property. In addition, another runway, Runway 15-33, 3,400 feet (1,034 m) long and 100 feet (30 m) wide, from northwest-southeast, transversing the existing Runway 3-21, was constructed at a cost of $25,000. The municipal airport issued a $125,000 bond for purchasing the title and the construction.[23]

In the same year, two radio transmitting stations to facilitate flight at night or in bad weather were built and aligned with the runway. One was two miles (3.2 km) and the other 1,500 yards (1.4 km) from the field.[24] Furthermore, the City of Memphis bought an additional 140 acres east of the field for $31,000 to build a new east-west Runway 9-27.[25] WPA officials approved a $214,271 municipal airport project for Memphis which was for the construction of Runway 15-33 and Runway 9-27, as well as for improvement in drainage and levelling down of the rolling land in the new acquired portion.[26]

In 1936, Runway 3-21 was widened to 150 feet (46 m) and repaved with a six-inch gravel

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[21] "First Takeoff from New Runway," Commercial Appeal 23 Oct. 1932.

[22] Mermon Potter, "Memphis, Air Hub of the Nation," Commercial Appeal 8 Oct. 1939.

[23] Paul Coppock, "City to Buy Airport Improve Flying Site," Commercial Appeal 30 Jan. 1935.

[24] "Use Radio Approach for Airport Safety," Commercial Appeal 11 July 1935.

[25] Land Acquisition is in detail discussed in the later section 4.5.

[26] "President Passes on Airport Work," 28 Sep. 1935.

foundation and a two-inch "hot mix"[27] surface instead of concrete at a cost of $275,000. The project was part of a $21,000,000 federal program to promote all-weather, all-purpose airports.[28] In addition, radio range and radio communication transmission equipment costing approximately $60,000 was installed by the Federal Bureau of Air Commerce.[29]

In 1937, the new east-west Runway 9-27, 5,280 feet (1,605 m) long and 150 feet (46 m) wide was constructed.[30]

In 1938, the Bureau of Air Commerce approved spending $106,700 for grading and drainage of the new section of the airport and lighting the entire boundary of the field, which was now 405 acres.[31]

At the time, the number of passengers a day was 80, about 29,000 annually. Annual airline schedule aircraft operations[32] were 3,000.[33]

4.2.3. Administration Building (1938 - 1941)

In 1938, the $140,000 Municipal Airport Administration Building was built by the City of Memphis and the WPA. The building housed ticket and administration offices, the weather bureau, radio traffic control tower and a restaurant.[34] This terminal building was expanded in

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[27] The "hot mix" method mixes the gravel with asphalt oil at a high temperature and puts the surface down with the high temperature maintained until it is spread.

[28] "Airport Gets 'Face Lifting' by WPA Crews'," Press Scimitar 31 Mar. 1936.

[29] "Federal Contract Let for Airport Radio," Commercial Appeal 22 Dec. 1937.

[30] "Airport Expansion Plans Announced," Press Scimitar 19 Apr. 1938.

[31] "$106,700 Approved for Airport Work," Press Scimitar 3 Feb. 1938.

[32] See the definition of aircraft operation in Glossary.

[33] Memphis Municipal Airport, (1947).

[34] "Airport Building to be Dedicated Tomorrow," Press Scimitar 14 Oct. 1938.

1941, 1947, 1952, and 1953.[35]

Figure 4.2.3.a. shows a general view of the Memphis Municipal Airport taken from an airplane and looking north in 1939. There were two hangers in left (west) of the Administration Building and one hanger in right (east) of it. The dotted lines at the right show a new north-south Runway 18-36 under construction.

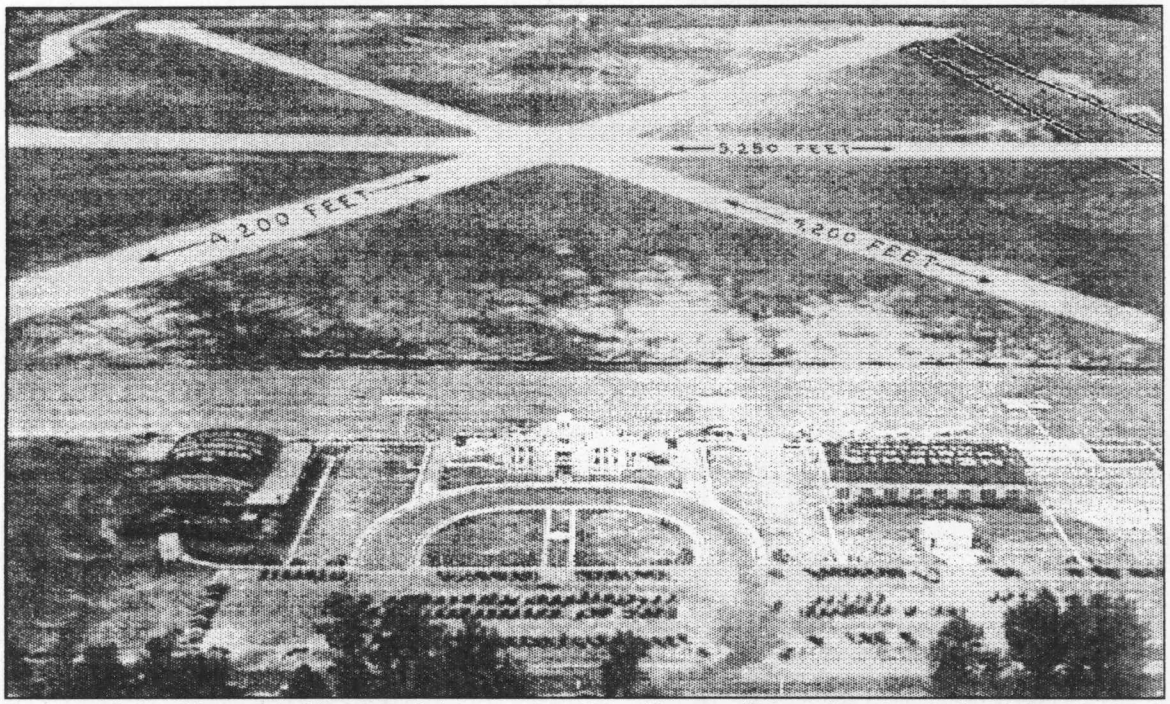


Figure 4.2.3.a. Memphis Municipal Airport in 1939. (Source: "Memphis Air Hub of the Nation," Commercial Appeal 8 Oct. 1939.)

Sixty three acres along the north border of the airport were bought for $20,715 to extend Runway 3-21 and Runway 15-33 from 3,400 feet (1,034 m) long to 4,200 feet (1,277 m) long to accommodate the larger transcontinental planes. The WPA approved an allotment of $250,000 for continuing airport modernization as part of the state and national program to strengthen facilities for both civil and military aeronautics.[36]

The City of Memphis purchased the Curtiss-Wright hanger built in 1928 for $15,000 and

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[35] Allen & Hoshall Consulting Engineers, (Mar. 1971).

[36] "63 Acres Purchased to Enlarge Airport," Commercial Appeal 6 May 1938.

the American Airlines Building for $8,500. Consequently, the city government owned all buildings at the airport.[37]

In 1939, an additional 43 acres east of the existing line of hangars was purchased at a cost of $18,000. The new land made room for two new hangars which housed the main offices and shops of Chicago & Southern Airlines.[38]

On February 15, 1939, Eastern Air Lines connected Memphis and Tampa, Fla, by way of Birmingham and Montgomery.[39]

In 1940, a fourth runway, Runway 18-36 4,968 feet (1,510 m) long and 150 feet (46 m) wide north-south, was constructed. In addition, the two new $128,471 hangars were built. The city's share in the hangars was $83,424. The WPA paid an additional $45,048. At the time, a beacon was rotating with a green code beacon flashing "MM" in oeder to identify the Memphis Airport. Airport service was now day and night.[40]

In 1941, the first airport zoning for public safety was adopted in Memphis and Shelby County.[41] A one and one-half inch new surface was put on the three runways by the federal government to handle heavier planes. [42]

4.2.4. Military Age (1939 - 1946)

Beginning in 1939, the airport was open to Army, Navy or Marine planes, both for routine landings and for over night stays.[43]

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[37] "City Buys Hangars, Plans Two New Ones," Commercial Appeal 14 Sep. 1938.

[38] "More Land for City's Airport," Press Scimitar 21 Mar. 1939.

[39] Mermon Potter, "Memphis Air Hub," Commercial Appeal 8 Oct. 1939.

[40] Airports (1940) p. 274.

[41] Memphis & Shelby County Planning Commision, (May 1962) p. 2.

[42] "Plans Made Known for Airport Work," Commercial Appeal 19 Apr. 1941.

[43] Mervin Rosenbush, "Airport Is Vital Link in Defense," Press Scimitar 7 Dec. 1941.

In 1941, 31.25 acres adjoining the southeast corner of the airport was purchased for $17,000 as a site for the 30th Reconnaissance Squadron attached to the Second Army. The new land increased the total size of the airport to 533.25 acres.[44] The allocation of $10,000 for construction of a post office building was announced by the Tennessee Aeronautics Commission at Nashville.[45]

In 1942, a $200,000 bond issue for improvements, including a new $125,000 hangar and a $45,000 two-story addition to one of the present hangars, was authorized by the City Commission.[46]

In March 1942, the city's condemnation of property from the north line of the airport to Democrat Lane was allowed $62,627 by a Circuit Court Jury of View to enlarge three of the existing runways to a full mile (1,609 m) in length.[47] The city now owned totally approximately one square mile of lands, all land adjoining the airport from Airways Boulvard to Harrington Road and from Winchester Pike to Democrat Lane.[48]

On June 22, 1942, the City Commission turned over the airport to the Army for the use of the Ferry Command and the air support base.[49] The city received one dollar a year from the Government for the use of the Memphis Airport under terms of a lease authorized during 1942 through 1949.[50]

In August 1942, Federal Judge Marion S. Boyd granted a petition filed by the U.S. government for condemnation of 466.76 acres of land east of the airport for the purpose of

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[44] "Proposed Addition to 'Round Out' Airport," Commercial Appeal 15 June 1941.

[45] "Memphis Airport Gets Postoffice," Press Scimitar 13 Nov. 1941.

[46] "$200,000 to be Spent on Improving Airport," Commercial Appeal 4 Feb. 1942.

[47] "First Step is Taken to Enlarge Airport," Commercial Appeal 4 Mar. 1942.

[48] "Land Purchased," Press Scimitar 3 Apr. 1942.

[49] Dave M'Connell,"Airport Taken Over as Army Ferry Base; Expansion Planned," Commercial Appeal 23 June 1942.

[50] "Army Leases Airport; City Gets $1 a Year," Commercial Appeal 2 July 1942.

enlarging it to meet military needs. This purchase was authorised by the War Department.[51]

In 1943, the airport was closed to commercial and private flying by the Civil Aeronautics Administration (CAA). Only the Army Air Forces, the Ferry Command, and regularly scheduled air carriers could use the airport at that time.[52]

A new traffic control tower was built on the north side of the field, near the Fourth Ferrying Group's base operations headquarters, where most of the activity was centered at the time. It was equipped with the most modern radio communications equipment. From January, 1942 to September, 1943 the number of flight operations handled daily increased more than 500 per cent. The tower replaced the old tower on top of the Terminal Building.[53]

By 1945, the City of Memphis purchased 608 acres of land adjoining the airport on all four sides as a cost of $240,000, in making the approaches to landing strips safer. The glide planes to the runways were lowered from a 30 to 1 to a 40 to 1 angle. The additional lands made it possible for utilization of greater landing strips.[54]

By February 1946, a $1,000,000 wartime improvement program to accommodate large military plane by the Army and Navy financed the airport. The improvements made to MEM under the program were:[55]

- Widening of Runway 15-33 from 100 feet (30 m) to 150 feet (46 m) and repavement of the entire 4,200 feet (1,277 m) of the runway.
- Resurfacing of the 5,200-foot (1,581 m) Runway 18-36.
- Rebuilding almost in the entirety and resurfacing of Runway 9-27.

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[51] "466 Acres are to be Added to City's Airport," Press Scimitar 11 Aug. 1942.

[52] "Airport Ban Is Issued By CAA," Press Scimitar 23 Apr. 1943.

[53] Hilmon Pinegar, "Memphis Airport Installs New Tower to Control Ever-Increasing Traffic," Press Scimitar 24 Sep. 1943.

[54] "Airport's Taxiways to be Widened Soon," Commercial Appeal 30 Nov. 1945.

[55] Ibid.

- Resurfacing and extension of Runway 3-21 1,000 feet (304 m) to a total length of 5,200 feet.
- Installation of new border lights for all runways, and considerable grading and resodding of various parts of the fields.
- Widening of taxiways in front of the Administration Building from 92 feet (28 m) to 142 feet (43 m).

During World War II, the four runways were paved with asphaltic concrete. At that time, the U.S. Army also installed 259 buildings on the north of the field. Sixty of these buildings were located on property owned by the City of Memphis; one hundred and ninety were located on a 435 acre tract of land owned by the U.S. government.[56]

4.2.5. Civilian Age (1946 - 1955)

In 1946, all four airlines, American Airlines, Braniff Airways, Chicago & Southern Airlines, and Eastern Airlines, started using four engine Douglas DC-4 aircraft.[57] The DC-4 carried 44 passengers, was powered by 1450-hp Pratt & Whitney R-2000 engines and cruised at 230 mph.[58]

On May 6, 1947, a report on Master Airport Plan City of Memphis and Urban Area written by the Memphis Municipal Airport, was submitted to the mayor and commissioners of Memphis. Using the number of actual annual passengers from 1938 to 1947, the report forecasted 1,920,000 annual passengers and 32,000 annual airline schedule aircraft oprations in 1957. The projected future growth indicated an increase of approximately 300 percent in airline passenger volume by 1957. On the basis of the forecast, the report recommended three development phases; phase one be accomplished by the end of 1948, phase two by the end of 1950 and phase three by the end of 1957 or earlier if traffic should demand. Figure 4.2.5.a shows ultimate plan as phase three. The

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[56] Memphis Municipal Airport, (1947) p. 40.

[57] "Hangar Remodeling will Relieve Airport," Commercial Appeal 19 Nov. 1945.

[58] Shevell, (1989) p. 18.

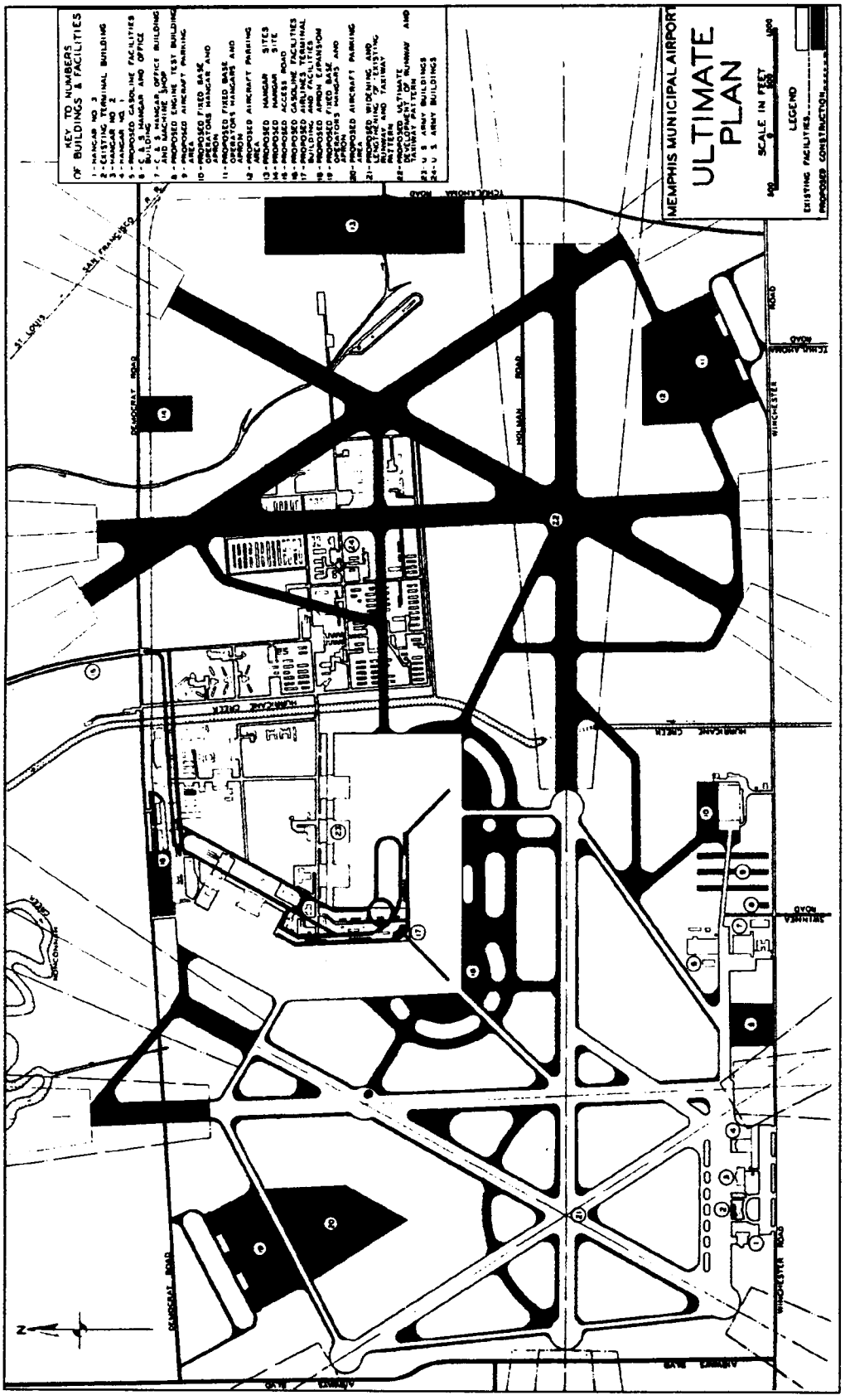


Figure 4.2.5.a. Ultimate Plan of Master Airport Plan in 1947. (Source: Memphis Municipal Airport, Master Airport Plan City of Memphis and Urban Area (1947) Plate 36.)

main recommended plans and the achievements were as follows:

Phase One at estimated cost of $2,382,674.

- Extend the three existing runways to a length of 6,100 feet (1,854 m) and to widen to 200 feet (61 m).
- Widen all existing taxiways to 75 feet (23 m).

Phase Two at estimated cost of $1,766,700.

- Construct a new terminal building on the north side of the airport field to separate commercial and private operations.

Phase Three at estimated cost of $6,368,612.

- Construct three new runways 6,100 feet long and 200 feet wide and extend one runway to a total length of 10,200 feet (3,101 m) at a width of 200 feet.

As a consequence, the achievements were: Runway 9-27 and Runway 3-21 were extended to 6,500 feet (1,976 m) and 5,800 feet (1,763 m) each without widening in 1950, the existing terminal building was enlarged in 1947, 1952 and 1953 instead of constructing the new terminal building, and the three new runways were not constructed.

In October 1947, the existing Terminal Building was enlarged at a cost of approximately $40,000 by the City. The expansion was a one-story wing over the concrete concourse wing on the north of the building and a new canopy at the front of the building. The addition increased the terminal's lobby space from 1,000 to 4,000 square feet, and the airport restaurant space from 479 to 2,500 square feet. The number of enplanements had increased from 38,000 in 1938 to 426,000 in 1946.[59]

In the same year, instrument landing was approved by the CAA. Minimum ceilings of 300 feet (91 m) and three-quarters of a mile (1.2 km) visibility were authorized for instrument landings.[60]

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[59] "New Wing on building Approved at Airport," Commercial Appeal 21 May 1947.

[60] "Three Airlines to Get Instrument Landing," Commercial Appeal 15 Sep. 1947.

In 1947, the four air carriers operating at that time offered direct air transportation to eighty cities located in all sections of the United States except the far northwestern section. There were eighty-two operations per day arriving at or departing from Memphis.[61]

Through passengers declined in 1948 because of American Airlines schedules which over-fly Memphis.[62]

In 1948, a new omni-directional radio range[63] was installed in the airport.[64]

In 1949, the city adopted an ordinance establishing take-off charge for aircraft of the six airlines despite airlines' objection. The rate was fixed at nine cents for each thousand pounds of airplane weight calculated by taking the maximum allowable take-off weight as fixed by the CAA. The temporary rates were DC 3s $3.92, DC 4s $12.04, DC 6s $12.04 and Convair's $6.07. The charges compensated the airport for the loss of revenue from commercial air lines caused by the 1949 Tennessee State Legislature abolishing a seven-cent tax on gasoline sold to the air lines.[65]

A five-man Airport Commission was named to supervise the expanding operation and development of the Municipal Airport in 1949 and was funded from a part of the budgets of the Department of Finances and Institutions. The airport was first activated in the late 1920s by an Airport Commission, but because the operation was so small in subsequent years on June 1937 it was decided to vest the Commissioner of Finance and Institutions with responsibility for its operation.[66]

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[61] Memphis Municipal Airport, (1947) p. 8.

[62] Robert Gray, "Airport Notes Growth during Past Decade," Commercial Appeal 19 Mar. 1951.

[63] Omni-directional has very high frequency (VHF). By using a pointer indicator which catches the frequency a pilot can fly visually instead of listening to signals in earphones. There is an almost infinite number of courses to or from a range station, instead of only four courses on low frequency equipment.

[64] "One of 50," Press Scimitar 5 Mar. 1948

[65] "Take-off Fees Fixed Despite Airline View," Commercial Appeal 28 Dec. 1949.

[66] "Airport Commission will be Established," Commercial Appeal 8 June 1949.

In 1950, Runway 9-27 was extended 1,300 feet (395 m) to a total length of 6,500 feet (1,976 m) and Runway 3-21 was extended 1,100 feet (334 m) to 5,800 feet (1,763 m). The new three taxiways were also extended totaling about 1,200 feet. High intensity lights were installed on Runway 9-21 and medium intensity lights were installed on Runway 3-21. Total cost was $600,000.[67]

Memphis was served by seven airlines in 1950. Of the seven, American Airline, Braniff Airways, Chicago & Southern Airlines, Capital Airlines and Eastern Airlines operated transcontinental routes. The other two, Southern and Ozark, were local service airlines. The number of annual enplanements of MEM in 1950 was 434,613.[68]

During 1952 and 1953, the lobby of the terminal building was enlarged, increasing passenger chairs from 82 to 232, air conditioning was added and the number of gates for passengers was increased from six gates to 12 gates. In all $376,590 in improvements were made, with the city assuming $141,147 of the cost, the Federal Government, $162,943, and the state, $72,500.[69] [70] [71]

In June 1952, the north end of Runway 18-36 and the northwest end of Runway 15-33 were closed to landing and takeoff for multi-engine aircraft, including all commercial aircraft after a series of air transport crashes near Newark Airport, each of which had killed residents of Elizabeth, N.J. The approach change kept planes from flying low over the heavily populated Bethel-LaBelle section and the dense housing behind Memphis General Depot.[72]

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[67] "City Analyzing Bids on Airport Protects," Commercial Appeal 17 June 1949.

[68] Robert Gray, "Airport Notes Growth during Past Decade," Commercial Appeal 19 Mar. 1951.

[69] "Space Problem at The Airport," Press Scimitar 5 July 1951.

[70] "Airport is Prepared to Welcome Jet Age," Commercial Appeal 22 Mar. 1953.

[71] "Increase is reported in Airport's Traffic," Commercial Appeal 18 Jan. 1953.

[72] Archie Quinn, "Heavy Planes to be Diverted from Populous Sections Here," Commercial Appeal 27 Apr. 1952.

Two hundred and twelve acres of property at the end of the airport were acquired to expand Runway 9-21.[73]

In 1954, Runway 9-21 was expanded from 6,500 feet (1,976 m) to 8,936 feet (2,717 m) to handle large jet equipment of the military and the heavy new DC-7 aircraft. The cost was $700,000. In addition to the lengthening of the runway, all taxi strips were reinforced with asphalt-concrete. The project cost $185,000.[74] The National Guard Bureau paid for those projects.[75]

4.2.6. Toward North-South (1956 - 1959)

On December 20, 1956, an airport master plan for expenditure of $14 million in 25 years was accepted by the Airport Commission. The plan recommended land acquisition and construction of two parallel north-south runways. On the contrary, the Airport Commission had recommended construction of another east-west runway paralleling Runway 9-27 and a new terminal building at the north of the field by January 1956.[76] The reason for extending the north-south runways was that the prevailing winds were from the north. It was prepared by Leigh Fisher & Associates, airport trade analysts and financial consultants from South Bend, Ind. after ten months of study. Harland Bartholomew & Associates, planning consultants, predicted that Shelby County's population would be 820,000 in 1970. On the basis of the prediction, the plan estimated that by 1970 the terminal would handle 130 departures and 11,500 passengers daily. In 1956, there were 60 daily departures and 1,600 passengers. The plan included the following

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[73] "Overton Gets Commission's O.K. to Close Deal to Make City Airport Jet-Worthy," Press Scimitar 20 Nov. 1952.

[74] Morris B. Baker, "Longer Runways Due at Memphis Airport," Commercial Appeal 10 Aug. 1953.

[75] Robert Gray, "Airport is Prepared to Welcome Jet Age," Commercial Appeal 22 Mar. 1953.

[76] "New East-West Runway Talked for Airport," Press Scimitar 1 Jan. 1956.

proposals: [77] [78] [79]

- Purchase about 1,000 acres in the area bounded by Airways Boulevard, Winchester Road, Swinnea Road, and Capleville-Whitehaven Road (later Shelby Drive). The city already owned about 450 acres in that area.
- Construct two parallel north-south runways from 7,400 (2,250 m) to 8,400 feet (2,554 m) long. The second runway would be constructed by 1970.
- Build a two-story terminal containing 140,000 square feet of floor space, 450 feet (137 m) wide of ticket counters, 180 feet (55 m) long of baggage claim space, and 17,000 square feet of food service area.
- Provide parking space for at least 2,400 cars.
- Extend clear zones with no obstruction, 7000 feet (2,128 m) long at each end of all runways,

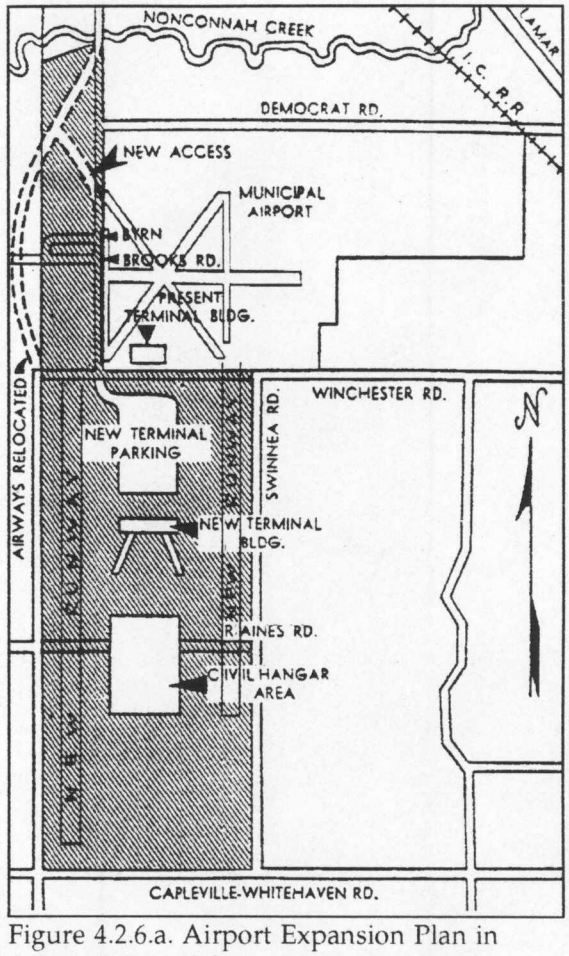


Figure 4.2.6.a. Airport Expansion Plan in 1956. (Adapted from: "Airport Expansion Accord is Reached," Commercial Appeal 18 Aug. 1956, and "$14 Million Plan Calls for Big Terminal and Two New Runways," Press Scimitar 21 Dec. 1956.)

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[77] "$14 million Plan Calls for Big Terminal and Two New Runways," Press Scimitar 21 Dec. 1956.

[78] Richard A. Allen, "Airport Expansion Plan Calls for Big Terminal, More Land," Commercial Appeal 21 Dec. 1956.

[79] "Airport Expansion Accord is Reached," Commercial Appeal 18 Aug. 1956.

- Eliminate Raines Road, between Airways Boulevard and Swinnea Road,
- Construct an additional public secondary airport to handle private, training and other non compatible aircraft.
- Provide a site for a large motel near the airport.

As a result, the first north-south Runway 18L-36R was constructed as 8,400 feet (2,554 m) long in 1963 and the second north-south Runway 18R-36L was constructed as 9,139 feet (2,778 m) in 1972. The new terminal builidng was also built in 1963.

Land acquisition for widening the clear zone west of Runway 9-21 was begun in 1957 and would cost about $370,000.[80]

In 1957, American Airlines started to operate air cargo with a DC-6A air-freighter through Memphis five days a week. Southern Airways followed the action.[81]

Land purchase for the new north-south Runway 18L-36R, 8,400 feet long and 150 feet wide (2,554 by 46 m), started in 1957 at a cost estimated to be more than four million dollars. In 1958, the construction of Runway 18L-36R , taxiways, drainage and related work was estimated at a cost of $3,885,000.[82]

In 1959, one million passengers passed through the airport.

4.2.7. Jet Age (1956 - 1968)

A new board of airport commissioners was named in 1956. They were charged with developing a modern airport for Memphis. A new $5.5 million terminal was dedicated on June 7, 1963, and the airport renamed Memphis Metropolitan Airport.

Roy P. Harrover, architect of the Memphis Metropolitan Air Terminal, introduced the

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[80] "Airport's Progress is Cited by Dillard," Commercial Appeal 30 Aug. 1957.

[81] Morris Baker, "Freight Warehouse Sought for Airport," Commercial Appeal 1 July 1957.

[82] Robert Gray, "Times Create Need for Modern Airport," Commercial Appeal 9 Mar. 1958.

concept of the new terminal as follows:[83]

> It was conceived in the earliest days of jet passenger travel, and is one of the first to be designed specifically for jet aircraft. In defining purpose, the criteria of public convenience and comfort were always placed first.
>
> The decision to locate all major public areas on the second floor level was based on the need to board the large jets through air conditioned, enclosed bridges from this second floor. Walking distance is minimized by placing the heavily used jet gates close to lobby; with the smaller feeders line more remote. The two lower floors of the building and concourse were constructed of brick masonry, with few window openings, to minimize the effects of jet noise and blast.
>
> Those low masonry masses also give the building a feeling of restful strength and security, particularly welcome to a passenger returning happily to earth. The form of the high roof and its supporting columns was chosen for dignity, cost economy, and a lifting quality, appropriate to a building involved with flight.
>
> We have attempted to give to Memphis and the Mid-South a building which will serve as a practical and beautiful gateway, symbolic of the potential for the future which we know to exist here.

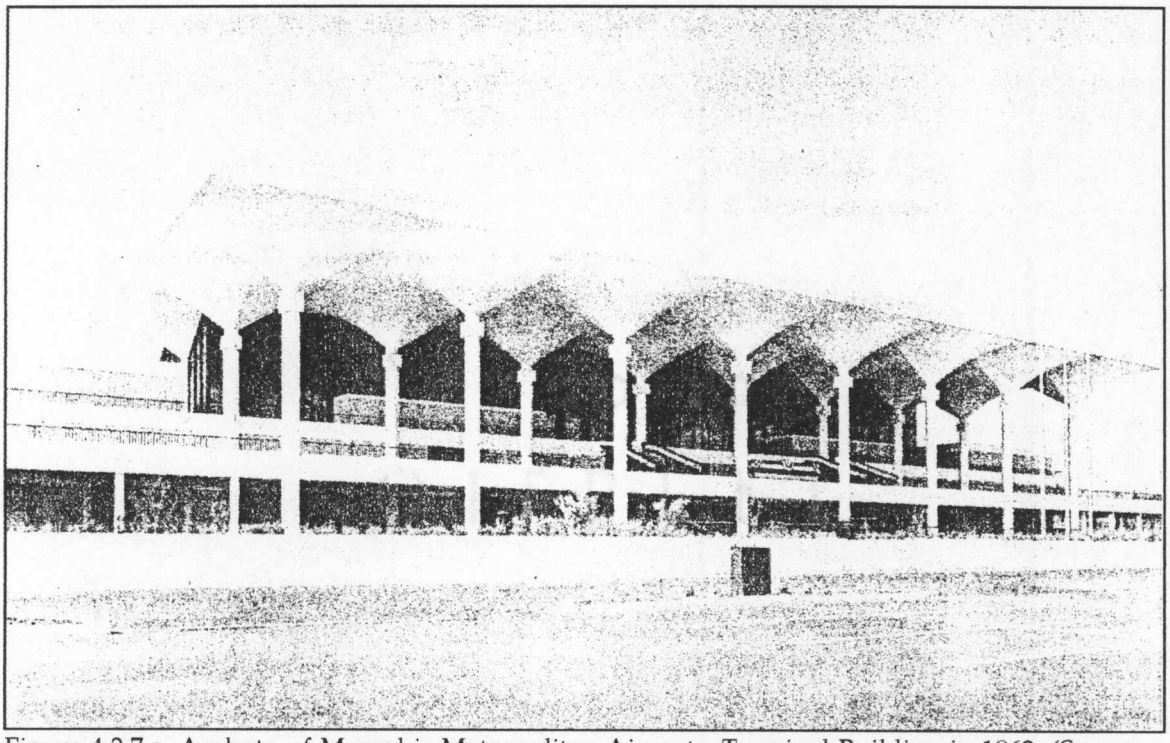


Figure 4.2.7.a. A photo of Memphis Metropolitan Airport - Terminal Building in 1963. (Source: Allen & Hoshall Consulting Engineers, Airport Layout Plan - Memphis International Airport Memphis: Memphis-Shelby County Airport Authority, (March 1971) Plate 5.)

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[83] Roy Perkins Harrover, "Epitome of Architectural Design," Ietage Airlines, Souvenir Program, Memphis: Memphis Metropolitan Airport (June 1963) p.16.

The new terminal had 22 gates serving seven airlines: American, Braniff International Airways, Delta Air Lines, Eastern Air Lines, Southern Airways, Trans-Texas Airways and United Air Lines.[84]

At the same time, the new Runway 18L-36R, was opened with a new "pancake" lighting system[85] in order to guide a pilot to center the end of a runway.[86] The old north-south Runway 18-36 was converted into a taxiway.[87]

In 1962, Winchester Tunnel, which carried four lanes of traffic beneath 18L-36R and a parallel taxiway, was constructed.[88]

On July 29, 1963, the first jet, an American Airlines Boeing 707 Astrojet, landed and left for New York.[89] The Boeing 707 Astrojet cruised at 611 mph and carried 120 passengers and eight crewmen.[90]

In 1964, Allen & Hoshall, airport engineers, reported a tentative plan for a new second north-south Runway 18R-36L to the Airport Commission. The commissioners presented it to the City Commission and the Planning Commission.[91] The runway was 9,300 feet (2,827 m) long and 150 feet (46 m) wide and paralleled 3,406 feet (1,035 m) west from the existing 8,400-foot Runway 18L-36R. Simultaneous instrument landings were not permitted on the parallel runways during bad weather, because runways needed to be at least 5,000 feet (1,520 m) apart for minimum safety.

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[84] Louis Silver, "Memphis Steps Proudly into Jet Age," Commercial Appeal 21 Jan. 1963.

[85] The system was called "pancake" light system. The strip of lights imbedded in the center strip of the began about 75 feet (23 m) from the south end of the runway. The center lights were spaced about 25 feet (8 m) apart all along the runway. They were visible from the either end of the runway, but not from the sides. When a pilot was coming in for a landing in bad weather, he could know that he had his plane headed right down the center of the runway.

[86] "'Pancake' Runway Lights will be Sky Safety Lane," Commercial Appeal 2 Feb. 1963.

[87] Louis Silver, "Memphis Steps Proudly into Jet Age," Commercial Appeal 21 Jan. 1963.

[88] Allen & Hoshall (March 1971) .

[89] "New Airport Terminal Now Officially Open," Press Scimitar 29 July 1963.

[90] "'Tin Goose' Alights in Memphis," Commercial Appeal 6 June 1963.

[91] "Runway Plan for Airport," Press Scimitar 10 July 1964.

If Memphis followed the 5,000-foot minimum, the new runway would have been put west of Airways Boulevard and the cost would have increased several million dollars just for the land.[92]

In 1965, 142 acres of land at the south corner of Shelby Drive and Airways Boulevard were purchased for a clear zone for Runway 18R-36L at a cost of $603,000.[93]

In April 1966, the FAA approved a $1,234,000 grant to help cover the cost of land for the new Runway 18R-36L. The funds paid about half the total cost of property for Runway 18R-36L.[94]

In September 1966, a master layout plan including the new $8.5 million Runway 18R-36L was approved by the FAA.[95]

Southern Airways replaced DC-3 aircraft with DC-9 jets in 1966. An officer of the airlines said that economy was the big factor sending the DC-3s into retirement. The break-even point of the DC-3 was occupancy of 17 of 25 seats and that of the DC-9 was 26 of 75 seats.[96]

In June 1967, the City Commission approved the hiring architect of Roy P. Harrover to design the proposed 15-million-dollar expansion of the airport terminal.[97] The proposed plan recommended the addition of new sub-terminals and north-south fingers to the east and to the west of the existing central terminal building. Each sub-terminal would be an independently functioning facility, similar to the existing terminal, but 60 percent of its size. The plan based on that the number of actual annual enplanements in 1966 was 960,031 and the number of projected annual enplanements in 1970 and 1975 would be 1,884,623 and 3,933,680. Furthermore, gates would accommodate the coming Boeing 747 super jets which airlines had ordered. The most favored recommendation was that by 1970 the two sub-terminals and 20 gates be added and that

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[92] Charles Thornton, "Work to Begin on Runway Site," Commercial Appeal 18 Oct. 1967.

[93] "$603,000 Price for 142 Acres," Press Scimitar 20 Jan. 1965.

[94] Charles A. Brown, "$1.2 Million OK'd for Airport," Press Scimitar 8 Apr. 1966.

[95] "O.K. Plans for New Runway," Press Scimitar 23 Sep. 1966.

[96] "Even Small Airlines are Turning to Jets," Commercial Appeal 20 Mar. 1966.

[97] "Commission OK's Airport Architect," Commercial Appeal 14 June 1967.

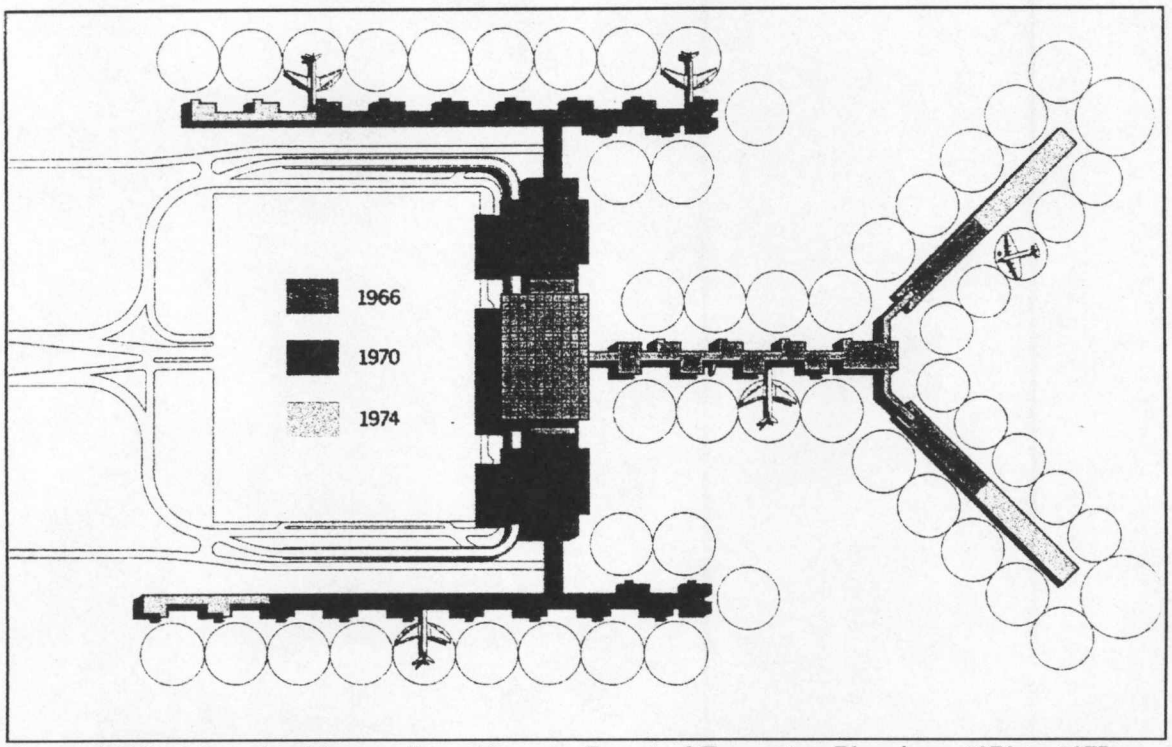


Figure 4.2.7.b. Memphis Metropolitan Airport - Terminal Expansion Plan from 1970 to 1975. (Source: Roy P. Harrover & Associates, Memphis Metropolitan Airport Terminal Building Expansion Plan, Memphis: Memphis Metropolitan Airport, (1967) Chart F2.)

by 1975 10 gates be added. Finally, there would be 54 gates at MEM in 1975. (See Figure 4.2.7.b.)[98] As a result, the sub-terminals were added in 1974.

In August 1967, the Air Force agreed to returned 379.9 acres of 461 acres which it had rented from the City of Memphis for one dollar per month since 1942. The 379.9 acres had been vacant since 1965.[99] The remaining, 81.1 acres, were used by the Tennessee Air National Guard.[100]

In March 1968, Piedmont Airlines started to connect Memphis with cities in Virginia and the Carolinas and Allegheny Airlines started serve between Memphis and cities in Kentucky, West

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[98] Harrover, (1967), pp. 28, 109, 129.

[99] "Airport Property is Sought by City," Commercial Appeal 17 Aug. 1967.

[100] "Airport Land Lies Fallow," Commercial Appeal 7 June 1967.

Virginia and Pennsylvania.[101] [102] In November, Frontier started servicing Memphis.[103]

A $20,755 soil testing for the runways was conducted because complete records of construction were not kept.[104]

On November 18, 1968, the Airport Commission chairman and the director of public service and liaison with the airport at City Hall discussed future development plans at Oakhaven School.[105] The director said that airport consultants had produced a drawing with a runway going through the center of Oakhaven although their study was not completed. In addition, the director said if the airport had to buy the homes in the area, residents would have at least five-year warning for the move. More than 1,200 nearby Oakhaven residents attended in the meeting.[106]

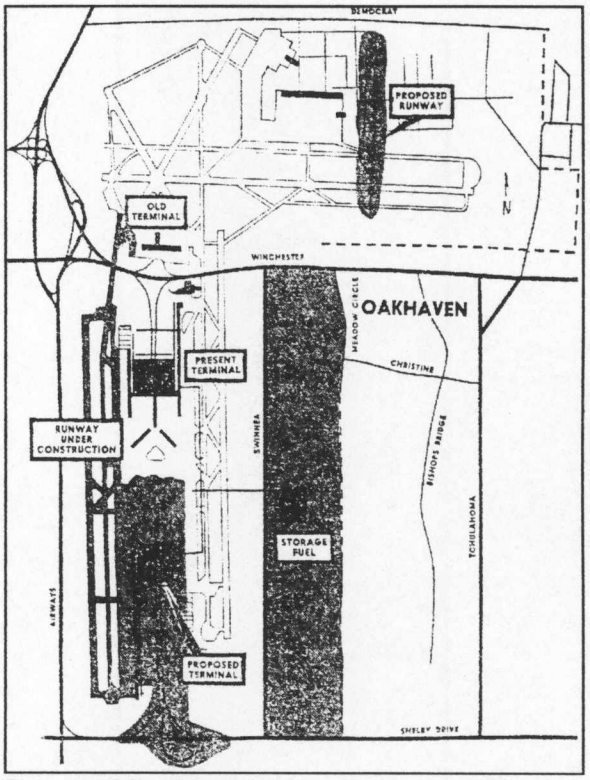


Figure 4.2.7.c. New Airport Expansion Plan in 1969. (Source: "Oakhaven Gets Cherry News," Commercial Appeal 9 Aprl 1969.)

On April 8, 1969, a $60,000 study by Peat, Marwick & Livington, San Francisco planners and consultants was unfolded. The

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[101] John Means, "Terminal to be Cramped if 2 Airline Win Approval," Commercial Appeal 29 Sep. 1967.

[102] "Air Travel Dips While Concern Rises," Commercial Appeal 16 Mar. 1968.

[103] Jefferson Riker, "Account of Airports's Growth Confirmed by the Numbers," Commercial Appeal 19 Jan. 1969.

[104] "$20,755 Airport Tests Approved," 27 Aug. 1968.

[105] "Airport Future to be Discussed," Press Scimitar 18 Nov. 1968.

[106] Pat Guibao, "Airport Expansion Plan Discussed in Oakhaven," Press Scimitar 19 Nov. 1968.

plan called for a second terminal to the south of the existing terminal and fuel tank farm. A buffer zone was planned in that area where the fuel farm would be build. Furthermore, the city would buy the buffer zone if residents desired to sell because of noise problems. There were 266 homes. The consultants thought Oakhaven would not be needed for a third north-south long jet carrier runway until 1990. In addition, a short runway north of Winchester Road for general aviation would be needed.[107] [108]

Site preparation for the new Runway 18R-36L was completed at a cost of 3.2 millions in May of 1969. [109]

4.2.8. Memphis International Airport and Airport Authority (1969)

In 1969 the airport had another change of title, to Memphis International Airport. Though at the time there were no international flights, the airport had a customs and immigration office. At the same time, airport control passed to a new Memphis-Shelby County Airport Authority. The main policy statements of the authority provided that:

- all capital improvements included in airport expansion programs shall be financed by self-liquidating general obligation bonds sold and approved by City Council,
- minor improvements can be handled by the Airport Authority provided that no revenue bond will be sold without prior approval of City Council,
- while Airport Authority will be given general management responsibility for operation of the airport, it will continue to make use of city services and departments,
- power of eminent domain will be held by City Council, acting on request by the

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[107] "Oakhaven Gets Cherry News," Commercial Appeal 9 Apr. 1969.

[108] Orville Hancock, "Oakhaven Residents Continue to Ask about Airport Plans," Press Scimitar 11 Apr. 1969.

[109] "New Runways Site near Completion," Commercial Appeal 29 Nov. 1968.

Airport Authority, and

- the Airport Authority will not sell any real estate without City Council approval.

The policy provided that the city purchasing department be used by the Airport Authority, and that the Airport Authority pay sewer and city service fees in the same fashion as any private organization, but that no tax equivalent would be charged. The enabling act for the Airport Authority provided that Memphis would have five members and two named from out side of the city. If Arkansas and Mississippi were eventually to come under the Airport Authority making it a tri-state organization, the Airport Authority membership likely would be expanded.[110] [111]

4.2.9. Second North-South Runway (1969-1973)

In May 1969, the FAA approved $500,000 for construction of Runway 18R-36L and taxiway.[112]

In the same year, steep approach and departure techniques for jet aircraft [113] were developed by tower personnel in cooperation with the FAA's Memphis area office and Memphis Air Route Traffic Control Center. In addition, six departure corridors and six arrival areas had been established, ringing the airport at distances of 20 to 30 miles (32 to 48 km). Each had a transfer control point at which traffic control responsibility was exchanged between the tower and the Memphis Air Route Traffic Control Center. As a side effect, the public benefited because the

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[110] Orville Hancock, "New Authority Nears Reality for Airport," Press Scimitar 14 Aug. 1969.

[111] "Commissioners, Councilmen form Rules to Guide Airport Authority," Commercial Appeal Aug. 15, 1969.

[112] "FAA Approves Airport Grants," Commercial Appeal 2 May 1969.

[113] All departing jet traffic climbed rapidly to 10,000 feet (3,040 m) and higher. Arriving jets approach the airport from about 20 miles (32 km) out between 4,000 and 6,000 feet (1,216 and 1,824 m), then descended rapidly as they near the airport. Meanwhile, propeller traffic within 20 miles of the airport operated below 3,000 feet (912 m), well clear of the jets. The system provides a minimum of 1,000 feet (304 m) vertical separation.

steep approaches and departures generated less noise in the vicinity of the airport.[114]

On February 2, 1971, the City Council approved of a plan to buy 497.9 acres which had 266 homes in the Oakhaven "buffer zone" east of Swinnea Road, the existing airport boundary, for various facilities and as an alternate site for the second terminal. The purchase was for cash on an as-offered basis. The money came from an additional five million dollars in general obligation bonds to be sold in June 1971.[115]

In 1972, a package sorting building was constructed with city bonds. Federal Express Corp., a $2.9 million overnight small package service company, started operating the building with Falcon jets in 1973. [116] The building was located on an industrial park east of MEM which the army returned in 1967. The Airport Authority has looked for prospective business related to aviation since 1968.[117]

After six years of planning and construction, the $17 million Runway 18R-36L was completed at the end of 1972 and opened in March 1973.[118] It was 9,139 feet (2,778 m) long and 150 feet (46 m) wide with more than 20 inches (50 cm) of concrete plus hard base. An additional six million dollars in apron parking had been completed.[119]

4.2.10. Rebuilt Runways, Expanded Terminal, and Improved Access Roads (1974-1977)

In November 1974, grading on the airport access road (expressway link) from I-240 to Winchester Road was started.[120]

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[114] Jefferson Riker, "New Takeoff: Like Homesick Angel," Commercial Appeal 12 June 1970.

[115] Jefferson Riker, "Oakhaven Plan Gets City's OK," Commercial Appeal 3 Feb. 1971.

[116] Orville Hancock, "Airport Expansion near Completion," Press Scimitar 16 Jan. 1974.

[117] Richard Lentz, "Industrial Park is under Study," Commercial Appeal 2 July 1968.

[118] Orville Hancock, "Airport Expansion near Completion," Press Scimitar 16 Jan. 1974.

[119] Orville Hancock, "$31 Million Airport Expansion Job Starts in 1971," Press Scimitar 31 Jan. 1971.

[120] Orville Hancock, "Airport Work will be Over by Spring," Press Scimitar 23 Nov. 1974.

In January 1974, the construction of a $14 million west subterminal was completed. In October, the construction of a nine million-dollar east subterminal was completed. In Christmas week, a new $2.3 million Sheraton Skyport Inn in the airport terminal was opened. It accommodated 60 sleeping rooms, with 30 rooms in both the east and west subterminal, and a conference room which could handle up to 150 persons.[121] The terminal expansion program began in 1970 and was supposed to be completed in two years as a cost of $32 million. It took five years, however, at a cost of $34.5 million financed with bonds. Square footage of the Airport Terminal and related buildings became more than double the original building with the expansion completion. There were dual runways, three loading concourses instead of the original one, double-deck parking, increased baggage areas and moving sidewalks. Assets of MEM at the end of 1975 totaled $102 million.[122] American Airline installed a new computerized control room. A ticket could be processed in 10 seconds, where before it took five minutes.[123]

In March 1975, rebuilding and resurfacing of Runway 18L-36R was finished.[124] A $2,434,493 grant was used to rebuild the old north-south runway.[125] Runway 9-27 was, in turn, rebuilt and resurfaced with asphalt at a cost of $5.5 million in order to bear the weight of the commercial jetliners.[126]

In 1976, MEM was granted $1,390,452 from the Department of Transportation for the Winchester Road overpass site preparation, installation of lighted wind cone, relocation of lighting control cables and panels and the purchase of a fire truck and protective fire suits for firemen at

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[121] Orville Hancock, "Airport Expansion near Completion," Press Scimitar 16 Jan. 1974.

[122] Orville Hancock, "Connector, Runway Next Airport Construction," Press Scimitar 14 Jan. 1976.

[123] Orville Hancock, "Innovations Accompanying Terminal's Expansion," Press Scimitar 19 Nov. 1975.

[124] Orville Hancock, "Airport Work will be Over by Spring," Press Scimitar 23 Nov. 1974.

[125] Orville Hancock, "Connector, Runway Next Airport Construction," Press Scimitar 14 Jan. 1976.

[126] Orville Hancock, "Airport Work will be Over by Spring," Press Scimitar 23 Nov. 1974.

MEM.[127]

From 1972 through 1976, $33 million street and road work around MEM was done. (See Figure 4.2.10.a.) A new parallel expressway access, Plough Boulevard, was built from Interstate 240 at Airways Boulevard into Brook Road which connected with the terminal. The access road was widened to six lanes from Democrat Road to Winchester Road. Tchulahoma Road was both widened and lengthened so that it ran from Democrat Road to Lamar Avenue, Winchester Road, Hollyford-Airways Boulevard, Democrat Road, Lamar Avenue were widened and improved. The work was financed by city and county governments. The next year, a connection road from Brooks Road to the terminal was constructed. The construction was paid by the Airport Authority.[128] [129]

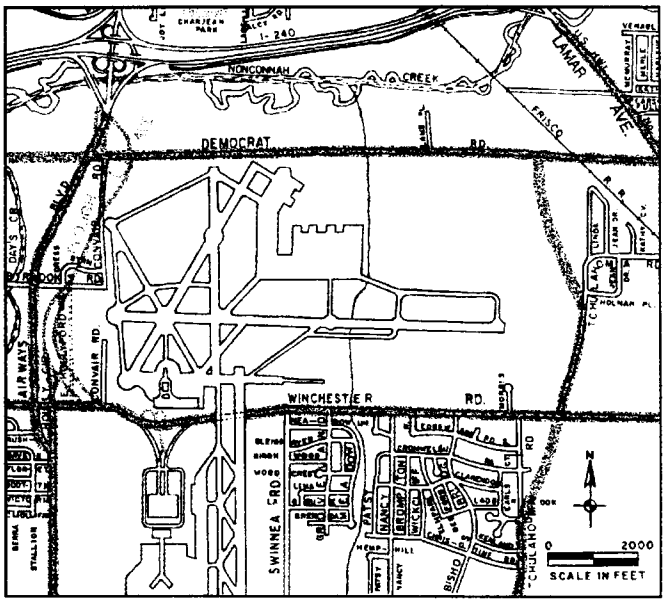


Figure 4.2.10.a. Street and Road Work around Memphis Airport from 1972 to 1976. (Adapted from: "Airport Changes Needed for Safety, Pilots Say," Press Scimitar 3 Dec. 1971.)

In April 1977, a new $2.5 million FAA airport traffic control tower was opened. The 190-foot structure, three years in the planning and almost two years in construction, was built by the FAA to replace a 110-foot tower which began operation in 1961. The new tower was equipped with the finest radar equipment and the automated computer system which had been installed in the old tower in 1976. The primary radar searched out solid objects such as airplanes while the secondary radar talked with a system on broad a plane.[130]

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[127] "Granted," Press Scimitar 1 Sep. 1976.

[128] "Airport Changes Needed for Safety, Pilots Say," Press Scimitar 3 Dec. 1971.

[129] "Air Passengers up Despite Fare Hike," Press Scimitar Jan. 1977.

[130] Mary Deibel, "New Airport Tower Opens," Commercial Appeal 26 Apr. 1977.

In 1977, Federal Express Corp. requested the Memphis Air Service Commission permission to fly larger aircraft to serve key cities with overnight small package service. Federal Express used the small Falcon jet, but it needed larger aircraft such as Boeing 727s to haul cargo to high density airports.[131]

4.2.11. Restructuring of Airline Flight Routes (1978-1986)

In 1978, Southern Airways was approved by the Civil Aeronautics Board (CAB) for a new route linking Memphis with Minneapolis-St. Paul and Milwaukee. Eastern Air Line discontinued service to Memphis.[132] United Airlines decided to make Memphis the focus of its new hub because of a combination of geography, good facilities and three years of lobbying efforts by a chairman of the Memphis Air Service Commission. United filed a proposal in June 1978 with CAB which would make Memphis its connecting hub for flights passing through the Southwest. Departures by United from Memphis would increase from six flights daily to 18. Instead of two gates, the company would have six. Delta Airlines and Southern Airways had employed the hub-spoke concept with Memphis as the center of interconnecting flights.[133] In September, flights by commuter airlines were scheduled by Skyways, which began service to Memphis.[134]

Federal Express rented about 13 acres more of apron parking space at a rental fee of $28,877 per year from the Airport Authority.[135]

On December 13, 1978, the supersonic Concord came to Memphis as part of a training

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[131] Orville Hancock, "Texas Airline Seeks Flights to Chicago," Press Scimitar 14 Feb. 1977.

[132] Orville Hancock, "Southern Airways Plans Memphis Expansion, 2 New Routes," Press Scimitar 22 Mar. 1978.

[133] Jerome Obermark, "Sales Pitch Paying Off for Memphis Airport," Commercial Appeal 1 Oct. 1978.

[134] Dan Henderson, "Airport Critics' Griping Nosedives," Commercial Appeal 16 July 1978.

[135] Orville Hancock, "Southern Airways Plans Memphis Expansion, 2 New Routes," Press Scimitar 22 Mar. 1978.

flight by Braniff International Airways.[136]

In 1978, the airport owned 3,600 acres, about 5 1/2 square miles. City officials had predicted in 1945 that an airport encompassing three square miles would be necessarily in the future.[137] There were 10 commercial airlines and three commuter airlines at MEM.[138]

In September 1979, MEM was promoted to a Group II Terminal Control Area (TCA) after a midair collision May 18, 1978 took six lives. Pilots obtained permission from the Memphis airport tower before flying into the Memphis area. In addition, all aircraft in TCA have to be equipped with transponders[139]. Air controllers then could recognize the plane as a specific aircraft and also could determine its altitude.[140]

A $34.9 million revenue bond issue to develop special facilities at MEM was approved by the Shelby County Commission's public service committee in 1979. The special facilities were used by Federal Express, which leased space from the Airport Authority. This was the third bond issue to be floated for Federal Express. The first issue, for $2.9 million was in January 1973; the second, for 4.2 million, was in November 1978.[141]

Six wind shear[142] stations[143] were installed off the end of each air carrier runway at a total

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[136] "Airport Expecting Another Big Year," Commercial Appeal 21 Jan. 1979.

[137] Dan Henderson, "Airport Critics' Griping Nosedives," Commercial Appeal 16 July 1978.

[138] Steve Sellers, "Record Buoys Airport," Commercial Appeal 22 Jan. 1978.

[139] Transponders are electronic devices that are triggered by a ground signal and reinforce the plane's image on ground radar.

[140] Morris Cunningham, "FAA Puts Airport Safety at Top Priority," Commercial Appeal 28 Dec. 1978.

[141] "Panel OKs Airport Bond Issue," Press Scimitar 28 July 1979.

[142] See the definition of wind shear in Glossary.

[143] Wind shear stations are tall, polelike structures with wind speed and direction sensors on them. Each pole had a transmitter receiver for telemetering the information to a computer located in the FAA control tower at an airport. If the sensors showed crucial differences in wind speed and direction or indicated that conditions were present that would cause a possible wind shear, the information was displayed in the control tower and the controllers relayed an alarm to the pilot.

cost of $50,000 by the FAA. Wind shear caused a major accident at New York 's Kennedy International Airport June 24, 1975. When an Eastern Air Line 727 jet was low, off the end of the runway, the plane suddenly sank, careening into a steel superstructure supporting blinking lights, and slammed into the ground. The crash scattered wreckage for miles. One hundred and nine passengers were killed instantly.[144]

In September 1979, the construction for a new taxiway overpass over Winchester Road to connect the airport's Runway 18R-36L with the northern access to the terminal building began. The overpass cut off a distance of about 5,000 feet (1,520 m) to taxi. It would save several minutes of taxitime for passengers and a great deal of fuel. The U.S. Department of Transportation funded $2,695,109 for the construction.[145]

In October 1981, Republic Airlines, which was formed by the merger of Southern Airways and North Central Airlines in 1979[146], started using MEM as a hub. Delta Airlines increased flights at its longer established hub. On the other hand, Braniff suspended operation when it declared bankruptcy in May.[147]

In 1981, Shelby County approved a $6.1 million taxiway improvement project.

On July 1, 1982, the Airport Authority boosted landing fees 66 percent for passenger airlines. The new fee was 35 cents for each 1,000 pounds of maximum allowable weight per aircraft. The old rate, which was introduced four years earlier, was 21 cents. For a Boeing 727, which weighs 180,000 pounds maximum, the new fee would be $63 each time the aircraft lands, or almost $23,000 annually if it landed once each day for an entire year.[148]

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[144] Orville Hancock,"Airport is Installing New Equipment to Warn of Dangerous Wind Shifts," Press Scimitar 30 July 1979.

[145] "Taxiway Plan is Extolled," Commercial Appeal 8 Aug. 1979.

[146] Peat, (May 1980).

[147] Marc Meltzer, "Airport Climbs to 29th Busiest in U.S.," Commercial Appeal 11 July 1982.

[148] Marc Meltzer, "Landing Fees of Airlines Get 66% Retroactive Lift," Commercial Appeal 20 Aug. 1982.

In 1983, the airport received a $450,000 grant from the U.S. Department of Transportation's airport improvement program for land acquisition.

On February 1, 1984, Delta inaugurated new Boeing 737-200 service at Memphis. These jets featured an advanced flight deck, digital electronic systems for the flight crew, new aerodynamic refinements, improved anti-skid and automatic brakes, a more powerful and fuel-efficient engine boosting payload, range and short field performance and electronically controlled cabin pressurization system for passenger comfort. The 737-200 aircraft replaced a large Boeing 727 for the Memphis-Dallas flight which usually served about 100. A 727 seats 148 passengers, and a 737-200, 102 passengers. The smaller 737 would permit the airline to maintain service for certain routes that might have been discontinued because they were uneconomical with larger aircraft.[149]

For one year from April 1984, the FAA had tested radar developed to improve weather readings near air terminal at MEM. The radar system was designed for better detection of wind shears and microbursts, sudden gusts of wind that move at speeds of up to 90 mph. MEM was selected as the initial test bed for three reasons. First, there was open land in and around the airport. Second, the runways were widely spaced at varied angles. Third, MEM had lots of afternoon thunderstorms and along thunderstorm season.[150]

In fall 1984, Republic Airlines added 11 daily departures from Memphis, bringing its total to 97. Delta Air Lines added six for a total of 54. In the late 1970s and earlier, American and Braniff Airlines were major players in the Memphis market. Key destinations for both were New York, Washington and the entire Southwest. But Braniff never returned to Memphis after its 1982 shutdown. American had cut its schedule in Memphis in half since 1979, focusing flights on its Dallas hub. At the time, Memphis passengers had to change planes more often at hubs in Atlanta,

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[149] Marc Meltzer, "Delta Joins Trans World, Pan Am with Direct Flights to JFK Airport," Commercial Appeal 17 Jan. 1984.

[150] "FAA Taps Memphis for Tests," Commercial Appeal 7 Jan. 1984.

Dallas, Denver or Chicago.[151]

The Airport Authority reported 5.26 million passengers used the airport in 1984, a decline of 4.6 percent from the year before. It was the first year-to-year decline reported since 1981 when 4.82 million passengers used the MEM. The Airport Authority president said the decline locally was due to the falloff in the number of passengers flown by Republic and Delta airlines. The number of takeoffs and landings for passenger flights at Memphis rose 2.5 percent compared with 1983. The gain was fueled mostly by a 30 percent increase in takeoffs and landings locally by commuter/regional airlines. The major airlines had been pulling out of large communities in the Southeast since deregulation went into effect.[152]

On April 28, 1985, Republic Airlines expanded Memphis departures to 157 daily flights from 97.[153]

In June 1, 1985, Republic Express, Republic Airlines' regional partner, started 15 flights per day at MEM.[154] It brought passengers from smaller cities within a 350-mile (563 km) radius to Memphis.[155]

In August 1985, $61 million in bonds were issued to provide capital improvements, including work to accommodate Republic's increased activity, runway shoulder paving, new runway lighting, baggage area enlargement, drainage and landfill work, and construction of a maintenance building.[156]

On October 1, 1986, Republic Airlines merged with new Northwest Airlines, which started

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[151] Marc Meltzer, "Memphis Trails Only Atlanta in Direct Flights," Commercial Appeal 11 Oct. 1984.

[152] Marc Meltzer, "Passenger Numbers Drop at Memphis Airport in '84," Commercial Appeal 23 Jan. 1985.

[153] "Airport Scores Triple Record during May," Commercial Appeal 18 June 1985.

[154] Louis Graham, "Airport Has Plans Up in Air," Commercial Appeal 1 June 1986.

[155] Louis Graham, "Elbow Room for the Eyes to Memphis," Commercial Appeal 28 July 1985.

[156] "Staying out Front," Commercial Appeal 27 Aug. 1985.

in Memphis.[157] The U.S. Department of Transportation granted approval for Northwest Orient Airlines to acquire the domestic routes of Republic Airlines in an $884 million deal on July 31, 1986.[158] The resulting company would be the third-largest airline in the United States, after No.1 United Airlines and No. 2 American Airlines, serving 100 U.S. cities, four in Canada, two in Mexico, 11 in Asia and eight in Europe.[159] In this year, Chicago-based United Airline acquired the Pacific routes of Pan American World Airways and Frontier Airlines from struggling People Express, the Newark-based, low-cost carrier, Trans World Airways merged with its St. Louis-based Ozark Airlines, and Houston-based Texas Air (which owned Continental and New York Air) acquired Miami-based Eastern Airlines.[160]

4.2.12. Plan of Third North-South Runway (1986)

On June 10, 1986, several hundred neighbors of MEM got their first look at proposed expansion plans and an explanation of what those plans might mean to their neighborhoods. Most of the discussion centered on a possible buyout of homeowners most severely affected by aircraft noise.[161]

On June 19, 1986, the Airport Authority opened the door for expansion by approving a consultant's report that recommended gradual construction of terminal space, more parking and a sixth runway. Figure 4.2.12.a. shows a concept plan in the report. The document, the result of

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[157] John J. Oslund, "'New Northwest' to Debut Wednesday," Minneapolis Star and Tribune 28 Sep. 1986.

[158] David Phelps, Oslund and Marcotty, "Federal Agency Rules out Competition Threat," Minneapolis Star and Tribune 1 Aug. 1986.

[159] Tina Daniell, "Northwest Takes a Big Step toward Ensuring Survival," Milwaukee (Wisconsin) Journal 24 Jan. 1986.

[160] David Phelps, Oslund and Marcotty, "Federal Agency Rules out Competition Threat," Minneapolis Star and Tribune 1 Aug. 1986.

[161] Louis Graham, "Airport Expansion, Buyout Plan Outlined to Residents of Noise-Prone Neighborhood," Commercial Appeal 11 June 1986.

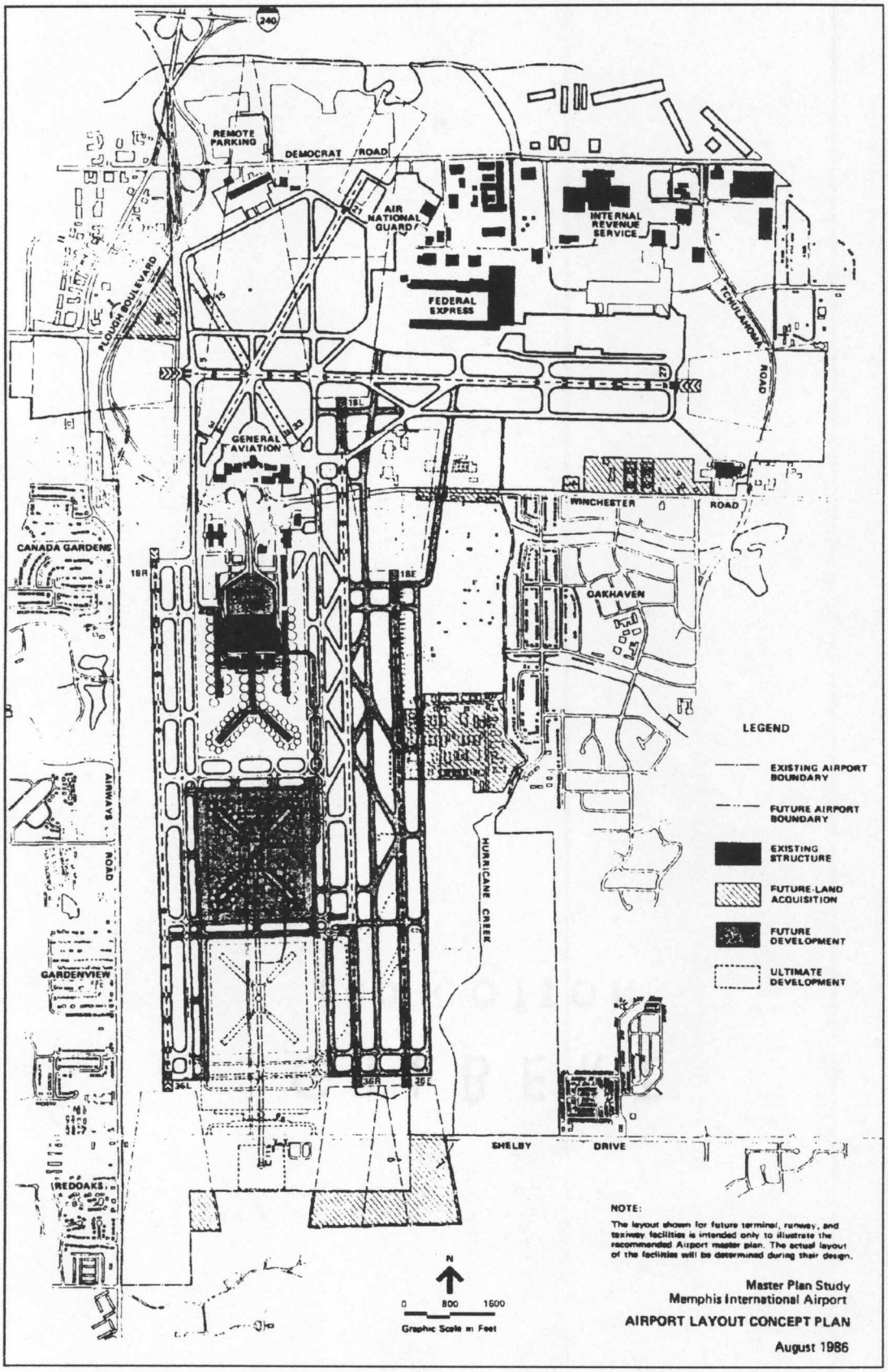


Figure 4.2.12.a. 2006 Airport Layout Concept Plan. (Source: Peat, Marwick, Mitchell & Co. Master Plan Memphis International Airport, (Memphis: Memphis-Shelby County Airport Authority, Oct. 1986) Exhibit 11.)

a year and a half of work by Peat Marwick Airport Consulting Services, recommended three development phases: phase one is required at the planning activity level of four million annual passenger enplanements, phase two at that of five million enplanements, and phase three at that of six million enplanements. These three development phases might be considered to approximate 5-year (1991), 10-year (1996) and 20-year (2006). The Main recommended developments were as follows:

Phase One at estimated cost of $123.5 million.

- Acquire 127 acres for new third north-south Runway 18E-36E's approach and clear zones.
- Construct new Runway 18E-36E, approximately 9,000 feet (2,736 m) long, separated from existing Runway 18L-36R by approximately 900 feet (274 m).
- Construct a new north-south taxiway, immediately east of Runway 18L-36R, connecting the north end of new Runway 18E-36E to the Federal Express apron.
- Reconfigure and enlarge existing baggage claim to provide approximately 13,000 square feet (0.3 acres) of additional baggage area.
- Construct regional/commuter airline terminal as first phase of new satellite terminal to south of existing terminal complex.
- Construct at-grade public parking "overflow" lot of approximately 1,000 spaces at the site of the existing rental car service area.

Phase Two at estimated cost of $188.5 million.

- Acquire approximately 31 acres between Runway 9-27 and Winchester Road for future Airport development.
- Construct second new north-south taxiway, east of the clear zone for Runway 18E-36E, connecting the north end of new Runway 18E-36E to be the Federal Express apron.
- Construct an east-west taxiway at the north edge of apron for the new satellite

terminal.

- Construct aircraft parking aprons and two-level concourse facilities at new south satellite terminal to provide approximately 20 aircraft parking positions for large jet aircraft.
- Construct tunnel with underground people-mover system to transfer passengers between the existing terminal buildings and the new south satellite terminal.
- Extend the existing parking structure to the north to provide approximately 2,500 additional public parking spaces in the parking structure.

Phase Three at estimated cost of $128 millions.

- Acquire approximately 54 acres of land and industrial property.
- Extend existing Runway 18L-36R to the north by approximately 900 feet (274 m) with connection taxiways and to the south by approximately 2,700 feet (821 m) with parallel taxiway and connecting across-taxiways.
- Construct parallel east-west taxiways at south of apron for new satellite terminal.
- Construct full-length parallel taxiway east of new Runway 18E-36E, with connecting cross-taxiways.
- Construct additional aircraft parking aprons, two-level concourses, and other facilities to provide approximately 20 additional aircraft parking positions for large jet aircraft.

The estimated cost of the total project was $440 million. Airport project costs not covered by federal appropriations were met with an Airport Authority revenue bond issue. Those bonds would be paid off through landing fees and other airport charges to the airlines using the facility.[162] [163] As a result of 1994, phase one is now in progress. The extension of Runway 18E-36E up to 900 feet to the north was eliminated because the extension could create interference with

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[162] Louis Graham, "Airport Taxis toward the Future," Commercial Appeal 20 June 1986.

[163] Peat, Master Plan (Oct. 1986).

aircraft using 9-27, and could constrain the use of future development of Federal Express and TANG faciliteis.[164] Runway 18E-36E will be completed in 1996.

4.2.13. Residential Buyout and Raising Funds (1986-1989)

On November 20, 1986, the Airport Authority approved a $35,000 contract with Yacoubian Research for a survey of airport neighbors.[165] The data of the survey was one of decision factors to determine buyout area and future land use.

On December 1986, the Airport Authority started to publish a noise compatibility newsletter named "Airport Neighborhood Update." The newsletter would provide a source of accurate and current information on the Airport master plan and noise compatibility and improve communications between the Airport Authority and residents affected by aircraft noise and so help make the noise compatibility program more effective.[166]

In April 1987, the Airport Authority unveiled to airport-area residents which homes ranked highest on a scale used to determine priority for purchase. The priority was given to homes exposed to the most noise and those inhabited by longtime residents.[167]

In June 1987, the City Council approved a $20 million bond issue to finance the purchase of houses in neighborhoods plagued by noise from jet aircraft at MEM. The $20 million was part of about $100 million needed for the buyout. The remaining $80 million came from federal and state governments. The Airport Authority paid the principal and interest on the bonds from an increase in the landing fee at MEM. The interest on bonds issue by the city would be significantly less than the interest on bonds issued by the Airport Authority. The savings would be about $2

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[164] FAA, Final Environmental Impact Statement, (Mar. 1993) v. 1 p.2-19.

[165] "Terminal at Airport Given OK," Commercial Appeal, 21 Nov. 1986.

[166] Airport Neighborhood Update (Dec. 1986) v. 1.

[167] "Homes Marked for Buyout," Commercial Appeal 27 Mar.1987.

million.[168]

In 1987, the FAA designated the airspace of MEM as Terminal Control Area (TCAs). A TCA is a section of airspace that resembles and inverted wedding cake. The airport is at the center surrounded by a five-mile wide circle. The top tier of the cake, at 12,500 feet (3,800 m), would stretch 30 miles (55.6 km). Planes entering the TCA must carry encoders that automatically tell controllers looking at radar screens where and how high the plane is flying. MEM had been designated an Airport Radar Area. Pilots had reported to air traffic controllers but had not been required to carry the encoders when flying through local airspace.[169]

In August 1988, the Airport Authority received $10.3 million from the federal government to buy about 160 nearby houses designated as too close to MEM for comfort. In 1987, the Airport Authority received more than $7 million from the government and had already bought 180 nearby houses.[170]

In 1988, $104 million in 30-year revenue bonds were issued for construction projects.[171] They included $24.5 million for expansion of parking facilities from 3,500 parking spaces to about 5,500 spaces, $10.9 million for expansion and renovation of the center concourse, $10.5 million for land acquisition for future airport development, $38 million for improvements of Northwest's terminal building and $4.7 million for connecting the east and west concourses. The cost of the last two projects, totaling $42.7 million, would be paid directly by Northwest Airlines. The remainder would be paid by increased landing fees.[172]

In 1988, passenger traffic at MEM was down 12 percent compared with 1987, primarily

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[168] Thomas Jordan, "Bond Issue Plan may Speed Buyout of Airport Homes," Commercial Appeal 19 June 1987.

[169] Mike Brennan, "Memphis Airspace might be Cut," Commercial Appeal 25 Aug. 1987.

[170] Steve Gaither, "Grant OK for Houses at Airport," Commercial Appeal 22 Sep. 1988.

[171] Deborah White, "Landing Fees at Airport Increased," Commercial Appeal 19 May 1989.

[172] Louis Graham, "Action to Fund Airport Projects Expected Today," Commercial Appeal 19 Nov. 1987.

because Northwest Airlines pursued a policy of fewer flight and fuller planes. Northwest offered 200 round trip flights a day from the MEM in December 1987, but began reducing service, settling to a level of 170-175 daily round-trip flights. In December, Northwest had 174 daily flights. Citing low demand, the carrier eliminated service to Baltimore; Cleveland, Ohio; Cincinnati; Des Moines, Iowa; Panama City, Fla.; Washington's Dulles International Airport; and Midway Airport in Chicago.[173]

On April 17, 1989, the Memphis Capacity Enhancement Task Force was published by the FAA. The Task Force was formed in 1986 to evaluate potential capacity enhancement and delay reduction options at MEM. At the same time, nine other American airports studied aviation problem funding by the FAA.[174] The Task Force at MEM used three annual traffic levels as benchmark based on the expected growth in aircraft operations. The first benchmark reflects the 1986 active level of 382,000 annual operations and 1,264 daily operations. The other benchmarks represent 440,000 and 510,000 annual operations; they are associated with 1,420 and 1,640 daily operations, respectively. The FAA's annual delay computer models, airfield delay simulation model (ADSIM) and runway delay simulation model (RDSIM), estimated that each operation had been delayed an average of 2.5 minutes at annual delay cost of $26.3 million in 1986. At the future demands, the average would increase to 3.9 and 7.6 minutes at annual costs of $47.2 and $107.4 million. The Task Force studied over 30 proposals for increasing capacity and reducing delays. The two most effective improvements in the proposals at 510,000 annual operations, were to distribute traffic uniformly within the hour at a cost saving of $69.4 million, and to do triple departures in all weather conditions assumed Runway 18E-36E at a cost saving of $38.8 million.[175]

In 1989, 27 residents filed a class-action lawsuit asking that increased noise and pollution

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[173] Deborah White, "Passenger Traffic Down 12% at Airport for 1988," Commercial Appeal 21 Jan. 1989.

[174] Gregory Vvistica, "FAA Looks to Reduce Late Flights in Memphis," Commercial Appeal 1 April 1989.

[175] FAA, Memphis International Airport Capacity Enhancement Plan, (Dec., 1988).

from the airport decreased the property values and the quality of life in neighborhoods involving far more homes than the Airport Authority had agreed to purchase.[176]

On July 1, 1989, rental fees for space in the airport and landing fees increased from $8.80 per square foot to $21.74 per square foot and from 47 cents per 1,000 pounds of landed weight to 56 cents per 1,000 pounds. The average landing fee for the Boeing 727 passenger airline would increase from about $70 to $84 per landing.[177]

4.2.14. Preparation for the Construction of the Third Runway (1989-1992)

On November 6 and 7, 1989, two public meetings for future land development in an 84-square mile (53,760 acres) area surrouding MEM were held at Southaven Library and Oakhaven High School. The meetings in Memphis and DeSoto County were part of a $640,000 comprehensive land-use and zoning study funded by the Airport Authority.[178]

In September 1990, Runway 3-21 was closed and Runway 15-33 was closed in August 1991. The two runways were general aviation runways.[179] The Master Plan of 1986 had stated that increased numbers of general aviation operations in the peak hours would result in significant delays to all air carrier aircraft using MEM.[180]

In September 1990, the Airport Authority accepted an $8.5 million federal grant for property acquisition of noise mitigation and enhancement of the airport's security system. Five million dollars of the grant was used to acquire 65 homes in the noise compatibility program.[181]

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[176] Peggy McKenzie, "Airport Protest Meeting Lures Packed House to Join Lawsuit," Commercial Appeal 27 May 1993.

[177] Deborah White, "Landing Fees at Airport Increased," Commercial Appeal 19 May 1989.

[178] Deborah White, "Land Development being Discussed," Commercial Appeal 23 Oct. 1989.

[179] FAA, Final Environmental Impact Statement - MEM, (1993) p. 1-5.

[180] Peat, Marwick, p. 27.

[181] Deborah White, "Airport Gets FAA Grant for Security Home Buys," Commercial Appeal 21 Sep. 1990.

In 1992, a Terminal Doppler Weather Radar (TDWR) system was constructed near Interstate 55 in Desoto County south of the MEM. The TDWR system, which relies on Doppler radar, adds a new level of sophistication to allow air traffic controllers to actually look inside storms and measure dangerous wind shifts that pose a threat to aircraft during the critical takeoff and landing phases of flight. Using the radar, MEM participated in FAA experiments ranging from wind shear tests to conducting simultaneous runway approaches.[182]

On May 8, 1992, a draft environmental impact statement (DEIS) on the expansion plan was published by the FAA. The FAA received comments from public and agency groups, neighborhood associations, and individuals, most of whom live in MEM area, during the 45-day comment period which closed June 22, 1992.[183] As a result of the comments, certain noise abatement departure flight tracks[184] presented in the DEIS were eliminated, because those departure flight tracks would create new areas of incompatible land uses in the vicinity of MEM.[185]

In 1992, MEM and Kansas City were dropped from the list of the nation's major passenger airports included in the monthly Air Traffic Consumer Report. The report ranks major airlines and airport based on on-time performance and other consumer -related concerns. To qualify for the somewhat selective list, an airport has to generate 1 percent or more of the nation's total domestic passenger boarding. In 1990, MEM contributed to 0.89 percent of total boarding.[186]

The FAA approved a $3 per ticket charge on airline passengers from August 1, 1992 through December 1, 1994, to help pay for airport expansion. However, federal approval of the Memphis PFC removed one cloud hanging over the project, which centered on Northwest Airlines'

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[182] Roland Klose, "Memphis is First to Get Wind-Tracking System," Commercial Appeal 15 Jan. 1992.

[183] FAA, Final Environmental Impact Statement, (Mar. 1993) v. 1 p. S-5.

[184] See noise abatement departure flight track in Glossary.

[185] Wayne Risher, "Residents Hit Airport on Pollution," Commercial Appeal 2 Feb. 1993.

[186] Roland Klose, "Memphis Dropped from List of Biggest," Commercial Appeal 8 Apr. 1992.

strong opposition to using the charge.[187]

According to the results of a June 1992 airport ticket survey, local passengers - those who begin or end their trips at hub cities - were 28 percent of the Northwest traffic at its Memphis hub, 60 percent in Minneapolis and 45 percent in Detroit. Airline industry experts say local passengers must account for 35 percent or more of an airline's daily traffic for a hub to prosper.[188]

MEM was the busiest air cargo facility in the world in 1992. More than 1.4 million metric tons of freight moved through MEM, the vast majority aboard Federal Express jets. [189]

On January 25, 1993, old Swinnea Road, a two-lane road, closed. About 10 days before the day, new Swinnea Road, a five-lane highway, opened about 400 yards (370 m) east. The old road would become the center of new Runway 18E-36E.[190] [191]

On March 31, 1993, the FAA approved the environmental impact statement for $177.5 million plan to expand MEM. Runway 18E-36E was scheduled for completion in 1996. The FAA would pay about $133 million, or 75 percent of the airport expansion costs, Federal Express would contribute $16.8 million and passenger airlines would be charged about $24 million through the current $3-per trip tax on passengers. The city paid about $4 million to relocate Swinnea Road to the east as part of the project. Runway 18E-36E would increase capacity at MEM about 25 percent.[192]

On May 7, 1993, U.S. District Judge Robert McRae ruled on a class-action lawsuit against

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[187] Roland Klose, "Airport's Passenger Fee OK'd," Commercial Appeal 30 May 1992.

[188] Dave Hirschman, "Faltering NW Hub Here Strives to Stay Airborne," Commercial Appeal 7 Feb. 1993.

[189] Dave Hirschman, "Shipping - City to Host Air Cargo Conference," Commercial Appeal 18 Nov. 1993.

[190] Ron Maxey, "Airport Buyout Residents Adjust to Future with Runway Neighbor," Commercial Appeal 9 Apr. 1992.

[191] Dave Darnell, "Making Way for Runway," Commercial Appeal 27 Jan. 1993.

[192] Dave Hirschman, "FAA Action Boosts Plan to Construct 4th Runway," Commercial Appeal 1 Apr. 1993.

the Airport Authority. The suit began for increased noise and pollution in 1989. Judge McRae wrote, " The Plaintiffs claim to be affected by the operation of Memphis International Airport and claim that member of the class would benefit from a comprehensive effort to address consequences of the operation." Judge McRae's order reversed a 1992 ruling by U.S. district Judge James D. Todd in the same case that held that airport area homeowners who lived various distances from the airport were affected by airport noise in different ways, and that each case should be decided independently. Judge Todd denied the motion for class certification. The airport Authority appealed the class-action ruling.[193]

In June 1993, construction for widening Airways Boulevard from two to seven lanes from the Tennessee border to State Line Road in Southaven started. The construction was approved by the Federal Highway Administration. The road would provide a link between MEM and Southaven northcentral DeSoto County.[194]

In June 1993, the Airport Authority approved $45 million in bonds to fund a Federal Express Corp. 250,000-square-foot maintenance facility that would employ about 300 aviation mechanics. The two-hanger facility will be large enough to house two wide-body and two narrow-body jets. It would be built north of Winchester Road near Northwest Airlink Hanger. The jets that would be serviced here would undergo preventive maintenance and minor repairs. Each of the company's Boeing 727s is inspected every two months, and inspections require about four days and 300 worker-hours to complete. Federal Express would lease the buildings from the Airport Authority.[195]

On August 25, 1993 the Airport Authority took possession of the last of the 309 properties purchased in the Oakhaven Acquisition Program. The program took about 2 1/2 years to

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[193] Dave Hirschman, "Thousands can Join Suit Against, Federal Judge Rules," Commercial Appeal 8 May, 1993.

[194] Richard Gardner, "Tearing up to Fix Up," Commercial Appeal 17 June. 1993.

[195] Dave Hirschman, "Aviation - Airport Panel OK's Bounds for Maintenance Facility," Commercial Appeal 16 July 1993.

complete at a cost of about $20 million. The purchased land would be part of the Aviation Facilities Planned Development area.[196]

On September 18, 1993, Delta Air Lines added Boeing 757 service to MEM, replacing a smaller MD80 aircraft.[197]

4.2.15. Clearing Land for the Third Runway (1993)

In October 1993, construction crews began clearing land for proposed Runway 18E-36E. The runway construction would take about three years.[198]

In December 1993, 16 homes which had been condemned in December 1992 were demolished or moved away for a 429-acre aviation park. The Airport Authority bought out 469 properties in Oakhaven, just east of the MEM and south of Winchester Road, beginning February 1991 to make way for new Swinnea Road and development. Among the properties were 310 homes. These homes were last in the area.[199]

On January 18, 1994, the FAA ruled to continue the Passenger Facility Charge, a three dollars per person ticket tax through 1999.[200]

On February 1, 1994, the Southaven Board of Aldermen voted 6-0 to start condemnation proceedings under the eminent domain statute to seize three homes in the buyout area of MEM. Under Mississippi law, eminent domain proceedings are conducted in Circuit Court. The court would determine the price of the property to be seized, based on appraisals from certified

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[196] Airport Neighborhood Update (Fall 1993) v.6 no.1.

[197] "Of Note...," Commercial Appeal 26 July 1993.

[198] Dave Hirschman, "Airport OK's Constructs to build Third Runway," Commercial Appeal 17 Sep. 1993.

[199] Ron Maxey, "Airport Area Holdouts Grow Used to Isolation Homes Dot Empty Expanses where Neighborhoods Stood," Commercial Appeal 16 Dec. 1993.

[200] Dave Hirschman, "Airport can Extend Ticket Tax, FAA Rules," Commercial Appeal 19 Jan. 1994.

appraisers.[201]

4.2.16. Northwest Airlines and Federal Express Become Active (1994)

On March 2, 1994, Northwest Airlines started new schedules. The schedules were designed to offer travelers more connections in a shorter amount of time and bring more regional travelers through Memphis as flights would arrive simultaneously.[202] The schedules might cause traffic and ground congestion.

In May 1994, the twin-engine Airbus A300/600 of Federal Express Co. first flew from Memphis to Phoenix, and Orlando. The widebody A300s can carry more than twice as much cargo while burning roughly the same amount of fuel as the Boeing 727s. In addition the planes are quieter than most Boeing 727s and the number of a crew is two pilots instead of three.[203]

Northwest Airlines and KLM Royal Dutch Airlines would decide within three months whether to begin direct flights to Europe from MEM. The two airlines had coordinated schedules, ticketing and ground operations around the world.[204]

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[201] William C. Bayne, "S'haven to Seize 3 Buyout Homes," Commercial Appeal 10 Feb. 1994.

[202] Dave Hirschman, "Northwest Hires 300, Begins New Schedule," Commercial Appeal 2 Mar. 1994.

[203] Dave Hirschman, "New FedEx Planes to Accent Efficiency," Commercial Appeal 15 May 1994.

[204] Dave Hirschman, "Airline - Northwest, KLM Mull Direct Flights from Memphis to Europe," Commercial Appeal 29 May 1994.

4.3. Runway Expansion

There are three reasons for runway expansion. One is to add new runways in order to increase the number of aircraft operations (airfield capacity). Another is to extend runway length in order to accommodate heavier aircraft or increase aircraft roll distance. The other is to add an alternative runway. When a runway is out of service the airfield capacity (hourly service volume) is significantly reduced, especially if the airfield use is very close to the annual service volume. Existing runways are not available for use during construction because it takes two or three years to reconstruct them. The design life of a runway is usually 20 years.

Since 1929 the Memphis Airport has constructed and expanded six runways. Until 1956 four runways had been constructed and extended to radial directions to allow all weather operations: Runway 3-21 (northeast-southwest), Runway 15-33 (northwest-southeast), Runway 9-27 (east-west) and Runway 18-36 (north-south). After 1956, two parallel runways of north-south direction, Runway 18L-36R and Runway 18R-36L, were constructed in order to minimize strong crosswind and reduce the impact of noise from jet aircraft and airfield space. The north-south runway orientation provides 97.2 percent wind coverage at 13 knot components.[211]

MEM now has three active runways and two inactive runways:

Runway	Direction	Length	Status
18R-36L	north-south	9,139 feet (2,778 m)	active
18L-36R	north-south	8,400 feet (2,554 m)	active
9-27	east-west	8,936 feet (2,717 m)	active
14-32	northwest-southeast	3,760 feet (1,143 m)	closed
3-21	northeast-southwest	5,800 feet (1,763 m)	closed

The master airport plan of MEM in 1986 recommended extending the length of runway 18L-36R and adding an alternative runway 18E-36E (Figure 4.3.a.). The Environmental Impact Statement of MEM in 1993 stated the following. Runway 18L-36R had been constructed in 1962

[211] Memphis-Shelby County Airport Authority, "Airport Layout Plan," 1994.

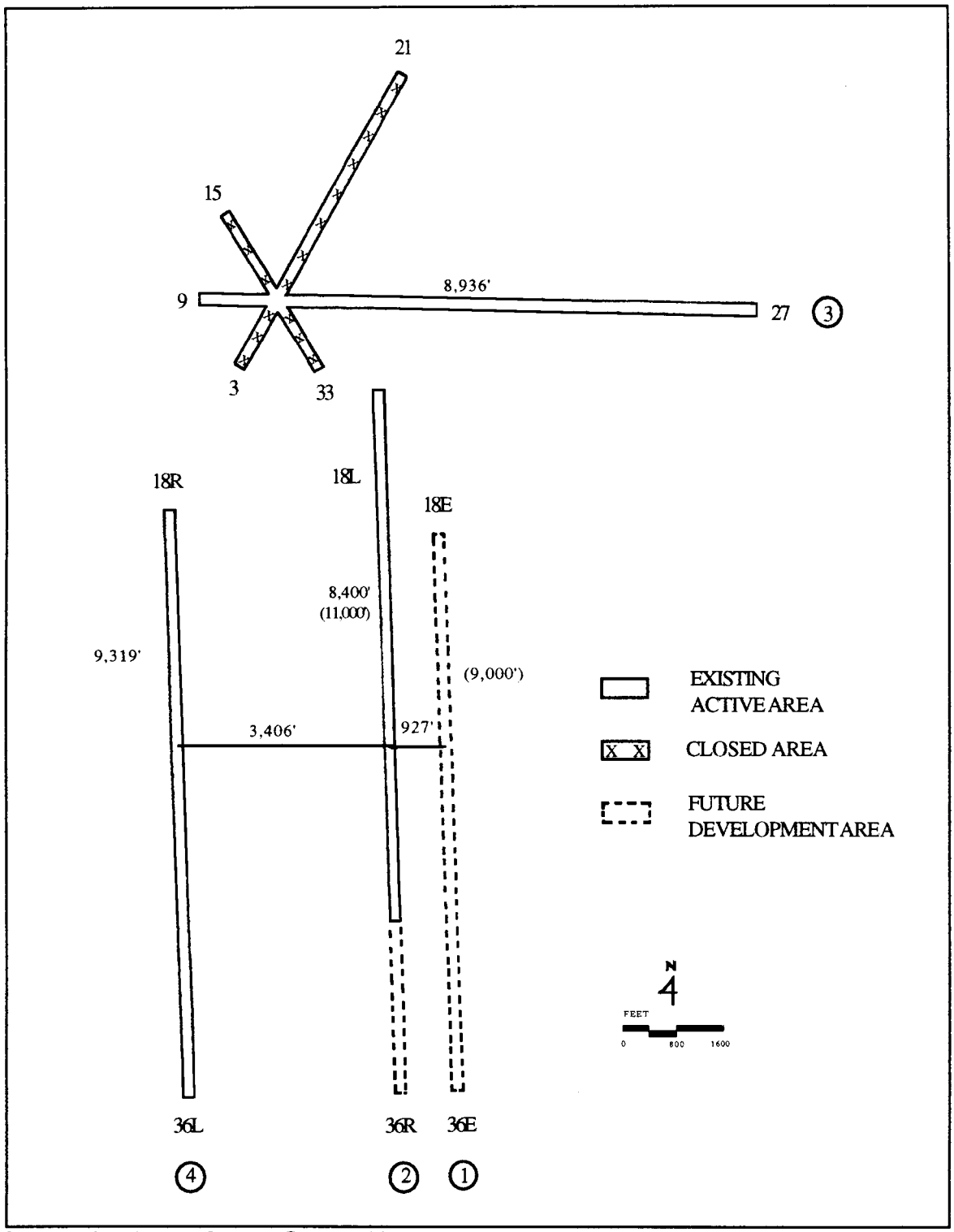


Figure 4.3.a. Airport Layout Concept Plan - Memphis International Airport. (Adapted from: Peat, Marwick, Mitchell & Co., Master Plan Memphis International Airport. (Memphis: Memphis-Shelby County Airport Authority, 1986), p. 57, Exhibit 11.)

and Runway 18R-36L in 1973. Runway 18L-36R presents a significant maintenance cost to keep in safe service and would require reconstruction over the next few years.[212] The proposed schedule for construction of a new runway and reconstruction of the existing runways was[213]:

1. 1993-1996 construction of Runway 18E-36E,
   9,000 x 150 feet (2,736 x 46 m)
2. 1996-1998 extension and reconstruction of Runway 18L-36R,
   11,120 x 150 feet (3,380 x 46 m)
3. 1998-1999 reconstruction of Runway 9-27,
   8,936 x 150 feet (2,717 x 46 m)
4. 1999-2000 reconstruction of Runway 18R-36L
   9,319 x 150 feet (2,833 x 46 m)

MEM provided longer runways as heavier aircraft showed up. Table 4.3.a. shows required runway lengths for take-off and landing of typical aircraft in the history of MEM. In the 1930s, MEM constructed two 3,400-foot (1,034 m) runways, Runway 3-21 and Runway 15-33, to accommodate heavier transportation aircraft. A few years later, the two runways were extended to 4,200 feet (1,277 m) long and Runway 9-27 was constructed 5,280-foot (1,605 m) long to accommodate larger transcontinental planes. As Douglas DC-4 aircraft showed up in 1946, Runway 9-27 and Runway 3-21 were extended to 6,500 feet (1,976 m) long and 5,800 feet (1,763) long each in 1950. Runway 9-21 was expanded to 8,936 feet (2,717 m) to accommodate large jet equipment of the military and Douglas DC-7 aircraft in 1954. 8,400-foot Runway 18L-36R was constructed in 1962, 9,139-foot (2,778 m) Runway 18R-36L in 1972, in due to increased aircraft operations volume.

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[212] v. 1 p. S-4

[213] Ibid, v. 1 Exhibit 1-9.

Table 4.3.a. Required Runway Lengths for Take-off and Landing of Typical Aircraft at MEM

	Landing		Takeoff	
Aircraft Type	Max. Weight (1000 Lbs.)	length (feet)	Max. Weight (1000 Lbs.)	Length (feet)
Douglas DC-3	25.2	4,000	25.2	3,300
Douglas DC-4	62.4	5,800	62.4	5,100
Douglas DC-7	97.0	6,600	122.0	6,480
Douglas DC-9-30	98.0	5,400	103.0	8,200
Boeing 727-00	135.0	5,000	153.0	7,800
Boeing 757-232	198.0	5,968	240.0	9,800
Boeing 707-400	207.0	7,750	272.0	10,500
Boeing 747	630.0	9,110	785.0	10,800

Remark: Data is calculated using FAA Advisor Circular AC-150/5325-4A: "Runway Length Requirements for Airport Design," based on elevation 332 MSL and mean daily maximum temperature in the hottest month (July) 91°F (33°C) at MEM.

Runway 18L-36R will be extended to 11,120 feet (3,380 m) long to accommodate aircraft for international travel such as the Boeing 747. The runway extension will allow MEM to better serve aircraft with very long stage lengths.

4.4. Demand Forecasts

Demand forecasts are an important process in airport planning because they indicate the timing of airport expansion. The development of a master plan update is recommended by the FAA to forecast aviation demand elements: annual passenger enplanements, annual aircraft operations, and hourly aircraft operations.

4.4.1. Passenger Enplanement Forecasts

Passenger enplanement forecasts are important in airport planning because the allocation of federal funds for air carrier airports is based on the volume of passenger enplanements. From early in the history of MEM, the policy change of airlines has affected in passenger demand of MEM. It might be necessary to trace passenger enplanements of major airlines involved in MEM in the past.

Through passengers in MEM declined in 1948 because of American Airlines schedules which over-flew Memphis. In 1946, the number of annual through passengers using American Airlines was 102,919, 53 percent of total through passengers or 24 percent of total annual passenger enplanements of MEM.[214] However, the peak of 1947 was recovered and surpassed in 1950.[215]

Figure 4.4.1.a. shows the actual annual passenger enplanements of MEM and U.S. domestic scheduled air carriers from 1960 to 1992. The trend of the annual passenger enplanements during 1962 and 1983 was similar in Memphis and the U.S. Annual increases of 13 percent and 10 percent of MEM and 14 percent and 15 percent of U.S. domestic, in the passenger enplanements during 1978 and 1979 were caused by the Airline Deregulation Act of 1978. The drops of 17 percent and 10 percent of MEM and six percent and four percent of U.S.

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[214] "City Releases Report on Airport Progress," Commercial Appeal 25 Mar. 1947.

[215] Robert Gray, "Airport Notes Growth during Past Decade," Commercial Appeal 19 Mar. 1951.

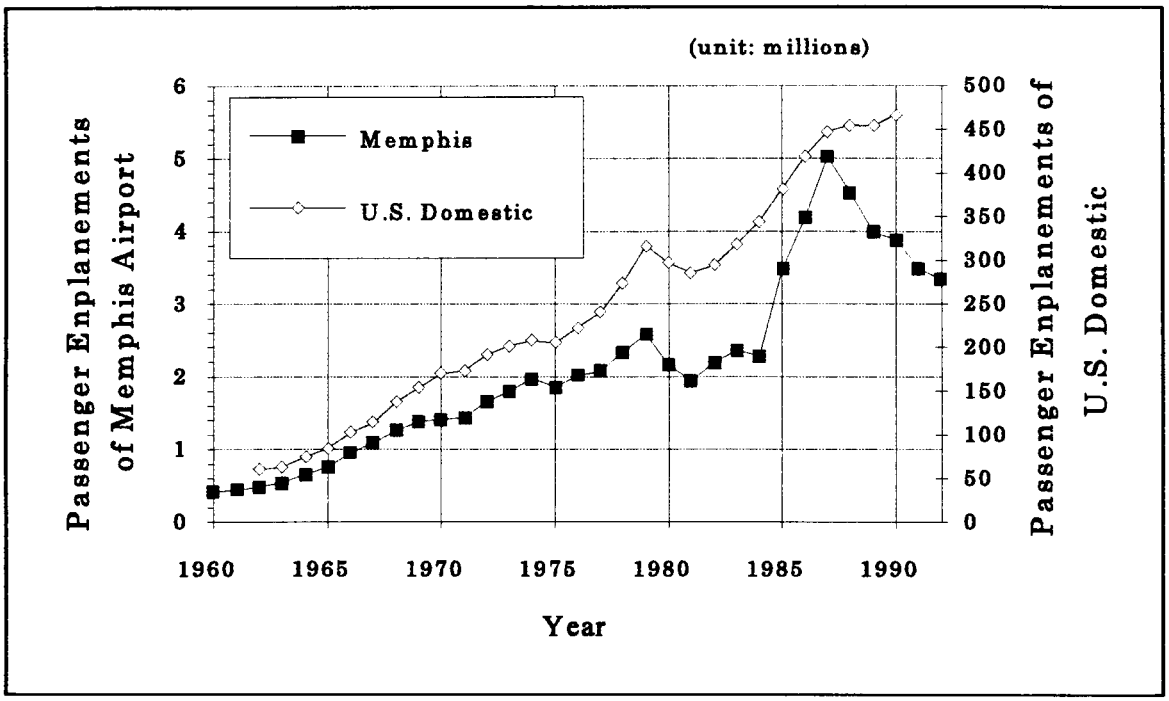


Figure 4.4.1.a. Actual Passenger Enplanements of MEM and U.S. Domestic. (Data source: U.S. Domestic data from Air Transportation Reports, and MEM data from Airport Activity Statistics of Certificated Route Air Carrier Reports.)

domestic, of the enplanements between 1980 and 1981, were caused by an oil shortage. Since 1985 the trend of passenger enplanements of MEM had drifted down more than that of U.S. domestic. The drastic increases, 52 percent (1985), 20 percent (1986), and 20 percent (1987), in the passenger enplanements of MEM were caused by the struggle and merger of airlines. The abrupt drops, 10 percent (1988) and 12 percent (1989), of the passenger enplanements of MEM were caused by the rearrangement of the route system. The economic recession in the United States has accelerated the drop since 1991.

The 1978 Airline Deregulation has changed airlines' structure in MEM. (See Figure 4.4.1.b.) Until 1981 Delta Air lines had been a leading airline in MEM. However, it stepped down from the leading role when Northwest Airlines started to use MEM as one of its hubs in 1986. Braniff Airlines withdrew from MEM because of its bankruptcy in 1982. Republic Airlines, which was formed by the merge of Southern Airways and North Central Airlines in 1979, drastically expanded the route system in MEM during 1983 through 1985. Republic Airlines scheduled 86

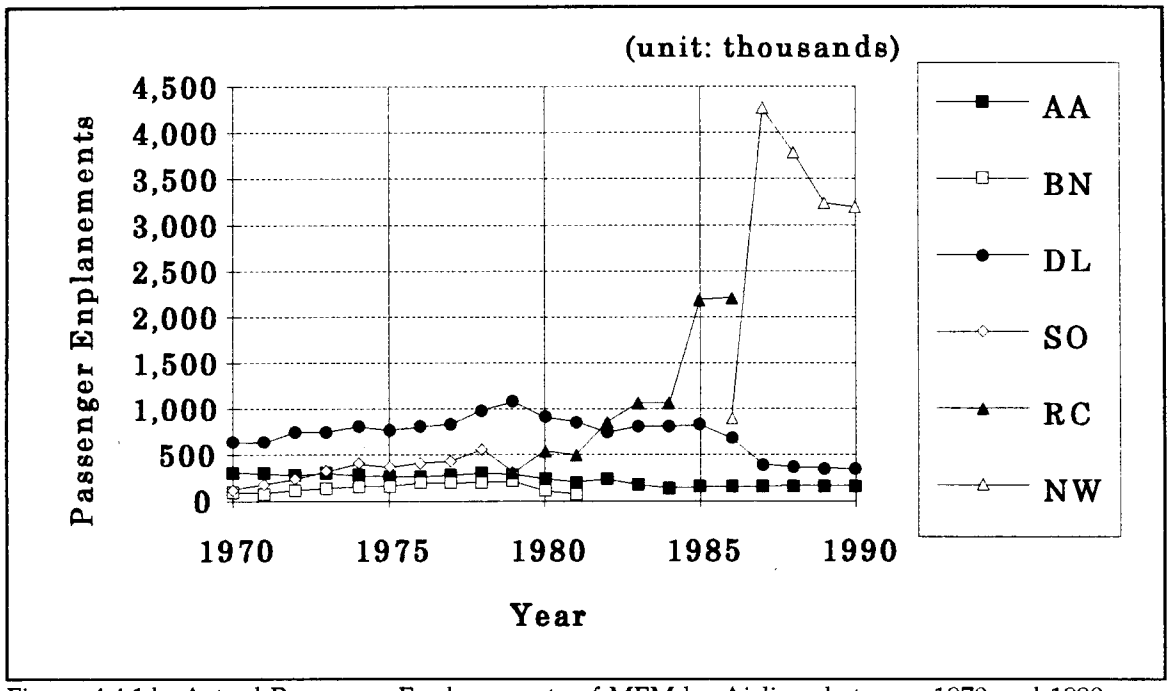


Figure 4.4.1.b. Actual Passenger Enplanements of MEM by Airlines between 1970 and 1990. Remarks: AA-American Airlines, BN-Braniff Airlines, DL-Delta Air Lines, SO-Southern Airways, RC-Republic Airlines and NW-Northwest Airlines. (data source: FAA, "Airport Activity Statistics of Certificated Route Air Carrier Reports," (1970-1990).)

daily flights, 97 daily flights, and 157 daily flights in MEM from 1983 to 1985. At last, Republic Airlines went bankrupt and merged with Northwest Airlines in 1986. After 1988, Northwest Airlines has changed its policy from increasing route system to increasing the load factor of passengers.

Figure 4.4.1.c. shows actual and forecast of annual passenger enplanements of MEM. Using exponential curve, airport consulting engineers forecasted 10,240,000 passenger enplanements in the year 1990 in 1970.[216] The value was two and half as much as actual passenger enplanements, 3,885,399. The master airport plan in 1986 forecast at least four million passenger enplanements in 1986, five million in 2000 and six million in 2010. The FAA forecasted in 1992 that the passenger enplanements of MEM would be approximately 5,977,000 in 2000 and

[216] Allen & Hoshall, Airport Layout Plan, (1971) p. Plate 8.

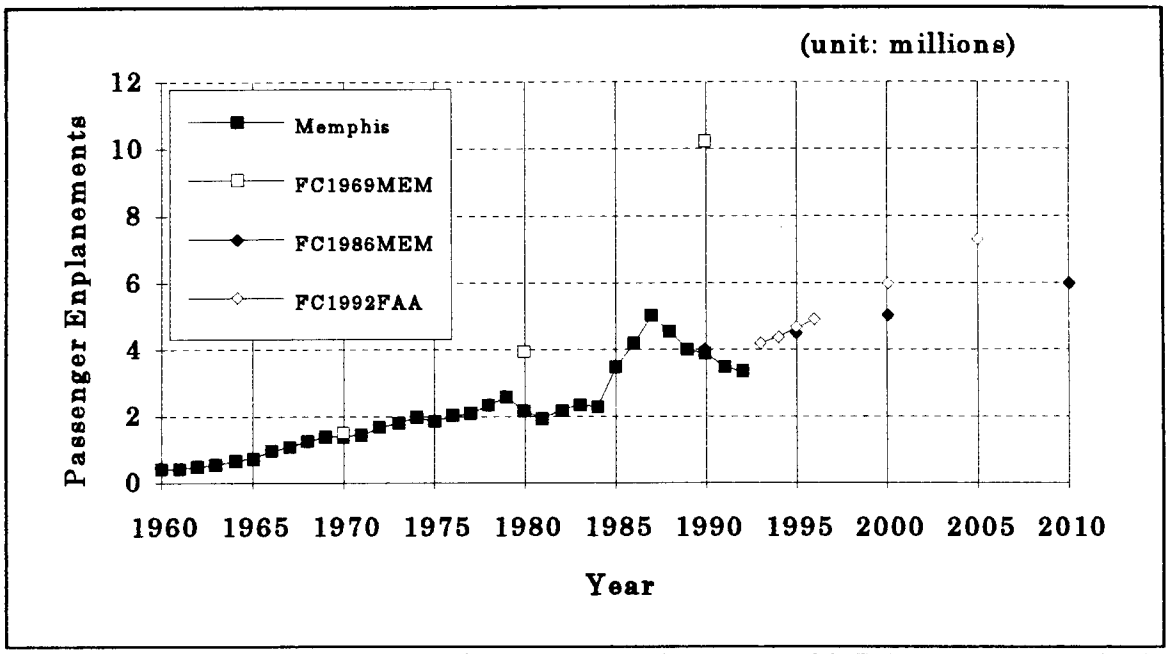


Figure 4.4.1.c. Actual and Forecast of Passenger Enplanements of MEM. (Data source: FAA, "Airport Activity Statistics of Certificated Route Air Carrier Reports," Allen &Hoshall, Airport Layout Plan (1971), Peat, Marwick, Mitchell & Co, Master Plan (1986), and FAA Terminal Area Forecast (1993).)

approximately 7,311,000 in 2005.[217] These figures show that it is difficult to make an accurate forecast of annual passenger enplanements. Long term forecasts made in 1986 were for a wider range from four million to 4.8 million passenger enplanements in 1990 and a range from five million to 5.9 million passenger enplanements in 2000.[218] It is interesting to note that the FAA continues to forecast increases in MEM passenger enplanements, even though they have declined in recent years.

4.4.2. Annual Aircraft Operation Forecast

Annual aircraft operation forecasts indicate the needs of runway expansion because the capacity of a runway is calculated with aircraft operations. The number of aircraft operations is influenced by the size of aircraft. For instance, larger aircraft can carry many passengers and

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[217] FAA, Terminal Area Forecast, (1993) p. 66.

[218] Peat, Marwick, Master Plan, p.8, Exhibit 1.

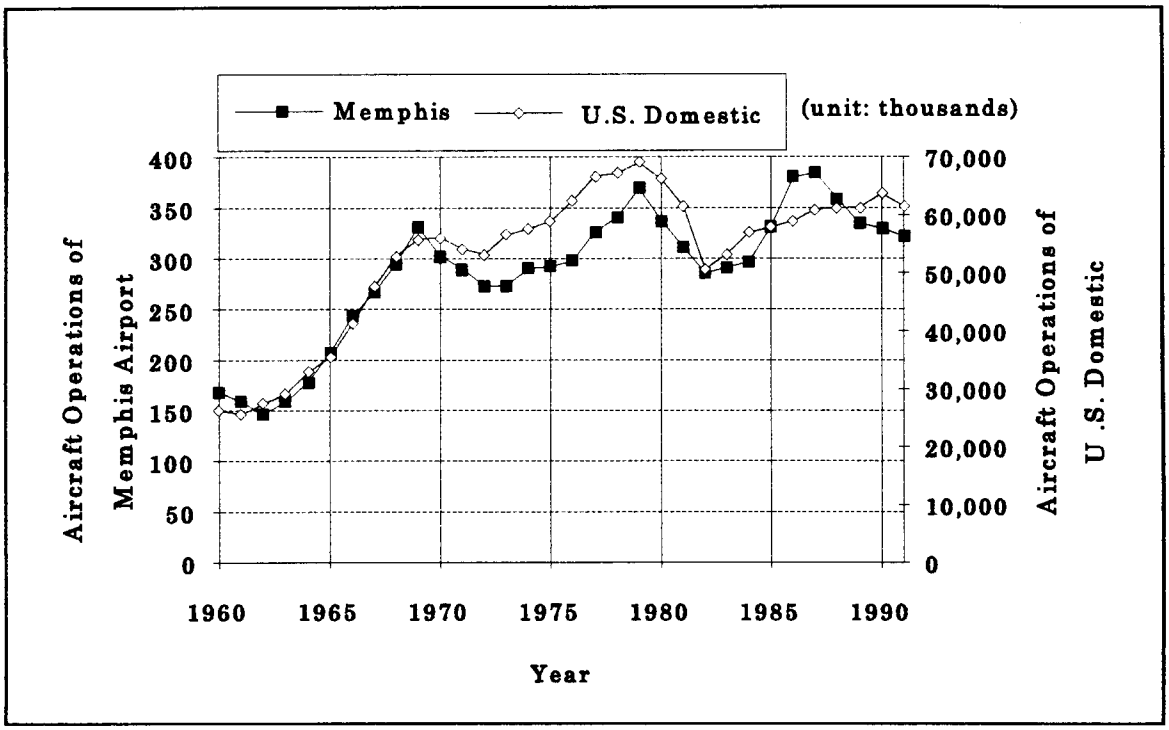


Figure 4.4.2.a. Annual Aircraft Operations of MEM and U.S. Domestic. (Data source: FAA, "Airport Activity Statistics of Certificated Route Air Carrier Report," and "FAA Air Traffic Activity - Fiscal Year.")

cargo, with less frequency of take-off and landing than smaller aircraft.

Figure 4.4.2.a. shows actual annual aircraft operations of MEM and U.S. domestic air carrier airports between 1960 and 1991. The trend of annual aircraft operations of both MEM and U.S. domestic airports was the same pattern as that of annual passenger enplanements except three years after 1970. (Refer Figure 4.4.1.a.) During 1970 and 1972, the number of passenger enplanements of both MEM and U.S. domestic increased, but the number of aircraft operations declined. The Boeing 747 entered service in 1970, followed in 1971 by the Lockheed L-1011 and the Douglas DC-10 wide-body trijets.[219] They carry over 200 passengers, each.

Figure 4.4.2.b. and 4.4.2.c. shows actual annual aircraft operations of U.S. domestic airports by activity type, and actual aircraft operations of MEM by activity type between 1960 and 1991. The trend of aircraft operations of itinerant air carrier of U.S. domestic and MEM was the same

[219] Shevell, (1989) p. 31.

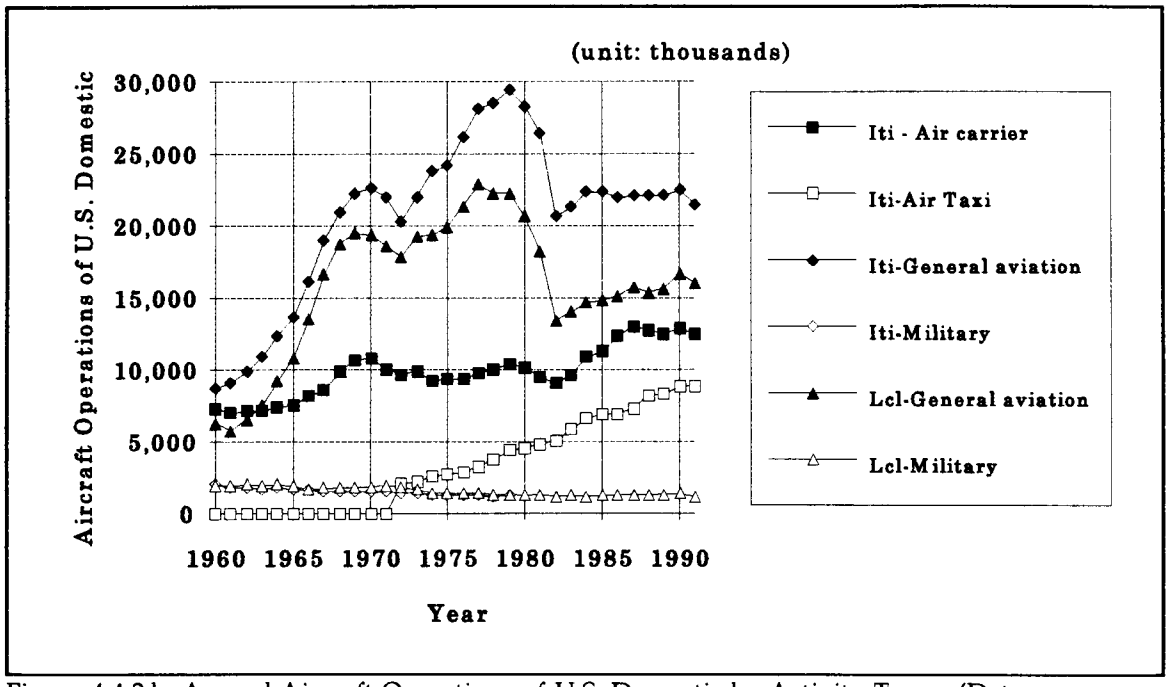


Figure 4.4.2.b. Annual Aircraft Operations of U.S. Domestic by Activity Type. (Data source: FAA, Airport Activity Statistics of Certificated Route Air Carrier Reports and "FAA Air Traffic Activity - Fiscal Year.")

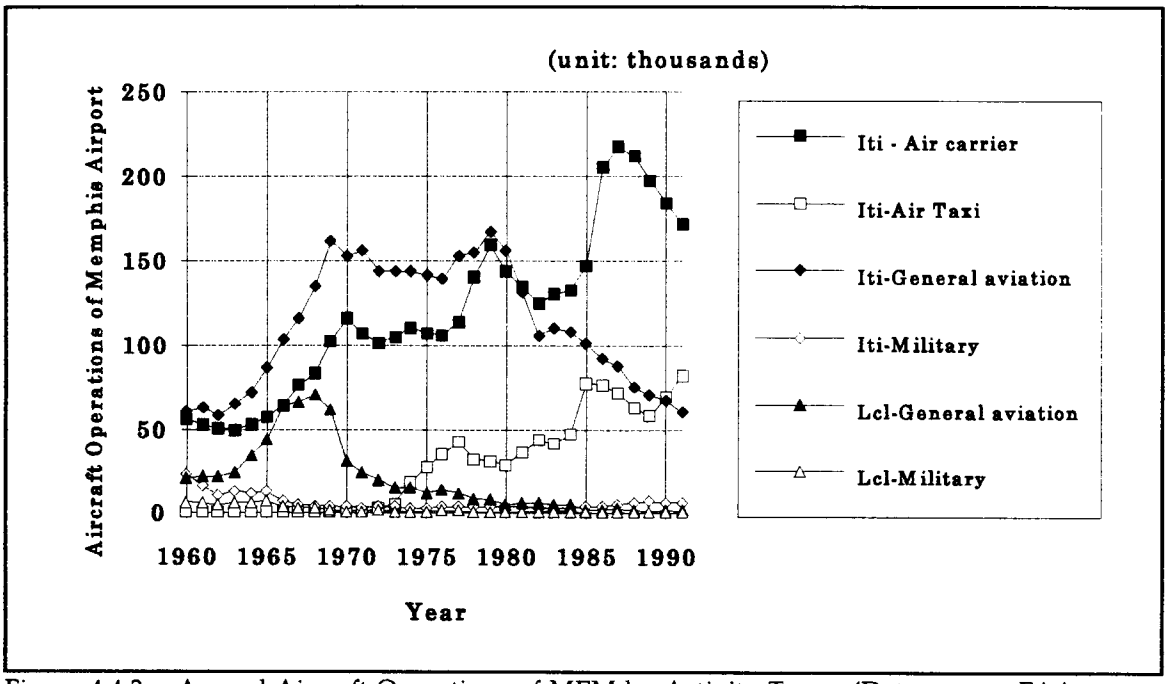


Figure 4.4.2.c. Annual Aircraft Operations of MEM by Activity Type. (Data source: FAA, Airport Activity Statistics of Certificated Route Air Carrier Reports and "FAA Air Traffic Activity - Fiscal Year.")

pattern as that of annual passenger enplanements except for the abrupt increment, 58,000 aircraft operations, of MEM in 1986. The reason for the exception came from the data gathering process. Although Federal Express started cargo service in 1973, since only 1986 , have the data of aircraft operations of Federal Express been included in itinerant air carrier category: approximately 38,000 (1986), 49,000 (1988) and 57,000 (1990) aircraft operations, The share of Federal Express in itinerant air carrier category increased: 19 percent (1986), 23 percent (1988) and 31 percent (1990). The proportion of aircraft operations of air carrier of MEM was 53 percent in 1991.

For U.S. domestic activity, after the drop of aircraft operations of itinerant and local general aviation in 1980, their recovery was slower than that of the other activities. The proportion of general aviation of MEM was lower than that of U.S. domestic because general aviation tended to use other airports near MEM. The decreases in aircraft operations of local general aviation at MEM since 1969 were caused by the policy of the Airport Commission in 1968; training flights and light flights, except corporate or business planes, have used a new downtown airport instead of MEM. The Commission expected that airline and commercial traffic would increase. The proportion of aircraft operations of total general aviation of MEM was 19 percent in 1991.

Aircraft operations of air taxi of both MEM and U.S. domestic have continued to increase since the 1970's. The ratio of aircraft operations of MEM was 26 percent in 1991.

Aircraft operations of itinerant military of MEM after 1966 were less than 6,000. Those of the local military of MEM were gradually declining and were approximately 150 in 1991. The proportion of aircraft operations of total military of MEM was two percent in 1991.

The demands of air carriers and air taxis will be key factors in demand forecasting at MEM. However, the use of annual aircraft operations data with annual passenger enplanements is problematic at best since MEM serves one of the largest cargo operations in the U.S. Packages and people are two distinct airport uses with entirely different purposes.

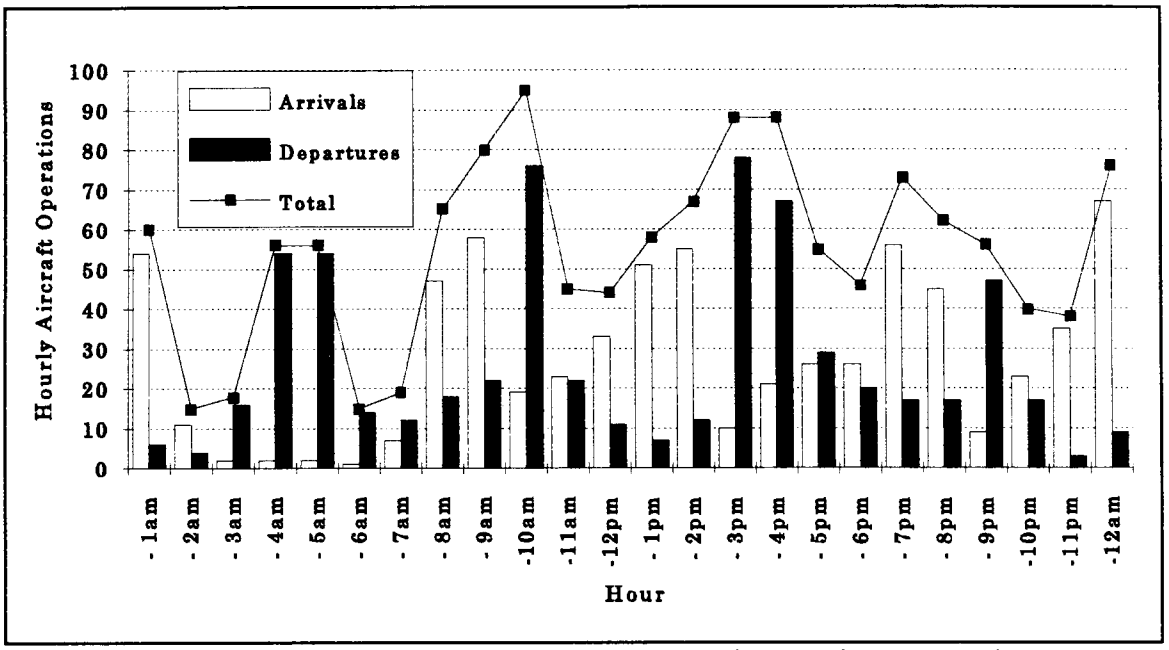


Figure 4.4.3.a. Hourly Distribution of 1,315 Average Aircraft Daily Operations of Four Busiest Days in 1993. (Data source: FAA Memphis Air Traffic Control Tower, 8/12, 9/16, 11/23, and 12/21 in 1993.)

4.4.3. Hourly Aircraft Operation Forecast

Hourly aircraft operation forecasting is important for airports where traffic patterns are not uniform, such as hubs. The forecasts are a key decision factor for new runway.

Figure 4.4.3.a. shows the hourly distribution of 1,315 average aircraft daily operations of MEM on four busiest days in 1993. MEM has controlled the hourly operation of air carriers in daytime and Federal Express in the nighttime. In daytime, three hours of departure operations: 9 a.m. - 10 a.m. and 2 p.m. - 4 p.m. were concentrated and arrival operations were even. At night between 10 p.m. and 6 a.m., arrival operations were concentrated from 11 p.m. - 1 a.m. and departure operations were concentrated from 3 a.m. - 5 a.m. These operation patterns accommodate the one night delivery system of Federal Express, headquartered in Memphis.

Comparing hourly capacity and hourly operation, airport planners know whether their airport need more additional runway capacity.

In calculating hourly capacity the following assumptions are used:

Runway use is the pattern of diagram 70 of FAA Advisor Circular AC 150/5060-5: "Airport Capacity and Delay." Primary arrivals and departures are to the south (arrival runways are 18R and 18L, and departure runways are 18R, 18L and 9). The mix index[220] of the aircraft fleet is drawn from the master plan of 1986. Each runway has 4 or 5 exits to a taxiway.

Hour	Mix Index	Ceiling Visibility	% of Arr.	Hourly Capacity	Actual Demand
- 1 a.m.	133	IFR	60%	75	60
- 2 a.m.	133	IFR	60%	75	15
- 3 a.m.	133	IFR	40%	105	18
- 4 a.m.	133	IFR	40%	105	56
- 5 a.m.	133	IFR	40%	105	56
- 6 a.m.	133	IFR	40%	105	15
- 7 a.m.	60	IFR	50%	80	19
- 8 a.m.	60	VFR	50%	120	65
- 9 a.m.	60	VFR	50%	120	80
- 10 a.m.	60	VFR	50%	120	95
- 11 a.m.	60	VFR	50%	120	45
- 12 p.m.	60	VFR	50%	120	44
- 1 p.m.	60	VFR	50%	120	58
- 2 p.m.	60	VFR	50%	120	67
- 3 p.m.	60	VFR	50%	120	88
- 4 p.m.	60	VFR	50%	120	88
- 5 p.m.	60	VFR	50%	120	55
- 6 p.m.	60	VFR	50%	120	46
- 7 p.m.	60	VFR	50%	120	73
- 8 p.m.	60	IFR	50%	80	62
- 9 p.m.	60	IFR	50%	80	56
- 10 p.m.	60	IFR	50%	80	40
- 11 p.m.	133	IFR	60%	75	38
- 12 a.m.	133	IFR	60%	75	76

[220] See the definition of mix index in Glossary.

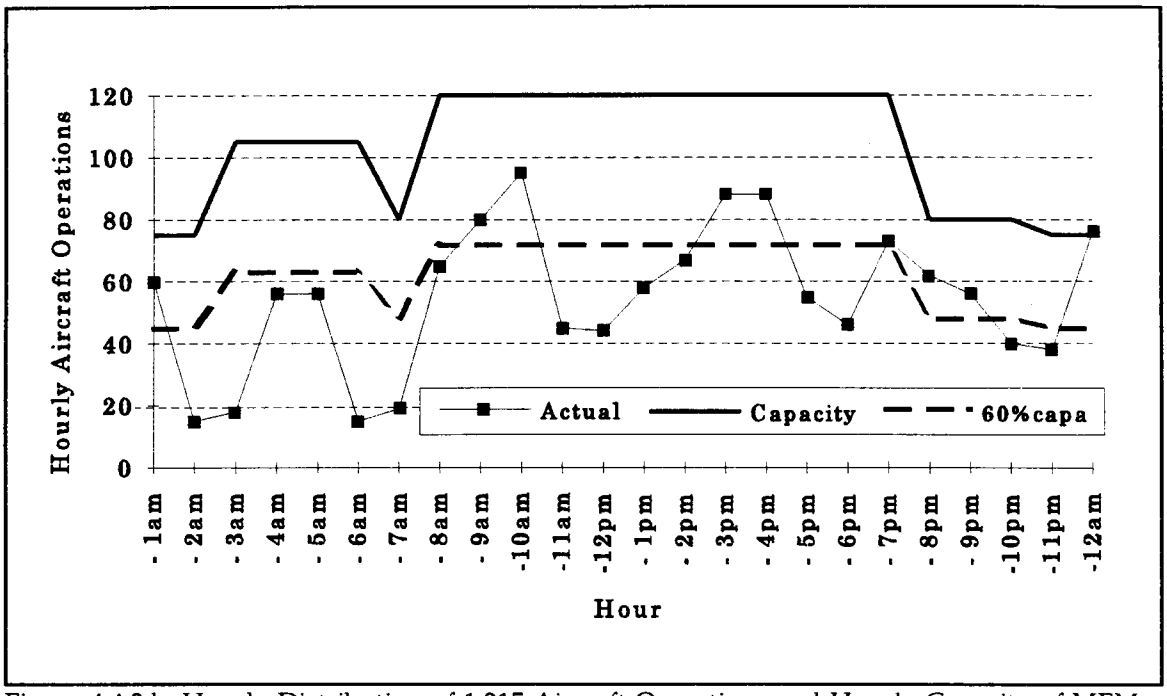


Figure 4.4.3.b. Hourly Distribution of 1,315 Aircraft Operations and Hourly Capacity of MEM in 1993. (Data source: FAA Memphis Air Traffic Control Tower, 8/12, 9/16, 11/23, and 12/21 in 1993.)

Visual flight rule (VFR) conditions occurs whenever the cloud ceiling is at least 1,000 feet (304 m) above ground level and the visibility is at least three statute miles (4.8 km). Instrument flight rule (IFR) conditions occur whenever the reported cloud ceiling is as least 500 feet (152 m) but less than 1,000 feet (304 m) and/or visibility is at least one statute mile but less than three statute miles. Figure 4.4.3.b. shows the hourly distribution of 1,315 aircraft operations and hourly capacity. If the number of hourly aircraft operations exceeds 60% of capacity, the airport starts to encounter delay. At present, hourly aircraft operations exceed over 60% of capacity at eight hours: 12 p.m. - 1 a.m., 8 a.m. - 10 a.m., 2 p.m. - 4 p.m., 7 p.m. - 9 p.m. and 11 p.m. - 12 p.m.. The most crucial hour is 11 p.m. - 12 p.m.

4.5. Land Acquisition (1935-1994)

MEM expanded by purchasing lands. There were four purposes for those land acquisitions in MEM. The first was to build or expand runways. The second was to build facilities: terminals, hangers, aprons, parking space and so on. The third was to make clear zones at the end of runways for safety. The fourth was to mitigate aircraft noise. Figure 4.5.a. shows the land acquisition history of MEM between 1935 and 1994.

1. In 1935 the original leased land, 202.5 acres, was titled to the City of Memphis for $100,000.[251] The land had been leased for $100 a month since 1928. In 1932, northeast-southwest Runway 3-21 was constructed. In addition, northwest-southeast Runway 14-32 were constructed in 1935.

2. In 1935, an additional 140 acres east of the field were bought for $31,000 to build new east-west Runway 9-27 about midway of the field, running east into the new portion of the airport.[252] In 1937, the runway was constructed.

3. In 1938, an additional 63 acres along the north border of the airport were bought from six landowners for $20,715 to extend Runway 3-21 and Runway 14-32 from 3,400 feet long to 4,200 feet long. The new land increased the total size of the airport to 405 acres.[253]

4. In 1939, an additional 43 acres east of the existing line of hangars were purchased at a cost of $18,000. The new land made room for two new hangars which housed the main offices and shops of Chicago & Southern Airlines.[254] The two hangars were built in 1940.

5. By 1939, additional about 54 acres east of the north border of MEM were purchased to construct north-south Runway 18-36. In 1940, the construction of the runway was completed.

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[251] Paul Coppock,"City to Buy Airport Improve Flying Site," Commercial Appeal 30 Jan. 1935.

[252] "President Passes on Airport Work," 28 Sep. 1935.

[253] "63 Acres Purchased to Enlarge Airport," Commercial Appeal 6 May 1938.

[254] "More Land for City's Airport," Press Scimitar 21 Mar. 21, 1939.

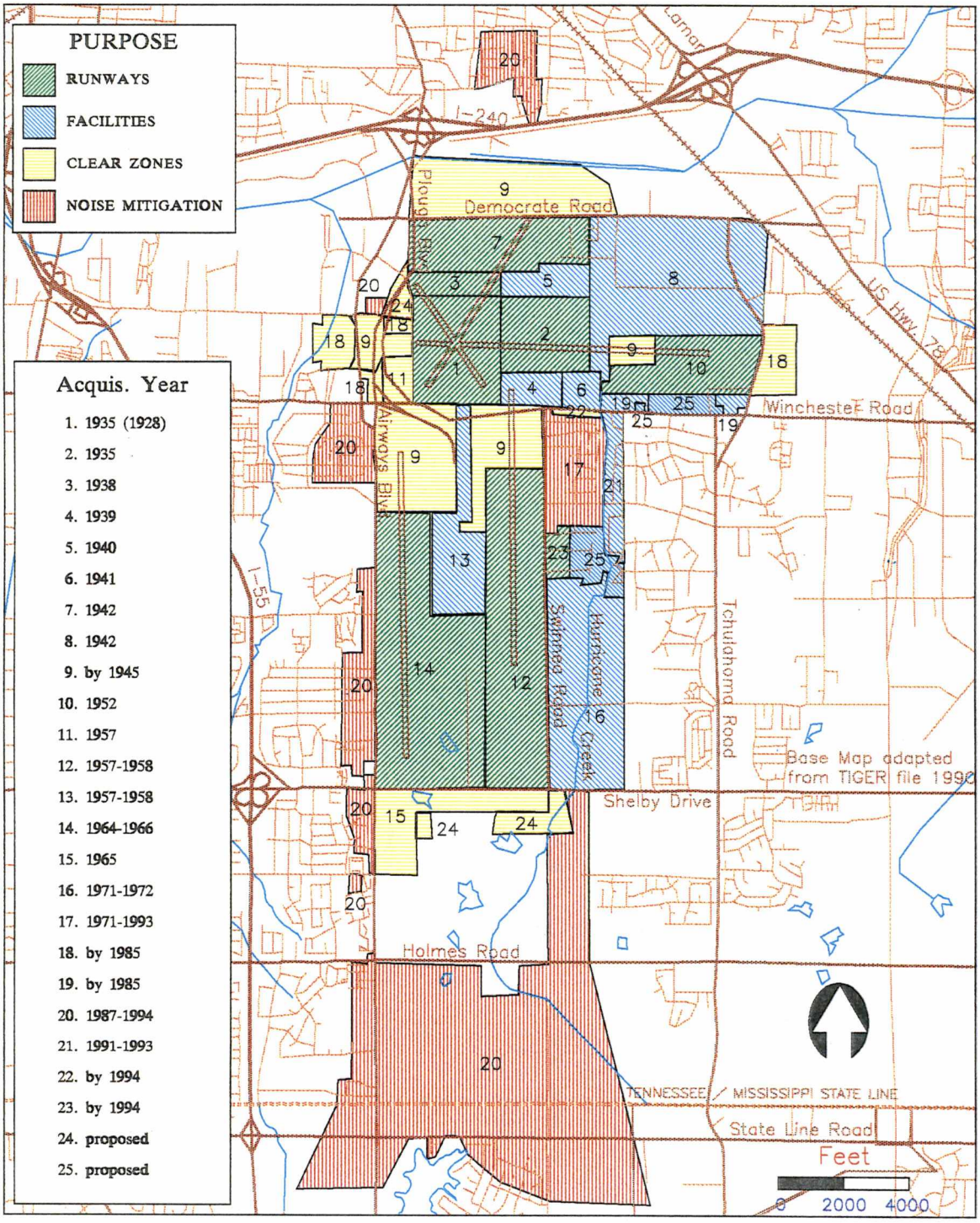


Figure 4.5.a. Land Acquisition History of Memphis Airport

6. In 1941, 31.25 acres adjoining the southeast corner of the airport was purchased for $17,000 as a site for the 30th Reconnaissance Squadron attached to the Second Army. The purchase was made from one landowner and included a six-room residence, storage house, garage and crops. The new land increased the total size of the airport to 533.25 acres.[255]

7. In 1942, the city's condemnation of property from the north line of the airport to Democrat Lane was allowed $62,627 by a Circuit Court Jury of View to enlarge three of the existing runways to a full mile in length. The property was held by five landowners and two family holdings.[256] In 1950, Runway 3-27 was extended to 5,800 feet long. By this time the city had purchased all land adjoining the airport from Airways Boulevard to Harrington Road and from Winchester Pike to Democrat Lane.[257] The city owned in total 733 acres of land.[258]

8. In August 1942, Federal Judge Marion S. Boyd granted a petition filed by the U.S. Government for condemnation of 466.76 acres of land adjacent to the airport for enlarging it to meet military needs. The acreage consisted of 14 parcels of land. The new property began at the intersection of Frisco Railroad and Tchulahoma Road and proceeded northeast to Democrat Lane, then west to Harrington Road, south along the western boundary of Harrington and east line of MEM , then east to Tchulahoma Road and finally north and east along Tchulahoma Road to the starting point.[259]

9. By 1945, the totally 608 acres of four lands at the ends of runways to provide clear approaches were purchased for $240,000 by the City of Memphis. There were several dwellings.[260]

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[255] "Proposed Addition to 'Round Out' Airport," Commercial Appeal 15 June 1941.

[256] "First Step is Taken to Enlarge Airport," Commercial Appeal 4 Mar. 1942.

[257] "Land Purchased," Press Scimitar 3 Apr. 1942.

[258] Memphis Municipal Airport, (1947) p. 38.

[259] "466 Acres Are to Be Added to City's Airport," Press Scimitar 11 Aug. 1942.

[260] "Airport's Taxiways to be Widened Soon," Commercial Appeal 30 Nov. 1945.

10. In 1952, 212 acres of property at the end of the airport, undeveloped except four houses, were acquired to expand Runway 9-27.[261] At the time, the total land area of airport property was 1,930 acres.[262] The runway was expanded to 8,936 feet (2,717 m) long in 1954.

11. In 1957, land acquisition for widening the clear zone west of Runway 9-27 begun at a cost of about $370,000.[263]

12/13. During 1957 and 1958, land purchase for new north-south Runway 18R-36L and a new terminal was made at a cost estimated to be more than four million dollars.[264] In 1963, the terminal was dedicated and Runway 18R-36L was opened.[265]

14. During 1964 and 1966, land for second north-south Runway 18R-36L was purchased between Winchester Road and Shelby Drive. The city had been buying land for the runway and clear zones for several years. In April 1966, all that remained were about eight pieces of property covering less than 25 acres.[266] In 1973, the runway was opened.[267]

15. In 1965, 142 acres of land at the south corner of Shelby Drive and Airways Boulevard were purchased for a clear zone of Runway 18R-36L at a cost of $603,000. There were several large homes on the land. The land was a large single parcel.[268] Property for clear zones extended north of Winchester Road and south of Shelby Drive.[269]

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[261] "Overton Gets Commission's O.K. to Close Deal to Make City Airport Jet-Worthy," Press Scimitar 20 Nov. 1952.

[262] Robert Gray, "Airport is Prepared to Welcome Jet Age," Commercial Appeal 22 Mar. 22, 1953.

[263] "Airport's Progress is Cited by Dillard," Commercial Appeal 30 Aug. 1957.

[264] "Times Create Need for Modern Airport," Commercial Appeal 9 Mar. 1958.

[265] Louis Silver, "Memphis Steps Proudly into Jet Age," Commercial Appeal 21 Jan. 1963.

[266] Charles A. Brown "$1.2 Million OK'd for Airport," Press Scimitar 8 Apr. 1966.

[267] Orville Hancock, "Airport Expansion near Completion," Press Scimitar 16 Jan. 1974.

[268] "$603,000 Price for 142 Acres," Press Scimitar 20 Jan. 1965.

[269] Charles A. Brown, "$1.2 Million OK'd for Airport," Press Scimitar 8 Apr. 1966.

16/17. In 1971 and 1972, 497.9 acres in the Oakhaven community east of Swinnea Road would have been purchased for fuel tank farm and noise problems and as buffer zone for noise problems There were 266 homes. The purchase was for cash on an as-offered basis.[270] Fifteen acres that had underground utilities already installed, streets, curbs and gutters were purchased for $387,000 in June 1971. By June, 29 homes were purchased and negotiations for 71 more were in progress.[271] Land of 115 acres was purchased from Airway Equipment Co. for $690,000 in August 1971. Fifty acres were purchased from several joint owners for 205,000. By August, 50 homes were acquired.[272] By June 1974, 183 homes were purchased.[273]

16. In 1971 and 1972, approximately 340 acres east of Swinnea Road and north of Shelby Drive were purchased as an alternative site of the second terminal and the site of a fuel tank farm.[274]

17. In 1971 and 1972, a part of approximately 140 acres in Oakhaven community was purchased as buffer zone for noise problems by the City of Memphis.[275] Between 1988 and 1993, 29 additional parcels were purchased by the Airport Authority at a cost of $2,842,000.

18. By 1985, several ten acre tracts on east and west of Runway 9-27 were purchased for clear zones.[276]

19. By 1985, approximately 32 acres on the south of Runway 9-27 were purchased.[277]

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[270] Jefferson Riker, "Oakhaven Plan Gets City's OK," Commercial Appeal 3 Feb. 1971.

[271] "Land Purchase Approved by Airport Board," Press Scimitar 25 June 1971.

[272] Orville Hancock, "Airport Authority Inherits 'Headache'," Press Scimitar 1 Sep. 1971.

[273] "Hop-Scotch," Commercial Appeal 1 June 1974.

[274] Jefferson Riker, "Oakhaven Plan Gets City's OK," Commercial Appeal 3 Feb. 1971.

[275] Ibid.

[276] Peat, Master Plan (October 1986).

[277] Ibid.

20. From 1987 through 1994, 1,258 of 1,362 properties eligible for noise mitigation were appraised and purchased for approximately 100 million dollars.[278] The purchased lands were approximately 630 acres.

21. From 1991 through 1993, 63 acres east of Hurricane Creek in Oakhaven community were purchased at a cost of about $20 million. There were 309 properties, the last 16 of which were condemned in December 1992. The purchased lands were part of the Aviation Facilities Planned Development area.[279] [280]

22/25. From 1988 through 1994, 396 of 455 eligible properties, 313 acres, for airport expansion were appraised for 24 million dollars.[281]

22. By 1994, an approximately seven-acre strip of commercial property along Winchester Road, between Runway 18L-36R and Hurricane Creek, was purchased for clear zone for future Runway 18E-36E.[282]

23. By 1994, approximately 25-acre land and industrial property immediately east of Swinnea Road were purchased for Runway 18E-36E, parallel taxiway, and setbacks.[283]

24. In the future, an approximately 20-acre triangle area of residential and industrial property east of Plough Boulevard will be purchased for approach area for Runway 18R-36L. Approximately 59-acre areas south of Shelby Drive were purchased for clear zones to Runway

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[278] "Property Acquisition Fact Sheet," Memphis: Memphis-Shelby County Airport Authority, 15 Feb. 1994.

[279] Airport Neighborhood Update Vol.6 No.1, fall 1993.

[280] Ron Maxey, "Airport Area Holdouts Grow Used to Isolation Homes Dot Empty Expanses where Neighborhoods Stood," Commercial Appeal 16 Dec. 1993.

[281] "Property Acquisition Fact Sheet," Memphis: Memphis Shelby County Airport Authority, 15 Feb. 1994.

[282] Peat, Master Plan, (1986) p.65.

[283] Ibid. p. 65.

18R-36L, future extended Runway 18L-36R and future Runway 18E-36E.[284]

25. In the future, an approximately 31-acres of land and property between Runway 9-27 and Winchester Road will be purchased for future MEM development, as will approximately 54-acre lands and industrial property between the 700-foot eastern MEM boundary and Hurricane Creek for future MEM development.[285]

Average price per one acre and the number of parcels or land owners of the purchased lands were as follows:

Land Acquisition Case #	Period	Land Size (acres)	Average Price per Acre		Number of Parcels
			Purchased Price	Adjusted for Inflation	
1.	1935	202.5	$500	$5,300	1
2.	1935	140	$220	$2,300	-
3.	1938	63	$330	$3,400	6
4.	1939	43	$420	$4,400	-
6.	1941	31.25	$550	$5,400	1
8.	1942	466.76	-	-	14
9.	1945	608	$400	$3,200	several
10.	1952	212	-	-	4
15.	1965	142	$4,200	$19,300	1
16/17	1971	115	$6,000	$21,400	1
20.	1987-1994	630	$159,000	$159,000	1,258
21.	1991-1993	63	$317,000	$317,000	309
22/25	1988-1994	313	$76,700	$76,700	455

Average prices per acre adjusted for inflation based on 1993 dollars are calculated with cost of living indexes of all items in the United States.[286]

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[284] Ibid. p. 66.

[285] Ibid. p. 73.

[286] Standard & Poor's Corporation, May 1994.

4.6. Noise Compatibility Program of MEM (1984-1994)

Memphis-Shelby County Airport Authority began a Noise Compatibility Program study under provisions of Federal Aviation Regulations (FAR) Part 150 in 1984.[291] The program report was submitted to the FAA in November, 1986 at the same time as was the master plan for a new third north-south runway. The report consists of the followings:

- Goal of Noise Compatibility Program,
- Three noise exposure maps,
- Policies and guidelines for a Noise Compatibility Program,
- 11 noise abatement actions, and
- 15 noise mitigation actions.

The report forecasted that all the key elements of the program would be implemented within five to ten years.

Two of the 11 noise abatement actions were to encourage the airlines serving MEM to continue to introduce into service FAR Part 36 Stage 3-compliant aircraft and to establish procedures to encourage compliance with noise abatement runway uses and flight tracks.

The initial phase of the 15 noise mitigation actions was to acquire properties developed in residential or other incompatible uses beginning with those residential properties that were exposed to the highest levels of aircraft noise.

The program was approved by the FAA in February, 1988.

4.6.1. Noise Exposure Maps

The report prepared three noise exposure maps. Noise exposure maps must contain and identify[292]:

- Runway locations,

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[291] Aitport Authority, "Noise Compatibility Newsletter," (Winter, 1989/1990).

[292] 14 CFR Part 150, (1993),

- Flight tracks,
- Noise contours of Ldn 65, 70 and 75 dB resulting from aircraft operations,
- An outline of the airport boundaries,
- Noncompatible land use within the noise contours, including those within the Ldn 65 dB contours, and
- Location of noise sensitive public buildings.
- Locations of any aircraft noise monitoring sites.

The three noise exposure maps show the noise exposure from 1) 350,000 actual aircraft operations with existing runways in 1985 (3.64 million annual passenger enplanements), 2) 400,000 forecast aircraft operations with existing runways in 1990 (four million annual passenger enplanements), and 3) 460,000 forecast aircraft operations with existing runways and the planned Runway 18E-36E between 2001 and 2010 (six million annual passenger enplanements). These noise exposure maps were accepted by the FAA under FAR Part 150 on September 10, 1987. The third map (Figure 4.6.1.a.) was adopted as the primary basis for the recommended noise compatibility program according to land use compatibility guidelines of FAR Part 150.

Areas in residential use exposed to aircraft noise levels of Ldn 75 dB and above based on the third map were identified as priority candidates of inclusion in the noise compatibility program (Table 4.6.1.a.).

Table 4.6.1.a. Estimated Land Areas, Population and Housing Units Exposed to Forecast Aircraft Operations between 2001 and 2010

	Off-airport (acres)	On-airport (acres)	Total (acres)	Housing Population	Housing units
>= Ldn 75	2,860	2,860	5,720	4,320	1,390
>= Ldn 70	6,010	460	6,470	27,550	9,550
>= Ldn 65	12,180	410	12,590	51,250	18,430
Total: Ldn 65 and above	21,150	3,730	24,780	83,120	29,370

(Source: Peat, Marwick, Mitchell & Co. Noise Compatibility Program Memphis International Airport, (Oct. 1986) p. 14, 15.)

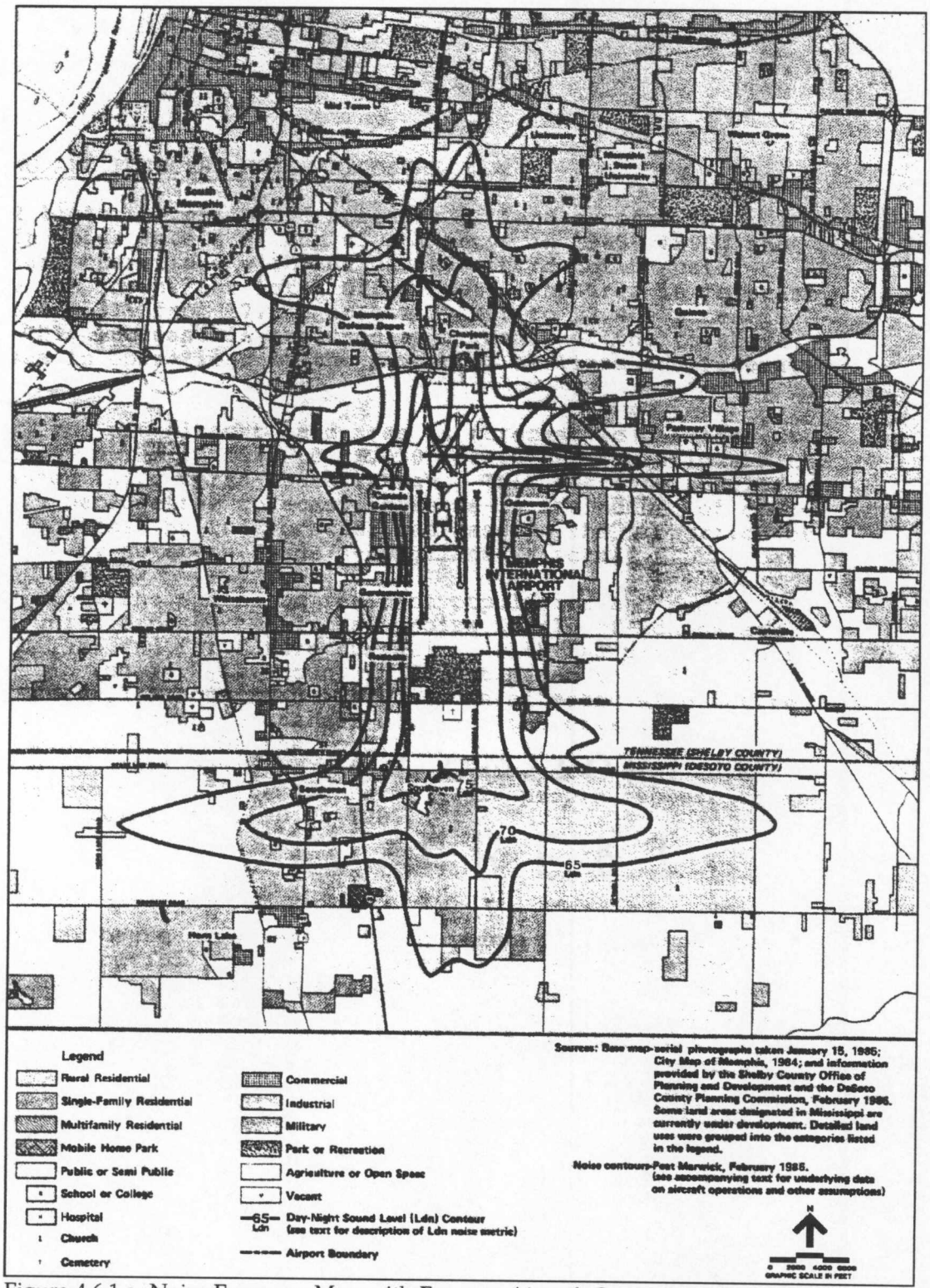


Figure 4.6.1.a. Noise Exposure Map with Forecast Aircraft Opration with the Planned Third North-South Runway between 2001 and 2010. (Source: Peat, Marwick, Mitchell & Co., Noise Compatibility Program Memphis International Airport, (Memphis: Memphis-Shelby County Airport Authority, Oct. 1986) Exhibit 3.)

4.6.2. Property Acquisition Program

The Authority employed a voluntary relocation program and provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 for the property acquisition that implemented the Noise Compatibility Program. The implementation included:

- Identification of areas eligible for acquisition,
- Door-to-door Survey,
- Input from the Noise Compatibility Committee,
- Voluntary offering of eligible properties from a property owner,
- Appraise of the properties by the Airport Authority, and
- Purchasing the properties.

Figure 4.6.2.a. shows the status history of the property acquisition program. In the Spring of 1987, the Airport Authority identified an eligible property acquisition area which contained approximately 1,300 dwelling units there. Five years later, the increase in the number of eligible properties leveled off at 1,362. Approximately 90 percent of the eligible properties applied

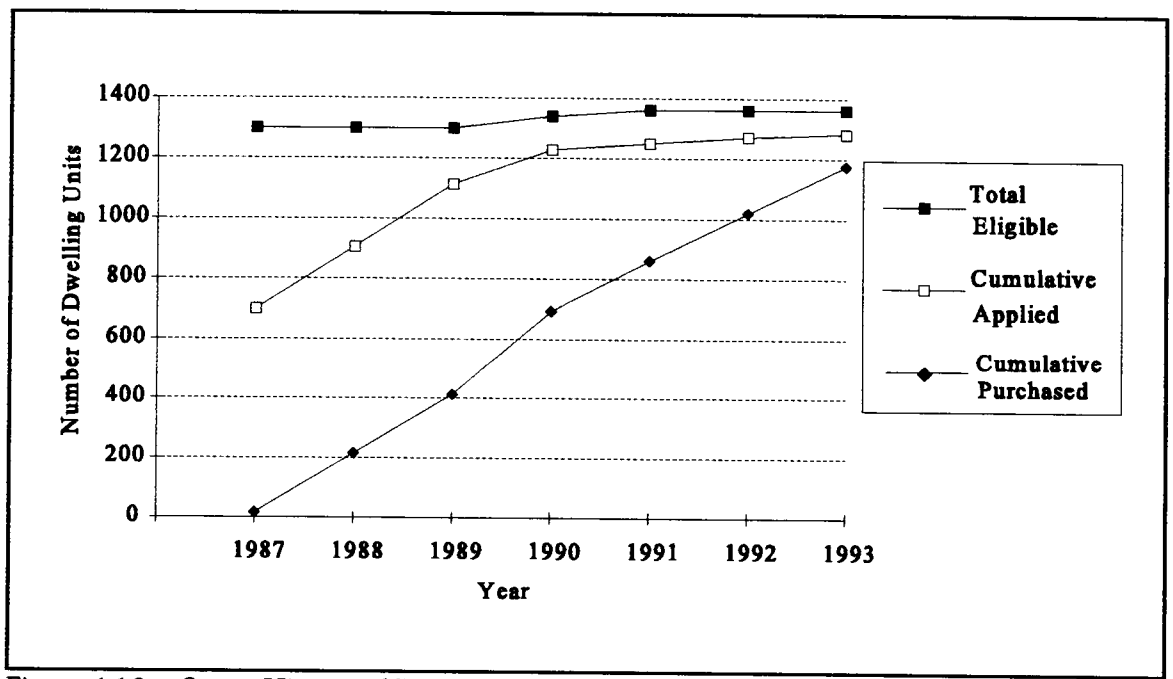


Figure 4.6.2.a. Status History of Property Acquisition Program. (Data source:FAA, "Noise Compatibility Newsletter," (1987-1993).)

to the program by 1990. By 1993, seven years after the program began, only 6 percent (78) of the eligible properties had yet to apply. The Airport Authority expected to be able to purchase an average of 20 properties per month,[293] in fact, 150 to 280 properties have been purchased each year.

4.6.3. Fund Sources for Property Acquisition

Funding for the property acquisition program consists of three sources. 8 percent of the funding is financed in part through an Airport Improvement Program grant from the FAA in accordance with the requirements of FAR Part 150, "Airport Noise Compatibility Planning." Ten percent of it is financed from the Transportation Equity Fund of the State of Tennessee. Ten percent is financed from the Airport Authority. To allow the program to begin without delay, the Airport Authority raised $20 million by issuing bonds which are repaid through airline fees and other airport revenue.[294] Since the acquisition program began, the following funding has been received for the program, as of February 1994:

	Amount	Share
FAA A.I.P.	$72,354,225	73%
State Grants	$3,886,225	4%
Airport Sponsor	$20,000,000	20%
Interest Earned	$2,814,001	3%
Total	$99,054,626	100%

[293] Airport Authority, "Noise Compatibility Newsletter," (October/November, 1987).

[294] Airport Authority, "Noise Compatibility Newsletter," (Winter, 1989/1990).

4.6.4. Identification of Acquisition Area

The priority candidate areas for the Noise Compatibility Program were chosen initially for acquisition areas. The boundaries for these areas were then extended to the end of each block to avoid breaking up neighborhood streets. The residential characteristics of the remaining neighborhood areas were also factors in determining the location of the boundary. For instance, the Ldn 75 dB contour line as a first boundary was depicted on aerial photos. If the first boundary was not on roads, a second boundary is extended to the roads. Furthermore, a third boundary is extended to homes if there were homes which face the homes within the second boundary. However, a home facing the boundary streets or on the corners is not included to prevent homes just outside the acquisition areas from facing the acquisition areas or from being isolated.[295]

Figure 4.6.4.a. shows eligible acquisition areas of Charjean Park on the north of MEM.

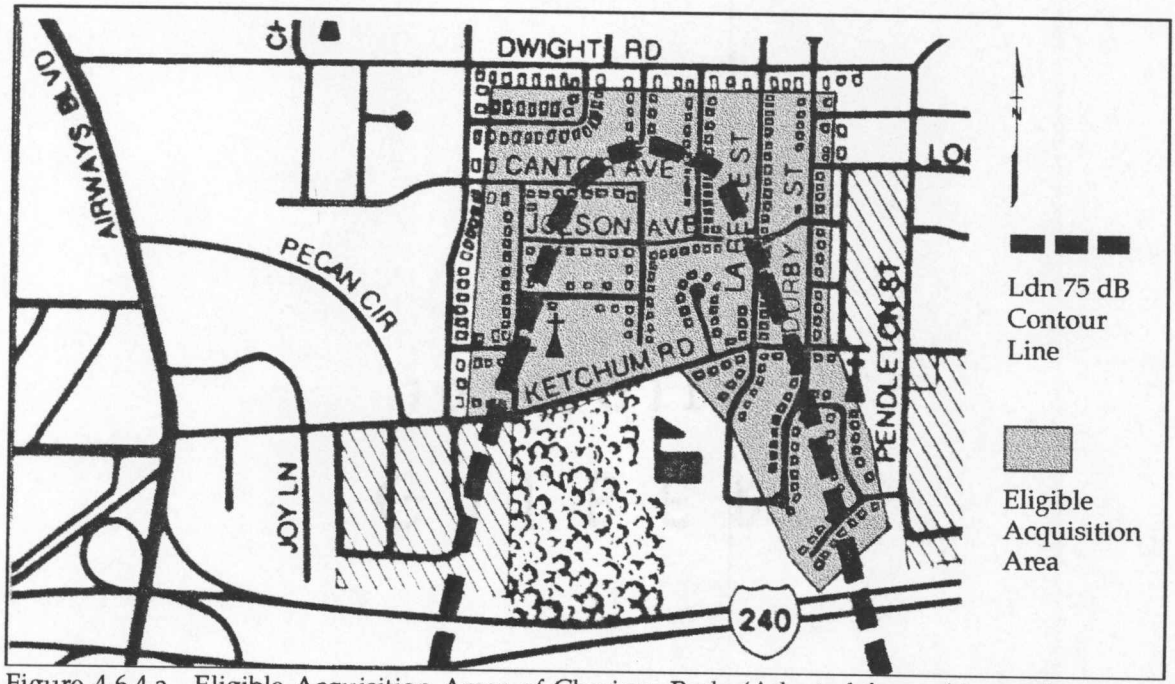


Figure 4.6.4.a. Eligible Acquisition Areas of Charjean Park. (Adapted from: Airport Authority, "Noise Compatibility Newsletter," (Spring 1990).)

[295]Airport Authority, "Noise Compatibility Newsletter," (May/June 1987).

The park is located directly north of the airport complex. This area includes approximately 340 homes. The area is bounded by Dwight on the north and Imogene on the west. The south boundary is Ketchum and the east boundary is Durby. The remaining portion of the area is south of Ketchum and located between Airways Junior High and McLemore Church.[296]

The number of all properties eligible for acquisition was 1,362 dwelling units in February 1994.

4.6.5. Neighborhood Survey

The Airport Authority conducted in-home interviews at 987 single-family homes in the acquisition area for the Noise Compatibility Program in 1987.

Residents were asked what time of the day or night they think the aircraft noise is worse. Out of all residents asked, 55% think aircraft noise in worse between 2 a.m. and 7 a.m., when most Federal Express planes takeoff; 44 percent think aircraft noise is worse between 5 p.m. and 10 p.m. when many passenger planes land and takeoff.

More than two out of three airport area residents (68%) strongly agree that some homes were too close to the airport and the best thing for these homeowners to do is to sell their homes and move to a quieter neighborhood.[297]

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[296] Airport Authority, "Noise Compatibility Newsletter," (Spring 1990).

[297] Airport Authority, "Noise Compatibility Newsletter," (Mar. 1987).

4.7. Zoning

4.7.1. First Airport Zoning

The first airport zoning was adopted in Memphis in 1941. This zoning has a solid basis in public safety. The regulations controlled land use and conformed height of structure. The zoning had airport districts and airport glide districts. Later amendments were made as runways were extended, and the slope of the glide angle was flattened from 1:30 to 1:50 to conform with the takeoff and landing characteristics of the more modern aircraft.[311]

4.7.2. Recommended Zoning in 1955 and Adopted Zoning in 1962

A Shelby County planning consultant recommended zoning inside the "Sound Boundary" in 1955 (Figure 4.7.2.a.). The time was the study period for the north-south runways. However, the zoning was not adopted.[312] Figure 4.7.2.b. shows the actual zoning of 1962.

Table 4.7.2.a. gives a comparison of the recommended zoning and the adopted zoning.

Table 4.7.2.a. Area Comparison between Recommended Zoning and Adopted Zoning inside "Sound Boundary"

Zoning Districts	Recommended in 1955 acres	%	Adopted in 1962 acres	%	Difference %
Residential (R, R-1, R-1-A, R-2, R-3, R-4-A, and R-C)	3,482	42.4%	5,362	65.4%	+23.0%
Commercial (C-1, C-2 and SC-1)	131	1.6%	235	2.9%	+1.3%
Industrial (M-L, M-1, and M-3)	1,581	19.3%	2,267	27.6%	+8.3%
Agricultural	2,293	28.0%	17	0.2%	-27.8%
Flood	713	8.7%	319	3.9%	-4.8%
Total Area	8,200	100%	8,200	100%	

(Adapted from: Memphis Shelby Co. Planning Commission, Study of Memphis Municipal Airport and Environs, 1962)

[311] Memphis and Shelby County Planning Commision, Study of Memphis Municipal Airport and Environs, (1962) p. 2.

[312] Ibid, p. 20.

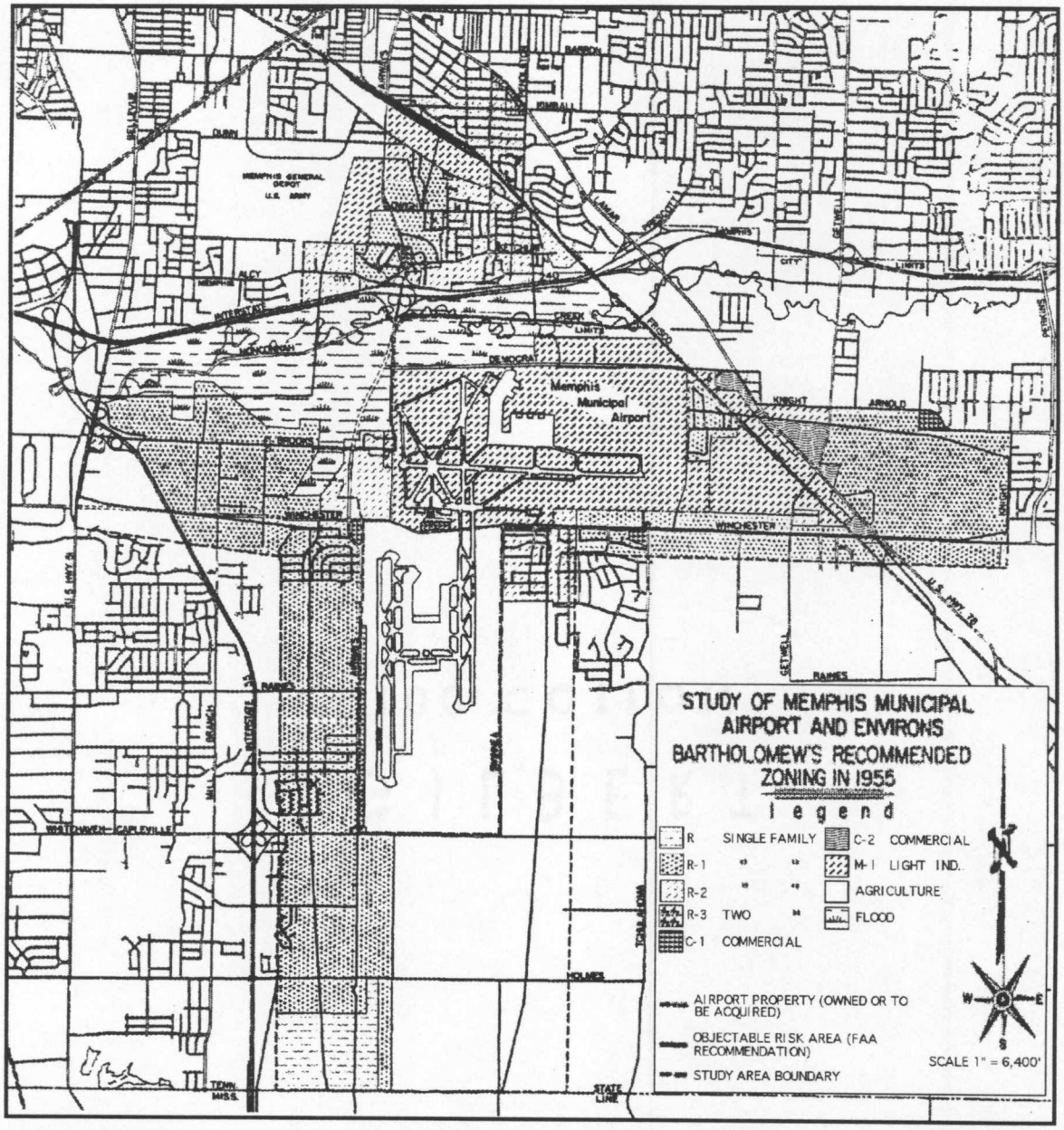


Figure 4.7.2.a. Recommended Zoning in 1955. (Source: Memphis and Shelby Co. Planning Commission, Study of Memphis Municipal Airport and Environs, (1962).)

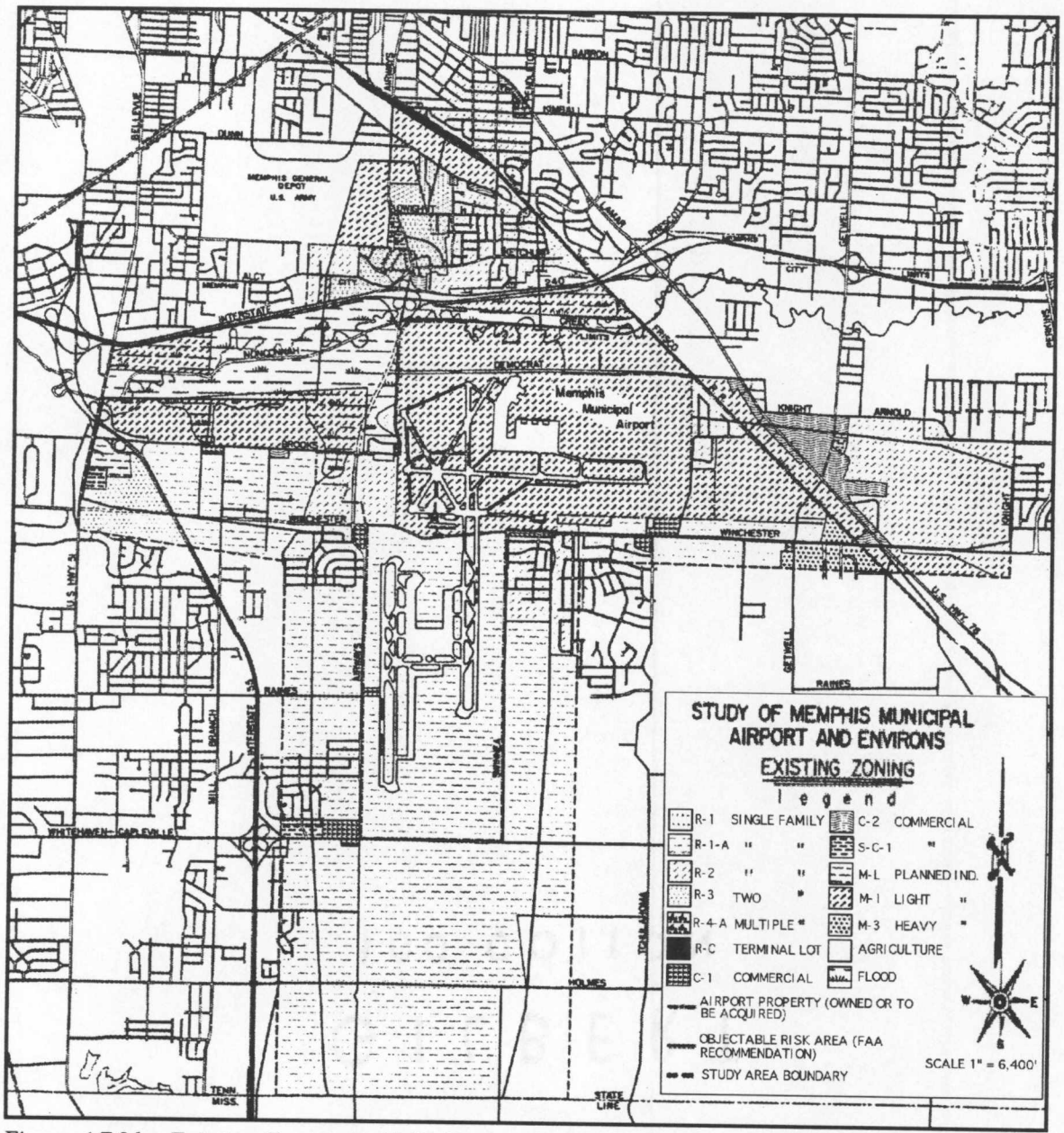


Figure 4.7.2.b. Existing Zoning in 1962. (Source: Memphis Shelby Co. Planning Commission, Study of Memphis Municipal Airport and Environs, (1962).)

Residential district area in the adopted zoning was 23.0 percent more than that in the recommended zoning. On the other hand, agricultural district area in the adopted zoning was 27.8 percent less than that in the recommended zoning.

4.7.3. Rezoning for New Runway 18E-36E (1989-1992)

According to rezoning records of Memphis and Shelby County, the Airport Authority applied for two rezoning, two planned developments and one special use for new Runway 18E-36E during 1989 to 1992 (Figure 4.7.3.a.).

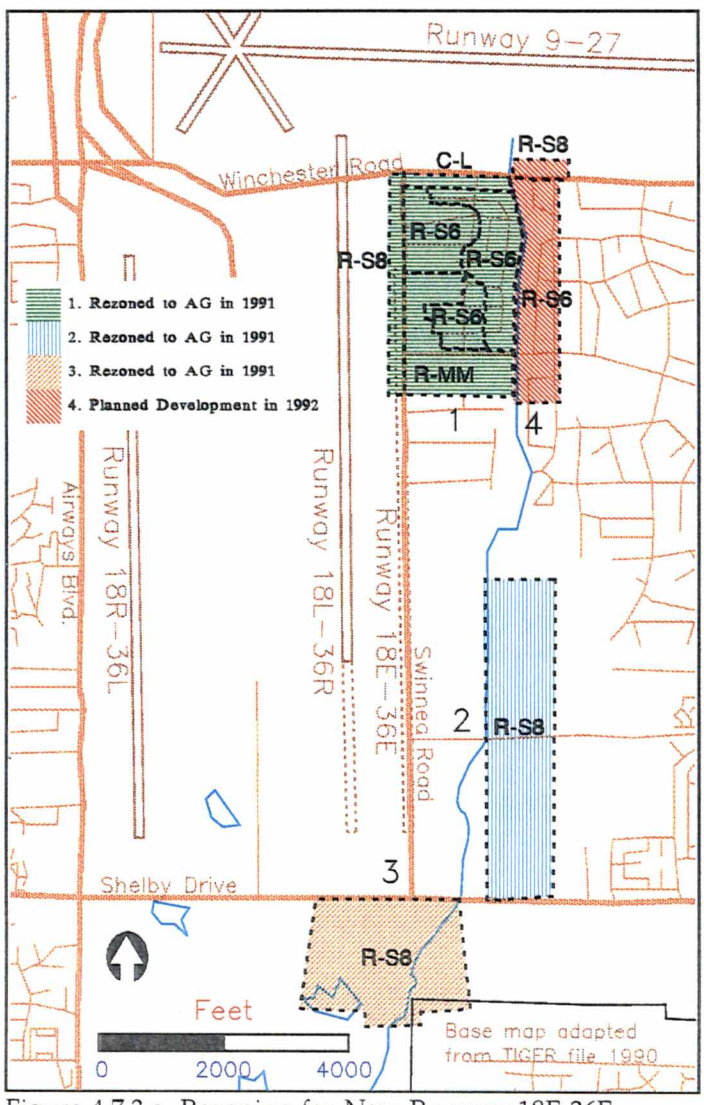


Figure 4.7.3.a. Rezoning for New Runway 18E-36E

1. Area south of Winchester Road and east of the airport boundary. Multiple Dwelling Residential District (R-MM) area in the area one was requested planned development for aviation facility in 1989 (PD89-370). However, the application was canceled because of no action after the application. Then, the area one was rezoned to Agricultural District(AG) in October 1991 (Z91-135). In addition, the area was requested planned development in 1992 with the area four (PD92-341).

2. Area east of the airport boundary and north of Shelby Drive. The area two was rezoned

from Single Family Residential District (R-S8) to Agricultural District (AG) in November 1991 (Z91-136).

3. Area south of the airport boundary was rezoned from R-S8 to AG for special use of the airport in November 1991 (SUP91-251).

4. Area east of Swinnea Road was requested planned development for aviation facility with the area one in 1992 (PD92-341) and approved in February 1994.

4.7.4. Generalized Existing Zoning Map in Airport Study Area

The 1993 Memphis and Shelby County Zoning Ordinance had twenty-four zoning districts and seven overlay districts (Flood Plain District, two Historic Districts and four Airport Hazard Zones). The 1989 City of Southaven Zoning had fifteen zoning districts. The 1994 City of Horn Lake Zoning had twenty zoning districts. The 1990 DeSoto County Zoning had 14 zoning districts. Although the City of Southaven, the City of Horn Lake and DeSoto County have overlay Airport Hazard Zones, those zones are not drawn on their zoning map. Each zoning district except overlay zones was generalized by the following criteria for the following Generalized zoning map in the Airport Study Area (Figure 4.7.4.a.).

Memphis and Shelby County

Agricultural - Agricultural District (AG)

Low Density Residential - Four Single Family Residential Districts (R-S15, R-S10, R-S8, and R-S6) and Duplex Residential District (R-D)

Multi-Family Residential - Four Multiple Dwelling Residential Districts (R-TH, R-ML, R-MM and R-MH) and Mobile Home District (R-MO)

Commercial and Office - Two Office Districts (O-L, and O-G) and Three Commercial Districts (C-L, C-H and CBD)

Light Industrial - Light Industrial District (I-L)

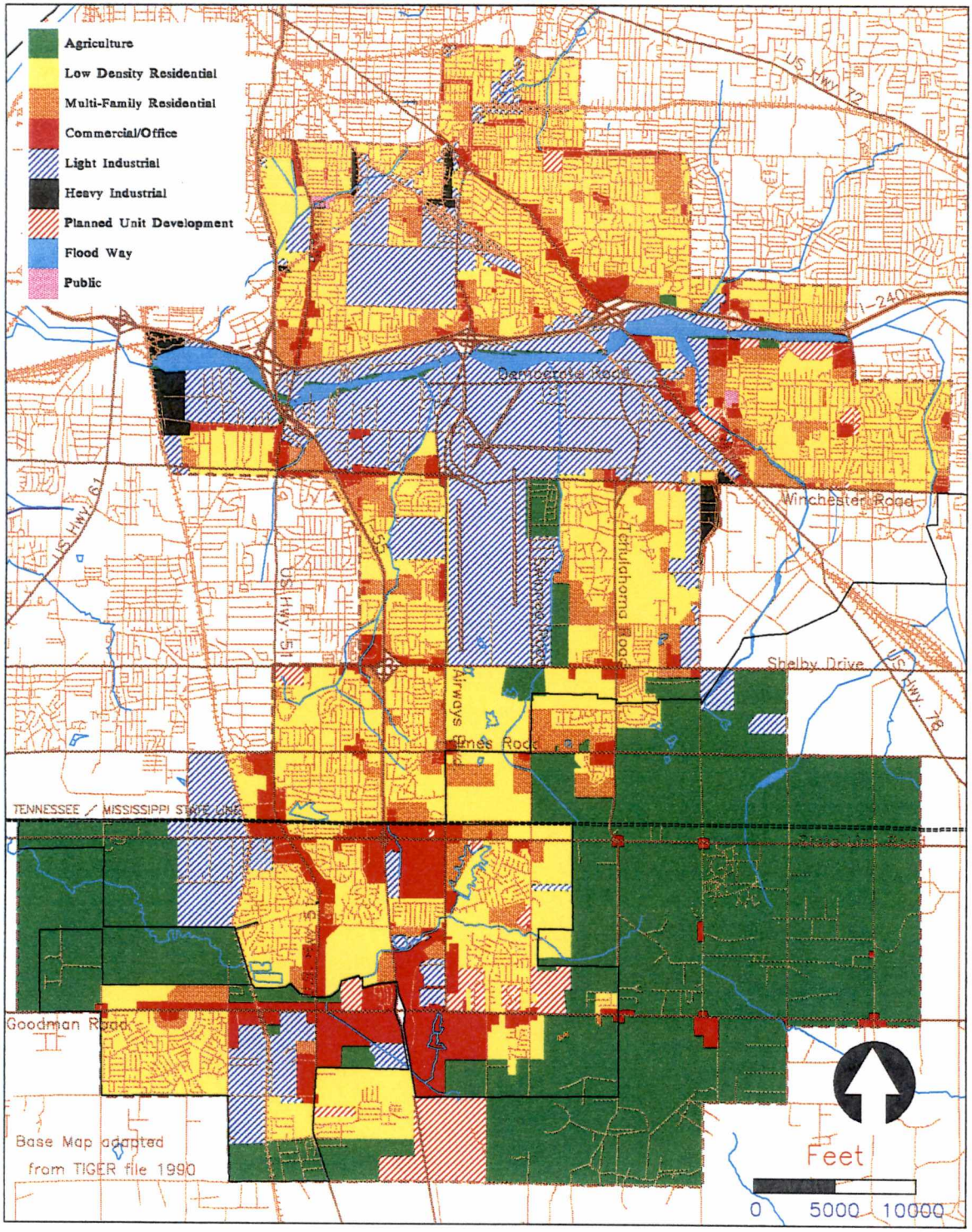


Figure 4.7.4.a. Generalized Existing Zoning Map in Memphis Airport Study Area

Heavy Industrial - Heavy Industrial District (I-H)

Flood Way - Flood District (FW)

Planned Unit Development - Planned Commercial District (C-P)

Others - Hospital District (H), College and University District (CU), Parking District (P) and SMSD (South Main Special District)

City of Southaven

Agricultural - Agricultural (A) and Agricultural-Residential (A-R)

Low Density Residential - Two Single Family Residential (R-1 and R-2)

Multi-Family Residential - Two Multiple Family Residential (R-3 and R-4)

Commercial and Office - Neighborhood Commercial (C-1), Highway Commercial (C-2), General Commercial (C-3) and Office (O)

Light Industrial - Light Industrial (M-1)

Heavy Industrial - Heavy Commercial (M-2)

Planned Unit Development - Planned Commercial (C-4) and Planned Unit Development (PUD)

City of Horn Lake

Agricultural - Agricultural (A) and Agricultural-Residential (AR)

Low Density Residential - Seven S/F Residential (R-40, R-30, R-20, R-15, R-12, R-10 and R-8)

Multi-Family Residential - Two Multi-Family Districts (RM-8 and RM-6)

Commercial and Office - Neighborhood Commercial (C-1), Highway Commercial (C-2), General Commercial (C-3) and Office (O)

Light Industrial - Light Industrial (M-1)

Heavy Industrial - Heavy Industrial (M-2)

Planned Unit Development - Planned Commercial (C-4), Planned Office (PO) and Planned Unit (PUD)

Desoto County

Agricultural - Agricultural (A) and Agricultural-Residential (AR)

Low Density Residential - Two Single Family Residential (R-1 and R-2)

Multi-Family Residential - Two Multiple-Family Residential (R-3 and R-4)

Commercial and Office - Neighborhood Commercial (C-1), Highway Commercial (C-2) and General Commercial (C-3) and Office (O)

Light Industrial - Light Industrial (M-1)

Heavy Industrial - Heavy Industrial (M-2)

Planned Unit Development - Planned Commercial (C-4) and Planned Unit Development (PUD)

Areas west, south and east of MEM are mostly in a Low Density Residential zone. However, areas along major street corridors in vicinity of MEM are occupied by Multi-Family Residential and commercial/office zones. In the City of Southaven, areas along Interstate 55 and U.S. Highway 51 are zoned as Commercial/Office use. Areas nearby the State line and east of Interstate 55 are Commercial/Office and Multi-Family Residential Use. In DeSoto County, most areas are agricultural and rural residential zones.

4.8. Land Use

4.8.1. Residential Expansion

At the beginning, the airport site was placed in an undeveloped area. While MEM was growing, the City of Memphis was growing. In addition, transportation systems, especially roads, were expanded outside of the city. Residential areas developed along highways and corridors. By 1964, residential land use had reached MEM. By 1975, MEM had been surrounded by residential development.

MEM had been a part of Ward Farm before it was dedicated in 1929. There was no residential development in the vicinity.

Generalized Land Use in Shelby County 1938 (Figure 4.8.1.a.) shows that MEM was two miles (3.2 km) away from the developed area of the City of Memphis in 1938. Most of the

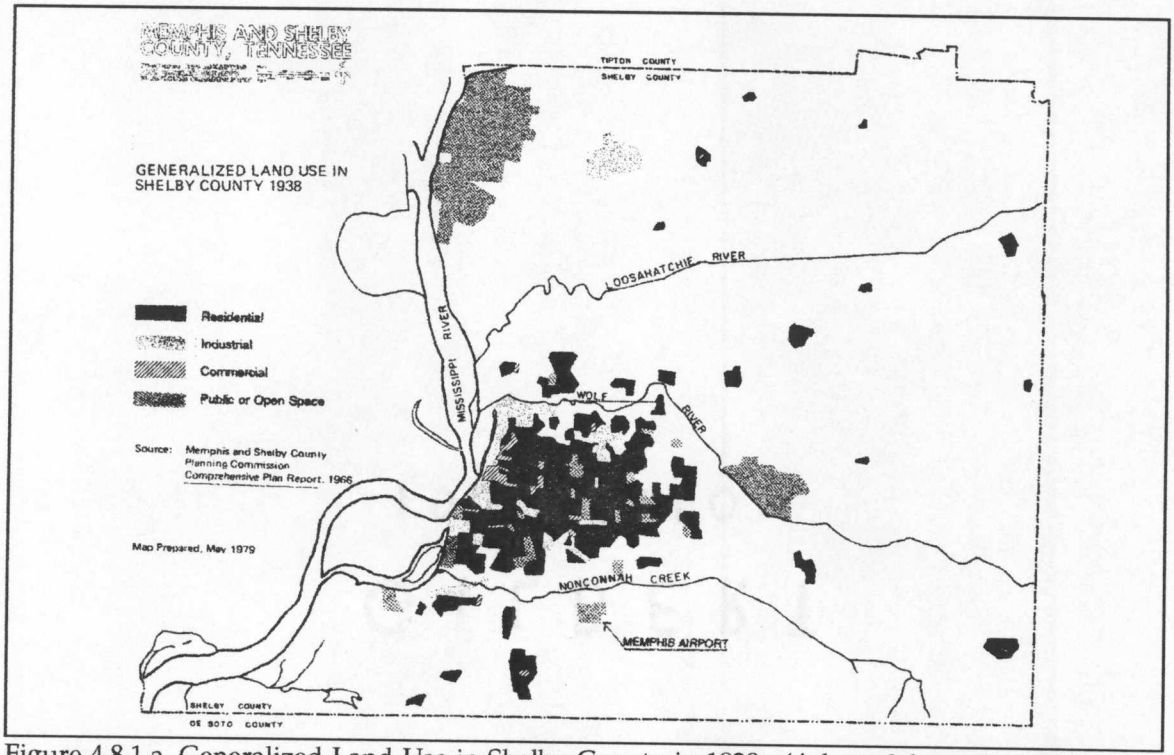


Figure 4.8.1.a. Generalized Land Use in Shelby County in 1938. (Adapted from: Memphis and Shelby Co. Office of Planning and Development, Memphis 2000 Land Use Background Report, (1979) p. 6.)

development areas were between Wolf River and Nonconnah Creek. Nonconnah Creek protected MEM from development in the vicinity of MEM. However, six isolated pockets of residential development showed up south of Nonconnah Creek and west of MEM. Two of them were along U.S. Highway 51, three miles (4.8 km) west of MEM. At the time, MEM had Runway 3-21 3,400 feet (1,034m) long, Runway 14-32 3,400 feet long and Runway 9-27 5,280 feet (1,605 m) long.

Between 1938 and 1953, Interstate 55 one mile west of MEM and South Interstate 240, a half mile north of MEM, were constructed. Generalized Land Use in Shelby County 1953 (figure 4.8.1.b.) shows that three small portions of residential development showed up near the entrance of MEM by 1953. According to Memphis 2000 Land Use Background Report, between 1938 and 1953 the developed area of Memphis nearly doubled, urban development traversed Nonconnah Creek and a community in the fringe of Whitehaven was established in the area along U.S.

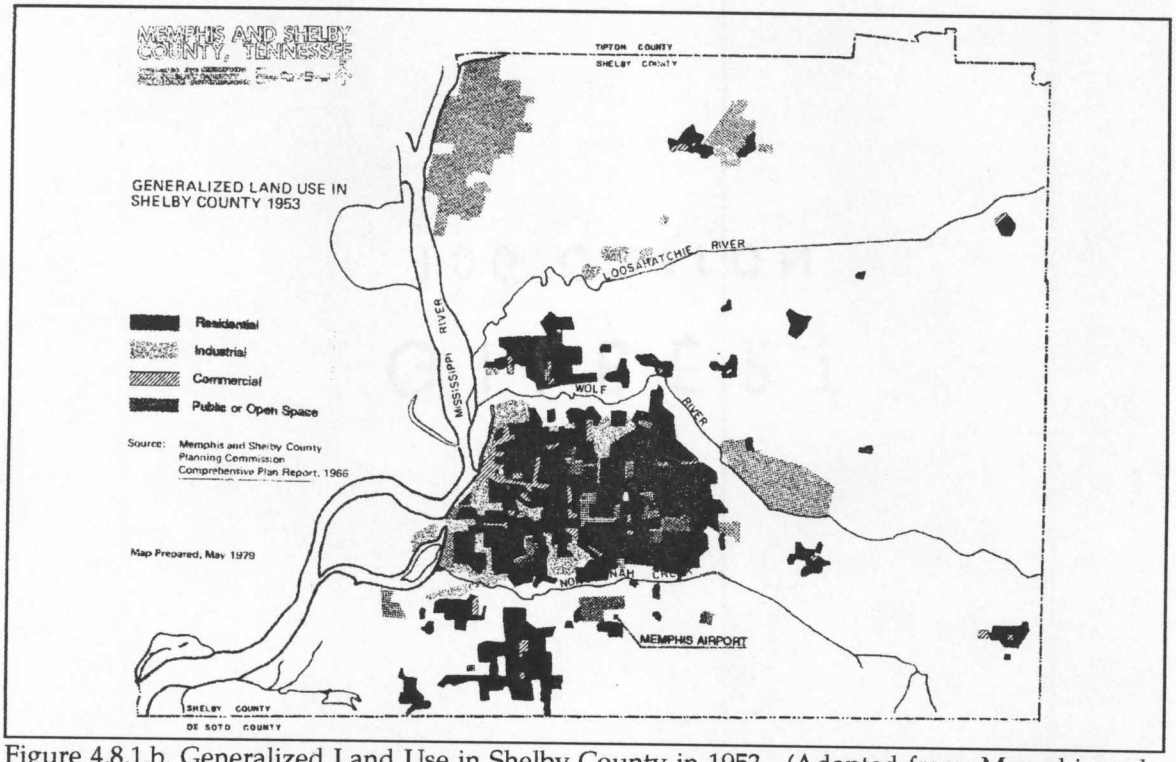


Figure 4.8.1.b. Generalized Land Use in Shelby County in 1953. (Adapted from: Memphis and Shelby Co. Office of Planning and Development, Memphis 2000 Land Use Background Report, (1979) p. 7.)

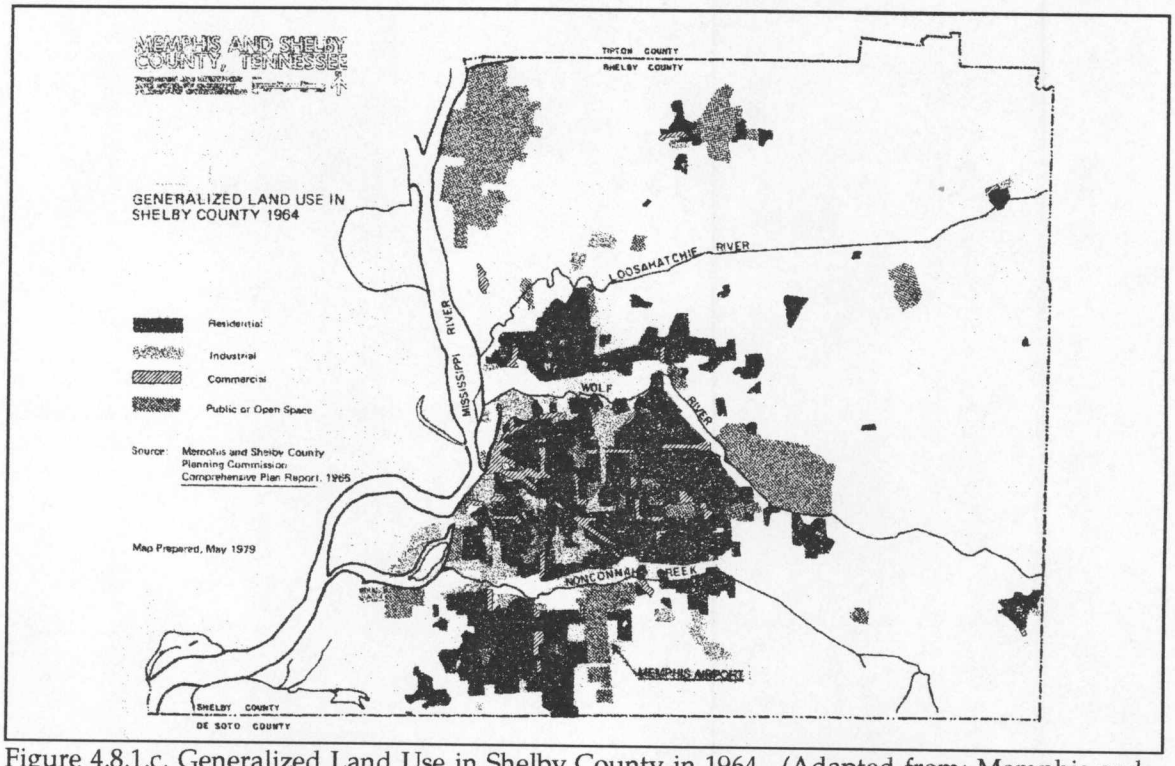


Figure 4.8.1.c. Generalized Land Use in Shelby County in 1964. (Adapted from: Memphis and Shelby Co. Office of Planning and Development, Memphis 2000 Land Use Background Report, (1979), p. 13.)

Highway 51. Interstate 55 on south of Nonconnah Creek was developed as residential. The area on north of Nonconnah Creek was almost developed. There were three isolated residential areas south of Nonconnah Creek and within two miles (3.2 km) east of MEM. During the period, north-south Runway 17-35, 4,968 feet (1,510 m) long, was constructed. In 1947, MEM proposed to expand the runways to eastward and build a new airlines terminal at the east corner of MEM.

Generalized Land Use in Shelby County 1964 (Figure 4.8.1.c.) shows that the area of west of MEM has been filled with residential by 1964. The north area of MEM was completely developed. Residential and industrial showed up on the east side of MEM. Some residential along U.S. Highway 51 south of Nonconnah changed to commercial strip. Residential uses near the entrance of MEM were also replaced by commercial uses. The area west of the middle of MEM remained vacant because the area was a clear zone of northeast-southwest Runway 3-21, 5,800 feet (1,763 m) long. MEM expanded toward the south. In 1962, north-south Runway 17-35,

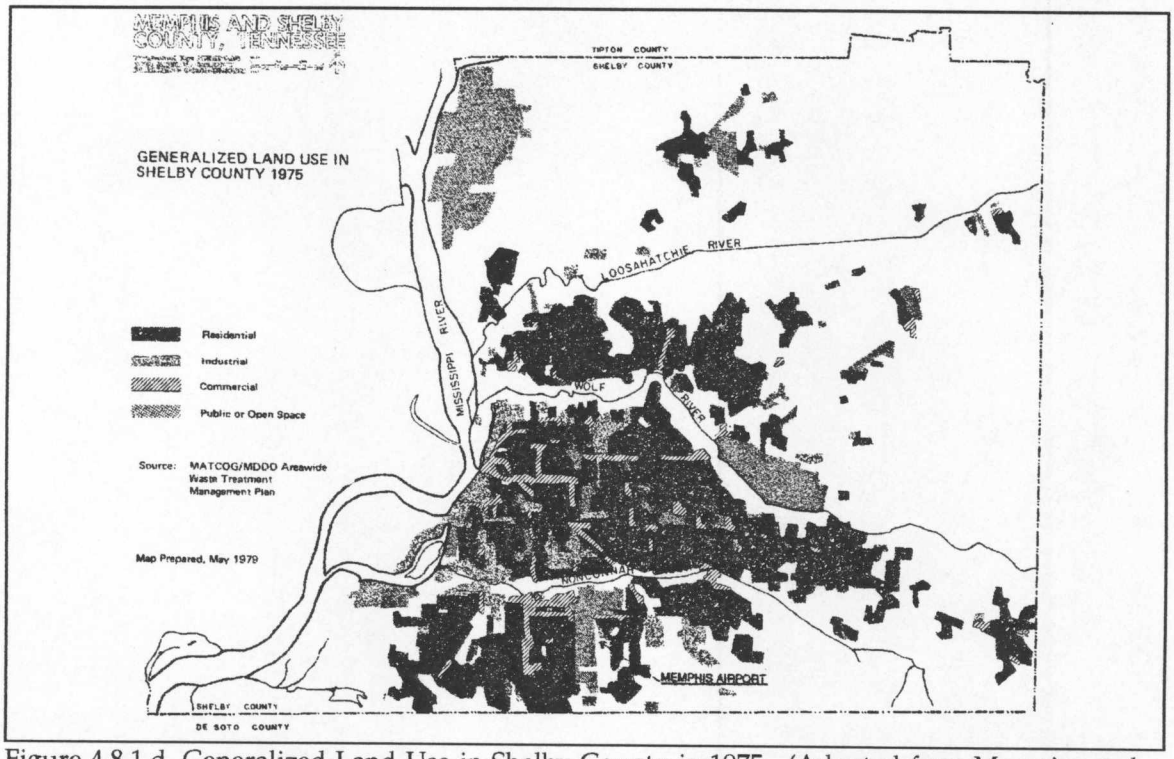


Figure 4.8.1.d. Generalized Land Use in Shelby County in 1975. (Adapted from:Mempjos and Shelby Co. Office of Planning and Development,Memphid 2000 Land Use Background Report, (1979),p. 15.)

8,400 feet (2,554 m) long, was constructed. The next year, a new terminal building was dedicated.

Generalized Land Use in Shelby County 1975 (Figure 4.8.1.d.) shows that the surroundings of MEM have been almost developed by 1975. The vicinity of Winchester Road between the south corner of MEM and U.S. Highway 51 and three quarters of U.S. Highway 51 from the south of Nonconnah Creek changed to a commercial strip. A commercial strip showed up the vicinity of Democrat Road between the west corner of MEM and U.S. Highway 51. In 1973, the second north-south runway 18R-36L was opened.

4.8.2. Existing Land Use of Memphis Airport Area

Figure 4.8.2.a. shows the generalized existing land use within the Airport environs. The area depicted was part of a defined "study area" used in the development of the off-Airport land use study sponsored by the City of Memphis, City of Southaven, City of Horn Lake, Shelby

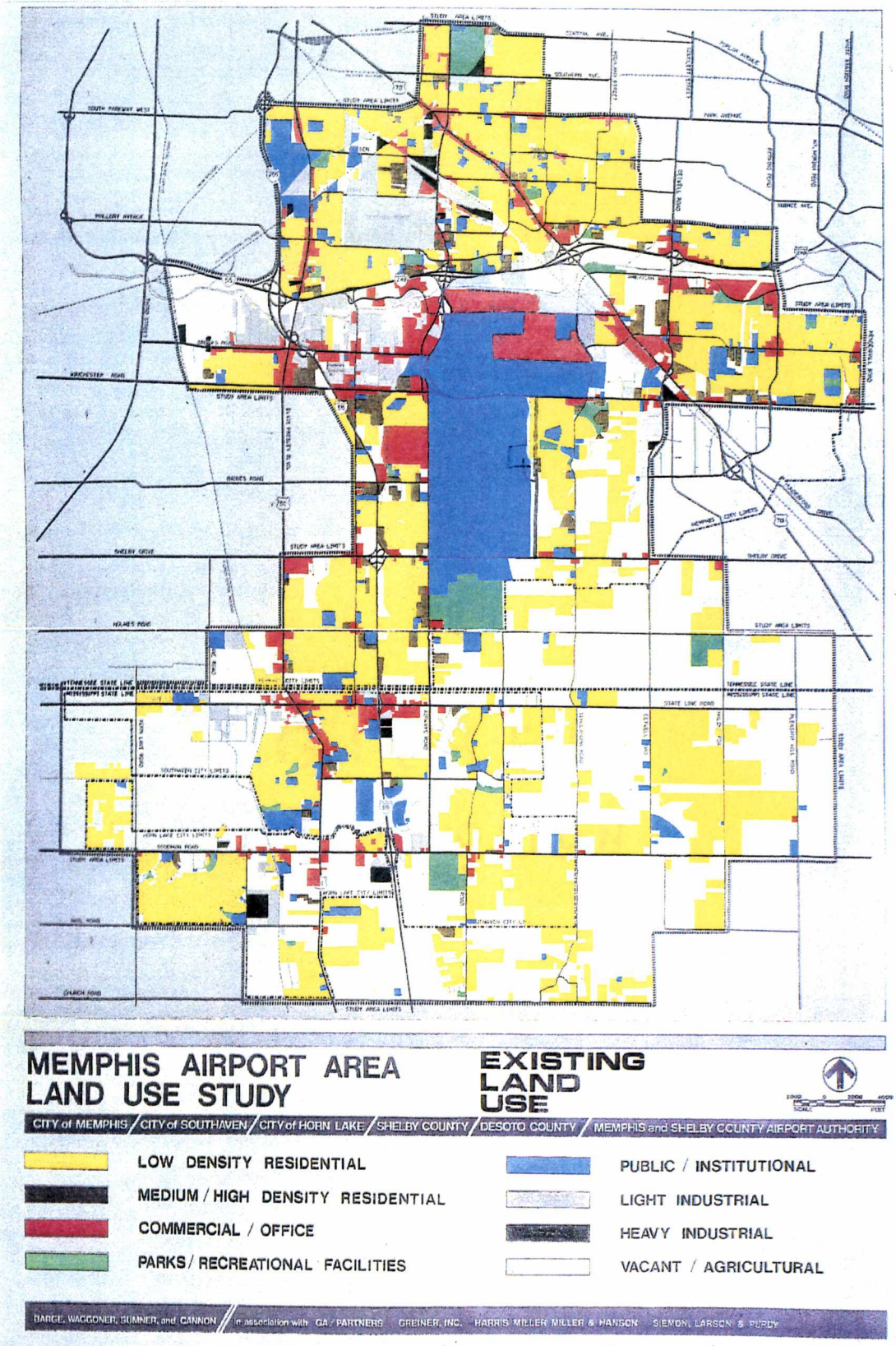


Figure 4.8.2.a. Generalized Existing Land Use of Memphis Airport Area. (Source: Barge, Waggoner, Sumner & Cannon, Memphis Airport Area Land Use Study, Inventory & Analysis, Memphis: Memphis-Shelby County Airport Authority, (1989) Map 5-1.

County, and DeSoto County, using funding from the Airport Authority. The land uses shown on the figure were identified and mapped in 1989 as part of study.[321]

The study area encompassed 57,270 acres (Table 4.8.4.a.). The Tennessee part, Memphis and Shelby County, occupied 33,060 acres (57.7%) of the study area. Residential uses were the predominant land use in the development portion of the study area. These in the Memphis area were 9,170 acres, Southaven 2,930 acres and DeSoto County 2,900 acres. Almost commercial and industrial uses were presented in Memphis. Thirty seven percent of the study area was undeveloped area. DeSoto County had 8,000 acres of undeveloped area, the largest portion in the five jurisdictions.

Table 4.8.2.a. Existing Land Uses in Memphis Airport Area (unit: acre)

Land Use Category	Memphis	Shelby County	Southaven	Horn Lake	DeSoto County	Total
Residential	9,170	910	2,930	1,100	2,900	17,010
Commercial	1,350	0	270	110	-	1,730
Office	400	-	40	0	-	440
Industrial	2,700	180	200	210	30	3,320
Public Lands	5,370	180	670	120	390	6,730
Roads & R.O.W.	4,740	300	800	300	650	6,790
Undeveloped	4,940	2,820	3,660	1,830	8,000	21,250
Total Area	28,670	4,390	8,570	3,700	11,940	57,270
percent residential	32.0	20.7	34.2	29.7	24.3	29.7
percent undevelopment	17.2	64.2	42.7	49.5	67.0	37.1

(Source: Barge, Waggoner, Sumner and Cannon Land Use Survey, (February and March 1989).)

The inventory indicates the following things. The area between MEM and Nonconnah Creek was occupied by commercial and office uses and was developed completely. North of South Interstate 240 was developed with residential use. The area west of MEM and between Winchester Road and the State line was predominantly in residential use. Mississippi south of MEM was occupied by residential use. However, a half of the Mississippi area was undeveloped.

[321] FAA, Final Environmental Impact, (1993).

4.8.3. Future Land Use

The Cities of Memphis, Southaven and Horn Lake, and Shelby and DeSoto Counties have cooperated in a regional land use study to determine the future of the area surrounding the MEM. A land use plan for the airport study area was coordinated in 1990 after an inventory and an analysis of existing conditions were conducted in 1989 and three alternative plans were evaluated in 1990. The land use plan recommendations were depicted on the Future Land Use map (Figure 4.8.3.a.) The recommendations and map are for the 20-year planning period ending in 2010. In general, the plan recommended the protection of established, low-density neighborhoods from encroachment of commercial and industrial uses. The plan also recommended that residential uses along major roads not be converted to strip commercial use. Commercial activity centers were identified on the map to serve the residential and employment areas. In developing areas, the future use of vacant land has been established to be compatible with existing development, as well as to provide for future growth needs of the community.[322]

The Future Land Use plan of 1990 was updated in 1993 (Figure 4.8.3.b.) The primary change in the updated version of the land use map is the increase in residential density planned for area in Southaven. The Land Use Plan had originally recommended that the area east of Swinnea Road and south of State Line Road be developed in rural residential uses to minimize the number of houses in that area exposed to significant aircraft noise levels. The area was already developing with single-family residences and it was thought that the plan to develop the area with rural residential uses would minimize the potential incompatibility with MEM operations and yet be consistent with DeSoto County's need for residential development. However, this plan was determined to fall short of the County's needs and the land use was changed to allow the area to be built at 3.5 dwelling units per acres. The final land use plan has

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[322] Barge, Waggoner, Sumner & Cannon, Memphis Airport Area Land Use Study, Final Plan, (1990).

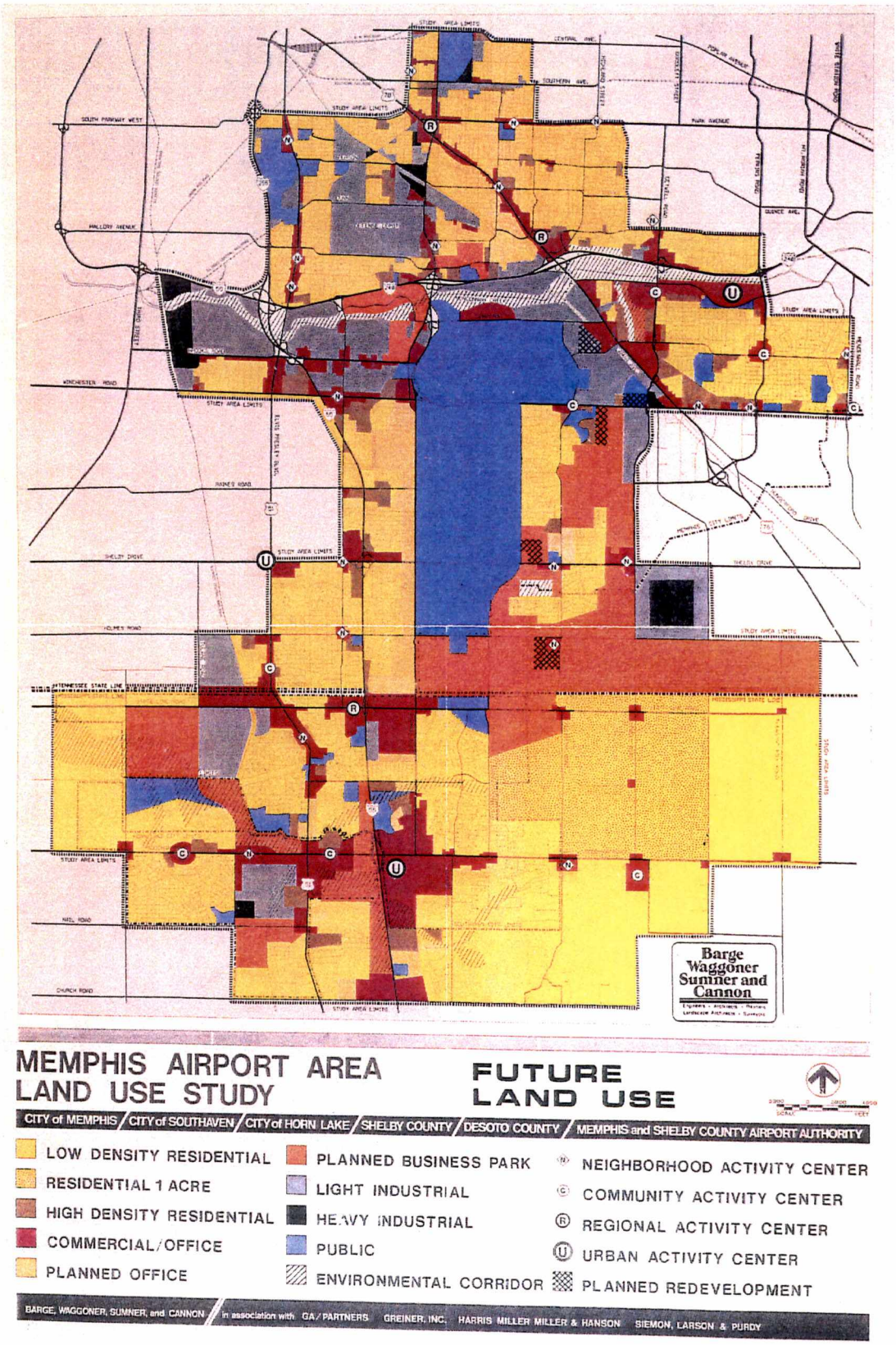


Figure 4.8.3.a. Future Land Use of Memphis Airport Area as of 1990. (Source: Barge, Waggoner, Sumner & Cannon, Memphis Airport Area land Use Study, Final Plan, Memphis: Memphis-Shelby County Airport Authority, (1990)

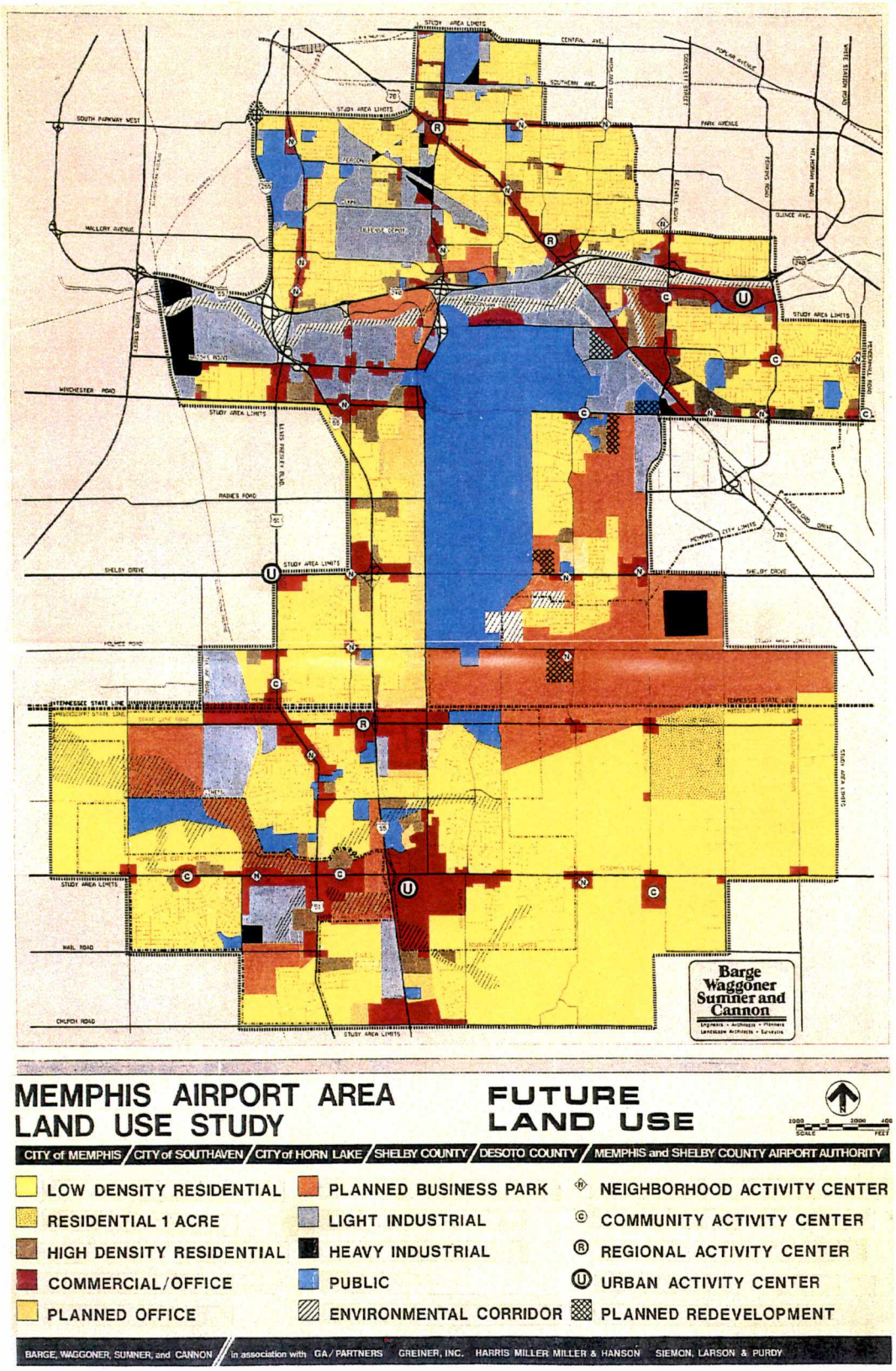


Figure 4.8.3.b. Future Land Use of Memphis Airport Area as of 1993. (Source: FAA, Final Environmental Impact Statement - Memphis International Airport, Memphis: Department of Transportation, (Mar. 1993) v. 1 Exhibit 5-29.

been updated to reflect this change.[323]

The major features of the plan include:

1. Development of the "buyout area" west of Airways Boulevard into planned office uses
2. Conversion of the Charjean Park neighborhood (east of Airways Boulevard, south of Dwight Road, and north of Interstate 240) into planned business park uses.
3. Conversion of the area east of Swinnea Road and north of State Line Road into noise-compatible uses.
4. Conversion of the buyout area in the Greenbrook subdivision of Southaven into a public use area. (Generally - Planned Business Park)

The land use plan was

accepted by DeSoto County, Mississippi, in December 1991,

adopted by the City of Horn Lake, Mississippi, in June 1991,

adopted by Shelby County, Tennessee, in June 1992.

adopted by the City of Memphis, Tennessee, in August 1992, and

not adopted by the City of Southaven, Mississippi.

Three jurisdictions, the City of Memphis, DeSoto County and the City of Southaven showed different reaction for the land use plan. The three jurisdictions are the closest to MEM.

According to a manager of Plans Development of the City of Memphis, the delay in the adoption of the future land use plan for the City of Memphis was due to concerns expressed by residents of the Airport Study Area during the Public Hearings before the Memphis City Council and Shelby County Commission. A number of the residents were concerned with the amount of traffic that would be attracted to the Planned Office and Business Park areas and would subsequently use the minor residential streets as short cuts to and from these sites. Both the City Council and County Commission asked the Office of Planning and Development and the City Engineering Department to hold additional meetings in the affected neighborhoods to try to reach

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[323] FAA, Final EIS, (1993).

a compromise. The compromise left the recommended land use in place but made significant changes to the transportation plan. The recommendations to add lanes to the Major Roads serving these employment areas were put on hold pending future study. In addition, certain minor residential streets which offered alternative routes rather than the continued reliance on the existing Major Roads were allowed to be closed until such time as studies by the Engineering Department show that they would have to be reopened.[324]

DeSoto County adopted its own Land Use Plan in March 1994. The adopted plan (Figure 4.8.3.c.) included a buyout area. However, strip planned commercial on Goodman Road and multi-family residential on the south of the city showed up.

The City of Southaven has not updated its Land Use Plan since 1983. It is considering the

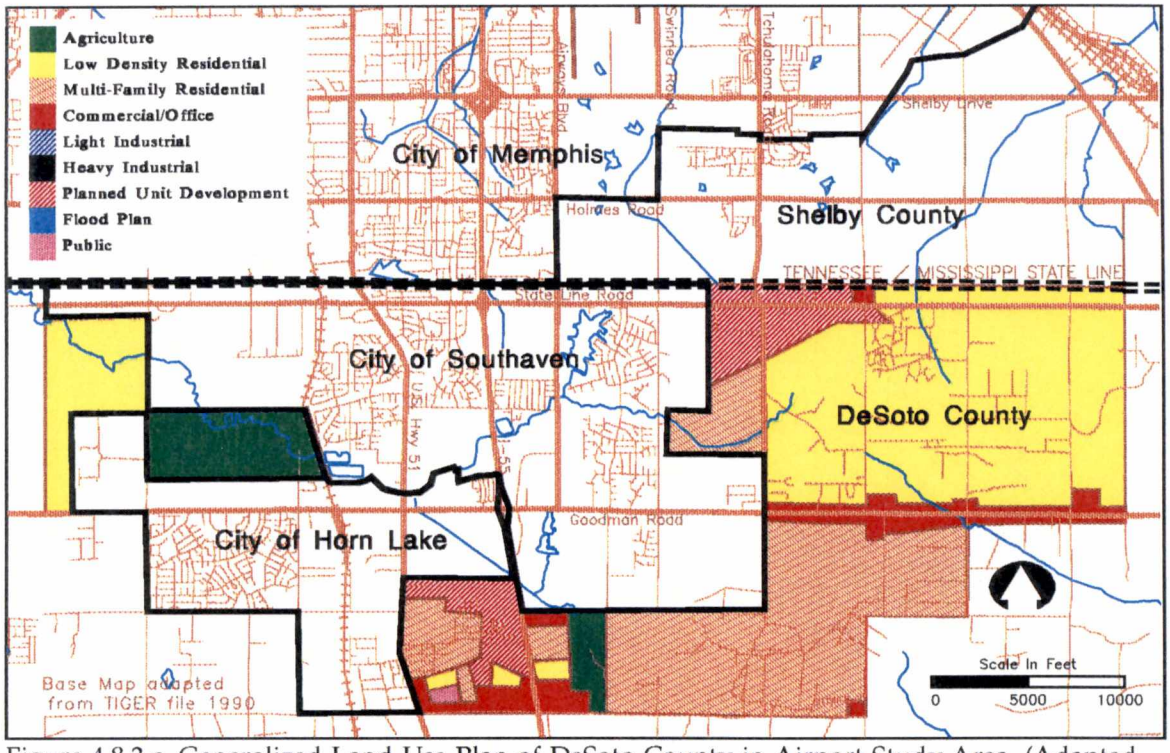


Figure 4.8.3.c. Generalized Land Use Plan of DeSoto County in Airport Study Area. (Adapted from: "Detailed Land Use Map DeSoto County Mississippi," (DeSoto, MS: Desoto County Planning Commission, 1993).)

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[324] Eugenes Bryan, a letter on December 20, 1994.

Land Use Plan as similar to existing zoning. A former director of the City of Southaven Planning Department, attempted two following things to the Land Use study. One was to change the noise contour line because the noise survey was inadequate. The other was to change the low density residential development area to the high density residential development on the east of the city because the city was growing toward the east.[325]

[325] Carl Allen, Interview on Aug. 8, 1994.

CHAPTER V

FINDINGS and CONCLUSIONS

5.1. Findings

This thesis has examined the issue of airport expansion related to runway expansions. The following is an overview of the findings presented through the research.

Airport master plans are guidelines, not final decisions. Airport planners always look at the demand of enplanements and aircraft operations and the capacity of the airport. They consider the need for expansion and submit an airport master plan to the FAA as the demand continues to increase. Plans were submitted for MEM in 1947, 1956, 1966, and 1986. However, some of the plans were amended, delayed or not implemented.

Accuracy is an attribute we expect in forecasting, a basis for planning, but it is difficult for long range airport forecasting. The main reason for this is that airports are effected directly by diverse events which cannot be anticipated very many years in advance. MEM has, so far, faced the following events: the shift from mail plane to passenger based flights; the onset and effect of WWII; the advent of jet aircraft; the introduction of tricycle landing gear and a steerable nose wheel, which greatly enhanced the ability of aircraft to land in cross winds; the move of Federal Express to MEM; the introduction of a hub-and-spoke system as a result of the Airline Deregulation Act of 1978; and noise control and mitigation as a major airport environmental problem.

Demand forecasting is a function of airline operations and business decisions as well as the economic activity of the host city. The effects of the 1978 Airline Deregulation and airline bankruptcies and mergers illustrate the point. The airline business sometimes makes different decisions from what airport planners expect. In the case of MEM, according to the Task Force funded by the FAA, one of the most effective improvements of aircraft operation delay was to distribute departures and arrivals uniformly within the hour, but Northwest Airlines started a

simultaneous arrival schedule in 1994 because some of its leased gates were vacant.

It is dangerous to project passenger enplanement demand from only total data of air carriers. Key air carrier changes through time. Some airlines have rapidly increased aircraft operations for three or five years and only to then face bankruptcy. Furthermore, airlines might change policy. The key air carrier in MEM changed from American Airlines to Delta Air Lines, then to Republic Airlines and finally to Northwest Airlines. Federal Express started collecting packages at other additional airports in 1989. In 1993, 70 percent of packages which Federal Express handled were collected and distributed at MEM.

Runway configuration changed from radial to parallel because of changes in aircraft technology. At the beginning, runways were constructed and extended to radial directions to allow all weather operations when an airport needed more than one runway. After the advent of jet aircraft, runways were constructed to parallel in order to minimize strong crosswind and reduce the impact of noise from jet aircraft and airfield space. Newer aircraft, with more power and steerable nosewheel, can handle more crosswind than older aircraft. In the forecasts, most of existing airport expansions might add new parallel runways beside existing runways, and more than one parallel taxiway beside a runway in order to increase the number of aircraft operations. Other common important airport expansions are to extend the length and to add the depth of pavements of existing runways for heavier aircraft.

Larger aircraft need longer runway and medium aircraft need more runways. Cargo carrier and international passenger carriers call for larger aircraft and need longer than 11,000-foot (3,344 m) runways. Domestic passenger carriers have more landings and take-offs and need more runways, because destinations of passengers in the United States tend to disperse. In addition, "hub-and-spoke" systems cause more aircraft operations than linear systems. In the case of MEM, Northwest Airlines is ordering about 100-seat plus aircraft such as Boeing 757 for domestic trips. Federal Express is ordering heavy aircraft such as A300/600.

The maintenance of runways might require a new runway. An airport which has demand close to capacity requires an alternative runway when an existing runway is closed for maintenance. A big part of maintenance of airports is to rebuild existing runways about every 20 years. This is not only because of wear, but also because of the need to serve advanced navigational aids.

Airport expansions involve many parties. In the history of MEM, the Airport Authority (and its predecessor organizations), airport consultants, city planners, the FAA, the EPA, HUD, politicians and surrounding neighborhoods have been involved in airport expansions. As MEM evolved from the Memphis Municipal Airport to the Memphis Metropolitan Airport to the Memphis International Airport, the lead agency changed from the City Commission to the Airport Authority in 1969. The Memphis-Shelby County Planning Commission has been involved in airport planning in recent years, but has not been the leadership organization.

The different agencies involved in airport expansions have different priorities. Airport planners are concerned with airport operations and their support of the area economy and business community. Airport consultants are concerned about the future potential for the airport. The FAA is concerned about safety. The planning commission is concerned about development in the airport region and how well it is coordinated with other aspects of the community. In the case of MEM, the Airport Authority supported business companies and airlines by leasing lands and facilities and guaranteeing bonds. The airport consultants studied potential demand of the airport about one year and then reported several alternative plans to the Airport Authority. The FAA provided a control tower, wind shear detector and landing aid indicators, and controlled the air traffic pattern. The planning commission provided plans for a land use and transportation system in the vicinity of MEM, including highways, changed zoning and building codes. In general, Airport master plans tend to provide for maximum potential air traffic volume, however the FAA tends to recommend minimum potential air traffic volume. The airport consultants play an important role in creating an airport master plan. The Airport Authority, therefore, looked for

the best airport consultants in the United States, whenever airport expansions were considered.

Airport expansion cannot accommodate runway expansions without land acquisitions. The reason is that most airports own only lands for present facilities and runways. In most of cases involved in MEM, lands were purchased when airport expansions were needed. Some of the purchased lands required condemnation of property. Land acquisition is a time-consuming process because it frequently involves many small parcels in vicinity of the airport, such as residential land uses. Land acquisition for the noise mitigation of MEM took eight years. It is difficult to hold lands for future airport expansion. Lands purchased for clear zones may, however, be used in part for extending the area of existing runways. Those lands needed for facilities may be replaced by a part of a new runway. According to the FAA regulations, the lands purchased for the noise mitigation must be resold and the proceeds from the sale must be used for the noise mitigation program. The resold lands may be replaced by a part of runway extension or a new runway.

Airport expansion involves regional and city planning, especially, roadway system and land use control. The regional impact of airport expansion is significant. Moving of increasing numbers of people and goods requires sophisticated roadway systems. Airport subregions tend to be large, and they require proper land use control. The City of Memphis provided new roads and highways and improved existing roads in the surrounding MEM as it developed. The Airport Study Area of MEM considered 57,270 acres to be sufficient for future land use control.

The possibility of residential encroachment in the vicinity of an airport is high. Since airport development invariably requires major investment in infrastructure and public utilities, the surrounding area becomes a natural focus for urban development.[1] It is clear that MEM has paid a price for residential encroachment. Some costs might have been prevented by not allowing residential subdivisions in the vicinity of MEM. On the other hand, MEM was in the path of a strong suburban growth trend in Memphis. In 1955, the County's planning consultant

[1] U.S. Department of HUD, Major Airports and Their Effects on Regional Planning, p. 3.

recommended compatible zoning of MEM study area. The zoning in 1962 had more single family districts and less agriculture districts than the consultant had recommended. It would have required very far-sighted planning and strong political support to have made a significant difference. That level of political support for planning is not in evidence in other aspects of such far-sighted development planning in the Memphis region.

Decision process of a buyout area in the Noise Compatibility Program must be clear. The buyout area is determined by 75 Ldn noise contour line. However, some residents in the vicinity of an airport might disagree the noise contour line. In the case of MEM, a buyout area was considered on the basis of the noise contour line and neighborhood characteristics. However, some residents who were not included in the area are going to court to be included.

Tools for protecting the land expansion area are zoning, a future land use plan and land banking. Zoning is powerful to protect potential expansion areas near an airport because it is an exercise of the police powers of a state or local government. However, it is impossible to rezone for future of 10 or 20 years, because rezoning requires reliable reason. On the other hand, a future land use plan supports long term airport planning. However, the future land use plan should not be based on only the airport study area. The plan should reflect the comprehensive plan of the local jurisdictions. It would also benefit from a program of land banking in which lands around an airport are acquired in advance of their actual need and placed in some interim use until needed. For the new runway of MEM in 1996, some areas adjacent to MEM were rezoned from residential districts to agricultural districts in 1991, although the airport master plan was approved in 1986. In addition, the rezoned areas were limited for clear zone and aviation business activities. The Airport Authority banks lands as parking space and aviation business park.

Land use compatibility planning is difficult to coordinate because of the number of jurisdictions involved and varied use of standards. In the case of MEM, the airport study area was limited to within five miles out of the City of Memphis, before the airport master plan of the year 1986. Five local jurisdictions have participated in studies of the future land use plan of the

airport study area since 1986. The five had the same concept for the land use plan of the area beyond 75 Ldn. However, one of them adopted its original land use plan of the area based on a standard of less than 75 Ldn. The other one will adopt the similar land use as its existing zoning.

Steep departure flight procedure is the most effective process for noise abatement. Passenger air carriers and cargo air carriers make efforts to abate aircraft noise by changing to quieter aircraft and by employing noise abatement departure flight tracks. It takes time to change to noise quieter aircraft because carriers cannot afford to change an entire aircraft fleet at once. On the other hand, the steep departure flight tracks can immediately be achieved. Aircraft for cargo can depart with steeper tracks than that for passengers.

Airport expansion programs require intensive investment. In the case of MEM, the construction of Runway 18E-36E is estimated at a cost of $177.5 million and Runway 18R-18L was constructed at a cost of $17 million ($60 million as 1993 dollars value) in 1972. Seventy-five percent, or more, of the funds for the airport expansions came from the federal government. The federal funds needed the approval of U.S. Congress every year after the FAA approved an airport master plan. In the case of MEM, some projects started with the revenue of MEM and the federal funds were used later. In order to gain more revenue for airport expansions, MEM raised landing fees and employed a Passenger Facility Charge for certain period.

5.2. Conclusions

While the history of MEM reveals many unexpected events related to airport expansions, most of these events are not unique to MEM. The case study of Memphis International Airport offers many insights into airport land expansion.

By 1969, the Airport Commission of the City of Memphis had made far-sight decisions in airport planning and city planning despite unpredictable and diverse events. The Commission provided highways in the vicinity of MEM as the airport expanded. The Airport Authority subsequently fostered aviation business such as Federal Express. The decision of Federal Express

to move was economically reasonable because the operations at night time infill vacant hours of MEM. However, if aircraft operations of Federal Express exceed those of the airlines, and airport expansion is needed, the problem of public use might be raised. Federal funds are granted for public use. In addition, the Airport Authority has purchased some lands for future needs, but these purchases were not enough to expand the airport..

New runway expansion in future is anticipated to east of Runway 18E-36E or west of Runway 18R-36L. The areas on both sides of the runways are residential, so it might be difficult to achieve the plan without the support of city and regional planners.

The staff of Memphis and Shelby County Division of Planning Development has emphasized that the City Commission paid attention to the consistency of land use among the Airport Study Area, its edges and in the vicinity of the study area.[2]

The National Research Council stated in 1988 that decisions about implementation of airport expansion will be driven not only by technical, safety, and cost considerations but also by broader concern for social, economic, and environmental impact. Many years may be needed to reach these decision.[3] Indeed, the construction of the third north-south runway of MEM, which will be completed in 1996, will occur about ten years after the latest airport master plan and about thirty years after the first notice was given to residents who live in the vicinity of the runway.

An airport master plan is the first step for airport expansion. The plan requires precise research on the past events as well as future potential. The airport planners of MEM have submitted airport master plans and attempted to implement them carefully. Airport expansions for MEM were not easy, but airport planners always studied the airport's potential and expanded carefully.

In 1952, the U.S. President's Airport Commission mentioned residential encroachment and

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[2] Don Jones, Interview on Feb. 23, 1995.

[3] Future Development of the U.S. Airport Network p.31.

the need of large space for future airport expansion.[4] Land use compatibility study becomes a very important portion of airport planning. However, the study needs the support of local jurisdictions surrounding the airport in order to reflect the safety, welfare and peace of mind of the people living in vicinity of the airports.

In conclusion, this case study of MEM indicates that continuing research and flexibility are fundamental requirements for airport land expansion, and that the support of city and regional planners is necessary to expand the airport. There is no sign that airport expansion will diminish or that airport land expansion will not continue to dominate airport planning.

[4] The Airport and Its Neighbors p. 5, 6.

Glossary

air carrier operations – Aircraft operating under certificates of public convenience and necessity, issued by the CAB, authorizing the performance of scheduled air transportation over specified routes and a limited amount of nonscheduled operations.

aircraft operation -- An aircraft arrival at or departure from an airport with FAA airport traffic control service. There are two types of operations -- local and itinerant.

1. Local operations are performed by aircraft which:
   (a) Operate in the local traffic pattern or within sight of the tower.
   (b) Are known to be departing for, or arriving from, flight in local practice areas located within a 20-mile radius of the control tower.
   (c) Execute simulated instrument approaches or low passes at the airport.

2. Itinerant operations:
   All aircraft arrivals and departures other than local operations.

air taxi -- An air taxi operator which: (1) performs at least five round trips per week between two or more points and publishes places between which such flights are performed; or (2) transports mail by air pursuant to a current contract with the U.S. Postal Service.

air traffic hub – Air traffic hubs are not airports; they are the cities and Standard Metropolitan Statistical Area requiring aviation services. Communities fall into four classes as determined by each community's percentage of the total enplaned passengers in scheduled service of the fixed-wing operations of the domestic certificated route air carriers in the contiguous 48 states and the District of Columbia.

Large	1.00% and over
Medium	0.25% to 0.99%
Small	0.05% to 0.24%
Nonhub	Less than 0.05%

based aircraft -- The number of locally owned normally hangared or based at an airport.

CAA -- Civil Aeronautice Administration.

FAA -- U.S. Federal Aviation Administration

FAR -- Federal Aviation Regulations

enplaned passengers -- see passenger enplanement.

General Aviation Aircraft -- All civil aircraft except those classified as air carriers.

General Aviation Operations -- All civil aircraft operations except those classified as air carriers. (See also aircraft operation.)

hub -- See air traffic hub.

itinerant operation -- See aircraft operation.

local operation -- See aircraft operation.

MEM -- Memphis Airport, Memphis Municipal Airport, Memphis Metropolitan Airport, or Memphis International Airport.

military operation -- An operation by military aircraft. (See also aircraft operation.)

mix index -- Mix index is a mathematical expression. It is the percent of Class C aircraft (large aircraft, more than 12,500 lb. and up to 30,000 lb.) plus 3 times the percent of Class D aircraft (heavy aircraft, more than 300,000 lb.), and is written: % (C+3D).

noise abatement departure flight track -- A flight pattern which calls a pilot for a sharp turn after take-off in due to abate aircraft noise at certain area in the vicinity of an airport.

nonprecision instrument runway -- A runway having an existing instrument approach procedure utilizing air navigation facilities with only horizontal guidance, or area type navigation equipment.

passenter enplanement -- The total number of revenue passengers boarding aircraft, including originating, stopover, and transfer passengers, in schedule and nonscheduled services.

Reliever Airport -- An airport to serve general aviation aircraft which might otherwise use a congested air-carrier served airport.

precision instrument runway -- A runway having an existing instrument approach procedure utilizing an Instrument Landing System (ILS) or Precision Approach Radar (PAR).

runway -- a defined rectangular area, on a land airport prepared for the landing and takeoff run of aircraft along its length.

wind shear -- A sudden shift in wind speed and direction. It makes a plane uncontrolled suddenly.

WPA -- Works Progress Administration.

BIBLIOGRAPHY

BIBLIOGRAPHY

Books and Reports

Allen & Hoshall Consulting Engineers.
Airport Layout Plan - Memphis International Airport. Revised.
Memphis: Memphis-Shelby County Airport Authority, Mar. 1971.

Apogee Research Inc.
U.S. Aviation: Making a Good System Better Final Report
Washington, D.C.: The National Council on Public Works Improvement, May 1987.

Ashford, Norman and Clifton A. Moore.
Airport Finance. New York: Van Nostrand Reinhold, 1992.

Ashford, Norman and Paul H. Wright.
Airport Engineering. 3rd ed. New York: Wiley-Interscience, 1992.

Babbie, Earl R.
The Practice of Social Research. 6th ed.
Belmont, CA: Wadsworth Pub. Co, 1991.

Barge, Waggoner, Sumner & Cannon.
Memphis Airport Area Land Use Study, Inventory & Analysis.
Memphis: Memphis-Shelby County Airport Authority, 1989.

Barge, Waggoner, Sumner & Cannon.
Memphis Airport Area Land Use Study, Final Plan.
Memphis: Memphis-Shelby County Airport Authority, Nov. 1990.

Hardway, M. Robert.
Airport Regulation, Law, and Public Policy : the management and growth of infrastructure. Westport, CT: Quorum Books, 1991.

Harrover Roy P. and Associates.
Memphis Metropolitan Airport Terminal Building Expansion Study
Memphis: Memphis Metropolitan Airport, 1967.

Horonjeff, Robert, and Francis X. McKelvery.
Planning and Design Airports. New York: McGraw-Hill, 1983.

Konrad, William Steven.
The Reliever Airport Planning and Implementation Process - a critical review.
Doctoral Dissertation. Department of Urban and Regional Planning.
College Station, TX: Texas A&M University, 1985.

Memphis and Shelby County Office of Planning and Development.
Memphis 2000 Land Use Background Report. Memphis, 1979.

Memphis and Shelby County Planning Commission.
Comprehensive Plan Report. Memphis, 1966.

Memphis and Shelby County Planning Commission.
Study of Memphis Municipal Airport and Environs. Memphis, May 1962.

Memphis Municipal Airport.
Master Airport Plan City of Memphis and Urban Area. Memphis, 1947.

National Research Council (U.S.), Transportation Research Board.
Future Development of the U.S. Airport Network : Preliminary Report and Recommended study plan. Washington, D.C., 1988.

Rhyne, Charles S.
Airports and The Courts.
Washington, D.C.: National Institute of Municipal Law Officers, 1944.

Peat, Marwick, Mitchell & Co.
Master Plan Memphis International Airport
Memphis: Memphis-Shelby County Airport Authority, October 1986.

Peat, Marwick, Mitchell & Co.
Memphis International Airport Demand-Capacity Study
Memphis: Memphis-Shelby County Airport Authority, May 1980.

Peat, Marwick, Mitchell & Co.
Noise Compatibility Program Memphis International Airport
Memphis: Memphis-Shelby County Airport Authority, October 1986.

Smith, T. Michael.
Aircraft Noise. Cambridge ; New York: Cambridge University Press, 1989.

Shevell, S. Richard.
Fundamentals of Flight. 2nd ed. Englewood Cliffs, NJ: Prentice-Hall Inc, 1989.

U.S. Congress, House.
Airport and Airway Safety, Capacity, and Intermodal Transportation Act of 1992.
Report No. 102-503, 102d Cong, 2d Sess, 1992.

U.S. Environmental Protection Agency.
Protective Noise Levels - Condensed Version of EPA Levels Document.
EPA 550/9-79-100. Washington, D.C., Nov. 1978.

U.S. Department of Housing and Urban Development, Office of International Affairs.
Major Airports and Their Effects on Regional Planning.
Washington, D.C.: U.S. Government Printing Office, 1973.

U.S. Department of Transportation, Federal Aviation Administration.
Airport Capacity and Delay. AC 150/5060-5. Washington, D.C., 23 Sept. 1983.

U.S. Department of Transportation, Federal Aviation Administration.
Airport-Land Use Compatibility Planning. AC 150/5050-6. Washington, D.C., 1977.

U.S. Department of Transportation, Federal Aviation Administration.
Airport Master Plans. AC 150/5070-6A. Washington, D.C., June 1985.

U.S. Department of Transportation, Federal Aviation Administration.
Enplanement and All Cargo Activity - Calendar Year 1992. FAA-PP-94-1.
Washington, D.C., 1994.

U.S. Department of Transportation, Federal Aviation Administration.
Impact of Noise on People. Washington, D.C., May 1977.

U.S. Department of Transportation, Federal Aviation Administration.
National Plan of Integrated Airport Systems (NPIAS) 1990 - 1999.
Washington, D.C., 1990.

U.S. Department of Transportation, Federal Aviation Administration.
Noise Control and Compatibility Planning for Airports. AC 150/5020-1.
Washington, D.C., 1983.

U.S. Department of Transportation, Federal Aviation Administration.
Runway Length Requirements for Airport Design. AC 150/5325-4A.
Washington, D.C., 29 Jan. 1990.

U.S. Department of Transportation, Federal Aviation Administration.
Terminal Area Forecasts FY1993-2005. FAA-APO-93-9.
Washington, D.C., 1993.

U.S. Department of Transportation, Federal Aviation Administration, Airports District Office.
Final Environmental Impact Statement Memphis International Airport.
Memphis, May 1993.

U.S. General Accounting Office.
Aircraft Noise : Eight Airports Efforts to Mitigate Noise.
Report no. GAO/RCED-89-189. Washington, D.C., 14 Sept. 1989.

U.S. President's Airport Commission.
The Airport and Its Neighbors.
Washington D.C.: U.S. Government Printing Office, 1952.

Wiley, John R.
Airport Administration and Management.
Westport, CT: Eno Foundation for Transportation, 1986.

Periodicals

Creswell, Lyn Loyd
"Airport policy in the United States : the need for accountability, planning, and leadership." Transportation Law Journal, 6 (1990): 1-111.

Memphis-Shelby County Airport Authority.
"Airport Neighborhood Update." Noise Compatibility Newsletter.
Memphis, 1986-1993.

Standard & Poor's Corporation.
Standard & Poor's Trade and Securities, Statistics: Price Indexes.
New York. May 1994.

Tennessee Aeronautics Commission.
Tennessee Airport Directory. Nashville, 1964.

Tennessee Bureau of Aeronautics.
Tennessee Airport Directory. Nashville, 1989 and 1992.

U.S. Department of Transportation, Federal Aviation Administration.
Airport Activity Statistics of Certificated Route Air Carrier Reports.
Washington, D.C., 1960-1990.

U.S. Department of Transportation, Federal Aviation Administration.
FAA Air Traffic Activity - Fiscal Year.
Washington, D.C., 1991-1992.

"Fuel Venting and Exhaust Emission Requirements for Turbine Engine Powered Airplanes,"
"Aeronautics and Space." U.S. Code of Federal Regulations 14, Part 34.
Washington, D.C.: U.S. Printing Office, 1993.

"Objects Affecting Navigable Airspace," "Aeronautics and Space,"
U.S. Code of Federal Regulations 14, Part 77,
Washington, D.C.: U.S. Printing Office, 1993.

"Tiger/Line Census Lines, 1990. Mississippi," [Computer File].
Washington D.C.: U.S. Dept. of Commerce, Bureau of the Census, Data User Services Division, 1991.

"Tiger/Line Census Lines, 1990. Tennessee," [Computer File].
Washington D.C.: U.S. Dept. of Commerce, Bureau of the Census, Data User Services Division, 1991

Newspapers

Allen, A. Richard. "Airport Expansion Plan Calls for Big Terminal, More Land."
Commercial Appeal (Memphis), 21 Dec. 1956.

Baker, B. Morris. "Freight Warehouse Sought for Airport." Commercial Appeal 1 July 1957.

Baker, B. Morris.
"Longer Runways Due at Memphis Airport." Commercial Appeal 10 Aug. 1953.

Bayne, C. William. "S'haven to Seize 3 Buyout Homes." Commercial Appeal 10 Feb. 1994.

Brennan, Mike. "Memphis Airspace might be Cut." Commercial Appeal 25 Aug. 1987.

Brown, A. Charles. "$1.2 Million OK'd for Airport."
Press Scimitar (Memphis) 8 Apr. 1966.

Coppock. Paul. "City to Buy Airport Improve Flying Site." Commercial Appeal 30 Jan. 1935.

Cunningham, Morris.
"FAA Puts Airport Safety at Top Priority." Commercial Appeal 28 Dec. 1978.

Daniell, Tina. "Northwest Takes a Big Step toward Ensuring Survival."
Milwaukee (Wisconsin) Journal 24 Jan. 1986.

Darnell, Dave. "Making Way for Runway." Commercial Appeal 27 Jan. 1993.

Deibel, Mary. "New Airport Tower Opens." Commercial Appeal 26 Apr. 1977.

Gaither, Steve. "Grant OK for Houses at Airport." Commercial Appeal 22 Sept. 1988.

Gardner, Richard. "Tearing up to Fix Up." Commercial Appeal 17 June. 1993.

Graham, Louis.
"Action to Fund Airport Projects Expected Today." Commercial Appeal 19 Nov. 1987.

Graham, Louis.
"Airport Expansion, Buyout Plan Outlined to Residents of Noise-Prone Neighborhood."
Commercial Appeal 11 June 1986.

Graham, Louis. "Airport Has Plans Up in Air." Commercial Appeal 1 June 1986.

Graham, Louis. "Airport Taxis toward the Future." Commercial Appeal 20 June 1986.

Graham, Louis. "Elbow Room for the Eyes to Memphis." Commercial Appeal 28 July 1985.

Gray, Robert. "Airport is Prepared to Welcome Jet Age." Commercial Appeal 22 Mar. 1953.

Gray, Robert. "Airport Notes Growth during Past Decade." Commercial Appeal 19 Mar. 1951.

Gray, Robert. "Times Create Need for Modern Airport." Commercial Appeal 9 Mar. 1958.

Guibao, Pat. "Airport Expansion Plan Discussed in Oakhaven." Press Scimitar 19 Nov. 1968.

Hancock, Orville. "Airport Authority Inherits 'Headache'." Press Scimitar 1 Sept. 1971.

Hancock, Orville. "Airport Expansion near Completion." Press Scimitar 16 Jan. 1974.

Hancock, Orville. "Airport is Installing New Equipment to Warn of Dangerous Wind Shifts."
Press Scimitar 30 July 1979.

Hancock, Orville. "Airport Work will be Over by Spring." Press Scimitar 23 Nov. 1974.

Hancock, Orville.
"Connector, Runway Next Airport Construction." Press Scimitar 14 Jan. 1976.

Hancock, Orville.
"Innovations Accompanying Terminal's Expansion." Press Scimitar 19 Nov. 1975.

Hancock, Orville. "New Authority Nears Reality for Airport." Press Scimitar 14 Aug. 1969.

Hancock, Orville. "Oakhaven Residents Continue to Ask about Airport Plans." Press Scimitar 11 Apr. 1969.

Hancock, Orville. "Southern Airways Plans Memphis Expansion, 2 New Routes." Press Scimitar 22 Mar. 1978.

Hancock, Orville. "Texas Airline Seeks Flights to Chicago." Press Scimitar 14 Feb. 1977.

Hancock, Orville. "$31 Million Airport Expansion Job Starts in 1971." Press Scimitar 31 Jan. 1971.

Henderson, Dan. "Airport Critics' Griping Nosedives." Commercial Appeal 16 July 1978.

Hirschman, Dave. "Airline - Northwest, KLM Mull Direct Flights from Memphis to Europe." Commercial Appeal 29 May 1994.

Hirschman, Dave. "Airport can Extend Ticket Tax, FAA Rules." Commercial Appeal 19 Jan. 1994.

Hirschman, Dave. "Airport OK's Constructs to build Third Runway." Commercial Appeal 17 Sept. 1993.

Hirschman, Dave. "Aviation - Airport Panel OK's Bounds for Maintenance Facility." Commercial Appeal 16 July 1993.

Hirschman, Dave. "Aviation FAA Study Endorses Expansion." Commercial Appeal 2 Apr. 1993.

Hirschman, Dave. "FAA Action Boosts Plan to Construct 4th Runway." Commercial Appeal 1 Apr. 1993.

Hirschman, Dave. "Faltering NW Hub Here Strives to Stay Airborne." Commercial Appeal 7 Feb. 1993.

Hirschman, Dave. "New FedEx Planes to Accent Efficiency." Commercial Appeal 15 May 1994.

Hirschman, Dave. "Northwest Hires 300, Begins New Schedule." Commercial Appeal 2 Mar. 1994.

Hirschman, Dave. "Shipping - City to Host Air Cargo Conference." Commercial Appeal 18 Nov. 1993.

Hirschman, Dave. "Thousands can Join Suit Against Airport, Federal Judge Rules." Commercial Appeal 8 May 1993.

Jordan, Thomas. "Bond Issue Plan may Speed Buyout of Airport Homes." Commercial Appeal 19 June 1987.

Klose, Roland. "Airport's Passenger Fee OK'd." Commercial Appeal 30 May 1992.

Klose, Roland. "Memphis Dropped from List of Biggest." Commercial Appeal 8 Apr. 1992.

Klose, Roland.
"Memphis is First to Get Wind-Tracking System." Commercial Appeal 15 Jan. 1992.

Lentz, Richard. "Industrial Park is under Study." Commercial Appeal 2 July 1968.

Martin, Tim. "Airport Sets Expansion." Tennessean (Nashville) 12 Feb. 1993

Maxey, Ron.
"Airport Area Holdouts Grow Used to Isolation Homes Dot Empty Expanses where Neighborhoods Stood." Commercial Appeal 16 Dec. 1993.

Maxey, Ron. "Airport Buyout Residents Adjust to Future with Runway Neighbor." Commercial Appeal 9 Apr. 1992.

McKenzie, Peggy. "Airport Protest Meeting Lures Packed House to Join Lawsuit." Commercial Appeal 27 May 1993.

M'Connell, Dave. "Airport Taken Over as Army Ferry Base; Expansion Planned." Commercial Appeal 23 June 1942.

Means, John. "Terminal to be Cramped if 2 Airline Win Approval." Commercial Appeal 29 Sept. 1967.

Meltzer, Marc. "Airport Climbs to 29th Busiest in U.S." Commercial Appeal 11 July 1982.

Meltzer, Marc. "Delta Joins Trans World, Pan Am with Direct Flights to JFK Airport." Commercial Appeal 17 Jan. 1984.

Meltzer, Marc.
"Landing Fees of Airlines Get 66% Retroactive Lift." Commercial Appeal 20 Aug. 1982.

Meltzer, Marc.
"Memphis Trails Only Atlanta in Direct Flights." Commercial Appeal 11 Oct. 1984.

Meltzer, Marc. "Passenger Numbers Drop at Memphis Airport in '84." Commercial Appeal 23 Jan. 1985.

Obermark, Jerome.
"Sales Pitch Paying Off for Memphis Airport." Commercial Appeal 1 Oct. 1978.

Oslund, J. John.
"'New Northwest' to Debut Wednesday." Minneapolis Star and Tribune 28 Sept. 1986.

Phelps, David, Oslund and Marcotty. "Federal Agency Rules out Competition Threat." Minneapolis Star and Tribune 1 Aug. 1986.

Pinegar, Hilmon. "Memphis Airport Installs New Tower to Control Ever-Increasing Traffic." Press Scimitar 24 Sept. 1943.

Potter, Mermon. "Memphis, Air Hub of the Nation." Commercial Appeal 8 Oct. 1939.

Riker, Jefferson. "Account of Airports's Growth Confirmed by the Numbers." Commercial Appeal 19 Jan. 1969.

Riker, Jefferson. "New Takeoff: Like Homesick Angel." Commercial Appeal 12 June 1970.

Riker, Jefferson. "Oakhaven Plan Gets City's OK." Commercial Appeal 3 Feb. 1971.

Risher, Wayne. "Residents Hit Airport on Pollution." Commercial Appeal 2 Feb. 1993.

Rosenbush, Mervin. "Airport Is Vital Link in Defense." Press Scimitar 7 Dec. 1941.

Sellers, Steve. "Record Buoys Airport." Commercial Appeal 22 Jan. 1978.

Silver, Louis. "Memphis Steps Proudly into Jet Age." Commercial Appeal 21 Jan. 1963.

Thornton, Charles. "Work to Begin on Runway Site." Commercial Appeal 18 Oct. 1967.

Quinn, Archie. "Aviation in Memphis Has Been Slim Times." Commercial Appeal 2 Apr. 1951.

Quinn, Archie. "Heavy Planes to be Diverted from Populous Sections Here." Commercial Appeal 27 Apr. 1952.

Vvistica, Gregory. "FAA Looks to Reduce Late Flights in Memphis." Commercial Appeal 1 Apr. 1989.

White, Deborah. "Airport Gets FAA Grant for Security Home Buys." Commercial Appeal 21 Sept. 1990.

White, Deborah. "Land Development being Discussed." Commercial Appeal 23 Oct. 1989.

White, Deborah. "Landing Fees at Airport Increased." Commercial Appeal 19 May 1989.

White, Deborah. "Passenger Traffic Down 12% at Airport for 1988." Commercial Appeal 21 Jan. 1989.

"Air Passengers up Despite Fare Hike." Press Scimitar (Memphis, Tennessee) Jan. 1977.

"Airport Ban is Issued by CAA." Press Scimitar 23 Apr. 1943.

"Airport Building to be Dedicated Tomorrow." Press Scimitar 14 Oct. 1938.

"Airport Changes Needed for Safety, Pilots Say." Press Scimitar 3 Dec. 1971.

"Airport Commission will be Established." Commercial Appeal 8 June 1949.

"Airport Expansion Accord is Reached." Commercial Appeal 18 Aug. 1956.

"Airport Expansion Plans Announced." Press Scimitar 19 Apr. 1938.

"Airport Expecting Another Big Year." Commercial Appeal 21 Jan. 1979.

"Airport Future to be Discussed." Press Scimitar 18 Nov. 1968.

"Airport Gets 'Face Lifting' by WPA Crews'." Press Scimitar 31 Mar. 1936.

"Airport is Prepared to Welcome Jet Age." Commercial Appeal 22 Mar. 1953.

"Airport Land Lies Fallow." Commercial Appeal 7 June 1967.

"Airport Lights to be Dedicated Tonight." Commercial Appeal 15 Mar. 1930.

"Airport's Progress is Cited by Dillard." Commercial Appeal 30 Aug. 1957.

"Airport Property is Sought by City." Commercial Appeal 17 Aug. 1967.

"Airport Scores Triple Record during May." Commercial Appeal 18 June 1985.

"Airport's Taxiways to be Widened Soon." Commercial Appeal 30 Nov. 1945.

"Air Travel Dips While Concern Rises." Commercial Appeal 16 Mar. 1968.

"Army Leases Airport; City Gets $1 a Year." Commercial Appeal 2 July 1942.

"City Analyzing Bids on Airport Protects." Commercial Appeal 17 June 1949.

"City Buys Hangars, Plans Two New Ones." Commercial Appeal 14 Sept. 1938.

"City Releases Report on Airport Progress." Commercial Appeal 25 Mar. 1947.

"City to Buy Airport if Title Approved." Press Scimitar 21 June 1935.

"Commission OK's Airport Architect." Commercial Appeal 14 June 1967.

"Commissioners, Councilmen form Rules to Guide Airport Authority." Commercial Appeal Aug. 15, 1969.

"Even Small Airlines are Turning to Jets." Commercial Appeal 20 Mar. 1966.

"FAA Approves Airport Grants." Commercial Appeal 2 May 1969.

"FAA Taps Memphis for Tests." Commercial Appeal 7 Jan. 1984.

"Federal Contract Let for Airport Radio." Commercial Appeal 22 Dec. 1937.

"First Step is Taken to Enlarge Airport." Commercial Appeal 4 Mar. 1942.

"First Takeoff from New Runway." Commercial Appeal 23 Oct. 1932.

"Granted." Press Scimitar 1 Sept. 1976.

"Hangar Remodeling will Relieve Airport." Commercial Appeal 19 Nov. 1945.

"Homes Marked for Buyout." Commercial Appeal 27 Mar.1987.

"Hop-Scotch." Commercial Appeal 1 June 1974.

"Increase is reported in Airport's Traffic." Commercial Appeal 18 Jan. 1953.

"Land Purchase Approved by Airport Board," Press Scimitar 25 June 1971.

"Land Purchased." Press Scimitar 3 Apr. 1942.

"Memphis Airport Gets Post Office." Press Scimitar 13 Nov. 1941.

"More Land for City's Airport." Press Scimitar 21 Mar. 1939.

"New Airport Terminal Now Officially Open." Press Scimitar 29 July 1963.

"New East-West Runway Talked for Airport." Press Scimitar 1 Jan. 1956.

"New Runways Site near Completion." Commercial Appeal 29 Nov. 1968.

"New Wing on building Approved at Airport." Commercial Appeal 21 May 1947.

"Oakhaven Gets Cherry News." Commercial Appeal 9 Apr. 1969.

"Of Note...." Commercial Appeal 26 July 1993.

"O.K. Plans for New Runway." Press Scimitar 23 Sept. 1966.

"One of 50." Press Scimitar 5 Mar. 1948

"Overton Gets Commission's O.K. to Close Deal to Make City Airport Jet-Worthy." Press Scimitar 20 Nov. 1952.

"'Pancake' Runway Lights will be Sky Safety Lane." Commercial Appeal 2 Feb. 1963.

"Panel OKs Airport Bond Issue." Press Scimitar 28 July 1979.

"Plans Made Known for Airport Work." Commercial Appeal 19 Apr. 1941.

"President Passes on Airport Work." 28 Sept. 1935.

"Proposed Addition to 'Round Out' Airport." Commercial Appeal 15 June 1941.

"Runway Plan for Airport." Press Scimitar 10 July 1964.

"Space Problem at The Airport." Press Scimitar 5 July 1951.

"Staying out Front." Commercial Appeal 27 Aug. 1985.

"Take-off Fees Fixed Despite Airline View." Commercial Appeal 28 Dec. 1949.

"Taxiway Plan is Extolled." Commercial Appeal 8 Aug. 1979.

"Terminal at Airport Given OK." Commercial Appeal, 21 Nov. 1986.

"Three Airlines to Get Instrument Landing." Commercial Appeal 15 Sept. 1947.

"Times Create Need for Modern Airport." Commercial Appeal 9 Mar. 1958.

"'Tin Goose' Alights in Memphis." Press Scimitar 6 June 1963.

"Use Radio Approach for Airport Safety." Commercial Appeal 11 July 1935.

"$106,700 Approved for Airport Work." Press Scimitar 3 Feb. 1938.

"$14 million Plan Calls for Big Terminal and Two New Runways." Press Scimitar 21 Dec. 1956.

"$200,000 to be Spent on Improving Airport." Commercial Appeal 4 Feb. 1942.

"$20,755 Airport Tests Approved." 27 Aug. 1968.

"$603,000 Price for 142 Acres." Press Scimitar 20 Jan. 1965.

"466 Acres are to be Added to City's Airport." Press Scimitar 11 Aug. 1942.

"63 Acres Purchased to Enlarge Airport." Commercial Appeal 6 May 1938.

Others

Allen, Carl. Personal Interview. 8 Aug. 1994.

Bryan, Eugenes. Personal Letter. 20 Dec. 1994.

Delta Air Lines. Delta Worldwide Timetable Atlanta: Delta Air lines, Inc., 1994.

Harrover, Perkins Roy. "Epitome of Architectural Design." Ietage Airlines, Souvenir Program. Memphis: Memphis Metropolitan Airport (June 1963) p.16.

Jones, Don. Personal Interview. 23 Feb. 1995.

Memphis-Shelby County Airport Authority. "Airport Layout Plan Memphis International Airport" Memphis, 2 Aug. 1994.

Memphis-Shelby County Airport Authority. "Property Acquisition Fact Sheet," Memphis, 15 Feb. 1994.

National Oceanic and Atmospheric Administration. "Memphis Sectional Aeronautical Chart," 52nd ed. Washington, D.C.: U.S. Department of Commerce, 28 Apr. 1994.

"Detailed Land Use Map DeSoto County Mississippi." DeSoto, MS: The DeSoto County Planning Commission, 1993.

"From Sod Field Take-off to Supersonic Landings in Fifty Years," 1929 50th Anniversary. Memphis: Memphis-Shelby County Airport Authority, 1979.

"Memphis and Shelby County Zoning Atlas." Memphis: Memphis and Shelby County Office of Planning and Development, 1 Jan. 1993.

"Memphis Zoning District Map." Memphis: Memphis and Shelby County Office of Planning and Development, 1 Jan. 1981.

"Official Zoning Map DeSoto County, Mississippi." DeSoto, MS: The DeSoto County Planning Commission, 2 Jan. 1990.

"Official Zoning Map Southaven DeSoto County, Mississippi." Southaven, MS: Southaven Mississippi and the DeSoto County Planning Commission, 19 June 1989.

"Official Street Map City of Horn Lake, MI." Hernando, MS: DeSoto County Planning Commission, 1993

"Recommended Land Uses," DeSoto 2010 v. II p. 64 DeSoto, MS: The DeSoto County Planning Commission, 1993.

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