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ACRP REPORT 27

Enhancing Airport Land Use Compatibility

Volume 1: Land Use Fundamentals and Implementation Resources

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AIRPORT COOPERATIVE RESEARCH PROGRAM

Airports are vital national resources. They serve a key role in transportation of people and goods and in regional, national, and international commerce. They are where the nation's aviation system connects with other modes of transportation and where federal responsibility for managing and regulating air traffic operations intersects with the role of state and local governments that own and operate most airports. Research is necessary to solve common operating problems, to adapt appropriate new technologies from other industries, and to introduce innovations into the airport industry. The Airport Cooperative Research Program (ACRP) serves as one of the principal means by which the airport industry can develop innovative near-term solutions to meet demands placed on it.

The need for ACRP was identified in *TRB Special Report 272: Airport Research Needs: Cooperative Solutions* in 2003, based on a study sponsored by the Federal Aviation Administration (FAA). The ACRP carries out applied research on problems that are shared by airport operating agencies and are not being adequately addressed by existing federal research programs. It is modeled after the successful National Cooperative Highway Research Program and Transit Cooperative Research Program. The ACRP undertakes research and other technical activities in a variety of airport subject areas, including design, construction, maintenance, operations, safety, security, policy, planning, human resources, and administration. The ACRP provides a forum where airport operators can cooperatively address common operational problems.

The ACRP was authorized in December 2003 as part of the Vision 100-Century of Aviation Reauthorization Act. The primary participants in the ACRP are (1) an independent governing board, the ACRP Oversight Committee (AOC), appointed by the Secretary of the U.S. Department of Transportation with representation from airport operating agencies, other stakeholders, and relevant industry organizations such as the Airports Council International-North America (ACI-NA), the American Association of Airport Executives (AAAE), the National Association of State Aviation Officials (NASAO), and the Air Transport Association (ATA) as vital links to the airport community; (2) the TRB as program manager and secretariat for the governing board; and (3) the FAA as program sponsor. In October 2005, the FAA executed a contract with the National Academies formally initiating the program.

The ACRP benefits from the cooperation and participation of airport professionals, air carriers, shippers, state and local government officials, equipment and service suppliers, other airport users, and research organizations. Each of these participants has different interests and responsibilities, and each is an integral part of this cooperative research effort.

Research problem statements for the ACRP are solicited periodically but may be submitted to the TRB by anyone at any time. It is the responsibility of the AOC to formulate the research program by identifying the highest priority projects and defining funding levels and expected products.

Once selected, each ACRP project is assigned to an expert panel, appointed by the TRB. Panels include experienced practitioners and research specialists; heavy emphasis is placed on including airport professionals, the intended users of the research products. The panels prepare project statements (requests for proposals), select contractors, and provide technical guidance and counsel throughout the life of the project. The process for developing research problem statements and selecting research agencies has been used by TRB in managing cooperative research programs since 1962. As in other TRB activities, ACRP project panels serve voluntarily without compensation.

Primary emphasis is placed on disseminating ACRP results to the intended end-users of the research: airport operating agencies, service providers, and suppliers. The ACRP produces a series of research reports for use by airport operators, local agencies, the FAA, and other interested parties, and industry associations may arrange for workshops, training aids, field visits, and other activities to ensure that results are implemented by airport-industry practitioners.

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FOREWORD

By Michael R. Salamone
Staff Officer
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ACRP Report 27: Enhancing Airport Land Use Compatibility presents a comprehensive account of issues associated with land uses around airports. The report is a comprehensive resource to both airports and local jurisdictions near airports. Volume 1 provides guidance to help protect airports from incompatible land uses that impair current and future airport and aircraft operations and safety. Volume 2 details 15 case studies that targeted a wide range of airports and land use issues. The case study sites include large commercial service, military, and general aviation airports and were geographically diverse. Volume 2 also offers states and local governments examples and a common basis for establishing zoning that protects the public interest and investment in airports. Volume 3 includes aircraft accident data, a framework for an economic assessment of airport costs, and an annotated bibliography. Volumes 1 and 2 are printed volumes. Volume 3 is located at www.trb.org.

Under ACRP Project 03-03, Mead & Hunt was asked to investigate and present the current breadth and depth of knowledge surrounding land uses around airports and to develop guidance to protect airports from incompatible land uses that impair current and future airport and aircraft operations and safety and constrain airport development. The research focused on providing a summary of current information on the topic of compatible land use near airports. Key tasks in this research included collecting published material related to land uses that are incompatible with federal and/or state land use safety standards for airports; collecting and evaluating state compatible land use legislation, rules and directives to identify commonality; collecting data on aircraft accident locations in the vicinity of airports to establish potential high risk areas; identifying airports where major expansion projects have been delayed or abandoned due to opposition from surrounding communities that arose from a failure to have taken appropriate measures to ensure compatible land uses around those airports; and developing land use compatibility zoning examples incorporating land use and third party risk that state and local governments can use as a basis for their ordinances.

CONTENTS

PREFACE

This document, produced in fulfillment of ACRP Project 03-03: Enhancing Airport Land Use Compatibility, consists of

- Volume 1: Land Use Fundamentals and Implementation Resources provides information that helps frame the discussion of land use compatibility; provides the background of why land use compatibility near airports is important; and focuses on the various regulations, tools, and techniques that can be utilized to address land use compatibility issues.
- Volume 2: Land Use Survey and Case Study Summaries contains summaries of both the case study survey that was an integral part of the data collection effort, as well as the individual case study summary reports for the 15 case study sites.
- Volume 3: Additional Resources contains some of the resource documents developed to support the information discussed in the first volume. It provides additional detail for those readers who may want to delve deeper into the specific topics of aircraft accident data and third-party risk, as well as the economic methodology for assessing the costs associated with incompatible land uses. An annotated bibliography also is provided which contains approximately 300 entries related to airport land use compatibility

Volumes 1 and 2 are printed volumes. Volume 3 is located at www.TRB.org.

VOLUME 1

Land Use Fundamentals and Implementation Resources

SUMMARY

Enhancing Airport Land Use Compatibility

Introduction

Airports are an important element in the viability of our nation and are a significant resource to both the national and global economy. Unfortunately, incompatible land uses are threatening the utility of airports and aircraft operations across the county. The FAA, as the federal agency charged with oversight of aviation issues, airport sponsors, state aviation departments, and local jurisdictions that are located near an airport, must encourage compatible land uses around airports to protect these important transportation and economic assets. Table S.1 summarizes some of the primary reasons for incompatibility and the associated consequences.

This research document offers a comprehensive resource to both airports and local jurisdictions that will provide recommendations that these entities can use to address incompatible land use issues. Since the FAA cannot mandate land use around airports, it is important that airports and local communities take a role in developing, implementing, and maintaining land use compatibility programs at their airports. With an effective compatible land use program, airports have a better opportunity to meet future needs, thus allowing for the growth and viability of the communities they serve, through the provision of aviation services.

This is not a new phenomenon. The need for compatible land uses near airports was discussed as early as 1952 when the *Doolittle Report* was released, which addressed many of the same issues airports and communities are facing today. Our nation's economy has changed since 1952, becoming increasingly dependent upon air transportation with more than $507 billion generated in economic activities nationwide in 2002 and more than 1.9 million on-airport jobs (ACI, 2002). Additionally, in 2007, more than 20 million tons of cargo was transported by air while commercial airlines transported over 769.2 million passengers in the United States (ATA, 2008). This demonstrates the significant economic contribution that aviation (both commercial service and general aviation) makes to the economy. Preservation of the nation's airports, through land use compatibility planning, is essential if this contribution to the economy is to be maintained into the future.

ACRP Project 03-03, "Enhancing Airport Land Use Compatibility," focused on providing a summary of current information on the topic of compatible land use near airports. The team assembled to research the project is a collection of individuals and firms with vast experience in airport land use compatibility issues, covering more than 30 years in the aviation industry, working coast-to-coast for both large commercial service airports and small general aviation airports. Team members' specialties in aviation planning and engineering, land use planning, legal topics, aviation noise, and economic research were utilized to guide the development of this research effort.

An important element of this research was the case study reviews. Fifteen case studies that targeted a wide range of airports were conducted to evaluate land use issues. The case study

Table S1.1 Reasons to prevent incompatibility.

Why is Incompatibility Occurring?	What are the Consequences of Incompatibility?
The United States population has increased by over 80 million people in the last 30 years. Urban areas are expanding and communities are pursuing dense development. Communities underestimate the adverse impacts of incompatible land use development on airport operations. Many airports are currently surrounded by flat, undeveloped land that is attractive for development because it is served by utilities and other infrastructure.	Degraded airport operations. Limited current and future economic development opportunities. Reduced quality of life for airport neighbors. Lost value of public investment. Decline in transportation access. Increased safety risk to aircraft and persons on the ground. Precludes airport expansion or modification resulting from demand or new technology.

sites included large commercial service, military, and general aviation airports and were geographically diverse. These case studies revealed that many airports acknowledge the impacts of incompatible land uses in proximity to their facilities; however, many have little or no authority to effect the development or implementation of land use plans or policies within their host community. This is a significant hindrance to the compatibility process. Additionally, a lack of funding sources to pay for the planning effort is also a concern for many communities and airports.

Types of Airport Land Use Compatibility Concerns

Airport compatible land uses are defined as uses that can coexist with a nearby airport without either constraining the safe and efficient operation of the airport or exposing people living and working nearby to unacceptable levels of noise or hazards. Determining the level of compatibility of land uses around an airport is affected by the type of use and associated concerns.

In typical planning documents such as master plans and zoning ordinances, classifications for land use are provided to distinguish different types of uses from one another. For the purposes of this discussion these classifications have been quantified into six broad categories:

- Residential
- Commercial
- Industrial
- Institutional
- Infrastructure
- Agricultural/open space

Often these classifications are further defined by their density and more specific type of use. For example, the residential classification may be separated into single-family residential, multi-family residential, and manufactured housing. Each of these classifications may pose a different land use concern to an airport depending on their classification and proximity to the airport. The relationship of these land classifications relative to the geographic proximity to an airport and its operation determine compatibility.

The determination of what is compatible is somewhat relevant to each individual airport and its surrounding communities. However, general provisions that guide the local decision-making process can be provided. It is recommended that careful consideration be taken on a site specific basis to address concerns of individual airports and surrounding communities as there are varying degrees of compatibility based on items such as type, uses, location, and size of buildings. Since land use classifications vary by community, this document allows for flexibility in interpretation and implementation. Each classification of land use has been reviewed in the document for the impacts it poses to the airport and its operations as well as to people and property on the ground.

It is recommended that the various land use classifications be evaluated for compatibility based upon several areas of concern that have the potential to impact aircraft operations or have a detrimental affect on persons located in proximity to an airport. These areas of concern generally include:

- Noise Related Concerns. The goal is to limit noise sensitive land uses to avoid issues such as annoyance and sleep disturbance to persons on the ground
- Safety Related Concerns. The goal is to limit uses that have potential impacts in the following two categories:
  - Those uses hazardous to airspace and overflights
    - Tall structures (cell towers, wind turbines, vegetation, tall buildings)
    - Visual obstructions (smoke, glare, steam, dust, lights)
    - Wildlife and bird attractants (wetlands, crops, open water)
  - Those uses that affect accident severity
    - High concentrations of people (schools, churches, arenas)
    - Risk-sensitive uses (nursing homes, hospitals, flammable materials)
    - Open lands

Consideration for these land use concerns is recommended when evaluating specific developments in proximity to an airport. In some instances, such as built-out urban environments, the only land use planning options may be to not make existing uses any more incompatible than they already are, since the ability to be proactive in limiting uses has already passed. A more detailed discussion of the various land use classifications and the potential concerns associated with these uses is contained in Chapter 2 of Volume 1 of this report.

Roles and Responsibilities of Stakeholders

A variety of federal and state agencies are stakeholders in the land use planning arena that need to be integrated into the planning process. Since the FAA is unable to mandate specific land uses near airports, it is the responsibility of local governments and airport sponsors to implement and enforce land use compatibility measures near airports. Each community and airport has unique situations that require policies be tailored to their individual airport and community needs to ensure compatible land uses. In many instances there often are contradictory regulations from these same stakeholders that must be addressed to achieve land use compatibility near an airport.

Relationships among stakeholders vary due to factors such as state enabling authority, airport ownership, and the type of airports involved. It is essential that effective communication and coordination occur between federal, state, regional, and local agencies, airports, and the communities they serve for an airport land use compatibility program to succeed. Specific roles and related activities for each of these stakeholder groups are discussed in Chapter 3 of Volume 1 of the report.

Additionally, the area of influence of an airport included in compatible land use planning efforts often crosses multiple governmental jurisdictions, which necessitate coordination. In many instances, this also may require state legislation that allows for extra-territorial planning and zoning powers to regulate lands outside the boundary of the primary political jurisdiction. For example, in the State of Wisconsin, an airport sponsor has the right to establish airport zoning within a 3-mile radius of a public use airport, regardless of the political boundaries within the 3-mile area. Once the airport zoning ordinance is established, the municipalities within the boundary are required to implement the resulting zoning ordinance. This takes the political issues out of the equation since the State has granted the airport sponsor the authority to establish land use zoning ordinances.

Federal Land Use Regulations and Guidance

Information is provided in Chapter 4 of Volume 1 of this report regarding federal regulations and guidance related to compatible land uses near airports. As noted previously, the FAA has no regulatory power to require or empower communities to implement land use planning. Those powers have been delegated to the individual states; consequently, the responsibility rests with state governments to provide for specific airport land use planning legislation.

The majority of the resources referenced in this document are federal resources that provide some regulations, but more often guidance on topics related to land use issues. For example, an FAA Advisory Circular (AC) exists that provides guidance on the topic of hazardous wildlife attractants (FAA AC 150/5200-33B). This AC provides recommendations on the separation distances within which hazardous wildlife attractants should be avoided, eliminated, or mitigated. It is left to the local airport sponsor to implement the recommendations found in the various resource documents to the best of their ability taking into account staffing levels, funding sources, and local support. It must be kept in mind that the overall goal of the planning process, in conjunction with the federal guidance, is to minimize runway incidents and protect adjacent properties as well as minimize or eliminate incompatible land uses, to maintain a safe airport.

Along with safety reasons, an airport's ability to receive FAA grant funds for airport improvements is tied to land use compatibility. As outlined in Grant Assurance 21 of the FAA grant, all airports that accept federal money must

> take appropriate action, to the extent reasonable, including the adoption of zoning laws, to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations, including landing and takeoff of aircraft.

This grant assurance obligates an airport sponsor to protect the federal investment through the maintenance of a safe operating environment.

Standards are not provided to implement this assurance. Moreover, the "to the extent reasonable" clause means that implementation varies widely. An airport's ability to adopt zoning or take other land use compatibility actions is much less when the surrounding lands are in a different jurisdiction than when the same agency controls both the airport and its environs, as previously noted.

Consequently, it is important that airports and local communities effectively communicate and work together to establish compatible land uses around airports. Additionally, use of the existing sources of federal guidance, and where applicable, state legislation, should be utilized to support the implementation of compatible land use planning efforts.

Economic Costs of Airport Land Use Incompatibility

While arguments can be made that incompatible land uses affect the safety of aircraft operations and safety of people and persons on the ground, it is hard to show the cost to airports and the communities they serve. The report addresses different methods and tools that can be used to address the costs of incompatible land uses. An important application discussed in the report that can be used to determine economic costs of land use incompatibility is in a benefit-cost analysis. A benefit-cost analysis allows decision makers to anticipate and evaluate the negative effects of a rule, policy, or public investment project. A fiscal impact analysis also can be used to estimate the impact of a development or land use change on the costs and revenues of a jurisdiction. Guidance, explanation of processes, principles, insight, examples, and tools of these analyses and evaluations are provided in the report for airports and their communities to use on a site-specific basis. The inclusion of these analyses and evaluations will allow airports and local communities to determine the economic costs associated with local incompatible land use issues.

Aircraft Noise and Land Use Compatibility

Aircraft noise has the potential to affect the quality of life on those persons who live and work in communities surrounding an airport. By preventing incompatible land uses that are sensitive to aircraft noise, an airport can continue to operate effectively without interfering with the health and welfare of local residents. A goal of the FAA's Next Generation Air Transportation System (NextGen) plan is for airports to be "valued neighbors" of the communities they serve by keeping the public well informed about environmental issues and through mitigation of environmental impacts. By addressing incompatible land use that are related to noise, even if only a perceived impact by local residents, airports may be able to foster greater public acceptance and reduce the incidence of impacts such as annoyance and sleep disturbance associated with aircraft noise.

Aircraft Accidents and Safety Concerns

Although aircraft accidents are rare, maintaining compatible land uses around airports helps to reduce the risk to those on the ground near airports, as well as those persons traveling by air, should an accident occur. Studies have been conducted to assess trends in aircraft accident locations and their relationship to the ends of runways to define zones of risk. The NTSB conduced a study that assessed aircraft accident statistics from 1978 -1987. Based upon those findings, it was concluded that of the 500 accidents contained in the data set, only 246 were relevant to the study of accident locations. A subsequent study entitled The Development of an Accident Database to Structure Land Use Regulations in Airport Runway Approach Zones, Part II, 1998, was able to include 873 accidents that covered a period from 1983 to 1992 (Cooper, 1998). It has been recommended based on the findings of these two studies, that additional data is necessary when accident and incident reports are filed. For example, additional information related to the precise location of the accident, the extent and location of any related debris field, as well as the point of take-off or touchdown and information regarding the surrounding terrain and land uses are recommended to be collected.

Additionally, an assessment of the amount of risk associated with land use incompatibility also is necessary. For example, in some discussions, people who support compatible land use planning argue that while the probability of an aircraft accident happening in any one location is relatively small, it only takes one accident for it to have potentially catastrophic consequences. Others who are not as favorable to this planning effort argue that the risk of an accident is so minute that there is little reason to plan for it. Consequently, local communities need to assess the general level of risk that they are comfortable assuming with regards to the potential of an aircraft accident and the subsequent impacts to the local community and property owners who may be in proximity to the accident site.

European countries, particularly in the United Kingdom and the Netherlands, have increasingly been performing risk analyses in developing land use compatibility guidance. The results of these European studies, along with a study conducted in the United States by the Minneapolis-St. Paul International Airport Joint Airport Zoning Board, suggest current airport land use compatibility criteria may overstate the risk to people and property on the ground. Models developed by the United Kingdom National Air Traffic Services Limited illustrate areas of risk result in a triangular contour with the base adjacent to the end runway and tapering to a point away from the runway.

Because of these findings from the European community, it would be desirable to have the development of a risk model to determine land use compatibility criteria that could be applied at different airports within the United States, based upon the additional aircraft accident data that is now available. An additional 17 years of data has been collected since the 1992 Cooper Study (Cooper 1998). This model would be available for use by state and local planners and elected officials, as well as airports and consultants, to analyze risk at an airport. Availability of this model would help to establish a more rational and customized approach in defining criteria for airport land use compatibility and acceptable levels of risk.

It should be noted that additional guidance would be necessary to accompany this sort of model to provide local policy decision makers to determine acceptable levels of risk compared to the tradeoff for development opportunities in order to reduce risk of aircraft accidents. The willingness will vary from community to community and would need to be based upon local assessment of the potential risks versus the anticipated cost, should an accident occur.

Techniques for Land Use Compatibility

Many communities have some form of incompatible land use in proximity to their local airport. Due to increased development in the 20th and early 21st century, urban areas have expanded rapidly and many airports that used to be on the outskirts of their host community often find themselves in the middle in urban areas today with incompatible land uses impacting the airport. Consequently, there is a need to provide communities and airports with a number of techniques that can be utilized to address these land use compatibility issues. For example, for a large commercial service airport in an already congested metropolitan area, the tools for addressing land use incompatibility may be much greater than those employed at a more remote general aviation airport.

The tools and techniques contained in Chapter 8 of Volume 1 offer the reader a number of options to address land use compatibility within several broad topics including techniques in planning and zoning, natural features, acquisition and notification, noise mitigation, and education and communications. When evaluating potential techniques, it is important to select methods that will allow for the mitigation and/or prevention of incompatible land uses in order to maintain safe and efficient airports along with protecting people and property on the ground.

Tables are provided in Chapter 8 of the report that outline potential techniques based on different types of communities, airport size, and growth pressure. It is important to note that many of the tools provided in the report have little chance of success if not built upon a solid foundation of cooperative planning between the airport and the local community. Along with cooperation between airports and local communities, multiple strategies should be employed to address land use compatibility issues.

Further Research

Based on the findings of this project, several areas were identified that would benefit from further research. These specific areas include: aircraft accident data, a discussion of density, the effectiveness of avigation easements and their long term impact on property values, the economic implications of incompatible land use, appropriate use of the 65-DNL contour as an acceptable threshold for noise and assessment of third party risk, and increased public awareness.

A more detailed examination of recent aircraft accident location data and accident reports is warranted. As most aircraft accident location studies were completed using data prior to 1997, an analysis of data available from the most recent 10 year period is needed to determine if previous accident rate patterns are still valid or if changes have occurred to this pattern. Additionally, more data that address the level of accident data recorded and analyzed also are needed. A more distinct assessment of accident data would be beneficial. For example, an accident due to an aircraft descending below the appropriate glide path and colliding with a tree on a ridge two miles from the airport during landing may not likely have occurred if in a similar situation at an airport surrounded with flat terrain. This demonstrates that a simple plot of accident locations, while interesting, may not provide the additional level of detail that would be helpful to address land use compatibility issues.

More research is needed to determine what an acceptable level of density is and how to maintain safe levels of density in proximity to an airport. Since different land uses have different levels of density, more research is needed to determine what acceptable levels for these various uses may be, as well as addressing if there should be a difference based upon the use or its proximity to the airport environs.

Another area of research should address how avigation easements may impact property values. A common question during the acquisition of an avigation easement is “how much will this affect my property value in the long run?” Providing an answer to this question or determining that the answer may vary depending upon a host of factors, would be beneficial to the industry.

Assessing additional economic implications in greater detail is also recommended. This research would look at the broader economic impact of land use incompatibility on the aviation industry in terms of possible topics such as capacity issues, legislative costs; lose in revenue and project delays as well as third-party exposure to risk. This information is expected to strengthen the case for land use compatibility planning as a whole, throughout the industry.

Conclusion

The purpose of this project is to make available, to airports and those responsible for planning decisions, a tool that can be referenced and used to address land use compatibility issues near airports. Along with defining compatible land uses, this document provides suggested techniques to address land use issues at local airports. Additionally, this document defines the roles and responsibilities of various stakeholders and summarizes various federal legislation and regulations related to compatible land use planning. Text that addressed the economic analysis of costs associated with incompatible land uses also is provided. Sample documents such as model state legislation and a model local zoning ordinance also are included to provide a base document of consideration by readers of the document. An extensive annotated bibliography is also enclosed with over 300 entries that can be used as resource documents.

It is the hope of the project team that this document demonstrates the importance of land use compatibility at and near airports. Through compatible land use, airports and communities can not only protect an important economic and community asset, but also ensure safety and maintain an acceptable quality of life for those in surrounding communities.

VOLUME 1, CHAPTER 1

Introduction

The Wright Brother's invention of the airplane in 1903 spawned an industry that has become one of the most important pieces of infrastructure in the world that provides access to the global economy. In the century since that first flight, aviation has evolved into an efficient mode of transportation utilized by billions of people annually, as well as providing for the transportation of goods throughout the world. While the industry continues to grow and demand for service increases, an often overlooked entity known as incompatible land use continues to threaten the success of the industry and the livability of the communities that the industry serves.

Historically, most airports were built in farm fields and other places well away from the nearest towns. As towns grew, they got closer to airports, and conflicts over noise, safety, and airspace protection arose. Often the result was closure of the airport and perhaps its replacement farther from town. This option was workable when airports consisted of little more than dirt strips. Replacement is much less feasible when airports represent investments of millions or even billions of dollars. Furthermore, as urban areas have expanded and the demand for buildable property has continued to escalate, sites where new airports can be built have become increasingly difficult to find. Then, when a new site is found, communities tend to expand outward toward the airport and the whole cycle begins again. These conflicts play out across the nation daily—within large urban areas as well as the smaller rural towns—as communities and airports struggle to find a balance between airport operations and compatible land use.

This incompatibility between airports and the land uses that surround them is not a new phenomenon. Indeed, a landmark study completed in 1952—the *Doolittle Report*—addressed many of the same issues that remain today. A point emphasized in that report was that airports and metropolitan areas should be jointly planned so that they each develop to serve the other. This concept has frequently been neglected and incompatible land uses have flourished in proximity to many of the nation's airports. More than ever, it is now imperative that a cooperative approach to airport land use compatibility planning be embraced—the preservation of airports from the encroachment of incompatible land uses must be a priority for the nation, as well as individual states, local governments, host communities, and airports themselves.

This document is intended to have a dynamic audience including airport managers, community planners, elected officials, developers, pilots, and local citizens. All have a vested interest in the land use compatibility planning that takes place near an airport. The contents of the report are expected to provide the reader with a better understanding of airport land use compatibility issues. It describes the types of compatibility conflicts that can occur between airport activities and land use development, evaluates the implications of these conflicts, outlines strategies that can be set in place to mitigate existing and avoid future conflicts, and defines the responsibilities for implementation of these strategies. All of this information is provided in an effort to be sure that airport land use compatibility will not only become better understood, but also acknowledged as an important issue in local planning decisions and then implemented so that the value of airports as part of the national transportation system can be preserved and the livability of nearby communities can be enhanced.

The contents of the overall document are separated into several volumes. Volume 1 – *Land Use Fundamentals and Implementation Resources* provides information that helps frame the discussion of land use compatibility; provides the background of why land use compatibility near airports is important; and focuses on the various regulations, tools, and techniques that can be utilized to address land use compatibility issues. Volume 2 – *Land Use Survey and Case Study Summaries* contains summaries of both the case study survey that was an integral part of the data collection effort, as well as the individual case study summary reports for the 15 case study sites. Volume 3 – *Additional Resources* contains some of the resource documents developed to support the information discussed in the first volume. It provides additional detail for those readers who may want to delve deeper into the specific topics of aircraft accident data and third party risk, as well as the economic methodology for assessing the costs associated with incompatible land uses. An annotated bibliography also is provided which contains approximately 300 entries related to airport land use compatibility. These three volumes combine to provide one of the first resources of its kind for airport land use compatibility issues.

The specific elements within the individual volumes include:

Volume 1 – Land Use Fundamentals and Implementation Resources
Chapter 1 – Introduction
Chapter 2 – Airport Land Use Compatibility Concerns
Chapter 3 – Roles and Responsibilities of Stakeholders
Chapter 4 – Federal Land Use Regulations and Guidance
Chapter 5 – Economic Costs of Airport Land Use Incompatibility
Chapter 6 – Aircraft Noise and Land Use Compatibility
Chapter 7 – Aircraft Accidents and Safety Considerations
Chapter 8 –Tools and Techniques for Land Use Compatibility
Chapter 9 – Conclusions
Appendices A–H

Volume 2 – Land Use Survey and Case Study Summaries
Introduction and Survey Summary
Case Studies (15)

Volume 3 – Additional Resources
Aircraft Accident Data Sources and Trends
Developing a Framework for the Economic Assessment of the Costs of Airport Land Use Imcompatibility
Annotated Bibliography

History of Land Use Compatibility

It is important to recognize that relatively little of the policy foundations for airport land use compatibility planning come directly from federal statutes. On the federal level, only guidance is provided since the U.S. Constitution precludes federal government regulation of local land uses. Federal government involvement in airport land use compatibility planning occurs mostly because of the federal grant funding upon which airports rely. Various federal agencies have established nonregulatory guidelines that pertain to airport land use compatibility; however, there is no single federal agency that provides overall coordination of these efforts.

Over the years, attention to this issue has taken many different directions, as has the level of action taken. Dating back to 1952, President Harry S. Truman commissioned the development of a document entitled *The Airport and Its Neighbors – The Report of the President's Airport Commission,* commonly known as the *Doolittle Report,* which documented the need to protect and preserve airports from incompatible land uses and protect people on the ground within the vicinity of airports from the nuisances caused by airport and aircraft operations.

Additional reports have been issued and various federal acts have since been adopted supporting some of the goals the 1952 Doolittle Report. For example, in 1969, the National Environmental Policy Act (NEPA) was adopted providing for environmental review of federally funded projects. NEPA looks at land use issues from an environmental and social impact perspective. In the early 1970s, the Department of Defense (DoD) identified the impacts of its operation on areas outside of military property boundary lines. Based on the study, Congress authorized the creation of the Air Installation Compatibility Use Zones (AICUZ) programs. These programs establish policies and guidelines to protect military operational compatibility by avoiding incompatible development that would prevent military installations from changing or expanding operations to meet new mission requirements as necessary.

In the 1980s, minimal attention was paid to the issue of land use compatibility with the exception of noise issues and height limits to protect airport airspace. Additionally, the DoD was authorized by Congress in 1985 to establish a community planning assistance grant program to complement the AICUZ program. This program was implemented as a Joint Land Use Study (JLUS) through the DoD Office of Economic Adjustment (OEA). The impacts of noise have long been the most targeted of the land use compatibility concerns with the FAA Part 150 Noise Study program specifically providing guidance on noise impacts and associated land use planning strategies for maintaining noise sensitive uses outside of specific noise contours. According to FAA sources, more than $8 billion in noise mitigation funds have been allocated to airports across the country since the inception of the FAR Part 150 program and associated Noise Compatibility Plans.

Since the 1980s, moderate efforts have been made to address land use compatibility issues, mainly at the state level with many state aviation departments pursuing the development of state land use regulations, as well as state guidance on land use compatibility issues. Additionally, various federal guidance documents have been developed to address specific topics such as the siting of municipal land fills in proximity to airports and wildlife attractants. In an effort to encourage more land use planning, Section 160 of Vision 100—Century of Aviation Reauthorization Act (2003) provided funding for large and medium hub airports and the communities that surround them to undertake land use planning programs. In mid-2009, four projects funded by this program were underway. Its continuation is included in the current FAA funding reauthorization request. Since its inception, this program has funded the following four projects:

- Des Plaines, IL, near Chicago O'Hare Int. Airport
- The Village of Harwood Heights, IL, near Chicago O'Hare Int. Airport
- San Mateo County, CA, near San Francisco Int. Airport
- The City of Ontario, CA, near Ontario Int. Airport

More recently, with the development of ACRP as part of TRB, a number of topics related to land use compatibility are being researched to provide current assessment of the industry.

As previously noted, some states have taken the initiative to address land use compatibility with state legislation and guidance. For example, the State of Minnesota, on January 1, 1946, enacted its first model airport zoning ordinance, and by 1958 it had designated specific safety zones as part of the model airport zoning standards. In 1973, local protective zoning was made a condition for receiving federal and state funds. Additionally, the Office of Aeronautics of the Minnesota State Department of Transportation publishes a model zoning ordinance to assist local governments and provides related technical assistance to the 136 publicly owned airports in the state.

In California, the state legislature first enacted portions of the State Aeronautics Act providing for the creation of airport land use commissions (ALUCs). It should be noted that there are statutory limitations on ALUCs which define that they have no authority over existing land use regardless of whether such uses are incompatible with airport activities. Another limitation on ALUCs authority is that they have no jurisdiction over airport operations. Any actions directed toward the day-to-day activities of an airport or the manner in which aircraft operate are beyond the purview of ALUCs. However, ALUCs have authority to review proposed airport plans or proposed development to the extent that such proposals could affect off-airport land uses.

The State of Oregon also has a long history with addressing airport land use compatibility issues, dating back to 1978 when the state first published a guidebook on the topic. This document was developed as a “first step to provide the necessary understanding and information in the developing area of land use compatibility in the airport environs” (*Airport Compatibility Planning*, 1978). Various updates to the document over the years have reinforced the state’s commitment toward compatible land uses around airports. The most recent update (2002) to this document follows in the tradition of the previous updates with the same purpose and audience. The 2002 update reflects one of the biggest changes to state regulations related to airports - the development of the Airport Planning Rule (APR) overseen by the Department of Land Conservation and Development. The APR provides many useful regulations to control development both on- and off-airport property.

In 1996, the Washington State Legislature passed amendments to the state’s Growth Management Act affecting airport land use compatibility. In recognition of the societal benefits provided by air transportation, the amendments require towns, cities, and counties to discourage incompatible development adjacent to public-use airports through comprehensive plans and development regulations. The policy to protect airport facilities must be implemented in county and city comprehensive plans and development regulations as they are amended in the normal course of land use proceedings. Further, the law requires the establishment of an airport land use compatibility technical assistance program available to local jurisdictions. The legislation also identifies public-use airports as essential public facilities.

These actions by various states over the years demonstrate their commitment to the preservation of the funds and time invested in the development of this valuable piece of transportation infrastructure. It also demonstrates the fact that there is no single method to address land use compatibility issues. Each state, airport, and community is unique and requires its own methods to address land use compatibility issues.

National Value of Aviation

Recognizing the importance of a strong national network of air transportation, it is incumbent upon federal, state, and local governments, and airport sponsors to establish a unified vision that will protect and promote aviation demands, while sustaining the nation’s economy. The United States has an extensive network of airports that moves people and cargo, as well as supports national defense objectives. National, regional, and local economic growth depends upon the United States network of air transportation.

To illustrate the value of air transportation to the nation, in its 2002 study, *The Economic Impact of U.S. Airports,* the Airports Council International (ACI) describes the increasing dependency of the U.S. economy on its airports.

- Airports create $507 billion each year in total economic activities nationwide.
- There are 1.9 million on-airport jobs in the United States and 4.8 million are indirectly created in local communities, for a total of 6.7 million airport-related jobs. These jobs translate into earnings of $190 billion annually.
- Airports generate $33.5 billion in local, state, and federal taxes.
- Over 1.9 million passengers each day rely on U.S. airports for business and leisure travel.

The relationship between airports, aviation, and industry is interconnected as they support and sustain each other's growth and development. As represented here, this strong network of air transportation is crucial to connect communities and businesses on local, regional, state, and national levels. Businesses depend on airports that provide air passenger and air cargo transportation, and businesses also rely upon airports that provide general aviation services. Airports are essential for job retention and recruitment for economic development groups and communities nationally.

Airports not only serve businesses and transport cargo; they also provide vital transportation services to all citizens. The report *Commercial Aviation and the American Economy 2006*, authored by the Campbell-Hill Aviation Group, determined the U.S. civil aviation economic impact on the U.S. economy to be:

- $1.37 trillion of national output in 2004
- $418 billion in personal earnings
- 12.3 million U.S. employees

While commercial aviation provided the most significant impact with:

- $1.2 trillion in output
- $380 billion in earnings
- 11.4 million jobs

Furthermore, the *2008 Economic Report* by the Air Transport Association (ATA) summarizes the impact of all U.S. commercial airlines in 2007 as follows:

- Cargo totaled just under 20 million tons.
- 769.2 million passengers were boarded on all U.S. airlines.
- U.S. airlines experienced a 5% increase in operating revenues including passenger, cargo, and charter totaling $173.1 billion, with a net profit of nearly $5 billion.
- After a decrease in airline employment from 2005-2006, the Average Full-Time Equivalents (FTE) for employment reached 560,997.
- The average yearly total compensation for airline employees totaled $74,786.
- U.S. airlines aircraft departures total just under 11.4 million.
- Aircraft, facilities, and equipment total nearly $96.3 billion.

As these figures demonstrate, the aviation industry, both commercial service and general aviation, have a significant impact on the U.S. and global economies. If the value of the military aspects of aviation, in terms of homeland security and military training, are added to the transportation value of the aviation system, it becomes evident that there is a significant resource within the United States that must be maintained. This maintenance begins with the preservation of not only the on-airport facilities such as runway pavement and lighting, but also the off-airport aspects of compatible land use that have a direct impact on the utility of each and every airport within the system of airports nationally. Recognition of this is critical to the fundamental basis for land use compatibility planning: namely, that significant funds are expended annually on airport related development and, if incompatible land uses are allowed to develop in proximity to airports, this investment in the aviation infrastructure may be compromised.

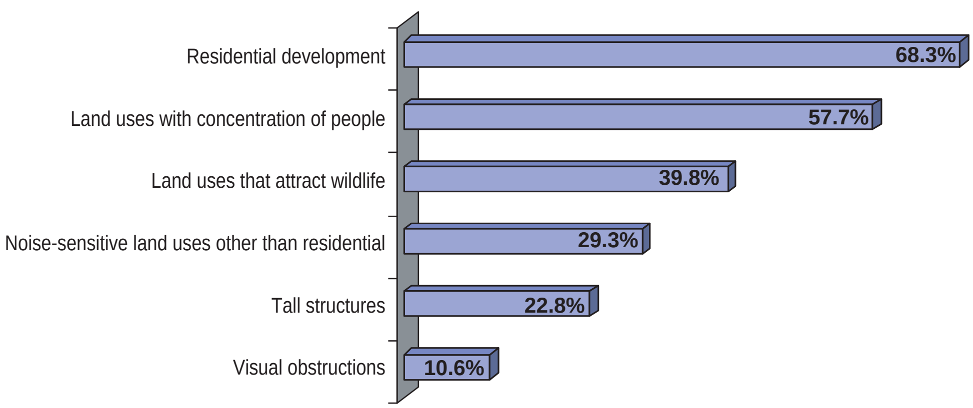
Consequences of Incompatible Land Uses

In 2004, the National Association of State Aviation Officials (NASAO) and the FAA as part of their ongoing Memorandum of Understanding (MOU) added an initiative to address land use policy. According to the document

> FAA and NASAO will partner to establish coordination in an effort to prevent land use decisions that may reduce the safe and efficient use of airspace. This collaboration will also protect against encroachment of airports due to the establishment of incompatible land uses across the country.

As noted by NASAO President Henry Ogrodzinski, while there was a wealth of anecdotal evidence that incompatible land use was having a strong and growing negative impact on airspace and airports, there was no existing documentation regarding incompatible land use on a nation-wide basis. Consequently, NASAO partnered with Mead & Hunt, Inc. to conduct a brief survey of the NASAO membership to generate a baseline assessment of the concerns associated with incompatible land uses through the United States. Of the 52 surveys distributed (50 states, Guam, and Puerto Rico), 40 responses were received for a response rate of 77%. These responses represented more than 7,000 airports across the 40 states. The results of the study indicated that is a growing concern about land use compatibility and is an issue that has implications to the national aviation system.

Since the NASAO survey was conducted at the state level and provided evidence that there are compatible land use concerns, the research team for this study thought it was important to delve into more site specific concerns. Consequently, the team initiated a national call for participation, using the NASAO membership connections to conduct a follow-up survey. This survey was initiated in 2007, as part of the development of this document. The survey obtained results from 123 airports from across the country that identified various types of land uses that pose potential hazards at the individual airports. An evaluation of the results from the survey showed evidence of the presence of incompatible land uses around airports with the most prevalent land use being residential development as shown in Figure 1.1-1



Percent of airports reporting moderate to extensive presence. (Sample=123 airports)
Source: Mead & Hunt, Inc., Land Use Survey, 2007.

Figure 1.1-1. Incidence of incompatible land uses around airports.

These findings are significant because the presence of incompatible land uses around airports have consequences, which give rise to costs—monetary and nonmonetary—for different stakeholders: airport sponsors, airport users, residents in surrounding communities, and concerned local and regional jurisdictions. Concerns about incompatibility arise from a number of reasons:

- Airport operations can be perceived to generate negative impacts on the local community. Communities often oppose airport growth because residents in the airport vicinity are exposed to adverse environmental effects, such as noise emissions. Community opposition often leads to restrictions on aircraft operations and constraints on airport capacity expansion.
- Land uses, such as those that pose physical obstructions, create visual distractions, and attract wildlife, can threaten the safety of aircraft operations as well as the safety of persons located in proximity to the airport environs.

The encroachment of incompatible land uses around airports places physical limits to safe and efficient aircraft operations and airport capacity expansion. Exposure to the undesirable effects of aviation operations, such as noise and safety related concerns, often contributes to community opposition. In particular, community opposition to aviation noise is a major obstacle to airport development according to the U.S. Government Accountability Office (GAO) and the Commission on the Future of the U.S. Aerospace Industry. For example, noise impacts were reported as the greatest environmental concern associated with aircraft operations, as found in a survey of the United States' 50 busiest airports conducted by the GAO in 2000. Community opposition generated by these concerns often lead to:

- Delays in airport development or require development of new facilities;
- Constraints to capacity expansion;
- Restrictions on airport operations;
- More stringent environmental standards, extensive review, and mitigation requirements; and
- More extensive public outreach requirements and in some cases, litigation.

✈ **Case Study Example:**
Denver International Airport

Denver International Airport is a prime example of land use constraints being so significant that construction of a new airport was the only prudent option to maintain capacity in the Denver area. Due to the extensive amount of commercial, industrial, and residential development that surrounded the former site, the Airport faced safety concerns, flight delays, expansion constraints, noise impacts, and lack of ability to keep up with growing projected demand for air service. In 1985, Adams County and the City and County of Denver signed a Memorandum of Understanding and began to move bilaterally to plan a new airport. On February 28, 1995 the new Denver International Airport (located 17 miles east of downtown Denver) became operational.

✈ **Case Study Example:**
Willmar Municipal Airport

Another example of airport relocation due to the existence of incompatible land uses is at Willmar Municipal Airport in Minnesota. The decision to relocate the airport and construct a new site started after the old airport initiated a master plan update process in 1989 and 1997 that explored expansion of the existing facility and runways to accommodate future increased demand. The airport and local community began to realize, too late, that the existing facility could not get FAA or state funding because of already-established incompatible land uses. In 1995, a joint airport-planning group recommended relocating the airport to a site two miles to the west.

✈ **Case Study Example:**
Indianapolis International Airport

Indianapolis International Airport demonstrates extensive public outreach requirements with minimal litigation needed to maintain compatible uses near their airport. Since most of the development surrounding the Airport was completed after the Airport was established, the existing land uses are generally compatible with Airport operations. In order to assure continued compatible land use development, the city of Indianapolis, under a federal grant and through the Department of Metropolitan Development, in cooperation with the Indianapolis Airport Authority, has been developing an Airport Vicinity Land Use Plan that works to improve aircraft safety, examine noise intensity in areas adjacent to the airport, and update transportation and land use planning.

Ultimately, all these lead to a variety of costs to airport users and sponsors, such as:

- Operating restrictions, development delays, and capacity constraints result in delay costs to airlines, passengers, and other airport users.

- Project delays, more stringent standards, more extensive requirements for environmental review and mitigation, and more extensive efforts for public outreach all increase the cost of airport development.
- Litigation costs such as attorneys' fees, airport staff time, and, in some cases, settlement or judgment costs.

From a broader perspective, according to the GAO, "constraints on efforts to expand airports or aviation operations could affect the future of aviation because the national airspace system cannot expand as planned without a significant increase in airport capacity." The national aviation system cannot accommodate the projected doubling or tripling of air traffic in the coming decades without additional airports and runways (GAO 2008b). Constraints on airport growth also have consequences for concerned local and regional jurisdictions. Airports contribute to the local economy by stimulating economic activity, creating employment, and generating income. Constraints on airport growth limit the positive economic impacts that surrounding communities and the larger region can derive from airport operations.

Safety is an equally important consideration. While aviation crashes rarely occur, the costs are great when they do. As will be discussed later in this document, data shows that aircraft crashes, in the vicinity of airports, tend to occur near runway ends below the approach and departure flight paths. Land uses that increase the risk of aviation crashes often include those that create physical obstructions, create visual distractions, and attract wildlife. In many instances, bird hazards are the most common wildlife hazard, especially when aircraft is airborne. However, incidents with wildlife on the ground during landing or take-off also can be a significant concern. Consequently, the term "wildlife" has been used throughout this document to include both birds and other animals. Land uses with high concentration of people in proximity to the airport and its operational areas increase third-party exposure to aviation crash risk. Table 1.1-1 lists the negative consequences to different stakeholders of the presence of incompatible land uses around airports.

Consequences and Costs to the Aviation System and Its Users

Incompatible land uses give rise to community opposition and physical constraints on airport development. These have various consequences that ultimately lead to aircraft delays and increased passenger travel time, development costs, increased risk of property damage, and fatalities from aircraft accidents.

Delays and Constraints to Airport Development

Community opposition can cause delays in the implementation of airport development projects. Project implementation delays result in monetary costs, arising from the need to update project plans, extend or change contracts, renew project approvals and permits, among other things. All these potentially increase airport development costs. More significantly, delays in much needed capacity expansion cause aircraft delays to continue and worsen.

Community opposition can limit capacity expansion leading to a variety of costly outcomes, such as persistence of aircraft delays; diversion of aircraft operations to other airports; or, in the extreme case, the need to build a replacement airport at another site. Every minute of delay costs aircraft operators in additional aircraft operating and maintenance cost and costs passengers in additional travel time. The relocation of an airport is a lengthy and costly process, as demonstrated in at least two cases in recent decades: the relocation of Denver International Airport and Willmar Municipal Airport, Minnesota.

Table 1.1-1. Consequences of airport land use incompatibility to different stakeholders.

Consequences to the aviation system and its users: • Delays and constraints to airport development, leading to system delays. • Restrictions on aircraft operations, leading to system delays and travel time penalties. • Constraints to runway approach protection, leading to runway capacity constraints and safety risks. • Litigation and related costs. • Increased development costs due to changes to proposed development and/or delays which increase costs of building materials and labor rates. • Increased risk of aviation crashes from the presence of tall structures, visual obstructions, and wildlife attractants.
Consequences to people who live near airports: • Exposure to noise. • Exposure to aviation crash risk.
Consequences to concerned local and regional jurisdictions: • Unrealized local and regional economic benefits due to constraints on airport growth.

The 2007 survey gathered information on where incompatible land uses have affected airport development in some way. As shown in Table 1.1-2, of 123 airport respondents, 33 airports or 26.8 % indicated that incompatible land uses delayed or prevented airport development from taking place.

Restrictions on Aircraft Operations

Public opposition can result in political action to impose restrictions on aircraft operations. Responding to the 2007 survey, 53 airports (43.1% of all respondents) reported operational restrictions prompted by land use issues as shown in Table 1.1-3. It should be noted that restrictions are typically intended to cover mandatory regulations such as curfews or maximum limits on operations. In many instances, noise abatement procedures are imposed, which are considered to be operational limitations, not restrictions. Many airports have noise abatement procedures for night time operations, which are successful when traffic is relatively light. Consequently, it is important to note the difference between restrictions and more general limitations such as noise abatement procedures

The most frequently cited restriction, reported by 44 airports, involves modification of flight procedures. Other restrictions include curfew on aircraft operations (including voluntary curfews), restriction of certain aircraft types, limiting the number of aircraft operations, voluntary noise abatement procedures, and preferential runway use. Twenty-four airports reported more than one type of restriction in place.

These restrictions on aircraft operations impose artificial limits on airport capacity that can exacerbate or leave aircraft delays unchecked at congested airports, resulting in increased aircraft

Table 1.1-2. Airports where incompatible land uses delayed or prevented airport development. (Sample = 123 airports)

	# of Airports	Runway or taxiway	Terminal	Fixed-Base Operator	Cargo	Hangar	Commercial Park
Total reported cases	**33**	**29**	**5**	**1**	**1**	**1**	**1**
Commercial Service (CS)	11	11	1	0	1	0	0
General Aviation (GA)	21	17	4	1	0	1	1
Private Use	1	1	0	0	0	0	0

Source: Mead & Hunt, Land Use Survey, 2007.

Table 1.1-3. Airports where incompatible land uses led to restrictions on aircraft operations. (Sample = 123 airports)

Airport	# of Airports	Curfew on aircraft operations	Limit on # of aircraft operations	Restriction of certain aircraft	Modification of flight procedure	Other
Total reported cases	**53**	**16**	**4**	**14**	**44**	**10**
Commercial Service (CS)	20	4	2	5	17	4
General Aviation (GA)	32	12	2	9	26	6
Private Use	1	0	0	0	1	0

Source: Mead & Hunt, Preliminary Interview Assessment Survey, 2007.

operating and maintenance costs and increased passenger travel time. Modified flight procedures often lead to additional minutes of flight, when pilots are required to take a less direct route for take off and landing.

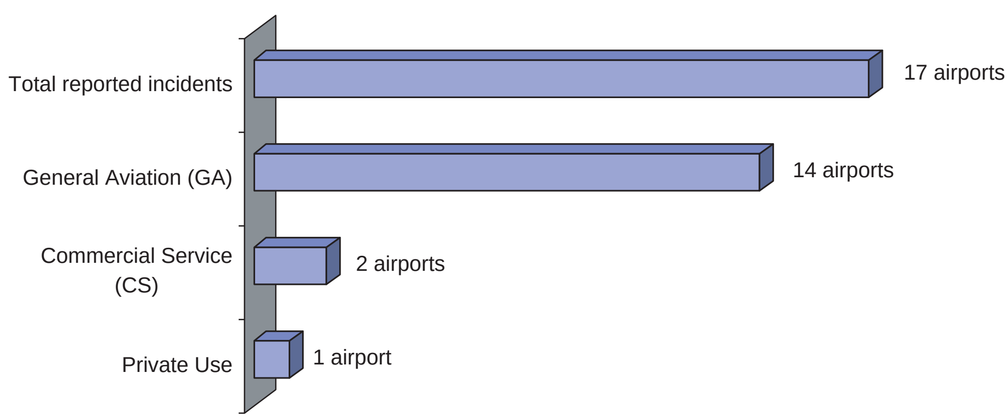
Impact on Approach Protection

The presence of incompatible land uses also can compromise runway approach protection, restricting runway use and posing potential hazard to aircraft safety. Of the 123 airport survey respondents, 17 airports, representing 13.8%, reported this problem as shown in Figure 1.1-2.

Litigation and Related Costs

Community opposition can often lead to litigation. As summarized in Table 1.1-4, 31 airports, representing 25.2% of the 123 airport respondents to the 2007 survey, reported litigation prompted by incompatible land uses. The majority of the reported cases (25 airports) involved noise. The other cases involved land uses with a high concentration of people, tall structures, and land uses that attract wildlife.

Litigation involves legal fees and other costs. The operators of the 31 airports were asked to complete a follow-on survey to obtain additional information on financial costs associated with litiga-



(Sample = 123 airports)
Source: Mead & Hunt, Preliminary Interview Assessment Survey, 2007.

Figure 1.1-2. Airports where incompatible land uses impacted runway approach protection.

Table 1.1-4 Airports that reported facing litigation involving land use issues. (Sample = 123 airports)

Airport	# of Airports	High concentration of people	Noise sensitive	Height/Tall Structures	Visual Obstruction	Wildlife attractant	Other
Total reported incidents	**31**	**9**	**25**	**2**	**0**	**1**	**3**
Commercial Service (CS)	16	6	14	0	0	0	1
General Aviation (GA)	15	3	11	2	0	1	2

Source: Mead & Hunt, Preliminary Interview Assessment Survey, 2007.

tion. Only 12 airports responded, in whole or in part, and the responses were insufficient to serve as basis for any generalized estimate of the costs associated with litigation. The responses showed wide variation from airport to airport. For example, the reported amount of attorneys fees paid ranged from $2,500 to $4 million, and estimates of the cost of airport staff time ranged from $2,734 to $500,000. Judgment or settlement amounts ranged from $8,500 to $130 million. In general, litigation costs include attorney's fees, staff time, and the amount of settlement, if any. The magnitude of costs depends upon the type of litigation, duration, and outcome.

Increased Development Costs

Actions to lessen environmental impacts have increased the costs of development, more so when incompatible land uses are present. The NEPA of 1969 calls for an environmental review of federal actions, including airport expansion projects. In particular, noise-mitigation measures include acquiring noise-sensitive properties, relocating people, modifying structures to reduce noise, encouraging compatible zoning, and assisting in the sale of affected properties. In addition to these efforts, some airports have voluntarily established some type of noise monitoring system, and conduct public outreach and education programs. Since the early 1980s, the federal government has issued grants to mitigate noise around various airports, predominately air carrier airports.

Since the early 1990s, the FAA also has allowed airports to impose passenger facility charges (PFC) for that purpose. As shown in Table 1.1-5, the FAA has provided almost $5 billion in Airport Improvement Program (AIP) grants, and airports have used almost $2.8 billion in PFCs for Part 150 noise mitigation studies and projects. In total, this amounts to nearly $8 billion in funds for noise related projects (GAO 2007). Additionally, in the last 10 years, the FAA also has spent almost $42 million on research to characterize noise and improve prediction methods, including developing a capability to determine the trade-offs between noise and emissions and quantifying the costs and benefits of various mitigation strategies (GAO 2007).

Table 1.1-5 AIP and PFC investments for part 150 noise mitigation studies and projects, 1982-2007.

Sources and Uses of Funds	Amount (in millions)
AIP funds, fiscal years 1982-2007	
Mitigation measures for residences	$1,903
Land acquisition	$2,170
Noise monitoring system	$170
Mitigation measures for public buildings	$703
Noise compatibility plan	$87
Total AIP funds	**$5,033**
PFC funds, fiscal years 1992-2007	
Multiphase	$1,283
Land acquisition	$481
Soundproofing	$1,018
Monitoring	$31
Planning	$15
Total PFC funds	**$2,828**
Grand Total AIP and PFC funds	**$7,861**

Increased Aviation Accident Risk

The safety of aircraft and their occupants, as well as people on the ground, is a very important concern for aviation policy. Aviation accident rates have fallen over the years due to relentless efforts to develop strategies that reduce the occurrence of accidents and to promote technologies, programs, and practices that enhance aviation safety. Air transport has become the safest way to travel with 0.75 accidents per million flights in 2007 according to the International Air Transport Association (IATA). However, when they do occur, aviation accidents are costly. They can result in substantial loss of lives, injuries, property damage, and substantial monetary costs associated with hospitalization, accident investigation, and litigation, in certain cases. Accident data suggest that aircraft accidents in the vicinity of airports tend to occur near runway ends under the approach and departure flight paths.

Consequences and Costs to People Who Live Near Airports

Community opposition to growth in airport operations and expansion of airport capacity often arises because people are exposed to potentially adverse environmental impacts of aviation (GAO 2000). Of these, aircraft noise is the leading cause of community opposition, and local air quality effects are increasingly gaining attention. In addition to being exposed to adverse environmental effects, people who live in certain areas near the airport face greater risk of exposure to aviation accidents.

Exposure to Aircraft Noise

While more stringent noise standards and advances in technology have made aircraft quieter, aviation noise will remain a concern when communities allow incompatible land uses, such as residences, schools, and hospitals, to be built near airports. Incompatible land uses expose people to aircraft noise, a leading cause of community opposition to airport expansion according to a 2008 GAO report. A 1993 World Health Organization (WHO) report entitled Community Noise, found that noise gives rise to a number of health problems, ranging from insomnia, stress, and mental disorders, to heart and blood circulation problems. The more severe of these adverse health effects, however, have not been demonstrated to occur at noise levels typically experienced around airports. While the WHO report has not been able to demonstrate that severe health effects occur at or near airports, this report indicates that there is certainly a basis for local citizens to perceive a noise impact from aircraft operations and overflights.

Exposure to Aviation Accident Risk

The presence of land uses with a high concentration of people near airports, especially near the runway approach and departure areas, increases third-party exposure to aviation accident risk. This topic is discussed in greater detail in Chapter 7 of this document.

Consequences and Costs to Concerned Local and Regional Jurisdictions

Airports are local economic engines; they stimulate local economic activity, create employment, and generate income to local residents. To the extent that incompatible land uses around airports constrain airport use and efficient air service, local and regional jurisdictions cannot realize the full potential of airports to generate positive regional economic impacts.

Given that the negative consequences of airport land use incompatibility are substantial, why do incompatible uses, particularly housing, continue to develop around airports? There are at least three reasons which include:

- Benefits to people living near airports;
- Costs of imposing land use controls are concentrated in one stakeholder, while the benefits are diffused among many; and
- Dynamics of the real estate development market.

First, people, and businesses that employee these people, are drawn to live near airports to have easy access to travel and employment opportunities. Residential development, which results from this attraction, in turn, benefits local jurisdictions by expanding the local tax base.

Secondly, the costs of imposing land use controls around airports to prevent incompatible developments are concentrated in one stakeholder – the local government who is also the agency with the authority to impose land use controls. In particular, there are costs to affected local jurisdictions in placing restrictions on development near airports – most notably residential uses. These costs fall into three categories: welfare losses, planning and enforcement costs, and fiscal losses. Disallowing residential developments near airports may result in welfare losses, because it may reduce the supply of land available for residential development in the entire city or county, making buildable land scarcer and indirectly limiting choices elsewhere in the city or county (Dings, et al 2003). Additionally, there are staffing and related costs involved in formulating land use plans and enforcing land use controls. Finally, local governments can also suffer from fiscal losses from a reduced property tax base, if alternative land uses do not generate the same amount in net fiscal revenues as residential development. While fiscal losses do not necessarily translate into economic welfare losses to society, as a whole, they are probably the more palpable consideration to local government officials and planners.

In contrast, the benefits of preventing incompatible land use development, while far more substantial in costs, are diffused among many different stakeholders who otherwise suffer the consequences of incompatible land uses. These consequences often include: the airport sponsors and users who suffer the consequences of operational restrictions, development constraints, and safety hazards; the people living near airports who are exposed to negative environmental effects; and the local and regional jurisdictions that fail to realize the full economic impact of unconstrained air service.

Finally, there is likely a cost to the dynamic of the real estate market in the local community. For example, the cost of potentially lost development opportunities to the real estate market should be considered as a consequence. In many instances, the methods to address this are looked at in a similar, if not identical method to traditional planning and zoning whereas a local community has been empowered to define and implement policies to protect the health, safety and welfare of the public good. This can mean zoning property to limit or restrict uses, so long as the property is not completely stripped of development potential. In some states the litmus test for this condition varies so it is recommended that additional review of local zoning laws be investigated to establish the specific test appropriate to determine usable value for a property.

Summary

With more than 19,000 airports in the United States, over 5,000 of which are open to the public, airports represent a significant resource that plays an essential transportation and economic role in the national and global economies. Preservation of this resource from the encroachment of incompatible land use is an important task for not only the FAA, but also every airport sponsor and state aviation department. The development of this guide and the subsequent use of the data by airport managers and local community planners will provide airport sponsors and host communities with a comprehensive resource of information and recommendations that can be used to address land use compatibility issues and protect the viability of every airport.

Local communities and airport sponsors must play a significant role in the preservation of the aviation system since they are the agencies tasked with the development, implementation, and maintenance of land use compatibility programs that can protect their individual airports. With the growth of the global economy, transportation of goods and passengers is increasingly becoming a key element of the aviation industry. Airport sponsors need to maintain and develop existing aviation infrastructure to ensure that the aviation system is preserved to meet future needs. Establishing compatible land uses near airports is a key component in the preservation and growth of this industry.

Airport Land Use Compatibility Concerns

Improving community and airport compatibility is crucial for the success of the stated federal policy to reduce, by 2025, "...the impact of aviation on community noise and local air quality... in absolute terms, even with anticipated growth in air traffic." Further, airports "... will be valued neighbors keeping the public well informed about environmental issues ... and ... mitigate environmental impacts related to the growth of aviation to foster public acceptance of air transportation growth ... " while allowing sustained aviation growth for the future of air transportation (FAA 2004). Achieving airport/community compatibility is a critical component in preparing for the future of the U.S air transportation system.

Land use compatibility with airports is comprised of two components: the concerns associated with compatibility, and the type of land use considered. Together, these components help determine the level of compatibility a certain land use has with its surrounding environs. This chapter examines both of these components.

The first component includes the types of compatibility concerns that affect the relationship between airports and their environs. These concerns include: airport impacts that adversely affect the livability of neighboring communities and community land use characteristics that can adversely affect the viability of airports. Airport land use compatibility concerns can broadly be classified as related either to noise related issues or safety related concerns. Each of these primary areas are addressed in this chapter to provide a foundation for understanding the potential impacts of each. Other types of airport impacts, like traffic generation and air quality, are also important environmentally, but have minimal relationship to the compatibility between airports and nearby land uses and thus are not addressed here.

The second component examined in this chapter covers the seven general types of land use and the concerns associated with each. Since the specific classifications can vary by community, the definitions in this section are kept broad to allow flexibility in interpretation and implementation by local planners and elected officials.

Definition of Compatible Land Use

The first challenge to addressing airport land use compatibility issues is to define what constitutes compatibility and incompatibility. Airport compatible land uses are defined as those uses that can coexist with a nearby airport without either constraining the safe and efficient operation of the airport or exposing people living or working nearby to unacceptable levels of noise or hazards. This definition may appear vague since no specific land use types are identified. The vagueness is intentional because various types of land use can be either compatible or incompatible depending upon the particular aspects of the land use. Land use variables include:

- Management of the land use;
- Location of the land use relative to the airport;
- Attributes of development; and
- Ancillary types of impacts associated with the land use.

For instance, land uses typically considered to be compatible with airport operations include commercial, industrial, and some agricultural activities; however, each of these also may contain aspects considered incompatible. Examples include:

- Dense concentrations of people that often characterize commercial land uses;
- Tall smoke/ventilation stacks generate smoke/steam that can create visual obstructions;
- Tall smoke/ventilation stacks also can create airspace concerns due to their height; and
- The attraction of wildlife to agricultural areas.

The underlying premise that must be addressed in order to identify and assess the degree of compatibility of a certain land use rests with two general questions:

- What are the conditions required for airports to operate safely and efficiently? (That is, what land use characteristics can adversely affect airport operations?)
- What attributes of airports potentially compromise the health, safety, and welfare of people occupying nearby residences, neighborhoods, and communities?

These two questions lay the foundation for the evaluation of compatibility for land uses near airports. At the local level, answers to these questions should guide the development and implementation of compatible land use planning tools and techniques to promote both the safety of aircraft operations and the well-being of persons on the ground near an airport.

Noise-Related Issues

Aircraft noise is a primary concern when addressing compatible land uses, and is sometimes considered the primary factor affecting or limiting airport operations. Aircraft operations can create sound levels that produce annoyance in communities near airports, as well as, additional effects such as speech interference, sleep disturbance, and affected classroom learning. These impacts are of concern as they impact the quality of life for residents located near airports.

As outlined in Vol. 1, Chapter 6, there are several methods used to measure and quantify noise depending on the number of events, their intensity or loudness, and their duration. For example, a few very loud events, as might occur around a military air base, some moderately loud events, as near a commercial jet airport, or many relatively quiet events as can occur around a general aviation airport all can be measured in different ways and be preserved with varying levels of impact by local residents. Factors that can affect the noise impacts at any given location near an airport include:

- Number of aircraft operations;
- Type of aircraft using the airport;
- Time of day of operations;
- Airfield layout;
- Percentage of time each runway or runway direction is used; and
- Location and frequency of use of flight tracks.

Several other factors can determine a community's response to noise, including:

- Type of surrounding land uses (commercial, industrial, institutional, and residential) and the level of noise it produces;

- Type of surrounding environment (rural, suburban, or urban) and its ambient noise level;
- Configuration of surrounding land use;
- Noise sensitivity of surrounding land uses;
- Past experience of the community to noise exposure; and
- Perceptions as to the necessity of the noise.

Alteration of any one of these may affect compatibility and community perceptions of noise. Similarly, each can be examined as a means for improving the compatibility between the airport and the surrounding community. Chapter 6 contains a more detailed assessment of land use compatibility and noise related issues.

Effects of Noise

There is no doubt that one of the primary motivations for establishing land use compatibility with respect to aircraft noise is to protect the public health and welfare. The EPA has explicitly examined this motivation on numerous occasions (U.S. EPA, December 1971, July 1973, and March 1974). However, more recent work (FICON, August 1992) recommends additional research on effects. Considerable information regarding noise effects is available, and may be useful to both communities and decision makers responsible for either airport or land use development and more information is developed annually. Some of the primary effects include:

- Annoyance;
- House vibration;
- Difficulty learning;
- Non-auditory health effects; and
- Sleep disturbance.

Based upon the study research, the most fundamental approach to enhancing noise compatibility is to minimize the extent noise disrupts human activities or otherwise creates an annoyance. In general, the best approach is to allow fewer people to occupy high noise-sensitive areas. When this approach is not practical, alternatives include:

- Shielding people from noise;
- Increase awareness of noise issues through educational programs; and
- Allow land uses that have relatively high ambient noise levels or are otherwise not particularly noise sensitive.

Safety-Related Issues

In many ways, addressing the safety aspects of airport land use compatibility planning poses a greater challenge than noise issues. Safety deals with what *might* happen on rare occasions, whereas noise is concerned with what *does* happen with every aircraft flight. For compatibility planning purposes, the safety topic can be divided into two broad categories: land use characteristics that constitute hazards to flight and can cause or contribute to causing an aircraft accident and land use characteristics that can add to or limit the severity of aircraft accidents when they occur. Within each of these categories are several specific types of concerns.

Land Use Characteristics that Can Be Hazards to Airspace and Overflight

Relatively few aircraft accidents are caused by land use conditions that are hazards to flight. The potential exists, however, and protecting against it is essential to airport land use safety compatibility. In addition, land use conditions that are hazards to flight may impact the continued viability of airport operations and limit the ability of an airport to operate as designed.

Tall Structures. When people think about land use characteristics that can be hazards to flight, the first thing likely to come to mind is tall structures. A person does not have to have aeronautical expertise to know that a high-rise building would pose a major problem if located at the end of a runway. Less obvious are tall buildings adjacent to a runway or ones located farther from the runway ends. Even structures not near an airport can be hazards to flight if they are tall enough. It is important to recognize that not just buildings and other structures pose potential concerns—trees, high terrain, power lines, temporary objects such as construction cranes, and mobile objects such as vehicles on a road also can be hazards in some situations.

The principal effect of tall structures is that they can reduce the utility of an airport. When aircraft approach an airport under instrument flight conditions—that is when the visibility is poor or cloud ceiling is low—they follow a defined set of procedures. The design of these procedures is directly affected by the height of objects along the runway approach course, as well as those in what is known as the missed approach segment. A new critically high object can necessitate increasing the minimum visibility and cloud ceiling criteria, thus also increasing the likelihood that an aircraft will not be able to land during bad weather.

Even under clear weather conditions when pilots visually navigate to an airport, tall objects can adversely affect airport utility. Airplanes descend to a runway along a fairly shallow slope. Just a few feet of penetration to the approach slope can require modifying the runway to move the landing point farther down the runway (known as a displaced threshold), thus giving airplanes less distance in which to stop before reaching the far end of the runway.

It is critical to discourage tall structures within the airport approach and departure surfaces. Additionally, tall structures also can pose hazards in areas beneath where aircraft circle as they begin their landing approach, or may overfly if they must "go around" because of low visibility or some other reason. Tall structures can be concerns even far away from an airport. When en route between airports, most aircraft fly high enough that structures on the ground are not a concern. Helicopters, however, fly at much lower altitudes and most helicopter accidents take place while en route rather than when landing or taking off. Other aircraft that fly low are military airplanes. The military regularly uses defined low-altitude airways during training flights and tall structures can adversely affect the use or safety of these corridors. Finally, many agricultural fields are sprayed by low-flying "crop dusters." Tall structures and power lines can increase the hazard of this type of flying and possibly limit the types of crops that can be grown.

Figures 1.2-1 and 1.2-2 illustrate some of the tall structure concerns. Where creation of these types of objects cannot be avoided, the risk to aircraft safety associated with tall structures can be minimized if structures are clearly marked with lighting and if a notice to airmen (NOTAM) is issued to pilots by the airport.

The criteria for evaluating whether a tall structure or other object represents a hazard to flight are established by the FAA. The primary

Source: www.istockphoto.com

Figure 1.2-1. Example of tall structures—wind farms.

standards are found in FAA FAR Part 77 (14 CFR 77), *Objects Affecting Navigable Airspace.* The standards used to define instrument flight procedures are set forth in the *U.S. Standard for Terminal Instrument Procedures,* known as TERPS. Chapter 4, "Federal Land Use Regulations and Guidance," provides additional background on these criteria as part of the discussion of federal guidance related to land use. Both sets of standards establish a 3-dimensional space in the air above the airport. The purpose and manner in which each functions differs, however.

Source: www.istockphoto.com

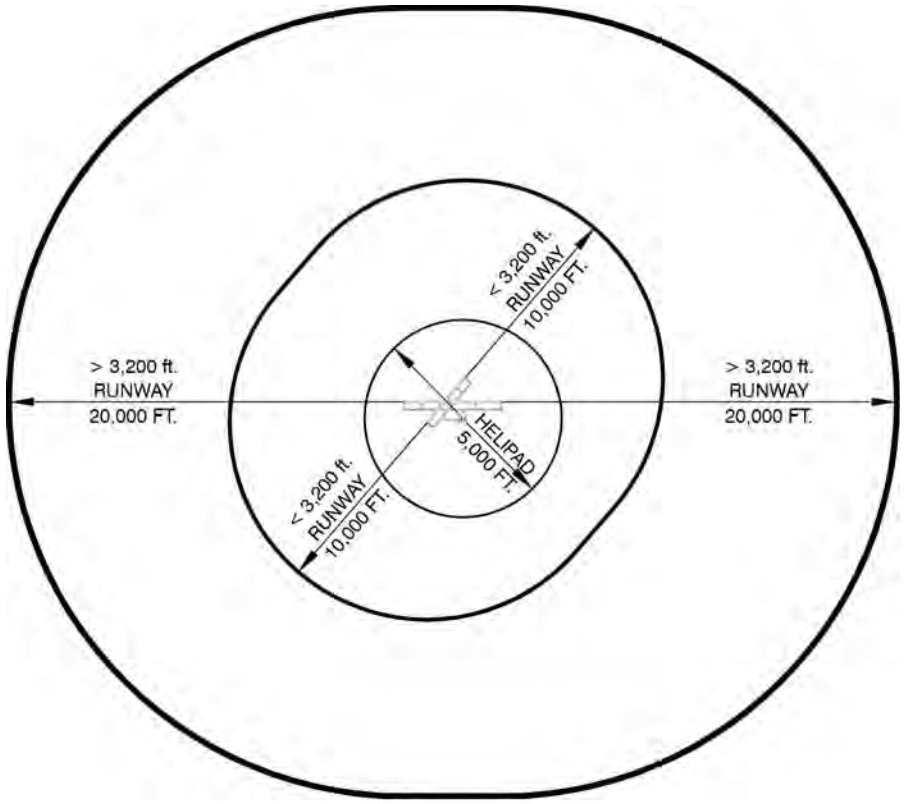
Figure 1.2-2. Example of tall structures—cell towers.

FAR Part 77 is primarily a notification device. It establishes standards for determining obstructions to navigable airspace and the effects of such obstructions on the safe and efficient use of airspace. FAA, as required by the regulations, must be notified of proposed construction or alteration of objects, if those objects reach a height that would exceed FAR Part 77 criteria. These objects include those that are permanent, temporary, or of natural growth. Proponents of objects near airports are required to submit a *Notice of Proposed Construction or Alteration* (FAA Form 7460-1) to the FAA, from which the FAA will conduct an airspace analysis and determine if the object would constitute a hazard to air navigation. Objects do not need to be very tall to require submission of a notice. Figure 1.2-3 illustrates the relationship between the three distances associated with the airspace analysis as it relates to new construction or alternations. A description of the triggers for filing the 7460-1 form can be found on the FAA website and include:

- Any construction or alteration exceeding 200 feet above ground level.
- Any construction or alteration:
  - Within 20,000 feet of a public use or military airport which exceeds a 100:1 surface from any point on the runway of each airport with at least one runway more than 3,200 feet.
  - Within 10,000 feet of a public use or military airport which exceeds a 50:1 surface from any point on the runway of each airport with its longest runway no more than 3,200 feet.
  - Within 5,000 feet of a public use heliport which exceeds a 25:1 surface.
- Any highway, railroad or other traverse way whose prescribed adjusted height would exceed the above noted standards.
- When requested by the FAA.
- Any construction or alteration located on a public use airport or heliport regardless of height or location.

Unless shielded by closer-in objects, notice is required for any object that penetrates a 100:1 slope from the runway (50:1 if the runway length is 3,200 feet or less). The FAA then conducts an aeronautical study of the proposed object. Any object that penetrates a second set of surfaces is considered to be an "obstruction." States and local communities generally use this set of surfaces to set limits on the heights of objects. Sometimes, the FAA finds an obstruction to not be a hazard to flight if the object is properly marked and lighted and not in a critical location. This evaluation process, known as Obstruction Evaluation/Airport Airspace Analysis (OE/AAA), is made available to the public through a web site www.oeaaa.faa.gov. This process can take several months and local communities, as well as the applicant of a proposed development, should take this into consideration in the review process. Adequate time should be planned to accommodate the review process and allow for receipt of the FAA airspace determination.

It should be noted that FAA review and issuance of an airspace determination does not approve or deny the construction of the proposed development—it is merely an acknowledgement that the



Source: FAA Form 7460-1

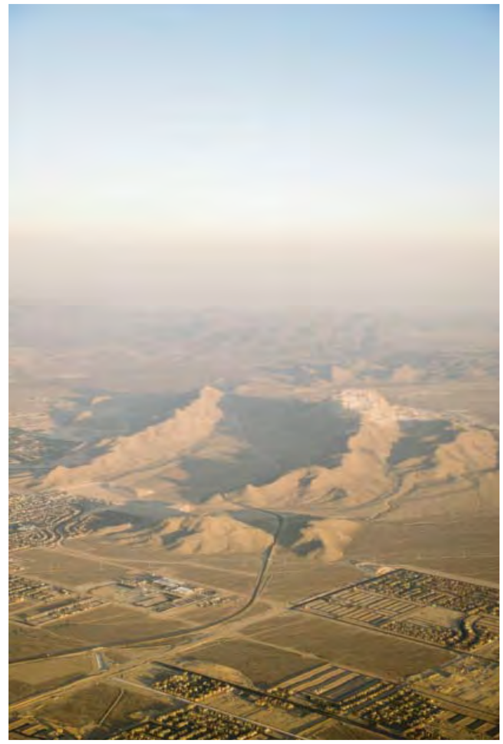
Figure 1.2-3. Proximity from an airport where filing an FAA Form 7460-1 is required.

FAA has reviewed the proposal and determined whether it is or is not a hazard to air navigation. Through this process, FAA may comment on the compatibility of a proposed land use or development, but it has no ability to regulate the construction or use at the local level. Under the federal regulation of FAR Part 77, the FAA is required to meet the airspace needs of all users and to the extent possible, revised aeronautical procedures and operations to accommodate antenna structures to fulfill broadcast requirements. Additionally, the authority of the FAA is limited to requiring mitigation for lighting and marking an obstruction. In rendering a decision of "No Hazard", the findings issued by the FAA are advisory in nature and provisions for enforcing mitigation measures do not exist. For example, the FAR Part 77 regulations do not empower the FAA to provide recommendations on alterative sites, options for site revision or no-build options. The topic of the FAA's role in airspace protection versus that of state and local agencies is further discussed in Chapters 3 and 4 of this document.

TERPS serves a different function: that of designing instrument flight procedures. TERPS surfaces are generally lower than FAR Part 77 surfaces along the runway approaches, but may extend farther from the airport. Unlike FAR Part 77 surfaces which are static unless the airport gets a new instrument approach procedure, TERPS surfaces can change with alterations in the design of the procedure or because of new obstacles. TERPS surfaces are always above any obstacles. If any new object penetrates a TERPS surface, the surfaces must be modified which usually means an increase in the approach minimums. FAR Part 77 surfaces, TERPS surfaces, and One Engine Inoperative procedures are discussed in further detail in Chapter 4 of this report.

Visual Obstructions and Electronic Interference Although not a physical obstruction in the same sense that structures are, visual obstructions also can pose hazards to flight. Maintaining an unobstructed view for pilots is an important element in creating land use compatibility. Since many aircraft operations take place without navigational aids, clear visibility of the area around airports is essential. Land uses that obscure pilot visibility should be limited to ensure safe air navigation. Visibility can be obscured in various ways, including: dust, glare, light emissions, smoke, steam, and smog. Each of these should be managed when feasible, to limit its impact on aircraft and airport operations.

Dust. Dust and dust storms carry particles through the air, which can create hazardous conditions due to severe reductions in visibility. When activities such as construction or farming occur within the vicinity of an airport, there is a risk of exposed dirt and debris being carried by winds across airport operational areas. Figure 1.2-4 illustrates an example of the reduced visibility that can result from dust. In areas where low-level flights during approach or departure are susceptible to such dust and risk reduced visibility conditions, caution should be exercised to minimize earth disturbance or the creation of open dirt areas that can contribute to these issues.



Source: www.istockphoto.com

Figure 1.2-4. Example of reduced visibility—dust.

Glare. Glare produced from reflective surfaces can blind or distract pilots during low-level flight operations. Water surfaces such as storm water detention ponds and light-colored or mirrored building materials can produce glare as well, as illustrated in Figure 1.2-5. It is important to evaluate these items during a local site plan review and to consider whether or not they may impact a pilot's vision. Measures should be taken to minimize the use of reflective materials in proximity of the airport to address this issue. For example, the angle of reflection from a proposed structure that may have reflective materials should be considered, relative to the angle of approach/departure that an aircraft may take upon ascent/decent from the runway surface. Additionally, the amount of sun exposure to a surface also may be a consideration. Coordination with the FAA is recommended if a local assessment identifies potential glare associated with various land uses.

Source: www.istockphoto.com

Figure 1.2-5. Example of visibility concerns: glare from building materials.

Light Emissions. Light emissions often are caused by lights that shine upward in the flight path. A pilot's ability to identify an airport during low-level flight altitudes can be hindered by emissions during evening hours, storm events, or times of reduced visibility such as fog. Also, lights arranged in a linear pattern can be mistaken for airport lights depicting operational areas. Figure 1.2-6 illustrates the linear light patterns created by street lights. Bright lights, including laser lights, are also a concern because they are distracting and can cause a blurred or momentary loss of vision for pilots as they pass from darkness into well-lit areas. Efforts should be made to require down-shielded lighting fixtures, as well as minimizing linear lighting near airport environs. Near military airports, certain colors of neon lights—especially red and white—should be avoided as they can interfere with the night vision goggles used by military pilots.

Smoke, Steam, and Smog. Smoke, steam, and smog can create a hazardous haze that contributes to reduced visibility for a pilot while operating an aircraft as seen in Figure 1.2-7. Generation of these conditions by land uses such as manufacturing and ethanol plants, or utilities such as electrical generation and nuclear power plants can pose a problem for pilots. Also a potential concern are the thermal plumes created by facilities such as these. A thermal plume may not be visible to pilots, but can cause air turbulence that could be hazardous to aircraft. The location of these types of land uses relative to the airports operational areas should be carefully considered.

Source: www.istockphoto.com

Figure 1.2-6. Example of light emissions: heavily populated areas can cause visual obstructions.

Source: www.istockphoto.com

Figure 1.2-7. Steam emissions creating visual obstructions.

Another type of hazard to flight that is not always considered, yet may be significant, is electronic or electromagnetic interference (EMI). Certain land uses may generate electronic signals that disrupt aircraft communication or navigation. Consideration should be given to possible creation of this form of interference when reviewing proposals for cellular communication tower and other telecommunication facilities. EMI is naturally present in the environment, however, if excessive levels are found in proximity to an airport, EMI may degrade the performance of some air navigational systems such as glide slopes, localizers, and Air Traffic Control Towers. As a result, efforts should be made to reduce the level of EMI near airports to maintain the level of performance of the various systems.

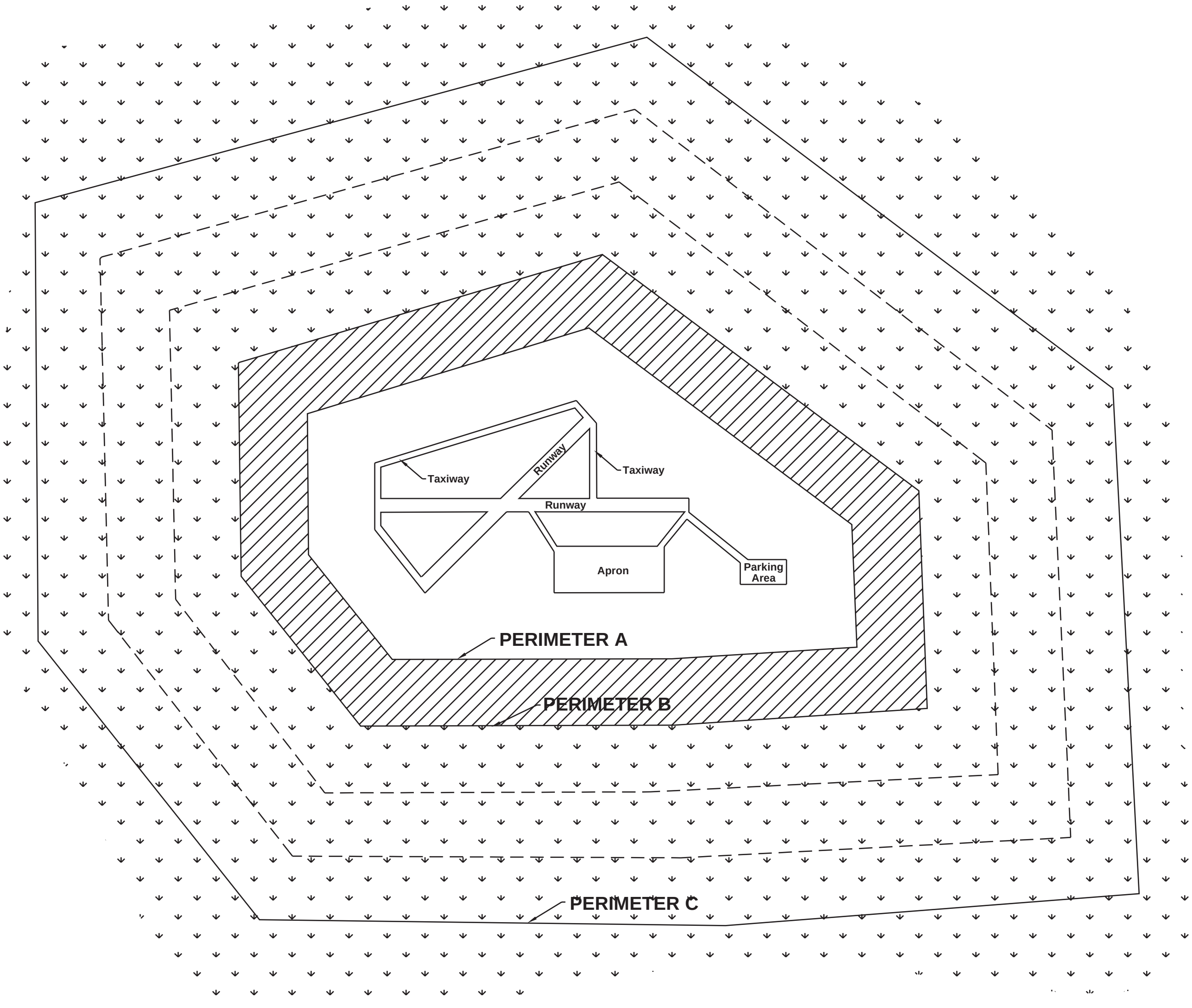
Wildlife and Bird Attractants. Aircraft collisions with wildlife are a threat to human health and safety and are steadily increasing. Wildlife strikes killed more than 194 people and destroyed over 163 aircraft since 1988 according to the *FAA Wildlife Strikes to Civil Aircraft in the United States 1990-2005.* Since 1990, 82,057 wildlife strikes have been reported to the FAA; 97.5% of the reported strikes involved birds, 2.1% involved terrestrial mammals, 0.3% involved bats, and 0.1% involved reptiles. The number of strikes reported annually has quadrupled since 1990 for several reasons, including an increase in the number of aircraft operations, and an increase in populations of hazardous wildlife species. Gulls are the most common bird species involved in the wildlife strikes reported. Approximately 60% of the reported bird strikes occurred at elevations of 100 feet or less, 73% occurred at 500 feet or less, and 92% occurred at or below 3,000 feet.

Monitoring wildlife activity and habitats on or near airports is an important first step in determining how to protect airports from wildlife hazards. Development and implementation of a wildlife management plan also plays a critical role in airport planning and zoning by giving an airport the tools and techniques to properly maintain habitat management controls. FAA AC 150/5200-33B, *Hazardous Wildlife Attractants on or Near Airports* discusses various incompatible land uses and bird attractants.

Wildlife attractants are defined in FAA AC 150/5200-33B as any human-made structure, land-use practice, or human-made or natural geographic feature that can attract or sustain hazardous wildlife within the landing or departure airspace or the airport's Airport Operations Area (AOA). These attractants can include architectural features, landscaping, waste disposal sites, wastewater treatment facilities, agricultural or aquaculture activities, surface mining, or wetlands.

Figure 1.2-8 illustrates the areas where wildlife attractants are not allowed on or near airport property. It can be seen that Perimeter A is 5,000 feet from the AOA and Perimeter B extends to 10,000 feet from operational areas. While the area for evaluation includes an area five statute miles from the AOA, it results in an area that can be up to nearly seven miles from the airport runways.

Guidelines urge airport sponsors to discourage the creation of pools, ponds, sewage lagoons, and fountains on or near an airport. Permanent water sources should be managed by removal, phy-



PERIMETER A: For airports serving piston-powered aircraft, hazardous wildlife attractants must be 5,000 feet from the nearest air operations area.
PERIMETER B: For airports serving turbine-powered aircraft, hazardous wildlife attractants must be 10,000 feet from the nearest air operations area.
PERIMETER C: 5-mile range to protect approach, departure and circling airspace.
Source: Graphic Developed by FAA Central Region Airports Division based upon guidance in FAA *AC150/5200-33B, Hazardous Wildlife Attractants on or Near Airports.*

Figure 1.2-8. Separation distances within which hazardous wildlife attractants should be avoided, eliminated or mitigated.

sical exclusion, or alteration of appearance. Underground facilities such as French drains or buried rock fields are examples of successful retention/detention designs, while temporary holding basins that drain within 24 hours are also an option. If drains and ditches cannot be removed, the banks should be steeply sloped and/or mowed regularly to control bird nesting and perching.

Control techniques to manage wildlife hazards or bird attractants include physical removal of wildlife, fence installation, and maintenance of airport grounds in such a manner that it deters wildlife habitation. Various habitat management controls include:

- Selecting and spacing tree species to minimize habitats;
- Maintaining appropriate grass lengths to minimize wildlife attractants;

- Prohibiting certain agricultural crops near airports;
- Eliminating standing water; and
- Using repellents to disperse wildlife in a humane manner.

In addition to establishing boundaries around the airfield where wildlife attractants should be mitigated or eliminated, the FAA also has established minimum distances between airport features and any on-airport agriculture crop. These distances can be found in AC 150/5300-13 Appendix 17, and are referenced in Table 1.2-1.

The U.S. Department of Agriculture (USDA) provides a listing of plants that are attractive to wildlife and should be avoided on or near airports. Woody plants such as oaks, firs, pines, maples, and cedars should be avoided, as they provide roosting habitats. Additionally, upland weeds and shrubs should be discouraged near airports as they provide a food source and habitats for wildlife. Marsh plants such as water lily, wild celery, and wild rice also can provide a food source for a variety of wildlife and are therefore discouraged. Cultivated or ornamental plants such as alfalfa, corn, birch, and dogwood trees species provide food sources, and some habitat options, and should be assessed for feasibility prior to planting.

Managing potentially hazardous wildlife on or near airports proves to be a challenge because it typically combines active control measures, such as repellents, along with passive control meas-

Table 1.2-1. Minimum distances between certain airport features and any on-airport agriculture crops.

Aircraft Approach Category and Design Group[1]	Distance in Feet From Runway Centerline to Crop		Distance in Feet From Runway End to Crop		Distance in Feet from Centerline of Taxiway to Crop	Distance in Feet from Edge of Apron to Crop
	Visual & ≥ ¾ mile	< ¾ mile	Visual & ≥ ¾ mile	< ¾ mile		
Category A & B Aircraft						
Group I	200[2]	400	300[3]	600	45	40
Group II	250	400	400[3]	600	66	58
Group III	400	400	600	800	93	81
Group IV	400	400	1,000	1,000	130	113
Category C,D, & E Aircraft						
Group I	530[3]	575[3]	1,000	1,000	45	40
Group II	530[3]	575[3]	1,000	1,000	66	58
Group III	530[3]	575[3]	1,000	1,000	93	81
Group IV	530[3]	575[3]	1,000	1,000	130	113
Group V	530[3]	575[3]	1,000	1,000	160	138
Group VI	530[3]	575[3]	1,000	1,000	193	167

1. Design Groups are based on wing span or tail height, and Category depends on approach speed of the aircraft as shown below:

Design Group	**Category**
Group I: Wing span up to 49 ft.	Category A: Speed less than 91 knots
Group II: Wing span 49 ft. up to 73 ft.	Category B: Speed 91 knots up to 120 knots
Group III: Wing span 79 ft. up to 117 ft.	Category C: Speed 121 knots up to 140 knots
Group IV: Wing span 113ft. up to 170 ft.	Category D: Speed 141 knots up to 165 knots
Group V: Wing span 171 ft. up to 213 ft.	Category E: Speed 166 knots or more
Group VI: Wing span 214 ft. up to 261 ft.	

2. If the runway will only serve small airplanes (12,500 lb. and under) in Design Group I, this dimension may be reduced to 125 feet; however, this dimension should be increased where necessary to accommodate visual navigational aids that may be installed. For example, farming operations should not be allowed within 25 feet of a Precision Approach Path Indicator (PAPI) light box.
3. These dimensions reflect the Threshold Siting Surface (TSS) as defined in AC 150/5300-13, Appendix 2. The TSS cannot be penetrated by any object. Under these conditions, the TSS is more restrictive than the OFA, and the dimensions shown here are to prevent penetration of the TSS by crops and farm machinery.

Source: FAA AC 150/5300-13-*Airport Design* ures, such as the prevention and elimination of refuges and the control of attractants. Another key component to implementing these short- and long-term control measures is to accurately monitor and record wildlife obstructions on and near airports. Reporting all bird and other wildlife strikes to the FAA is important for the study of this issue. In addition to the AC 150/5200-33B, the FAA has published a manual titled *Wildlife Hazard Management at Airports.* The manual serves as a reference for wildlife issues within proximity to airports.

The FAA and the USDA, Animal and Plant Inspection Services (APHIS) Wildlife Services (WS) have signed a MOU to resolve wildlife hazards to aviation, thus enhancing public safety. The MOU establishes that WS has the expertise to provide technical and operational assistance to alleviate wildlife hazards at airports, such as the one shown below in Figure 1.2-9. The *Rural Development, Agriculture, and Related Agencies Appropriations Act of 1988* authorizes and directs the Secretary of Agriculture to cooperate with states, individuals, public and private agencies, organizations, and institutions in the control of nuisance mammals and birds deemed harmful to the public. Airports can enter into a cooperative agreement with the USDA APHIS WS for the completion of a wildlife hazard assessment or mitigation efforts.

Source: Mead & Hunt, Inc.

Figure 1.2-9. Example of wildlife hazards: flock of birds on runway/taxiway.

Source: Mead & Hunt, Inc.

Figure 1.2-10. Example of wildlife attractants: wetland and standing water.

When initial consultations indicate concern, a more complete assessment may be necessary. A wildlife hazard assessment can be conducted by a wildlife damage management biologist to provide the scientific basis for the development, implementation, and refinement of a Wildlife Hazard Management Plan, if needed. The Plan is prepared by both the wildlife biologist and airport staff. Airport staff provides historical information regarding wildlife activity at airports. Typically, the wildlife biologist conducts a 12-month assessment of the current activity from which to make recommendations for reduction of wildlife activity. U.S. Code of Federal Regulations title 14 Aeronautics and Space Part 139 Certification of Airports, Subpart D 139.337 *Wildlife Hazard Management* requires airport sponsors take action to eliminate wildlife hazards on or near airport environs.

While aviation safety is of paramount concern, it is recognized that the elimination of all wildlife hazards to aviation is not possible and that not all wildlife are equally hazardous to aviation. Guidelines and assistance provided by the USDA WS should be followed in order to effectively analyze the comparative threats by wildlife. Figure1.2-10 shows an example of a wetland, a common wildlife attractant.

Land Use Characteristics that Affect Accident Severity

Land use characteristics in this group do not have the potential to cause or contribute to the cause of aircraft accidents, but they can greatly affect the consequences of accidents when they occur. To minimize the consequences, controls on land use development are necessary. The degree of control varies depending upon the likelihood of aircraft accidents in any given part of the airport environs. Chapter 7, Aircraft Accidents and Safety Considerations, covers the geographic distribution of aircraft accidents, and Volume 3 of this report contains a discussion of the aircraft accident data sources and trends. The strictest land use controls are needed close to the ends of runways as this is where the risk of accidents is highest. However, restrictions on uses that present very high consequences also may be appropriate relatively far away from a runway.

High Concentrations of People. The land use characteristic tied most closely to the consequences of aircraft accidents is the number of people concentrated in the accident area. Establishment of criteria limiting the maximum number of dwellings or people in areas close to the airport is the most direct method of reducing the potential severity of an aircraft accident. In setting these criteria, consideration must be given to the two different forms of aircraft accidents: those in which the aircraft is descending, but is flying under directional control of the pilot; and those in which the aircraft is out of control as it falls. Available data indicates that a substantial percentage, if not the majority, of general aviation aircraft accidents fall into the former category. Additionally, these data do not include the mishaps in which the pilot made a successful emergency landing—the latter generally are categorized as "incidents" rather than as accidents and do not appear in NTSB data.

Limits on *usage intensity*—the number of people per acre—must take into account both types of potential aircraft accidents. To the extent that accidents and incidents are of the controlled variety, then allowing high concentrations of people in a small area would be sensible, as long as intervening areas are lightly populated. However, concentrated populations present a greater risk for severe consequences in the event of an uncontrolled accident at that location. Land use compatibility policies should address both of these circumstances. Limiting the average usage intensity over a site reduces the risks associated with either type of accident. In most types of land use development, though, people are not spread equally throughout the site. To minimize the risks from an uncontrolled accident, policies also should limit the extent to which people can be concentrated and development can be clustered in any small area.

The challenge that airports and local communities face in establishing specific usage intensity limits is that little established guidance is available. Unlike the case with noise, there are no formal federal regulations or guidelines that set safety criteria for land use compatibility around civilian airports except within runway protection zones (RPZs) and with regard to airspace obstructions as described earlier in this chapter. For military airports, safety compatibility recommendations are included as part of the Air Installation Compatible Use Zone program. FAA safety criteria primarily are focused on the runway and its immediate environment. RPZs—then called clear zones—were originally established mostly for the purpose of protecting the occupants of aircraft that overrun or land short of a runway. Now, they are defined by the FAA as intended to enhance the protection of people and property on the ground.

Examination of the usage intensity criteria that airports and communities have established in California suggests that three risk-related variables are important to consider.

- *Runway Proximity* In general, the areas of highest risk are closest to the runway ends and secondarily along the extended runway centerline. However, many common aircraft flight tracks do not follow along the runway alignment, particularly on departures. Also, where an aircraft crashes may not be along the flight path that was intended to be followed or even in an area that is regularly overflown.
- *Urban versus Rural Areas* Irrespective of airports, people living in urban areas face different types of risks than those living in rural areas. Also, differences in land values and other factors mean that the cost of avoiding risks differs between these two settings. Consequently, it may be reasonable to set higher usage intensity limits in heavily developed urban areas than would be appropriate for partially undeveloped suburban areas or minimally developed rural locations.
- *Existing versus Proposed Uses* Another distinction in compatibility policies can be drawn between existing and proposed development. It is reasonable for safety-related policies to be established

that prohibit certain types of new development while considering identical existing development to be acceptable. Cost is an important factor in this regard. The range of risks can be divided into three levels. At the bottom of this scale are negligible and acceptable risks for which no action is necessary. At the top are intolerable risks for which action is necessary regardless of the cost. In between are risks that are significant, but tolerable. Whether action should be taken to reduce these risks depends upon the costs involved. Typically, the cost of removing an incompatible development is greater than the cost of avoiding its construction in the first place.

Another land use factor that is sometimes considered is frequency of use. A facility that is occupied only occasionally and vacant the remainder of the time perhaps could be allowed to have a higher concentration of people than would be permitted for a more continually used facility. The risk to this approach, of course, is that an accident could occur just when the facility is in use. In general, the frequency-of-use factor should be ignored except in unusual circumstances such as a facility that is only used at night being located near a runway that is unlighted and thus not used at night.

High Risk-Sensitive Uses. Certain critical types of land uses pose high risks and should be avoided near the ends of runway regardless of the number of people on the site. Chief among these uses are ones in which the mobility of occupants is effectively limited—schools, hospitals, nursing homes, etc. Other uses to be avoided fall under the heading of critical community infrastructure. These types of facilities include power plants, electrical substations, public communications facilities and other facilities, the damage or destruction of which could cause significant adverse effects to public health and welfare well beyond the immediate vicinity of the facility. Lastly, above ground storage of large quantities of materials that are highly flammable or otherwise hazardous (ones that are explosive, corrosive, or toxic) may pose high risks if involved in an aircraft accident and therefore are generally incompatible with airports and especially close to runway ends.

Open Land. A final characteristic that can affect the severity of an aircraft accident is open land. Open land serves two functions: open land uses generally have few occupants, thus limiting the number of people placed in harm's way; and open land areas can potentially enhance the survivability for the occupants of an aircraft forced to make an emergency landing away from a runway. If sufficiently large and clear of obstacles, open land areas can be valuable for light aircraft anywhere near an airport. For large and high-performance aircraft, however, open land has little value for emergency landing purposes and is most useful primarily where it is an extension of the clear areas immediately adjoining a runway.

Because open land areas must be relatively large (football field size or greater) even for small aircraft, planning for such areas must be made during preparation of community plans or plans for large developments. By the time a development has proceeded to where it is split into individual parcels, providing open land is seldom possible. Also important to emphasize is that "open land" differs from "open space." As the latter term is typically used in community planning, it may include wooded areas, sports parks, and other land uses that would not meet the purposes of open land. On the other hand, farm fields and even wide roadways may serve as open land, but not show as open space in local plans.

Example Guidance

The race track illustrated in Figure 1.2-11 represents a type of land use that poses several compatibility issues. Although used relatively infrequently, it holds a high concentration of people when it is in use. Moreover, as an essentially outdoor use, the structure offers little protection should an aircraft strike it. Also, the height of the light towers could be airspace obstructions and

Source: www.istockphoto.com

Figure 1.2-11. Example of a land use with a high concentration of people.

Source: www.istockphoto.com

Figure 1.2-12. Example of residential land use near a runway.

the glare from the lights could be visual hazards to aircraft. In this particular example, noise may not be a concern. However, noise intrusion could be a critical factor for similar uses such as an amphitheater.

Residential development near a runway, as shown in Figure 1.2-12, is another example of a land use that presents multiple compatibility issues. Foremost is noise. Even with added sound insulation, noise levels inside are likely to be intrusive on a regular basis. Safety is also a concern in that many people are living in an area where the risk is significant, though not as great as beyond the runway ends.

At this time, a national standard is not available to define population concentrations nor usage intensities around an airport; however, the American Planning Association (APA), has established some industry guidelines for various land use types that can be helpful in setting criteria. These are listed here to provide some general guidance. Residential land uses are often the most common topic when population density is discussed in planning situations. For example, in APA's recently published document, *Planning and Urban Design Standards,* definitions of density for residential development have been identified including: the measure of units per acre, as well as floor-area ratio. Residential density is most commonly measured by the number of dwelling units per acre (du/ac). Examples of these densities from the *Planning and Urban Design Standards* include:

- Low residential density: 4 units per acre (4du/ac);
- Medium residential density: 16 units per acre (16du/ac); and
- High residential density: 48 units per acre (48du/ac).

In dense urban areas, the floor area ratio also may be used to determine the density. The floor area ratio is defined as the ratio of the gross building floor area to the net lot area of the building site. Scales of residential development also can be defined. Samples of these scales may include:

- Small scale: five to 50 units per zero to 10 acres;
- Medium scale: 50 to 500 units per 10 to 50 acres; and
- Large scale: 500 or greater units per 50 or greater acres.

While the aforementioned definitions are specific densities related to residential uses, there are methods for determining densities of other types of land uses such as commercial and industrial uses. Local communities may wish to utilize the following tools to establish their own levels of density:

- Analysis of parking requirements established in local zoning ordinances;
- Maximum occupancy levels set in accordance with building codes; and
- Surveys of similar uses.

Several states have defined various land use densities within their land use planning documents. For example, the *California Airport Land Use Planning Handbook* provides some measures that a municipality can use as a benchmark when defining concentrations of people for various land uses within their community, including:

- Light Industrial use: 35 to 50 people per acre within the facility.
- Two-Story Motel: 35 to 50 people per acre within the dwelling unit.
- Single-Story Shopping Center: 75 to 125 people per acre within the facility.
- Single-Story Office: 50 to 100 people per acre within the building.
- Sit-Down Restaurant: 100 people per acre within the building.
- Fast Food Restaurant: 150 people per acre within the building.

The *Airport Land Use Compatibility Manual* for the state of Minnesota, established rules prohibiting public assembly uses and limiting population and building concentrations in several safety zones, which are intended to include all land under a runway's approach path. These zones are specifically defined by state statue (Minnesota Rule 8800.2400) which contains the following density restrictions and prohibitions on use:

- The most restrictive zone (Zone A) may contain no buildings, temporary structures, exposed transmission lines, or other similar land use structural hazards, and restricts development to those uses, which will not create, attract, or bring together an assembly of persons.
- The zone that represents the majority of the approach path areas (Zone B) is restricted in use as follows:
  - Each use shall be on a site whose area shall not be less than three acres,
  - Each use shall not create, attract, or bring together a site population that would exceed 15 times that of the site acreage,
  - Each site shall have no more than one building plot, and
  - Each site shall adhere to the minimum ratios as outlined in Table 1.2-2.

In general, the higher the concentrations of people that a land use supports or attracts, the less compatible it will be in proximity to an airport. Conversely, the lower the concentration of people, the more compatible land uses are near airports. Additional elements to consider in this discussion include the following:

- Whether the people are within an enclosed area (buildings, stadiums, arenas) or in large open spaces (parks, sports fields); and
- The mobility of persons and their ability to care for themselves (hospitals, daycares, schools).

The topic of mobility becomes an issue when land uses are proposed that create a concentration of people that may require additional assistance to extricate themselves from the structure or area in the event of a crash. For example, if a school were constructed near an airport and aircraft crashed into the building, there would be a concern about the ability of the number of

Table 1.2-2. Minnesota Rule 8800.2400, Zone B Minimum Ratios.

Site Area at Least (acres)	But Less Than (acres)	Ratio of Site Area to Building Plot Area	Building Plot Area (square feet)	Maximum Site Population (15 persons/acre)
3		12:1	10,900	45
	4	12:1		
4		10:1	17,400	60
	6	10:1		
6		8:1	32,600	90
	10	8:1		
10		6:1	72,500	150
	20	6:1		
20	And up	4:1	218,000	300

Source: *Minnesota Land Use Compatibility Study*, 2006 adults to mobilize and evacuate the students in an effective manner, due to the ratio of adults to children who would likely require significant direction to exit the building. A similar situation could be experienced with a hospital where the occupants are often challenged to care for themselves and would likely find it difficult to exit the building if necessary without assistance. These two examples demonstrate the concerns associated with development of land uses that encourage the concentration of people in proximity to an airport. As demonstrated, there are safety concerns associated with the placement of a large concentration of people near an airport where there is limited open space to provide opportunities for aircraft to land should the need arise.

Common Land Uses Near Airports

Types of land use can generally be categorized into seven common classifications, although they can take many shapes and sizes which make their assessment as compatible uses difficult. At the primary level, the type of use such as residential or commercial is reviewed on a broad level of compatibility. In addition to the primary use, there are often other attributes of development that can play a key role in increasing the compatibility of a neighboring land use to an airport. For example, the types of buildings, the density of the development, the size of the development, and the geographic location relative to the runway environment can all be secondary considerations in the evaluation of compatibility. These attributes affect development types and their compatibility with the surrounding environment and their community airport. Several examples of various attributes which can be considered are discussed below.

Building type is one attribute that can contribute to increased compatibility. Building type refers to the individual building units and their placement in relationship to each other on a site and also the building materials used. Building types can range from a modular home to a “big-box” retail store. Additionally, construction materials also can be considered when evaluating potential compatibility. For example, materials such as concrete and brick offer more structural integrity to a building compared to use of glass surfaces.

The density of development, as well as the intensity of a use, also should be considered when evaluating land use compatibility. Density refers to the number of building units per area of land. A common measure of density is units per acre (u/ac). It also may be measured in floor area ratio (FAR), which is the ratio of the gross building floor area to the net lot area of the building site, often used in denser urban environments. Intensity refers to the number of persons within an area or structure relative to the amount of time they occupy an area. Limiting both the density of a development and intensity of the use are recommended to reduce the incompatibility issues.

Consideration of the size of a development is important because it can dictate additional development requirements that can have land use concerns. The size of a project refers to the land area of the project or development. For example, it can range from a small, single-lot 1,000 square foot residential home, to a 4,000-acre commercial development. For example, a large commercial development with extensive parking areas would typically require water detention areas to accommodate storm water runoff. These detention areas can contribute to wildlife attractants. Smaller developments like a corner convenience store, may not require water detention facilities since they have a smaller footprint of impervious surface. Consequently the scale or size of the project should be considered.

The geographic location of a proposed development also should be considered when evaluating compatible land use. Where feasible, development should be encouraged to locate away from the airport and its extended runway centerlines, as well as away from approach and departure areas. Minimizing the density and intensity of development in these areas, and advocating for open space around the AOA is recommended.

Residential Activities

A residential use is generally defined to include any dwelling used to house people. As the nation's population continues to increase, residential land use development often encroaches upon what was once open space surrounding airport property. Residential developments near airports should be discouraged or, at a minimum, planned and designed with care to address safety issues related to high concentrations of people and potential noise impacts.

Table 1.2-3 illustrates specific examples of residential development types and the areas of potential concern associated with each. This information is not intended to be an all-inclusive summary, but rather it provides a general overview of the topic from which to begin an evaluation of compatible land use on a case-by-case basis for individual communities.

As shown in Figure 1.2-13, residential dwellings can range from a single-lot rural farmhouse to a multistory high-rise condominium development in a downtown setting. This activity should be carefully considered because building height may result in obstructions that potentially threaten safe airport operations.

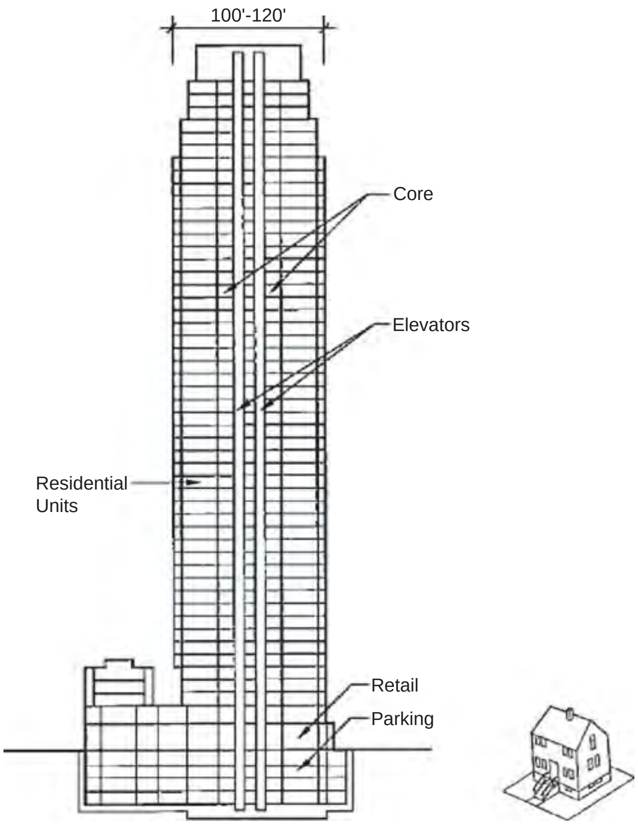
Due to the variety of housing types, densities can vary greatly. For example, a multilevel apartment development typically has a greater density than a single-family subdivision-style development. Comparative densities are shown in Figure 1.2-14. This attribute should be taken into consideration when determining land use compatibility with AOA areas because high concentrations of people have a greater risk associated with them and contribute to incompatible land use.

Development sizes, which can vary greatly, play another important role in determining compatibility. For example, developments such as small, cluster-type projects, which incorporate open space, may be considered more compatible with airport operational areas than a 2,000-acre suburban project that contains several hundred homes and limited open space. The availability of open space is essential to aircraft operations in the event of a forced landing; therefore, the project size should be given careful consideration when assessing compatibility. Unfortunately, smaller developments such as semi-rural residential areas are often the most sensitive to aircraft noise, whereas more urban developments are less sensitive to aircraft noise due to the inherent nature of more noisy urban areas.

Table 1.2-3. Land use compatibility chart for residential activities.

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Single-Family Uses (attached and detached)	**I**	**P**	**N**	**P**	**P**
Multi-Family Uses (i.e., two or more principal dwelling units within a single building on the same parcel, apartments such as condominium, elder, assisted living, townhouse-style)					
Low-Rise (1-3 Levels)	**I**	**P**	**N**	**P**	**P**
Mid-Rise (4-12 Levels)	**I**	**I**	**P**	**I**	**P**
High-Rise (13+ Levels)	**I**	**I**	**I**	**I**	**P**
Group Living Uses (i.e., assisted living, group care facilities, nursing and convalescent homes, independent group living)	**I**	**I**	**P**	**I**	**P**
Manufactured Housing Parks	**I**	**I**	**N**	**P**	**I**

I = Impact; **P** = Possible Impact; **N** = No Impact.
Source: Mead & Hunt, Inc.



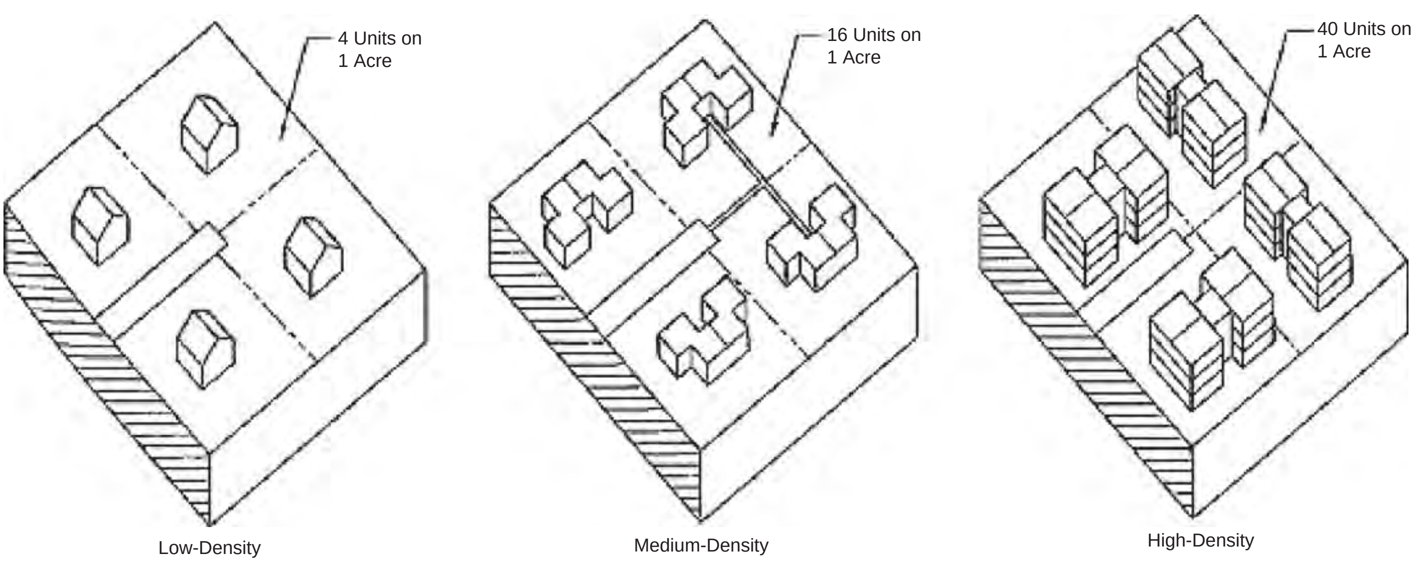
Source: APA Planning and Urban Design Standards

Figure 1.2-13. High-rise condominium development v. single-lot house.

Geographic location of a development in relationship to the airport and the context surrounding the location are vital in determining compatibility. Residential developments in lower density areas away from the airport and out of the Runway Protection Zones (RPZs) and approach zones are typically considered more compatible with airport operational areas from the standpoint of safety; however, not necessarily from a noise perspective, than a development located adjacent to the runway end in a denser urban environment. Street lighting in residential developments within the airport approach may be aligned in a linear pattern parallel to the runway, and as a result, can cause visual obstructions for pilots. Figure 1.2-15 compares a typical parcel layout with parallel linear lighting to a more acceptable parcel layout that utilizes variances and modifications to setbacks to reduce the amount of development within the approach to improve compatibility. Noise is another concern related to location. Development that is close to the airport will be impacted by aircraft noise, which may disturb residents and result in a lower quality of life.

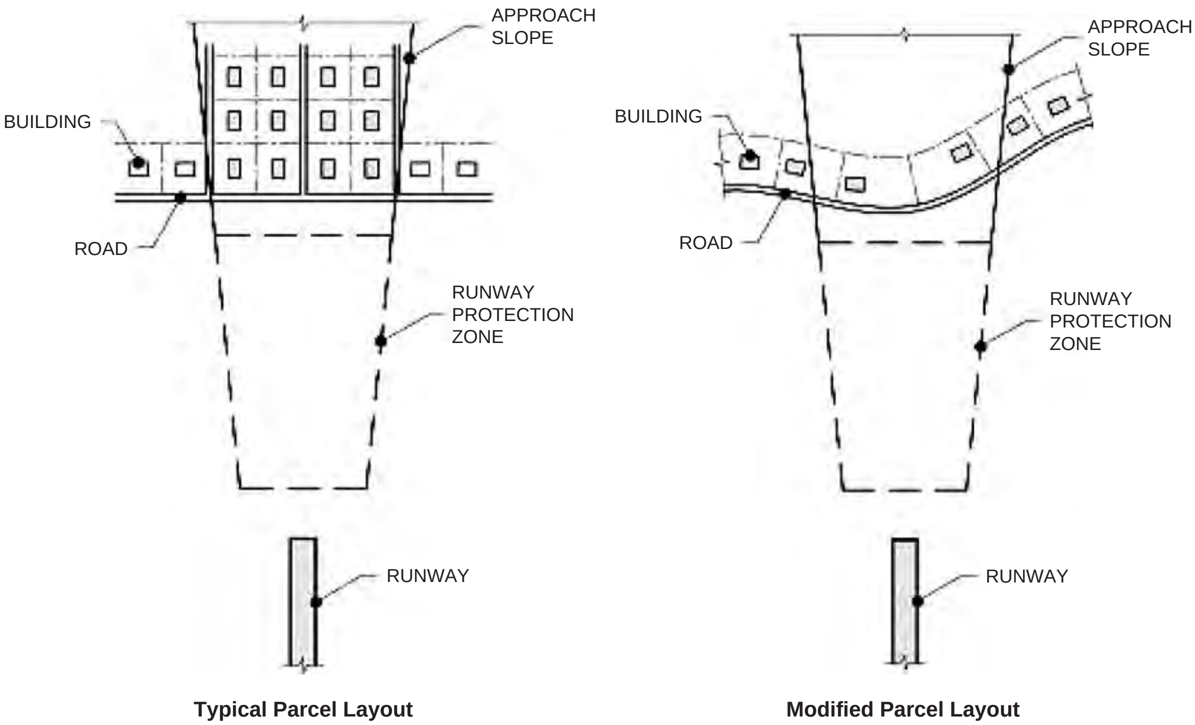
Commercial Activities

A commercial use is generally defined to include any use that involves the sale of products or services for profit. Due to the variety of commercial uses, commercial activities often require specific review and evaluation by local planners to determine compatibility with airport operational areas. Because diverse compatibility issues arise between airport environs and commercial land uses, it is difficult to generalize the benefits or detriments created by commercial land use types. Nevertheless, local planners should carefully review the development of commercial activities near airports so that hazards within the areas closest to airports are not created.



Source: APA Planning and Urban Design Standards

Figure 1.2-14. Comparative densities.



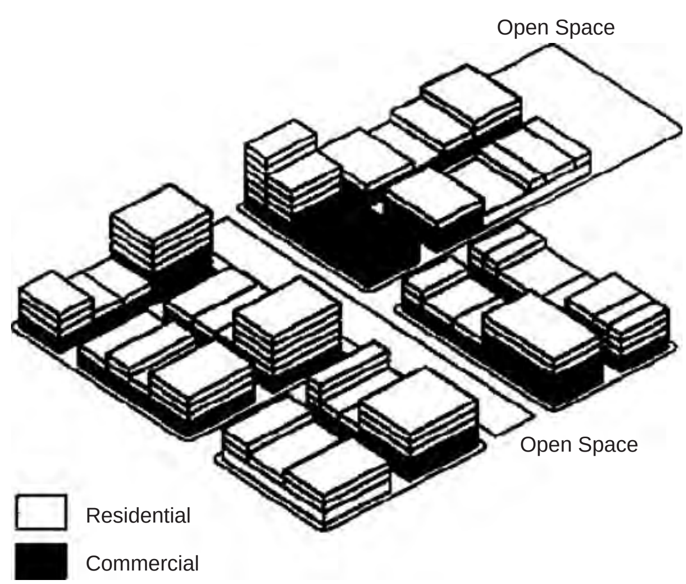
Source: Mead & Hunt

Figure 1.2-15. Typical parcel layout v. modified parcel layout.

Mixed-use development is an emerging trend in planning because it often offers commercial, leisure, and residential uses in a single area. Such developments can include mixed-use buildings that incorporate retail or office space at the street level and living space in the upper levels, all within a central area, as shown in Figure 1.2-16. These developments offer challenges in defining density because the variety of uses results in varying concentrations of people at differing times. Thus, the specific types of uses, hours of occupancy, and density should be evaluated when reviewing mixed-use developments.

Table 1.2-4 contains examples of commercial development types and potential concerns associated with each. This information is not intended to be an all-inclusive summary, but rather it provides a general overview of the topic from which to begin an evaluation of compatible land use on a case-by-case basis for individual communities. Design elements for commercial land uses, which should be considered when evaluating compatibility, include the following:

Commercial developments can range from a small corner convenience store, to a strip mall offering smaller storefronts, to a large multilevel shopping mall. This attribute should be carefully considered because building height may result in obstructions that potentially threaten safe airport operations. In addition, the type of lighting used in parking lots may mimic runway lighting and create visual obstructions for pilots, especially at night if located in proximity to an airport. In many instances, commercial buildings often are constructed



Source: APA Planning and Urban Design Standards

Figure 1.2-16. Mixed use development layout.

Table 1.2-4. Land use compatibility chart for commercial activities.

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Commercial Activities					
Eating and Drinking Establishments	**I**	**I**	**P**	**P**	**I**
Quick Vehicle Servicing Uses	**N**	**P**	**N**	**P**	**N**
Office Uses (i.e., business, government, professional, medical, or financial)					
Low-Rise (2-3 Levels)	**I**	**P**	**N**	**P**	**P**
Mid-Rise (3-12 Levels)	**I**	**I**	**P**	**P**	**P**
High-Rise (12+ Levels)	**I**	**I**	**I**	**P**	**I**
Retail Uses (i.e., sale, lease, or rent of new or used products)					
Sales-Oriented *Personal Service-Oriented* *Repair-Oriented*	**P**	**P**	**P**	**P**	**P**
Hospitality-Oriented (hotels, motels, convention centers, meeting halls, event facilities)	**I**	**P**	**P**	**P**	**I**
Low-Rise (2-3 Levels)	**I**	**P**	**N**	**P**	**P**
Mid-Rise (3-12 Levels)	**I**	**I**	**P**	**P**	**P**
High-Rise (12+ Levels)	**I**	**I**	**I**	**I**	**I**
Outdoor Storage and Display-Oriented	**P**	**P**	**N**	**P**	**P**
Surface Passenger Services (i.e., passenger terminals for buses, rail services, local taxi and limousine services)	**P**	**I**	**P**	**P**	**P**
Vehicle Repair Uses (i.e., vehicle repair or service shops, alignment shops, tire sales)	**N**	**P**	**N**	**P**	**P**

I = Impact; **P** = Possible Impact; **N** = No Impact.
Source: Mead & Hunt, Inc.

with sprinklers and other features that mitigate some of the risk if struck by a small aircraft, which tend to suggest a greater compatibility with airport operations.

Development sizes, which can vary greatly, also are important in determining land use compatibility. Small downtown commercial developments that incorporate mixed-uses and open space may be considered more compatible than a large outdoor shopping plaza with limited open space. The availability of open space is essential to aircraft operations in the event of a forced landing. In addition, the presence of features such as water detention ponds for larger developments can attract wildlife and pose a threat to safe aircraft operations. Therefore, project size and general layout should be given careful consideration when assessing compatibility with airport operational areas.

Industrial/Manufacturing Activities

An industrial use is often defined as any use relating to, used in, or created by industry. Historically, industrial parks were composed solely of industrial uses. Today, however, industrial parks are often a mix of industrial businesses, manufacturing facilities, office parks, and research and development complexes within the same geographic area. Occasionally, even hotels, restaurants, and retail activities have developed along the fringes of industrial parks to provide necessary support facilities and stimulate economic development within these areas. Each use has unique compatibility concerns and issues, which should be reviewed by local planners and possibly the FAA.

Industrial and manufacturing areas are typically encouraged within a community as a means to attract business, increase the business tax base and employment levels, and enhance economic benefits to the community. To complement the development of these land uses, industrial and manufacturing areas are often located in proximity to major transportation arteries such as highways, interstates, railroads, and airports in order to provide inter-modal connectivity. Transportation arteries are critical for companies to increase productivity and allow for just-in-time delivery options that are becoming more prevalent in the current economy.

A specific land use within this category, which requires special attention, is waste disposal facilities. Waste disposal facilities consist of landfill and compost sites, garbage dumps, and waste transfer and storage facilities. Waste disposal facilities share similar zoning requirements with airports; both should be located away from residential areas because they can create wildlife hazards/attractants, but need to be accessible to the population as they are a critical community service. Although they have similarities, waste disposal facilities are not compatible land uses and therefore should not be located near airports. The FAA has issued specific guidance related to the development and management of landfills in AC 150/5200-34A, *Construction or Establishment of Landfills near Public Airports.* In addition, 40 CFR 258, Subpart B, *Criteria for Municipal Solid Waste Landfills,* contains specific information regarding landfills in proximity to airports. Both documents should be consulted when addressing these types of land uses within a community near an airport.

Table 1.2-5 contains examples of specific types of industrial development and the areas of potential concern associated with each. This information is not intended to be an all-inclusive summary,

Table 1.2-5. Land use compatibility chart for industrial/manufacturing activities.

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Industrial/Manufacturing Activities					
Industrial Service Uses (i.e., machine shops, tool repair, towing and vehicle storage, building supply yards, etc.)	**N**	**I**	**P**	**P**	**P**
Manufacturing and Production Uses (i.e., manufacturing, processing, fabrication, packaging or assembly of goods)					
Technical/Light Manufacturing	**P**	**I**	**P**	**I**	**P**
General Manufacturing	**N**	**I**	**P**	**I**	**P**
**Heavy Manufacturing*	**N**	**P**	**I**	**I**	**I**
Mining and Extraction Uses	**N**	**P**	**N**	**I**	**I**
Salvage Operations (i.e., firms that collect, store, and dismantle damaged or discarded vehicles, machinery, appliances, and building material)	**N**	**N**	**P**	**P**	**P**
Self-Service Storage Uses (i.e., mini-warehouses/storage facilities)	**N**	**N**	**N**	**P**	**P**
Warehouse and Freight Uses (i.e., major wholesale distribution centers, general freight storage, etc.)	**N**	**P**	**P**	**P**	**P**
Waste-Related Uses (i.e., recycling centers, sanitary landfills, waste transfer stations, composting, etc.)	**N**	**N**	**P**	**I**	**I**
Wholesale Sales Uses (i.e., sale, lease, or rental of products to retailers for industrial, institutional, or commercial business users)	**N**	**N**	**N**	**P**	**P**

I = Impact; ***P*** = Possible Impact; ***N*** = No Impact
* Heavy Manufacturing typically has excessive smoke, dust, or hazardous waste
Source: Mead & Hunt, Inc.

Source: Mead & Hunt, Inc.

Figure 1.2-17. Steam emissions from industrial operations.

but rather, it provides a general overview of the topic from which to begin an evaluation of compatible land use on a case-by-case basis for individual communities. Design elements for industrial land uses, which should be considered when evaluating compatibility, include the following.

Industrial developments can range from a small hardware repair shop to a large ethanol plant. This attribute should be carefully considered because building height may result in obstructions that potentially threaten safe airport operations. In addition, exterior lighting types and smoke/steam emissions from smoke stacks can create visual obstructions for pilots, as shown in Figure 1.2-17.

Institutional Activities

Institutional uses are generally defined to include all uses related to an organization that is influential in the community. Typically, institutional land uses should not be located on or near airports due to noise sensitivity and the risk associated with high concentrations of people. Such land uses include, but are not limited to, places of worship, daycare, eldercare centers, hospitals, health care facilities, and educational facilities. These types of facilities may contain people who are unable to care for themselves, thus making evacuation difficult in the event of an aircraft accident. These uses also can contain large parking lots and water detention areas that may contribute to light emission and wildlife attractant concerns.

Table 1.2-6 contains examples of specific types of institutional development and the areas of potential concern associated with each. This information is not intended to be an all-inclusive summary, but rather, it provides a general overview of the topic from which to begin an evaluation of compatible land use on a case-by-case basis for individual communities. Design elements for institutional land uses, which should be considered when evaluating compatibility, include the following.

Due to the variety of institutional building types, densities can vary greatly. For example, a public high school will typically have a greater intensity of use with students and staff occupying the building for a minimum of 8 hours per day, Monday through Friday, than a church in which worshipers spend a couple hours in attendance several days per week. This attribute should be taken into consideration when determining land use compatibility with airport operational areas because high concentrations of people have a greater risk associated with them and contribute to incompatible land use.

Infrastructure Activities

Infrastructure activities include a variety of land uses such as above ground utilities, cellular communication towers, water towers, and wind farms. Each of these types of land uses have compatibility concerns that should be assessed prior to construction within the vicinity of airports.

The use of cellular communication has prompted the construction of numerous cellular communication towers around the nation. Cellular communication towers have appeared and continue to multiply in business parks, industrial and shopping mall areas, and along the national highway system. As a result, cellular communication towers are a significant concern when evaluating height issues near airport environs. These towers can pose a concern to aircraft during low-

Table 1.2-6. Land use compatibility chart for institutional activities.

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Institutional Activities					
College and Universities	**I**	**I**	**I**	**I**	**I**
Community Service Uses (i.e. public, nonprofit, or charitable nature providing a local service to the people)					
General Community Service (i.e., libraries, museums, transit centers, park and ride facilities, etc.)	**I**	**I**	**P**	**I**	**I**
Community Service-Shelter (i.e., transient housing)	**I**	**P**	**N**	**P**	**P**
Daycare Uses (i.e., childcare centers, adult daycare, preschools, after school programs)	**I**	**I**	**N**	**I**	**I**
Detention Facilities (i.e., prisons, jails, probation centers, juvenile detention homes, halfway houses)	**I**	**I**	**P**	**I**	**I**
Educational Facilities (i.e., public and private schools)					
General Educational Facilities (i.e., public and private elementary, middle, junior, and senior high schools including religious, boarding, military schools)	**I**	**I**	**I**	**I**	**I**
Specialized Education Facilities (i.e., specialized trade, business, or commercial courses, nondegree-granting schools)	**I**	**I**	**P**	**P**	**P**
Hospitals (i.e., hospitals, medical centers)	**I**	**I**	**I**	**I**	**I**
Religious Assembly Uses (i.e., churches, temples, synagogues, mosques, Masonic, eagles, moose, or elk lodges)	**I**	**I**	**I**	**I**	**P**

I = Impact; **P** = Possible Impact; **N** = No Impact
Source: Mead & Hunt, Inc.

level flight, approach, and departure operations. Electronic interference associated with the operations of cellular communication is also a concern related to these uses.

Wind farms are becoming increasingly prevalent as oil prices continue to rise and the use of renewable energy gains momentum in the United States. California, Texas, and Iowa are ranked as the leading states in wind energy production, as noted by Iowa's Energy Center. While this increase in use is beneficial to the nation's energy system, these types of land uses pose a potential concern when located near airports. Specifically, the height of these structures can be a compatibility concern. Wind farms generally contain numerous tall wind turbines that cover a sizeable area. Wind farms can create clutter on radar screens, and potentially cause hazardous conditions for air-traffic controllers in recognizing aircraft. However, a study conducted in June 2003 by the British Department of Trade and Industry (DTI), *American Wind Energy Association, Wind Turbines and Radar an Informal Resource* determined that efforts could be implemented to reduce or eliminate wind turbine clutter effects on air traffic control radar systems. Additionally, wind turbine blades can generate glare, which can create potential visual problems for a pilot. Many of the impacts associated with wind farms can be mitigated during the design phase of the facility, as long as the local community and developer are mindful of potential concerns and work to address them early.

Table 1.2-7 contains examples of specific types of infrastructure development and the areas of potential concern associated with each. This information is not intended to be an all-inclusive

Table 1.2-7. Land use compatibility chart for infrastructure activities.

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Infrastructure Activities					
Basic Utility Uses (i.e., utility substation facilities, electrical substations, water and sewer lift stations, water towers)	**N**	**N**	**P**	**I**	**I**
Communication Transmission Facility Uses (i.e., broadcast, wireless, point to point, emergency towers and antennae)	**N**	**N**	**I**	**I**	**P**
Parking Uses (i.e., ground lots, parking structures)	**N**	**P**	**I**	**P**	**P**
Transportation Uses (i.e., highways, interstates, local and county roads)	**N**	**P**	**N**	**P**	**N**
Utility Uses (i.e., solar power generation equipment, wind generators, wind farms)	**N**	**N**	**I**	**I**	**N**

I = Impact; **P** = Possible Impact; **N** = No Impact
Source: Mead & Hunt, Inc.

Source: Mead & Hunt, Inc.

Figure 1.2-18. Runway lighting at night.

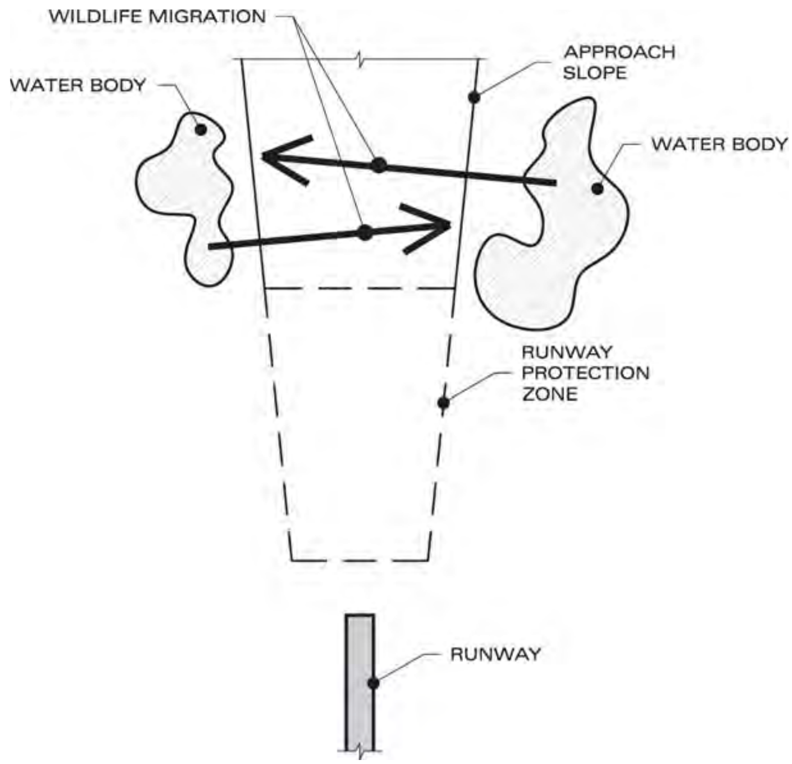
summary, but rather, it provides a general overview of the topic from which to begin an evaluation of compatible land use on a case-by-case basis for individual communities. Since infrastructure land uses can range from a county road to a tall communication tower, careful consideration should be given to building height that may result in obstructions that potentially threaten safe airport operations. In addition, the type of lighting used, especially for transportation such as the illumination of long stretches of highways in a linear pattern, can mimic runway lighting and create visual obstructions for pilots, especially at night, as shown in Figure 1.2-18.

Agriculture and Open Space Activities

Agriculture and open space activities are most commonly defined as any use related to farming, including the use of both manmade and naturally occurring water resources, and mining. When evaluating the potential impacts of agriculture and open space land uses, it is important to recognize that these land uses are often perceived as the least serious of the incompatible land uses; however, they can have significant wildlife and bird management concerns.

The proximity of farmland, especially row crops and orchards, to airports may cause detrimental interactions between wildlife and aircraft. Crops and vegetation act as a wildlife attractant and may lead to wildlife and bird strikes with low-level flight, approaching, and departing aircraft. If crops are highly attractive to birds or wildlife for their nutritive or nesting value, the risk increases. Coordination of land use concerns between airports, local communities, and local farmers and horticulturists is crucial to reduce the potential of wildlife strikes. Specific areas of airports that should be free from all agricultural activities are summarized in FAA AC 150/5300-13 Change 14, *Airport Design,* Appendix 17, *Minimum Distances Between Certain Airport Features and any On-Airport Agriculture Crops.*

Open water is also a significant concern because of its attractiveness to waterfowl, such as geese, by providing opportunities for nesting, feeding, resting, and protection. Wildlife tend to migrate from one water body to another and back, creating migration routes that can intersect the RPZs and approach zones as shown in Figure 1.2-19. Coordination between airports and local natural resource agencies is essential to allow those agencies to identify specific species of wildlife that are hazardous to that particular airport, as well as develop a management plan to reduce wildlife risks to local airport operations. Distinguishing characteristics of individual airports and the associated wildlife in the area should be identified to address compatibility in a comprehensive manner.



Source: Mead & Hunt, Inc.

Figure 1.2-19. Wildlife migration routes.

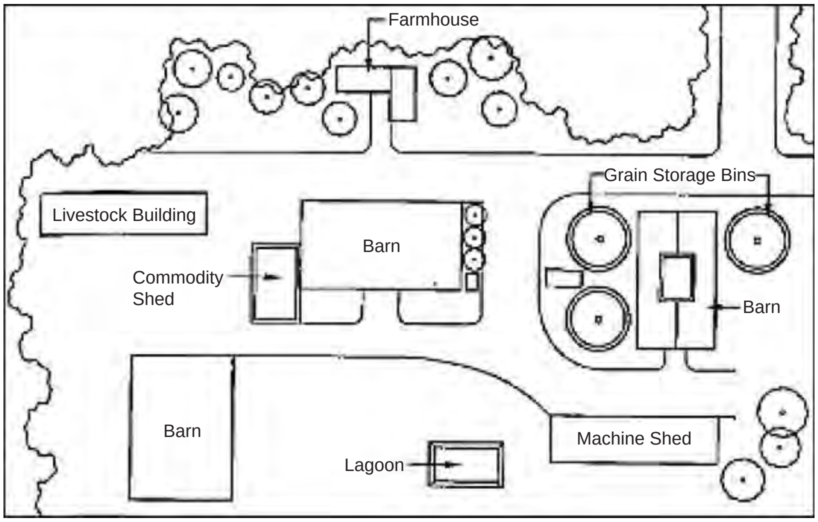
Table 1.2-8 contains examples of specific examples of compatible agriculture and open space activities. This information is not intended to be an all-inclusive summary, but rather it provides a general overview of the topic.

Agriculture and open space activities can range from a small farmhouse to a multilevel grain elevator. For example, a commercial livestock operation will typically have a number of structures for feeding and housing livestock, which usually leaves little open space of green areas. A more traditional farm

Table 1.2-8. Land use compatibility chart for agriculture and open space activities.

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Agriculture and Open Space Activities					
Agricultural Uses (i.e., commercial cultivation of plants, livestock production)					
Plant & Animal Related	**N**	**N**	**P**	**N**	**I**
Resident-related (i.e., single-family home, mobile home if converted to real property and taxed)	**I**	**N**	**P**	**P**	**I**
Facility-related (i.e., fuel bulk storage/pumping facility, grain elevator, livestock/seed/grain sales)	**P**	**P**	**I**	**P**	**I**
Floodplains	**N**	**N**	**N**	**N**	**I**
Water Bodies (i.e., open bodies containing water)					
Man-made resources (i.e., mining and extraction, water detention ponds, wetlands)	**N**	**N**	**N**	**I**	**I**
Naturally occurring (i.e., lakes, ponds, prairie pot holes, rivers, streams, wetlands)	**N**	**N**	**N**	**I**	**I**
Wildlife Preservation Areas	**I**	**P**	**N**	**I**	**I**

I = Impact; **P** = Possible Impact; **N** = No Impact
Source: Mead & Hunt, Inc.



Source: APA Planning and Urban Design Standards

Figure 1.2-20. Farmstead.

focused on the production of row crops provides for more open space, although the area is covered with the various crops.

A small subsistence farm with open space may be considered more compatible with airport operational areas than a commercial farming operation that has a great deal of infrastructure with limited open space, as shown in Figure 1.2-20. The availability of open space is essential to aircraft operations in the event of a forced landing. Additionally, the presence of water bodies and crops can attract wildlife and pose a threat to safe aircraft operations.

Parks and Recreational Activities

Parks and recreational land uses typically take place outdoors and can generate a number of concerns with airport compatibility. Recreational activities can include passive activities such as resting on a park bench, or physical activities such as fishing, swimming, hunting, and participating in sporting events.

Table 1.2-9 contains examples of specific types of parks and recreational development and the areas of potential concern associated with each. This information is not intended to be an all-inclusive summary, but rather it provides a general overview of the topic from which to begin an evaluation of compatible land use on a case-by-case basis for individual communities.

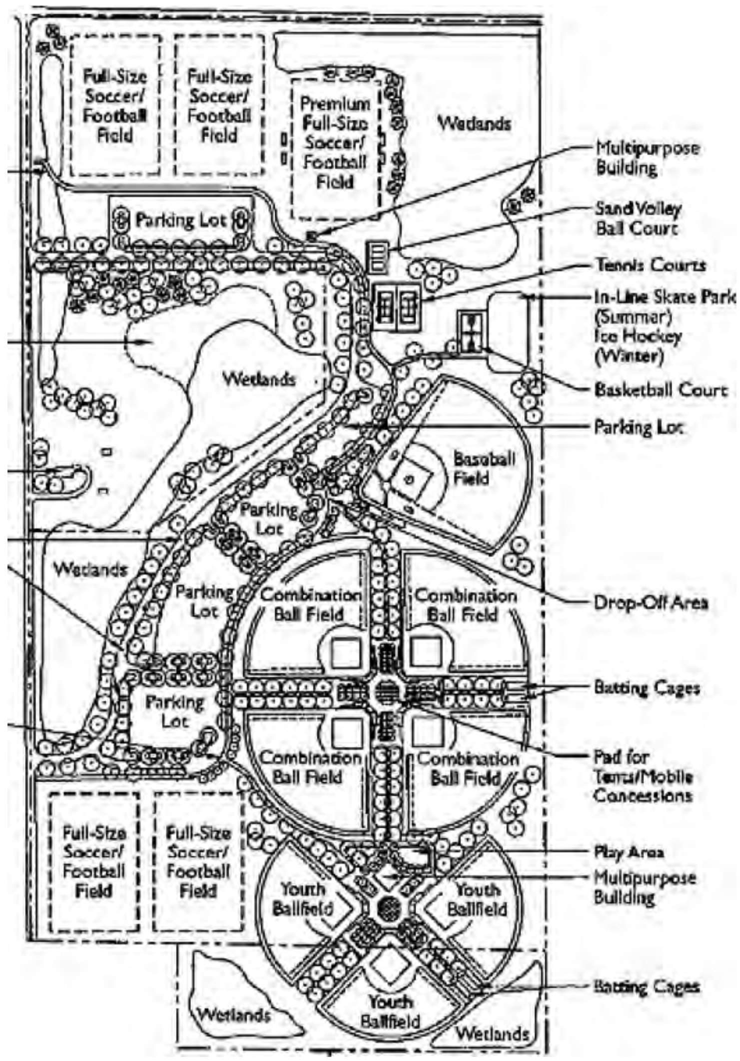
Table 1.2-9. Land use compatibility chart for parks and recreation activities.

Land Uses	Noise Sensitivity	Concentration of People	Tall Structures	Visual Obstructions	Wildlife & Bird Attractants
Parks and Recreation Activities					
Commercial Recreational Uses (i.e., facilities used for physical exercise, recreation, or culture)					
Outdoor (i.e., campgrounds, tennis/swimming facilities, drive-in theaters, skating rinks, pavilions, amphitheaters)	**I**	**P**	**P**	**I**	**P**
Indoor (i.e., physical fitness centers, health clubs, bowling alleys, skating rinks, billiard halls, arcades, indoor theaters)	**P**	**I**	**P**	**I**	**P**
Golf (i.e., golf driving ranges, outdoor miniature golf, 9+ hole courses)	**I**	**N**	**N**	**P**	**I**
Utility Uses (i.e., amusement/theme parks, fairgrounds, racetracks, sports arenas)	**I**	**I**	**I**	**I**	**I**
Parks (i.e., aquatic, mini, private, sports, neighborhood, school, community)	**I**	**P**	**I**	**P**	**P**
Casino	**N**	**I**	**P**	**I**	**I**

I = Impact; ***P*** = Possible Impact; ***N*** = No Impact
Source: Mead & Hunt, Inc.

Parks and recreational developments can range from a community baseball field to a professional auto racing track. The types of lighting used for parks, recreational areas, and associated parking lots is often high intensity, which can create visual obstructions for pilots, especially at night. Due to the variety of development types, intensities of use can vary greatly. For example, a casino will typically have a greater intensity, with numerous customers and staff occupying the building at all times, than a golf course, which is of a larger size, but where golfers typically spend only a few hours playing. This attribute should be taken into consideration when determining land use compatibility with airport operational areas because high concentrations of people have a greater risk associated with them and contribute to incompatible land use. Furthermore, facilities that accommodate higher intensities of human activity often attract wildlife with increased litter and trash receptacles that lead to incompatible land uses.

Development sizes, which can vary greatly, play another important role in determining land use compatibility. A neighborhood park that incorporates open space may be considered more compatible than an outdoor sports complex with large areas for parking and limited open space, as shown in Figure 1.2-21.



Source: APA Planning and Urban Design Standards

Figure 1.2-21. Outdoor sports complex.

Summary

Land use compatibility is determined by the type of land use and the concerns associated with it. This chapter explores the types of compatibility concerns that affect the relationship between airports and their environs, and the seven general classifications of land use–residential, commercial, industrial, institutional, infrastructure (special uses), agriculture (open space), and parks and recreation–and their compatibility with airports and airport operations.

Each of the previously discussed concerns carries a different level of relevance at individual airports within each host community. Careful consideration is recommended on a site specific basis to address these concerns in a manner that is appropriate for the local airport and community. Each land use has varying degrees of compatibility based on the attributes of development such as building types, project size, and location. Because land use classifications vary by community, the definitions within this chapter are broad to allow for flexibility in interpretation and implementation by elected officials and planners. Each type of land use has been reviewed for general impacts it may pose to safe airport and aircraft operations, as well as the safety of persons on the ground near airports.

VOLUME 1, CHAPTER 3

Roles and Responsibilities of Stakeholders

This chapter discusses the roles and responsibilities for land use protection and compatibility as they relate to the multiple levels of government and interest groups involved. The various roles and responsibilities for providing compatible land uses surrounding airports are interrelated in a complex manner requiring a significant amount of coordination and communication among the entities involved.

Responsibilities for Compatible Land Use Overview

Airport land use compatibility planning requires coordination among local, state, and federal organizations in order to preserve the national airport system and protect the public health and welfare. Federal and state agencies develop guidelines and recommendations that protect airports and the associated airspace through compatible land use programs. Local government officials, planners, airport sponsors, and community members must implement and enforce these programs to satisfy the unique needs and uses of an individual airport.

Various stakeholders must be involved in the compatible land use process for the program to be successful. Stakeholders may include a diverse group of individuals, as illustrated in the following list:

- Federal government agencies, including the FAA and environmental agencies;
- State governmental agencies, including transportation and environmental departments;
- Regional government agencies, such as regional planning organizations;
- Local government agencies, including elected officials and planning departments;
- Airport sponsors (owners), operators, and managers;
- Local citizens; and
- Airport users.

Land use decisions are influenced by numerous, often conflicting, considerations. It is critical to understand the complicated relationship between an individual airport, the surrounding land uses, and the function of the airport within the host community. A consistent flow of communication and information among stakeholder groups is critical to the development, implementation, maintenance, and success of a compatible land use program.

Federal Stakeholders

There are numerous stakeholders at the federal level that can affect local land use planning decisions. This chapter discusses the role of the FAA, which is identified as the primary federal authority on aviation related issues. Additionally, other federal agencies with a more cursory role in land use decisions also are highlighted. It is important to note that the federal role in land use planning has largely been advisory in nature and provides information to guide and support local land use decisions since the right to establish local land use controls resides with individual states and local communities. Many of the federal agencies provide permitting and oversight of decisions that can have impacts on compatible land use decisions. Specific federal land use regulations and guidance are provided in Chapter 4 and should be consulted for more detail on the federal role in land use planning.

FAA

The FAA is the primary agency responsible for federal regulations and guidance relevant to land use compatibility as it relates to the national aviation system. Federal Aviation Regulations (FAR), FAA Orders, and FAA AC are the primary tools used for management at the national level to preserve, protect, manage, and grow the national airport system. The FAA is also the primary funding source for airport construction, airport master plans, and noise studies. As a general rule, land use studies and other efforts associated with land use compatibility historically have gone unfunded unless tied to airport noise studies.

Another important role of the FAA is to provide policy leadership for airport land use compatibility; however, this role has largely been focused on the protection of airspace with minimal guidance placed on land uses outside of the prescribed noise contours and basic design standards. This may be due to the fact that FAA has limited authority and scope to ensure that airspace is kept clear of obstructions. Notification of development in certain areas adjacent to airports is a federal requirement, but the FAA authority is limited in that their findings are advisory in nature.

Historically, FAA guidance has focused on airport safety and land uses that could pose hazards to air navigation. The preservation and safe operations of the national airport system is at risk as incompatible land uses continue to encroach upon airport property. In response, the FAA has taken a more active stance by developing regulations and documents addressing land use concerns such as wetlands, bird attractants, and telecommunication towers. The tools and techniques contained within the various FAA regulations, in combination with state and local resources, are an essential foundation for the development of forward-thinking compatible land use strategies by local communities.

FAA Funding. The FAA is the primary funding source for capital improvement projects at airports that are part of the National Plan of Integrated Airport Systems (NPIAS). The primary source of funding comes from the AIP. Funding is related to land use compatibility in several ways:

- Master planning;
- Land acquisition, including fee simple and avigation easements tied to airport improvements, runway protection zones, and high noise levels; and
- Noise related mitigation measures – per FAR Part 150.

FAA funding is available to support planning activities, including master planning and system planning. FAA funding also is available to acquire and clear runway safety and approach areas. Ideally, funding also would be available to acquire easements that provide height controls on properties near airports. Additional FAA funding opportunities exist for noise related issues, such as noise mitigation measures associated with FAR Part 150 noise studies. Examples of FAA funded noise mitigation measures that can improve land use compatibility include soundproofing structures, construction of noise barriers, or property acquisition to remove or relocate a noise sensitive development. In many cases, FAA funding is an important tool to influence local decision makers to embrace FAA guidance. The FAA funding also provides a regulatory aspect to land use compatibility through grant assurances. As part of a federal grant, an airport sponsor is required to agree to a variety of grant assurances, one of which is the requirement to protect airports from incompatible land uses. These FAA programs, including direct financing of land use related projects and requirements of grant assurances provide the foundation of the federal land use program.

NPIAS. In the mid-1940s, as the aviation industry began a period of rapid growth following the end of World War II, the need for a national approach to manage the emerging aviation system was recognized. A national standard for airport system planning was first addressed in 1946 through the National Airport Plan, the precursor to what is today called the NPIAS. The NPIAS provides the basis for which the aviation system is defined. Updated every two years, the most recent version of the NPIAS addresses the future development of the system from 2009-2013.

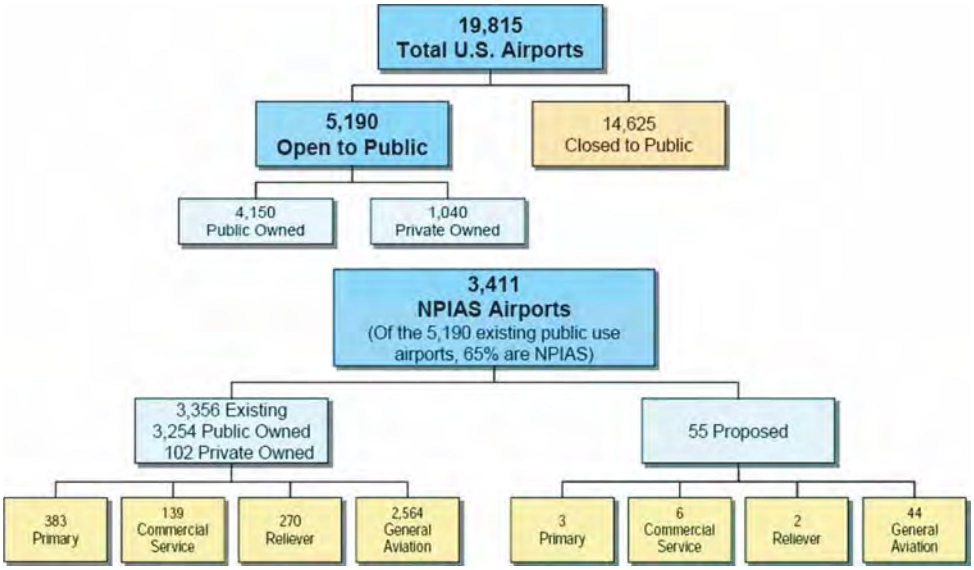
Purpose of the NPIAS. A primary function of the NPIAS is to assess the performance of the national airport system. The key factors used to assess the system's performance include capacity, safety, environment, pavement condition, surface accessibility, and financial performance. Each of these factors is relevant to the overall quality of the national aviation system and the provision of air transportation. Combined, these factors provide a good indication of overall system performance. These factors also can be used to assess the performance and guide the development of individual airports.

Additionally, the NPIAS is used by the FAA management in administering the AIP. If an airport is included in the NPIAS, the airport is eligible to receive grants under the FAA AIP. As noted previously, if an airport chooses to accept federal funding under the AIP, they are subject to various regulatory grant assurances, one which requires the protection of airports from incompatible land uses. The 2009-2013 NPIAS estimated that, over the next five years, there would be $49.7 billion in AIP-eligible infrastructure development spread over the various segments of the national aviation system.

The NPIAS is guided by the following nine primary principles:

1. Airports should be safe and efficient, located at optimum sites, and developed and maintained to appropriate standards.
2. Airports should be affordable to users and government, relying primarily on user fees and placing minimal burden on the general revenues of the local, state, and federal governments.
3. Airports should be flexible and expandable, capable to meet increased demand, and able to accommodate new aircraft types.
4. Airports should be permanent, with assurances that they will remain open for aeronautical use over the long term.
5. Airports should be compatible with surrounding communities and maintain a balance between the needs of aviation and the requirements of residents in neighboring areas.
6. Airports should be developed in conjunction with improvements to the air traffic control system.
7. The airport system should support national objectives for defense, emergency readiness, and postal delivery.
8. The airport system should be extensive and provide as many people as possible with convenient access to air transportation. Commuters should ideally have to travel no more than 20 miles to the nearest NPIAS airport.
9. The airport system should help air transportation contribute to a productive national economy and international competitiveness.

In addition, the NPIAS also is governed by Executive Order 12893, which states that investment in federal infrastructure systems must be cost beneficial. Therefore, the national priority system, as outlined by the NPIAS through the aforementioned principles, guides the general distribution of funds for airport system development.



Source: FAA Report to Congress: NPIAS 2009-2013

Figure 1.3-1. Distribution of U.S. airports.

NPIAS and Non-NPIAS Airports As of January 2008, the FAA reported that 5,190 airports were open for public-use within the United States; of these, 65% are NPIAS airports. Figure 1.3-1 shows the distribution of U.S. airports by ownership and use, including distribution of those airports that are part of the NPIAS system.

FAA Order 5090.3C spells out the rules for including an airport in the NPIAS. Although there are various exceptions to the rules, in general an airport is included in the NPIAS if it meets the following minimum criteria and excluded if it does not:

- Have at least 10 based aircraft, and
- Located at least 20 miles (or 30 minutes driving time) from another NPIAS airport.

According to the *FAA Report to Congress: NPIAS 2009-2013,* non-NPIAS public-use airports have an average of one based aircraft compared to an average of 33 based aircraft at general aviation NPIAS airports.

Other Federal Agencies

While the FAA is the primary agency responsible for airport-related land use issues, other agencies also are involved in more limited ways. These agencies may have an impact or decision-making authority over issues that directly or indirectly impact land use issues. For example, the EPA and the Corp of Engineers has wetland mitigation criteria that do not necessarily agree with FAA criteria; this poses a concern and may suggest that other coordination is necessary. Federal agencies that have a role and responsibility to regulate and review various aspects of airport development and land use compatibility issues include, but are not be limited to:

- DoD - The DoD's mission is to provide the military forces needed to deter war and to protect the security of our country. www.dod.gov
- Department of Homeland Security (DHS) - The DHS works to anticipate, preempt, detect and deter threats to the homeland and to safeguard our people and their freedoms, critical infrastructure, property and the economy of our nation from acts of terrorism, natural disasters, and other emergencies. www.dhs.gov

- Department of Housing and Urban Development (HUD) – HUD ensures fair and equal housing opportunities for all citizens through an array of civil rights laws, executive orders, and regulations. This agency typically becomes involved in aviation related issues when land acquisition or significant noise concerns arise. www.hud.gov
- Department of the Interior/National Parks Service - The National Park Service preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations. The Park Service cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world. www.nps.gov
- Department of Transportation (DOT) – The DOT works to ensure a fast, safe, efficient, accessible and convenient transportation system that meets the vital interests of the United States and enhances the quality of life for Americans today and in the future. www.dot.gov
- Environmental Protection Agency (EPA) – The EPA is focused on protecting human health and the environment. EPA is responsible for researching and setting national standards for a variety of environmental programs that implement environmental laws enacted by Congress. EPA delegates to states and tribes the responsibility for issuing permits, monitoring, and enforcing compliance. Where natural standards are not met, EPA can issue sanctions and take other steps to assist the states and tribes in reaching the desired levels of environmental quality. www.epa.gov
- Federal Communication Commission (FCC) - The FCC is an independent United States government agency. The FCC was established by the Communications Act of 1934 and is charged with regulating interstate and international communications by radio, television, wire, satellite and cable. The FCC's jurisdiction covers the 50 states, the District of Columbia, and U.S. possessions. www.fcc.gov
- Federal Emergency Management Agency (FEMA) - The primary mission of the FEMA is to reduce the loss of life and property and protect the nation from all hazards, including natural disasters, acts of terrorism, and other man-made disasters, by leading and supporting the Nation in a risk-based, comprehensive emergency management system of preparedness, protection, response, recovery, and mitigation. www.fema.gov
- United States Army Corps of Engineers (USACE) – The USACE provides protection to the nation's aquatic resources, including wetlands. The USACE should be contacted for assistance when siting a new airport or expanding an airport that may impact wetlands or water bodies. www.usace.army.mil
- United States Fish and Wildlife Service (USFWS) – The USFWS is a bureau within the Department of the Interior that works to conserve, protect, and enhance fish, wildlife, plants and their habitats for the continuous benefit of the American people. The USFWS connection to airport land use compatibility is focused on wildlife issues. Coordination with the local office of the USFWS is recommended when evaluating issues such as wetland and floodplains impacts, wildlife concerns and attractants, and migration issues. www.fws.gov

Airport and local community coordination with these agencies is important in order to make the compatible land use program effective. As airport related concerns arise, these agencies should be consulted on a site-specific basis to provide adequate coordination.

✈ **Case Study Example:**
Naval Air Station Pensacola

The DoD plays a key role in compatibility planning around military installations. The DoD is responsible for supporting the implementation of a JLUS at military bases in the United States. While the DoD does not provide funding for the implementation of a JLUS, they are responsible for meeting with the base commander and surrounding community to discuss the JLUS process. At Naval Air Station (NAS) Pensacola, the DoD, the base commander, and the surrounding community entered into a commitment with one another to carry out fully the extent of the JLUS and implement the recommendations that arise as part of the study to promote compatible land uses near the base and protect military operations and the surrounding community. Their efforts were met with great success and the JLUS recommendations were adopted into Escambia County's comprehensive plan and zoning ordinances to effectively mitigate incompatible land use encroachment.

State Stakeholders

The role of the state government is vital in the distribution of regulatory power related to land use planning. In the United States, the states are sovereign entities possessing governmental power; they determine what powers any local governments, special districts, or regional authorities shall be given. Each state is different in regards to the type and amount of power they grant to local governments, resulting in an array of diverse land use planning regulations. Understanding the role of state government is essential to understanding land use compatibility planning practice in the United States.

State agencies can play a significant role in guiding airport land use compatibility issues. Individual state agencies act as advocates for aviation and deliver services that promote safe, comprehensive, and competitive air transportation systems to enhance economic development and improve the quality of life for state residents. Each state aviation agency, typically a division or bureau within the state department of transportation, may have additional goals or objectives; however, the primary emphasis is typically placed on the safe movement of aircraft and passengers.

The diversity of state involvement in land use issues is wide. Some states have adopted very aggressive mandatory compatible land use programs. Others have created guidelines that can be voluntarily implemented and yet others have done little to address land use compatibility within their individual states. These variances in state approaches to land use compatibility provide a brief glimpse of how broad this topic is within the national system. With no two states addressing the concept in an identical manner, it becomes obvious that there is a need for the FAA to provide flexibility to allow individual states and communities to address land use issues that are unique to their areas.

State Aviation Agencies

Each state, as part of the national airport system, has a responsibility to support local airport sponsors in the pursuit of compatible land use within the vicinity of airport property. Some states have recognized this responsibility in the form of state legislation that requires (or in some instances suggests) airport land use compatibility be undertaken. Others have been lax in addressing these issues and instead leave the discussion of this topic to the FAA through their regional and airport district offices. The support can take many forms, depending upon the level of interest and funding available from an individual state. For example, individual states can develop state specific land use programs to address compatible land use. In the state of California, it is mandatory for public-use airports to develop an airport compatible land use plan to protect the flying public, as well as the general populace on the ground near airports. Other states, such as Wisconsin and Oregon, have adopted state legislation authorizing individual airports within their respective states to voluntarily create airport land use zoning. The Wisconsin Department of Transportation Bureau of Aeronautics developed a state guidebook on airport compatible land uses and also created a program to assist in funding studies to develop airport zoning within their state. Unfortunately, many states do nothing to support the development of airport compatible land use programs.

State agency leadership can establish a framework for the creation of airport compatible land use plans and zoning and make these an important element in the overall goal to establish airport compatible land uses. State level guidance and support is an essential part of the overall airport and local community planning process. When an individual state acknowledges the importance of compatible land uses near airports, it lends credibility to those in local communities who advocate protection of their airports from encroachment by incompatible land uses. State agencies should be encouraged to address land use issues in several ways including, but not limited to:

- Information and education – provides airport sponsors, elected officials, planning professionals, and local citizens with information on the need for land use compatibility and educates them on methods available to implement such a program.
- Voluntary land use programs and enabling legislation – provides, at a minimum, guidance on a voluntary basis to establish land use programs and create enabling legislation that provides the legal mechanism to allow local jurisdictions to establish land use or zoning ordinances that address airport-related land use compatibility issues.
- Mandatory airport zoning – provides a specific requirement for local entities to address land uses by establishing a legal mechanism that allows local jurisdictions to create zoning ordinances to address airport land use issues.
- Funding of land use planning and zoning programs – provides local agencies the financial means to create a land use compatibility program which otherwise may be unattainable due to limited local fiscal resources.

Each action is a suggestion that individual states can undertake to provide support to local airport sponsors. States need to assess their ability to support the individual tasks and create a comprehensive program that addresses the needs of the airports within their state aviation system.

✈ **Case Study Example:**
Independence State Airport
The Independence State Airport is owned and operated by the state of Oregon Department of Aviation (ODA). As part of the Oregon Revised Statutes, the Airport Planning Rule (APR) establishes a series of local government requirements and rules pertaining to aviation facility planning, and was developed to promote a convenient and economic system of airports in the state and provide for land use planning to reduce risks to aircraft operations and nearby land uses. The APR serves as the state regulatory basis to ensure that local government airport planning conforms to the hierarchy of state plans and statutory requirements. In addition, the state statute requires all airports with three or more based aircraft to be identified and zoned as an airport in local planning documents.

State Aviation System Plans. As a complement to the NPIAS, individual states have developed state airport system plans (SASP) that provide guidance to achieve and maintain a viable airport system within the individual states. The SASPs provide a detailed assessment of airports within each state and includes those identified within the NPIAS as being important to the national airport system, as well as non-NPIAS airports that are recognized by the state as being important to the state airport system. The state airport system plans include approximately 5,000 airports, roughly 33% more than the number contained in the NPIAS.

An individual SASP assesses the interaction of airports within the geographic boundary of the state and evaluates the aviation needs, economic benefits, population requirements, and surface transportation needs of individual airports and the state as a whole. FAA AC 150/5070-7, *Airport System Planning Process,* provides guidance for the development of a state airport system plan report. It also identifies the steps involved in the planning process, provides a summary of the various data that should be evaluated, and lists the types of information that should be provided. The

FAA suggests the following components be considered in the development of a state airport system plan:

- Inventory of the state's existing public-use airport system, including current facilities and activity levels.
- Identification of each airport's functional role within the state airport system.
- Evaluation of each airport's performance relative to the airport's functional role within the state airport system.
- Identification of deficiencies of individual airports within the state airport system.
- Documentation of individual airport projects within the state airport system.
- Estimation of development costs.
- Identification of available funding programs for various public-use airports.

The state airport system planning process should be consistent with state or regional goals and include input from both the airports and aviation users within the state.

The SASP should address the identification, preservation, and enhancement of both the existing public-use airports and the potential development of new facilities that may be required to adequately meet capacity needs. The planning process also may identify resources needed to implement the plan and evaluate alternative strategies to meet desired goals, such as development of compatible land uses near local airports. Once completed, the SASP provides state decision makers with a comprehensive assessment that can be used to make critical decisions related to the management of individual airports, as well as the overall state airport system.

State Aviation Land Use Plans/Guidance. In addition to state airport system plans, some states have developed specific land use plans or guidance for their individual states. California, for example, has taken an aggressive approach to land use planning. With limited exceptions, the state requires the establishment of an airport land use commission in each county as a means of minimizing creation of new incompatible land use development near airports. Additionally, the state commissioned the development of a handbook as a resource for the preparation of the land use plans. While these items are all very helpful, incompatible land uses continue to plague airports within the state.

Wisconsin passed legislation making it legal for an airport sponsor to develop a stand-alone airport zoning ordinance that targets land use restrictions. They also developed a guidebook that provides supporting data to demonstrate the need for land use compatibility planning; however, there is no mandatory obligation for airports to participate in the development of an airport land use plan. Consequently, there are many airports with no land use planning documents or zoning ordinances in place to protect the airports and the public from the impacts of incompatible land use.

Each state, based upon their own enabling legislation, should look to develop appropriate state guidance and tools to support local airports in their efforts to preserve compatible land uses. This effort could range from adoption of state legislation that mandates airport land use planning down to development of state guidance on land use planning and hosting educational seminars on the importance of land use compatibility issues near airports. The point that needs to be made is that this topic must have greater exposure and commitment from the individual state agencies if local airports are going to be successful in their efforts to develop airport land use compatibility plans.

Additional State Agency Stakeholders

Various departments and agencies can often have a significant role in land use compatibility planning as their areas of interest and expertise can overlap with the aviation sector. For example, a state environmental quality agency can have very specific requirements for wetland mitigation measures which may be directly contrary to recommended airport-related land use planning goals. Communication and coordination between agencies to discuss issues such as these are imperative if a successful planning effort is expected to result. Since there is a wide range of state agencies and programs, as well as state regulations, a coordinated and comprehensive attempt to involve all necessary parties is essential to incorporate appropriate state guidance and information. An example of state agencies that should be considered in land use planning decisions can include but not be limited to the following and will vary depending upon the specific structure of individual state governments:

- Department of Agriculture;
- Department of Community Health and Human Resources;
- Department of Economic Development;
- Department of Environmental Quality;
- Department of Historic Preservation; and
- Department of Natural Resources.

Regional Stakeholders

Regional agencies play a supporting role in land use planning, as they are often a guiding entity for local governments who administer and enforce land use regulations. Regional agencies can be influential in helping local governments coordinate plans and regulations where airport influence areas cross jurisdictional boundaries. The effectiveness of the role of regional stakeholders is greatly strengthened where state legislation mandates regional cooperation.

Agencies such as Metropolitan Planning Organizations (MPOs) often provide regional guidance related to airport compatible land use planning. An MPO is a group comprised primarily of local elected officials that serve as a forum for local decision making on transportation system and regional planning matters. The federal government requires that an MPO be designated for each urbanized area with a population of more than 50,000. Through the traditional MPO functions, they have the ability to develop growth management policies that can help guide population growth away from airport environs. Additionally, an MPO has two primary purposes that are related to airport land use compatibility:

- Develop a long-range transportation plan that will provide a multimodal investment strategy for meeting the mobility needs of people and businesses throughout a metropolitan area.
- Develop a short-range transportation improvement program that prioritizes improvement projects for federal funding purposes.

An MPO ensures that state and federal laws that pertain to regional transportation planning are implemented in each metropolitan planning area. The federal government defines the planning area as the existing urbanized area plus the projected 20-year growth area. The area is mutually determined by the MPO and the state. Funding for MPO transportation planning is provided through a combination of federal, state, and local funds.

MPOs can serve as an important link in the compatible land use process, as they often bring a diverse group of municipal entities together to discuss airport land use compatibility issues that often cross political or municipal boundaries. MPOs often have a comprehensive view of the broader geographic area where impacts of land use concerns are found. They also have the ability to look beyond the individual municipal boundaries to assess land use impacts and mitigation measures for the benefit of the larger area of influence. State agencies should work closely with MPOs to develop a comprehensive and coordinated approach to local, regional, and state transportation planning, including airport land use compatibility planning.

✈ **Case Study Example:**
Naval Air Station Pensacola
To help maintain compatible land uses around NAS Pensacola and protect both the military base and surrounding populations, Escambia County and NAS Pensacola conducted a JLUS. This study was conducted to identify encroachment issues and recommend strategies to address the issues in Escambia County's comprehensive plan and zoning regulations. While this effort is supported by the DoD, the military base, and the city of Pensacola, the majority of the cost of conducting the study and the original interest in the study came from the County. Escambia County has successfully implemented the recommendations from the JLUS into their comprehensive plan and zoning ordinances to help mitigate incompatible land uses near the military base, protecting the community's valuable asset.

Local Stakeholders

A solid understanding of airport land use compatibility issues at the local level is critical because most land use decisions are vested with local governments. The coordination and communication among local government officials and airports sponsors is vital to effectively implement and enforce land use compatibility initiatives. In an effort to build cooperation, stakeholders need to be identified and engaged in the process of planning for airport-compatible land uses. Local governmental stakeholders represent a diverse group that includes cities, counties, townships, planning agencies, and local economic development agencies.

Elected officials and planning professionals from cities, counties, and townships must be educated about the adverse effect that incompatible land use can have on a local airport, as well as the impacts airport operations can have on surrounding land uses. Regional and local economic development agencies that recognize the value of airports and the local economy may play a role in education advocacy and even coordination of local governments providing an economic assessment of the value of compatible land use decisions.

✈ **Case Study Example:**
O'Hare International Airport – O'Hare Noise Compatibility Commission
The O'Hare Noise Compatibility Commission (ONCC) was established in 1996 by the mayor of Chicago, Richard Daley, and is dedicated to reducing the impact of aircraft noise on the communities surrounding the O'Hare International Airport. This commission works to support effective communication and cooperation between the airport, the FAA, pilots, and the surrounding communities. With the inception of the ONCC, the local municipalities have been able to become more actively engaged in the planning process and affect change within their local communities, as well as the airport. So far the commission has been very successful in reducing aircraft noise each year, with the help of their sound insulation committees and the nighttime O'Hare Fly Quiet program that works to implement alternate flight procedures during the night when annoyance levels are higher.

Planning and Zoning Authorities

Local agencies derive land use powers from a variety of sources which include federal laws, state enabling legislation, and state constitutions. Two primary tools available for local control of land uses around airports are:

- Comprehensive Plan - a policy document that includes maps, charts, and text to explain goals and objectives regarding future development, past and present conditions, and locations of resources within a locale. The actual name of these types of plans varies by state including general plans and master plans. A comprehensive plan generally includes discussion to address facilities required for future growth, where growth should occur, and impacts that may be associated with growth, should it occur. The development of a plan typically includes research on population and economic issues and an inventory of community services and land uses. Local governments use the comprehensive plan as a basis to develop and amend zoning ordinances and capital improvements that influence and guide compatible land use development.

- Zoning Ordinance – documents that provide regulations and standards designating a range of land use zones that protect, preserve, and enhance the quality of life for residents. Addressing airport compatibility concerns as part of a communitywide zoning ordinance, perhaps as an overlay to the underlying land use designations, is an effective way of ensuring that compatibility issues are not overlooked. The FAA has developed a model airport zoning ordinance to address airspace protection issues. Some communities have expanded this model to cover noise and safety issues as well.

Each of these tools is discussed below in greater detail, as these are the most likely methods used to address land use compatibility issues.

Local Comprehensive Planning. Local comprehensive planning is a technique that can be used to prevent and mitigate incompatible land uses. These local comprehensive plans provide the first and often the best opportunity to examine the big picture issues, of which airport land use compatibility is one. Local municipalities can be empowered by state government to develop local planning documents. If this option is available, a local community can develop a comprehensive plan that addresses issues relating to land use and quality of life for area residents. For example, housing, environmental issues, and transportation systems are typical topics that can be evaluated as part of a local comprehensive plan.

Metropolitan and general aviation airports are of significant importance to the local region as an economic center and often an employment center. They can also be a significant traffic generator and a major land user. More notably, they can often be considered a "LULU" (locally unwanted land use) type of land use that many citizens believe should be kept out of their local community. It is this perspective that must be kept in mind when developing a local comprehensive plan, so that an adequate amount of resources can be allocated to the preservation of a local airport and the necessary environs around it to maintain a safe operating and compatible environment. The state of Washington has taken a unique approach and designated airports as Essential Public Facilities (EPFs). EPFs are facilities, such as municipal landfills, correctional facilities, and substance abuse facilities, that are necessary in a community to make the community function efficiently but often fall in to the LULU category and are therefore often hard to locate or develop in a community without public opposition. By acknowledging airports as EPFs, their importance to the community has already been established and the need to protect them is validated by the state.

Several areas should be considered when evaluating comprehensive plan elements as they relate to airports. Provisions should be made to plan for airside growth including runways, aprons, and buildings areas. This requires additional planning for open areas near an airport. Additionally, off-airport growth should be considered. Plans must provide for open areas in existing and future approach areas, as well as development for growth of parking lots, entrance roads, and ancillary development such as rental car facilities, trucking or cargo facilities, and commercial development. The needs of each of these land uses differ in infrastructure requirements and compatibility with airport operations and should be considered in the local comprehensive planning process.

Land use planning and zoning tools are the most important measures local governments can utilize to protect residents from adverse impacts that airports create, while still maintaining healthy airport environs. Land use planning and zoning are used to make sure that development within the airport environs is compatible to the airport itself. Airport land use planning, however, becomes a complicated challenge because airports generally encompass multiple jurisdictions, which causes difficulties in both setting and implementing policies to protect both the land surrounding the airport and the local residents' safety and quality of life. More importantly, airports are often owned by a jurisdiction different from the one where they are located. In many instances, the local community has a different agenda as to what is important in its community compared to the goals and objectives of the airport. This usually leaves the airport with little or no authority to control its destiny with respect to land use compatibility.

Airport Master Plan and Airport Layout Plan. As it relates to community planning, local planners should take into account local airport master plans and airport layout plans. An airport master plan and an airport layout plan (ALP) are valuable tools for an airport since they document the project justification as well as the proposed development of an airport facility. The master plan report, very similar to a local community comprehensive plan, summarizes the existing facilities, the projected levels of demand, facility requirements, alternatives and preferred development options for an airport. This document provides the project justification for the airport facilities that are graphically represented in the ALP drawing set. These documents, while very important to the persons associated with the airport, are often overlooked by local planners when undertaking planning for the local community around an airport. It is imperative that local planners be involved in the airport planning process. Additionally, they should be provided copies of the resulting documents for inclusion in the local community planning process.

Airport Land Use Compatibility Plan. An airport land use compatibility plan (ALUCP) is more specific than a local comprehensive plan. The purpose of an ALUCP is to promote compatibility between local airports and the surrounding property. It is a long-term plan that supports anticipated growth of airport activity, using a variety of tools and techniques to maintain compatible land use. An ALUCP combines the previously mentioned planning techniques with the specific goals, objectives, and needs of an individual airport. The result is the creation of a detailed document that guides land use decisions within the proximity of individual airports.

Specific elements of an ALUCP vary depending on what is authorized by individual state enabling legislation. In some states, airports are required to develop a plan, while in others state legislation allows voluntary participation in airport land use compatibility planning. In either case, the plan should be based upon a full assessment of existing and future needs of an airport, as well as the needs of the local community.

In most cases, an ALUCP is developed by a local community and is consistent with local and state laws. As the geographic limits of an ALUCP often extend beyond the confines of a single municipal boundary, coordination between adjoining communities is often necessary. When allowed by the state, this can involve extraterritorial zoning. What distinguishes most ALUCPs from traditional comprehensive planning is that they are exclusionary. They typically describe what land uses and land use characteristics are incompatible and therefore should not be allowed in the airport vicinity. They may also list the conditions that must be met in order for a particular land use to be allowed (sound attenuation, usage intensity limits, height limitations, avigation easements, etc.).

Quite often an ALUCP also contains an airport zoning ordinance, which is the legislative tool used to implement the findings or recommendations of the ALUCP. This ordinance can be a standalone document or can be a segment of a local zoning code. Some communities even develop them as an overlay zone to the existing base zoning, creating an overlay district. There are many methods to develop an ordinance. As part of Chapter 8 of this document, a sample local airport zoning ordinance is included for reference.

Airport Related

An airport sponsor or manager is an ambassador for the local airport and has the responsibility to inform local government officials and citizens of the importance of compatible land use planning on or near airport environs. Airport sponsors and managers must be vigilant with efforts to stay informed about local community actions regarding land use issues within the airport's proximity. They must make a concerted effort to establish solid communication and coordination with the local community and elected officials to demonstrate the value of and justification for compatible land uses near their local airport.

Airport Sponsors

Airport sponsors and local governments should work together to ensure that the sponsor is involved in the early stages of planning for any development that can potentially create an incompatible land use and endanger the safe operations of an airport or expose the public to excessive noise or risks. In conjunction with local officials, airport sponsors should assist with the development of local comprehensive plan elements and zoning regulations to:

- Preserve the viability of airports;
- Prevent and minimize surrounding incompatible land uses;
- Mitigate and minimize potential noise impacts on surrounding areas; and
- Preserve adequate space for airport operations, expansion, and safety zones.

Airport Managers

Airport managers, along with sponsors, can take an active role in the comprehensive planning process by providing local planners with airport and aviation information and documents. Airport-specific information provides the community with a good foundation from which to create the transportation and economic development elements of a comprehensive plan and to develop an airport land use compatibility plan. Airport information and documents may include any, or all, of the following:

- Location map.
- Airport type (commercial service, general aviation).
- Airport facility description (runways, taxiways, navigational aids, approaches).
- Current and forecast airport operational information (activity levels, based aircraft, enplanements).
- Map of current and forecast noise contours and associated information if available or applicable.
- Description of approach clearance considerations.
- Copy and explanation of the airport master plan, along with any future development expected at the airport.
- Copy of the airport Exhibit "A" Property Map that illustrates existing avigation easements near the site.
- List of opportunities to develop links with other transportation modes.
- Reports that demonstrate the economic value of the airport

Local municipalities should be involved with the airport planning process to educate the local stakeholders about the importance of the airport and the land use planning process. Airport sponsors and managers should encourage local participation in the development of the airport master plan, which can increase community involvement in the planning process. Local interests, as well as state aviation departments and the FAA should be involved in the airport planning process. The development of an airport master plan should be done in accordance with FAA AC 150/5070-6B, *Airport Master Plans.*

Airport Master Plan

An airport master plan is a long-range planning tool that guides the growth and development of individual airports. The plan is typically developed to address facility needs within a 20-year period with updates completed every five years, as warranted. The document is usually generated by an airport sponsor and its governing body to evaluate future growth and development needs based upon the projected facility usage.

FAA AC 150/5070-6B, *Airport Master Plans,* provides criteria for the creation of an airport master plan. As outlined in the AC, a typical master plan process includes the following elements:

- Inventory of facilities and airspace;
- Forecast of anticipated growth in activity;
- Demand/capacity analysis;
- Facility requirements;
- Alternative plan concepts;
- Environmental overview;
- Plan implementation;
- Airport layout plan; and
- Public involvement process.

The master plan process should include a comprehensive public involvement strategy and encourage communication between various stakeholders. Public input can provide a critical connection between the airport and the community, leading to improved compatible land use decisions.

The master plan leads to the development of an airport capital improvement plan (ACIP). An ACIP is a summary of development goals for a 5-year planning period, based upon the findings of the airport master plan. The airport master plan and ACIP should be utilized as a guide for the continued growth and development of an airport. It is beneficial to make the plans available to elected officials, local planners, and local land use decision makers to enhance an understanding of the airport needs and associated compatible land use issues during the evaluation process of proposed development projects within proximity to airport environs.

✈ **Case Study Example:**
Indianapolis International Airport (IND)
IND is owned and operated by the Indianapolis Airport Authority (IAA). State statutes have given the IAA the right to zone land within the city of Indianapolis, adjacent townships, and counties to ensure compatible land use. The IAA has designated specific areas around the Airport which fall within specific noise thresholds and has set up a purchase assistance system where owners of a home within a designated assistance area are able to sell their house and property to the IAA, who then clears it and maintains the open space to further mitigate the encroachment of incompatible land uses on the Airport.

Airport Users and Pilots

Airport users, including pilots and aircraft owners, represent a diverse network of people within a community and provide a unique opportunity for the collection and dissemination of information related to the airport and compatible land use issues. Like airport sponsors, users can attend local meetings to keep abreast of potential land use issues and report back to airport sponsors with information that may affect operations at the airport.

General aviation users, airlines, and air cargo carriers need to be made aware of land use impacts that aircraft operations impose on the surrounding environs. Both commercial service and general aviation pilots should follow standard operating procedures and operate their aircraft in a prudent manner to reduce noise impacts on local land uses. They should adhere to local noise abatement procedures and posted traffic patterns during approach and departure operations as a means to promote airport land use compatibility.

✈ **Case Study Example:**
O'Hare International Airport
In June 1997, the *Fly Quiet Program* was started to reduce nighttime noise impacts for residential areas that lie in either the approach or departure paths of aircraft utilizing the airport. This program identifies preferred departure runways, flight paths, and operating procedures that encourage airlines/pilots to reduce noise impacts on local residents during the hours of 10:00 p.m. to 7:00 a.m. The program is strictly voluntary and is not mandatory due to possible safety concerns that may arise.

✈ **Case Study Example:**
Collin County Regional Airport
To help reduce the impacts of aircraft noise on the community and residents surrounding the Collin County Regional Airport, a brochure called *Flying Friendly* was distributed to pilots and airport users which discussed how a pilot can help reduce aircraft noise concerns. Pilots are asked to sign a *Pilot Good Neighbor Pledge,* which recognizes their commitment to fly in a reasonable manner.

Local Citizens

The local population within a community can influence the decisions made by local planners, elected officials, and policymakers. Therefore, it is essential to educate the public so that informed decisions can be made regarding the implementation of planning techniques required for compatible land uses on or near airport environs. Public awareness of the implementation of compatible land use initiatives is beneficial to creating a safe environment for an airport and the neighboring citizens.

Local citizens are often the most affected by techniques used to develop compatible land uses and should be educated and involved in the land use planning process. For example, a homeowner whose residence is located within a runway approach zone should be provided with an explanation of the safety issues related to a clear airspace within this zone. The need for clear airspace should be outlined in such a manner that the homeowner understands the rationale behind the existence of these areas, as well as the necessity for land use regulations within these zones. When mitigation is necessary, the homeowner should also be educated about the various options available to meet the specific needs of the particular situation. Outlining these needs and the justification for them, as well as the various methods for mitigation, is essential to the success of a local compatible land use program.

Additionally, when developing an airport land use compatibility plan it is important to listen to the local citizens to assess their comments and concerns about the plan. The educational process should create an open line of communication between all parties involved, which can lead to a more comprehensive and successful plan.

Case Study Example:
Collin County Regional Airport
To help reduce the impacts of aircraft noise on the community and residents surrounding the Collin County Regional Airport, a noise hotline has been established by the city of McKinney to identify flight anomalies. Citizens that are being affected by aircraft noise are strongly urged to call the noise hotline. Each complaint and comment received on this hotline is recorded and investigated.

Real Estate Interests

Businesses and individuals, who comprise the real estate interests in a local or regional community, should be involved in the compatible land use discussion. As these individuals are often responsible for brokering sales of property and bringing business into a community, they need to be educated on the land use concerns. Their role is to be responsible stewards for both the airport and the area around it. Efforts should be made to educate real estate interests such as agents/brokers and developers of the concerns associated with land use compatibility and the impact it can have on different types of development.

Additionally, efforts should be made, through this group of businesses, to implement some of the strategies for compatibility such as disclosure notices and avigation easements as part of land sales near airports or their approach areas. These two forms of preservation and mitigation strategies are discussed in Chapter 8. Working to alert developers or future tenants of potential compatibility concerns before development takes place is essential to minimizing impacts.

Case Study Example:
Baltimore/Washington International Thurgood Marshall Airport (BWI)
At BWI, a notification process by owners and/or realtors has been implemented to inform prospective buyers and renters of a property's location within the Airport Noise Zone (ANZ), which has been determined by the Maryland Aviation Administration (MAA). The Maryland State Real Estate Commission has established an educational program with the Anne Arundel County and Howard County Boards of Realtors to provide notification as part of standard real estate transactions within the ANZ.

Summary

A variety of federal and state agencies provide land use guidance, policy, and implementation funding to local agencies. Local governments and airport sponsors are given the authority to implement and enforce land use compatibility policies and regulations specific to a particular airport. Each community and airport has unique physical requirements, goals, users, service markets, surrounding environs, and local economies. Relationships among stakeholders may vary by local community depending upon factors such as state enabling authority, ownership patterns, and type of airports involved. Due to the various authorities involved with the regulation of land use, a diverse set of guidance is available to help local communities address land use compatibility concerns. Communication and coordination between federal, state, regional, and local agencies, as well as airport sponsors, airport managers, airport users, and local citizens is essential to the development and implementation of a successful airport land use compatibility program.

VOLUME 1, CHAPTER 4

Federal Land Use Regulations and Guidance

Land use decisions are often influenced by an array of criteria; therefore, it is imperative to understand the complicated relationship among land uses; airports; federal, state, and local governments; and host communities. Federal, state, and local resources have been invested to develop the necessary infrastructure to support aviation activity at airports nationwide. Compatible land uses within proximity to airports will protect the airport and its airspace, as well as the health, safety, and welfare of residents within airport environs.

An airport's area of influence and related airspace often can span across multiple jurisdictions, further complicating the implementation of land use controls. Local governments and host communities need to realize the importance of maintaining an obstruction-free airport and associated airspace. This includes the area that encompasses the airport, runway protection zones, approach areas, and the general vicinity of the airport. In many cases, these areas are owned by airports, however, the bulk of the land beyond airport boundaries is privately owned and needs to be managed by the governing municipality in which the airport lies.

Federal and state agencies provide guidelines and recommendations through legislation to assist in maintaining compatible land uses within proximity to airports. However, the majority of the responsibility for implementation and enforcement of programs and decisions lies with local governments. Too often, local governments review and approve land uses and structures with little consideration on how the land use or structure will affect airport operations and the ability to protect area residents. FAA criteria along with aviation crash statistics provide the foundation on which the justification for compatible land uses can be based upon.

The Doolittle Report

The need for compatible land use was nationally recognized as early as 1952 in a document entitled *The Airport and Its Neighbors – The Report of the President's Airport Commission,* commonly known as the Doolittle Report after James Doolittle, the commission's chairman. President Harry S. Truman appointed a President's Airport Commission to undertake the task of investigating ways to protect and preserve airports as well as to protect people on the ground within the vicinity of airports from the nuisances caused by airport and aircraft operations. The commission's research was separated into a number of topics that provided the foundation from which the commission was able to develop a set of recommendations to address land use compatibility. The general topics and basic recommendations included:

- Airport growth
  - Support required airport development
  - Improve existing airports
  - Develop helicopters for civil use

- Zoning
  - Establish effective zoning laws
- Federal assistance
  - Expand Federal-Aid Airport Program
- Runway design and length
  - Revise present crosswind equipment
  - Extend use of single runway system
  - Meet standard requirements for runway length
- Nuisance factors
  - Accelerate ground noise reduction programs
  - Instruct flight personnel concerning nuisance factors
- Standardization and training
  - Minimize training flights at congested airports
  - Minimize test flights near metropolitan areas
  - Avoid military training over congested areas
  - Provide more flight crew training
- Airport planning
  - Integrate municipal and airport planning
  - Incorporate cleared runway extension areas into airports
- Navigable airspace
  - Clarify laws and regulations governing use of airspace
  - Define navigable airspace in approach zones
  - Maintain positive air traffic control
  - Raise circling and maneuvering minimums
  - Accelerate installation of aids to air navigation
  - Arrange flight patterns to reduce ground noise
  - Separate military and civil flying at congested airports
- Airport certification
  - Extend Civil Aeronautics Act to certificate airports

Over a half a century later, many of the recommendations that address land use compatibility remain unfulfilled due to the societal hesitation over implementation of strict land use controls. Additionally, there are inherent challenges associated with administering these recommendations over an aviation system spread across 50 states and thousands of local airports and communities. Reviewing these recommendations from the Doolittle Report provides support to the argument that land use concerns have been a long-standing issue for the aviation industry. Recent events, such as the aircraft overrun at Midway Airport in 2007, demonstrate that having compatible land uses near airports is very important to the safety of both those operating the aircraft as well as persons on the ground in proximity to airports.

A brief review of some of the recommendations reveals that efforts have been made, where feasible, to establish some form of guidance and standards to address land use issues. However, many of the recommendations require funding, enforcement, increased understanding, coordination, and cooperation to be effective. A sample of the recommendations is outlined below to provide a brief glimpse into the diversity of the topics covered. Also given is a brief assessment of each recommendation's status and applicability to today's aviation system. The assessments contained here are not meant to be an inclusive list of all activities, regulations, or actions that have taken place since 1952, but are intended to be a very brief assessment of the specific topic by today's general standards.

- *Support required airport development*
  - Doolittle Report Summary: New airports will be necessary and present airports must be improved to meet the aviation demands. State, county, and municipal governments should be prepared to assume their proper share of this expense.

- General Assessment: The aviation infrastructure of the nation today includes more than 19,000 airports with 5,190 open for public use. Of these, 3,411 are identified as part of the 2008 NPIAS making them eligible for federal funding from the FAA. Local airport sponsors and their host communities are matching federal funding and provide local support to the development of the aviation industry. Additionally, individual states have established offices or departments of aviation or aeronautics, dedicated to the preservation and development of aviation within their respective states. The Doolittle Report advocates for state, county, and local government support for required airport development, however, very little funding—federal, state, or local—is dedicated to compatible land use airport planning efforts.

- *Expand Federal-Aid Airport Program (FAAP)*
  - Doolittle Report Summary: Authorization of matching funds for federal aid to airports should be implemented by adequate appropriations. Highest priority in the application of federal aid should be given to runways and their protective extensions incorporated into the airport to bring major municipal airports up to standards recommended in this report.
  - General Assessment: Creation of the FAAP and subsequent incarnations including the current Airport Improvement Program (AIP) has promoted this goal and has continued to foster federal participation in the development of airports across the nation. However, while funding continues to reach new levels, additional effort must be placed upon land use compatibility programs by funding additional projects that target this issue, since most funding opportunities are not used to address land use planning. Also, for such programs to succeed, the FAA will need to be more aggressive in promoting the importance of airport land use compatibility and in supporting long-range land use compatibility planning efforts.
- *Integrate municipal and airport planning*
  - Doolittle Report Summary: Airports should be made a part of community master plans completely integrated with transportation requirements for passenger, express, freight, and postal services. Particular attention should be paid to limited access highways and other transportation facilities to reduce time to the airport from sources of air transport business.
  - General Assessment: While the recommendation of integrating municipal and airport planning appears to be fairly simple on the surface, the actual implementation of such a recommendation is monumental. Since the 1950s, many communities have excluded aviation and airport elements from the local planning process. There is little research on this issue that identifies specific reasons for the lack of integration or attention to this mode of transportation. Many questions exist regarding this topic and the lack of interest paid to airports as it relates to local comprehensive planning. In the limited instances where integrated planning has been done successfully, it has mostly been at major commercial service airports which have the political and financial resources to make it possible. Efforts to employ multimodal planning have been able to address some of these issues. At most airports, however, it is very difficult to bring the appropriate players to the table to discuss the issue of airport land use compatibility planning, let alone realize actual implementation of a plan or recommendation. While not necessarily widely accepted, developing a planning process and resulting plans to achieve integrated planning is still an essential goal that communities and their local airports both should strive to achieve. Some sort of national direction or incentive program to facilitate their cooperation in planning efforts is needed. Better multimodal planning efforts should be encouraged to allow for greater development of the transportation systems that take advantage of the existing infrastructure, as well as the future needs of these systems.

✈ **Case Study Example:**
Naval Air Station Pensacola

To help maintain compatible land uses around NAS Pensacola and protect both the military base and surrounding populations, Escambia County and NAS Pensacola conducted a JLUS. This study was conducted to identify encroachment issues and recommend strategies to address the issues in Escambia County's comprehensive plan and zoning regulations. Escambia County has successfully implemented the recommendations from the JLUS into their comprehensive plan and zoning ordinances to help mitigate incompatible land uses near the military base, protecting the community's valuable asset.

- *Incorporate cleared runway extension areas into airports*
  - Doolittle Report Summary: The dominant runways of new airport projects should be protected by cleared extensions at each end at least one-half mile in length and 1,000 feet wide. This area should be completely free from housing or any other form of obstruction. Such extensions should be considered an integral part of the airport.
  - General Assessment: This recommendation led to the federal requirement for establishment of standards for clear zones, now known as RPZs, at the ends of airport runways. Although initially intended to protect the runway approaches, the FAA now states that the function is "to enhance the protection of people and property on the ground." Airport ownership over RPZs is strongly encouraged and is essentially mandatory for new airports and runways. However, it is not a federal requirement for existing airports. Consequently, the RPZs of many airports, especially older airports in urban areas, contain land uses that put people at significant risk in the event that an aircraft overruns or lands short of a runway.
- *Establish effective zoning laws*
  - Doolittle Report Summary: A fan-shaped zone beyond the half-mile cleared extension described in a previous recommendation, at least two-miles long and 6,000 feet wide at its outer limits should be established at new airports by zoning law, air easement or land purchase at each end of dominant runways. In this area, the height of buildings and also the use of land should be controlled to eliminate the erection of places of public assembly, churches, hospitals, schools, etc., and to restrict residences to the more distant locations within the zone.
  - General Assessment: The principal outcome of this recommendation has been the creation of FAR Part 77 (14CFR77) which defines the federal process for addressing "objects affecting navigable airspace." However, the main portion of the recommendation was lost as the establishment of these areas is not based in "zoning law," as noted in the recommendation, but is merely a notification process leading to an FAA aeronautical study of the objects that may be obstructions to the airspace. Furthermore, FAR Part 77 only addresses whether the objects might be hazards to air navigation, not the underlying use of the land. Except where noise may be an issue, the FAA has no criteria with regard to land use compatibility beyond the RPZs. Implementation at the state and local levels also is missing. Some states did adopt various types of airport zoning enabling legislation in the late 1940s and early 1950s; however, they did not address or pay particular detail to the fan-shaped zone suggested in the Doolittle Report. Even with respect to airspace protection, most states have not adopted laws enabling enforcement of FAR Part 77 standards. Few communities in the country have adopted zoning ordinances protecting the runway approaches from obstructions, let alone from incompatible land uses. This is a primary recommendation that is still not being addressed today.
- *Improve existing airports*
  - Doolittle Report Summary: Existing airports must continue to serve their communities. However, cities should go as far as is practical toward developing the cleared areas and zoned runway approaches recommended for new airports. No further building should be permitted on runway extensions and wherever possible, objectionable structures should be removed. Operating procedures should be modified in line with the commission's recommendations for minimizing hazards and nuisances to persons living in the vicinity of airports.
  - General Assessment: If historical photos of airports across the country were compared to the conditions today, it would become readily apparent that the limitations on building near airports has, as a general rule, not been successful and therefore is still a goal that has gone unrealized.

- *Clarify laws and regulations governing use of airspace*
  - Doolittle Report Summary: Authority of the federal, state, or municipal governments with respect to the regulation of the use of airspace should be clarified to avoid conflicting regulations and laws.
  - General Assessment: It is clear from both statutory and case law that the federal government has pre-emptive authority over regulation of the operation of aircraft in the airspace. Equally clear from the U.S Constitution is that state and local governments, and not the federal government, have authority over land use decisions. At the intersection of these powers is where the law is less clear. Litigation continues to arise over issues involving restriction of land uses to protect airport airspace. Moreover, the outcome of these cases often depends more on state laws than federal ones. Protection of airports from airspace obstructions thus is inconsistent from state to state.
- *Define navigable airspace in approach zones*
  - Doolittle Report Summary: The limits of the navigable airspace for glide path or take-off patterns at airports should be defined.
  - General Assessment: FAR Part 77 and other federal standards attempt to define and guide the protection of airspace for approach zones for airports. This guidance has continually been improved over time to better reflect the way aircraft fly and to respond to new instrument flight capabilities. However, while these standards are used to define the areas of concern, the federal government cannot enforce the clearance of areas for unobstructed approaches and few states have adopted legislation to do so. Instead, when obstructions are identified, the outcome frequently is to modify the airport's instrument approach procedures—usually by increasing the minimums for descent height and visibility minimums—to accommodate the obstruction. This increase limits the utility of the runway. On the whole, the Doolittle Report recommendation to better delineate navigable airspace continues to be followed, but the underlying concern over protection of this airspace remains largely unmet today.
- *Accelerate installation of aids to air navigation*
  - Doolittle Report Summary: Research and development programs and installation projects designed to improve aids to navigation and traffic control in the vicinity of airports, especially in congested areas, should be accelerated. Installation and adequate manning of radar traffic control systems should be given high priority.
  - General Assessment: For quite some time, there was a plateau in air navigational aids where facilities such as Non-directional Beacons (NDBs) and Very High Frequency Omnirange (VOR) navigational aids and instrument landing systems (ILSs) provided the sole source of navigational aids. The FAA was not a leader in pushing air navigation technology forward. More recently, though, the FAA, the DoD, and private industry have worked together to enable rapid progress in the technology, particularly with the use of Global Positioning Systems (GPS) technology. Approaches such as area navigation (RNAV) and localizer performance with vertical guidance (LPV), as well as wide area augmentation system (WAAS), are now commonplace and are replacing the use of VOR and NDB approaches across the county. With the commissioning of these new approaches, there is no requirement for ground based equipment because everything is satellite-based with the GPS equipment. This is beneficial from a cost standpoint with limited needs for investment in equipment. It also is beginning to enable implementation of approach and departure routes that can be designed to avoid overflight of sensitive land uses and that can be flown more precisely than traditional procedures. However, the tradeoff for these noise abatement types of procedures is that height limits in the newly overflown locations may need to be more restrictive than necessary with traditional procedures aligned with the runway.

- *Accelerate ground noise reduction programs*
  - Doolittle Report Summary: Engine run-up schedules and run-up locations should be adjusted to minimize noise near airports. Adequate acoustical treatment in run-up areas and at test stands should be provided.
  - General Assessment: While there are airports that have constructed run-up enclosures or constructed more isolated areas for engine testing or engine run-up areas, many airports do not have the funds to consider the construction of these types of structures since many of their ground noise issues are often very limited. Consequently, this is an issue that could likely benefit from additional study under FAR Part 150 studies, as well as site specific assessments if there are extensive amounts of engine run-up activities such as aircraft maintenance activities.
- *Instruct flight personnel concerning nuisance factors*
  - Doolittle Report Summary: A tight discipline with respect to airport approach and departure procedures to minimize noise nuisance to people on the ground (within the limits of safe operating procedures) should be maintained at all times.
  - General Assessment: Implementation of this recommendation is predicated upon the successful communication of the developed procedures to pilots utilizing the airport. For example, if an airport establishes noise abatement procedures, it is imperative that local pilots, as well as itinerant pilots, are made aware of these procedures so that they can be cognizant of them during their take-off and landing activities at the subject airport. If left uneducated about the site specific procedures, it is likely that the implementation and the resulting noise reduction that is desired will not be realized. Many airports have established "Fly Quiet" programs or otherwise provide information on noise abatement procedures in an effort to educate the users of their airport about noise issues. As a result of these efforts, the vast majority of pilots today are aware of the noise impacts of their aircraft and do all they can within the limits of safety to operate their aircraft quietly and avoid overflight of noise-sensitive areas.
- *Arrange flight patterns to reduce ground noise*
  - Doolittle Report Summary: Airways and flight patterns near airports should be arranged to avoid unnecessary flight over thickly settled areas to minimize noise, but only within the limits of safe flight practice.
  - General Assessment: The FAA, through the FAR Part 150 – Noise Control and Compatibility Planning for Airports, works to reduce existing incompatible land uses near airports by measuring airport noise and identifying uses that are incompatible with various levels of noise. While there may be some general understanding of incompatible land uses near airports in regards to noise, many airports today are becoming increasing constrained by incompatible development, and the options for developing flight patterns to avoid populated areas which may be affected by noise impacts are limited. Most common noise abasement procedures, such as preferential runway use and departure tracks are usually implemented through voluntary use by pilots. In some instances, modification to flight standards can be implemented, however, these actions are usually considered to be "measures of last resort." With that said, new technologies, such as GPS approaches, are becoming available that enable aircraft to safely fly airport approach and departure routes that are modified to minimize noise impacts. On the whole, progress is being made with regard to this recommendation, but slowly.

As mentioned, these summaries are only a sample of the 25 individual recommendations. Significant steps have been taken over the years to increase awareness of airport land use compatibility issues and to address them, but growth of airports and the communities around them have continued to add to the problem and have made finding solutions increasingly challenging. As decisions to allow incompatible land uses near airports continue to threaten the nation's aviation system, implementation of compatible land use controls has become an industry priority.

Primary FAA Criteria Related to Land Use

FAA criteria laying the foundation for land use compatibility from a federal perspective are primarily found in four places:

- Grant assurances as part of the AIP funding process.
- FAA design standards pertaining to the physical layout of an airport.
- FAR Part 150, Noise Compatibility Program, provides guidance on noise related land uses within airport noise contours and airport environs.
- FAR Part 77 provides guidance on navigable airspace around an airport, in addition to providing procedures for construction notification and the airspace review and aeronautical study to be conducted by the FAA.

The airport land use compatibility criteria set forth in each of these places are discussed in the following sections.

Grant Assurances, Airport and Airway Improvements Act of 1982, United States Code (USC), Title 49, Subtitle VII as Amended

Grant assurances are required as part of a project application from airport sponsors who are eligible to request federal funds. Upon acceptance of grant money, these assurances are incorporated into and become part of the grant agreement. The airport sponsor is obligated to comply with specific assurances including the maintenance of compatible land use within the vicinity of the airport. The assurances that apply to planning-related projects are limited compared to other types of projects and have stipulations outlined in the grant agreement documents. Assurances include but are not limited to the following:

- Compliance with all applicable federal laws, regulations, executive orders, policies, guidelines, and requirements as they relate to the project.
- Responsibility and authority of the sponsor to carry out the proposed project.
- Availability of the local share of funds for the proposed project.
- Preservation of the rights and powers of the sponsor and airport.
- Consistency with local plans.
- Accurate accounting, auditing, and recordkeeping process.
- Public access to project information and planning processes.
- Compliance with civil rights issues.
- Provision of engineering and design services.
- Compliance with current policies, standards, and specifications.

Grant Assurance 21 included in the September 1999 amendment to 49 USC 47107, specifically requires all airports that accept federal money to "take appropriate action, to the extent reasonable, including the adoption of zoning laws, to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations, including landing and takeoff of aircraft." This grant assurance obligates an airport sponsor to protect the federal investment through the maintenance of a safe operating environment.

Standards are not stated to implement this assurance. Moreover, the "to the extent reasonable" clause means that implementation varies widely. An airport's ability to adopt zoning or take other land use compatibility actions is much less when the surrounding lands are in a different jurisdiction than when the same agency controls both the airport and its environs.

In 2000, Congress passed legislation requiring the FAA to compile a Land Use Compliance Report. This report provides a detailed assessment of individual airports that are not in compliance with federal grant assurances or other Federal land use requirements with respect to airport land. Each FAA Regional Office conducts a minimum of two land use inspections per year in order to compile the report. When inspections identify incompatible land uses around airports, the airport sponsors are encouraged to take corrective action to address the issue. If they are non-compliant, they risk losing their eligibility for receiving Federal AIP grants. The FAA has recently been successful enforcing Grant Assurance 21 through litigation with a non-compliant airport.

Grant Assurance 20, Hazard Removal and Mitigation, requires airports to take "appropriate action to assure that such terminal airspace as is required to protect instrument and visual operations to the airport (including established minimum flight altitudes) will be adequately cleared and protected by removing, lowering, relocating, marking, or lighting or otherwise mitigating existing airport hazards and by preventing the establishment or creation of future airport hazards." This assurance works to protect those in the air and on the ground by identifying and removing hazards to safe aircraft navigation.

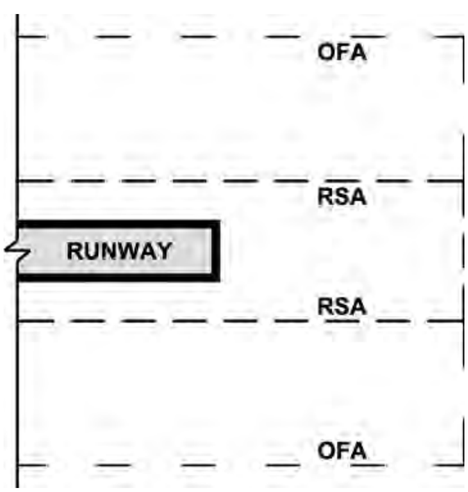
FAA Design Standards

Safety areas, as defined by FAA AC 150/5300-13, *Airport Design,* are implemented for the safe and efficient operation of an airport. There are many design requirements contained in this advisory circular. Nearly all pertain to aircraft operating areas and facilities located on airport property. The requirements discussed below are directly related to areas in proximity to runway ends and approach areas near runways that may be off airport property. These areas fulfill safety-related functions for an airport and for aircraft using the airport. It is important to fully understand the role of each area during land use discussions. The safety areas focus on requirements on the ground and include, runway safety areas, runway object free areas, and runway protection zones.

Runway Safety Areas. Runway safety areas (RSAs) are rectangular, two-dimensional areas surrounding a runway as illustrated in Figure 1.4-1. FAA notes that RSAs should be cleared, graded, properly drained, and free of potentially hazardous surface variations. RSAs also should be capable of supporting snow removal, aircraft rescue and fire fighting (ARFF) equipment, or an aircraft that overshoots the runway without causing damage to that aircraft. Taxiways also have similar safety area requirements. The actual size of an RSA is dependent upon the FAA classification of the runway (A-I, B-II, C-III, etc). This surface ranges from 120 feet to 500 feet in width and from 240 feet to 1,000 feet in length beyond each end of the runway.

Runway Object Free Areas. Runway object free areas (OFAs) are two-dimensional ground areas surrounding runways where all aboveground objects must be removed unless fixed by their function, such as runway lights. FAA standards prohibit objects and parked aircraft from being located within the runway OFA. Taxiways also have OFAs. The dimensions of an OFA range in width and length from 240 feet to 800 feet in width, and 240 feet to 1,000 feet in length depending upon aircraft design groups. Figure 1.4-2 depicts the proximity of OFAs to the runway.

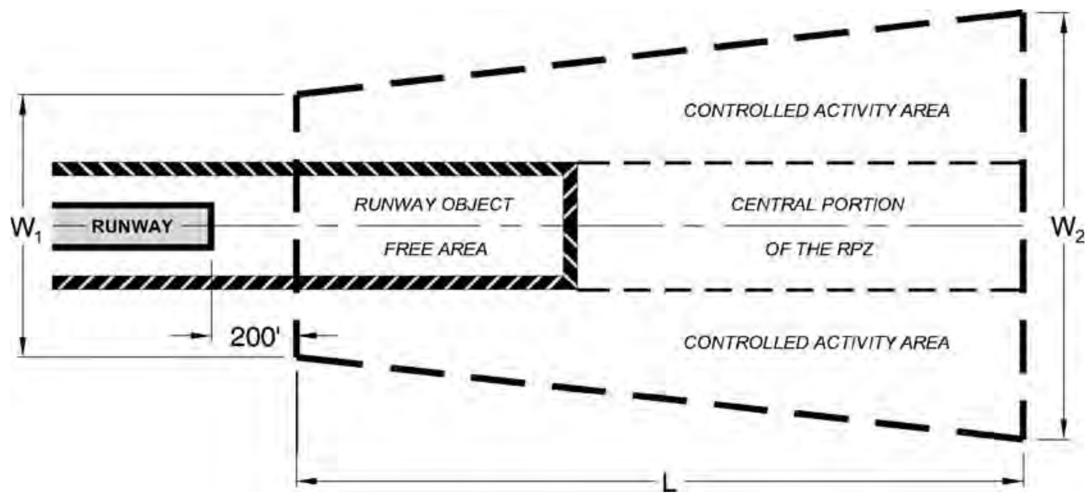
RSAs and OFAs are almost always contained within airport property. If an RSA or an OFA is not fully on airport property, special measures must be taken in the design of the runway to provide an equivalent degree of safety.



Source: *FAA AC 150/5300-13, Airport Design Standards*.

Figure 1.4-1. Proximity of OFAs to RSAs.

Runway Protection Zones. RPZs, formerly known as clear zones, were originally established to define land areas below aircraft approach paths in order to



Source: *FAA AC 150/5300-13, Airport Design Standards.*

Figure 1.4-2. RPZ diagram.

prevent the creation of airport hazards or development of incompatible land use. First recommended in a 1952 report by the President's Airport Commission titled *The Airport and Its Neighbors,* the establishment of clear areas beyond runway ends was deemed worthy of federal management. These clear areas were intended to preclude the construction of obstructions potentially hazardous to aircraft and to control building construction for the protection of people on the ground. The U.S. Department of Commerce concurred with the recommendation on the basis that this area was "primarily for the purpose of safety for people on the ground." The FAA adopted clear zones with dimensional standards to implement the commission's recommendation.

RPZs are designed with the intent to protect people and property on the ground. They are located at the end of each runway and, ideally, should be controlled by the airport. Control is preferably exercised by acquisition of sufficient property interest to achieve and maintain an area that is clear of all incompatible land uses, objects, and activities. RPZs often can extend beyond airport property. Therefore, from an off-airport land use compatibility perspective, the critical safety zone identified by FAA design standards is the RPZ. The FAA recommends that, whenever possible, the entire RPZ be owned by the airport and be clear of all obstructions if practicable. Where ownership is impracticable, avigation easements are recommended to obtain the right to maintain the height of structures and vegetation within the RPZ footprint. Obtaining easements that are often restrictive enough to limit building opportunities, as well as height are often just as costly to procure as purchasing the property outright.

The RPZ is trapezoidal in shape and centered on the extended runway centerline. Dimensions for a particular RPZ are based upon the type of aircraft and approach visibility minimums associated with the runway end. Unless noted by a special circumstance, the RPZ begins 200 feet beyond the end of the runway and has specific land use restrictions in order to keep the approach and departure areas clear of obstructions. The RPZ has two specific areas as shown in Figure 1.4-2. First is the central portion of the RPZ, which is equal in width to the runway OFA. The second area is the controlled activity area, which is adjacent to the central portion of the RPZ. Table 1.4-1 contains specific dimensional information for the RPZs.

In addition to the general clearing requirements associated with the OFA, RSA, TSA, and Obstacle Free Zones (OFZ), RPZs have a critical need for protection from incompatible land uses and have land use related criteria that must be maintained. It is desirable to clear all objects from

Table 1.4-1. RPZ dimensional requirements.

Approach Visibility Minimums [1]	Facilities Expected to Serve	Dimensions			
		Length **L** feet (meters)	Inner Width $\mathbf{W_1}$ feet (meters)	Outer Width $\mathbf{W_2}$ feet (meters)	RPZ acres
Visual and not lower than 1-Mile (1,600m)	Small aircraft exclusively	1,000 (300)	250 (75)	450 (135)	8.035
	Aircraft Approach Categories A & B	1,000 (300)	500 (150)	700 (210)	13.770
	Aircraft Approach Categories C & D	1,700 (510)	500 (150)	1,010 (303)	29.465
Not lower than ¾-mile (1.200m)	All Aircraft	1,700 (510)	1,000 (300)	1,510 (453)	48.978
Lower than ¾-mile (1,200 m)	All Aircraft	2,500 (750)	1,000 (300)	1,750 (525)	78.914

[1]The RPZ dimensional standards are for the runway end with the specified approach visibility minimums. The departure RPZ dimensional standards are equal to or less than the approach RPZ dimensional standards. When an RPZ begins other than 200 feet (60m) beyond the runway end, separate approach and departure RPZs should be provided. Refer to FAA AC 150/5300-13, Change 14, Appendix 14 for approach and departure RPZs.
Source: *FAA AC 150/5300-13, Airport Design Standards*

the RPZ, per the criteria noted in FAA AC 150/5300-13, *Airport Design,* although some uses are permitted, provided they:

- Do not attract wildlife;
- Are outside of the runway OFA; and
- Do not interfere with navigational aids.

For example, automobile parking facilities are discouraged; however, they can be permitted provided lighting, as well as the lots themselves, are located outside the central portion of the RPZ and meet the aforementioned three (3) criteria. Land uses that are prohibited from the RPZ areas, according to FAA AC 150/5300-13 Change 14, *Airport Design,* include:

- Fuel storage facilities;
- Residential structures (homes, condominiums, apartments, and manufactured housing parks); and
- Place of public assembly (places of worship, schools, hospitals, office buildings, shopping centers, or other uses with similar concentrations of people).

However, when it is determined impracticable for the airport sponsor to acquire and plan the land uses within the entire RPZ, provisions can be made to maintain existing residential structures so long as they do not pose a hazard to safe air navigation. The land use standards can provide a recommendation status for that portion of the RPZ that is not controlled by the airport sponsor. If this option is impractical, the airport sponsor should consider the acquisition of an avigation easement to provide control over the RPZ area.

FAR Part 150, Noise Compatibility Program, CFR Title 14

This document establishes the measures required by the *Aviation Safety and Noise Abatement Act* (ASNA) and was revised to include a standardized airport noise compatibility program, including:

- Voluntary Noise Exposure Maps (NEM) and Noise Compatibility Programs (NCP) submitted by airport owners to the FAA;
- Standard noise measurement methodologies and units;

- Identification of land uses which the FAA deems to be normally compatible or incompatible with various levels of noise; and
- Procedures and criteria for preparing and submitting a NEM and NCP.

FAR Part 150 contains the regulations that implement the provisions of the ASNA. Under FAR Part 150, local jurisdictions can prepare and submit to the FAA a NEM for the airport's environs and a NCP. The program is open to all publicly owned, public-use airports included in the NPIAS. Although the FAR Part 150 program is voluntary, airports must participate if they wish to obtain FAA funding for noise-abatement measures such as sound attenuation of existing residences and schools or installation of noise monitors.

FAR Part 150 focuses solely on noise compatibility issues. Safety and airspace protection concerns are not addressed except to the extent that they may affect or be affected by noise-related measures. Among the noise-related provisions of the regulation are:

- Making the A-weighted decibel [dB (A)] scale the universal noise measurement tool;
- Making the Day-Night Level (DNL) the universal noise contour measure; and
- Defining acceptable land uses for areas within each DNL noise contour.

FAR Part 77, "Objects Affecting Navigable Airspace" (14 CFR 77)

FAR Part 77 establishes standards for providing notice to the FAA regarding proposed objects that may be obstructions to air navigation and for FAA review of these objects to determine if they would be hazards to flight. The regulations apply to civil airports and heliports, as well as to military airports.

FAA Form 7460-1 §77.15 Construction or alteration not requiring notice states:

> No person is required to notify the Administrator for any of the following construction or alteration: (a) Any object that would be shielded by existing structures of a permanent and substantial character or by natural terrain or topographic features of equal or greater height, and would be located in the congested area of a city, town, or settlement where it is evident beyond all reasonable doubt that the structure so shielded will not adversely affect safety in air navigation. (b) Any antenna structure of 20 feet or less in height except one that would increase the height of another antenna structure. (c) Any air navigation facility, airport visual approach or landing air, aircraft arresting device, or meteorological device, of a type approved by the Administrator, or an appropriate military service on military airports, the location and height of which is fixed by its functional purpose. (d) Any construction or alteration for which notice is required by any other FAA regulation.

Therefore, unless shielded by closer objects, notice to the FAA must be provided for any object having a height that exceeds a 100:1 slope from the runway (50:1 for runways up to 3,200 feet long). Determination of whether an object would be an airspace obstruction is based upon a set of imaginary surfaces defined in the air around each airport. The imaginary surfaces outlined in FAR Part 77 include:

- Primary surface;
- Approach Surface;
- Transitional Surface;
- Horizontal Surface;
- Conical Surface; and
- Outer Horizontal Surface (military airports only).

Together with runway design standards, FAR Part 77 are intended to ensure that aircraft can safely approach, land, takeoff, and depart an airport. The difference is that FAR Part 77 surfaces identify airspace areas of concern around an airport while design standards protect specific ground areas on the airport. The dimensions of FAR Part 77 surfaces vary depending on the type of runway approach. There are three types of runway approaches: visual, nonprecision instrument, and precision instrument. The primary differences between these approaches are:

- A visual approach runway is one in which the pilot must visually see the runway and maneuver/control the aircraft to the runway by looking outside of the aircraft without use of on-board instruments. Visual approaches also include instances where the existing or planned instrument approach terminates in circling rather than a straight-in approach. A circling approach requires the pilot to have visual contact with the runway while aligning the aircraft for landing.
- A nonprecision instrument runway uses RNAV and Lateral Precision with Vertical Guidance (LPV) approaches with horizontal guidance for aircraft, aligning them with the runway for straight-in approaches.
- A precision instrument runway approach uses an Instrument Landing System (ILS), a Precision Approach Radar (PAR), a Microwave Landing System (MLS), or other new approach procedures such as GPS, which provide a greater degree of flexibility in the definition of nonprecision and precision instrument approaches. To date, FAA has not altered the standards related to FAR Part 77 to reflect these new technologies. These approach systems provide both vertical (a glide slope) and horizontal alignment for aircraft to a particular runway. Airports with scheduled commercial passenger traffic and heavily used general aviation airports usually have existing or planned precision instrument approaches.

Additionally, two other terms should be defined which are relevant to the discussion of FAR Part 77 surfaces. These include the meaning of utility and visual as they apply to defining specific dimensions for the FAR Part 77 surfaces. A utility runway is a runway that is constructed for and intended to be used by propeller driven aircraft of 12,500 pounds gross weight or less. Additionally, a distinction is also made as to the definition of a visual runway. A visual runway is a runway intended solely for the operation of aircraft using visual approach procedures, with no straight-in instrument approach procedure and no instrument designation indicated on an FAA approved airport layout plan, a military service approved military airport layout plan, or by any planning document submitted to the FAA by competent authority.

Under FAR Part 77, the FAA is authorized to undertake an aeronautical study to determine whether a structure or vegetation is, or could be, a hazard to air navigation. However, the FAA is not authorized to regulate tall structures nor is there specific authorization in any statute that permits the FAA to limit structure heights or determine which structures should be lighted or marked. In fact, in every aeronautical study determination, the FAA acknowledges that state or local authorities control the appropriate use of property beneath an airport's airspace. This illustrates the need for local land use controls to support the findings of the FAA.

Primary Surface. The primary surface must be clear of all obstructions except those fixed by their function, such as runway edge lights, navigational aids, or airport signage. The majority of the primary surface is already controlled by runway safety area criteria contained in FAA AC 150/5300-13 *Airport Design Standards* and therefore does not warrant inclusion as a land use zone.

Even though the primary surface is not included as a land use zone, it functions as an important safety area since it is longitudinally centered on a runway and is intended to provide an obstruction free area around the runway surface. When the runway has a prepared hard surface, the primary surface extends 200 feet beyond each end of that runway. When the runway does not have a prepared hard surface, or planned hard surface, the primary surface terminates at each end of the runway. The width of a primary surface ranges from 250 to 1,000 feet depending on the existing or planned approach and runway type (visual, nonprecision, or precision). Table 1.4-2, Figure 1.4-3, and Figure 1.4-4 depict various dimensional requirements for the primary surface and other FAR Part 77 *Surfaces.*

Table 1.4-2. FAR Part 77 surface dimensional requirements.

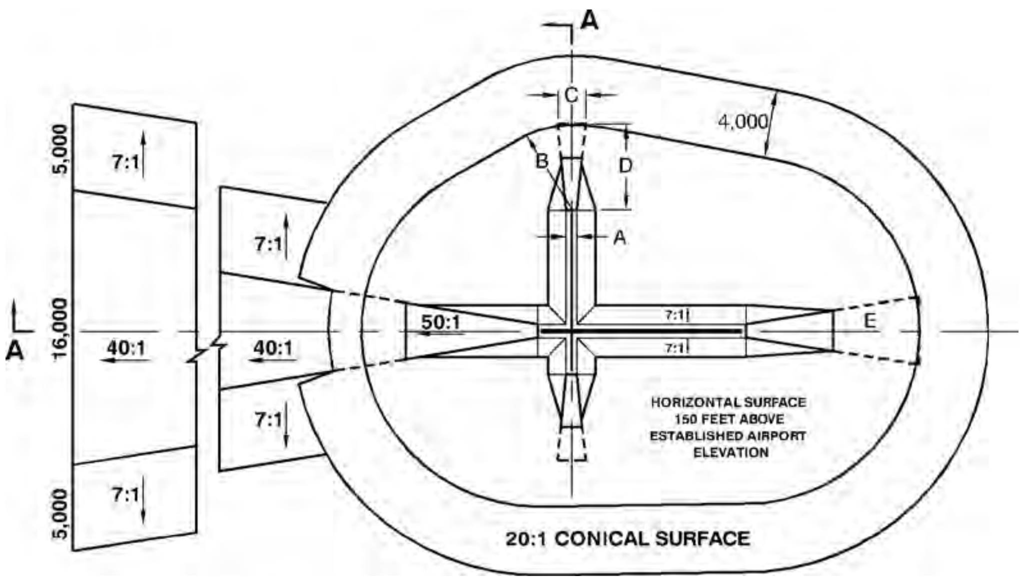
Dimensions shown in Figure 4	Item	Dimensional Standards (Feet) for Runway Classifications (*see legend below*)					
		Visual Runway		Non-Precision Instrument Runway			Precision Instrument Runway*
				A	B		
		A	B		C	D	
A	*Primary surface* width and approach surface width at inner end	250	500	500	500	1,000	1,000
B	*Horizontal surface* radius	5,000	5,000	5,000	10,000	10,000	10,000
C	*Approach surface* end width	1,250	1,500	2,000	3,500	4,000	16,000
D	*Approach surface* length	5,000	5,000	5,000	10,000	10,000	10,000
E	Approach slope	20:1	20:1	20:1	34:1	34:1	*
F	*Conical surface* width	4,000	4,000	4,000	4,000	4,000	4,000
G	*Transitional surface slope*	7:1	7:1	7:1	7:1	7:1	4,000

Runway Classification Legend
A – Utility runway.
B – Runway larger than utility.
C – Visibility minimums greater that ¾ of a mile.
D – Visibility minimums as low as ¾ of a mile.
* – Precision instrument approach slope is 50:1 for inner 10,000 feet and 40:1 for an additional 40,000 feet.
Source: *FAR Part 77 Objects Affecting Navigable Airspace*.

Approach Surface. The approach surface is longitudinally centered on the extended runway centerline and extends outward and upward from the end of the primary surface. A visual approach runway has relatively small surfaces with approach and horizontal surfaces extending 5,000 feet from the primary surface at an approach slope of 20 feet horizontally for each one foot vertically (20:1). For a nonprecision approach runway, both the approach and horizontal surfaces extend either 5,000 or 10,000 feet from the primary surface, depending on the design category of the runway. The approach surfaces for precision approach runways are similar to those for nonprecision approach runways except that the approach surface extends 50,000 feet from the primary surface, and the horizontal surface extends 10,000 feet from the primary surface.

The approach slope has a ratio of 20:1, 34:1, or 50:1, depending on the approach type (and 40:1 in the outer portion of a precision approach surface). The length of the approach surface varies from 5,000 to 50,000 feet and also depends upon the approach type. The inner edge of the approach surface is the same width as the primary surface and expands uniformly to a width ranging from 1,250 to 16,000 feet, depending on the type of runway and approach. Dimensional standards for the various approaches are illustrated in Table 1.4-2, Figure 1.4-3, and Figure 1.4-4.

Transitional Surface. The transitional surface extends outward and upward at right angles to the runway centerline and extends at a slope of seven feet horizontally for each one foot vertically (7:1) from the sides of the primary and approach surfaces. The transitional surfaces extend to the point at which they intercept the horizontal surface at a height of 150 feet above the established airport elevation. For precision approach surfaces that project through and beyond the limits of the conical surface, the transitional surface also extends 5,000 feet horizontally from the edge of the approach surface and at right angles to the runway centerline. Table 1.4-2, Figure 1.4-3, and Figure 1.4-4 depict the dimensional requirements of the approach surface.

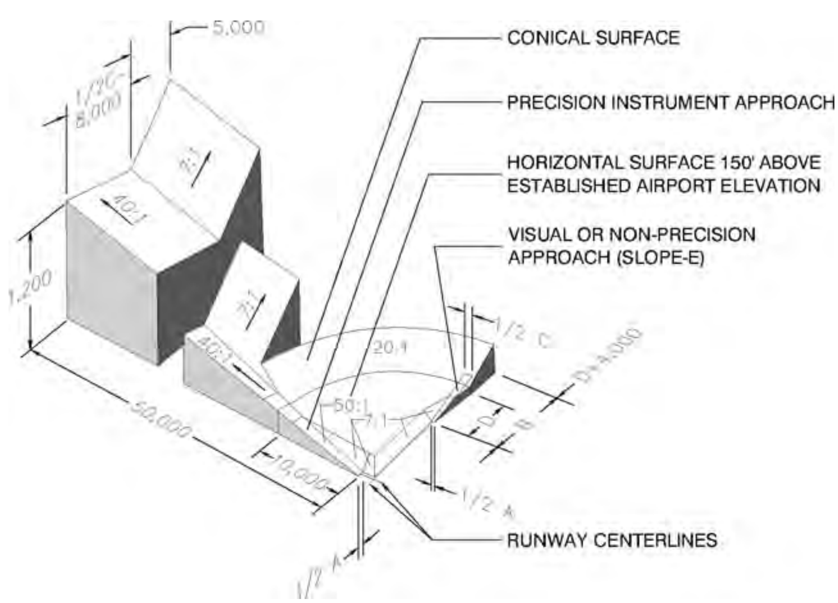


Source: *FAR Part 77 Objects Affecting Navigable Airspace*

Figure 1.4-3. FAR Part 77 surfaces – plan view.

Horizontal Surface. As illustrated in Table 1.4-2, Figure 1.4-3, and Figure 1.4-4, the horizontal surface is a horizontal plane located 150 feet above the established airport elevation and encompasses an area from the transitional surface to the conical surface. The perimeter is constructed by generating arcs from the center of each end of the primary surface and connecting the adjacent arcs by lines tangent to those arcs. The radius of each arc for all runway ends designated as utility or visual is 5,000 feet and 10,000 feet for precision and nonprecision runway ends.

Conical Surface. The conical surface extends upward and outward from the periphery of the horizontal surface at a slope of 20 feet horizontally for every one foot vertically (20:1) for a horizontal distance of 4,000 feet. Height limitations for the surface range from 150 feet above the



Source: *FAR Part 77 Objects Affecting Navigable Airspace*

Figure 1.4-4. FAR Part 77 surfaces – 3D isometric view of Section A.

airport reference elevation at the inner edge to 350 feet at the outer edge, as shown in Table 1.4-2, Figure 1.4-3, and Figure 1.4-4.

Other Airport-Related Surfaces

In addition to the RPZs and FAR Part 77 Surfaces, there are other surfaces, which are evaluated by the FAA for obstructions. Several of these surfaces are worth mentioning since they may contribute to the height limitations for airports with instrument approaches and in some instances air carrier operations.

Terminal Instrument Flight Procedures (TERPS)

Order 8260.3 B Change 19 through 22, United States Standard for Terminal Instrument Procedures, contains standards for establishing and designing terminal instrument flight procedures (TERPS). The criteria are applicable at any location over which the United States has jurisdiction. TERPS are similar to FAR Part 77 in that there are constraints placed on the airspace in the vicinity of the airport that may have an impact on the land uses allowable beneath those surfaces.

One-Engine Inoperative (OEI) Obstacle Identification Surface

For runways and airports that support air carrier operations, FAA AC 150/5300-13, Appendix 2, *Airport Design,* requires the identification of these additional departure surfaces. Providing a 62.5 feet vertically to one foot horizontally (62.5:1) slope, the inner dimension of the surface is 600 feet wide, with the outer width at 12,000 feet wide. The corresponding length is 50,000 feet. This area is much larger than the surfaces provided for in FAR Part 77 and TERPS, making it difficult to coordinate the potential impacts to airspace and airport operations should an obstruction exist. Although the FAA plays no direct role in the actual protection of the OEI airspace, the protection of the OEI airspace can be critical to preserve the viability of commercial air service at airports and should be considered when evaluating compatible land use impacts near airports.

Departure Surface for Instrument Runways

This surface is applied to runways with an instrument approach and is defined in FAA AC 150/5300-13, Appendix 2, *Airport Design.* This surface has a slope of 40 feet vertically to one foot horizontally (40:1) with corresponding dimensions of 1,000 foot inner width, 6,466 foot outer width, and 10,200 feet in length. Objects penetrating this surface may affect departure procedures, just as approach procedures can be affected by these same penetrations. Consideration should be given to this surface for compatible land uses which may affect the clearance of the 40:1 surface.

Other Federal Regulations Related to Land Use

FAA ACs, the Code of Federal Regulations (CFR) provide standards and policies for controlling incompatible land uses near airports. The majority of this information is provided to the public and airport sponsors by the FAA. These resources create the foundation for the development and implementation of the airport planning process as well as the planning necessary for compatible land use.

The following list of regulations is not all inclusive of the resources which relate to compatible land use planning. As noted previously, there are a multitude of federal and state agencies with regulatory authority over a wide range of areas that could impact land use decisions near airports. Trying to identify each of these groups and the associated legislation would be a daunting task; consequently, it is suggested that each airport and its host community evaluate the specific needs of their airport and surrounding community to identify other agencies, particularly state agencies, that may need to be consulted prior to development of a land use plan.

Planning and Design Related Regulations and Policies

This section includes federal statutes, ACs, and CFRs, relevant to land use compatibility and provides a summarization of the primary regulations. The sources noted below are not meant to be an all-inclusive list, but rather a general summary and overview of resources relating to planning and design.

AC 70/7460-1K Change 2, Marking and Lighting. This AC works within the requirements of FAR Part 77. A sponsor proposing any type of construction or alteration of a structure that may affect the National Airspace System is required to submit FAA Form 7460-1 "Notice of Proposed Construction or Alteration." This form should then be sent to the Obstruction Evaluation Service (OES) of the FAA.

AC 70/7460-2K, Proposed Construction or Alteration of Objects that May Affect the Navigable Airspace. This AC provided information regarding the erection or alteration of an object on or near an airport that may affect the navigable airspace as required in FAR Part 77. In addition, this AC explains the process by which to petition for discretionary review, thereby providing the FAA the opportunity to:

- Recognize potential hazards and minimize the effects to aviation.
- Revise published data and/or issue a Notice to Airmen (NOTAM).
- Recommend appropriate marking and lighting to make objects visible.
- Depict obstacles on aeronautical charts.

AC 150/5070-7, Airport System Planning Process. This document outlines the development of effective airport system planning. Developing an airport system plan provides guidance and establishes a balanced integrated system of public-use airports. The airport system planning process should be consistent with state or regional goals that involve examining the relationship between airports and aviation user requirements. Once these relationships are established, the airport system planning process should result in the identification, preservation, and enhancement of both the current and future aviation demand. This AC provides a detailed outline for the development of an acceptable airport system plan.

FAA AC 150/5190-4A, Model Zoning Ordinance to Limit Height of Objects Around Airports. Language that can be used by local land use jurisdictions to implement and enforce the provisions of FAR Part 77 are found in this AC. The wording provided is advisory only and, except with regard to the technical description of the airspace surfaces, is often modified by individual jurisdictions.

FAA AC 150/5300-13 Change 14, Airport Design. This AC provides the basic standards and recommendations for airport design. The most recent update provides expanded information regarding new approach procedures for RPZs, threshold-siting criteria, and new instrument approach categories. The criteria contained in this document are the primary spatial standards for on-airport development.

Form 7460-1, Proposed Construction of Alteration of Objects that May Affect the Navigable Airspace and Form 7460-2, Supplemental Notice of Actual Construction or Alteration. Form 7460-1 & Form 7460-2 are required for development proposed in proximity to any public-use airport to assess each proposed or temporary construction in the vicinity of the airport. The FAA conducts an aeronautical study and issues a determination to the airport sponsor. The determination identifies whether or not the proposed development is a hazard to flight. It is imperative that local planners be aware of the various critical safety considerations when developing around airports. These forms can be found online at www.oeaaa.faa.gov and they must be submitted at least 30 days prior to the date the construction or alteration is to begin. FAA will evaluate the proposed development and provide a finding regarding the potential of the development to be a hazard to air navigation. One of three specific findings can be expected: no hazard, hazard or potential hazard. If a potential hazard is found, the FAA may request additional information to further assess the potential impact. This process is merely a notification procedure and provides an opportunity for the FAA to comment on potential development. Unfortunately, the FAA does not have any regulatory power to deny the development; it may only comment on the expected impact of a proposed development. Limitation of a potential development is the sole responsibility of the local community.

Form 7480-1, Notice of Landing Area Proposal. This form works in conjunction with FAR Part 157, which requires a 90-day notification prior to any construction, alteration, deactivation, or change to the use of an airport. Notice is required for the following:

- Construct or otherwise establish a new airport or activate an airport;
- Construct, realign, alter, or activate any runway, or other aircraft landing or takeoff area of an airport;
- Construct, realign, alter, or activate a taxiway associated with a landing or takeoff area on a public-use airport;
- Deactivate, discontinue using, or abandon an airport or any landing or takeoff area for a period of one year or more;
- Deactivate, abandon, or discontinue using a taxiway associated with a landing or takeoff area on a public-use airport;
- Change to status of an airport from private-use to an airport open to public or from public-use to another status;
- Change status from instrument flight rules (IFR) to visual flight rules (VFR) or VFR to IFR; and
- Establish or change any traffic patterns or traffic pattern altitude or direction.

FAR Part 157, Notice of Construction, Alteration, Activation, and Deactivation of Airport. This part provides guidelines, procedures, and standards that shall be used in determining what effect construction, alteration, activation, or deactivation of an airport will have on the safe and efficient use of the navigable airspace by aircraft. Part 157 applies to civil and joint-use airports that do not receive federal funding.

Noise-Related Laws and Policies

There are a number of federal laws related to noise impacts. The following regulations provide federal guidelines for two primary areas: measurement of noise and methods of noise mitigation. This section is not meant to present an all-inclusive list, rather, a summary of primary federal laws related to noise issues. The FAA provides guidance for the development of plans for areas affected by aircraft noise in several FARs, each of which is discussed below.

AC 150/5020-1, Noise Control and Compatibility Planning for Airports. This document provides guidance for the implementation of FAR Part 150, which allows for the development of an airport plan that establishes a compatible relationship between land uses and noise-related issues. This is accomplished by the reduction of incompatible land uses around airports and noise sensitive areas, and the prevention of additional incompatible land uses.

AC 150/5020-2, Guidance on the Balanced Approach to Noise Management. This document provides guidance for noise control and compatibility planning for airports and the guidance for preparing airport noise exposure maps and airport noise compatibility programs implemented in FAR Part 150, and the Aviation Safety and Noise Abatement Act of 1979.

AC 150/5320-14, Airport Landscaping for Noise Control. This document establishes guidance for the implementation of landscaping for noise control purposes. It also recommends a variety of vegetative species to use for such purposes.

US Code Title 49 Transportation, Subtitle VII Aviation Programs, Part B, Chapter 471 Airport Development. This document gives the FAA the ability to protect the public's freedom of airspace transit given to all airspace users, including national defense, commercial and general aviation, and space operations. The FAA is also charged with the task of ensuring the safety of aircraft and the preservation of navigable airspace as it relates to the public interest. Specifically, *Subchapter I Airport Improvements, Section 47101* describes policy that regulates navigable airspace. Several specific elements of Section 47101 are noted below that have relevance to the noise related issues of land use:

(a) General (7) - "It is the policy of the United States . . . that airport construction and improvement projects that increase the capacity of facilities to accommodate passenger and cargo traffic be undertaken to the maximum feasible extent so that safety and efficiency increase and delays decrease."

(a) General (8) - "It is the policy of the United States . . . to ensure that non-aviation usage of the navigable airspace be accommodated but not allowed to decrease the safety and capacity of the airspace and airport system."

(a) General (9) - "It is the policy of the United States . . . that artificial restrictions on airport capacity:

- Are not in the public interest
- Should be imposed to alleviate air traffic delays only after other reasonably available and less burdensome alternatives have been tried
- Should not discriminate unjustly between categories and classes of aircraft"

(a) General (10) - "It is the policy of the United States . . . that special emphasis should be placed on converting appropriate former military air bases to civil use and identifying and improving additional joint-use facilities."

(c) Capacity Expansion and Noise Abatement - "It is the policy of the United States . . . it is in the public interest to recognize the effects of airport capacity expansion projects on aircraft noise. Efforts to increase capacity through any means can have an impact on surrounding communities. Noncompatible land uses around airports must be reduced and efforts to mitigate noise must be given a high priority."

Environmental Related Laws and Policies

This section is not intended to be an all-inclusive list of federal law, rather, as a general guide for the review of environmental impacts. For example, the NEPA of 1969 is referenced, as is the FAA's *Airport Environmental Handbook,* which includes more than 20 different categories of environmental consideration. This illustrates the diverse range of issues that may be impacted by or create an impact on airport development. Each airport project sponsor should seek both FAA and state-agency assistance regarding site-specific environmental issues.

AC 150/5200-34, Construction or Establishment of Landfills near Public Airports. This AC provides guidance regarding compliance with new federal statutory requirements for the construction or establishment of MSWLF units near public airports. Section 503 of the *Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR-21), Pub. L. No. 106-181 (April 5, 2000)* replaced Section 1220 of the 1996 *Reauthorization Act, 49, USC Statute 44718(d),* with new language that further limits the construction or establishment of a municipal solid waste landfill (MSWLF) unit near certain smaller public airports.

These new limitations apply only to airports receiving federal grants, or to those that primarily serve general aviation aircraft and scheduled air carrier operations using aircraft with fewer than 60 passenger seats. The new restrictions require a minimum separation distance of six miles between a new MSWLF unit and a public-use airport.

AC 150/5200-33, Hazardous Wildlife Attractants on or near Airports. As previously discussed in Chapter 2, this AC provides guidance regarding the types of land uses considered incompatible near airports due to their nature as wildlife attractants. These uses include, but are not limited to, wastewater treatment facilities, wetlands, dredge spoil containment areas, and solid waste landfills. Typically, these uses should be located at least 5,000 feet away from an airport runway end, if the airport serves piston-type aircraft, and at least 10,000 feet away from an airport runway end, if the airport serves turbojet aircraft.

FAR Part 139.337, Wildlife Hazard Management Plan. A wildlife hazard assessment is conducted by a wildlife damage management biologist to provide the scientific basis for the development, implementation, and refinement of a Wildlife Hazard Management Plan, if needed. Part of the Wildlife Hazard Management Plan can be prepared by the biologist who conducts the wildlife hazard assessment. However, some parts can be prepared only by airport staff. For example, airport management assigns airport personnel responsibilities, commits airport funds, and purchases equipment and supplies. Airport management should request that the wildlife biologist review the finished plan prior to submitting it to the FAA for review and approval.

FAR Part 258, Subpart B, Criteria for Municipal Solid Waste Landfills, CFR Title 40. This subpart establishes criteria for the expansion and/or development of new landfills with regard to airports. In part, it states:

> Owners or operators of new Municipal Solid Waste Landfills (MSWLF) units and lateral expansions located within 10,000 feet (3,048 meters) of any airport runway end used by turbojet aircraft, or within 5,000 feet (1,524 meters) of any airport runway end used by piston-type aircraft only, must demonstrate that the units are designed and operated in such a way that the MSWLF unit does not pose a bird hazard to aircraft.

Owners or operators proposing to site new MSWLF units and lateral expansions within a five-mile radius of any airport runway end used by turbojet or piston-type aircraft must notify the affected airport and the FAA.

NEPA of 1969. The NEPA resulted from the development of guidelines for the application of a federal government national policy to consider impacts of proposed action on the environment. The act specifically states that "governments, and other public and private organizations, use all practical means and measures to create and maintain conditions under which man and nature can exist in harmony." When an airport sponsor proposes a project or action requiring federal approval, then all actions are reviewed to determine their impacts on the environment.

Order 1050.1E, Environmental Impacts. This Order's policies and procedures comply with NEPA implementation regulations. Also, the Order considers the application of the effects a proposed action and its alternatives have on human quality of life, avoids or minimizes adverse impacts on the environment, and restores and enhances environmental resources and environmental quality.

Order 5050.4B, Airport Environmental Handbook. This regulation establishes the instructions and guidance for preparing and processing an Environmental Assessment (EA), Finding-of-No-Significant-Impacts (FONSI), or an Environmental Impact Statement (EIS) for development projects requiring federal environmental approval. Categories of impacts to be evaluated are found in Chapter 5 of Order 5050.4A.

Land Acquisition

Land acquisition related laws and policies are primarily focused on the fair and equitable treatment of land owners. Uniform methods of acquisition are outlined in these documents.

AC 150/5100-17, Land Acquisition and Relocation Assistance for Airport Improvement Program Assisted Projects. This AC provides guidance to sponsors of an airport to develop land acquisition and relocation assistance procedures in conformance to the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Pl 91-646, as amended).

The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970. This act is the most comprehensive and equitable legislation on land acquisition and the associated relocation of displaced persons. Under this act, persons will not suffer disproportionate injuries as a result of programs designed for the benefit of the public as a whole. The Uniform Act provides minimum real property acquisition policies and requires uniform and equitable treatment of persons displaced as a result of a federally-assisted program or project. Property can be acquired through several methods, such as the purchase of property interests (fee) or through eminent domain (condemnation). It can also be acquired through easements or by donation or exchange.

Operational and Management Guidance

This section includes federal statutes, ACs, and CFRs relevant to operational and management guidance and provides a summarization of the primary regulations. The sources listed below are not meant to be all inclusive, but rather a general summary and overview of resources relating to operational and management guidance.

Order 5100.38, Airport Improvement Program Handbook. This order provides guidance to be used during the administration of the AIP. The handbook also references tools and techniques and summarizes information and guidance from multiple orders and ACs.

Order 5190.6, Airport Compliance Requirements. This order provides guidance relating to airport compliance. The Airport Compliance Program monitors the performance of airport owners to maintain a high degree of safety and efficiency in airport design, construction, operation, and maintenance.

Order 7400.2, Procedures for Handling Airspace Matters. This order specifies procedures in the joint administration of the airspace program. It addresses actions associated with airspace allocation and utilization, obstruction evaluation, obstruction marking and lighting, airport airspace analysis, and the management of air navigation aids.

Summary

This chapter provides information regarding federal regulations and guidance and how these individual policies relate to the importance of compatible land use near airports for both the safety of pilots and those in the vicinity of airports. FAA standards help to minimize runway incidents and protect adjacent properties, as well as attempt to minimize the presence of incompatible land uses. The success of these design standards rests with the host community and their desire to maintain a safe airport. The maintenance or development of compatible land uses near airports is supported through cooperative comprehensive planning that includes the FAA standards, and others, presented in this chapter. Land use compatibility is a requirement for eligibility to receive FAA grant money for airport improvements – making it important that local airports and communities work to establish compatible uses. Adjacent land uses that are not compatible with airports may result in the loss of federal or state funding for airports which greatly hinders the growth and development of the aviation system as a whole.

VOLUME 1, CHAPTER 5

Economic Costs of Airport Land Use Incompatibility

While arguments that incompatible land uses near an airport can affect the safety of aircraft operations and persons on the ground, it is often hard to quantify these claims in a manner translated into a common unit that people comprehend. For example, the Integrated Noise Model (INM) evaluates aircraft noise impacts and utilizes specific data inputs that result in a standard set of outputs used within the aviation and environmental industries to define noise impacts. Unfortunately, no national model exists that generates an "airport land use compatibility contour" based upon a standard set of inputs and results in an output that meets the needs of every airport. This results in the need to define both the impacts of incompatible land uses and their associated costs in a manner that utilizes a number of relevant parameters. This chapter will address the different methods and tools available to address the costs of incompatible land use.

It is important to note that different analytical tools to assess the economic costs of incompatible land uses near airports are available depending upon the context and objective of the analysis. To assess the economic costs arising from the presence of incompatible land uses around airports, the main tool is *economic valuation.* By itself, economic valuation of the costs of incompatible land uses is useful for increasing awareness of these costs and gaining support for efforts to promote airport-compatible land use planning. It is also useful in setting appropriate values for taxes and fees to charge airport users to compensate for negative externalities. Finally, to aid in decision making, the benefits of reducing or avoiding the costs of incompatible land uses must be weighed against the costs of proposed public investments and regulatory interventions to mitigate aviation's environmental effects, prevent the development of incompatible land uses around airports, and promote compatible land use development. All of this can be done within the framework of benefit-cost analysis. Two other methods – economic impact analysis and fiscal impact analysis—are also useful to the assessment of certain considerations related to compatible land use planning. These two methods serve purposes different from those of economic valuation and benefit-cost analysis. Economic impact analysis can be used to assess the regional economic impacts of airport operations, and fiscal impact analysis can be used to assess the net fiscal impacts of developments around airports and for comparing the net fiscal impacts of different types of development, residential and nonresidential. Regional economic impacts and fiscal impacts are not typically considered in economic valuation and benefit-cost analysis because they consist largely of transfers—they do not result in net gain or loss in economic value to society. Yet, these impacts are of utmost concern to the local government officials and planners who make local land use planning decisions.

Economic Valuation

Economic valuation is one of many ways of defining and measuring value. Economic values are useful to consider when making economic choices – choices that involve tradeoffs in allocating resources (King and Mazzotta 2000). In economics, the term *value* has a specific meaning, defined in terms of what people want (preferences) and the choices they make. The economic value of a particular good, service, or state of the world is measured by the maximum amount of the other things that a person is willing to give up for it. Money is a convenient measure because the amount of money that a person is willing to pay for something indicates how much of all other things a person is willing to give up for it – known as willingness-to-pay (WTP) (King and Mazzotta 2000, and Lipton and Wellman 1995). A concept related to WTP is an individual's *willingness-to-accept* (WTA) compensation for not receiving an improvement. WTA also can provide a valid measure of opportunity cost and produce a measure comparable to WTP under special circumstances described by the Office of Management and Budget (OMB) (2003). Economic valuation can be used for three different purposes including:

- Contributing to public debate and awareness of a particular problem, for example, airport incompatible land use and its associated consequences. People can more readily grasp the extent of the problem when expressed in monetary terms (Moons 2003).
- Aiding in decision making by using economic valuation in benefit-cost analysis of policy and investment decisions (for example, a benefit-cost analysis of a policy decision to enforce compatible land use zoning). Economists are interested in measuring how much better off people would be if a specific policy or investment were implemented (Moons 2003, Lipton and Wellman 1995, POST 2003b).
- Helping set values for economic instruments to deal with environmental externalities (for example, aviation fuel taxes, noise-related landing charges, and tradable permits on emissions) (POST 2003b).

Economic Valuation Methods

Economic valuation methods have been developed in the field of environmental economics. Detailed descriptions of these methods, illustrations of their applications, specification of data requirements, and discussions of advantages and disadvantages are provided in Lipton and Wellman (1995), King and Mazzotta (2000), and OMB (2003).

A range of methods can be used to measure economic value. When goods and services are traded in the market, observable price and quantity data (*revealed preferences*) are used. When goods and services are not traded in the market, values can sometimes be inferred from observable prices for related goods or services. In cases where values cannot be inferred from market transactions, economists have devised measurement techniques based on *stated-preference* surveys – by asking people what they would be willing to pay for a particular benefit (WTP) or how much compensation they would be willing to accept to bear a particular cost (WTA) (Lipton and Wellman, 1995; HM Treasury, 2007).

The presence of incompatible land uses gives rise to certain financial costs. Examples include: additional aircraft operating and maintenance costs incurred by airlines due to flight delays; increased airport development costs due to the need for more extensive environmental reviews, more expensive environmental mitigation programs, litigation costs, among others; replacement and repair of damaged aircraft in the case of accidents; and accident investigation costs. For these types of costs, economic values can be based on revealed-preference data from actual market transactions.

Airport land use incompatibility also gives rise to certain nonmonetary costs that may include an increase in passenger travel time due to flight delays, injuries and fatalities due to aviation accidents, annoyance and adverse health effects from aircraft noise, and adverse health effects and environmental damage from local air pollution. For these types of costs, no direct market transactions can be observed. Economic values can be derived using revealed preferences from related market transactions – for example, home sales, wages and salaries, job choices, and travel choices – and using stated preference surveys.

A popular revealed preference method used in valuing environmental effects is *hedonic pricing*. The hedonic pricing method is used to estimate economic values for certain attributes of a particular commodity or service that directly affect market prices. This method is most commonly applied to variations in housing prices that reflect the value of local environmental attributes. It can be used to estimate the economic costs of aircraft noise from airport sources.

Ideally, one should conduct an original economic valuation study using data specific to a particular airport. However, faced with limited time and money, estimates of economic values from completed studies in similar context can be used. This approach is called the *benefit transfer* method.

Limitations of Economic Valuation

Economic valuation has a number of limitations: Firstly, economic valuation is subject to a number of uncertainties especially when applied to the environment. Secondly, there are ethical issues to consider, and policies maximizing economic efficiency do not necessarily lead to a fair outcome. Finally, certain things just cannot be measured in terms of money, and the application of economic valuation in these cases is limited.

Relevant Economic Values for Evaluating the Costs of Airport Land Use Incompatibility

The FAA published a guide titled *Economic Values for FAA Investment and Regulatory Decisions* that was most recently updated in December 2004 by GRA, Incorporated. This document recommends standardized methods and economic values to be used in evaluating airport investment and regulatory decisions. This guide presents economic values for many of the costs arising from the presence of incompatible land uses:

- Value of time - to be used in valuing the cost to passengers of travel delays resulting from constraints to airport operations and capacity development;
- Aircraft operating and ownership cost - to be used in valuing the costs to airlines of aircraft delays;
- Value of statistical life - to be used in valuing the cost of fatalities and personal injuries from aviation accidents, as certain incompatible land uses increase the risk of aviation accidents or expose communities to risk of aviation accidents;
- Aircraft replacement and restoration costs - to be used in valuing damaged aircraft from aviation accidents; and
- Aviation accident investigation costs - for valuing costs to the federal government and the private sector of the increased risk of aviation accidents.

The FAA guide does not present standard economic values for quantifying the cost to people living near the airports of exposure to noise, but the literature provides extensive references with respect to the valuation of noise effects.

Valuation of the Cost of Travel Delays

Delays impose costs on passengers in terms of increased travel time and on aircraft operators in terms of increased operating costs. To assess these costs, the following data are needed: a measure of the difference in delay or travel time per aircraft operation with and without the constraint,

Table 1.5-1. Recommended hourly values of travel time. (In 2000 U.S. dollars per person)

Category	Recommended Value	Sensitivity Range	
		Low	High
Air Carrier:			
Personal	$23.30	$20.00	$30.00
Business	$40.10	$32.10	$48.10
All Purposes	$28.60	$23.80	$35.60
General Aviation:			
Personal	$31.50	NR	NR
Business	$45.00	NR	NR
All Purposes	$37.20	NR	NR

NR - No recommendation.
Sources:
GRA, Incorporated, *Economic Values for FAA Investment and Regulatory* Decisions, *A Guide*, Draft Final Report Prepared for FAA Office of Aviation Policy and Plans, December 31, 2004.
FAA Office of Aviation Policy and Plans, "Treatment of Values of Travel Time in Economic Analysis," *APO Bulletin APO-03-01*, March 2003.U.S. Department of Transportation, "Revised Departmental Guidance--Valuation of Travel Time in Economic Analysis," *Office of the Secretary of Transportation Memorandum*, February 11, 2003.

the number of affected aircraft operations, the number of passengers per aircraft operation or total affected passengers, economic values for travel time, and unit aircraft operating costs.

Measures of changes in delay or travel time per aircraft operation are derived using appropriate analytical models or simulation models that vary in degree of technical sophistication and computational requirements. The FAA Airport Benefit-Cost Analysis Guidance, published by the FAA Office of Aviation Policy and Plans in 1999, provides a summary of airfield and capacity simulation models used to estimate aircraft operational delay including: the FAA Airport and Airspace Simulation Model (SIMMOD), the Airfield Delay Simulation Model (ADSIM), and the Runway Delay Simulation Model (RDSIM) (FAA 1999).

Value of Travel Time

The recommended values for travel time, depending upon the type of air carrier used and the purpose of the trip, is shown in Table 1.5-1. These values were derived from passenger survey data and represent fractions of the average hourly wage. Business travel time is valued at 100% of average hourly income, and personal travel time is valued at 70% of average hourly income.

Aircraft Operating Costs

Flight delays are costly, not only to passengers, but to airlines as well. Every additional minute spent in flight, taxiing or idle on the ground, causes airlines to incur additional operating costs. Table 1.5-2 presents the average operating costs for air carrier, general aviation, and military aircraft. The FAA guidance (GRA Incorporated, 2004) must be consulted for detailed estimates of operating costs by equipment type.

Table 1.5-2. Aircraft operating costs per block hour.

Air Carrier Category	Crew	Fuel & Oil	Total Maintenance	Subtotal Variable Costs	Rentals	Depreciation	Insurance	Subtotal Fixed Costs	Total Costs
Large (Form 41) Passenger Part 121 Air Carrier	$737	$722	$641	$2,100	$377	$246	$17	$640	$2,741
Large (Form 41) Air Freight Carrier	$1,417	$1,443	$1,479	$4,339	$835	$680	$69	$1,583	$5,922
Regional (Form 41) Passenger Air Carrier	$426	$1,015	$901	$2,342	$876	$1,008	$1,884	$3,218	$4,226
Regional (Form 41) Air Freight Carrier	$514	$1,177	$326	$2,017	$1,219	$702	$1,921	$3,235	$3,938
Alaskan (Form 298) Passenger Air Carrier[1]	$104	$102	$153	$359	-	$76	$32	$108	$467
Non-Alaskan (Form 298) Passenger Air Carrier[1]	$169	$214	$238	$622	-	$225	$31	$256	$878

[1] For these air carrier categories, the figures under depreciation include rental, and the figures under insurance include other fixed expenses.

Source: BTS Form 41 for year-end 2002. Also Schedule P5.2. Compiled in GRA, Incorporated, Economic Values for FAA Investment and Regulatory Decisions, A Guide, Draft Final Report Prepared for FAA Office of Aviation Policy and Plans, December 31, 2004.

Valuation of Aviation Accident Risks. Safety is another important motivation for promoting compatible land use planning. The presence of certain land uses that create physical and visual obstructions increases the risk of aviation accidents. In addition, the presence of land uses with many people near runway approaches exposes these people to harm from potential aviation accidents. Aviation accidents are costly to society. They can result in fatalities, injuries, property damage, and significant resources spent on accident investigation. A major responsibility of the FAA and airport sponsors is to reduce the incidence of such outcomes (FAA 1998).

To assess the costs of increased accident risk from the presence of safety hazards, a determination must be made to identify the extent by which the incidence of preventable accidents is increased (or reduced in the case of regulations or investments to promote safety). In addition, costs of increased accident risk must be assessed to determine the rate of fatality, injury, and property damage per accident; and quantify the associated costs (or benefits) in dollars. To assess the costs of incompatible land uses that expose communities to aviation accidents, the analyst needs to delineate the areas exposed to this risk, determine the extent of risk exposure within these areas, estimate the number of people in these areas, and quantify the costs of third-party fatalities, injuries, and property damage in dollars.

FAA's revised guide to *Economic Analysis of Investment and Regulatory Decisions* (FAA 1998) describes a standard approach for measuring accidents per unit of exposure—for example, accidents per number of aircraft operations—and methodologies for estimating changes to this rate of accident exposure. The alternative methodologies include the construction of models that compute the number of accidents that can be expected to occur per unit of exposure with and without a particular variable (for example, a safety obstruction, or a particular measure to increase safety), and judgmental accident evaluation. FAA also describes ways of estimating accident risks when there are no historical data, like analytical deduction, analogies, and statistical estimation when limited and incomplete data exist.

Value of Statistical Life

The standard economic values prescribed for assessing the costs of fatalities and injuries are based on the *value of statistical life* (VSL) – the monetary value that individuals are willing to accept in exchange for a small change in the probability of a fatality (Ashenfelter 2006). Past estimates of VSL were based on an individual's discounted lifetime earnings. Recent estimates are based on WTP derived using three principal methods: (1) wage-risk tradeoffs, (2) revealed-preference studies, and (3) stated-preference surveys. Recent reviews of empirical research have produced the following estimates of VSL, adjusted to 2007 prices: Mrozek and Taylor (2002), $2.6 million; Miller (2000), $5.2 million; Viscusi (2004), $6.1 million; Kochi et al (2006), $6.6 million; and Viscusi and Aldy (2003), $8.5 million. DOT (2008) recommends using the mean of these five values, $5.8 million, for transportation regulatory and investment analysis, and alternative values of $3.2 million and $8.4 million for sensitivity analysis. The cost of nonfatal injuries, or the value of averted nonfatal injuries, can be assessed as a proportion of VSL depending on the severity and duration of injury, as shown in Table 1.5-3.

Other Injury Costs

Table 1.5-4 shows the values recommended by the FAA for other costs, such as the costs of emergency services, medical care, and legal and court services (the cost of carrying out court proceedings, not the cost of settlement). When available aviation injury data are not detailed enough, the FAA recommends values by the International Civil Aviation Organization (ICAO) injury classification of minor and serious, as shown in Table 1.5-5.

Table 1.5-3. Relative disutility factors by injury severity level.

AIS Level	Injury Severity	Selected Injuries	Fraction of VSL
1	Minor	Superficial abrasion or laceration of skin; digit sprain; first-degree burn; head trauma with headache or dizziness (no other neurological signs).	0.0020
2	Moderate	Major abrasion or laceration of skin; cerebral concussion (unconscious less than 15 minutes); finger or toe crush/amputation; closed pelvic fracture with or without dislocation.	0.1550
3	Serious	Major nerve laceration; multiple rib fracture (but without flail chest); abdominal organ contusion; hand, foot, or arm crush/amputation.	0.0575
4	Severe	Spleen rupture; leg crush; chest-wall perforation; cerebral concussion with other neurological signs (unconscious less than 24 hours).	0.1875
5	Critical	Spinal cord injury (with cord transection); extensive second- or third-degree burns; cerebral concussion with severe neurological signs (unconscious more than 24 hours).	0.7625
6	Fatal	Injuries, which although not fatal within the first 30 days after an accident, ultimately result in death.	1.0000

AIS - Abbreviated Injury Scale
VSL - Value of statistical life
Sources:
U.S. DOT, "Revised Departmental Guidance: Treatment of the Value of Preventing Fatalities and Injuries in Preparing Economic Analyses, February 5, 2008.
GRA, Incorporated, Economic Values for FAA Investment and Regulatory Decisions, A Guide, Draft Final Report Prepared for FAA Office of Aviation Policy and Plans, December 31, 2004.

Table 1.5-4. Per victim medical and legal costs associated with injuries (2001 dollars).

AIS Code	Description of Maximum Injury	Emergency/ Medical	Legal/Court	Total Direct Costs
AIS 1	Minor	$600	$1,900	$2,500
AIS 2	Moderate	$4,000	$3,100	$7,100
AIS 3	Serious	$16,500	$4,700	$21,200
AIS 4	Severe	$72,500	$39,100	$111,600
AIS 5	Critical	$219,900	$80,100	$300,000
AIS 6	Fatal	$52,600	$80,100	$132,700

Sources: Economic Values for Evaluation of Federal Aviation Administration Investment and Regulatory Programs, FAA-APO-89-10, October 1989, Section 3, as adjusted for price level changes. Presented in GRA, Incorporated, Economic Values for FAA Investment and Regulatory Decisions, A Guide, Draft Final Report Prepared for FAA Office of Aviation Policy and Plans, December 31, 2004.

Table 1.5-5. Average per victim injury values for serious and minor injuries (2001 dollars).

ICAO Code	WTP Values	Emergency/ Medical	Legal/ Court	Total Value
Minor (ICAO 2)	$37,900	$2,300	$2,700	$42,900
Serious (ICAO 3)	$536,000	$31,300	$13,400	$580,700

Source: GRA, Incorporated, Economic Values for FAA Investment and Regulatory Decisions, A Guide, Draft Final Report Prepared for FAA Office of Aviation Policy and Plans, December 31, 2004.

Table 1.5-6. Aircraft replacement and restoration values (amounts in 2003 dollars).

Air Carrier Category	Aircraft in Fleet	Avg. Replacement Value		Avg. Monthly Lease Rate	Restoration Costs as % of Replacement
		Base Value	Market Value		
Air carrier					
Passenger	8,666	$13,481,560	$11,460,743	$140,811	13%
Cargo	1,065	$13,138,732	$10,641,925	$153,671	15%
General aviation					
Pre-1982	160,592		$94,661		26%
1982 and beyond	50,651		$1,817,062		15%
All years	211,244		$361,943		20%
Military	15,974		$24,400,000		3%

Source: Aviation Specialists Group (data includes all U.S. registered aircraft); compiled in GRA, Incorporated, Economic Values for FAA Investment and Regulatory Decisions, A Guide, Draft Final Report Prepared for FAA Office of Aviation Policy and Plans, December 31, 2004.

Aircraft Replacement and Restoration Costs

Aviation accidents also result in damage to aircraft. Table 1.5-6 presents a summary of replacement values for destroyed aircraft and restoration values for damaged aircraft. Detailed values by equipment are presented in GRA, Incorporated (2004) and on the FAA Office of Aviation Policy and Plans (APO) website. For air carrier aircraft replacement value, there are two alternatives: base and market value. The base value refers to the aircraft value in an orderly market without excess supply or excess demand, which reflects the long-run relationship between current value, age, and original price. The restoration cost of aircraft with minor damage is negligible as a proportion of the market value, so restoration cost values are presented only for aircraft with substantial damage.

Accident Investigation Costs

In addition to fatality, injury, and property damage costs, the NTSB, the FAA, and the private sector expend a significant amount of resources in accident investigation – resources that could otherwise be put to other productive uses. Table 1.5-7 presents values for accident investigation cost by type of investigation and user type. The two types of investigations are major investigations directed by NTSB headquarters and field office investigations conducted by NTSB field offices. Major investigations are conducted for major air carrier accidents involving numerous

Table 1.5-7. Aviation accident investigation cost (amounts in 2002 dollars).

Category	Cost per Accident					Number of Accidents 1991-2002
	Federal			Private	Total	
	NTSB	FAA	Subtotal			
By type of investigation:						
Major	$1,931,800	$681,700	$2,613,500	$5,933,400	$8,546,900	59
Field Office:						
Regular	$38,300	$25,700	$64,000	$57,400	$121,400	6,016
Limited	$300	$13,800	$14,100	0	14,100	18,648
Weighted Average by User Type:						
Air Carrier (including Air Taxi)	$110,300	$57,800	$168,100	$280,900	$449,000	1,551
General Aviation	$7,700	$16,200	$23,900	$11,200	$35,100	23,172

Source: National Transportation Safety Board, Federal Aviation Administration, Aviation Rulemaking Cost Committee, and GRA, Incorporated. See GRA, Incorporated, Economic Values for FAA Investment and Regulatory Decisions, A Guide, Draft Final Report Prepared for FAA Office of Aviation Policy and Plans, December 31, 2004.

fatalities and substantial property damage. Field office investigations are classified into regular or limited. Regular investigations are conducted for air carrier accidents involving limited loss of life and for most fatal general aviation accidents. Limited investigations are conducted for other general aviation accidents.

Valuation of Noise. Land uses with concentrations of people such as residences, schools, and hospitals near airports increase the number of people exposed to aviation noise. Noise is an example of a negative externality and is an uncompensated external cost (Nelson 2008). External costs are by-products of economic activities that affect third parties or people not directly involved in the market transactions. Because the costs are generally not borne by those who caused them, they are often not reflected in market prices and hence not taken into account when making decisions on how much to produce or use of a particular good or service.

The costs of noise and the benefits of reducing the exposure of people to noise must be addressed in economic analysis. For example, the European Commission's "Green Paper on Future Noise Policy" (EC 1996) and Directive 2002/49/EC on noise assessments (EC 2002) called attention to the need to value noise effects as part of benefit-cost analyses of specific noise mitigation and abatement measures (Nelson, 2008). Economic valuation of noise is also important in determining the full costs of aviation and in designing economic instruments to make aviation users pay for the costs of noise (Nelson 2008). Over the last decade, transportation policy and research in Europe has been geared toward developing economic instruments to promote the internalization of transportation's external costs—making "polluters" pay (Pearce and Pearce 2000; United Kingdom (UK) Department for Transport 2003; Dings, et al 2003; van Essen, et al 2007).

The valuation of noise effects, however, is difficult because there are no clearly defined property rights to peace and quiet, and hence no market where people can buy and sell these rights. Deriving empirical estimates is difficult because it requires numerous assumptions and compromises (FAA 1998). Existing FAA guidance addresses the measurement of noise effects, but not monetary valuation. The *BCA On-line Guide* maintained by the California Department of Transportation (Caltrans) also acknowledges the difficulty of assigning dollar value to noise impacts. It states that, for a benefit cost analysis (BCA), it is sufficient to estimate how much noise there will be when a transportation project is complete, choose appropriate abatement methods, if necessary, and include the cost of abatement in the cost of the project. For very large projects that drastically increase or reduce noise, Caltrans suggests the use of hedonic pricing (HP)and contingent valuation methods – the two most commonly used methods (Lambert, et al 1998).

HP is a revealed preference (RP) method that derives the value of noise impacts also called *noise discount* or *noise depreciation index* (NDI), from differences in housing prices. Assuming two similar properties, the one exposed to higher noise levels will tend to be cheaper. The observed differences in prices paid for homes exposed to different levels of noise, after controlling for differences in other housing characteristics, can be used to calculate a noise discount. This noise discount, usually expressed as percentage reduction in the market value of a residential property per one-decibel (dB) increase in noise exposure, is expected to fall with increasing distance from the airport as exposure to aircraft noise diminishes. Regression analysis of real estate transactions is used to unbundle housing prices and calculate a hedonic price for the avoidance of noise (Nelson, 2008).

Contingent valuation (CV) falls under the category of stated preference (SP) methods. People are asked in a survey to state how much they are willing to pay, for example, in terms of additional rent or mortgage, local taxes, or payments to local businesses to reduce their noise exposure by a given amount (EC 2003), or how much they are willing to accept for increased noise exposure (Dings, et al 2003). The survey must be designed and implemented very carefully to avoid biases in the responses.

While countries in Europe have adopted representative values for use in economic analysis (EC 2003, UK Department for Transport 2003, Dings et al, 2003, van Essen et al 2007), there is yet no standard value recommended in the United States for aircraft noise. Over the past 40 years, however, empirical research has produced a variety of estimates for specific airport environs. Earlier literature reviews reported mean NDI values of 0.50% to 0.70% per dB (Nelson 1980, 2004). Studies that are more recent, reviewed in Nelson (2008), yield 24 estimates with an unweighted mean value of 0.92%, an interquartile mean value of 0.80%, and a median value of 0.74% per dB. Recent estimates are slightly higher than earlier ones, possibly reflecting rising real incomes and differences in econometric techniques. Nelson (2008) concludes that the unit NDI values are reasonably stable over time, which bodes well for benefit transfers. Table 1.5-8 presents NDI estimates from studies done in the United States.

Table 1.5-8. Noise deprecation index: Estimates from studies in the United States

Reference Study	Method	Airport &/or Area	Study Period	NDI %
Nicosia (2003)	HP	Addison, TX	2002	0.80 for apartments
Cohen & Coughlin (2008)	HP	Atlanta, GA	2000-2002	0.89-1.59 in 65 dB zone; 1.34-2.65 in 75 dB zone
O'Byrne et al (1985)	HP	Atlanta, GA (blocks)	1970	0.64
O'Byrne et al (1985)	HP	Atlanta, GA (houses)	1979-80	0.67
BAH-FAA (1994)	HP	Baltimore, MD	1990	1.07
Price (1974)	HP	Boston, MA (rentals)	1970	0.81
Nelson (1979)	HP	Buffalo, NY	1970	0.52
McMillen (2004a, 2004b)	HP	Chicago O'Hare	1996-2001	0.74 in the 65 dB zone; 0.91 in the 75 dB zone
Nelson (1979, 1980)	HP	Cleveland, OH	1970	0.29
Blaylock (1977)	HP	Dallas, TX	1970	0.99
De Vany (1976); NAS (1977)	HP	Dallas Love Field, TX	1970	0.58-0.8
Feitelson, et al (1996)	CV	Dallas-Fort Worth	1996	1.5 for houses; 0.9 for apartments
BAH-FAA (1994)	HP	John F. Kennedy, New York, NY	1993	1.2
BAH-FAA (1994)	HP	La Guardia, New York, NY	1993	0.67
BAH-FAA (1994)	HP	Los Angeles, CA	1991	1.26
Emerson (1969, 1972)	HP	Minneapolis, MN	1967	0.58
Fromme (1978)	HP	National, Washington, DC	1970	1.49
Nelson (1978)	HP	National, Washington, DC	1970	1.06
Nelson (1979, 1980)	HP	New Orleans, LA	1970	0.4
Pope (2007)	HP	Raleigh-Durham, NC	1992 and 2000	0.19 in the 55-65 dB zone before noise disclosure; 0.25 in the 65-70 dB zone before noise disclosure; 0.39 in the 65-70 dB zone after noise disclosure
Kaufman (1996); Espey & Lopez (2000)	HP	Reno, NV	1991-1995	0.28-0.43
Myles (1997)	HP	Reno, NV	1991	0.37
Maser et al (1977); Quinlan (1970)	HP	Rochester, NY (suburban)	1971	0.55-0.68
Maser et al (1977); Quinlan (1970)	HP	Rochester, NY (urban)	1971	0.82-0.95
Nelson (1979, 1980)	HP	San Diego, CA	1970	0.74
Nelson (1979, 1980)	HP	San Francisco, CA	1970	0.58
Dygert (1973)	HP	San Francisco, San Mateo, CA	1970	0.5
Dygert (1973)	HP	San Jose, CA	1970	0.7
Nelson (1979, 1980, 1981)	HP	Six airports	1970	0.55
Mark (1980)	HP	St. Louis, MO	1969-1970	0.56
Nelson (1979, 1980)	HP	St. Louis. MO	1970	0.51

Sources: Individual studies, and literature reviews in Nelson (2004, 2008), McMillen (2004a); Jacobs Consultancy and Nelson (2008).

Assessment of Regional Economic Impacts and Fiscal Impacts. Regional economic impacts and fiscal impacts are typically not considered in economic analysis, as will be explained later, because they represent *transfers.* The assessment of regional and fiscal impacts, however, is important, especially to local government agencies in understanding the implications to them of airport land use compatibility issues. As discussed above, local and regional jurisdictions also stand to lose from the constraints imposed by incompatible land uses on airport development because airports are important drivers of the local economy. Different land uses also have different fiscal impacts in terms of their contributions to local governments' tax revenue and expenses. For example, residential development may contribute positively to the local tax base, but the costs of related infrastructure and services may outweigh the additional tax revenues. The assessment of regional economic impact and fiscal impacts can be addressed by economic impact analysis and fiscal impact analysis.

Benefit–Cost Analysis

An important application of economic valuation is in the benefit-cost analysis of regulatory policies and public investment. In the context of this research on airport land use, compatibility examples include:

- Noise mitigation and abatement measures including curfews, quieter aircraft, preferential runway use, modification of flight paths, restriction of certain aircraft
- Airport expansion, taking into account the full costs including environmental effects
- Regulations, policies, and measures to promote compatible land use planning, taking into account the full benefits of removing restrictions on aviation system capacity and development, as well as reducing or avoiding the exposure of third parties to adverse environmental effects.

BCA helps decision makers to anticipate and evaluate the likely consequences of rules, policies, and public investment projects. It provides a formal way of organizing the evidence on the key effects – good and bad – of various alternatives. The motivation is to learn if the benefits of an action are likely to justify the costs, or if determination of various possible alternatives would be the most cost-effective. To promote efficient policy development and use of resources, the analysis needs to take into account the wider social costs and benefits of proposed measures or investments. To the extent possible, benefits and costs must be quantified and expressed in monetary units. Where this is not possible, the analysis can include an assessment of certain costs and benefits in physical units or in qualitative terms.

Official Guidance

The following laws, regulations, and guidance provide the official direction on the requirements and recommended methodologies for the benefit-cost analysis of public investment projects and regulatory actions:

- Executive Order (EO) 12866, "Regulatory Planning and Review," September 30, 1993.
- Executive Order 12893, "Principles of Federal Infrastructure Investment," January 26, 1994.
- Airport Noise and Capacity Act of 1990 (ANCA) [49 U.S.C. App. 2158].
- Office of Management and Budget Circular No. A-4, "Regulatory Analysis," September 17, 2003.
- Office of Management and Budget Circular No. A-94 Revised, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs," October 29, 1992.
- Economic Analysis of Investment and Regulatory Decisions – Revised Guide, FAA-APO-98-4, January 1998.

- Federal Aviation Administration Policy and Final Guidance Regarding Benefit Cost Analysis on Airport Capacity Projects for FAA Decisions on Airport Improvement Program (AIP) Discretionary Grants and Letters of Intent (LOI), December 15, 1999.
- FAA Airport Benefit-Cost Analysis Guidance, December 15, 1999.

The BCA Process

The BCA process consists of the following steps:

1. Define the objective of the proposed investment, policy, or regulation.
2. Specify the assumptions about future airport and local market conditions.
3. Identify the base case. The base case serves as the reference for assessing the incremental benefits and costs of alternatives.
4. Identify reasonable alternatives for meeting the stated objective.
5. Determine the evaluation period. The evaluation period must be long enough (for example, 20 years) to encompass the important benefits and costs of the proposed action.
6. Estimate benefits and costs. For each alternative, identify the associated incremental benefits and costs over the entire evaluation period, measure them in physical units, and, to the extent feasible, express them in monetary terms.
7. Compare benefits and costs. Benefits and costs must be discounted using the appropriate discount rate, and compared using the following criteria: (1) net present value (NPV), which must be positive; and (2) benefit-cost ratio (BCR), which must be at least one.
8. Perform sensitivity analysis. The impact of uncertainties must be evaluated using techniques such as sensitivity analysis, Monte Carlo simulation, and decision analysis.
9. Make recommendations. Recommend (1) whether to pursue the objective, and/or (2) which alternative should be undertaken to meet the objective. The recommendation will depend on the comparison of benefits and costs, sensitivity analysis of results to changes in assumptions, and consideration of non-monetized or hard-to-quantify benefits and costs.

According to Office of Management and Budget (OMB) Circular A-94 Revised, when evaluating government programs and policies, BCA of federal programs and projects that affect private citizens and other levels of government must consider benefits and costs to *society,* not to the federal government. According to the FAA BCA Guidance, the analysis of airport capacity projects should consider all benefits and costs affecting the *aviation public* or directly attributable to aviation. This is because airport investments are funded in whole or in part using AIP funds from the Airport and Airway Trust Fund, which historically has received its revenue from taxes imposed on the aviation system users.

Basic Principles and Other Considerations

Following are some basic principles and considerations in BCA:

- *Economic analysis versus financial analysis.* Economic analysis is not financial analysis. Economic analysis considers social costs and benefits, while financial analysis considers only the cash benefits and costs accruing to the entity making the investment or implementing a particular measure.
- *Willingness to pay.* The starting point for measuring costs or benefits is the concept of WTP. WTP measures how much individuals or firms are willing to pay to avoid a particular cost or enjoy a particular benefit.
- *Life-cycle costs and benefits.* A given project or regulation will generate costs and benefits over a number of years over its service life cycle in the case of an infrastructure or equipment. Life-cycle costs and benefits must be considered.

- *Treatment of inflation.* Inflation occurs when the prices of goods and services in the economy are rising over time. Because inflation is very hard to predict, it is best practice to forecast life-cycle costs and benefits without inflation – that is, expressed in constant base-year dollars.
- *Time value of resources.* Benefits and costs have greater value if they occur sooner than later. The time value of resources is measured by the discount rate, which is equal to the economic return that could be earned if the resources were invested in their next best alternative use. OMB Circular No. A-94 recommends a 7% real discount rate for federal investment and regulatory analysis.
- *Difference between real costs (benefits) and transfer payments.* Benefit and cost estimates should reflect real resource use, and exclude transfer payments. There are no economic gains (or losses) from a pure transfer payment because the benefits to those who receive it are offset by the costs borne by those who pay it (OMB 1992, 2003). Tolls, other user charges, taxes, subsidies, and insurance payments are examples of transfer payments and should not be included in the BCA of public investment and regulation (DOT Economic Analysis Primer).
- *Treatment of regional economic benefits.* According to OMB Circular A-94, resources should be treated as if they were likely to be fully employed. Therefore, regional economic benefits should not be included in BCA, because they are either transfers from another location or another representation of transportation benefits (Small and Verhoef 2007, Lee 2000, FAA 1999, OMB 1992).
- *Treatment of hard-to-quantify benefits and costs.* There may be certain intangible benefits and costs that are just too difficult to measure in dollars. They should be identified and expressed in physical units if possible, or described qualitatively.
- *Treatment of distributional impacts.* From a societal perspective, welfare improves as long as approved projects and regulations have benefits greater than costs. However, those who benefit are not always those who bear the costs. BCA should identify the gainers and losers, and significant distributional effects must be disclosed (OMB 1992, FAA 1998).

Economic Impact Analysis

Economic impact analysis should not be confused with BCA. Economic impact analysis is a methodology for determining how a change in regulation, policy, or industry affects regional income and other economic activities including revenues, expenditures, and employment. It provides measures of economic activity, not measures of economic or social value (Lipton and Wellman 1995). Airport sponsors conduct economic impact studies to educate the public about the significant economic contributions of airport operations. Economic impact studies can be used as public information tools to gain community and local government support for airport development and compatible land use planning. Economic impact analysis estimates the local economic activity generated by airport operations in terms of employment, earnings, and output. Total economic impact includes direct, indirect, and induced effects from the provision and use of aviation services.

Economic Impact Analysis – Modeling Options

DiPasquale and Polenske (1980), Pleeter (1980), and Richardson (1972) identify three basic categories of models used to derive regional multipliers for estimating total economic impact:

- *Economic base models.* Economic base models divide local industries between export and service, and consider regional trade as the primary driver of growth.
- *Econometric models.* Econometric models involve estimating multiple-equation systems that attempt to describe the structure of a local economy and forecast aggregate variables such as income, employment, and output. Econometric models calibrated for specific counties,

or aggregation of counties, are commercially available from Regional Economic Models, Inc. (REMI).

- *Input-output models.* Input-output (I-O) models are based on an accounting framework called an I-O table, which shows the distribution of inputs purchased and outputs sold for each industry. They are widely used because they provide details on how the impact of one sector spreads throughout other sectors in the economy. The FAA guidance on airport economic impact studies (FAA 1992) recommends the use of input-output multipliers from the Regional Input-Output Modeling System (RIMS II) maintained by the U.S. Bureau of Economic Analysis (BEA). Input-output multipliers from MIG, Inc. (IMPLAN) are also widely used.

Components and Sources of Airport Economic Impact

Total economic impact consists of the direct impact of an initial demand spending and the multiplier effects on the local economy as illustrated in Figure 1.5-1. Multiplier effects arise when businesses buy inputs from each other (indirect impact) and when their workers spend their income on various purchases (induced impact). Airports generate economic impact from the following sources:

- *Aviation provision.* This refers to the economic activity of business and government entities engaged in providing aviation and aviation-support services at an airport.
- *Aviation use.* This refers to the economic activity of off-airport businesses that provide goods and services to users of aviation services. Visiting airport passengers spend money on lodging, food, retail purchases, ground transportation, and recreation, supporting various off-airport businesses within the region.

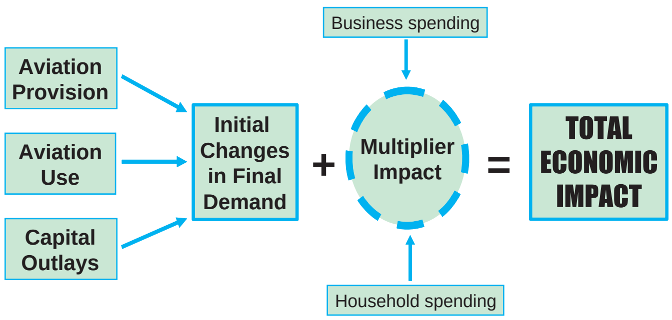


Figure 1.5-1. Components and sources of airport economic impact.

Measures of Economic Impact

The three most widely used measures of economic impact are employment, earnings, and output. Employment refers to the number of jobs generated by an economic activity. Earnings refer to employee compensation, measured by payroll costs on employees whose jobs depend directly and indirectly on the presence of the airport. Output is the broadest measure of economic impact. Typically measured by sales or business revenue, output refers to the value of goods and services produced by an economic activity. Airport economic impact studies also often present an assessment of the state and local tax revenue associated with the economic activity generated by airport operations.

Fiscal Impact Analysis

Local governments are often interested in how a particular development or land use change would affect the local budget. Fiscal impact analysis is a planning tool for estimating the impact of a development or land use change on the costs and revenues of governmental units serving the development. It is particularly relevant in assessing and comparing the net fiscal impact of residential and nonresidential development in airport-compatible land use planning. Fiscal impact analysis helps local governments:

- Estimate the difference between the costs of providing services to a particular development and the tax revenues that will be generated by the development.
- Compare the net fiscal impacts of alternative land uses: for example, residential and commercial/industrial developments.

The following discussion is based on the description of fiscal impact analysis in Edwards' Community Guide to Development Impact Analysis (Edwards, 2000).

Approaches to Fiscal Impact Analysis

There are a number of standard approaches to fiscal impact analysis, ranging from a per-capita multiplier method to a case study method, which relies on local interviews. A key consideration in selecting the appropriate method is the approach to assessing the cost of services that development imposes on a local government. There are two cost assessment approaches:

1. *Average costing* is the simpler more common procedure. It attributes costs to new development based on the average cost per unit of service in existing development times the number of units in the new development. It does not take into account excess or deficient capacity to deliver services, and it assumes that the average cost of municipal services will remain stable in the future.
2. *Marginal costing* relies on the analysis of supply and demand for public services. It recognizes excess or deficient capacity existing in communities, and views growth as a cyclical process – as opposed to linear – in terms of the impact on local expenditures.

Fiscal Impact Estimation Process

This section illustrates the fiscal impact estimation process for a mixed-use development using a combination of per-capita and case study approach. In comparing alternative land use developments, the same process can be followed to estimate the fiscal impact of only one type of development – residential development only or non-residential development only. The following data are needed:

- Description of development: for example, number and type of homes in residential development; square footage of non-residential space.
- Local revenue and expenditure data.
- Local property value data and current mill rate.
- Number of workers in the community.
- Number of workers anticipated with the new development.

The process can be described in nine steps:

1. Determine the number of residents and/or employees associated with the development.
2. Disaggregate local government budgets into categories of service expenditures (for example, general government, police, fire protection, inspection, public works, conservation/development, health/human services, culture/recreation, and debt service).
3. Allocate costs to residential and nonresidential land uses.
4. Divide residential costs by total population to estimate service costs per capita. Divide nonresidential costs by total employees to estimate service costs per employee.
5. Calculate the total costs associated with the development under study. Calculate services costs by multiplying per unit costs by the number of people in the case of a residential development, or the number of workers in the case of a nonresidential development. Where applicable, determine the annual debt service payment on the capital costs of required public infrastructure. In many cases, these capital costs are paid by developers or by residents through user fees, and are therefore not explicitly included in traditional fiscal impact analysis.
6. Disaggregate local budgets into categories of revenue (for example, property taxes, other taxes, special assessments, state-shared revenues, other inter-government revenues, licenses and permits, fines and forfeits, public charges, intergovernmental charges and miscellaneous).
7. Allocate revenues to land uses and estimate per capita and per employee revenues.

8. Calculate property taxes, shared revenues, and total revenues associated with the development.
9. Compare estimated costs to estimated revenues to determine the net fiscal impact of the development.

Limitations of Fiscal Impact Analysis

Fiscal impacts are only one type of impact associated with a development, and fiscal impact analysis has a number of limitations:

- *Interaction of land uses.* Fiscal impact analysis does not capture the interaction among land uses when development occurs. For example, a commercial development may show a net positive fiscal impact but may generate costs outside of the development – for example, traffic congestion leading to higher expenditures for street maintenance and repair. It may also affect property values in adjacent developments, which are not captured in fiscal impact analysis.
- *Fiscal impacts on other jurisdictions.* While a development could have impacts on jurisdictions other than where it is located, standard approaches to fiscal impact analysis are typically designed to examine the effects of development on a single unit of government.
- *Cumulative impacts of development.* Standard fiscal impact analysis does not consider cumulative impacts. Whereas a single development may have a slight effect on a community's fiscal balance sheet, a series of development over time may have a significant impact.

Summary

It is difficult to develop a single solution to determine the economic impact of incompatible land use since each airport and its surrounding community is unique. Considering this, multiple methods should be employed to determine financial affects of incompatibility of airports and their surrounding communities. Economic valuation methods can determine the value of a specific event or development. This is useful when establishing the effects and consequences of land use incompatibility in monetary terms, aiding decision making through BCA of policy and investment decisions, and in setting values for economic instruments dealing with environmental externalities.

Other methods for evaluation include BCA that anticipate and evaluate the consequences of rules, policies, and public investment projects. Economic impact analyses may determine how a change in regulation, policy, or industry affects regional income and other economic activities. Fiscal impact analyses provides a planning tool for estimating the impact of a development or land use on the costs and revenues of the local government jurisdiction serving the land use or development.

The use of these various methods can determine the value of travel time, cost of travel delays, operating costs of aircraft, and costs associated with aircraft accidents. They can also determine the valuation of noise on communities surrounding airports and provide an assessment of regional economic and fiscal impacts. The use of these methods, as appropriate for each airport's unique environment, can demonstrate in monetary terms the impact of incompatible land uses.

VOLUME 1, CHAPTER 6

Aircraft Noise and Land Use Compatibility

Intuitively, almost anyone who works in managing an airport or who lives in the vicinity of an airport knows that aircraft noise is a primary issue raised by communities when airport development or expansion is proposed. But beyond intuition, the survey of airports conducted as part of this study provides confirmation that noise is the predominant issue. Volume 2 of this study provides details of this survey and results of the case studies.

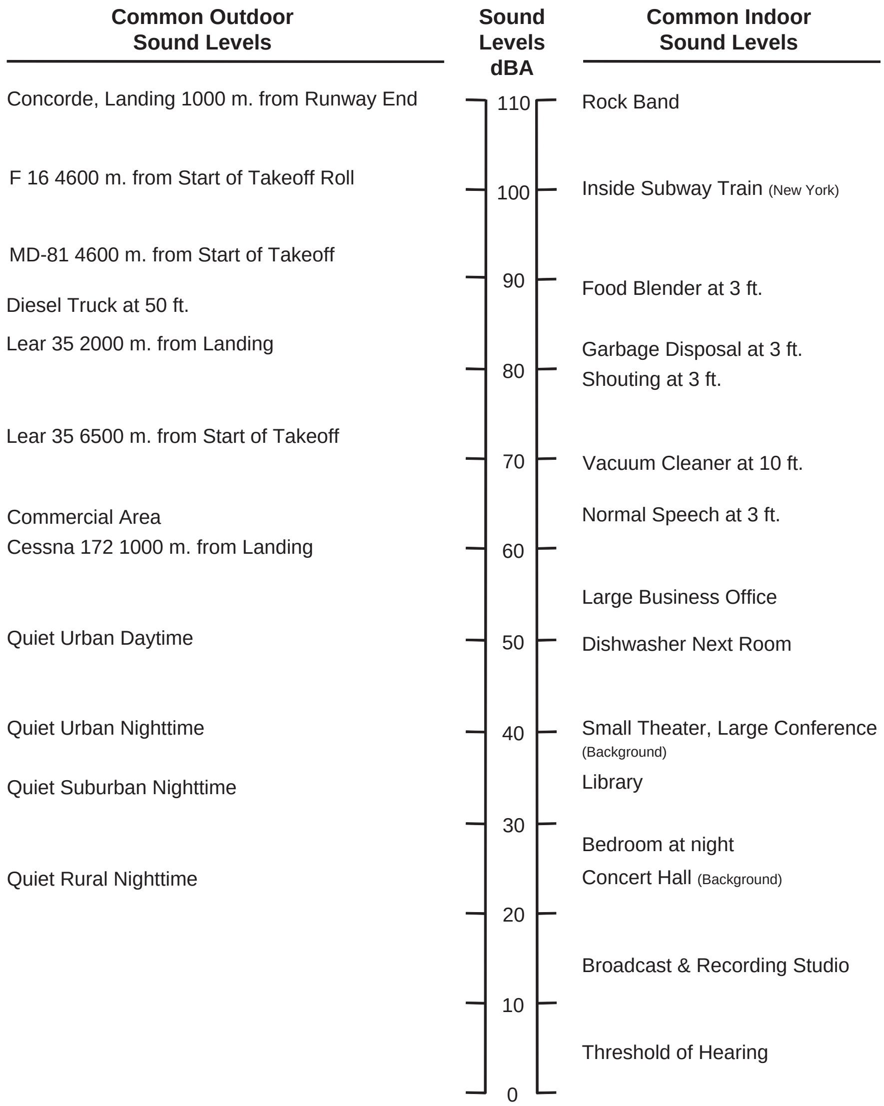
Thirty-four commercial service airports and 89 general aviation airports provided answers to 15 questions related to land use issues. In general, noise sensitive land uses (residential and noise sensitive nonresidential) are the uses most often cited as being of extensive concern to airports. This high level of concern was despite the fact that up to 90% of the responding airports said they had formal land use compatibility plans for the area surrounding the airport. Moreover, when asked whether the airport had been involved in litigation related to land use, more than 50% of the commercial airports responded that they had, and their cases involved noise issues for more than 80% of these airports that were sued.

Aircraft operations can create sound levels that produce annoyance in communities near airports as well as additional effects such as speech interference, sleep disturbance, and affected classroom learning. This chapter is intended to provide a basic understanding of aircraft noise, its effects as documented by research, the evolution of noise and land use compatibility guidelines, and concepts that interested airports and surrounding communities may wish to consider if improved compatibility is a goal.

Definition of Some Noise-Related Terms and Metrics

A variety of terms and metrics are used to describe aircraft noise. These form the basis for the majority of noise analyses conducted at most airports in the United States.

- **Decibel** (dB) - The decibel is a ratio of the sound pressure of the sound source of interest (e.g., the aircraft overflight) to a reference pressure (the quietest sound we can hear). Because the range of sound pressures is very large, we use logarithms to compress the measurement of sound to a smaller range, and express the resulting value in decibels (dB). Two useful rules of thumb to remember when comparing individual noise sources are: (1) most of us perceive a 10 dB increase to be about a doubling of loudness, and (2) changes of less than about 3 dB are not easily detected outside of a laboratory.
- **Weighted Decibel** [dB(A)] - Frequency, or "pitch," is an important characteristic of sound. Because our ears are less sensitive to both low and high frequencies, the A-weighting is designed to approximate this sensitivity and better assess the relative loudness of various sounds as heard by humans. Figure 1.6-1 provides a comparison of some common indoor and outdoor sound levels.



Source: *Federal Interagency Committee on Aviation Noise (FICAN)*

Figure 1.6-1. Comparison of common noise levels.

- **Maximum A-weighted Sound Level** (L_{max}) - Sound levels from most sources vary with time. For example, the sound level increases as an aircraft approaches, then falls and blends into the background as the aircraft recedes into the distance. We often describe a particular noise "event" by its maximum sound level (L_{max}). In fact, two events with identical L_{max} may produce very different total exposures. One may be of very short duration, while the other may be much longer. This difference is significant and is accounted for in the Sound Exposure Level (SEL) metric.
- **Sound Exposure Level** (SEL) - The most common measure of noise exposure for a single aircraft flyover is the SEL. Mathematically, it is the sum of the sound energy over the duration of a noise event – one can think of it as an equivalent noise event with 1-second duration. Because SEL is normalized to one second, it will always have a larger magnitude than the L_{max} of the event unless the duration of the event is less than one second. SEL provides a comprehensive way to describe noise events for use in modeling and comparing noise environments. Many computer noise models base their calculations on SEL values.

- **Day-Night Average Sound Level** (DNL) - The DNL is a 24-hour measure of the total noise in this period, with the noise events occurring at night (10 p.m. to 7 a.m.) treated as 10 dB louder than they really are. This 10 dB penalty is applied to account for greater sensitivity to nighttime noise and the fact that events at night are often perceived to be more intrusive because nighttime ambient noise is less than daytime ambient noise. DNL normally can be measured with standard monitoring equipment or predicted with computer models. Most aircraft noise studies utilize computer-generated estimates of DNL, determined by accounting for all of the SELs from individual events comprising the total noise dose at a given location on the ground. Computed values of DNL are often depicted as noise contours reflecting lines of equal exposure around an airport (similar to topographic maps that indicate contours of equal elevation). DNL contours usually reflect annual average operating conditions, taking into account the average number of flights each day, how often each runway is used throughout the year, and where over the surrounding communities the aircraft normally fly.
- For most environmental noise considerations, the FAA utilizes the DNL, also sometimes symbolized as L_{dn}, as the primary metric of noise measurement. DNL is widely accepted as a useful measure of noise and land use compatibility. However, because DNL is a summation of total sound energy, there are numerous ways of creating a given value of DNL, depending on the number of events, their intensity or loudness, and their duration. For example, a few very loud events, as might occur around a military air base, some moderately loud events, as near a commercial jet airport, or many relatively quiet events as can occur around a general aviation airport can all produce the same value of DNL.

Effects of Noise

There is no doubt that one of the primary motivations for establishing land use compatibility with respect to aircraft noise is to protect the public health and welfare. The EPA has explicitly examined this motivation on numerous occasions (EPA - Community Noise, 1971). However, more recent work, such as the *Federal Agency Review of Selected Airport Noise Analysis Issues* published by the Federal Interagency Committee on Noise (FICON), recommends additional research on effects. Since these previous efforts, considerable information has become available on effects that could be of use to both communities and decision makers responsible for either airport or land use development and more information is developed annually. Some of the primary effects include:

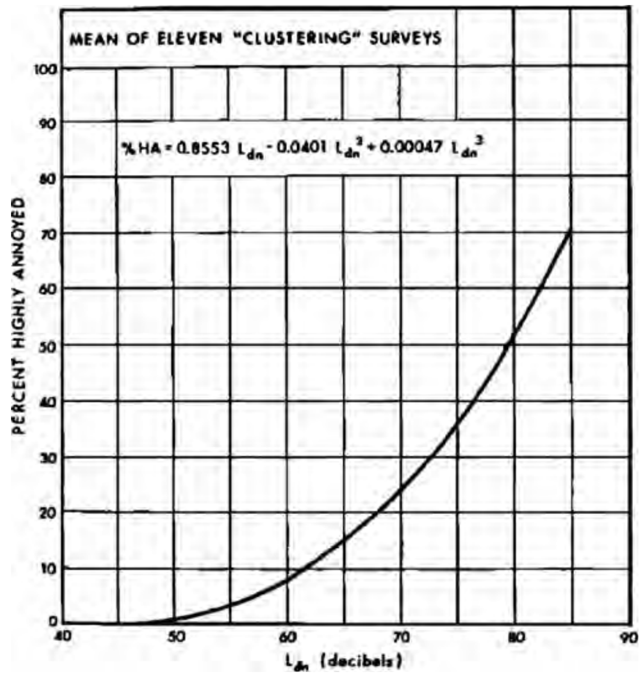
- Annoyance;
- House vibration;
- Difficulty learning;
- Non-auditory health effects; and
- Sleep disturbance.

For additional information and insight on how communities respond to aircraft noise, see *ACRP Report 15: Aircraft Noise: A Toolkit for Managing Community Expectations.*

Annoyance

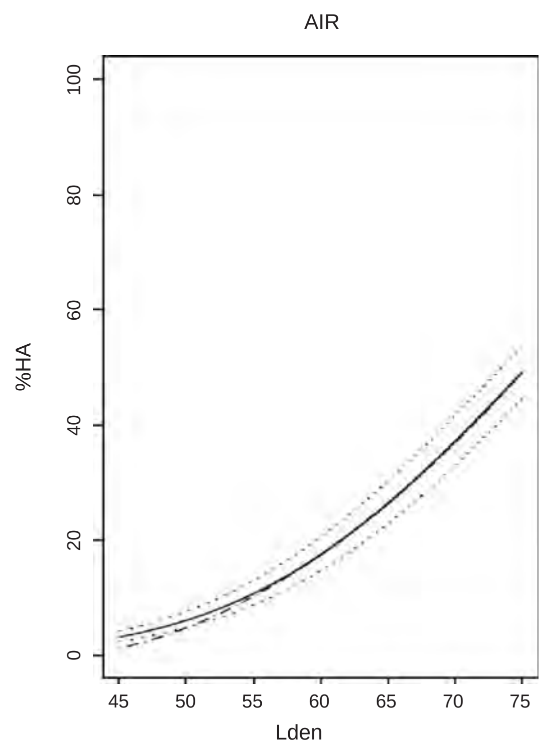
The original work that related DNL values to the percent of the population that were highly annoyed by noise was published in the *Journal of Acoustical Society of America* in 1978 by T.J. Schultz, see Figure 1.6-2. Schultz used social survey data to determine the percent of the population that is, on average, likely to be highly annoyed. The data used to develop the curve included surveys for all transportation modes. More recent investigations in the United States and Europe have focused either exclusively on aircraft or separately on aircraft, highway and rail traffic, and find somewhat different relationships. When only the survey data relating annoyance to aircraft noise are used, the resulting percent highly annoyed is about 26% for an exposure of 65 dB DNL, as opposed to 12% of highly annoyed at 65 dB DNL, as shown by the Schultz Curve (Miedema and Oudshoorn 2002). Figure 1.6-3 provides the curve proposed for use by the European Commission Working Group 2.

Despite this possibility that the Schultz relationship may need revision, DNL as a metric provides a useful planning tool for determining land use compatibility. To the extent that communities, planners or others find it a difficult metric to understand, the problems lie with the interpretation of the metric, rather than its utility for land use planning. Because it is a measure of 24 hour noise exposure, it cannot represent how aircraft noise sounds to a listener in a community. As mentioned above in the discussion of terms and metrics, a given value of DNL can be produced by many different operational conditions. The following sections, Evolution of Noise/Land Use Compatibility Guidelines, and Including Noise in a Local Land Use Ordinance, provide more background on DNL and describe how it can be translated for easier understanding by the public and decision makers responsible for land use planning. Additionally, in situations where nighttime noise is of special concern, a new standard provides a means for computing likely awakenings from nighttime noise events, see Sleep Disturbance.



Source: Synthesis of Social Surveys on Noise Annoyance, *The Journal of Acoustical Society of America*, 1978

Figure 1.6-2. Original "Schultz Curve."



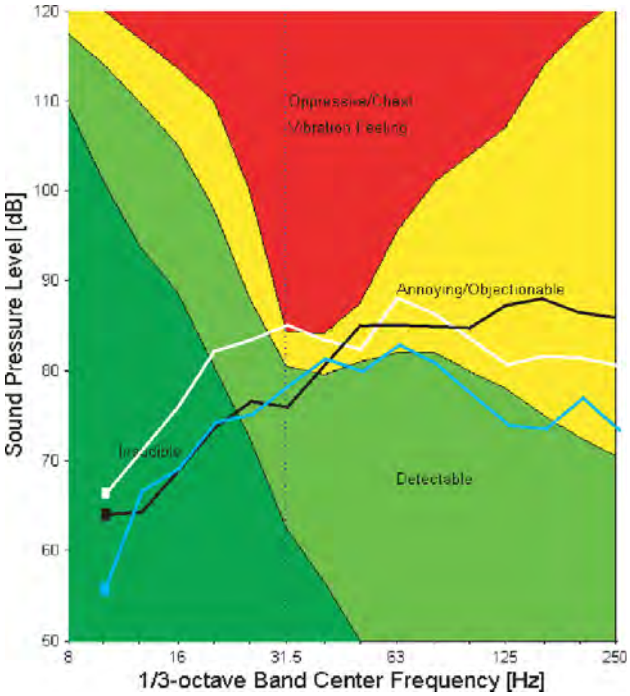
Source: European Commission Working Group 2

Figure 1.6-3. European recommended relationship of percent highly annoyed to aircraft noise.

House Vibrations

There appears to be sufficient information to quantitatively estimate when aircraft noise is likely to produce house vibrations that produce negative reactions by the inhabitants (Hubbard 1982). These studies developed relationships between low-frequency aircraft noise (or simply low-frequency noise) and the resulting responses of house vibrations and of the inhabitants' negative reactions. How people react to low-frequency noise depends upon the level and frequency content of the sound. Consequently, consideration should be given to limit development of housing stock in close proximity to airport runways where low frequency noise from jets during start of takeoff or using reverse thrust on landings can produce house vibrations.

For example, noise measurements were made at a home located approximately 3200 feet to the side of the takeoff end of a runway at a commercial service airport (Miller 1998). Figure 1.6-4 compares the measured sound levels of three takeoffs with human response as developed by researchers (Hodgdon 2006). From this comparison, at least two of the three events are likely to be judged as annoying or objectionable, and such was the case as reported by the resident who experienced them (Miller 1998).



Source: Final Report, *Partner Low-Frequency Noise Study*, August 16, 2007

Figure 1.6-4. Three measured takeoff noise events compared with human perception criteria.

Learning

Since schools often are noted as an incompatible land use, it is important to address noise implications as they relate to learning. Speech interference is the most problematic aspect of aircraft noise in classrooms; it makes teaching, listening, and learning very difficult. The American National Standards Institute, *Standard for Acceptable Noise Levels in School Classrooms* addresses intruding transportation noise, as well as interior noise such as that produced by heating and air conditioning systems. (American National Standards Institute, ANSI S12.60-2002) This standard recommends that in a typical classroom, noise from transportation sources, such as aircraft, not exceed an A-weighted level of 40 dB for more than 10% of the loudest hour of the school day.

Nonauditory Health Effects

There have been many studies that hypothesize chronic exposure to industrial and environmental noise levels can lead to increased incidence of cardiovascular disease, hypertension, physician appointments, and drug purchases. However, these results are contradicted by other studies which suggest that:

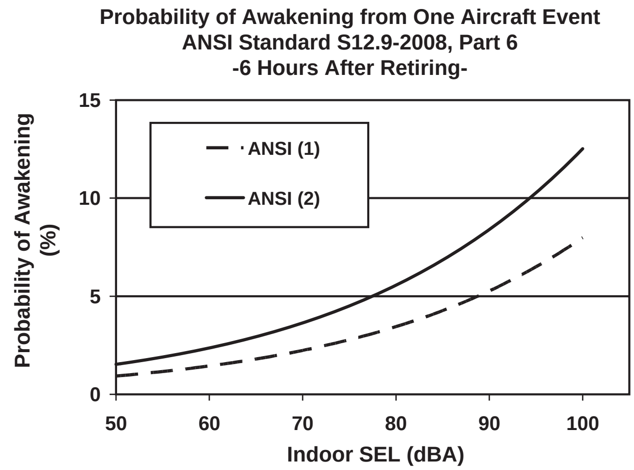
- The data showing health effects are of poor quality (Von Gierke 1993);
- Improvements in exposure characterization and mediating variables are needed (Lercher, 1998);
- That annoyance with aircraft noise is not associated with blood pressure levels (Goto 2003); and
- That there is no statistical significance in the relationship of higher noise levels and higher cardiovascular risk (Babisch 2006).

One recent study does, however, suggest that there is a positive correlation between nighttime exposure to aircraft noise and increased risk of high blood pressure (Babisch 2005). However, a recent review of noise effects research still finds no convincing connections between adverse health effects and aircraft noise (Mestre 2008). Consequently, the validity of nonauditory health effects is questionable, or at least unproven at this time.

Sleep Disturbance

Noise-induced awakenings have been found to correlate highly with single-event noise (SEL) and L_{max}. A remarkable number of sleep studies have been conducted in people's homes over the past 15 or so years (Basner 2004). The results of these studies could be used to better quantify the likelihood of aircraft operations awakening portions of the populations surrounding airports. It should be noted that at least one of these studies (Fidell 1994) found no relationship between cumulative measures of nighttime noise (such as the night portion of DNL) to awakenings.

Recently, the data from some of these and other sleep studies have resulted in a standard for estimating awakenings from nighttime noise events, as shown in ANSI S12.9-2008, Part 6, *Methods for Estimation of Awakenings Associated with Outdoor Noise Event Heard in Homes.* This standard includes two methods for estimation: one considers just the number of "noise events" and each one's SEL value, and the second includes the time of night that each noise event occurs. Time of night has been found to be important with awakening occurring more easily as the night progresses (Brink 2006). Figure 1.6-5 shows the probabilities of awakening from a single aircraft overflight 6 hours after retiring. ANSI (1) refers to the method that does not include time of night; ANSI (2) does include time of night.



Source: Derived from ANSI S12.9-2008, Part 6

Figure 1.6-5. Probability of awakening from one aircraft event.

Evolution of Noise/Land Use Compatibility Guidelines

In 1964, the FAA and the U.S. Department of Defense published similar guidelines for land use planning in areas affected by aircraft noise. The guidelines established three zones: Zone 1 for areas exposed to aircraft noise less than 65 DNL [the DNL is an approximation; it had not been identified as a metric at the time. A different metric, Community Noise Rating (CNR) was in use at that time] no complaints would be expected though noise may interfere occasionally with certain activities; Zone 2 for areas exposed to 65 to 80 DNL, individuals may complain, perhaps vigorously and concerted group action is possible; Zone 3 for areas greater than 80 DNL where individual reaction would likely include repeated, vigorous complaints and possible concerted group action.

In 1971, the Department of Housing and Urban Development (HUD) published its *Noise Assessment Guidelines.* These guidelines used the concept of acceptability categories. For aircraft operations, these were determined by plotting Noise Exposure Forecast (NEF) contours produced by aircraft operations and measuring to different distances from these contours. Translation to DNL is problematic, but roughly equates to:

- Clearly Acceptable for exposures less than 55 DNL;
- Normally Acceptable for exposures between 55 DNL and 65 DNL;
- Normally Unacceptable in areas between 65 DNL and 75 DNL; and
- Clearly unacceptable above 75 DNL.

The U.S. Congress took legislative action with the Noise Control Act of 1972. It required the U.S. EPA Administrator to conduct a study of the " . . . implications of identifying and achieving levels of cumulative noise exposure around airports . . . " (EPA – Impact Characterization, 1973). This requirement resulted in the identification of Day Night Average Sound Level as the measure of cumulative noise, and DNL 60 dB as the threshold of compatibility; below this level, there should be limited annoyance and minimal complaints about aircraft noise. The report (U.S. EPA, July 1973) provides extensive discussion of why DNL was chosen and why DNL 60 dB was identified as the appropriate limit of exposure. The discussion focuses on the effects on people and communities, including hearing, interference with speech, sleep and learning / thinking, annoyance, and complaints, and provides some information on nonauditory health effects.

The Noise Control Act of 1972 also required the Administrator of the U.S. EPA to publish " . . . information on the levels of environmental noise the attainment and maintenance of which in defined areas under various conditions are requisite to protect the public health and welfare with an adequate margin of safety." This requirement resulted in what is now commonly referred to as "The Levels Document" (see U.S. EPA, March 1974). This report recommended that to provide this protection, the value of the Day-Night Level not exceed 55 dB.

In 1979, the FICUN was formed to coordinate and consolidate Federal policy and guidance on noise. FICUN's membership included the FAA, the EPA, the FHWA, and the DoD, HUD, and Veterans Affairs (VA). The committee developed consolidated federal agency land use compatibility guidelines and issued a report entitled *Guidelines for Considering Noise in Land Use Planning and Control* in June 1980. This report established the Federal government's DNL 65 dB standard and agreed that standard residential construction was compatible for noise exposure from all sources up to DNL 65 dB. The FAA then established DNL 65 dB as the threshold level of incompatibility in response to Congress's authorization of the Part 150 noise compatibility program. This program was initiated in 1981 to fund airport noise compatibility planning and projects to mitigate aircraft noise impacts. When incompatible land uses, such as housing, occur around airports and experience this level of noise exposure or higher, federal funding may be available for assisting with noise mitigation measures such as sound insulation and property acquisition, provided the appropriate noise analyses are conducted.

Some provisions established by Part 150 include:

- The dB (A) scale is the unit of noise measurement tool;
- The DNL is the metric of cumulative aircraft noise; and
- Compatible land uses are identified for various values of DNL.

Part 150 describes acceptable types of land uses for each DNL value. Table 1.6-1 illustrates the compatibility of land uses based upon aircraft sound levels. Areas exposed to levels of DNL 70 dB or greater should ultimately be acquired by the airport sponsor. Typically, large, high-activity airports have noise level impacts beyond airport property. However, noise levels of DNL 70 dB or greater are usually contained within airport property for airports with low activity. For small airports, the DNL 65 dB contour will often fall within the airport property line. For larger airports, this contour may extend well beyond the airport property line. FAA guidelines indicate in Table 1.6-1 that residential developments should not be allowed in areas exposed to levels of DNL 65 dB or greater. If a noise-sensitive facility must be developed with a noise exposure of DNL 65 dB or greater, the FAA recommends construction that utilizes noise level reduction (NLR) techniques.

It is important to consider the implication of the first note to Table 1.6-1 - "The designations contained in this table . . . etc."

This statement acknowledges that local authorities have the responsibility for determining compatible land uses around an airport. Consequently, it is important that the implications of various land use decisions be clear if a jurisdiction intends to adopt a noise and land use compatibility ordinance or by-law. With regard to aircraft noise, this responsibility means that local authorities should understand DNL and the implications of different values of that metric as it relates to their specific airport and to the effects on their communities. The next section, Including Noise in a Local Land Use Ordinance, is written for jurisdictions and airports who wish to explore improving noise and land use compatibility through ordinance or by-law, and who are concerned that the common use of 65 DNL may not serve this goal adequately for their specific situation.

Including Noise in a Local Land Use Ordinance

The literature review associated with the development of this document shows that some states and many local jurisdictions have adopted DNL values identical to those of the FAA for land use compatibility with aircraft noise, though some also identify dimensions of a "noise sensitivity zone" (Minnesota, Oregon, and Clark County, Nevada). Several jurisdictions have used a lower DNL of 60 dB in defining planning objectives or goals (see *ACRP Synthesis 16: Compilation of Noise Programs in Areas Outside DNL 65.*) Limits are provided as guidance (Wisconsin and Oregon), and may include zoning ordinances and planning templates (Oregon). Other states, notably California and Maryland, have set specific procedures that must be followed in examining airport or aircraft noise.

Table 1.6-1. Land use compatibility *with yearly day-night average sound levels (DNL).

Land Use	Yearly Day-Night Average Sound Level (DNL) in Decibels					
	Below 65	65-70	70-75	75-80	80-85	Over 85
RESIDENTIAL						
Residential Homes	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
PUBLIC USE						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and 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
COMMERCIAL USE						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale/Retail -bldg matrls/hardware/farm equip.	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
Communication	Y	Y	25	30	N	N
MANUFACTURING & PRODUCTION						
Manufacturing - general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agricultural (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing	Y	Y	Y	Y	Y	Y
RECREATIONAL						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

*The designations contained in this table do not constitute a federal determination that any use of land covered by the program is acceptable or unacceptable under federal, state, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under FAR Part 150 are not intended to substitute 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:
Y (yes) = Land use and related structures compatible without restrictions.
N (no) = Land use and related structures are not compatible and should be prohibited.
25, 30, 35 = Land use and related structures generally compatible; measures to achieve Noise Level Reduction of 25, 30, 35 dB must be incorporated into design and construction of structure.

Notes:
(1) = Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor 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 assume mechanical ventilation and closed windows year-round. However, the use of NLR criteria will not eliminate outdoor noise problem.
(2) = Measures to achieve NLR 25 dB must be incorporated into the design and construction of portions 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 portions 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 portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.
(5) = Land use compatibility provided special sound reinforcement systems are installed.
(6) = Residential buildings require an NRL of 25 dB.
(7) = Residential buildings require an NRL of 30 dB.
(8) = Residential building not permitted.

Source: FAR Part 150, *Airport Noise Compatibility Planning*, Appendix A, Table 1.

This section is intended for jurisdictions and airports that wish to fully understand the effects on their community and airport before adopting an aircraft noise and land use compatibility ordinance. The issue addressed here is translating DNL so that informed decisions can be made about what uses are compatible with what levels of exposure.

Understanding the implications of DNL values is widely acknowledged as difficult. The April 2000 Government Accounting Office (GAO) report (Aviation and the Environment 2000) suggests that, despite the widespread use of quantitative compatibility thresholds, computation measures, and procedures for determining land use compatibility, developing a compatible interface between airports and the surrounding land use has not gone smoothly. The GAO report notes that the cumulative single metric approved by the FAA, DNL, fails to provide sufficient information to effectively convey to people what they can expect to hear in any given area. The report recommends supplemental metrics such as single-event measures, L_{max}, and SEL or estimates of population proportions that will be highly annoyed by transportation activities. The FICAN identified a similar need in its 1992 report. The FAA now has explicitly included use of supplemental metrics and consideration of land uses exposed to levels down to DNL 60dB (FAA Order 1050.1E) and has been funded by Congress to provide more information to prospective home buyers through access to the Noise Exposure Maps produced during *Title 14, Code of Federal Regulations, Part 150* (commonly called Part 150) studies (Public Law 108-176).

The limitations of using DNL as the sole method for communicating to citizens about noise and its effects are evident. There have been several attempts to provide more informative data to the public. Chief among these efforts has been that by the Australian Transportation and Regional Services (Expanding Ways to Describe and Assess Aircraft Noise, 2000). A project to expand Sydney Airport in Australia encountered extreme community resistance, and the use of the cumulative metric (Australian Noise Exposure Forecast System (ANEF) – similar to DNL) was believed to confuse, if not mislead, decision makers and the public. Consequently, considerable effort was devoted to developing a combination of graphic depictions of flight corridors, tabulations of the number of operations, times of use (and non-use), and the number of operations exceeding a level causing indoor speech interference.

Other efforts have focused on "normalizing" or adjusting DNL by factors such as whether the noise is created by a new source or a source people have experienced before, whether or not there are pure tones or impulses present in the sound, the existing level of the background noise, and other factors (Shomer 2002). These various efforts have met with mixed success in determining community reactions to new or changes in noise, but an understanding of DNL and what it means for a specific community / airport is essential to land use compatibility decisions.

The following material discusses the issues that need to be considered in determining whether or how aircraft noise is to be included in a local land use ordinance. Because each airport and its surrounding jurisdictions are unique, the value of providing specific ordinance components, criteria, and wordings is limited. The noise components must be crafted uniquely for and by each airport and its local jurisdiction. Rather than providing specific sections and wordings, this section attempts to alert those interested in preserving or improving noise compatibility between an airport and the surrounding jurisdictions to the hurdles of pursuing this compatibility through a noise based land use ordinance.

What follows is based on both the experiences of this report's authors, and on the airport case studies reported in Volume 2. Readers are encouraged, after reading this section on noise land use ordinance issues, to read through the case studies contained in Volume 2 of this report, for an understanding of some of the specific efforts that have been made to pursue airport noise and land use compatibility. Reading of ACRP Synthesis 16 would also be beneficial.

A land use ordinance cannot be written and adopted and then expected to function without involvement of both the jurisdiction and the airport. Primarily, both the land use of the jurisdiction and the operations and possibly configuration of the airport, are dynamic. The ordinance will almost certainly include a variance process. This means that decision makers will have to decide whether such a variance is in the interest of the jurisdiction, and the airport, likely without any real authority, and will have to decide whether it can or should try to influence the decision makers. Prospective home-buyers will come into the area and may very well make buying decisions without full awareness of how airport operations noise may affect their life style and their feelings about owning a house near an airport. The airport may respond to increasing demand for flight operations and want to increase its capacity to handle those operations efficiently and safely.

Other dynamic changes are possible, but each of these has the potential for placing new residents in areas of noise they find inappropriate or unacceptable in terms of their expectations. For variances, jurisdictions are likely to face conflicting needs. Will new development provide additional needed housing and associated tax revenues? Will eventual residents who buy homes built through variance find living conditions unacceptable within a noise environment which was intended to be inappropriate for residential use? Will airport management be able to muster sufficient supporting evidence and generate sufficient understanding of airport needs to argue effectively for denial of variances?

Potential home buyers should be well-informed about the realities of living near an airport. But is there the political will to include meaningful disclosures as part of the home selection process and as a part of the land use ordinance implementation? Both owners selling homes and realtors tend to oppose providing adequate information to potential buyers.

Can the land use ordinance be sufficiently forward-looking to accommodate airport growth? Restricting land use on the basis of uncertain future airport (noise) growth is likely to be difficult and a problem that no airports or jurisdictions known to the authors have successfully addressed.

What Are the Goals of the Airport and of the Surrounding Jurisdictions?

As a starting point, the airport and jurisdiction goals should be articulated and codified. Is the airport master plan up-to-date and does it accurately reflect the desired future conditions? Is the airport able to identify or agree to a future limit to its growth? With no limit, land use compatibility, however it is finally determined, will serve only a temporary purpose. Eventually incompatibilities are likely to grow, and expansion plans challenged. Does the jurisdiction have a comprehensive plan for the community or possibly regional plans that may be appropriate? How important and how explicit are protection of health and welfare and quality of life in the jurisdiction's master plan?

If either the airport or the jurisdiction does not have current or fully developed master plans, development of the land use ordinance could provide a forum for updating or refining portions of the master plans. For both the airport and the jurisdiction master plans, aircraft noise issues probably have not been addressed to the extent needed as a basis for a land use ordinance and working through ordinance development can serve to clarify noise-related aspects of the plans.

Choosing Noise and Land Use Compatibility Criteria

Selection of the noise and land use compatibility criteria to be used in the ordinance is the fundamental decision that must be made. For those jurisdictions and state and federal agencies that have land use noise criteria (or guidelines), virtually all use a value of the DNL. California uses the Community Noise Equivalent Level (CNEL)—almost identical to DNL—and throughout the world, countries that attempt to address aircraft noise compatibility issues use similar metrics. However, the value of DNL selected to identify the threshold above which residential land use is incompatible will be difficult and require dialog between the airport and the jurisdiction.

Common practice is to use the land use compatibility guidelines found in the FAA's regulation 14 CFR Part 150 (FAR Part 150). (The annotated bibliography provides detailed information about this and many other noise-related documents and the previous section, Evolution of Noise/Land Use Compatibility Guidelines, provides some background on FAR Part 150.) For residential uses, FAR Part 150 identifies DNL 65 dB as the upper limit of residential land use compatibility. While this limit was developed by the FAA in cooperation with other agencies, it has become increasing clear that many local communities and local residents do not believe that DNL 65 sufficiently identify levels that can be considered acceptable. As discussed in the associated annotated bibliography, this level was higher than that recommended by the U.S. EPA at the time (1973 and 1974) and is higher than World Health Organization (WHO) recommendations (Berglund 1999).

It is true that these EPA and WHO recommended levels are presented as goals and do not consider feasibility, so use of higher levels in practice may be justifiable based on feasibility considerations. However, feasibility often depends upon time, and technology has provided an aircraft fleet that is as much as 15 - 20 dB quieter than the one that existed when the Part 150 guidelines were developed.

Adopting the Part 150 guidelines is understandable: they are available to be copied, easily referenced, and widely used. They are, however, inadequate to protect either the public from the adverse effects of aircraft noise or the airport from community displeasure and activism that can limit airport operations and growth. While it is true that at this level of DNL and higher, the FAA can provide funding assistance for housing sound insulation and property acquisition, DNL 65 dB is not the lower limit of the adverse effects of aircraft noise. DNL is a metric that conveys nothing of the sense of what the aircraft noise actually sounds like and its effects on peoples' lives.

Therefore, in selecting noise compatibility criteria for a land use ordinance, both the airport and the jurisdiction should develop a clear understanding of the details of the aircraft noise produced by the airport and the associated effects likely to result. Setting compatibility criteria in terms of a value or values of DNL is appropriate, but to ensure informed decisions about criteria selection, relationships between DNL values and noise effects for the specific airport should be developed. This emphasis is intended to draw attention to the fact that each airport will have its own unique relationship between DNL and effects. This variable relationship, which depends upon specific aircraft types and number of operations, is one of the confusing aspects of DNL.

As an example of this variable relationship, consider Table 1.6-2. This table gives hypothetical (but computationally accurate) relationships between a level of DNL 65 dB and maximum aircraft sound levels, number of operations and approximate times the aircraft sound level would be greater than 60 dB(A) – a level at which speech interference begins. An average maximum level of 95 dB(A) might occur near the end of a commercial jet departure runway, a level of 85 dB(A) at about one mile from the runway, and a maximum of 75 dB(A) at about three to four miles from the runway end. Clearly, the sound environments experienced for these different combinations of levels and numbers would be perceived as very different despite having the same DNL value of 65 dB.

Table 1.6-2 Combinations of maximum aircraft levels and operations that create DNL 65 dB.

Maximum Aircraft Sound Level	Required No. of Operations in 24 Hrs (none at night)	~Time Above 60 dB(A), Each	~Total Time Above 60 dB(A)
95 dB(A)	10	50 Seconds	8 Minutes
85 dB(A)	100	35 Seconds	1 Hour
75 dB(A)	1000	20 Seconds	6 Hours

Source: Harris Miller Miller & Hanson, Inc.

When the original recommendations for compatibility were developed in the early 1970s, they were based upon the associated likely effects of the noise levels on people. Considerable research on noise effects has been

Table 1.6-3. Estimated noise effects for an average day, at a large air carrier airport.

DNL Range (dB)	Percent of Population		Number of Aircraft Events that:	
	Awakened at least once by aircraft noise (%)	Annoyed (%)	Interfere with Conversation Indoors (windows open)	Cause Feelable House Vibration
>70	> 40	> 40	> 250	>200
65 - 70	35 - 40	30 - 40	100 - 250	50 - 200
60 - 65	30 - 35	20 - 30	50 - 100	<50
55 - 60	20 - 30	10 - 20	< 50	negligible

Source: Harris Miller Miller & Hanson, Inc.

published since that time, and there is now sufficient information to develop associations of DNL and effects similar to those presented in Table 1.6-3. The actual percents of population and numbers of events are naturally highly dependent upon the number and type of aircraft operations, the population distributions around the airport and a number of assumptions such as the outdoor-to-indoor sound level reductions provided by typical homes, whether people sleep with windows open or closed, whether homes are air conditioned, and numbers of operations at night.

The important consideration is that decisions about what compatibility criteria are best for any airport / jurisdiction relationship can be informed by much more than reliance on a qualitative or subjective understanding of what DNL values mean for those who live with them. The effects can be quantified and judgments made on the basis of numbers or percent of people awakened or annoyed, number of interruptions, and number of feelable vibrations. (Note that it is also possible to identify noise areas within which schools should not be located.) These numbers will bear different relationships to DNL for each airport or jurisdiction and hence, criteria can be chosen on the basis of what best serves the community with respect to the specific airport—not on a one-size-fits-all approach. In the end, selection of criteria is a policy decision, but quantification of effects can help make this an informed decision as well as provide an important logic trail for future legal defense, if needed.

The airport would likely be responsible for development of the information of the type in Table 1.6-3. The research on which these numbers are based is well documented, but the computation methods are not. Should there be general acceptance within the airport community that such information is valuable, it may be of benefit to the FAA and /or the ACRP program to develop supporting documentation of the computational methods.

For the criteria selection process to function in the long run, which is the primary intent, the airport will need to consider in some detail, if and how it expects to change and/or grow in the coming years. Also, because of the basic human inability to predict the future, the airport and the jurisdiction should include within the ordinance some guidance or criteria for revisions.

It is the opinion of the authors of this report that such quantified information can provide a significant improvement in assisting airports and jurisdictions to develop well-informed and consequently more effective noise sections of land use ordinances. Criteria will be better understood, and more likely to withstand challenges; their justification will be based on understandable (by the public, courts and juries, and developers) goals of preventing or minimizing acknowledged adverse effects of noise. Further, assuming the final land use criteria are stated in terms of DNL, there is significant support in the literature for values as low as 55 dB.

Implementation of the Noise Section

The noise section of the land use ordinance, or a stand alone noise ordinance, should include sections that address at least the following topics:

Identification of Compatibility Criteria. The selected criteria will be clearly presented along with associated acceptable land uses. For documentation purposes, a section should be considered that provides a full description of the derivation of the criteria. Clear documentation will support the jurisdiction and / or the airport in withstanding legal challenges.

Determination of Noise Exposure Levels. Assuming the criteria are expressed in terms of DNL, the methods for their computation should be based on use of the FAA's Integrated Noise Model (INM). Specifics in the ordinance of the use and documentation of the INM modeling may be derived from FAR Part 150, Appendix A, Part B, Sec. A150.103. The resulting DNL contours will identify the areas of compatibility / incompatibility with noise. The contour computations should include some allowance for future changes at the airport. One approach is to compute a current and one or more future contours and use the largest or some combination of the different years' contours.

A future problem, for which few, if any, airports have developed a satisfactory solution, is the likely changing size and shape of contours over the years. Areas incompatible in one period can become compatible in a later period (as aircraft become quieter, for example). The question arises, should these formerly incompatible areas be turned into compatible areas, thus permitting development? The areas may later become incompatible as air traffic increases or new aircraft types use the airport. One approach might be to identify a "buffer area" based on a second criterion that is lower than the criterion that identifies the limit of acceptability for residential use; see Volume 2 of this research report for the case study summary on Buckley Air Force Base Case Study and the discussion of Airport Influence Areas and zoning regulations for the City of Aurora near Denver International Airport.

It is important that some flexibility for delineation of incompatible areas be provided. It is generally imprudent to strictly define incompatibility by noise contours. The contours will likely divide neighborhoods in arbitrary ways; it has been shown to be better to use streets or other boundaries (e.g., rail lines, rivers, etc.) to define the areas as being compatible or incompatible.

Review of Development Plans. Most jurisdictions that have some sort of zoning or land use ordinance will have a process for review of development plans. For the aircraft noise compatibility portion of the ordinance, an additional review should be identified for noise sensitive properties proposed to be constructed within specific "noise zones." One approach might be to have a single noise zone within which residential building construction is prohibited without a variance and the variance, if granted, could require such things as special amounts of sound insulation and noise disclosures to potential buyers. Another or additional approach could be to have a second, lower exposure noise zone in which residential construction is permitted, but approval requires noise disclosures. It is also possible (and some jurisdictions do require) that post-construction sound insulation testing be conducted to confirm that the additional sound insulation was properly designed and included.

There should be a requirement in the review process that the airport also receive copies of some or all of the development plans for any residential or noise sensitive construction proposed within one or more "noise zones." The airport should be included in any review meetings / hearings related to such development proposals, and given an opportunity to provide its perspective on the proposal. The Airport Land Use Commissions (ALUCs) in California are an example of this sort of coordination where the ALUCs must be involved in the development process to assess potential land use concerns. The Maryland Aviation Administration has authority to deny building permits within the "Noise Zone;" see Volume 2 of this report for the case study report on Baltimore Washington Thurgood Marshall Airport.

Disclosures / Informed Home Buyers. One of the almost inevitable and frustrating occurrences is the arrival of a new resident who purchased a home with little or no awareness of the prevalence of aircraft noise. It is an all too common experience for a jurisdiction and an airport to have spent literally years working with citizens developing the most acceptable, feasible noise control measures, only to have a new resident arrive at a public meeting or call the airport and say "you've got to do something about all this aircraft noise." A jurisdiction and airport should decide whether and to what degree this eventuality can be prevented.

It is the authors' opinion that there are means to present objective information to potential home buyers that would help them make a well-informed decision about purchasing a home in a noise exposed area. An airport can tell a potential home buyer: where and how often aircraft fly, what types of aircraft utilize the airport, whether there are late night or early morning operations, whether there are night time engine runups, etc. Potential buyers can be advised of times they can visit properties to experience the loudest conditions.

In other words, it is well within an airport's or jurisdiction's ability to provide objective information about airport operations noise. The obvious issue is how to integrate providing such information into the home buying process. To be most effective, the information needs to be provided face-to-face early in the process. Providing a sheet of paper at closing that says something like "your house lies within the airport noise zone" does nothing more than provide some legal cover for the realtor / seller / jurisdiction / airport, if that.

One possible solution is the use of disclosure notices. Home sellers and realtors may often object to any such provision, as there is a perception that they will be unable to sell their home should this disclosure be made. For example, there are concerns that house sale prices are likely to be affected or that house sales may take longer. Solutions to this disclosure issue are possible, but could require considerable negotiation and money. At the time of this writing, no airport or jurisdiction has, to the authors' knowledge, found a solution to this problem of the "uninformed home buyer."

Summary

Improving community and airport compatibility is crucial for not only the continued functioning of airports and for the health and welfare of local residents. It is crucial for the success of the stated federal policy to reduce, by 2025, " . . . the impact of aviation on community noise and local air quality . . . in absolute terms, even with anticipated growth in air traffic," as noted in the *Next Generation Air Transportation System Integrated Plan* by the FAA. Further, the process described in the previous section responds to a goal of NextGen, namely that cooperative efforts between airports and communities are envisioned as airports are to be " . . . valued neighbors keeping the public well informed about environmental issues. . . . and . . . mitigate environmental impacts related to the growth of aviation to foster public acceptance of air transportation growth . . . " while allowing sustained aviation growth for the future of air transportation. Achieving airport/community compatibility is a critical component of preparing for the future of the U.S air transportation system.

VOLUME 1, CHAPTER 7

Aircraft Accidents and Safety Considerations

The overall objective of the research on enhancing airport land use compatibility described in this report is to develop guidance to protect airports from encroachment of incompatible land uses. To gain support for this objective, it is important to educate policy makers and various stakeholders on the types of problems and costs associated with incompatible land uses around airports. This chapter discusses the safety consequences and risks associated with incompatible land uses near airports. The following topics are addressed:

- Aircraft accidents;
- Safety considerations for those on the ground near airports; and
- Examples of state guidance on aircraft accident risks and safety of those on the ground.

As discussed throughout this document, it is critical to maintain a safe operational environment both on airport property and in communities surrounding airports. One of the factors in determining land use compatibility relates to the proximity of a specific land use to an airport and its runways. One of the objectives of airport land use compatibility planning is to ensure that the land uses around airports do not have an unacceptable level of risk for those on the ground from the possibility of an accident occurring from aircraft landing or departing from an airport. Although the principal concern in evaluating the risk to those on the ground near airports is to ensure that proposed changes in land use do not result in an undesirable increase in risk, consideration also should be given to changes in airport operations that may affect the level of risk.

A key aspect of assessing risk to those on the ground near airports is determining where aircraft accidents in the proximity of an airport are distributed with respect to the runway ends. Since most aircraft accidents that occur near airports happen during the process of landing or taking off, the distribution of accident locations are concentrated in an area that extends beyond the runway ends for some distance from the airport and on either side of the arrival and departure flight paths to and from each runway.

As discussed in this chapter, a proportion of aircraft accidents occur on the airport itself. Although these accidents are of concern from the standpoint of aviation safety and the design of airport facilities, they do not affect third-party risk outside the airport and are not discussed in detail in this chapter. Thus, the primary focus of this chapter is placed on accidents that occur to landing aircraft before it crosses the runway threshold or to departing aircraft after it has crossed the departure end of the runway. By definition, consideration of risk to those on the ground near airports only involves those accidents that occur beyond the airport property. However, since airport property boundaries will vary in their distance from the runway end from airport to airport, it makes sense to structure the analysis with respect to the runway ends and then make any necessary adjustments in each case to account for the distance of the airport property boundary from the runway end.

Since aircraft accidents are statistically rare, particularly those involving commercial airliners, analysis of accident locations in the vicinity of airports generally needs to utilize data collected over an extended period of time. However, aircraft accident rates have been reduced significantly over the past two decades because of continued efforts to improve aviation safety. This is particularly true for general aviation accidents, which constitute by far the largest proportion of accidents in the vicinity of airports. Therefore, any rational assessment of the risk posed by aircraft accidents to those on the ground near airports must take into account this reduction in the probability of such accidents occurring.

A more detailed analysis of aircraft accident sources and recent trends in aircraft accident rates is provided in a white paper in Volume III titled "Aircraft Accident Data Sources and Trends." This additional discussion addresses the sources of aircraft accident data, prior studies of aircraft accident locations, accident databases for third party risk and other studies, the development of an integrated aircraft accident database, and an analysis of aircraft accident trends. The data contained in this paper also provides supplementary additional information that could support further research into the occurrence of aircraft accidents in the vicinity of airports.

Aircraft Accidents

The past few years have seen major efforts to improve aviation safety (FAA 2006). These efforts have involved both detailed analysis of aircraft accidents and their causes in order to develop targeted strategies to reduce their occurrence and the promotion of (and in some cases the requirement for) technologies, programs, and practices to enhance safety. The analysis of accident causes and development of reduction strategies include the work of a wide range of FAA safety programs and joint FAA and industry safety activities, including:

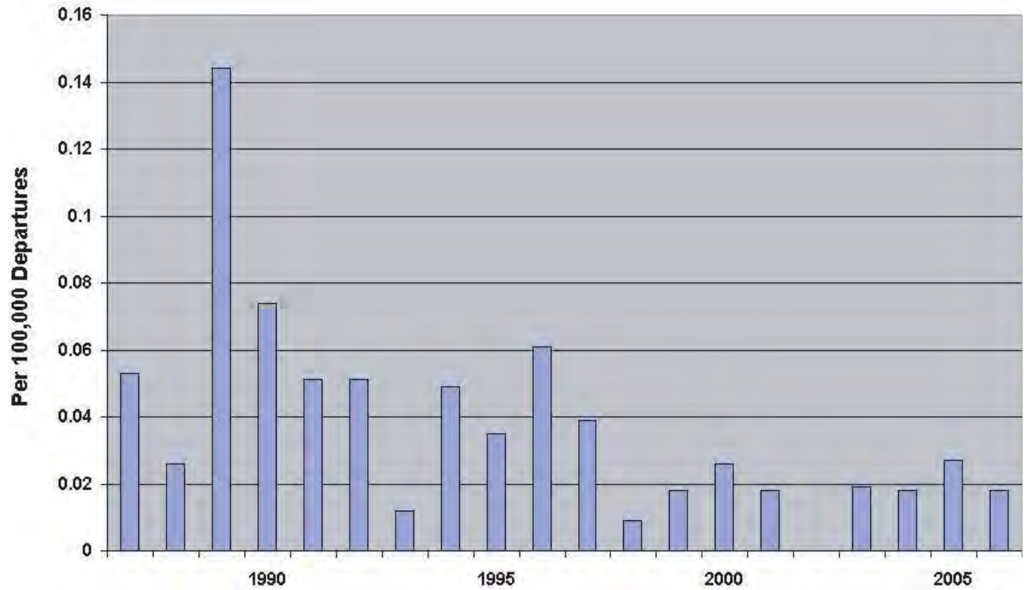
- Commercial Aviation Safety Team (CAST);
- Joint Safety Analysis Teams (JSAT);
- Joint Safety Implementation Teams (JSIT);
- Joint Implementation Monitoring Data Analysis Team (JIMDAT); and
- General Aviation Joint Steering Committee (JSC).

Improved safety management technologies, strategies, and programs include the widespread adoption of Flight Operational Quality Assurance (FOQA) programs within airlines and increasingly corporate aviation requirements for formal safety management systems (SMS), and the development of nonpunitive programs to encourage reporting and analysis of incidents and hazardous occurrences such as Aviation Safety Action Programs (ASAPs) in airline flight operations departments (FAA 2002).

The combined result of all these, and other safety enhancement efforts, appears to be reducing aircraft accident trends shown in Figure 1.7-1 and Figure 1.7-2.

The fatal accident rate for commercial aviation in the United States for the 10-year period from 1997 to 2006 is significantly lower than for the previous 10-year period, although the rate appears to have been stable for the past 10 years. The average fatal accident rate for 1987-1996 was 0.054 fatal accidents per 100,000 departures, while the rate for 1997-2006 was 0.019 (a decline of about 65%). The fatal accident rate for general aviation shows a much smaller reduction. After showing a steady decline through the 1990s, the general aviation rate appears to be showing an increasing trend in recent years. The average fatal accident rate for 1987-1996 was 1.6 fatal accidents per 100,000 flight hours, while the rate for 1997-2006 was 1.3 (a decline of approximately 20%).

These data exclude fatal accidents due to terrorism, suicide, sabotage, and use of stolen or unauthorized aircraft, including the terrorist attacks involving commercial airliners that resulted in

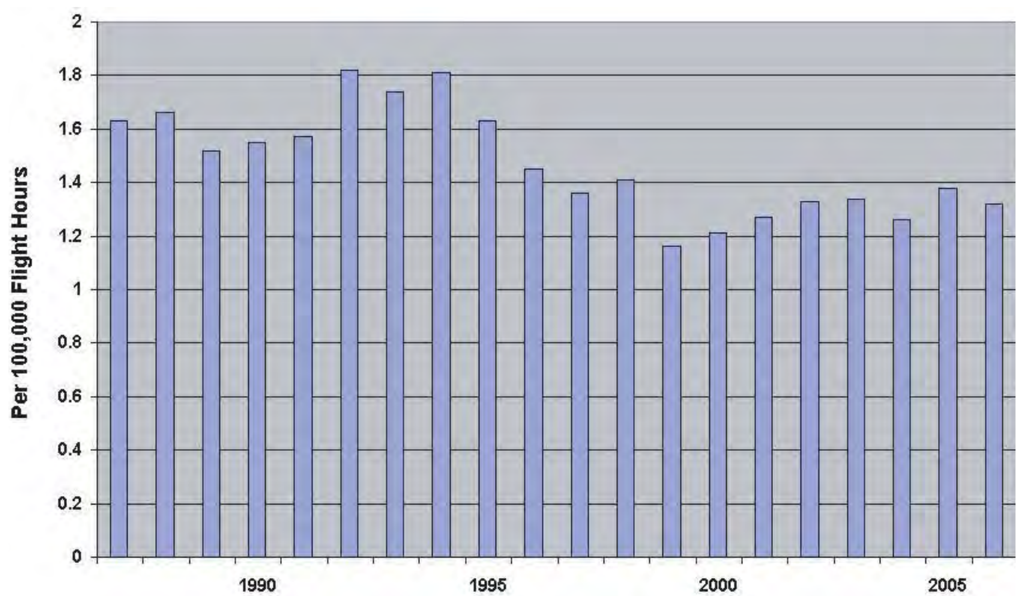


Source: Data from NTSB, Aviation Accident Statistics, 2007
Scheduled and Nonscheduled Operations under FAR Part 121

Figure 1.7-1. Fatal accident rate – large commercial air carriers.

fatalities on September 11, 2001. While it is clear that these incidents are not accidents in the sense of an unintended event, the extent to which they should be included in the calculation of risk to those on the ground is open to debate. In any event, the terrorist attacks of September 11, 2001, occurred at specific targets that were not in the immediate vicinity of an airport (or only coincidentally so in the case of the Pentagon), while the other cases are not likely to have a significant affect on the statistics.

Starting in Fiscal Year 2008, the FAA changed its safety metric for commercial air carrier accidents from fatal accidents per 100,000 operations to fatalities per 100 million people on board. While this new metric may give a better measure of the risk to an individual air traveler, it is not a



Source: Data from NTSB, Aviation Accident Statistics (NTSB 2007), Operations under FAR Part 91

Figure 1.7-2. Fatal accident rate – general aviation operations.

particularly relevant measure from the standpoint of third-party risk, which is primarily concerned with the risk that an aircraft accident will occur at a particular location, not the risk to the people on board the aircraft. There is also the practical difficulty of obtaining a time-series of past accident rates using the new metric. For these reasons, the discussion of commercial aircraft accident rates in this working paper uses the established NTSB metric of fatal accidents per 100,000 departures.

Aircraft Accident Locations

The distribution of the location of aircraft accidents with respect to runway ends has been a subject of considerable interest for some time. This distribution affects the design of airfield safety areas and separation criteria, as well as control over development in areas beyond the ends of the runways. This information has been used to establish safety criteria in the past based on subjective interpretation of the aircraft accident data. Recognition of the need to protect runway ends and control development within the airport environs in the United States dates back to the 1950s with the Doolittle Report. Similarly, the 1957 Committee of Safeguarding Policy in the United Kingdom suggested Public Safety Zones be adopted adjacent to runway ends in which development would be restricted. The proposed Public Safety Zones had a longitudinal limit of 4,500 feet on the basis that this would contain 65% of aircraft accidents occurring during landing and takeoff. Subsequent studies of the location of aircraft accidents near airports have attempted to determine both the longitudinal distance of each accident location from the departure threshold in the case of takeoffs or the landing threshold in the case of landings and the lateral distance from the runway centerline or extended centerline.

FAA Study of the Location of Commercial Aircraft Accidents/Incidents. In 1990, the FAA published the results of a study regarding the location of commercial aircraft accidents and incidents relative to runways (David 1990). This was based on a detailed examination of accident and incident data from investigations from 1978 to 1987 undertaken by the NTSB and FAA within the United States. Unfortunately, information pertaining to the exact locations where aircraft came to rest after an accident or incident was not always provided in the computerized data files. Therefore, investigators reviewed investigation notes contained within the accident or incident docket, and in some cases, contacted the investigators and/or others familiar with the event or reviewed media accounts. The study then classified each accident or incident into one of five types:

- Undershoots;
- Landings off the runway;
- Veeroffs;
- Overruns; and
- Other events in the vicinity of the airport.

Undershoots occur when an aircraft does not reach the beginning of the runway or lands short when approaching the runway for landing. Landings off the runway indicate that during landing, the aircraft does not touch down on the runway pavement but lands somewhere other than on the runway surface, such as a landing on a taxiway that was mistaken for the runway. Veeroffs or overruns involve an aircraft that lands or is in the process of taking off and veers or overruns off the runway surface. Other events were defined as landings where the aircraft came to rest more than 2,000 feet short of the runway threshold or takeoffs where the event occurred after the aircraft had become airborne but before the first airborne power reduction or the aircraft reached the airport traffic pattern altitude. Of the over 500 accidents or incidents reviewed, 246 were identified as relevant to the study. A detailed database was assembled with key information for each event including:

- Airport;
- Aircraft type;
- Operator;

- Type of operation;
- Runway length, width, and surface condition; and
- Lateral and longitudinal distance from the threshold where the aircraft came to rest.

In cases of excursions, instances where aircraft leave the runway surface, the database also noted the distance from the threshold where the aircraft first left the runway, the maximum distance from the runway that it traveled, and the distance from the threshold where it re-entered the runway. Also included was a remarks field that provided more detail on the event, such as whether the aircraft was operating under instrument meteorological conditions or if a missed approach had been initiated.

Of the aircraft in the FAA study involved in either an accident or incident, there were 18 undershoots of which eight occurred within 200 feet of the threshold and all but three occurred within 1,000 feet of the threshold. There were two overruns, each of which traveled more than 1,000 feet beyond the departure threshold. However, 37 landing aircraft came to rest more than 2,000 feet from the arrival threshold while 50 aircraft on takeoff came to rest more than 2,000 feet from the departure threshold. For a significant proportion of the events that ended up more than 2,000 feet from the threshold, it was not possible to identify either the longitudinal or lateral location where the aircraft came to rest. This data illustrates the need for appropriate land use controls to protect the safety of people in an aircraft as well as those on the ground in proximity to airport runway ends.

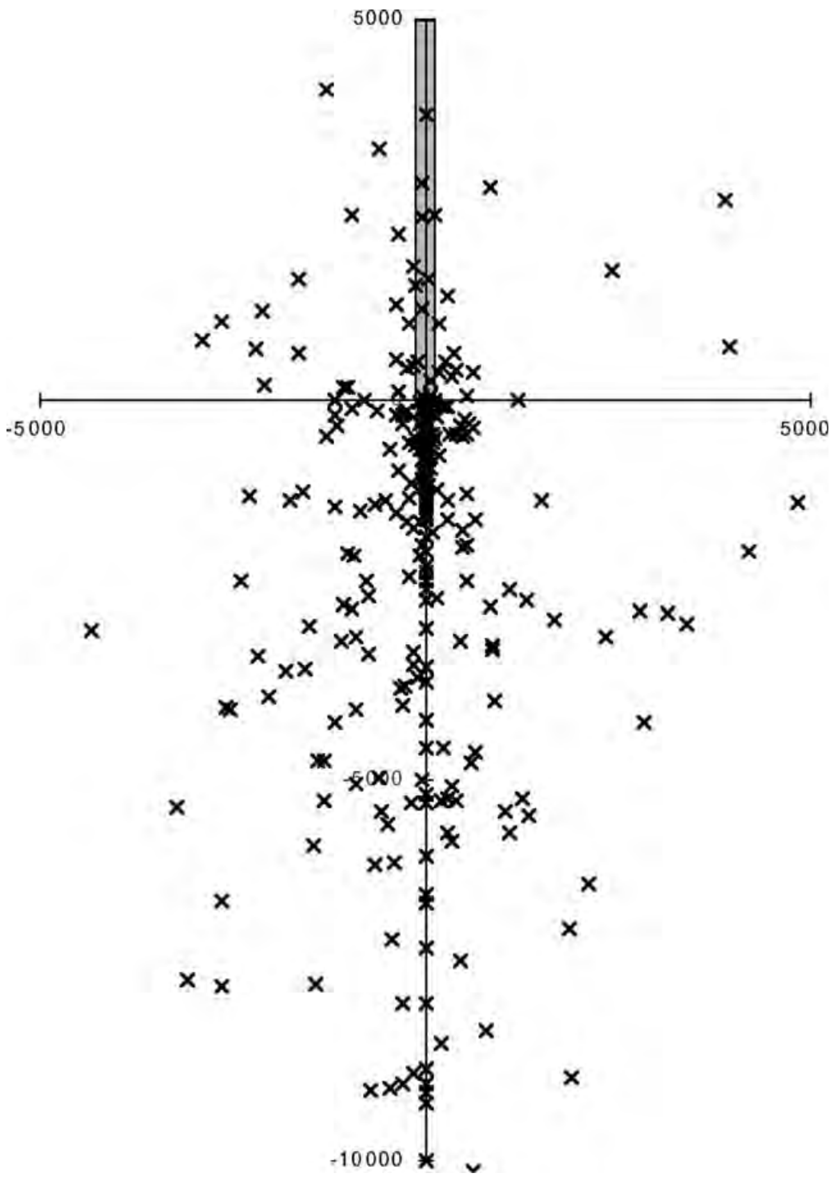
Institute of Transportation Studies General Aviation Accident Database. As part of the research for the development of the California Airport Land Use Planning Handbook, the Institute of Transportation Studies (ITS) at the University of California at Berkeley developed a database of the location of general aviation aircraft accidents in the vicinity of airports (Cooper & Gillen 1993). The initial study examined NTSB accident data for 11 states for the years 1983 to 1989 and the remaining states for the years 1983 to 1985 and identified those accidents that occurred within five miles of a departure or arrival into airports. Further research was conducted utilizing microfiche copies of the detailed Factual Accident Report for the selected accidents to identify a more precise location of the accident, defined as the point of initial impact or touchdown and measured with respect to the landing threshold or runway end at the start of the takeoff roll. A large number of accidents were rejected because the accident reports did not provide sufficient information to identify the location with sufficient accuracy. The resulting database included 396 accidents classified into arrivals and departures, in-flight collisions, and accidents in which the pilot had no control of the landing location of his aircraft. Plots were then generated showing the locations with respect to the runway end.

A subsequent study (Cooper & Chira-Chavala 1998) followed the same procedure to expand the database to cover accidents in all 50 states for the period from 1983 to 1992. This study yielded a much greater number of accidents totaling 873 in all. A typical accident plot from the second study is shown in Figure 1.7-3.

In addition to the accident location relative to the runway end, the database included a range of information from the NTSB Factual Report, including:

- Airport where the accident occurred;
- Aircraft make and model;
- Date and time that the accident occurred;
- Prevailing weather conditions;
- Extent of pilot control;
- Accident swath length and direction;
- Whether the accident involved an in-flight collision with an obstruction; and
- Number of fatalities and serious injuries onboard the aircraft and on the ground.

Of the 873 accidents, only six involved fatalities on the ground, as shown in Table 1.7-1.



Source: Cooper, D.L., and T. Chira-Chavala,The Development of an Accident Database to Structure Land Use Regulations in Airport Runway Approach Zones, Part II, 1998

Figure 1.7-3. Scatter plot of arrival accidents in the ITS database.

Other Studies. As part of a study of the risk of aircraft accidents to those on the ground near airports undertaken by the UK National Air Traffic Services (NATS) Limited for the UK Department of Transport (Evans, Foot et al. 1997), an analysis was performed on location information for 354 aircraft accidents worldwide involving aircraft in airport-related phases of flight with a maximum authorized takeoff weight of 4 tons or more that occurred between 1970 and 1995. The results of this analysis are shown in Figure 1.7-4 and indicate that nearly 25% of landing accidents occurred within 1,640 feet of the runway end, while just less than 50% of both landing and takeoff accidents were within 164 feet of the runway centerline. This data can be used to assess the extent of the area in proximity to the airport within which in may be reasonably expected that aircraft accidents are likely to occur. The study also included a review of several earlier European studies of aircraft accident locations.

Table 1.7-1. Average values of select variables in the ITS accident database.

Category	Number*	Percentage
Accidents	873	
Arrivals	445	50.9
Visual Approaches	346	77.8
Precision Approaches	70	15.7
Non-Precision Approaches	28	6.3
Departures	428	49.0
Time		
Day	604	69.2
Night	220	25.2
Dusk	37	4.2
Dawn	11	1.3
Flight Rules		
VFR	688	79.0
IFR	182	20.9
Pilot Control		
None	665	76.1
Some	164	18.8
No Information	44	5.0
Inflight Collision Factor?	277	31.7
Yes	130	46.8
No	147	52.9
Number Of Engines		
Single	636	72.8
Twin	235	26.9
Other	2	0.2
Landing Pattern		
Left	687	84.7
Right	123	15.2
Aircraft Damage		
Destroyed	568	65.1
Substantial	304	34.8
Minor	1	0.1
Accidents With Onboard Fatalities	463	53.0
Accidents With Ground Fatalities	6	0.7
Accidents With Onboard Serious Injuries	227	26.0
Accidents With Ground Serious Injuries	6	0.7
Median Runway Length	4600	

*Numbers in each category may not add up to 873 due to missing data in some files
Source: Cooper, D.L., and T. Chira-Chavala, The Development of an Accident Database to Structure Land Use Regulations in Airport Runway Approach Zones, Part II, 1998

A study conducted by the HNTB Corporation in 2002 for the Minneapolis-St. Paul International Airport Joint Airport Zoning Board (HNTB, 2002) examined the distribution of aircraft accidents by flight segment or phase of flight based on NTSB accident data for the period from 1982 to 1998. The analysis found that 8.9% of all accidents occurred during the takeoff and initial climb phase of flight within 5 nautical miles of the runway, 4% occurred during final approach, and 4% occurred between the final approach fix and the final approach (within 8 nautical miles of the runway). However, only 0.4% of accidents occurred during a missed approach and only 0.3% occurred while in the airport traffic pattern. This same study also reported the findings regarding the location of commercial aircraft accidents between 1974 and 1997 relative to runway ends that was conducted by the Air Line Pilots Association (ALPA). That analysis covered 706 accidents worldwide, of which 192 were turbojet aircraft.

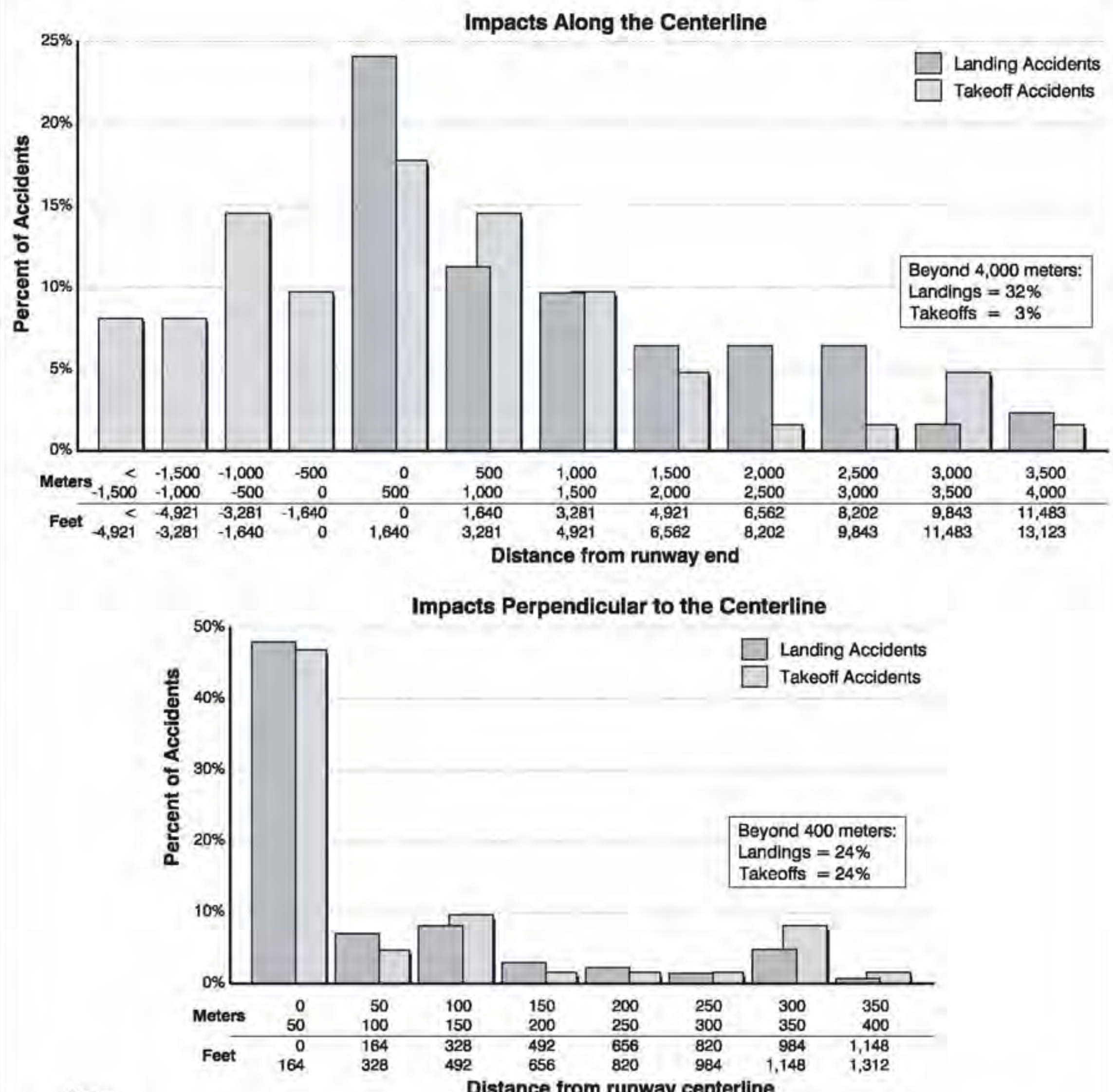
Safety Considerations for Those on the Ground Near Airports

In order to determine whether the possibility of an aircraft accident in the vicinity of an airport poses a large enough risk to people to place restrictions on particular land uses or activities, it is necessary first to define the level of risk and then determine whether that risk level is acceptable or not, based upon each airport's own risk tolerance and unique circumstances. The majority of the research conducted on measuring the risk to those on the ground near airports has been completed in Europe with a more subjective approach taken to assessments in the United States. Consequently, the following discussion of risk draws extensively from research completed outside the United States but considered relevant to this discussion.

Defining Risk

Not surprisingly, there is a large body of literature on the general subject of risks posed by hazardous activities to the people affected by them with the topic receiving considerable attention from social scientists, policy analysts, safety engineers, and others. Within this field, risk is defined as the value obtained by multiplying the probability of occurrence of some undesired event and the magnitude of the consequences were it to occur. Since the probability of occurrence is a dimensionless number (typically very small), the units of risk are the same as those in which the consequences are measured (e.g., the number of people killed). However, the probability of occurrence will depend on the time period over which the risk is being determined as it is common to express the probability of occurrence as the expected number of events per year. Due to this, the risk is measured in units of the expected consequences per year.

Although an aircraft accident can result in property damage and injuries to people on the ground, it is common to define the risk from such accidents solely in terms of the likelihood of



Notes:

- Data represents accidents involving commercial air carrier aircraft having a maximum authorized total weight of 4.0 metric tons or more. Locations are international and cover the period between 1970 and 1995.
- Takeoff and landing overrun accidents are excluded from this data.
- Landing percentages are based on 125 landing accidents occuring prior to the landing threshold; 55 landing accidents occurring beyond the threshold are excluded.
- Takeoff percentages are based on 62 takeoffs accidents; locations indicated are relative to the far (departure) end of the runway.

Source: National Air Traffic Services Limited, London; Third Party Risk Near Airports and Public Safety Zone Policy (1997)

Source: California Department of Transportation, California Airport Land Use Planning Handbook, 2002.

Figure 1.7-4. Distribution of air carrier accidents from NATS study.

people on the ground being killed. This implicitly assumes that the expected extent of injuries or property damage in the event of an aircraft accident is proportional to the number of people killed, and that in determining an acceptable level of risk of loss of life, this takes into account injuries and property damage that may occur as well. The reasonableness of this assumption is discussed further below.

When restricting land uses or activities near airports in order to reduce the risk to those on the ground, it is necessary to assess the level of risk due to an aircraft accident at particular locations. Since it would seem reasonable that the risk will decline with both distance from the aircraft flight paths and distance from the airport, it follows that a set of risk contours can be defined around the airport where each risk contour connects points of equal risk level, somewhat similar to aircraft noise contours (although quite possibly of a very different shape). The calculation of the expected risk level at a given location will depend on three factors:

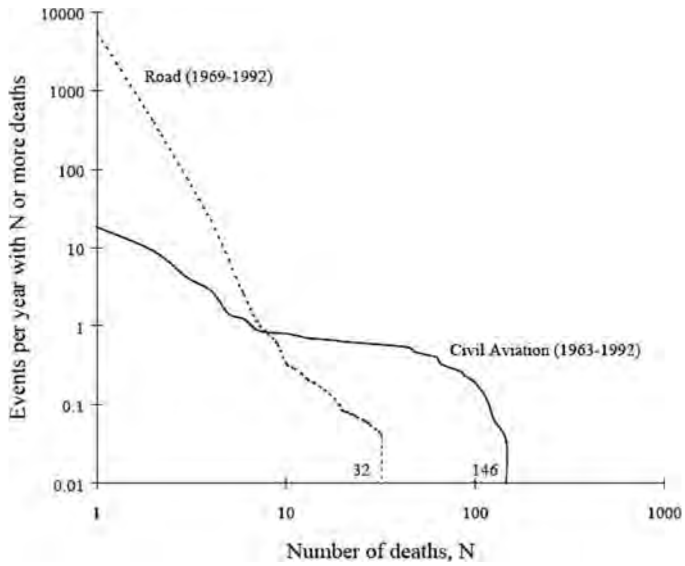
- The probability of an accident occurring at all;
- The probability that the accident (if it happens) occurs at the given location; and
- The expected consequences of the accident occurring at that location.

The expected risk level is the mathematical product of these three factors. However, the concept of an accident location deserves some discussion. What is really meant is the accident occurring in a way that causes adverse consequences (e.g., killing someone) at the given location. In general, a location of interest will have a finite size (e.g., a home or school). Similarly, an aircraft crash will typically create a damage swath. In the case of a large aircraft, particularly on takeoff when heavily loaded with fuel, there may be an extensive fire. Thus, the accident location may cover an extensive area, some of which may overlap all or part of the location of interest. The way both the location of interest and the accident location are defined will affect how the consequences are assessed. For example, if the area around the airport is divided into cells and the probability of an accident occurring in a particular cell occupied by the given location is determined as the second of the above factors, then the expected consequences will vary with the size of the cells. If the cell size were large, it would be possible for a crash to occur in the same cell as the given location. Thus, the expected consequences would vary inversely with the size of the cell.

It should be noted that any assessment of risk could only determine the expected level based on assumptions. Risk assessment is a statement about what can be expected to occur in the future, and the future is inherently unknowable. Unforeseen factors can arise (and quite likely will arise) that will change the circumstances from those assumed. Similarly, it should be understood that the probability of an event occurring at a particular rate (such as once every 10 years) does not mean that these events will occur at a uniform rate. Randomly occurring events follow what is called a Poisson process (named after the French mathematician who developed the mathematics that describe such a process) and occur at irregular intervals that can be quite short (this means that others are much longer than the average). Thus, even if the underlying probability of occurrence is once every 10 years, it is entirely possible (although rare) to have several events occur in the same year. Furthermore, if this occurs, it does not mean that it can be expected that there will be a longer interval to the next event. A Poisson process is said to be "memory-less." The probability of an event occurring in a given time period is independent of how many events already have occurred or when the last event occurred.

Individual Versus Societal Risk. An important distinction in calculating the risk posed by a particular hazard (such as an aircraft accident) is whether the risk applies to a single individual at a location in question or to a society as a whole. Individual risk, as the name implies, is the risk that would be incurred by a single individual occupying the location for a given proportion of the time. This is commonly calculated assuming that the individual occupies the location for 24 hours a day, 365 days per year. Of course, in reality, people do not usually remain at one location all the time (although there are special cases, such as nursing homes, where this may be approximately true). However, if the individual risk is calculated in this way, it can be easily adjusted for people who only spend a part of the time at the location in question. However, these adjustments typically assume that the risk is constant over time, so that someone spending only eight hours a day at the location would only have a third of the individual risk. This may be an oversimplification in the case of the risk to those on the ground from aircraft accidents, as discussed further below.

Societal risk measures the total risk to all people exposed to the hazard in question. It is clearly the appropriate metric to use when considering such issues as whether to locate a school, hospital, or sports arena in the vicinity of an airport. While the risk to any one occupant of a hospital (patient or staff) in a given location might satisfy the criteria for an acceptable level of individual risk, the possibility of having large numbers of people killed or injured in a single accident is clearly the issue of concern.



Source: Evans, A.W., P.B. Foot, et al., Third Party Risk Near Airports and Public Safety Zone Policy, June 1997

Figure 1.7-5. FN curves for British road and civil aviation accidents.

Risk analysts have suggested that one way to reflect the differing levels of risk with the scale of the potential consequence is through a frequency-number (FN) curve that indicates how the frequency of occurrence declines as the scale of the consequence, for example the number of deaths, increases as shown in Figure 1.7-5. Note that the FN curves in Figure 1.7-5 show what occurred, not whether people found that acceptable. However, comparing the curves for British road and civil aviation accidents, it can be seen that while there were far more road accidents than civil aviation accidents that killed nine or fewer people, there were more civil aviation accidents than road accidents that killed 10 or more people and some of these killed significantly more people than the worst road accident. However, civil aviation accidents that killed more than 10 people occurred less than once per year on average.

Although the FN curves shown in Figure 1.7-5 were derived for the country as a whole and considers all fatalities from road or civil aviation accidents and not just those for third parties, clearly similar curves could be developed for any particular geographic area, such as the area around a given airport, and could consider only fatalities to those on the ground from aircraft accidents. However, it would not be meaningful to base such an analysis on past accidents in the specific area, since in most cases very few or no such accidents will have happened. Rather, the analysis would need to develop FN curves analytically based on the anticipated probability of accidents occurring with a varying number of casualties. Clearly, this will depend not only on the probability of accidents occurring at different locations, but also how the density of people varies across the area. In such an analysis, the expected frequencies of occurrence of accidents with a given consequence will generally be very much less than one per year, and thus are more appropriately described as probabilities.

In contrast to individual risk, which is a single number that varies geographically across a given area, this approach to expressing societal risk applies to an entire area (although the area in question could be narrowly defined, such as specific facility) and is a functional relationship between the magnitude of the consequence and the expected frequency of its occurrence. It thus attempts to answer the question how likely a truly catastrophic accident could occur.

Societal risk is also an appropriate metric for considering the overall costs and benefits of changes to the airport, as distinct from changes to the land uses around the airport. Consequently, construction of a new runway, which may expose an entire community to a risk that did not exist before, should consider the societal risk involved and not just the individual risk to each person in those communities. Whether to express risk in terms of individual risk or societal risk depends on the question being faced. It is important to understand the difference between the two measures and to use the appropriate one for any given policy issue or the results of the analysis could be highly misleading.

Determining Acceptable Risk

Calculating the risk of some particular undesirable outcome, such as the risk of someone on the ground being killed in an aircraft accident, is one thing. Deciding whether that risk is acceptable is an entirely different issue. While the calculation of risk is largely a technical issue (although the reasonableness of the assumptions used may be open to debate), deciding an acceptable level of risk is essentially a political issue and will most likely vary from situation to situation. Since reducing the risk of an accident will generally involve some cost, either to those benefiting from the activity creating the hazard in question (such as operating or flying in aircraft) or to those whose activities are curtailed in some way in order to reduce their exposure to the hazard, determining an acceptable level of risk involves trade-offs between the benefits of the activity creating the hazard and costs incurred by those exposed to the hazard, either through foregone opportunities, the additional cost of protective measures to reduce the risk, or the costs incurred if an accident occurs. This trade-off becomes more complicated in situations such as the risk to those on the ground near airports where those benefiting from the activity are different from those incurring the risk.

This issue is not unique to the risk to those on the ground around airports and arises in a number of policy questions involving public safety, notably hazards posed by such activities as nuclear power plants and industrial facilities involving flammable, explosive, or toxic materials. As a result, governments have generally established criteria for acceptable levels of risk, although sometimes these criteria are buried in what may appear to be technical decisions and not always based on a consistent approach. However, it is generally recognized that acceptable levels of risk are greater for activities that are voluntarily undertaken and from which the person exposed to the risk derives some benefit than what the risks are imposed on individuals without their agreement or from activities from which they derive no additional benefit compared to the population at large. Thus, one might expect that the level of acceptable risk to an airline passenger on a flight would be greater than for those on the ground near airports, since the airline passenger derives some benefit from the flight and is in a position to decide if the risk involved is justified by the benefit. The person living under the flight path from an airport has no choice in whether aircraft fly overhead or not and does not derive any specific benefit from those flights beyond that derived by others in the population who are not exposed to the risk. However, determining what is an appropriate difference in acceptable risk between these two situations is another matter entirely.

It is also recognized that from the perspective of public policy, it is desirable that the criteria for acceptable risk should be applied consistently across different activities. This not only facilitates the consistent formulation of public policy in different areas, but also satisfies basic concepts of fairness. It is hard to argue that those living near an airport are somehow deserving of a different level of safety than those living near an oil refinery or chemical plant. While this may be accepted in principle, it is often less clear how it should be applied in practice, since the nature of the hazards involved is often very different.

Catastrophic Events. Notwithstanding the need to ensure a consistent application of acceptable risk criteria, it is also recognized that the scale of the potential consequences do affect the level of risk that society is willing to accept. In general, people are less willing to accept the risk of an event that could have catastrophic consequences than one of a similar level of risk where the worst case (although more frequent) outcome is much less severe. Thus, the public expects a higher level of safety from nuclear power plants than from railroad crossings. Discussion of this issue is complicated by the fact that, in general, the probability of occurrence of a catastrophic outcome (for example, a wide-body commercial aircraft crashing into a school) is much lower than for a less disastrous outcome, such as a small general aviation aircraft crashing into a house. People appear to have a harder time evaluating the risk of something that is expected to occur very rarely indeed than something that occurs on a much more frequent basis.

While the use of FN curves provides a convenient way to express how the probability of an event occurring changes with the severity of the consequences, it is less clear how to express acceptable levels of risk in this situation. Conceptually, one can imagine an "acceptable risk limit" that would be a functional relationship between the magnitude of the consequence and the acceptable probability of events (in effect a curve on an FN diagram). As long as the predicted FN relationship lies below the acceptable risk limit, the risk would be considered acceptable. However, quantifying such a relationship has proven difficult, in part because the probabilities depend on the area considered.

Ranges of Acceptable Risk. Discussion of levels of acceptable risk is further complicated by three considerations. First, the level of risk that people are willing to tolerate depends in part on their perception of the value of the activity creating the risk. Although they may not undertake a formal cost-benefit assessment, there is nonetheless recognition that it may be acceptable to incur higher risks from activities that offer greater benefits. Second, the view of the acceptable level of risk may be different between those exposed to the risk and those who are not, in particular between those establishing safety policies and those likely to suffer the consequences if an accident occurs. Governments are understandably anxious to facilitate activities such as air transportation that contribute to the general economic well-being, while those directly at risk are more likely to be concerned about their own personal exposure rather than the general good. Third, defining a limit of acceptable risk does not mean that there should not be efforts to improve safety beyond that point. There are clearly benefits to reducing risk below the level that is deemed the threshold of acceptability.

As a result, it is common to define a range of risk between an upper bound that should not be exceeded and a lower level that is so sufficiently small that it can be reasonably ignored (sometimes termed the *de minimis* level). Recognizing that reducing risks typically incurs costs or results in foregone benefits and that these costs or foregone benefits are likely to vary with the situation, government policies often require efforts to reduce risk to levels "as low as reasonably practical" putting the onus on those considering a specific project to establish what this is.

Implications for Risk Assessment

It follows from the foregoing discussion that an assessment of risk of an aircraft accident occurring in the same location as those who live near airports needs to take account not only the probability of an accident occurring at any given location, but also the range of possible consequences. While the probability of an accident occurring to any given aircraft landing at or departing from an airport may be viewed as a random occurrence, the distribution of the location where the accident occurs (strictly where the aircraft impacts the ground) is clearly not random, but rather will depend on the distribution of the flight paths and the likelihood of an accident occurring at different points along the flight path. Therefore, consideration needs to be given to the pattern of accident locations with respect to the arrival and departure flight paths and the distance from the ends of the runway in question.

Since the level of risk is determined by both the probability of an accident occurring at a given location and the consequences of such an occurrence, consideration also must be given to the type and size of aircraft involved. Since there is a difference between a single-engine, two-seat aircraft crashing into a neighborhood and a wide-body aircraft loaded with fuel doing the same thing, the analysis of the risk of an aircraft accident to those on the ground should consider the pilot's ability to minimize the consequences of an accident. Since a common cause of general aviation aircraft accidents on takeoff is engine failure, in which the pilot still has the ability to select the location for a forced landing, care must be taken in analyzing the locations of such accidents. While a given accident may have occurred in a field in a particular location relative to the end of the runway, it does not follow that the accident would have occurred in the same location if there had been a school there. This is not just the result of pilots trying to minimize danger to others. Their own chances of survival are greatly improved if they are able to avoid colliding with large, solid structures.

A third consideration in assessing the level of risk is the nature of the land use or development at each location. In particular, large concentrations of people will result in a higher level of risk due to the greater potential consequence of an accident. However, consideration also has to be given to the proportion of time that any particular facility is occupied. A sports stadium may have a large number of occupants for a few hours, but will spend large proportions of time with just a few staff present. In contrast, a hospital may have fewer occupants but a more consistent level of occupancy over time. It therefore follows that any risk assessment needs to consider potential for some land uses resulting in a large number of casualties in the event of an aircraft accident at that location, even if the risk to any one individual at that location is fairly small.

The typical approach to expressing individual risk assumes that the individual is at the given location for 24 hours per day. In practice, the level of occupancy of particular land uses varies considerably over the day. While residences normally have fewer people in them during the daytime, the reverse is true for offices. However, the level and composition of air traffic using an airport also varies over the day, and thus the risk of an accident. While residences have higher levels of occupancy at night, the level of air traffic is typically much less and thus the overall risk may be lower. Conversely, while office buildings may only be heavily occupied for perhaps 10 hours a day, those hours also correspond to the hours of the greatest level of air traffic and thus the risk to the occupants is not reduced proportionally to the fraction of the day that the buildings are occupied. While the appropriate adjustments are not difficult to do, they do require information on both the variation in occupancy of different facilities over the day and the hourly pattern of air traffic activity.

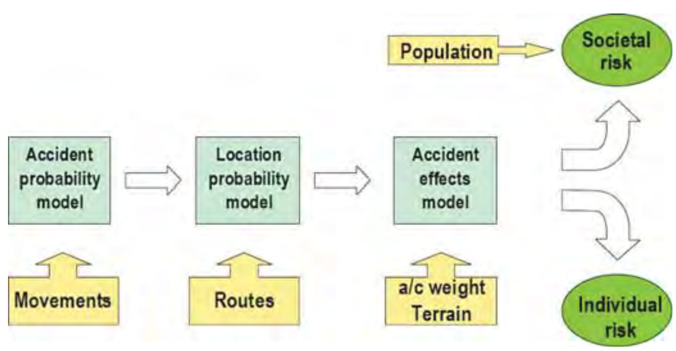
Analysis of the Risk of Aircraft Accidents to Those on the Ground

Past studies of the risk to those on the ground from aircraft accidents fall into two broad categories: studies that discuss or have attempted to quantify this risk in general and those that have attempted to quantify the risk around specific airports or have developed analytical models to predict risk levels around a specific airport. The former include studies undertaken as part of academic research into risk analysis and management while the latter is mostly performed by or for aviation-related organizations for planning or regulatory purposes. The studies or articles within each category are discussed in chronological order to illustrate the evolution of prior work on the subject.

General Approach to the Analysis of Safety Around Airports. A briefing paper prepared by the European Transport Safety Council (ETSC) titled, Safety In and Around Airports (ETSC 1999), looked at a broad range of safety issues affecting airports, including the risk of aircraft accidents to those on the ground. The ETSC examined the growing concern regarding the increased levels of air traffic, as well as public concern about airport safety. The study was in part initiated from a number of highly visible aircraft accidents and incidents, including the crash of a Boeing 747 into an apartment building in Amsterdam in 1992. These concerns prompted the ETSC to take action to address the management of safety in and around European airports to protect the health, safety, and welfare of residents in proximity. The paper identified a number of emerging trends affecting safety management at airports, including a concern over the risk to those on the ground in a growing number of European countries. It reviewed the institutional framework for managing airport safety and identified several critical safety issues that needed to be addressed. The findings suggested that a common framework for risk management was needed, including managing the risk to third parties, and called for the establishment of third-party risk tolerability criteria for land use planning and common risk assessment methodology. In addition, it is recommended that a number of actions be undertaken by the European Commission, including mandatory inclusion of third-party risk in Environmental Impact Statements, for all European airports.

A subsequent paper by Ale, Smith & Pitblado (1999) also examined the recent developments regarding safety around airports and discussed future directions to address the risk to those on the ground near European airports. The paper noted the increasing concern about risk levels near airports, as mentioned in the 1999 ETSC paper, and reported that assessments of risk near a major airport indicated that these risks could be comparable to those associated with major chemical plants. As noted by the authors, chemical plants are subject to strict legislation requiring the operators to manage risks to third parties through structured safety management systems, implement practicable risk reduction measures, and undertake emergency planning. The paper reviewed the recent experience with third-party risk assessment in the Netherlands and the United Kingdom and identified lessons for other countries.

The Ale, Smith & Pitblado paper briefly described the history of the application of risk analysis in the Netherlands to policy issues such as the height of flood defenses and construction of liquefied petroleum gas shipping terminals. It then discussed the application of this approach to decision making regarding the expansion of Schiphol Airport in Amsterdam and the intensified concern following the Boeing 747 crash in October 1992 that killed 39 people on the ground. Figure 1.7-6 summarizes the methodology for third-party risk assessment that was developed by the Netherlands National Aerospace Laboratory (NLR). The paper also discussed alternative risk metrics and defined individual risk as the probability per year that a person permanently residing at a particular location in proximity to an airport would be killed as a direct consequence of an aircraft accident, while societal risk is the probability that in a given year 'N' or more people would be killed as a direct consequence of a single aircraft accident. It was noted that individual risk is location-specific, while societal risk is determined for the entire area surrounding an airport.



Source: Ale, B., E. Smith and R. Pitblado, Safety Around Airports – Developments in the 1990s and Future Directions, 1999

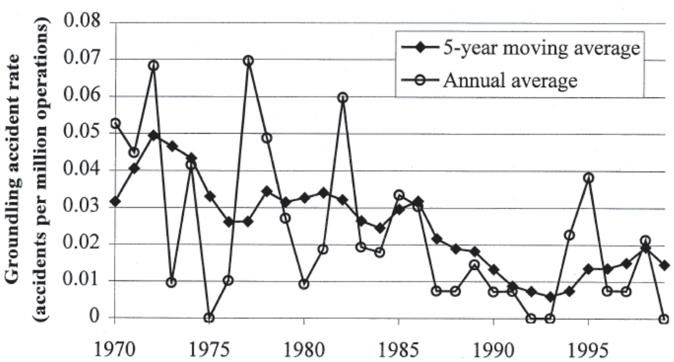
Figure 1.7-6. Components of the NLR approach to airport risk calculations.

The paper reported that the limits for individual risk established by the Dutch government at the time for industrial facilities were set at 10^{-6} per year for new situations or developments and 10^{-5} per year for existing situations or developments. These limits were established by law and could not be exceeded. The limits for societal risk were guidelines and defined as a frequency of occurrence of $10^{-3}/n^2$ (where presumably 'n' is the same as 'N' in the definition of societal risk, although the authors are unclear regarding the 'N' factor presented).

The Ale, Smith & Pitblado paper also discussed the history of development of standards for Public Safety Zones (PSZs) in the UK and the application of formal models of third-party risk for the reassessment of PSZ criteria in the late 1990s. In the early 1990s, third-party risk became a major issue during the Public Enquiry into a proposed second runway for Manchester Airport, and risk assessments were made by a number of parties and introduced into evidence. With a major inquiry into the planned Terminal 5 at London Heathrow about to begin, the Department of Transport (as it then was called) commissioned a study to develop suitable methodology for third-party risk assessment and suggest appropriate risk criteria, which was undertaken by a team of consultants led by the National Air Traffic Services (NATS) Limited (Evans, Foot, et al. 1997).

Risk of Fatalities from Unintentional Aircraft Crashes

A subsequent paper by Thompson, Rabouw, and Cooke (2001) examined the risk of fatalities from unintentional aircraft crashes to those on the ground, termed "groundlings." The NTSB aircraft accident data from 1964 to 1999 was utilized for this study and the trend in the number of accidents over this period was investigated. The study concluded that the risk of an accident in which someone on the ground was killed had declined throughout this time period. The analysis excluded fatalities to people voluntarily exposed to the hazard of being involving in an aircraft accident, such as ground crews. The "groundling accident rate" was defined as the number of aircraft accidents in which people on the ground who were uninvolved in the flight were killed per million operations. The resulting annual average and 5 year moving average rate is shown in Figure 1.7-7. The study concluded that the groundling accident rate appeared to be stable from the late 1980s through 1999. The authors calculated separate rates for air carrier, air taxi and commuter, and general aviation operations for the period 1987 to 1999, as shown in Table 1.7-2.



Source: Thompson, K.M., R.F. Rabouw, and R.M. Cooke, *The Risk of Groundling Fatalities from Unintentional Airplane Crashes*, December 2001

Figure 1.7-7. Groundling accident rate 1970-1999.

Table 1.7-2. Average groundling accident rate by type of operation 1987-1999.

Category	Air carrier	Air taxi/commuter	General aviation
Number of groundling accidents in 1987–1999[a]	2	4	14
Number of airport operations in millions 1987–1999[b]	174.5	174.3	1,413.4
Groundling accident rate per million operations[c]	0.011	0.023	0.0099

[a] Counting collisions between aircraft of different categories in each category because two planes were involved in the accident (total number of groundling accidents is 19, which includes one collision between an air carrier and general aviation and one collision between an air taxi/commuter and general aviation).

[b] Numbers are provided by the Terminal Area Forecasting system of the Federal Aviation Administration.[9]

[c] Groundling accident is an accident that causes at least one groundling fatality.

Source: Thompson, K.M., R.F. Rabouw, and R.M. Cooke, *The Risk of Groundling Fatalities from Unintentional Airplane Crashes*, December 2001

As shown in Figure 1.7-7, the 5 year moving average of the overall accident rate steadily declined from 1986 to 1993 to an all-time low, then increased again in 1998, largely as result of the increase in annual accident rates in 1994 and 1995. However, given that there were only 20 accidents in the dataset from 1987 to 1999, it is unclear whether the apparent stability in the accident rate that the authors observed in the data was merely a result of the very low number of accidents in any given year the nature of random processes. Interestingly, the study found that the average groundling accident rate for general aviation during the period 1987 to 1999 was not significantly different from that for air carrier accidents. Although the authors do not discuss this aspect, one possible explanation is that the higher rate of general aviation accidents is offset by the fact that fewer of them involve ground fatalities due to the smaller size of the aircraft and extent of development around general aviation airports compared to commercial service airports.

The study calculated the expected number of fatalities of persons on the ground per aircraft accident by type of operation using the full dataset from 1964 to 1999. The average number of fatalities was greatest from air carrier accidents and least from general aviation accidents, as shown in Table 1.7-3. However, the difference between the average number of fatalities per accident for air carrier accidents and general aviation accidents is surprisingly small, given the relative size of typical aircraft within the two categories.

Table 1.7-3. Average number of fatalities per grounding accident 1964-1999.

Category	Air carrier	Air taxi/commuter	General aviation
Number of groundling accidents in 1964–1999[a]	14	11	66
Number of groundling fatalities in 1964–1999[b]	60	25	120
Expected number of groundling fatalities per groundling accident	4.3	2.3	1.8

[a] Counting collisions between aircraft of different categories in each category because two planes were involved in the accident (88 accidents total includes two collisions between general aviation and air carriers and one accident between general aviation and an air taxi/commuter).

[b] Groundling fatalities that resulted from a collision between aircraft of different categories were evenly divided.

Source: Thompson, K.M., R.F. Rabouw, and R.M. Cooke, *The Risk of Groundling Fatalities from Unintentional Airplane Crashes*, December 2001

In conclusion, the study utilized the results of the foregoing analysis to perform two separate analyses regarding exposure of the population to the risk of an aircraft accident. The first analysis utilized FAA forecasts of expected air traffic growth and population projections from the U.S. Census Bureau to explore the likely future change in average risk across the population as a whole. Since the forecast air traffic and population increased at approximately the same rate and the analysis assumed a stable accident rate per million operations, the resulting projected accident risk did not change significantly. The second analysis developed a model of expected risk to those on the ground as a function of distance from an airport. This considered the distance of crash locations from the relevant airport and the distribution of population relative to different categories of airport using a geographical information system (GIS) analysis of U.S. census data. As would be expected, the results showed that risk declines as distance from an airport increases. Thus, the primary value of the study lies in the analysis of accident rates and fatalities per accident.

Minnesota Airport Land Use Compatibility Manual

Carter and Burgess, Inc., in association with Clarion Associates, undertook a review of third-party risk research and analysis that was incorporated into Appendix 7 of the Minnesota *Airport Land Use Compatibility Manual* (Minnesota Department of Transportation 2006). The review discussed the criteria used in various studies to determine crash probability, crash distribution, crash size, and population density. The review noted that the FAA criterion for the length of the Runway Safety Area (RSA) beyond the end of the runway is based on containing 90% of undershoot or overrun accidents, while 90% of the crash locations identified in the 1997 NATS study (Evans, Foot *et al.* 1997) occurred within a rectangle centered on the extended runway centerline approximately 2,200 feet wide and extending 9,800 feet beyond the runway end.

This study proposed a crash probability relationship based on the 20 year average aircraft accident rates for air carriers, commuter airlines, and general aviation from NTSB accident data for the time period of 1984 to 2003. The study also contains a discussion of the likely size of the crash area and relative kinetic energy of different aircraft types.

Analysis of Risk to Those on the Ground Near Specific Airports

A number of studies have analyzed the risk to those on the ground around specific airports or developed third-party risk analysis models, as discussed below.

UK Public Safety Zone Policy

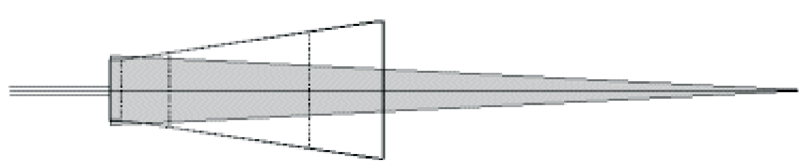
In 1997, the UK Department for Transport (DfT) issued a consultation document on PSZs at airports (UK Department for Transport 1997). This document summarized the results of a consultant study that had been undertaken by a team led by NATS Ltd. and discussed tolerable risk criteria, proposed changes to the shape of PSZs, and guidelines for allowable development within PSZs. It also raised a number of policy issues on which the department sought public input.

The details of the consultant study are presented in a separate report prepared by NATS (Evans, Foot, et al. 1997). This undertook an extensive review of third-party risk analysis performed by other organizations, described a third-party risk model developed by NATS, and documented the application of this model to five sample airports in the UK. The recommendations of the consultant study, that were incorporated into the DfT consultation document, resulted in a significant change in the shape of the proposed PSZs compared to the previous standards, as shown in Figure 1.7-8. Unlike the trapezoidal shape of the previous standard, the proposed PSZs based on third-party risk contours (the gray area in Figure 1.7-8) form an isosceles triangle with the greatest width at the runway end and reducing to a point on the extended runway centerline some distance from the runway. Although the length of the PSZ varies with the extent of the risk contours, the analysis of the five sample airports indicated that in general the PSZ should extend much further from the runway than the previous standard.

More details of the development of the UK Public Safety Zone Policy and the supporting studies are presented in Volume I, Appendix A, *European Approach to Third-Party Risk Analysis.*

Airport Hazard Overlay Zone Analysis for the Town of Hilton Head Island

In 1999, Shutt Moen Associates was retained by the Town of Hilton Head Island to assist in the revision of its Airport Hazard Overlay Zone Ordinance (Shutt and Moen Associates 2002). The study involved two tasks: development of proposed hazard zone boundaries based on accident probabilities and definition of potential policies for the hazard zone ordinance. The airport was projected to serve about 100,000 aircraft operations per year, mostly general aviation with a small amount of commuter and air taxi activity. The analysis of accident probability was based on the most recent NTSB data for the national accident rate for commuter/air taxi and general aviation operations. It was noted that the accident rates had declined since 1976, but the analysis did not assume any further reduction in accident rates. The analysis of the expected accident distribution was based on the data of general aviation accident locations collected by the Institute of Transportation Studies (ITS). Contours of equal accident risk were developed for operations in each direction on the runway. These were not symmetrical since the accident location data was not symmetrically distributed on either side of the runway centerline. This is largely due to a statistical artifact of the relatively small number of accidents at any given distance from the runway. The overlap of these different areas resulted in some 21 different zones being defined with an associated average number of years between a fatality and serious injury to those on the ground. These zones were then aggregated into areas of low risk, moderate risk, and high risk. The high and moderate risk areas were used to define an Inner Hazard Zone and an Outer Hazard Zone. However, the report does not show the boundaries of these hazard zones.



Source: UK Department for Transport, Public Safety Zones: A Consultation Document, 1997

Figure 1.7-8. Comparison of proposed PSZ shape compared to previous standard.

The Inner Hazard Zone was defined to include the runway protection zone, the object free area, and the obstacle free zone, as defined by the FAA. The report presents a number of potential intensity of use or density limits, site design criteria, structural standards, and prohibited uses for consideration in the Overlay Ordinance. The report includes a discussion of the safety impact thresholds developed by the County of Santa Barbara, California for determining the significance of risk associated with major events such as landslides or offshore oil spills. These are based on a comparison of the expected frequency of occurrence and the severity of the consequences. However, the report noted that this approach had not been previously applied to aircraft accidents and that applying the Santa Barbara definitions would consider the risk level in the entire area designated low risk to have a significant level of risk. (Strictly, the Santa Barbara methodology was developed for environmental impact assessments and refers to a “significant impact.” Whether this is the same thing as a significant level of risk is unclear and not discussed in the report.) Therefore, the report redefined the frequency classifications from those used in the Santa Barbara methodology so that only the areas of high and moderate risk were considered significant (presumably, the authors meant the areas would have a significant level of risk).

This study points out some of the difficulties with applying any sort of risk analysis to aircraft accidents around airports. Aside from the technical issue of determining what the level of risk is in any given area, these risk levels are likely to be very low (the levels found in the study for different areas ranged from an average of about 3,700 years between accidents resulting in a fatality or severe injury to someone on the ground to over a million years between such accidents). It is also unclear from the report whether these risk levels are the risk to any one individual or the risk of such an accident occurring somewhere within each zone. If it is the latter, then the individual risk is even lower. Furthermore, it is unclear from the report how the expected consequence of each accident was determined. Accepting the projected frequencies of fatalities or serious injuries at face value, the critical issue becomes how to decide what a tolerable level of risk is. It seems quite plausible that most people would consider the risk of a fatal accident every 3,000 years rather remote and not something that they would spend much time worrying about.

NLR Model of External Risk Around Airports

In 1992, the NLP developed a method for calculating the risk to those on the ground around airports. This comprised three sub-models: accident probability, accident location probability, and accident consequence (Ale, Smith, and Pitblado 1999). With the availability of additional historical data and the experience gained in applying the model in many airport risk studies, the risk models were updated in 1999 (Pikaar, Piers, & Ale 2000).

The risk models were applied to assessing the risks to those on the ground around Amsterdam Schiphol Airport, as described in more detail in Volume I, Appendix A, *European Approach to Third-Party Risk Analysis.* The updated models give a significantly lower level of individual risk than the earlier model. In the case of Amsterdam Schiphol Airport, the areas within the 1 in 1,000,000 individual risk contours were significantly reduced, while the corresponding FN curve for any given level of severity (more than N fatalities per year) gave between a 5-fold to 10-fold reduction in risk.

HNTB Study of Aircraft Accident Risk at Minneapolis-St. Paul International Airport

In 2002, the HNTB Corporation was asked by the Minneapolis-St. Paul International Airport (MSP) Joint Airport Zoning Board to investigate whether there are any empirical data to support the imposition of Minnesota State Safety Zones outside the FAA RPZ at the south end of the new Runway 17-35 at MSP (HNTB Corporation 2002). The Minnesota Department of

Transportation (Mn/DOT) defines two trapezoidal safety zones beyond the end of a runway. State Safety Zone A begins 200 feet from the runway end and extends for a distance of two-thirds of the runway length. It has a width of 1,000 feet at the runway end and increases in total width at a rate of 3 feet for every 10 feet out from the runway end. State Safety Zone B begins at the end of State Safety Zone A and extends for a distance of one-third of the runway length. It has the same width as State Safety Zone A at the boundary between the two zones and increases in width at the same rate as State Safety Zone A.

HNTB defined several zones, including the part of State Safety Zone A beyond the RPZ, State Safety Zone B, and areas on either side of Zones A and B. They calculated separate average annual accident rates for air carriers operating under FAR Part 121 (airlines operating large aircraft) and air carriers operating under FAR Part 135 (scheduled commuters) using nationwide NTSB accident data for the period 1982 to 2000. This gave average accident rates of 0.38 accidents per 100,000 flights for Part 121 carriers and 0.68 accidents per 100,000 flights for Part 135 carriers. These accidents rates were then used to estimate the number of accidents per year for the high forecast for operations on the south end of Runway 17/35 in 2010 as developed in earlier studies, using NTSB data to determine the proportion of all accidents that occurred in the flight segments between the runway end and the outer limit of State Safety Zone B. The distribution of these accident probabilities to the various zones was then done using the accident location data from ALPA mentioned earlier in this chapter.

The resulting accident probabilities were then compared to two identified risk standards. The first, which HNTB referred to as the FAA Risk Standard, was one accident per 10 million operations. The second was termed the UK Risk Standard for the risk of death to persons on the ground from aircraft crashes and was reported as one death on the ground per 100,000 operations. The HNTB memorandum does not cite a source for either criterion. The quoted UK Risk Standard appears to be a misunderstanding of the individual risk level of 1 in 100,000 used in the UK Public Safety Zone consultation described above. The results of the analysis indicated that the expected number of accidents within each of the two State Safety Zones and outside the RPZ would be significantly lower than either of the two criteria quoted in the memorandum. HNTB therefore concluded that there was no empirical basis to support the imposition of the two zones.

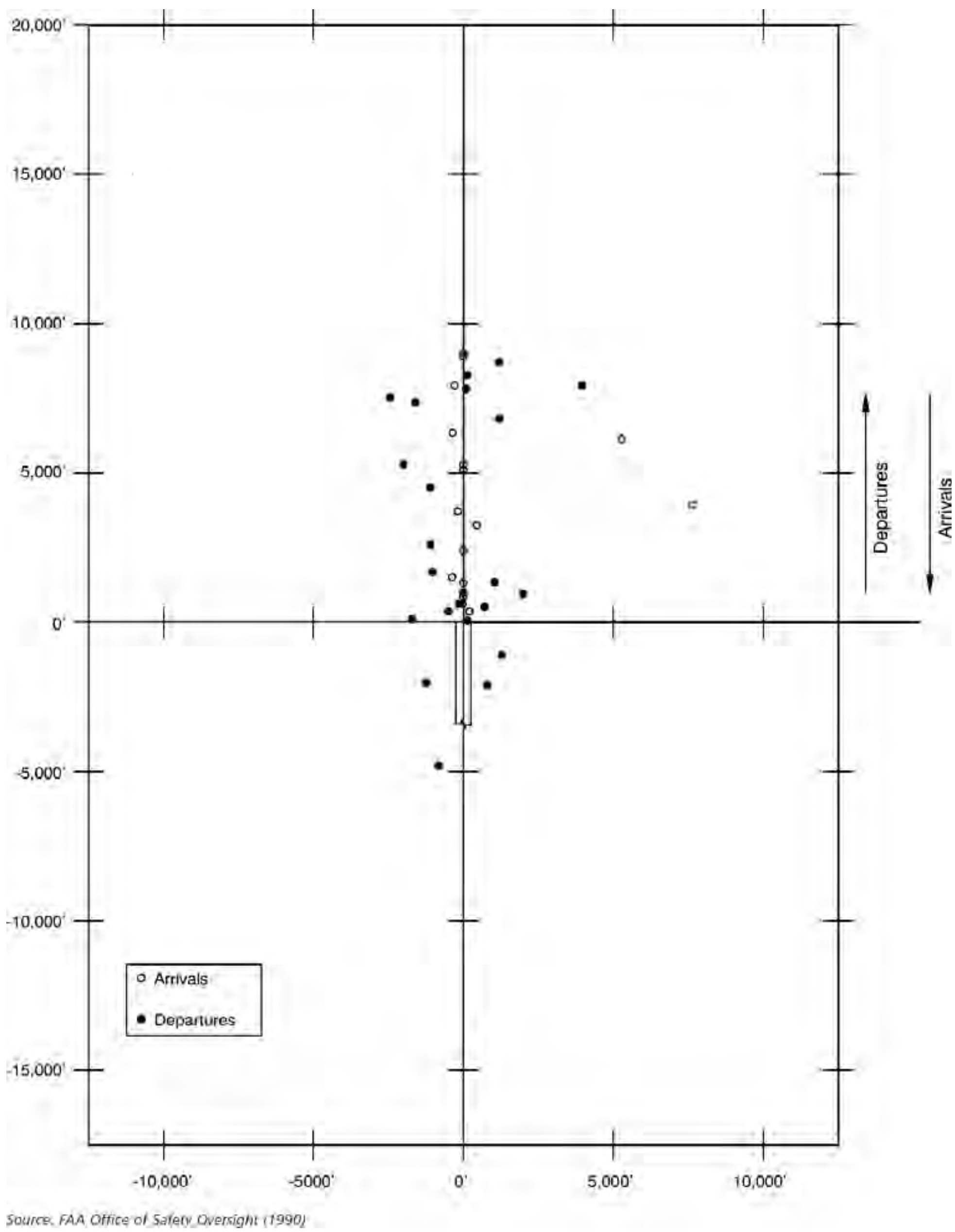
Examples of State Guidance on Aircraft Accident Risks and Safety of Those on the Ground

Several states have developed airport land use compatibility planning handbooks or manuals. These generally follow a similar approach to addressing the safety of those on the ground. There are differences between states, in part due to reflecting differences in state land use planning legislation and in minor differences in approach.

California

California was one of the first states to develop airport land use compatibility planning guidance, largely in response to state legislation that established Airport Land Use Commissions at the county level to prepare for Airport Land Use Compatibility Plans for each public use airport in their jurisdiction. The 2002 edition of the *California Airport Land Use Planning Handbook* (CA Handbook) (California Department of Transportation 2002) defines a system of Safety Compatibility Zones within which restrictions are imposed on construction of structures, particular land uses, or concentrations of people. The extent of the various zones vary with the type of airport and aircraft using it based on the length of the runway for general aviation airports as well as the level of activity.

The analysis on which the California Safety Compatibility Zone criteria is based was originally undertaken by the ITS at the University of California, Berkeley (Cooper & Gillen 1993) and later extended by expanding the accident database as part of the 2002 update of the CA Handbook (Cooper & Chira-Chavala 1998). The CA Handbook update also took into consideration the findings of additional studies of third-party risk from aircraft accidents, including studies by the United Kingdom National Air Traffic Services (UK NATS 1997) and Shutt and Moen Associates (2002). The results of this analysis are presented in Chapter 8 of the CA Handbook, which includes diagrams showing the location of accidents relative to the landing threshold in the case of arrival accidents and the departure end of the runway in the case of departure accidents. Figure 1.7-9 provides a typical diagram showing the findings of the study of commercial aircraft accident locations performed by the FAA Office of Safety Oversight (David 1990).



Source: California Department of Transportation, California Airport Land Use Planning Handbook, 2002

Figure 1.7-9. Commercial aircraft accident location pattern.

Chapter 9 of the CA Handbook provides detailed guidance on establishing airport safety compatibility policies. It notes that there are three distinct safety concerns:

- Protecting people and property on the ground;
- Minimizing injury to aircraft occupants in the event of an aircraft accident or forced landing; and
- Preventing hazards to aircraft in flight, including tall structures or other objects that create obstructions to airspace required for flight near airports, wildlife hazards, and other forms of interference with safe flight, navigation, or communication.

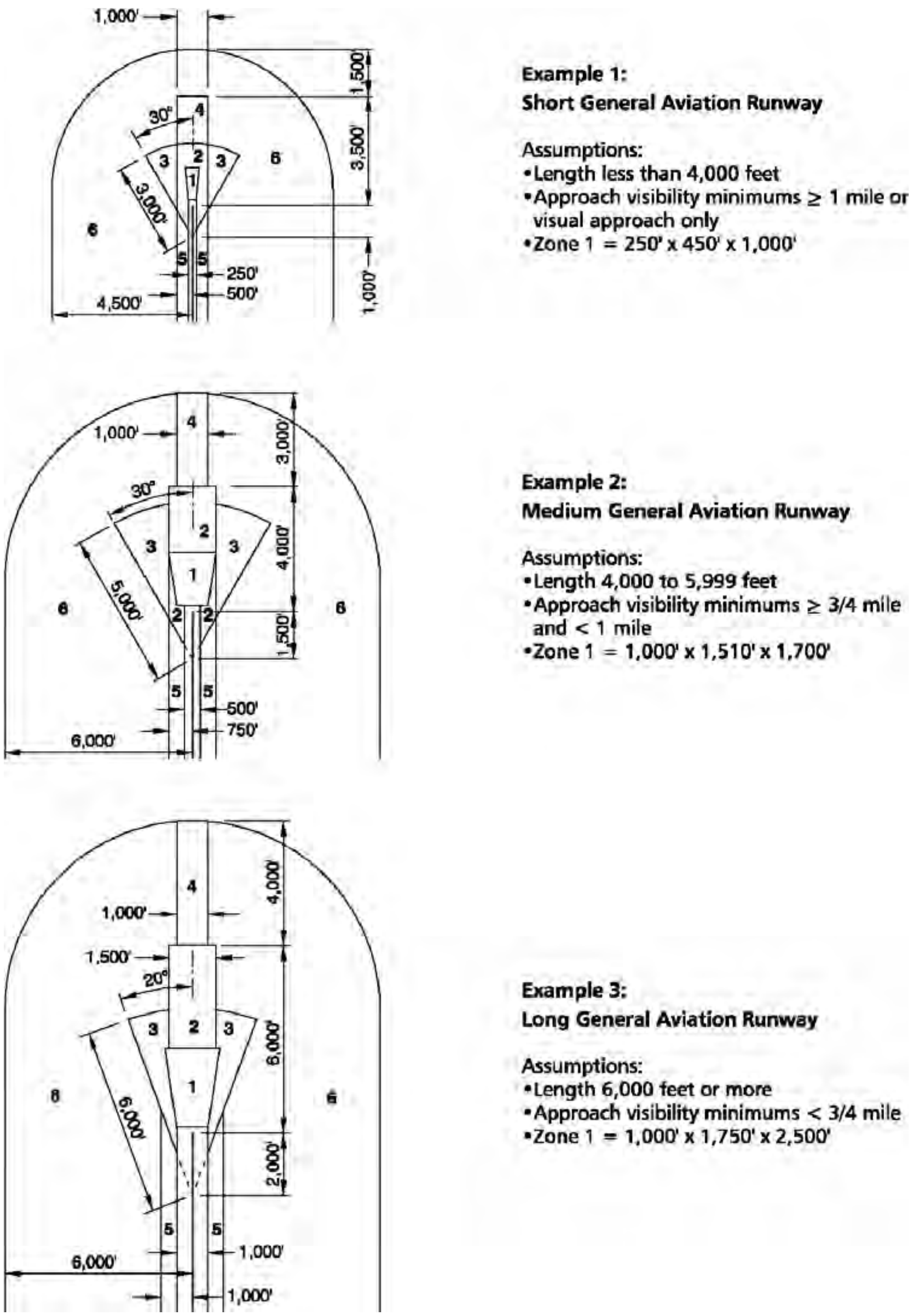
The chapter includes a useful discussion of risk concepts, risk measurement, risk perception, and judging acceptable risk. It also presents a series of figures showing distribution contours for general aviation accidents that contain a specified percentage of the accidents in the database, subdivided into different categories such as arrival or departure accidents and accidents to aircraft using runways of different lengths. The contours are quite irregular and resulted from the use of GIS software that counted the number of other accident locations within a specific radius of each accident location and used this to rank the locations. The discussion noted that the resulting irregular contours were not particularly satisfactory for land use planning so a system of more regular safety zones were defined, as illustrated in Figure 1.7-10 and Figure 1.7-11. These comprise six defined zones:

- Zone 1: Runway protection zone;
- Zone 2: Inner approach/departure zone;
- Zone 3: Inner turning zone;
- Zone 4: Outer approach/departure zone;
- Zone 5: Sideline zone; and
- Zone 6: Traffic pattern zone.

The dimensions of each zone vary with the type of traffic handled by the airport and with the runway length and activity level in the case of general aviation airports as indicated in Figure 1.7-10 and Figure 1.7-11. The configuration of the inner turning zones for general aviation airports also should be modified to reflect the direction of the traffic pattern. The CA Handbook includes an analysis of the percentage of accident locations in the aircraft accident database used to develop the safety criteria that occurred in each of the safety zones for the three main categories of general aviation runway and the resulting percentage of accidents per acre in each zone.

The CA Handbook provides guidance on land uses that can be allowed in each safety zone and those that should be limited, avoided, or prohibited. Limited uses are acceptable only if residential density or nonresidential intensity restrictions are met. These are presented in the CA Handbook for each safety zone in terms of ranges of dwelling units per gross acre or average number of people per gross acre, with factors for the maximum number of people per single acre and the use of special risk-reduction building design. The CA Handbook provides guidance on measuring usage intensities as well as minimizing injury to aircraft occupants through the provision of contiguous open land areas in the different safety zones.

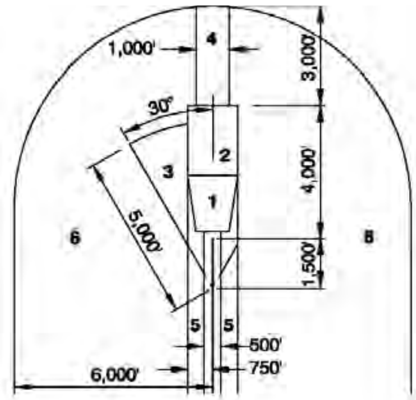
The analysis of the distribution of the aircraft accident locations within each safety zone given in the CA Handbook shows that outside Zone 1 (the RPZ) the percentage of accidents per acre is very low, much less than 1% in Zone 2 (the inner approach/departure zone) and 0.1% or less in the other zones. A small percentage of accidents that occur result in fatalities or serious injuries on the ground, and there is a very low probability of an accident occurring in any given location outside the RPZ. Therefore, given the low frequency of aircraft accidents, the risk to anyone in any of the safety zones outside the RPZ and the inner approach/departure zone is very low. Whether it is sufficiently low to be considered acceptable is a separate issue.



Source: California Department of Transportation, California Airport Land Use Planning Handbook, 2002

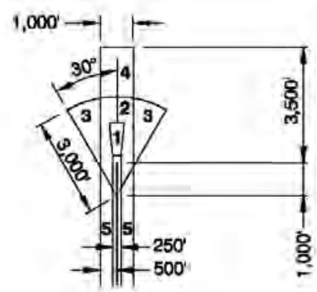
Figure 1.7-10. California safety compatibility zones—general aviation runways.

(continued on next page)



Example 4:
General Aviation Runway with Single-Sided Traffic Pattern

Assumptions:
- No traffic pattern on right
- Length 4,000 to 5,999 feet
- Approach visibility minimums ≥ 3/4 mile and < 1 mile
- Zone 1 = 1,000' x 1,510' x 1,700'



Example 5:
Low-Activity General Aviation Runway

Assumptions:
- Less than 2,000 takeoffs and landings per year at individual runway end.
- Length less than 4,000 feet
- Approach visibility minimums ≥ 1 mile or visual approach only
- Zone 1 = 250' x 450' x 1,000'

Legend

1. Runway Protection Zone
2. Inner Approach/Departure Zone
3. Inner Turning Zone
4. Outer Approach/Departure Zone
5. Sideline Zone
6. Traffic Pattern Zone

Notes:

- RPZ (Zone 1) size in each example is as indicated by FAA criteria for the approach type assumed. Adjustment may be necessary if the approach type differs.
- See Table 9A for factors to consider regarding other possible adjustment to these zones to reflect characteristics of a specific airport runway.
- See Tables 9B and 9C for guidance on compatibility criteria applicable with each zone.

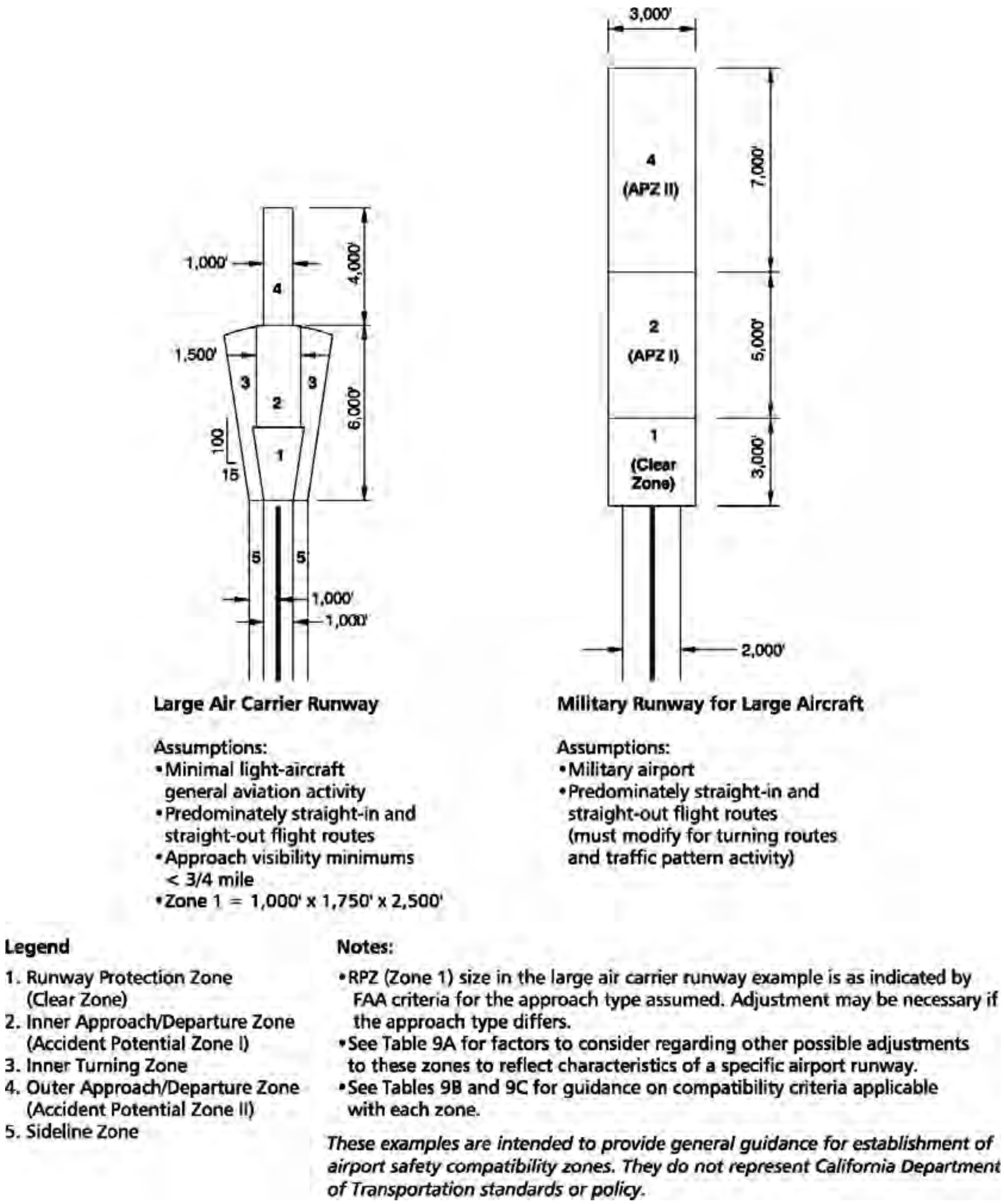
These examples are intended to provide general guidance for establishment of airport safety compatibility zones. They do not represent California Department of Transportation standards or policy.

Source: California Department of Transportation, California Airport Land Use Planning Handbook, 2002

Figure 1.7-10. **(Continued).**

Minnesota

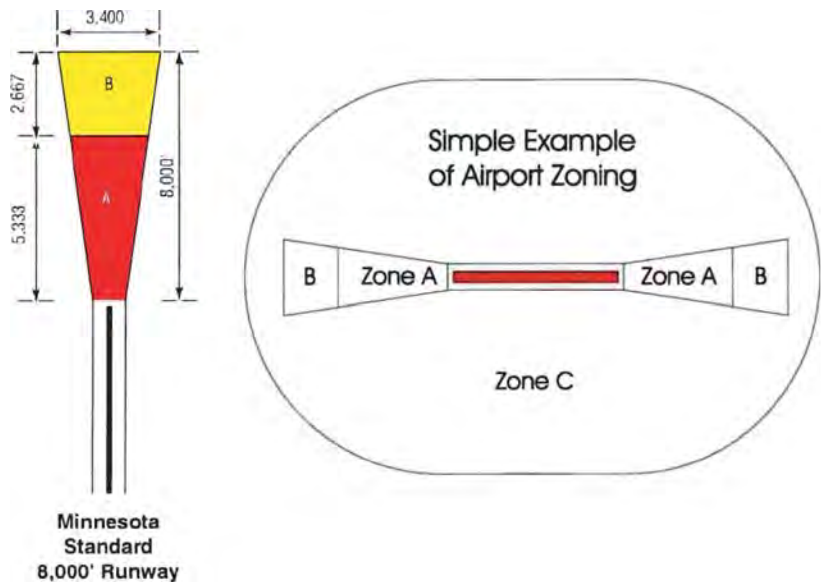
The State of Minnesota first enacted a model airport zoning ordinance in 1946 and by 1958 it had designated specified safety zones. In 1973, local protective zoning was made a condition of an airport receiving federal and state funding, and in 1990 the model zoning ordinance was amended to designate three safety zones termed A, B, and C as shown in Figure 1.7-12. The model zoning ordinance specifies the minimum dimensions of the three safety zones and designates specific land use restrictions, height controls, and use prohibitions within each of the zones. The dimensions of safety Zones A and B are determined by the length of the runway, with Safety Zone A extending for two-thirds the length of the runway and Safety Zone B extending for a further one-third the length of the runway. Both zones increase in width at the rate of 3 feet per 10 feet from the runway.



Source: California Department of Transportation, California Airport Land Use Planning Handbook, 2002

Figure 1.7-11. California safety compatibility zones—large air carrier and military runways.

In 2004, it was clear to the MnDOT that there was a need to update the model zoning ordinance and provide more guidance in its application. This led to a study to revise the model zoning ordinance and develop the *Airport Land Use Compatibility Manual* (Minnesota Department of Transportation 2005). The MnDOT Manual focuses on preventing land uses that are incompatible with airport operations due to the potential danger to people and property on the ground from aircraft crashes and to aircraft pilots and occupants from obstructions to flight. It does not address land use compatibility with respect to aircraft noise since it was felt that



Source: Minnesota Department of Transportation, *Airport Land Use Compatibility Manual*, 2006

Figure 1.7-12. Minnesota airport safety zones.

adequate guidance already existed on this aspect. However, an appendix within the manual provides supplementary information on airport noise mitigation and strategies.

The MnDOT Manual includes a review of institutional roles and responsibilities, the evolution of airport land use planning in Minnesota, and successes and challenges with the then current approach toward airport safety. In the MnDOT Manual, Chapter 4 discusses preventive and corrective strategies for airport land use compatibility, Chapter 5 discusses applicable laws, statutes, and legal issues, and Chapter 6 describes the model airport safety zoning ordinance and provides a procedural guide to the application of the ordinance.

The MnDOT Manual also contains a discussion of the process to be followed in cases where local jurisdictions request the MnDOT Commissioner to accept modified airport safety zone boundaries and certify the regulations in compliance with Minnesota statute (360.065 Subdivision 2) on the grounds that the "social and economic costs of restricting land uses in accordance with the standards outweigh the benefits of a strict application of the standards." The discussion summarizes the findings of a review of third-party risk undertaken as part of the preparation of the MnDOT Manual discussed above (Weichmann 2005) and includes a more detailed review of the third-party risk research and literature as Appendix 7 in the MnDOT Manual. This section of the MnDOT Manual describes the evidence required in support of airport safety zone modifications and factors that the commissioner should consider in determining modification requests. This is supported by a series of tables that present values for each factor based on a decision metric used for each factor. The seven factors listed in the manual with the associated decision metric are as follows:

- Number of aircraft operations (annual operations per runway end);
- Type of aircraft operations (general aviation, FAR Part 135 scheduled, FAR Part 121);
- Development location (distance from runway end and extended runway centerline);
- Aircraft size and speed (design aircraft weight and approach category);
- Development density (high rise or persons per acre);
- Occupant mobility (type of development); and
- Occupancy time (type of development).

A concern that may arise from the assessment procedure described in the guidance is how to determine whether the social and economic costs of restricting land uses in accordance with the standards outweigh the benefits of a strict application of the standards (as stated in the statutes). In order to determine whether the social and economic costs of doing so outweigh the benefits, it is necessary to quantify both the costs and the value of the reduction in risk. Unfortunately, there appears to be no obvious way to translate the values of the seven different factors into an estimate of the change in risk that can then be assigned an economic value due to the very nature of various factors and their evaluation.

Texas

The Aviation Division of the Texas Department of Transportation published *Airport Compatibility Guidelines* covering compatibility planning, compatible land use zoning, and hazard zoning for airports in the state (Texas Department of Transportation 2003). These guidelines are based on the Texas Airport Zoning Act (AZA) and address aircraft noise, height of structures or other obstructions, and land uses that could interfere with electrical transmissions or otherwise create a hazard to aircraft such as wildlife attractants. As considered in the AZA, hazard refers primarily to hazards to the operation of aircraft. Hazards to those on the ground are mentioned in this document only in the context of aircraft colliding with tall structures or obstructions, which is stated as one reason to establish height limitations. There is no discussion of the safety of those on the ground or of restrictions on development density in areas in the vicinity of airports that are exposed to an increased risk of an aircraft crash occurring.

Washington

Guidance on airport compatible land use planning for the state of Washington is provided in the document *Airports and Compatible Land Use.* It is intended to assist local planners and decision makers comply with the requirements of the Washington State Growth Management Act as it relates to land use around airports (Washington State Department of Transportation 1999). The Growth Management Act, as amended, requires every city, town, and county having a general aviation airport in its jurisdiction to discourage the siting of land uses that are incompatible with the airport. The policy to protect airport facilities must be implemented through the jurisdiction's comprehensive plan and development regulations following formal consultation with the aviation community and copies of the plans must be filed with the Washington State Department of Transportation (WSDOT) Aviation Division. The guidance document identifies three critical compatibility areas: height hazards, safety, and noise.

The document includes a section that discusses basic concepts of risk, risk perception and acceptability, and communicating risk to the public. However, the discussion provides no explicit guidance on how to quantify risk. Two appendices define six safety zones with respect to the end of a runway and present land use guidelines and land use planning strategies for each zone. The definitions of the zones follow those established in the 1993 *Airport Land Use Planning Handbook* prepared by Hodges and Shutt and the Institute of Transportation Studies at the University of California, Berkeley, for the California Department of Transportation. The dimensions of each zone depend on the length of the runway with different dimensions for runways less than 4,000 feet long, between 4,000 and 5,999 feet, and 6,000 feet in length and greater.

Summary

Although aircraft accidents in the immediate vicinity of an airport are fairly rare, there is an understandable concern about determining the extent of the risk to those on the ground in the area under the arrival and departure flight paths beyond the ends of the runway and establishing appropriate land use compatibility criteria to reduce the risk to an acceptable level. Previous studies have examined the distribution of aircraft accident locations relative to the ends of the runways and the results of these studies have been used to define zones of different risk and establish associated land use compatibility criteria. Although a more explicit risk analysis has not generally been performed in the United States as part of developing airport land use compatibility guidance, this is being done increasingly in Europe, particularly in the United Kingdom and the Netherlands.

The results of these European studies, as well as recent analysis that was undertaken in the United States for the Minneapolis-St. Paul International Airport Joint Airport Zoning Board, suggest that the current practice for airport land use compatibility criteria may exaggerate the risk from aircraft accidents to those on the ground over much of the area covered by the criteria. Whether there are areas where this risk is understated is less clear. The models of risk to those on the ground developed by the UK National Air Traffic Services Limited result in risk contours that are approximately triangular in shape, with the base adjacent to the end of the runway and the contours tapering to a point at some distance from the end of the runway. These contours have been used in the formulation of the UK policy for Public Safety Zones beyond the end of each runway.

Since aircraft accidents are rare, previous studies of aircraft accident locations in the vicinity of airports have tended to be based on accident data from an extended time period. The fact that many of these studies were performed 10 or more years ago also means that the accident data on which they are based are quite old. There have been significant changes in aviation accident rates over the past 10 years, particularly for large air carriers. While these changes will certainly reduce the expected accident rate in the vicinity of airports, their implications for the distribution of aircraft accident locations is less clear. There is a need to update the studies with more recent data and to take a closer look at the circumstances surrounding various accidents at different locations in order to better understand the extent to which accident locations with respect to the runway at the airport where it occurred is a reasonable indicator of the likelihood of other accidents occurring in the future at a similar location at a different airport.

In order to tailor airport land use compatibility criteria to the circumstances at different airports, particularly the projected level and composition of future traffic, it would be desirable for the FAA to sponsor the development of an airport third-party risk model, as has been done in the United Kingdom and the Netherlands. The model should be made available to state and local planning staff and their consultants to analyze the level of risk posed to those on the ground near a given airport. The availability of a standardized risk model will help to establish a more rational and customized approach to defining criteria for airport land use compatibility to ensure the safety of those on the ground and occupants of aircraft using an airport.

Finally, the application of a risk-based approach to addressing the safety of those on the ground in the vicinity of airports requires guidance on acceptable levels of risk and appropriate land use restrictions to apply within areas of concern. The acceptable level of risk and associated restrictions are likely to vary from airport to airport depending on the local community's willingness to forego development opportunities in order to reduce their exposure to the risk of aircraft accidents. Therefore, those involved in formulating and approving local policies will need guidance in how to make tradeoffs with these issues.

VOLUME 1, CHAPTER 8

Tools and Techniques for Land Use Compatibility

The prevention and mitigation of incompatible land use is a challenging task that often requires the use of a multitude of techniques. This chapter summarizes a collection of generally accepted tools and techniques for the prevention and mitigation of incompatible land uses. These can be adapted to the specific needs of individual airports and communities. It should be noted that some of these approaches to land use compatibility are more appropriate for use by airport-related staff than local planners and elected officials; however, it is recommended that a number of tools and techniques be employed to create more robust methods to address land use compatibility concerns at a broader level. For example, if an entry-level community planner, who has no experience with airport compatibility planning, reviews this document, it is hoped that they would read about airport master plans, wildlife management plans and noise abatement measures right along with specific tools that a community would traditionally have available to them. This should make the planner more aware of these other documents that may be available from the airport sponsor. Conversely, it is hoped that local airport managers and airport-related staff will review the more traditional planning related sections, and as a result, have a better understanding of community planning functions and identify with methods to become more involved in that process for the success of the airport.

While federal and state agencies develop guidelines and recommendations for compatible land use, the primary responsibility for the development, implementation, and enforcement of programs and decisions resides with government officials at the local level; village, city, township, and county planners; airport sponsors; airport users; and citizens. Land use decisions are often influenced by an array of criteria; therefore, it is imperative to understand the complicated relationship between land uses, airports, and communities.

An airport's area of influence, including related airspace, noise impact area, and area of safety concern often can span multiple jurisdictions, complicating the implementation of land use controls. Communities that lie within an airport's influence area must coordinate efforts to preserve and protect land use compatibility in the airport's environs. Effective communication between all entities involved is essential to the development, implementation, enforcement, and maintenance of compatible land uses.

Table 1.8-1 summarizes the various compatibility techniques related to their proximity to the runway. Many of the techniques and tools can be applied in several areas of influence. However, some are more appropriate in one area than in others. For example, land acquisition is most appropriate in the RPZ area. There are instances, however, when land acquisition is an option in the transitional surface area or in the approach areas. An evaluation of individual tools to meet specific development concerns is recommended for each airport and its local community.

These techniques can be used on a case-by-case basis or in conjunction with multiple approaches to preserve and mitigate land uses to best suit community and airport needs. The selection of these

Table 1.8-1. Techniques for land use compatibility overview.

	Runway Protection Zone (RPZ)	Approaches Areas	Areas Adjacent to Runway	Traffic Pattern Area
Planning & Zoning Techniques				
Community Comprehensive Plan	A	A	A	A
Area Plan	A	A	A	A
Joint or Regional Planning and Intergovernmental Agreements	A	A	A	A
Airport Land Use Compatibility Plan Including zoning ordinances for land use and height	A	A	A	A
Airport Master Plan/Airport Layout Plan	A	A	A	O
Extraterritorial Zoning	A	A	A	A
Height Zoning Ordinance	A	A	A	A
Site Plan Review	A	A	A	O
Plat Review	O	O	O	O
Deed Restrictions	O	O	O	O
Natural Features Techniques				
Wildlife Management Plan	A	A	A	O
Natural Features Inventory and Mitigation Strategy	A	A	A	O
Acquisition and Notification Techniques				
Fee Simple Acquisition	A	O	O	L
Avigation and Noise Easements	A	A	O	O
Conservation Easements	A	A	O	O
Transfer of Development Rights	A	A	O	O
Purchase of Development Rights	A	A	O	O
Non-Suit Covenants and Hold Harmless Agreements	A	A	O	O
Disclosure Notice	A	A	A	A
Noise Related Techniques				
Noise Compatibility Program	A	A	A	A
Building Codes	A	A	A	O
Purchase Assurance	A	A	O	L
Sales Assistance	A	A	O	L
Sound Barriers	L	L	A	L
Sound Insulation	A	A	A	O

A = acceptable; O = optional; L = limited
Note: The success of any of these techniques has a significant dependence upon the location of the specific land use relative to the airport environs, as well as, the level of noise exposure. For example, noise barriers are only useful when the source of the noise is on the ground.
Source: Mead & Hunt, Inc.

tools and techniques is multi-pronged and can be implemented and enforced by communities in a variety of different ways. Planning is not "one-size-fits-all"; therefore, this chapter summarizes compatibility techniques designed to provide a reference based on the size of community, type of airport, and amount of growth pressure, in order to guide government officials, planners, airport sponsors, airport users, and citizens to develop an appropriate mitigation plan.

Planning and Zoning Techniques

Planning and zoning techniques provide a framework with which to establish a baseline of existing land uses and a forecast for future growth. Compatible land use planning techniques focus on site-specific issues within local communities. Local governments have multiple choices of which planning tools and techniques can be used to discourage incompatible land uses.

The planning techniques noted in this section address the issue of incompatible land uses and relation to airports. The intent is to help airport sponsors, planners, government officials, and residents understand the need for compatible land use near airports. Specific case studies have been cited throughout this chapter as examples for implementation. Table 1.8-2 illustrates the agencies generally responsible for administering the various planning tools. In many instances, other agencies may need to be involved or engaged in the development of these techniques to facilitate successful implementation.

Strong local leadership and support from government officials is important to successful planning efforts at the airport and community level. Engaging and educating local citizens within the vicinity of an airport is also essential to an effective working relationship among local government officials, airports, and residents. Greater understanding by all participants in the planning

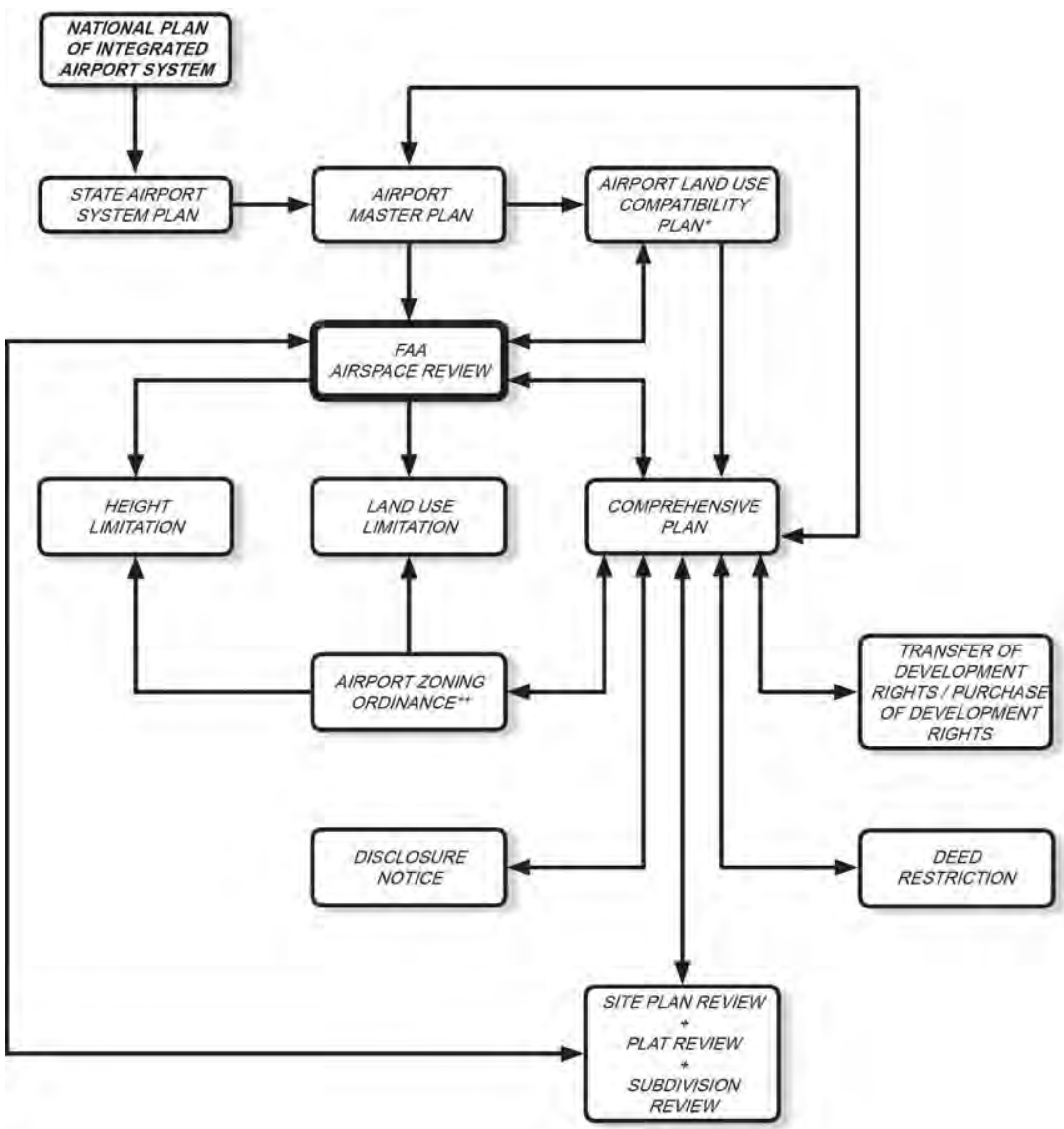
Table 1.8-2. Typical agencies responsible for planning related techniques.

Techniques	Primary Responsibility
Planning Techniques	
Comprehensive Plan	Local Unit of Government
Area Plan	Local Unit of Government
Joint or Regional Planning and Intergovernmental Agreement	Local Unit of Government; Regional Governmental Agency
Airport Land Use Compatibility Plan	Airport Sponsor; Local Unit of Government
Airport Master Plan / Airport Layout Plan	Airport Sponsor
Zoning	
Extraterritorial Zoning	Local Unit of Government
Airport Zoning Ordinance	Airport Sponsor; Local Unit of Government
Height Zoning Ordinance	Airport Sponsor; Local Unit of Government
Plan Review	
Site Plan Review and Plat Review	Planning Commission / Planning Staff
Deed Restrictions	Planning Commission / Planning Staff

Source: Mead & Hunt, Inc.

process can enhance the implementation and success of planning techniques. Figure 1.8-1 illustrates the general relationship among the various planning techniques.

Planning techniques serve as the foundation from which mitigation measures can be implemented for compatible land use issues that involve existing developments, future growth of the airport, and surrounding communities. Table 1.8-3 illustrates planning techniques to promote compatible land uses on or near airport environs. Planning documents (plans) provide the basis for the development of ordinances and regulations that give structure for the implementation of land use controls. Ordinances and regulations are legal documents that are developed by municipalities to regulate land uses and associated activities in designated locations to protect, preserve, and enhance the quality of life of residents. More broadly, ordinances and regulations are the tools used to implement the recommendations of the comprehensive plan. One of the most effective



*In some states, local airports have the authority to create ALUCP outside the authority of their local planning agency.
** Some states allow for airport zoning as part of their planning and zoning enabling legislation or by specific state regulations.

Source: Mead & Hunt, Inc.

Figure 1.8-1. Relationship of planning techniques.

Table 1.8-3. Planning techniques for compatible land uses.

Technique	Description	Key Value	Primary Shortcoming	When to Use
Comprehensive Plan	Long term techniques with goals, objectives, maps, charts and text	Provide for organized community growth and development including land use and (sometimes) airport elements	Airports and communities do not always plan growth together, thus allowing the encroachment of incompatible land uses into airport environs	Comprehensive plans must be completed by local communities and updated periodically, and preferably, in conjunction with the airport master plan / airport layout plan
Area Plans	Area specific techniques with goals and objectives	Address specific areas which require more detailed methods to guide land use regulations such as areas surrounding airports	Implementing and enforcing area specific criteria that control land uses near the airport	Area plans are typically completed as a follow-on element to the findings or recommendations of a comprehensive plan and may need to be updated to reflect changes or updates to an airport master plan/airport layout plan.
Joint or Regional Planning and Intergovernmental Agreement	Coordinated planning and zoning efforts between multiple jurisdictions to ensure airport viability	Provide roles, responsibilities, and obligations to regulate and plan for airport compatible land uses	Implementing and enforcing land use controls across multiple jurisdictions, as well as consensus and participation among all jurisdictions impacted by airport operations	Should be utilized to coordinate and plan in multiple jurisdictions that are impacted by an airport
Airport Land Use Compatibility Plans including land use zoning ordinance	Typically a sub-section of the comprehensive plan or area plan that addresses airport land use compatibility goals and objectives	Provide structure and regulations pertaining to community development within the airport's environs; specifically addresses compatibility issues and sets compatibility criteria	Implementing and enforcing land use controls over multiple jurisdictions; agency preparing ALUCP may not be same as local land use jurisdiction	Should be completed for every jurisdiction impacted by an airport
Airport Master Plan / Airport Layout Plan	Long term planning document with goals, objectives, maps, charts and text - typically has a twenty-year window for proposed development	Provide guidance for future growth and development of the airport	Addresses only airport growth and development and usually does not consider the growth and development happening in the surrounding communities	Should be utilized to coordinate organized growth and development for both the surrounding communities and the airport as well and should be evaluated every 5-years or after significant development has occurred to assess the progress of development and updated accordingly, if necessary
Plan Review	Airport overlay zoning which regulates land uses and height limitation within the airport's environs	Coordinated zoning and regulations that protect the airport from encroachment of incompatible land uses	Cooperation and implementation from all municipalities involved	Should be utilized to regulate land use decisions within the airport's environs
Height Zoning Ordinance	Regulate the height of structures, objects, or natural vegetation within the airport's environs	Eliminate hazardous conditions for aircraft utilizing the airport	Only regulates height concerns and does not address additional safety hazards such as visual obstructions, noise, wildlife and bird attractants, and concentrations of people	Should be utilized in conjunction with or as part of airport overlay zoning ordinance
Site Plan / Plat Review	A set of plans that illustrates the type of development or amount of divisions a parent parcel of property will be divided	Plans that contain a detailed description of the parcel of property to be split and the type of proposed development / expansion, location within the parcel of property, material being used, vegetation, etc.	Municipality may not address airport needs and concerns prior to approval of site plan / plat review	Should be utilized for any development new or existing to ensure that development is airport compatible
Deed Restrictions	A legal document attached to the deed/title of a parcel of property which follows the property in perpetuity	Restriction placed on a parcel of property to ensure land use compatibility is achieved within airport environs	Potential property owners / lessees are not always aware of the restrictions prior to purchase or construction of a hazardous structure, object, or natural vegetation	Should be utilized within areas impacted by airport operations and aircraft overflight areas; can be required as condition for development approval

Source: Mead & Hunt, Inc.

techniques for ensuring compatibility is the development of state legislation that specifically empowers local communities to secure land use compatibility near airports. This typically results in a dedicated piece of legislation that defines the need for compatibility near airports, along with the authority to develop airport compatible land use zoning ordinances. An example of Airport Land Use Compatibility Model State Legislation is contained in Appendix B of this document and is intended to be used as a guide for the development of individual state legislation related to airport land use zoning. Modifications are recommended to generate a document that meets the needs of individual states, based upon their planning initiatives and existing legislation.

A combination of these techniques is often necessary for effective land use planning. Where possible, it is encouraged that airport and community development be planned jointly to complement each other. This integration of airport and community planning can provide a comprehensive approach to compatibility planning. Each of these techniques is further explained in the following sections to provide more detail on their use.

Comprehensive Plan

A local comprehensive plan (called a general plan in some states) should address land use as it relates to growth and development of the community, on a county, township, city, and village basis. A comprehensive plan is a strategic long-range document that generally includes maps, charts, and text that explain the goals and objectives established within the plan. The development of a comprehensive plan consists of several phases including initial planning and preparation, followed by public participation, review and evaluation, and final adoption and implementation. It is recommended that state-wide legislation be adopted requiring that comprehensive plans acknowledge and address the issue of land use compatibility near airports. If a state is considering adopting a state-wide airport zoning ordinance, a model for state legislation has been developed as part of this document and is included in Appendix A.

Ideally, local governments would use comprehensive plans to guide the development of zoning ordinances. Inclusion of, or at least reference to, local airport master plans / airport layout plans, and airport land use compatibility plans, should be addressed in the development of the comprehensive plans, in order to make coordinated decisions regarding compatible land use within the airport's jurisdictional boundary. Comprehensive plans can look 40-50 years into the future, while airport master plans/layout plans, and airport land use compatibility plans use a 20-year planning time frame.

Because airports can affect multiple jurisdictions, each individual jurisdiction impacted by an airport should consider the airport in its comprehensive plan and zoning ordinance. By doing so, surrounding communities can protect the airport from incompatible land uses that may hinder airport growth and development, as well as protect the health, safety, and welfare of persons on the ground nearby.

It is essential that the community's comprehensive planning process consider its local or neighboring airport(s). If a local planning document does not provide a foundation to support decision making regarding the development of compatible land use in the vicinity of an airport, it is unlikely that an effective planning process can be accomplished. Airport sponsors should become involved early in the planning process to communicate the airport's needs and future development plans with the local community, such as supplying the municipality with a copy of the airport's master plan, airport layout plan, and/or the airport's land use compatibility plan. This involvement should focus on educating the local community regarding the value the airport brings to the community, as well as the need to preserve its operational areas. Airport sponsors can become involved in the planning process in several ways:

- Have representation on the planning advisory / steering committee.
- Provide comments during the public comment portion of the process.

- Provide comments to other representatives of the advisory / steering committee to present airport related concerns and issues.
- Share airport master plans / airport layout plans with the local municipality to inform them of airport development.
- Become engaged in the general planning process.
- Become involved on a regular basis during the site plan review process, not just throughout the comprehensive planning stages.

Area Plans

In addition to comprehensive planning, communities sometimes develop area plans (i.e., airport critical or sensitive areas, small area, neighborhood, or corridor plans) that identify and address specific needs. These area plans are intended to guide land use decisions that are appropriate within specified, limited locations in the community and usually provide greater detail than found in comprehensive plans. This level of detail and geographic focus makes these plans an excellent place in which to address airport land use needs and concerns, such as identifying noise-sensitive areas and safety-related areas.

As with all planning processes, it is essential to involve key stakeholders such as the FAA, airport sponsor / manager, airport users, elected officials, planning staff, and most importantly citizens to provide a diverse group that represents the needs of both the community and the airport. During the area planning process it is imperative that the community understands the value and contribution the airport makes to the local economy. This provides a foundation upon which the importance of land use compatibility can be promoted. Area plans should be regularly updated in conjunction with the comprehensive plan to allow for continuity between plans. These plans should reflect both community growth and airport growth, which are essential to ensuring land use compatibility planning efforts protect the airport, the community, and its citizens. Area planning efforts and land use controls are not intended to stifle community growth and development nor airport growth and development, but to allow the community and the airport to complement each other and grow together.

✈ **Case Study Example:**
Denver International Airport
Planning techniques such as area plans, concept plans, corridor plans, and other area-specific plans can be utilized by local and county governments to minimize or prohibit incompatible land uses within designated areas surrounding airports to further protect airports from encroachment issues. For example, the Adams County Airport Environs Concept Plan discourages residential and institutional (schools) land uses within proximity to airports and encourages commercial and industrial uses that are compatible with airport operations.

Joint or Regional Planning and Extraterritorial Zoning

Airport influence areas often cross multiple jurisdictional boundaries creating challenges associated with airport planning and zoning. Therefore, it is critical to necessitate extensive coordinated planning and zoning efforts between each individual local unit of government impacted by airports. Local governments are responsible to ensure compatible land use planning around airports. Coordination and communication between local governments and airports is vital to the effective implementation and subsequent enforcement of land use compatible initiatives.

Often neighboring jurisdictions surrounding an airport will enter into an intergovernmental agreement to coordinate and plan for airport compatible land uses. Intergovernmental agreements typically involve a formal contract between all stakeholders. The intent of an intergovernmental agreement is to clarify the roles, responsibilities, and obligations for all participating jurisdictions. Some states such as Minnesota, Wisconsin, Washington, Florida, and California have state statutes that require joint or regional airport planning and intergovernmental agreements.

Another form of joint or regional planning extending across multiple municipal jurisdictions is the use of "extraterritorial zoning" which is allowed in some states, such as Wisconsin. This form of zoning can be utilized by an airport sponsor or an airport to allow for adequate growth and development of the airport beyond the communities' boundaries, while preventing the encroachment of incompatible land uses. Extraterritorial authority allows a municipality to either annex or zone areas outside of the municipal jurisdictional boundary. The most common instance of this strategy is the application of an airport overlay zoning ordinance or and ALUCP, which allows a local community the right to regulate land use beyond its jurisdictional boundaries. When feasible or permitted by law, communities engaged in comprehensive planning should consider extraterritorial zoning to promote airport compatible land use planning.

Airport Land Use Compatibility Plans

Preservation of airports from incompatible land use can be enhanced through the development and implementation of proactive measures such as Airport Land Use Compatibility Plans (ALUCP). An ALUCP provides airport sponsors, government officials, planners, and citizens the guidance necessary to address land use compatibility issues. Through due diligence in implementing the guidelines included in an ALUCP, communities can accommodate compatible growth and development of airports, as well as protect and allow for future growth and development of the community.

The FAA, through the Vision 100-Century of Aviation Reauthorization Act (Vision 100) Section 160 has made funds available for the development of land use plans at large and medium hub airports for the communities impacted by the airport operations. As of early 2009, four communities (Des Plaines and Harwood Heights in Illinois near O'Hare International Airport, along with San Mateo County in California near San Francisco International Airport, and the City of Ontario, California near Ontario International Airport) have requested funding under this program. Additionally, funding also may be available to address some land use compatibility issues from the FAA based upon the findings of an FAR Part 150 noise study.

The basic function of an ALUCP is to promote compatibility between airports and the land uses that surround them. To implement effective land use planning and regulations it is necessary to identify airport planning boundaries. These boundaries will define the airport impact area for land use planning purposes. The ALUCP should include an area large enough to protect airports and persons on the ground. It is typically based upon an airport's master plan and associated ALP. These plans typically have a 20-year time horizon. This may not look far enough into the future to fully complement a community's comprehensive plan nor may that time frame take into account long-term development of the airport. This difference should be taken into consideration during the development of an ALUCP—if anything, an ALUCP should look beyond the time frame of a comprehensive plan in order to ensure indefinite continuation of land use compatibility. The plan also should contain federal and state airport design criteria, safety areas, noise areas, and overflight areas with land use controls unique to the community.

An ALUCP can become a sub-section of the comprehensive plan within each individual community surrounding an airport, or, it can become part of an area plan, as noted above. The intent of the ALUCP is to provide specific guidance for preventing or limiting the encroachment of incompatible land use upon airports. An ALUCP should precisely spell out the parameters of what constitutes compatible land use, including any conditions that must be met to ensure compatibility. Noise, safety, and airspace compatibility concerns should all be covered. Overflight issues can also be addressed. Additionally, individual types of land uses can be evaluated with respect to the compatibility criteria and proximity to the airport, and the compatibility, incompatibility, or conditions to be met can be listed.

Sample Compatibility Zones

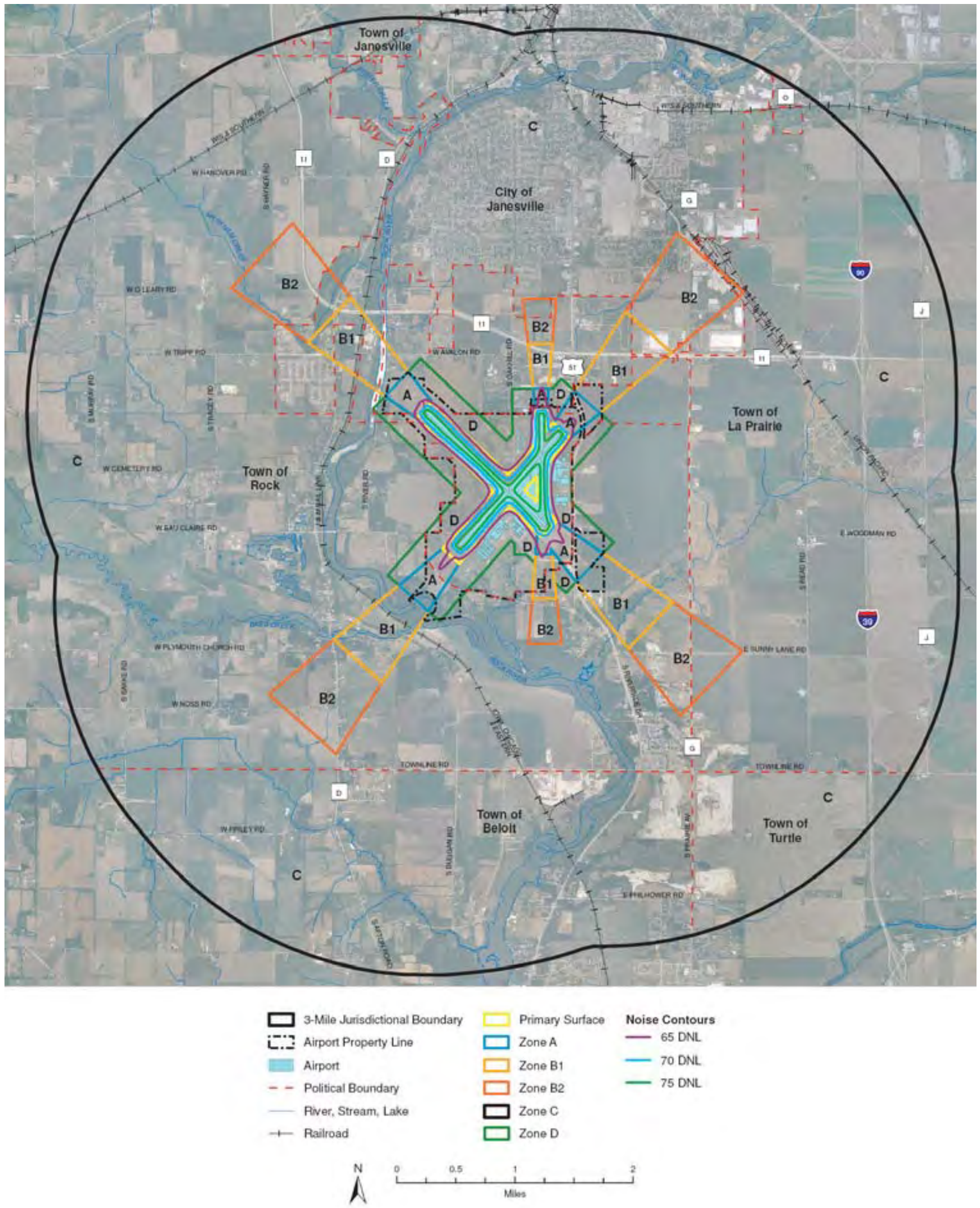
An important element of the creation of an ALUCP is the development of airport compatibility zones. As demonstrated by the previously referenced accident data and discussion of risk to persons located on the ground near an airport in Chapter 7 – Aircraft Accidents and Safety Considerations, a local community developing an airport land use compatibility zoning plan must take into account the geographic areas around the airport that make up the airport area of influence and focus on maintaining compatible land uses in these areas. These areas should be evaluated for land use compatibility by the surrounding municipalities. The specific size for each area can depend on a number of criteria such as, but not limited to, airport classification, critical aircraft identified for the airport, aircraft traffic pattern, and individual approach types for each runway end, as well as proposed approaches, future airport development and future community development. Since these criteria vary for each airport, it is important to recognize that individual plans will be necessary to accommodate each specific airport's needs.

Figure 1.8-2 and Table 1.8-4 illustrate an example of the various areas which should be considered, when establishing land use compatibility zones. This set of zones is not an exhaustive list of the areas of interest but rather a representative sample. As noted previously in Chapter 7, some states such as California and Washington have implemented other zones such as turning areas, while states such as Minnesota have identified only three zones for compatibility planning. Airports should consult their state aviation agencies to determine if specific state legislation or guidance exists that would guide the development of compatibility zones within their own community. Otherwise, airports are encouraged to consider the areas referenced in Table 1.8-4 as a potential template for use in the development of a site specific set of land use zones. Rationale for the suggested use of each zone is discussed below along with an explanation of their functions, sample dimensions, and potential compatible land uses within each zone.

Zone A – RPZ. Zone A is intended to provide a clear area that is free of above ground obstructions and structures. This zone is closest to the individual runway ends. The dimensional standards for this zone are recommended to be the same as those described in FAA AC 150/5300-13, Change 14, *Airport Design for Runway Protection Zones,* and are illustrated in Table 1.8-5 and Figure 1.8-3. Most land uses within Zone A should be limited, where possible, based upon the criteria outlined by the FAA in AC 150/5300-13. Best practices should be used when determining compatible land uses such as parking lots, roadways, and open spaces in proximity to the airport's operational areas. Construction of new structures should be prohibited, while existing structures and vegetation should be removed through the use of land acquisition and/or the purchase of avigation easements, when practical.

Zones B1 and B2 – Approach/Departure Areas. Zones B1 and B2 are areas critical to the safe operation of aircraft. These areas reflect the approach and departure paths for each runway at any given airport. In the example provided, the sizes of Zone B1 and Zone B2 are predicated on the approach type at a specified runway and the type/size of aircraft utilizing the runway. Table 1.8-6 and Figure 1.8-4 illustrate the various sizes of Zone B1 and B2 based upon approach surface criteria for visual, nonprecision and precision approaches.

Separation of the approach/departure areas into two parts—inner and outer—provides a local community the ability to apply more flexibility to land use limitations, as the distance between the runway end and the approach area increases. It should be noted that a portion of Zone B is superseded by Zone A – RPZ, because the approach surface and RPZ overlap for the



Source: Mead & Hunt, Inc.

Figure 1.8-2. Sample layout of the example airport compatibility zones.

entire length of the RPZ. Consequently, the length of Zone B1 begins at the inner edge of the RPZ. In this example, the length of Zone B1 and Zone B2 combined equals the length of the approach slope, as defined by FAR Part 77 Surfaces. For this sample, as shown in Figure 1.8-4, Zones B1 and B2 are divided equally beyond Zone A. A local community could divide Zones B1 and B2 into any combination that it deems appropriate, based upon the local land use concerns. It is important to note that the FAR Part 77 surface dimensions are used in this example, as the basis for the sizing of these two areas. Since FAR Part 77 is already an acknowledged federal regulation that addresses one of the five primary areas of concern, height, it is prudent that other land use concerns should be evaluated within this same geographic area.

Table 1.8-4. Examples of airport compatibility zones.

Zone	Description
A	Runway Protection Zone (RPZ)
B1	Inner Approach/Departure Area
B2	Outer Approach/Departure Area
C	Aircraft Traffic Pattern Area
D	Areas Adjacent to Runway Environs

Source: Mead & Hunt, Inc.

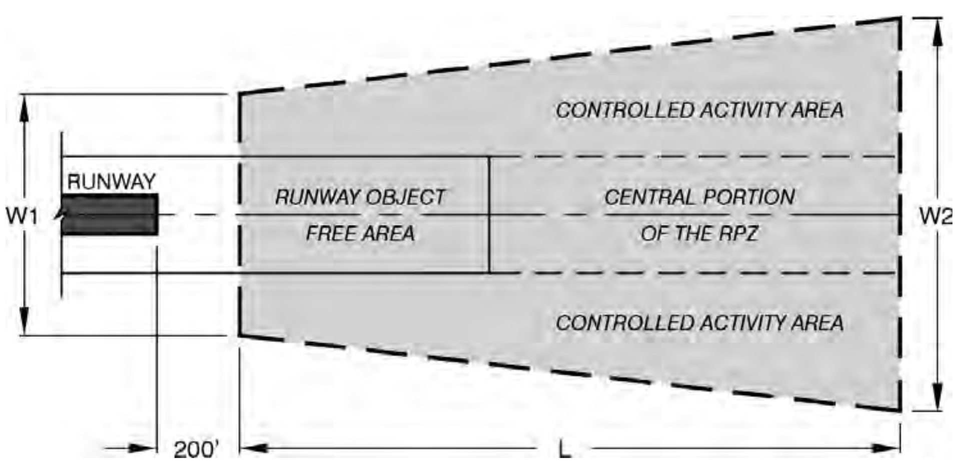
Table 1.8-5. Suggested Zone A dimensions.

Approach Visibility Minimums 1/	Facilities Expected to Serve	Dimensions: Length L Feet (meters)	Dimensions: Inner Width W1 Feet (meters)	Dimensions: Outer Width W2 Feet (meters)	Dimensions: RPZ acres
Visual and Not Lower than 1 Mile (1600 m)	Small Aircraft Exclusively	1,000 (300)	250 (75)	450 (135)	8.035
	Aircraft Approach Categories A & B	1,000 (300)	500 (150)	700 (210)	13.770
	Aircraft Approach Categories C & D	1,700 (510)	500 (150)	1,010 (303)	29.465
Not Lower than ¾ Mile (1200m)	All Aircraft	1,700 (510)	1,000 (300)	1,510 (453)	48.978
Lower than ¾ mile (1200m)	All Aircraft	2,500 (750)	1,000 (300)	1,750 (525)	78.914

1/ The RPZ dimensional standards are for the runway end with the specified approach visibility minimums. The departure RPZ dimensional standards are equal to the approach RPZ dimensional standards. When a RPZ begins other than 200 feet (60m) beyond the runway end, separate approach and departure RPZs should be provided. Refer to Appendix 14 (AC 150/5300-13) for approach and departure RPZs. Source: FAA AC 150/5300-13, *Airport Design*

Land uses allowed in Zone B1 and B2 may require review or conditional use to maintain compliance with land use guidelines that limit concentrations of people, wildlife attractants, visual obstructions, tall structures, and noise-sensitive developments. For example, ideally, residential developments should be discouraged from this area; however, some single family developments, if low in density, may be permitted if it is determined that the proposed development or land use is compliant with the primary areas of interest identified in Chapter 2 of this document.

Zone C – Aircraft Traffic Pattern Area. The area that typically encompasses an aircraft traffic pattern is recommended as Zone C. This area is typically an elliptical shape, depending upon the runway types and configurations at individual airports. Figure 1.8-4 and Table 1.8-6 illustrate the dimensions for Zone C. A typical airport traffic pattern is defined as a rectangular circuit that aircraft fly while waiting for clearance to land. The specific size of an airport traffic pattern varies depending upon the size of the aircraft utilizing the airport. For example, a small single engine



Source: *FAA AC 150/5300-13, Airport Design*

Figure 1.8-3. Sample Zone A - RPZ diagram.

Table 1.8-6. Sample dimensions for airport overlay Zones B1, B2, C, and D.

Dimensions shown in Figure 1.8-4	Item	Dimensional Standards (Feet)[1]					
		Visual Runway		Non-Precision Instrument Runway			Precision Instrument Runway
				A	B		
		A	B		C	D	
W1	Width of Primary Surface, inner width of Zone A & Zone B1	250	500	500	500	1,000	1,000
W2	Outer width Zone A			Shown in Table 1.8-5			
W3	Outer width Zone B2	1,250	1,500	2,000	3,500	4,000	10,000
W4	Width of Zone D from Primary Surface	1,050	1,050	1,050	1,050	1,050	1,050
L1[2]	Length of Zone A			Shown in Table 1.8-5			
L2	Combined Length of Zone B1/B2	5,000	5,000	5,000	10,000	10,000	10,000[3]
L3	Radius Zone C	5,000	5,000	5,000	10,000	10,000	10,000

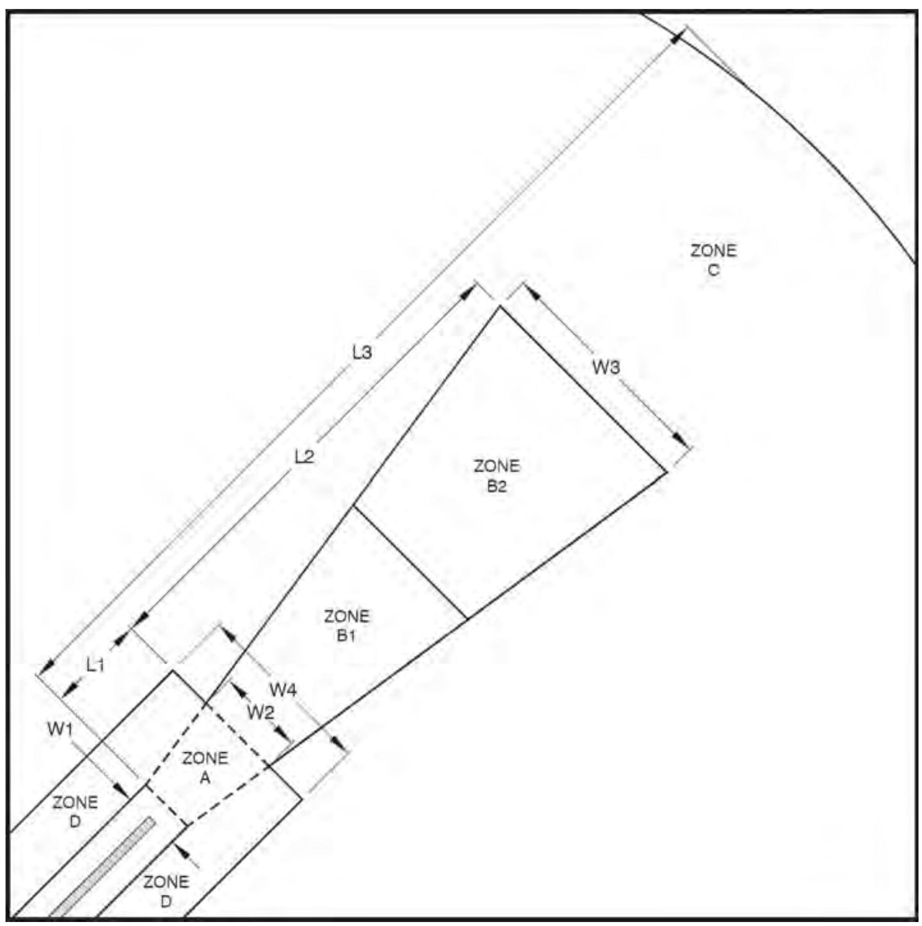
Note: [1] Runway Classification Legend

A – Utility runway (runway servicing aircraft weighing 12,500 pounds or less)
B – Runway larger than utility (runway servicing aircraft weighting 12,501 pounds or greater)
C – Visibility minimums greater than ¾ of a mile
D – Visibility minimums as low as ¾ of a mile

[2] Zone A and B1/B2 begin 200’ from the end of the runway threshold.

[3] The length of Zone B1 and B2 combined, for a precision instrument runway is 10,000 feet for the purposes of the land use zone, it doesn’t extend for the additional 40,000’, as noted in FAR Part 77.

Source: Mead & Hunt, Inc., utilizing *FAR Part 77 Object Affecting Navigable Airspace data*



Source: Mead & Hunt, Inc.

Figure 1.8-4. Sample dimensional details for Zone B1 and Zone B2.

plane has a smaller traffic pattern than the pattern of a larger corporate aircraft. These types of traffic patterns are most common at general aviation (GA) airports. At large GA airports and commercial service airports, aircraft traffic patterns can often take on a much more linear appearance and lose the rectangular element. This is due to the much greater area needed for sequencing aircraft for landing and departure where aircraft may need up to 10 miles or more to align with the runway and develop a course for landing. Because of this difference between airport traffic patterns, it is recommended that local communities consider the flight pattern for their individual airport when establishing land use planning zones and design zones accordingly to meet the specific use patterns at their airport.

Zone C has a substantial number of aircraft over-flights within its boundary during approach or departure at an airport. This zone should be clear of all uses that may generate visual obstructions, wildlife attractants, or tall structures because aircraft typically operate at lower altitudes and slower air speeds in this area while landing or departing the airport. If a pilot is distracted by visual obstructions, potential safety concerns can arise. Land uses that encourage congregations of people or involve development of tall structures should also be discouraged in this area. Noise-sensitive developments should also be limited. Due to the proximity to the runway end, Zone C areas are not likely impacted by a noise level above the 65 DNL that are FAA and HUD benchmarks. Consequently, the impact from noise in these areas is typically a perceived impact by persons on the ground in comparison to an actual impact that is defined as a higher noise level. Little can be done to mitigate noise impacts for the property owner within this area; therefore, residential development or outdoor uses should be discouraged in Zone C to reduce these impacts.

Zone D – Areas Adjacent to Runway Environs. The areas within Zone D are those that parallel the runway pavement, extending away from the edge of the runway surface and is suggested to parallel the runway and extended runway centerline to a length equal to the outer edge of Zone A and then squared to meet Zone A at a 90 degree angle. Table 1.8-6 and Figure 1.8-4 illustrate the specific dimensions for Zone D based upon various options for the primary surface that is predicated on the type of approach and critical aircraft. The majority of this area is usually owned and maintained by an airport since it often includes aviation related uses such as hangars and terminal areas that accommodate aviation needs. Ideally, this area would have structures of low height and relatively low density. Relative to the FAR Part 77 Surfaces, this area may be referred to as the transitional surface area. In this example, the dimension for this zone is based upon the transitional surface and its associated dimensional standards. The transitional surface begins at the edge of the primary surface and extends out seven foot horizontally for each foot vertical height to a height of 150 feet above the airport elevation. Consequently, the dimension for Zone D in this example would be 1,050 feet from each edge of the primary surface and would tie into Zone A at a 90 degree angle and be parallel to the extended runway centerline.

Once a community defines airport compatible land use zones, the task of defining specific uses allowed with these zones must be accomplished. Each zone must have definition of allowed or compatible land uses. As with traditional zoning, creating a definitive geographic line between various land uses is often difficult, and more often, specific physical boundaries are used to separate land uses such as roads or topographic features such as rivers or streams. This often creates grey areas where various land uses can blend. Such may be the case with airport compatibility zones. Since the zones may follow specific dimensional criteria, parcels of property are likely impacted by more than one zone in transitional zone areas. This can create inconsistencies where land use can be noted as permitted on one side of the line while requiring additional review on the opposite side of the line, consequently, additional review may be necessary in these transitional areas. A sample zoning ordinance contained in Appendix C of this document provides suggestions for limitations for various land uses based upon the suggested zones outlined previously. These suggestions assume a specific type of land use is either compatible, incompatible or conditionally compatible which means it may be found to be compatible, if certain terms or conditions are met to minimize potential adverse effects.

Existing Land Uses. There are different considerations for existing land uses and future land uses. It is not suggested that existing incompatible land uses currently located in a zoning area be relocated or that property values be diminished due to the location in relation to an airport. It is however, recommended that additional review or conditional use be given to any expansion or redevelopment of property that is destroyed or looking to expand. Primary areas of interest, noted in Chapter 2, need to be applied to the existing land use when considering redevelopment or expansion of that development. Compatibility guidelines should be utilized during the site plan review process to limit or minimize the following issues:

- Concentrations of people (density);
- Noise sensitivity;
- Tall structures;
- Visual Obstructions; and
- Wildlife and bird attractants.

For example, if an expansion to an existing office building is requested in an area where this type of land use is incompatible, the local municipality should consider the application of tools to mitigate the development to meet compatibility criteria. It is not the intent of the airport compatibility zones to prevent this from happening; however, the application of compatibility criteria should be utilized to limit or minimize the above concerns.

Compatible Land Uses. Compatible or permitted uses should be made subject to all other applicable regulations that would be set forth in an airport land use compatibility ordinance, including topics such as air space obstruction regulations, noise compatibility restrictions, the general performance standards and the waste disposal facility siting standards listed later in this chapter. Local zoning standards should be tailored based on, among other things, the character of flying operations conducted at the airport, the airport location, the nature of the terrain within the zones, existing land uses and surrounding neighborhood character, the uses to which the land to be zoned are planned and adaptable, and the social and economic costs of restricting uses versus the safety and other benefits of applying use restrictions.

Compatible land uses are not expected to be hazardous to airport and aircraft operations and are reasonably safe for persons on the ground within proximity of airports. Criteria for compatibility include:

- Will not attract concentrations of people;
- Will not exceed height standards;
- Will not cause a visual distraction;
- Will not cause a source of smoke/steam;
- Will not cause an electrical, navigational, or radio interference;
- Will not create wildlife and bird attractants;
- Will not create large area of standing water;
- Will not create storage of flammable substances or materials;
- Will not create a pilot to have difficulties distinguishing the airport from the surroundings, such as street lights, billboards, signs, and linear roads and street lighting; and
- Will not exceed compatible DNL noise levels of 65 DNL or greater.

For example, when agricultural crops are managed properly they may be a compatible land use near the airports. Specific considerations should be given to FAA AC 150/5300-13, Appendix 17 which provides guidance on agricultural uses near airports. Additionally, the local office of the

U.S. Department of Agriculture (USDA) APHIS Wildlife Services (WS) should be contacted to provide comments on agricultural uses prior to their development on or near airport property to limit possible wildlife hazards.

As previously discussed, each individual airport and its host community are encouraged to adopt a compatible land use plan that fits their needs. The following items summarize general performance standards that are recommended for consideration for all land uses. Subject to any applicable height restrictions such as FAR Part 77, all uses within airport land use compatibility zones are suggested to consider the following performance standards, as applicable.

Outdoor Lighting. No use should project lighting directly onto an existing runway or taxiway or into existing airport approach and landing paths except where necessary for safe and convenient air travel. Lighting for any new or expanded use should incorporate shielding in their designs to reflect light away from airport approach and landing paths. No use should imitate airport lighting or impede the ability of pilots to distinguish between airport lighting and other lighting.

Glare. No glare producing material, including but not limited to unpainted metal or reflective glass, should be used on the exterior of structures located within airport approach and landing paths or on nearby lands where glare could impede a pilot's vision.

Industrial Emissions. No agricultural, industrial, mining or similar use, or expansion of an existing agricultural, industrial, mining or similar use, as part of its regular operations, should cause emissions of smoke, dust, or steam that could obscure visibility of pilots, except upon demonstration, supported by substantial evidence, that mitigation measures imposed as approved conditions will reduce the potential for safety risk or incompatibility with airport operations to an insignificant level.

Communications Facilities and Electrical Interference. No use should cause or create electrical interference with navigational signals or radio communications operated on the airport or operated between an airport and aircraft. Proposals for the location of new or expanded radio, radio-telephone, and television transmission facilities and electrical transmission lines should be coordinated with FAA prior to approval.

Approval of cellular and other telephone or radio communication towers on leased property located within an airport land use compatibility zone should be required to be removed within 90 days following the expiration of the lease agreement. A bond or other security should be required to ensure this result. Proof of as-constructed height should be required by the approving body to ensure the construction of the structure was done in compliance with the submitted plans and does not exceed applicable heights for FAR Part 77 or other sources.

Water Impoundments and Wildlife Attractants. Prior to considering development, a property owner should coordinate with the local airport sponsor, and applicable state aeronautics and/or natural resources agencies, and the FAA regarding proposed water impoundments to review potential short- and long-term increase in hazardous movements of birds feeding, watering, or roosting in areas across runways or airport approach and departure paths, and proposed mitigation. As reasonably necessary to determine the potential for significant bird strike hazards, the property owner may be required to submit a wildlife hazard assessment for resource agency review and comment. In many states such as Minnesota and Colorado, local branches of federal agencies can offer excellent advice to local airports. The local branch of the USDA APHIS may be able to conduct an airport specific wildlife assessment. The development of Municipal Solid

Waste Landfills (MSWLFs) is also a concern that should be addressed relative to wildlife hazards. FAA AC 150/5200-34 provides guidance on this issue.

Fire and Explosion Hazards. No use or structure should promote concentrations of flammable substances or materials,.

Waste Disposal Facilities. As outlined in FAA AC 150/5200-34, no new waste disposal facilities should be permitted within 10,000 feet of any airport runway used or scheduled for use by turbojet aircraft unless approval is obtained from the FAA. No new waste disposal facilities should be permitted within 5,000 feet of any airport runway used or scheduled for use by piston type aircraft only unless approval is obtained from the FAA. Expansions of existing land disposal facilities within these distances could be permitted only upon demonstration that the facility is designed and will operate so as not to increase the likelihood of bird/aircraft collisions. Timely notice of any proposed expansion must be provided to the airport sponsor and the FAA, and any approval shall be accompanied by such conditions as are necessary to ensure that an increase in bird/aircraft collisions is not likely to result.

Waste disposal facilities tend to attract many birds, which create a bird strike hazard for aircraft and in many instances, attract small rodents which in turn, often attract raptors. Given these issues, restricting all new waste disposal facilities from the airport environs is considered the best approach.

✈ **Case Study Example:**
Denver International Airport
When Denver International Airport was relocated, the airport hoped to purchase and close an existing landfill in the airport vicinity, but was unable to do so because of prohibitive cost. The existing facility owner has been cooperative in using best management practices to reduce potential bird attractants at the site. However, given that the landfill has a lifespan of at least another 25 years, the airport remains concerned that the facility could change hands to a less responsive operator in the future, which could create a problem.

As part of the ALUCP process, an airport zoning ordinance (AZO) is often created which enables enforcement of compatible land uses by imposing land use restrictions and height limitations on building, structures, objects, and natural vegetation within airport planning boundaries. The sponsoring jurisdiction often determines the airport planning boundary governed by the AZO, as well as the specific limitations to be applied. An Airport Land Use Compatibility Model Zoning Ordinance is contained in Appendix C and may be used a guide for the development of a local AZO.

An AZO can be utilized to evaluate land use decisions in proximity to an airport. The AZO may include:

- Land use related restrictions based on noise and safety concerns;
- Height related restrictions; and
- A combination of height and land use related restrictions.

It is recommended that a combination of height and land use restrictions be utilized when developing an AZO in order to adequately protect airports, as well as those persons on the ground within the vicinity of an airport. Often AZOs are created as an overlay to existing zoning districts. This “overlay” applies additional conditions or restrictions within the airport planning boundary while retaining the existing base zoning classification underneath the overlay zoning districts. An AZO can be highly effective in addressing a number of potential incompatibilities related to airport operational areas. An AZO may limit the height of objects, as well as restrict specific land uses that create conditions potentially hazardous to navigable airspace. As noted under extraterritorial zoning, it is often important for the limits of an AZO to extend beyond the boundary of the local municipality and function with the benefit of extraterritorial zoning or joint planning and zoning efforts.

Land Use Related Restrictions. An AZO often supersedes the existing underlying zoning within specified zoning districts and is adopted by the village, city, township, and/or county governments in order to address land use issues, which include but are not limited to:

- Safety related issues:
  - Concentrations of people (usage intensity);
  - Tall structures;
  - Visual obstructions; and
  - Wildlife and bird attractants.
- Noise sensitivity related issues.

Height-Related Restrictions. An AZO that focuses on the safety of the airport typically includes height restrictions for developments beyond airport property lines to preserve navigable airspace. As previously mentioned, guidance regarding the airspace in the vicinity of an airport should be protected from tall structures. The most critical locations are beneath the airport approach surfaces and aircraft overflight areas. Tall objects in the approach corridors may pose risks and can adversely affect minimum instrument approach altitudes. Therefore, the approval process for tall structures should require the submission of FAA Form 7460-1, as discussed in Chapter 2 and Chapter 4 of this document, as well as gain local and airport approval prior to construction, to ensure safe aircraft navigational areas. The requirements for submittal of Form 7460 should be stated in the AZO.

Noise-Related Restrictions. In addition to height restrictions, noise-related restrictions can be included in an AZO. For example, an AZO can include requirements for added sound insulation of structures in high-noise areas. As noted previously, noise is considered incompatible due to the level of annoyance experienced by persons close enough to hear it. Populations in the vicinity of an airport experience heightened levels of noise the closer they are to the airport location. Increased levels of noise that stem from aircraft operations often result in a decreased level of compatibility with certain types of land uses that surround airports, most notably residential development. Therefore, efforts to mitigate certain types of land uses that are deemed noise-sensitive likely will result in an increased level of compatibility between the airport and the surrounding community. Guidance for developing a local land use noise ordinance can be found in Chapter 6 – Aircraft Noise and Land Use Compatibility. This guidance contains specific discussions of issues to consider when developing an aircraft noise related ordinance.

✈ **Case Study Examples:**

Buckley Air Force Base

The airport traffic pattern utilized primarily for flight training at Buckley Air Force Base has been recognized by Arapahoe County as an area requiring additional regulations that restrict land use types and densities beneath the airport traffic pattern area. Arapahoe County restricts land uses, such as noise sensitive uses, and limits density to protect the health, safety, and welfare of citizens within this area.

Denver International Airport

To further support area planning, the City of Aurora has developed a framework plan that identifies the types of land uses allowed within specific areas in order to protect the airport from incompatible land uses. This plan designates land to be maintained as permanent, undeveloped land that may be used for agricultural or open space in order to assist with the preservation and protection of the Airport.

Determination of Compatibility. Incompatible land uses can have attributes associated with them that may endanger the health, safety, and welfare of persons on the ground in proximity to an airport, as well as the aircraft, crew, and passengers within aircraft operating at the airport. For example, multi-family residential structures should not be located on or near the airport property due to concentrations of people. Also there may be possible height concerns associated with tall structures, such as apartment buildings or condominiums. Additionally, potential visual obstructions associated with glare may be generated by certain building materials such as glass used in the construction of these facilities.

Some uses may be considered to be conditionally compatible, which means the use may be made compatible in that zone when specific criteria set forth by the local community in an airport land use zoning ordinance or other form of document is met. To approve such a use, the decision-making officer or body, typically a planning commission or city council, shall find that the use complies with all conditions; that the use, taking into consideration compliance with all reasonable conditions of approval, will be compatible with airport operations; and that the use, if approved, is consistent with the intent of the specific local ordinance or planning document that allows for regulation of the land use.

This designation of conditionally compatible allows flexibility for municipalities to utilize best practices to provide compatible land uses within the airport influence area. This designation may allow a marginally accepted land use to be located within a specific area/zone after extensive review has been completed by planners and developers to identify the best site location, while accounting for the safe operations at the airport.

For example, a manufacturing company may propose a plant within the vicinity of the airport and has acknowledged that the plant will produce smoke and steam. Using the conditionally compatible use designation, the local community would have several options. First the local planner may work with the developer to reduce potential impacts associated with the smoke/steam issue. This may be done by changing location, changing the height of the emission stacks, or even changing manufacturing techniques. If these actions result in appropriate measures to reduce incompatibility and risk of hazards, the local community may approve the use or designate it as a conditional use. If this exercise can not limit the concern, the local community may determine the use is incompatible and deny the use. This sort of assessment should be done with an understanding that specific criteria, as outlined within the compatible designation, should provide the basis for decision making.

The intent of the conditionally compatible designation is to evaluate the proposed use and identify areas where alterations or mitigations could be utilized to minimize potential impacts to specific areas of concern such as wildlife attractants, visual obstructions, tall structures, concentrations of people, and noise sensitive developments. This designation is not intended to preclude development within the specific zone but to provide an opportunity for the governing agency to evaluate these mitigation options and provide guidance to the property owner/applicant/developer, etc. regarding these development concerns.

A use may be subject to applicable conditions in order to achieve compatibility within the airport land use compatibility zone. There may be a number of criteria or conditions that a community may designate as being necessary to achieve compatibility. For example, the following criteria should be considered when evaluating compatibility:

- The type, size, height, and nature of buildings and structures;
- The number and density of employees and customers per unit area of site in relation to business hours and employment shifts or the density of residential use, as applicable;
- The amount and nature of any nuisances generated on the premises, including but not limited to noise, smoke, odor, glare, vibration, radiation, and fumes; and

- The impacts created by the proposed use on aircraft flight operations and safety to persons and property on the ground from airport operations will not be greater than that of other uses allowed in the zone.

Airport Master Plan/Airport Layout Plan

An airport master plan/airport layout plan is a long-range plan that details the growth and development of an airport. These plans are typically based on a 20-year planning time frame and should be reviewed every five years to assess the airport's progress towards development illustrated in the documents, as well as address any changes that may have occurred. This 20-year window is often inadequate for the planning time frame associated with community comprehensive plans; however, it generally suits the timeframe associated with the aviation development and industry trends. While the time frame for an Airport Master Plan/ALP is typically 20 years, there are many airports that have the same Master Plan/ALP well beyond that or at least look at phased development over that time frame. Discussion of the development of a master plan and the involvement of local municipalities in the airport planning process is an essential element in evaluating local planning issues and airport development for potential impacts/conflicts. While traditional urban planning usually looks well beyond the 20 year airport planning horizon, the urban planning process will never take into account airport compatible land use needs if a solid Master Plan/ALP is not in place. Consequently, careful consideration for ultimate growth and development options should be considered to address this issue when assessing existing, future, and ultimate land use compatibility concerns. The suggested contents of an airport master plan are governed by the FAA AC 150/5070-6B, *Airport Master Plans* and can include the following elements:

- Inventory of existing facilities;
- Projections of aviation demand;
- Demand/capacity analysis and determination of facility requirements;
- Alternative plan concepts;
- Capital improvement plans;
- Public involvement;
- Environmental considerations;
- Existing conditions;
- Aviation forecasts;
- Facility requirements;
- Alternatives development and evaluation;
- Airport layout plans;
- Facilities implementation plan; and
- Financial feasibility analysis.

An Airport Master Plan/ALP provides local decision makers with information to guide growth and development of the airport and should be used as a resource for the development of other community planning documents, such as a comprehensive plan or area plan. It should be provided to local land use decision makers for use when evaluating projects near an airport for compatibility. Additionally, an Airport Master Plan/ALP can assist local land use decision makers with planning for projected growth and development areas for villages, cities and townships surrounding airports, and allowing for adequate community growth without encroachment of incompatible land uses upon the airport(s).

AC 150/5070-6B, Airport Master Plans outlines the development of airport master plans. The guiding principle of the airport planning process is to develop a safe and efficient airport through the use of acceptable planning standards. While there are many steps in the planning process, none of the steps should be treated in a piecemeal manner. The airside and landside issues must be evaluated equally to create a plan that provides compatible airport and community development, where possible. This AC provides a detailed outline for the development of an acceptable airport master plan.

Site Plan and Plat Review

Local zoning ordinances often require that individuals/developers requesting development approval submit a site plan of the proposed construction. Local municipal planners review the site plan to verify that the proposed development meets all zoning requirements. During the review process, consideration should be given to address airport land use compatibility regarding the specific location and use of the proposed development. As part of the review process, population intensity and development density should be studied for airport compatibility and be subject to change of the local planning commission. The number of people that will congregate within a particular development should be reviewed along with an evaluation to determine if a development will attract wildlife, generate visual obstructions, construct height hazards, or create noise sensitivity concerns within the development.

The layout of property boundaries and placement of structures also should be reviewed in order to preserve areas of open space adjacent to or within one mile of the airport for use, should an aircraft need to land in the event of an emergency. The site plan review process provides an opportunity for these issues to be discussed between local officials and individuals/developers before the development is allowed to begin. Plat review is also an important tool in preserving airport environs through the legal overview of parcel maps and subdivided parcels before development can begin. Such review is typically called for in a subdivision ordinance.

The site/plat plan review process can identify airport land use compatibility concerns, both existing and proposed, which may arise if current airport activities and land use development patterns persist into the future. Questions that are often asked regarding project layout may include:

- To what extent are generally recognized types or compatibility concerns apparent locally?
- How does the community feel about these concerns?
- What land use or airport-related actions are being taken to minimize the concerns?

Land use compatibility concerns to consider may include:

- Concentrations of people (usage intensity):
  – Number of people in a given area at one time in proximity of the airport.
  – Anticipated growth of the development.
  – Outdoor activities associated with the use.
  – Type of development and location of development relative to the runway ends and runway extended centerlines.
- Tall structures:
  – Height of structure.
  – Location of structure relative to the runway ends and runway extended centerlines.
  – FAA Form 7460.
- Visual obstructions:
  – Amount of dust, glare, light emissions, smoke, steam, or smog the development will emit.
  – Location of lighting fixtures relative to the runway ends and runway extended centerlines.
  – Glare or reflection from glass windows or open water bodies such as retention ponds.
- Wildlife and bird attractants:
  – Appropriately select and space vegetation species to minimize habitats.
  – Maintain appropriate grass lengths to minimize wildlife attractants.
  – Prohibit certain agricultural crops near airports such as those listed in Chapter 2.
  – Eliminate standing water.
  – Use of proper techniques to disperse or eliminate wildlife in a humane manner.

- Noise sensitivity related issues:
  - Extent of noise impact in relation to airport environs.
  - Anticipated growth of airport.
  - Utilization of building codes.
  - Implementation of fly quiet program.
  - Extent of sound insulation.
  - Extent of sound barriers.

Additional land use compatibility concerns to consider within proximity to airports:

- Hazardous (flammable, explosive, toxic, corrosive) substances or materials:
  - Prohibit substances or materials that may be flammable near airports.
- Electrical, navigational, or radio interference:
  - Prohibit land uses that may emit electrical, navigational, or radio interference.
  - FAA From 7460.

A land use compatibility planning checklist can be useful in the process of determining the compatibility of a certain land use included in a site plan or plat review. A sample checklist can be found in Appendix C.

✈ **Case Study Examples:**

Buckley Air Force Base

When an incompatible land use was proposed in proximity to Buckley Air Force Base, a resident and the Chamber of Commerce spoke out in opposition to the development in local news circulations and urged the City to deny the proposal. The permit denial could protect the Air Base from an incompatible land use that may have hindered airport operations or endangered the health, safety, and welfare of the residents in proximity to the airport.

Baltimore/Washington International Thurgood Marshall Airport

The MAA has established a four-mile radius around airports, in which all development proposals must be reviewed to ensure compatibility with the airport for height, vegetation, and storm water management. MAA has also developed a process to identify an "Airport Noise Zone" in which residential development is prohibited. Other states have similar airport jurisdictional boundaries that are predicated within the FAR Part 77 Surfaces.

Deed Restrictions

Deed restrictions are also an effective way to identify the potential impact on a specific parcel of property. A deed restriction is a legal document, recorded with the county, which follows the title of that particular parcel of property in perpetuity. The deed restriction defines what the property owner can and cannot do with the property, as well as notifies future property owners of restrictions on the property since the restriction is recorded with the title of the land, not just the current property owner. Deed restrictions can be established as part of a site and/or plat plan review process by either the local municipality or the county that has jurisdiction over the airport.

Natural Features Techniques

Natural features should be considered in airport zoning and land use planning. Tall trees or the presence of wildlife can threaten navigable airspace. Table 1.8-8 suggests the agencies responsible for administering the appropriate mitigation tool(s) to assist with the management of wildlife and bird attractants and height of vegetation to promote compatible land uses in proximity to an airport's environs. Techniques used to consider natural features compatibility with the airport include addressing wildlife hazards and vegetation concerns. Table 1.8-9 illustrates natural feature techniques to promote compatible land uses on or near airport environs.

Table 1.8-8. Typical agencies responsible for natural features-related techniques.

Mitigation Techniques	Primary Responsibility	Supporting Responsibility
Wildlife Management Plan	Airport Sponsor	Various State Agencies
		FAA
		U.S. Department of Agriculture Animal and Plant Inspection Services Wildlife Services
		U.S. Fish & Wildlife Services
Natural Features Inventory and Mitigation	Airport Sponsor	Various State Agencies
		FAA
		U.S. Department of Agriculture Animal and Plant Inspection Services Wildlife Services

Source: Mead & Hunt, Inc.

Wildlife Management Plan

A significant amount of research has been completed on issues pertaining to wildlife management and is consolidated in the FAA/Department of Agriculture, *Wildlife Hazard Management at Airports* manual. This manual was developed for airport personnel and provides a considerable amount of information related to wildlife hazards on or near airport environs. In order to further address this issue, ACRP has commissioned a new study, ACRP-04-06 "Guidebook for

Table 1.8-9. Natural features techniques for compatible land uses.

Technique	Description	Key Value	Primary Shortcoming	When to Use
Wildlife Management Plan	Specific planning tool which assesses wildlife hazards within airport environs	Inventories and identifies existing wildlife activity and habitats to determine potential wildlife hazards	Continuous monitoring and control measures must be used to reduce or eliminate wildlife attractants	Should be utilized to reduce or eliminate wildlife activities such as migratory bird patterns or other wildlife concerns and habitats on or near airport property and in conjunction with FAA wildlife strikes Form 5200-7
Natural Features Inventory and Mitigation	Specific planning tool which assesses vegetation within airport environs	Inventories and identifies existing vegetation hazardous to airport operations and safe aircraft movement	Vegetation may not be on airport property, therefore, creating a challenge to remove, trim, or mark	Used in conjunction with easements or land acquisition to mitigate the height of vegetation which penetrate allowable heights within the critical flight paths

Source: Mead & Hunt, Inc.

Addressing Aircraft/Wildlife Hazards at General Aviation Airports" which will provide guidance for general aviation airports to reduce hazards related to wildlife strikes.

The *Wildlife Hazard Management at Airports* manual should be consulted to develop site-specific wildlife management plans for the reduction or elimination of wildlife attractants on or near airport property. Implementation efforts to monitor wildlife activity are an important step to determine how to protect airports from wildlife hazards, such as aircraft strikes with deer and birds, based upon the specific wildlife concerns.

Each airport has a unique blend of wildlife concerns ranging from waterfowl (i.e., geese and ducks) and raptors (i.e., hawks, owls, and falcons) to songbirds (sparrows and starlings) and various sizes of mammals (i.e., mice to deer). Available resources and management techniques need to be utilized to develop a wildlife management plan that addresses specific airport needs and wildlife concerns.

Methods to address wildlife mitigation issues typically begin with a wildlife hazard assessment. This process evaluates specific wildlife issues at airports and provides a baseline from which mitigation can be developed through the use of a Wildlife Control Plan. A Wildlife Control Plan is a comprehensive tool that includes specific control techniques and habitat modifications to minimize wildlife within an airport's environs. Control techniques include wildlife removal, fence installation, and grounds maintenance that discourage wildlife from the vicinity of an airport.

Available wildlife habitat management techniques can include, but are not limited to:

- Adequate spacing of nonfruit bearing trees.
- Maintenance of vegetation such as grass in a manner to be undesirable, unattractive cover and habitat to indigenous and migratory wildlife.
- Reduction and/or elimination of standing water to diminish the attractant.
- Use of audio repellents such as propane cannons to scare and disperse wildlife.
- Management of consumer waste to reduce accessibility.
- Manage crops in farmed areas to minimize available food sources such as prohibiting cereal grain crops.
- Installation of wildlife fence to reduce access to airport operational areas.

Additionally, there are techniques available that can be used to mitigate wildlife problems such as:

- Physical relocation of wildlife, such as trapping and removal of deer;
- Depredation of wildlife, which may require permits from local, state, or federal agencies; and
- Use of pyrotechnics or noise makers to scare wildlife.

If considering depredation of migratory birds, the U.S. Fish and Wildlife Service, as well as the local natural resource agency, should be contacted for permitting information.

Many states and the FAA have entered into a cooperative agreement with the USDA APHIS WS that allows the USDA APHIS WS to conduct wildlife consultations (hazard assessments and control plans) at GA airports. The USDA APHIS WS utilizes the information gathered from GA airports to assist and develop methods for reducing threats to aircraft posed by the multitude of wildlife species including but not limited to deer, small rodents, birds, and other animals that threaten aviation safety.

In addition to wildlife hazard assessments and wildlife control plans, a concerted effort should be made to catalog all wildlife concerns, including wildlife strikes. All wildlife strikes should be reported to the FAA using Form 5200-7, and should include the type of strike and animal involved. Reporting of these strikes is critical to the assessment of wildlife hazards at airports and should be done on all wildlife strikes to provide accurate data for evaluation.

Natural Features Inventory and Mitigation

In order to protect navigable airspace and the safe movement of aircraft, an inventory of existing vegetation within runway approach areas and RPZs is recommended. From this inventory, mitigation measures can be developed to reduce the likelihood of wildlife strikes or hazards on or near an airport. Control measures to limit the height of vegetation (i.e., trees and shrubs), objects, and structures within these areas should be outlined in an AZO. Efforts should be made to limit the existence of vegetation on or near airport environs due to height and wildlife attractant hazards. Planting species of vegetation with short growth heights can be an effective management tool. Species of vegetation should also be evaluated for potential wildlife habitat and food source attractants.

Consultation with the USDA APHIS WS is encouraged to manage site-specific issues related to wildlife hazards and vegetation concerns. Essentially, efforts should be undertaken to limit opportunities for wildlife to access food, water, and shelter. When evaluating vegetation concerns near airports, best practices should be utilized to minimize potential wildlife attractants. These best practices include but are not limited to the following:

- Limitations on planting bushy trees which provide protected roosting areas for birds and cover for small mammals (i.e., ornamental trees such as Bradford pears or evergreens such as spruce and fir trees should be avoided due to their dense foliage).
- Limitations on planting trees or vegetation that produce fruits or berries used as a food source for birds or animals.
- Limitations on clusters of trees or vegetation that provide a protected environment for birds and small mammals (i.e., a cluster of trees would be discouraged, while a planting of singular trees and shrubs, spread over a large area would be more desirable).
- Removal or trimming of trees or vegetation which penetrate the approach slope.
- Installation of marker lights that alert aircraft within the airport environs of the hazard that may affect approach or departure procedures.
- Issue a notice to airmen (NOTAM) regarding the obstruction within the approach or departure of the airport of the presence of wildlife on or near the airport where/when appropriate.

Acquisition and Notification Techniques

As a prevention and mitigation technique, land acquisition and notification techniques can be used to remove, lower, or control existing land uses within RPZs and areas very close to airport environs. As a preventive tool, acquisition or notification to property owners should take place prior to the development of a conflicting land use to limit future incompatible uses. Notification to a property owner will alert an owner of potential compatibility concerns and may define a compensation for an impact identified as part of an easement. Table 1.8-10 identifies suggested agency(s) responsible for administering the appropriate acquisition and notification mitigation tool(s) to assist in the promotion and education of compatible land uses in an airport's environs

Table 1.8-11 illustrates the key elements of acquisition and notification techniques to promote compatible land uses on or near airport environs. Acquisition and notification techniques are discussed here in greater detail to illustrate the various options available to acquire property or notify property owners about land use concerns relative to an airport's environs and more importantly relative to the extended runway centerline.

Table 1.8-10. Typical agencies responsible for acquisition and notification related techniques.

Techniques	Primary Responsibility
Acquisition / Easement Techniques	
Fee Simple Acquisition	Airport Sponsors / Airport Authority
Avigation and Noise Easement	Airport Sponsors / Airport Authority
Conservation Easement	Airport Sponsors / Airport Authority
Transfer of Development Rights	Airport Sponsor / Airport Authority
	Property Owner
Purchase of Development Rights	Airport Sponsor / Airport Authority
	Property Owner
Agreement / Notification Techniques	
Non-suit Covenants and Hold Harmless Agreements	Planning Commissions / Planning Staff
Disclosure Notice	Real Estate Agents

Source: Mead & Hunt, Inc.

Fee Simple Acquisition

Fee simple acquisition is the process by which an airport sponsor purchases property from the existing property owner in its entirety, including the structures and/or facilities on the property, as well as the air and mineral rights. This is the most effective mitigation strategy to protect an airport since the airport assumes sole ownership of the property, thus allowing the airport sponsor to maintain the property in a compatible manner. The FAA recommends airport sponsors own, where practicable, the property within the RPZ and highly recommends ownership within the inner runway approach areas.

The federal process outlined in FAA AC 150/5100-17 Change 3, *Land Acquisition and Relocation Assistance for Airport Improvement Program Assisted Projects,* the *Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970* (P.L. 91-646), and the *Federal Aviation Authorization Act of 1994* FAR Part 24 must be adhered to when property is purchased with federal funds. The FAA has developed a brochure entitled *Land Acquisition for Public Airports,* which summarizes the required process for land acquisition.

Property acquisition may be expensive; however, it is the most effective technique to address existing impacts and limit future development that can create incompatible land uses. If an airport has areas with many incompatible land uses, the airport sponsor may consider developing a specific plan for property acquisition to address land use concerns.

Table 1.8-11. Acquisition and notification techniques for compatible land uses.

Technique	Description	Key Value	Primary Shortcoming	When to Use
Acquisition / Easement Techniques				
Fee Simple Acquisition	Purchase of land and all land use rights	Complete control over future and pre-existing land uses is vested with airports; not reversible	Often very costly with possible legal opposition. Land removed from tax roles	Protection of RPZs and areas subject to high levels of noise impact. Effective to resolve existing problems and avoid future problems. FAA grant may be available for acquisition
Avigation and Noise Easements	Obtain the rights to use or restrict use in a specified manner	Provides more positive control than zoning. Less expensive than fee simple acquisitions, land may remain on active tax roles. Attached to the title of the property	Does not completely alter existing incompatible land uses. Does not prevent political action to prevent airport expansion or future operational restrictions	Used to compensate land owner for impacts and to gain right to remove obstructions (i.e., trim trees) and limit future growth on the property
Conservation Easements	Obtain the rights to restrict the uses of a parcel of property which is attached to the deed / title of a parcel of property which follows the property in perpetuity	Restricts and preserves land at its current use best used for agriculture, forest, wetlands, scenic or open space land	Does not completely alter existing incompatible land uses. Does not prevent political action to prevent airport expansion or future operational restrictions	Used to preserve land within critical flight paths to mitigate or prevent incompatible land uses from encroaching on airport environs
Transfer of Development Rights (TDR)	Property development rights transferred to alternative geographic location	Less costly than fee simple acquisition; allows buildable value to be shifted to a different site, maintaining taxable property	Applicable in limited situations and requires creation of a TDR market. Requires coordination and local or state funding may be required	TDR opportunities may substantially differ between cities, counties and states. Coordination with local authorities regarding the legality of the use of a TDR is suggested
Purchase of Development Rights (PDR)	Property development rights are purchased by local government and held in perpetuity	Less costly than fee simple acquisition; allows property owner to be compensated	Requires coordination and a funding mechanism, typically a local or state source	PDR opportunities may substantially differ between cities, counties and states. Coordination with the local community and aviation agency is suggested
Agreement / Notification Techniques				
Non-Suit Covenants and Hold Harmless Agreements	Legal document between property owner and airport sponsor that is recorded with the property title	Typically used in conjunction with an avigation or noise easement, property owner agrees to NOT hold the airport liable for any land use issues	Does not alter existing incompatible land uses but merely acknowledges the existence of an issue. Does not limit future incompatibilities. Does not prevent political action to prevent airport expansion or future operational restrictions	Used to record impacts and notify a property owner of the potential impacts while removing liability for an airport
Disclosure Notice	Legal document between property owner and airport sponsor that is recorded with the property title	Informs the property owner of potential issues with developments near an airport and discloses the issues	Does not alter existing or future land issues; is an informative type tool only. Does not prevent political action to prevent airport expansion or future operational restrictions	Suggested for inclusion when a new subdivision or development is established near an airport

Source: Mead & Hunt, Inc.

✈ **Case Study Example:**
Indianapolis International Airport
Indianapolis International Airport has a property acquisition plan in place that includes both purchase assurance and sales assistance to clear areas of increased risk and maintain safety for passengers and residents alike.

Denver International Airport
Denver International Airport owns all of the land that lies beneath the airport impact zones, which include the runway protection zones, and the inner and outer approach/departure zones. The airport maintains the FAA dimensional design standards for the airfield including the Building Restriction Line; however, much of the remaining areas within the larger aircraft traffic pattern area is outside of the airport property and is outside of the City of Denver's jurisdiction for control, thus limiting the options for land use control.

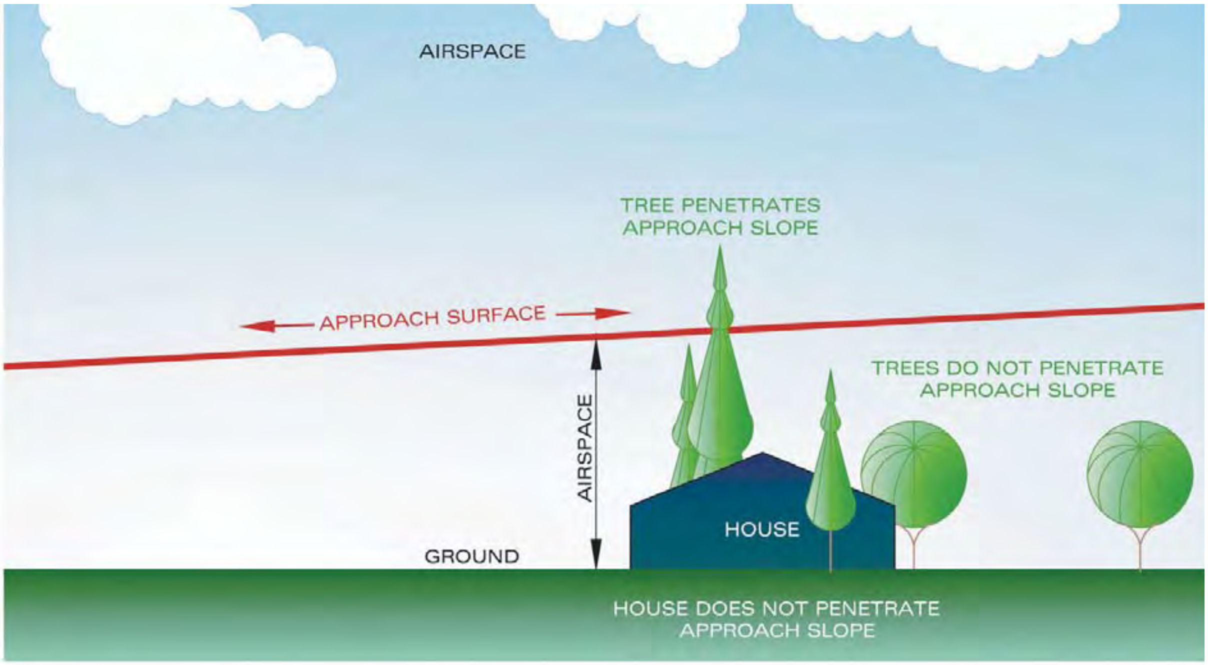
Avigation and Noise Easements

An easement is a right or privilege that one party has over the property of another party and is often purchased by an airport sponsor to protect the surrounding air space from incompatible development or encroachment. An easement is a legal document, which is attached to the property title/deed and places existing and future property owners on notice that their property can be subject to noise impacts and other land use controls associated with the airport. Additionally, avigation easements can be utilized to mitigate existing incompatible land uses that are hazardous to airports and aircraft operations, such as trimming natural vegetation back to appropriate heights.

Avigation and noise easements should be used in conjunction with a broader land use plan and must be enforced to ensure their success. Easement acquisitions are governed by the same rules that apply to the fee simple process, including the *Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Federal Aviation Authorization Act of 1994* FAR Part 24, and associated FAA ACs.

Different forms of avigation easements may be acquired to address the specific needs in a geographic area or the condition of the existing property. For example, an avigation easement within an RPZ area may preclude any future development of structures, as well as limit the height of natural vegetation, while an easement within an approach area may only limit the allowable height of structures or vegetation. The details associated with each easement should be based upon review of the specific property concerns and airport needs. Figure 1.8-5 illustrates a sample penetration in an approach surface, which an airport may work to remedy with an avigation easement. In this example, the easement would likely include the rights to prune the tree that is an existing penetration, as well as provide the perpetual right to trim trees that may penetrate the approach surface in the future. Additionally, the easement would likely limit the construction of any new structures, which would penetrate this surface. Sample avigation easements have been included in Appendix D of this document.

✈ **Case Study Example:**
Naval Air Station Pensacola and Centennial Public Airport Case
Arapahoe County utilizes avigation easements within the airport jurisdictional boundary to mitigate incompatible land uses, such as noise impacts and air rights. In addition, airport noise disclosures are utilized at the time of sale or lease of any property within the airport influence area, thereby putting all current or future property owners or leasers on notice regarding their proximity to the airport and the impacts associated with airport operations as noted on page 10 of the Centennial Public Airport Case Study. Naval Air Station Pensacola



Source: Mead & Hunt, Inc.

Figure 1.8-5. Sample property in a runway approach.

uses the aforementioned noise mitigation tools, as well as land use compatibility mitigation techniques.

Conservation Easement

Similar to an avigation or noise easement, a conservation easement legally preserves land that is attached to the property title or deed in perpetuity and is registered with the county. A conservation easement allows for restrictions to be placed on the type of land uses that can be developed on a specific parcel of property. Typically conservation easements are utilized to protect land from certain development types. These restrictions can be used to preserve and mitigate land underneath critical flight areas such as approaches and departures paths, RPZ, runway extended centerlines, aircraft overflight areas, as well as noise sensitive areas.

Conservation easements are generally best used on agricultural, forest, wetland, scenic, or open space land to limit or prevent the development of incompatible land uses on or near airport environs. However, the land continues to be privately owned and managed, therefore not diminishing the value of the land and still allowing the land to be utilized by the property owner. A conservation easement is intended to legally protect land against future growth and development, which may be incompatible with airport operations while allowing the current land use to be maintained.

Transfer of Development Rights

A tool which has been used in other areas of development is the concept of Transfer of Development Rights (TDR). A TDR program involves separation of property ownership and the use of rights associated with a parcel of land. Under a TDR, the development rights (sending zone) of a property are transferred to an alternate location (receiving zone) where they may be used to intensify allowable development. For example, land identified in a local comprehensive plan may be zoned to allow medium density housing. If this land falls within a runway approach zone, the local government may allow the property owner to transfer (send) the development rights from this property to another piece of property within the community (receiving zone) that would otherwise not be zoned for medium density housing. This allows the property owner to benefit from the developments potential but within a different geographic location, which is more compatible with airport operation.

It is recommended that a TDR be properly recorded to be certain it will appear during a title/deed search for the property. The use of TDRs, while acknowledged in urban planning activities, has had limited use in airport applications. Since it is a relatively new tool, local and state authorities should be contacted to assess the legality of using this particular tool for planning within a local community or state.

Funding for a TDR program typically comes from a local or state-developed program focused on the preservation of a certain resource. The governing entity that purchases the land holds the development rights in perpetuity, thereby, restricting development that would otherwise take place.

✈ **Case Study Example:**
Buckley Air Force Base
For military facilities, a program exists call the Readiness and Environmental Protection Initiation (REPI). The REPI has had political support from Senate leaders in favor of planning initiatives to create buffers and provide environmental protection to property surrounding military installations. The REPI program provides funding for land acquisition; however, the land acquired must be transferred to a third-party organization for permanent maintenance and conservation, such as a Trust for Public Lands.

Buckley Air Force Base has utilized the REPI program as part of their land use planning to create conservation areas where the land can be maintained and conserved in perpetuity.

Purchase of Development Rights

Another tool that uses development rights is the Purchase of Development Rights (PDR). Under a PDR program, the ownership and the use rights associated with a parcel of land are separated. Typically the local airport sponsor purchases the development rights of a parcel deemed worthy of protection. The property owner can maintain ownership of the property and can sell the property at a later date. However, the land uses allowed on the property are maintained within the PDR agreement. For example, if property near an airport is deemed important to the preservation of an airport, an airport sponsor may elect to purchase the development rights or "value" of subject property using a PDR program. This pays the property owner for the right to maintain the property as it is. This tool has most often been used for preservation of environmentally sensitive areas and agricultural properties.

This concept has been utilized in the state of New Jersey for preserving privately owned public-use airports. In that instance, a local property owner was being offered funds to sell his privately owned airport for non-aviation development. The economic benefit to the property owner was very attractive since the offer was well above what his property was "worth" as an airport. However, the state of New Jersey felt there was a substantial value in maintaining the GA airport. Consequently, the State purchased the development rights to the airport, which provides the property owner with the funds he would have received from the developer, but maintains the property as an airport in perpetuity.

Funding for a PDR program typically comes from a local or state program focused on the preservation of a certain resource. The governing entity that purchases the land holds the development rights in perpetuity, thereby restricting development that would otherwise take place. Successful PDR programs include those that have targeted farmland, scenic view sheds, historic areas, and environmentally sensitive lands. A PDR program may be a cost-effective way to protect airports through the acquisition of development rights on adjacent land areas that are not yet developed.

✈ **Case Study Example:**
Buckley Air Force Base
As noted in the Buckley Air Force Base Case Study, a PDR program has been utilized to preserve areas around the base.

Nonsuit Covenants and Hold Harmless Agreements

Nonsuit covenants and hold harmless agreements are legal contracts between a property owner and an airport sponsor, which acknowledge the potential for incompatible land use issues. A non-suit covenant or hold harmless agreement is typically used in conjunction with an avigation and noise easement. These agreements legally record that a property owner has agreed not to sue an airport over noise or other land use incompatibility issues, because the property owner acknowledges the issues exist.

Nonsuit covenants or hold harmless agreements may monetarily compensate a property owner for the agreement depending upon the specific situation. Neither will alter incompatible land uses, nor limit future incompatibilities. They are merely declaration of acknowledgement between the two parties. A template of a nonsuit covenant and a hold harmless agreement can be found in Appendix E and Appendix F.

Disclosure Notices

Disclosure requirements can be an effective way to notify future property owners of their proximity to an airport or area impacted by aircraft use. A disclosure notice is a recorded legal document that follows the title for a specific parcel of property in perpetuity. Disclosure requirements can be established as part of a site plan review, local zoning ordinance, or can be a standalone process for properties near-airport environs.

A disclosure requirement can be as simple as a notice to a property owner that a specific parcel of property lies in proximity to an airport. The notice may indicate potential safety hazards and noise issues associated with living near an airport. A sample disclosure statement can be found in Appendix G, and Chapter 6 discusses some of the issues to consider when developing a disclosure notice to inform a potential buyer about aircraft noise.

Real Estate Disclosure Notice

The term "buyer beware" is a common phrase when purchasing real estate. Many issues should be evaluated prior to the purchase and development of property near an airport. As noted in the previous sections, there are a number of planning, zoning, and land acquisition techniques used to guide and regulate land use activities within a community and in proximity to an airport. A buyer needs to be made aware of any land use compatibility issues that may arise on a piece of property near an airport, as well as the various easements, agreements, and rights that may already be in place on the property. Local and state governments can require the disclosure of information to real estate buyers to communicate development concerns to potential buyers. Many states already require this disclosure. Those that do not have this in place are encouraged to implement a process for disclosure. A sample real estate disclosure notice can be found in Appendix H of this document.

✈ **Case Study Example:**
Denver International Airport
Due to their diligence in advising property owners/leasers prior to the sale or lease of any property, real estate disclosure forms have been effective for Denver International Airport to lessen the number of noise complaints received by the airports from near-by residents.

Noise Mitigation Techniques

Aircraft noise is a major concern for land use compatibility planning. Prevention and mitigation options are typically costly and can include but are not limited to: sound insulation, noise barriers, noise abatement departure procedures, and land acquisition. Additionally, a local land use noise ordinance, as referenced earlier in this chapter as part of the airports zoning ordinance discussion, could be utilized to address some of the noise related concerns. Noise mitigation options are usually guided by AC 150/5020-1, *Noise Control and Compatibility Planning for Airport,* FAR Part 150, *Noise Study,* and the development of noise compatibility plans. As outlined in *FAR Part 150,* a noise study must follow a specific process and include key elements that include:

- Identification of noise and land use issues and problems;
- Definition of current and future noise exposure;
- Evaluation of alternative measures;
- Development of a noise compatibility plan;
- FAA approval of plan; and
- Development of an implementation and monitoring plan.

Noise studies are usually applicable to larger general aviation airports or commercial service airports that experience significant levels of aircraft operations. These levels of activity can generate cumulative noise levels greater than 65 DNL, which may affect areas beyond the airport property boundaries. The specific process, analysis, and associated deliverables of a FAR Part 150 study are not discussed in this document but can be further reviewed by utilizing the *Airport Noise Compatibility Planning Toolkit,* and FAR Part 150 documents available on the FAA web page. Table 1.8-12 identifies agencies responsible for administering noise mitigation techniques used to address the various noise compatibility issues related to the 65 DLN contour. Note that the 65 DNL may or may not be important, depending on how the local jurisdiction defines compatibility; see Chapter 6 for additional discussion of aircraft noise and land use compatibility issues.

Based upon the results of the FAR Part 150 noise study, specific issues are identified for mitigation. Table 1.8-13 illustrates noise mitigation techniques to promote compatible land uses on or near airports. Typical mitigation techniques, such as creation of sound barriers, sound insulation, land acquisition, and development of an airport master plan can be implemented to promote airport land use compatibility. These mitigation tools are often utilized to address incompatible noise issues around airports. As previously noted, land acquisition can be used as a corrective as well as a preventive mitigation measure to maintain land use compatibility within the airport's environs.

Noise Compatibility Program

Noise compatibility programs are intended to be a planning process that brings together the various stakeholders and develops techniques to establish and maintain compatible uses in areas around the airport. The requirements for development of the program are identified in 14 CFR Part 150, and include, at a minimum, the analysis of the alternatives listed in Table 1.8-13.

Table 1.8-12. Typical agencies responsible for noise related techniques.

Techniques	Primary Responsibility	Supporting Responsibility
Noise Compatibility Program	Airport Sponsor / Airport Authority	Local Unit of Government
		State Aviation Agency
		FAA
Construction Building Codes	Planning Commission / Planning Staff	Developers
		Airport Sponsor / Airport Authority
Sound Barriers	Airport Sponsor / Airport Authority	Developers
		Planning Commission / Planning Staff
Sound Insulation	Airport Sponsor / Airport Authority	Developers
		State Aviation Agency
	Planning Commission / Planning Staff	FAA

Source: Mead & Hunt, Inc.

Noise Compatibility Programs utilize various types of noise abatement or mitigation alternatives, which are designed to limit the amount of aircraft noise affecting populated areas, and to encourage land uses compatible with the aircraft noise that can not be abated. Noise compatibility programs may contain the measures listed in Table 1.8-13, but may also include procedures such as:

- Designating preferential runway usage;
- Establishing designated areas for ground run-up usage, install ground run-up enclosures, and designate ground run-up times;
- Installation of noise abatement signage on the airfield to remind pilot to be good neighbors;
- Acquisition of noise and/or radar monitoring systems; and
- Limitations on training flights.

Noise compatibility programs should be developed cooperatively with the FAA, the airport, airport users, local governments, planning staff, and citizens to ensure the effectiveness of the program. The implementation of a noise compatibility program will involve active participation by many of these stakeholders, and their commitment will be enhanced by ensuring they have had an active role in the development of the plan.

✈ **Case Study Examples:**

Centennial Public Airport

The National Business Aircraft Association's (NBAA) *Fly Quiet* offers guidance to mitigate and lessen aircraft noise impacts. Centennial Public Airport recommends that pilots utilizing the airport follow NBAA Fly Quiet procedures. The procedures can also be found on the NBAA web site, at www.nbaa.org/quietflying.

Table 1.8-13. Noise mitigation techniques for compatible land uses.

Technique	Description	Key Value	Primary Shortcoming	When to Use
Noise Techniques				
Noise Compatibility Program	Comprehensive analysis and selection of noise mitigation and abatement measures including: • Land acquisition • Sound barriers • Preferential runway • Flight procedures • Use restrictions based on noise • Sound insulation of homes and schools	Provides extensive stakeholder participation in thorough identification of means to improve, and maintain land use compatibility; study supported by federal funds; can provide eligibility for federal funding of some measures; can establish productive working relationships among stakeholders	To be successful, requires considerable time and involvement by airport staff, public, airport users; may raise public expectations unless carefully managed; commits airport to continuing updates of noise exposure maps	When airport management concludes federal assistance is necessary to establish adequate noise mitigation/abatement measures for the airport
Building Codes	Building codes implemented by the local unit of government can be an effective way to minimize aircraft noise impacts	Construction zoning regulations require the use of noise reduction materials and techniques that minimize the amount of aircraft noise impacts on the indoor environment	Increased cost of construction materials, thereby increasing the cost of the home / structure to potential buyers	Should be utilized within airport noise impact areas as determined by either the Noise Compatibility Program or by local criteria; see Appendix B
Sound Barriers	Barriers utilized to minimize noise impacts on areas in close proximity to areas of aircraft ground operations	Installation of natural vegetation, earth berms, or fences are needed to shield noise sensitive areas. Construction of structures to house aircraft during run-up periods may also be effective	These options do not completely shield noise sensitive areas from aircraft noise	Should be utilized for areas surrounding the airport where aircraft noise impacts noise sensitive areas, such as locations near aircraft test areas, aircraft run-up areas, aircraft taxiways
Sound Insulation	Measures used to lessen the affects aircraft noise has on the indoor quality of life for citizens in proximity to airports	Installation of windows, doors, insulation, etc., that minimize the amount of noise allowed to infiltrate a home / structure	Reduces only the indoor noise levels. Costs of construction materials, may increase the cost of the home / structure for potential buyers	Should be utilized within airport noise impact areas as determined by either the Noise Compatibility Program or by local criteria, see Appendix B

Source: Mead & Hunt, Inc.

O'Hare International Airport

The O'Hare Noise Compatibility Commission has developed the O'Hare Fly Quiet program, which is loosely based upon the *Fly Quiet* program. Additional details can be found on the O'Hare Noise Compatibility Commission's web site, at www.oharenoise.org.

Indianapolis International Airport

In addition to changing flight procedures as part of their noise abatement program, the Indianapolis International Airport has offered purchase and sales assistance programs for those properties deemed impacted by airport operations. This has enabled them to minimize noise impacts on surrounding properties and residents, creating a more compatible environment.

Building Codes

In order to promote good health, safety, and welfare of citizens, implementing building codes that target the reduction of noise is recommended. Regulating new construction, alterations, remodeling, repairs, maintenance, and changes of use within homes or structures impacted by

Source: O'Hare Noise Compatibility Commission, Building Codes.

Figure 1.8-6. Home/structure noise entry points.

aircraft noise provides protection from exterior noise levels that may affect the quality of life for citizens in proximity to airports. Noise can enter homes and structures in a multitude of different ways, as illustrated in Figure 1.8-6. The intent of implementing building codes is to reduce entry points that noise can travel to enter the home or structure through the use of construction methods and building techniques designed for noise reduction.

The level of noise acceptable to persons in the vicinity of an airport is ambiguous and can vary depending on the amount of ambient noise, which can mask aircraft noise intrusions. Noise sensitive land uses such as residential, institutional (schools), hospitals, hotels/motels, elder care homes, places of worship, etc., may be required to utilize specific building construction techniques or meet noise insulation requirements defined in building codes, that reduce interior aircraft noise. The following building code provisions represent a sampling of criteria that could be incorporated into the local ordinances to limit or prevent further noise incompatibility in proximity to airports; however, it is not all inclusive:

- Require specific exterior wall materials to reduce noise impacts;
- Limit the amount of penetrations through exterior walls; if a wall is penetrated caulk or fill should be utilized to prevent a path for noise to travel;
- Prohibit the use of window or through-the-wall uses such as:
  - Ventilation units / air conditioning units; and
  - Mail boxes.
- Require specific rough frame and sheathing construction methods to reduce noise impacts;
- Require insulation minimums to dampen noise effects;
- Require noise reducing windows and doors, as well as require weather stripping to limit access points for noise to enter the home/structure;
- Require combined roof and ceiling construction methods that will not allow noise intrusions to penetrate from the top of the home/structure;
- Regulate the use of exterior ventilation such as:
  - Enforce the use of ventilation units that provide a fresh air supply and cooling;
  - Limit the size and amount of gravity vent openings;
  - Regulate forced ventilation units and ducts to require specific insulation methods to dampen and reduce noise while traveling through the tubes; and
  - Mandate the use of well-fitted dampers on fireplaces.

Building code provisions such as these can also be used to mitigate noise in areas affected by highways, railroads, arterial roads, and other nonresidential sources of excessive noise.

Sound Barriers

Sound barriers can lessen or mitigate noise impacts within the airport vicinity. Sound barriers have limited applications and are typically used on airport property to shield noise-sensitive areas from noise that is produced while aircraft are on the ground. Generally, there are three types of noise-producing operations that may be mitigated by a barrier. First, when propeller aircraft prepare for departure, the engines are brought up to full power and then tested. This action, called a pre-takeoff run-up, often creates a high decibel noise level at the end of the runway just prior to takeoff. If an airport has a noise sensitive area near the runway end, a sound barrier can be installed to shield the area from aircraft noise. Second, aircraft repair or maintenance facilities often test engines as well. A specific location for such facilities can be designated and a sound barrier can be used to limit aircraft noise. Finally, jet aircraft produce considerable noise at the start of takeoff, and nearby noise sensitive areas may benefit from properly designed sound barrier. Naturally, any sound barrier design must comply with maximum height and/or clear area requirements.

Sound barriers take many different forms. Coniferous trees and shrubs can be used but serve only as visual barriers. They may result in future airspace obstructions or wildlife attractants if not managed or maintained properly. Care should be taken to assess the impacts of vegetation barriers. Topographic features can also be used as barriers. Earthen berms are commonly used as barriers since they are relatively inexpensive to construct and maintain.

Man-made barriers are a costly option and often include wooden fencing or masonry walls. Fences are the most common type of noise barrier because they screen out both the view and sound. Masonry wall barriers are used in areas where there is a specific point of sound generation, such as an engine run-up area.

Sound Insulation

Sound insulation, though considered a prevention and mitigation measure, is a partial solution to noise issues. Unfortunately, no home/structure can be completely soundproofed from aircraft noise; however, the intent is to lessen the amount of interruption on a person's quality of life surrounding airports. Sound insulation is aimed at reducing aircraft noise affects within homes/ structures. The O'Hare Noise Compatibility Commission (ONCC) has published a handbook, *Sound Insulating Your Home,* which provides several suggested ways of sound insulating homes affected by resulting aircraft noise from the Chicago O'Hare International Airport. Some of their suggested ideas include:

- Ceiling modifications;
- HVAC modifications;
- Replacement of storm doors; and
- Replacement of sky lights with storm windows.

If a home or structure is determined to be within an area that experiences a high level of aircraft noise, the house/structure can be sound insulated to reduce the levels of noise within the structure. Noise follows the path of least resistance and penetrates the home or structure through doors, windows, vents, walls, ceilings, chimneys, window air conditions, etc. Sound insulation techniques include changes such as installing windows and doors of a more substantial construction, as well as installing central air conditioning systems to reduce the need to open windows and allow noise to enter the home/structure. Additional roof and wall insulation also can be installed to reduce intruding aircraft noise.

Sound insulation addresses only the indoor environment, and does nothing to lower the outside noise levels. Outdoor noise levels should be considered during the development of a compatible land use plan.

In summary, airports should consider use of the following tools to limit the impacts produced by aircraft noise on surrounding residential uses. Most of these may be examined and developed through the Part 150 study as described in 14 CFR Part 150.

- Develop aircraft noise abatement departure and approach procedures to limit the number of aircraft overflights.

- Implement preferential runway use to encourage pilots to fly over less populated areas.
- Develop operating restrictions (usually informal or voluntary) to limit the use of runways during evening and early morning hours. If such restrictions are to be mandatory, it is likely that a Part 161 will be necessary (U.S. DoT, FAA, FAR Part 161, 1991).
- Implement ground based noise reduction measures, such as limiting all aircraft engine noise during evening and early morning hours, including powerback and engine run-up restriction. In addition, the design and construction of sound barriers may be useful in limiting the noise of engine run-ups.
- Develop cooperative programs between airlines, pilots, and airports that encourage the use of quieter aircraft or flight procedures to lessen noise impacts for surrounding residents.
- Implement continued noise monitoring programs, which can include a noise hotline for citizens to register their concerns, the production of monthly and/or quarterly noise reports, and the design and acquisition of permanent noise monitoring systems. These systems may be eligible for federal funding through completion and FAA approval of a Part 150 study.
- Implement land use compatibility controls that prohibit noise sensitive developments (e.g., residential, institutional) within aircraft noise impact areas. Also, utilize real estate disclosure forms to notify potential homebuyers or renters of potential aircraft noise impacts in the area. Appendix B discusses issues associated with the development of a land use ordinance that includes aircraft noise.
- Implement noise assistance programs, both voluntary and mandatory, to mitigate noise incompatibilities. Noise compatibility programs, such as land acquisition, homeowner assistance, resale assurance, and residential and school soundproofing, can be offered to residents within noise impact areas in an effort to protect residents from excessive noise as well as to preserve the future viability of the airport.
- Develop programs to inform airport users and community residents of the noise compatibility programs that have been implemented by the airport. Publication of materials that promote noise compatibility planning and discuss noise mitigation programs can educate both the airport users and surrounding citizens.

Education and Communication Techniques

Successful public education and outreach programs are important elements to prevent the encroachment of incompatible land uses upon airport environs. Information must be provided to and shared with the community to enhance credibility and ensure success in airport planning efforts. In particular, public education and outreach during airport and local planning efforts are essential in preventing future incompatible land use issues. Public education and outreach programs can be successfully accomplished in a variety of different ways. Table 1.8-14 illustrates the agencies typically responsible for distributing information regarding airport compatible land use planning, as well as community planning efforts.

It is the responsibility of local governments and airport sponsors to adequately provide and exchange information with stakeholders during planning efforts both for community and airport planning initiatives. That means the airport sponsors must reach out and include planners, government officials, property owners, citizens, and airport users during the planning processes. Likewise, community planning efforts must also encompass the same group of stakeholders, including airport representations. Public workshops explaining the planning process allow for an open dialog with stakeholders regarding airport land use compatibility planning and community planning efforts. *ACRP Report 15: Aircraft Noise: A Toolkit on Managing Community Expectations* provides a wealth of information related to the topic of educating the public on the issue of airport noise. This document is recommended as a resource for local communities.

Table 1.8-14. Typical agencies responsible for education related techniques.

Techniques	Primary Responsibility	Supporting Responsibility
Advisory Committee	Airport Sponsor	Citizens / Airport Users
		State Aviation Agency
	Local Unit of Government	FAA
Brochures	Airport Sponsor	Citizens / Airport Users
		State Aviation Agency
	Local Unit of Government	FAA
Pilot Notice	Airport Sponsor	State Aviation Agency
		FAA
Public Meetings	Airport Sponsor	Citizens / Airport Users
		State Aviation Agency
	Local Unit of Government	FAA
Web Sites	Airport Sponsor	State Aviation Agency
		FAA
Workshops	Airport Sponsor	Citizens / Airport Users
	Local Unit of Government	State Aviation Agency

Source: Mead & Hunt, Inc.

As evidenced by the following case study examples, extensive public outreach and education is being done throughout the nation to include the public in land use planning.

Case Study Examples:

Independence State Airport

Committees comprised of local representatives, airport members, and volunteers, such as the Independence Monmouth Positive Action Community Team and the Independence State Airport Support Group, that are involved with the planning, development, and operation of an airport can promote land use compatibility plans and airport overlay zoning in an attempt to protect the airport.

O'Hare International Airport

The O'Hare Noise Compatibility Commission has an extensive outreach program and holds approximately 30 public meetings annually. In addition, the commission has outfitted a vehicle, called the Community Outreach Vehicle, which can demonstrate aircraft noise monitoring. The vehicle is equipped with an interactive aircraft noise demonstration system and a video presentation to help residents understand aircraft noise concerns.

Randall Airport
Communication and networking has allowed Randall Airport to comment on or mitigate the proposed development of incompatible land uses surrounding the airport, which ultimately could have impacted airport operations.

Willmar Municipal Airport
An established personal and professional relationship between the City of Willmar and County of Kandiyohi Planning Directors led to a joint effort in developing, implementing, and enforcing functional airport zoning. According to Minnesota Statutes, airport sponsors/owners can impose airport zoning on surrounding jurisdictions that are impacted by their airport. However, this is not the case for numerous states, therefore cooperation, coordination, and communication between all stakeholders is critical for airport zoning to be successful.

Centennial Public Airport
Opportunities for public comment and interaction during the planning process (e.g., Airport Master Plans, FAR Part 150 Noise Studies, and Airport Land Use Compatibility Plans) provide citizens the ability to stay engaged and informed regarding the economic contributions that an airport can bring to local communities, as noted in the Centennial Public Airport Case Study.

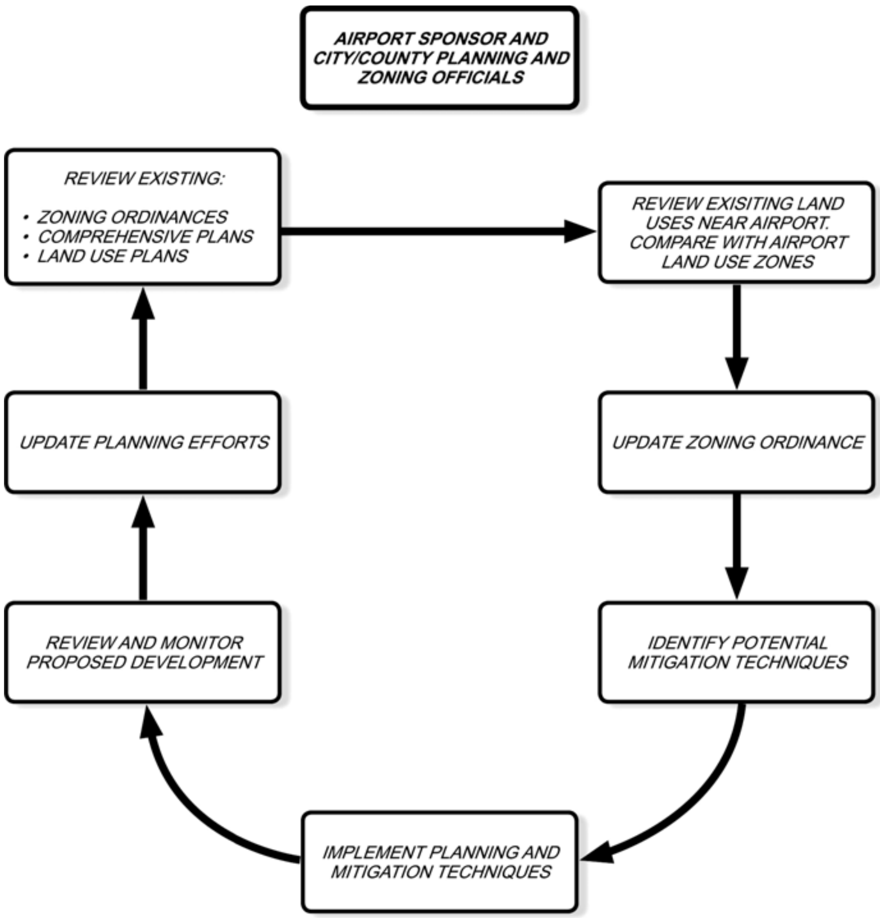
As illustrated in these case study examples, public involvement can be accomplished using many techniques. Education and outreach has proven to be key to promoting compatible land uses in airport communities around the country. Information must be provided to and shared with the community to enhance credibility and ensure success in airport planning efforts. Successful collaboration can lead to a safer, more compatible airport environment, for those in the air and on the ground.

Implementation

Airport sponsors will be most effective in ensuring compatible land use around airports if potential stakeholders understand the importance of airports and the need for compatible land use. In addition to city and county officials, and regional planners, local citizen involvement will assist in planning and mitigation techniques. Airport sponsors must work closely with city and county officials in developing comprehensive plan elements, zoning regulations, and airport zoning ordinances that:

- Preserve the viability of airports;
- Minimize and/or mitigate potential safety and noise impacts on surrounding areas;
- Preserve adequate space for airport operations, expansion, and safety zones; and
- Protect airports and airport environs from encroachment and incompatible land uses.

Airport sponsors and managers need to remain alert to proposed development or expansion projects within the airport's environs to ensure compatibility with the airport and the safe movement of aircraft. As airport sponsors develop long range plans, city and county planners need to be consulted to provide a comprehensive assessment and open line of communication. Educating and informing local citizens of the importance of compatible land uses around airports is essential to the preservation of the aviation system and the safety and quality of life of persons on the ground in the proximity of local airports. These individual citizens influence the decisions



Source: *Iowa Airport Land Use Guidebook, 2008*

Figure 1.8-7. Land use compatibility planning actions.

of planners and elected officials who are directly responsible for the implementation of the planning techniques required for compatible land uses.

Planning is a cyclical process that requires continual monitoring and updating to implement and maintain compatible land uses near airports. This process is necessary to continually evaluate and assess land use concerns as they change and evolve within individual communities. Figure 1.8-7 illustrates the cyclical process of evaluating and planning. Utilization of the various techniques referenced in this chapter is recommended to create a multifaceted approach to the development of appropriate land use planning tools that meet or address individual community and airport needs.

Summary

Utilizing the findings of case studies conducted as part of this research effort, it was apparent that there is no single method of addressing land use compatibility near airports. Many of the case study sites used a number of the techniques previously discussed and had mixed results in their application. Consequently, it is important to provide an airport and its local community with a variety of mitigation and preservation techniques, because each airport has its own unique set of land use issues. This effort begins with a solid understanding of the existing and future needs of the local airport as well as the local community. Using this assessment as a foundation, the airport sponsor and impacted jurisdictions can move forward to develop complementary comprehensive plans and airport master plans/airport layout plans that can guide the development of airport compatible land use that utilizes a number of techniques, including planning, zoning, land acquisition, and natural features mitigation. Tables 1.8-15 through 1.8-18 illustrate suggested techniques for addressing various land use concerns based upon four general scenarios. This is not intended to be an exhaustive list, but a general guide to begin evaluation of land use concerns.

Many of the tools discussed in this chapter have little chance of success if they are not built upon a sound foundation of cooperative planning between the airport and the local community. Establishing a solid plan for development near an airport is essential to providing a framework that outlines the areas of interest. From there, a local community and its airport can utilize a combination of other techniques to implement the planning recommendations. It is recommended that multiple techniques be employed to address land use compatibility issues and the local needs of both the community and the airport.

Table 1.8-15. Compatibility techniques – small rural town/city.

Local Gov / Airport Type / Growth Pressure	Planning Techniques		Natural Features Mitigation	Acquisition and Notification Techniques		Noise Techniques	Education
	Planning	Zoning		Land Acquisition / Easement	Agreements / Notifications		
Small rural Town/City **General Aviation Airport** **Minimal Growth Pressure**	Develop comprehensive plan with airport element Develop Airport Land Use Compatibility Plan incorporating airport compatible land uses Encourage industrial and commercial uses near the airport while discouraging residential uses or those with public assemblies	Adopt airport zoning ordinance Discourage land fills and water/sewer facilities, and public assemblies (schools, churches, etc.) in proximity to the airport environs Encourage low density developments outside airport safety zones	Assess wildlife activity in proximity to airport Issue Notice to Airmen (NOTAM) during crop harvest or migration periods in proximity to airport Inventory vegetation, remove or trim tall vegetation hazardous to airport operations	Acquire incompatible land within RPZ Acquire easements adjacent to airport property to remove or prune hazardous vegetation	Encourage disclosure notices and/or nonsuit covenants for new residential development in proximity to airport	Include a noise element in the comprehensive plan and/or in the Airport Land Use Compatibility Plan Encourage new development to use appropriate sound insulation methods in proximity to airport	Hold public meetings for plan adoption Inform citizens regarding airport land use issues Work with farmers to avoid planting crops that attract wildlife

Source: Mead & Hunt, Inc.

Table 1.8-16. Compatibility techniques – midsize town/city.

Local Gov / Airport Type / Growth Pressure	Planning Techniques		Natural Features Mitigation	Acquisition and Notification Techniques		Noise Techniques	Education
	Planning	Zoning		Land Acquisition / Easement	Agreements / Notifications		
Midsize Town/City **General Aviation Airport with Commercial Service** **Modest Growth Pressure**	Develop comprehensive plan with airport element Develop airport land use compatibility plan incorporating airport compatible land uses Encourage industrial, and commercial uses near the airport and discourage residential uses or those with public assemblies	Adopt airport zoning ordinance Discourage land fills and water/sewer facilities, and public assemblies (schools, churches, etc.); zone industrial and commercial uses in proximity to the runway environs Encourage low density developments outside airport safety zones	Assess wildlife activity in proximity to airport Issue Notice to Airmen (NOTAM) during crop harvest or migration periods in proximity to airport Develop wildlife management plans to reduce wildlife hazards Inventory vegetation, remove or trim tall vegetation hazardous to airport operations	Acquire incompatible land within RPZ Purchase land to develop airport compatible land uses around airport then resell acquired land with restrictive easements, disclosures, and covenants Acquire easements on properties adjacent to airport property to remove or prune hazardous vegetation and limit incompatible land use	Require disclosure notices and/or nonsuit covenants for new development and/or potential home buyers in proximity to airport	Include a noise element in the comprehensive plan and/or in a compatible land use plan Adopt construction building codes that require sound insulation methods in proximity to airport	Hold public meetings for plan adoption Inform citizens regarding airport land use issues Develop educational brochures discussing airport operation and land use concerns If agricultural activities are present, work to educate local farmers on crops to avoid due to wildlife attractant concerns

Source: Mead & Hunt, Inc.

Table 1.8-17. Compatibility techniques – suburban city.

Local Gov / Airport Type / Growth Pressure	Planning Techniques		Natural Features Mitigation	Acquisition and Notification Techniques		Noise Techniques	Education
	Planning	Zoning		Land Acquisition / Easement	Agreements / Notifications		
Suburban City **General Aviation Airport with Corporate Jet Traffic** **Major Growth Pressure**	Develop comprehensive plan with airport element Develop area plans designating areas around airport for appropriate business and residential development Develop airport land use compatibility plans incorporating airport compatible land uses Encourage industrial, and commercial uses near the airport and discourage residential uses or those with public assemblies	Adopt airport zoning ordinance Discourage land fills and water/sewer facilities, and public assemblies (schools, churches, etc.) in proximity to the airport environs Encourage low density developments outside airport safety zones	Assess wildlife activity in proximity to the airport Develop wildlife management plans to reduce wildlife hazards Inventory vegetation, remove or trim tall vegetation hazardous to airport operations Issue Notice to Airmen (NOTAMs) if/when wildlife are near or on the airport environs	Acquire incompatible land within RPZ Acquire easements on property within airport safety areas to limit incompatible land uses in proximity to airport Purchase land to develop compatible land uses around the airport then resell acquired land with restrictive covenants, easements and appropriate disclosure notices in place	Require disclosure notices and/or nonsuit covenants for new development and/or potential home buyers and/or leases in proximity to airport	Include a noise element in the comprehensive plan and/or in a compatible land use plan Conduct an FAR Part 150 noise study and develop a noise compatibility program Adopt new construction building codes and require sound insulation methods in proximity to airport Consider Purchase Assurances and Sales Assistance Programs for residential home within airport noise impact areas	Establish multi-jurisdictional citizen airport advisory committee Hold public meetings for plan adoption Inform citizens regarding airport land use issues Develop educational brochures Develop pilot good neighbor brochures to encourage quiet flying practices

Source: Mead & Hunt, Inc.

Table 1.8-18. Compatibility techniques – large city.

Local Gov / Airport Type / Growth Pressure	Planning Techniques		Natural Features Mitigation	Acquisition and Notification Techniques		Noise Techniques	Education
	Planning	Zoning		Land Acquisition / Easement	Agreements / Notifications		
Large City **Commercial Service Airport** **Existing Development / Infill**	Develop comprehensive plan with airport element Develop area plans designating areas around airport for appropriate business and residential development Develop airport land use compatibility plan incorporating airport compatible land uses Develop airport compatible in-fill redevelopment plan supporting community and airport	Adopt airport zoning ordinance Revise zoning to encourage compatible in-fill development within airport safety zones Discourage expansion of existing high density residential uses and prohibit new residential uses locating them away from airport safety areas Discourage land fills and water/sewer facilities and public assemblies (schools, churches, etc.) in proximity to the airport environs	Assess wildlife activity in proximity to the airport Develop wildlife management plans to reduce wildlife hazards Inventory vegetation, remove or trim tall vegetation hazardous to airport operations Issue Notice to Airmen (NOTAMs) if/when wildlife are near or on the airport environs	Acquire incompatible land within RPZ Acquire easements on property within airport safety areas to limit incompatible land uses in proximity to airport Purchase and remove incompatible land uses and nonconforming uses utilizing urban renewal tools Purchase land to develop compatible land uses around the airport then resell acquired land with restrictive covenants, easements, and appropriate disclosure notices in place	Require disclosure notices and/or nonsuit covenants for new development and/or potential home buyers and/or leases in proximity to airport	Include a noise element in the comprehensive plan and/or in a compatible land use plan Develop noise compatibility programs through the FAR Part 150 noise study program Adopt new construction building codes that require sound insulation methods in proximity to airport Require Purchase Assurances and Sales Assistance Programs for residential home within airport noise impact areas	Establish multi-jurisdictional citizen airport advisory committee Hold public meetings for plan adoption Inform citizens regarding airport land use issues Develop educational brochures Develop noise abatement educational materials

Source: Mead & Hunt, Inc.

V O L U M E 1 , C H A P T E R 9

Conclusions

As demonstrated with the publication of the Doolittle Report in 1952, the topic of land use compatibility near airports has been around for more than 57 years. Unfortunately, since vacant land was a readily available commodity for many of the 57 years, many communities took little initiative to institute measures to preserve compatibility near their local airports. Existing airports were relocated to new sites outside of the growing areas, but today available open areas for relocation are limited. Additionally, the environmental considerations that must be taken into account and the cost of development have created a less favorable climate for the relocation of airport facilities to new locations. Consequently, airports and their local host communities are faced with the challenge of working together to preserve the utility of their local airport while minimizing the potential impacts of aircraft operations on the surrounding population located near the airport.

Based upon the case study interviews conducted as part of this research effort, a picture of land use compatibility issues across the nation was developed and it is somewhat bleak. While many of the airports understand the need for compatible land uses around their aviation facilities, they openly acknowledge that they are most often not the agency that can implement the necessary process to address this need. In many instances, the local municipal entity is the governing body responsible for these types of activities. The level of understanding within these local agencies regarding land use compatibility issues and the severity of the situation is often misunderstood and thus the topic of airport land use compatibility is often not addressed in a manner necessary to protect this transportation resource.

There are a number of land use concerns that need to be considered when establishing various land uses in proximity to an airport. As outlined in Chapter 2, issues such as noise sensitivity, tall structures, wildlife hazards, and concentrations of people in proximity to an airport should be evaluated for developments near an airport. Ideally these topics are addressed in an Airport Land Use Compatibility Plan but can also be acknowledged in various ways through other documents such as community comprehensive plans, airport zoning ordinances, airport master plans, FAR Part 150 noise studies, wildlife management plans, and site plan reviews. An approach that employs multiple techniques, as outlined in Chapter 8, is recommended for local communities and airports to implement a program to address land use compatibility concerns.

General Findings for Enhancing Airport Land Use Compatibility

Based upon the study research and the associated case studies, there is still a significant amount of work that must be done to develop a comprehensive approach to land use compatibility planning. General findings from the research effort are summarized below.

Local jurisdictions appear to generally understand and appreciate the overall economic benefit of an airport. Most, however, do not view land use incompatibility issues as truly jeopardizing the existence of the airport. Efforts to encourage land use compatibility regulations quantify the overall economic impact of the airport, but existing tools are not sophisticated enough to convey the incremental economic impact of the approval of a single airport incompatible development. Without a clear and quantifiable link between a particular development approval and resulting economic impact, local jurisdictions are not likely to be motivated to restrict land uses based on economics. Unless or until such analysis is available, other more fruitful methods of motivating local jurisdictions are needed.

If ample land exists nearby for relocation of an airport, there may be few negative consequences for a local airport owner allowing incompatible uses around an existing facility. Federal and state grants pay for the vast majority of airport relocation and reconstruction costs. In many cases, the airport owner can recover its share of the costs over time through the sale of the former airport lands and redevelopment of these lands with tax-generating uses. Funding for airport relocation may need to be structured so that local airport owners share more of the cost burden or are otherwise motivated not to fall back on relocation as an attractive alternative to good land use planning.

Local governments do not share proportionately in the risks and benefits of airport land use compatibility. Airports can be penalized (funding withheld) for airport land use incompatibility, but cannot require surrounding local jurisdictions to adopt or enforce airport land use compatibility zoning. A variety of approaches could bring local jurisdictions' motivations into alignment with airports. These approaches include:

- State requirements for local airport protection zoning;
- Withholding of state or federal transportation funds for local jurisdictions' projects beyond airport funding; and
- Wider participation of local jurisdictions in sharing airport costs, financial risks, and revenues.

In some cases, local jurisdictions intentionally use airport incompatible land use guidance to achieve outcomes other than airport protection. For example, by permitting the construction of incompatible uses such as tall structures and those with increased densities, local governments may seek to restrict runway expansion, limit airport operations, or channel airport traffic patterns. In essence, local governments want to dictate the land area an airport can impact. However, the inherent uncertainty in future airport impacts means that the strategy can backfire with land uses that are later subject to serious impacts. Again, there is a need to bring the motivations of local jurisdictions and airports into better alignment to avoid such outcomes.

Airports encompass not only the physical ground location of the on-airport facilities, but also above ground areas for the navigable airspace, including approach and departure areas and airport traffic patterns. Since these areas are substantially larger than the airport owned property, they often cross jurisdictional boundaries and thus necessitate the involvement and cooperation of multiple governmental entities.

Many communities take their lead regarding what needs to be accomplished or implemented at their airport from the FAA or their state aviation agencies. Since the FAA recommends compatible land use near airports, but has no legal authority to implement or regulate local land use ordinances, that responsibility falls to the state and local jurisdictions. Many state agencies have not taken the initiative to create enabling legislation that empowers airports to develop compatible land use plans and zoning ordinances and often extraterritorial zoning power that is critical for effective land use planning.

Many of the airport owners/sponsors that were contacted for interviews acknowledge an active communication with community members (i.e., citizens, governmental bodies, airport association groups, etc.) as being instrumental in protecting their airports from incompatible land uses. Maintaining a proactive, two-way dialog about airport activities and community development is essential, both formal and informal. It allows opportunities for open discussion where citizens and governmental bodies can comment on and also are educated about current and future operational needs and requirements of the airport, as well as community activities and plans. Continued education and information exchange can breed community pride and a community sense of ownership. For example, in the Pensacola case study, the residents of that community are vested in the airbase and feel a sense of pride and ownership of the airport. Residents are aware of the need to zone and protect the airport from incompatible land use which would threaten its viability.

Many airport sponsors are often hesitant to pursue the topic of land use compatibility because of the ramifications that can be associated with the process of implementing a compatibility program. For example, the fear of litigation related to a claim of a "taking" is often a prevalent concern. Additionally, there are even instances where inverse condemnation has been argued by property owners when compatibility guidelines have been instituted. The cost of litigation is a significant concern for many airport sponsors as they try to defend themselves in court against the property owners who view themselves as being wronged. In addition, the intangible cost associated with the negative publicity that is often associated with these types of cases is a significant concern for many sponsors.

Additionally, the research resulted in the following more specific topic findings:

Airspace-Related Findings

Many local jurisdictions inherently understand the need to keep tall structures out of runway approach and departure zones. Fewer accept the need for strict height controls under the conical surfaces, particularly near airports where few flights vary from standard airport traffic patterns and airports that operate exclusively on instrument landing systems. Seldom do jurisdictions understand that a proposed 50-foot tower located 10 to 30 nautical miles from the airport may exhibit similar obstruction hazards.

It appears that some local governments interpret the lack of federal requirements to protect the FAR Part 77 Surfaces as meaning that adjustments to airport traffic patterns are an acceptable mitigation alternative to height restrictions on individual land uses. Unfortunately, airports are often not informed about the proposed hazard until a public hearing is held and by then have little power to negotiate with the jurisdiction against developing this potential hazard and incompatible land use.

Noise-Related Findings

Communities and airports nationwide appear to pay the most attention to the noise element of airport land use compatibility. However, the implementation of noise compatibility land use regulations continues to be contentious and patchwork, particularly where an airport is surrounded by a jurisdiction(s) that is not the airport owner. It was noted in several instances that the FAA or individual state aviation agencies could help local jurisdictions by providing clear, alternative noise land use compatibility recommendations for areas where ambient noise conditions are low.

Many communities find that using the 65 day/night noise level (65 DNL) contour is not adequate to resolve noise impacts or complaints. This is either because of the contrast where ambient noise levels are low, and/or because the DNL calculation, which uses average noise level, does not address the degree of annoyance and disruption caused by single noise events. Some airports/communities, therefore, strive to use the 60 DNL contour as the basis for land use restrictions, which often covers substantially more land area. Without strong state or federal guidance, many local jurisdictions do not have the political will to restrict or condition development in this larger contour area, even where current residents within this contour complain.

Airports often have access to funding associated with noise related issues through Part 150 studies. Utilizing these funds to develop programs, which address land use compatibility beyond fee-simple acquisition and sound insulation programs, is highly recommended. For example, Indianapolis International Airport utilizes funds from their Part 150 study, as well as passenger facility charges (PFCs) and bond revenues, to do traditional fee-simple acquisition well beyond the 65 DNL contour. This may include sound insulation or more innovative measures such as right-of-first-refusal, purchase assistance programs, and purchase and redevelopment for more compatible uses. This is complemented by an airport zoning ordinance that provides land use guidance in the vicinity of the airport.

Safety-Related Findings

Safety is an aspect of airport land use compatibility that is the least understood or accepted by local jurisdictions. More than noise and tall structures, safety compatibility guidance tends to be questioned because of the limited number of accident data points and the very low probability of airplane crashes. As such, the aviation industry's excellent safety track record works against acceptance of local land use restrictions for safety compatibility. In most communities, citizens do not make daily complaint calls regarding safety compatibility as they often do for noise. However, the consequences of incompatible land use decisions, such as airplane crashes and airport closure, are far more serious.

According to FAA safety guidelines, few local governments have adopted regulations to limit land use and development density. Even basic safety restrictions, such as prohibition of above-ground storage of flammable materials, are often lacking. Airports are often reluctant to bring the issue of safety compatibility to the public's attention for fear of creating adversaries in the community.

Communities are more likely to accept land use restrictions to address safety compatibility around military airfields than civilian airports. Due to the clear economic link and possibility of base closure, as well as a citizenry with close military ties, there is a greater tendency to support regulations to safeguard the installation.

Local jurisdictions' failure to adopt and enforce safety compatibility regulations may indicate one of two things: (1) a lack of understanding of why and how to avoid incompatible uses in the safety zones, or (2) a willingness to accept the low risk/high consequences of incompatible uses within the safety zones in exchange for benefits. Many case study interviewees knew much less about safety compatibility than noise compatibility. This suggests that the aviation community should be more forthright about potential risk within safety zones.

Appropriate levels of population density or concentrations of people are a safety issue that is hard to define. The definition of density varies from one community to another and from one type of land use to another; therefore, providing clear cut guidelines that affect the use of a structure or general land use is very difficult for local jurisdictions and the FAA to regulate. For example, residential housing is not encouraged in proximity to an airport as noted by the FAA. However, there are airports throughout the nation that have a residential airpark component that allows residential development on or near the airport. Many locations view these airparks as a compatible land use because the home owners are usually pilots and thus understand the potential danger of living in proximity to an airport. Airparks often provide value for the community with an increased tax base. In addition, residents often sign covenants and/or avigation easements acknowledging the existence of the airport and potential impacts such as noise, risk, and increased accident potential. Additionally, residents often are willing to tolerate more noise exposure and risk than what the FAA guidance provides.

Another example of the population density issue is the conflict between state legislation requirements to in-fill urbanized areas with denser residential developments and the need for safety. The theory of preserving agricultural areas and managing a city's growth by requiring a higher per acre residential density inside already designated urban areas poses a direct conflict of land use interest to the FAA and airports. They rely on open areas to reduce incompatible population and housing units, as well as preserve safety areas without having to purchase property within those zones. A good example of this is the implementation of the Growth Management Act (GMA) in the state of Washington. The GMA requires that local communities address land use compatibility in the local comprehensive plans, which is positive measure, however, the GMA also establishes urban growth boundaries (UGBs) that define where development will take place and often establishes higher densities of use within the UGB than would normally be recognized. This is done in an attempt to maximize the use of existing infrastructure and reduce the amount of urban sprawl. In this example, many airports within the state of Washington find themselves located within UGBs of their local community and thus face development pressures from higher density uses, placing a significant pressure to develop near the airport.

Further Research

There are several areas of interest that were determined to warrant additional research based upon the findings of this research effort. Below are summaries of the additional areas of interest that explain the recommended research. The topics are listed in no particular order, as all of the topics are considered to be equally important to the topic of land use compatibility planning.

Analysis of More Current Accident Data

Although previous studies have done an extensive job of analyzing past data on the location of aircraft accidents relative to runway ends, most of this analysis has been based on data prior to 1997. The analysis by HNTB Corporation of Runway 17-35 at Minneapolis-St. Paul International Airport included NTSB accident data through 2000, although the period of the analysis extended from 1982. The analysis of accident locations performed for the California Airport Land Use Planning Handbook that has been widely quoted and incorporated in other state guidance material was undertaken almost a decade ago. Given the recent trends in aviation safety discussed earlier in this report, it would be appropriate to examine more recent data to determine whether the patterns found in the data prior to 1997 are still valid or whether changes in the accident rate have also been associated with changes in the distribution of accident types and locations.

There is also a need for a more detailed analysis of the existing accident data in order to better understand how the distribution of the probability of an accident occurring at a particular location might vary from airport to airport. For example, an accident due to an aircraft descending below the glide path and colliding with trees on a ridge two miles from the runway would not have occurred in a similar situation at an airport surrounded by flat terrain. Therefore, taking the accident location two miles from the runway and treating this as if it could have occurred at any airport will overestimate the probability of an accident happening in that general location at most other airports. Conversely, it would underestimate the probability of an accident happening at that location at another airport that also has high terrain two miles from the runway.

Given the relatively small number of accidents that occur, one cannot afford to disregard any accident data, however unique the circumstances were surrounding the accident. Similarly, one cannot address differences in local circumstances by subdividing the data into separate clusters on the basis of some criteria of interest. There is simply not enough data to support this type of approach. Rather, what is needed is an approach that considers the circumstances surrounding each accident in the accident database and uses these data selectively to ensure that only those accidents relevant to the situation being analyzed are considered in the analysis.

Avigation Easements

As compatible land acquisition concerns continue to rise and the implementation of more nonprecision and precision approaches are developed with new instrumentation (Global Positioning System) approaches, acquisitions of avigation easements are expected to rise. One of the primary questions often asked by property owners who are asked to sell their avigation rights for the safe navigation of aircraft is what will happen to the value of their property once an easement is in place. It is unknown if there are any specific studies that address this issue so that an answer could be provided to the property owner. Identifying an answer to this question would allow consultants and sponsors to better address property owner concerns related to this issue.

The purpose of additional research would be to conduct a multi-step effort to assess the question of the impact of an avigation easement on the value of a parcel over the short- and long-term period of its existence and provide a written document that can be referenced by industry and real estate professionals when conducting avigation easement projects.

Establishing a general assessment of the impact of avigation easements on long-term property values would facilitate a more educated approach to the appraisal, negotiation, and general assessment of the land acquisition process. According to many of the industry professionals polled in an informal survey conducted by Mead & Hunt, Inc., it was noted that there are very few, if any, existing documents that address this topic. Consequently, it is expected that this task would be a very brief effort, but still essential to provide background information on what may have been previously compiled.

It is recommended that various industry groups be polled regarding easements and property value assessments within their various agencies. Industry groups would likely include: NASAO, the administration of the FAA, regional offices and local airport district offices, the Appraisal Institute, the Uniform Standards of Professional Appraisal Practice (USPAP), and the International Right of Way Association (IRWA). These assessments also would be used to identify airports/communities where avigation easements have been acquired to provide a pool of potential candidates for specific case studies to provide actual field assessment of values.

Based upon the information collected in the survey effort, a selection of case study airports/communities that have undertaken acquisition projects over the past 15 to 20 years could be developed. Consideration would be given to the proximity of the easements to the runway ends, the types of airports, the types of approaches on the runway, the degree of restrictions on the property, types of uses on the surrounding property, and possibly noise contours, if available.

Once identified, the case study sites could be analyzed by the project team to evaluate the existing conditions, the historic actions associated with the easement acquisition, the limitations/restrictions associated with the easement, and the appraisal documents. Then, new appraisals would be conducted on a sample of properties in the area, including those encumbered by avigation easements to determine the current value of the subject parcels and comparable parcels without easements. These case studies would provide the basis for the study findings.

The research may result in a summary of case studies that can be utilized as a resource for industry consultation, or if specific trends are found, general guidelines may be developed that can assist in future assessments.

Development Density

A significant amount of consideration was given to the topic of land use density and the intensity of use, as it relates to compatibility with airports. It is readily acknowledged that different land uses have different levels of density associated with them with regards to the amount of ground area they cover. Additionally, these same land uses often can have a diverse level of intensity in terms of the number of times in which persons are utilizing the land use. These two issues are an important element in the discussion of land use compatibility; however, it is likely one of the hardest to define. Since there are very few studies available that address what is deemed to be adequate or acceptable levels of density and intensity of use, it is recommended that additional research be done to address this issue. Most likely, this research should be partnered with the accident data research to assess the impacts of previous accidents on surrounding land uses to evaluate possible trends. The primary questions that need answers include how to determine acceptable levels of density and how to maintain safety levels associated with density.

Development of a Third-Party Risk Model

It is clear from the foregoing discussion that since the third-party risk at any particular location near an airport runway depends on the composition and level of traffic using that runway, the development of airport land use compatibility criteria to address third-party risk needs to be based on a sound and consistent analysis tailored to the circumstances of each airport. While the necessary calculations are extensive, the process is conceptually straightforward and has been applied in existing models developed by the National Air Traffic Services Limited in the United Kingdom and the National Aerospace Laboratory (NLR) in the Netherlands. However, as with any such models "the devil is in the details" as the proverb says and, in particular, the results are very dependent on the assumptions embedded in the model or used as input to the analysis. Therefore, it is highly desirable that a third-party risk model be developed for use at U.S. airports that could be used at other airports as well. Given the sensitive nature of the issues addressed by such a model, the model should be developed in cooperation with a broad range of stakeholder and interest groups to ensure that the resulting model has broad political acceptance. It would also be advisable to establish an independent technical oversight panel of suitably qualified experts in the fields of aviation safety, risk analysis, and specifically, third-party risk near airports in order to ensure that the resulting model is technically sound and incorporates the latest thinking and research.

In order to ensure that the model is widely accepted, the source code should be freely available to permit independent validation of the model logic. Users of the model should be encouraged to include the input data and assumptions with any presentation of model output so that any interested party can replicate the results. At all costs, the model development should avoid creating a model which is only known to the model developers.

The availability of such a model, together with appropriate user documentation, will allow airport operators, local planning agencies, and their consultants to develop third-party risk contours for any runway. How those risk contours are used to establish land use compatibility criteria is a separate issue, although one for which guidance also would be desirable. However, determining the level of third-party risk is clearly a critical first step in any meaningful land use planning process that is addressing third-party risk from aircraft accidents.

The ability to generate third-party risk contours or societal risk estimates is only of limited value if there is no agreement on what level of risk is acceptable. This issue is not unique to aircraft accidents and there is an extensive body of literature and established policies in other fields. However, guidance is needed on how to apply this to third-party risk from aircraft accidents and whether levels of acceptable risk in other industries or transportation sectors are appropriate to use for aircraft accidents. The effective application of third-party risk models to aircraft accidents in the vicinity of airports requires guidance on what levels of risk to adopt for land use planning and what restrictions are appropriate within particular risk contours. Research is needed to synthesize existing practice in other industries and transportation sectors as well as in other countries to develop recommendations for how this should be applied to third-party risk from aircraft accidents. This may well identify the need for further research to better understand the levels of risk from aircraft accidents that those living or working around airports are willing to accept.

Economic Implications

There are significant economic impacts that come from the existence of incompatible land uses near airports. Since the economic evaluation of incompatibilities can be assessed from a number of perspectives, this may be one of the most difficult areas of further research to address. For example, among the different types of costs associated with incompatible land uses, the following can benefit from more systematic survey efforts and case studies:

- Litigation and related costs;
- Project delays caused by community opposition and related costs;
- Increased development costs such as costs of environmental impact assessment and mitigation;
- The extent of third-party exposure to aviation accidents in the United States; and
- The incidence of aviation accidents near airports caused by the presence of incompatible land uses.

Additionally, further research is recommended to better understand the costs to local governments of imposing land use controls. This assessment might include the following topics for additional research:

- Standardized planning factors for evaluating the local government costs and revenues of residential versus nonresidential land uses; and
- Review of literature on fiscal impact assessment studies.

Benefit Costs Assessments (BCAs) are also an area that may benefit from additional research. A BCA provides a quantitative framework for weighing the benefits of reducing or avoiding the costs of airport land use incompatibility against the costs of proposed public investments and regulations to mitigate aviation's environmental effects and prevent the development of incompatible land uses. The following subjects could benefit from further research:

- Third-party property damage costs in aviation accidents;
- Establishing standard economic values for noise discount;
- The local air pollution effects of emissions from airport sources; and
- Linking economic values for emissions to the number of people exposed to local air pollution effects of emissions from airport sources.

Noise Impacts and the 65 DNL Contour

One of the fundamental questions raised as part of this study, especially through the case study effort was "Is 65 DNL an acceptable level of noise?" There was considerable discussion regarding the continued use of this level as the standard criteria for noise mitigation. Often the question was asked "Is it realistic to delineate noise contours and expect those falling just outside of the 65 DNL not to be affected by aircraft noise if they don't fall within the boundary?"

Since there are numerous ACRP projects that address noise related issues, it is recommended that a coordinated effort with these other studies be made to focus on this question through an existing ACRP study or possibly a dedicated study that would address this issue. As demonstrated in the case studies associated with the project, many noise related incompatibility concerns arose from areas well outside the 65 DNL noise contour.

Public Education/Involvement

As evidenced in the case study surveys and the 2004 NASAO study, there is a limited amount of understanding of why compatible land use near airports is important. Consequently, focusing on an educational outreach program is recommended as an additional work effort. Developing methods to improve public education and outreach is critical to the overall success of airport compatible land use planning. This research effort, in which materials would be readily usable by local community planners to both better educate themselves about these issues as well as serve as a foundation for them to use to educate their local elected and appointed officials and the general public on this topic, is encouraged.

One item that is recommended is a compilation of individual state legislations that summarizes the planning legislation that is already available in each state. This would provide a starting point for local planners who are interested in determining what existing state legislation may be available for use to assist in the development of airport compatibility planning requirements.

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APPENDIX A

European Approach to Third-Party Risk Analysis

As discussed in Chapter 7 *Aircraft Accidents and Safety Considerations*, greater attention has been given to assessing the safety of those on the ground in the vicinity of airports in Europe than in the United States. In particular, formal analytical models of the risk from aircraft accidents posed to those on the ground near airports have been developed in both the Netherlands and the United Kingdom, and land use controls in the areas off the ends of runways have been based on the results of the application of these models. This appendix provides more detail on these European approaches to assessing what those studies have termed third-party risk.

UK Public Safety Zone Policy

In 1997, the UK Department for Transport (DfT) issued a consultation document on Public Safety Zones (PSZs) at airports (UK Department for Transport, 1997). This document summarized the results of a consultant study that had been undertaken by a team led by the National Air Traffic Services (NATS) Ltd. and discussed tolerable risk criteria, the proposed changes to the shape of PSZs, and guidelines for allowable development within PSZs. It also raised a number of policy issues on which the department sought public input. The document stated that the department was satisfied that a constrained cost-benefit analysis was an appropriate method for selecting the individual risk contour to be used to determine the size of the PSZ and noted that this approach was broadly consistent with UK Health and Safety Executive's framework for risk tolerability within other industries. The document recommended an upper limit to the tolerable risk of death to any individual for third parties of 1 in 10,000. The consultation document also proposed adopting the same value of statistical life for third-party deaths in aviation accidents that was used for road accidents, which at the time was approximately £848,000 in 1996 prices.

The details of the consultant study are presented in a separate report prepared by NATS (Evans, Foot, et al., 1997). This undertook an extensive review of third-party risk analysis performed by other organizations, described a third-party risk model developed by NATS, and documented the application of this model to five sample airports in the UK. An example of the resulting individual third-party risk contours is shown in **FIGURE 1**.

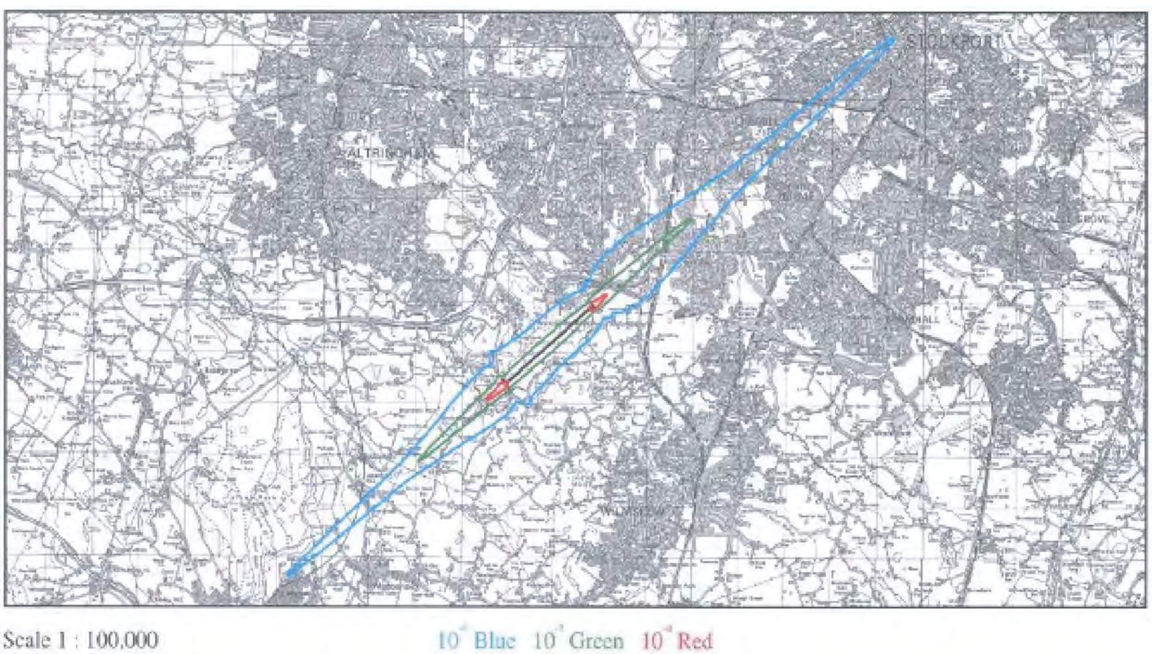

FIGURE 1 Individual risk contours at Manchester Airport.

SOURCE: Evans, A.W., P.B. Foot, et al., Third Party Risk Near Airports and Public Safety Zone Policy, 1997.

The NATS study included an extensive analysis of both the frequency of occurrence of aircraft accidents and the location of these accidents with respect to the airport runways. The study noted that the calculation of individual risk contours requires three elements:

- Annual probability of an aircraft crash occurring near a given airport
- Distribution of such crashes with respect to the runway being used
- Size of the crash area and number of people likely to be killed within this area

The study included an extensive discussion of the likely size of the impact area and the consequential number of people likely to be killed. The subsequent analysis was based on the assumption that all the people in the impact area of a commercial aircraft crash would be killed but that only 30% of those within the impact area of a general aviation aircraft crash would be killed, reflecting the smaller size, resulting kinetic energy, and fuel load of general aviation aircraft.

The report then documented in detail the third-party risk model developed by NATS and its application to the sample airports. The report also discussed at length possible criteria for tolerable risk and made recommendations that were subsequently incorporated into a DfT consultation document and guidance circular described below. A detailed description of the NATS third-party risk model is beyond the scope of this review, but this report is essential reading for anyone interested in the subject of third-party risk assessment. As part of the overall study, a separate study was undertaken by researchers at the University of Newcastle upon Tyne that examined the tolerability of third-party risk and the valuation of risk reduction near airports through a focus group survey conducted at three locations with participants who lived in the vicinity of Gatwick, Leeds-Bradford, and Luton airports (Jones-Lee & Loomes, 1996).

The survey obtained responses from 89 individuals and examined attitudes toward different levels of third-party risk from aircraft accidents (whether reducing aircraft accidents was more important than reducing road accidents, and whether it would be better to prevent one aircraft accident with a large number of third-party fatalities or a number of smaller accidents with fewer casualties). The results indicated that about 60% of the respondents found a level of individual risk of 1 in 1,000,000 too small to worry about, but that almost 85% would require compensation or relocation for a level of individual risk of 1 in 100,000. The results also showed that, in general, respondents did not favor reducing aircraft accidents over road accidents and that the majority were indifferent between the value of reducing a few accidents with a large number of fatalities and reducing a larger number of smaller accidents that killed the same number of people, although there were a few who favored reducing those accidents with a large number of fatalities. This latter result is interesting and conflicts with the widely accepted idea that people are much more concerned about accidents that result in a large number of fatalities than those that kill fewer people each but occur so much more often that they result in more fatalities in total.

The recommendations of the consultant study, that were incorporated into the DfT consultation document, resulted in a significant change in the shape of the proposed PSZs compared to the previous standards, as shown in **FIGURE 2**. Unlike the trapezoidal shape of the previous standard, the proposed PSZs based on third-party risk contours (the gray area in **FIGURE 2**) form an isosceles triangle with the greatest width at the runway end and reducing to a point on the extended runway centerline some distance from the runway. Although the length of the PSZ varies with the extent of the risk contours, the analysis of the five sample airports indicated that in general the PSZ should extend much further from the runway than the previous standard.

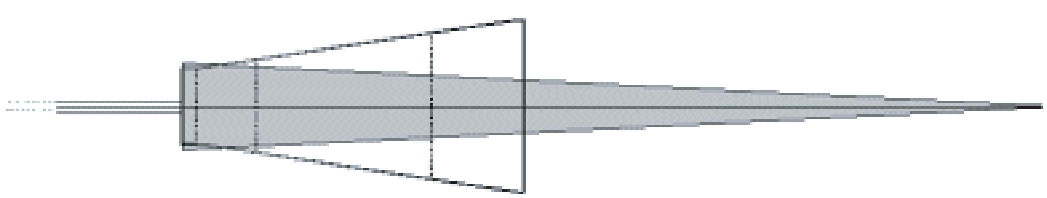

FIGURE 2 Comparison of proposed PSZ shape compared to previous standard.
Source: UK Department for Transport, Public Safety Zones: A Consultation Document, 1997

Subsequently, the DfT issued Circular 1/2002 (UK Department for Transport, 2002) on *Control of Development in Airport Public Safety Zones* to provide guidance to local planning authorities. This described the use of individual third-party risk contour modeling as the basis for establishing Public Safety Zones at airports and stated that the areas of PSZs essentially correspond to the 1 in 100,000 individual risk contours at each airport based on the forecast number and types of aircraft movements in 2015. The use of 2015 activity forecasts for the risk modeling was chosen to provide some reasonable period of stability after the introduction of the PSZs. The DfT stated that the individual risk contours will be remodeled at intervals of about 7 years based on forecasts 15 years ahead or in the event of a significant expansion of airport activity that was not anticipated in the existing risk contours or if a runway is extended or the landing threshold moved. It was recognized that this might result in a change to the extent of the PSZ but there was no discussion of the implications of this for land use planning. The DfT also stated that the Secretary of State considered the maximum tolerable individual third-party risk of being killed as a result of an aircraft accident to be 1 in 10,000 and wished to see the emptying of all residential property within the 1 in 10,000 individual risk contour, although noting that in some cases this lay within the airport property and thus no residential property was affected. However, it also stated that there should be no further development within the PSZs, although it allowed some exceptions, such as extension or alteration of existing property or uses involving a low density of people working or congregating in the zone such as long-stay car parks or warehousing. The DfT also noted that transport infrastructure, such as railway stations or park and ride schemes, could involve concentrations of people comparable to residential development and new uses of this type should not be permitted in PSZs, although it was not necessary to remove existing uses. Public open space was considered an acceptable use where there was reasonable expectation of low intensity of use. However, attractions such as children's playgrounds or playing fields should not be allowed.

NLR Model of External Risk Around Airports

In 1992, the Netherlands National Aerospace Laboratory (NLR) developed a method for calculating third-party risk around airports. This comprised three sub-models: accident probability, accident location probability, and accident consequence, as described by Ale, Smith, and Pitblado (1999). With the availability of additional historical data and the experience gained in applying the model in many airport risk studies, the risk models were updated in 1999 (Pikaar, Piers, & Ale, 2000). The improvements and extensions consisted of revisions of the model parameters and conceptual changes to the external risk models.

The changes to the accident rate model, in addition to a larger set of accident data, involve the calculation of accident probabilities for a given airport based on a selection of accidents that occurred near airports with similar conditions to the airport in question. For example, an airport surrounded by mountains would not be included in the selected airports if the airport in question were in a relatively flat area. Accident rates are also determined separately for six different types of accident (landing overrun, landing undershoot, landing veeroff, takeoff overrun, takeoff overshoot, and takeoff veeroff) and three aircraft generations, as shown in **TABLE 1**. It can be seen that accident rates reduce significantly with later generations of aircraft (although the definition of each aircraft generation is not given in the report).

TABLE 1 Accident Rates for Accident Types by Aircraft Generation

Accident type	Accident Rate (per million flights)		
	Generation 1	Generation 2	Generation 3
Landing overrun	0.251	0.200	0.062
Landing undershoot	0.753	0.145	0.124
Landing veer-off	0.879	0.181	0.093
Take-off overrun	0.377	0.109	0.062
Take-off overshoot	0.126	0.046[1]	
Take-off veer-off	0.377	0.034	

Note 1: Difference between accident rates is not statistically significant

Source: Pikaar, A.J., M.A. Piers, and B. Ale, External Risk Around Airport: A Model Update, 2000

Historical accident location data has been updated and divided into five types of accident (landing and takeoff veeroffs are combined). The other principal enhancement of the accident location model is the division into a route dependent part and a route independent part, in order to reflect the fact that some accidents impacted the ground while following a defined route to or from the airport, while in other accidents no particular route was being followed. The report notes that many accidents that were reported as occurring on the extended runway centerline may in fact have only been close to, but not exactly on, the centerline. Thus, the lateral distribution of route dependent accidents is derived from operational data on the distribution of traffic with respect to its intended route.

The accident consequence model has been revised to reflect the results of an analysis of the size of the impact area for 71 accidents. This gave a relationship of 83 square meters per ton of maximum takeoff weight. An analysis was also undertaken of the number of people within the impact area and the number of fatalities for 115 accidents. Only 31 accidents occurred in populated areas. Based on these data, the lethality was estimated as 28% of the people in the impact area.

The updated models give a significantly lower level of individual risk than the earlier model. In the case of Amsterdam Schiphol Airport, the areas within the 1 in 1,000,000 third-party individual risk contours are significantly reduced, as shown in **FIGURE 3.** The corresponding FN curve for Schiphol Airport is also significantly less, as shown in **FIGURE 4**. Note that the axes in **FIGURE 4** are logarithmic, so the difference for any given level of severity (more than N fatalities per year) is between a 5-fold to 10-fold reduction in risk.

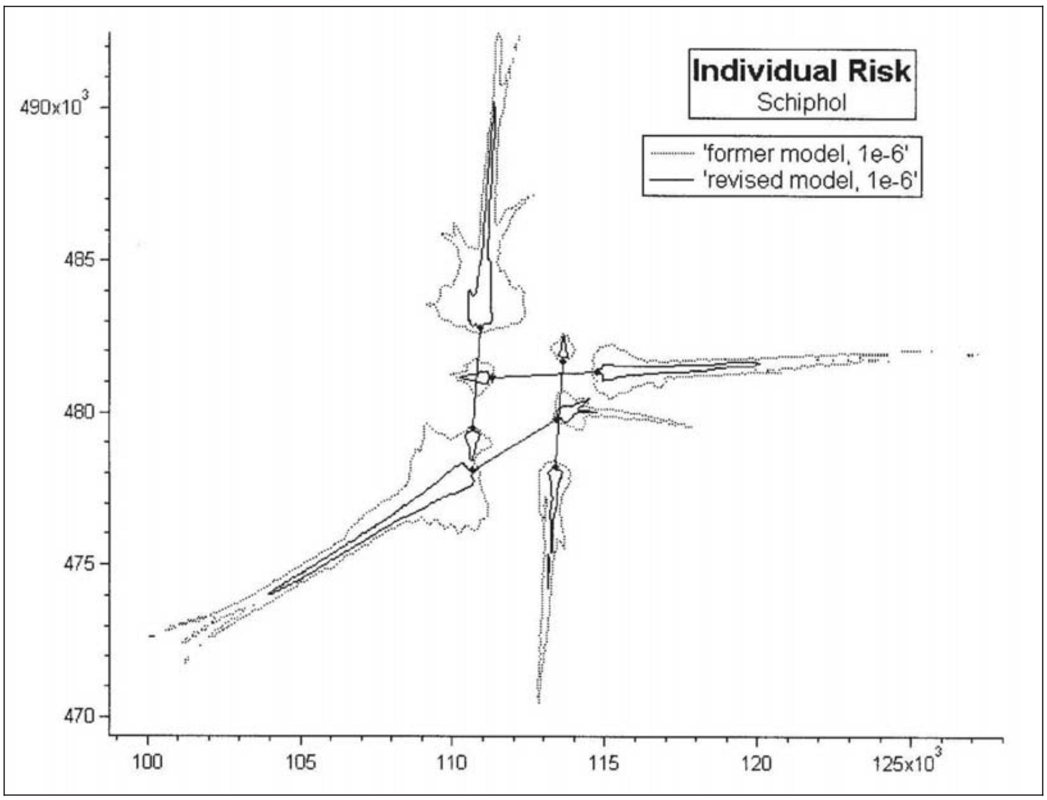

FIGURE 3 Comparison of individual risk contours around Schiphol Airport.
Source: Pikaar, A.J., M.A. Piers, and B. Ale, External Risk Around Airport: A Model Update, 2000

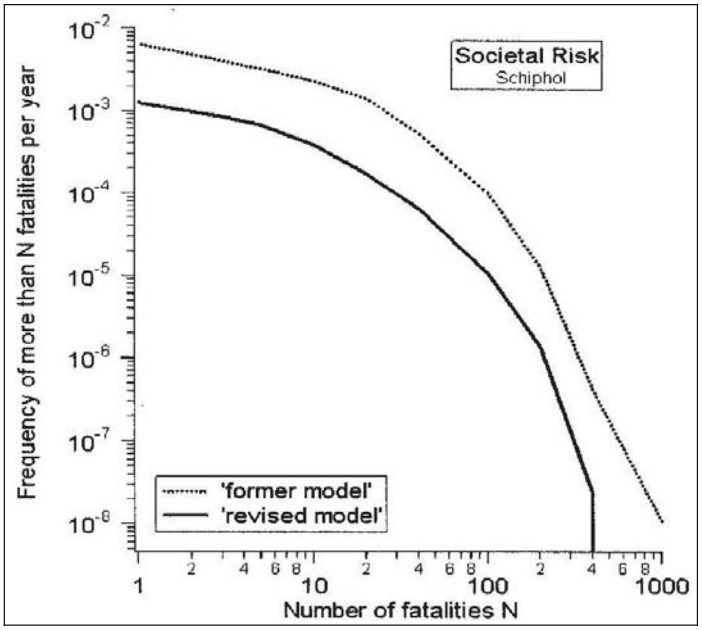

FIGURE 4 Comparison of societal risk around Schiphol Airport.
Source: Pikaar, A.J., M.A. Piers, and B. Ale, External Risk Around Airport: A Model Update, 2000

NATS Study of Third-Party Risk Contours for Frankfurt Airport

The NATS third-party risk model has continued to undergo development since the 1997 UK Department for Transport (DfT) consultation and has been used to analyze third-party risk at various airports. In 2003, the Department of Analysis and Research of NATS undertook a study to develop third-party risk contours for possible runway configurations for Frankfurt Airport under a contract to Fraport AG, the owner and operator of the airport (Marren, Mason & Wilson, 2003). The report provides a brief description of the risk modeling approach and includes figures showing the 1 in 10,000 and 1 in 100,000 individual risk contours for the actual airport traffic level in 2000 and two potential runway configurations with forecast 2015 traffic levels, as well as the associated Public Safety Zones (PSZs). The report proposed a slight modification to the triangular PSZs used in the UK to more closely conform to the shape of the 1 in 100,000 individual risk contours, as shown in **FIGURE 5**. This tapers at a greater rate for some initial distance from the runway end and then tapers more slowly for the remainder of the length.

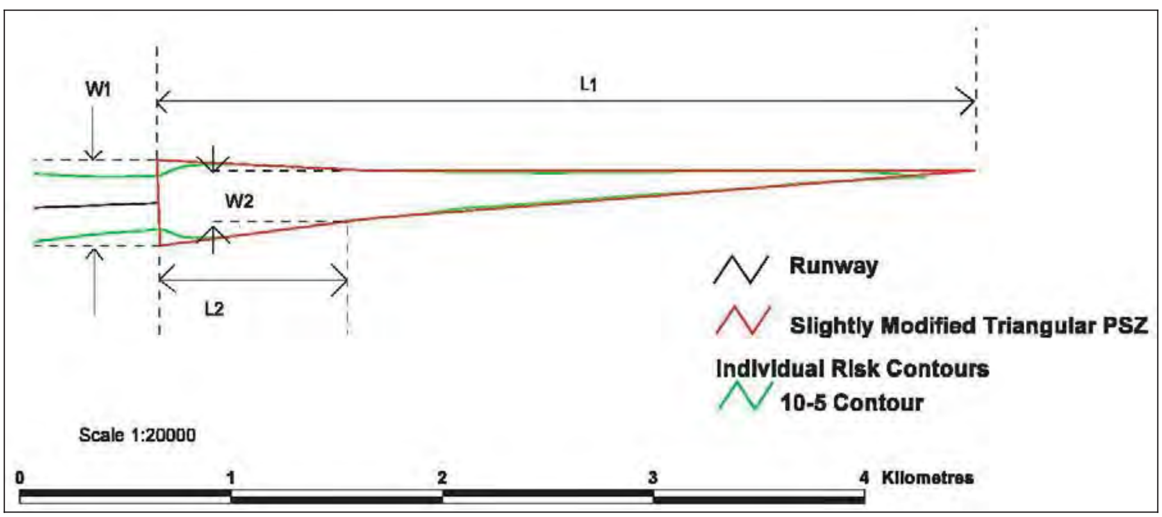

FIGURE 5 Example of a 'slightly modified' triangular PSZ.
Source: Marren, K., S. Mason and E. Wilson, Third Party Risk Contours for 2000 and 2015 Movements for Possible Runway Configurations at Frankfurt Airport, 2003

Summary
Although aircraft accidents in the immediate vicinity of an airport are fairly rare, there has been an increasing recognition in Europe of the need to determine the extent of the risk to those on the ground in the area under the arrival and departure flight paths and to establish appropriate land use controls to reduce the risk to an acceptable level. The approach being followed increasingly in Europe is to undertake a formal analysis of third-party risk and set explicit criteria for acceptable risk that can be used to define the area within which land use controls will be applied. Formal third-party risk models have been developed for this purpose in both the Netherlands and the United Kingdom. The third-party risk models developed by the UK National Air Traffic Services Limited result in contours of third-party risk that are approximately triangular in shape, with the base adjacent to the end of the runway and the contours tapering to a point at some distance from the end of the runway. These contours have been used in the formulation of the UK policy for Public Safety Zones beyond the end of each runway as well as in similar analysis of third-party risk at other airports in Europe.

The Netherlands National Aerospace Laboratory has continued to maintain a database of worldwide aircraft accidents and use this to update its third-party risk models with more recent data. As could be expected from the general improvement in aircraft safety, the most recent update shows that the extent of the contours of equal risk has been shrinking steadily at major airports, in spite of the increase in air traffic activity over time.

APPENDIX B

Airport Land Use Compatibility Model State Legislation

The Airport Cooperative Research Program (ACRP), with Federal Aviation Administration (FAA) sponsorship, under the auspices of the national Transportation Research Board (TRB), announced in February 2006 that it would grant $500,000 to fund research to assess the impacts of incompatible land uses near airports. The objective of this research is to better define incompatible uses and develop tools that state and local governments can utilize to assess the current and future impacts that incompatible land uses may have on future airport expansion and ultimately the life of an airport. One product of this ACRP research project is a model state legislation that can be utilized by state governments to enable and direct local governments to address airport land use compatibility and third party risk through local zoning.

One of the perennial challenges facing modern airports is the encroachment of incompatible land uses. Such encroachments can be in the form of high-intensity uses like arenas or schools that are incompatible with airport operations in terms of safety because they attract large numbers of people close to the airport take-off and landing areas. In other instances, structures such as tall office buildings may be built too close to runways so that they impede aircraft operations. Also, adjacent residents' noise concerns abound at the busiest urban airports and are often a significant constraint on aviation operations.

The FAA is heeding calls for action and is currently undertaking several federal initiatives to more comprehensively address airport land use compatibility. One important initiative is an overhaul of the FAA Advisory Circular 150/5190-4A, *A Model Zoning Ordinance to Limit Heights of Objects around Airports*. Working collaboratively with the American Planning Association's aviation transportation committee, the FAA intends to expand the scope of the circular and republish it as Advisory Circular 150/5190-4B, *Compatible Airspace and Land Use*. Work on the revised circular is continuing through 2008 and into 2009.

Defining the Threat – Incompatible Land Uses

In addition to the safety and health risks noted above, airport land use incompatibilities can have operational consequences for airports and negative economic consequences for communities. For example, depending on the type and severity, the incompatible land use might:

- Force an airport to change operations and flight paths,
- Force an airport to close an existing runway or forgo development of a planned runway,
- Deter an air carrier from choosing to offer service from the airport, or
- Cause the airport to become ineligible for FAA funding.

It is important that state governments enable, encourage, or require local political subdivisions and agencies to protect the huge investment in public dollars that airports represent. In a time of tight state, local, and federal budgets, no one can afford to make decisions detrimental to the airports and permit incompatible land uses that interfere with airport operations. These decisions can have an even more serious consequence beyond dollars and cents. While air travel is the safest form of mass transportation, and recent studies from 2004 even indicate that the number of accidents is dropping, aircraft accidents can and will happen. Putting houses and large structures like arenas and schools too close to runways significantly increases the chance of a catastrophic accident with many casualties.

State legislation can play an important role in enabling, encouraging, or requiring local jurisdictions to adopt zoning that protects investment in airports, protects citizens regardless of the jurisdiction they live in, and avoids conflicts as communities and demand for air travel grow. Research and case studies for this project indicate that when states offer clear guidance and minimum standards, the existence and consistency of local airport land use compatibility improves. In jurisdictions that do not own or operate the airport but do have jurisdiction over airport hazard or overflight areas, the political will to enact protective zoning may be weak in comparison to other competing pressures.

Who Should Use this Model Legislation
While a variety of people may find this model legislation a useful reference, it is aimed primarily at state and regional officials. The primary document provides a discussion of the various entities that should be involved in the development of land use compatibility programs that can include development of an ordinance such as this model. To complement and further this model state legislation, Appendix D of the full report contains an airport land use compatibility model zoning ordinance for local jurisdictions to tailor and adopt.

How the Model Legislation Was Prepared
This ordinance was prepared using the national experience of Clarion Associates and Mead & Hunt in writing state manuals and legislation for airport land use compatibility and advising local and state governments on airport land use compatibility issues. In addition, this model ordinance contains a range of best practices derived from the research, interviews, and case studies undertaken as part of the ACRP 03-03 project.

How to Use the Model Legislation
The model airport land use compatibility state legislation reflects modern airport zoning and land use practices. It also contains suggested best practices identified through research and case studies. The intent is to provide choices and options for state governments to tailor airport safety zoning legislation to their unique state context that will authorize and direct local governments to enact protective airport land use compatibility zoning standards.

The model state enabling act suggests a variety of standards and approaches including straight-forward, minimum standards as well as national “best practices” for promoting protection for persons and property on the ground and in the air. Thus, the model airport land use compatibility act gives basic guidance but also offers best practices for jurisdictions that want to go somewhat further in ensuring compatibility. Standards recommended as “best practices” are specially noted in the new model ordinance by the “BP” symbol.

This model legislation provides sample language for each of the important sections needed for a legally enforceable Act. However, airport zoning enabling legislation need not duplicate existing statutes that enable local zoning. The commentary in the document encourages the use of appropriate cross-references to existing provisions for basic sections, such as enforcement provisions or variance criteria. The use of such cross-references reduces redundancy, simplifies administration, and ensures that any future change to statutes that control zoning in general will automatically apply equally to airport zoning bodies and procedures.

A state government should begin the process of tailoring the model legislation by identifying the desired level of protection that is to be accomplished with the subject ordinance. Once that is accomplished, the adopting body may utilize the model language as a menu of options for the development of an ordinance that is tailored to meet stated local needs and resources. To complete and tailor the model legislation, the state adopting body should:

- Fill in the appropriate blanks.
- Delete instructional language contained within brackets.
- Delete unnecessary punctuation and numbers that are not applicable.
- Identify and insert cross-references to applicable, existing state statutes.
- Determine which of the basic and Best Practice provisions to adopt and/or tailor to the state circumstances and related law.

TABLE OF CONTENTS

TITLE

COMMENTARY: This Section is used to identify the title and provide a short title for easy citation.

(A) **TITLE**

This act is the Airport Land Use Compatibility Zoning Enabling Act of the State of ______________.

(B) **SHORT TITLE**

This act shall be known and may be cited as the *"Airport Zoning Act."*

PUBLIC INTEREST

COMMENTARY: This Section establishes the public interest in protecting against airport incompatible land use. BP It also declares incompatible land uses as a public nuisance and a threat to public health, safety, and welfare that justify local action.

(C) The ____________ [*adopting body*] hereby finds that an airport incompatible land use:

(1) Endangers the lives and property of users of the airport and of occupants of land and other persons in its vicinity, and

(2) If such land use constitutes an obstruction to aircraft flight, in effect it reduces the size of the area available for the landing, taking off, and maneuvering of aircraft, thus tending to destroy or impair the utility of the airport and the public investment therein.

(D) Accordingly, it is hereby declared:

(1) That it is necessary in the interest of the public health, safety, and general welfare to prevent the creation or establishment of airport incompatible land uses.

(2) That to the extent legally possible, this should be accomplished by proper exercise of the police power without compensation.

(3) That prevention of the creation or establishment of airport hazards, and other land use incompatibilities and the elimination, removal, alteration, mitigation, or marking and lighting of existing airport hazards are public purposes for which appropriate political subdivisions and agencies may raise and expend public funds to acquire land or property interests therein.

(4) [BP] That the creation or establishment of an airport incompatible land use is a public nuisance and an injury to the community served by the airport in question.

LOCAL ACTION

COMMENTARY: This Section allows or requires a local government unit or joint airport zoning board with jurisdiction over any portion of an airport influence area to adopt protective zoning. Many state airport zoning acts enable but do not require local airport zoning. Some, such as Oregon and Florida, require local action while others, such as Minnesota, do not require local action but condition eligibility of state funding for airports on adequate local zoning protections.

As discussed extensively in the primary document and specifically in the project case studies, local failure to enact appropriate airport land use compatibility zoning by either the airport host community or surrounding jurisdictions is one of the major causes of airport land use incompatibility. Stronger state legislation typically leads to better and more consistent local protections.

(E) LOCAL REGULATION

In order to prevent the creation or establishment of airport hazards, every political subdivision having an airport hazard area within its territorial limits ____________ [*may/shall*], by _______________ [*insert date*], adopt, administer, and enforce, under the police power and in the manner and upon the conditions hereinafter prescribed, airport zoning regulations for such airport hazard area.

(1) Any airport zoning regulations adopted under this chapter may require that a permit be obtained before any new structure, tree, or use may be constructed or established and before any existing use or structure may be substantially changed or substantially altered or repaired.

(2) Regulations shall provide that before any nonconforming structure or tree may be replaced, substantially altered or repaired, rebuilt, allowed to grow higher, or replanted, a permit must be secured from the local agency authorized to administer and enforce the regulations, authorizing such replacement, change, or repair.

(3) No permit shall be granted that would allow the establishment or creation of an airport hazard or would permit a nonconforming structure, tree, use, or nonconforming use to be made or become higher or to become a greater hazard to air navigation than it was when the applicable regulation was adopted or than it is when the application for a permit is made.

(F) FAILURE TO ENACT REGULATIONS

COMMENTARY: This section is only applicable where local regulation is mandatory.

If a political subdivision or joint airport zoning board fails to adopt within a reasonable time or adopts regulations or amendments that do not conform to the standard of this Act, the __________________ [*Insert title of administrator of the state transportation department or aeronautics agency*] may, for the protection of the public safety, adopt, amend, supplement, or repeal the airport zoning regulations for the political subdivision or agency until conforming airport zoning rules are adopted by the political subdivision or joint airport zoning board. The __________________ [*Insert title of administrator of the state transportation department or aeronautics agency*] shall have the same powers with reference to the airport zoning regulations as are granted to political subdivisions and agencies, airport zoning commissions, and boards of adjustment. An action taken under this subdivision is subject to review by the courts.

(G) **PURCHASE OR CONDEMNATION OF AIR RIGHTS OR NAVIGATION EASEMENTS**

A political subdivision or airport authority may acquire, by purchase, grant, condemnation, or easement, any property, structure, use, air right, avigation easement, or other estate or interest in such property if:

(1) The property, structure, or use contains a potentially incompatible land use, structure, or activity;

(2) It is desired to remove, lower, or otherwise terminate a nonconforming structure or use;

(3) The necessary approach protection cannot, because of constitutional limitations, be provided by airport zoning regulations under this part; or

(4) It appears advisable that the necessary approach protection be provided by acquisition of property rights rather than by airport zoning regulations.

COORDINATION [BP]

COMMENTARY: This Section enables or requires coordination between jurisdictions and allows for joint zoning boards. State legislation that requires airport land use compatibility protections both by airport host jurisdictions and by jurisdictions that are not airport owners typically leads to better airport land use compatibility outcomes.

(H) **OTHER JURISDICTIONS**

Where an airport is owned or controlled by a political subdivision and any airport hazard area associated with such airport is located wholly or partly outside the territorial limits of said political subdivision, the political subdivision owning or controlling the airport and the political subdivision within which the airport hazard area is located ____________ [*may/shall*] either:

(1) By interlocal agreement, adopt, administer, and enforce airport zoning regulations applicable to the airport hazard area in question; or

(2) By ordinance or resolution duly adopted, create a joint airport zoning board. This board shall have the same power to adopt, administer, and enforce airport zoning regulations applicable to the airport hazard area in question as that vested in paragraph (1) in the political subdivision within which such area is located. Each joint board shall have as its members ______ [*Insert number*] representatives appointed by each political subdivision participating in its creation and in addition a chair elected by a majority of the members so appointed. However, the airport manager or managers of the affected political subdivisions and agencies shall serve on the board in a nonvoting capacity.

(I) **FAILURE TO ACT**

COMMENTARY: This section is only applicable where local regulation is mandatory.

If within 60 days of receiving a request from an owning or controlling political subdivision pursuant to paragraph (A) a political subdivision fails to adopt or thereafter fails to enforce the zoning regulations or fails to join in creating a joint airport zoning board, then the owning or controlling political subdivision may request that the __________ [*Insert name of state department of transportation, aeronautics agency, or* *other relevant agency*] adopt, administer, and enforce airport zoning regulations for the airport hazard area in question pursuant to Section 3(B) or may directly adopt, administer, and enforce such regulations in the airport hazard area.

STANDARDS [BP]

BP *COMMENTARY:* This Section sets out minimum land use compatibility requirements of local zoning regulations. Although some state legislation does not include minimum standards, case studies and other research conducted as part of the ACRP 03-03 project indicate that such guidance usually results in better land use compatibility outcomes.

This Section offers two equally effective approaches for setting out minimum state standards. The first option is to enumerate minimum standards in the legislation. The second option is to direct local governments to meet standards as indicated in a guidance manual. In the second option, local governments are typically directed to conform to a state-specific manual adopted by an appropriate state agency, but another option would be to direct local governments to conform to the Federal Aviation Administration (FAA) guidance manual, *Land Use Compatibility and Airports*. A hybrid approach is also possible, with the legislation setting out some limited minimum standards and the guidance document providing additional detail.

Some of the standards in Option 1 of this Section refer to FAA land use compatibility guidance. If the state has other guidance, references to FAA guidance would typically be replaced with appropriate references to state guidance.

Whether the minimum standards are enumerated in the legislation or in a stand-alone manual, each state should tailor them as appropriate to the unique context of that state.

Finally, regardless of the approach selected for minimum standards (in the legislation or a stand-alone manual), most states explicitly allow local governments to establish more stringent local land use controls than the minimum standards.

(J) **MINIMUM STANDARDS** [BP]

[Option 1: INDICATE SPECIFIC STATUTORY MINIMUMS]

This option clearly indicates a minimum set of standards to which local airport land use compatibility zoning must conform. This approach is most appropriate when state requirements are limited to a small number of measurable standards.

A local political subdivision or agency shall adopt airport compatibility requirements that shall, at a minimum:

(1) Prohibit new residential development and public assembly uses within the Runway Protection Zone as defined in FAA AC 150/5300-13, *Airport Design*;

(2) Control the height of buildings, structures, towers and other objects in a manner consistent with Federal Aviation Administration FAR Part 77, *Objects Affecting Navigable Airspace;*

(3) Limit the establishment of uses within a noise impact boundary consistent with the levels identified in FAR Part 150, *Noise Compatibility Program*, Appendix A, Table 1;

COMMENTARY: The source referenced in item (3) above provides guidance based upon the recommendations outlined in this federal legislation which is based upon the Aviation Safety and Noise Abatement Act of 1979 (ASNA). Additionally, FAA AC 150/5020-1, *Noise Control and Compatibility Planning for Airports*, along with FAA AC 150/53220-14, *Airport Landscaping for Noise Control*, offer guidance on noise-related issues and may be referenced as well. At the time of writing of this model state legislation, as part of the Airports Cooperative Research Program, numerous aircraft noise-related studies have recently been undertaken to address the measurement, impacts, and mitigation of aircraft-related noise on surrounding land uses. The results of these various studies can also be used to provide supporting documentation associated with this issue. These resources can be found on the Transportation Research Board web page at www.trb.org. When state legislation is written and adopted, officials should take care to determine whether the referenced source documents are the most current and accurate references.

(4) Prohibit the siting of new industrial uses and the expansion of existing industrial uses where, as a part of regular operations, would cause emissions of smoke, dust, or steam that would obscure visibility within airport approach corridors;

(5) Limit outdoor lighting for new industrial, commercial, or recreational uses or the expansion of such uses to prevent light from projecting directly onto an existing runway or taxiway or into existing airport approach corridors except where necessary for safe and convenient air travel;

(6) Prohibit the establishment of new landfills near airports, consistent with Federal Aviation Administration Circular 150/5200-33, *Hazardous Wildlife Attractants On or Near Airports*;

(7) Regulate water impoundments consistent with the Federal Aviation Administration Circular 150/5200-33, *Hazardous Wildlife Attractants On or Near Airports*;

(8) Limit electrical interference consistent with Federal Communication Commission regulations

(9) Require, at the expense of the political subdivision or agency, removal, lowering, or other change or alteration of any structure or tree, or a change in use, not conforming to the regulations when adopted or amended;

(10) Require a property owner to permit the political subdivision or agency at its own expense to install, operate, and maintain on the property such markers and lights as necessary to indicate to operators of aircraft the presence of an airport hazard; and

(11) Provide that a pre-existing nonconforming structure, tree, or use, shall not be replaced, rebuilt, altered, allowed to grow higher, or replanted, so as to constitute a greater airport hazard than it was when the airport zoning regulations or amendments to the regulations were adopted.

OR

[*Option 2:* STANDARDS IN STAND-ALONE MANUAL]

This option directs a state agency to develop and adopt a manual to guide local political subdivisions and airport agencies and further directs that local airport land use compatibility zoning must conform to that guidance. Strengths of the Option 2 approach are that a guidance manual – and hence, the standards – may be more detailed, and that the manual may be updated periodically without requiring a legislative act.

Alternatively, this section could refer local municipalities to adhere to the FAA guidance manual, *Land Use Compatibility and Airports*. This relieves the state of the burden of creating a new manual and promotes national consistency across state land use compatibility regulations.

(1) The Department of Transportation [*or applicable state agency*] shall adopt by rule recommended guidelines regarding compatible land uses in the vicinity of airports. These guidelines shall utilize acceptable and established quantitative measures, such as the Department of Defense Air Installation Compatible Use Zone standards, state statutes, and applicable Federal Aviation Administration documents.

(2) All airport land use compatibility zoning regulations adopted by political subdivisions and agencies shall conform to the standards indicated in the state guidance manual indicated in paragraph (1).

(K) **MORE STRINGENT LOCAL REGULATIONS** [BP]

A local political subdivision or agency may adopt more stringent regulations than the minimum requirements in _________ [*this Act or the state agency/Federal Aviation Administration guidance manual*].

LIMITATIONS TO AIRPORT ZONING REGULATIONS

COMMENTARY: This Section limits the scope of local airport zoning regulations. The listed restrictions in this model legislation are common restrictions found in a range of states' legislation. Some state legislation includes additional restrictions, such as limits on changes to the density standards in existing neighborhoods or on regulation of existing and future school sites. Each state should tailor restrictions as appropriate to the unique context of the state.

The following shall be limits on a local airport land use compatibility zoning regulations:

(L) **NON-CONFORMING USES**

No airport zoning regulations adopted under this article shall require the removal, lowering, or other change or alteration of any structure or tree not conforming to the regulations when adopted or amended, or otherwise interfere with the continuance of any nonconforming use, except as provided in Section 3.

(M) **HEIGHT**

(1) The height restrictions shall not be more stringent than necessary to protect airport function and airspace as recommended by the Federal Aviation Administration in Part 77, *Objects Affecting Navigable Airspace*, or other Federal Aviation Administration orders and regulations, such as those relating to instrument approaches and one engine inoperable departure slopes, or as the local airport zoning advisory committee deems appropriate based on findings specific to the local airport environs.

(2) Height restrictions shall not apply to legal fences or to farm crops that are cut at least once each year.

(N) **EXTENT**

The airport land use compatibility zoning may not regulate the location, size, height, and use of buildings or the density of population in any area that is further than three miles from the boundary of the airport and less than 500 feet above the elevation of the airport. Should a greater restriction be deemed necessary for the proper protection of airport operations or against an airport hazard, such greater restriction shall be secured by voluntary imposition by the land owner or purchase of the property or investment therein.

(O) **REASONABLENESS**

COMMENTARY: This subsection limits zoning restrictions based on a standard of reasonableness. **BP** It further directs local governments as to what considerations should be used in determining reasonableness.

(1) All airport zoning regulations adopted under this chapter shall be reasonable and none shall impose any requirement or restriction which is not necessary to effectuate the purposes of this Act.

(2) [BP] In determining what regulations it may adopt, each political subdivision and joint airport zoning board shall consider, among other things:

a. The character of the flying operations expected to be conducted at the airport;

b. The nature of the terrain within the airport hazard area and runway protection zones;

c. The character of the neighborhood;

d. The uses to which the property to be zoned is put and adaptable; and

e. The impact of any new use, activity, or construction on the airport's operating capability and capacity.

AIRPORT LAND USE COMPATIBILITY ZONES

COMMENTARY: This Section enables establishment of airport land use compatibility zones and defines such zones to be used at each local airport. Generally, airport protection outcomes are better when the state has clear definitions of the zones rather than leaving it to each local jurisdiction to decide the dimensions of the zones. Furthermore, if state funding is tied to adoption of protective zones, then local governments should all meet the same standard required protection area.

In defining airport land use compatibility zones, some states use the Airport Impact Zones defined in the FAA guidance manual, *Land Use Compatibility and Airports*. However, some states, such as Minnesota, Iowa, and Florida, modify the FAA zones to address unique circumstances or state context. In addition to these safety-related zones, if local jurisdictions are to be allowed to adopt zoning that will address noise land use compatibility, as considered in the model local ordinance include in Appendix D of the full report, then noise contours must also be indicated as a valid airport land use compatibility zone.

If a state agency is responsible for adopting a guidance manual, the zones may alternatively be defined in the manual – rather than in the legislation – and this section may be eliminated or revised in favor of a reference to the zones in the manual.

(P) The zoning regulations ________ [*may/shall*] divide the area into airport land use compatibility zones and, within the airport land use compatibility zones, may specify the land uses permitted and regulate and restrict the height to which structures and trees may be erected or allowed to grow.

(Q) **[BP]** The airport land use compatibility zones shall be compatible with the [*airport land use compatibility zones established in the state guidance manual* or *the Airport Impact Zones established in the most current edition of the Federal Aviation Administration guidance manual*, Land Use Compatibility and Airports*]* and with measured airport noise impact contours.

CONFLICTING PROVISIONS

COMMENTARY: This Section resolves the primacy of any conflicting regulations.

Where a conflict exists between any of the regulations or limitations prescribed in this Act and any other regulations applicable to the same area, whether the conflict be with respect to the height of structures, trees, the use of land, or any other matter, than the more stringent limitation or the regulation that provides a higher degree of protection from airport hazards shall govern.

PROCEDURES

COMMENTARY: This Section specifies procedures for adopting airport land use compatibility zoning regulations. This may be a specific procedure for airport land use compatibility zoning, however most states' standard procedures to adopt local zoning regulations apply equally well to adoption of airport zoning. **BP** Thus, for simplification and consistency, this section may refer to existing state statute that sets out procedures for adopting local land use regulations.

(R) AIRPORT ZONING ADVISORY COMMISSION

(1) Prior to the initial zoning of any airport hazard area under this part, the political subdivision or joint airport zoning board that is to adopt the regulations shall appoint a commission, to be known as the airport zoning advisory commission, to recommend the boundaries of the various zones to be established and the regulations to be adopted.

(2) The commission shall make a preliminary report and hold public hearings before submitting its final report. The legislative body of the political subdivision or the joint airport zoning board may not hold its public hearings or take other action until it has received the final report of the commission.

(S) ADOPTING, AMENDING, AND REPEALING AIRPORT ZONING REGULATIONS

(1) [BP] In adopting, amending, and repealing airport zoning regulations under this chapter, the governing body of a political subdivision shall follow the procedure in ________________ [*Insert reference to existing state statue governing the adoption of local zoning regulations*].

COMMENTARY: Some states, such as Minnesota, have a state agency that is authorized to review local action for consistency with the state legislation. If such agency is authorized, the state may choose to require notification of the state agency as part of the local review and decision-making process.

(2) In addition to the notification required per paragraph (1), at least 15 days prior to the hearing, the political subdivision shall notify _________________ [*Insert name of applicable state agency*] in writing.

OR

(1) An airport zoning regulation may not be adopted, amended, or repealed under this part except by action of the legislative body of the political subdivision in question or the joint zoning board provided for in this Act, after a public hearing at which parties in interest and citizens shall have an opportunity to be heard.

(2) At least 15 days prior to the hearing, notice of the hearing shall be published in an official paper or a paper of general circulation in the political subdivision or subdivisions in which the airport hazard area to be zoned is located.

(3) In addition to the notification required per paragraph (2), at least 15 days prior to the hearing, the political subdivision shall notify _________________ [*Insert name of applicable state agency*] in writing.

VARIANCES

COMMENTARY: This Section requires local governments to allow for variances to airport zoning regulations. State legislation typically establishes basic criteria for granting of a variance. **BP** For simplification and consistency, this section may refer to existing state statute that sets out variance criteria.

As in Section 9, above, in a state where a state agency is authorized to review local action for consistency with this legislation, the state may choose to require notification of the state agency as part of the local review and decision-making process.

(T) Any person desiring to erect or increase the height of any structure, to permit the growth of any tree, or otherwise use the person's property in violation of airport zoning regulations adopted under this Act may apply to the board of adjustment for a variance from the zoning regulations.

(U) At least 15 days prior to a hearing, to grant a variance, the political subdivision shall notify _________________ [*Insert name of applicable state agency*] in writing.

(V) [BP] Variances shall be allowed only as in ______________ [*Insert reference to existing state statute addressing variances to local zoning*].

OR

Variances shall be allowed only where a literal application or enforcement of the regulations would result in practical difficulty or unnecessary hardship and the relief granted would not be contrary to the public interest but would do substantial justice and be in accordance with the spirit of the regulations and this chapter; provided, however, that any such variance may be allowed subject to any reasonable conditions that the board of adjustment may deem necessary to effectuate the purposes of this Act.

BOARD OF ADJUSTMENT

COMMENTARY: This Section provides for the establishment of an airport zoning board of adjustment or allows the use of existing board of adjustment. **BP** For simplification and consistency, this section may refer to existing state statute that enumerates powers, duties, and procedures for other local boards of adjustment generally.

(W) **ESTABLISHMENT**

All airport zoning regulations adopted under this part shall provide for an airport zoning board of adjustment. If a zoning board of appeals or adjustment already exists, it may be appointed as the airport zoning board of adjustment.

(X) POWERS, DUTIES, AND PROCEDURES

[BP] The airport zoning board of adjustment shall have the same powers and duties and its procedure shall be subject to the same provisions as established in ______________ [*Insert reference to existing state statute establishing powers and duties of a local board of adjustment*].

OR

(1) ***Powers***
The airport zoning board of adjustment shall have and exercise the powers to hear and decide the following:

a. Appeals from any order, requirement, decision, or determination made by the administrative agency in the enforcement of the airport zoning regulations;

b. Special exceptions to the terms of the airport zoning regulations upon which the board may be required to pass under the regulations; and

c. Variances.

(2) ***Membership and Quorum***

a. If a zoning board of appeals or adjustment already exists, it may be appointed as the airport zoning board of adjustment. Otherwise, the airport zoning board of adjustment shall consist of ____ [*Insert number*] members, each to be appointed for a term of ____ [*Insert number*] years, by the authority adopting the regulations and to be removable by the appointing authority for cause and upon written charges and after public hearing.

b. The concurring vote of a majority of the members of the airport zoning board of adjustment shall be sufficient to reverse any order, requirement, decision, or determination of the administrative agency; to decide in favor of the applicant on any matter upon which it is required to pass under the airport zoning regulations; or to effect any variation in the regulations.

(3) ***Procedures***

a. The board shall adopt rules in accordance with the provisions of the ordinance or resolution by which it was created.

b. All hearings of the board shall be public. Meetings of the board shall be held at the call of the chair and at other times as the board may determine.

c. The chair, or in the chair's absence the acting chair, may administer oaths and compel the attendance of witnesses.

d. The board shall keep minutes of its proceedings and records of its examinations and other official actions, all of which shall be a public record.

ENFORCEMENT

COMMENTARY: This Section grants local political subdivisions and agencies power of enforcement for violations of regulations adopted pursuant to this Act. **BP** For simplification and consistency, this section may refer to existing state statute that sets out local zoning enforcement powers and procedures.

Each violation of this Act or of any regulations, order, or rules promulgated pursuant to this Act, shall constitute a simple misdemeanor and each day a violation continues to exist shall constitute a separate offense.

(Y) [BP] A political subdivision or agency shall have the same enforcement powers and its procedure shall be subject to the same provisions as established in ______________ [*Insert reference to existing state statute establishing local zoning enforcement powers and procedures*].

OR

(A) A political subdivision or agency adopting zoning regulations under this part may issue a stop work order, impose a monetary fine, or institute in any court of competent jurisdiction an action to prevent, restrain, correct, or abate any violation of this Act, of airport zoning regulations adopted under this Act, or of any order or ruling made in connection with their administration or enforcement.

(B) The court shall adjudge to the plaintiff the relief, by way of injunction or otherwise, as may be proper under all the facts and circumstances of the case in order fully to effectuate the purposes of this part and of the regulations adopted and orders and rulings made pursuant to them.

APPEALS

COMMENTARY: This Section sets out the appeals process. **BP** For simplification and consistency, this section may reference an existing state statute of appeals procedures.

(C) **RIGHT TO APPEAL**

Any person aggrieved or affected by any decision of any administrative agency made in its administration of airport zoning regulations adopted under this Act, any governing body of a political subdivision, or any joint airport zoning board that is of the opinion that a decision of an administrative agency is an improper application of airport zoning regulations of concern to the governing body or board may appeal to the board of adjustment created pursuant to Section 11 of this Act.

(D) **APPEAL PROCEDURES**

[BP] Appeals shall be subject to the same provisions as established in ______________ [*Insert reference to existing state statute addressing appeals of local zoning decisions*].

OR

(1) All appeals taken under this section must be taken within a reasonable time as provided by the rules of the board, by filing with the agency from which appeal is taken and with the board a notice of appeal specifying the grounds of the appeal. The agency from which the appeal is taken shall transmit to the board the record upon which the action appealed from was taken.

(2) An appeal shall stay all proceedings in furtherance of the action appealed from unless the agency from which the appeal is taken certifies to the board, after the notice of appeal has been filed with it, that by reason of the facts stated in the certificate a stay would, in its opinion, cause imminent peril to life or property.

In such cases, proceedings shall not be stayed except by an order of the board on notice to the agency from which the appeal is taken and on due cause shown.

(3) The board shall fix a reasonable time for the hearing of appeals, give public notice and due notice to the parties in interest, and decide the same within a reasonable time. Upon the hearing, any party may appear in person or by agent or by attorney.

(4) The board may, in conformity with the provisions of this Act, reverse, affirm wholly or partly, or modify the order, requirement, decision, or determination appealed from and may make such order, requirement, decision, or determination as ought to be made, and to that end shall have all the powers of the administrative agency from which the appeal is taken.

DEFINITIONS

COMMENTARY: This Section lists definitions of key terms of the ordinance that are specific to airport land use compatibility. As the model legislation is tailored for a particular state, the state should consider which definitions should be retained, removed, or added to this section.

The following words, terms, and phrases, when used in this Act, shall, for the purposes of this Act, have the meaning given in this Section unless otherwise specifically defined, another intention clearly appears, or the context otherwise requires:

(E) **AIRPORT**

Any area of land or water designed and set aside for the landing and take-off of aircraft and utilized, or to be utilized, in the interest of the public for such purposes.

(F) **AIRPORT HAZARD**

Any structure, tree, or use of land that would exceed the federal obstruction standards as contained in 14 C.F.R. sections 77.21, 77.23 and 77.25 as revised March 4, 1972, and that obstructs the air space required for the flight of aircraft and landing or take-off at an airport, is otherwise hazardous to such landing or taking off of aircraft, or places significant number of people or property at risk from airport operations.

(G) **AIRPORT HAZARD AREA**

Any area of land or water upon which an airport hazard might be established if not prevented as provided by this Act.

BP *COMMENTARY:* Alternatively, the legislation can specifically define Airport Hazard Area in terms delineated zones around an airport runway, as suggested by Section 7. For an example, see Section 7 of the Model Local Airport Land Use Compatibility Ordinance provided in Appendix D of the full report.

(H) **INCOMPATIBLE LAND USE**

A use of land that is defined in FAR Part 150 as normally incompatible with the impacts of aircraft and airport operations.

(I) **OBSTRUCTION**

Any tangible, inanimate physical object, natural or artificial, that protrudes above the surface of the ground.

(J) PERSON

Any individual, firm, co-partnership, corporation, company, association, joint stock association, or body politic, and includes any trustee, receiver, assignee, or other similar representative thereof.

(K) RUNWAY PROTECTION ZONE

A trapezoidal-shaped area centered about the extended runway centerline that is used to enhance the protection of people and property on the ground. It begins 200 feet beyond the end of the runway or area usable for takeoff or landing. The runway protection zone dimensions are functions of the design aircraft, type of operation, and visibility minimums.

(L) STRUCTURE

Any object constructed or installed by humans, including, but without limitation, buildings, towers, smokestacks, and overhead transmission lines, including the poles or other structures supporting the same.

APPENDIX C

Airport Land Use Compatibility Model Local Zoning Ordinance

The Airport Cooperative Research Program (ACRP), with Federal Aviation Administration (FAA) sponsorship, under the auspices of the national Transportation Research Board (TRB), announced in February 2006 that it would grant $500,000 to fund research to assess the impacts of incompatible land uses near airports. The objective of this research is to better define incompatible uses and develop tools that state and local governments can utilize to assess the current and future impacts that incompatible land uses may have on future airport expansion and ultimately the life of an airport. One product of this ACRP research project is a model zoning ordinance that can be utilized by state and local governments to address land uses which affect land use compatibility and third party risk.

One of the perennial challenges facing modern airports is the encroachment of incompatible land uses. Such encroachments can be in the form of high-intensity uses like arenas or schools that are incompatible with airport operations in terms of safety because they attract large numbers of people close to the airport take-off and landing areas. In other instances, structures such as tall office buildings may be built too close to runways so that they impede aircraft operations. Of course, adjacent residents' noise concerns abound at the busiest urban airports and are often a significant constraint on aviation operations.

The FAA is heeding calls for action and is currently undertaking several federal initiatives to more comprehensively address airport land use compatibility. One important initiative is an overhaul of the FAA Advisory Circular 150/5190-4A ("A Model Zoning Ordinance to Limit Heights of Objects around Airports"). Working collaboratively with the American Planning Association's aviation transportation committee, the FAA intends to expand the scope of the circular and republish it as Advisory Circular 150/5190-4B, "Compatible Airspace and Land Use." Work on the revised circular is continuing through 2008 and into 2009.

Defining the Threat – Incompatible Land Uses

The true story of one airport illustrates many of the challenges and problems airports are facing with development that interferes with operations and create potential safety hazards. A city approved several major developments around its airport several decades ago, including lighted ball fields, a 130-foot high grain storage elevator, residential uses, and a nursing home. Like many communities, the city saw these developments as important to the city's economic health and tax base and did not appreciate the impact these decisions would have on future airport operations until it was too late. When a new airport master plan determined the city's airport would have to expand or improve its facilities to accommodate future demand, the city realized it would never get federal or state funding for the expansion because of the already-established incompatible land uses. As a result, the city has closed its current airport and built a brand new airport two miles away at a cost of more than $20 million dollars.

The airport sponsor in our story learned its lessons and has already purchased hundreds of acres of land around the new airport site to preclude incompatible uses. Additionally, a new multi-jurisdictional zoning board authorized by state law has been convened, and so far cooperation among the airport, city, county, and townships to limit potentially incompatible land uses is encouraging. The airport sponsor is working hard to retain agricultural uses around the airport and to limit residential uses on adjacent properties.

This case demonstrates how important it is to protect the huge investment in public dollars that airports represent. In a time of tight state, local, and federal budgets, no one can afford to make decisions detrimental to the airports and permit incompatible land uses that interfere with airport operations. But these decisions can have an even more serious consequence beyond dollars and cents—building houses, businesses, schools, cell towers, grain elevators, and other structures near runways may inevitably have serious safety consequences. While air travel is the safest form of mass transportation, and recent studies from 2004 even indicate that the number of accidents are dropping, aircraft accidents can and will happen. Putting houses and large structures like arenas and schools too close to runways significantly increases the chance of a catastrophic accident with many casualties.

National Transportation Safety Board (NTSB) records indicate that over 61 percent of accidents occur in the vicinity of an airport. Chapter 7, Aircraft Accidents and Safety Considerations of the primary document discusses the number of commercial and general aviation aircraft accidents that occurred during each portion of flight. The data clearly show that most of the risk involved with air transportation is associated with the takeoffs and landings, with arrival accidents exceeding departure incidents by almost three to one. Interestingly, general aviation flying has more accidents per operation by a factor of approximately five when compared to commercial scheduled flights.

Airport safety can be broken down into three categories:

- Protecting people and property on the ground
- Minimizing injury to aircraft occupants
- Preventing creation of hazards to flight

The primary compatibility concerns range from tall buildings that may be obstructions to flight, to inappropriate higher intensity uses that put people on the ground in harm's way (such as arenas, schools, residential subdivisions, and apartment buildings), to uses that might interfere with aircraft operations (e.g., bright lights on towers, radio interference, landfills, and standing water that might attract birds).

Since population density is a major factor in estimating a crash consequence, limiting uses that encourage the concentration of people is recommended. For example, a pilot is trained to look for areas of open space or at least low-density development in the event of an incident that causes him or her to need to land their aircraft. This is often able to be accomplished if the pilot has some form of control over the aircraft. However, in areas of high-density development, the risk of a catastrophic accident involving people on the ground is greatly increased because there are often less open spaces and higher numbers of persons in the area. Moreover, occupants in developments such as hospitals, schools, and sports stadiums are more vulnerable in the event of an accident because of mobility constraints and probable panic.

In addition to its primary focus on safety and hazards to flight, this model ordinance addresses some airport noise land use compatibility considerations. Airport noise is often the primary focus of public attention and concern in the local jurisdictions around an airport. As described in Chapter 6, Aircraft Noise and Land Use Compatibility, there are many challenges associated with how commonly-used noise metrics can be utilized to achieve noise land use compatibility. In some communities, where annual average day-night level noise contour data are available, airport land use noise compatibility regulations have been tied to these contours. An excellent example of this approach, from the State of Florida, is appended to this model ordinance. However, in addition to the aforementioned challenges, this approach to airport noise land use compatibility may not be realistic in communities where contour information is not available or where local government is reluctant to regulate based on measured contours that may change over time.

A simplified approach to airport noise land use compatibility is therefore included in this model ordinance. Noise impacts can be roughly correlated with the extended runway areas, approach zones, and airport traffic pattern area described in this model ordinance as "airport land use compatibility zones." This ordinance suggests restrictions and treatments of noise sensitive uses within the land use compatibility zones. While this approach is less precise at targeting exact levels of noise impact than the use of measured contours, its advantage is that it is easy to understand and apply within the same geographic areas as other land use compatibility regulations.

In summary, the critical areas at an airport that need to be secured and protected from a land use compatibility standpoint include the runway approach and departure zones. To enhance airport safety, it is important to maintain obstruction-free airport airspace and a reasonable amount of vacant land or land with very low intensity uses within proximity of both ends of the runway. While some of these potential hazard areas can be purchased by an airport in fee, the majority are typically substantially beyond normal airport boundaries. Acquisition of huge tracts of land is cost prohibitive. Thus the primary tools available to local governments to prevent incompatible development are zoning and land use controls.

Who Should Use this Model Ordinance

While a wide variety of people will find this model ordinance a useful reference, it is aimed primarily at local officials who manage airports and those who make local land use decisions such as city council members, zoning administrators, county commissioners, planning commissioners, planning staff, and their legal counsel. The primary document provides a discussion of the various entities that should be involved in the development of land use compatibility programs which can include development of an ordinance such as this model.

Local landowners and developers will also find this manual a helpful guide about do's and don'ts for projects within the vicinity of an airport, as will members of the aviation industry who may be interested in the plan for an airport or who will use the facilities identified in the plan. Finally, members of the general public who want to understand the basics of airport compatibility planning will hopefully find it an instructive primer.

How the Model Ordinance Was Prepared

This ordinance was prepared using the extensive national experience of Clarion Associates and Mead & Hunt in writing local airport land use compatibility ordinances and advising local and state governments on airport land use compatibility issues. In addition, this model ordinance contains a range of best practices derived from the research, interviews, and case studies undertaken as part of the ACRP 03-03 project. Federal Aviation Regulations (FAR) Part 77, Objects Affecting Navigable Airspace, was utilized as a foundation for the creation of some of the recommended zoning districts contained in the model ordinance. It should be noted that there are many other airspace requirements that are identified and governed by the FAA that are not reflected in this ordinance. In an effort to maintain a document that could be applied across a diverse range of airport types and local community demographics, it was important to narrow the focus of the development of the model ordinance. Communities may wish to contract their local state aviation agencies or their local FAA office to discuss other airspace concerns that call for more restrictive limitations than those generally outlined in this model.

How to Use the Model Ordinance

The Airport Land Use Compatibility Zoning Model Ordinance reflects modern airport zoning and land use practices. It also contains suggested best practices identified through research and case studies. The intent is to provide choices and options for local governments to tailor an airport safety zoning ordinance to their own unique circumstances.

This model ordinance is intended to help local governments and airports codify airport land use compatibility zoning standards. The model ordinance suggests a variety of zoning standards and approaches including straight-forward, minimum standards as well as national "best practices" for ensuring optimal protection for persons and property on the ground and in the air. Thus, the airport land use compatibility ordinance gives basic guidance but also offers best practices for jurisdictions that want to go somewhat further in ensuring compatibility. Standards recommended as "best practices" are specially noted in the new model ordinance by the "BP" symbol. The model ordinance language can be adopted either as a stand-alone ordinance or integrated into a local zoning code as a zoning district or overlay district. The structure and content of the document indicate that there is no "one-size-fits-all" airport zoning ordinance that can be applied across airports and local jurisdictions and thus provide a range of options for each local government entity to consider.

A local government should begin this process by identifying the desired level protection which is to be accomplished with the subject ordinance. Once that is accomplished, the adopting body may utilize the model language as a buffet of options for the development of an ordinance that is tailored to meet local needs. When adopting an airport zoning ordinance, each local jurisdiction must also consider any existing state legislation which may affect the suggested text of this model code.

To complete and tailor the model ordinance, the adopting body should:

- Fill in the appropriate blanks.
- Delete instructional language contained within brackets.
- Delete unnecessary punctuation and numbers that are not applicable.
- Determine which, if any, of the basic and Best Practice provisions to adopt and/or tailor to the affected jurisdictions' circumstances and state law.

TABLE OF CONTENTS

SECTION 1: TITLE AND INTRODUCTION

COMMENTARY: This Section is used to identify the title and provide a brief introduction to the ordinance and identify the airport(s) which the ordinance is applicable.

______________________________ *[Insert name of airport]* AIRPORT ZONING ORDINANCE

An ordinance regulating and restricting the height of structures and objects of natural growth, and otherwise regulating the use of property, in the vicinity of the ________________________ Airport by creating the appropriate zones and establishing the boundaries thereof; providing for changes in the restrictions and boundaries of such zones; defining certain terms used herein; referring to the ______________________________ Airport Zoning Map that is incorporated in and made a part of this ordinance; providing for enforcement; and imposing penalties.

SECTION 2: AUTHORITY

COMMENTARY: This Section is used to indicate any state statutes that enable or require local municipality to enact land use regulations, either for the general purpose of the protection of the public safety and welfare or public facilities, or for the specific purpose of the maintaining land use compatibility around an airport(s).

This ordinance is authorized by __________ *[Insert reference to applicable state enabling statute]*.

SECTION 3: STATEMENT OF PURPOSE AND FINDINGS

COMMENTARY: This Section establishes the importance of the airport to the community by acknowledging hazards posed to public health, safety, and quality of life to individuals affected by airport operations. It identifies any specific findings that local government has made in the adoption process for the airport land use compatibility ordinance. The suggested findings can be modified as appropriate to the individual airport.

The ____________________ [*Insert name of jurisdictional governing board*], hereby finds and declares that:

(1) The ____________________ *[Insert name of airport]* Airport is an essential public facility.

(2) An airport hazard endangers the lives and property of users of the ____________________ Airport, and property or occupants of land in its vicinity, and also if of the obstructive type, in effect reduces the size of the area available for the landing, takeoff, and maneuvering of aircraft, thus tending to destroy or impair the utility of the ____________________ Airport and the public investment therein.

(3) The creation or establishment of an airport hazard is a threat to public health safety and welfare of the jurisdictions served by the ____________________ Airport.

(4) For the protection of the public health, safety, order, convenience, prosperity, and general welfare, and for the promotion of the most appropriate use of land, it is necessary to prevent the creation or establishment of airport hazards.

(5) The prevention of these airport hazards should be accomplished, to the extent legally possible, by the exercise of the police power without compensation.

(6) The prevention or the creation or establishment of airport hazards and the elimination, removal, alteration, mitigation, or marking and lighting of existing airport hazards and public purposes for which political subdivisions may raise and expend public funds.

SECTION 4: SHORT TITLE

COMMENTARY: This Section establishes a short title, in order to simplify references to the Ordinance. This section may be unnecessary if the airport land use compatibility regulations are incorporated in to an existing zoning ordinance.

This Ordinance shall be known as, "____________________ Airport Zoning Ordinance," [*or* "____________________ Airport Area Overlay District"] and is referred to as "this Ordinance" [*or* "this Airport Area Overlay District"] in the following sections.

SECTION 5: APPLICABILITY

COMMENTARY: This Section identifies the jurisdictional boundaries of and those properties encompassed within the airport ordinance and its land use compatibility zones. In addition, the official Airport Land Use Zoning Maps should be attached to the Ordinance in an appendix or as an exhibit. In some instances, runway dimensions and approach types may be specified for each runway at the airport. Alternatively, a more general description of the vicinity of the airport may be used.

This Ordinance shall apply only to those parcels of land shown on the Official Zoning Map, which is attached to this Ordinance as Exhibit "A."

OR

This ordinance encompasses a general area around the ____________________ Airport including a ____________________ mile boundary. Specific dimensions associated with the zoning boundary are shown in the Airport Land Use Compatibility Zoning Map.

SECTION 6: AIRSPACE OBSTRUCTION/HEIGHT LIMITATION ZONE

Commentary: This section establishes zones within which height limitations apply that are consistent with the FAA's Part 77 guidance on airspace obstructions. The FAA and/or state aeronautics agency can assist local governments with the mapping of these surfaces/the zone for a particular local airport.

(A) ESTABLISHMENT OF AIRSPACE OBSTRUCTION/HEIGHT LIMITATION ZONE

(1) An airport obstacle/height limitation zone is established to carry out the purposes of this Ordinance, as set forth in Section 3 above. More specifically, the airport obstacle/height limitation zone regulations in this Section restrict the height of structures and objects that may be hazardous to the operational safety of aircraft operating to and from the ______________ Airport.

(2) The boundary of the airport obstacle/height limitation zone shall be the full extent of the area described by all of the imaginary airspace surfaces described in FAR Part 77 of the FAA guidance and defined in Section 21 of this Ordinance, as applied to the ______________ Airport.

(B) APPLICABILITY OF HEIGHT RESTRICTIONS

The height restrictions of Section 6(C) shall apply to all properties located within the airspace obstruction/height limitation zone established in Section 6(A) above.

(C) PROHIBITION OF AIR SPACE ZONE OBSTRUCTIONS

(1) *General Height Restrictions*
Except as otherwise provided in this Ordinance, and except as necessary and incidental to airport operations, no structure or tree shall be constructed, altered, maintained, or allowed to grow in the airspace obstruction/height limitation zone so as to project above any of the imaginary airspace surfaces described in FAR Part 77 of the FAA guidance. Where an area is covered by more than one height limitation, the more restrictive height limitation shall apply.

(2) *Height Exceptions and Variances* BP
Height exceptions or variances may be permitted only when supported in writing by the airport sponsor and the FAA. Applications for height variances shall follow the procedures for other variances stated in Section 13 of this Ordinance and shall be subject to such conditions and terms as recommended by the FAA.

(3) *Conflicting Regulations* BP
When the height limitations of the applicable zone district are more restrictive than those of this Ordinance, the applicable zone district height limitations shall apply and control.

SECTION 7: AIRPORT LAND USE COMPATIBILITY ZONE DISTRICTS

COMMENTARY: This Section establishes specific airport overlay zoning districts and contains regulations for land uses that should be allowed, conditionally allowed, or prohibited in the zones. It also contains height regulations, based on FAR Part 77 height restrictions, that apply in the districts and development density restrictions.

(A) ESTABLISHMENT OF AIRPORT LAND USE COMPATIBILITY ZONES

The following four airport land use compatibility zones are established to carry out the purposes of this Ordinance, as set forth in Section 3 above. More specifically, the four airport land use compatibility zones regulations in this Section restrict uses that may be hazardous to the operational safety of aircraft operating to and from the _______________ Airport. The zones furthermore limit population and building density in the runway approach areas to avoid concentrations of people and create sufficient open space to protect life and property in case of an accident. Additionally, the zones restrict uses that would be adversely affected by airport operational impacts, such as noise, if placed in the respective zone with or without mitigation measures. All of the zones are also subject to the standards of Section 7(C), *General Performance Standards*. **FIGURE 7-1** illustrates the four zones and the relationship between the zones.

BP *COMMENTARY: Designate and map airport land use compatibility zones for all planned runways, as well as for existing runways. Designating land use compatibility zones for planned runways can help avoid the establishment of incompatible land uses and potential air space obstruction before the runway is built and should help to inform property owners' and investors' reasonable expectations about the potential uses of such lands. The FAA, as well as many states, define additional zones with airport impacts, such as transitional surfaces along the runway sides which are typically on airport property, turning safety zones for airports where turning actions are frequent, and a conical surface that extends upward and outward from the horizontal surface. Depending on the nature of airport operations where substantial overflights or other impacts occur in these zones, a local jurisdiction would be wise to consider defining land use restrictions in such additional zones. The 2002 California Land Use Compatibility Handbook and the 2007 Iowa Airport Land Use Guidebook both contain example land use compatibility recommendations for zones beyond those included in this model ordinance.*

(1) *Zone A – Runway Protection Zone*

a. Zone A is closest to the individual runway ends. This zone is intended to provide a clear area that is free of above ground obstructions and structures.

FIGURE 7-1 and **FIGURE 7-2** illustrate Zone A and **TABLE 7-A** indicates the required dimensions for Zone A.

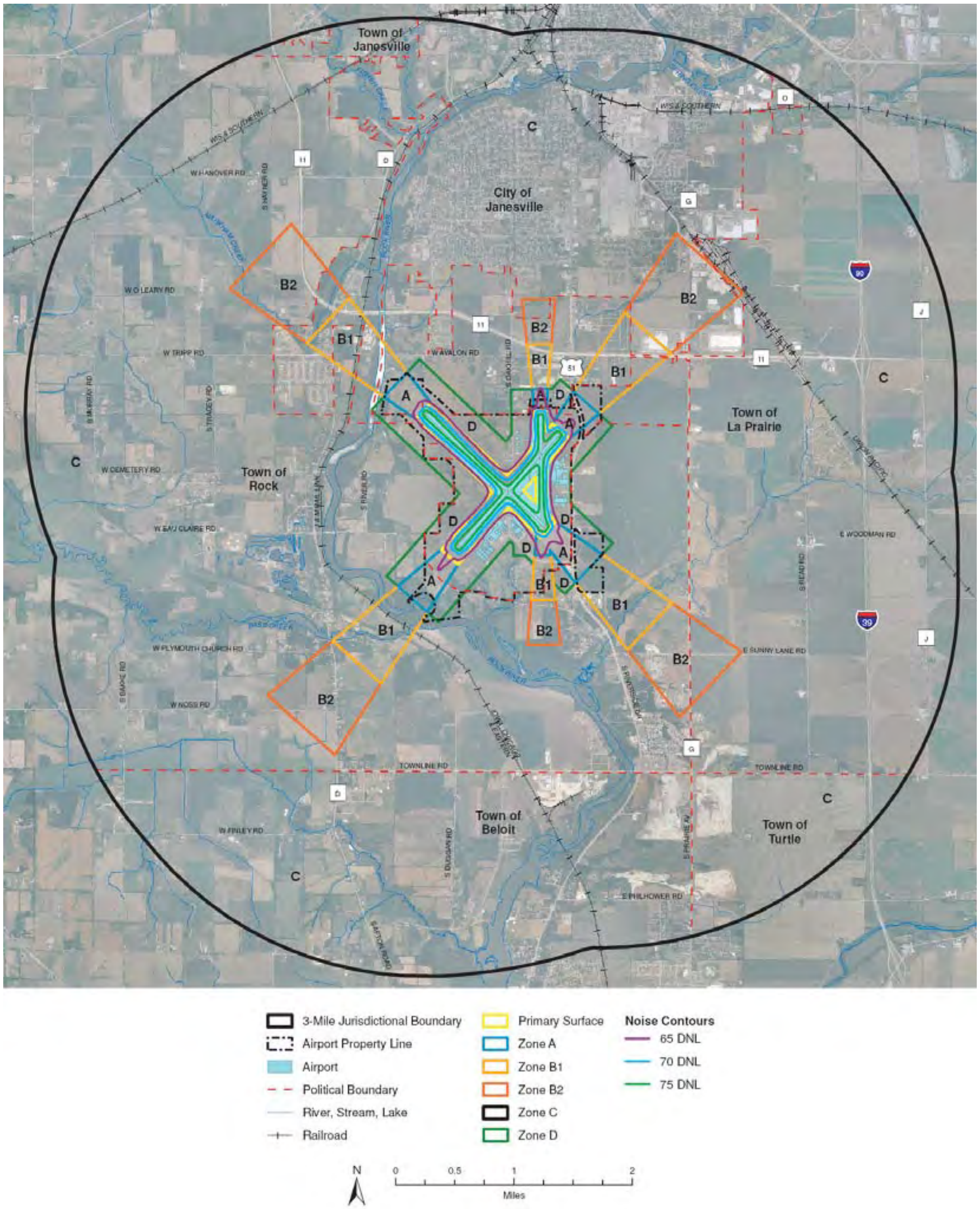

Figure 7-1: Airport Land Use Compatibility Zones

Source: Mead & Hunt, Inc.

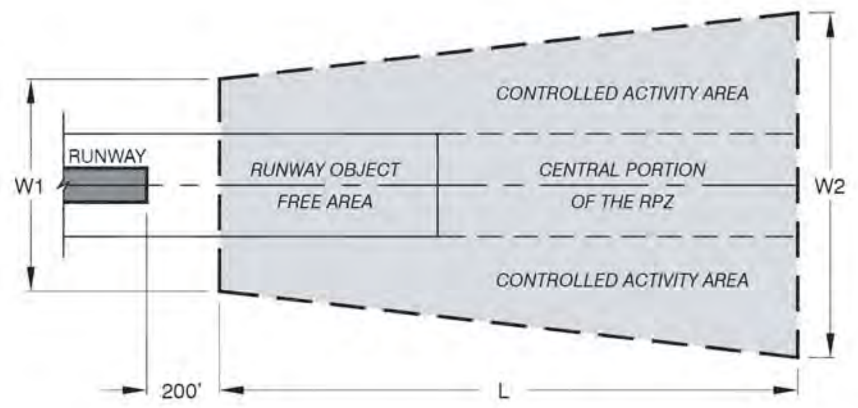

FIGURE 7-2: Zone A – Runway Protection Zone

Source: Mead & Hunt, Inc.

Table 7-A: Dimensional Requirements for Zone A

Approach Visibility Minimums 1/		Dimensions: Length L_1 (feet)	Inner Width W_1 (feet)	Outer Width W_2 (feet)	RPZ (acres)
Visual And Not Lower than 1-Mile	Small Aircraft Exclusively	1,000	250	450	8.035
	Aircraft Approach Categories A & B	1,000	500	700	13.770
	Airport Approach Categories C & D	1,700	500	1,010	29.465
Not lower than ¾-mile		1,700	1,000	1,510	48.978
Lower than ¾-mile		2,500	1,000	1,750	78.914

1/ The RPZ dimensional standards are for the runway end with the specified approach visibility minimums. The departure RPZ dimensional standards are equal to or less than the approach RPZ dimensional standards. When an RPZ begins other than 200 feet beyond the runway end, separate approach and departure RPZs should be provided. Refer to FAA AC 150/5300-13, Appendix 14 for approach and departure RPZs.

Source: *FAA AC 150/5300-13, Airport Design Standards*

(2) *Zone B1 – Inner Approach Zone and Zone B2 – Outer Approach Zone*

- Zones B1 and B2 are critical overlay zoning surfaces that reflect the approach and departure areas for a runway. The size of the two zones is predicated on the approach type (visual, non-precision, or precision) at a specific runway and the type/size of aircraft utilizing the runway. Consequently the overall length of

Zone B1 and B2 is equal to the length of the approach surface as shown in **TABLE 7-B**, and as illustrated previously in **FIGURE 7-1** and in **FIGURE 7-3** below. The fan shape of the approach is maintained within both zones.

a. A portion of the approach surface is superseded by Zone A because the approach surface and RPZ overlap. Since there are several instances where the RPZ may be slightly smaller than the approach surface, a small "tail" along each side of the RPZ may result which may be defined within Zone B1. With this existing coverage from Zone A, the remainder of the approach surface beyond the limits of Zone A is divided into two parts resulting in Zone B1 and Zone B2.

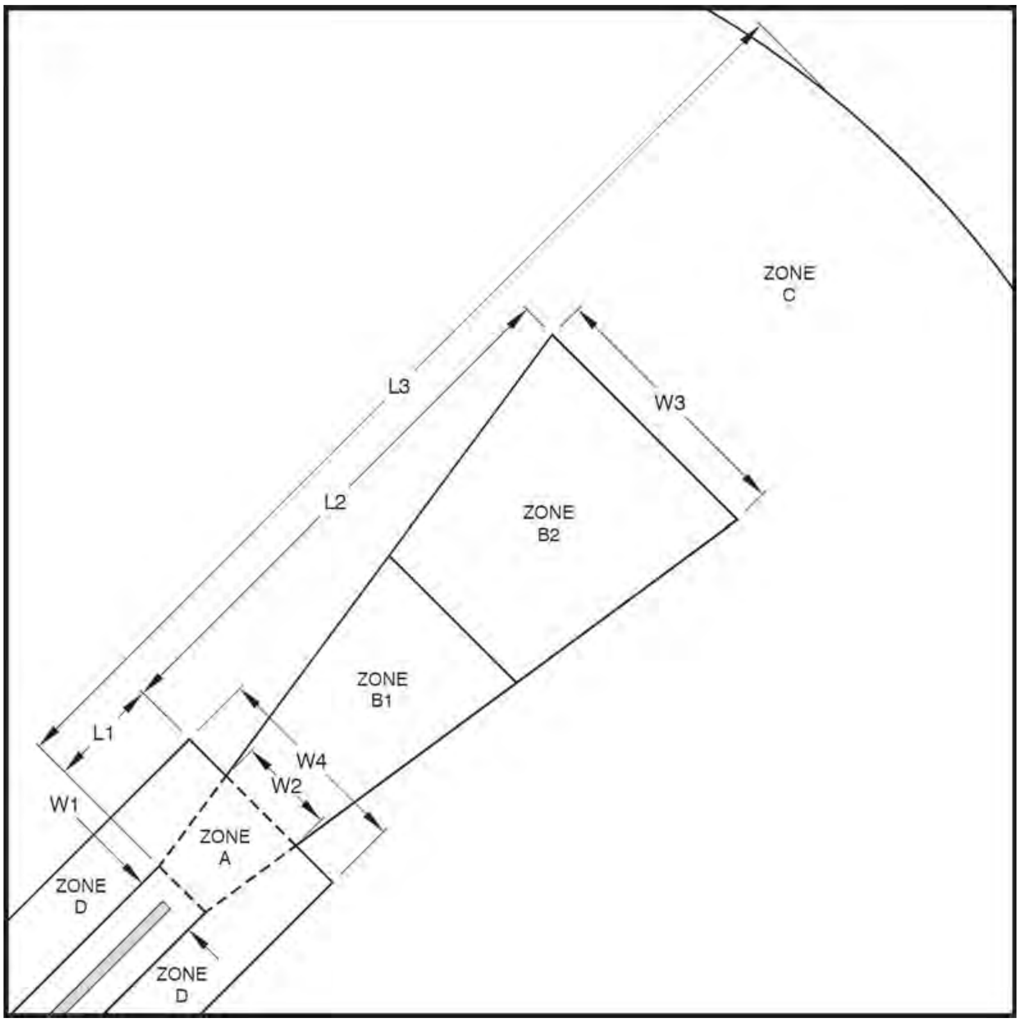

FIGURE 7-3: Zones A, B1, B2, and C

Source: Mead & Hunt, Inc.

TABLE 7-B Sample Dimensions for Airport Overlay Zones B1, B2, C, and D

Dimensions shown in Figure 4	Item	Dimensional Standards (Feet) 1/					
		Visual Runway		Non-Precision Instrument Runway			Precision Instrument Runway
				A	B		
		A	B		C	D	
W1	Width of Primary Surface, inner width of Zone A & Zone B1	250	500	500	500	1,000	1,000
W2	Outer width Zone A	Shown in Table 5					
W3	Outer width Zone B2	1,250	1,500	2,000	3,500	4,000	10,000
W4	Width of Zone D from Primary Surface	1,050	1,050	1,050	1,050	1,050	1,050
L1 2/	Length of Zone A	Shown in Table 5					
L2	Combined Length of Zone B1/B2	5,000	5,000	5,000	10,000	10,000	10,000 3/
L3	Radius Zone C	5,000	5,000	5,000	10,000	10,000	10,000

Note: 1/ *Runway Classification Legend*

A – Utility runway (runway servicing aircraft weighing 12,500 pounds or less)
B – Runway larger than utility (runway servicing aircraft weighting 12,501 pounds or greater)
C – Visibility minimums greater than ¾ of a mile
D – Visibility minimums as low as ¾ of a mile

2/ Zone A and B1/B2 begin 200' from the end of the runway threshold.

3/The length of Zone B1 and B2 combined, for a precision instrument runway is 10,000 feet for the purposes of the land use zone, it doesn't extend for the additional 40,000', as noted in FAR Part 77.

Source: Mead & Hunt, utilizing *FAR Part 77 Objects Affecting Navigable Airspace data*

(3) *Zone C –Horizontal Surface*

This zone encompasses the FAR Part 77 Surfaces. Zone C is calculated by intersecting arcs drawn from the end of runway centerlines which corresponds to the appropriate length for the horizontal surface as outlined in FAR Part 77 and connecting them with tangent lines to create a typically elliptical shaped surface. Zone C has a substantial number of aircraft over-flights during approach or departure from an airport. This zone encompasses the typical airport traffic area. It should be clear of all uses that may generate visual obstructions, wildlife attractants, as well as tall structures, objects, or natural vegetation because aircraft typically operate at lower altitudes and slower air speeds in this area. **FIGURE 7-1** illustrates Zone C and **TABLE 7-B** indicates the dimensional requirements for Zone C.

COMMENTARY: Optional Zone D – Areas Adjacent to the Runway Environs can be added to the zoning ordinance if a community wants to include additional protection of the areas parallel to the runways. The limitations or restrictions associated with this area will vary greatly depending upon the dimensional standards established within the ordinance. In many instances, this zone will be substantially located on airport owned property and will include aviation related uses (terminal buildings, hangars, apron areas, etc.) which would be considered as compatible uses. This area may mimic the FAR Part 77 Transitional Surface. Specific compatibility designations are not shown in Table 7-A due to the flexibility that is anticipated with the inclusion of this zone in an ordinance.

BP *COMMENTARY: The above airport land use compatibility zones are based on certain surfaces defined by FAA, including the runway protection zone (Zone A); the inner approach zone (Zone B1); the outer approach zone (Zone B2) and the horizontal surface (Zone C). These zones are considered by the authors to be the minimum zones needed to ensure airport land use compatibility at most airports. The FAA, as well as many states, defines additional zones with airport impacts, such as transitional surfaces along the runway sides, which are typically on airport property, turning safety zones for airports where turning actions are frequent, and a conical surface that extend upward and outward from the horizontal surface. Depending on the nature of airport operations, where substantial overflights or other impacts occur in these zones, a local jurisdiction would be wise to consider defining land use restrictions in such additional zones. The 2002 California Land Use Compatibility Handbook and the 2007 Iowa Airport Land Use Guidebook both contain example land use compatibility recommendations for zones beyond those included in this model ordinance.*

(B) APPLICABILITY OF LAND USE RESTRICTIONS AND EXEMPTIONS

(1) *The land use compatibility standards of* Section 7(C) *shall apply to all properties located within one or more of the airport land use compatibility zones established in Section 7(A) above.*

OR

(1) *Except as exempt under Section 7(B)(2), the land use compatibility standards of* Section 7(C) *shall apply to all properties located within one or more of the airport land use compatibility zones established in Section 7(A) above.*

(2) *[Insert any exceptions to applicability of land use compatibility standards.]*

(C) LAND USE COMPATIBILITY STANDARDS

COMMENTARY: Section 7(C), together with the height restrictions of Section 6, comprises the substantive heart of the Model Airport Zoning Ordinance. In this Section 7(C), specific uses are prohibited, restricted, or allowed depending on their compatibility with airport use and operations. The Model Ordinance presents several options for implementing land use compatibility standards. The options differ in their comprehensiveness and, consequently, in their complexity. In deciding on an optimal approach, each implementing body should consider a number of key factors:

(1) The degree of existing encroachment and the likelihood of future encroachment of incompatible land uses in the zones;

(2) The current usage, traffic patterns, and planned, future usage and possible expansion of the airport;

(3) The affected jurisdictions' current approach to zoning land uses and how easily an option might be integrated and used with the existing general zoning scheme; and

(4) Available staff and other administrative resources to fairly implement, administer, and enforce the land use compatibility standards.

No one option is the guaranteed "right" approach to regulating compatible land uses near airports.

(1) *Intent*

This Section's land use compatibility standards restrict uses that may be hazardous to the operational safety of aircraft operating to and from the _____________________ Airport, and to limit population and building density in the runway approach areas, avoid concentrations of people, and create sufficient open space to protect life and property in case of accident.

(2) *Applicability*

a. The land use compatibility standards in this Section shall apply to all activities and uses of land located in one or more of the airport land use compatibility zones established in Section 7(A).

b. In addition, the general performance standards of Section 7(C)(3) shall apply to all uses that may otherwise be exempt from the land use compatibility standards according to Section 7(B)(2). [*Omit if no exceptions indicated in Section 7(B)(2)*]

(3) *General Performance Standards Applicable to All Uses in All Zones*

Subject at all times to the height restrictions set forth in Section 6, all uses made of any land in any of the airport land use compatibility zones defined in Section 7(A) shall comply with all of the following performance standards, as applicable:

a. *Outdoor Lighting*

No use shall project lighting directly onto an existing runway or taxiway or into existing airport approach and landing paths except where necessary for safe and convenient air travel. Lighting for any new or expanded use shall incorporate shielding in their designs to reflect light away from airport approach and landing paths. No use shall imitate airport lighting or impede the ability of pilots to distinguish between airport lighting and other lighting.

b. *Glare*

No glare producing material, including but not limited to unpainted metal or reflective glass, shall be used on the exterior of structures located within airport approach and landing paths or on nearby lands where glare could impede a pilot's vision.

c. *Industrial Emissions*

No agricultural, industrial, mining or similar use, or expansion of an existing agricultural, industrial, mining or similar use, shall, as part of its regular operations, cause emissions of smoke, dust, or steam that could obscure visibility of pilots, except upon demonstration, supported by substantial evidence, that mitigation measures imposed as approved conditions will reduce the potential for safety risk or incompatibility with airport operations to an insignificant level. The review authority shall impose such conditions as necessary to ensure that the use does not obscure visibility.

d. *Communications Facilities and Electrical Interference*

1. No use shall cause or create electrical interference with navigational signals or radio communications operated on the airport or operated between an airport and aircraft. Proposals for the location of new or expanded radio, radio-telephone, and television transmission facilities and electrical transmission lines shall be coordinated with FAA prior to approval.

2. BP Approval of cellular and other telephone or radio communication towers on leased property located within an airport land use compatibility zone established according to Section 7(A) of this Ordinance, shall be conditioned to require their removal within 90 days following the expiration of the lease agreement. A bond or other security shall be required to ensure this result. Proof of as-constructed height shall be required by the approving body to ensure the construction of the structure was done in compliance with the submitted plans and does not exceed the heights as noted in Section 6.

e. *Water Impoundments and Wildlife Attractants*

1. Any use or activity that would result in the establishment or expansion of a water impoundment shall comply with the requirements of this subsection. This subsection shall not apply to:

a. Stormwater management basins established by an airport.

b. Seaplane landing areas within an airport.

c. Wetland mitigation, creation, enhancement, or restoration projects located outside Zones A, B1, B2, and C, provided they are located, designed, and maintained in perpetuity to avoid creating a wildlife hazard or increasing hazardous movements of birds across runways or in approach and departure paths.

2. No new or expanded water impoundments of one-quarter (¼) acre in size or larger are permitted:

a. Within Zones A, B1, and C and within 5,000 feet from the end or edge of a runway, whichever is greater; or

b. On land owned by the airport sponsor that is necessary for airport operations.

3. The establishment of a new water impoundment one-quarter (¼) acre in size or larger within Zone C and outside Zones A, B1, and B2, is allowed only with the prior approval of an airport zoning permit[1] and subject to the following conditions:

a. The ___________ [*City Council/Town Board/County Board*] shall be the final decision-making body on the airport zoning permit application rather than the zoning administrator.

b. BP Prior to filing its application, the applicant shall coordinate with the airport sponsor, [*Insert applicable state aeronautics and/or natural resources agencies*] and the FAA regarding the proposed water impoundment and its short and long-term potential to significantly increase hazardous movements of birds feeding, watering, or roosting in areas across runways or airport approach and departure paths and proposed mitigation. As reasonably necessary to determine the potential for significant bird strike hazards, the applicant may be required to submit a bird strike study for these agency's review and comment.

[1] If airport compatibility land use regulations are adopted as an overlay district in a zoning ordinance, then this reference should be to a "zoning permit", "development review approval", or similar term that is consistent with the zoning ordinance.

COMMENTARY: In many states, such as Minnesota and Colorado, local branches of federal agencies can offer excellent advice to local airports. The local branch of the USDA Animal Plan Health Inspections Services or the U.S. Fish and Wildlife Service may be able to conduct an airport-specific wildlife assessment.

c. BP An application for an airport zoning permit according to Section 12 shall not be deemed complete for review purposes until the applicant has filed with the *[City/Town/County]* a final bird strike study, as applicable, addressing comments from agencies as listed in subsection b. above. If a bird strike study was not required, an application for an airport zoning permit shall not be deemed complete until the applicant submits correspondence or other sufficient proof demonstrating agreement among the agencies that no bird strike study is required and no unmitigated significant bird strike hazard will result from approval of the permit.

d. In addition to the review criteria stated in Section 12, the [*City Council/Town Board/County Board*] shall approve an airport zoning permit for a new water impoundment only if it makes all of the following findings:

i. The proposed water impoundment, taking into consideration any proposed or recommended mitigation measures, will not significantly increase the risk of bird strike hazards to air navigation.

ii. Proposed mitigation measures are based on accepted technology and industry practices, and have been demonstrated to be effective, reliable over time, and affordable to implement.

iii. The applicant has demonstrated an ability to pay for necessary short-term and long-term mitigation measures, and to ensure the perpetual implementation, monitoring, and maintenance of such measures.

f. *Fire and Explosion Hazards*
No use or structure shall promote concentrations of flammable substances or materials.

g. *Other Hazards to Aircraft Operations*
In addition to the specific prohibitions stated in this subsection (4), no use or structure shall otherwise endanger the landing, taking off, or maneuvering of aircraft.

COMMENTARY: Some communities include general performance standards in this section related to noise that apply to all airport land use compatibility zones. For example, a general standard could restrict development of new noise sensitive uses (i.e., new residential units, places of assembly, schools, and care facilities for the infirm or elderly); require construction techniques to reduce interior noise levels of all noise sensitive use; require real estate disclosure of noise impacts on the sale of all single-family homes; or require recording of avigation easements for noise impacts as a condition of approval of all new subdivision plats. Alternatively, such provisions might be addressed in each zone, or not at all. For further discussion of noise land use compatibility regulations, see Chapter 6 of the primary document.

(4) *General Limitations on Waste Disposal Facilities*

a. No new waste disposal facilities shall be permitted within 10,000 feet of any airport runway used or scheduled for use by turbojet aircraft unless approval is obtained from the Federal Aviation Administration.

b. No new waste disposal facilities shall be permitted within 5,000 feet of any airport runway used or scheduled for use by piston type aircraft only unless approval is obtained from the Federal Aviation Administration.

c. Expansions of existing land disposal facilities within these distances shall be permitted only upon demonstration that the facility is designed and will operate so as not to increase the likelihood of bird/aircraft collisions. Timely notice of any proposed expansion shall be provided to the airport sponsor, *[Insert state aeronautics agency if applicable]* and the FAA, and any approval shall be accompanied by such conditions as are necessary to ensure that an increase in bird/aircraft collisions is not likely to result.

BP COMMENTARY: Waste disposal facilities tend to attract many birds, which create a strike hazard for aircraft and in many instances, small rodents which in turn, often attract raptors. When Denver International Airport was relocated, the airport hoped to purchase and close an existing landfill in the airport vicinity, but was unable to do so because of prohibitive cost. The existing facility owner has been cooperative in using best management practices to reduce potential bird attractants at the site. However, given that the landfill has a lifespan of at least another 25 years the airport remains concerned that the facility could change hands to a less responsive operator in the future, which could create a problem. Given these issues, restricting all new waste disposal facilities from the airport environs is considered the best approach.

(5) *Use Restrictions in the Airport Land Use Compatibility Zones*

a. *Applicability*

1. *General Rule*
The land use compatibility standards of this subsection (5) shall apply to all properties located in the specified airport land use compatibility zone.

2. *Applicability of Regulations to Properties Located in More than One Zone*
If a single parcel is located in more than one airport land use compatibility zone, the applicable zone use restrictions shall apply only to the portion of the property located in that zone. For example, if a property under single ownership is located half in Zone A and half in Zone B1, the half located in Zone A is subject to the use restrictions applicable in Zone A, and the half located in Zone B1 is subject to the applicable Zone B1 use restrictions.

OPTION 1: REGULATION THROUGH GENERAL LAND USE CATEGORIES ONLY - NO DETAILED LISTING OF USES

COMMENTARY: Option 1, which does NOT incorporate a detailed use list, is relatively simple in approach that may be appealing for a small jurisdiction with limited staff. It may offer adequate protection for a general aviation airport expecting few problems with encroaching incompatible land uses. On the other hand, this option's provisions are relatively vague and unclear about the wider range of compatible uses (particularly nonresidential uses) that may be allowed close to an airport, which could result in development delays while an applicant seeks an interpretation, or may even result in missed economic development opportunities. Use restrictions that are encouraged are indicated as best practices ("BP") for a community's consideration.

b. *Use Restrictions in Zone A*
Subject at all times to the height restrictions set forth in Section 6, the general performance standards in subsection 7(C)(3), and waste disposal facility siting

standards in subsection 7(C)(4), areas designated as Zone A shall comply with the following use restrictions:

1. Above-ground structural hazards are prohibited, including buildings, temporary structures, exposed transmission lines, and other similar above-ground structures.

2. Public assembly uses are prohibited.

3. New residential uses are prohibited.

4. Permitted uses shall be limited to uses that do not create, attract, or bring together an assembly of people. Permitted uses shall include, but shall not be limited to, agriculture (seasonal crops), horticulture, raising and breeding of livestock, wildlife habitat, light outdoor recreation (non-spectator only), cemeteries, and vehicle parking associated with the airport.

c. *Use Restrictions in Zone B1 – Inner Approach/Departure Area*
Subject at all times to the height restrictions set forth in Section 6, the general performance standards in subsection 7(C)(3), and waste disposal facility siting standards in subsection 7(C)(4), areas designated as Zone B1 shall comply with the following use restrictions:

1. Public assembly uses are prohibited. "Public assembly" uses include, but are not limited to, churches, hospitals, schools, theaters, stadiums, hotels, motels, campgrounds, and other similar uses. See definition of "public assembly use" in Section 21 of this Ordinance.

2. Multi-family residential uses, mobile home parks, and institutional living facilities such as nursing homes and senior assisted living facilities are prohibited unless such facilities comply with the maximum site population standard in subsection (6) below.

3. BP Uses that represent significant fire or explosion hazards, including fuel storage tank farms, above-ground fuel tanks, and gasoline stations, are prohibited.

4. BP Telecommunication and radio tower structures are prohibited.

5. BP Approvals of wind turbines and above-ground, power-generating structures shall be conditioned on whether the equipment causes any hazard to the airport due to height, electromagnetic or other interference with air traffic communications, heat plumes, or other characteristics.

d. *Use Restrictions in Zone B2 – Outer Approach/Departure Area*
Subject at all times to the height restrictions set forth in Section 6, the general performance standards in subsection 7(C)(3), and waste disposal facility siting standards in subsection 7(C)(4), areas designated as Zone B2 shall comply with the following restrictions:

1. Public assembly uses are prohibited. "Public assembly" uses include, but are not limited to, churches, hospitals, schools, theaters, stadiums, hotels, motels, trailer courts, campgrounds, and other similar uses. See definition of "public assembly use" in Section 21 of this Ordinance.

2. Multi-family residential uses, mobile home parks, and institutional living facilities such as nursing homes and senior assisted living facilities, are prohibited unless such facilities comply with the maximum site population standard in subsection (6) below.

3. BP Uses that represent significant fire or explosion hazards, including fuel storage tank farms, above-ground fuel tanks, and gasoline stations, are prohibited.

4. BP Telecommunication and radio tower structures are prohibited.

5. BP Approval of wind turbines and other above-ground, power-generating equipment shall be conditioned on whether the equipment causes any hazard to the airport due to height, electromagnetic or other interference with air traffic communications, heat plumes, or other characteristics.

e. *Use Restrictions in Zone C – Aircraft Traffic Pattern*
Zone C shall be subject only to height restrictions set forth in Section 6, the general performance standards in subsection 7(C)(3), and waste disposal facility siting standards in subsection 7(C)(5).

COMMENTARY: If an Optional Zone D, Areas Adjacent to the Runway Environs, is added to the zoning ordinance, the limitations or restrictions associated with this area will vary greatly depending upon the dimensional standards established within the ordinance. In many instances, this zone will be substantially located on airport owned property and will include aviation related uses (terminal buildings, hangars, apron areas, etc.) which would be considered as compatible uses. This area may mimic the FAR Part 77 Transitional Surface. Specific compatibility designations are not shown in Table 7-A due to the flexibility that is anticipated with the inclusion of this zone in an ordinance. Local agencies should include specific use limitations as appropriate to their airport layout.

OPTION 2: REGULATION THROUGH DETAILED LISTING OF COMPATIBLE AND INCOMPATIBLE USES BP

BP *COMMENTARY: In Option 2, the general categories of land uses in Option 1 are divided into detailed use classifications, categories, and specific use types. There are a relatively few number of broad use classifications (e.g., residential, commercial, industrial), that are further divided into a greater number of general use categories, and in some instances, further divided into more precise use types. The advantage of this detailed listing approach, as seen in most modern zoning ordinances, is that it removes most of the need for interpretation of standards found in more general use listings (as in Option 1 above) or in a more performance-based approach that looks at overall impacts, not uses. Each listed use can be denoted as compatible or incompatible within a given level of airport safety impacts. This greatly simplifies the task of local planners when they evaluate individual development proposals in the vicinity of the airport. The disadvantage of this approach is the work required to evaluate each use in light of local circumstances and the effort necessary to ensure consistency in the listing and interpretation of airport compatible uses in an airport zoning ordinance with a local jurisdiction's unique listing of uses for other local zoning purposes. This could be especially challenging when an airport zoning ordinance is adopted to apply to multiple local jurisdictions, the latter which may have varying approaches to categorizing land uses for zoning purposes.*

f. *Table of Allowed Uses*
Table 7-C sets forth the categories and types of uses allowed within the respective airport land use compatibility zones.

COMMENTARY: For communities interested in implementing Option 2's detailed use table approach, the implementing body should carefully review Table 7-C below and tailor it, as necessary, to fit local circumstances and zoning practices. Local zoning practice, for example, may already employ a "permitted use table" in the general zoning code. If so, the implementing body should use essentially the same use classification and categorization approach in its airport zoning ordinance as in its more general zoning regulations. That will aid in future administration and interpretation of the airport safety zoning regulations. Other implementing bodies may wish to simplify the list of permitted and prohibited uses and collapse the specific use types into fewer, broader use categories.

*In many instances, **TABLE 7-C** recommends that a particular use be allowed in a zone subject to specific limitations and provides an indication of the conditions to be applied to the use that would typically make the use compatible within the zone. When the use is indicated as conditionally compatible, the conditions may be structured as absolute requirements subject to administrative review, or a local hearing body may be given authority to approve the use with consideration of such conditions in a discretionary review (such as a conditional use permit review).*

Each jurisdiction needs to consider what specific conditions are appropriate under local circumstances. For example, "limit density" means the use should be restricted in terms of the number of structures per building site or the number of visitors, employees, or customers on site during the use's operating hours. Other typical conditions address the location of the proposed use. For example, a use that may not be compatible if located directly on or adjacent to the runway centerline extended may be considered compatible if located a specified horizontal distance away from the centerline extended. Other additional regulations refer to minimization of likely adverse impacts, such as conditions prohibiting the creation of glare or dust, or conditions prohibiting the creation of new water impoundments.

1. *Explanation of Table Abbreviations*

a. *Incompatible Uses ("I")*
"ϴ" in a table cell means the specific use is incompatible in that zone.

b. *Compatible Uses ("C")*
"C" in a cell indicates that the use type is compatible and permitted by right in the respective zone. Compatible and permitted uses are subject to all other applicable regulations in this Ordinance, including without limitation the air space obstruction regulations in Section 6, noise compatibility restrictions in Section 8, and the general perfomance standards in Section 7(C)(3)and the waste disposal facility siting standards in Section 7(C)(4).

***BP**: Each local jurisdiction should consider which uses that are recommended as conditionally compatible ("CC") uses may instead be locally compatible ("C"), or incompatible ("I") based on an analysis and understanding of local conditions. Local zoning standards should be tailored based on, among other things, the character of the flying operations conducted at the airport, the airport location, the nature of the terrain within the zones, existing land uses and surrounding neighborhood character, the uses to which the land to be zoned are planned and adaptable, and the social and economic costs of restricting uses versus the safety and other benefits of applying use restrictions.*

c. *Conditionally Compatible Uses ("CC")*
"CC" in a cell means the specified use may be made compatible in that zone when conditioned according to Table 7-C. To approve such a use, the [*decision-making officer or body*] shall find that the use complies with all conditions; that the use, taking into consideration compliance with all reasonable conditions of approval, will be compatible with airport operations; and that the use, if approved, is consistent with the intent of this Ordinance.

i. As reasonably necessary to aid in the decision-making body's determination, the applicant shall submit substantial evidence, including studies and reports prepared by qualified professionals, to support the application for approval of the use. This may include, but is not limited to an FAA Form 7460-1, bird strike studies, and noise studies.

d. *Conditions Required to Achieve Compatibility*
A use may be subject to applicable conditions in order to achieve compatibility within the airport land use compatibility zone. A number entered with the table entry refers to one or more conditions described in the last column of the table titled "Conditions Required to Achieve Compatibility." For example, if a table cell shows "CC-1" as the entry, the condition numbered "1" in the last table column applies to that use in that zone. The decision-making body shall only approve the use if it complies with all stated conditions in Table 7-C.

2. *Table of Land Uses Allowed in the Airport Land Use Compatibility Zones*
The following **TABLE 7-C** states the compatible, conditionally compatible, and incompatible uses in the four airport land use compatibility zones.

TABLE 7-C: AIRPORT LAND USE COMPATIBILITY BY ZONE					
Use Categories and Specific Use Types	**Compatibility Zones**				**Conditions Required to Achieve Compatibility**
	Zone A	**Zone B**	**Zone C**	**Zone D**	
ϴ = Incompatible use - recommend that local jurisdictions prohibit in the Zone C = Compatible use - recommend that local jurisdictions allow in the Zone CC = Conditionally compatible use - may be made compatible through compliance with indicated conditions. Recommend that local jurisdictions require discretionary local review and/or conformance with standards.					
GENERALLY PROHIBITED USES AND ACTIVITIES IN ALL ZONES					
Uses that create large areas of standing water	ϴ	ϴ	ϴ	ϴ	See Section 7(C)(3), *General Performance Standards.*
Uses that create electrical, navigational, or radio interference between airport and aircraft	ϴ	ϴ	ϴ	ϴ	
Uses (or structures) that emit fly ash, dust, vapor, gases or other emissions	ϴ	ϴ	ϴ	ϴ	
Uses that foster an increase in bird population	ϴ	ϴ	ϴ	ϴ	
Use, device, structure that causes difficulty in distinguishing airport lights (billboards, lights, signs)	ϴ	ϴ	ϴ	ϴ	
Use, device, structure that causes glare or impairing pilot visibility	ϴ	ϴ	ϴ	ϴ	

TABLE 7-C: AIRPORT LAND USE COMPATIBILITY BY ZONE					
Use Categories and Specific Use Types	Compatibility Zones				Conditions Required to Achieve Compatibility
	Zone A	Zone B	Zone C	Zone D	
ϴ = Incompatible use - recommend that local jurisdictions prohibit in the Zone C = Compatible use - recommend that local jurisdictions allow in the Zone CC = Conditionally compatible use - may be made compatible through compliance with indicated conditions. Recommend that local jurisdictions require discretionary local review and/or conformance with standards.					
Uses or structures that promote concentrations of flammable substances or materials	ϴ	ϴ	ϴ	ϴ	
EXISTING STRUCTURES AND USES IN ALL ZONES					
Existing residential structures, including residential accessory structures	C-1, 2	C-1, 2	C-1, 2	C-1, 2	1: Existing structures may remain unless determined to pose an imminent danger to public safety. 2: Existing structures that do not meet the applicable standards for a new use are subject to Section 11, *Treatment of Non-conforming Structures and Uses*.
Existing non-residential uses	C-1, 2	C-1, 2	C-1, 2	C-1, 2	
Existing Trees that exceed the height limitations of this Ordinance	ϴ	ϴ	ϴ	ϴ	
NEW RESIDENTIAL AND ACCOMMODATION USES					
Residential Uses					
Single Family, Two-Family, Duplex Dwellings	ϴ	CC-1, 2	CC-1, 2	CC-2	1: Limit density per Section 7(C)(6). 2: Construct to reduce interior noise to safe level.[2]
Multi-Family Dwellings	ϴ	ϴ	CC-1,2	CC-2	
Nursing Homes and Other Group Living	ϴ	ϴ	CC-1,2	CC-2	
Permanent Mobile Home Parks and Courts	ϴ	ϴ	CC-1	CC-2	
Accommodation Uses					
Hotels & motels	ϴ	ϴ	CC-1, 2	CC-2	1: Limit density per Section 7(C) (6). 2: Construct to reduce interior noise to safe level.
Transient mobile home parks courts (RV Parks) or lodgings	ϴ	ϴ	CC-1	CC-2	
NEW PUBLIC, CIVIC, AND INSTITUTIONAL USES					
Educational Uses					
Schools and Other Educational Services	ϴ	ϴ	CC-1, 2	CC-2	1: Limit density per Section 7(C) (6). 2: Construct to reduce interior noise to safe level.
Day Care Facilities	ϴ	ϴ	CC-1, 2	CC-2	
Institutional and Assembly Uses					
Correctional Institutions	ϴ	ϴ	CC-1, 2	C-2	1: Limit density per Section 7(C) (6). 2: Construct to reduce interior noise to safe level.
Government Offices	ϴ	CC-1	CC-1, 2	C	

[2] **[BP]** COMMENTARY: In jurisdictions where noise monitoring is feasible, this note would be better if more specific, such as "Construct so that interior noise level is not greater than 45 DNL." FAA guidance suggests, and State of California noise law requires, that residential and other noise sensitive land uses can be compatible in moderately noisy environments if construction techniques reduce interior noise levels to not greater than 45 DNL. In areas where airport noise impacts are not greater than 65 DNL, standard modern building practices typically achieve an interior noise level not greater than 45 DNL. In areas with greater noise impacts, noise sensitive uses are not recommended but may be allowed with enhanced construction techniques.

TABLE 7-C: AIRPORT LAND USE COMPATIBILITY BY ZONE					
Use Categories and Specific Use Types	Compatibility Zones				Conditions Required to Achieve Compatibility
	Zone A	Zone B	Zone C	Zone D	
ϴ = Incompatible use - recommend that local jurisdictions prohibit in the Zone C = Compatible use - recommend that local jurisdictions allow in the Zone CC = Conditionally compatible use - may be made compatible through compliance with indicated conditions. Recommend that local jurisdictions require discretionary local review and/or conformance with standards.					
Hospitals	ϴ	ϴ	CC-1, 2	CC-2	
Libraries	ϴ	ϴ	CC-1, 2	CC-2	
Religious or Cultural Assembly Uses (Outdoor or Indoor)	ϴ	ϴ	CC-1, 2	CC-2	
Other Miscellaneous Public, Civic, or Institutional Uses Not Specifically Listed	ϴ	CC-1	CC-1, 2	CC-2	
Other Public Uses					
Cemeteries	CC-1	C	C	C	1: No buildings, structures, or other above-ground objects hazardous to airport operations are allowed.
Parks and Nature Exhibitions	CC-2, 3	CC-1, 3	CC-3	C	1: Limit density per Section 7(C) (6). 2: No public facilities, above-ground structures, spectator facilities, or parking allowed. 3: Minimize wildlife attractants.
NEW COMMERCIAL USES					
Business & Professional Offices					
Medical & Other Health Care Offices Or Clinics	ϴ	CC-1	CC-1	C	1: Limit density per Section 7(C)(6).
All Other Business and Professional Offices	ϴ	CC-1	CC-1	C	
Retail Sales or Services					
Shopping Malls & Centers	ϴ	ϴ	CC-1	C	1: Limit density per Section 7(C)(6).
All Other Retail Sales or Service Uses, Including Repairs and Personal Services	ϴ	CC-1	CC-1	C	
Eating and/or Drinking Establishment					
Eating and drinking places	ϴ	CC-1	CC-1	C	1: Limit density per Section 7(C)(6).
Amusement, Entertainment, and Recreation Establishments					
Fairgrounds, Amusement Parks, Theaters, Amphitheaters, and All Other Amusement, Entertainment, and Recreation Establishments Not Specifically Listed (Indoor or Outdoor)	ϴ	ϴ	CC-1	C	1: Limit density per Section 7(C)(6). 2: No spectator facilities, clubhouses, or locker rooms allowed. 3: Minimize wildlife attractants. 4: No public facilities or parking allowed.
Golf Courses, Driving Ranges, Riding Stables and Water Recreation Establishments	CC-2, 3, 4	CC-1, 2, 3	CC-3	C	
Recreational Vehicle Accommodations And Campgrounds	ϴ	ϴ	ϴ	C	
Zoos	ϴ	CC-1, 3, 4	CC-3	C	
Vehicle Sales, Rental, or Service Establishment					
Vehicle Body Repair Shops, Parts and Supply Distributors, Sales and Service	ϴ	CC-1, 2, 3	CC-1	C	1: Limit density per Section 7(C)(6). 2: Allow only if accessory to rental and related sales. 3: Subject to airport approval.
Automobile Rental/Leasing Agencies	CC-1, 3	CC-1, 3	CC-1	C	

TABLE 7-C: AIRPORT LAND USE COMPATIBILITY BY ZONE

Use Categories and Specific Use Types	Compatibility Zones: Zone A	Zone B	Zone C	Zone D	Conditions Required to Achieve Compatibility
Θ = Incompatible use - recommend that local jurisdictions prohibit in the Zone C = Compatible use - recommend that local jurisdictions allow in the Zone CC = Conditionally compatible use - may be made compatible through compliance with indicated conditions. Recommend that local jurisdictions require discretionary local review and/or conformance with standards.					
NEW INDUSTRIAL, WHOLESALE TRADE AND STORAGE USES					
Manufacturing, Assembly, or Processing Uses					
Chemicals and Allied Production, Liquefied & Bottled Gas Production or Distribution, Rubber & Misc. Plastics Manufacturing, Primary Metal Industries, Fabricated Metal Production	Θ	CC-1, 2	CC-1, 2	CC-2	1: Limit density per Section 7(C)(6). 2: Review for compliance with general performance standards in Section 7(C)(3).
Explosives and Pyrotechnic Production	Θ	Θ	CC-1, 2	CC-2	
General Industry, Heavy – Not Otherwise Listed	Θ	CC-1, 2	CC-1, 2	C	
General Industry, Light – Not Otherwise Listed	Θ	CC-1	C	C	
Mail Order House	Θ	CC-1	C	C	
Mini-Storage Warehouse	Θ	CC-1	C	C	
Petroleum Refining & Related Industries (Gasoline, Diesel & Heating Oil)	Θ	Θ	CC-1, 2	CC-2	
Building and Contracting					
Building Materials And Hardware, Construction, General Building Contractors, Building Materials Supply	Θ	CC-1	C	C	1: Limit density per Section 7(C)(6).
Manufactured/Mobile Home – Sales Only	Θ	CC-1	C	C	
Wholesale Trade					
Wholesale Trade	Θ	CC-1	C	C	1: Limit density per Section 7(C)(6).
Automotive, Marine & Aircraft Accessories	Θ	CC-1	C	C	
Warehouse and Storage Services					
Warehousing And Storage Services	Θ	CC-1	C	C	1: Limit density per Section 7(C)(6). 2: Review for compliance with general performance standards in Section 7(C)(3).
Explosives Storage	Θ	Θ	CC-1, 2	CC-2	
Waste and Salvage Uses					
Hazardous Waste Facility	Θ	CC-1, 2	CC-1, 2	CC-2	1: Limit density per Section 7(C)(6). 2: Review for compliance with general performance standards in Section 7(C)(4).
Landfills, Solid Waste Facility	Θ	Θ	CC-1, 2	CC-2	
Recycling Collection Facility	Θ	CC-1, 2	CC-1, 2	CC-2	
Refuse Hauling Facility	Θ	CC-1, 2	CC-1, 2	CC-2	
Salvage or Junk Yard	Θ	CC-1, 2	CC-1, 2	CC-2	

TABLE 7-C: AIRPORT LAND USE COMPATIBILITY BY ZONE					
Use Categories and Specific Use Types	**Compatibility Zones**				**Conditions Required to Achieve Compatibility**
	Zone A	**Zone B**	**Zone C**	**Zone D**	
ϴ = Incompatible use - recommend that local jurisdictions prohibit in the Zone C = Compatible use - recommend that local jurisdictions allow in the Zone CC = Conditionally compatible use - may be made compatible through compliance with indicated conditions. Recommend that local jurisdictions require discretionary local review and/or conformance with standards.					
NEW TRANSPORTATION, PARKING, AND UTILITY USES					
Transportation Facilities (Railways, Highways/Roads, Terminals)	CC-4, 2	C	C	C	1: Limit density per Section 7(C)(6). 2: Lights, buildings, structures, above-ground pipelines, utility lines, and transmission lines are prohibited. 3: Subject to airport authority approval. 4: Allow only if no practicable alternatives exist and/or use is directly related to airport operations. 5: Condition as applicable per Section 7(C)(5) 6: Above ground-structures are prohibited except as necessary for lighting and access control. 7: Allow only if accessory to an allowed primary use.
Passenger Facilities	ϴ	CC-1,3	CC-1, 3	C	
Cargo-Freight Facilities	ϴ	CC-1, 3	C	C	
Communications / Telecommunications / Broadcast Communications	CC-2	CC-1,3	CC-3	C	
Utilities, Including Large Wind Energy Conversion Facilities	CC-2, 3, 4, 5	CC-1, 2, 3, 5	CC-1, 5	C	
Vehicle Parking, Primary	ϴ	CC-6	C	C	
Vehicle Parking, Accessory	CC-6, 7	CC-7	C	C	
NEW AGRICULTURAL AND RESOURCE EXTRACTION USES					
Agricultural Uses					
Agriculture, General (Except Livestock)	CC-2,3	CC-1	CC-1	C	1: Limit density per Section 7(C)(6). 2: Above-ground structures prohibited. 3: Minimize wildlife attractants (e.g., discouraged cereal grain crops) and substantially mitigate hazards if allowed.
Agricultural Accessory Housing	ϴ	CC-1	CC-1	C	
Agricultural Related and Support Activities	CC-2	CC-1	C	C	
Forestry Activities & Related Services	CC-2	CC-1	C	C	
Fishing and Hunting Activities & Related Services	C-2, 3	CC-1, 2	CC-3	CC-3	
Greenhouses	ϴ	CC-1	C	C	
Livestock Farms And Ranches Not Otherwise Listed	CC-2, 3	CC-1	C-2	C	
Poultry And Small Mammal Production/Breeding	ϴ	CC-1	C	C	
Resource Extraction Uses					
Mining Activities And Related Services	ϴ	CC-1, 2	C	C	1: Limit density per Section 7(C)(6). 2: Activities involving water impoundment shall mitigate wildlife/bird attractants.
Oil & Natural Gas Wells	ϴ	I	CC-2	CC-2	
Stone & Mineral Quarries	ϴ	CC-1, 2	CC-2	CC-2	
OTHER NEW USES					
Water Areas	ϴ	CC-2	CC-2	CC-2	1: Public facilities and above-ground structures prohibited. 2: Consider/minimize wildlife/bird attractant issues.
Open Space	CC-1, 2	C-2	C	C	
Surface Stormwater Detention Facilities Accessory to Another Use	ϴ	CC-2	CC-2	CC-2	
Undeveloped and Vacant Land	C	C	C	C	

a. *Unlisted Uses* BP

1. *Procedure for Approving Unlisted Uses*

Where a particular use category or use type is not specifically allowed under this Ordinance and **TABLE 7-C** above, the use category or type may be permitted by the ___________ [*Insert name of decision-maker, e.g., the Board of Adjustment or Zoning Administrator]* upon a finding that the criteria of subsection 2., below, are met. The ___________ *[Insert name of decision-maker]* shall give due consideration to the intent of this Ordinance, the character of the uses specifically identified in **TABLE 7-A**, and the character of the use(s) in question. [*Optional:* In addition, the ______________ *insert name of decision-maker]* shall refer all requests for approval of unlisted uses to ______________[*Insert name of state office of aeronautics]*, for review and comment prior to making a final decision on the request.]

2. *Criteria for Approving Unlisted Uses*

The ____________ *[Insert name of decision-maker*] may allow an unlisted use in the airport land use compatibility zone if he finds that the proposed use has an impact that is similar in nature, function, and duration to the other uses allowed in the specific airport land use compatibility zone. In making such finding, the ____________ *[Insert name of decision-maker*] shall assess all relevant characteristics of the proposed use, including but not limited to the following:

a. Any processing done on the premises, including assembly, manufacturing, or any dangerous, hazardous, toxic, or explosive materials used in the processing;

b. The nature and location of storage and outdoor display of merchandise; enclosed, open, inside or outside the principal building; and predominant types of items stored (such as business vehicles, work-in-process, inventory, and merchandise, construction materials, scrap and junk, and raw materials including liquids and powders hazardous or not);

c. The type, size, height, and nature of buildings and structures;

d. The number and density of employees and customers per unit area of site in relation to business hours and employment shifts or the density of residential use, as applicable;

e. The amount and nature of any nuisances generated on the premises, including but not limited to noise, smoke, odor, glare, vibration, radiation, and fumes; and

f. The impacts created by the proposed use on aircraft flight operations and safety to persons and property on the ground from airport operations will not be greater than that of other uses allowed in the zone.

(6) Density Restrictions for Conditionally Compatible Uses

COMMENTARY: Controlling development density can help to reduce accident hazard because in most airplane crashes, pilots have some ability to steer the aircraft toward open areas if such areas exist. One basic way to address development density is prescribe set minimum lot size requirements and maximum lot coverage requirements for uses permitted within some zones. The Minnesota model airport zoning ordinance includes minimum lot sizes in approach zones. (No minimum lot size is typically stated for Zone A, the runway protection zone, because the requirement that it be maintained free of structures accomplished the desired effect.)

BP To ensure that open areas result from minimum lot size, local jurisdictions should pair minimum lot size regulations with regulations for maximum lot coverage. Otherwise, the lot could be built with very little open area into which a pilot could steer.

a. *Lot Area*

1. The minimum lot size or site area for each permitted use in Zone B1 shall be three acres.

2. The minimum lot size or site area for each permitted use in Zone B2 shall be one acre.

BP COMMENTARY: Jurisdictions may consider specific limitations on uses and/or density in Zone C, especially if long-range plans for the airport include runway expansion or relocation, or if noise impacts are an issue or concern. In such cases, best practice suggests limits on multi-family residential uses and public assembly uses in Zone C. In addition, limits on the density of permitted single-family residential uses may be appropriate (e.g., establish a maximum density of one dwelling unit per one acre—the same as the Zone B2 limit). Such use restrictions need not apply to the entire Zone C—some jurisdiction may find these use limits most effective applied only in Zone C areas within a specified horizontal distance (e.g., 250 or 500 feet) adjacent to or along the runway centerline extended. As one example, the airport zoning ordinance for Rochester, Minnesota Airport limits Zone C single-family residential density to one dwelling unit per acre.

b. *Lot Coverage*

1. The maximum percent of the gross lot area covered by structures in Zone B1 shall be 25 percent.

2. The maximum percent of the gross lot area covered by structures in Zone B2 shall be 33 percent.

OR

c. *Maximum Building Envelope Ratio and Site Population* BP

BP *COMMENTARY*: A more sophisticated approach to controlling development density uses the ratio of the building envelope to the lot area, which scales with the lot size, and determination of the projected site population. The benefit of this approach is that it is more tailored for each specific site and use. However, this approach requires more time and effort for each development review and may not be appropriate for small jurisdictions with limited staff.

1. Each site shall have no more than one building envelope upon which any number of structures may be erected. A building envelope shall be a single, contiguous, uniform, and non-contrived area, whose shape is uncomplicated.

2. The building envelope shall not exceed the maximum lot area ratios with respect to the total site area shown in **TABLE 7-D** below.

TABLE 7-D: RATIO OF SITE AREA TO BUILDING ENVELOPE					
Total Site Area At Least (Acres)	**Total Site Area Less Than (Acres)**	**Maximum Ratio of Site Area to Building Envelope Area**		**Maximum Building Envelope (Sq. Ft.)**	
		Zone B1	**Zone B2**	**Zone B1**	**Zone B2**
1	3	n/a	10:1	n/a	13,100
3	4	12:1	6:1	10,900	21,800
4	6	10:1	5:1	17,400	34,800
6	10	10:1	5:1	32,700	65,400
10	20	6:1	3:1	73,600	147,200
20	-	4:1	2:1	218,000	436,000

3. In Zone B1, each use shall not create, attract, or bring together a site population that would exceed 15 times that of the site acreage. See **TABLE 7-E** below.

4. In Zone B2, each use shall not create, attract, or bring together a site population that would exceed 30 times that of the site acreage. See **TABLE 7-E** below.

5. *Determination of Site Population BP*
Each use shall not create, attract, or bring together a site population that would exceed that indicated in **TABLE 7-E** below.

COMMENTARY: Jurisdictions are seeking more direction about how to determine the projected population of a site, in order to administer standards that limit use based on the expected site population. The following provision is taken from the airport zoning ordinance for the Duluth International Airport (1986, as amended 1996), for consideration. The provision provides one way to determine normal site population for a proposed land use based on fire/building code occupancy load standards. By specifying an approach to calculating site population, a community can lend significant certainty to the development review process and enable a straightforward check for compliance with the maximum person-per-acre standards stated in subsections (C)(6)c.3. and (C)(6)c.4., above.

a. The Zoning Administrator shall make all final decisions regarding a determination of normal site population for a proposed land use. Such determination shall be based on the seating capacity for those uses with fixed seats, or on the following standards—whichever is applicable:

b. For uses involving fixed booths, benches or pews, the occupant load shall be not less than the number of seats available based on one person for each 18 inches of length of pew or bench or portion thereof. When benches are used in dining areas, the occupant load shall be based on one person for each 24 inches of bench length or portion thereof.

c. For all other uses, the site population shall be determined by totaling the gross floor area of all habitable structures on the development site (expressed in square feet) and dividing by the appropriate “use factor” set forth in the Table 7-E below. If a use is not listed in the table below, the Zoning Administrator shall establish an occupant load factor based on the most similar listed use.

For example: To determine the normal occupancy of a 2,400 square foot office building, the following calculation shall apply: Normal occupancy load = 2,400 / 100 = 24 persons.

TABLE 7-E: USE FACTORS FOR DETERIMING SITE POPULATION *SOURCE: UNIFORM BUILDING CODE*	
Land Use	**People/Use**
Aircraft hangars	500
Auction rooms	7
Assembly Areas: Concentrated Use (without fixed assets):	
Auditorium	7
Bowling alleys	
Churches and chapels	
Dance floors	
Lodge rooms	
Reviewing stands	
Stadiums	
Assembly Areas: Less Concentrated Use:	
Conference rooms	15
Drinking rooms	
Drinking establishments	
Exhibit rooms	
Gymnasiums	
Lounges	
Stages	
Children's Home or Home for the Aged	80
Classrooms	20
Dormitories	50
Dwellings	300
Garage parking	200
Hospitals, Nursing homes, and similar institutional uses	80
Hotels and apartments	200
Kitchen—commercial	200
Library reading room	50
Locker room	50
Mechanical equipment room	300
Nurseries for children/day care	35
Offices	100
School shops and vocational rooms	50
Skating rinks	50 for rink area; plus 15 for decks

TABLE 7-E: USE FACTORS FOR DETERIMING SITE POPULATION *SOURCE: UNIFORM BUILDING CODE*	
Land Use	**People/Use**
Stores—retail sales rooms:	
Basement	20
Ground floor	30
Upper floor	50
Swimming pool	50 for pool area; plus 15 for decks
Warehouse	300
Lobby (accessory to an assembly use)	7
Malls	See appendix to chapter 7, U.B.C.
All others	100

SECTION 8: AIRPORT NOISE ZONES

COMMENTARY: Some communities choose to define noise zones. If noise zones are to be defined and regulated, these should be defined in this Section 8. If an airport has not completed a Part 150 study or otherwise mapped noise contours, noise impacts can be roughly correlated to the airport safety zones where overflights are common. Although this approach is somewhat imprecise, it is relatively easy to administer. Where an airport has completed a Part 150 study or has otherwise mapped airport noise exposure contours, it may be advisable to consider defining noise impact zones based on noise exposure contours. Within these zones, noise sensitive land uses, such as single-family homes, schools, hotels, places of worship, and medical and social care facilities may be restricted or regulated to mitigate noise impacts. The FAA gives guidance on land use compatibility and airport noise. An example of land use restrictions by noise impact zone is included in the Appendix to this model ordinance. Though decibel values are given for compatibility criteria in this model ordinance, before adopting any such criteria, a jurisdiction/airport should consider the issues discussed in Chapter 6, Airport Noise and Land Use Compatibility, of the primary document.

OPTION 1: *[For airports without a noise impact study]*

(B) AIRPORT NOISE IMPACT ZONE

There is hereby created and established an overlay land use noise zone for *[Insert name of local government*]. The zone is shown on the Airport Noise Impacted Zone appended to and made a part of this ordinance. The noise impact zone was created by outlining an area [*Beneath the standard VFR traffic pattern and buffer airspace established by measuring one-half the length of the longest runway on either side of and at the end of each runway* or as *in FAA Order 7400.2C]* which underlies the majority of recurring flight paths aircraft will use operating at ________________ Airport. This zone shall be considered to have an existing and projected yearly averaged, 24-hour day/night average noise level (DNL) impact of [*70 Ldn to 75 Ldn*] for land use purposes.

OPTION 2: *[For airports with an approved FAR Part 150 noise impact study or defined noise contours:]*

(C) AIRPORT NOISE IMPACT ZONES

There are hereby created and established three overlay land use noise zones: 75 DNL Noise Zone, 70 DNL Noise Zone, and 65 DNL Noise Zone. Such Zones are shown on the Airport Noise Impacted Zones for *[Insert name of local government*] appended to and made a part of this Ordinance. The noise zones contained herein are based on projected yearly averaged, 24-hour day/night average noise level (DNL) impact projections arising from aircraft flight operations at ____________ Airport through the year ____.

(1) 75 DNL Noise Zone: That area commencing at the outermost boundary of the airport and extending outward to a boundary indicated on the Noise Zone Map as "DNL 75". The outer boundary of the 75 DNL Noise Zone approximates a projected yearly averaged, 24-hour day/night average noise level contour of 75 DNL.

(2) 70 DNL Noise Zone: That area commencing at the boundary indicated on the Noise Zone Map as the outer boundary of 75 DNL Noise Zone and extending outward to the boundary indicated on the Noise Zone Map as "DNL 70". The outer boundary of the 70 DNL Noise Zone approximates a projected yearly averaged, 24-hour day/night average noise contour of 70 DNL.

(3) 65 DNL Noise Zone: That area commencing at the outer boundary indicated on the Noise Zone Map as the outer boundary of the 70 DNL Noise Zone and extending outward to the furthermost boundary indicated on the Noise Zone Map. The outer boundary of the 65 DNL Noise Zone approximates a projected yearly averaged, 24-hour day/night average noise level contour of 65 DNL.

(D) LEGAL DESCRIPTION OF NOISE IMPACT ZONE BOUNDARIES

OPTION 1: [*For airports without a noise impact study]:*

That area surrounding the ____________ Airport runways [List runways] in__________________ *[Insert name of local government*] etc., as appropriate or necessary for legal sufficiency]

OPTION 2: [*For airports with a noise impact study*]:

(1) The 75 DNL Noise Zone applies to an area encompassing a projected yearly averaged, 24-hour day/night average noise level impact of 75 DNL and above surrounding ____________ Airport runways *[List runways]* at various depths.

(2) The 70 DNL Noise Zone applies to an area encompassing a projected yearly averaged, 24-hour day/night average noise level impact of 70 DNL to 75 DNL surrounding the ____________ Airport in __________________ *[Insert name of local government*] more particularly described as follows: [*As appropriate or necessary for legal sufficiency*]

(3) The 65 DNL Noise Zone applies to an area encompassing a projected yearly averaged, 24-hour day/night average noise level impact of 65 DNL to 70 DNL surrounding the ____________ Airport in __________________ *[Insert name of local government*] more particularly described as follows: [*As appropriate or necessary for legal sufficiency*]

(E) PERMITTED AND RESTRICTED ACTIVITIES

All land uses shall be permitted in the several noise zones as provided in the Aviation Compatible Land Use Chart appended to and made a part of this Ordinance. Those activities and land uses not specifically listed in the Chart are permitted or restricted in the appropriate zones based on their similarity to noise tolerance and compatibility with normal airport operations as exhibited by the activities and land uses which are listed in the Chart.

(F) NOISE IMPACT ZONE SOUND LEVEL REDUCTION REQUIREMENTS

These provisions shall apply to the construction, alteration, moving, repair, replacement, and use of any building or occupied permanent structure within __________________ *[Insert name of local government*] located within any noise impacted zone defined in this Ordinance. Additions, alterations, repairs, and changes of use or occupancy in all buildings and structures shall comply with these provisions.

(1) *Applicability*

a. *Existing Buildings*

General buildings or structures to which additions, alteration, or repairs are made shall comply with all the requirements of this Ordinance except as specifically provided below:

1. When additions, alterations, or repairs within any three-year period exceed 50 percent of the value of an existing building or structure, such buildings or structures shall be made to conform to the requirements of this Ordinance.

2. Alterations or repairs not exceeding 50 percent of the value of an existing building or structure and which are nonstructural may be made with the same materials of which the building or structure is constructed.

3. Not more than 50 percent of the roof covering of any building or structure shall be replaced in any three-year period unless the next roof covering is made to conform to the requirements of this Ordinance.

4. Buildings in existence at the time of the passage of this Ordinance may have their existing use or occupancy continued if such use or occupancy was legal at the time of passage provided such continued use does not jeopardize life or health.

b. *Moved Buildings*

Buildings or structures moved into or within __________________ *[Insert name of local government*] shall comply with applicable provisions of this regulation.

c. *New Buildings*

Newly constructed buildings or structures shall comply with the applicable provisions of this regulation before permanent occupancy is permitted.

(2) *Design Requirements*

The Noise Level Reduction (NLR) requirements of the Aviation Compatible Land Use Chart may be achieved by any suitable combination of building design, choice of building materials and construction techniques in accordance with established architectural and acoustical principles. The reduction requirements shall apply to all occupied rooms having one or more exterior walls or ceilings, when furnished in accordance with the intended final usage of the room.

BP COMMENTARY: The FAA recognizes airport land use compatibility issues in areas where noise impacts are 65 DNL and greater, based on studies that demonstrate negative health impacts from annual noise exposure at these levels. In a number of communities impacted by airport noise, including Centennial, Colorado, and Pensacola, Florida, local jurisdictions also regulate noise sensitive uses within lower contours such as the 55 or 60 DNL. Use of such lower levels may be appropriate for a jurisdiction after consideration of the issues discussed in Chapter 6, Aircraft Noise and Land Use Compatibility

Zoning in DNL contours less than 65 may address noise land use compatibility in a variety of ways such as restricting new residential uses, requiring construction techniques to reduce interior noise levels, requiring avigation easements for new platting or construction, or requiring real estate disclosure of existing and potential future airport noise impacts.

SECTION 9: OFFICIAL AIRPORT ZONING MAP

COMMENTARY: This Section incorporates the Official Airport Zoning Map of the four airport land use compatibility zones by reference as a part of the Ordinance.

The air space and airport land use compatibility zones established by this Ordinance are shown on the _____________________________ Airport Zoning Map consisting of ____ [*Insert number*] sheets, prepared by __________________________________, and dated _________________________, attached as Exhibit A to this Ordinance. Such Official Airport Zoning Map, as may be amended from time to time, and all notations, references, elevations, data, zone boundaries, and other information thereon, is hereby adopted by reference as part of this Ordinance.

SECTION 10: ADMINISTRATION—BOARD OF ADJUSTMENT AND AIRPORT ZONING ADMINISTRATOR

COMMENTARY: This Section identifies the entities that will administer and enforce the regulations prescribed in the Ordinance. This section will also define the powers given to the administrator to exercise their duties and procedures within the provision of the Ordinance. If the airport land use compatibility regulations are incorporated into a zoning ordinance, the administration procedures will need to be coordinated and made consistent with zoning ordinance administration procedures.

(A) AIRPORT ZONING ADMINISTRATOR

It shall be the duty of the ______________________, *[Insert the title of an appropriate local zoning or planning official]* referred to herein as the "Airport Zoning Administrator," to administer and enforce the regulations prescribed in this Ordinance. Applications for permits and variances shall be made to the ________________________________ *[Insert name of appropriate official or department, such as the planning or building department]* upon a form furnished by them. Permit applications shall be promptly considered and granted or denied by the Airport Zoning Administrator according to the regulations prescribed in this Ordinance. Variance applications shall be transmitted by the _____________________________ *[Insert name of appropriate official or department, such as the planning or building department]* for action by the Board of Adjustment, according to Section 12 of this Ordinance.

(B) BOARD OF ADJUSTMENT

COMMENTARY: The Board of Adjustment, established to administer variance and appeal requests under this Ordinance, may be a newly created board or an existing Board of Appeals or Adjustment.

OPTION 1: [*Appointment of existing body as the Board of Adjustment*]

(1) *Establishment*
The ____________________ *[Insert name of existing body*], shall serve as the Board of Adjustment for the ____________________ Airport Zoning Ordinance.

OR

OPTION 2: [*Creation of new Board of Adjustment for purposes of this Ordinance*]

(2) *Establishment*
The Board of Adjustment shall consist of five members appointed by the ____________________ *[Insert name of appointing body*], and each shall serve for a term of three years and until his successor is duly appointed and qualified. Of the members first appointed, one shall be appointed for a term of one year, two for a term of two years, and two for a term for three years. Upon their appointment, the members shall select a chairperson to act at the pleasure of the Board. Members shall be removable by the ____________________ *[Insert name of removal body; typically same as appointing body]* for cause, upon written charges, after a public hearing.

(3) *Powers*
The Board of Adjustment shall have and exercise the following powers:

a. Hear and decide appeals from any order, requirement, decision, or determination made by the Airport Zoning Administrator in the enforcement of this Ordinance.

b. Hear and decide special exceptions to the terms of this Ordinance upon which such Board of Adjustment under such regulations may be required to pass.

c. Hear and decide specific variances.

(4) Procedures

a. The Board of Adjustment shall adopt rules for its governance and procedure in harmony with the provisions of this Ordinance and state law. Meetings of the Board of Adjustment shall be held at the call of the chairperson and at such other times as the Board of Adjustment may determine. The chairperson, or in his absence the acting chairperson, may administer oaths and compel the attendance of witnesses. All hearings of the Board of Adjustment shall be public. The Board of Adjustment shall keep minutes of its proceedings showing the vote of each member upon each question or, if absent or failing to vote, indicating such fact, and shall keep records of its examinations and other official actions, all of which shall immediately be filed in the office of the Airport Zoning Administrator and shall be a public record.

b. The Board of Adjustment shall make written findings of facts and conclusions of law giving the facts upon which it acted and its legal conclusions from such facts in reversing, affirming, or modifying any order, requirement, decision, or determination which comes before it under the provisions of this ordinance.

c. The concurring vote of a majority of the members of the Board of Adjustment shall be sufficient to reverse any order, requirement, decision, or determination of the Airport Zoning Administrator or to decide in favor of the applicant on any matter upon which it is required to pass under this Ordinance, or to effect any variation in this Ordinance.

SECTION 11: TREATMENT OF NONCONFORMING USES AND STRUCTURES

COMMENTARY: This Section establishes general rules for treatment of uses and structures existing at the time of adoption of the Ordinance that do not conform to the provisions of Ordinance. Generally, such nonconforming uses and structures are allowed to continue, and are allowed to expand only if the expansion would not increase the extent of the non-conformity. This suggested treatment of non-conforming uses may be altered to be similar or even identical to existing procedures outlined in an existing ordinance.

(A) GENERAL PROVISIONS

(1) *Regulations Not Retroactive—Nonconformities Allowed to Continue*
The regulations prescribed by this Ordinance shall not be construed to require the removal, lowering, or other changes or alteration of any structure or tree not conforming to the regulations as of the effective date of this Ordinance, or otherwise interfere with the continuance of any nonconforming use.

(2) *Prior Nonconformities Continue*
Any nonconformity created under application of a previous airport zoning ordinance or regulations shall continue to be nonconformity under this Ordinance, and shall be subject to the limitations of this Section 11, unless the Airport Zoning Administrator finds that the use, tree, structure, or lot complies with the applicable terms of this Ordinance.

(3) *Completion of Construction or Alteration Allowed*
This Ordinance shall not require any change in the construction, alteration, or intended use of any structure, the construction or alteration of which began prior to the effective date of this Ordinance, provided the construction or alteration is diligently prosecuted and completed within two years of the construction or alteration start date.

(4) *Determination of Nonconformity Status BP*
The burden of establishing that a nonconformity lawfully exists is on the owner, not the ________ *[Insert name of jurisdiction or simply refer to "the City," "the County", etc.]*

(B) CHANGE OF TENANCY OR OWNERSHIP BP

Changes of tenancy, ownership, or management of an existing nonconformity are permitted and in such cases the nonconforming situation continues to be subject to this Section.

(C) REPAIRS AND MAINTENANCE BP

Ordinary repairs and normal maintenance required to keep nonconforming uses, structures, and trees in a safe condition shall be permitted. All ordinary repair and normal maintenance shall be subject to this Section's limitations regarding expansion and enlargement of the nonconforming structure or use.

(D) ENLARGEMENT OR EXPANSION BP

(1) *Nonconforming Uses*

a. *Structure Enlargement.*
A structure or portion thereof devoted to a nonconforming use shall not be enlarged, extended, constructed, reconstructed, moved, or structurally altered except to change the use of the structure to one permitted in the applicable airport land use compatibility zone.

b. *Expansion of Nonconforming Uses*

1. A nonconforming use shall not be extended to any land or portion of property outside of any building that was not used for the nonconforming use when the use was legally established, except when such extension is the direct result of an intervening government action.

2. A nonconforming use may be enlarged, expanded, or extended to occupy any parts of the building housing such use that were designed or arranged for such use when the use was legally established. However, if such enlargement, expansion, or extension will result in an increased impact, the Board of Adjustment shall review the request according to the procedures stated in Section 13, *Variances*. In no case, however, shall the enlargement or expansion result in violation of the performance standards stated in Section 7(C) of this Ordinance. For purposes of this provision, "increased impact" occurs when:

a. The expanded use will result in an increase in site population per acre that is either:

i. Five percent or greater than the site population per acre that existed when the use was legally established; or

ii. Greater than the site population per acre permitted under Section 7(C) of this Ordinance.

b. The expanded use will operate in a different manner, in areas such as hours of operation or number of employees.

The Zoning Administrator shall make all determinations of "increased impact," subject to the Appeals procedure in Section 16 of this Ordinance.

3. The Board of Adjustment may approve an expansion request only if the expansion satisfies the following criteria:

a. The expansion will not interfere with the operation of conforming uses in the same zone or surrounding zones; and

b. The expansion will cause no greater adverse impacts on surrounding properties than did the original nonconforming use.

(2) *Nonconforming Structures* BP

a. Any enlargement, alteration, or expansion of a nonconforming structure that increases the height of the structure is prohibited unless the Board of Adjustment grants a variance. Expansions of the structure that comply with applicable height standards, or that decrease the height of the structure are permitted and do not require a variance, provided such expansion meets all other applicable standards in this Ordinance.

b. The Board of Adjustment may approve an expansion request only if the expansion satisfies the following criteria:

1. The expansion will not interfere with the operation of conforming uses in the same zone or surrounding zones; and

2. The expansion will cause no greater adverse impacts on surrounding properties than did the original nonconforming use.

(E) RELOCATION OF A NONCONFORMING USE BP

No person shall move a nonconforming use within the same parcel or to another parcel unless the use conforms with the use regulations of the applicable zone. This provision shall not apply if the relocation of the nonconforming use is the direct result of government action.

(F) CHANGES IN USE BP

A nonconforming use may only be changed to a new conforming use.

(G) ACCESSORY USES BP

(1) No use that is accessory to a principal nonconforming use shall continue after the nonconforming principal use ceases to exist.

(2) No additional accessory use, building, or structure that did not exist when the nonconforming use was legally established shall be established on the site of a nonconforming use.

(H) NONCONFORMING USES OR STRUCTURES ABANDONED OR DESTROYED

(1) *Abandonment of Nonconforming Uses—Reestablishment Prohibited BP*

a. Whenever a nonconforming use is discontinued for a period of 180 consecutive days, such use shall not thereafter be reestablished and any future use shall comply with this Ordinance.

b. At such time as any nonconforming, individual mobile home existing on a private lot is removed from such lot or is vacated, the use shall be deemed abandoned and shall not thereafter be returned or occupied except in compliance with this Ordinance.

(2) *Compliance Required After Abandonment or Destruction*

a. Whenever the Zoning Administrator determines that a nonconforming structure or tree has been abandoned under subsection (1) above, or has been more than 75 percent torn down, deteriorated, destroyed, or decayed, no development or building permit shall be granted that would allow such structure to be used or occupied contrary to this Ordinance's use regulations, or that would allow such structure or tree to exceed the applicable height limit or otherwise deviate from this Ordinance's regulations.

OR:

BP: Whenever the Zoning Administrator determines that a nonconforming structure or tree has been abandoned under subsection (1) above, or has been torn down, deteriorated, destroyed, or decayed to the extent of greater than 50 percent of its market value and no building permit has been applied for within 180 days of when the property is damaged, any subsequent use or occupancy of the land or premises shall be a conforming use or occupancy, and all reconstruction and repair shall comply with the applicable height limit and all other applicable standards stated in this Ordinance.

b. Whether application is made for a permit under this subsection or not, the Zoning Administrator may order the owner of the abandoned or partially destroyed nonconforming structure, at his own expense, to lower, remove, reconstruct, or equip the same in the manner necessary to conform to the provisions of this Ordinance. In the event the owner of the nonconforming structure shall neglect or refuse to comply with such order for ten days after receipt of written notice of such order, the Zoning Administrator may, by appropriate legal action, proceed to have the abandoned or partially destroyed nonconforming structure lowered, removed, reconstructed or equipped, and assess the cost and expense thereof against the land on which the structure is or was located.

c. Unless such an assessment is paid within 90 days from the service of notice thereof on the owner of the land, the sum shall bear interest at the rate of ______ [Insert interest rate] percent per annum from the date the cost and expense is incurred until paid, and shall be collected in the same manner as are general taxes.

(3) *Nonconforming Tree*
No nonconforming tree shall be allowed to grow higher or be altered, repaired, or replanted.

SECTION 12: AIRPORT ZONING PERMITS

COMMENTARY: This Section establishes requirements for application and review of Airport Land Use & Height Overlay Zoning Permits. An "airport zoning permit" may be administered as an entirely new kind of local land development or zoning permit. Alternately, for ease of administration, the "airport zoning permit" provisions may be drafted to allow an existing site plan check, land use permit, or other development permit to function as the required "airport zoning permit."

(A) PERMIT REQUIRED

In any airspace zone or land use compatibility zone, the following activities shall require an Airport Zoning Permit to be granted by the Zoning Administrator:

(1) *New Structure*
Except as specifically provided in Section 12(B), new construction of any structure.

(2) *Existing Structure*
Except as specifically provided in Section 12(B), substantial alteration, changed, rebuilding, repair, or replacement of an existing structure.

(3) *Expansion, Alteration or Reconstruction of a Nonconforming Structure*
Expansion, extension, or reconstruction of a nonconforming structure, for which no permit shall be issued except in conformance with the regulations stated in Section 11 of this Ordinance, as applicable.

(4) *Compliance with State and Federal Requirements*
The applicant shall submit a statement that all other necessary approvals and permits from any other local, state, or federal agency, including but not limited to the Federal Aviation Administration FAR Part 77.13 and a "no hazard" determination, prior to final approval.

(B) EXCEPTIONS TO PERMIT REQUIREMENT

(1) *Permit Not Required For Certain Structures Less than 75 Feet in Height*
An airport zoning permit is not required for a tree or structure of less than 75 feet of vertical height above the ground in Zone C or Zone B2, except when such tree or

structure, because of terrain, land contour, or topographic features, would exceed the height or land use limit prescribed for the respective zone.

(2) *No Violation of Height or Land Use Restriction Permitted*
Nothing contained in this subsection shall be construed as permitting or intending to permit any construction, alteration, or growth of any structure or tree in excess of any land use compatibility standards and limitations set forth in Section 7(C).

(C) SUBMITTAL REQUIREMENTS AND DECISION

(1) Each airport zoning permit application shall indicate the purpose for which the permit is desired and shall contain sufficient detail to permit the Zoning Administrator to determine the application's compliance with this Ordinance's regulations.

(2) The Zoning Administrator shall approve and grant an airport zoning permit only upon finding that the permit application complies with all application regulations in this Ordinance, except those for which a Variance is approved according to Section 13.

(3) The Zoning Administrator shall not grant a permit that would allow the establishment or creation of an airport hazard, or that would permit a nonconforming use, structure, or tree to become a greater hazard to air navigation or safety to persons or property on the ground than it was on the effective date of this Ordinance, as amended, or than it is when the application for the permit is made.

SECTION 13: VARIANCES

COMMENTARY: This Section establishes criteria for the variance process, as well as identifies the entity responsible for the implementation and enforcement of variance applications. If the airport land use compatibility regulations are integrated into an existing zoning ordinance, the standard zoning ordinance variance provisions should apply. Section 13D provides for optional conditions to be imposed on the grant of any variance. Legal counsel should be consulted prior to the imposition of any condition requiring an avigation easement or non-suit covenant.

(A) VARIANCES AUTHORIZED

Any person desiring to erect or increase the height of any structure, permit the growth of any tree, or use his property not in accordance with the regulations stated in this Ordinance, may apply to the Board of Adjustment for a variance from such regulations.

(B) REFERRAL TO STATE AERONAUTICS AGENCY BP

The Board of Adjustment shall refer a variance application to the relevant airport sponsor for review, comments, and recommendation prior to the public hearing on the variance application. It may also refer the variance application to _______ [*Insert name of state aeronautics agency or equivalent, if applicable*] for review, comment, and recommendation.

(C) CRITERIA FOR VARIANCE REQUESTS

The Board of Adjustment shall approve a variance only when, based on substantial evidence presented, the Board can make the following findings:

(1) A literal application or enforcement of this Ordinance's regulations would result in practical difficulty or unnecessary hardship, and

(2) Relief granted would not be contrary to the public interest but do substantial justice and be in accordance with the intent of this Ordinance.

Any variance so allowed may be subject to any reasonable conditions that the Board may deem necessary to effectuate the purpose of this Ordinance. See Section 21 of this Ordinance for the definition of the term "practical difficulty or unnecessary hardship."

(D) VARIANCE CONDITIONS

(1) Any variance that permits an incompatible noise-sensitive land use shall require as a condition of approval that sound insulation be installed to attenuate interior noise to a level determined acceptable and appropriate by the Board of Adjustment based on a recommendation from the Airport Zoning Administrator.

(2) As a condition of any variance, the Board of Adjustment may require a non-suit covenant whereby the applicant agrees to refrain from filing any legal action against the airport sponsor or ___________ (insert name of local jurisdiction) based on adverse noise, safety, or other impacts associated with the __________ airport.

(E) FAILURE OF BOARD OF ADJUSTMENT TO TAKE FINAL ACTION BP

[Reference procedures commonly in use by the adopting local governing body when a decision-making body fails to act on a variance application or, if different, insert detail regarding procedures applicable under this Ordinance.]

SECTION 14: ALLOWANCE FOR HAZARD MARKINGS AND LIGHTING

COMMENTARY: This Section provides for safe aircraft operations, as well as the health, safety, and welfare of individuals on the ground within the vicinity of the airport by identifying lighting and marking requirements.

(A) NONCONFORMING USES

The owner of any nonconforming structure or tree is hereby required to permit the installation, operation, and maintenance thereon of such markers and lights, as shall be deemed necessary by the Zoning Administrator or the FAA, to indicate to the operators of aircraft in the vicinity of the airport the presence of such airport hazards. Such markers and lights shall be installed, operated, and maintained at the expense of the ____________________________________ *[Insert Name of Airport Owner]*.

(B) PERMITS AND VARIANCES

In the grant of a variance or permit, the Board of Adjustment or Zoning Administrator may require the owner of the structure or tree in question, at his own expense, to install, operate, and maintain thereon such markers and lights as may be necessary to indicate to pilots the presence of an airport hazard. The decision-making body may impose such a condition if it finds that hazard markings and lighting is advisable to further the intent of this Ordinance and is reasonable under the specific circumstances.

SECTION 15: AVIGATION EASEMENTS AND REAL ESTATE DISCLOSURES BP

BP *COMMENTARY: This Section requires avigation easements to be recorded with the approval of new land uses or real estate disclosures as part of property sales documents. Either tool can serve as an important "Buyer Beware" about airport impacts. Avigation easements are a more far-reaching legal tool to protect the airport against future legal action based on airport impacts. Applied broadly, they can help to hedge against the inherent* *uncertainly in airport impacts such as changes in aircraft fleet mix and air traffic routing. Local jurisdictions may also wish to require non-suit covenants as a condition of approval for an airport zoning permit or variance (as set forth in Section 13). By signing a non-suit covenant, an applicant would agree to forego filing a legal action against the airport sponsor or local jurisdiction approving the permit based on adverse noise, safety, or other airport impacts.*

Avigation and real estate disclosures are especially important in areas where increased airport impacts are anticipated based on planned future expansion of airport facilities or operations. Typically, zoning ordinances are limited to requiring disclosures related to new developments needing an airport zoning permit. Some jurisdictions have adopted broad real estate disclosure requirements for all sales of residential properties (not just related to new development). Such requirements are usually set forth in ordinances outside of the local zoning code because zoning ordinances are triggered by development applications and do not apply to sales of existing properties.

(A) AVIGATION EASEMENTS BP

The following uses shall dedicate an avigation easement to the airport sponsor as a condition of obtaining approval of an airport zoning permit or building permit:

(1) New residential, commercial, industrial, institutional or recreational buildings or structures intended for habitation or occupancy by humans or animals, or

(2) For expansions of such buildings or structures by the lesser of 50 percent or 1,000 square feet, whichever is less.

The avigation easement shall be in a form acceptable to the airport sponsor and shall be signed and recorded in the deed records of the County in which the subject property lies. The avigation easement shall allow unobstructed passage for aircraft and ensure safety and use of the airport for the public. Property owners or their representatives are responsible for providing the recorded instrument prior to issuance of building permits.

(B) REAL ESTATE DISCLOSURES BP

The decision-making body may (optional: “shall”), as a condition of any residential development approval required by this Ordinance, require all residential property owners to disclose the fact of the property’s location in an airport land use compatibility zone to all future prospective purchasers of the property. Such disclosure, if required, shall include notice of the potential for adverse noise, overflight, or safety impacts from the property’s vicinity to a public airport. (See a sample real estate disclosure notice below.)

(1) Sample Real Estate Disclosure Notice[3]

Notice of airport in vicinity: This property is presently located in the vicinity of an airport, within what is known as an airport *[land use compatibility zone or air space zone or noise contour]*. For that reason, the property may be subject to some of the annoyances or inconveniences associated with proximity to airport operations (for example: overflights, noise, vibration, or odors). Individual sensitivities to those annoyances can vary from person to person. The Buyer may wish to consider what airport annoyances, if any, are associated with the property before you complete your purchase and determine whether they are acceptable to you.

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[3] Source: The Truckee Tahoe Airport Land Use Compatibility Plan. Disclosure notices should be prominently displayed in capitalized or bold print on real estate sales contracts for residential development located within the relevant airport impact area.

SECTION 16: APPEALS

COMMENTARY: This Section defines the appeals process. This may be similar or even identical to existing procedures outlined in an existing ordinance.

(A) RIGHT TO APPEAL

Any person, property owner, or taxpayer impacted by any decision of this Ordinance, may appeal to the Board of Adjustment. Appeals may also be made by any governing body of a municipality, county, or airport zoning board alleging that a decision of the Airport Zoning Administrator is an improper application of this Ordinance.

(B) PROCEDURE FOR APPEALS

[Reference or insert detail regarding appeals procedures commonly in use by the adopting governing body.]

SECTION 17: JUDICIAL REVIEW

COMMENTARY: This Section defines the method for the judicial review process. This may be similar or even identical to existing procedures outlined in an existing zoning ordinance and may be governed by state law.

Any person aggrieved, or any taxpayer affected, by any decision of the Board of Adjustment, may appeal to the Court of Record as provided in ________________________ [*Insert reference to local regulation or state enabling statute*].

SECTION 18: PENALTIES

COMMENTARY: This Section defines the method to enforce penalties for non-compliance with the Ordinance. This may be similar or identical to existing procedures outlined in an existing local zoning ordinance.

Any person who shall construct, establish, substantially change, alter, or repair any existing structure or use, or permit the growth of any tree, in violation of this Ordinance or who, having been granted a permit or variance under the provisions of this Ordinance, shall construct, establish, substantially change, or substantially alter, or repair any existing growth or structure or permit the growth of any tree, contrary to the terms and conditions contained in such permit or variance, shall be guilty of a misdemeanor and shall be punished by a fine of not more than $_________[*Insert maximum fine amount*], or imprisonment for not more than _________ [*Insert maximum number of days*] days, or by both. Each day a violation continues to exist shall constitute a separate offense. The Zoning Administrator may enforce all provisions of this Ordinance through such proceedings for injustice relief and other relief as may be proper under the laws of ________________ [*Inert name of State*] and all other applicable law.

SECTION 19: CONFLICTING REGULATIONS

COMMENTARY: This Section clarifies the relationship of this Ordinance in relationship with other law or regulations.

Where there exists a conflict between any of the regulations or limitations prescribed in this Ordinance and any other regulations applicable to the same area, whether the conflict be with respect to the height of structures or trees, the use of land, or any other matter, the more stringent limitation or regulation shall govern and prevail.

SECTION 20: SEVERABILITY

Should any section or provision of this Ordinance be declared by the courts to be unconstitutional or invalid, such decision shall not affect the validity of the Ordinance as a whole or any part thereof other than the parts so declared to be unconstitutional or invalid.

BP *COMMENTARY: As discussed in Chapter 6 of the main document, in some cases, local airport land use compatibility regulations may lead to property takings claims. Although most case law concludes that so long as a reasonable economic use of the property remains, restrictions based on airport land use compatibility is an appropriate exercise of the police power and not a taking. In limited contravening instances, a few courts have found airport land use compatibility zoning to result in a taking and have awarded compensation to property owners. Inclusion of the following additional severability clause can protect a local government agency from potential liabilities.*

In any case in which the provisions of this Ordinance, although generally reasonable, is held by a court to interfere with the use or enjoyment of a particular structure or parcel of land to such an extent, or to be so onerous in their application to such a structure or parcel of land, as to constitute a taking or deprivation of that property in violation of the constitution of this state or the constitution of the United States, such holding shall not affect the application of this Ordinance as to other structures and parcels of land, and to this end, the provisions of this Ordinance are declared to be severable.

SECTION 21: DEFINITIONS

COMMENTARY: This Section establishes definitions for terms and words used in the Ordinance. The list draws primarily from the FAA's definitions of terms as used in advisory circulars and other published materials. Use of these definitions in whole or part is at the discretion of the local community as an ordinance is developed. Additional definitions may need to be included to accurately define text contained in the local ordinance. If airport land use compatibility regulations are incorporated into an existing zoning ordinance, the definitions should be integrated into the general definitions section of the zoning ordinance.

As used in this Ordinance, the meaning of each term defined in this Section 21 shall be as indicated below, unless the context otherwise requires:

A. Agricultural and Resource Extraction Uses.
A use category that includes the following land uses:

(1) Any land used primarily for the production of crops or livestock including irrigated meadows, irrigated and dry pasture, irrigation ditches, stock drive routes, lands used for barns, corrals and storage of crops or agricultural products, but not including lands used primarily for the production of commercial timber; or

(2) Land uses involved in the process of (1) removing or extracting minerals and building stone from naturally occurring veins, deposits, bodies, beds, streams, fields, pools or other concentrations in the earth's crust, including the preliminary treatment of such ore or building stone; and (2) the extraction, exploration or production of oil or natural gas resources, including oil and gas wells and accessory offices, storage buildings, rig camps and gas transmission lines.

B. Airport. *(FAA FAR Sec. 152.3)*
Defined as an area of land or water that is used, or intended to be used, for the landing and taking off of aircraft. Any appurtenant areas that are used, or intended for use, for airport buildings, other airport facilities, or rights-of-way; and all airport buildings and facilities located on the areas specified in this definition. The ____________________ Airport owned by the ____________________ (City/County).

C. Airport Environs.
The land use and people in the areas surrounding an airport which can be directly affected by the operation of the airport.

D. Airport Hazard. *(FAA FAR Sec. 152.3)*
Any structure or object of natural growth located on or in the vicinity of a public airport, or any use of land near a public airport that obstruct the airspace required for the flight of aircraft landing or talking off at the airport or is otherwise hazardous to aircraft landing or taking off at the airport.

E. Airport Land Use Compatibility. *(FAA Web site)*
The coexistence of land uses surrounding the airport with airport-related activities.

F. Airport Land Use Compatibility Zones.
A zone intended to place additional land use conditions on land impacted by the airport while retaining the existing underlying zone. The specific zones create a comprehensive area focused on maintaining compatible land use around airports. Refer to Section 7 for dimensions and diagrams of these zones.

- **Zone A -** is intended to provide a clear area that is free of above-ground obstructions and structures. This zone is closest to the individual runway ends. Land uses are more limited in this zone than in Zones B1, B2, and C.
- **Zone B1/B2 -** extends out from Zone A beneath the inner approach and departure areas for each runway at an airport. The size of Zone B1 and B2 is predicated upon the type of approach (visual, non-precision, or precision) that a specific runway has and the type/size of aircraft utilizing the runway and the method in which the local community splits the surface to accommodate an inner and outer area.
- **Zone C -** is the FAR Part 77 horizontal surface, which typically extends around the airport in an elliptical shape depending upon the runway types and configurations at an individual airport.

G. Airport Noise Zones.
The [*Insert Name(s) of Zones*] as established in Section 8 of this Ordinance.

H. Airport Zoning Permit.

Airport zoning permit allowing new development or alteration or expansion of a nonconforming use within an airport land use compatibility zone.

I. Airspace. *(FAA Web site)*

The space lying above the earth or above a certain area of land or water that is necessary to conduct aviation operations.

J. Avigation Easement. *(FAA Web site)*

A grant of a property interest in land over which a right of unobstructed flight in the airspace is established.

K. Commercial Uses.

A use category including land uses or activities involving the production, processing, manufacturing, or sale of goods or services for financial gain, including uses that provide business, personal, medical/personal care, or repair service, or that involve the selling, leasing, or renting of merchandise to the general public. Accessory uses may include offices, storage, food service, or other amenities primarily for the use of employees and parking for employees and visitors.

L. Compatibility.

The degree to which land uses or types of development can coexist or integrate.

M. Conditionally Compatible Use.

A land use or development as identified by this Ordinance that generally would not be compatible with airport operations, but which a decision-making body may allow with appropriate restrictions and based on findings that the restrictions will either ensure greater compatibility with near-by airport operations or substantially mitigate potential adverse impacts associated with proximity to the airport.

N. Compatible Use.

Any structure, tree, object of natural growth, or use of land that complies with all the applicable provisions of this Ordinance or any amendment to this Ordinance.

O. Day-Night Average Sound Level (DNL).

A 365-day averaged, day-night average sound level measurement expressed in decibels. DNL is the metric designated to define airport noise impact for Noise Programs conducted under the provisions of FAR Part 150.

P. Easement. *(FAA AC 5020-1)*

The legal right of one party to use a portion of the total rights in real estate owned by another party. This may include the right of passage over, on, or below property; certain air rights above the property, including view rights; and the rights to any specified form of development or activity, as well as any other legal rights in the property that may be specified in the easement document.

Q. FAR Part 77. *(FAA FAR Sec. 77.1)*

A regulation established by the Federal Aviation Administration entitled, in full, “Objects Affecting Navigable Airspace - Part 77” which (a) establishes standards for determining obstructions in navigable airspace; (b) defines the requirements for notice to the FAA Administrator of certain proposed construction or alteration; (c) provides for aeronautical studies of obstructions to air navigation to determine their effect on the safe and efficient use of airspace; (d) provides for public hearings on the hazardous effect of proposed construction or alteration on air navigation; and (e) provides for establishing antenna farm areas.

R. General Aviation Airport.

Any airport that is not a commercial air carrier airport or a military facility.

S. Height.

For the purpose of determining the height limits in all zones set forth in this Ordinance and shown on the Official Zoning Map, height shall be measured as the highest point of a structure, tree, or other object of natural growth, measured from the mean sea level elevation unless otherwise specified.

T. Industrial, Wholesale Trade, and Storage Uses.

A use category including the following use types:

1. Industrial development or uses involved in the research, design, manufacturing, processing, fabrication, packaging, or assembly of goods. Natural, man-made, raw, secondary, or partially completed materials may be used. Products may be finished or semi-finished and are generally made for the wholesale market, for transfer to other plants, or to order for firms or consumers. Goods are generally not displayed or sold on site, but if so, they are a subordinate part of sales (typically ten percent or less of the total gross floor area). Relatively few customers come to the site.
2. Industrial, manufacturing, wholesale trade, and warehouse/storage uses including uses that produce goods from raw or finished materials, uses that distribute goods in large quantities to primarily wholesale customers, or provide for storage or warehousing of goods, either in enclosed buildings or outdoors. Few customers, especially the general public, come to the site. Accessory activities may include sales, offices, parking, and storage.

U. Imaginary Surfaces. *(FAA FAR Part 77.25)*
Those areas established in relation to the airport and to each runway consistent with FAR Part 77, in which any object extending above these imaginary surfaces, by definition, is an obstruction.

- **Transitional surface**
  The transitional surface extends outward and upward at right angles to the runway centerline and extends at a slope of seven feet horizontally for each one foot vertically (7:1) from the sides of the primary and approach surfaces. The transitional surfaces extend to the point at which they intercept the horizontal surface at a height of 150 feet above the established airport elevation.
- **Horizontal surface**
  The horizontal surface is a horizontal plane located 150 feet above the established airport elevation and encompasses an area from the transitional surface to the conical surface. The perimeter is constructed by generating arcs from the center of each end of the primary surface and connecting the adjacent arcs by lines tangent to those arcs.
- **Conical surface**
  The conical surface extends upward and outward from the periphery of the horizontal surface at a slope of 20 feet horizontally for every one foot vertically (20:1) for a horizontal distance of 4,000 feet.
- **Approach surface**
  The approach surface is longitudinally centered on the extended runway centerline and extends outward and upward from the end of the runway primary surface. The approach slope of a runway is a ratio of 20:1, 34:1, or 50:1, depending on the approach type. The length of the approach surface varies from 5,000 to 50,000 feet and also depends upon the approach type.

V. Incompatible Land Use. *(FAA FAR Sec. 150.7)*

The use of land which is normally incompatible with the aircraft and airport operations (such as, but not limited to, homes, schools, nursing homes, hospitals, and libraries).

W. Lighting and Marking of Hazards to Air Navigation.

Installation of appropriate lighting fixtures, painted markings, or other devices to such objects or structures that constitute hazards to air navigation.

X. Noise Exposure Contour. *(FAA Web site)*

Lines drawn around a noise source indicating constant energy levels of noise exposure. DNL is the measure used to describe community exposure to noise.

Y. Noise Impact.

A condition that exists when the noise levels that occur in an area exceed a level identified as appropriate for the activities in that area.

Z. Noise Sensitive Land Use.

A use where airport noise typically interferes with normal activities associated with the use. Examples of noise-sensitive land uses include residential, educational, health, and religious structures and sites, and parks, recreational areas (including areas with wilderness characteristics), wildlife refuges, and cultural and historical sites where a quiet setting is a generally recognized feature or attribute.

AA. Noise Reduction (NR) or Noise Level Reduction (NLR).

Reduction in sound level transmission between locations or rooms for the expressed purpose of lessening or mitigating the impact of noise in one of the locations. The term Sound Level Reduction (SLR) can imply the same function.

BB. Non-Conforming Use.

Any pre-existing structure, tree, or use of land that is inconsistent with the provisions of this Ordinance.

CC. Object. *(FAA AC 150/5300-13)*

Includes, but is not limited to above ground structures, people, equipment, vehicles, natural growth, terrain, and parked aircraft.

DD. Obstruction. *(FAA AC 150/5190-4A)*

Any structure, tree, plant growth, or other object, including a mobile object, that exceeds a limiting height, specific to its geographic location relative to the runway/airport.

EE. Overlay Zone. *(FAA Web site)*

A mapped zoning district that imposes a set of requirements in addition to those of the underlying zoning district.

FF. Part 150 Study. *(FAA Web site)*

Part 150 is the abbreviated name for the airport noise compatibility planning process outlined in Part 150 of the Federal Aviation Regulation (FAR) that allows airport owners to voluntarily submit noise exposure maps and noise compatibility programs to the FAA for review and approval. See "Noise Compatibility Plan."

GG. Performance Standard.

A zoning standard that permits land uses based on the use’s compliance with a particular set of standards of operation, rather than based on the particular type of use at issue. Performance standards in this Ordinance provide specific criteria limiting glare, dust, smoke emissions, heat, fire, or explosion hazards associated with any use of land subject to this Ordinance. Performance standards are imposed on uses in addition to other general zoning regulations such as specific use restrictions or density/intensity limits.

HH. Person.

An individual, firm, partnership, corporation, company, association, joint stock association, or body politic, and including a trustee, receiver, assignee, administrator, executor, guardian, or other representative.

II. Planned Development.

As used in this Ordinance, refers only to those proposed future airport developments that are so indicated on a planning document having the approval of the Federal Aviation Administration, and ____________________ *[Insert name of municipality owning the airport]*.

JJ. Practical Difficulty or Unnecessary Hardship.

The property in question cannot be put to a reasonable use if used under conditions allowed by this Ordinance, and the plight of the landowner is due to circumstances unique to the property not created by the landowner, and the variance, if granted, will not be contrary to the purpose and intent of this Ordinance. Economic considerations alone shall not constitute a “practical difficulty or unnecessary hardship” if reasonable use for the property exists under the terms of this Ordinance.

KK. Instrument Runway.

A runway with an instrument approach procedure utilizing an Instrument Landing System (ILS), a Microwave Landing System (MLS), a Precision Approach Radar (PAR), a Transponder Landing System (TLS), or a satellite-based system capable of operating to the same level of precision guidance provided by the other indicated systems.

LL. Primary Surface. *(FAA AC 150/5190-4A)*

A surface longitudinally centered on a runway. When the runway has a specially prepared hard surface, the primary surface extends 200 feet beyond each end of that runway; for military runways or when the runway has no specially prepared hard surface, or planned hard surface, the primary surface ends at each end of that runway. The width of the primary surface is set forth in FAR Part 77. The elevation of any point on the primary surface is the same as the elevation of the nearest point on the runway centerline.

MM. Primary Runway. *(FAA AC 150/5325-4B General Definition)*

The runway used for the majority of airport operations. Large, high-activity airports may operate two or more parallel primary runways.

NN. Public Assembly Use.

Means a structure or outdoor facility where concentrations of people gather for purposes such as deliberation, education, shopping, business, entertainment, amusement, sporting events, or similar activities, but excluding air shows. "Public assembly use" does not include places where people congregate for relatively short periods of time, such as parking lots and bus stops, or uses approved by the FAA in an adopted airport master plan.

OO. Public Use Airport. *(FAA AC 150/5190-6)*

Means either a publicly owned airport or a privately owned airport open for public use.

PP. Public, Civic, and Institutional Uses.

A use category that includes uses of a public, quasi-public, nonprofit, or charitable nature generally providing a local service to the people of the community. Generally, they provide the service on-site or have employees at the site on a regular basis. The service is ongoing, not just for special events. This use category includes the following use types:

1. Community centers or facilities that have membership provisions or are open to the general public to join at any time (for instance, any senior citizen could join a senior center).
2. Public assembly uses, such as private lodges, museums, libraries, clubs or halls, educational institutions, and religious assembly uses are also included in this category.
3. Facilities for the provision of public services, including governmental offices and public safety and emergency response services, such as police, fire and ambulance services. Such facilities often need to be located in or near the area the service is provided.

QQ. Refuse Hauling Facility.

A place where refuse is taken from a collection vehicle, temporarily stored or stockpiled, and ultimately moved to a disposal facility.

RR. Residential and Accommodation Uses.

A use category that includes the following use types:

1. <u>Residential uses</u> that provide living accommodations, including sleeping, eating, cooking, and sanitary facilities, to one or more persons, and where tenancies typically last longer than 30 days.
2. <u>Accommodation uses</u> characterized by visitor-serving facilities that provide temporary lodging in guest rooms or guest units, for compensation, and with an average length of stay of less than 30 days. Accessory uses may include pools and other recreational facilities for the exclusive use of guests, limited storage, restaurants, bars, meeting facilities, and offices.

SS. Runway.

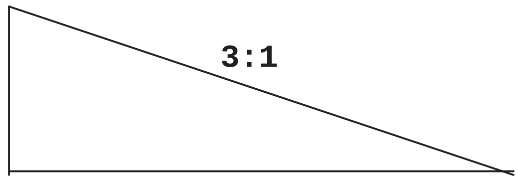
Any existing or planned paved surface or turf covered area of the airport which is specifically designated and used or planned to be used for the landing and/or taking off of aircraft.

TT. Runway Protection Zone (RPZ). *(FAA AC 150/5300-13)*

An area off the runway end designed to enhance the protection of people and property on the ground. Consistent with Zone A in this Ordinance.

UU. Slope.

An incline from the horizontal expressed in an arithmetic ratio of horizontal magnitude to vertical magnitude.



For example: Slope = 3:1, which is the same as three feet horizontal to one foot vertical.

VV. Sound Level.

The quantity in decibels measured by an instrument satisfying the requirements of American Standard Specification for Type I Sound Level Meters. The sound level shall be the frequency weighted sound pressure level obtained with the frequency weighting "A" and the standardized dynamic characteristic "SLOW".

WW. Special-purpose Airport.
A public airport, as defined in this Section 21, intended for use by aircraft issued an FAA special airworthiness certificate in the light sport category.

XX. Structure.

An object anchored, constructed, attached, erected, gathered, located, placed, piled, or installed by man, either on the ground or in or over a body of water, either moveable or immovable, and either temporary or permanent. The term “structure” includes, but is not limited to, antennae, buildings, cranes, fences, overhead transmission lines, patios and decks, man-made ponds, signs and sign structures, smokestacks, towers, utility poles, wires, and anything attached to any of the foregoing either temporarily or permanently.

YY. Substantially Alter or Altered.

An addition to the footprint of a building or structure, or an addition to the existing maximum height of a building or structure, or a change in use of land, building, or structure.

ZZ. Transportation, Parking & Utility Uses.

A use category that includes the following use types:

1. Mass transit, which means a coordinated system of one or more transit modes providing regular transportation to the general public including, but not limited to, bus or rapid transit but not including charter bus, school bus, or sightseeing transportation.
2. Public utility uses engaged in providing railroad, airline, bus, electric, rural electric, telephone, telegraph, communications, gas, gas pipeline carrier, water, sewerage, pipeline, street transportation, sleeping car, express, or private car line facilities and services.
3. Transportation and parking service uses including a variety of facilities generally open to the public, related to the movement of passengers and goods, whether by private auto or public transportation.

AAA. Variance.
Any modification or variation of this Ordinance’s provisions where it is determined that, by reason of exceptional circumstances, the strict enforcement of the Ordinance provision(s) would cause “practical difficulty or unnecessary hardship,” as defined in this Section 21.

BBB. Vehicle Parking Associated with the Airport.

The temporary storage of motor vehicles inside or outside of a structure, including parking lots, garages, driveways, and legally designated areas of public streets. “Associated with,” for the purposes of this definition, means that a minimum of 75 percent of the available parking shall serve airport employees, patrons, or automobile rental or leasing agencies.

CCC. Vehicle Parking, Accessory.

A non-commercial parking lot or structure that is incidental and subordinate to an allowed primary use, and is intended to serve employees and patrons of the primary use.

DDD. Vehicle Parking, Primary.

A parking lot or structure that is the primary use of the property on which it is located, and may be commercial in nature. The use does not include parking for an automobile rental or leasing agency use.

EEE. Water Impoundment.

Areas constructed or intended to contain water such as wastewater treatment settling ponds, surface mining ponds, detention and retention ponds, artificial lakes and ponds, and similar water features. A new water impoundment includes an expansion of an existing water impoundment except where such expansion was previously authorized by land use action approved prior to the effective date of this Ordinance.

FFF. Wildlife Attractants.

Any human-made structure, land-use practice, or human-made or natural geographic that can attract or sustain hazardous wildlife within the landing or departure airspace or the airport's air operations area. These attractants include, but are not limited to, architectural features, landscaping, waste disposal sites, wastewater treatment facilities, agricultural or aquaculture activities, surface mining, or wetlands. Naturally occurring features such as open bodies of water, wetlands or forested areas may also be defined as wildlife attractants which can attract or sustain hazardous wildlife within the landing or departure airspace or the airport's air operations area.

GGG. Wildlife Hazards. (FAA Advisory Circular 150/5200-33A)

Species of wildlife (birds, mammals, reptiles, etc.), including feral animals and domesticated animals, that are associated with aircraft strike problems, are capable of causing structural damage to airport facilities, or act as attractants to other wildlife that pose a strike hazard.

HHH. Zoning Administrator.

The public official in each affected local government as set forth in Section 11 of this Ordinance.

SECTION 22: EFFECTIVE DATE

COMMENTARY: This Section establishes the date of adoption and certification of the appropriate governing body.

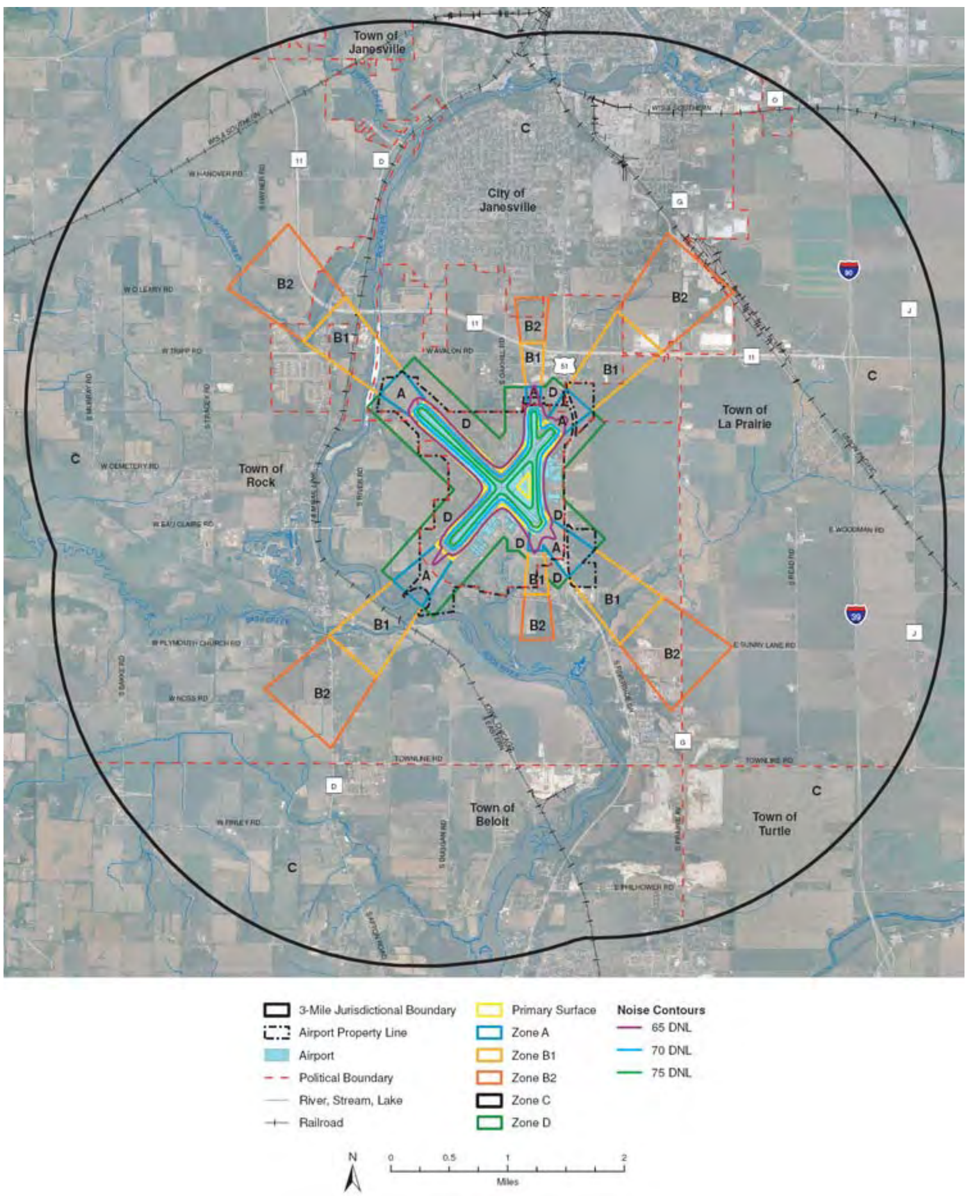
This ordinance shall take effect on the ___________ day of ____________________________, 20_____. Copies thereof shall be filed with [*As applicable: state and local agencies* ___________________.]

Passed and adopted after public hearing by the [*As applicable:* ______________ *Board of County Commissioners/City Council of* ___________________] this __________ day of ___________________________, 20_____.

EXHIBITS TO MODEL ORDINANCE

Airport Land Use & Height Overlay Zoning Map

[*This exhibit provides the Official Airport Land Use & Height Overlay Zoning Maps to be kept on file with the appropriate governmental entities. The maps must be amended when changes occur within the jurisdictional boundaries of the maps. The maps must be prepared and adopted concurrently with the Ordinance.]*



APPENDIX A: AIRPORT NOISE COMPATIBLE LAND USE ZONES CHART

Source: Florida Transportation Department, Office of Aviation. "Airport Land Use Compatibility Guidance for Florida Communities." 1999.

NOTE: This table has been modified from the original to (1) eliminate letter references to Florida zones to avoid confusion with the zones and names in the model ordinance, and (2) to remove columns devoted to Florida's "Overflight Zones," as this example is included for the purpose of demonstrating an approach to airport noise zones only.

CHART KEY

Y(Yes) Land use is normally compatible without restriction and should be allowed.

C(1...n) Land use is generally compatible with some limitations or restrictions. The use should be allowed if Condition Note (1...n) is met,

I(1...n) Land use is basically incompatible and should be discouraged. Where there is a demonstrated community need for the use and viable alternative options are not possible, the use may be allowed if Condition Note(1...n) is met. Condition Note(1...n) will not eliminate or alter the basis of the incompatibility but is intended to lessen or mitigate the potential for impact on the land use function, activity, or occupants.

N (No) Use is not compatible and should not be permitted.

* Federal guidelines in 14 CFR Part 150 considers all land uses below the 65 DNL contour to be compatible. This should not be taken to imply that residents, occupants or users in lesser contour areas will not be adversely affected by airport generated noise. Where practical and feasible, communities should consider limiting future noise-sensitive development in airport noise exposures below 65 DNL.

** Residential uses and noise sensitive activities are not compatible in impacted areas exceeding 80 DNL.

LAND USE AND ACTIVITIES	LAND USE COMPATIBILITY AIRPORT NOISE IMPACTED ZONES				
	* 55-65 DNL	C 65-70 DNL	B 70-75 DNL	A 75-80 DNL	** 80+ DNL
RESIDENTIAL DEVELOPMENT					
Single Units; Row, Semi- & Detached	Y	I1	I2	N	N
Duplexes	Y	I1	I2	N	N
Multi-Family Units	Y	I1	I2	N	N
Residential Hotels & Motels	Y	I1	I2	N	N
Transient Lodgings	Y	I1	I2	I3	N
Mobile Home Parks & Courts	Y	N	N	N	N
Recreational Vehicle (RV) Parks	Y	N	N	N	N
Other Residential	Y	I1	I2	N	N

LAND USE AND ACTIVITIES	LAND USE COMPATIBILITY AIRPORT NOISE IMPACTED ZONES * 55-65 DNL	C 65-70 DNL	B 70-75 DNL	A 75-80 DNL	** 80+ DNL
RELIGIOUS; CULTURAL; RECREATIONAL OUTDOOR ACTIVITIES					
Religious Services & Assemblies	Y	N	N	N	N
Entertainment Assemblies	Y	N	N	N	N
Sports Event Assemblies	Y	C4	I4	N	N
Sports Arenas, Courts, Fields & Tracks	Y	C4	C4	I4	N
Circuses & Carnivals	Y	C4	I4	N	N
Amusement & Theme Parks	Y	C4	I4	N	N
Playgrounds & Neighborhood Parks	Y	C6	C6	I6	N
Community & Regional Parks	Y	I6	I6	N	N
INDOOR ACTIVITIES					
Churches, Mosques, Synagogues & Temples	Y	I2	I3	N	N
Theaters & Auditoriums	Y	I 2,4	I 3,4	N	N
Stadiums & Arenas	Y	C 1,4	I 2,4	I 3,4	N
Gymnasiums & Natatoriums	Y	C1	I2	I 3,4	N
SERVICES					
Hospitals & Nursing Homes	Y	I2	N	N	N
Other Medical Facilities	Y	I2	N	N	N
Day Care Facilities	Y	I2	N	N	N
Educational Facilities	Y	I2	N	N	N
Governmental Services	Y	C1	C2	I3	N
Correctional Institutions	Y	C1	I2	N	N
Cemeteries	Y	C1	C2	C3	C 6,7
Professional, Financial & Insurance	Y	C1	C2	I3	N
Business & Real Estate	Y	C1	C2	I3	N
Repairs and Contract Construction	Y	C1	C2	I3	N
Personal & Miscellaneous	Y	C1	C2	I3	N
TRANSPORTATION; COMMUNICATION; UTILITIES					
Passenger Facilities	Y	C1	C2	C3	N
Cargo-Freight Facilities	Y	Y	C2	C3	C 6,7
Road, Rail, and Water Transit Ways	Y	Y	C2	C3	C 6,7
Vehicle Parking	Y	Y	C2	C3	C 6,7
Vehicle Storage	Y	Y	C2	C3	C 6,7
Tele Communications	Y	C1	C2	I3	C 6,7
Broadcast Communications	Y	C1	C2	I3	N
Electric Generating Plants	Y	Y	C1	C2	C 6,7
Sewer-Waste Water Treatment	Y	Y	C1	C2	C 6,7
Gas Utility Facilities	Y	Y	C1	C2	C 6,7
Electric Utility Facilities	Y	Y	C1	C2	C 6,7
RETAIL TRADE					
Building Materials & Hardware	Y	Y	C1	C2	I 3,7
Automotive, Farm & Marine Craft	Y	C1	C2	C3	N

LAND USE AND ACTIVITIES	LAND USE COMPATIBILITY AIRPORT NOISE IMPACTED ZONES				
	* 55-65 DNL	C 65-70 DNL	B 70-75 DNL	A 75-80 DNL	** 80+ DNL
Apparel & General Merchandise	Y	C1	C2	C3	N
Groceries & Food Stuff	Y	C1	C2	C3	N
Eating & Drinking Establishments	Y	C1	C2	C3	N
Shopping Malls & Centers	Y	C1	C2	C3	N
Gasoline, Diesel & Heating Oil	Y	Y	C1	C2	I 3,7
Liquefied & Bottled Gas	Y	Y	C1	C2	I 3,7
WHOLESALE TRADE					
Home Furnishings & Building Materials	Y	Y	C1	C2	C 3,7
Food Products & General Merchandise	Y	Y	C1	C2	C 3,7
Liquefied Gasses	Y	Y	C1	C2	C 3,7
Petroleum & Distillate Products	Y	Y	C1	C2	C 3,7
Industrial Chemicals	Y	Y	C1	C2	C 3,7
Explosive & Pyrotechnic Products	Y	Y	C1	C2	C 3,7
Other Wholesale Trade	Y	Y	C1	C2	C 3,7
MANUFACTURING					
Food Products & Processing	Y	Y	C1	C2	I 3,7
Textiles & Apparel	Y	Y	C1	C2	I 3,7
Lumber & Wood Products	Y	Y	C1	C2	I 3,7
Paper & Allied Products	Y	Y	C1	C2	I 3,7
Chemicals & Allied Products	Y	Y	C1	C2	I 3,7
Petroleum Refining & Related Products	Y	Y	C1	C2	I 3,7
Explosive & Pyrotechnic Products	Y	Y	C1	C2	I 3,7
Rubber & Plastics Products	Y	Y	C1	C2	I 3,7
Clay & Glass Products	Y	Y	C1	C2	I 3,7
Primary & Fabricated Metal Products	Y	Y	C1	C2	I 3,7
Electronic & Optic Products	Y	C1	C2	I3	N
Professional & Scientific Products	Y	C1	C2	I3	N
Other Manufacturing	Y	C1	C2	C3	N
RESOURCE PRODUCTION & RECOVERY					
Livestock & Poultry Farming	Y	C 2,5	I 3,5	I5	N
Animal & Poultry Breeding	Y	I 2,5	I 3,5	N	N
Crop & Related Agricultural Production	Y	C 1,5	C 2,5	C 3,5	I 6,7
RESOURCE PRODUCTION & EXTRACTION					
Fishing & Aquaculture Activities	Y	C 1,5	C 2,5	C 3,5	C 6,7
Forestry & Timber Production	Y	C 1,5	C 2,5	C 3,5	C 6,7
Oil & Natural Gas Wells	Y	Y	C2	C3	C 6,7
Strip & Open Pit Mining	Y	Y	C2	C3	C 6,7
Stone & Mineral Quarries	Y	Y	C2	C3	C 6,7
Other Mining & Resource Recovery	Y	Y	C2	C3	C 6,7

CHART KEY

Y(Yes) Land use is normally compatible without restriction and should be allowed.

C(1...n) Land use is generally compatible with some limitations or restrictions. The use should be allowed if Condition Note (1...n) is met,

I(1...n) Land use is basically incompatible and should be discouraged. Where there is a demonstrated community need for the use and viable alternative options are not possible, the use may be allowed if Condition Note(1...n) is met. Condition Note(1...n) will not eliminate or alter the basis of the incompatibility but is intended to lessen or mitigate the potential for impact on the land use function, activity, or occupants.

N (No) Use is not compatible and should not be permitted.

* Federal guidelines in 14 CFR Part 150 considers all land uses below the 65 DNL contour to be compatible. This should not be taken to imply that residents, occupants, or users in lesser contour areas will not be adversely affected by airport generated noise. Where practical and feasible, communities should limit future residential development in airport noise impacted zones below the 65 DNL contour.

** Residential uses and noise sensitive activities are not compatible in impacted areas exceeding 80 DNL.

CONDITION NOTES

1: Measures to achieve NLR of 25dB must be included in the design and construction of structures where occupants reside; the public is received; office areas are located; or noise sensitive activities or functions occur.

2: Measures to achieve NLR of 30dB must be included in the design and construction of structures where occupants reside; the public is received; office areas are located; or noise sensitive activities or functions occur.

3: Measures to achieve NLR of 35dB must be included in the design and construction of structures where occupants reside; the public is received; office areas are located; or noise sensitive activities or functions occur.

4: Sound reinforcement or amplification systems must be installed.

5: Residential structures are not permitted.

6: Occupied structures are not permitted.

7: Individual hearing protection devices must be worn where structural or other forms of physical noise attenuation are not available.

APPENDIX D

Sample Easements

E-1 Avigation Easement (Property located outside Runway Protection Zone (RPZ))
E-2 Avigation Easement (Property located inside Runway Protection Zone (RPZ))
E-3 Noise Easement

E-1 AVIGATION EASEMENT (Property located outside Runway Protection Zone (RPZ))

COMMENTARY: The suggested avigation easements in Appendix D are written to apply to any level of aircraft operations, type of aircraft, or future flight patterns. As an option, the avigation easements could be drafted to apply to a specific planning document (e.g., a noise exposure map for a Part 150 Study) or current flight or noise levels associated with the airport in question.

THIS INDENTURE is made this ________ day of ________________, 20 ____ between _____________________, whose address is ______________________________, ____________________, *[Insert State]* ("GRANTOR");
and ____, whose address is ___________________________________, _____________________, *[Insert State]* ("GRANTEE").

WHEREAS, the GRANTEE is the owner and operator of the __________________________ *[Insert name of airport]* Airport ("AIRPORT"), situated in ________________ County, *[Insert State]*, and in close proximity to the GRANTOR's property, as described below, and the GRANTEE desires to obtain and preserve for the use and benefit of the public a right of free and unobstructed flight for aircraft landing upon, taking off from, or maneuvering about the AIRPORT.

NOW THEREFORE, for and in consideration of the sum of $__________________________ dollars ($_______________) and other good and valuable consideration, the receipt and sufficiency of which is acknowledged, the GRANTOR grants, bargains, sells and conveys to the GRANTEE, its successors and assigns, for the benefit of the general public at large, an easement and right-of-way for the free, unobstructed passage of aircraft, by whomsoever owned or operated, in and through the air space over and across those parts of the GRANTOR's land containing ______________
acres of land within the boundary described as follows:

(See Property Description)

provided, however, that the air space in which that easement and right-of-way is granted shall be that which lies above the heights described and depicted on the attached Exhibit X, which is incorporated by reference.

The GRANTEE and its successors and assigns are to have and to hold that easement and all rights appertaining to it until the AIRPORT is abandoned and no longer used for airport purposes.

In furtherance of this easement and right-of-way, the GRANTOR, for the consideration recited above, grants and conveys to the GRANTEE, its successors and assigns:

(a) a continuing right to keep the air space above the heights described and depicted on Exhibit X clear and free from any and all fences, crops, trees, poles, buildings, and other obstructions of any kind or nature which now extend, or which may at any time in the future extend, above those heights;

(b) a continuing right, at the GRANTEE's option, to remove to ground level any or all natural growths which extend on the above property above the heights described and depicted on the attached Exhibit X to extent such action is needed. The GRANTEE may determine such action is needed because the GRANTEE in the GRANTEE'S sole discretion finds (i) trimming is unsafe or not reasonably possible, (ii) the species of the tree or other natural growth is too fast growing, or (iii) trimming would have a reasonable probability of killing the tree or other natural growth or causing it to be too susceptible to disease;

(c) The GRANTEE shall have the right of ingress to, egress from, and passage over the GRANTOR's land described above for the purpose of removing obstructions. Except in cases of imminent danger to health, safety, or welfare, the GRANTEE shall provide the property owner at least 20 days advance written notice of its use of this right.

In addition, for the consideration recited above, the GRANTOR covenants, both on the GRANTOR's own behalf and on behalf of the GRANTOR's heirs, executors, administrators and assigns, for and during the life of this easement, as follows:

(1) The GRANTOR shall not construct nor permit nor suffer to remain upon the GRANTOR's land any present or future obstruction that extends above the heights described and depicted on the attached Exhibit X. Provided, however, that any removal or trimming of trees or other natural growth on the GRANTOR's land as described above which extends above the heights set forth in the Exhibit X shall be conducted by the GRANTEE or the GRANTEE's agents and at no cost to the GRANTOR.

(2) The GRANTOR shall not use nor permit nor suffer use of the GRANTOR's land described above in such a manner as to create electrical interference with radio communication between the installation upon the AIRPORT and aircraft or as to make it difficult for fliers to distinguish between airport lights and others, or as to result in glare in the eyes of fliers using the AIRPORT, or as to impair visibility in the vicinity of the AIRPORT, or as otherwise to endanger the landing, taking-off or maneuvering of aircraft; and

(3) There is reserved to the GRANTEE, its successors and assigns for the use and the right to cause in said air space such noise, vibration, fumes, dust, and fuel particulates, as may be inherent in the operation of aircraft, now known or hereafter used for navigation of or flight in air, using said air space for landing at, taking off from, or operating on the AIRPORT;

(4) The GRANTOR shall not use nor permit, nor suffer use of the GRANTOR's land described above for land fills, open dumps, waste disposal sites, etc., storm water retention ponds, creation of new wetlands, crops that would attract or sustain hazard bird movements, or any use that would be incompatible with the maintenance and operation of the AIRPORT.

These covenants shall run with the GRANTOR's land described above, for the benefit of the GRANTEE and its successors and assigns in the ownership and operation of the AIRPORT.

SIGNED THIS _______ DAY OF ___________________, 20__:

PRINTED NAME	**SIGNATURE**
____________________________________	____________________________________(L.S.)
____________________________________	____________________________________(L.S.)

STATE OF ________ *[Insert State]* }
COUNTY OF ______________________________________} ss.

On this _______________ day of _______________________, 20 ____, before me, a Notary Public, in and for said County, personally appeared ____to me known to be the same person(s) described in, and who executed the within instrument, who acknowledged the same to be __________ free act and deed.

____

Notary Public, ________________ County, *[Insert State]*

My Commission Expires: _______________

Parcel No.: ____
Name: ____
Project No.: ____

Property Tax Code:	**Parcel No.:**

PROPERTY DESCRIPTION:

Insert EXHIBIT X Avigation Easement (outside RPZ) here

E-2 AVIGATION EASEMENT (Property located inside Runway Protection Zone (RPZ))

THIS INDENTURE is made this ________ day of ________________, 20 ____ between _____________________, whose address is ______________________________, ____________________, __*[Insert State]*___ ("GRANTOR");
and
____, whose address is ___________________________________, ____________________, ___*[Insert State]*___ ("GRANTEE").

WHEREAS, the GRANTEE is the owner and operator of the _____*[Insert name of airport____]* Airport ("AIRPORT"), situated in ____________ County, __*[Insert State__]*, and in close proximity to the GRANTOR's property, as described below, and the GRANTEE desires to obtain and preserve for the use and benefit of the public a right of free and unobstructed flight for aircraft landing upon, taking off from, or maneuvering about the AIRPORT.

NOW THEREFORE, for and in consideration of the sum of $_________________________ dollars ($______________) and other good and valuable consideration, the receipt and sufficiency of which is acknowledged, the GRANTOR grants, bargains, sells and conveys to the GRANTEE, its successors and assigns, for the benefit of the general public at large, an easement and right-of-way for the free, unobstructed passage of aircraft, by whomsoever owned or operated, in and through the air space over and across those parts of the GRANTOR's land containing ______________
acres of land within the boundary described as follows:

(See Property Description)

provided, however, that the air space in which that easement and right-of-way is granted shall be that which lies above the heights described and depicted on the attached Exhibit X, which is incorporated by reference.

The GRANTEE and its successors and assigns are to have and to hold that easement and all rights appertaining to it until the AIRPORT is abandoned and no longer used for airport purposes.

In furtherance of this easement and right-of-way, the GRANTOR, for the consideration recited above, grants and conveys to the GRANTEE, its successors and assigns:

(a) a continuing right to keep the air space above the heights described and depicted on Exhibit X clear and free from any and all fences, crops, trees, poles, buildings, and other obstructions of any kind or nature which now extend, or which may at any time in the future extend, above those heights;

(b) a continuing right, at the GRANTEE's option, to remove to ground level any or all natural growths which extend on the above property above the heights described and depicted on the attached Exhibit X to extent such action is needed. The GRANTEE may determine such action is needed because the GRANTEE in the GRANTEE'S sole discretion finds (i) trimming is unsafe or not reasonably possible, (ii) the species of the tree or other natural growth is too fast growing, or (iii) trimming would have a reasonable probability of killing the tree or other natural growth or causing it to be too susceptible to disease;

(c) The GRANTEE shall have the right of ingress to, egress from, and passage over the GRANTOR's land described above for the purpose of removing obstructions. Except in cases of imminent danger to health, safety or welfare, the GRANTEE shall provide the property owner at least 20 days advance written notice of its use of this right.

In addition, for the consideration recited above, the GRANTOR covenants, both on the GRANTOR's own behalf and on behalf of the GRANTOR's heirs, executors, administrators and assigns, for and during the life of this easement, as follows:

(1) The GRANTOR shall not construct nor permit nor suffer to remain upon the GRANTOR's land any present or future obstruction that extends above the heights described and depicted on the attached Exhibit X. Provided, however, that any removal or trimming of trees or other natural growth on the GRANTOR's land as described above which extends above the heights set forth in the Exhibit X shall be conducted by the GRANTEE or the GRANTEE's agents and at no cost to the GRANTOR. This easement prohibits any ground structures, natural growth, storage of equipment, vehicles or aircraft, flammable material storage facilities, or activities which encourage the congregation of people or create an incompatible use in the Runway Protection Zone as referenced in paragraph (5) of this easement.

(2) The GRANTOR shall not use nor permit nor suffer use of the GRANTOR's land described above in such a manner as to create electrical interference with radio communication between the installation upon the AIRPORT and aircraft or as to make it difficult for fliers to distinguish between airport lights and others, or as to result in glare in the eyes of fliers using the AIRPORT, or as to impair visibility in the vicinity of the AIRPORT, or as otherwise to endanger the landing, taking-off or maneuvering of aircraft.

(3) There is reserved to the GRANTEE, its successors and assigns for the use and the right to cause in said air space such noise, vibration, fumes, dust, and fuel particulates, as may be inherent in the operation of aircraft, now known or hereafter used for navigation of or flight in air, using said air space for landing at, taking off from, or operating on the AIRPORT;

(4) The GRANTOR shall not use, nor permit, nor suffer use of the GRANTOR's land described above for land fills, open dumps, waste disposal sites, etc., storm water retention ponds, creation of new wetlands, crops that would attract or sustain hazard bird movements, or any use that would be incompatible with the maintenance and operation of the AIRPORT.

(5) The GRANTOR shall not use nor permit construction on the GRANTOR's land described above, any structure that is a hazard to the general public or air navigation including the construction of new residences, fuel handling and storage facilities, smoke-generating activities, or places of public assembly, such as churches, schools, office buildings, shopping centers, and stadiums.

These covenants shall run with the GRANTOR's land described above, for the benefit of the GRANTEE and its successors and assigns in the ownership and operation of the AIRPORT.

SIGNED THIS _______ DAY OF ___________________, 20__:

PRINTED NAME	**SIGNATURE**
____________________________________	____________________________________(L.S.)
____________________________________	____________________________________(L.S.)

STATE OF _________ , *[Insert State]* }
COUNTY OF ______________________________________} ss.

On this _______________ day of _______________________, 20 ____, before me, a Notary Public, in and for said County, personally appeared ____to me known to be the same person(s) described in, and who executed the within instrument, who acknowledged the same to be __________ free act and deed.

____

Notary Public, _________________ County, *[Insert State]*

My Commission Expires: ______________________

Parcel No.: ____
Name: ____
Project No.: ____

AVIGATION EASEMENT (in RPZ)

Property Tax Code:	Parcel No.:

PROPERTY DESCRIPTION:

Insert EXHIBIT X Avigation Easement (outside RPZ) here

E-3 NOISE EASEMENT

This indenture made this _____ day of ____________________, 20____, by ____________________ and between ___________________________, hereinafter referred to as Grantor, and ________________ County, a municipal corporation organized and existing under the laws of the State of ___*[Insert State]*___, hereinafter referred to as Grantee, witnesseth:

WHEREAS the Grantor is the owner in fee of a certain parcel of land in the County of _________________, State of __*[Insert State]*___; and

WHEREAS said parcel of land is near ____*[Insert name of airport]*____Airport, and is within an Airport Noise Overlay Zone as defined by the Zoning Ordinance of the County of _________________, and is subject to existing or forecast aircraft noise levels in excess of 65 DNL; and

WHEREAS the Grantee is the owner and operator of the ______*Insert name of airport]*_____ Airport; and

WHEREAS the Grantor proposes to make a use of said land and to develop thereon the following:

____

____

which use and development require approval by Municipal and County authorities subject to the applicable provisions of law; and

WHEREAS the Grantor has been advised that the subject property is located in a noise-impacted area; that these present and future noise impacts might be annoying to users of the land for its stated purpose and might interfere with the unrestricted use and enjoyment of the property in its intended use; that these noise impacts might change over time by virtue of greater numbers of aircraft, louder aircraft, seasonal variations, and time-of-day variations; that changes in airport, air traffic control operating procedures or in airport layout could result in increased noise impact; and that the Grantor's and users' own personal perceptions of the noise exposure could change and that his or her sensitivity to aircraft noise could increase;

NOW, THEREFORE, for and in consideration of the mutual covenants, agreements and conditions contained herein, the parties hereto agree as follows:

Grantor does hereby grant a permanent noise easement to Grantee overall of the following described real estate:

Provided, however, that the airspace in which the said easement and right-of-way is herein granted shall be that airspace which lies at or above ___________ feet above mean sea level (MSL) which is __________ feet above the present surface level of the land, which land is __________ feet above MSL. Determination of non-conforming obstructions shall be based on the height of the obstruction above mean sea level (MSL).

By virtue of this agreement, the Grantor, for and on behalf of himself and all successors in interest to any and all of the real property above described, waives as to Grantee or any successor agency legally authorized to operate said airport, any and all claims for damage of any kind whatsoever incurred as a result of aircraft using the "easement" granted herein regardless of any future changes in volume or character of aircraft overflights, or changes in airport design and operating policies, or changes in air traffic control procedures.

The Noise Easement shall run with the land of the Grantor, as hereinabove described, for the benefit of the Grantee, and its successors and assigns in the ownership, use and operation of the aforesaid airport.

Grantee, its successors and assigns, shall have and hold said easement and all rights appertaining thereto until said airport shall be abandoned and shall cease to be used for airport purposes.

IN WITNESS WHEREOF, the Grantor has hereunto set its hand and seal the day and year first above written.

____________________________________ (SEAL)

____________________________________ (SEAL)

NOTARY ACKNOWLEDGEMENT

STATE OF ________ *[Insert State]*

COUNTY OF ________________________

Personally, came before me, this _________ day of _____________, 20____.
_______________________ and _______________________________ of the above named Corporation, to me known to be the person who executed for foregoing instrument and to me known to be such __________________________ and ______________________________ of said Corporation, and acknowledged that they executed the foregoing instrument such officers as the deed of said Corporation, by its authority.

____
Notary Public, State of _______ *[Insert State]*

My Commission Expires ______________________

APPENDIX E

Non-Suit Covenant

This indenture made this _____ day of ____________________, 20____, by and between ___________________________, hereinafter referred to as Grantor, and ________________ County, a municipal corporation organized and existing under the laws of the State of __*[Insert State]*____, hereinafter referred to as Grantee, witnesseth:

WHEREAS the Grantor is the owner in fee of a certain parcel of land in the County of _________________, State of ___*Insert State]*___; and

WHEREAS the Grantee is the owner and operator of the ____*[Insert name of airport]*____ Airport; and

WHEREAS the Grantor proposes to make a use of said land and to develop thereon the following:

____

____

which use and development require approval by Municipal and County authorities subject to the applicable provisions of law; and

WHEREAS the Grantor, for and on behalf of himself and all successors in interest to any and all of the real property above described, does further hereby covenant and agree with the Grantee, its successors and assigns, that it will not, from and after the effective date hereof, sue, prosecute, molest, or trouble the Grantee, its successors and assigns, in respect to or on account of the flight of any and all aircraft over or near the said parcel of land, or for any effects resulting there from including but not limited to noise, air pollution, or any and all other possible damages to or taking of said property resulting from such flights.

This covenant shall run with the land of the Grantor, as hereinabove described, for the benefit of the Grantee, and its successors and assigns in the ownership, use and operation of the aforesaid airport.

IN WITNESS WHEREOF, the Grantor has hereunto set its hand and seal the day and year first above written.

___________________________________ (SEAL)

___________________________________ (SEAL)

NOTARY ACKNOWLEDGEMENT

STATE OF _________ *[Insert State]*

COUNTY OF ________________________

Personally, came before me, this _________ day of _____________, 20____. _______________________ and _______________________________ of the above named Corporation, to me known to be the person who executed for foregoing instrument and to me known to be such __________________________ and ______________________________ of said Corporation, and acknowledged that they executed the foregoing instrument such officers as the deed of said Corporation, by its authority.

____
Notary Public, State of _____*[Insert State]*_______

My Commission Expires: ______________________

APPENDIX F

Hold Harmless Agreement

KNOW ALL MEN BY THESE PRESENTS, that the undersigned, hereinafter referred to as Grantees (whether singular or plural), hereby covenant and agree that they shall not, by reason of their ownership or occupation of the following described real property, protest or bring suit or action against the ________________*[Insert name of airport]* Airport or the City (County) of __ *[Insert City (County)]*___ for aviation related noise, property damage or personal injuries resulting from activities at or connected with the ___*[Insert name of airport]*______ Airport when such activities conform to the then existing rules and regulations of said airport and the applicable federal air regulations and no negligence on the part of said airport is involved. The real property of Grantees subject to this covenant and agreement is situated in the County of ___*[Insert County]*_____, State of __*[Insert State_____]*, and described as follows:

(Insert legal description and appropriate map)

This covenant and agreement is made and executed by the Grantees in consideration of the City (County) of ____*[Insert City (County)]*______ granting a conditional use permit for Grantees use and development of the above described real property, which real property is located in the airport approach zone of the ___ *[Insert name of airport]*______ Airport. The execution of this covenant and agreement by Grantees is required by the City (County) of ____*[Insert City (County)]*_______ as a prerequisite to the granting of the above said conditional use permit to Grantees. This agreement is executed for the protection and benefit of the __*[Insert name of airport]*______ Airport and the City (County) of __*[Insert City (County)]*_____, interest in said airport and to prevent development in adjacent lands to said airport which will interfere with the continued operation existent and development of said airport. This covenant and agreement is intended to be binding upon the Grantees, their heirs, assigns, and successors and enure to the benefit of the City (County) of ___*[Insert City (County)]*______ and the Airport, their successors and assigns.
DATED this ___________ day of _____________________, 20____.

STATE OF _______, *[Insert State]* _____ GRANTEES:

ss.____________________

City/County of ______*[Insert City (County)]*)______________________

APPENDIX G

Disclosure Statement

A disclosure statement, adhering to the form of the statement below, shall be provided to and signed by each potential purchaser of property within the Airport Influence Area as shown on the approved Airport Land Use Drawing. The signed statement will then be affixed by the Seller to the agreement of the sale.

The tract of land situated at
_____*[Insert address of property]*____ in ______*[Insert township/City, County and State]* ___, consisting of approximately ____*[Insert number of acres]* __ acres which is being conveyed from_________*[Insert seller name]* ___to __*[Insert buyer name]* ___ lies within __*[Insert number]* _____ miles of _______ *[Insert name of airport____]* may be subjected to varying noise levels, as the same is shown and depicted on the official Zoning Maps.

The undersigned purchaser(s) of said tract of land certify(ies) that (he) (her) (they) (has) (have) read the above disclosure statement and acknowledge(s) the pre-existence of the airport named above and the noise exposure due to the operation of said airport.

____
(SIGNED)

____
(SIGNED)

____
(SIGNED)

STATE OF ________ *[Insert State]* }
COUNTY OF __________________________________} ss.

On this _____________ day of ____________________, 20 ____, before me, a Notary Public, in and for said County, personally appeared ______________________________________to me known to be the same person(s) described in, and who executed the within instrument, who acknowledged the same to be ________ free act and deed.

____

Notary Public, ______________ County, *[Insert State]*

My Commission Expires: ___________________

APPENDIX H

Disclosure to Real Estate Buyer

Customarily, someone will request a letter from the municipality about outstanding charges and assessments against a property. Something similar to this language, adapted for your airport, can be incorporated into a letter sent to buyers and title companies in preparation for closing.

This indenture made this _____ day of ____________________, 20____, by ____________________ and between ___________________________, hereinafter referred to as Grantor, and __*[Insert City/ County]*_____, a municipal corporation organized and existing under the laws of the State of ___ *[Insert State]*____, hereinafter referred to as Grantee, witnesseth:

WHEREAS the Grantor is the owner in fee of a certain _________________ parcel of land in the County of _________________, State of ___*[Insert State]*___; and

Please be advised that the ____________ parcel of property is located within the height restriction zone of the ___*[Insert name of airport]*_____ Airport, and/or is located within a similar distance from the airport.

WHEREAS it is conceivable that standard flight patterns would result in aircraft passing overflight (or nearly so) to the property at altitudes of less than ____________ feet.

Current _____*[Insert name of airport]*_____ Airport use patterns suggest that the average number of takeoffs and landings exceeds ____________ annually. The property buyer of aforementioned parcel number _______________should be aware that air traffic use patterns vary greatly, with the possibility of increased traffic on ______________________.

WHEREAS the ___ *[Insert name of airport]*_____ Airport presently serves primarily _____________________ aircraft, and there are no current initiatives to extend any runway beyond the current __________________ length. Airport plans allow for runway extension in the future, which might impact the number and size of both pleasure and non-pleasure aircraft.

THEREFORE, generally it is not practical to redirect or severely limit airport usage and/or planned-for expansion, and residential development proximate to the airport ought to assume, at some indefinite date, an impact from air traffic."

Grantee, its successors and assigns, shall have and hold said easement and all rights appertaining thereto until said airport shall be abandoned and shall cease to be used for airport purposes.

IN WITNESS WHEREOF, the Grantor has hereunto set its hand and seal the day and year first above written.

____________________________________ (SEAL)

____________________________________ (SEAL)

NOTARY ACKNOWLEDGEMENT

STATE OF _________, *[Insert State]*

COUNTY OF ________________________, *[Insert County]*

Personally, came before me, this _________ day of _____________, 20____. ________________________ and ________________________________ of the above named Corporation, to me known to be the person who executed for foregoing instrument and to me known to be such ___________________________ and _______________________________ of said Corporation, and acknowledged that they executed the foregoing instrument such officers as the deed of said Corporation, by its authority.

____

Notary Public, State of ________ *[Insert State]* ___

My Commission Expires _______________________

Abbreviations and acronyms used without definitions in TRB publications:

AAAE	American Association of Airport Executives
AASHO	American Association of State Highway Officials
AASHTO	American Association of State Highway and Transportation Officials
ACI–NA	Airports Council International–North America
ACRP	Airport Cooperative Research Program
ADA	Americans with Disabilities Act
APTA	American Public Transportation Association
ASCE	American Society of Civil Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
ATA	Air Transport Association
ATA	American Trucking Associations
CTAA	Community Transportation Association of America
CTBSSP	Commercial Truck and Bus Safety Synthesis Program
DHS	Department of Homeland Security
DOE	Department of Energy
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FMCSA	Federal Motor Carrier Safety Administration
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
HMCRP	Hazardous Materials Cooperative Research Program
IEEE	Institute of Electrical and Electronics Engineers
ISTEA	Intermodal Surface Transportation Efficiency Act of 1991
ITE	Institute of Transportation Engineers
NASA	National Aeronautics and Space Administration
NASAO	National Association of State Aviation Officials
NCFRP	National Cooperative Freight Research Program
NCHRP	National Cooperative Highway Research Program
NHTSA	National Highway Traffic Safety Administration
NTSB	National Transportation Safety Board
PHMSA	Pipeline and Hazardous Materials Safety Administration
RITA	Research and Innovative Technology Administration
SAE	Society of Automotive Engineers
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005)
TCRP	Transit Cooperative Research Program
TEA-21	Transportation Equity Act for the 21st Century (1998)
TRB	Transportation Research Board
TSA	Transportation Security Administration
U.S.DOT	United States Department of Transportation