Technical Report Documentation Page

1. Report No. TX-99/1988-S	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle EVALUATION OF THE RELATIONSHIP OF SERVICE LEVELS, FUNCTIONAL CATEGORIES, AND DESIGN STANDARDS FOR GENERAL AVIATION AIRPORTS		5. Report Date August 1999
		6. Performing Organization Code
7. Author(s) Jeffrey D. Borowiec, and George B. Dresser, Ph.D.		8. Performing Organization Report No. Report 1988-S
9. Performing Organization Name and Address Texas Transportation Institute The Texas A&M University System College Station, Texas 77843-3135		10. Work Unit No. (TRAIS)
		11. Contract or Grant No. Project No. 7-1988
12. Sponsoring Agency Name and Address Texas Department of Transportation Research and Technology Transfer Office P.O. Box 5080 Austin, Texas 78763-5080		13. Type of Report and Period Covered Project Summary: September 1998 - August 1999
		14. Sponsoring Agency Code

15. Supplementary Notes

Research performed in cooperation with the Texas Department of Transportation.
Research Project Title: Evaluation of the Relationship of Service Levels, Functional Categories, and Design Standards for General Aviation Airports

16. Abstract

This study examines certain airport design standards in an effort to understand the rationale behind their development. Researchers studied the standards to identify potential standards for relaxing. The focus is on smaller, less active airports where revised standards may make certain needs and projects affordable without compromising safety and operational capabilities. Accident records were reviewed to determine what role, if any, the accidents were caused by insufficient design standards. Existing standards were reviewed and revised standards were recommended based on the role and functional category of particular airports. Finally, the impacts of these revised standards for smaller, less active airports were examined by reviewing the potential for cost saving on projects included in two separate capital improvement programs.

17. Key Words Airport System Planning, Texas Airport System, Airport Design Standards, Airport Roles, Airport Functional Categories	18. Distribution Statement No restrictions. This document is available to the public through NTIS: National Technical Information Service 5285 Port Royal Road Springfield, Virginia 22161

19. Security Classif.(of this report) Unclassified	20. Security Classif.(of this page) Unclassified	21. No. of Pages 90	22. Price

Form DOT F 1700.7 (8-72) **Reproduction of completed page authorized**

EVALUATION OF THE RELATIONSHIP OF SERVICE LEVELS, FUNCTIONAL CATEGORIES, AND DESIGN STANDARDS FOR GENERAL AVIATION AIRPORTS

by

Jeffrey D. Borowiec
Assistant Research Scientist
Texas Transportation Institute

and

George B. Dresser, Ph.D.
Research Scientist
Texas Transportation Institute

Research Report 1988-S
Research Study Number 7-1988
Research Study Title: Evaluation of the Relationship of Service Levels, Functional Categories, and Design Standards for General Aviation Airports

Sponsored by the
Texas Department of Transportation

August 1999

TEXAS TRANSPORTATION INSTITUTE
The Texas A&M University System
College Station, Texas 77843-3135

IMPLEMENTATION RECOMMENDATIONS

Based on the results of this research project, the research team proposes the following recommendations for TxDOT:

1. Where applicable and appropriate, use the NASAO/IES lighting guidelines at smaller general aviation airports. This could result in a cost savings while providing the facility with a level of service adequate for its functional category.

2. Continue to give consideration to the functional category, role, and service level of airports requesting funding. This practice has shown that resources are being appropriately allocated. This is particularly the case for pavement construction/rehabilitation projects due to the substantial costs involved with such projects.

3. In addition to the NASAO/IES guideline, use of the revised design standards outlined in Chapter 4 for smaller, less-active general aviation airports can result in some cost savings.

4. Continue to explore and pursue potential cost saving strategies with respect to pavement construction and pavement management projects. This includes more aggressive marketing of the RAMP program to reduce costs associated with replacing and maintaining pavements. Since the majority of the funds are expended in this area, exploring this further for potential cost savings has the greatest opportunity to yield greater economic impacts than in any other single area.

DISCLAIMER

The contents of this report reflect the views of the author who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the views or policies of the Texas Department of Transportation (TxDOT), the Federal Highway Administration (FHWA), or the Federal Aviation Administration (FAA). This report does not constitute a standard, specification, or regulation. It is not intended for construction, bidding, or permit process. This report was prepared by Jeffrey D. Borowiec, assistant research scientist. George B. Dresser, Ph.D. was the research supervisor.

ACKNOWLEDGMENTS

The research team would like to thank the staff at TxDOT for their support of this project from the beginning through final review. They would also like to thank the project director, Linda Howard, for her support and guidance throughout the entire project. In addition, the team would also like to thank those who assisted by providing information from their respective organizations.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY

The Texas airport system consists of airports that range from large commercial service facilities that enplane millions of passengers to the many small airports that serve the needs of local communities. Often, these smaller airports are the only access to the air transportation system available to communities. For several reasons, these smaller airports are important to the local community, not the least of which is the impact on the economy. Unfortunately, however, many of these smaller communities have difficulty funding projects at their airports. This study examined certain design standards in an effort to determine which, if any, standards the state could relax. The research team sought to identify areas where deviations in the standards could potentially make project improvements more affordable without compromising the safety and operational capabilities of the facility.

This report attempts to establish the rationale behind the development of design standards relating to runway width, airport lighting systems, dimensions of runway protection zones, safety areas, obstacle free zones, and object free areas, as well as parallel taxiway standards. This was not an easy task as the development process evolved through the years and there is very little documentation. Records on establishing and updating design standards were not kept and personnel changes over time contributed to a lack of institutional memory.

Accident records were reviewed to determine what role, if any, airport design standards contributed to aircraft accidents. Research showed that there was no connection.

The research team reviewed the existing Policies and Standards Document and developed recommendations for revising certain design standards at certain airports keeping in mind the role and function of the airport.

Finally, the research team examined the impact of these revisions on smaller, less active airports using two different capital improvement programs. Analysis showed that perhaps the state could realize some cost savings, but when determining airport standards and project costs, planners should collectively consider the community and the role and function of the airport. The analysis also showed that the vast majority of project costs are associated with the airport pavement construction and maintenance. Additional cost savings are possible by exploring strategies related to pavement rehabilitation cost including more aggressive marketing of the Routine Airport Maintenance Program (RAMP) which has significantly reduced pavement maintenance and rehabilitation costs.

CHAPTER 1. INTRODUCTION

Airports are grouped and classified into different categories for different purposes. These purposes include the service level they provide to a community, the role they play in a state's airport system, and the subsequent design standards that are directly related to the service level and role classifications.

The classification of airports by service level in Texas is based on the classifications established at the federal level to select airports for the National Plan of Integrated Airport Systems (NPIAS). Texas uses four classifications for airport service levels. These are primary commercial service, non-primary commercial service, reliever, and general aviation. Primary commercial service airports support scheduled passenger service by large and medium transport aircraft and enplane at least 10,000 passengers per year. Non-primary commercial service airports support smaller transport aircraft and enplane between 2,500 and 10,000 passengers per year. Reliever airports provide congestion relief for larger commercial service airports by offering general aviation traffic alternative facilities and services. General aviation airports provide access to communities for business jets and single and light twin-engine piston-powered aircraft.

Additionally, airports are classified by the role they play in the economic and social development of a particular community and the state as a whole. The role designations used for airports are transport, general utility, and basic utility. According to the Texas Airport System Plan (TASP), transport airports "provide access to turboprop and turbojet business aircraft and are located where there is sufficient population or economic activity to support a moderate to high level of business jet activity and/or to provide capacity in metropolitan areas" (1). The TASP further explains that "service areas containing a population of about 10,000 persons and generating $100 million annually in agricultural production, mineral production, or family purchasing power will frequently attract economic activities requiring business jets. However, at least 500 annual business jet operations are normally necessary to support the facilities associated with a transport airport."

According to the TASP, general utility airports "provide primary business access to smaller communities throughout the state, capacity in many of the metropolitan areas, access to the state's agricultural and mineral production, and access to important recreational resources" (1). The facilities typically accommodate single and twin-engine piston-powered aircraft. Typically, there is enough activity to support a fixed based operator (FBO) on the airport.

The third airport role is the basic utility airport. As stated in the TASP, "basic utility airports are located within the service area of a commercial service, reliever, general aviation transport, or general utility airport; have very low use; or both. These airports provide additional convenience for visual flight rule (VFR) flying and student training operations. Some basic utility airports provide the only public landing site for many miles."

The general standards for airport design are listed in the Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5300-13, *Airport Design* (2). The design criteria in the AC are related to the type of aircraft using, or forecast to use, the airport. Design standards are closely related to the airport roles described above. They include transport and utility airports with utility airports additionally classified as either general or basic utility.

The airport design standards mentioned above relate to specific airports through an airport reference coding system. The advisory circular states that the airport reference code (ARC) is "used to relate the airport design criteria to the operational and physical characteristics of the airplanes intended to operate at the airport (2)." Based on the service level and role of the airport, certain design standards are applied. Ultimately, these design standards are related to the aircraft with the highest ARC expected to use the facility on a regular basis. These are found in the Policies and Standards document of the Aviation Division (10) as well as in Appendix A and C of this report.

The airport reference code consists of two components. These are the aircraft approach category and the airplane design group. The aircraft approach category concerns the operational characteristics of the intended aircraft and refers specifically to the approach speed of the aircraft. Table 1 shows the categories and their respective approach speeds.

TABLE 1
Aircraft Approach Categories

Category	Approach Speed Range
A	Speed less than 91 knots
B	Speed 91 knots or more but less than 121 knots
C	Speed 121 knots or more but less than 141 knots
D	Speed 141 knots or more but less than 166 knots
E	Speed 166 knots or more

Source: *Airport Design*, AC 150/5300-13, Change 5, Federal Aviation Administration

The airplane design group concerns the physical characteristics of the intended aircraft and refers specifically to the wingspan of the aircraft. Table 2 shows the design groups and their respective wingspans.

TABLE 2
Airplane Design Groups

Group	Airplane Wingspan
I	Wingspan less than 49 feet
II	Wingspan 49 feet up to but not including 79 feet
III	Wingspan 79 feet up to but not including 118 feet
IV	Wingspan 118 feet up to but not including 171 feet
V	Wingspan 171 feet up to but not including 214 feet
VI	Wingspan 214 feet up to but not including 262 feet

Source: *Airport Design*, AC 150/5300-13, Change 5, Federal Aviation Administration

For example, an aircraft with an approach speed of 100 knots and a wingspan of 65 feet has an airport reference code of B-II

As stated earlier, utility airports are further classified as either general or basic utility. A utility airport is a facility that is designed and constructed to accommodate aircraft in approach categories A and B which represent the slower end of the spectrum. Additionally, general utility and basic utility airports are further defined as either stage I or stage II. Planners can design these utility airports for small aircraft (those 12,500 pounds or less) or large aircraft (those exceeding 12,500 pounds), and the facility may include instrument approaches. Utility airports designed for large aircraft with visual, non-precision, or precision runways are classified as General Utility II. Transport role airports are designed to accommodate aircraft in approach categories C, D, and E. These are aircraft with higher approach speeds. Commercial service airports are designed to transport airport design standards and they are not examined in this study.

Many publicly-owned airports in the state currently do not meet the design standards appropriate to their role in the state airport system. Typically, a major project on an airport will include an effort to upgrade the airport to the appropriate design standards, although the airport may function adequately with respect to operations and safety. For example, the runway width design standard for airports serving aircraft in approach category C or D is 100 feet wide. However, many airports with runway widths of 75 feet are serving these aircraft with no difficulty. Many airport sponsors are more concerned with providing additional runway length than with expanding runway width. The state, as the agent for federal and state airport funding, is concerned about being financially prudent without compromising safety.

This special study examines the data and supporting studies that led to the specification of various airport standards as they relate to the various service levels, functional categories, and airport roles used for planning and programming. Understanding the underlying basis for the standard allows airport planners to better judge when a modification of the recommended standard is acceptable. As written, the AC on airport design explains what the standards are, but provides little explanation as to the underlying analysis and reasoning that led to the standard.

By developing a better understanding of the standards, it is expected that the state could realize some cost savings in the programming of state funds for general aviation airports. Figures 1 through 3 are examples of the types of airports of interest to this study. Figure 1 shows the runway area at a small rural airport. Although this specific airport is a General Utility I airport, its functional category is "access," meaning that it provides minimal service to the community and any future funding will only provide monies for pavement maintenance. This and the other functional categories are more fully discussed later in this report. Figure 2 shows the runway/taxiway intersection while Figure 3 shows the ramp area at the same airport. These photographs should help illustrate the type and size of airports that are the focus of this report. Larger airports have the capability and support level to fund needed improvements while the smaller ones have difficulty, despite their importance to the community.

FIGURE 1. Runway at a Small Rural Access Airport

FIGURE 2. Runway-Taxiway Intersection at a Small Rural Access Airport

FIGURE 3. Ramp Area at a Small Rural Access Airport

CHAPTER 2. REVIEW OF SELECTED DESIGN STANDARDS

This study began with a determination of design standards that were of interest to the research team. These design standards were selected as a result of their potential in providing cost savings at smaller, low-activity general aviation airports. These standards include runway width, airport lighting, runway protection zones, approach surfaces, safety areas, obstacle free zones, object free areas, parallel taxiway standards, and pavement standards. The research team sought to investigate the basis for these standards including their original rationale.

INTERVIEWS/LITERATURE REVIEW

The research team interviewed four states with large general aviation programs to determine if any use state developed standards for airport projects. These states included Michigan, Illinois, Wisconsin, and Florida. The results of the interviews are discussed below. The Federal Aviation Administration (FAA) was also interviewed to help in determining the original design rationale for the standards of interest.

Michigan

According to the State Bureau of Aeronautics, Michigan does have some state licensing standards that apply to pavements, approach surfaces, and runway widths. Michigan has experienced trouble in obtaining the specified materials for pavements outlined by the FAA. Therefore, the state has developed a comparable substitute material to use for airport pavements and it has FAA approval.

With regard to approach surfaces, the state's basic utility airports have a primary surface minimum width of 100 feet but no less than the width of the runway. The FAA standard requires a minimum 250 feet for utility runways having only visual approaches. This is the only variation in approach surface standards.

Runway width standards are different as well. State standards for basic utility airports require minimum runway widths of 25 feet for paved runways with an additional 38 feet on both sides clear of obstructions. A minimum width of 50 feet is required for unpaved runways. Minimum standard widths at General Utility airports for unpaved runways are 100 feet and the minimum standard for paved runways is 35 feet. The FAA minimum design standard for any runway at a utility airport is a minimum width of 60 feet. Michigan will not fund airport projects unless the runway widths are brought up to at least general utility state standards. Those airports receiving FAA funding must meet the minimum FAA standards. It should be noted that airports must adhere to state standards to meet state funding provisions and to be included in the state airport system.

Michigan uses FAA standards for lighting, separation between runways and parallel taxiways, and recommended lengths and widths for runways, despite having the minimum licensing standards mentioned above. The state has no requirement for runway safety areas, but airports are encouraged to follow federal standards for runway safety areas, object free areas, and runway protection zones where possible and practical. As far as lighting is concerned, the state will not fund low-intensity runway lighting (LIRL) projects despite the FAA's acceptance of this type of project for certain airports and operational characteristics.

Illinois

The Division of Aeronautics in Illinois only uses state standards for pavement materials. Like Michigan, Illinois found it difficult to comply with the FAA standards on materials because they were not readily available in the state. This would have required the state to import the materials at a considerable cost. The state developed alternative specifications for airport pavement materials that were tailored to using local materials and expertise. The FAA approved the new specifications which do not compromise the quality of the pavement.

Wisconsin

According to the Wisconsin Bureau of Aeronautics, the state does not have any state design standards for their airports, but they do have a set of construction specifications. These construction specifications outline less expensive, local materials that provide the state with some economy of scale in their purchasing. These specifications cover pavement bases and pavement materials and have FAA approval. The specifications cover all state airports, including primary and general aviation airports, and are very similar to the national standards.

The state does not deviate from design standards outlined in the FAA AC on Airport Design. They do not have any problems or concerns with the current FAA standards. They have developed, however, a set of "Electric Details" that include guidance on electrical systems at airports. These standards relate to other issues including runway lighting systems. The electrical standards were established because there was no guidance from the FAA on the issue.

Florida

According to the Florida Aviation Office, Florida has state specifications for construction of general aviation airports. These standards are essentially those established in AC 150/5370-10A but adapted to Florida's specific material and environmental conditions (3). All of these specifications have FAA approval. They do not have state standards pertaining to runway widths, airport lighting, or any of the geometric dimensions. For these dimensions, the state conforms to the standards set out by the FAA in the design circular.

Federal Aviation Administration - Washington, D.C.

Researchers contacted the FAA Airport Design Division in an effort to help establish the basis and rationale for the design standards of interest mentioned above. Division officials indicated that the design circular was developed by a number of FAA "old-timers" either who have moved on from the FAA or who are now deceased. The airport design division does not have, nor are they aware of, any documentation for the justification or rationale of the current design standards. These standards were originally determined and have since evolved into their current state without any institutional memory to document the evolution and revision process.

This Washington, D.C. office does issue waivers for design standard issues pertaining to pavement and navigational aids (NAVAIDS). Waivers on issues concerning taxiway widths and separations and grade limitations on runways and runway safety areas are referred from the Washington office and addressed by the regional offices.

The Washington office also mentioned a "hierarchy" of sorts about the importance or significance of certain design standards when considering waivers. The obstacle free zone standards rarely are waived followed by the runway safety area, the object free area, and the runway protection zone (RPZ). For example, the FAA prefers that the trapezoidal shape of the runway protection zone be maintained. In cases where the airport sponsor cannot buy the property, easements possibly are appropriate. The FAA does not want the RPZ coming onto the airport thus diminishing the use of runways.

Federal Aviation Administration - Southwest Regional Office, Fort Worth, Texas

The FAA Southwest Regional Office also mentioned that design standards were developed over a period of time and that the rationale used to develop these standards does not exist in any way that is easily obtained. They reiterated the comments of the Washington office regarding retired personnel being responsible for developing and updating the standards. One avenue of better understanding these design standards is to trace them as they were updated and determine what has changed and why. Complicating this process is the fact that many libraries that have government document holdings discard certain series when they are updated. This largely appears to be the case with FAA ACs.

Airport Lighting Systems

During the previous interviews, the persons interviewed mentioned issues regarding airport lighting systems. These issues are noted here. The FAA guidelines for runway and taxiway edge lights (AC 150/5340-24) outline the use of LIRL for runways at visual flight rule (VFR) airports having no planned approach facilities (4). However, personnel at Manairco, Inc (an airport lighting company) and the State Bureau of Aeronautics in Michigan indicated that the FAA would not fund LIRL. Neither will Michigan Aeronautics fund LIRL. These LIRL systems are being bought by owners of farm strips and private airports.

In interviews with airport lighting companies, they stressed that costs associated with medium intensity runway lighting (MIRL) are significantly greater than LIRL. The higher cost is associated with the size of the lens. Airport personnel can install different watt bulbs in either of the systems, but the size of the lens dictates the performance. No performance measure was mentioned to indicate how much further a MIRL was visible compared to a LIRL. No ratio of cost was provided either except that the cost difference was significant. The cost difference also results from MIRL's requiring a constant current 6.6-amp system whereas the LIRL systems are 120-volt systems.

National Association of State Aviation Officials/Illuminating Engineering Society

The National Association of State Aviation Officials (NASAO) and the Illuminating Engineering Society (IES) have been working on airport lighting issues since their subcommittee was formed in 1981 to study the issues. With states involved in the planning, development, operation, and maintenance of airports, NASAO has undertaken an effort along with the IES to address concerns regarding the affordability of airport lighting equipment. Some airports that are not in the NPIAS as well as other smaller airports that are important to their communities do not qualify for federal grant money or cannot afford the local share of the grant. Therefore, "individual airport operators and state aviation agencies have devised 'affordable' equipment and systems to meet the needs of airports in these situations (5)."

The NASAO/IES subcommittee, developed in 1981 as the Subcommittee on Visual Aids, addressed these needs and developed uniform guidelines for lighting equipment. Appendix D, taken from the NASAO/IES guidelines, shows the lighting equipment and the recommended level of service according to the airport type.

Other Literature

Other identified studies and documents published on this subject pertain to state standards and specifications for airports. All cover pavement or construction standards where states have asked for, and received waivers or permission to use alternative materials for airport pavements because FAA standard materials are not adequately available in the particular state. These studies on state standards are not necessarily related to the design standards of interest in this study. They include *Standard Specifications for Construction of General Aviation Airports: Airports Serving Aircraft of 30,000 Pounds Gross Weight or Less* and *Proposed Asphalt and Base Specifications for TxDOT General Aviation Construction* (6) (7).

CHAPTER 3. AIRCRAFT ACCIDENT DATA

In the review of design standards for this study, the research team studied aircraft accident data to determine any correlation between airport-related accidents and airport design. Researchers reviewed accident data for the past five years from the National Transportation Safety Board (NTSB). The records examined were those where airport facilities were listed in the accident report as a possible cause or factor. Researchers selected the "airport facilities" heading for further review based on discussions with NTSB officials who determined that any accidents where airport design related issues were a cause or factor would be included in this category. The NTSB categorizes accidents under several headings of which one is airport facilities.

The NTSB search produced 287 accident records where airport facilities were listed as a cause, a factor, or noted in the accident record. Each record represents one aircraft accident. Each record, however, has multiple listings of causes, factors, and/or notes pertaining to the accident. This includes records that have more than one entry under the airport facilities heading. The following table lists accidents included in the airport facilities category found in the 287 accident records reviewed. These records include all those in the NTSB database for the given time period including private runways and grass/turf/gravel runways.

TABLE 3
Aircraft Accidents Listing Airport Facilities as Cause in Accidents Reviewed

Category	Sub-Category
Airport/Facilities	Inadequate
Airport/Facilities	Closed
Runway/Landing Area Condition	Closed
Runway/Landing Area Condition	Exposed Runway Lip/Edge
Runway/Landing Area Condition	Narrow
Runway/Landing Area Condition	Other
Runway/Landing Area Condition	Uneven
Runway/Landing Area Condition	Unidirectional
Runway/Landing Area Condition	Displaced Threshold
Runway/Landing Area Condition	Ditch
Runway/Landing Area Condition	Downhill
Runway/Landing Area Condition	High Vegetation

Category	Sub-Category
Runway/Landing Area Condition	High Obstruction(s)
Runway/Landing Area Condition	Hidden Obstruction(s)
Runway/Landing Area Condition	Icy
Runway/Landing Area Condition	Loose Gravel/Sandy
Runway/Landing Area Condition	None Suitable
Runway/Landing Area Condition	Rising
Runway/Landing Area Condition	Rough/Uneven
Runway/Landing Area Condition	Runway
Runway/Landing Area Condition	Slush Covered
Runway/Landing Area Condition	Snowbank
Runway/Landing Area Condition	Snow Covered
Runway/Landing Area Condition	Soft
Runway/Landing Area Condition	Uphill
Runway/Landing Area Condition	Water/Glassy
Runway/Landing Area Condition	Water/Frozen
Runway/Landing Area Condition	Berm
Runway/Landing Area Condition	Grass
Runway/Landing Area Condition	Congested/Confined Area
Runway/Landing Area Condition	Construction Area
Runway/Landing Area Condition	Drop-off/Descending Embankment
Runway/Landing Area Condition	Other
Runway/Landing Area Condition	Short Runway/Landing Area
Runway/Landing Area Condition	Wet
Instrument Approach Lights	Not Operating
Visual Approach Slope Indicator(VASI)	Inoperative

Category	Sub-Category
Visual Approach Slope Indicator(VASI)	Unavailable
Visual Approach Slope Indicator(VASI)	Not Available on Selected Runway
Runway Edge Lights	Failure/Partial
Runway Edge Lights	Inoperative
Runway Edge Lights	Unavailable
Runway Edge Lights	Not Operating
Runway Edge Lights	Not Available on Selected Runway
Runway Edge Lights	Not Installed
In-Runway Lights	Failure/Partial
In-Runway Lights	Not Available on Selected Runway
Rotating Beacon	Not Operating
Ramp Facilities	Congested
Ramp Facilities	Inadequate
Taxiway Condition	Closed
Taxiway Condition	Unmarked
Taxiway Condition	Icy
Taxiway Condition	Snowbank
Taxiway Condition	Soft
Taxiway Condition	Weak Ice
Taxiway Condition	Congested/Confined Area
Taxiway Condition	Construction Area
Taxiway Condition	Wet
Taxiway Lighting	Not Installed
Taxiway Marking	Lack of Frangibility
Helipad	Inadequate

Category	Sub-Category
Runway Safety Area	Inadequate
Runway Safety Area	Narrow
Runway Safety Area	Not Installed
Runway Overrun Area	Unavailable
Runway Overrun Area	Ditch
Runway Overrun Area	Downhill
Runway Overrun Area	High Vegetation
Runway Overrun Area	High Obstruction(s)
Runway Overrun Area	Rising
Runway Overrun Area	Snowbank
Runway Overrun Area	Soft
Runway Overrun Area	Berm
Runway Overrun Area	Grass
Runway Sign(s)	Not Installed

Source: National Transportation Safety Board Aircraft Accident Database, 1995-1999.

As shown in the table above, the airport facilities category encompasses a variety of subjects used to classify aircraft accidents. They range from the runway/landing area to taxiway conditions and several aspects of airport lighting. While this list is quite exhaustive, it is likely that other categories exist as this list only includes those mentioned in the sample of 287 accidents over the period studied.

There were a total of 377 causes, factors, and notes associated with the 287 accidents and some accident records listed multiple causes, factors, and notes. Of these 377, nine were causes, 280 were factors, and 88 were notes accompanying the accident record regarding conditions present at the time. To better understand which of these areas is most frequently seen as a cause or a factor or simply found to be present at the airport during an accident, Table 4 shows the top 20 categories over the period studied.

TABLE 4
Most Frequently Found Causes, Factors, and Conditions in Aircraft Accidents Reviewed

Heading	Sub-Heading	Frequency	Percent of Total
Runway/Landing Area Condition	Wet	65	17%
Runway/Landing Area Condition	Grass	35	9%
Runway/Landing Area Condition	Rough/Uneven	28	7%
Runway/Landing Area Condition	Snow Covered	27	7%
Runway/Landing Area Condition	Soft	26	7%
Runway/Landing Area Condition	Short Runway	22	6%
Runway/Landing Area Condition	Icy	18	5%
Runway/Landing Area Condition	Snowbank	12	3%
Runway/Landing Area Condition	High Vegetation	9	2%
Runway/Landing Area Condition	Uphill	8	2%
Runway/Landing Area Condition	Downhill	7	2%
Runway/Landing Area Condition	Narrow	6	2%
Runway/Landing Area Condition	Runway	6	2%
Runway/Landing Area Condition	Congested/Confined Area	6	2%
Runway Edge Lights	Inoperative	5	1%
Runway/Landing Area Condition	Construction Area	4	1%
Runway Edge Lights	Unavailable	4	1%
Runway Edge Lights	Not Installed	4	1%
Taxiway Condition	Congested/Confined Area	4	1%
Runway Overrun Area	Ditch	4	1%
TOTAL		**300**	**80%**

Source: National Transportation Safety Board Aircraft Accident Database, 1995-1999.
Note: Numbers may not add due to rounding.

Table 4 shows that various conditions of the runway are the most frequently encountered causes, factors, and conditions found in the aircraft accidents studied. This is followed by runway lights, which are a distant second. The top 10 factors all fall under the heading of runway/landing areas and account for 66% of the causes and factors found. The top 20 accounted for 80% of the total.

It should be noted that airport facilities were the cause of only eight of the 287 accidents reviewed with one accident having two causes that both fit the airport facilities category. The remaining were either factors in the accident or noted as part of the conditions present at the time of the accident. Table 5 shows a broader picture of what airport facility parts are being reported as causes, factors, and/or conditions in accident records. The heading under airport facility is reported with the number of times it was entered as a cause, factor, and/or condition.

TABLE 5
Frequency of Airport Facility Elements as a Cause, Factor, and/or Condition in Aircraft Accidents

Airport Facility Element	Frequency	Percent of Total
Runway/Landing Area Condition	310	82%
Runway Edge Lights	18	5%
Runway Overrun Area	17	5%
Taxiway Condition	13	4%
Visual Approach Slope Indicator	4	1%
Runway Safety Area	3	1%
Ramp Facilities	2	1%
In-Runway Lights	2	1%
Rotating Beacon	1	0%
Taxiway Lighting	1	0%
Instrument Approach Lights	1	0%
Runway Sign	1	0%
Airport Inadequate	1	0%
Helipad	1	0%
Taxiway Marking	1	0%
Airport Closed	1	0%
TOTAL	**377**	**100%**

Source: National Transportation Safety Board Aircraft Accident Database, 1995-1999.

These numbers clearly show that the condition of the runway accounts for the majority of accidents among the airport facility elements. It should be noted that the vast majority of the runway accidents are not a result of a lack of appropriate design standards. Nor did a lack of design standards play a role in most of the other accidents. In most cases, the accidents were a result of poor conditions at the time. Most notable were soft, wet, and rough/uneven conditions at grass airstrips. Maintenance was also an issue as some lighting elements were inoperative. Other records showed pilots landing on runways that were not equipped with lights. Construction areas, congested conditions, and weather conditions, among others, played a role in these accidents or were noted as part of the operating conditions at the time of the accident.

AIRPORT FACILITIES-RELATED ACCIDENT CAUSES

Despite no significant relationship to design standard issues, it is beneficial to discuss the eight accidents where airport facilities were listed as a cause. The accidents are discussed not only for informative purposes, but to also point out that they were not related to design standards. Of the eight accidents, one report listed airport facilities as a cause twice bringing the total listed causes to nine. All of the accidents except one listed runway/landing area conditions as the cause. These causes included soft runways, wet and icy runways, and rough/uneven/unsuitable runways. The remaining accident was attributed to the taxiway condition. As the aircraft was taxiing, its nosewheel fell through the weak ice and the propeller struck the ice. These eight accidents and their causes are further illustrated in Table 6 below.

TABLE 6
Aircraft Accidents with Cause Attributed to Airport Facilities

Accident Number	Airport Facility	Cause
1	Runway/Landing Area Condition	Unsuitable Runway/Forced Landing
2	Runway/Landing Area Condition	Rough/Uneven Runway
3	Runway/Landing Area Condition	Car on Runway/Wing Struck Ground
4	Taxiway Condition	Weak Ice/Nose Wheel Fell Through
5	Runway/Landing Area Condition	Icy Runway
6	Runway/Landing Area Condition	Soft Grass Runway
7	Runway/Landing Area Condition	Soft Grass Runway
	Runway/Landing Area Condition	Wet Grass Runway
8	Runway/Landing Area Condition	Soft Grass Runway

Source: National Transportation Safety Board Aircraft Accident Database, 1995-1999.

In the first accident listed in the table, the pilot had to make a forced landing and the selected landing area was determined to be unsuitable, thus attributing the cause to the airport facility. The second accident was attributed to rough and uneven runway pavement. The accident report states that the aircraft struck a large pothole that collapsed the nose landing gear causing the propeller to hit the pavement. The report also states that the airport facility directory listed the runway as having cracks and weeds. The third accident was caused by the aircraft wing striking the ground as the pilot tried to avoid a car that pulled out in front of the landing aircraft. The fourth accident was caused by the aircraft nose wheel falling through the weak ice as it taxied prior to takeoff.

The last four accidents were all attributed to the runway/landing area conditions. The fifth accident was caused by an icy runway and the subsequent collapse of the landing gear as the plane slid sideways down the runway. The sixth accident was caused by the collapse of the nose wheel into a soft spot on the grass runway. The runway had several soft spots as well as standing water. The seventh accident listed two causes, both attributed to airport facilities. The first was a soft grass runway and the second was a wet grass runway. Both were the result of rain. The aircraft main landing gear was caught in the soft grass at the end of the rollout and the aircraft flipped over. The final accident was also caused by a soft grass runway where a soft spot caused the aircraft to nose over.

The causes mentioned above were related, for the most part, to weather and rough landing area conditions. Design standards did not come into play. The next section examines some of the cases where design standards either were factors in the accident or mentioned in the report as part of the prevailing conditions at the time of the accident.

ACCIDENT FACTORS RELATED TO DESIGN STANDARDS

Before moving into the accidents specifically related to airport design standards, it is beneficial to first discuss those accidents where airport lighting was a factor. Because airport lighting is one of the select areas where alternative standards are being discussed and proposed, it is useful to understand the role lighting has played in the accidents reviewed for this study.

Airport Lighting Systems

Lighting systems accounted for 27 of the 377 cause, factor, and condition entries in the accidents reviewed. Of these 27, none were the causes of accidents, 19 were factors in accidents, and eight were listed in the accident record noting the conditions when the accident occurred. Some of these are noted in Table 4, but more discussion is warranted.

The most frequent lighting element that surfaced as an accident factor was runway edge lighting. Runway edge lights were a factor in accidents for several reasons. The following is a list of the sub-categories under the runway lights factory category: failure/partial, inoperative, not installed on selected runway, not installed, not operating, and unavailable. These categories make distinction between whether or not the facility had lighting, and if so, why the lights were not activated. This includes systems where they were not working, times where pilots did not activate the lights, and occasions where they were in working condition but not made available to the pilot to activate. This element was a factor in 13 accidents. The remaining six accidents where lighting was a factor were split among four other lighting elements. In-runway lights were a factor in two accidents where there was a failure of the system on one occasion, and where the lights were not available on the selected runway in the other. Visual approach slope indicators (VASI) were a factor in two accidents as well. On one occasion, they were inoperative and on the other they were unavailable. Instrument approach lights that were not operating was a factor in one accident as were taxiway lights that were not installed. No accidents were attributed to lighting systems because of their level of intensity. Only systems that were working but not activated played a role in the accidents.

ACCIDENTS RELATED TO DESIGN STANDARDS

The search of the accident records revealed six accidents that were related either directly to airport design standards or indirectly in a fashion that warranted their discussion in this section. None of these accidents was caused by inappropriate or inadequate design standards but design standards were listed as a factor in some of them. These six accidents, the airport where the accident occurred, and the probable causes and related factors of the accident are discussed below. Of these six airports, four are private and four are open to the public. One of the airports is privately owned but researchers could not determine its use.

Camp River Airport, Camp River, Wisconsin (Privately Owned-Public Use)

This accident involving a Cessna 172 was caused by the pilot's failure to remain clear of trees that were located along the side of the runway. The pilot was making a pass to the side of the grass airstrip to inspect it when his wing struck some tree branches. The investigation of the accident revealed that the trees were located 82 feet from the runway edge. This distance is short of the FAA recommended 87.5-foot clear area to the side of the runway. This distance is clearly articulated in the design AC 150/5300-13 Change 4, the current circular at the time. While the report did not specifically mention this as the cause or even a factor in the accident, it was noted in the report as part of the general conditions at the airport when the accident occurred.

Chico Hot Springs Lodge Airstrip, Pray, Montana (Privately Owned-Use Unknown)

This accident involved a Piper PA-28R-180 landing on a 6,000-foot long by 30-foot wide airstrip. The crosswind made it difficult to land and the cause of the accident was the pilot's delay in initiating a go-around procedure. Although eventually deciding to go around, the pilot could not maintain sufficient airspeed and the aircraft stalled with the left wing striking the ground. The narrow runway was listed in the report as being a factor in the accident. Further, it was stated that the runway dropped off into ditches immediately beyond the runway edges on both sides.

Auburn Municipal Airport, Auburn, California (Publicly Owned-Public Use)

This accident involving a Cessna 425 occurred during landing when the pilot experienced a hydraulic/brake system failure. The airplane veered off the runway and into a ditch where the nose gear collapsed. The runway was 3,100 feet long by 60 feet wide. The narrow runway was listed as a factor in the accident despite meeting the recommendations in the AC.

Bullard Airstrip, Firebaugh, California (Publicly Owned-Public Use)

This crash of an Ayres S2R-T65 aerial application aircraft was caused when the pilot lost control of the aircraft during a takeoff roll. The strong crosswind that was present contributed to the accident, as the pilot was unable to control the aircraft when it veered to the left and drifted off the runway and onto the shoulder. The airplane then nosed over into a ditch adjacent to the runway. The narrow runway was also attributed as a factor in the accident.

Private Airstrip, Welsh, Louisiana (Privately Owned-Private Use)

This accident involved an Ayres S2R-T34 agricultural aircraft similar to the aircraft in the previous accident record. During takeoff, the pilot struck a truck that was crossing in front of the departure end of the runway on a gravel road. At approximately five feet above the ground, the main landing gear and propeller struck the truck. The determined cause was the pilot's failure to remain clear of the vehicle. Factors in the accident were the lack of runway signs and no runway safety area.

Brennand Airport, Neenah, Wisconsin (Privately Owned-Public Use)
This accident involved a Beech 23 aircraft that was on final approach to the airport. The left main landing gear of the aircraft struck a dump truck that was traveling on a road that crossed in front of the runway. The treeline and a cornfield adjacent to the runway and road made it difficult for the pilot to see vehicles, especially light colored vehicles. The cause of the accident was attributed to the terrain condition that led to the obstructed view of the vehicle. Factors in the accident included in inadequate runway safety area. A note was also made in the accident report concerning the obstacle free zone. It states that "the distance from the edge of the runway to the road was reported by the pilot as approximately 180 feet. The recommended obstacle free zone as defined in AC 150/5300-13 CHG4 is 200 feet. The latest Wisconsin Department of Transportation survey of the airport reported the road height as two feet higher elevation than the runway end. A three-degree angle projection from the end of the runway to the near edge of the road would give a road crossing height of 7.4 feet, at this point. The height of the dump truck was approximated by local law enforcement personnel as 10 feet (8)." The obstacle free zone was not listed as a cause or factor but was found to differ from the recommended geometry and is included in the summary below.

SUMMARY
None of the accidents cited above was caused by the lack of, or inadequate design standards. There were, however, accidents where design standards and related issues were factors in accidents. The design standards of concern in these cases are shown in Table 7 along with their frequency. One of the accidents had two design standard related factors.

TABLE 7
Airport Design Standards Listed as Factors in Aircraft Accidents

Design Standard	Occurrences
Narrow Runways (Runway Width)	3
Obstacle Free Zone	2
Runway Safety Area	2

Source: National Transportation Safety Board Aircraft Accident Database, 1995-1999.

CHAPTER 4. RELATIONSHIP OF TEXAS AIRPORT SYSTEM PLAN (TASP) FUNCTIONAL CATEGORIES AND DESIGN STANDARDS

Following the literature review, the interviews with other state aviation programs, and efforts to understand the rationale and purpose of the current design standards, the research team reviewed the Division of Aviation's published Policies and Standards Document. This review followed Aviation Division's determination of functional categories for airports. In addition, researchers reviewed and evaluated the airport service levels, airport roles, and airport functional categories relative to the investigation documented above. The result is a series of recommended revisions to the Policies and Standards Document presented below.

In addition to service level and role, the airports in the TASP were further subdivided into functional categories related specifically to the airport's use or expected use. The functional categories are commercial, reliever, regional, multipurpose, industrial, special use, agricultural, remote, and access. A description of the nine functional categories follows. Table 8 shows the categories and the number of TASP airports in each category. Appendix A lists the typical aircraft using airports based on ARCs. Appendix B lists the TASP airports by functional category. For reference purposes, the existing design standards are presented in Appendix C.

TABLE 8
TASP Functional Categories

Functional Category	Number of Airports
Commercial	27
Reliever	23
Regional	42
Multipurpose	140
Industrial	5
Special Use	9
Agricultural	19
Remote	7
Access	26
Total Number of Airports in TASP	**298**

Source: Texas Department of Transportation, Aviation Division, Policies and Standards Document (8).

The role of the airport influences the design and the type of aircraft it can accommodate. Similarly, the main functional use of the airport further determines what design elements are needed to accommodate the needs of the users and the community. The primary use of the airport determines the airport's functional classification when its primary use is at least 60% of its total operations.

Section XII of the Policies and Standards Document provides a description of the airport design elements (runway, taxiway, apron, approach, lighting, visual approach aids, and service) appropriate for each TASP service level and role. These design elements in Section XII are further refined by the functional classification of the airport. For some functional classifications, the design elements are more demanding and for other functional classifications, the design elements are less demanding. The design elements in Section XII are modified by functional classification as presented below. Again, note that this study focused on the development of a relationship between design standards and functional categories for general aviation airports. However, all functional classes are included here for continuity purposes.

COMMERCIAL AIRPORTS

These airports provide scheduled passenger service. They are owned by the public and boardings exceed 2,500 passengers. Table 9 shows the applicable design standards for commercial service airports.

TABLE 9
Applicable Design Standards for Commercial Service Airports

Airport Role	Airport Reference Code (ARC)	Airplane Type/Size
Transport	C-II	Large airplanes
Transport	C-III	Large airplanes
Transport	D-I	Large airplanes
Transport	D-II	Large airplanes
Transport	D-III	Large airplanes
Transport	D-IV	Large airplanes

Design Element Changes

No design element changes are recommended for this functional category as the focus of this report is on general aviation airports.

RELIEVER AIRPORTS
These airports are designated by the FAA to relieve congestion at large commercial service airports and increase access to general aviation in the community. Table 10 shows the applicable design standards for reliever airports.

TABLE 10
Applicable Design Standards for Reliever Airports

Airport Role	Airport Reference Code (ARC)	Airplane Type/Size
General Utility Stage I	B-I	Small airplanes
General Utility Stage I	B-II	Small airplanes
General Utility Stage II	B-II	Large airplanes
Transport	C-II	Large airplanes
Transport	C-III	Large airplanes

Design Element Changes
No design element changes are recommended for this functional category as the focus of this report is on smaller general aviation airports.

REGIONAL AIRPORTS
These airports are designed to support higher performance aircraft than the surrounding smaller general aviation facilities in the area and are the focal point of aviation activity for a region or the largest population center. These facilities may experience air taxi, commuter, or charter service periodically. The airside facilities should provide the best technology possible for weather, approach minimums, and approach aids. Table 11 shows the applicable design standards for regional airports.

TABLE 11
Applicable Design Standards for Regional Airports

Airport Role	Airport Reference Code (ARC)	Airplane Type/Size
General Utility Stage II	B-II	Large airplanes
Transport	C-II	Large airplanes
Transport	C-III	Large airplanes

Design Element Changes
The following design element changes are recommended for airports fitting the regional airport functional category. They are shown in Table 12.

TABLE 12
Recommended Design Element Changes for Regional Airports

Design Element	Recommended Changes
Minimum apron	Add apron lighting
Minimum visual approach aids	Add AWOS III or Better
Minimum service	Add satellite weather Data Transmission Network/Aviation Center (DTN) in terminal building

MULTIPURPOSE AIRPORTS

The operations at these airports are diversified and are not dominated by any one type of activity. The general criteria used for determining airport roles are adequate for planning purposes, however, the airport may require special features to meet the needs of specific users. Table 13 shows the applicable design standards for multipurpose airports.

TABLE 13
Applicable Design Standards for Multipurpose Airports

Airport Role	Airport Reference Code (ARC)	Airplane Type/Size
General Utility Stage I	B-II	Small or large airplanes
General Utility Stage II	B-II	Large airplanes

Design Element Changes

No design element changes are proposed at this time for multipurpose airports.

INDUSTRIAL AIRPORTS

This functional category describes the type of businesses associated with the airport, particularly those that are aviation-related. The itinerant traffic specifically conducts business with a tenant or industry based at the airport. These visitors may not have a need for access, or to conduct business within the community, however, their transactions support the economy and tax revenue base of that community. The need for a terminal or meeting facility would depend upon the total operations not associated with the industrial activity. The airside facilities should provide the best technology for weather, approach minimums, and approach aids. Table 14 shows the applicable design standards for industrial airports.

TABLE 14
Applicable Design Standards for Industrial Airports

Airport Role	Airport Reference Code (ARC)	Airplane Type/Size
General Utility Stage II	B-II	Large airplanes
Transport	C-II	Large airplanes
Transport	C-III	Large airplanes
Transport	C-IV	Large airplanes
Transport	D-III	Large airplanes
Transport	D-IV	Large airplanes

Design Element Changes
The following design element changes are recommended for airports in the industrial airport functional category. They are shown in Table 15.

TABLE 15
Recommended Design Element Changes for Industrial Airports

Design Element	Recommended Changes
Minimum runway	Add runway strength appropriate to specifically identified critical aircraft
Minimum apron	Add apron lighting
Minimum visual approach aids	Add AWOS III or Better
Minimum service	Add satellite weather Data Transmission Network/Aviation Center (DTN) in terminal building

SPECIAL USE AIRPORTS
This functional category includes airports that are used on a seasonal basis primarily for tourism, hunting, or other recreational purposes. Many of these rural airports are located near significant parks, lakes, or provide access to various types of hunting. The operations at these sites are typically low volume except in season and may include large and small airplanes. Many of these airports provide a significant contribution to the local economy. Special use airports located in South Texas serve exotic game range hunting, deer hunting, and bird hunting in season. Table 16 shows the applicable design standards for these special use airports serving primarily hunting needs. Table 18 shows the applicable design standards for the special use airports serving primarily parks and lakes. Tables 17 and 19 show the recommended design element changes for the hunting and parks/lakes uses respectively.

TABLE 16
Applicable Design Standards for Special Use Airports - Hunting

Airport Role	Airport Reference Code (ARC)	Airplane Type/Size
General Utility Stage II	B-II	Large airplanes
Transport	C-II	Large airplanes

Design Element Changes - Hunting
The design element changes listed in Table 17 are recommended for special use airports serving the needs of hunting communities in the state.

TABLE 17
Recommended Design Element Changes for Special Use Airports - Hunting

Design Element	Recommended Changes
Minimum taxiway	Delete need for full parallel taxiway
Minimum service	Delete manager's office, vending machines, 16-hour attendance, and a local altimeter

TABLE 18
Applicable Design Standards for Special Use Airports - Parks/Lakes

Airport Role	Airport Reference Code (ARC)	Airplane Type/Size
Basic Utility Stage I	B-I	Small airplanes

Design Element Changes - Parks/Lakes
The design element changes in Table 19 are recommended for special use aircraft serving recreational parks and lakes.

TABLE 19
Recommended Design Element Changes for Special Use Airports - Parks/Lakes

Design Element	Recommended Changes
Minimum runway	Minimum runway width 50 feet paved or 75 feet stabilized turf

AGRICULTURAL AIRPORTS
This functional category includes airports that serve areas of intense agricultural production. Agricultural spraying services are required to support the production capability of many small communities, therefore, many of the design standards of these general aviation airports are specifically related to the needs of agricultural operators. Terminal facilities and runway lights are not always required. Agricultural activities may occur at a variety of facilities and the special

needs of this type of activity, including use of chemicals and traffic patterns, may require additional features for safe operations. The airport may require additional roads to provide access for chemical trucks and to prevent trucks from driving on the aircraft apron. The airport may also need to construct segregated agricultural aprons when there is also significant non-agricultural operations. Figure 4 shows an example of a self-contained concrete agricultural pad. Figure 5 shows an example of an access road adjacent to an agricultural pad. Paved access roads are not necessarily required as gravel roads can economically meet the needs of users. Figure 6 shows an agricultural access road and connecting pad being utilized by an aerial applicator. The applicable design standards for agricultural airports are shown in Table 20.

TABLE 20
Applicable Design Standards for Agricultural Airports

Airport Role	Airport Reference Code (ARC)	Airplane Type/Size
Basic Utility Stage I and II	B-I	Small airplanes

FIGURE 4. Self-Contained Agricultural Pad

FIGURE 5. Agricultural Airport Access Road

FIGURE 6. Aerial Application Activity on an Agricultural Pad at a Public Airport

Design Element Changes

The design element changes in Table 21 are recommended for airports serving the agricultural community.

TABLE 21
Recommended Design Element Changes for Agricultural Airports

Design Element	Recommended Changes
Minimum runway	Minimum runway width 50 feet paved or 75 feet stabilized turf
Minimum apron	Add agricultural apron (self-contained), 80,000-pound PCC agricultural chemical truck parking pad adjacent to PCC agricultural aircraft loading apron designed for chemical wash-down and containment
Other	Access road, paved or gravel, suitable for carrying an 80,000-pound chemical truck from the public road to the agricultural chemical truck parking pad

The truck and airplane loading design elements shown for agricultural airports are appropriate at any airport with significant agricultural operations regardless of the functional classification of the airport.

REMOTE AIRPORTS

This functional category includes airports serving remote areas. Many rural communities are separated by more than 100 miles from each other or from larger communities. This is frequently true in west and south Texas. Many typical rural activities such as ranching and oil and gas production require access to these communities by air. In addition, emergency medical access by air is essential to remote communities. The applicable design standards for these remote airports are shown in Table 22.

TABLE 22
Applicable Design Standards for Remote Airports

Airport Role	Airport Reference Code (ARC)	Airplane Type/Size
Basic Utility Stage II	B-I	Small airplanes

Design Element Changes

Table 23 shows the recommended design element changes for remote airports.

TABLE 23
Recommended Design Element Changes for Remote Airports

Design Element	Recommended Changes
Minimum approach	Add circling or straight-in published instrument approach

ACCESS AIRPORTS

This functional category includes airports that provide minimal service to the community and, as a result, would not likely receive funds to replace the facility. These airports are eligible to receive funding for pavement preservation. The applicable design standards are shown in Table 24.

TABLE 24
Applicable Design Standards for Access Airports

Airport Role	Airport Reference Code (ARC)	Airplane Type/Size
Basic Utility Stage I	B-I	Small airplanes

Design Element Changes

Table 25 shows the recommended design element changes for remote airports.

TABLE 25
Recommended Design Element Changes for Access Airports

Design Element	Recommended Changes
Minimum runway	Minimum runway width 50 feet paved or 75 feet stabilized turf

Stabilized turf runways are suitable for agricultural and access airports. Figure 7 shows an example of agricultural operations from a turf runway.

FIGURE 7. Agricultural Operations From a Turf Runway

CHAPTER 5. IMPACTS OF REVISED POLICIES AND STANDARDS

After evaluating and reviewing airport service levels, airport roles, and airport functional categories, the research team developed a series of recommended revisions to the Aviation Division's Policies and Standards. These revisions are recommended changes in airport design elements with respect to the functional category of the airport. Based on how the airport functions as a part of the community it serves, the research team developed recommendations on what design changes, if any, are needed so the airport can better serve its customers and community.

REVISED POLICIES AND STANDARDS

As clearly articulated in Chapter 4, these changes included adding certain elements as well as deleting certain elements. Table 26 summarizes the elements that were added and the functional categories they impact.

TABLE 26
Summary of Added Design Elements

Design Element Added	Airport Functional Categories Impacted
Apron lighting	Regional/Industrial
AWOS III or Better	Regional/Industrial
DTN/satellite weather	Regional/Industrial
Runway strength	Industrial
Circling/straight-in instrument	Remote
Agricultural apron/pad	Agricultural
Agricultural access road	Agricultural

As shown in the table, these changes mainly impact larger airports whose role is either Transport or General Utility stage II. They typically serve aircraft with ARCs of B-II or larger, airports that generally serve large airplanes. Examples of these airplanes are listed in Appendix A.

The one exception is the addition of a non-precision instrument approach for airports serving remote communities. Often these airports serve the ranching and energy industries that drive the local economy. That, along with the need for medical emergency access that is essential for these remote areas, makes an instrument approach an important addition to these communities. Depending on the level of medical accessibility in a particular community, an instrument approach is possibly a necessity. Since this study focuses on the smaller, less active general aviation airports that often have difficulty generating and justifying financial support, the discussion will focus on those airports.

At agricultural airports, there are legitimate needs for both agricultural loading pads and access roads for these pads. Pads built for aerial applicators provide an area to safely and efficiently operate away from other general aviation traffic. They also prevent other apron areas from being damaged due to the weight of trucks and other equipment used to support the agricultural aviation activity. For the same reasons, access roads separate from the main airport entrance are needed for these operations.

Facilities classified as regional and industrial do not, by their simple definition, face the same level of funding shortfall and disinterest as those airports whose function and significance are not as clear and wide-reaching. The design element changes suggested for regional and industrial airports listed above should enhance the operational capabilities and user base of those already well utilized and successful airports, thus justifying their expense. The recommendations that reduce costs for smaller less-used airports are the focus. Table 27 summarizes the design elements recommended for deletion and the functional categories where they apply.

TABLE 27
Summary of Deleted Design Elements

Design Element Deleted	Airport Functional Categories Impacted
Full parallel taxiway	Special Use - Hunting
Manager’s office, vending machines, 16-hour attendance, and local altimeter	Special Use - Hunting
Reduce Runway width from 60 foot to 50 foot or 75 foot stabilized turf	Special Use - Parks and Lakes/ Agricultural/Access

Special use airports primarily serve those involved in hunting activities and are used on a seasonal basis. Operations at these airports are typically low volume. Although they may serve some large airplanes and have ARCs of B-II, the need for a full parallel taxiway is not justified. Partial taxiways or stub-taxiways to aprons with turnarounds are appropriate. For these same airports, the lack of activity and seasonal use does not warrant a manager’s office, vending machines, the 16-hour attendance, or the local altimeter.

A paved 50-foot wide runway or stabilized turf runways that are 75-feet wide can adequately serve special use airports used for visiting parks and lakes, agricultural airports, and those classified as access airports—airports that have ARCs of B-I. Since special use airports serving the hunting community often accommodate larger aircraft and have a B-II or C-II ARC, these changes are not recommended for this airport category. With access airports providing a minimal level of service to a community, turf runways are appropriate. Since many aerial applicators across the state currently operate from turf strips with no negative impacts to their operation, these runways are appropriate for agricultural airports.

IMPACTS OF REVISED POLICIES AND STANDARDS

To examine the impact of the recommended design element changes outlined above, researchers reviewed the capital improvement programs (CIP) for two different periods. The CIP for aviation projects is a tentative schedule of state and federal projects for a given time period. While it is not a commitment for funding, the CIP does include projects that are under serious consideration for funding. The detailed list of projects is based on expected funding levels at both the federal and state level. Therefore, it is a useful platform for examining the impacts of revised standards.

The two CIP periods are the 1998-2000 CIP and the 2000-2002 CIP. Note that there is an overlap of one year between these two documents. Also, some projects may roll over from one year to the next. However, since each project and airport is studied individually for its cost saving potential, this should not be a problem. The idea is to not necessarily make determinations on cost savings for any specific planning period, but, more importantly, to ascertain the potential savings for specific projects at specific types of airports. These airports include those functionally categorized as agricultural, special use, remote, and access. The CIPs used were selected because they include a CIP completed prior to this study and a recently submitted CIP. They reflect the funding needs and desires of the state's airports at the current time and should prove helpful in assessing what cost savings, if any, certain airports can realize from the revised standards.

In reviewing the CIPs for potential cost savings, the research team considered multiple perspectives. First, researchers considered the airport's ARC along with the current design standards for the particular airport. Secondly, they considered the functional category along with the recommended revisions for design standards affecting the applicable functional category. Note that because design standards, current or recommended, allow planners to include certain projects in the CIP, a potential cost savings was not determined in cases where functional category, ARC, airport activity, economic impact, geography and other factors collectively justified a particular project. As is expected in this type of exercise, some airports, regardless of functional categories and prescribed design standards, require certain projects to meet their level of activity and the needs of the particular community they serve. Therefore, some professional judgement is needed when attempting to determine potential cost savings.

1998-2000 Capital Improvement Program

The 1998-2000 CIP consisted of more than $108.5 million in total project costs with $46.3 million, $45.4 million, and $16.7 million slated to come from federal, state, and local sources, respectively. The program only included projects for eight airports classified as agricultural, special use, remote, or access. Table 28 lists those airports, their functional category, the fiscal year when the projects were programmed, and the project costs. The list included five agricultural airports and three access airports. Total costs for projects at these eight airports over the period were $3.87 million with $3.483 million projected to come from the state and the remaining $387,000 from local sponsors.

TABLE 28
Airports with Potential Cost Savings, 1998-2000 CIP

Airport	Functional Category	Fiscal Year	Total Project Cost	Federal	State	Local
Colorado City	Access	1998	$270,000	$0	$243,000	$27,000
Dilley Airpark	Access	1998	$400,000	$0	$360,000	$40,000
Teague	Access	1998	$180,000	$0	$162,000	$18,000
Fabens	Agricultural	1998	$860,000	$0	$774,000	$86,000
Fisher County	Agricultural	1998	$50,000	$0	$45,000	$5,000
Fisher County	Agricultural	1999	$410,000	$0	$369,000	$41,000
Haskell	Agricultural	1998	$70,000	$0	$63,000	$7,000
Haskell	Agricultural	1999	$570,000	$0	$513,000	$57,000
Kent County	Agricultural	1998	$120,000	$0	$108,000	$12,000
Lamesa	Agricultural	1998	$90,000	$0	$81,000	$9,000
Lamesa	Agricultural	1999	$850,000	$0	$765,000	$85,000
TOTAL			**$3,870,000**	**$0**	**$3,483,000**	**$387,000**

Of the $3.87 million in programmed projects at the airports of interest identified above, approximately 84%, or $3.262 million, is allocated for pavement work and pavement-related projects. This includes pavement construction, reconstruction, rehabilitation, resurfacing and overlays, and drainage improvements for runways, taxiways, and apron areas. Also included in this category are expenses for striping and marking pavement. Approximately 10% of the costs, or $368,000, are for lighting projects that include rotating beacons, visual approach aids (PAPIs), lighted windcones and segmented circles, runway threshold lights, and runway and taxiway lighting. Approximately 6% of the costs are for design work. This includes airport layout plan (ALP) development and engineering and design work necessary for future construction projects.

Since pavement work is the most basic of necessities in the operation of an airport, it is not uncommon to see the majority of costs allocated to preserving and protecting the airport pavement. Any potential cost savings will most likely not come from the costs associated with pavement work without major changes in the current use, design standards, and functional category of the airport in question. Safety and operational requirements demand adequate pavement and anything short of shutting down the airport or developing a grass strip will not likely produce any cost savings. As a matter of policy, those airports at the lower end of the spectrum in terms of use and service are eligible only for pavement preservation funding. These airports provide minimal service to the community and would not likely receive funding for any other projects including replacement of the facility.

Since design and engineering work is required to commence future projects, it is not a likely candidate for cost-savings measures. ALPs are also included in this category and with updated ALPs necessary for GPS approaches, this is money well spent.

Airport lighting, the third category of projects, accounted for 10% of the total costs. Some potential exists for saving money in airport lighting. This is, of course, relative to the current level of funding and service provided at particular airports. According to the NASAO/IES report on airport lighting mentioned earlier, states have become involved in obtaining or developing affordable lighting systems for smaller airports that have difficulty paying for the systems (5). A summary of the recommended airport lighting system guidelines is included in Appendix D. Researchers used these guidelines, along with current airport design standards, roles, and functional categories, to determine potential cost savings of airport lighting projects in the 1998-2000 CIP. The only potential for cost savings researchers found was a $150,000 project upgrading LIRL to medium-intensity runway lighting (MIRL). Although current design standards require a minimum of MIRL for BU-II airports, this particular airport currently has LIRL.

The $150,000 project to replace LIRL with MIRL is one that should garner additional consideration. The airport has six based aircraft, a 3,300-foot runway, and no instrument approach. It is an access functional category airport, and, because of this, it is not likely that the airport would receive any project funding aside from funding for pavement preservation work.

Finally, the NASAO/IES guidelines recommend LIRL for Basic Utility-II airports that have no instrument approach. This LIRL is an affordable alternative for this type of airport. Any project costs above and beyond that level are potentially a cost saving. However, it is clear that no set of standards or guidelines can possibly cover all airports under all circumstances. In the interest of safety and operations at the airport, the unique situation and conditions prevalent at the airport should determine what projects are, and are not, appropriate and adequate.

2000-2002 Capital Improvement Program

The 2000-2002 CIP, the most current CIP, consists of more than $147.5 million in total project costs with $72.3 million, $51.6 million, and $23.6 million slated to come from federal, state, and local sources, respectively. The program only included projects for nine different airports that fit the classification of agricultural, special use, remote, or access. Table 29 lists those airports, their functional category, the fiscal year when the projects are programmed, and the project costs. This included three agricultural airports, one access airport, one remote airport, and four special use airports. The total project costs for these nine airports over the period were $7.09 million with $6.38 million projected to come from the state, $108,000 from the FAA, and the remaining $387,000 from local airport sponsors.

TABLE 29
Airports with Potential Cost Savings, 2000-2002 CIP

Airport	Functional Category	Fiscal Year	Total Project Cost	Federal	State	Local
Stanton Mun.	Access	2002	$500,000	$0	$450,000	$50,000
Dimmitt Mun.	Agricultural	2002	$800,000	$0	$720,000	$80,000
Eagle Lake	Agricultural	2001	$50,000	$0	$45,000	$5,000
Spearman Mun.	Agricultural	2000	$101,000	$0	$90,900	$10,100
Spearman Mun.	Agricultural	2001	$632,000	$0	$568,800	$63,200
Dell City Mun.	Remote	2002	$200,000	$0	$180,000	$20,000
Cotulla-LaSalle	Special Use	2000	$407,600	$0	$366,840	$40,760
Cotulla-LaSalle	Special Use	2001	$1,677,500	$0	$1,509,750	$167,750
Dimmitt County	Special Use	2000	$227,000	$0	$204,300	$22,700
Dimmitt County	Special Use	2001	$680,000	$108,000	$612,000	$68,000
Dimmitt County	Special Use	2002	$888,000	$0	$180,000	$88,800
Mustang Beach	Special Use	2002	$200,000	$0	$799,200	$20,000
Rusty Allen Arpt.	Multipurpose	2000	$73,200	$0	$65,880	$7,320
Rusty Allen Arpt.	Multipurpose	2001	$654,700	$0	$589,230	$65,470
TOTAL			**$7,091,000**	**$108,000**	**$6,381,900**	**$709,100**

As mentioned earlier, the 2000-2002 CIP includes a total of $7.09 million in programmed projects at the airports of interest identified above. Approximately 74%, or $5.28 million, is allocated for pavement work and pavement-related projects. This includes pavement construction, reconstruction, rehabilitation, resurfacing and overlays, and drainage improvements for runways, taxiways, and apron areas. Also included in this category are expenses for striping and marking pavement. Approximately 13% of the costs, or $934,900, are for lighting projects that include rotating beacons, visual approach aids (PAPIs), lighted windcones and segmented circles, runway threshold lights, and runway and taxiway lighting. Approximately 12% of the costs are for design, engineering, and planning work. This includes ALP development and engineering and design work necessary for future construction projects. It also includes money for airport action plans and environmental assessments. Not categorized here is $21,000 programmed for deer fencing at an airport.

Like the previous CIP, the 2000-2002 CIP shows little room for reducing costs for pavement work. In assuming no reduction in pavement-related unit costs, pavement preservation improvements are not likely to be a source of potential cost savings without reductions in safety and operational capabilities. Since pavement preservation work for airports is a top priority, even with access category airports capable of obtaining funding for pavement projects, other areas need study to realize cost reductions.

Airport design, engineering, and planning work is also not likely to be source of cost savings. As stated previously, producing these documents and plans are critical to the planning and programming process. Without them, future improvements are not made and needs are not met.

The most likely source, if any, of cost savings at these smaller, less active airports is in the area of airport lighting. As in the previously examined CIP, some potential does exist for cost savings by using the NASAO/IES guidelines. A $190,000 project at a Basic Utility-II airport to upgrade LIRL with MIRL is programmed. Current airport design standards for the airport call for MIRL. However, NASAO/IES guidelines recommend LIRL for Basic Utility-II airports without an instrument approach. Further, this particular airport is functionally categorized as an access airport, one that provides minimal service to the community. Also, it is understood that airports in this category only receive funding for pavement work to keep the airport operational. Additional consideration is needed to determine the benefits and necessity of funding a project of this nature at an airport of this role and function.

One final potential cost savings opportunity presents itself in the 2000-2002 CIP. This is a $50,000 project to install runway end identifier lights (REILs) at an agricultural airport. Design standards state that REILs are needed at General Utility-I airports, the functional classification for this type of airport. This functional category means that at least 60% of the activity at the airport is agricultural activity. The NASAO/IES guidelines recommend low-intensity REILs for General Utility-I airports with no instrument approach. However, the airport may not fit the mold of those airports the NASAO/IES report targets. With a significant investment in the airport pavement being made, and the current design standard calling for a minimum of a straight-in instrument approach, reducing the intensity of the REILs for a small cost savings does not seem appropriate. This is clearly an example of the type of consideration that is needed for specific projects. A "big picture" perspective is needed before realizing any cost savings by implementing any reduced or revised standards. Planners should consider many factors in addition to safety.

CONCLUSION

Reviewing the CIPs of two different planning periods and considering the airport's functional category, role, as well as certain industry guidelines and recommended revised standards in the process, highlights some important considerations. First, the vast majority of programmed funds are allocated for pavement construction and pavement preservation. None of the revised standards or policies impact pavement or pavement maintenance and, consequently, there is no opportunity for cost savings without addressing the pricing and cost issues associated with various pavement materials and the process of constructing, resurfacing, and rehabilitating the pavement. Neither is there much opportunity for reducing costs associated with developing planning, engineering, and design documents. Since these are required for projects to move forward, there is little savings available in this area as the market generally dictates the costs of producing these drawings and reports.

There is some potential for cost savings, however, in the area of airport lighting systems. Now that the state has functional categories for its airports, the applicable standards are more clear. With guidelines available for smaller, less active airports developed and accepted by the state airport industry, states should feel more comfortable in their planning and programming decisions. Airport lighting is one area where cost savings potential does exist. However, multiple factors need consideration. These include the role of the airport, its functional category, the level of activity and based aircraft, the level of local support received by the airport, the impact of the standard on safety, the current design standard, and the future role and design standard of the airport. Planners should consider all of these issues collectively to make an informed decision.

Perhaps more importantly, this analysis reveals that large sums of money are not being needlessly spent at the system's smaller, less active airports. Though they are important to the state and the communities they serve, they are not being overbuilt. Although this conclusion does not include all of the smaller and less active airports, it does pertain to those that have the local interest and support to develop needed projects. Airports on the small end of the spectrum that have projects included in the recent and current CIPs showed little opportunity for cost savings. Those that did not have any projects included in the CIP can potentially benefit from the NASAO/IES lighting guidelines or from other revised standards if the standards are more affordable than the previous alternative. Finally, all small, low activity airports that serve important functions in their community and region should benefit from a planning approach that considers the airport's role, function, and any alternative standards simultaneously. This lower cost approach may make improvements possible for some airports while reducing overall costs to the state.

It appears that using NASAO/IES airport lighting guidelines where appropriate can result in some cost savings. However, with the majority of costs associated with pavement construction and pavement management projects, significant cost savings are unlikely without cost reduction strategies in that area. Nevertheless, identifying cost-saving alternatives on non-pavement projects that make up 25% of the project costs in the CIP is possible, and planners should pursue this effort. Therefore, the research team recommends using NASAO/IES guidelines when appropriate as well as the revised standards outlined in Chapter 4. The team also recommends exploring and pursuing potential cost saving strategies with respect to pavement construction and pavement management projects including more aggressive marketing of the RAMP program to reduce costs associated with replacing pavement. Since the majority of funds are expended in this area, exploring this further for potential cost savings has the opportunity to yield greater economic impacts than in any other single area.

REFERENCES

1. Horton, A.M., and G..B. Dresser. *Texas Airport System Plan Development Needs Assessment*. Prepared for Texas Department of Transportation, Aviation Division. College Station, TX: Texas Transportation Institute, The Texas A&M University System, December 1996.

2. Federal Aviation Administration. *Airport Design.* AC 150/5300-13, Changes 1-5. Washington, D.C.: U.S. Department of Transportation, February 14, 1997.

3. Federal Aviation Administration. *Standards for Specifying Construction of Airports.* AC 150/5370-10A, Change 12. Washington, D.C.: U.S. Department of Transportation, February 2, 1999.

4. Federal Aviation Administration. AC 150/5340-24, *Runway and Taxiway Edge Lighting Systems.* AC 150/5340-24, Change 1. Washington, D.C.: U.S. Department of Transportation, September 3, 1975.

5. National Association of State Aviation Officials. *Guidelines for Airport and Airfield Lighting Systems at General Aviation Airports*. Center for Aviation Research and Education/Illuminating Engineering Society, 1987.

6. Texas Aeronautics Commissions. *Standard Specifications for Construction of General Aviation Airports: Airports Serving Aircraft of 30,000 Pounds Gross Weight or Less.* Austin, TX: 1980.

7. Center for Transportation Research. *Proposed Asphalt and Base Specifications for TxDOT General Aviation Construction*. Austin, TX: The University of Texas at Austin, 1996.

8. National Transportation Safety Board. *Aircraft Accident Database, 1995-1999.* www.ntsb.gov.

9. Horonjeff, Robert, and Francis X. McKelvey. *Planning and Design of Airports.* 4th ed. New York: McGraw-Hill, Inc., 1994.

10. Texas Department of Transportation. *Policies and Standards Document.* Prepared for the Aviation Division. Austin, TX, 1999.

APPENDIX A
General Aviation Aircraft Categorized by Airport Reference Code
(TxDOT/Aviation Division, Policies and Standards Document)

1. Service Level - General Aviation
   Role - Basic Utility
   Applicable Design Standard - Basic Utility Stage I, ARC A-I, small airplanes
   - Aerospatiale TB10 Tobago
   - Aerospatiale TB20 Trinidad
   - Aerospatiale TB360 Tangara
   - Air Tractor 401B
   - Air Tractor 402A/B
   - Air Tractor 502A/B
   - Air Tractor 602
   - Air Tractor 802/802A
   - Ayres 400 Turbo Thrush
   - Ayres 510 Turbo Thrush
   - Ayres 660 Turbo Thrush
   - Bellanca Viking 17-30A
   - Cessna 150/152
   - Cessna 172 Skyhawk
   - Cessna 177 Cardinal
   - Cessna 180/185 Skywagon
   - Cessna 182 Skylane
   - Cessna 206 Stationair
   - Cessna 210 Centurion
   - Cessna 337 Skymaster
   - Gulfstream American Lynx
   - Gulfstream American Cheetah
   - Mooney Allegro
   - Mooney Bravo
   - Mooney Eagle
   - Mooney Encore
   - Mooney Ovation
   - North American Rockwell Commander 111, 112, 114
   - Piper PA-20 Pacer
   - Piper PA-22 Tri-Pacer
   - Piper PA-24 Comanche
   - Piper PA-28-161 Warrior 3
   - Piper PA-28-181 Archer 3
   - Piper PA-28R-201 Arrow
   - Piper PA-32R-301 Saratoga
   - Piper PA-34-220T Seneca 5
   - Piper PA-44-180 Seminole
   - Piper PA-46-350P Malibu Mirage
   - Raytheon Beech Bonanza A36
   - Raytheon Beach Bonanza B36TC

Raytheon Beach Bonanza F33A
Raytheon Beach Bonanza V35B
Raytheon Beach Baron B55/E55
Raytheon Beech Duchess 76

2. Service Level - General Aviation
   Role - Basic Utility
   Design Standard - Basic Utility Stage II, ARC B-I, small airplanes
   - Cessna 402
   - Cessna 404 Titan
   - Cessna 414 Chancellor
   - Cessna 421 Golden Eagle
   - Embraer 121 Xingu
   - Gulfstream Cougar GA-7
   - Piper Cheyenne III-A
   - Piper 400LS Cheyenne
   - Piper 31-310 Navaho
   - Piper 60-602P Aerostar
   - Raytheon Beach Baron 58, 58P, 58TC
   - Raytheon Beech Duke B60

3. Service Level - General Aviation; Reliever
   Role - General Utility
   Design Standard - General Utility Stage I, ARC A-II and B-II, small airplanes, less than ten passenger seats
   - Cessna 441 Conquest
   - Cessna 206B Super Cargo Master
   - Cessna CitationJet
   - Commander 560
   - Fairchild Merlin III
   - Raytheon Beech E18S
   - Raytheon Beech King Air C90B
   - Raytheon Beech King Air B200

   General Utility Stage I, ARC A-I, A-II, B-I, and B-II, small airplanes, ten or more passenger seats
   - Cessna 208 Caravan 675
   - Cessna 208B Grand Caravan
   - Cessna 421
   - De Havilland Twin Otter
   - Embraer 120
   - Fairchild Merlin IV
   - Fairchild Metro Executive

Mitsubishi MU-2
Raytheon Beech Airliner C99
Raytheon Beech King Air BE-200
Raytheon Beech King Air BE-300LW

4. Service Level - General Utility
Role - General Utility
Design Standard: General Utility Stage II, ARC B-I and B-II, large airplanes, greater than 12,500 pounds and less than 30,000 pounds
    Bombardier Learjet 28
    Bombardier Learjet 29
    Bombardier Learjet 31A
    British Aerospace Jetstream 31
    Cessna Citation 7
    Cessna Bravo
    Cessna Excel
    Cessna Ultra
    Dassault Aviation Falcon 10
    Embraer-110 Bandeirante
    Fairchild Aerospace Merlin 4C
    Israel Aircraft Industries Astra SP, SPX
    Mitsubishi Diamond MU-300
    Piaggio PD-808
    Raytheon Beech 1900D Airliner
    Raytheon Beech Jet BE 400 A
    Raytheon Beech King Air 350
    Raytheon Beech Starship BE 2000
    Raytheon Aircraft Co. Hawker 800XP
    Sabreliner Corp. Sabreliner 40, 60, 65
    Shorts 330
    Shorts 360

General Utility Stage II, ARC B-II, large airplanes, greater than 30,000 pounds and less than 60,000 pounds
    Bombardier (de Havilland) Dash 8Q-200, Dash 8Q-300
    Cessna Citation 10
    Dassault Aviation Falcon 20, 50
    Dassault Falcon 200
    Dassault Aviation Falcon 900C, 900EX
    Dassault Aviation Falcon 2000
    Fokker F-27-500

5. Service Level - General Aviation
   Role - Transport
   Design Standard: Transport, ARC C-II or C-III, airplanes less than 60,000 pounds
      Bombardier Canadair SE
      Bombardier Challenger 600W, 601-IA, 601-3A, 601-3R, 604
      Bombardier Corporate Jetliner
      Bombardier Learjet 35A, 45, 60
      Dassault Aviation Falcon 50EX
      Dassault Aviation Falcon 900B
      Fairchild Aerospace Envoy 3
      Fokker F-28-3000, F28-4000
      Israel Aircraft Industries Galaxy
      Raytheon Aircraft Co. Beechjet 400A
      Raytheon Aircraft Co. Hawker Horizon
      Sabreliner Corp. Sabreliner 80.

APPENDIX B
Airports by Functional Class

AIRPORT NAME	CITY	FUNCTIONAL CATEGORY
Abilene Regional	Abilene	COMMERCIAL
Amarillo International	Amarillo	COMMERCIAL
Austin-Bergstrom International	Austin	COMMERCIAL
Brownsville/South Padre Island International	Brownsville	COMMERCIAL
Bush Intercontinental	Houston	COMMERCIAL
Corpus Christi International	Corpus Christi	COMMERCIAL
Dallas Love Field	Dallas	COMMERCIAL
Dallas-Fort Worth International	Dallas-Fort Worth	COMMERCIAL
Easterwood Field	College Station	COMMERCIAL
El Paso International	El Paso	COMMERCIAL
Ellington Field	Houston	COMMERCIAL
Gregg County	Longview	COMMERCIAL
Jefferson County	Beaumont/Port Arthur	COMMERCIAL
Killeen Municipal	Killeen	COMMERCIAL
Laredo International	Laredo	COMMERCIAL
Lubbock International	Lubbock	COMMERCIAL
Mathis Field	San Angelo	COMMERCIAL
McAllen Miller International	McAllen	COMMERCIAL
Midland International	Midland	COMMERCIAL
Rio Grande Valley International	Harlingen	COMMERCIAL
San Antonio International	San Antonio	COMMERCIAL
Sheppard AFB/Wichita Falls Municipal	Wichita Falls	COMMERCIAL
Texarkana Regional-Webb Field	Texarkana	COMMERCIAL
Tyler Pounds Field	Tyler	COMMERCIAL
Victoria Regional	Victoria	COMMERCIAL
Waco Regional	Waco	COMMERCIAL
William P. Hobby	Houston	COMMERCIAL
Addison	Dallas	RELIEVER
Arlington Municipal	Arlington	RELIEVER
Austin/Waller County (New)	Austin/Waller	RELIEVER
Brazoria County	Angleton/Jackson	RELIEVER
Clover Field	Houston	RELIEVER
David Wayne Hooks Memorial	Houston	RELIEVER
Denton Municipal	Denton	RELIEVER
Fort Worth Alliance	Fort Worth	RELIEVER
Fort Worth Meacham International	Fort Worth	RELIEVER
Fort Worth Spinks	Fort Worth	RELIEVER
Georgetown Municipal	Georgetown	RELIEVER
Grand Prairie Municipal	Grand Prairie	RELIEVER
Greater Austin-Pflugerville (New)	Pflugerville	RELIEVER
La Porte Municipal	La Porte	RELIEVER
Lancaster	Lancaster	RELIEVER
McKinney Municipal	McKinney	RELIEVER

AIRPORT NAME	CITY	FUNCTIONAL CATEGORY
Mesquite Metro	Mesquite	RELIEVER
Montgomery County	Conroe	RELIEVER
Redbird	Dallas	RELIEVER
San Marcos Municipal	San Marcos	RELIEVER
Stinson Municipal	San Antonio	RELIEVER
Sugar Land Municipal	Houston	RELIEVER
West Houston	Houston	RELIEVER
A. L. Mangham Jr. Regional	Nacogdoches	REGIONAL
Alice International	Alice	REGIONAL
Alpine-Casparis Municipal	Alpine	REGIONAL
Angelina County	Lufkin	REGIONAL
Aransas County	Rockport	REGIONAL
Avenger Field	Sweetwater	REGIONAL
Bay City Municipal	Bay City	REGIONAL
Big Spring McMahon-Wrinkle	Big Spring	REGIONAL
Brownwood Regional	Brownwood	REGIONAL
Burnet Municipal Kate Craddock Field	Burnet	REGIONAL
C.David Campbell Field-Corsicana Municipal	Corsicana	REGIONAL
Cleburne Municipal	Cleburne	REGIONAL
Cox Field	Paris	REGIONAL
Dalhart Municipal	Dalhart	REGIONAL
Del Rio International	Del Rio	REGIONAL
Draughon-Miller Central Texas Regional	Temple	REGIONAL
Maverick County Memorial International	Eagle Pass	REGIONAL
Fort Stockton-Pecos County	Fort Stockton	REGIONAL
Scholes International Airport	Galveston	REGIONAL
Garner Field	Uvalde	REGIONAL
Graham Municipal	Graham	REGIONAL
Hale County	Plainview	REGIONAL
Harrison County	Marshall	REGIONAL
Hereford Municipal	Hereford	REGIONAL
Huntsville Municipal	Huntsville	REGIONAL
Hutchinson County	Borger	REGIONAL
Jasper County-Bell Field	Jasper	REGIONAL
Kerrville Municipal/Louis Schreiner Field	Kerrville	REGIONAL
Kimble County	Junction	REGIONAL
Kleberg County	Kingsville	REGIONAL
Levelland Municipal	Levelland	REGIONAL
Midland Airpark	Midland	REGIONAL
Moore County	Dumas	REGIONAL
Mount Pleasant Municipal (New)	Mount Pleasant	REGIONAL
New Braunfels Municipal	New Braunfels	REGIONAL
Odessa-Schlemeyer Field	Odessa	REGIONAL

AIRPORT NAME	CITY	FUNCTIONAL CATEGORY
Ozona Municipal	Ozona	REGIONAL
Perry Lefors Field	Pampa	REGIONAL
Stephens County	Breckenridge	REGIONAL
Wharton Municipal	Wharton	REGIONAL
Wilbarger County	Vernon	REGIONAL
Winston Field	Snyder	REGIONAL
Grayson County	Sherman/Denison	INDUSTRIAL
Hondo Municipal	Hondo	INDUSTRIAL
Majors	Greenville	INDUSTRIAL
Mineral Wells	Mineral Wells	INDUSTRIAL
TSTC Waco	Waco	INDUSTRIAL
Andrews County	Andrews	MULTIPURPOSE
Arledge Field	Stamford	MULTIPURPOSE
Athens Municipal	Athens	MULTIPURPOSE
Atlanta Municipal	Atlanta	MULTIPURPOSE
Bandera County (New)	Bandera	MULTIPURPOSE
Beaumont Municipal	Beaumont	MULTIPURPOSE
Beeville Municipal	Beeville	MULTIPURPOSE
Bishop Municipal	Bishop	MULTIPURPOSE
Bowie Municipal	Bowie	MULTIPURPOSE
Brazoria County	Angleton/Lake Jackson	MULTIPURPOSE
Brenham Municipal	Brenham	MULTIPURPOSE
Bridgeport Municipal	Bridgeport	MULTIPURPOSE
Bruce Field	Ballinger	MULTIPURPOSE
Caddo Mills Municipal	Caddo Mills	MULTIPURPOSE
Caldwell Municipal	Caldwell	MULTIPURPOSE
Calhoun County	Port Lavaca	MULTIPURPOSE
Castroville Municipal	Castroville	MULTIPURPOSE
Center Municipal	Center	MULTIPURPOSE
Chambers County	Anahuac	MULTIPURPOSE
Cherokee County	Jacksonville	MULTIPURPOSE
Childress Municipal	Childress	MULTIPURPOSE
City of Tulia/Swisher County Municipal	Tulia	MULTIPURPOSE
Clarendon Municipal	Clarendon	MULTIPURPOSE
Clark Field Municipal	Stephenville	MULTIPURPOSE
Clarksville-Red River County	Clarksville	MULTIPURPOSE
Cleveland Municipal	Cleveland	MULTIPURPOSE
Clifton Municipal/Isenhower	Clifton	MULTIPURPOSE
Cochran County	Morton	MULTIPURPOSE
Coleman Municipal	Coleman	MULTIPURPOSE
Colorado City	Colorado City	MULTIPURPOSE
Comanche County-City	Comanche	MULTIPURPOSE

AIRPORT NAME	CITY	FUNCTIONAL CATEGORY
Commerce Municipal	Commerce	MULTIPURPOSE
Coulter Field	Bryan	MULTIPURPOSE
Crosbyton Municipal	Crosbyton	MULTIPURPOSE
Culberson County	Van Horn	MULTIPURPOSE
Curtis Field	Brady	MULTIPURPOSE
Dan E. Richards Municipal	Paducah	MULTIPURPOSE
Decatur Municipal	Decatur	MULTIPURPOSE
Denver City	Denver City	MULTIPURPOSE
Devine Municipal	Devine	MULTIPURPOSE
Eastland Municipal	Eastland	MULTIPURPOSE
Eden-Concho County (New)	Eden	MULTIPURPOSE
Edinburg International Airport	Edinburg	MULTIPURPOSE
Ennis Municipal	Ennis	MULTIPURPOSE
Fayette Regional Air Center	La Grange	MULTIPURPOSE
Floydada Municipal	Floydada	MULTIPURPOSE
Follett/Lipscomb County	Follett	MULTIPURPOSE
Franklin County	Mount Vernon	MULTIPURPOSE
Gaines County	Seminole	MULTIPURPOSE
Gainesville Municipal	Gainesville	MULTIPURPOSE
Gatesville City-County	Gatesville	MULTIPURPOSE
Giddings-Lee County	Giddings	MULTIPURPOSE
Gillespie County	Fredericksburg	MULTIPURPOSE
Gilmer-Upshur County	Gilmer	MULTIPURPOSE
Gladewater Municipal	Gladewater	MULTIPURPOSE
Gonzales Municipal	Gonzales	MULTIPURPOSE
Granbury Municipal	Granbury	MULTIPURPOSE
Gruver Municipal	Gruver	MULTIPURPOSE
H.H.Coffield Regional	Rockdale	MULTIPURPOSE
Hallettsville Municipal	Hallettsville	MULTIPURPOSE
Hamilton Municipal	Hamilton	MULTIPURPOSE
Hawthorne Field	Kountze/Silsbee	MULTIPURPOSE
Hearne Municipal	Hearne	MULTIPURPOSE
Hemphill County	Canadian	MULTIPURPOSE
Hillsboro Municipal	Hillsboro	MULTIPURPOSE
Houston County	Crockett	MULTIPURPOSE
Houston Gulf	Houston	MULTIPURPOSE
Houston Westside (New)	Houston	MULTIPURPOSE
Houston-Southwest	Houston	MULTIPURPOSE
Jackson County	Edna	MULTIPURPOSE
Jones Field	Bonham	MULTIPURPOSE
Karnes County	Kenedy	MULTIPURPOSE
Kendall Co-Boerne (New)	Boerne	MULTIPURPOSE
Kickapoo Downtown Airpark	Wichita Falls	MULTIPURPOSE
Lampasas	Lampasas	MULTIPURPOSE

AIRPORT NAME	CITY	FUNCTIONAL CATEGORY
Leon County (New)	Buffalo/Centerville	MULTIPURPOSE
Liberty Municipal	Liberty	MULTIPURPOSE
Littlefield Municipal	Littlefield	MULTIPURPOSE
Live Oak County	George West	MULTIPURPOSE
Livingston Municipal	Livingston	MULTIPURPOSE
Llano Municipal	Llano	MULTIPURPOSE
Lockhart Municipal	Lockhart	MULTIPURPOSE
Marfa Municipal	Marfa	MULTIPURPOSE
Marian Airpark	Wellington	MULTIPURPOSE
Mason County	Mason	MULTIPURPOSE
McGregor Municipal	Waco	MULTIPURPOSE
McKinley Field	Pearsall	MULTIPURPOSE
Memphis Municipal	Memphis	MULTIPURPOSE
Menard County	Menard	MULTIPURPOSE
Mexia-Limestone County	Mexia	MULTIPURPOSE
Miami-Roberts County	Miami	MULTIPURPOSE
Mid Valley	Weslaco	MULTIPURPOSE
Midlothian/Waxahachie Municipal	Midlothian/Waxahachie	MULTIPURPOSE
Mills County (New)	Goldthwaite	MULTIPURPOSE
Mineola-Quitman	Mineola/Quitman	MULTIPURPOSE
Muleshoe Municipal	Muleshoe	MULTIPURPOSE
Navasota Municipal	Navasota	MULTIPURPOSE
Newton Municipal	Newton	MULTIPURPOSE
Nueces County	Robstown	MULTIPURPOSE
Olney Municipal	Olney	MULTIPURPOSE
Orange County	Orange	MULTIPURPOSE
Palacios Municipal	Palacios	MULTIPURPOSE
Palestine Municipal	Palestine	MULTIPURPOSE
Panhandle-Carson County	Panhandle	MULTIPURPOSE
Panola County-Sharpe Field	Carthage	MULTIPURPOSE
Pecos Municipal	Pecos	MULTIPURPOSE
Perryton Ochiltree County	Perryton	MULTIPURPOSE
Pineland Municipal	Pineland	MULTIPURPOSE
Pleasanton Municipal	Pleasanton	MULTIPURPOSE
Port Isabel-Cameron County	Port Isabel	MULTIPURPOSE
Post-Garza County Municipal	Post	MULTIPURPOSE
Quanah Municipal	Quanah	MULTIPURPOSE
Robert R. Wells, Jr	Columbus	MULTIPURPOSE
Rockwall Municipal	Rockwall	MULTIPURPOSE
Rooke Field	Refugio	MULTIPURPOSE
Roy Hurd Memorial	Monahans	MULTIPURPOSE
Rusk County	Henderson	MULTIPURPOSE
Rusty Allen	Lago Vista	MULTIPURPOSE
San Patricio County	Sinton	MULTIPURPOSE

AIRPORT NAME	CITY	FUNCTIONAL CATEGORY
San Saba County Municipal	San Saba	MULTIPURPOSE
Seymour Municipal	Seymour	MULTIPURPOSE
Shamrock Municipal	Shamrock	MULTIPURPOSE
Sherman Municipal	Sherman	MULTIPURPOSE
Slaton Municipal	Slaton	MULTIPURPOSE
Smithville Municipal	Smithville	MULTIPURPOSE
Sonora Municipal	Sonora	MULTIPURPOSE
Starr County	Rio Grande City	MULTIPURPOSE
Sulphur Springs Municipal	Sulphur Springs	MULTIPURPOSE
T.P.McCampbell	Ingleside	MULTIPURPOSE
Taylor Municipal	Taylor	MULTIPURPOSE
Terrell Municipal	Terrell	MULTIPURPOSE
Terry County	Brownfield	MULTIPURPOSE
Tradewind	Amarillo	MULTIPURPOSE
Weatherford (New)	Weatherford	MULTIPURPOSE
West Texas	El Paso	MULTIPURPOSE
Wheeler Municipal	Wheeler	MULTIPURPOSE
Wills Point Municipal	Wills Point	MULTIPURPOSE
Winkler County	Wink	MULTIPURPOSE
Winnsboro Municipal	Winnsboro	MULTIPURPOSE
Yoakum Municipal	Yoakum	MULTIPURPOSE
Benger Air Park	Friona	AGRICULTURE
Cameron Municipal Airpark	Cameron	AGRICULTURE
Chambers County-Winnie Stowell	Winnie/Stowell	AGRICULTURE
Dimmitt Municipal	Dimmitt	AGRICULTURE
Eagle Lake	Eagle Lake	AGRICULTURE
Fabens	Fabens	AGRICULTURE
Fisher County	Rotan/ Roby	AGRICULTURE
Foard County	Crowell	AGRICULTURE
Hamlin Municipal	Hamlin	AGRICULTURE
Haskell Municipal	Haskell	AGRICULTURE
Kent County	Jayton	AGRICULTURE
Knox City Municipal	Knox City	AGRICULTURE
Lamesa Municipal	Lamesa	AGRICULTURE
Munday Municipal	Munday	AGRICULTURE
Oldham County	Vega	AGRICULTURE
Spearman Municipal	Spearman	AGRICULTURE
Stratford Field (New)	Stratford	AGRICULTURE
Sunray (New)	Sunray	AGRICULTURE
T-Bar	Tahoka	AGRICULTURE
Brooks County	Falfurrias	SPECIAL USE
Charles R. Johnson	Port Mansfield	SPECIAL USE

AIRPORT NAME	CITY	FUNCTIONAL CATEGORY
Cotulla-LaSalle County	Cotulla	SPECIAL USE
Dimmit County	Carrizo Springs	SPECIAL USE
Duval-Freer	Freer	SPECIAL USE
Jim Hogg County	Hebbronville	SPECIAL USE
Mustang Beach	Port Aransas	SPECIAL USE
Possum Kingdom	Graford	SPECIAL USE
Zapata County	Zapata	SPECIAL USE
Dell City Municipal	Dell City	REMOTE
Edwards County	Rocksprings	REMOTE
Lajitas	Lajitas	REMOTE
Mile High	Sierra Blanca	REMOTE
Presidio Lely International	Presidio	REMOTE
Real County	Leakey	REMOTE
Terrell County	Dryden	REMOTE
Abernathy Municipal	Abernathy	ACCESS
Albany Municipal/Hickman Field	Albany	ACCESS
Cisco Municipal	Cisco	ACCESS
Crane County	Crane	ACCESS
Crystal City Municipal	Crystal City	ACCESS
Cuero Municipal	Cuero	ACCESS
Cypress River	Jefferson	ACCESS
Dilley Airpark	Dilley	ACCESS
Dublin Municipal	Dublin	ACCESS
Eldorado	Eldorado	ACCESS
Greater Morris County	Daingerfield	ACCESS
Groveton-Trinity County	Groveton	ACCESS
Higgins-Lipscomb County	Higgins	ACCESS
Jacksboro Municipal	Jacksboro	ACCESS
Kirbyville	Kirbyville	ACCESS
Madisonville Municipal	Madisonville	ACCESS
Marlin	Marlin	ACCESS
McLean/Gray County	McLean	ACCESS
Robert Lee	Robert Lee	ACCESS
San Augustine County	San Augustine	ACCESS
Stanton Municipal	Stanton	ACCESS
Stonewall County	Aspermont	ACCESS
Teague Municipal	Teague	ACCESS
The Carter Memorial	Luling	ACCESS
Upton County	McCamey	ACCESS
Winters Municipal	Winters	ACCESS

APPENDIX C
Existing Design Standards
(TxDOT/Aviation Division, Policies and Standards Document)

A. Service Level - General Aviation
Role - Basic Utility
Applicable Design Standard:

- Basic Utility—Stage I (BU-I), ARC A-I, small airplanes

1. Minimum Runway:
    - Length - Design for Aircraft Approach Category A and Airplane Design Group I aircraft and 75 percent of small airplanes with less than 10 passenger seats (Table 5).
    - Width - 60 feet.
    - Strength - 12,500 pounds.

2. Minimum Taxiway: Stub taxiway to tie-down area.

3. Minimum Apron:
   Per AC 150/5300-13 "Airport Design" - Appendix 5, based on area needed for itinerant and local parking.

4. Minimum Approach: Visual.

5. Minimum Lighting: None.

6. Minimum Visual Approach Aids: Wind indicator and segmented circle. See Section X, paragraph C and Appendix A for criteria.

7. Minimum Service: Telephone.

   Typical Aircraft: Typical small airplanes in Aircraft Approach Category A and Airplane Design Group I with less than 10 passenger seats:

   Aerospatiale Tobago TB 10
   Aerospatiale Trinidad TB20
   Beech Bonanza 33/35/36
   Cessna 150/152
   Cessna 172 Skyhawk
   Cessna 177 Cardinal
   Cessna 180/185 Skywagon
   Cessna 182 Skylane
   Cessna 206 Stationair
   Cessna 210 Centurion
   Gulfstream AA1
   Gulfstream AA5 Cheetah
   Mooney M20

Piper PA-20 Pacer
Piper PA-22 Tri-Pacer
Piper PA-24 Comanche
Piper PA-28 Cherokee/Warrior
Piper PA-28 Arrow
Rockwell Commander 122/114

B. Service Level - General Aviation
Role - Basic Utility
Applicable Design Standard:
Basic Utility—Stage II (BU-II), ARC B-I

1. Minimum Runway:
   - Length - Design for Aircraft Approach Category B and Airplane Design Group I aircraft and 95 percent of small airplanes with less than 10 passenger seats (Table 6).
   - Width - 60 feet.
   - Strength - 12,500 pounds.

2. Minimum Taxiway: Partial or full parallel taxiway if needed to meet AC 150/5300-13 line-of-sight standards. Stub taxiway to apron and runway end turnarounds if no taxiway.

3. Minimum Apron:
   Per AC 150/5300-13 "Airport Design" - Appendix 5, based on area needed for itinerant and local parking.

4. Minimum Approach: Visual.

5. Minimum Lighting: MIRL and taxiway turnout lights.

6. Minimum Visual Approach Aids: Lighted wind indicator, rotating beacon, and segmented circle,. See Section X, paragraph C and Appendix A for criteria.

7. Minimum Service: Basic terminal with public space, male and female restrooms, 24-hour telephone.

   Typical Aircraft: The aircraft served by Basic Utility I airports plus small airplanes in Aircraft Approach Category B and Airplane Design Group I:

   Beech Twin Bonanza
   Beech Baron B55/56
   Beach Baron 58

Beech Duchess 76
Beech Duke 1B60
Cessna 337 Skymaster
Cessna 404 Titan
Cessna 414 Chancellor
Gulfstream Cougar GA-7
Mooney M20
Piper PA-44 Seminole
Piper 31-310 Navaho
Piper 60-602P Aerostar

C. Service Level - General Aviation; Reliever
Role - General Utility

Applicable Design Standards:

- Acceptable: General Utility—Stage I, ARC B-I;
- Recommended: General Utility—Stage I, ARC B-II.

1. Minimum Runway:
   - Length - Design for Aircraft Approach Category B and Design Group I aircraft and 100 percent of small airplanes with less than 10 passenger seats (Table 7).
   - Width - 60 feet acceptable, 75 feet recommended.
   - Strength - 12,500 pounds.

2. Minimum Taxiway: Part or full parallel taxiway if needed to meet AC 150/5300-13 line-of-sight standards. Runway end turnarounds if no taxiway.

3. Minimum Apron:
   Per AC 150/5300-13 "Airport Design" - Appendix 5 based on area needed for itinerant and local parking.

4. Minimum Approach: Straight-in non-precision instrument.

5. Minimum Lighting: MIRL. Taxiway centerline or edge reflectors on taxiways to lighted runway. Taxiway exit signs in lieu of 2 blue lights may be included as part of a runway lighting project.

6. Minimum Visual Approach Aids: Lighted wind indicator, rotating beacon, and segmented circle. PAPI-2 and REILs both ends of primary runway. PAPI-2 and REILs both ends of secondary runway if the runway is needed for wind coverage. See Section X, paragraph C for criteria on visual approach aids. See Section X, paragraph D for criteria on instrument approach aids.

7. Minimum Service: Terminal with male and female restrooms, telephone, public space, flight planning area, manager's office, vending machines; aviation gasoline and Jet A fuel; and a local altimeter.

   Typical Aircraft: The aircraft served by basic utility airports plus small airplanes in Aircraft Approach Categories A and B and Airplane Design Group II with less than 10 passenger seats:

   Beech 18
   Beech King Air C90A
   Cessna 441 Conquest
   Cessna Caravan
   Cessna 402
   Commander 560
   Embraer 12 Xingo
   Fairchild Merlin III
   Piper Cheyenne III-A
   TBN-700

   Typical small airplanes in Aircraft Approach Categories A and B and Airplane Design Groups I and II with 10 or more passenger seats:

   Beech Airliner A99
   Beech King Air BE-200
   Beech King Air BE-300LW
   Cessna 421
   De Havilland Twin Otter
   Embraer 120
   Fairchild Merlin IV
   Fairchild Metro Executive
   Mitsubishi MU-2

D. Service Level - General Aviation; Reliever
Role - General Utility

Applicable Design Standard:
General Utility—Stage II, ARC B-II;

1. Minimum Runway:
   - Length- Design for Aircraft Approach Category B and Airplane Design Group II aircraft, 75 percent of the fleet and 60 percent useful load (Table 9).
   - Width - 75 feet.
   - Strength - 30,000 pounds.

2. Minimum Taxiway: Full parallel taxiway.

3. Minimum Apron:
   Per AC 150/5300-13, “Airport Design” - Appendix 5 based on area needed for local and itinerant parking.

4. Minimum Approach: Straight-in, non-precision instrument, 600 ft.-1 mile minimums for Category A and B aircraft.

5. Minimum Lighting: MIRL. Taxiway centerline or edge reflectors on taxiways to lighted runway. Turnout MITLs or taxiway exit signs in lieu of 2 blue lights may be included as part of a runway lighting project.

6. Minimum Visual Approach Aids: Lighted wind indicator, rotating beacon, and segmented circle. PAPI-4 and REILs both ends of primary runway. PAPI-4 and REILs both ends of secondary runway if the runway is needed for wind coverage. See Section X, paragraph C for criteria on visual approach aids. See Section X, paragraph D for criteria on instrument approach aids.

7. Minimum Service: Terminal with male and female rest rooms, telephone, public space, flight planning area, manager’s office, vending machines; aviation gasoline and Jet A fuel, 16 hour attendance; and a local altimeter.

   Typical Aircraft: The aircraft served by basic utility and general utility airports plus large airplanes in Aircraft Approach Categories A and B and Airplane Design Groups I, II, or III and weighing 30,000 pounds or less:

   Beech Jet BE 400 A
   Beech King Air BE-350
   Beech Starship BE 2000
   Cessna Citation II
   Cessna Citation III
   Dassault Falcon-10
   Dassault Falcon-20
   Embraer-110 Bandeirante
   Gates Learjet 28
   Gates Learjet 29
   Mitsubishi Diamond MU-300
   Piaggio PD-808
   Rockwell Sabre 40/60/65
   Shorts 330
   Shorts 360

Typical large airplanes in Aircraft Approach Categories A and B and Airplane Design Groups I, II or III and weighing between 30,000 and 60,000 pounds:

British Aerospace BSE 125
Canadair Challenger S
Convair 440
Convair 580
De Havilland Dash 7-100
De Havilland Dash 8-300
Dassault 941
Dassault Falcon-50
Dassault Falcon-200
Dassault Falcon-900
Fairchild FH-227 B,D
Fokker F-27-500
Fokker F-28-1000

E. Service Level - General Aviation; Reliever
Role - Transport

Applicable Design Standards:

- Transport, ARC C-II;
- Transport, ARC C-III.

1. Minimum Runway:
   - Length- Design for Aircraft Approach Categories C and D and Airplane Design Group II aircraft, 75 percent of the fleet and 60 percent useful load (Table 9) or critical aircraft.
   - Width - 100 feet.
   - Strength - 30,000 pounds.

2. Minimum Taxiway: Full parallel taxiway.

3. Minimum Apron:
   Per AC 150/5300-13, "Airport Design" - Appendix 5 based on area needed for local and itinerant parking.

4. Minimum Approach: Straight-in, non-precision instrument, 600 ft.-1 1/2 mile minimums for Category C and D aircraft.

5. Minimum Lighting: MIRL. Taxiway centerline or edge reflectors on taxiways to lighted runway. Turnout MITLs or taxiway exit signs in lieu of 2 blue lights may be included as part of a runway lighting project.

6. Minimum Visual Approach Aids: Lighted wind indicator, rotating beacon, and segmented circle. PAPI-4 and REILs both ends of primary runway. PAPI-4 and REILs both ends of secondary runway if the runway is needed for wind coverage. See Section X, paragraph C for criteria on visual approach aids. See Section X, paragraph D for criteria on instrument approach aids.

7. Minimum Service: Terminal with male and female rest rooms, telephone, public space, flight planning area, manager's office, vending machines; aviation gasoline and Jet A fuel, 16 hour attendance; and a local altimeter.

   Typical Aircraft: The aircraft served by basic utility and general utility airports plus large airplanes in Aircraft Approach Categories A and B and Airplane Design Groups I, II, or III and weighing 30,000 pounds or less; plus typical large airplanes in Aircraft Approach Categories C and D and Airplane Design Groups I, II, or III and weighing between 30,000 and 60,000 pounds.

F. Service Level - Non-Primary Commercial Service
Role - Transport

Applicable Design Standards:

- Transport, ARC C-II;
- Transport, ARC D-I;
- Transport, ARC D-II.

1. Minimum Runway:
   - Length- Per AC 150/5325-4A, "Runway Length Requirements for Airport Design."
   - Provide runway length for the critical aircraft forecast to use the airport or use the runway length curve for large aircraft less than 60,000 pounds and for 75 percent of the fleet and 60 percent useful load, which ever is greater.
   - Width - 100 feet minimum.
   - Strength - Based on the weight of the critical aircraft forecast to use the airport.

2. Minimum Taxiway: Full parallel taxiway.

3. Minimum Apron: Per AC 150/5360-13, "Planning and Design Guidelines for Airport Terminal Facilities".

4. Minimum Approach: Precision instrument (ILS), 200 ft.-1/2 mile minimums.

   FAA Order 7031.2B "Airway Planning Standard Number One - Terminal Air Navigation Facilities and Air Traffic Control Services" establishes minimum criteria for an ILS based on annual instrument approaches (AIA) by air carrier, air taxi, and general aviation aircraft.

5. Minimum Lighting: MIRL, MITL to lighted runway, MALSR with ILS.

6. Minimum Visual Approach Aids: Lighted wind indicator and rotating beacon. Segmented circle at non-towered airports with non-standard traffic patterns. PAPI-4 and REILs both ends of primary runway. PAPI-4 and REILs both ends of secondary runway if the runway is needed for wind coverage. See Section X, paragraph C for criteria on visual approach aids. See Section X, paragraph D for criteria on instrument approach aids.

7. Minimum Service: Terminal with male and female rest rooms, telephone, public space, flight planning area, manager's office, vending machines; aviation gasoline and Jet A fuel, 18 hour attendance; and a local altimeter.

   FAA AC 150/5360-9, "Planning and Design of Airport Terminal Building Facilities at Nonhub Locations" and AC 150/5350-13, "Planning and Design Guidelines for Airport Terminal Facilities" establish guidance for airport terminal building development.

G. Service Level - Primary Commercial Service
Role - Transport

Applicable Design Standards:

- Transport, ARC C-II;
- Transport, ARC C-III;
- Transport, ARC D-II;
- Transport, ARC D-III;
- Transport, ARC D-IV.

1. Minimum Runway:
   - Length- Per AC 150/5325-4A, "Runway Length Requirements for Airport Design." Provide runway length for the critical aircraft forecast to use the airport.
   - Width- 100 feet minimum.
   - Strength- Based on the weight of the critical aircraft forecast to use the airport.

2. Minimum Taxiway: Full parallel taxiway for all runways used by scheduled air carriers.

3. Minimum Apron: Per AC 150/5360-13, "Planning and Design Guidelines for Airport Terminal Facilities."

4. Minimum Approach: Precision instrument (ILS), 200 ft.-1/2 mile minimums.

   FAA Order 7031.2B, “Airway Planning Standard Number One - Terminal Air Navigation Facilities and Air Traffic Control Services” establishes minimum criteria for an ILS based on annual instrument approaches (AIA) by air carrier, air taxi, and general aviation aircraft.

5. Minimum Lighting: Medium Intensity Approach Light System with Runway Alignment Indicator Lights (MALSR), MIRL, and MITL to the lighted runway.

6. Minimum Visual Approach Aids: Lighted wind indicator and rotating beacon. Segmented circle at non-towered airports with non-standard traffic patterns.

7. Minimum Service: Terminal with telephone and rest rooms, aviation gasoline and Jet A fuel, 24 hours attendance, and a local altimeter.

   FAA AC 150/5360-9, “Planning and Design of Airport Terminal Building Facilities at Nonhub Locations” and AC 150/5350-13, “Planning and Design Guidelines for Airport Terminal Facilities” establish guidance for airport terminal building development.

APPENDIX D
Recommended Airport Lighting Equipment
(NASAO/IES Subcommittee Recommendations)

Airport Lighting System	Flying Field	Basic Utility I	Basic Utility II	General Utility	Other Than Utility
	Minimum/Enhanced	**Minimum/Enhanced**	**Min/VFR/IFR**	**Min/VFR/IFR**	**VFR/NPIA/PIA**
Wind Indicator	WI/WI	LWI/LWI	LWI/LWI/LWI	LWI/LWI/LWI	LWI/LWI/LWI
Rotating Beacon	-/-	x/x	x/x/x	x/x/x	x/x/x
Runway Lighting	-/-	LIRL/LIRL	LIRL/LIRL/MIRL	MIRL/MIRL/MIRL	MIRL/MIRL/MIRL
PAPI	-/-	-/PAPI	-/PAPI/PAPI	-/PAPI/PAPI	PAPI/PAPI/PAPI
REIL	-/-	-/LREIL	-/LREIL/REIL	-/LREIL/REIL	-/REIL/-
Radio Control	-/-	-/x	-/x/x	-/x/x	x/x/x
Approach Lights	-/-	-/-	-/-/-	-/-/-	-/-/x
Taxiway Lighting	V/R	R/R	R/R/R	R/R/R	MITL/MITL/MITL

Abbreviations:

Wind Indicator:

- WI — Wind indicator with segmented circle
- LWI — Lighted wind indicator with segmented circle

Rotating Beacon:

- – — does not apply
- x — airport beacon (green/clear)

Runway Markings:

- V — daytime Visual markers (nonelectric) contrasting with the air operations area
- R — Reflective visual aid for day or night use
- LIRL — Low Intensity Runway Light
- MIRL — Medium Intensity Runway Light
- HIRL — High Intensity Runway Light

PAPI:

- – — does not apply
- PAPI — Precision Approach Path Indicator

REIL:

- – — does not apply
- LREIL — Low Intensity Runway End Identifier Lights
- REIL — Runway End Identifier Lights

Radio Control:

- – — does not apply
- x — pilot activated radio control of airport lighting

Approach Lights:

- – — does not apply
- x — may include the following

Taxiway Markings:

- V — daytime Visual markers (nonelectric) contrasting with the air operations area
- R — Reflective visual aid for day or night use
- MITL — Medium Intensity Taxiway Light

Notes:

Any airport development may exceed the recommended minimum guidelines

Flying Field **-** the designation of a minimum, turf runway airport developed to state established guidelines or standards.

- NPIA — Non-Precision Instrument Approach
- PIA — Precision Instrument Approach