

PB2001-108573



UNIVERSITY OF MINNESOTA

CENTER FOR TRANSPORTATION STUDIES

R E S E A R C H R E P O R T

THE GROUND SIDE EFFECTS OF AIR TRANSPORTATION

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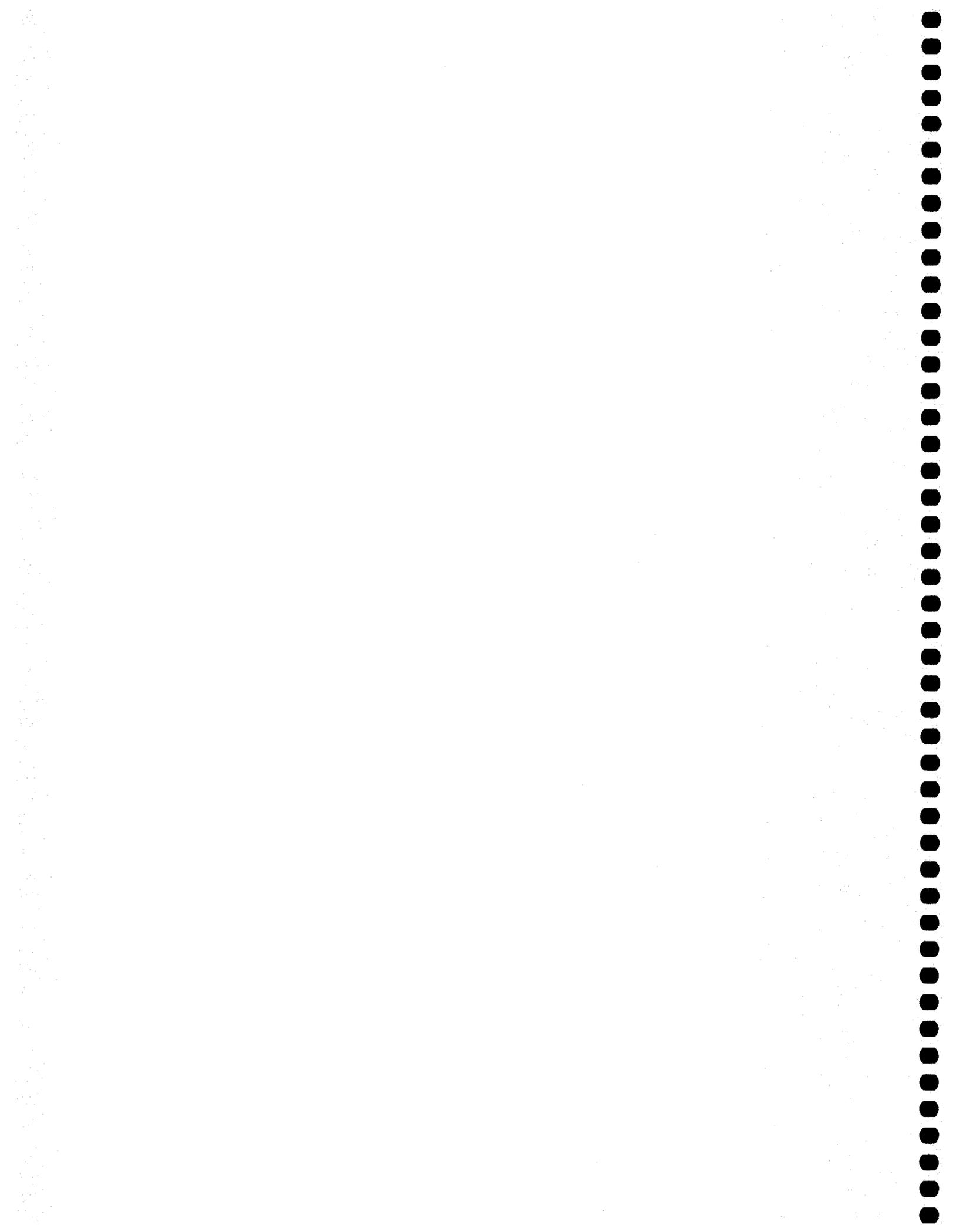
CTS 01-02

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U.S. Department of Commerce
National Technical Information Service
Springfield, Virginia 22161



Technical Report Documentation Page

1. Report No. CTS 01-02	2.	3. Recipient's Accession No.	
4. Title and Subtitle THE GROUNDSIDE EFFECTS OF AIR TRANSPORTATION		5. Report Date August 2001	
		6.	
7. Author(s) Julie L. Cidell and John S. Adams		8. Performing Organization Report No.	
9. Performing Organization Name and Address: Department of Geography 414 Social Science Building 267 19th Avenue South Minneapolis, MN 55455		10. Project/Task/Work Unit No.	
		11. Contract (C) or Grant (G) No. (C) (G)	
12. Sponsoring Organization Name and Address Center for Transportation Studies 200 Transportation and Safety Building 511 Washington Ave. S.E. Minneapolis, MN 55455		13. Type of Report and Period Covered	
		14. Sponsoring Agency Code	
15. Supplementary Notes			
16. Abstract (Limit: 200 words) This report systematically examines land uses around airports across the country, as well as the consequences for a metropolitan region of expanding versus moving an airport. A combination of methodologies is found to be the best approach. The airports in Minneapolis-St. Paul and Denver are further examined as case studies for the question of expansion versus new construction. Conclusions include: the larger the city, the more specialized the airport land uses, and regional economic needs and wants override local economic, social, and environmental needs and wants. Future study should take a more historical approach and more carefully define the region influenced by an airport.			
17. Document Analysis/Descriptors airports, land use, air transportation		18. Availability Statement No restrictions. Document available from: National Technical Information Services, Springfield, Virginia 22161	
19. Security Class (this report) Unclassified	20. Security Class (this page) Unclassified	21. No. of Pages 90	22. Price



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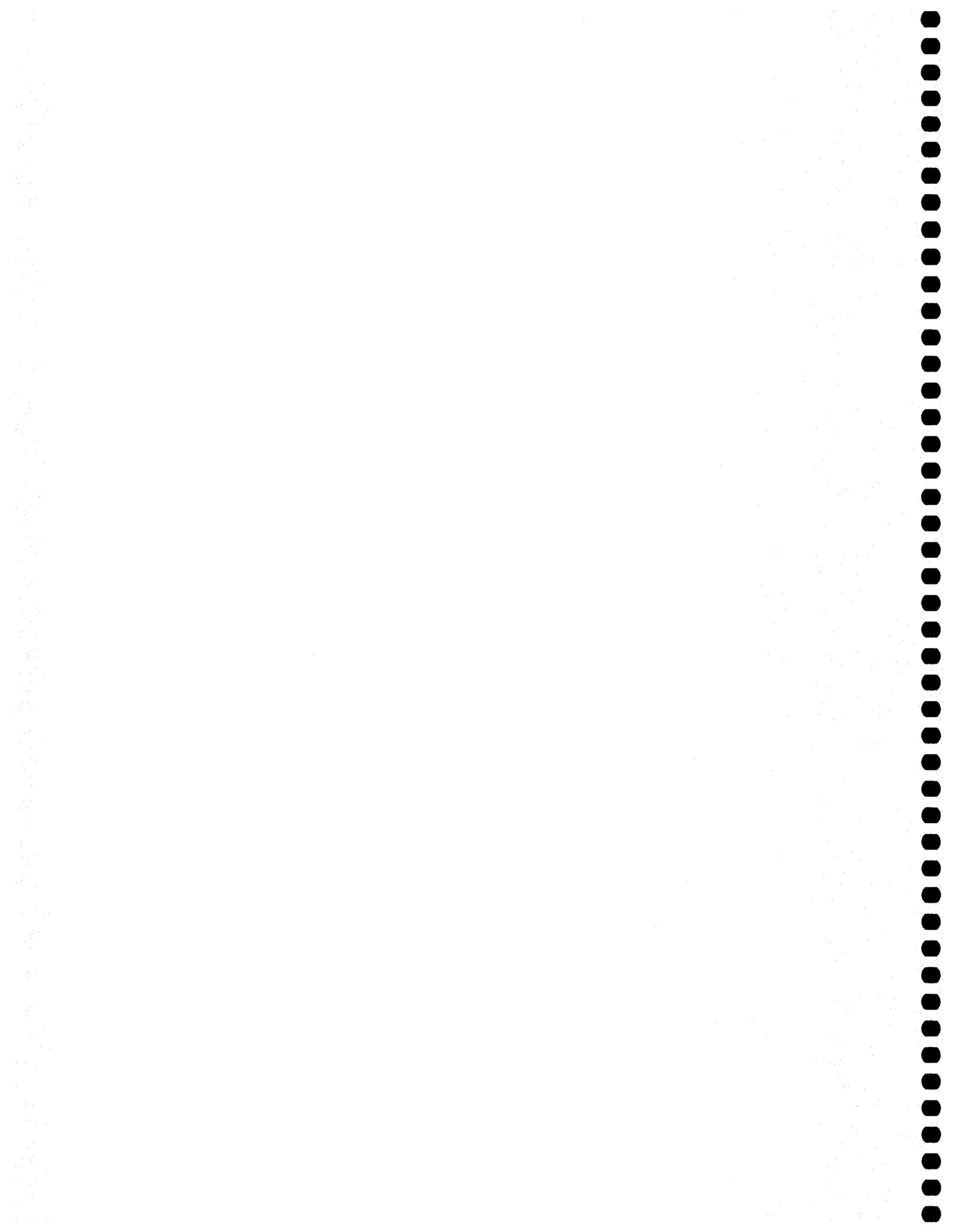
Published by

Center for Transportation Studies
University of Minnesota
200 Transportation and Safety Building
511 Washington Ave. S.E.
Minneapolis, MN 55455

August 2001

CTS 01-02

This report represents the results of research conducted by the authors and does not reflect the official views or policy of the Center for Transportation Studies. This report does not constitute a standard, specifications, or a regulation.



ACKNOWLEDGMENTS

The authors would like to thank the following individuals: David McCord, Department of Zoning, City of Aurora, CO; Terry Rosapep, Department of Public Works, City and County of Denver, CO; and especially Nickole Stoner, Planning Manager, Adams County, CO. We also acknowledge Lorinda Bodman, Park Field apartment homes; Chuck Cannon, Department of Public Affairs, Denver International Airport; and Joe Taylor, Charlotte-Mecklenburg Planning Commission, Charlotte, NC. Special thanks are also due to the Interlibrary Loan Office of the University of Minnesota Libraries.

This work was supported by a grant from the Center for Transportation Studies, University of Minnesota.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	i
CHAPTER 1. INTRODUCTION	1
CHAPTER 2. AIRPORTS AND LAND USE IN THE LITERATURE	5
Airports and the Economy	
Planning Process	
Noise and Property Values	
Controlling Airport Noise	
Airports and Land Use	
CHAPTER 3. METHODOLOGIES	23
Methodologies in the Literature	
Selecting Airports for Study	
Topographic Maps	
Zoning and Land Use Maps	
Qualitative Methods	
SIC Codes	
Other Methods	
CHAPTER 4. THE GROUNDSIDE EFFECTS	35
Major Findings	
Other Findings	
Hartsfield International Airport	
Charlotte International Airport	
Dallas-Ft. Worth International Airport	
Detroit Metropolitan Wayne County Airport	
John F. Kennedy International Airport	
LaGuardia Airport	
Los Angeles International Airport	
O'Hare International Airport	
Lambert-St. Louis International Airport	
Tampa International Airport	
CHAPTER 5. MINNEAPOLIS-ST. PAUL AND DENVER	69
Histories	
The Decision-Making Process	
Acting on the Decisions	
CHAPTER 6. CONCLUSION AND LESSONS LEARNED	89
APPENDIX A	A-1

LIST OF FIGURES

Figure 2.1: Noise Contours Around Minneapolis-St. Paul International Airport	10
Figure 3.1: Selected Airports	26
Figure 5.1: Environs of the Denver International Airport (DEN), Denver, Colorado	70
Figure 5.2: Environs of the Minneapolis-St. Paul International Airport (MSP), Minneapolis, Minnesota	71

LIST OF TABLES

Table 2.1: Methods of Controlling Airport Noise and the Percentage of Airports that Employ Them	15
Table 4.1: Firms in the Airport Environs by SIC Sector	40
Table 4.2: Firms in the Metropolitan Statistical Areas by SIC Sector, 1992	41
Table A.1: Land Use Compatibility Chart	A-1

EXECUTIVE SUMMARY

This research represents preliminary work on the feasibility of a larger study on the effects of airports on land uses in surrounding communities. There are two parts to this report: one evaluating the various methodologies employed, and one describing the results achieved with those methods.

Airports present an interesting paradox of transportation and land use requirements. The purpose of air travel is to move goods and people quickly, a process that needs to continue past the terminal. At the same time, for safety and noise reasons, airports require a great deal of open space around their runways. Therefore, while certain land uses are discouraged, others are encouraged, which should result in a predictable pattern of development.

There has not been a systematic examination of land uses around airports across the country, or of the consequences for a metropolitan region of expanding versus moving an airport. This report explores both of these issues. The literature on airports and land use falls into four main categories: (1) regional-scale shifts in the economy; (2) the airport planning process; (3) the effects of noise on property values and government efforts to control noise; and (4) a historical approach to land use changes in a particular city or set of cities. This literature is further reviewed in Chapter 2.

This report finds that a combination of methodologies is the best approach to understanding the groundside effects of air transportation. Topographic maps are a good, cheap, easily available starting point, and contain a surprisingly large amount of information themselves. Zoning and land use maps are more limited in usefulness because they focus on a particular municipality, yet they provide data on specific land uses that are unavailable from topographic maps. Qualitative analysis, including documents and interviews, both provokes additional questions and finds ways to answer them, particularly when fieldwork is part of the analysis. Finally, Standard Industrial Classification (SIC) code analysis provides a way to describe and analyze the kinds of businesses that locate near an airport. These methodologies are explored further in Chapter 3.

The following major findings of this report are explained and supported in Chapters 4 and 5:

- There is an inevitable tradeoff between local disbenefits and regional benefits when it comes to expanding or moving an airport. Although it is true that airports can bring economic benefits to a region, they can damage the economies of cities located close by.
- There is a paradox of local land use responsibility versus federal control of the aviation system. Most of the actions that can be taken to minimize incompatible land uses are up to local governments, but that local control only extends so far: communities that have attempted to assert their municipal land use rights over airport expansion plans have been told by the courts and state legislatures that regional and national needs take priority.
- Unlike the traditional roads-versus-development question, it is undeniable that airports drive development, and a lack of development encourages promotion of airport development. To some extent, development precedes airports at a metropolitan scale, but its *absence* is what drives airport siting.
- As a corollary, an airport is unlikely to change the character of development within its geographic sector. Even when firms move to a metropolitan area because of the air service, they may not locate in the same geographic sector as the airport.
- Cities that do not directly adjoin airports, but are still affected by noise, tend to experience the same disadvantages with fewer benefits. Because of development pressures, cities such as these may not be able to plan far enough ahead to zone buffer land. At the same time, they are usually too far away to take advantage of the land uses that are drawn to the airport environs such as hotels or warehouses.
- Other undesirable, Not In My Back Yard (NIMBY) uses tend to be located near airports: uses that take up a great deal of space and are no more compatible with residences than are airports (prisons, sports stadiums, etc.).
- Water or parks are frequently used as buffers for safety and noise reasons.
- The larger the city and more specialized the airport, the more specialized the land uses surrounding it.

- Airports that have separate exits for people and cargo reflect that difference in the kinds of businesses that locate on each side.
- Communities can be creative when dealing with the effects of airport noise. They may sue airports or even airlines, create special zoning districts, or take a more positive attitude by using airport proximity as a marketing tool.
- Locating airport-related businesses off airport property can make a difference in communities' opinions of airport expansion by strengthening their tax bases.
- Some expected sectors such as transportation tend to concentrate in the airport environs, but some expected firms such as finance, insurance, and real estate do not.

Future work in this area should take more of a historical view, focusing on *changes* in land use over time. A more careful definition of the study area is in order; in fact, defining the extent of the area for which land uses are affected by an airport is a study in itself. Finally, additional methods should be explored for their potential usefulness.

CHAPTER 1: INTRODUCTION

When connections between land use and transportation are considered, attention usually focuses on road or rail. Though ground transportation does have the most impact on patterns of land use, other modes wield influence as well. Where an interface occurs between water or air transportation and ground transport, land use is likely to become highly specialized, focused on making connections between modes as easy as possible. The cities of the early United States grew around their harbors because their health and that of their hinterlands depended on facilitating the transfer of people and goods between land and sea. Today, the concept of ports has expanded to include places that connect land and air. Airports and the aerospace industry have contributed to the creation of cities in the same way that ocean harbors did centuries ago.

Airports present an interesting paradox of transportation and land use requirements. The purpose of air travel is to move goods and people quickly, a process that needs to continue past the terminal. At the same time, for safety and noise reasons, airports require a great deal of open space around their runways. For this reason, new facilities such as Denver International Airport are sited far from existing development, with good highway access. As time goes on, necessary services migrate towards the airport, producing growth in what was an empty quarter of the metro area. For this mode of transportation, it is the airport that drives development in a particular place, not the reverse.

Land use near an airport can be affected in two ways. First, some uses are precluded by noise or airspace restrictions. Residential neighborhoods and schools, for example, are incompatible uses within the immediate, noisiest vicinity. There are also limits to land use based on height restrictions. At the same time that an airport limits certain land uses, it encourages others. Air cargo has become a booming business, and thus facilities to transfer goods from air to ground transport are in high demand. Companies whose staff travels frequently, such as high-tech firms,

also prefer to be close to an airport. It follows that the services that these travelers need are also attracted to the airport neighborhood: car rental agencies, hotels, and restaurants, for example.

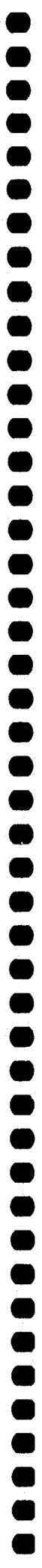
These factors usually produce a land-use pattern of low buildings and acres of parking lots and roads that obviously requires a great deal of room. This pattern also requires a ground transportation system to connect the pieces, as well as to connect the airport to the rest of the metropolitan area. This system almost always includes a limited-access road of some sort, meant to move vehicles at high speed in and out of the facility. These types of roads also provide a good buffer between airport activity and the immediate surroundings. In large cities, a bus or rail transit system may link the airport with the central business district (CBD). The communities or neighborhoods along transit lines may thus indirectly benefit from the airport by means of their access to such a transit system.

The Federal Aviation Administration (FAA) encourages communities to take land use issues into account when preparing a master plan for a new airport. However, local land use planning is not usually part of the airport planning process. Despite the FAA's encouragement, land use concerns, and thus community involvement in the decision-making process, usually enter the picture only in terms of noise exposure or height restrictions. Furthermore, the powers of local governments in regard to controlling land uses do not extend to protecting their citizens from changes in the airport. Expansion plans that are deemed necessary for regional economic growth override local concerns, sometimes to the point of eliminating entire towns.

Most of the literature on metropolitan airports focuses on their place within the urban system as a whole, whether based on location or on their functions as employment nodes. Much of the literature that actually looks at land use focuses on the effects of airports on property values, either through noise pollution or by encouraging ground transportation. The work that explicitly looks at how airports influence the multitude of land uses around them is usually done only for a handful of places, with no attempt made to generalize across locations. Nor has any work been done explicitly comparing the land use consequences of expanding an airport as opposed to building a

new one. While the FAA has acknowledged a gap in its information on the groundside facilities of airports, this gap exists in the scholarly literature as well.

This research is preliminary work on the feasibility of conducting a larger study examining the effects of an airport on land uses in the surrounding community. It examines twelve of the largest airports in the United States. There are two parts to this report: one evaluating the various methodologies employed, and one describing the results achieved with those methods. Chapter 2 reviews literature on airports and land use, while Chapter 3 reviews methodologies used in that literature as well as the methods employed in this study. Chapter 4 presents results from examining all 12 airports, and Chapter 5 compares Minneapolis-St. Paul and Denver as cities that chose different answers to the expand-versus-build question.



CHAPTER 2: AIRPORTS AND LAND USE IN THE LITERATURE

As far as we have been able to determine, there has never been a systematic examination of land uses around airports across the country, nor of the consequences for a metropolitan region of expanding versus moving an airport, both of which this report aims do. The literature on airports and land use falls into four main categories: (1) regional-scale shifts in the economy; (2) the airport planning process; (3) the effects of noise on property values and government efforts to control noise; and (4) a historical approach to land use changes in a particular city or set of cities. This section explains each of these four categories, along with some of the technical issues concerning the question of airport noise. A review of the methodologies employed in this literature appears in the next chapter.

Airports and the Economy

Airports have received a great deal of attention in the literature with respect to their importance to the regional economy. Studies such as Ivy et al. [1] and Irwin and Kasarda [2] identify clear connections between number of flights and service-sector employment, with both indicating that air service has a stronger influence on job creation than vice versa. This linkage is particularly true for hub airports, further encouraging cities to seek airlines to hub at their facilities. Ivy et al. cite a 1989 survey that found that for firms making locational decisions within a metropolitan area, easy access to an airport was second only to easy access to domestic markets, customers, and clients. Irwin and Kasarda found that airline centrality came out ahead of even highway centrality in determining where “producer-service” firms locate, and it was the most important locational factor in their analysis. They conclude, “Because of aviation, the structure of economic interdependence owes less to geographic proximity and more to position in the airline network” [3].

At a more local scale, Taira [4] found that in a survey of 32 Japanese companies with branches in the Chicago metropolitan area, 23 considered accessibility to O'Hare the most important factor in their locational decision, followed by highway access at ten companies, and the existence of customer companies at eight. While this finding might not explain why international firms are drawn to a particular metropolitan area, it does explain why they locate where they do within that region. Finally, Kasarda's exploration of "Global Air Cargo-Industrial Complexes as Development Tools" goes so far as to say, "The combined thrust of [globalization and just-in-time manufacturing] is creating an entirely new economy where aviation and airports will ultimately supplant seaports, rail, and highway systems as the primary job and wealth generators for states and localities" [5].

The 1987 report by Coley/Forrest, Inc., "Ready for Takeoff," comes closest to the aim of this study [6]. It reviews "the timing, scale and type of business development that did occur in the airport environs" [7] of what were the three most recent large-scale airport projects in the United States: Atlanta, Dallas-Ft. Worth, and Kansas City. The report listed nine major findings and described their applicability to Denver. First, a new airport will inevitably draw certain kinds of businesses, but it takes strong marketing to draw businesses that are not directly airport-related. Second, international businesses follow international flights, something Denver is counting on. An upscale image and strong public sector economic development activity can draw businesses to the airport area even if it is in a traditionally underdeveloped sector of the city. Next, a definite order of development was observed: lodging, industrial/office/warehouse (first single-user, then small multiple-user, then large), multistory office buildings, and restaurants. Large-scale developments of over 1,000 acres can make a significant difference in attracting additional development due to their marketing efforts. Finally, air cargo can attract even more development than passenger flights and should not be overlooked as an economic development tool.

These are the types of studies that airport operators and cities often use to justify their need for increasing the size of an airport or relocating the facility altogether. It is undeniable that airports can have a powerful impact on metropolitan economies, both in and of themselves, and as catalysts for other kinds of economic growth. But only the Coley/Forrest study takes those economic impacts

down to the local level, showing what types of land uses are and are not attracted to the airport environs, along with the potential influence that cities can exert over the development process. It is unfortunate that this study looked at only three airports.

Planning Process

If airports have such an important influence over a region's economy, one would think that their planning processes would be particularly well designed, but most authors think otherwise. Paul Barrett, in his historical analysis of aviation policy [8], finds that while airports have long been considered to have important economic effects, they have been treated by planners as almost equivalent to highways in their impact on the surrounding landscape: "Like boosters in nineteenth-century cities seeking railroad connections, civic leaders in our period seemed preoccupied with commercial growth, real estate values, and symbols of urban greatness. Scant attention was paid to how the land surrounding these icons and profit generators was developed;" [9] and "(t)he fact that major airports were not effectively integrated into metropolitan planning in the formative period of commercial aviation still affects inner-city job seekers and noise-ridden suburban homeowners alike" [10]. While Barrett blames this outcome in part on the many actors involved—federal, state, and myriad local governments, as well as airlines and travelers—he also blames it on the failure of cities to realize the land use effects of this particular form of transportation.

Bright's attitude towards the planning process is also negative, but for different reasons. She places more of the blame for poor planning at the federal level, both on the FAA for failing to enforce existing land use regulations, and on the federal appropriations process that requires money to be spent within a defined time limit, thus discouraging careful, thorough planning. For example, she notes that "despite FAA policy statements that indicate funds for new airports will be conditioned on effective noise abatement planning, neither the author nor any FAA official interviewed from Boston to Los Angeles knew of a case where a request for funding was rejected on these grounds" [11]. Especially when airport operators and noise-affected communities are not

one and the same, the former may be unwilling to pay for noise abatement that will not benefit them directly, especially if enforcement is lax.

In contrast, Drollinger states, “The role of the federal government, namely FAA, in airport planning is generally limited to providing funding for airport improvements, land purchase, and technical assistance to state and local governments ... states are primarily involved in preparation of state airport system plans, provision of financial aid for airport development, and technical assistance The land use planning power is generally in the hands of a municipal or county government” [12]. He suggests that local governments are the ones ultimately responsible for land use controls, regardless of federal funding. While Drollinger is mainly concerned with general aviation airports, not large commercial ones, his notion of “right-to-fly” legislation suggests a method similar to right-to-farm laws, allowing airport operators the right to maintain operations over the objections of residents who came along after the airport was in place.

The two articles by Goetz and Szyliowicz [13,14] examine the planning question for a particular place, namely Denver. The infamous Denver International Airport (DIA), the first major airport built in the United States in two decades, garnered a great deal of criticism for being well over budget in terms of time and money. At the time the decision was made to build a new airport, Denver was a hub for two major airlines, Continental and United, as well as the smaller Frontier. The airlines did not want to leave their established facilities at Stapleton International Airport, and so made demands of the city that they would have been unable to make without the threat of moving their hubs elsewhere. Goetz and Szyliowicz note that this additional power of the airlines is unaccounted for by the rational model that the FAA and Denver used to plan the new airport; the resulting lack of flexibility led to increases in costs and time that could not have been foreseen. Furthermore, the passenger forecasts on which the model relies heavily turned out to be wildly. Because these forecasts formed the foundation for the entire process, DIA will probably have excess capacity for many years to come. A more flexible planning process would have been better able to absorb the politics and changing demand of the early 1990s.

Analyzing the airport planning process reveals that many of these plans fail to take land use into account, partially because of the fragmented nature of land use controls. Particularly at airports that are surrounded by a dozen or more municipalities while being owned and operated by the major city, such cooperation can be quite difficult. Lack of cooperation only exacerbates the environmental consequences described below.

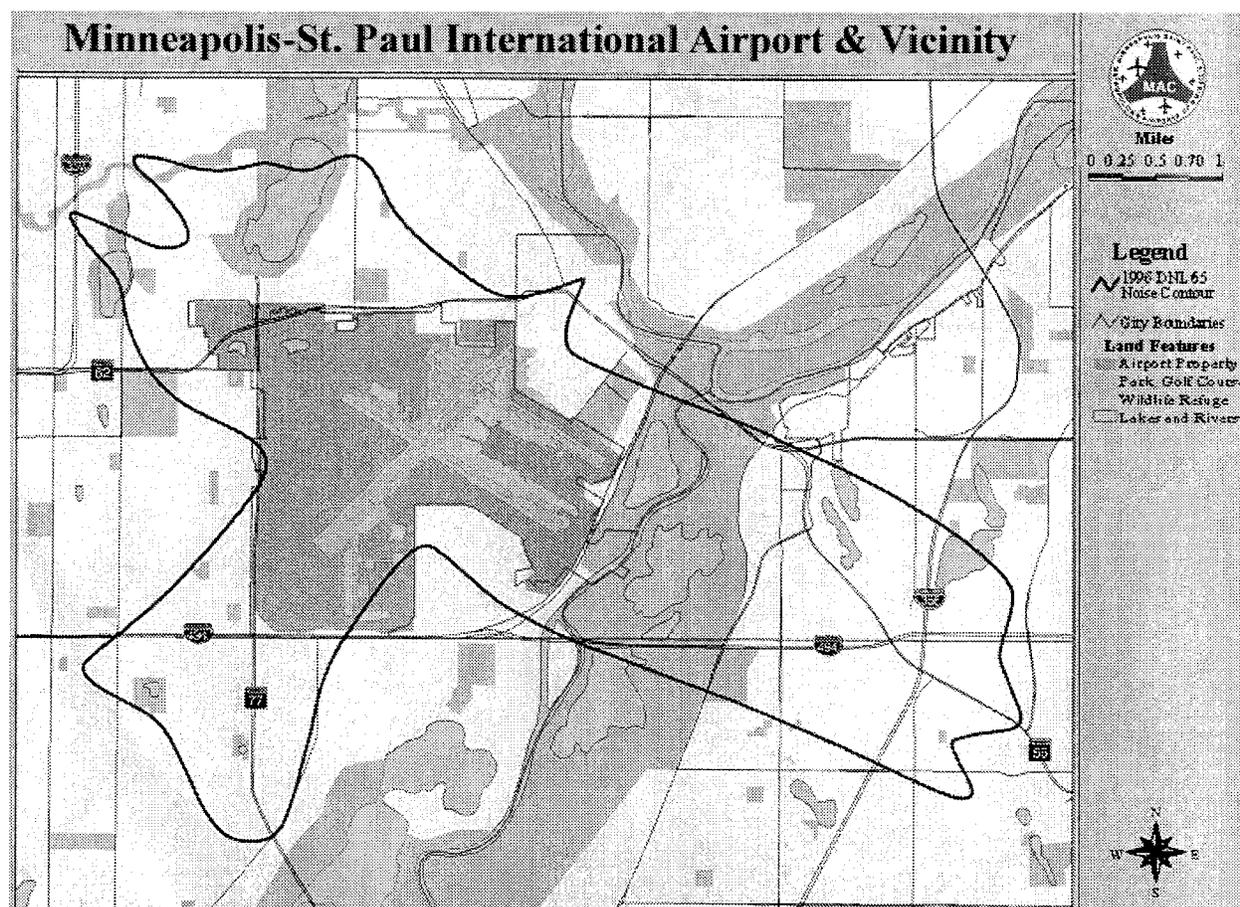
Noise and Property Values

Environmental externalities, particularly noise, have received the most attention in the literature when looking at land use at the local level. In fact, much of the work that has been done on housing values in general has been concerned with the effects of aircraft noise on property values [15,16,17,18,19,20,21,22]. While these studies all conclude that there is a significant decrease in property values for every decibel increase in average noise, they vary as to whether or not that decline is offset by the advantages of living near an airport, that is, whether housing is an incompatible use of land near airports.

Before discussing this particular literature, it is necessary to explain some technical details about how noise is measured in the airport vicinity. The FAA averages aircraft noise over a 24-hour period, resulting in a Level of Day-Night noise recorded as, for example, 65 Ldn. Ldn levels are assessed via computer modeling by “incorporat[ing] such factors as noise level of individual aircraft, number of operations, types of aircraft using the airport, and height of the flight paths” [23]. Noise between 10 P.M. and 7 A.M. is given a weight of ten extra decibels; since the decibel scale is logarithmic, this means that nighttime flights are considered ten times as noisy as daytime ones, due to less background noise and the fact that most residents are sleeping.

When an airport wants to receive federal funding for noise abatement procedures such as soundproofing of nearby residences or schools, it must conduct a study as specified in the Code of Federal Regulations, Chapter 14, Part 150. Part 150 studies require a map of Ldn levels shown as “noise contours,” as in the example in Figure 2.1.

Figure 2.1.—Noise Contours Around Minneapolis-St. Paul International Airport



The contours for 60 Ldn and higher must be shown, and a chart is included indicating what land uses are considered compatible with each level of noise. This chart is reproduced in Appendix A. It is estimated that there are five million people in the United States living in areas that are at 65 Ldn or higher, despite the “incompatibility” of residential land use with that noise level [24]. Part 150 studies are voluntary, so airports unwilling to pay for noise abatement procedures may not want to conduct such a studyⁱ. Appendix A further explains the requirements of a Part 150 study, including local and federal obligations.

ⁱ There may be other reasons as well; Knack and Schwab report that the suburbs surrounding O’Hare opposed a Part 150 study because they did not want property values to go down if houses were identified as being within a certain noise contour.

The noise contours are acknowledged as rough estimates, for they are created by computer model and merely backed up with noise monitoring stations. Part 150 legislation specifically states that “Acceptance of a noise exposure map does not constitute an FAA determination that any specific parcel of land lies within a particular noise contour” [25]. However, there have been cases where houses on one side of a street were torn down as inappropriate land uses, leaving vacant lots that surely reduced the property values of the houses that remained. Furthermore, the averaging method has come under fire from residents (as revealed in Environmental Impact Statements) who feel that the Ldn method does not accurately reflect the noise levels with which they have to live. Living inside the 65 Ldn contour means that the *average* noise level is like having a blender or garbage disposal constantly on and is well over the 45 dB level that can interfere with speech [26, 27]. But this can include houses exposed to near-constant, medium-level noise as well as houses where the walls occasionally vibrate from 100+ dB take-offs.

Despite residents’ complaints of dropping property values, studies throughout the century have been inconclusive as to whether or not living near an airport is automatically undesirable. For example, a 1930 Harvard study said that airports decreased the value of previously developed land, but that since most early airports were built near undeveloped land, land values on average went up. Furthermore, a 1942 survey of 19 cities found that while residential values did decline near airports, business land values rose, and studies in the 1950s found little difference in land values between airport environs and similar regions elsewhere in the metro area [28]. The question seems to be not if land values themselves go up or down, but whether the desirability of a certain kind of land use is changed by the presence of an airport.

Most studies that focus specifically on housing do show a drop in prices due to noise; for example, Nelson’s 1980 review of 13 such studies found a mean depreciation of 0.62 percent in housing value for every Ldn decibel, ranging from 0.4 percent to 1.1 percent per decibel [29]. His own regression, carried out for Census blocks near the airports of six cities, found a depreciation of about half a percent per decibel. O’Byrne et al. found similar results years later for a single neighborhood adjacent to Hartsfield International [30]. Their study used both Census block data

and individual sales data in order to determine the reliability of the Census's owner-estimated housing values. They found a depreciation of 0.67 percent for sales data and 0.64 percent for Census block data. Both of these studies also mention a 1960s study that found depreciation rates of over two percent per decibel, suggesting that the introduction of jet aircraft in the 1950s made a tremendous difference in homeowners' perceptions of the cost of aircraft noise.

Not all of the externalities associated with living near an airport are negative, however, nor are they impossible to overcome. Mieszkowski and Safer, for example, studied residential neighborhoods in the vicinity of Toronto International Airport [31]. They found that while houses within the Ldn 70 contour averaged a 15 percent lower price than houses outside that line, the costs of noise abatement for all of the houses within the contour could easily be covered with a tax of \$1 per airport passenger. However, they acknowledged the potential political difficulties of instituting such a tax, and made some surprising recommendations concerning airports and residential land uses. First, "to the extent that the relative advantages and disadvantages of the expansion of an existing airport versus building a new airport tend to balance out, it is probably much easier politically and administratively to build the new facility, as a compensation mechanism does not currently exist and it is easier (for politicians) to get the passengers to accept a longer trip or a higher cab fare than to pay a noise pollution tax" [32]. But the area around such a new airport, they argue, does not need to be kept house-free: "We also conclude that new residential construction in noise impacted areas should *not* be barred, unless the land has higher value in commercial or industrial development" [33]. They argue that there are enough benefits associated with living a short distance from a major airport that certain people would be willing to put up with the noise in order to attain those benefits.

Tomkins et al. take a similar approach, considering benefits as well as costs [34]. They observe that the traditional approach is to compare *regional* benefits such as economic and job growth with *local* disbenefits such as noise and pollution. Their study of Manchester, England, finds that houses near the airport but not directly under a flight path actually have higher prices than similar houses located at a greater distance. Similarly, houses that are miles away from the airport

but are located under an approach or take-off pattern suffer the disbenefits of noise without the benefits of access. In short, they suggest that the traditional area of analysis—the neighborhoods immediately adjacent to the airport—should instead follow the noise contours, which are more elongated (as shown in Figure 2.1).

Harvey et al. approached the question of airport noise in a different way: how do homeowners react [35]? Do they protest, or move, or do nothing? Their survey of neighborhoods near Buffalo International Airport found some expected results: airport workers are less likely to feel they are stressed by noise, while older households as well as those of higher social status reported more noise stress. Homeowners who are younger and/or better off are more likely to protest noise. But this report also found that length of residence was not a significant factor in stress levels, indicating that residents near an airport do not, in fact, get used to the noise over time. This is an important finding, because airport officials often seem to assume that residents who have lived near an airport throughout its existence have accepted it and its noise as part of the neighborhood.

Controlling Airport Noise

Historically, the federal government has had little influence over the control of airport noise. Beginning in 1926, the Air Commerce Act prohibited federal agencies from building or operating airports. In 1933, the law was changed to allow federal aid to be given to local governments, and many airfields were built in this manner as part of the Depression-era public works projects [36]. As airports and cities grew, especially with the addition of airfields for WWII, Congress considered passing legislation in 1944 that would have allowed the Civil Aeronautics Authority to impose zoning around airports from the federal level. This legislation was defeated, largely due to the U.S. Conference of Mayors, who understandably did not want their local zoning powers usurped [37]. It was not until 1976 that federal funding could be used for land acquisition for noise compatibility [38].

There are two categories of measures that can be taken to reduce residential exposure to airplane noise: operational control (either within airport boundaries or without) and land use. Unfortunately, these measures rarely fall under the control of a single entity, and can be split among different levels of government, multiple municipalities, and private corporations. Furthermore, land use controls can rarely be used after development is already in place, and imposing these controls in advance of development is often politically infeasible. Bragdon's survey of noise control measures at four hundred airports across the country revealed the most common measures actually employed by airports, shown by the percentage of airports that use a particular measure (Table 2.1).

Many of the operational control measures have met with opposition from the airlines. These measures include limiting numbers of flights or times of day at which flights can occur, altering landing or takeoff patterns, using some runways preferentially over others, restricting where and when "ground runups" of engines can be conducted for maintenance purposes, and towing aircraft on the ground rather than having them taxi. Some of the airlines' objections are on the grounds of safety, particularly with regard to taking off at less than full power or at being forced to turn too quickly and/or sharply after takeoff. Curfews are the most opposed form of noise control due to their limitations on airline flexibility, though they may be among the most popular for residents. The two most common measures in this category, ground runup restrictions and preferential runways, have little impact on airline operations, showing the influence the airlines have in the planning process.

Table 2.1. Methods of Controlling Airport Noise and the Percentage of Airports That Employ Them

Operational Control Measures	Percent of airports where used
preferential runways	34.5
ground runup restrictions	23.3
aircraft bans and curfews	20.5
training restrictions	20.1
noise-abatement profiles	13.6
slots and capacity	10.1
noise emission levels/caps	6.4
noise-abatement flight tracks	1.9
aircraft towing	1.2
operational fees	0.7
Land Use Control Measures	
zoning	33.0
comprehensive plan	26.8
land acquisition	19.1
avigational easements	12.1
noise disclosure	8.4
building codes	7.9
capital improvements	4.4
sound insulation	3.9
development	2.4
site design	2.2
land banking	1.7
tax incentives	0.7
subdivision regulation	1.4
Environmental Impact Reports	8.2

Data source: Bragdon 1989.

Land use controls are meant to complement operational controls, either to prevent incompatible uses from coming into being at all, or to deal with pre-existing ones. Unfortunately, since many of these methods are either voluntary or little enforced, they are not always effective. The two most commonly used controls, zoning and comprehensive plans, are rarely set in stone, although they are among the easiest to implement. The two next most common, acquisition of land and avigational easements (air rights), are the most expensive options, but in many cases are the only ones available. It is somewhat surprising that noise disclosure is so rare, since one of the best ways

to keep residents from complaining about noise is to make them aware of its presence when they first move in.

The first set of controls is usually under the purview of the airport authority, either an independent agency or a municipality, with the airlines responsible for most of the actual actions. The latter set of controls is up to the local units of government surrounding the airport, which may or may not include the city that actually owns the airport. The politics of airport noise can thus get quite complicated.

Airports and Land Use

Despite the wealth of investigation into the role of airports in the economy, particularly in the types of jobs and firms they attract, and into the effects of externalities on housing prices, little work has been done concerning the general effects of airports on the land uses around them. The studies that have been done generally look at a specific effect, such as rail access, or at a specific place.

In a technical paper, Shapiro and Katzman did a calculation of the number of vehicle trips generated per passenger for a major airport, then used that to estimate an equation for the number of parking spaces required [39]. They calculated that each originating passenger generates 3.5 daily trips in terms of employees, cargo, and visitors, while each connecting passenger accounts for 0.8 trips per day. This analysis produced the following equation:

$$\textit{Parking spaces required} = 1476 + 0.001427 \times \textit{annual originating passengers}.$$

Thus, for example, an airport such as Minneapolis-St. Paul with approximately 6.7 million originating passengers per year requires nearly 11,000 parking spaces.

McDonald and Osuji investigated the effects of airport ground transportation beyond the airport itself [40]. Their study of residential land along Chicago's Orange Line, from downtown to Midway Airport, found that land values increased by 17 percent three years before the line even opened. Like McAdams's study cited below, this work suggests that the ground transportation links to and from an airport (and not just the highways) can have as large an impact on land use as the airport itself.

Karsner did a historical analysis of three airports—Tucson, Tampa, and Detroit—as one way of getting at the question of land use around airports [41]. He said that the propensity of an airport to attract certain kinds of businesses was first noted nearly sixty years ago:

In a March 1941 article in *Collier's*, W.B. Courtney predicted that in the near future, businessmen would build small manufacturing plants and offices close to airports to take advantage of rapid freight and passenger service. He asserted that for many businessmen, locating near an airport would soon become as important to the success of their businesses as being near railroad depots had once been. This would enhance the real estate value of the land...against most conventional wisdom that saw airports lowering adjacent land value and not attracting much development. [42]

Karsner's analysis pointed out how the differences among the three cities, both in terms of their mix of industries and in the history of their airfields, have shaped the patterns of development in nearby areas. His results will be further explored in Chapter 4. Briefly, he noted that Tampa is a particularly good example of the postindustrial city and its ties to aviation, while Detroit's indecisiveness about where to locate its commercial air facilities meant that development has been slow in coming, and Tucson's defense-heavy business climate meant that industrial parks were initially far more plentiful than hotels in the airport environs.

The only other study discussed here that takes the connections between airports and the economy and applies them at a very local scale is McAdams's thesis on land use around General Mitchell International Airport in Milwaukee [43]. He found, not surprisingly, that there are two main kinds of influences that airports have on their surroundings: direct, from activities such as hotels and air cargo firms that depend directly on flights; and indirect, from activities such as manufacturing and office buildings that find it a locational advantage to be near the airport but not a necessity. In fact, in contrast to the studies mentioned above, McAdams found that many of the firms located along the spur road from I-94 to the airport are located there not because of the access to the airport, but rather because of the access to the interstate highway system. However, this may be largely due to the "shadow effect" of O'Hare, particularly since it is the hub for two major airlines. McAdams concludes that

in many ways the airport's relative location to commercial and consumer markets, the quality of the transportation access, and the amount of easy to assemble vacant land more strongly determined the type and quantity of the related development...[W]hat makes the airport different is that it can buy and clear surrounding residential areas on grounds of creating a noise buffer. This vacated land, which was previously individual residential parcels, can now be reassembled and sold as industrial and commercial property. [44]

Aschman's 1978 study of offices near O'Hare was designed to apply traditional location theory to offices, and to treat airports as the same sort of nodal transfer points as railroad stations and harbors [45]. His first observation was that planners' failure to realize the impact that O'Hare would have in terms of drawing offices and hotels to its environs is one of the reasons the Kennedy Expressway (the link between the airport and downtown) is so congested today. His survey of firms located near O'Hare, as well as in three other suburban office sites, resulted in a number of interesting findings: ORD offices tend to be with firms that "export" their services more than firms in other office concentrations, have more clients outside the metro area, have more employees that travel by air, and have heavier communication flows outside the metro area (as measured by phone calls). However, as compared with three control sites, these offices did not tend to be regional headquarters, have a higher proportion of sales activities, or have a higher proportion with main offices elsewhere in the country. Aschman's work was inconclusive as to whether the location's prestige drew offices, as well as to the importance of highway access or proximity of executives' homes. He found too few businesses directly related to aviation to tell whether or not they clustered particularly around ORD (including aircraft and parts manufacturing, air transportation, travel agents, ticket services, transportation equipment and supplies, aircraft and accessories retailing, aerial photography, and car rental).

Thus, the literature on land use around airports approaches the issue from four different sides, but rarely in a complete manner. One method is to ascertain the regional economic impact of an airport, as well as the likelihood of businesses to locate close to the airport itself. Another is to examine the planning process to determine why there seem to be so many poor land-use decisions by local governments. The third method is to look at a very local level to determine the effects of airport noise on property values, usually in reference to housing. Finally, a few studies have looked

at land use in detail around one to three airports, using a historical approach to explain why the airport neighborhood looks the way it does today.

However, none of these studies attempts to make generalizations about airport land use across the country, at least not based on more than three facilities. One reason is that the above methods are either at too large a scale to show the local land use patterns, or are too detailed to be implemented at more than a few locations. Nor have there been any attempts to compare the land use effects of a decision to build a new airport in contrast to expanding an existing one, largely because there have been so few new major airports in the last several decades. The next chapter reviews the methodologies employed in these studies, as well as the methods tested in this particular research, in order to determine what the best approach would be for a more general examination of land use around airports across the country.

Works Cited

- [1] Ivy, R.L., T.J Fik, and E.J. Malecki (1995). Changes in air service connectivity and employment. *Environment and Planning A*, 27, pp. 165-79.
- [2] Irwin, Michael D., and John D. Kasarda (1991). Air passenger linkages and employment growth in U.S. metropolitan areas. *American Sociological Review*, 56, pp. 524-37.
- [3] Irwin and Kasarda 1991, p. 535.
- [4] Taira, Atsushi (1993). Location patterns and attributes of Japanese companies in the Chicago metropolitan area. *Geographical Review of Japan*, 66, pp. 173-82.
- [5] Kasarda, John (1991). Global air cargo-industrial complexes as development tools. *Economic Development Quarterly*, 5, p.188.
- [6] Coley/Forrest, Inc. (1987). *Ready for takeoff: the business impact of three recent airport developments in the United States*. Denver: Colorado National Banks.
- [7] Coley/Forrest, Inc. 1987, p. 1-1.
- [8] Barrett, Paul (1987). Cities and their airports: policy formation, 1926-1952. *Journal of Urban History*, 14, pp. 112-37.

- [9] Barrett 1987, p. 115.
- [10] Barrett 1987, p. 155.
- [11] Bright, Elsie M. (1982). Secondary impacts of airports: an assessment of planning procedures. *Transportation Quarterly*, 36, p. 86.
- [12] Drollinger, Michael T. (1991). Land use planning approaches to mitigating general aviation aircraft noise. *Transportation Research Record*, 1332, pp. 14.
- [13] Szyliowicz, Joseph S., and Andrew R. Goetz (1995). Getting realistic about megaproject planning: The case of the new Denver International Airport. *Policy Sciences*, 28, pp. 347-67.
- [14] Goetz, Andrew R., and Joseph S. Szyliowicz (1997). Revisiting transportation planning and decision making theory: the case of Denver International Airport. *Transportation Research, A* 31, pp. 263-80.
- [15] Bragdon, Clifford R. (1989). Control of airport- and aircraft-related noise in the United States. *Transportation Research Record*, 1143, pp. 12-16.
- [16] Nelson, John P. (1980). Airports and property values: a survey of recent evidence. *Journal of Transport Economics and Policy*, pp. 37-51.
- [17] Tomkins, J., N. Topham, J. Twomey, and R. Ward (1998). Noise versus access: the impact of an airport in an urban property market. *Urban Studies*, 35, pp. 243-58.
- [18] Knack, Ruth Eckdish, and Jim Schwab (1996). Learning to live with airports. *Planning*, pp. 11-15.
- [19] Mieszkowski, Peter, and Arthur M. Safer (1978). An estimate of the effects of airport noise on property values. *Journal of Urban Economics*, 5, pp. 425-440.
- [20] McDonald, John F., and Clifford I. Osuji (1995). The effect of anticipated transportation improvement on residential land values. *Regional Science and Urban Economics*, 25, pp. 261-78.
- [21] O'Byrne, Patricia Habuda, Jon P. Nelson, and Joseph J. Seneca (1995). Housing values, Census estimates, disequilibrium, and the environmental cost of airport noise: a case study of Atlanta. *Journal of Environmental Economics and Management*, 12, pp. 169-78.

- [22] Harvey, Milton E., John W. Frazier, and Mindaugas Matulionis (1979). Cognition of a hazardous environment: reactions to Buffalo airport noise. *Economic Geography*, 55, pp. 263-86.
- [23] *Airport Noise Compatibility Planning* (1993). *U.S. Code*. Vol. 14, Part 150, p. 24.
- [24] Bragdon 1989.
- [25] *Airport Noise Compatibility Planning* 1993.
- [26] El Toro Reuse Planning Authority (1999). The El Toro Airport info site. <http://www.eltoroairport.org>, May 6.
- [27] Federal Aviation Administration (1983). Noise control and compatibility planning for airports. AC 150/5020-1.
- [28] Barrett 1987.
- [29] Nelson 1980.
- [30] O'Byrne et al. 1995.
- [31] Mieszkowski and Safer 1978.
- [32] *Ibid.*, p. 434.
- [33] *Ibid.*, p. 435.
- [34] Tomkins et al. 1998.
- [35] Harvey et al. 1979.
- [36] Szyliowicz and Goetz 1997.
- [37] Barrett 1987.
- [38] Bright 1982.
- [39] Shapiro, Phillip S., and Marcy Katzman (1996). Relationships between airport activity and ground transportation needs. *Transportation Research Record*, 1622, pp. 8-12.
- [40] McDonald and Osuji 1995.
- [41] Karsner, Douglas (1997). Aviation and airports: the impact of the economic and geographic structure of American cities, 1940s-1980s. *Journal of Urban History*, 23, pp. 406-36.
- [42] *Ibid.*, p. 408-409.

[43] McAdams, Michael (1995). *The land use impact of an airport and urban structure: a case study in Milwaukee, Wisconsin*. Ph.D thesis, University of Wisconsin-Milwaukee.

[44] Ibid., p. 189-190.

[45] Aschman, Michael P. (1976). *Three miles from L.A. and New York: a study of intrametropolitan office location near Chicago-O'Hare International Airport*. Ph.D. thesis, Syracuse University.

CHAPTER 3: METHODOLOGIES

This chapter examines different methodologies used in exploring land uses around airports. Results of these methods are presented in the next chapter. This chapter discusses only the merits and disadvantages of each of the four methods: topographic maps, zoning maps, qualitative data, and mapping Standard Industrial Classification (SIC) codes. Since one of the overall purposes of this inquiry is to determine the feasibility of a larger study about airports and land use, it is important to know which methods are most helpful. First, we briefly review the methodologies employed in previous studies of land use around airports; then, we explain how we chose which particular airports to study; finally, each method used is explained and evaluated in two ways: the process of obtaining dataⁱⁱ and the usefulness of the data.

Methodologies in the Literature

Since two of the three articles reviewed here used SIC codes, as did we, this classification method needs to be explained. SIC codes were first invented in 1938 to enable economists to better study what kinds of businesses existed in the United States and where they were locatedⁱⁱⁱ. SIC codes have four digits, the first describing one of eight general sectors such as Services or Wholesale Trade, with each successive number specifying additional detail. For example, all codes starting with 6 refer to establishments engaged primarily in “Finance, Insurance, and Real Estate” businesses; numbers beginning with 60 refer to “Depository Institutions;” numbers beginning with 606 refer to “Credit Unions;” and the individual code 6061 belongs to Credit Unions—Federally Chartered. SIC codes are used by private companies and are mandated by the

ⁱⁱ To some extent, the availability of certain kinds of data was limited by time constraints; on a larger project, some methods would be more feasible when there was more than a month available to gather data.

ⁱⁱⁱ The U.S. has recently joined with Canada and Mexico to produce the North American Industrial Classification System (NAICS), which will be used for all data after 1997. Since the most recent data available are still in SIC form, that is what we will be describing here.

Office of Management and Budget for use by the Census Bureau and other federal agencies (the differences between these sources will be elaborated on later).

The first study mentioned in the previous chapter, Ivy et al.'s study of the relationship between air service and employment, used "administrative and auxiliary workers" as a proxy for professional employment [1]. In the Census Bureau's annual publication, *County Business Patterns*, each of the eight general sectors determined identified by SIC codes has a category called administrative and auxiliary workers.^{iv} The authors then used these data to obtain the total number of professional workers for a metropolitan area, based on the Census delineation of Metropolitan Statistical Areas. A statistical analysis of the relations between the number of professional workers and a measure of connectivity based on air service, with both numbers taken for each year from 1978 to 1988, yielded the results described in the previous chapter.

McAdams used a few specific SIC codes to determine the actual distribution of businesses that are thought to be drawn to the airport vicinity, such as trucking, warehousing, hotels, and so forth [2]. He also gathered data at the general sector or one-digit level to determine what overall pattern of uses existed in his study area. Data were gathered for the years 1980, 1985, and 1993. He used two control sites elsewhere in the Milwaukee metro area to determine if changes over time at the airport vicinity were indicative of larger-scale trends. McAdams obtained his information from the City of Milwaukee Property Information Database, which meant that he had parcel-level data down to the four-digit SIC code. These data meant that he could track changes in assessed value by parcels, as well as building area, lot area, cost per square foot, and residential use. This wealth of data made possible an informative study of Milwaukee, but it would be difficult to carry it out for more than two or three locations, both because of the time involved and because such information may not be available for all cities.

^{iv} SIC codes are assigned to places of work, not to workers themselves, so that those employees who perform service duties in a non-service establishment (such as an accountant in a factory) would not be counted as service workers, and vice versa. Ivy et al. attempted to get around this problem by using *County Business Patterns* rather than SIC establishment data.

Karsner's historical analysis used materials from city archives, newspapers, and scholarly sources to reconstruct the land use changes that took place around Tampa, Detroit, and Tucson from the 1940s to the 1980s [3]. This methodology is an example of qualitative analysis described below, and like McAdams's work, it is quite useful for a small number of airports. However, the amount of work and travel involved make it less useful when trying to establish broader generalizations about land use around airports.

Selecting Airports for Study

The first step in this project was to choose the number and location of the airports to evaluate. We began by taking the FAA's data on Primary Enplanement Activity for 1997, the most recent year available^v [4]. Of these 431 airports, those that serve at least 1 percent of the total enplanements in the previous year (640 million in 1997) are termed Large Hubs (not to be confused with hubs designated by individual airlines in their operations), usually around thirty airports each year. We decided that twelve was a manageable number to work with, and so we chose twelve of the Large Hubs in order to balance the following criteria:

- One current or former designated hub for each of the six major airlines (United, American, Continental, Northwest, USAirways, and TWA), as well as airports that are not airline hubs;
- Location near the center of a city versus the outskirts;
- Different regions of the United States; and
- Growing versus stagnant metropolitan areas.

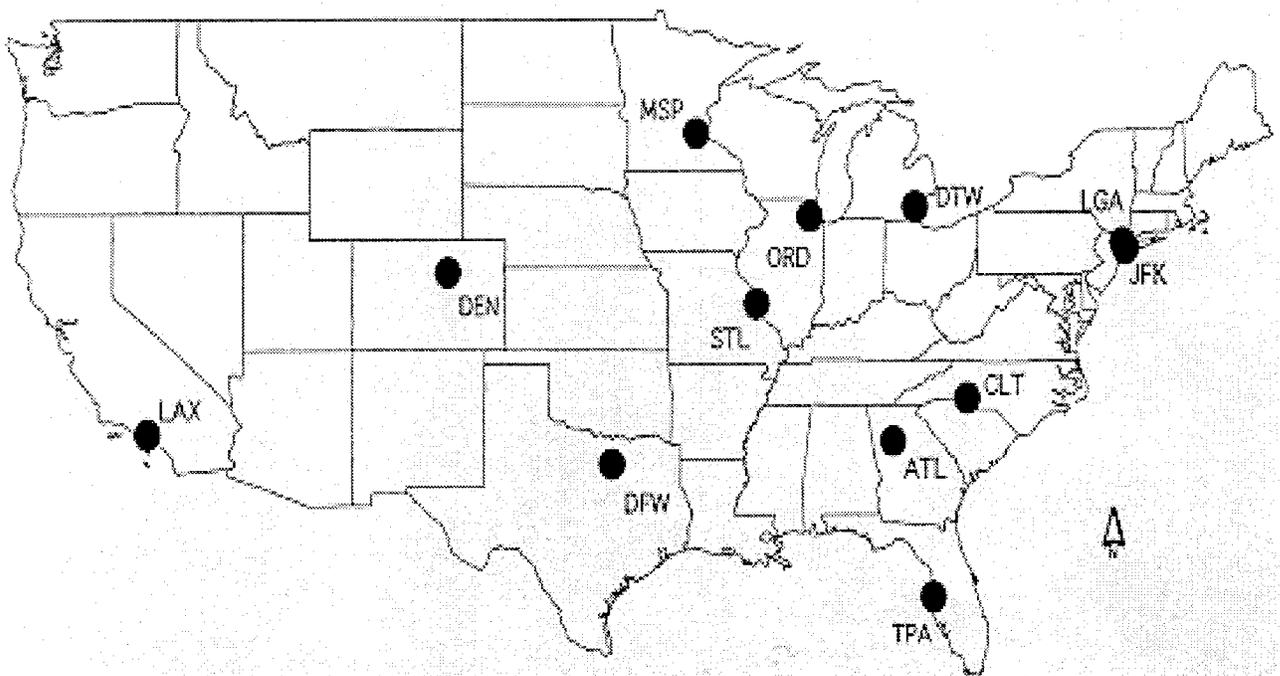
The twelve airports chosen were: LaGuardia Airport and John F. Kennedy International Airport (both in New York City); Charlotte/Douglas International Airport (Charlotte, NC); Hartsfield International Airport (Atlanta, GA); Tampa International Airport; Detroit Metropolitan

^v Primary airports are those that serve at least 10,000 passengers per year; enplanements refer to the number of people that board a plane at a particular airport. This means that a traveler who changes planes along his or her journey (common at hub airports) is counted twice, whereas a passenger whose flight makes a stop but continues in the same plane is counted once. FAA aid to airports is based in part on number of enplanements. Since enplanements count only passengers boarding, there are approximately twice as many people passing through an airport in a given year as are accounted for in this data.

Wayne County Airport; O'Hare International Airport (Chicago, IL); Minneapolis-St. Paul International Airport; Lambert-St. Louis International Airport; Dallas-Ft. Worth International Airport; Denver International Airport; and Los Angeles International Airport (Figure 3.1).

Having chosen the airports to study, the next task was to apply the different methodologies to each of them. Not all data were available for each place; this is taken into account in the evaluation of each method. Again, Chapter 4 describes the results obtained in the research; Chapter 3 merely describes the merits and disadvantages of each method used.

Figure 3.1 Selected Airports.



Topographic Maps

Topographic maps are created by the U.S. Geological Survey and are a good starting point for land use research. They are standard across the entire country, and include roads, urban areas, large buildings, and physical features such as height contours and wetlands. Their scale of 1:24,000

(1 inch=2,000 feet) is appropriate for this sort of work. The main drawback to using topographic maps is that their updating time can vary from five to ten years. Moreover, land uses have to be largely inferred from building shapes, presence of highways or railroads, natural features, and road patterns. However, as industrial or large commercial buildings are shown individually, while houses are not, this inference is relatively easy. Airport terminals are among the buildings shown, which makes it possible to determine where passengers and cargo exit the airport grounds. The main advantage of topographic maps is their ubiquity: they cover the entire country in a standard fashion, and do not stop for municipal boundaries. Also, they show any physical limitations such as rivers or hills that might constrain development to certain areas.

Zoning and Land Use Maps

Zoning and land use maps are produced by individual municipalities and show the authorized and/or actual uses to which individual parcels are being put. The last chapter mentioned that zoning is the most common control that local authorities employ to make land uses compatible with airport activity. For this reason, zoning maps are quite helpful in that they show what steps a municipality has taken to ensure compatibility with the airport. On the other hand, zoning is criticized as an ineffective method of land use control because of its excessive flexibility, so zoning maps may not reflect actual uses, or the categories may be extremely broad.

It thus becomes necessary to obtain zoning maps, which show the planned use of a parcel, as well as land use maps, which show the actual use of that parcel. The process of obtaining the maps ranged from easy to difficult, and most of the maps cost more than expected, especially since up to ten different cities were needed for a particular airport. Since many of the municipalities in question operate with tight budgets, some that we contacted did not have zoning maps available; it is even less likely that digital maps would be available for more than the largest cities. Besides their cost, these maps are often physically large and are different from one another in terms of scale and zoning designations, making comparison difficult even within metropolitan areas as well as from place to place.

Of course, if zoning and land use maps are truly useful, then cost and accessibility problems are less important. These maps are highly detailed, portraying land uses at nearly the parcel level, data not obtainable in other ways. Also, they are available to the public, unlike some forms of data. Zoning maps in particular show the steps a city has or has not taken to make land uses compatible with airport operations, including in some cases Airport Noise Overlay Districts. Maps in communities directly adjacent to an airport may also include Part 150 noise contours, making it easy to see to what extent compatible uses have been achieved. On the other hand, of the fifteen zoning maps of communities adjacent to an airport, nine failed to mention its presence across the street, which may be an indicator of how important the airport is in their planning. In short, for research focusing at an extremely local level, zoning and land use maps can be quite useful, even when they are almost too detailed and expensive.

Qualitative Methods

In this study, qualitative methods included reading newspaper and magazine articles, studying results of previous research, traveling to particular places for fieldwork, and conducting interviews. The first method, reading articles in the popular press, is effective at bringing forth questions about particular areas or developments that one would not otherwise think of asking—for example, how land prices are rising in the Shepard-Davern neighborhood of St. Paul as a result of the nearby airport’s expansion. This anecdote illustrates the limit of this method’s worth, however, as the press covers “newsworthy” items rather than shows trends across space or time. Many newspapers do not have online, easily available archives, and the time it takes to search through years of microfilmed editions in search of a few tidbits of information can be hard to justify.

Many of the studies reviewed in the previous chapter included airports that were also on our list, which meant that we were able to learn from those studies’ specific findings. Of course, this is not a reliable way to examine multiple airports, since the same methods were not used from study to study, but it is a useful way to obtain basic information about a specific airport and its environs if that airport has been chosen for study.

Field work and interviews, on the other hand, are the best ways to answer questions raised through any of the other methods discussed here. Traveling to Denver made it possible to not only get an idea of what the place looks like, something that maps alone can not do, but to come across contacts that we would not have known about without physically going there. Of course, the expense involved makes it impractical to visit more than a few locations, but for research focusing on a particular place, there is no substitute for an on-site investigation.

SIC Codes

The final method we employed, and the one that took the most time, was that of mapping businesses by their SIC codes, explained above, for all ZIP code areas containing the sample airports and adjacent to them. This particular method requires a little more explanation before it can be evaluated. Overall, it shows the most promise for investigating *business* activity around an airport, though not land use in general.

There are two main sources of SIC data: a privately produced directory known as the Dun & Bradstreet Regional Business Directory (D&B) [5], and the U.S. Economic Census [6]. Both of these sources break down data by ZIP codes and both are updated yearly (the Census for counties or ZIP code areas). Both also list *companies* rather than *establishments*, so that the headquarters for a hotel chain, for example, would be counted as a hotel business, even though the building serves only administrative functions.

There are some differences between the two sources as well. Census data are available online for no charge and attempt to include all businesses within a ZIP code. On the other hand, they list only one SIC code per establishment, so that a factory that produces two different products would only be listed under the code for the product it makes the most of. Also, businesses are only counted, not listed as individual firms, so no data are available about size, age, or street address. D&B does list all SIC codes associated with a particular business. However, since it only includes the 20,000 largest businesses in a metropolitan area, it lists only about half to a third of the businesses covered in the Census, and certain sectors dominated by smaller establishments, such as

retail, tend to be underrepresented. Furthermore, since this is a directory that is intended to make a profit, it is generally only available in the cities for which it is produced. This means that numerous inter-library requests are necessary, and even then, all of the data may not be available. While business listings include street address, phone number, size, and age, leaving open the possibility for more detailed research, there are no totals by SIC code for a ZIP code, which means that extensive tabulations must be done. One advantage of D&B is that it cross-lists businesses by SIC code, so that, for example, all of the car rental agencies in the directory can be pinpointed by ZIP code or address. D&B also tends to define metropolitan areas as larger in geographic extent than does the Census, often including almost an entire state.

Since we did not discover the usefulness of Census data sources until late in the project, we used the D&B data for much of the analysis described in the following chapter. For each airport, we identified the ZIP code(s) containing the airport itself and the ZIP codes immediately adjacent. We then requested two kinds of information for each metropolitan area: the pages listing all of the establishments for a particular ZIP code, and the pages listing all of the establishments under the six SIC codes we thought most likely to be located near an airport^{vi}. We requested this information for both the 1990 and 1999 directories, but rarely received it for more than 1999; however, most cross-date comparisons showed insignificant change over that relatively short time period. Also, for some reason, we received more data by ZIP code than by SIC code, so the results in the next chapter focus on that type of data.

Once we had the ZIP code data, we tabulated all businesses in each ZIP code by their two-digit SIC code; for example, Air Courier Services (4513), Air Transportation Scheduled (4512), and Airports, Flying Fields, and Airport Terminal Services (4581) were all counted as 4500. D&B lists branches of a company separately, but if a business was listed twice with the same SIC code, same address, and same telephone number, it was counted only once. For the relevant ZIP codes in each airport region, we made two maps: one showing the distribution of the six codes thought most

^{vi} The six codes were as follows: Aircraft Manufacture, Freight Transfer, Non-Local Trucking, Air Transportation, Hotels and Motels, and Passenger Car Rental.

likely to be near the airport; and one showing the distribution of businesses by the most general sectors. We also compared the mix of sectors with the overall mix for the metro area, as defined by the Census and recorded in the 1992 Economic Census^{vii}.

Overall, the SIC method is the best one for more traditional airport research: what businesses locate near an airport, or, in other words, what economic influence does an airport have on its surroundings? These data could be used for further research, particularly by mapping firms based on their address for determining how businesses cluster in certain areas, or by contacting different types of firms located near an airport in order to determine how much of an influence the airport was when making their locational decision. A more detailed analysis of the metro-wide distribution of firms that are expected to be located near airports would also be interesting, including more analysis into what those expected firms might be. Since drawing businesses to a metro area is one of the justifications most often given for airport expansion, it is important to know where those businesses end up locating. However, for looking at land use in a more general way, which was the topic of this study, SIC codes are not an appropriate method, and the majority of work time should not have been spent on it.

Other Methods

There are a few methods that were not employed in this study that might be of value in a larger study. One is the use of a sequence of air photos, which would be an excellent way to examine not only what kinds of land uses can be found in an area, but also how they have changed over time. Zoning and land use maps are usually maintained only in an updated form, and topographic maps are not updated on a regular basis in the same manner as air photos. Exploring the *change* in land uses over time is an issue that we were unable to investigate as much as we would have liked, partially because of the methods we were using. Air photos would help to solve that, though obtaining and interpreting them can be expensive.

^{vii} As explained above, this is not necessarily a good match; not only does the Census list many more businesses, but it tends to include a larger percentage of certain sectors than does D&B.

Another method that was not fully explored was the use of digital land use data. Metropolitan planning organizations often have land use data available in digital form, which then can be manipulated through a GIS to obtain more quantitative results than are available from simply examining a paper map.

In short, a combination of methodologies is the best approach. Topographic maps are a good, cheap, easily available starting point and contain a surprisingly large amount of information on their own. Zoning and land use maps are more limited because of their focus on a particular municipality, but they provide data on specific land uses that are unavailable from topographic maps. Qualitative analysis both raises additional questions and finds ways to answer them, particularly when fieldwork is part of the analysis. Finally, the SIC code analysis provides a way to determine the kinds of businesses that locate near an airport; while these results are more detailed, they are also one of the most useful sources of information for nearby local governments. The next chapter shows the results of applying these methods to twelve different airports, while Chapter 5 shows what happens when they are used in more detail on two specific case studies.

Works Cited

- [1] Ivy, R.L., T.J Fik, and E.J Malecki,. (1995). Changes in air service connectivity and employment. *Environment and Planning A*, 27, pp. 165-79.
- [2] McAdams, Michael (1995). *The land use impact of an airport and urban structure: a case study in Milwaukee, Wisconsin*. Ph.D. thesis, University of Wisconsin-Milwaukee.
- [3] Karsner, Douglas (1997). Aviation and airports: the impact of the economic and geographic structure of American cities, 1940s-1980s. *Journal of Urban History*, 23, pp. 406-36.
- [4] Federal Aviation Administration (1999, September 1). Airport activity & development statistics home page. <http://www.faa.gov/arp/A&D-stat.htm>.
- [5] Dun & Bradstreet (1999). *D & B Regional Business Directory*. Bethlehem, PA: Dun & Bradstreet.

[6] United States Census Bureau (1992). Economic census 1992. <http://govinfo.kerr.orst.edu/econ-stateis.html>, September 3, 1999.



CHAPTER 4: THE GROUND SIDE EFFECTS

This chapter presents results of the four methods described in Chapter 3. First, the major and minor findings are reviewed, then the individual airports are described. Because Minneapolis-St. Paul and Denver are of special interest, they follow as Chapter 5.

Major Findings

There is an inevitable tradeoff between local disbenefits and regional benefits.

Airport expansion or relocation is often phrased as essential to the economic health of a metropolitan area. It is true that air service can drive up professional employment and the number of international firms with branches in a particular city. But the local economy of the airport environs may suffer as a result. Besides the inevitable complaints from residents about noise or pollution, other effects may appear as well. Housing prices are threatening to increase beyond affordability in the neighborhood of St. Paul nearest to Minneapolis-St. Paul International Airport (MSP) because of the land's attractiveness to car rental agencies and hotels. At the other extreme, the relocation of residents due to runway expansion is paid for in part by the airport, but businesses that lose customers in such a fashion are not. In nearly all the cases reviewed, where an airport is located in the suburbs it is owned and operated by the central city, sometimes even without being contiguous to that city. The lack of political voice for the affected residents in such a situation only makes it worse.

There is a paradox of local land use responsibility versus federal control of the aviation system.

Most of the actions that can be taken to minimize incompatible land uses are the responsibility of local governments, and the FAA itself washes its hands of any responsibility for such measures. Towns such as Eagan, MN, or Bridgeport, MO, are expected to zone themselves to keep residential development out of the noisiest areas, while airport operators are responsible for making sure airlines and pilots follow approved flight patterns. But that local control only extends

so far. Communities such as Bridgeport have attempted to assert their municipal land use rights, only to be told by the courts that regional and national needs take priority. It is a difficult situation.

Unlike the traditional roads-versus-development question, it is undeniably airports that drive development, and the lack of development that encourages airports.

To some extent, development precedes airports at a metropolitan scale, but its absence drives airport siting. The Twin Cities' proposed new airport would have gone in the slowest-growing sector of the metro area, not the one with the most demand for air travel. Denver's new airport was sited as close to downtown as there was open land available, which means it is in the largely undeveloped northeastern sector. While the selection of this site is logical, it means that air transportation is not the same as other kinds of transportation as regards its connections with land use. Communities may encourage airport expansion or reorganization because of the development that they assume will come their way; however, the type of development to follow is not always a given.

As a corollary, an airport will probably not change the character of development within its geographical sector.

Denver is planning on warehousing and freight transfer to continue moving out in the direction of its new airport, not the office buildings and high-tech industries that are as of yet absent from the northeast sector. Dallas-Ft. Worth drew the same kind of office buildings in its direction that were already in existence in the northern part of the metro area. Even though Atlanta has attracted a great deal of international business with its improved air service, that business has chosen to locate on the side of town opposite from the airport, because that is where office development has traditionally gone. Coley/Forrest noted that it takes active boosterism by local officials to bring any more development to the area than that dependent directly on the airport.

Cities that do not directly adjoin airports, but are still affected by noise, tend to experience the same disadvantages as adjoining cities but receive fewer benefits.

Of the noise complaints received by MSP in May 1999, the second largest number came from Inver Grove Heights, on the other side of Eagan and Mendota Heights from the airport [1]. St. Charles, MO, on the far side of the Missouri river from Lambert Field, is considering suing the airport for neglecting to consider the effects of noise on its residents in its Environmental Impact Statement, even though they are not located in the official noise contours. Because of development pressures, cities such as these may not be able to plan far enough ahead to zone buffer land, so that as airports expand and noise worsens (but not enough to qualify for federal aid), their residents are stuck. At the same time, they are usually too far away to take advantage of the land uses such as hotels or warehouses that are drawn to the airport environs^{viii}.

Other Findings

These findings are based on observations from the topographic, zoning, and SIC maps that were examined.

Other undesirable, Not In My Back Yard (NIMBY) uses tend to be located near airports.

Several of the airports examined had sports stadiums nearby, a number had sewage treatment facilities, and a few had prisons. The first use may also be taking advantage of good ground transportation links, but all three are uses that take up a great deal of space and are no more “compatible” with residences than an airport.

Water or parks are good buffers for safety and noise reasons.

Three of the airports have large parks or preserves bordering at least one side of the airport, while four have water close at hand. Not only are these uses more compatible with noise than residences, but they make safer surfaces than concrete in case of a missed landing or takeoff.

^{viii} For example, a survey of industrial developers in Atlanta found that the ideal location features access to the airport road and visibility of planes landing and taking off [2].

The larger the city and more specialized the airport, the more specialized the land uses.

Tampa and Charlotte, the two smallest cities, have the greatest similarity between the breakdown of firms located around the airport and those in the metro area as a whole. In New York City, LaGuardia and JFK serve different purposes, and this is revealed in their patterns of land use, which are different from each other and from anywhere else.

Airports that have exits for people and cargo on different sides of their property reflect that difference in the kinds of businesses that locate at each side.

Atlanta, Charlotte, and Tampa all send passengers and cargo in different directions from the runways. This separation of traffic is reflected in the zoning and land uses that appear on each side. Especially in cases such as Atlanta, where each side of the airport is under the jurisdiction of a different city, differences in traffic flows can result in different reactions on the part of those cities to airport activities. Communities on the east side of Hartsfield, where development tends to be industrial in relation to the cargo exit, support the proposed new terminal on their side of the airport in order to gain the service-oriented development that occurred on the west side when the main terminal moved there in the 1980s.

Communities can be creative when dealing with the effects of airport noise.

There have been a number of situations where communities went to court against airports or even airlines over what they perceived as violations of their rights. They have almost always lost. One action that is more within the power of a local community is zoning—not just placing residential uses out of the way of noise, but creating districts such as Bridgeton, MO's, "Travel/Entertainment Services District" to draw specific, airport-related uses as a way of compensating for development opportunities lost to airport land. Alternatively, communities may embrace their role as the gateway to an international airport; El Segundo, CA, and Romulus, MI, for example, include an airplane in their town seals.

Locating airport-related businesses off airport property can make a difference in communities' opinions of airport expansion.

As a condition for allowing land condemnation for a fifth runway, the city of College Park, GA, is negotiating with Atlanta to move the car rental agencies that are currently located on airport property into College Park instead, so the city can benefit from a car rental tax. On the other hand, St. Paul residents are not pleased with developers' plans to create more off-airport parking immediately across the Mississippi River from the airport since there is no more room at the airport itself. Denver has chosen to locate all car rental agencies within its airport land; there are already two park-and-fly lots immediately outside the Denver city line, encouraged by neighboring governments that want their share of the economic development. Texas passed a state law allowing municipalities that gave up land for the new Dallas-Ft. Worth airport to retain the taxes from any businesses built on that land as a way of gaining their cooperation. As more and more airports move towards incorporating shopping malls inside their terminals, this issue may become more important.

Based on SIC data, some expected sectors such as transportation are concentrated in the airport environs, but some expected firms such as finance, insurance, and real estate are not. When the proportion of firms in each industry at or near each airport is tabulated using D&B data (Table 4.1), the results diverge significantly from the proportions calculated from Census data (Table 4.2).

Unsurprisingly, the transportation sector accounts for a much higher proportion in areas immediately around the airport as compared with the whole metro, since aviation firms are usually found only in the immediate vicinity, and trucking and warehousing firms are drawn to the area as well. Another easy-to-predict result is the spatial separation between hotels and car rental agencies, usually found near passenger exits and towards the CBD, and freight transfer and warehousing firms, found more often near cargo exits and closer to the urban fringe. There is usually more

manufacturing in the airport environs than elsewhere, a function of its compatibility with aircraft noise and its need for air and ground transport.

One surprising finding was the relatively lower percentage of finance, insurance, and real estate firms as compared with the metropolitan areas at large. The theory that financial or insurance firms locate near the airport for their frequent travelers seems not to be the case. Another unexpected result was that the presence or absence of a hub did not seem to affect the types of businesses nearby, since the non-hub, non-New York cities failed to show notably different mixes when comparing airport environs with metro totals. However, the role of an airport within a multi-airport system did display a striking difference in land uses, as with JFK versus LaGuardia.

Table 4.1. Firms in the Airport Environs by SIC Sector

	ATL (%)	CLT (%)	DEN (%)	DFW (%)	DTW (%)	JFK (%)	LAX (%)	LGA (%)	MSP (%)	STL (%)	TPA (%)
Constr.	6	11	10	7	5	3	15	3.4	5	8	8
Mfg	12	15	21	11	22	2	17	15	12	15	10
TCU*	23	13	14	13	18	66	9	23	12	14	6
Wholesale	11	20	24	14	10	5	13	9	12	14	13
Retail	9	10	10	12	16	8	21	8	47	15	12
FIRE	5	4	2	10	5	4	7	6	9	4	13
Service	34	28	21	33	25	13	18	34	33	29	37
Total	666	1309	2029	1358	1056	155	135	753	1048	576	1886
Land Area (Sq. miles)	79	76	846	N/A	196	21	14	28	43	33	32

*TCU=Transportation, Communication, and Utilities.

Note: The sectors for Agriculture and Public Administration were eliminated, as they were always below 1 percent.

Data source: Dun & Bradstreet Regional Business Directories for Atlanta (1998), Charlotte (1999), Denver (1999), Dallas-Ft. Worth (1999), Detroit (1999), New York City (1990), Los Angeles (1999), Minneapolis-St. Paul (1999), St. Louis (1999), and Tampa (1999). No appreciable difference was found between 1990 and 1999 data for those cities for which both were available.

Table 4.2. Firms in the Metropolitan Statistical Areas by SIC Sector, 1992

	ATL (%)	CLT (%)	DEN (%)	DFW (%)	DTW (%)	JFK (%)	LAX (%)	LGA (%)	MSP (%)	STL (%)	TPA (%)
Constr.	9	12	9	7	9	6	6	6	9	12	9
Mfg	6	8	6	7	9	7	9	7	8	7	5
TCU	3	3	3	3	3	4	3	4	3	4	3
Wholesale	11	12	10	12	9	11	10	11	10	10	8
Retail	23	24	21	23	26	23	21	23	23	28	25
FIRE	11	10	12	12	8	15	10	15	10	11	12
Service	37	31	40	38	36	35	40	35	37	39	39

Note: The Agriculture sector was eliminated, as its percentages were always below 1 percent. Data source: U.S. Economic Census, 1992. The smallest available area was taken, i.e., the New York City PSMA instead of the three-state CMSA.

Having reviewed the major and minor findings, we now present the data, sorted by airport (in alphabetical order). These data are in the form of qualitative information about each place, and include observations from topographic and zoning maps and a summarization of the SIC maps. Minneapolis and Denver, as the two case studies, form a separate section at the end, in order to better compare the airport that chose to stay with the airport that chose to move.

Hartsfield International Airport, Atlanta, GA

<i>Date founded</i>	1929
<i>Distance from CBD</i>	9 miles south
<i>Size</i>	3,750 acres
<i>Metro population, 1990</i>	3.0 million
<i>Rank in passengers, 1997</i>	#1 (33.2 million)
<i>Percent O&D*</i>	36.7
<i>Rank in cargo, 1997**</i>	#16 (2.2 million tons)
<i>Rail transit access</i>	Yes

*O&D refers to "Origin and Destination" passengers, those who are leaving from or arriving in an airport specifically for that city, not simply changing planes there.

**These data are taken from FAA statistics and count only all-cargo flights; since most cargo is actually carried in passenger planes, the total figures should be much higher.

In the words of Mayor Andrew Young, "No City owes as much to its Airport as Atlanta does to Hartsfield Atlanta International" [2].

Nine miles south of the city of Atlanta, today's Hartsfield International Airport is located in an area more reliant on manufacturing and freight transfer than on offices of the international

corporations that it draws to the metro area. Hartsfield is a prime example of the effects that near-continuous airport expansion can have on neighboring communities. It also raises the question of whose economy actually enjoys airport-related growth.

As with so many municipal airports around the country, Atlanta's was built in the late 1920s aviation boom, just in time for the Depression. Passenger traffic grew quickly after WWII, and by the 1960s, two runways for jet planes were built, along with a modern terminal on the northern side of the airfield. The Master Plan that was drawn up in 1968 proved to be quite accurate in its passenger forecasts, correctly predicting the 45 percent increase in passenger traffic from 1970 to 1980.

In the mid-1970s, Atlanta was faced with the classic question: expand or move? Hedging their bets, city officials purchased two 10,000-acre tracts of land to the northeast and northwest of the city in 1975, making them the only major airport operators in the U.S. to participate in "land banking" (they still own the land today). The airport was completely redesigned in the late 1970s, which included adding two more runways, lengthening existing ones, and moving the terminal from the northern to the western side of the airfield. In keeping with the airport's role as a major hub for Delta, the terminals were designed as parallel strips that could be lengthened or increased in number to accommodate growth. A fifth runway is under construction and should be completed in 2002; plans are already underway for a potential sixth runway and an additional terminal on the eastern side.

The airport is estimated to be responsible for 15 to 20 percent of the economy of the Atlanta region, and Delta alone accounts for as much as 5 percent of the state's economy [4]. Delta made Hartsfield into a hub operation in the 1960s, well before deregulation made the practice common. While Delta is entrenched enough that it has never threatened to move its hub operations, it has hinted at moving more flights to Cincinnati or Orlando if the airport does not expand enough to reduce delays. The international flights that Delta started into Atlanta in 1978 show a clear correlation with the number of international corporations with branches in Atlanta, and the 1996 Olympics brought even more international attention to the city. The perception is that if those

international flights went elsewhere, businesses would, too. “It seems clear that the ‘need’ for a second airport is *measured* in terms of airfield capacity; but that ‘need’ is also *defined* by the perception of negative economic impacts which will befall Atlanta if the growth in aviation traffic goes elsewhere” [5].

Of course, the economic impact of Hartsfield is bound to have some influence on land use in the surrounding communities. The 1987 Coley/Forrest study found that “over 90 percent of the structures built within the Airport Environs developments are single story industrial buildings designed for office warehouse and office distribution use”^{ix} [6].

Interestingly, the corporations that have set up offices in Atlanta, even though they chose the city because of its air connections, have largely chosen not to locate in the geographic sector containing the airport. The CBD and the northern suburbs have the bulk of Atlanta’s office development, because the northern sector is the fastest growing and offers the high-end housing, master planned developments, and good schools that attract CEOs and thus companies. Communities adjacent to the airport have experienced economic growth mainly in terms of services, warehousing, and manufacturing—those that have experienced growth at all. Coley/Forrest contend that the area was “red-lined” by lending agencies due to its traditionally low development, even after the airport expansion in 1980. A twenty-five square mile Community Development Area around the airport has declined in population overall since 1980, with a very small increase in the number of housing units [7].

An examination of SIC codes confirms these findings. The area adjacent to the airport has significantly fewer businesses engaged in finance, insurance, and real estate, as well as a higher percentage of manufacturing and transportation firms, when compared with the Atlanta MSA as a whole. Hotels and car rental agencies are concentrated to the west, where passengers exit the airport,

^{ix} The Coley/Forrest study subjectively defined Airport Environs based on conversations with local businessmen and governmental officials, trying to move beyond the use of local government boundaries as overly simplified, but without an objective criteria for determining what exactly the geographic limits of the environs are. As explained in the conclusions in Chapter 6, one of the shortcomings of our study is the failure to make a careful definition of a study area, including perhaps a definition of Airport Environs of our own.

while freight transfer firms are more concentrated to the south, with access to three interstates and less congestion from the CBD.

The airport expansion of the late 1970s had a number of profound effects on nearby towns. Hapeville, to the north, lost over half of its population once the airport terminal moved to the east. Not only did airport-related businesses such as hotels leave, but the establishments such as gas stations that served workers as well as travelers no longer had a source of business. As the airport's website delicately puts it, "the cities of College Park, Forest Park and Hapeville have experienced a transition in land use patterns due largely to buy-out activities through the City of Atlanta's Noise Abatement Program" [8]. This statement means that hundreds of homes were bought and turned into industrial uses for the runway expansions of the 1970s. The town of Mountain View was bought out almost in its entirety, and no longer exists as a municipality. Two-thirds of the existing Foreign Trade Zone to the east is on land that was formerly residential. Currently, a fifth runway with a length of 6,000 feet and meant for commuter planes is scheduled to be completed by 2002. (The airport Master Plan, however, already calls for that runway to be extended to 9,000 feet to accommodate jets.) An estimated 350 households and 150 businesses will have to be moved; a high school that moved twenty years ago in the last expansion will have to move again.

College Park, immediately to the east, has both benefited from and been harmed by the airport's expansions. When the terminal was moved from the north side, hotels, restaurants, and gas stations followed, causing an economic boom (and illustrating the often zero-sum nature of airport development). The Georgia International Convention Center, with its easy access from the airport, was built as an alternative to the larger convention centers downtown. Now it will lie 150 feet from the new runway, and negotiations are underway with the City of Atlanta to rebuild the center at a more appropriate distance from the runways. College Park is also seeking reparations for the taxes to it will lose when 100 businesses and 250 homes are moved for the new runway in its 9,000-foot form. But the city is also taking some actions of its own. A 606-acre district was placed on the National Register of Historic Places, in part to make it harder for Hartsfield to expand farther in that direction. Furthermore, two hotels are being planned for an area that is under consideration for a

sixth runway. “Expansion plans have not been completed by the airport, but [College Park mayor] Longino said College Park cannot delay development. He also stated that if airport expansion encroaches on the hotels, the airport will have to buy out the owners. ‘You don’t stop just because somebody is talking about their plans,’ Longino said” [9]. While it is true that this kind of development can be considered a tactic to halt further runway expansion into a town that has already lost a lot, it is also an example of how incompatibilities can exist even when planning is begun years in advance on the part of an airport.

As previously mentioned, airport officials are already trying to decide where to place a sixth runway. It would be parallel to those existing; it would displace 10,000 to 12,000 residents; and communities on the north and south are both vehemently opposed to it. Unfortunately, the solution for each group seems to be to put the runway in the other’s territory. This would be the last expansion on the current site, able to accommodate 75 million passengers when completed. An additional terminal on the east would be welcomed by communities there, which expect the same kind of airport-service development that sprang up in College Park when the terminal was moved there in the 1980s.

Future airport growth will come not with new runways, but with a new airport, either on one of the land-banked parcels to the north, or on an as-yet-undetermined site. This new airport would be an origin-and-destination facility, especially with its proximity to the growing north sector, while Hartsfield would be primarily a Delta hub facility. Presumably this arrangement would result in further land use changes, since travelers who are merely making connections would not need the services now available outside the airport entrance, while the new origin-and-destination airport would need the hotels, car rental facilities, and other services that currently exist in the south sector, as well as facilities to handle freight. As with many other airport neighbors, College Park and the other neighbors of Hartsfield have to balance the noise and other undesirable elements of an airport, particularly an expanding one, with the economic growth that it can bring.

Charlotte-Douglas International Airport, Charlotte, NC

<i>Date founded</i>	1935
<i>Distance from CBD</i>	4 miles west
<i>Size</i>	N/A
<i>Metro population, 1990</i>	1.2 million
<i>Rank in passengers, 1997</i>	#20 (11.3 million)
<i>Percent O&D</i>	23.0
<i>Rank in cargo, 1997</i>	#37 (881,000 tons)
<i>Rail transit access</i>	No

The only reason Charlotte appears in the Large Hub category is that it is the major hub for USAirways. After all, only 23 percent of its passengers have Charlotte itself as their origin or destination, the lowest of all airports examined here. But there are actually six million people within 100 miles, making this an airport with a surprisingly well-populated hinterland. One would expect to find a great deal of cargo going in and out on the many hub flights, and for this to be reflected in an industrial/warehouse district nearby, and that is indeed the predominant land use.

Charlotte's airport began as an airmail stop for Eastern Airlines in the mid-1930s. Its first passenger service was in 1937, and its first jet service was in 1962, both a little later than most of the other airports studied. The current terminal opened in 1982, and a fourth runway is scheduled to open in 2001. The airport is estimated to contribute \$4 billion to the region's economy. Irwin and Kasarda cited Charlotte as one of the cities most likely to benefit from the international connections that a hub would bring. The airport's official web page states that the number of foreign-owned businesses in the city has gone from 147 to 340 since the new terminal was completed in 1982. While this increase is no doubt largely due to the globalization of firms that is taking place everywhere, the international flights also play a role. In summer 1999 Charlotte gained daily service to London from a second airline (USAirways as well as British Airways), which may bring even more international business to North Carolina.

The Charlotte airport environs fit a simple, expected pattern of business land use. There is an overall mix quite similar to that of the metropolitan area, with services barely dominating over wholesale, manufacturing, and transportation, more construction than average, and little finance, insurance, and real estate. Hotels and car rental agencies, as well as all service firms, are more

prevalent towards the CBD, with freight transfer heaviest in the airport zip code itself. There are a couple of special land uses revealed on topographic maps that may have located near the airport in order to concentrate undesirable land uses away from residential areas—a prison complex and the Charlotte Coliseum. Charlotte is one of the few cities to create an Airport Noise Overlay District, where any future development will be restricted to that which is considered compatible with aircraft noise.

When Charlotte was vying with Raleigh-Durham and Greensboro for a regional FedEx hub in 1998, there was much less public protest in Charlotte than Raleigh. This has been attributed to the fact that the neighborhoods around the Charlotte airport are generally poorer, with residents not only more in need of jobs, but also less politically powerful. Local residents say, however, that after their protests over the fourth runway were ignored, they believed that no complaint they made would be heard.

Charlotte's smaller size both in terms of population and air travelers means that a more detailed study would have been in order, since any land use patterns are likely to occur at a smaller scale than in larger metropolitan areas. However, one can still see that many of the same elements of other cities are present here—struggles between nearby residents who are harmed by airport externalities and an airport authority that is trying to create economic development for an entire region; siting NIMBYs near each other so as to minimize impact; and clear differentiation in land uses near the cargo and passenger exits from the airport, even if they are both located in the same city.

Dallas-Ft. Worth International Airport, Irving, TX

<i>Date founded</i>	1974
<i>Distance from CBD</i>	17.5 miles north
<i>Size</i>	17,800 acres
<i>Metro population, 1990</i>	4.0 million
<i>Rank in passengers, 1997</i>	#4 (28.1 million)
<i>Percent O&D</i>	34.0
<i>Rank in cargo, 1997</i>	#12 (2.9 million tons)
<i>Rail transit access</i>	No

Dallas-Ft. Worth International Airport (DFW) was, at the time it was built in 1974, the first major airport to be built in the U.S. in quite some time, and it remained that way until the Denver project in the mid-1990s. It has some highly desirable features, like the 17,800 acres of land that leave a lot of room for noise abatement. It has not had a large impact on the metropolitan area in terms of shifting the direction of growth, but like Hartsfield, DFW has certainly contributed to the rapid increase in the number of companies moving their corporate headquarters to the region. Yet despite its great distance from downtown(s) and the fact that it owns enough land to most likely avoid noise complaints, DFW has experienced some conflict with neighboring communities, largely due to its expansions.

In the 1960s, the cities of Dallas and Ft. Worth each operated their own airports, Love Field in Dallas and Meacham Field in Ft. Worth. The FAA decided that funding each of these airports was wasteful, and so it told the two cities to combine their aviation facilities. A site was chosen equidistant from each downtown, far enough away that land was fairly cheap, consisting of mostly undeveloped farm and ranch land. Meacham Field was closed and converted to a variety of office and residential uses, while the fledgling Southwest Airlines insisted on keeping its three-plane operation at Love Field. DFW is owned and operated jointly by Dallas and Ft. Worth, with Airport Board members in the same 9:5 ratio as that of the two cities' populations.

Irwin and Kasarda cited Dallas-Ft. Worth in particular as a region that would benefit from the international connections that the American Airlines hub would provide. However, Dallas has not received the international attention that Atlanta has, perhaps because it is a much longer flight from Europe, and too far from the West Coast to receive as much Asian business as Los Angeles or Seattle. However, there have been more than enough domestic companies that have moved their headquarters to Dallas—400 of them—to make DFW equivalent to Hartsfield in terms of stimulating economic growth. From 1970 to 1996, the population nearly doubled, with employment growing 1.5 times (national figures were 30 percent and 67 percent respectively). One study estimated that DFW contributes \$11 billion annually to the region's economy, both directly and

indirectly. DFW has been credited with driving high tech employment ahead of Boston and second only to Silicon Valley [10].

At a more local scale, tremendous changes have come to the formerly small towns surrounding the airport. Grapevine, to the northwest, has grown from 7,000 to 36,000 residents, a dramatic gain even for a rapidly suburbanizing sector of the metro area. Development has been encouraged by a Texas state law that allows cities to keep the tax revenue from land they gave up for the airport [11]. Two huge business parks have become models for how to develop around a new airport, attracting tenants such as IBM, Mercedes-Benz, and Citicorp. The small town of Euless now has a multimillion-dollar center that consolidated car rentals in one place, again with the town receiving the tax revenues.

Not all of the changes have been positive, however. The initial three runways had already grown to six by the early 1980s when the airport started to plan a seventh and eighth. *The Los Angeles Times* reported, "Unlike the first six runways, whose touch-down and lift-off points were nearly three miles from any dwellings, the seventh would end within a half-mile of one Irving residential neighborhood, and barely one mile from two others. The eighth runway would put landing and departing planes directly over an area of Grapevine that is on the National Register of Historic Places" [12]. Furthermore, DFW experienced two crashes early in its history, one on landing and one on takeoff, one of which killed people on the ground. Safety was an equal concern to noise. So Grapevine sued the airport, claiming that its municipal rights were being usurped by Dallas and Ft. Worth. Unlike many such suits, Grapevine won. However, the airport, together with the airlines and the FAA, lobbied the state to pass a law that exempted DFW from the laws that define municipal powers. Grapevine appealed to the federal courts, but was told that the FAA had to have final say because of safety issues. As the mayor of the town put it, "The trouble with that is that there are no checks and balances in dealing with the FAA. . . . The FAA does the environmental studies that will determine your quality of life, they pay for them, and then they rule on their sufficiency" [13]. Nearly half of the \$300 million cost of the seventh runway went to buy nearly 1,000 homes or to soundproof another 1,100.

In short, like Hartsfield, DFW has brought significant economic prosperity to its region, sometimes at the cost of individuals or large portions of communities. It stands as an example of what an airport can contribute to a metropolitan region, how it can shape development in its immediate vicinity, and how the needs and wants of the many outweigh the needs and wants of the few.

Detroit Metropolitan Wayne County Airport, Detroit, MI

<i>Date founded</i>	1927
<i>Distance from CBD</i>	18 miles southwest
<i>Size</i>	6,700 acres
<i>Metro population, 1990</i>	5.2 million
<i>Rank in passengers, 1997</i>	#9 (15.4 million)
<i>Percent O&D</i>	52.8
<i>Rank in cargo, 1997</i>	#41 (786,000 tons)
<i>Rail transit access</i>	No

Comparing the airports of Detroit and Atlanta shows the difference between an old Midwestern manufacturing city and a rising southern service city. With nearly twice as many people as Atlanta, Detroit has just over half the annual air passengers, even though it is a hub for Northwest. Part of this record is due to a reduced need for air travel on the part of metro area businesses, and part is due to the smaller hub of Northwest in comparison with Delta's hub at Atlanta. As Northwest shifts more operations to Detroit, however, particularly international traffic, Detroit may come to more closely resemble Atlanta.

Though Wayne County Airport (DTW) was founded in 1927 as a flying field, it was not until the 1960s that city officials chose to make it the major airport for the area. Detroit City airport, much closer to downtown, had served that function until jets required longer runways than could be achieved at that site. The Willow Run airport, only a little farther west than DTW, was a close competitor, but is now a cargo facility. Detroit became the hub for Republic Airlines in 1984, and, after that airline's merger with Northwest, has alternated with Minneapolis-St. Paul as the lead hub for Northwest. This hubbing led to rapid traffic growth. By 1985, the airport was handling the number of passengers that in the previous year had been predicted for the year 2000. So a fourth

runway was added, and terminals are being redone at a cost of \$1.2 billion. Northwest plans to make Detroit its main hub for domestic and international flights, in part because it will have a new terminal all to itself.

One of the consequences of the late designation of DTW as the metropolitan area's main airport was that businesses were reluctant to commit themselves to a location if city officials were indecisive. Karsner notes that DTW developed commercial and industrial facilities quite late for this reason. Furthermore, the airport's distance from the city meant that even today, it lies on the fringe of development, with much undeveloped land to the south and west. In fact, the noise exposure contours lie over mostly agricultural land, even to the north and east. Residents who live nearby have come into conflict with the airport, however: the county has spent over \$31 million buying property and soundproofing houses and schools. The airport promises that the switch to Stage 3 aircraft will shrink the extent of noise exposure contours so that they lie almost entirely within airport property^x.

SIC maps reflect Detroit's manufacturing character, since it was the only city studied to contain service and manufacturing firms with nearly equal frequency. In fact, it had the highest percentage of manufacturing firms of any of the airports studied. Finance, insurance, and real estate firms were less common in Detroit than any other metro area, with a similarly low percentage near DTW itself. Detroit has a few more professional offices near its airport than Atlanta, but it appears to be quite similar in that the businesses it attracts because of its airport often choose to locate some distance from the airfield itself.

The rural character of the airport surroundings, shown by the low number of firms of any type, is changing. Wayne County is actively pursuing development around the airport, starting with upgrading roads so that semitrailer trucks can access 7,000 more acres than they can now. The county expects up to \$2.5 billion in private-sector development to follow the roads, with 90,000 new

^x January 2000 was the deadline for airlines to convert all of their aircraft to Stage 3 engines, a much quieter machine. Instead of building new planes, airlines can fit existing ones with "hush kits" that are designed to muffle their engines. As can be seen from decibel monitors near MSP, however, the hush-kitted planes are not necessarily any quieter than they were before (see http://www.macavsat.org/ANOMS/msp54_internet/PDF_files/may99_TA.pdf as an example).

jobs [14]. The county is also working to create a technology corridor between DTW and Willow Run, seven miles to the west. Officials want to attract international companies in the same manner that Atlanta has, along with warehouse and distribution centers meant to handle the increasing use of just-in-time manufacturing by Detroit’s automakers. The county is also pushing an “aeropark” to the south side of the airport, including hotels, retail, and other mixed uses^{xi}. Some of this growth is due to the fact that the edge of development extending out from the central city has reached the airport area, but a great deal of it is being actively pursued in conjunction with DTW’s expansion. Detroit stands as an example of a local government actively using transportation improvements, both in the air and on the accompanying roads, to drive development.

John F. Kennedy International Airport, New York, NY

<i>Date founded</i>	1948
<i>Distance from CBD</i>	15 miles east
<i>Size</i>	4,390 acres
<i>Metro population, 1990</i>	19.5 million
<i>Rank in passengers, 1997</i>	#10 (15.2 million)
<i>Percent O&D</i>	62.1
<i>Rank in cargo, 1997</i>	#6 (5.1 million tons)
<i>Rail transit access</i>	No

LaGuardia Airport, New York, NY

<i>Date founded</i>	1947
<i>Distance from CBD</i>	8 miles northeast
<i>Size</i>	650 acres
<i>Metro population, 1990</i>	19.5 million
<i>Rank in passengers, 1997</i>	#21 (10.9 million)
<i>Percent O&D</i>	90.3
<i>Rank in cargo, 1997</i>	N/A
<i>Rail transit access</i>	No

There is little to be said about *changing* land uses at JFK and LaGuardia, largely because these facilities have not expanded for years and have little or no hope of doing so. Located eight miles from the center of Manhattan, LaGuardia is prohibited by federal law from handling flights of

^{xi} Controversy over this development stems from the fact that the county wants to fund it with leftover revenue from a hotel and rental car tax meant to fund the purchase of land for two downtown Detroit stadiums. Many people feel that since the purpose of the taxes was to fund downtown redevelopment, any surplus should not be directed towards projects at the suburban fringe.

over 1,500 miles. Up until summer 1999, both airports were also limited by the “slot rule,” meaning that they could only allow a certain number of takeoffs and landings per hour. Although that rule has been lifted for planes carrying under fifty passengers, it will not be phased out until 2007 for large jets, in deference to local communities.

With its small size and proximity to downtown, LaGuardia is the airport of choice for business travelers, as revealed in the high figure of 90 percent O&D passengers. It receives no all-cargo flights, and thus does not even register on the FAA’s list. LaGuardia is limited to the south by the Grand Central Parkway, and the other two sides of its triangular shape are bounded by Flushing Bay. Both runways have already been partially extended into the bay, and there is no room for a third runway. There are plenty of residents already exposed to airport externalities, however: the National Resources Defense Council recently named LaGuardia as the airport with the most people affected by noise pollution (150,000). Air pollution is also a problem, with neighborhoods in Queens and Bronx closest to the airport experiencing some of the highest rates of asthma in the city. While power plants and highways are also contributing causes, it is apparent that airport externalities here include health as well as nuisance issues.

JFK, on the other hand, is the country’s premier airport for international flights. It is also one of the country’s major cargo airports, handling up to 35 percent of U.S. air exports to Europe, even though only 3.7 percent of that traffic actually originates in the New York area [15]. It is a standard-size airport, over 4,000 acres, and has the added benefit of a National Wildlife Refuge as one of its borders. JFK was actually the first airport to experience massive protests from residents after jets were introduced in 1958. In more recent years, a combination of more public participation opportunities and fewer politically powerful residents has meant less protest.

There are few firms of any type located around LaGuardia, confirming that it is a mostly residential area. Those that do make it onto the map lie to the north or east of the study area, with only transportation firms showing up in the airport ZIP code itself. There are few hotels or car rental agencies, since downtown Manhattan is so close, and barely any freight transfer or related businesses such as electronics manufacture, in keeping with LaGuardia’s function as a passenger

airport. LaGuardia has the second highest concentration of transportation firms, but this 23.3 percent concentration is far exceeded by the 65.8 percent of firms that are transportation-related around JFK. JFK scores lowest in terms of all other sectors but finance, insurance, and real estate out of the ten airports for which SIC codes were studied. These numbers reflect the environs' extreme concentration on transportation services, both in terms of airline offices and freight transfer operations. Like Charlotte, LaGuardia has a prison and sports stadium close by, and JFK has a National Wildlife Refuge to provide buffer land. Both airports are limited by water from easy expansion, but this setting also gives them an easy way to prevent neighboring uses that are incompatible, and allows a certain measure of safety as well.

There is a surprising lack of rail transit service to either of New York's main airports. Currently, one has to transfer from rail to a bus to reach either by public transportation. A light rail connection to JFK has been approved, and local officials are working with the Port Authority (which will be maintaining the line) to improve the appearance of the intervening neighborhoods in the hopes of attracting consumers waiting for their flights. A few miles away, local residents along the proposed line to LaGuardia do not want the negatives of a rail line, particularly if it is an elevated line, passing through their neighborhoods. In Chapter 2, we discussed the results of a study showing that land values actually rose when the mostly-elevated Orange Line was put through from downtown Chicago to Midway. However, this line went through a mostly industrial sector of the city, not through the kind of commercial and residential land that would be traversed on the way to LaGuardia.

The New York airports, taken together, show the differences in land use depending on the primary purpose of an airport, and how specialized land uses can become in a very large metropolitan area. Though New York and Los Angeles are highly similar in terms of overall mix of firms, the LaGuardia and JFK environs are quite different from those around LAX, since they each serve a more specific purpose.

Los Angeles International Airport, Los Angeles, CA

<i>Date founded</i>	1928
<i>Distance from CBD</i>	9 miles southwest
<i>Size</i>	3,425 acres
<i>Metro population, 1990</i>	14.5 million
<i>Rank in passengers, 1997</i>	#3 (28.9 million)
<i>Percent O&D</i>	77.2
<i>Rank in cargo, 1997</i>	#5 (5.5 million tons)
<i>Rail transit access</i>	No

Los Angeles International Airport (LAX) is of similar size and age to many of the airports studied here. It is unusual, however, in that it serves such a large metropolitan area; even with three other airports to help distribute traffic, it is still the third largest in the country in terms of passengers and fifth largest in terms of cargo. Like many other airports, it lay well beyond the built-up urban area when it was first opened, but has since been surrounded by residential land uses that have generated a great deal of conflict. As it continues to expand, despite the opportunities available at other airports, it is expected that more of these residences will be converted to more “compatible” uses.

By 1929, when many municipal fields around the country were just being built, there were already fifty-two in Los Angeles County, with regular passenger service by six airlines. The official Los Angeles Municipal Airport, located nine miles from downtown, was considered too far from the center of the city to be used by the airlines. Even with three or four aircraft manufacturers nearby, commercial service was not considered by the airlines until 1937. At that time, the five major airlines were willing to shift their operations from Glendale and Burbank, but as a forerunner of today’s airline-city battles, only if the city would improve the airport facilities. Los Angeles had to turn to the federal government for assistance, and thus federal aid to airport construction was born [16]. Though the airfield was briefly turned over to the Army for military aircraft production during WWII, by 1946, the five major airlines had moved in. In 1950, the airport became Los Angeles International, and in 1959 it gained its first jet service.

That was when “incompatible land uses” began to appear. The Air Transport Association and Aircraft Industries Association had assured nearby residents that jets would be no noisier than

pistons. Residents quickly found that the promise was false. At the same time, LAX was expanding, adding runways to the north and lengthening existing ones, aggravating the noise problem. By 1970, the airport was faced with forty different lawsuits for a total of \$3 billion [17]. Friedman notes that this flurry of litigation was largely due to the city's inappropriate handling of the noise problem. But a 1978 estimate found that the cost to acquire all houses affected by airport noise would be over \$1 billion.

The Department of Aviation tried a number of other tactics, including a joint-use agreement with the military to run commercial flights out of Palmdale Airport (over seventy miles north of L.A. and still without any significant passenger traffic, thirty years later), and conducting night landings *and* take-offs over the ocean. The latter plan was quickly abandoned due to safety concerns.

Communities around LAX have reacted in a variety of ways, usually unsuccessfully. The two towns immediately to the north, Westchester and Playa del Rey, are the wealthiest, and as part of Los Angeles, have City Council representation. When 68 acres of Playa del Rey were condemned in 1965 for a new runway, homeowners sued for more compensation on the grounds that the airport had caused their housing values to depreciate. However, the court found that property values had actually increased over time. Inglewood, the municipality immediately to the east and arguably the most affected by LAX's four east-west runways, created a noise ordinance and tried to bring criminal charges against Continental Airlines for violating it. However, the U.S. District Court ruled that federal regulations concerning airport operations took priority over municipal ordinances^{xii}. Hundreds of Inglewood residents then banded together in a class action suit against the airport on the grounds of damage to property values; the California Supreme Court ruled that because the amount of damage would differ with each house, a class action suit was inappropriate. El Segundo, located directly to the south, was for a time accepting of the airport,

^{xii} This case is unusual in that suit was brought against an airline rather than the airport. The courts have only forced airport operators to pay damages to residents or municipalities, not manufacturers, airlines, pilots, or the FAA, which is further evidence that land use compatibility issues are considered a local problem.

since many of the region's aircraft manufacturers were located within its borders. Runway expansion changed that attitude, however, as well as pilots who failed to wait until they were over the ocean before starting to turn eastward. So the city put up a billboard on its highest hill, pleading with pilots to avoid flying overhead. It has been largely successful; El Segundo now even uses its proximity to the airport as a marketing tool [18].

Los Angeles had the highest percentage of construction and retail jobs of any of the airports studied. The latter makes sense considering the residential character of the area, but the former is surprising in such a built-up area. ZIP codes that had more than a handful of firms were dominated by service, transportation, and manufacturing, in keeping with the region's history of air transportation. More electronics and aircraft manufacturers were found here than anywhere else. Countering the high manufacturing and transportation was a much lower than metro-wide amount of finance, insurance, and real estate firms. There was surprisingly little freight transfer, considering LAX's importance as a cargo hub.

While much of the land near the airport is still residential, that may soon change. LAX is planning a \$8 to \$12 billion expansion, meant to handle nearly twice as many passengers and nearly three times as much cargo as it does now. Plans include a new terminal on the west side of the airfield, as well as one or two more runways and extension of the existing ones to handle Boeing's proposed 600-passenger jumbo jets [19]. Roadways around the airport would be widened, and the mayor wants to bring rapid transit into the airport as well.

The city is currently seeking federal approval to continue a \$3 passenger fee that would enable them to purchase over 2,500 houses to make way for the expansion. Residents of these homes are more than willing to move, since their neighborhood has been slowly shifting to industrial uses, particularly aviation-related, as a means of increasing compatibility with the airport, and has experienced an increase in crime. Inglewood has been using federal funds since the mid-1980s to either soundproof houses or replace them with commercial buildings. "Big box" stores such as Kmart and Home Base have moved to the noisier parts of town, another example of siting one NIMBY near another.

In one of the most interesting stories of land use conflict, the Morongo Indians of far southeastern California have sued the airport for failing to conduct an Environmental Impact Statement for a recent change in arrival patterns. The Morongo argue that the new arrival pattern, which sends 220 planes per day over their sacred lands, is actually a precursor to expansion and thus should have been included in the EIS for the expansion. The sound and the sight of contrails, even at high altitudes, “destroys the sacred character of the sites historically and currently relied on by tribal members for their religious and cultural practices” [20]. This is probably the most extreme example of how far an airport’s influence on land uses can extend.

There are four major airports in the Los Angeles metropolitan area: LAX, Ontario, John Wayne (Orange County), and Burbank. There are four more sites that are joint-use or former military bases: Palmdale, San Bernardino, March (Riverside), and George (Victorville). The former El Toro base, just south of John Wayne, is currently being hotly debated as the next major LA airport. So why does LAX have to expand? For one, airlines have shown little willingness to add a fifth or sixth airport to their operations. Secondly, the military sites are all at the edge of the metropolitan area—good for prohibiting incompatible development, but bad for attracting business. Finally, the three other commercial airports are struggling just as fiercely with adjoining communities over expansion issues. As long as LAX ranks so high nationally in passengers and cargo, it will continue to grow, necessitating further shifts in nearby land uses.

O’Hare International Airport, Chicago, IL

<i>Date founded</i>	1957
<i>Distance from CBD</i>	15 miles northwest
<i>Size</i>	7,700 acres
<i>Metro population, 1990</i>	8.2 million
<i>Rank in passengers, 1997</i>	#2 (32.9 million)
<i>Percent O&D</i>	43.9
<i>Rank in cargo, 1997</i>	#13 (2.6 million tons)
<i>Rail transit access</i>	Yes

O'Hare recently lost its title of World's Busiest Airport in terms of passengers to Atlanta, although it is still busiest in terms of landings and takeoffs, with 2,500 a day. Located in one of the world's most-studied cities, O'Hare is also a frequently studied airport, even if the results are applicable to few other places. Like many other airports, conflicts between suburban residents and city aviation officials are common, despite the city's relatively good job of buffering residents against noise by means of zoning laws. Chicago has faced the "build or expand" question for decades now, and has almost always chosen expansion.

O'Hare (ORD) was built at an unusual time, right after the inauguration of jet service. This timing is due to the fact that Chicago's existing airport, Midway, was too small (one square mile) to handle jet aircraft, and could not be expanded because of the cost to remove the housing that surrounded it. So a former aircraft manufacturer's field, well outside the urbanized area, became the city's airport, and it grew rapidly. As Aschman described it in 1978, "Farmland only ten years ago, the O'Hare area now contains over 4 million square feet of office space, and more than 6,000 hotel rooms" [21].

As described in Chapter 2, the ground transportation in the airport vicinity was not up to the task of dealing with the massive development that ORD would inspire. As early as 1973, a quarter of the business travelers to the airport went no farther than the complex of hotels, offices, and convention centers immediately outside the airport in Rosemont [22]. Unlike Atlanta, the international businesses that were drawn to the Chicago area because of the air service were drawn to the actual airport environs, partially because this zone has traditionally been the fastest-growing sector of the metropolitan area. Office activity in 1978 was much higher than that of any other suburban Chicago center, though it was still a fraction of that downtown. Aschman noted that "These [convention] activities have almost nothing to do with the city's economic, social, and cultural activity; many of the participants never leave the immediate vicinity of the airport while in Chicago. The fact that there is little to see or do near the airport is an advantage" [23].

Neighboring cities have experienced problems similar to Atlanta or St. Louis in that they do not have any direct political power over the agency that controls the airport, attached to Chicago by

the median of the Kennedy Expressway. A coalition of suburban mayors that has fought O'Hare for years over noise is the best organized of such coalitions. The Suburban O'Hare Commission (SOC) has existed for fifteen years, an alliance of thirteen suburbs that is funded by dues of \$1.20 per capita, netting \$345,000 annually to fight airport noise. A coalition founded by Chicago and funded at \$200,000 by the Department of Aviation includes another 23 municipalities that work with the airport to reduce noise problems. SOC has won some victories, including the installation of the FlyQuiet program, under which pilots are supposed to climb higher and fly over interstates and forest preserves from 10 P.M. to 7 A.M. The city has also promised \$74 million to soundproof over 2,300 houses.

Individual communities have done much to reduce residents' exposure to noise. Zoning and topographic maps show that more of the land adjoining ORD is industrial than in any other city. Forest preserves and interstates offer further buffers. However, there are still a great many residents exposed to noise. Although all of their homes were built after the airport was in place, with its jet aircraft already in operation, there has certainly been an increase in flights since 1959. The city revised its noise exposure contour map in 1997, using actual decibel data from noise monitors instead of relying solely on computer modeling as in 1993. The result was an increase in residences in the over-65 Ldn zone from 44,700 to 49,515, despite the increased use of quieter aircraft. Because this increase is considered by the city to be due to more accurate modeling rather than noisier conditions, the projection for the year 2000 (after Stage 3 aircraft are mandatory) showed a drop of 45 percent in houses exposed to more than 65 Ldn.

As with most major airports across the country, Chicago is facing the expansion versus moving question. While O'Hare would remain in place, there has been a push for a third airport for nearly twenty years, with locations proposed from a new island in Lake Michigan, to Gary, Indiana, to the current favorite, an agricultural area about forty miles south of the city near a small town called Peotone. Mayor Daley has come out strongly against a third airport in the far southern metro, largely because of the loss of tax dollars that Chicago would experience (even Chicago cannot annex land that far away). Most of the suburbs adjoining O'Hare, however, are in favor of

the third airport, as is the governor. Daley has countered, correctly, that those suburbs would lose a great deal of their tax base if the industrial and office firms that are now located near O'Hare were to move to the new site. On the other hand, Daley is not currently willing to seek expansion at the existing site, largely due to conflicts with the governor (the Illinois Department of Transportation has to approve any such project, and the governor could essentially veto the project by keeping IDOT from granting the necessary permits). Local residents near Peotone are vehemently opposed to the airport completely disrupting their rural way of life, and argue that the hour-long taxi ride into the city would mean that no business travelers would want to use it. Furthermore, all of the major airlines that fly into Chicago have stated their unwillingness to move to a facility so far out of town, in the poorest sector of the metropolitan area. With neither expansion or new construction in the near future, ORD will have to take advantage of the lifting of the same slot rule that beset New York to make better use of its space, and neighboring communities will have to continue to balance industrial and office growth with the inevitable aircraft noise.

Lambert-St. Louis International Airport, St. Louis, MO

<i>Date founded</i>	1924
<i>Distance from CBD</i>	15 miles west
<i>Size</i>	1,980 acres
<i>Metro population, 1990</i>	2.5 million
<i>Rank in passengers, 1997</i>	#14 (14.0 million)
<i>Percent O&D</i>	41.7
<i>Rank in cargo, 1997</i>	#49 (639,000 tons)
<i>Rail transit access</i>	Yes

Lambert exemplifies the complicated politics of airport land use and expansion. The airport itself is owned and operated by the City of St. Louis, even though it is miles away from the actual city. Residents from nearby communities have no voting power over what happens at the airport, which like many around the country has expanded several times during its history and is doing so again, each time changing the local landscape. There are also interstate politics at play, so that what might be the best solution for travelers and airport neighbors alike stands hardly a chance of coming to pass.

Lambert Field, which opened in 1924, is one of the oldest airports still operating. At the time, it was quite far out of town—15 miles. Now, the suburbs to its east and south are already being passed over by people looking for a less crowded place to live, while those to the north and west are booming. The airport is the sole hub for TWA, an airline that has struggled since deregulation but seems to be recovering. Nor is the metropolitan region itself booming at the rate of Atlanta or Dallas, which means that demand for air service is not growing too rapidly. However, Lambert is one of those airports where the two main parallel runways are too close together for use in bad weather, instrument-only flying conditions. Thus, delays have grown to the point where a new runway is deemed necessary.

St. Louis, like Detroit, is less service-oriented as a whole, with an even smaller percentage of services than average. The airport environs have even fewer services and finance, insurance, and real estate firms than the metro area, with the usual higher percentages of transportation and wholesaling. What services there are tend to be more prevalent towards the suburbs, not the CBD, with trucking following that pattern as well. The city of Bridgeton is one of the few to have instituted a special zoning designation for airport-sensitive uses, a “Travel/Entertainment Services” designation along the interstate exits closest to the airport.

The last major expansion of the airport occurred in the early 1970s, when a process similar to Minnesota’s dual-track planning occurred (discussed in Chapter 5). A search was conducted for a new site, with some possibilities in Illinois considered; however, in part because of a referendum on the part of St. Louis County voters, the city decided to expand Lambert. Additionally, government leaders at the city and state levels have long fought the idea of any air traffic moving across the river to Illinois. But the expansion on the original site has not necessarily had a positive effect on communities nearby. Towns such as Bridgeton and Hazelton have lost land to the airport; the town of Kinloch, to the east, once considered the largest black community in the U.S., has fallen from 7,000 to 2,000 people. Due to home buyouts and businesses that failed without customers living nearby, what is left is mostly abandoned buildings and illegal dump sites [24].

The cities that remain are determined the same thing will not happen to them as a result of the airport's newest expansion project. A third runway is planned to the southwest of the current airfield, and is due to be completed by 2004. Two thousand homes and businesses, mostly in the town of Bridgeton, need to be bought and demolished for the runway, not counting the extra noise that remaining residents will experience with the expansion of the noise contours. Bridgeton charges that the businesses that will be forced to close when 5,600 to 6,000 residents leave the area should be recompensed for their losses as well; up to a quarter of the city's sales tax revenue could be lost [25]. The city has already sued St. Louis, claiming that zoning approval should have been obtained from Bridgeport before taking land for the expansion. The Circuit Court, however, ruled that the airport's, and thus the new runway's, importance to the economy of the entire region overrules the needs of a single community.

Here again lies the paradox of airport land use control: local governments are responsible for keeping development compatible with airport activity, yet have little or no influence on that activity on the grounds that it is part of a nationwide system. This situation is especially vivid in St. Louis, where the city that owns the airport contains none of the residents who are most affected by the noise and traffic it generates. In the words of an editorial from the *St. Louis Post-Dispatch*:

The expansion plan that the city of St. Louis is pushing is the most costly, most destructive single runway project in the history of this country. Most cities would never consider displacing almost 6,000 people in an action that would increase noise in such a densely populated area. But St. Louis politicians think they can get away with this plan because they do not have to answer on election day to those suffering the consequences of their decision. [26]

There is an additional, ironic note to the story of airports, land use, and politics in St. Louis. The city of Mascoutah and county of St. Clair, fifteen miles east of St. Louis in Illinois, reached a joint use agreement with Scott Air Force Base to run commercial flights. A second parallel runway was constructed so that commercial flights could take place without disrupting military operations and vice versa. The base is surrounded by mostly undeveloped land, and the county has established zoning to keep incompatible development from getting too close. The Mid-America Airport officially opened in March of 1999 and has only two scheduled flights per day, on the newly

revived Pan Am. One reason is the dominance of TWA at Lambert and that airline's unwillingness to relocate. Additionally, while other airlines are generally unwilling to move to a new facility to challenge a hub airline within a metro area, they are even less likely to do so in a metro area that lacks the demand of Atlanta or Dallas. There is also relatively little demand for air travel east of St. Louis in this poorer, more industrial sector of the metropolitan area. But the main reason for Mid-America's failure to be considered a viable alternative to Lambert, and to the \$2 billion expansion with its displacement of 6,000 people, is the refusal of local and state officials to allow the airport to move to Illinois. These officials have an opportunity to reduce delays at Lambert through encouraging the shifting of at least cargo operations to Mid-America, or by choosing not to invest in the new runway at Lambert. But the unwillingness to overcome state rivalries (and a possible loss of state jobs) means that 6,000 people and hundreds of businesses will have to move or close to keep the region's economy going.

Tampa International Airport, Tampa, FL

<i>Date founded</i>	1928
<i>Distance from CBD</i>	4 miles northwest
<i>Size</i>	3,400 acres
<i>Metro population, 1990</i>	2.1 million
<i>Rank in passengers, 1997</i>	#29 (6.6 million)
<i>Percent O&D</i>	89
<i>Rank in cargo, 1997</i>	#65 (417,000 tons)
<i>Rail transit access</i>	No

The growth of airports like Tampa's was crucial to the transition from an industrial to a postindustrial society ... characterized by decentralizing residences and businesses, a service and light industry economy run by educated professional and technical managers, and mass consumerism based on rising real income, leisure time, and advertising expenditures. [27]

Tampa has a long aviation history; the world's first commercial passenger flight was from St. Petersburg across the bay to Tampa in 1914. Drew Field opened in 1928 as the municipal airport for Tampa on 400 acres. Like many municipal airports, it was briefly handed over to the military during WWII, then resumed civilian operations after 1945. By 1952, the airport was serving international flights, and had expanded for jet service by 1960, with a new, modern terminal

by 1971. Karsner credits active boosterism on the part of city officials with not only steadily increasing the number of flights to the region, but to drawing them to Tampa as opposed to St. Petersburg. Current projections are for a 4.5 percent increase in passengers and 3 percent increase in cargo per year, reflecting the region's reliance on tourism rather than manufacturing or freight transfer.

Nevertheless, airport officials are trying to attract more cargo. Although the largest concentration of industry in the Tampa Bay area is directly north of the airport, about half of the products manufactured in the region are actually flown out of Orlando or Miami, with their more frequent flights to more destinations. Of products bound for foreign countries, nearly ninety percent are flown from those other airports [28]. Not only are most planes out of Tampa too small to hold standard cargo pallets, the only nonstop international destinations are to Canada or the Caribbean. Therefore, one would not expect much activity in terms of freight transfer or warehousing in the airport vicinity. On the other hand, passenger traffic at Tampa is booming. Southwest Airlines started service in 1996, and passengers promptly increased by 20 percent [29]. Forty percent of Tampa's passengers are traveling for business, unlike Orlando's Disney-oriented, more seasonal passenger flow.

As the quote above stated, Tampa is a prime example of a post-industrial, service-oriented city. Indeed, the Census reveals that Tampa has a higher percentage of finance, insurance, and real estate and service businesses than most other cities—the kind of firms that require more air travel. Tampa had the highest percentage of both these sectors in its environs of any of the airports studied; it also had the highest number of jobs per square mile (58.2). The mix of firms around the airport is quite similar to that of the metropolitan area, with an increase in wholesale firms the only notable difference (despite our expectations to the contrary). As with most other cities, hotels and car rental agencies are located closer to the CBD, while freight transfer is found more towards the urban edge. The home of the Tampa Bay Buccaneers is a short distance from the runways, making this yet another city with a stadium as an airport neighbor.

Tampa has already added a fourth runway in recent years, and says there is no more room to expand. Since the ends of the main runways extend mostly over industrial areas or water, there have been relatively few resident complaints. Airport officials state that their plan for future expansion is new technology; they feel that by the time another new runway would be needed, the technology will exist to allow vertical takeoffs, or at least greatly shortened takeoffs in comparison to today's planes [30]. Other future plans include keeping an eye on Cuba; with Miami International Airport already quite crowded, Tampa is ready to fill the expected demand for air service if relations open with Cuba.

Works Cited

- [1] Metropolitan Airports Council (1999). Minneapolis-St. Paul International Airport. <http://www.msairport.com>.
- [2] Speizer, Irwin (1998). Charlotte hears few voices against FedEx hub. *The News and Observer* (Raleigh, NC), p. D1.
- [3] Apogee Research Inc., Spensley and Associates, and Hickling Ltd. (1990). *Hub airport case studies: major airport search area study*. St. Paul: Metropolitan Council, p. 21.
- [4] Hendricks, Gary, and Scott Thurston (1998, September 14). Hartsfield's growing pains; Airport's massive economic impact is felt in every corner of metro area. *The Atlanta Journal and Constitution*, p. 6E.
- [5] Apogee Research et al. 1990, p. 20.
- [6] Coley/Forrest Inc. 1987, pp. 3-58.
- [7] City of Atlanta Department of Aviation (1999, July 17). Hartsfield International Airport. <http://www.atlanta-airport.com>.
- [8] Ibid.
- [9] Ellerton, Delbert (1998, July 16). Two hotels near airport get go-ahead. *The Atlanta Journal and Constitution*, July 16, p. 1JK.

- [10] Herndon, Ray (1998, May 28). Texas airport: big growth, big hassles; planners look to Dallas-Fort Worth as model of dual-facility system. *The Los Angeles Times*, p. A1.
- [11] The Associated Press State & Local Wire (1998, October 24). DFW airport board strikes revenue-sharing, land deal with Irving.
- [12] Herndon 1998.
- [13] Ibid.
- [14] Stopa, Marsha (1997, November 3). \$125M plan aims to open airport area: county seeks upgrades for ring roads. *Crain's Detroit Business*, p.3.
- [15] Page, Paul (1994). Small airports take the cargo alternative, pitch shippers on new freight gateways. *Traffic World*, 8, November, p. 24.
- [16] Friedman, Paul David (1978). *Fear of flying: the development of the Los Angeles International Airport and the rise of public protest over jet aircraft noise*. M.A. thesis, University of California-Santa Barbara.
- [17] Ibid.
- [18] Rasmussen, Cecilia (1995, October 24). Community profile: El Segundo. *The Los Angeles Times*, p. B4.
- [19] Belgum, Deborah, and Jean Merl (1997, July 7). A look ahead. *The Los Angeles Times*, p. B1.
- [20] Merl, Jean (1998, July 6). A distant Indian tribe goes to court to challenge a new flight pattern above their lands, giving coastal cities an unlikely ally in the air war over LAX expansion. *The Los Angeles Times*, p. B1.
- [21] Aschman, Michael P. (1976). *Three miles from L.A. and New York: a study of intrametropolitan office location near Chicago-O'Hare International Airport*. Ph.D. Thesis, Syracuse University.
- [22] Karsner, Douglas (1997). Aviation and airports: the impact of the economic and geographic structure of American cities, 1940s-1980s. *Journal of Urban History*, 23, pp. 406-36.
- [23] Aschman, p. 32.

[24] (1998b, March 31). Another neighbor besieged: Kinloch, Mo., has lost land, residents to airport project. *Kansas City Star*, p. A7.

[25] Goodrich, Robert (1997, November 2). Neighbors don't seem worried about noise at mid-America. *St. Louis Post-Dispatch*, p. G1.

[26] Barwinski, Sara (1997, December 28). FAA ignores real impact of Lambert plan. *St. Louis Post-Dispatch*, p. B3.

[27] Karsner 1997, p. 407.

[28] Huettel, Steve (1996, October 28). Winging it; air freight is booming, but Tampa International has yet to become a major player as most products produced in the bay area fly out of other airports. *The Tampa Tribune*, p. 16.

[29] Heller, Jean (1998, December 4). TIA ridership up 8.5%. *St. Petersburg Times*, p.9B.

[30] Loft, Kurt (1999, June 6). Airports will speed up and airplanes may nose up as the number of passengers swells. *The Tampa Tribune*, p. 7.

CHAPTER 5: MINNEAPOLIS-ST. PAUL AND DENVER

The Twin Cities and Denver areas have much in common. Their populations are roughly equal, and the Twin Cities area is second only to Denver in rate of growth among non-coastal metro areas. Both are gateway cities for large portions of the interior U.S., historically for railroads and today for air transportation. Both have shifted a majority of economic activity from a manufacturing to a service economy; both serve as hubs for a major airline. Finally, both of these cities were faced in the 1980s with the question of whether to expand their existing airports, constrained by residential development, or to build a new airport well outside of the developed area. The Twin Cities chose to expand, while Denver chose to build. The similarity of these cities thus makes them a good case study of the land use impacts of expanding versus moving an airport.

Denver International Airport, Denver, CO (DEN)

<i>Date founded</i>	1995
<i>Distance from CBD</i>	24 miles northeast
<i>Size</i>	53,000 acres
<i>Metro population, 1990</i>	2.0 million
<i>Rank in passengers, 1997</i>	#6 (16.6 million)
<i>Percent O&D</i>	45.6
<i>Rank in cargo, 1997</i>	#20 (1.6 million tons)
<i>Rail transit access</i>	No

Minneapolis-St. Paul International Airport, Minneapolis, MN (MSP)

<i>Date founded</i>	1943
<i>Distance from CBD</i>	7 miles southeast/southwest
<i>Size</i>	3,100 acres
<i>Metro population, 1990</i>	2.5 million
<i>Rank in passengers, 1997</i>	#13 (14.4 million)
<i>Percent O&D</i>	46.2
<i>Rank in cargo, 1997</i>	#34 (970,000 tons)
<i>Rail transit access</i>	No

Figure 5.1: Environs of DEN

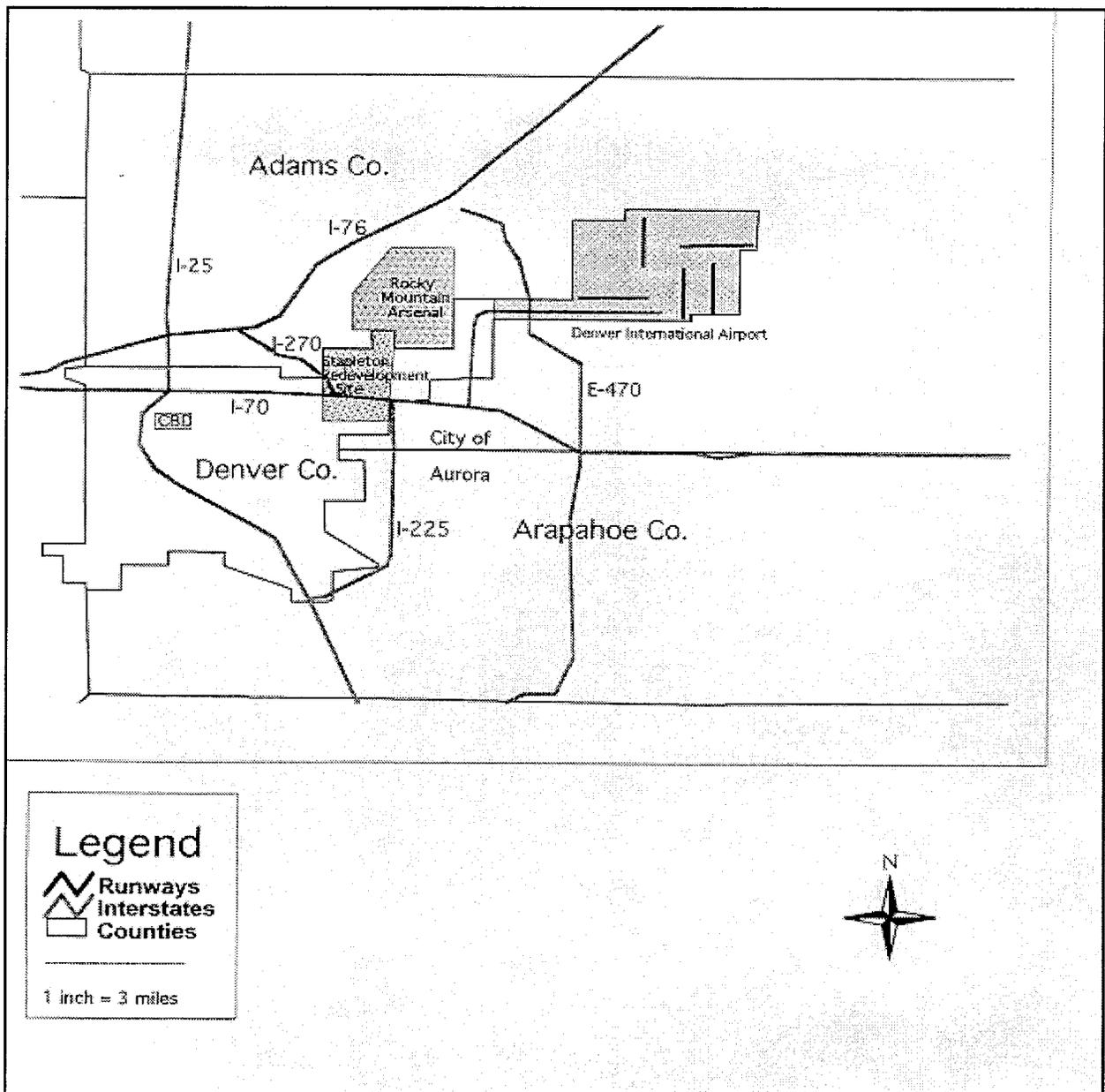
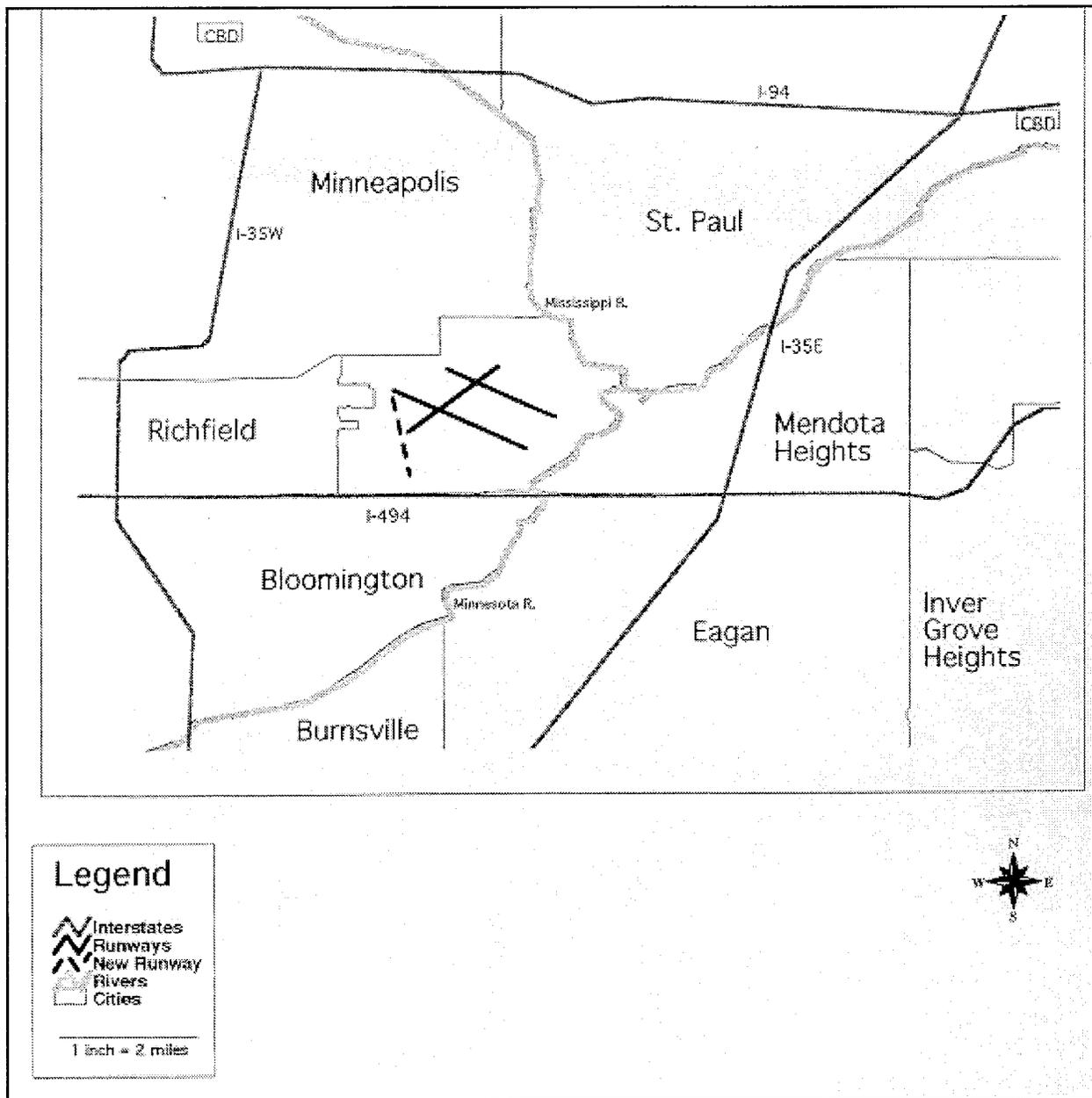


Figure 5.2: Environs of MSP



Histories

Atlanta began a boom in the mid-1960s that was propelled by its airport reconfiguration and expansion in 1980 and has not slowed down since...If Denver experiences only half the change that has transformed Atlanta, it will be unrecognizable in the 21st century—culturally, economically, and visually. [1]

Denver's municipal airport opened in 1929, later named for the mayor who had brought it into being. Stapleton (SIA) was built seven miles from downtown in order to be far from existing development (Figure 5.1). But over time, residential and commercial development grew out from downtown to envelop the airport on three sides; as happened in many other places, this was a tolerable situation for residents until the introduction of jet aircraft around 1960. SIA did have one direction in which to expand: the Army had built the Rocky Mountain Arsenal just to the north during WWII, and SIA officials asked for permission to extend a runway onto arsenal land as early as 1954. In the early 1970s, the Army finally granted permission, and a fourth runway was added to SIA's existing three.

The mix of SIC sectors around Stapleton in the early 1990s was quite different from the metropolitan area as a whole. It was almost an inverse of the mix that one would expect around the airport for a major western city: very low services and finance, insurance, and real estate, and very high manufacturing, transportation, and wholesale. This particular quadrant of Denver has traditionally been the site of freight transfer operations, from the railroads in the 1800s to the airport today. The giant stockyards were located here, and even today the aptly-named town of Commerce City has a higher percentage of semi-truck traffic on its roads than almost anywhere else in the country. The area immediately around the airport, of course, contained a great many hotels and car rental agencies but none of the office buildings that are seen around MSP or O'Hare.

Fort Snelling, Minnesota, was built on a bluff above the confluence of the Mississippi and Minnesota Rivers in 1839, and shortly thereafter the cities of Minneapolis and St. Paul were sited approximately seven miles upstream and downstream, respectively (Figure 5.2). As the land's usefulness as a military outpost decreased, it was eventually turned into a racetrack, and then an airfield in the 1920s. As was the case with Dallas and Ft. Worth, each city operated its own airport

until the government stepped in, this time the newly formed Metropolitan Airports Commission (MAC). Since the Ft. Snelling site was nearly equidistant from both downtowns, it was chosen as the region's major metropolitan airport. MSP is unusual in that it is not owned by a city, but by a combination of the Minneapolis Park Board, MAC, the state of Minnesota, and the federal government, while being operated by a regional authority. This pattern of ownership removes some of the airport-suburb conflicts found in Chicago, St. Louis, or Atlanta.

In 1990, the SIC codes of the airport environs were quite similar to those of the metro: services and retail dominated, with slightly more transportation and manufacturing than average. There is a clear separation in the land uses on either side of the Minnesota River, with transportation, wholesale, and freight more likely to be found east of the river. Hotels and car rental agencies are found mainly to the west, breaking the rule that they are usually found in the direction of the CBD, in this case because of the residential neighborhoods in both directions. Zoning and topographic maps reveal that Mendota Heights and Eagan to the east have taken great care to keep residences out of the areas most affected by noise by zoning for industrial uses.

The Decision-Making Process

Deregulation was initially good to Denver, as it became a hub for United, Continental, and Frontier Airlines. Between 1978 and 1986, passenger levels doubled. Unfortunately, two of SIA's runways were too close together to be used under inclement conditions, which occur more frequently in Denver than most airports. By 1974, well before the deregulation boom, SIA was already seeking more land. Not only was the Army opposed to giving away more arsenal land (more for safety and cleanup costs than anything else), but Adams County, the county immediately northeast of Denver, had its sights set on the arsenal land if and when it should close. However, a 1979 report by the Denver Regional Council of Governments (DRCOG, or Dr. Cog, as it is affectionately known) concluded that expansion of SIA was the better alternative over moving to a new location; a 1982 report by the City of Denver concurred, and the date was set to begin expansion in 1983.

Dempsey, Goetz, and Szyliowicz cite a number of factors as playing a role in the ensuing reversal of the Denver expansion decision [2]. One was the continuing persistence of Adams County, which not only wanted some relief for its residents from SIA noise, but also wanted the economic development that a new airport could bring. Another was the election of Federico Peña as mayor, who not only became more amenable towards a new airport than the previous mayor, but also took that support with him when he became the federal Secretary of Transportation. The FAA did its part, pointing out that the problem of the too-close runways was still there, 14,000 residents were being exposed to unacceptable noise levels, and there was an Airport Trust Fund that had been accumulating from passenger fees since DFW's construction in 1974. DRCOG concluded that if one counted the cost of cleaning up the remnants of mustard gas and nerve gas production at the arsenal, expansion and new construction would actually cost the same. The reversal was made official when the City of Denver and Adams County signed a Memorandum of Understanding in 1985, whereby Adams County would cede over fifty square miles to Denver for a new airport in exchange for a promise to close Stapleton. The requisite vote of approval on the part of Adams County residents passed, and a vote on the part of Denver residents passed as well.

As previously mentioned, the northeast sector of Denver has not been a traditional hotbed of growth (see Figure 5.1). It began as the industrial sector, and the addition of the arsenal, the Fitzsimmons Army Medical Center, Buckley Air National Guard Base, and Lowry Air Force Base during WWII further discouraged growth. The two local governments most affected by DIA are Adams County and the city of Aurora, a suburb almost the same age and geographic size as Denver itself. Of the former, Dempsey et al. said, "Adams County was a largely unplanned industrial area, home to such facilities as a petroleum refinery, a cement plant, a dog track, and grain elevators. Its residents felt that Denverites considered them their social inferiors" [3]. The county covers 1,194 square miles, ranging from built-up areas immediately north of downtown Denver to farming and grazing land, with some of the best agricultural soils in the state. Even before DIA was built, the character of the county was slowly changing—from 1970 to 1995, the population grew from 185,770 to nearly 303,000, with 75 percent of all residents in incorporated cities or towns [4]. From 1990 to

1995, the county's annual growth rate of 2.7 percent was slightly ahead of the state's average of 2.5 percent, and faster than any county but Douglas, south of Denver and one of the fastest-growing counties in the nation. In contrast to Douglas County, however, the median household income in Adams County is fifth in the six-county metropolitan area, reflecting its largely working-class population. The county projects its 2020 population to be somewhere between 460,000 and 475,000 [5].

Aurora is a typical first-ring suburb in many ways—old, large, and home to a diverse population, from the lowest of incomes to the highest, with a wide variety of ethnic groups represented. While Stapleton was in operation, approximately half of the 14,000 residents living in the 65 Ldn noise contour resided in Aurora, and so the city was firmly in favor of the new airport. In recent years, the city has been hit by the closure of Fitzsimmons Army Medical Center and Lowry Air Force Base, both within its borders or immediately adjacent. From 1990-1995, the population grew at an average of 1.8 percent, while jobs grew at 5.1 percent. However, 70 percent of all workers commute outside the city, mostly to Denver, and the city of Aurora would like to change that [6].

MSP's decision process was a few years behind Denver's. In 1989, the legislature passed the Metropolitan Airport Planning Act, which set up a dual-track planning process. One task force would work on planning the expansion of the existing airport, while the other would select a search area for a new airport, select a specific site, and plan the new facility. Each track was to be completed by 1996, at which time a decision would be made as to which route to pursue. This process, though it had to be re-evaluated by the Legislature for its cost-effectiveness, had the flexibility that Dempsey et al. wished Denver had included in its airport planning. Since state law required a major airport to be located as equidistant as possible from Minneapolis and St. Paul, the search area was somewhat reduced from the start. The 37-member New Airport Search Area Advisory Task Force, composed of airlines, local governments, community groups, environmentalists, and economic developers, settled on one site well north of the metro, one site well

south, and one closer in on the southeast. The southeastern, Dakota County site was finally chosen, with preliminary cost estimates for the project ranging from \$3.7 to \$4.1 billion.

Within the search site, located 20 miles south of St. Paul and 25 miles southeast of Minneapolis, 14,900 acres were designated for the new airport. The lack of environmental constraints such as topography or wetlands, combined with a fairly low population, made for an ideal combination. The breakdown of existing land uses was 89 percent agricultural, less than one percent residential, three percent commercial or industrial, and seven percent parks and recreation [7]. This particular geographic sector was the slowest to develop in the metro, partly because of its location across the Mississippi River from St. Paul and across the Minnesota River from Bloomington and Minneapolis, and partly because of the existence of MSP itself. This was ideal for an airport in terms of allowing relatively easy access from the metro area as a whole. Of thirty major destinations selected throughout the region, only the town of Anoka was over an hour's drive away.

However, in a region already self-conscious about its low-density, sprawling growth pattern, surprisingly little concern was raised about the inevitable impacts of an airport on regional development. The dual-track process final report did note that this site would require "major transportation improvements," but little mention was made of their potential impact on communities located between existing major highways and the airport. The case of the Metropolitan Urban Services Line (MUSA) illustrates this even better. The MUSA is the line inside which the Metropolitan Council, the regional government, provides such services as sewer lines, and thus defines the growth boundary within the seven county core. The search committee decided that any area within the MUSA would have too high a residential density to be compatible with an airport, and thus would only consider areas outside the MUSA line. Since the Metropolitan Council would undoubtedly be extending sewer lines to serve the new airport, and thus effectively extending the MUSA line through areas not originally planned for development, it appears that the leapfrog effect of the airport should have been better considered.

Another part of the dual-track process was deciding what to do with the existing airport, which was to be closed to aviation. The task force on the reuse issue advocated a mixed-use plan, with particular attention paid to the open space opportunities for the site, located as it is above the Minnesota-Mississippi confluence. The final report said, “The focus should be on economic development sectors of the future” [8] and identified six major possibilities: “international corporate center, biomedical and health care center, major research park, entertainment/major outdoor-indoor recreational center, high-tech manufacturing, transportation center and aviation reuse” [9]. The size of the parcel meant that redevelopment activity should be thought of in terms of twenty to fifty years, and they recommended an incremental process both as a means of insuring a steady income for future phases, and so that flexibility would be possible. There were three major “design concepts” proposed, one focusing on a parkway similar to those found throughout the Twin Cities, one maintaining the grid pattern of the surrounding neighborhoods, and one concentrating development in the center with open space all around. No matter which design concept was chosen, a mix of housing was advocated, along with office and commercial development, and whatever plan was adopted needed to be transit- and pedestrian-friendly in order to discourage traffic congestion. Finally, the task force acknowledged that “Although creating new growth is the priority, some internal shifting of economic activity in the region will likely occur” [10].

Acting on the Decisions

The Memorandum of Understanding between Adams County and Denver, the official notice of the decision to build DIA, was signed in 1985. The next ten years, during which the airport was planned, built, and opened, have been the subject of at least two scholarly articles, a book, and numerous newspaper and magazine articles, because of all of the things that went wrong in that time period.

To start with, there were the overly optimistic passenger forecasts. At the start of 1985, the FAA predicted that DEN would be second to O’Hare by the year 2000 in terms of passengers [11].

This forecast was based on a number of factors: Denver's long-term predicted population and economic growth; its central location within the U.S. as a strategic location; the service orientation of its economy; and the higher-than-average education levels of its population, an indicator of high travel. Colorado's importance as a tourist destination also led to the predictions of increased growth. What the FAA did not know was that Continental Airlines would pull out of Denver as a hub in May 1985, and Frontier would go bankrupt. Within two years, ticket prices had risen 63 percent, and passenger traffic actually declined from 1986 to 1990; the month after Continental left saw a six percent drop in passengers at DEN and a 67 percent rise at Colorado Springs [12].

But the airport planning process had already begun, using the FAA's forecasted numbers. By 1986, the site and runway configuration had been chosen for Denver International Airport (DIA). The land was not purchased for another three years, which resulted in an increase in land prices of up to ten times greater than its original price ^{xiii}; furthermore, "the law that obliged the city to pay for the land based on a valuation tied to its 'highest and best use' rather than its fair market value, as determined by a board comprised of real estate professionals, further limited the city's ability to acquire the land at lower prices" [13]. Additional costs that appeared fairly quickly included the purchase and demolition of 152 houses, as well as an agreement between Denver and affected school districts to pay a lump sum in compensation for the property taxes that would be lost to the airport [14].

DIA is the only major airport in the U.S. to have been built since deregulation. As a result, Dempsey et al. argued, Denver was more vulnerable to its three hub airlines than it would have been before 1978, which caused it to go well over budget in terms of both time and money. When United and Continental expressed unwillingness to move to a new airport, the city had to make a number of concessions to keep them in Denver. This included building a more expensive terminal for Continental, which was essentially wasted once that airline abandoned its Denver hub due to financial troubles. The main concession to United was the infamous automated baggage system,

^{xiii} Dempsey et al. noted that "no charges were ever filed" against the two people who owned 80 percent of the land that became DIA, suggesting that this speculation was somewhat questionable.

which was the cause for a year's worth of delays and became well-known for its luggage-chewing capabilities shortly after opening in January of 1995.

While Stapleton neighbors are pleased with the reduction in noise around their homes, there is, of course, a new group of residents who have to deal with aircraft noise. In all of 1994, the final year of its operation, Stapleton received a total of 431 noise complaints; in the first year after DIA began operations, it received over 57,000 complaints [15]. (The second most complaints that year were received by MSP—about 7,200 [16].) Part of this stems from the fact that neighbors of the new airport live in an area with much less background noise; also, they were unaccustomed to the noise (or to the futility of complaining, some might say). Another factor is the ten families that accounted for over a quarter of the complaints, including one couple who contributed 1,406 calls in the first six months [17]. The airport promised that noise would decrease at the end of 1999, when Stage 3 planes must be in use, but for an airport that was deliberately located far from the urbanized area in order to minimize noise complaints, the initial year was a shock.

As in Minneapolis, an equally important part of the planning process was deciding what to do with Stapleton, owned by the city of Denver. Approximately 65 percent of the 4,700 acres will go to urban development, while the rest will be devoted to various kinds of open space, including both restoration/preservation and recreation areas. There will be eight distinct districts, each with an identifiable center, with employment within walking distance from housing. As with the proposed MSP redevelopment, the focus is on creating jobs, including an incubator to support environmental technology firms. The city of Denver is actually more interested in creating high-tech jobs here than close to the new airport, since this site is less isolated. Housing is as important a part of the redevelopment plan as jobs, since Denver is trying to, as one city official put it, “get more bodies.” Denver is like central cities around the country in that it has been losing population while its environs have been booming. Not only the annexation of the airport land, but also the opportunity to put 10,000 households on the SIA site gives the city a chance to substantially increase its population, not something many central cities can do anymore. Officials from both Denver and

Aurora note that existing housing across the street from the former runways is already rising in price and helping to stabilize those neighborhoods [18].

Redevelopment at Stapleton is estimated to be a ten- to fifteen-year process. The former concourses have already been removed, as well as many of the parking lots and the commuter runway^{xiv}. Several hotels and car rental agencies have already left the area (except for citizens protesting the cost of DIA, the only group to speak out against the closure of Stapleton was a coalition of nearby hotel owners). United has invested thousands of dollars in a training facility, maintaining a presence onsite. Only about 5 to 10 percent of the land is contaminated, leaving plenty of room for residential development. Still, about 23 percent of the land is covered with concrete, some of it up to four feet deep. Though the site is surrounded by land fully served with utilities, there is little infrastructure within the site itself; the \$145 million that will be needed to install that infrastructure will be raised through a TIF district.

Because of the long cleanup process, land has been slow to sell; some of the bonds that were sold to finance the new airport were meant to be paid back with revenue from selling SIA land, creating further financial problems for the city. In light of this fact, as well as the previously mentioned troubles, Dempsey et al. concluded, “Instead of acting like an economic fountain, spraying benefits over the communities in the state and the region, DIA has acted more like a vacuum cleaner, sucking money away from these communities and from Denver itself, to United’s headquarters in Chicago” [19].

When the Twin Cities’ dual-track planning process came to an end in 1996, the early results of Denver’s decision were already in. Undoubtedly, this contributed to the decision to expand MSP rather than build on the Dakota County site. Cost was the major consideration: a new airport would cost about twice as much as expanding the old one, and Denver was a clear example of how easy it was to go over budget or rely too heavily on inaccurate passenger forecasts. The incremental nature of MSP redevelopment also made it more flexible, whereas “the New Airport alternative

^{xiv} Over half of this material is being recycled as roadbed for the National Wildlife Refuge that is replacing the Rocky Mountain Arsenal.

requires most of the construction to occur in one phase. Any reduction in air traffic below forecast levels after construction would result in excessive facilities and create a significant financial burden” [20]. Northwest’s threats to relocate most of the jobs at its Eagan headquarters to another city rather than build a new facility in Dakota County also may have played a role.

The expansion plan has two major components: a new 8,000-foot runway to run approximately north-south near the western border of the property, and a new terminal to be built at the northwest corner of the site and connected underground to the existing concourses. An additional 3,500 parking spaces will be added, and shops and restaurants will be part of a redeveloped terminal. More air cargo facilities will be located on the west side of the airport as well. While the new terminal is not guaranteed, construction of the runway began in 1999, as did improvements to the existing terminal.

The new runway will significantly change the noise contours around MSP; when combined with Stage 3 requirements, the number of residents within the 65 Ldn contour should shrink from 22,000 in 1994 to 7,600 by 2005 [21]. MAC must spend \$185 million on the insulation and acquisition of houses that will experienced increased noise, as well as soundproof four Minneapolis and two Richfield schools.

However, those are only the obvious land use impacts from the expansion decision. Cities on each side of the airport will be affected in a different way (see Figure 5.2). For Minneapolis, the number of residents exposed to noise is expected to drop overall, though there will be a shift from southwestern to southern neighborhoods. If and when the western terminal is built, there is likely to be a great deal of pressure on this almost exclusively residential neighborhood for airport services such as hotels and car rental agencies, as happened in College Park, GA. St. Paul is already experiencing that sort of pressure, as hotel developers push for exemptions to height restrictions along the Mississippi River. Residents of the neighborhood immediately across the Mississippi from the airport have expressed concern about park-and-ride facilities that reduce the attractiveness of the area and push their property values and taxes higher; the city has considered a development moratorium on the area [22]. Mendota Heights and Eagan, across the Minnesota River to the east,

are the primary locations for cargo distribution activities associated with MSP; if cargo facilities are enhanced along the west, these cities might not receive as much business. Bloomington will be affected because of height restrictions for the new runway; a number of hotels and office buildings will need to be removed, while future development will be restricted in that area. The Minnesota Valley National Wildlife Refuge will receive \$20 million from MAC to buy land farther upstream to compensate for the refuge areas that will be disrupted by takeoffs and landings.

Richfield, the city directly to the west, will be the most affected. Of the 444 households displaced, 390 reside in Richfield. The city will likely feel the same development pressures as Minneapolis if the terminal is moved. However, the biggest impact will come in the form of low-frequency noise, something not traditionally considered by the FAA in its creation of noise contours and that can not be mitigated by the usual soundproofing methods. With the new runway literally across the street, Richfield worries about vibrations and noise associated with takeoffs, taxiing, and engine braking. Their proposed solution is to redevelop the first one to three blocks west of the airport with high density commercial or office space in order to provide a buffer of well-insulated buildings, then redevelop the next two blocks with high-density housing so that the affected residents can remain in the neighborhood [23]. MAC has agreed to fund this proposal in exchange for the city's promise not to sue in the future [24]. Unfortunately, the state legislature decided not to support this with a TIF district, placing the burden on the FAA to approve the use of airport landing fees to fund the project. As an editorial in the *Star-Tribune* stated, "Don't hold your breath. A successful claim by Richfield could bring on a stampede. Minneapolis, Bloomington and untold numbers of cities across the nation would queue up for landing fee money to mitigate low-frequency noise...the state has yet to spend a penny on the adverse consequences of keeping the airport where it is" [25].

Of course, the communities immediately adjacent are not the only places where land use changes will occur. More aircraft noise in the far south metro, in Burnsville and Lakeville, may discourage further residential development underneath flight tracks. The additional jobs and firms that the airport hopes to attract with its increased capacity will probably find a home in the same

sectors where they are now concentrated: the southwest and west. Most noticeably, Dakota County will not experience the massive development associated with a new airport, but will continue to grow in accordance with the regional plan. Overall, reaction to the expansion has been largely harmonious, with not even Richfield formally protesting the plan. As the project is actually implemented, however, that acceptance is always subject to change.

Denver, Aurora, and Adams County are about to experience that massive development that Dakota County avoided, induced not only by the airport but also by a recently opened tollroad. While one of the motivations for each of these places to support the new airport was to encourage development, they also have to make sure that it is compatible with the airport, so as not to repeat the experience of the neighborhoods adjoining Stapleton.

Within the first year, only one hotel had been built near DIA, and officials were worrying that their hopes were too high. But after four years, the DIA environs were well ahead of where DFW was at that time in terms of certain kinds of development—3,300 hotel rooms versus 2,300, and 8.4 million square feet of industrial space versus 500,000 in Dallas [26]. Whether cheap land and good highway access are drawing these firms, as McAdams noted for Milwaukee, or whether it's the airport itself, the fact remains that the development boom is just beginning, “creat[ing] a higher quality image” for the traditionally industrial area [27].

Neighboring communities have laid out a number of rules for development to make sure it remains compatible with the airport. First, Denver obtained enough land so that the entire 65 Ldn contour falls within the airport; additionally, that contour is shrinking with the introduction of more and more Stage 3 aircraft. Next, the original annexation agreement between Denver and Adams County stated there was to be no residential development within two miles of any runway [28]. The City of Aurora already had a rule requiring that no housing be built inside the 60 Ldn contour, a much stricter standard than federal guidelines. That rule has been adopted by Adams County and the cities of Brighton and Commerce City as well. Adams County added the rule in its Comprehensive Plan that all buyers of residential property within two miles of the 60 Ldn contour

must be notified of the potential for aircraft noise, to forestall future problems if flight patterns should change [29].

Despite its eagerness for development associated with the airport, Adams County is also trying to ensure that those who move there for its still largely rural lifestyle are able to find it. With that in mind, they have not put in infrastructure to encourage development outside of incorporated areas. “The [Comprehensive] Plan must recognize the importance of agriculture to the economy and life-style of the County, and seek ways to minimize the impacts of growth on farming areas” [30]. While the twenty-two miles of sewer and water lines that Denver installed to connect the airport to the rest of the city thus give that city an advantage in attracting development, it also means that the rural character of that area is likely to be lost more quickly [31].

A housing boom is on the way as well, though it is somewhat restricted by the 60 Ldn rule. The easternmost neighborhood of Denver in particular has increased its construction rate tremendously, in part because Denver city workers have to live in the city, and now there is more city in which to live. The area issued 314 residential building permits in 1997, and expects to issue over 4,000 over the next ten years, with potential for 15,000 more [32]. A couple of developments are targeting airport employees in particular, as well as companies with frequent travelers who want to maintain a “crash pad” near the airport. Developers are already experiencing conflicts over how close they can build to the 60 Ldn line, arguing that demand should override noise protection. City officials, determined not to repeat the problems of Stapleton, are so far holding their ground.

Growth around DIA is being encouraged not just because of the airport, but because of an extension of the region’s outermost beltway, I-470. Known as E-470 through the eastern metro, this toll road runs just west of the new airport, all the way down to the south metro. The road was already being planned before the airport was built, and was actually built by the private sector. The City of Denver has been an opponent of this road, worrying that it will draw more people and jobs out of the central city into the undeveloped eastern metro, furthering urban sprawl [33]. The undeveloped eastern metro, on the other hand, is eager for the chance to sprawl. Aurora’s land use study of the corridor states,

The convergence of [E-470], which will open the eastern portion of the Denver metropolitan area to potential development, with one of the world's largest airports, the recently opened Denver International Airport (DIA), creates an economic opportunity currently unmatched in the U.S.... The E-470 Corridor, with its ready access to DIA and other existing regional economic activity centers, has the potential to not only shift the balance of development intensity region-wide, but gives the City the opportunity to create a "New Aurora," where higher quality development will be encouraged and expected [34].

Aurora has imposed a Highway Expansion Fee within 1.5 miles of E-470, ostensibly to recoup the costs of development, but also to take advantage of one of the consequences of impact fees and keep out low-end housing and industrial uses. From its Comprehensive Plan:

Uses in [this] corridor should reflect the vision for the area as follows: business and financial services, hospitality, office showroom and warehouse, and high technology uses...heavy trucking and manufacturing uses should be limited...the first two interchanges south of DIA along the new E-470 tollway should be preserved for future regional retail or office uses and other high-end development related to the airport.... [T]his area has been referred to as the International Center, which development concept involves a destination hotel, resort, and office campus [35].

For now, however, the land uses around DIA remain largely in the planning stages. Whether houses are successfully kept out of the noise contours, or whether the kind of development that is attracted to the airport environs is what neighboring cities desire, depends on whether those cities are able to stick to their plans. But no doubt, within twenty to thirty years, the land around DIA will be unrecognizable. After all, the desire for development was one of the motivating factors for building the new airport.

In conclusion, why did Denver and Minneapolis-St. Paul make different decisions? Cost is one factor: with cleanup of the arsenal land included, Denver estimated that either option would cost the same, while MSP was looking at \$2.7 versus \$4.7 billion. Second, there was less public pressure from residents near MSP to move the airport, largely because they are located on only two sides of the airport, not three as at Stapleton. Next, Denver was motivated by the desire to increase its land area by fifty percent, along with the potential to expand its population and jobs as well. Since a new Minnesota airport would probably be owned by the same regional commission that operates MSP, there would have been no "land grab" involved. Finally, when the time came for Minneapolis-St. Paul to make its decision, Denver was experiencing its initial wave of problems,

including a two-year delay, budget overruns of millions of dollars, and the notorious automated baggage system.

What consequences have those decisions had for the land uses in each of the two metropolitan areas? While those consequences will not be fully felt for decades, it is possible to make some initial observations. First, there is the obvious difference between Dakota County, MN, still largely rural and growing relatively slowly, and Adams and Denver Counties, CO, ready to experience a building boom (or to experience urban sprawl, depending on your perspective). The connections between Denver's new airport and the existing transportation system are driving more development than the airport site itself. The new tollroad, conceived of separately from the airport but undoubtedly connected, may have an equally large impact in shifting growth to the eastern metro. Next, the communities around MSP are bracing for more noise, or at least a shift in noise patterns, while housing values around SIA have already begun to increase. As Richfield prepares to reconfigure the land uses along its border with the airport, Denver is preparing to attract 10,000 households. Minneapolis-St. Paul is planning to build its first light rail line from downtown Minneapolis through the airport to the Mall of America, with the potential to redevelop portions of the inner city and to concentrate development in a transit- and pedestrian-friendly manner. Denver has experienced an increase in vehicle miles traveled (VMT) of 800,000 per year in a city already plagued by air pollution, with no transit to the airport planned for the near future^{xv}.

Works Cited

[1] Dempsey, Paul, Andrew Goetz, and Joseph Szyliowicz (1997). *Denver International Airport : Lessons Learned*. New York: McGraw-Hill.

[2] Ibid.

[3] Ibid., p. 101.

^{xv} Though airport officials claim to be eager to attract light rail, other city officials charge that the airport does not want to encourage any alternative forms of transportation that would reduce its parking revenues.

- [4] Balloffet and Associates, Inc., and Clarion Associates (1999). *Adams County comprehensive plan*. Commerce City, CO: Adams County Planning and Development Department.
- [5] Ibid.
- [6] *City of Aurora comprehensive plan*. (1998). Aurora, CO: City of Aurora.
- [7] *Selecting a search area for a new major airport*. (1991). St. Paul: Metropolitan Council.
- [8] *Minneapolis-St. Paul International Airport reuse study*. (1992). St. Paul: Metropolitan Council, p. 28.
- [9] Ibid, p. 6.
- [10] Ibid, p. 10.
- [11] Dempsey *et al.* 1997.
- [12] Ibid.
- [13] Ibid, p. 512.
- [14] U.S. Department of Transportation, Federal Aviation Administration, and Federal Highway Administration (1989). *Final environmental impact statement for new Denver airport*. Denver: County of Denver, State of Colorado.
- [15] Dempsey *et al.* 1997.
- [16] Bettelheim, Adriel (1996). DIA leads nation in noise complaints; tougher U.S. jet-sound standards urged. *The Denver Post*, p. A-11.
- [17] Hubbard, Burt (1995, August 20). DIA drowns out noise complaints; Elbert County couple makes hundreds of calls but planes keep roaring. *Denver Rocky Mountain News*, p. 5A.
- [18] Rosapep, Terry (1999, July 22). Director of Transportation Planning, City and County of Denver. Interview by author, Denver, CO.
- [19] Dempsey *et al.* 1997, p. 165.
- [20] *Dual track airport planning process: summary and decision*. (1996). St. Paul: Metropolitan Airports Commission, p. 14.
- [21] Ibid.

- [22] Duchschere, Kevin (1997, October 2). St. Paul council delays decision on moratorium. *Star Tribune (Minneapolis)* pg. 7B.
- [23] The Brauer Group, Inc. (1998) *A mitigation proposal for the impacts of Richfield stakeholders resulting from development and operation of new north-south runway (17/35)*. Richfield, MN: City of Richfield.
- [24] Blake, Laurie (1998, December 18). Airport, Richfield to work together; Noise and vibrations from jets on the ground will be targeted. *StarTribune (Minneapolis)*, p. 1B.
- [25] Airport noise; A better solution for Richfield. (1999, June 5). *StarTribune (Minneapolis)*, p. 20A.
- [26] Narvaes, Emily (1999, February 28). Blueprint for growth; Denver's northeast side has huge development potential. *The Denver Post*, p. 1.
- [27] 1998.
- [28] Cannon, Chuck (1999, July 20). Department of Public Affairs, Denver International Airport, Interview by author.
- [29] Balloffet and Associates, Inc. and Clarion Associates 1999.
- [30] *Ibid.*, p. 10.
- [31] Hellmuth, Obata, and Kassabaum, Inc.; Leland Consulting Group; and Daniel, Mann, Johnson, and Mendenhall (1998). *E-470 corridor/land use study*. Aurora, CO: City of Aurora.
- [32] Griego, Tina (1998, February 15). Prairie's progress: Denver's once-quiet outlying neighborhoods burst with development as airport stirs growth. *The Denver Rocky Mountain News*, p. 5A.
- [33] Rosapep 1999.
- [34] Balloffet and Associates, Inc. and Clarion Associates 1999, p. 26.
- [35] 1998, p. 96.

CHAPTER 6: CONCLUSION AND LESSONS LEARNED

More than any other form of transportation, the effects of air transport on land use depend heavily on the city that is being discussed. Because there is usually one commercial airport for a metropolitan area, the land uses that exist around it have to take into account regional needs. Land uses are also determined in large part by region-wide patterns, so that a new airport is likely to attract the same uses that already exist in that geographical sector. In short, aside from direct airport-related uses such as hotels or car rental agencies, it is difficult to predict the mix of land uses near a major airport.

That having been said, there are some conclusions that can be drawn from the sample of airports studied here. For one, smaller cities tend to show little difference in the mix of firms located around the airport as compared with the mix of the metropolitan area as a whole. For large cities with multiple airports, there is more differentiation in the airport environs, particularly in New York where the airports perform different functions. Some land uses tend to occur frequently: water or open space as a sound buffer or for safety reasons, or sports stadiums that require the same good ground transportation as an airport and are equally undesirable residential neighbors. Next, the siting of airport-related businesses such as car rental agencies on or off airport property makes a difference in neighboring communities' attitudes towards the airports. Communities can launch a variety of responses to airport expansion or construction, though their limited political power means their actions are always in fact reactions, and regional economic needs and wants override local economic, social, and environmental needs and wants.

Were this project to be continued as a larger study, there are some things that should be done differently. For one, a more historical view would be helpful, focusing on land use *change* rather than simply on current uses. A ten-year interval between SIC analyses was not long enough; the expansion and construction at Minneapolis-St. Paul and Denver occurred too recently for a full analysis. Examining, for example, Atlanta and Dallas as examples of expansion-versus-building would be more fruitful. This approach would also allow one to get at the question of how different a

hub airport is from a non-hub, for changes in the hubbing airline's fortunes could be tracked along with land use changes.

Second, the study area should be more carefully defined. ZIP Code Areas were used because they were the most convenient for SIC data gathering, but they do not accurately reflect the area that is influenced by the airport in question. In fact, defining the extent of the area in which land uses are affected by an airport is a study in itself, perhaps showing different zones of influence from the immediate environs to the metropolitan edge.

Next, different ways of selecting airports should be used. Choosing airports based on cargo as well as passenger statistics would allow a look at different kinds of airports than this study did. As more cities look towards all-cargo airports as a way of reducing traffic at their congested facilities, it is increasingly important to remember that not all airports are focused on serving passengers, and such differences wield an influence on local land use. Looking at smaller airports might be helpful, not least because it would make the results applicable to more places. Choosing a multi-airport region such as Los Angeles, central Florida, or New York would also help to show the extent to which differentiation among airport functions is revealed in the local landscape. Depending on the questions asked, a larger sample size would enable better generalizations to be made, while choosing fewer airports would allow more detailed research.

None of the four methods used here can be rejected. They all provided useful information that was not available in any other fashion and showed that a combination of methods is the best approach. The use of additional methodologies, however, including air photos and digital land use data, could answer (and provoke) additional questions. Further study should focus on explaining how large an area is influenced by an airport; what difference the size of the metropolitan area and airport itself makes in terms of land uses; how much the airport itself draws businesses as opposed to the infrastructure that goes along with the airport, as well as where businesses that are drawn to a metropolitan area because of the air service actually locate; and what the long-term consequences are of expanding as opposed to building a new facility.

APPENDIX A

**Table A.1—Land Use Compatibility
with Yearly Day-Night Average Sound Levels**

Yearly Day-Night Average Sound Level (decibels)

Land Use (from Standard Land Use Coding Manual)	Below 65	65-70	70-75	75-80	80-85	Over 85
<u>Residential</u>						
Residential, other than mobile homes & transient lodgings	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
<u>Public Use</u>						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals & nursing homes	Y	25	30	N	N	N
Churches, auditoriums, & concert halls	Y	25	30	N	N	N
Government services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
<u>Commercial Use</u>						
Offices, business & professional	Y	Y	25	30	N	N
Wholesale & retail—building materials, hardware & farm equipment	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade—general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communications	Y	Y	25	30	N	N
<u>Manufacturing & Production</u>						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic & optical	Y	Y	25	30	N	N
Agricultural (exc. livestock) & forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming & breeding	Y	Y(6)	Y(7)	N	N	N
Mining & fishing, resource production & extraction	Y	Y	Y	Y	Y	Y
<u>Recreational</u>						
Outdoor sports arenas & spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits & zoos	Y	Y	N	N	N	N
Amusement, parks, resorts & camps	Y	Y	Y	N	N	N
Golf courses, riding stables & water recreation	Y	Y	25	30	N	N

Numbers in parentheses refer to notes. Designations contained in this table do not constitute a federal determination that any kind of land covered by the program is acceptable or unacceptable under federal, state or local law. Responsibility for determining acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with local authorities. FAA determinations under part 150 are not intended to substitute for federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

Key to Table A-1.

Y (Yes)—land use and related structures compatible without restrictions.

N (No)—Land use and related structures are not compatible and should be restricted.

NLR—Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.

25, 30, or 35—Land use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

Notes for Table.

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus the reduction requirements are often stated as 5, 10, or 15 dB over standard construction, and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR 25 dB must be incorporated into the design and construction of these buildings where the public is received, office areas, noise-sensitive areas or where the normal noise level is low.

(3) Measures to achieve NLR 30 dB must be incorporated into the design and construction of these buildings where the public is received, office areas, noise-sensitive areas or where the normal noise level is low.

(4) Measures to achieve NLR 35 dB must be incorporated into the design and construction of these buildings where the public is received, office areas, noise-sensitive areas or where the normal noise level is low.

(5) Land use compatible provided special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

Source [19]