# CORONA MUNICIPAL AIRPORT
# COMPREHENSIVE LAND USE PLAN

## COUNTY OF RIVERSIDE
## AIRPORT LAND USE COMMISSION

**ADOPTED: March 17, 1993**

**ARIES CONSULTANTS LTD.**

# CORONA MUNICIPAL AIRPORT
# COMPREHENSIVE LAND USE PLAN

Prepared for

**County of Riverside**
**Airport Land Use Commission**

The preparation of this report was financed in part
through a California Aid to Airports Program Grant from the
State of California, Department of Transportation, Division of Aeronautics.

Adopted: March 17, 1993

Prepared by

**ARIES CONSULTANTS LTD.**
Morgan Hill, California

AIRPORT LAND USE COMMISSION — COUNTY OF RIVERSIDE

**RESOLUTION NO. 93.2**
**ADOPTING THE CORONA AIRPORT COMPREHENSIVE LAND USE PLAN**

WHEREAS, California Public Utilities Code Section 21670 et. seq., requires each county in the state with an airport or landing strip operated for the benefit of the general public, to establish a Commission called the Airport Land Use Commission (ALUC) that will promote public health, welfare and safety for those areas around the public use airports in said county; and,

WHEREAS, in December 1970, after a duly noticed public hearing, the Riverside County Board of Supervisors, acting in conjunction with the mayors of the cities in the county, designated the existing five member Riverside County Aviation Commission to assume the planning responsibilities of an ALUC and did in 1982, augment the ALUC with two members selected by the Committee of Mayors; and,

WHEREAS, Public Utilities Code Section 21675 provides that an ALUC shall formulate and adopt a comprehensive land use plan (CLUP) for each operating, public use airport and that each CLUP shall contain land use planning guidelines to promote compatible land use development in the areas surrounding each airport; and,

WHEREAS, on February 7, 1991, the Riverside County Board of Supervisors authorized the Riverside County ALUC to prepare the Corona Airport Comprehensive Land Use Plan (hereinafter alternatively referred to as "the project") and,

WHEREAS, in order to comply with California Public Resources Code Section 21000 et. seq., an initial study has been prepared by the Riverside County (ALUC) to evaluate the potential of the project for adverse environmental impact; and,

WHEREAS, as a result of the initial study, there is no evidence before the Riverside County ALUC that the project will have a potential for adverse environmental impact; and,

WHEREAS, a negative declaration has been prepared to signify that no adverse environmental impacts will, in fact, occur; and,

WHEREAS, in accordance with Section 711.2 of the Fish and Game Code, the Riverside County ALUC has found that the project will not individually or cumulatively have an adverse effect on wildlife resources; and,

WHEREAS, a public hearing was held before the Riverside County ALUC on January 20, 1993 at which time all public and affected government agency comments, testimony and evidence were presented.

NOW THEREFORE, BE IT RESOLVED, FOUND, DETERMINED AND ORDERED, by the Riverside County ALUC, in regular session assembled on February 17, 1993, that the Corona Airport Comprehensive Land Use Plan is hereby adopted.

BE IT FURTHER RESOLVED by the Riverside County ALUC that it reviewed and considered the initial study for the Corona Airport Comprehensive Land Use Plan prior to making this determination and that the negative declaration prepared as a result of the initial study is also hereby adopted.

The foregoing resolution was adopted on a motion by Commissioner HARKER and seconded by Commissioner ZOPF at a regularly scheduled meeting held on the 17 th day of March, 1993 by the following vote;

AYES: Commissioners: CHAIRMAN BUTLER, COMM. CANNON, COMM. SULLIVAN, COMM. HUTCHISON

NOES: Commissioners:

ABSENT: Commissioners: COMM. LEJA

Chair, Riverside County Airport Land Use Commission

WITNESS, my hand this 17 day of March, 1993.

Executive Secretary, Riverside County Airport Land Use Commission

# TABLE OF CONTENTS


| Section | | Page |
|---|---|---|
| 1.0 | INTRODUCTION | 1-1 |
| | 1.1 Purpose and Scope | 1-1 |
| | 1.2 Legal Authority | 1-1 |
| 2.0 | CORONA MUNICIPAL AIRPORT AND ENVIRONS | 2-1 |
| | 2.1 Airport Location | 2-1 |
| | 2.2 Airport Characteristics | 2-1 |
| | 2.2.1 Existing Airport Facilities | 2-1 |
| | 2.2.2 Future Airport Facilities | 2-8 |
| | 2.3 Airport Environs | 2-13 |
| | 2.3.1 Regional Setting | 2-13 |
| | 2.3.2 Existing Land Use | 2-13 |
| | 2.3.3 General Plan Land Use and Zoning | 2-16 |
| 3.0 | LAND USE COMPATIBILITY GUIDELINES | 3-1 |
| | 3.1 Introduction | 3-1 |
| | 3.2 California Airport Land Use Planning Guidelines | 3-1 |
| | 3.3 Noise Compatibility Guidelines | 3-2 |
| | 3.4 Safety Compatibility Guidelines | 3-2 |
| | 3.4.1 Inner Safety Zone | 3-4 |
| | 3.4.2 Outer Safety Zone | 3-4 |
| | 3.4.3 Emergency Touchdown Zone | 3-7 |
| | 3.4.4 Traffic Pattern Zone | 3-7 |
| | 3.4.5 Extended Runway Centerline Zone | 3-7 |
| | 3.4.6 Special Considerations in all Safety Zones | 3-8 |
| | 3.5 Airport Vicinity Height Guidelines | 3-9 |
| | 3.6 Summary — Airport Influence Area | 3-11 |

**TABLE OF CONTENTS** -- Continued


| Section | | | Page |
|---|---|---|---|
| 4.0 | AIRPORT NOISE INFLUENCE AREA ISSUES AND ALTERNATIVES | | 4-1 |
| | 4.1 | Introduction | 4-1 |
| | 4.2 | Noise Methodology | 4-1 |
| | 4.3 | INM Input Data | 4-2 |
| | | 4.3.1 Activity Data | 4-2 |
| | | 4.3.2 Fleet Mix | 4-2 |
| | | 4.3.3 Time of Day | 4-3 |
| | | 4.3.4 Runway Use | 4-3 |
| | | 4.3.5 Flight Profiles and Tracks | 4-3 |
| | 4.4 | INM Output | 4-3 |
| | | 4.4.1 Existing 1990 Noise | 4-4 |
| | | 4.4.2 Forecast Noise | 4-4 |
| | 4.5 | Noise Impacts and Issues | 4-7 |
| | | 4.5.1 Impacts on Existing Land Use | 4-7 |
| | | 4.5.2 Impacts on Future Land Use | 4-8 |
| | | 4.5.3 Planning Issues | 4-8 |
| | 4.6 | Land Use Management Alternatives | 4-9 |
| | 4.7 | Summary | 4-9 |
| 5.0 | AIRPORT SAFETY INFLUENCE AREA ISSUES AND ALTERNATIVES | | 5-1 |
| | 5.1 | Introduction | 5-1 |
| | 5.2 | Areas of Safety Concern | 5-1 |
| | 5.3 | Safety Issues | 5-1 |
| | | 5.3.1 Inner Safety Zone | 5-3 |
| | | 5.3.2 Outer Safety Zone | 5-3 |
| | | 5.3.3 Emergency Touchdown Zone | 5-4 |
| | | 5.3.4 Traffic Pattern Zone | 5-4 |
| | | 5.3.5 Summary of Issues in Safety Zones | 5-5 |
| | 5.4 | Potential Land Use Measures | 5-6 |
| | 5.5 | Summary | 5-6 |

**TABLE OF CONTENTS** -- Continued

Section Page


6.0 AIRPORT HEIGHT INFLUENCE AREA ISSUES AND ALTERNATIVES 6-1
6.1 Introduction . . . . . 6-1
6.2 Height Protection Areas . . . . . 6-1
6.2.1 Primary Surface . . . . . 6-4
6.2.2 Approach Surface . . . . . 6-4
6.2.3 Transitional Surface . . . . . 6-4
6.2.4 Horizontal Surface . . . . . 6-4
6.2.5 Conical Surface . . . . . 6-4
6.3 Height Protection Issues . . . . . 6-5
6.3.1 Existing Penetrations and Topography . . . . . 6-5
6.3.2 Current Height Limits in Zoning Ordinances . . . . . 6-5
6.3.3 Summary of Height Control Issues . . . . . 6-7
6.4 Potential Land Use Management Measures . . . . . 6-7
6.5 Summary . . . . . 6-8

7.0 COMPREHENSIVE AIRPORT LAND USE PLAN . . . . . 7-1
7.1 Introduction . . . . . 7-1
7.2 Airport Influence Area . . . . . 7-1
7.3 Land Use Compatibility Standards . . . . . 7-1
7.3.1 Noise Compatibility Standards . . . . . 7-1
7.3.2 Safety Compatibility Standards . . . . . 7-6
7.3.3 Height Standards . . . . . 7-10
7.4 Related Land Use Policies . . . . . 7-10
7.4.1 Findings as to Similar Uses . . . . . 7-10
7.4.2 Findings for Land Uses Which are to be Discouraged . . . 7-11

**TABLE OF CONTENTS** -- Continued


| Section | | | | Page |
|---|---|---|---|---|
| 8.0 | IMPLEMENTATION PLAN | | | 8-1 |
| | 8.1 | Adoption of Plan | | 8-1 |
| | 8.2 | Update and Amendment of Plan | | 8-1 |
| | 8.3 | Administration of Plan | | 8-1 |
| | | 8.3.1 | Scope of ALUC Development Review Responsibilities | 8-1 |
| | | 8.3.2 | Coordination with Local Governments | 8-2 |
| | | 8.3.3 | County Geographic Information System | 8-3 |
| | | 8.3.4 | Criteria for ALUC Review of General Plan Amendments | 8-3 |
| | 8.4 | Recommended Action by Local Governments | | 8-4 |
| | | 8.4.1 | General Plan Amendments | 8-4 |
| | | 8.4.2 | Noise and Avigation Easements | 8-4 |
| | | 8.4.3 | Airport Height Restrictions Overlay Zoning | 8-5 |
| | | 8.4.4 | Building Code Amendments | 8-5 |
| | | 8.4.5 | Subdivision Regulations | 8-5 |
| 9.0 | REFERENCES | | | 9-1 |

## APPENDICES

Appendix | Page

A. GLOSSARY . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . A-1

B. NOISE EXPOSURE AND LAND USE COMPATIBILITY . . . . . . . . B-1

C. SAFETY CONSIDERATIONS IN THE VICINITY OF AIRPORTS . . C-1

# LIST OF TABLES


| Table | | Page |
|---|---|---|
| 1 | Existing Runway Approach Characteristics | 2-5 |
| 2 | 1987 Forecast and 1990/1991 Estimated Based Aircraft and Aircraft Operations | 2-7 |
| 3 | Future Runway Approach Characteristics | 2-10 |
| 4 | Future Aircraft Operations | 2-12 |
| 5 | Land Use Guidelines for Noise Compatibility | 3-3 |
| 6 | Land Use Compatibility Guidelines for Airport Safety Zones | 3-5 |
| 7 | FAR Part 77 Dimensions | 6-3 |
| 8 | Building Height Restrictions Under FAR Part 77 Surfaces | 6-6 |
| 9 | Land Use Compatibility Standards for Airport Safety Zones | 7-7 |

## LIST OF FIGURES


| Figure | | Page |
|---|---|---|
| 1 | Location Map | 2-2 |
| 2 | Existing Airport Facilities | 2-4 |
| 3 | Air Traffic Patterns | 2-9 |
| 4 | Airport Vicinity Existing Land Use Patterns | 2-14 |
| 5 | General Plan Land Use | 2-17 |
| 6 | Suggested Airport Safety Zones Off Runway Ends | 3-6 |
| 7 | FAR Part 77 Typical Civil Airport Imaginary Surfaces | 3-10 |
| 8 | Existing 1990 Noise Contours | 4-5 |
| 9 | Future 1997 Noise Contours | 4-6 |
| 10 | Airport Safety Zones | 5-2 |
| 11 | FAR Part 77 Surfaces | 6-2 |
| 12 | Airport Influence Area | 7-2 |
| 13 | Riverside County Land Use Standards for Noise Compatibility | 7-3 |
| 14 | Runway Safety Zone Dimensions | 7-8 |

# Section 1.0

# INTRODUCTION

## 1.1 PURPOSE AND SCOPE

The Comprehensive Land Use Plan for Corona Municipal Airport is intended to protect and promote the safety and welfare of residents of the Airport vicinity and users of the Airport while ensuring the continued operation of the Airport. Specifically, the plan seeks to protect the general public from the adverse effects of aircraft noise, to ensure that people and facilities are not concentrated in areas susceptible to aircraft accidents, and to ensure that no structures or activities encroach upon or adversely affect the use of navigable airspace.

The Comprehensive Land Use Plan must be based upon an adopted Airport Master Plan or a Federal Aviation Administration (FAA) approved Airport Layout Plan. A Master Plan for the Corona Municipal Airport was adopted by the City of Corona in February 1978 and amended in December 1990. The adopted Master Plan, any associated environmental documentation, and the FAA approved Airport Layout Plan provide the foundation for this Comprehensive Airport Land Use Plan. Implementation of this plan will promote compatible development in the Airport vicinity and restrict incompatible development, thus allowing for the continued operation of the Airport.

## 1.2 LEGAL AUTHORITY

Public Utilities Code of the State of California, Sections 21670 et seq. requires the establishment of an Airport Land Use Commission (ALUC), and defines its range of responsibilities, duties and powers.

Section 21675 requires the Airport Land Use Commission for Riverside County to formulate a comprehensive land use plan for the area surrounding each public use airport within Riverside County. The Commission may also formulate a plan for the area surrounding any federal military airport located within Riverside County.

Section 21675 also specifies that comprehensive land use plans will:

"(a) . . . provide for the orderly growth of each public airport and the area surrounding the airport within the jurisdiction of the Commission, and will safeguard the general welfare of the inhabitants within the vicinity of the airport and the public in general. The Commission plan shall include a long-range master plan that reflects the anticipated growth of the airport during at least the next 20 years. This plan shall not be inconsistent with the State Master Airport Plan. In formulating a land use plan, the Commission may develop height restrictions on buildings, may specify use of land, and may determine building standards, including soundproofing adjacent to airports, within the planning area. The comprehensive land use plan shall not be amended more than once in any calendar year.

"(b) The Commission may include within its plan formulated pursuant to subdivision (a) the area within the jurisdiction of the Commission surrounding any federal military airport for all the purposes specified in subdivision (a) . . ."

## Section 2.0

## CORONA MUNICIPAL AIRPORT AND ENVIRONS

### 2.1 AIRPORT LOCATION

Corona Municipal Airport is geographically located in the northwestern area of Corona, California, as shown on the Location Map, Figure 1. The Airport is located wholly within the corporate limits of the City. The Airport is bordered on the south by Butterfield Drive and Corona's waste treatment plant; on the east by the City's percolation ponds that abut Smith Avenue and Rincon Street; and on the north and west by open land of the Prado Flood Control Basin.

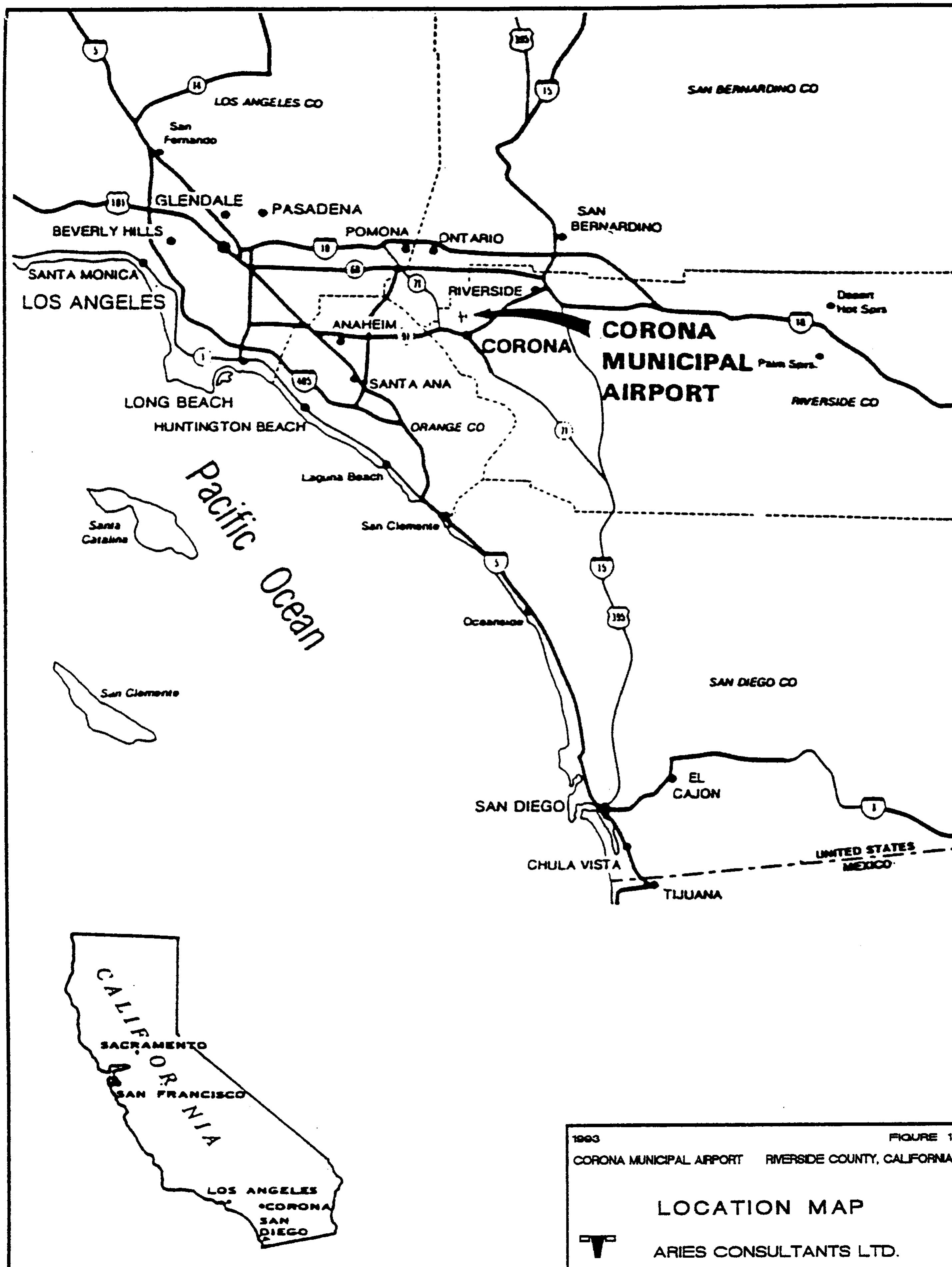
### 2.2 AIRPORT CHARACTERISTICS

The Corona Municipal Airport Master Plan and the Airport Master Plan Update describe existing and future development at the Airport. The following information is summarized in the material that follows: airport layout, focusing on the runway and a summary of facilities and services; type of runway approach, including obstructions; airspace and air traffic control, with emphasis on traffic patterns; and aircraft operations levels.

#### 2.2.1 Existing Airport Facilities

The Corona Municipal Airport moved to its present location in 1959. The Airport site consists of about 100 acres of land and is located entirely within the Prado Flood Control Basin on land owned by the U.S. Army Corps of Engineers and leased to the City for 50 years. The lease for the Airport site is part of a Master Recreational lease between the City of Corona and the Corps of Engineers. Within this master lease, the City controls the Airport site and several hundred additional acres used for recreational purposes. The lease restricts use of the land to recreational purposes, such as Butterfield Drive Park. However, current and anticipated aviation activity at the Airport meets the recreational requirement. The recreational restriction is broad enough to allow sanitation facilities, which is why the City has its wastewater treatment plant and percolation ponds in the area just south and east of the Airport site, respectively.

The original runway and parallel taxiway were located south of the present buildings. By 1963, the runway was determined to be restricting the growth of the Airport. The Federal Aviation Administration (FAA) denied the City's funding request to construct a new runway and the City subsequently applied to and received funding from the




1993 FIGURE 1

CORONA MUNICIPAL AIRPORT RIVERSIDE COUNTY, CALIFORNIA

LOCATION MAP

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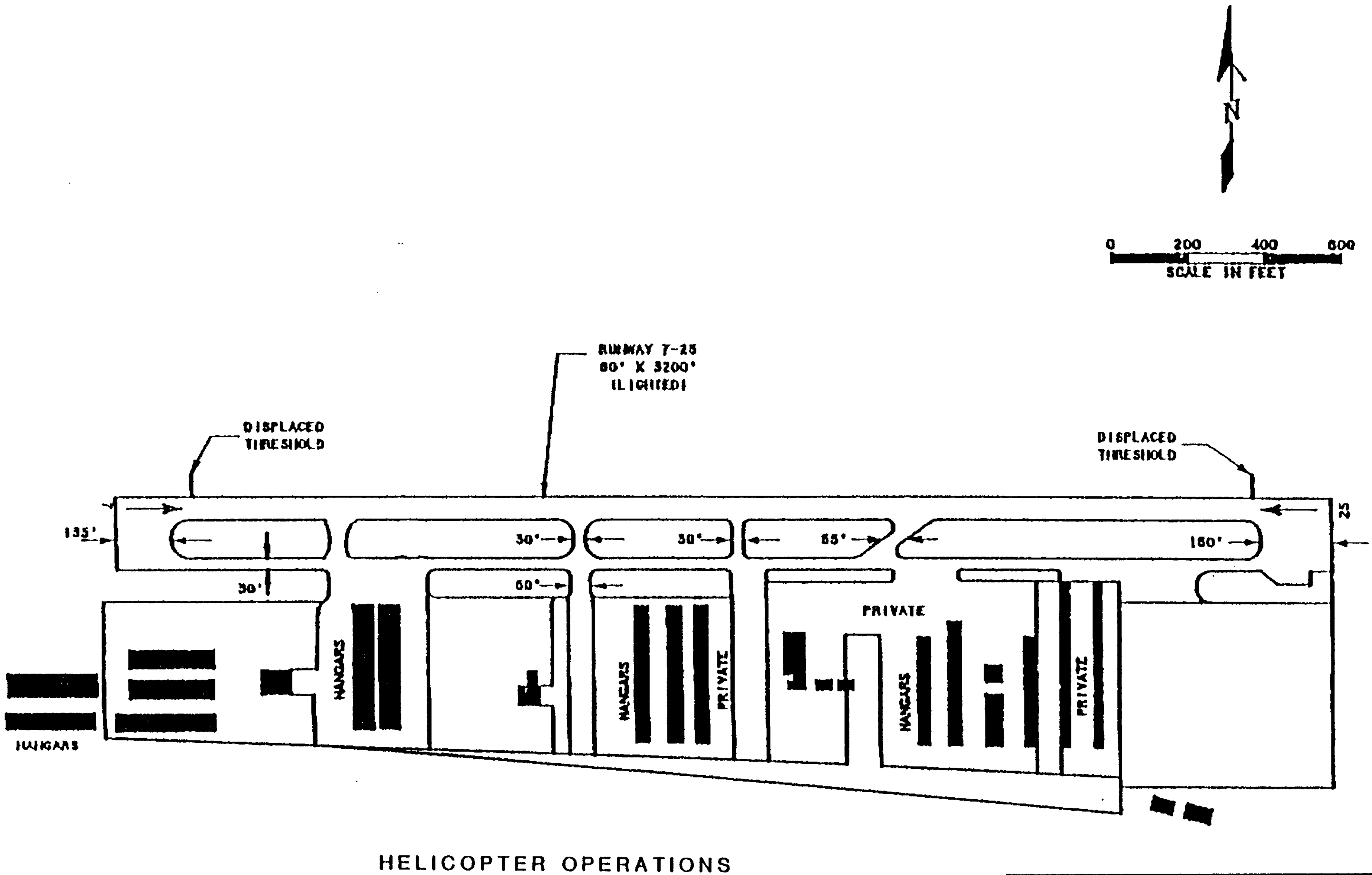
State of California. Funds were provided over several years and by 1970 sufficient funds were available to begin construction. The new runway was completed in late 1970. The old runway was abandoned and removed while the old taxiway remains in service as the Airport access road.

Since the site is wholly within the Prado Flood Control Basin, it is subject to occasional flooding. Extended heavy rains during 1969, 1978, 1980 and 1992 resulted in the short-term storage of water in the Prado Flood Control Basin. Although flooding was avoided in downstream areas, the water level behind the dam rose high enough to inundate all, or portions of, the Airport site. Aircraft at the Airport were either moved to nearby airports, or to higher ground, and suffered little or no damage. Structures and other non-movable facilities have suffered minimal to moderate damage.

The Corps of Engineers have indicated that the 25-year flood (a flood with a probability of occurring once every 25 years) would inundate the western half of the Airport site. Indications are that the 50-year flood would encompass the entire site, with water depths ranging from 5 to 20 feet over the runway. Floods of greater size are not expected to cause much more damage than the 50-year flood, since once the site is completely inundated, little more damage can occur. This is primarily because the floods in the basin consist of relatively still water and the existing spillway on Prado Dam limits the maximum water level to about 543 feet above MSL. (The elevation of the Airport is 533 feet above MSL.)

The Corps of Engineers is currently moving forward on a project to raise the height of Prado Dam and its spillway. The spillway will be raised 20 feet. This improvement will allow the dam to contain a 190-year return period flood. Orange County is the local sponsor for the project and the county is currently acquiring the additional lands that will be flooded. Construction of the dam improvements is currently scheduled to take place during the period 1997-2000. In flood conditions, the Airport is likely to be inundated to a greater depth, but it is estimated this would not endanger the Airport any more often or cause any more damage.

The existing Airport facilities are illustrated on Figure 2. The airfield consists of a single east-west Runway 7-25, which is 3,200 feet long and 60 feet wide. It was designed to accommodate aircraft of up to 12,500 pounds maximum gross weight. The thresholds at both ends of the runway have been displaced 200 feet, thereby shortening the effective landing length to 3,000 feet. Runway and elevations, type of approach and approach slope characteristics of the existing runway are summarized in Table 1. Helicopter landing and takeoff pads are located south of the access road and hangar area.




1993 FIGURE 2

CORONA MUNICIPAL AIRPORT RIVERSIDE COUNTY, CALIFORNIA

## EXISTING AIRPORT FACILITIES

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Table 1

**EXISTING RUNWAY APPROACH CHARACTERISTICS**
**Corona Municipal Airport**

| Runway | | | |
|---|---|---|---|
| No. | End Elevation | Type of Approach | FAR Part 77 Approach Slope |
| 7 | 515 | Visual | 20:1 |
| 25 | 533 | Visual | 20:1 |

Source: Corona Municipal Airport Layout Plan

The runway is complemented by a full-length, 30 foot wide parallel taxiway, a 150 foot by 165 foot holding apron on the east end, a 115 foot by 150 foot holding apron on the west end, and three intermediate exit taxiways. The parallel taxiway is offset 150 feet, centerline-to-centerline, south of Runway 7-25.

Aircraft basing and terminal/administrative areas are located south of the runway. Presently, the Airport has paved apron space to accommodate 155 aircraft and can provide an additional 35 spaces on crushed rock or turf. There are 123 spaces available in hangars.

The Corona Municipal Airport is home to at least ten fixed base operators (FBO). The range of services available include: pilot training, aircraft rental, aircraft sales, aircraft services and supplies, charter flights, tiedown and hangar rental, power plant and airframe repair, aircraft painting, and fuel sales including jet fuel.

The Corona Municipal Airport is open 24 hours a day, but is operational only about 84 percent of the time. Of this 84 percent, approximately 70 percent of the time operations are conducted under VFR conditions (Visual Flight Rules - ceiling 1,000 feet or higher and visibility 3 miles or more) and 14 percent of the time operations are conducted under IFR conditions (Instrument Flight Rules - ceiling between 700 and 1,000 feet and/or visibility between 1 and 3 miles). Only two natural factors are likely to close the Airport (disregarding flood conditions): low visibility or ceiling and excessive crosswinds. Of the 16 percent of the time when the Airport is unusable, 5 percent is due to low visibility, typically because of short-term early morning fog, and about 11 percent is due to high crosswinds. There is no control tower at the Airport.

The instrument approach to Corona Municipal Airport is from the Paradise VOR, which is approximately 3.6 nautical miles east-northeast of the Airport. Several airports in the area utilize this navigational aid for instrument approaches. Lengthy holding delays can occur in the vicinity of the VOR during IFR conditions. The demand for instrument approaches to the Airport is limited to peak VFR periods when aircraft are queued up on the holding apron ready for takeoff and aircraft are circling the field waiting to land.

Navigational aids at Corona Municipal Airport include a lighted rotating beacon, runway end identifier lights (REIL) for Runway 25, and a single-unit visual approach slope indicator (VASI) for Runway 25. The Airport also has a lighted wind cone and segmented circle.

Aircraft operations at the Corona Municipal Airport are summarized in Table 2, and the Master Plan forecast operations for 1997 are presented in Section 2.2.2. In May

Table 2

**1987 FORECAST AND 1990/1991 ESTIMATED BASED AIRCRAFT AND AIRCRAFT OPERATIONS Corona Municipal Airport**

| | 1987 Forecast[a] | May 1990 Estimate[b] | 1991 Estimate[c] |
| --- | --- | --- | --- |
| Based Aircraft | 549 | --- | 550 |
| Total Annual Operations | 351,400 | 297,440 | 295,000 |
| Fixed Wing | --- | 147,440 | 170,000 |
| Helicopter | --- | 150,000 | 125,000 |

Sources: [a]Corona Municipal Airport Master Plan.
[b]FAA 2-Week Survey of Aircraft Operations in May 1990 extrapolated to 52 weeks.
[c]Airport Manager, Corona Municipal Airport

1990 and December 1991, the FAA conducted surveys of aircraft operations. The May 1990 estimate of 297,440 annual aircraft operations was used to develop existing noise contours (see Section 4). The December 1991 data has not yet been evaluated by the FAA.

Two trends are apparent in the estimated data in Table 2: 1) helicopter operations have become the dominant type of aircraft in the current mix of aircraft, and 2) the level of operations at the Airport are below forecast levels. The high level of helicopter operations is due to helicopter training activities at the Airport. The lower than forecast level of operations generally reflects a nationwide trend of slower growth in general aviation activity throughout the 1980's.

Before January 1993, the airport traffic pattern for light aircraft was left hand for both Runways 7 and 25. However, a revised traffic pattern was approved by FAA and took effect in January 1993. The current traffic pattern shown on Figure 3 is right hand for Runway 7 and left hand for Runway 25. The traffic pattern for helicopters is currently operating right hand for Runway 7 and left hand for Runway 25 and did not change in January 1993. Helicopters actually operate from pads located between Aviation Drive and the southern boundary of the Airport. Traffic pattern altitudes are 1,500 feet AGL or higher for light aircraft and 1,000 feet AGL or lower for helicopters. Aircraft must enter the traffic pattern at about the midpoint of the downwind leg and straight-in approaches are not allowed. Noise abatement procedures for Runway 7 require all departing aircraft to make a 15 degree right turn to follow Temescal Wash.

### 2.2.2 Future Airport Facilities

Future plans for the Corona Municipal Airport, as specified on the Airport Layout Plan and the Master Plan, focus on increasing the Airport's ability to handle a greater volume of general aviation aircraft and a mix of general aviation aircraft that includes a greater percentage of multi-engine aircraft. In the Master Plan forecast of aircraft operations helicopters were expected to be only one percent of the mix, which grossly understates existing helicopter operations (see Table 2).

A parallel runway of equal dimensions as the existing runway, with a nonprecision approach, was proposed to handle 1997 forecast operations. The approach characteristics would change to those shown in Table 3. A full length parallel taxiway was also proposed. The Airport was proposed to expand to 225 acres. However, the Airport is now located in a federally protected wetlands and the Prado Basin is a breeding site for the Least Bell's Vireo (a songbird on the federal endangered species

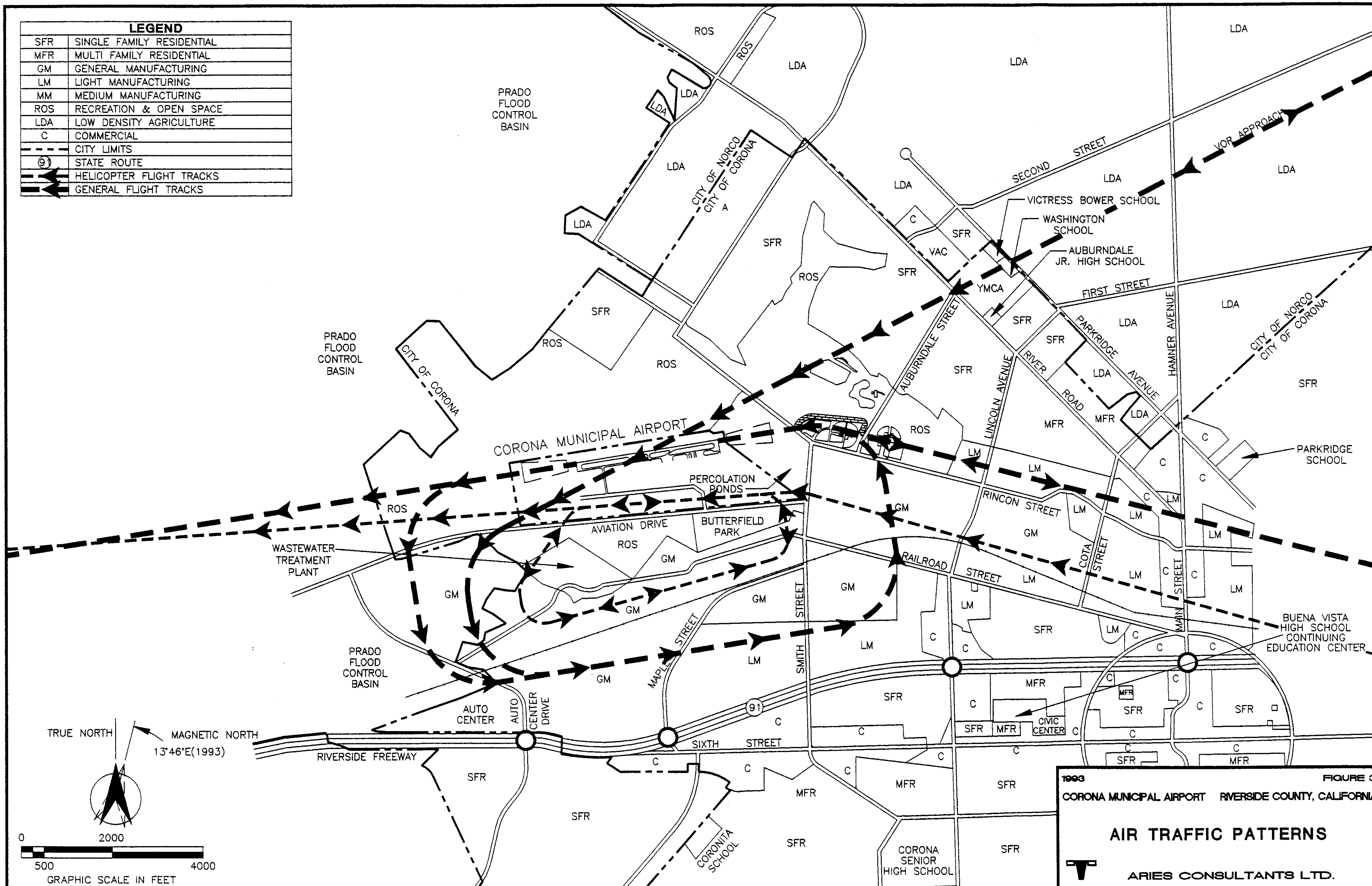
LEGEND
SFR SINGLE FAMILY RESIDENTIAL
MFR MULTI FAMILY RESIDENTIAL
GM GENERAL MANUFACTURING
LM LIGHT MANUFACTURING
MM MEDIUM MANUFACTURING
ROS RECREATION & OPEN SPACE
LDA LOW DENSITY AGRICULTURE
C COMMERCIAL
CITY LIMITS
91 STATE ROUTE
HELICOPTER FLIGHT TRACKS
GENERAL FLIGHT TRACKS
PRADO FLOOD CONTROL BASIN
CITY OF NORCO
CITY OF CORONA
CORONA MUNICIPAL AIRPORT
PERCOLATION PONDS
AVIATION DRIVE
BUTTERFIELD PARK
WASTEWATER TREATMENT PLANT
VOR APPROACH
SECOND STREET
FIRST STREET
VICTRESS BOWER SCHOOL
WASHINGTON SCHOOL
AUBURNDALE JR. HIGH SCHOOL
YMCA
VAC
AUBURNDALE STREET
LINCOLN AVENUE
RIVER ROAD
PARKRIDGE AVENUE
HAMNER AVENUE
PARKRIDGE SCHOOL
RINCON STREET
RAILROAD STREET
COTA STREET
MAIN STREET
SMITH STREET
MAPLE STREET
BUENA VISTA HIGH SCHOOL CONTINUING EDUCATION CENTER
CIVIC CENTER
AUTO CENTER
AUTO CENTER DRIVE
SIXTH STREET
RIVERSIDE FREEWAY
CORONITA SCHOOL
CORONA SENIOR HIGH SCHOOL
TRUE NORTH
MAGNETIC NORTH
13°46'E(1993)
0
2000
500
4000
GRAPHIC SCALE IN FEET
1993
FIGURE 3
CORONA MUNICIPAL AIRPORT RIVERSIDE COUNTY, CALIFORNIA
AIR TRAFFIC PATTERNS
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Table 3

**FUTURE RUNWAY APPROACH CHARACTERISTICS**
**Corona Municipal Airport**

| Runway | | | |
|---|---|---|---|
| No. | End Elevation | Type of Approach | FAR Part 77 Approach Slope |
| 7R[a] | 616 | Visual | 20:1 |
| 25L[a] | 637 | Visual | 20:1 |
| 7L | 613 | Nonprecision | 20:1 |
| 25R | 631 | Nonprecision | 20:1 |

[a]Existing runway

Source: Corona Municipal Airport Layout Plan list). Based on these environmental factors it is virtually impossible for the Airport to expand and the possibility of adding a second runway and taxiway seem improbable.

The current estimated number of annual fixed-wing operations at the Corona Municipal Airport is between 150,000 and 175,000 and has remained so for the past six years. Based on the actual growth of aircraft operations at the Airport, and particularly the changes that have occurred in the mix of aircraft, there is a question as to the need for these additional airfield improvements. Without the research associated with a revised Airport Master Plan such questions cannot be answered.

For purposes of this Comprehensive Airport Land Use Plan, an estimate of potential future airport operations was made as presented in Table 4. The parallel runway proposed in the Airport Master Plan was not included, which limits growth at the Airport to the capacity of existing airfield facilities. The capacity of the existing single runway was estimated from FAA AC 150/5060-5, "Airport Capacity and Delay", to be 230,000 fixed-wing aircraft operations per year. This assumes installation of a control tower and additional navigational aids. Without a control tower fixed-wing aircraft operations could go slightly higher because separations between aircraft would be based on pilot judgement rather than controller instrumentation.

Helicopters, which currently do not operate from the runway, were assumed to continue to operate from areas south of the runway. The level of helicopter operations was assumed to gradually decline, as foreign helicopter training requirements decline, to a level of 70,000 operations, or about 50 percent of current helicopter operations. In January 1993, the west end of the Airport was flooded and the helicopter pilot training school moved its operations to temporary facilities at another airport. Helicopter operations could decline more significantly and sooner if the helicopter pilot training school permanently relocates its activities to another airport.

Total operations at Corona Municipal Airport could reach a level of about 300,000 operations by 2010 as shown in Table 4. This is considerably less than the 565,800 operations forecast for 1997 in the last Airport Master Plan. If the helicopter pilot training school relocates to another airport it is unlikely the Airport would reach the estimated 300,000 total annual operations by the year 2010, if ever.

Any decisions concerning future improvements to the Airport must be part of a new Master Plan study. The City would like to revise the Airport Master Plan and is prepared to do so. However, the City is hampered by the fact that the Corps of Engineers has reserved the right to cancel the lease on short notice (30 to 60 days) in

Table 4

**FUTURE AIRCRAFT OPERATIONS**
**Corona Municipal Airport**

| | 2010[1] Estimate |
|---|---|
| Based Aircraft | N.A. |
| Annual Operations | 300,000 |

1. Estimated for purposes of this Comprehensive Land Use Plan as discussed in Section 2.2.2.

N.A. = Not Available

emergency situations. Severe water shortages requiring the storage of water in the Basin or National Wars are among the types of emergencies that might cause the Corps to exercise this term of the lease. However, because of this term of the lease, the FAA is reluctant to provide the necessary planning grant because the City cannot guarantee a 20-year life for the Airport. The City is continuing to work with both agencies to resolve this issue. For purposes of this Comprehensive Airport Land Use Plan, the parallel runway proposed in the Airport Master Plan was not considered.

## 2.3 AIRPORT ENVIRONS

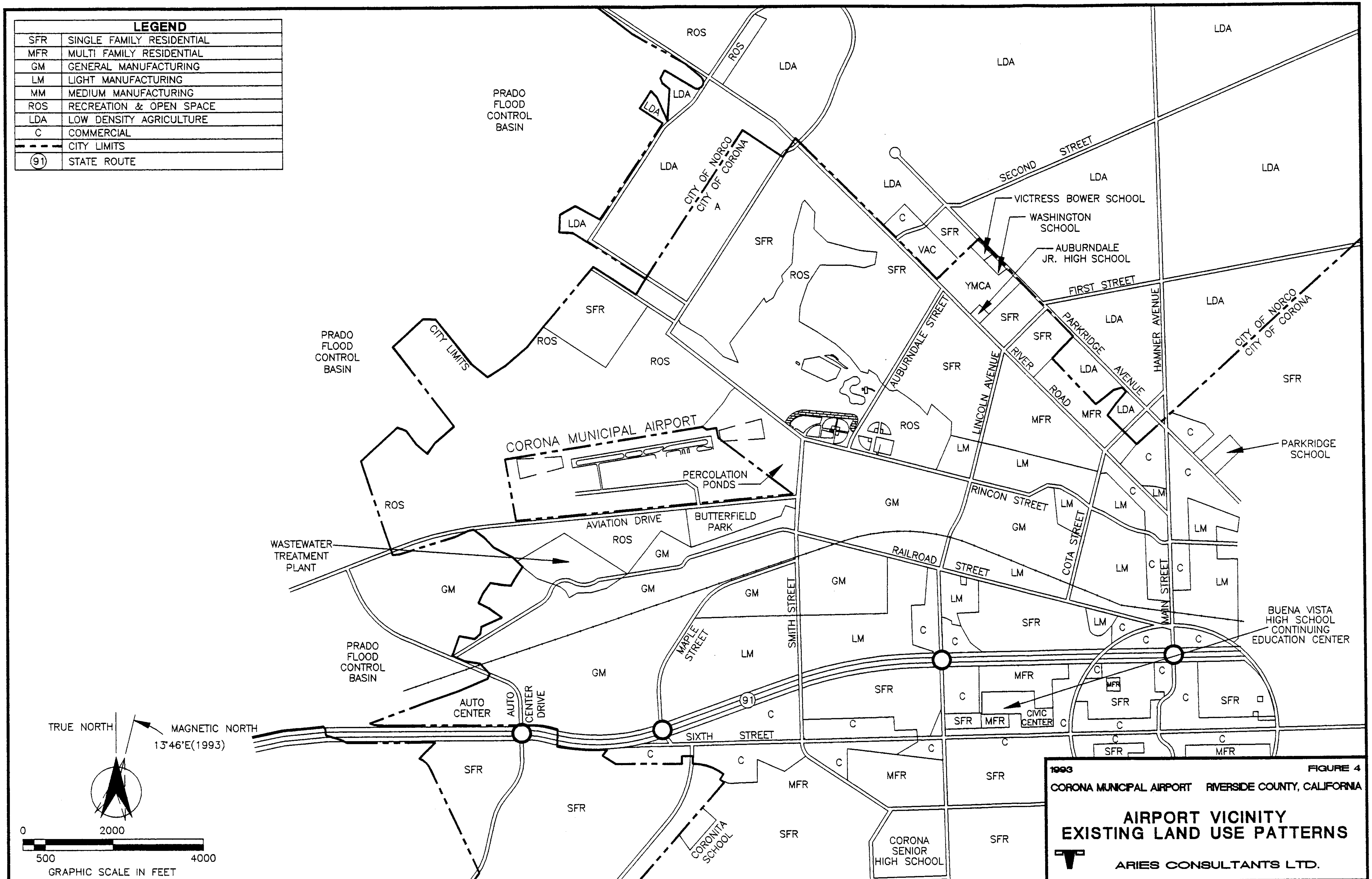
This section documents existing and future land use and development patterns in the vicinity of the Airport. The purpose is to define the nature and extent of nearby development and its relationship to the Airport. The information developed here will be further evaluated in later sections to determine the compatibility of these land uses to the Airport and its operations.

### 2.3.1 Regional Setting

The regional setting provides a framework for economic activities in the vicinity of the Airport. Changes in this larger area forms the basis for understanding change and growth in the areas surrounding the Airport. The City of Corona has undergone rapid historical population growth. From 1960 through 1990 the population increased five fold with an overall annual compound rate of 5.7 percent per year. By contrast, Los Angeles, San Bernardino, Orange, and Riverside Counties grew at compound annual rates of 1.2, 4.1, 3.5, and 4.4 percent, respectively, during the same period. Corona's faster growth is attributed to the availability of land and the upgrading of State Route 91 and Interstate 15.

### 2.3.2 Existing Land Use

The Corona Municipal Airport is within the northwestern corner of the City, generally lying north of the Riverside Freeway (State Route 91) and west of Main Street to the City boundary. Population in this area is about 5,700 people. Existing land uses in the Airport environs are as illustrated on Figure 4. Single family residential land uses in this area are concentrated to the north and east of the Airport. Some multiple-family residential uses are concentrated east of the Airport near Main Street. A mixed single and multiple-family area is located southeast of the Airport along the Riverside Freeway near Buena Vista Avenue. These residential areas are largely built out, and no significant new residential development is anticipated.




1993 FIGURE 4

CORONA MUNICIPAL AIRPORT RIVERSIDE COUNTY, CALIFORNIA

AIRPORT VICINITY EXISTING LAND USE PATTERNS

ARIES CONSULTANTS LTD.

The remainder of the area is dominated by industrial and commercial development which lies south and southeast of the Airport, between the Airport and the Riverside Freeway. The industrial development consists mostly of light and general manufacturing operations. There are many properties still vacant in these industrial areas so infill can be expected to continue for some time. The City's wastewater treatment plant and percolation ponds are located in this industrial development.

Commercial development, which consists of both retail and office type uses, are concentrated to the east along Main Street. Other more general commercial uses, as well as hotels and motels are found along the Riverside Freeway. Further south and east, south of the Riverside Freeway and east near Main Street, single and multiple-family residences are interspersed among commercial uses.

Areas to the northwest, west and southwest of the Airport are part of the Prado Flood Control Basin. Parts of the Basin that are outside the corporate limits of Corona, are classified as open space. The Corps of Engineers subleases some of these areas for agricultural uses, mainly for open field crops that support the local dairy industry. Portions of the Prado Basin Leasehold controlled by the City, exclusive of the Airport property, are used for open space and recreational uses but are zoned for agriculture.

The riparian habitat within the Prado Basin is valuable to wildlife and supports a wide diversity of species. Mammals likely to utilize riparian habitat include: raccoon (Procyon lotor), striped skunk (Mephitis) and mule deer (Odocoileus hemionus). Several species of amphibians and reptiles are also likely to be found in riparian habitats, including Pacific tree frog (Hyla regilla), bullfrog (Rana catesbeiana), western toad (Bufo boreas), common kingsnake (Lampropeltis getulus) and gopher snake (Pituophis melanoleucus). Numerous bird species utilize riparian habitats. Common species likely to be found in the vicinity of the Airport include: house wren (Troglodytes aedon), bewick's wren (Thryomanes bewickii), American goldfinch (Carduelis tristis), brown headed cowbird (Molothrus ater), red winged blackbird (Agelaius phoeniceus) and black phoebe (Sayornis nigricans).

Also located in the vicinity of the Airport is the Least Bell's Vireo (Vireo belli pusillus), which is listed on the federal and state lists of endangered species. There are about 900 Least Bell's Vireos left in the United States. Least Bell's Vireos breed in the Prado Basin between March and September and spend the winters in Mexico and Baja California. About 45 pairs of Least Bell's Vireo live in the 4,400 acre Prado Basin. According to the Prado Dam environmental impact study, there are 83 acres of willow-shrubbery habitat in elevations between 495 and 500 feet MSL.

The Prado Dam Basin has been declared a "wetlands" area, so any expansion of the Airport will have to be offset by an equally sized area of new "wetlands".

### 2.3.3 General Plan Land Use and Zoning

General Plan land use is illustrated on Figure 5. Generally, because the area is built up, the land uses proposed in the General Plan are virtually identical to the existing land uses.

In the immediate vicinity of the Airport, the City has proposed development of a Sports Complex in a portion of the Prado Flood Control Basin at the intersection of Auburndale Road and Rincon Street. Since this complex has not been adopted as an amendment to the General Plan, it is illustrated on Figure 4 rather than on Figure 5. The design of the complex is still evolving. The current proposal places a golf course and driving range abutting the residential area to the northeast and a series of baseball diamonds along the north side of Rincon Street. It should be noted that the Sports Complex is illustrated in this Comprehensive Land Use Plan for informational purposes only and its illustration should not be construed as approval of the Sports Complex plan by the Airport Land Use Commission. If the City of Corona moves forward with development of the Sports Complex in its proposed location, the project will require Airport Land Use Commission review. The ALUC will make a determination as to whether or not it is a compatible land use based on the final project.


LEGEND
RESIDENTIAL
LOW DENSITY
MEDIUM DENSITY
HIGH DENSITY
COMMERCIAL
OFFICE PROFESSIONAL
GENERAL/COMMUNITY
INDUSTRIAL
GENERAL INDUSTRY
LIGHT INDUSTRY
AGRICULTURE
PARKS AND OPEN SPACE
FLOOD CONTROL BASIN
TRUE NORTH
MAGNETIC NORTH
13°46'E(1993)
0
2000
500
4000
GRAPHIC SCALE IN FEET
CORYDON
SECOND
PARKRIDGE
RIVER ROAD
FIRST
AUBURNDALE
AVENUE
HAMNER AVENUE
RINCON
LINCOLN AVE.
COTA STREET
RAILROAD
HARRISON
BLAINE
SMITH
SHERMAN
MAPLE
POMONA
RINCON
CIRCLE STUDY
RIVERSIDE FREEWAY
PALISADES DR.
SIXTH STREET
SERFAS CLUB
RIDGELINE DR.
VIA SANTIAGO
1993
FIGURE 5
CORONA MUNICIPAL AIRPORT RIVERSIDE COUNTY, CALIFORNIA
GENERAL PLAN
LAND USE
ARIES CONSULTANTS LTD.

**Section 3.0**

# LAND USE COMPATIBILITY GUIDELINES

## 3.1 INTRODUCTION

This section presents land use compatibility guidelines which have been established by the Riverside County Airport Land Use Commission for use in comprehensive land use planning within airport influence areas. These guidelines are intended to provide a common approach for identifying potential areas of incompatibility and for establishing land use criteria at each of the County's airports.

While providing a basis for a common analytical approach, the guidelines do provide for some flexibility in making specific determinations as to land use compatibility in any given situation. The many differences among the various airports in the County and in their environs makes it prudent to ensure that appropriate variations may be made to meet special circumstances in order to protect the public health, safety, and welfare. When variations are necessary, specific findings justifying the variations should be made and included in the Comprehensive Land Use Plan.

## 3.2 CALIFORNIA AIRPORT LAND USE PLANNING GUIDELINES

Aircraft noise is often the most disturbing environmental impact associated with the operation of an airport. As jet aircraft came into common use at civilian airports in the 1960's, public concern about aircraft noise became a serious issue. This concern was heightened as the environmental movement of the 1970's gathered steam. In response to these concerns, Congress and some state legislatures, in addition to numerous Federal and state agencies, began developing programs and guidelines to promote aircraft noise abatement and compatible development within noise-impacted areas.

At the same time, concern was growing in the aviation community about burgeoning urban development in the vicinity of airports. The development boom of the 1950's and 1960's, following the long slow-growth period of the 1930's and 1940's, corresponded with a sharp growth in aviation. Not only was noise a concern, but the safety of persons on the ground and in the air became an increasing concern with the construction of tall buildings and towers near airports and increasing development of all kinds within airport approaches.

In California, the state legislature responded to these public concerns by enacting the law mandating the creation of Airport Land Use Commissions and the preparation of comprehensive land use plans for all public airports in each county (Public Utilities

Code, Chapter 4, Art. 3.5). In order to assist Airport Land Use Commissions in implementing the provisions of the law, the California Department of Transportation prepared a reference guide for local agencies. Published in 1983, the Airport Land Use Planning Handbook provides planning guidelines and suggestions based on a review of the research on noise and safety issues and a review of comprehensive land use plans in force at the time the document was prepared.

For purposes of preparing comprehensive land use plans for airports in Riverside County, the guidelines presented in the Airport Land Use Planning Handbook are used as described in this section. Because the state guidelines are not rigidly defined, but provide for local adjustments based on local conditions and concerns, some refinements in the state guidelines have been made for use in the County. Furthermore, the state guidelines are somewhat general. It is possible that additional detail will need to be developed to provide specific land use planning and regulation in certain airport areas. Such adjustments will be considered for each airport as needed.

## 3.3 NOISE COMPATIBILITY GUIDELINES

Table 5 shows the noise compatibility guidelines intended for use in the County. These are based on the guidelines suggested by the State of California in the 1983 Airport Land Use Planning Handbook. At general aviation airports, the guidelines call for discouraging new single-family dwellings and prohibiting mobile homes, within the 60 dB CNEL contour. Where homes are permitted within the 60 dB CNEL, the need for sound insulation should be studied and noise easements should be acquired.

Within the 65 dB CNEL, new residential construction should not be allowed. New hotels or motels are permissible if the need for sound insulation is studied. Institutional uses should be discouraged within the 65-70 dB CNEL range. If no alternative location is available, the need for sound insulation should be studied before the institution is built. Commercial, industrial, and recreational uses are considered compatible with noise levels between 65 and 70 dB CNEL.

## 3.4 SAFETY COMPATIBILITY GUIDELINES

The State has suggested the creation of five safety zones around airports. The zones are intended to promote land use planning and regulation which in turn promotes the safety of persons on the ground while reducing the risks of serious harm to aircraft crews and passengers making forced landings in the immediate airport environs.

The State provides for several options in the definition of the safety zone boundaries and in the scope of land use regulations applying within the boundaries. The specific

**Table 5**

## LAND USE GUIDELINES FOR NOISE COMPATIBILITY

| Type of Airport/ Land Use | 55–60 CNEL | 60–65 CNEL | 65–70 CNEL | 70–75 CNEL | 75–80 CNEL | 80+ CNEL |
|---|---|---|---|---|---|---|
| Air Carrier and Military | | | | | | |
| Residential/Lodgings | | ■ Potential for annoyance exists; identify high complaint areas.<br>■ Determine whether sound insulation requirements should be established for these areas.<br>■ Require acoustical reports for all new construction.<br>■ Noise easements should be required for new construction. | ■ Discourage new single family dwellings<br>■ Prohibit mobile homes.<br>■ New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation is included in the design.<br>■ Noise easements should be required for new construction.<br>■ Develop policies for "infill". | ■ New construction or development of residential uses should not be undertaken.<br>■ New hotels and motels may be permitted after an analysis of noise reduction requirements is made and needed noise insulation is included in the design. | ■ New hotels and motels should be discouraged. | |
| General Aviation | | | | | | |
| Residential/Lodgings | ■ Potential for annoyance exists; identify high complaint areas.<br>■ Determine whether sound insulation requirements should be established for these areas.<br>■ Noise easements should be required for new construction.<br>■ Discourage residential use underneath the flight pattern. | ■ Discourage new single family dwellings.<br>■ Prohibit mobile homes.<br>■ New construction or development should be undertaken only after analysis of noise reduction an requirements is made and needed noise insulation is included in the design.<br>■ Noise easements should be required.<br>■ Develop policies for "infill." | ■ New construction or development of residential uses should not be undertaken.<br>■ New hotels and motels may be permitted after an analysis of noise reduction requirements is made and needed noise insulation is included in the design. | ■ New hotels and motels should be discouraged. | | |
| All Airports | | | | | | |
| Public/Institutional | | ■ Satisfactory with little noise impact and requiring no special noise insulation requirements for new construction. | ■ Discourage institutional uses.<br>■ If no other alternative location is available, new construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation is included in the design. | ■ No new institutional uses should be undertaken. | | |
| Commercial | | | ■ Satisfactory with little noise impact and requiring no special noise insulation. Requirements for new construction. | ■ New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed insulation features included in the design. Noise reduction levels of 25–30 dB will be required. | ■ New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation features included in the design. Noise reduction levels of 25–30 dB will be required. | ■ New construction or development should not be undertaken unless related to airport activities or services. Conventional construction will generally be inadequate and special noise insulation features should be included in the construction. |
| Industrial | | | | ■ Satisfactory with little noise impact and Requiring no special noise insulation requirements for new construction. | ■ New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation features included in the design.<br>■ Measures to achieve noise reduction of 25–35 dB must be incorporated in Portions of building where the public is received and in office areas. | ■ New construction or development should not be undertaken unless related to airport activities or services. Conventional construction will generally be inadequate and special noise insulation features should be included in the construction. |
| Recreation/ Open Space | | | ■ Satisfactory, with little noise impact and requiring no special noise insulation for new construction.<br>■ Outdoor music shells and amphitheater should not be permitted. | ■ Parks, spectator sports, golf courses and agricultural generally satisfactory with little noise impact.<br>■ Nature areas for wildlife and zoos should not be permitted. | ■ Land uses involving concentrations of people (spectator sports and some recreational facilities) or of animals (livestock farming and animal breeding) should not be permitted. | |

Source: Airport Land Use Planning Handbook, A Reference Guide for Local Agencies, prepared for California Department of Transportation, Division of Aeronautics, by Metropolitan Transportation Commission and Association of Bay Area Governments, 1983, p.5

scope of the guidelines proposed for use in Riverside County are described in Table 6 and discussed further below. All but the Traffic Pattern Zone (TPZ) zone are shown on Figure 6.

### 3.4.1 Inner Safety Zone

The Inner Safety Zone (ISZ) is an area immediately off the runway end, 1,500 feet wide and from 1,320 to 2,500 feet long. The length of the zone varies depending on the type of runway approach and the type of aircraft using the runway. The shorter distance is for visual runways serving single and twin-engine propeller aircraft. The longer is for precision and non-precision instrument runways or runways serving jet aircraft. By their nature, instrument runways are used during bad weather and periods of poor visibility. Those are also periods of increased accident risk. Jet aircraft tend to be larger than propeller aircraft and operate at higher speeds, thus creating the risk of more severe damage on the ground in the event of an accident.

Of the five safety zones, this is the area with the greatest aircraft accident risk. At most airports, the FAA-defined runway protection zone (RPZ), a trapezoidal area, will lie within the ISZ. At airports with precision instrument runways, however, the outermost corners of the RPZ will extend just outside the ISZ. (See Figure 6.) In such cases, the boundaries of the ISZ should be adjusted to include all of the RPZ.

Within the Inner Safety Zone, no structures should be permitted. Storage of petroleum products and explosive materials should not be permitted, nor should petroleum or natural gas pipelines or above-grade powerlines.

### 3.4.2 Outer Safety Zone

The Outer Safety Zone (OSZ) is an area along the extended runway centerline immediately beyond the ISZ. It is 1,500 feet wide and ranges from 2,180 to 2,500 feet long. The length is based on the same factors as the Inner Safety Zone.

Within the OSZ, the density of the population in structures would be limited to 25 persons per acre or 150 persons per building, whichever is less. For uses not in structures, the density would be limited to 50 persons per acre. Structures should not cover more than 25 percent of individual property. Land uses that concentrate people at single locations should be prohibited within the OSZ. These include dwellings; hotels/ motels; places of public assembly (schools, hospitals, government services, concert halls, auditoriums, stadium, and arenas); public utility stations and plants including electric power and telephone switching stations; and industries handling flammable materials.

Table 6
**LAND USE COMPATIBILITY GUIDELINES FOR AIRPORT SAFETY ZONES[1, 2]**

| Safety Zone | Maximum Population Density | Maximum Coverage By Structures | Land Use |
|---|---|---|---|
| ETZ — Emergency Touchdown Zone | 0[3] | 0[3] | No significant obstructions[4] |
| ISZ — Inner Safety Zone | 0[3] | 0[3] | No petroleum or explosives<br>No above-grade powerlines |
| OSZ — Outer Safety Zone | Uses in structures:[5]<br>25 persons/ac.<br>OR<br>150 persons/bldg.<br>(see text for explanation)<br>Uses not in structures:<br>50 persons/ac. | 25% of net area | No residential<br>No hotels, motels<br>No restaurants, bars<br>No schools, hospitals, government services<br>No concert halls, auditoriums<br>No stadiums, arenas<br>No public utility stations, plants<br>No public communications facilities<br>No uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials |
| ERC — Extended Runway Centerline Zone | 3 du/net acre<br><br>Uses in structures[5]: 75 persons/ac. or 300 persons/bldg. (see text for explanation) | 50% of gross area or 65% of net area, which-ever is greater | No uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials.[6] |
| TPZ — Traffic Pattern Zone | Not Applicable | 50% of gross area or 65% of net area, which-ever is greater | Discourage schools, auditoriums, amphitheaters, stadiums<br>Discourage uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials.[6] |

[1]The following uses shall be prohibited in all airport safety zones:

a. Any use which would direct a steady light or flashing light of red, white, green, or amber colors associated with airport operations toward an aircraft engaged in an initial straight climb following takeoff or toward an aircraft engaged in a straight final approach toward a landing at an airport, other than an FAA-approved navigational signal light or visual approach slope indicator.

b. Any use which would cause sunlight to be reflected towards an aircraft engaged in an initial straight climb following takeoff or towards an aircraft engaged in a straight final approach towards a landing at an airport.

c. Any use which would generate smoke or water vapor or which would attract large concentrations of birds, or which may otherwise affect safe air navigation within the area.

d. Any use which would generate electrical interference that may be detrimental to the operation of aircraft and/or aircraft instrumentation.

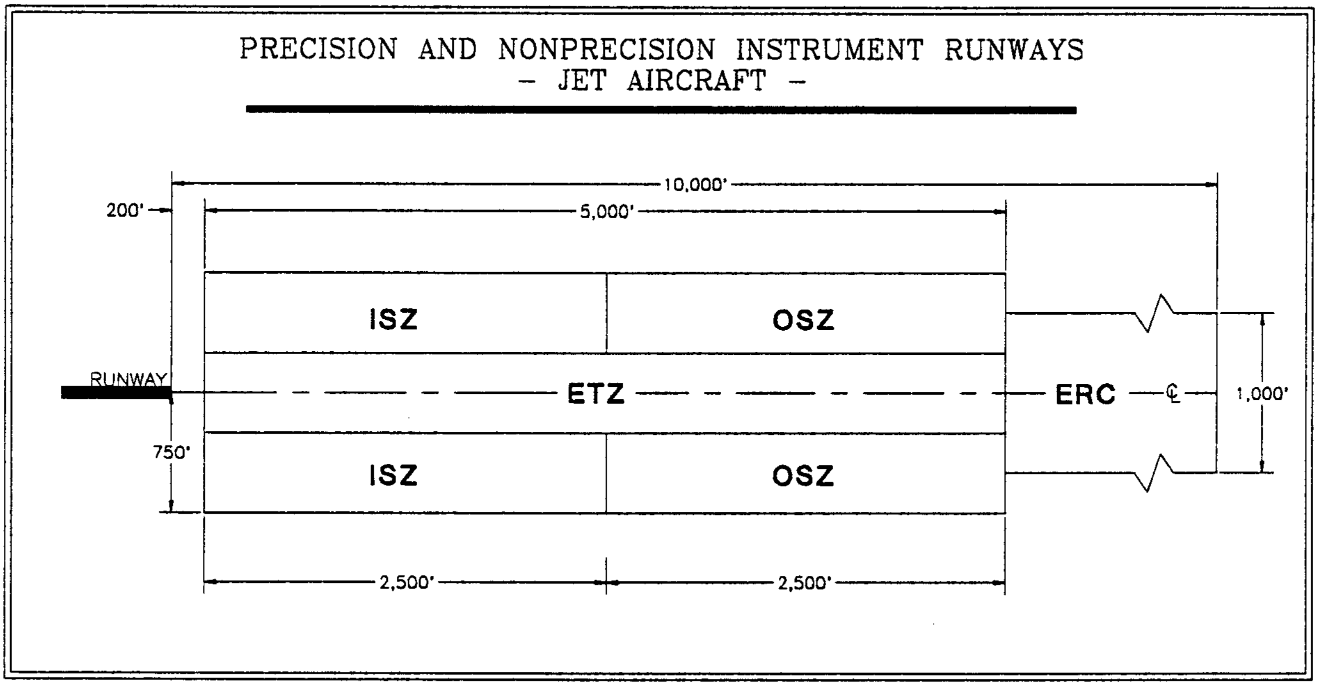
[2]Avigation easements shall be secured through dedication for all land uses permitted in any safety zones.

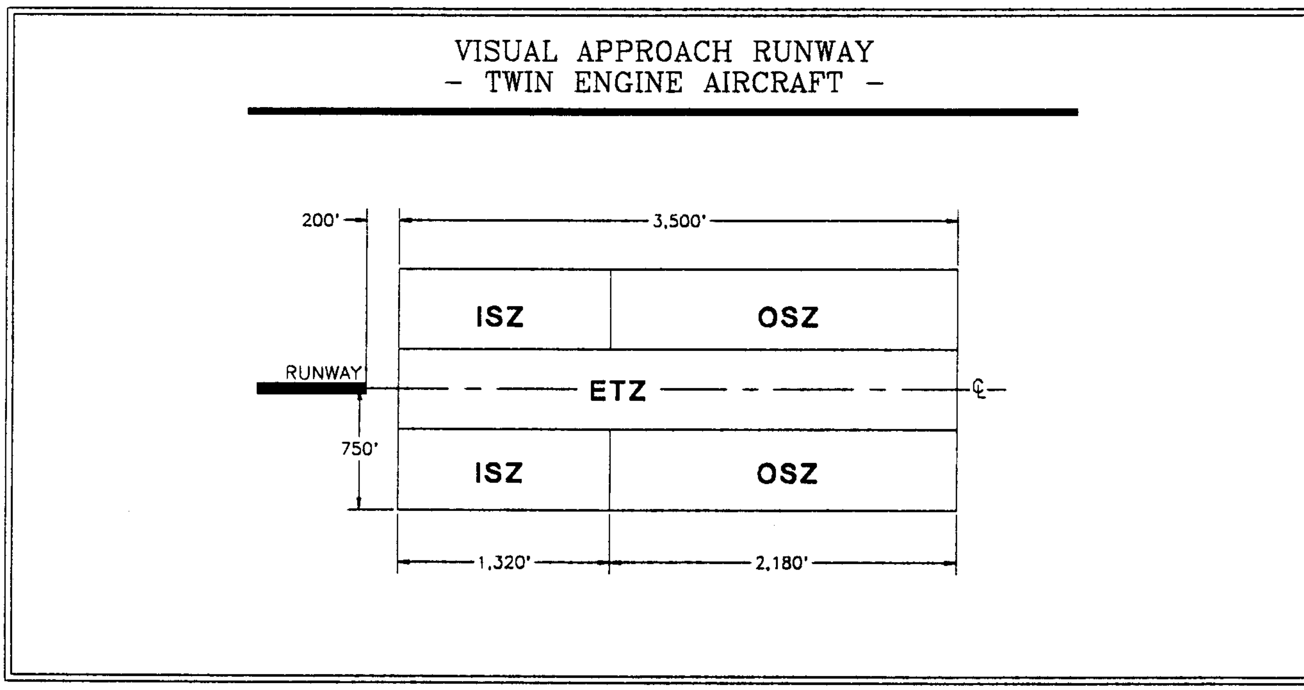
[3]No structures permitted in ETZ or ISZ.

[4]Significant obstructions include but are not limited to large trees, heavy fences and walls, tall and steep berms and retaining walls, non-frangible street light and sign standards, billboards.

[5]A "structure includes fully enclosed buildings and other facilities involving fixed seating and enclosures limiting the mobility of people, such as sports stadiums, outdoor arenas, and amphitheaters.

[6]This does not apply to service stations involving retail sale of motor vehicle fuel if fuel storage tanks are installed underground.




SOURCE: Airport Land Use Planning: A Reference and Guide for Local Agencies, prepared for California Department of Transportation, Division of Aeronautics, by the Metropolitan Transportation Commission and Association of Bay Area Governments.

**LEGEND**

OSZ – OUTER SAFETY ZONE
ISZ – INNER SAFETY ZONE
ETZ – EMERGENCY TOUCHDOWN ZONE
ERC – EXTENDED RUNWAY CENTERLINE

FIGURE 6

SUGGESTED AIRPORT SAFETY ZONES OFF RUNWAY ENDS
CORONA MUNICIPAL AIRPORT

### 3.4.3 Emergency Touchdown Zone

The Emergency Touchdown Zone (ETZ) is a 500-foot wide area extending to the end of the OSZ. It is intended as an emergency landing area. Within this area, no structures or significant obstructions should be permitted.

### 3.4.4 Traffic Pattern Zone

The Traffic Patten Zone (TPZ) is the area around the airport which is most frequently overflown by aircraft and within which the local traffic pattern is located. For the sake of clear and unambiguous definition of the area, the boundaries should be set at the outer edge of the horizontal surface based on FAR Part 77. The horizontal surface extends 5,000 feet off the ends and sides of the runway primary surface with only visual approaches and off utility runways with non-precision approaches. The surface extends 10,000 feet off the ends and sides of the runway primary surface with precision approaches and off runways classified as "larger than utility" with non-precision approaches. These are reasonably close approximations of the limits of a traffic pattern area for these different runways and approaches.

Within the TPZ, maximum dwelling unit density should be limited to 0.4 to 3.0 units per acre, depending on the prevailing need for developable land for housing. This corresponds to minimum lot sizes of 2.5 acres down to 14,520 square feet. The 2.5 acre minimum is consistent with the policy language in the Riverside County Comprehensive Plan and has been the policy of the Riverside County Airport Land Use Commission for several years. The 14,520 square feet minimum is based on various comprehensive land use plans reviewed by the State as presented in the 1983 Airport Land Use Planning Handbook.

Structures within the TPZ should occupy no more than 50 percent gross lot area or 65 percent net lot area, whichever is greater. This would help to ensure that emergency landing areas are available within this area of frequent low-level overflights.

While it may be impractical in all areas to encourage strict land use controls within the TPZ, certain uses should be discouraged in the area. These include schools, auditoriums, amphitheaters, stadiums and other similar places of public assembly. Industries involved in the primary handling of flammable materials should also be discouraged in the TPZ.

### 3.4.5 Extended Runway Centerline Zone

The Extended Runway Centerline Zone (ERC) would apply only off the ends of precision or non-precision instrument runways or runways serving jet aircraft. It is

1,000 feet wide and extends 5,000 feet beyond the Outer Safety Zone (OSZ). These types of approach typically occur in bad weather and during periods of poor visibility.

The California Airport Land Use Planning Handbook notes that poor visibility has been a contributing factor in accidents where aircraft undershot the approach course.

Within the ERC, land uses involving large concentrations of people should be discouraged. These would include churches, schools, auditoriums, major office

developments, shopping centers, hospitals, stadiums and other uses where large concentrations of people occur.

### 3.4.6 Special Considerations in all Safety Zones

Particularly hazardous land uses should be prohibited in all designated safety zones. These include those which would cause smoke, water vapor, or light interference, thus impeding the pilot's ability to see the airfield. Other uses which cause electrical interference with aircraft navigational and communications equipment also should be prohibited in the airport vicinity. Other inappropriate uses include those which attract large numbers of birds. Examples include landfills and some types of food processing plants involving outdoor storage of grain and other raw materials or food by-products.

The Airport Land Use Planning Handbook offers the following descriptions of land uses which are considered hazardous and should be prohibited within all airport safety zones:

- Any use which would direct a steady light or flashing light of red, white, green, or amber colors associated with airport operations toward an aircraft engaged in an initial straight climb following takeoff or toward an aircraft engaged in a straight final approach toward a landing at an airport, other than an FAA approved navigational signal light or visual approach slope indicator.

- Any use which would cause sunlight to be reflected toward an aircraft engaged in an initial straight climb following takeoff or toward an aircraft engaged in a straight final approach toward a landing at an airport.

- Any use which would generate smoke or which would attract large concentrations of birds, or which may otherwise affect safe air navigation within this area.

- Any use which would generate electrical interference that may be detrimental to the operation of aircraft and/or aircraft instrumentation.

Due to the frequency of aircraft flights, it has been the long standing policy of the ALUC to require avigation easements within the area circumscribed by the perimeter of the horizontal surface (see Section 3.5 for a description). Avigation easements grant an airport the right to perform aircraft operations over the designated property, including operations that might cause noise, vibration, and other effects. This easement may also include specific prohibitions on the uses for which the property may be developed. Maximum heights of structures and other objects may also be specified. In this Comprehensive Land Use Plan, the horizontal surface is equated to the Traffic Pattern Zone discussed in Section 3.4.4. The ALUC intends to maintain its policy regarding avigation easements within the Horizontal Surface/Traffic Pattern Safety Zone and extends this policy to all safety zones including the Traffic Pattern Safety Zone.

## 3.5 AIRPORT VICINITY HEIGHT GUIDELINES

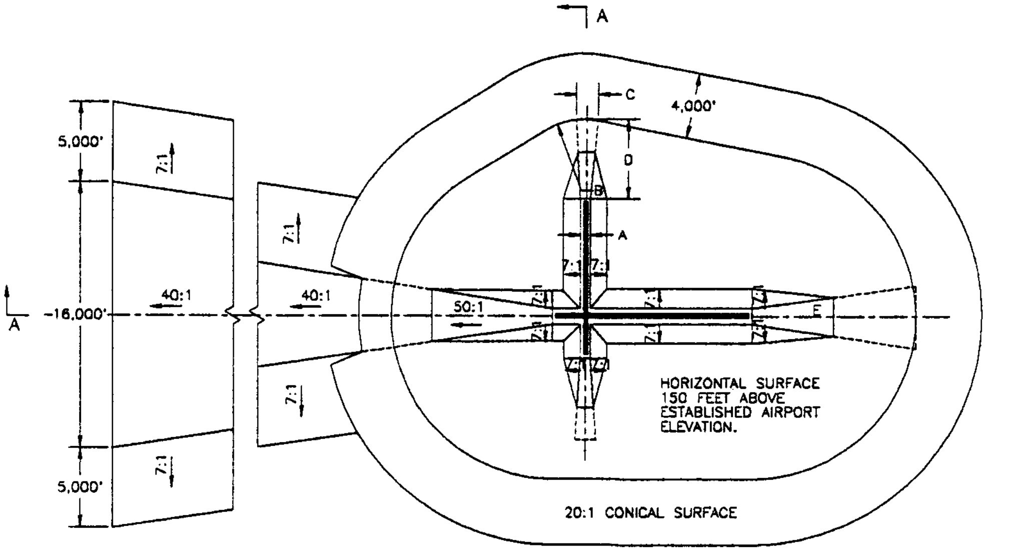
Airport vicinity height limitations are required for two reasons. The first is to protect the public safety, health, and welfare by ensuring that aircraft can safely fly in the airspace around an airport. This protects both the interest of those in the aircraft and those on the ground who could be injured in the event of an accident. Secondly, height limitations are required to protect the operating capability of airports, thus preserving an important part of the State's transportation system.

The Federal government has developed standards for determining obstructions in the navigable airspace. Federal Aviation Regulations (FAR) Part 77 defines a variety of imaginary surfaces around airports. Each surface is defined at a certain altitude around the airport. Figure 7 shows the range of imaginary surfaces addressed in FAR Part 77.

As Figure 7 illustrates, the dimensions of the surfaces vary depending on the type of approach to the runways. Non-precision runways have larger surfaces and flatter approach slopes than visual runways. Precision instrument runways have still larger surfaces and flatter approaches than nonprecision runways.

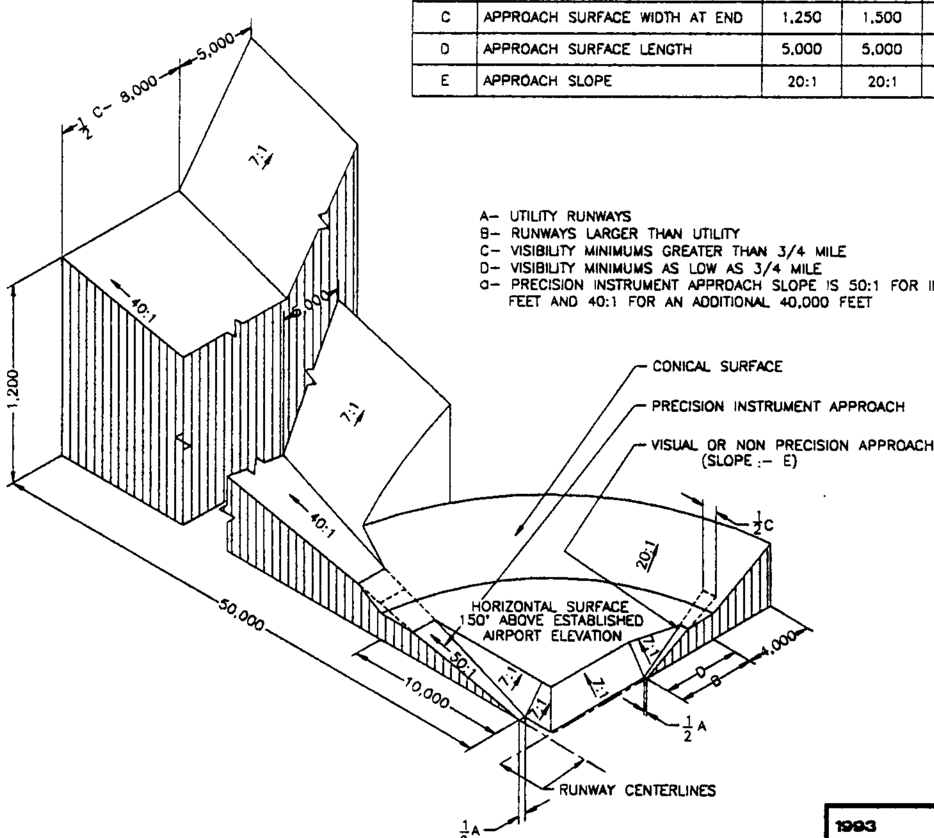
FAA uses these FAR Part 77 obstructions standards not as absolute height limits, but as elevations above which structures may constitute a safety problem. Any penetrations of the FAR Part 77 surface are subject to review on a case by case basis. If a safety problem is found to exist, FAA will issue a determination of a hazard to air navigation. FAA does not have the authority to prevent the encroachment. It is up to the local zoning authorities to enforce the FAA recommendation.

The California Airport Land Use Planning Handbook states the following with respect to height limitation standards:




| DIM | ITEM | DIMENSIONAL STANDARDS (FEET) | | | | | |
|---|---|---|---|---|---|---|---|
| | | VISUAL RUNWAY | | NON – PRECISION INSTRUMENT RUNWAY | | | PRECISION INSTRUMENT RUNWAY |
| | | A | B | A | B | | |
| | | | | | C | D | |
| A | WIDTH OF PRIMARY SURFACE AND APPROACH SURFACE WIDTH AT INNER END | 250 | 500 | 500 | 500 | 1,000 | 1,000 |
| B | RADIUS OF HORIZONTAL SURFACE | 5,000 | 5,000 | 5,000 | 10,000 | 10,000 | 10,000 |
| | | VISUAL APPROACH | | NON – PRECISION INSTRUMENT APPROACH | | | PRECISION INSTRUMENT APPROACH |
| | | | | A | B | | |
| | | A | B | | C | D | |
| C | APPROACH SURFACE WIDTH AT END | 1,250 | 1,500 | 2,000 | 3,500 | 4,000 | 16,000 |
| D | APPROACH SURFACE LENGTH | 5,000 | 5,000 | 5,000 | 10,000 | 10,000 | a |
| E | APPROACH SLOPE | 20:1 | 20:1 | 20:1 | 34:1 | 34:1 | a |

A– UTILITY RUNWAYS
B– RUNWAYS LARGER THAN UTILITY
C– VISIBILITY MINIMUMS GREATER THAN 3/4 MILE
D– VISIBILITY MINIMUMS AS LOW AS 3/4 MILE
a– PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET




ISOMETRIC VIEW OF SECTION A–A

1993 FIGURE 7

CORONA MUNICIPAL AIRPORT RIVERSIDE COUNTY, CALIFORNIA

**FAR PART 77 TYPICAL CIVIL AIRPORT IMAGINARY SURFACES**

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While it is important to understand that these (FAR Part 77) are in fact review standards, it is equally important to recognize that these standards provide a reasonable and defensible balance between the needs of the airspace users and the rights of property owners beneath the flight patterns. In this regard, the use of FAR Part 77 obstruction standards as recommended height limits is appropriate.

The practice of using of FAR Part 77 standards as height limits has been widely followed by Airport Land Use Commissions in California. FAA has encouraged this by producing a model zoning ordinance to limit the height of objects around airports (FAA Advisory Circular 150/5190-4A, "A Model Zoning Ordinance to Limit Height of Objects Around Airports"). The model ordinance proposes the use of the FAR Part 77 surfaces as regulatory height limits.

In view of the widespread acceptance of the FAR Part 77 criteria, they will be used as the basis for height limitations in this Comprehensive Land Use Plan.

## 3.6 SUMMARY — AIRPORT INFLUENCE AREA

This section has presented the overall planning guidelines and criteria to be used in developing the Comprehensive Land Use Plan for Corona Municipal Airport. The noise and safety guidelines are based on the recommendations of the State of California as presented in the Airport Land Use Planning Handbook (1983). The height guidelines are based on FAR Part 77, as recommended by the State in the Airport Land Use Planning Handbook.

For purposes of defining the "airport-influence area" around the Airport, the composite of the noise and height-influence areas will be used. The outer boundaries of the noise-influence area correspond to the 60 dB CNEL contours of existing and forecast conditions. The outer boundary of the height-influence area is the edge of the conical surface. The outer boundary of the safety-influence area is the horizontal surface which lies within the conical surface.

## Section 4.0

## AIRPORT NOISE INFLUENCE AREA ISSUES AND ALTERNATIVES

### 4.1 INTRODUCTION

This section presents an analysis of existing and forecast noise conditions at Corona Municipal Airport. The discussion includes an outline of the assumptions used in modeling these conditions, a presentation of the aircraft noise impacts and issues, and identification of alternative noise abatement actions.

### 4.2 NOISE METHODOLOGY

Aircraft noise levels for the Corona Municipal Airport were created using the Integrated Noise Model (INM), Version 3.9. The INM, which was developed by the Federal Aviation Administration, includes a data base of noise and operational characteristics for 81 aircraft types and variations. When a user specifies a particular aircraft class from the INM data base, the model automatically provides the necessary inputs concerning aircraft power settings, departure and arrival profiles and associated noise levels. The model actually 'flies' the departure and arrival profiles and flight track for each type aircraft accumulating noise exposure levels within a grid around the Airport. The model then connects the grid locations of equal noise level to produce a contour of aircraft noise for each defined output noise level.

This report uses the Community Noise Equivalent Level (CNEL) to assess noise exposure. The CNEL is the State of California standard noise level descriptor (California Administrative Code, Title 21). CNEL represents the average daytime noise level during a 24-hour day, adjusted to an equivalent level to account for the lower tolerance of people to noise during the evening and nighttime periods, relative to the daytime period. In the calculation of CNEL values, events which occur between 7:00 p.m. and 10:00 p.m. receive a 'penalty' of 5 additional decibels (Db); and events which occur between 10:00 p.m. and 7:00 a.m. receive an additional 10 dB penalty. The final CNEL value expresses the 24-hour average of the summed, energy adjusted events.

The FAA accepts CNEL as a measure of cumulative noise exposure that is essentially equivalent to FAA's Day-Night Average Sound Level ($L_{dn}$) standard. The $L_{dn}$ standard differs from the CNEL in that it provides a penalty for nighttime operations, but not for evening operations.

## 4.3 INM INPUT DATA

The INM utilizes the following information about an airport:

- The types of aircraft, often referred to as the "mix" of aircraft
- Runway configuration
- Aircraft flight track definition
- Aircraft stage length
- Aircraft departure and approach profiles
- Aircraft traffic volume
- Flight track utilization by aircraft types

### 4.3.1 Activity Data

The existing Master Plan forecasts operations only through 1997 and is in need of updating, as noted in Section 2. Since this Comprehensive Land Use Plan is limited by the Master Plan and the Airport Layout Plan, the noise forecast is similarly limited. Since the 1997 forecast overstates expected growth at the Airport, under the conditions of this study, it can be considered a 'Worst Case' representation of expected noise. The noise contours for 1990 operations are presented as the existing noise influence area. Aircraft operations for 1990 and 1997 are summarized below:

| | 1990 Operations | 1997 Forecast |
|---|---|---|
| Single Engine | 125,324 | N/A |
| Multi-Engine | 22,116 | N/A |
| Business Jet | --- | N/A |
| Helicopter | 150,000 | N/A |
| Total | 297,440 | 565,800 |

N/A = Not Available

Sources: 1990 Data (FAA Survey)
1997 Forecast (1977 Corona Municipal Airport Master Plan)

### 4.3.2 Fleet Mix

The general fleet mix is implied by the above summary. The INM data base provided the operational characteristics and noise data for all aircraft modeled for 1990 operations. It was assumed that all single engine aircraft would be represented by a variable pitch single reciprocating engine aircraft. Twin-engine aircraft were represented by a Beechcraft Baron. Helicopter operations were represented by the Bell 206 Long Ranger, which is a typical turboshaft helicopter. Although the INM data base does not include helicopter noise level and flight profile data, relevant information was obtained from FAA Report No. FAA-EE-82-16, "Helicopter Noise Exposure Curves for Use in Environmental Impact Assessment," November 1982.

### 4.3.3 Time of Day

The distribution of aircraft operations by time of day is important because evening and nighttime operations have a 5 and 10 dB penalty added, respectively. The day/evening/night distribution of aircraft operations for 1990 was assumed to be:

| | Percent | |
|---|---|---|
| | Fixed Wing | Helicopters |
| Day | 90 | 76 |
| Evening | 7 | 19 |
| Night | 3 | 5 |

### 4.3.4 Runway Use

Based on current usage patterns, 90 percent of the aircraft operations are to the West on Runway 25. It was assumed this pattern will continue.

### 4.3.5 Flight Profiles and Tracks

The INM allows the user to define the flight profiles and flight tracks, although the data base includes standard flight profiles. The standard flight profiles were used in developing the 1990 analysis. The flight tracks were discussed earlier in Section 2 and were illustrated on Figure 3. Approximately 85 percent of the single and multi-engine fixed wing aircraft operations were assumed to be touch-and-go; 75 percent of the helicopter operations were assumed to be touch-and-go.

## 4.4 INM OUTPUT

The INM model was used to produce noise contour lines at values of 55, 60, 65, and 70 dB CNEL for existing 1990 conditions. Noise contours for 1997 were taken from the Airport Master Plan.

### 4.4.1 Existing 1990 Noise

Noise contours based on 1990 aircraft operations are illustrated on Figure 8. The areas encompassed by these contours are summed below. The 55 dB CNEL was modeled but is not illustrated on Figure 8.

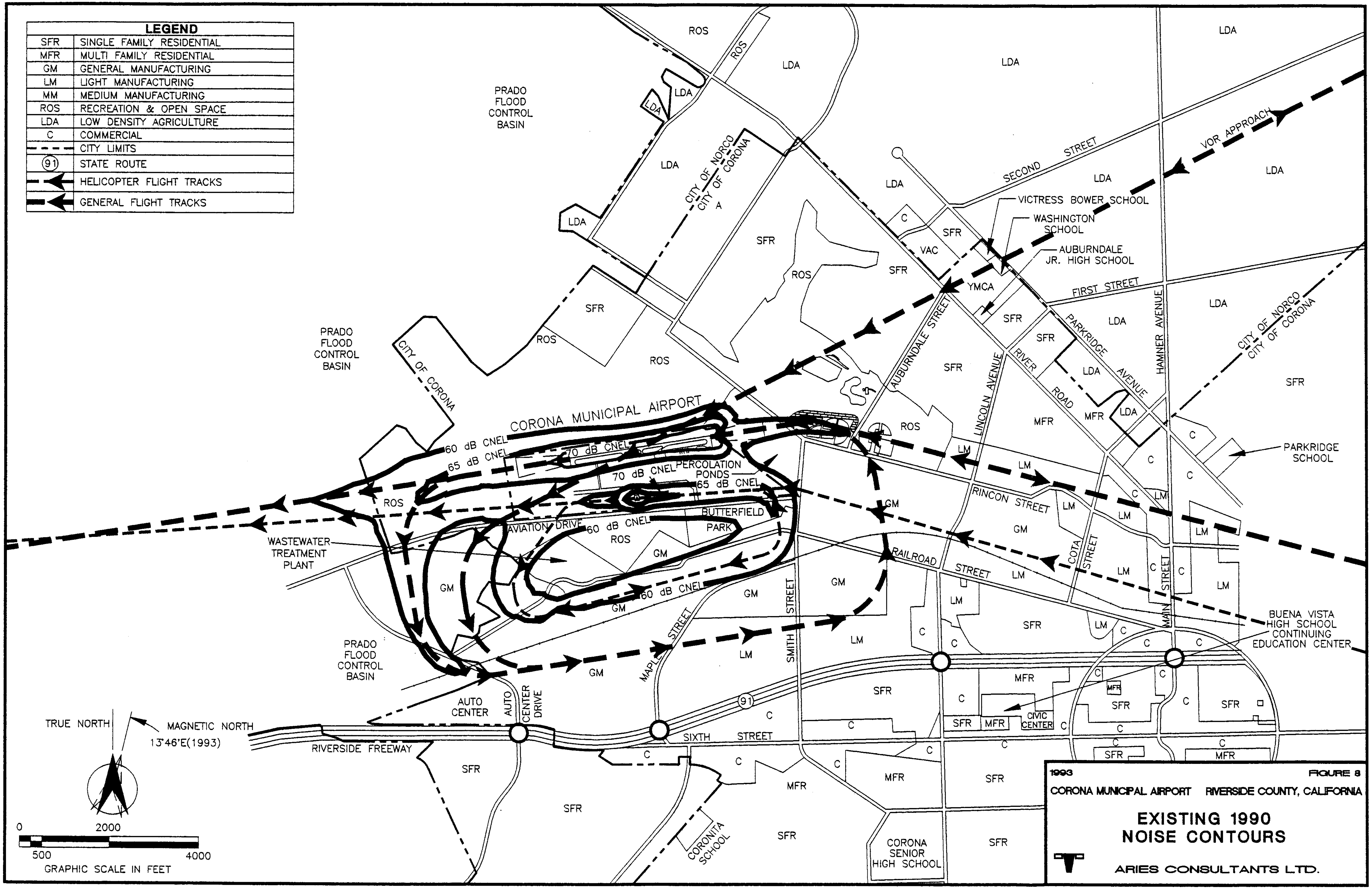
| | 1990 | |
|---|---|---|
| CNEL (dB) | Sq. Miles | Acres |
| 55 | 2.90 | 1,856 |
| 60 | 0.98 | 627 |
| 65 | 0.23 | 147 |
| 70 | 0.05 | 32 |

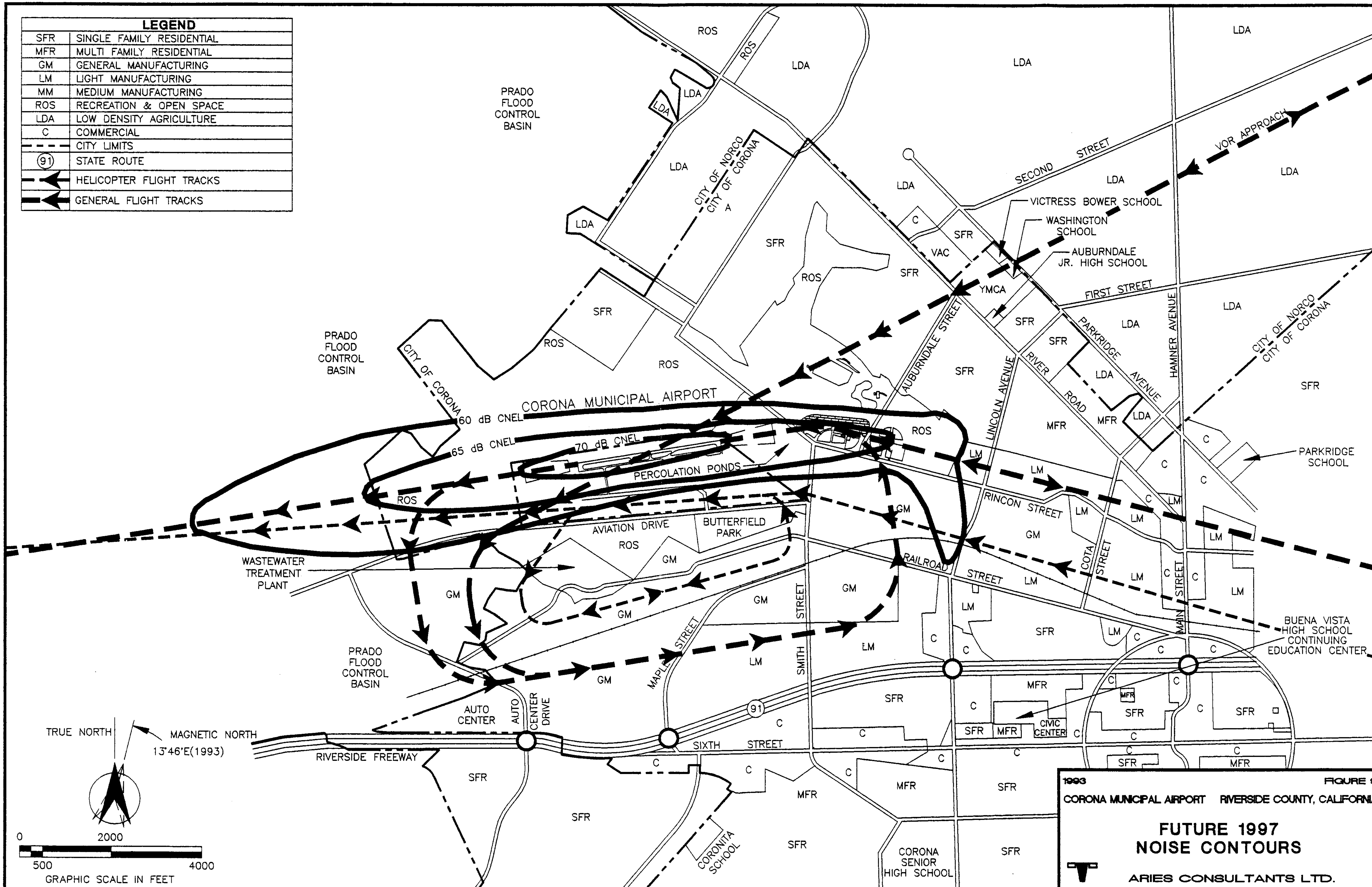
The shape of the noise contours is due to the assumption that 90 percent of the operations are to the west and helicopter operations are to the south. As noted in Section 2, helicopter operations are centered in an area approximately 1,000 feet south of the runway. This separation is obvious in the INM output which shows 65 and 70 dB CNEL contours surrounding each principal operation area. The 70 dB CNEL contour for both the runway and helicopter pad area are sufficiently small to remain within the Airport boundary. The 65 dB CNEL contour for the runway extends about 2,000 feet beyond the western Airport boundary and about 500 feet beyond the eastern Airport boundary. The 65 dB CNEL contour for the helicopters is mostly contained within the Airport boundary although a portion of the contour curves to follow the approach path and extends about 400 feet across Butterfield Drive and into Butterfield Park.

The 60 dB CNEL contour extends out from the Airport much further and curves to follow the touch-and-go flight tracks. The 60 dB CNEL contour extends about 4,300 feet west and 3,000 feet east of the Airport boundary. The 60 dB CNEL contour also has a long tail extending about 4,000 feet to the southwest which is associated with the fixed-wing aircraft touch-and-go traffic pattern. There is also a portion of the 60 dB CNEL contour that follows the helicopter touch-and-go traffic pattern, creating a doughnut-shaped contour, extending about 2,000 feet south.

### 4.4.2 Forecast Noise

Noise contours based on 1997 forecast aircraft operations were taken from the Airport Master Plan and are illustrated on Figure 9.


LEGEND
SFR SINGLE FAMILY RESIDENTIAL
MFR MULTI FAMILY RESIDENTIAL
GM GENERAL MANUFACTURING
LM LIGHT MANUFACTURING
MM MEDIUM MANUFACTURING
ROS RECREATION & OPEN SPACE
LDA LOW DENSITY AGRICULTURE
C COMMERCIAL
CITY LIMITS
91 STATE ROUTE
HELICOPTER FLIGHT TRACKS
GENERAL FLIGHT TRACKS
PRADO FLOOD CONTROL BASIN
CITY OF NORCO
CITY OF CORONA
CORONA MUNICIPAL AIRPORT
60 dB CNEL
65 dB CNEL
70 dB CNEL
PERCOLATION PONDS
AVIATION DRIVE
BUTTERFIELD PARK
WASTEWATER TREATMENT PLANT
VOR APPROACH
SECOND STREET
FIRST STREET
VICTRESS BOWER SCHOOL
WASHINGTON SCHOOL
AUBURNDALE JR. HIGH SCHOOL
YMCA
VAC
AUBURNDALE STREET
LINCOLN AVENUE
RIVER ROAD
PARKRIDGE AVENUE
HAMNER AVENUE
PARKRIDGE SCHOOL
RINCON STREET
RAILROAD STREET
COTA STREET
MAIN STREET
SMITH STREET
MAPLE STREET
BUENA VISTA HIGH SCHOOL CONTINUING EDUCATION CENTER
CIVIC CENTER
AUTO CENTER
AUTO CENTER DRIVE
RIVERSIDE FREEWAY
SIXTH STREET
CORONITA SCHOOL
CORONA SENIOR HIGH SCHOOL
TRUE NORTH
MAGNETIC NORTH
13°46'E(1993)
0 500 2000 4000
GRAPHIC SCALE IN FEET
1993
FIGURE 8
CORONA MUNICIPAL AIRPORT RIVERSIDE COUNTY, CALIFORNIA
EXISTING 1990 NOISE CONTOURS
ARIES CONSULTANTS LTD.




1993 FIGURE 9

CORONA MUNICIPAL AIRPORT RIVERSIDE COUNTY, CALIFORNIA

**FUTURE 1997 NOISE CONTOURS**

ARIES CONSULTANTS LTD.

The surface areas falling within these contours are summed below:

| | 1997 | |
|---|---|---|
| CNEL (dB) | Sq. Miles | Acres |
| 55 | Contour not available | |
| 60 | 1.2 | 795 |
| 65 | 0.5 | 293 |
| 70 | 0.1 | 54 |

The 70 dB CNEL contour is virtually contained within the Airport boundary. The 65 dB CNEL contour, which represents the City's noise standard, extends beyond the Airport boundary to the east and the west. To the west, the contour overlays the City's Prado Basin leasehold. To the east, the 65 dB CNEL contour overlays the City's Percolation Ponds, portions of the Prado Basin Leasehold, and private lands south of Rincon Street. The 60 dB CNEL contour, which represents the ALUC's noise standard, extends further to the west and east, but generally affects the same land uses.

## 4.5 NOISE IMPACTS AND ISSUES

The impacts and issues suggested by the noise contours illustrated on Figures 8 and 9 are discussed further in this subsection.

### 4.5.1 Impacts on Existing Land Use

Existing land use was presented and discussed in Section 2, and the associated land use patterns are included on Figure 8. North and west of the Airport, the various noise contours impact recreational and open space land uses in the City's Prado Basin Leasehold area. Such land uses are fully compatible at the 60 and 65 dB CNEL noise levels.

Wildlife in the Prado Flood Control Basin may also be affected by the aircraft noise. Potentially, the most seriously affected wildlife in the Basin is the Least Bell's Vireo which is an endangered species. The exact location of the nesting areas are not published to protect the birds so it is difficult to draw a direct relationship between the noise contours and the bird's locations. Since operations at the Airport have been at the current level for some time, with no apparent effect on the bird's mating or migration habits, either the birds have adapted to the noise or they are unaffected by it. The relationship of the Least Bell's Vireo to continued development of the Airport is a subject that must be addressed in the environmental documentation associated with an update to the Airport Master Plan.

South and east of the Airport, the noise contours impact manufacturing and industrial land uses, as well as park and open space uses. The 65 dB CNEL contour for the helicopter operations shows a very short western bulge and a long eastern tail. This is because the helicopter rises from the ground at a faster rate than fixed-wing aircraft producing a smaller takeoff noise footprint. On landing, however, the helicopter descends more gradually producing the long noise "tail" to the east. This contour extends beyond the Airport boundary along Butterfield Drive. Except for Butterfield Park, most of the land on the south side of Butterfield Drive is vacant at present. The 60 dB CNEL contour extends further south to below Railroad Street. The open space and the manufacturing land uses in this area are compatible at the 60 and 65 dB CNEL noise levels.

### 4.5.2 Impacts on Future Land Use

The current Airport Master Plan limits the forecast of future operations to 1997. Land use patterns in 1997 are expected to be almost identical to those of 1990 as illustrated on Figure 9. Since operations levels forecast for 1997 in the master plan are significantly higher than actual levels in 1990, the associated noise curves greatly increase the areas affected by aircraft noise. However, it should be noted that the 1997 forecast did not envision a large number of helicopters in the mix.

North and west of the Airport, the 60 and 65 dB CNEL noise level curves encompass larger areas of the City's Prado Basin Leasehold and extend further into the Prado Basin itself. Affected lands are used for recreational and open space purposes and are compatible in the noise range from 60 to 70 dB CNEL.

East of the Airport, the noise contours extend over the City's percolation ponds and proposed Sports Complex, as well as manufacturing uses south of Rincon Street. These land uses are compatible in the noise range from 60 to 70 dB CNEL.

### 4.5.3 Planning Issues

The most significant planning issue regarding noise is whether or not the ALUC noise standards should replace those of the City. The major difference is in the residential land use categories, where the ALUC criteria restricts residential use above 60 dB CNEL, while the City's criteria restricts residential uses above 65 dB CNEL. The ALUC has based its criteria on a suburban standard while the City has set its criteria on an urban standard.

Noise caused by aircraft is not a significant issue at Corona Municipal Airport due to the large areas of open space surrounding the Airport and the City's emphasis on noise compatible industrial and recreational land uses. However, the Noise Element of the City's General Plan cites the Airport as one of the principal noise sources in the City.

Efforts to reduce aircraft noise at the source are not going to have much effect on noise levels in the immediate future. While great strides have been made in reducing the noise of jet aircraft, with benefits accruing to persons living near larger airports, little has been accomplished in the technology to reduce the noise of general aviation piston-driven aircraft. Even if a technological breakthrough were to occur, it would be many years before the benefits would be heard because the number of new general aviation aircraft being built is very low and retrofit programs are likely to be very expensive.

The major options available to local government include: land use controls, the use of noise abatement procedures at the Airport, adoption of realistic noise performance standards for all transportation vehicles, development of an aggressive monitoring program and acquisition of noise easements.

## 4.6 LAND USE MANAGEMENT ALTERNATIVES

The City of Corona has already taken many steps to address the effects of aircraft noise. The City has instituted noise abatement procedures at the Airport; where appropriate, they have acquired noise and avigation easements; and zoning in the Airport vicinity reflects mostly Airport compatible land uses. The City has also cited the Airport specifically in the Noise Element of its General Plan which restricts new residential development inside the "aircraft-generated 65 [dB] CNEL" contours.

The City, with FAA approval, has published noise abatement procedures for aircraft operating at the Airport. The revised flight patterns which took effect in January 1993 will remove a portion of the existing pattern north of the Airport reducing aircraft flights over the single family residential areas north and northwest of the Airport.

## 4.7 SUMMARY

This section has reviewed the aircraft noise in the vicinity of the Corona Municipal Airport based on current and expected future noise levels through 1997. The City has already taken steps to reduce the impacts of aircraft noise which is evident in the fact that none of the noise impacted areas have incompatible land uses.

Once the City updates its Airport Master Plan, a longer range view of the Airport's noise impacts can be developed, and if necessary, additional noise mitigation measures can be taken.

## Section 5.0

## AIRPORT SAFETY INFLUENCE AREA ISSUES AND ALTERNATIVES

### 5.1 INTRODUCTION

Safety of people on the ground and in the air and the protection of property from airport-related hazards are among the responsibilities of the Airport Land Use Commission. This section provides an analysis of safety issues at Corona Municipal Airport, defining the airport safety areas and discussing safety compatibility planning issues and alternatives.

### 5.2 AREAS OF SAFETY CONCERN

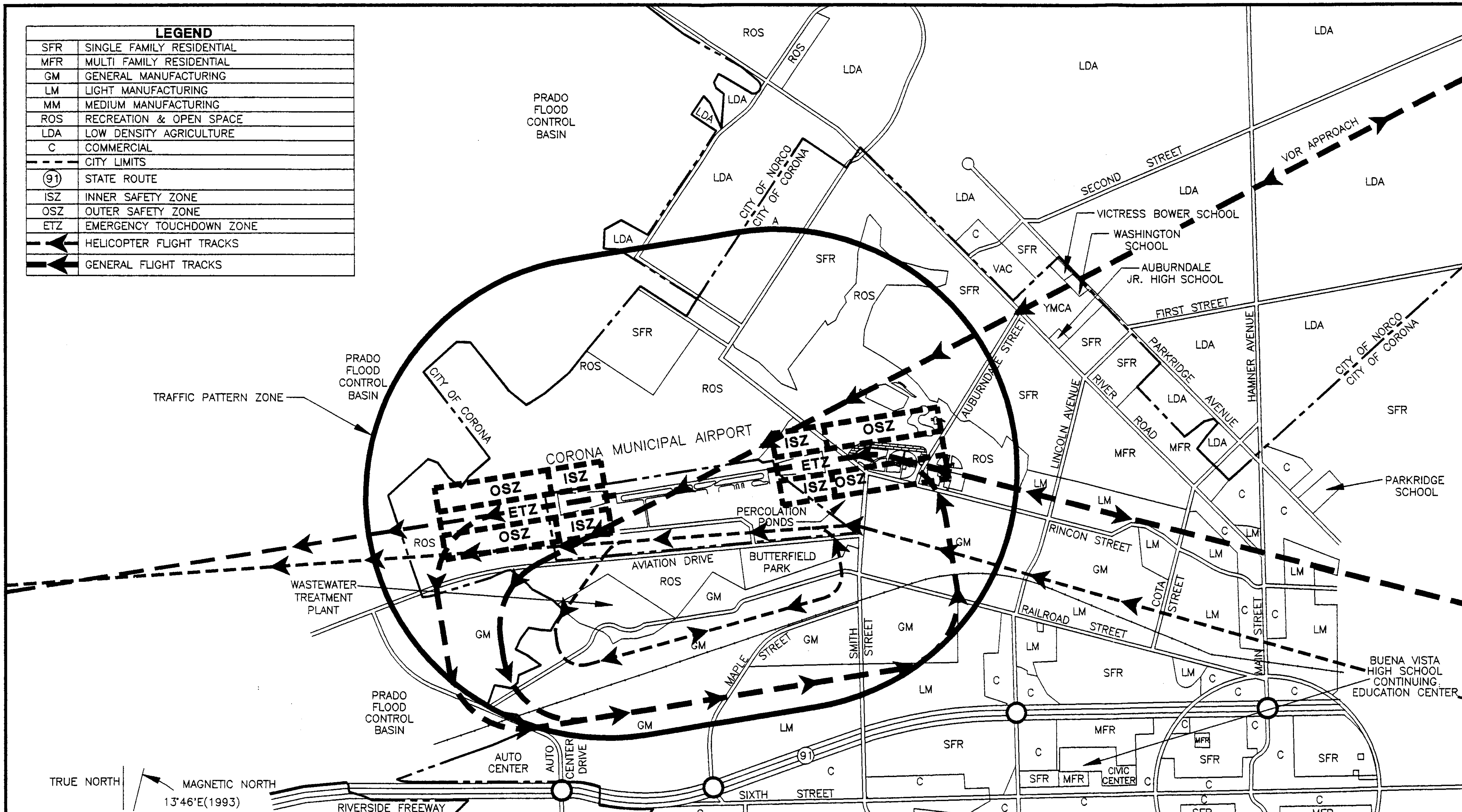
The general character of the airport safety zones and related land use compatibility guidelines were established in Section 3. The safety zones for Corona Municipal Airport are illustrated on Figure 10. These safety zones do not take the proposed parallel runway into account and are based on a visual approach runway standard as presented earlier on Figure 6. These safety zones define the areas within which the Airport Land Use Commission guidelines are applied.

Safety zones at the west end of the runway begin 200 feet from the runway end and extend 3,500 feet westward at a width of 1,500 feet centered on the extended centerline of the runway. The first 1,300 feet of these zones generally fall within the Airport boundary; the remainder fall beyond the Airport boundary but within the City's Prado Basin leasehold area.

At the east end of the runway, the safety zones begin 200 feet east of the displaced threshold and extend 3,500 feet eastward at a width of 1,500 feet centered on the extended centerline of the runway. Virtually the entire safety zone area is located outside the Airport boundary. Only a small segment of the safety zone area affects privately-owned land.

### 5.3 SAFETY ISSUES

In determining the impact of these safety zones on land use compatibility in the area surrounding Corona Municipal Airport, it is necessary to compare the safety zone boundaries and associated land use compatibility guidelines from Table 5, presented earlier, with the future land use plan and existing zoning.




1993 FIGURE 10

CORONA MUNICIPAL AIRPORT RIVERSIDE COUNTY, CALIFORNIA

AIRPORT SAFETY ZONES

ARIES CONSULTANTS LTD.

### 5.3.1 Inner Safety Zone

The Inner Safety Zone (ISZ) is intended to be very restrictive due to its proximity to the runway. The ISZ allows no structures, no above-ground powerlines, nor the storage of petroleum or explosives. At Corona Municipal Airport, each of the four ISZ areas overlay public lands.

At the west end of Runway 7-25, one ISZ area falls wholly within the Airport boundary and the second area falls outside the Airport boundary, but within the City's Prado Basin Leasehold area. Both areas are currently undeveloped and are used for recreational and open space uses. The City's General Plan, reflecting the general terms of the leasehold agreement, indicates the area is to continue to be used for recreation and open space uses.

At the eastern end of Runway 7-25 the ISZ areas mostly overlay the City's percolation ponds with portions within the Airport boundary and in the Prado Basin Leasehold area. There are no structures in either of these areas, although the percolation ponds have a series of raised embankments surrounding each holding area. The City's proposed Sports Complex along the north side of Rincon Street does not fall within the ISZ.

### 5.3.2 Outer Safety Zone

Based on the land use compatibility guidelines in Table 6, several kinds of land uses should be prohibited in the Outer Safety Zone (OSZ), including residences, various public assembly uses, and industries with flammable materials. Limits on the number of persons per acre and per building are also advised. Places of public assembly include: schools, hospitals, government services, concert halls, auditoriums, stadiums, and arenas.

The OSZ areas west of Runway 7-25 overlay portions of the Prado Basin Leasehold area which contains no structures and is used for recreational purposes. Terms of the leasehold agreement prevent the land from being used for other than recreational purposes so it is unlikely that the current land use will change.

On the east end of Runway 7-25, the OSZ area north of the extended runway centerline overlays portions of the Prado Basin Leasehold and clips a corner of the percolation ponds area. The OSZ area south of the extended runway centerline overlays private lands in the southeastern quadrant of the intersection of Smith Street and Rincon Street as well as portions of the percolation ponds area and the Leasehold area. The private lands are currently used for general manufacturing purposes, a compatible use based on the guidelines, and appear to be compatible with the criteria limiting the number of persons per acre or per building, although a specific analysis was not performed. A major portion of the City's proposed Sports Complex falls within the OSZ. During limited periods of intensive use, the Sports Complex may exceed the suggested limits on the number of persons per acre. The City has designed the complex to limit activities along the extended runway centerline, which shifts the more intense activities to the OSZ. Plans for the sports complex were not complete at the time this Comprehensive Airport Land Use Plan was adopted. The City will be required to submit completed plans for the sports complex to the Airport Land Use Commission and a full determination of compatibility with the guidelines adopted in this plan will be made at that time.

### 5.3.3 Emergency Touchdown Zone

The Emergency Touchdown Zone (ETZ) is a narrow band of land which allows the pilot to set an aircraft down in an emergency just after takeoff. No structures and no significant obstructions should be permitted within the ETZ, based on the criteria presented earlier in Table 6. The ETZ is an important safety element and an area of high risk.

The first 1,300 feet of the ETZ area west of Runway 7-25 falls within the Airport boundary, and the remainder overlays the City's Prado Basin Leasehold area. There are no structures in this area and no development is anticipated in the future. At the east end of Runway 7-25, the ETZ area overlays the City's percolation ponds and eastern portions of the Prado Basin leasehold extending to Auburndale Street. Portions of the City's proposed Sports Complex fall within the ETZ. These areas tend to be the outfield areas of the proposed baseball diamonds, parking areas, and golf course. Except for the raised embankments in the percolation pond area and lighting standards in the proposed Sports Complex there are no structures in the ETZ area. As noted above, the City will need to submit completed plans for the sports complex to the Airport Land Use Commission for review.

### 5.3.4 Traffic Pattern Zone

The Traffic Pattern Zone (TPZ) corresponds with the FAR Part 77 definition for the horizontal surface (see discussion in Section 6). Places of public assembly are to be discouraged as are industries with flammable products. The TPZ encompasses an area of 3,088 acres as illustrated on Figure 10.

Approximately 1,684 acres of the TPZ are part of the Prado Flood Control Basin, and of that amount, approximately 1,186 acres are within the City's Leasehold area. The remainder of the TPZ includes the manufacturing areas south and southeast of the Airport, including the wastewater treatment plant, Butterfield Park, and the proposed Sports Complex, as well as single-family residential areas to the north and northeast.

"Light" and "general" manufacturing are allowed in the manufacturing areas south and southeast of the Airport. Flammable and explosive materials are not specifically excluded from the City's M-1 and M-2 zoning districts which control the siting and development criteria for light and general manufacturing, respectively. Also, chemical laboratories are allowed in the M-1 district and the manufacture of paint, shellac, turpentine, linseed oil, lacquer or varnish is allowed as a conditional use in the M-2 district. If these specific industries are located in the TPZ, particularly in the area south of the Airport where the helicopter training flights and fixed-wing touch-and-go operations are conducted, they should be considered incompatible. A specific analysis of each manufacturing plant in the affected area was not performed.

The single-family residential areas north and northeast of the Airport are at less risk, particularly so after the flight patterns changed in January 1993. Schools serving this area are located further east and outside the TPZ.

### 5.3.5 Summary of Issues in Safety Zones

Generally, the safety zones defined for the Corona Municipal Airport are free of incompatible land uses. However, some manufacturing zoning districts allow incompatible land uses and should be amended. The zoning regulations are not structured to set clear guidelines and policies to property owners, administrators or policy makers as to the Airport compatibility concerns that should be addressed in their land use planning and decision making. While these people may attempt to make good faith efforts to consider these issues, the ordinances are not designed to make this easy. Under current policy, the ALUC, through its review of development proposals, is the only entity expressly taking the Airport issues into consideration.

Clearly, changes in local regulations should be made to ensure that airport compatibility considerations are addressed at the outset of the planning and development process. This requires changes in the City zoning regulations.

At the time the Airport Master Plan is updated, consideration should be made to curving the safety zones to follow the flight tracks. At Corona, this is particularly significant for the safety zones on the east end of Runway 7-25 where current noise abatement procedures of the City direct aircraft to turn right 15 degrees to follow Temescal Wash north of, and parallel to, Rincon Street. Had the suggested safety zones been curved to follow existing flight tracks, except for the acreages impacted, the impacts themselves and the incompatibilities would not change from that described in this section. As part of Prado Dam project ( see Section 2.2.1), a floodwall will be constructed in areas north and east of the airport. Once the floodwall is constructed near the Sports Complex, pilots should be instructed not to execute the 15 degree turn until over the floodwall. This procedure puts the aircraft in the Temescal Wash corridor and eliminates air traffic directly over the Sports Complex playing fields.

## 5.4 POTENTIAL LAND USE MEASURES

The City's Prado Basin Leasehold, which lies below most of safety zone areas defined in this section, has built-in restrictions on development that have nothing to do with the Airport. Nonetheless, the safety zones are free of incompatibilities due largely to the leasehold restrictions.

Other areas in the Airport vicinity, notably the manufacturing areas south and southeast of the Airport, are also free of safety incompatible land uses more by circumstance than planning. In the future, the zoning regulations need to be more specific as to airport safety concerns and provide clear guidance to property owners, administrators and policymakers.

Given the specialized safety compatibility concerns in different areas around the Airport, the only reasonable regulatory instrument would appear to be airport environs overlay zoning. Ordinances amending the current City zoning regulations could be adopted establishing overlay districts corresponding to the Airport safety zones. The land use guidelines presented earlier in Table 6 could serve as the regulations applying within each overlay zone. The overlay regulations would supplement the requirements of the underlying districts.

## 5.5 SUMMARY

Aircraft operations at Corona Municipal Airport are predominantly to the west, and a very large percentage of operations are touch-and-go placing many aircraft in the traffic patterns. If aircraft operations increase, areas south and west of the Airport will be exposed to increasing levels of risk associated with aircraft accidents.

Based on existing land use, the airport safety zones are almost completely free of potentially hazardous encroachments. Based on a review of future land use plans and existing zoning, this favorable situation may or may not remain through the future. Several zoning districts around the Airport permit potentially hazardous land uses within the safety zones.

While review of development proposals by the ALUC provides some assurances against the development of incompatible land uses in the safety areas, efforts should be made to encourage the City of Corona to adopt some form of airport environs overlay zoning to implement the safety compatibility guidelines of this plan.

# Section 6.0

# AIRPORT HEIGHT INFLUENCE AREA ISSUES AND ALTERNATIVES

## 6.1 INTRODUCTION

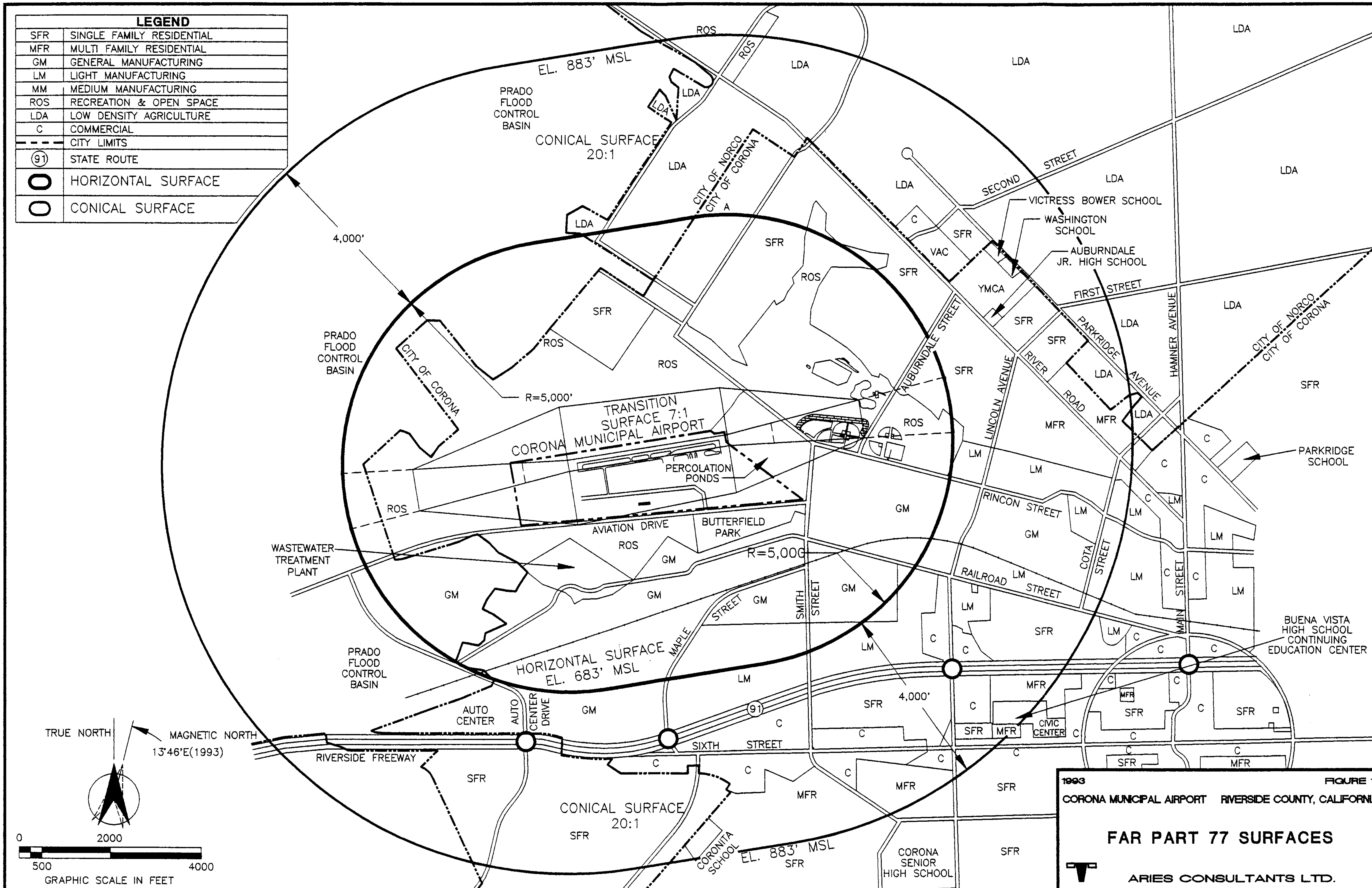
Federal Aviation Regulations (FAR) Part 77, "Objects Affecting Navigable Airspace," establishes imaginary surfaces for airports and runways as a means to identify objects that are obstructions to air navigation. The ALUC is using these surfaces as height protection guidelines and this section reviews the application of these imaginary surfaces to the Corona Municipal Airport.

## 6.2 HEIGHT PROTECTION AREAS

The imaginary surfaces in FAR Part 77 are intended to guide the review of proposed tall structures in the vicinity of airports. Proposed penetrations through these imaginary surfaces should be evaluated by FAA for a hazard determination. FAR Part 77 does not authorize the FAA to regulate land use in the airport vicinity. An FAA finding that a proposed penetration is hazardous is an advisory ruling and does not necessarily stop a project. Since local land use control remains in the hands of local government, FAA recommends that height controls be incorporated into the local zoning ordinance. To facilitate the use of FAR Part 77 criteria in the zoning ordinance, FAA has published, "A Model Zoning Ordinance to Limit Height of Objects Around Airports," (see FAA Advisory Circular 150/5190-4A, December 14, 1987).

Figure 7 presented earlier in Section 3 illustrates FAR Part 77 surfaces at a typical airport. They define a bowl or stadium-shaped area with ramps sloping up from each runway end. The dimensions of each surface vary depending on the runway classification and approach. The standards of FAR Part 77 applicable to Corona Municipal Airport are based on a visual approach.

A layout of the FAR Part 77 surfaces for Corona Municipal Airport is presented on Figure 11. This shows all of the area within the conical surface, which includes portions of the Prado Flood Control Basin, the City of Corona, and the City of Norco. Dimensions for these various surfaces are listed in Table 7. Each FAR Part 77 surface is discussed below.


LEGEND
SFR SINGLE FAMILY RESIDENTIAL
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C COMMERCIAL
CITY LIMITS
91 STATE ROUTE
HORIZONTAL SURFACE
CONICAL SURFACE
EL. 883' MSL
PRADO FLOOD CONTROL BASIN
CONICAL SURFACE 20:1
4,000'
R=5,000'
CITY OF NORCO
CITY OF CORONA
TRANSITION SURFACE 7:1
CORONA MUNICIPAL AIRPORT
PERCOLATION PONDS
AVIATION DRIVE
BUTTERFIELD PARK
WASTEWATER TREATMENT PLANT
HORIZONTAL SURFACE EL. 683' MSL
MAPLE STREET
SMITH STREET
AUBURNDALE STREET
LINCOLN AVENUE
RIVER ROAD
PARKRIDGE AVENUE
HAMNER AVENUE
SECOND STREET
FIRST STREET
RINCON STREET
RAILROAD STREET
COTA STREET
MAIN STREET
SIXTH STREET
VICTRESS BOWER SCHOOL
WASHINGTON SCHOOL
AUBURNDALE JR. HIGH SCHOOL
YMCA
VAC
PARKRIDGE SCHOOL
BUENA VISTA HIGH SCHOOL CONTINUING EDUCATION CENTER
CIVIC CENTER
AUTO CENTER
AUTO CENTER DRIVE
RIVERSIDE FREEWAY
CORONITA SCHOOL
CORONA SENIOR HIGH SCHOOL
TRUE NORTH
MAGNETIC NORTH 13°46'E(1993)
0 500 2000 4000
GRAPHIC SCALE IN FEET
1993
FIGURE 11
CORONA MUNICIPAL AIRPORT RIVERSIDE COUNTY, CALIFORNIA
FAR PART 77 SURFACES
ARIES CONSULTANTS LTD.

Table 7

**FAR PART 77 DIMENSIONS**
**Corona Municipal Airport**

| | Runway 7-25 |
|---|---|
| Runway Type | Visual |
| Primary Surface | |
| Length (feet) | 3,600 |
| Width (feet) | 250 |
| Approach Surface | |
| Slope | 20:1 |
| Length (feet) | 5,000 |
| Inner Width (feet) | 250 |
| Outer Width (feet) | 1,250 |
| Transitional Surface | |
| Slope | 7:1 |
| Horizontal Surface | |
| Elevation (feet MSL) | 683 |
| End Radius | 5,000 |
| Conical Surface | |
| Slope | 20:1 |
| Width (feet) | 4,000 |

### 6.2.1 Primary Surface

The primary surface is in the immediate runway area. Its surface is the ground elevation. It extends 200 feet off each runway end and varies in width depending on the type of runway. At Corona Municipal Airport, the primary surface for Runway 7-25 is 250 feet wide and 3,600 feet long. This surface is virtually contained within the Airport boundary.

### 6.2.2 Approach Surface

The approach surface is a trapezoidal area extending outward and sloping upwards from the end of the primary surface. The approach slope, width, and length vary depending on the type of runway approach. At Corona Municipal Airport, Runway 7-25 has a visual approach on each runway end. The approach slope is 20:1 extending 5,000 feet outward from the ends of the primary surface. The approach surface on the west end of Runway 7-25 intersects and rises above the horizontal surface at a point about 3,400 feet from the primary surface. The approach surface on the east end of Runway 7-25 intersects and rises above the horizontal surface at a point about 3,000 feet from the primary surface. Since the horizontal surface is the lower of the two surfaces, it becomes the controlling surface beyond each intersection point.

### 6.2.3 Transitional Surface

Transitional surfaces with a slope of 7:1 are defined between the primary and approach surfaces and the horizontal surface.

### 6.2.4 Horizontal Surface

The horizontal surface is a flat plane 150 feet above the airport field elevation. Its outer boundary is 5,000 feet from the primary surface for visual and utility runways. The horizontal surface is a reasonable representation of the outer limits of a typical airport traffic pattern area.

At Corona Municipal Airport, the dimensions of the horizontal surface are defined by Runway 7-25. The boundaries are set at a radius of 5,000 feet from the runway primary surface. The elevation of the horizontal surface is 683 feet MSL.

### 6.2.5 Conical Surface

The conical surface slopes upward from the horizontal surface at a rate of 20:1 extending 4,000 feet outward from the horizontal surface. This standard applies at all airports. At Corona Municipal Airport, the elevation at the outer edge of the conical surface is 883 feet MSL.

## 6.3 HEIGHT PROTECTION ISSUES

### 6.3.1 Existing Penetrations and Topography

At the present time, there are no structures or terrain penetrations of the FAR Part 77 imaginary surfaces.

### 6.3.2 Current Height Limits in Zoning Ordinances

The height of structures permitted by local zoning ordinances is an important consideration in height protection planning. The 3,611 acres of the Prado Flood Control Basin that fall within the horizontal and conical surfaces do not appear to pose a height protection issue due to recreational land use restrictions. However, the remaining 3,718 acres contain single family, multiple-family, commercial, and manufacturing uses that might pose such an issue. The combination of terrain and existing zoning create a situation where one or more of the FAR Part 77 surfaces might be penetrated.

Terrain in the Prado Flood Control Basin where the Airport sits is relatively flat. To the north and northwest bluffs rise sharply 80 to 100 feet and more. To the south the land also rises 100 feet and more, but the rise is more gradual. Single and multiple-family housing is generally located on the bluffs to the north, while the commercial and manufacturing areas are located in the low flat areas to the east and in the higher more gently sloping areas south and southeast of the Airport.

An analysis of allowed building heights in the City of Corona's Zoning Ordinance reveals the information summarized in Table 8. Only those zoning districts that appear under the FAR Part 77 surfaces are presented in Table 8. It should be noted that roof structures for the housing of elevators, stairways, tanks, ventilating fans, or similar equipment required to operate and maintain the building, and fire or parapet structures may be erected above the height limits prescribed provided they do not increase available floor space. Radio and television transmitters, as well as buildings exceeding permitted height limits, are handled through conditional use permits.

The potential exists for approval of construction or alteration of structures that penetrate one or more of the FAR Part 77 surfaces. In some of those areas zoned M-2 at the higher elevations, a manufacturing plant facility constructed within allowed building heights might penetrate the horizontal and conical surfaces. Potential

Table 8

**BUILDING HEIGHT RESTRICTIONS UNDER FAR PART 77 SURFACES**
**City of Corona Zoning Ordinance**

| Zoning District | | Allowed Building Height (feet) |
|---|---|---|
| Symbol | Name | |
| R-1-X[1] | Single Family Residential | 30 |
| R-2 | Low Density Multiple-Family Residential | 30 |
| R-3 | Multiple-family Residential | 40 |
| MP | Mobile Home Park | 30 |
| C-1 | Neighborhood Stores | 30 |
| C-2 | Restricted Commercial | 40 |
| C-3 | General Commercial | 40 |
| C-F | Freeway Access | 30 |
| M-1 | Light Manufacturing | 40 |
| M-2 | General Manufacturing | 100 |
| M-3 | Heavy Manufacturing | 100 |

[1]The "X" refers to the minimum square footage of the lot and varies from 7,200 to 20,000 square feet at prescribed values.

Source: City of Corona Zoning Ordinance

conflicts might also occur in the eastern approach areas. For example, in the proposed Sports Complex area the location of the tall lighting poles needs to be monitored and in the southeastern quadrant of the Rincon Street-Smith Street intersection elevator housings, roof-top water tanks, and antennas need to be monitored. Figure 11 illustrates that there is no conflict, but the actual flight tracks are curved in this area reflecting noise abatement procedures (see Figure 3).

A developer is required to obtain FAA review of a structure's height if it exceeds 200 feet at the site (see FAR Part 77, Subpart B). The approval of development in the Airport vicinity is subject to review by the City of Corona and, if it is within the Airport Influence Area (defined in Section 7), there is additional review by the Airport Land Use Commission. These reviews provide ample opportunity to comment on the height of structures and ensure compatibility with the Airport's height restriction requirements.

### 6.3.3 Summary of Height Control Issues

In order to comply with the height limitation guidelines presented in Section 3.6, the FAR Part 77 surfaces should be considered maximum height limits. Selected zoning districts allow incompatible uses that need to be specifically addressed in the vicinity of the Airport.

## 6.4 POTENTIAL LAND USE MANAGEMENT MEASURES

Height protection is best achieved through overlay zoning. The FAA's model height protection overlay zoning would be an appropriate model for the City of Corona to consider. If overlay zoning for noise and safety compatibility is also considered, it would be desirable to design a comprehensive airport environs overlay zoning ordinance.

Administration of height control regulations deserves careful consideration. It would be appropriate to adopt, by reference, the FAR Part 77 surfaces for the Airport as the height control zoning map. The basic zoning maps of the City should somehow be marked to trigger a check of the FAR Part 77 map for developments proposed in the area. For construction or alteration of structures proposed under the FAR Part 77 surfaces, applicants should be required to provide detailed information on the elevation of the structure with respect to the FAR Part 77 surfaces to enable a determination of compliance to be made. Any construction or alteration that requires notification to the FAA Administrator in accordance with FAR Part 77, Subpart B., should be reviewed by the ALUC.

If the City of Corona wishes to have a procedure for the consideration of variances, approval should be conditioned upon a finding by FAA that no hazard would be created by the penetration. The developer should file FAA Form 7460-1, Notice of Proposed Construction or Alteration, with the FAA and copies and should be provided to the City as part of the application package. In addition, compliance with the conventional City standards relating to variances should be ensured.

The County's geographic information system (GIS), managed by the County Transportation Department, could be a valuable aid in the administration of height control zoning. The system includes topography for the County. If three-dimensional FAR Part 77 maps for the airports in the County were also added to the system, it would enable preparation of a quick obstruction analysis for any proposed structure. The quality of the analysis, of course, will only be as accurate as the topographic data in the system. Currently, this is somewhat variable. More accurate topographic information can always be added to the GIS when it is available. Nevertheless, such a capability could be very valuable to the Airport Land Use Commission, local government planners, and land owners or developers.

## 6.5 SUMMARY

Based on the current FAR Part 77 criteria for Corona Municipal Airport, there are no obstructions. Current height limits in the Corona Zoning Ordinance do not appear to be an issue, if airport height requirements are reflected in the review process.

While review of development proposals by the City of Corona and the Airport Land Use Commission provides some assurance against the construction or alteration of structures penetrating the FAR Part 77 surfaces, additional regulations addressing the entirety of the horizontal and conical surfaces would be helpful. The Commission should encourage the adoption of height protection overlay zoning to implement the height protection guidelines of this Plan. Use of the County's GIS should be seriously considered as an aid to administration of the zoning.

## Section 7.0

## COMPREHENSIVE AIRPORT LAND USE PLAN

### 7.1 INTRODUCTION

This section presents the adopted Comprehensive Land Use Plan for the Corona Municipal Airport. It includes a description of the Airport Influence Area, land use compatibility standards, and related land use policies for use by the Riverside County Airport Land Use Commission.

### 7.2 AIRPORT INFLUENCE AREA

The "Airport Influence Area" is that area within which the Riverside County Airport Land Use Commission shall exercise its responsibilities under the California Public Utilities Code, Chapter 4, Article 3.5, Section 21670 et seq. As discussed in Section 3.6, the Airport Influence Area shall be the outer boundaries defined by overlaying the FAR Part 77 surfaces, the 60 dB CNEL noise contour and the Airport safety zones.

Figure 12 illustrates the Airport Influence Area at Corona Municipal Airport. It shows the 60 dB CNEL noise contours for the year 1997, the airport safety areas, the edge of the FAR Part 77 horizontal surface, and the outer edge of the conical surface.

### 7.3 LAND USE COMPATIBILITY STANDARDS

Land use compatibility standards within the Airport Influence Area at Corona Municipal Airport are based on three separate considerations: airport noise, safety, and height. These criteria are based on the policy guidelines discussed in Section 3. They have been refined for specific application at Corona Municipal Airport.

These land use standards are intended to be applied comprehensively. Where any parcels of land are subject to more than one set of land use compatibility standards, the most restrictive standard shall apply.

#### 7.3.1 Noise Compatibility Standards

Figure 13 shows the land use standards for noise compatibility at Corona Municipal Airport. These standards are based on the guidelines shown in Table 5 in Section 3. They are presented in a format similar to FAA's land use compatibility guidelines to make them simpler to understand and implement. As noted in Section 4, these suggested standards differ slightly from those adopted by the City in the Noise

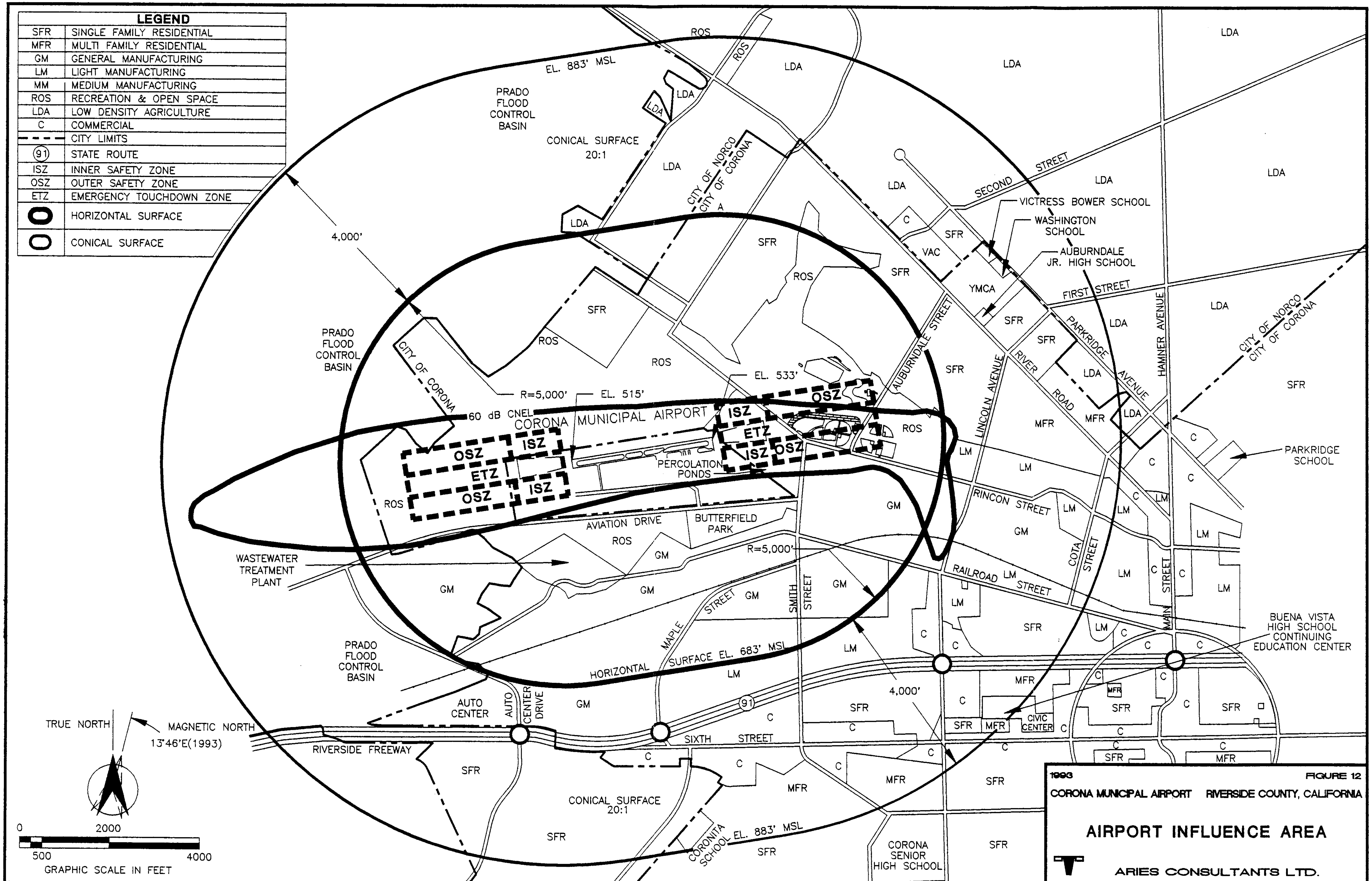

LEGEND
SFR SINGLE FAMILY RESIDENTIAL
MFR MULTI FAMILY RESIDENTIAL
GM GENERAL MANUFACTURING
LM LIGHT MANUFACTURING
MM MEDIUM MANUFACTURING
ROS RECREATION & OPEN SPACE
LDA LOW DENSITY AGRICULTURE
C COMMERCIAL
CITY LIMITS
91 STATE ROUTE
ISZ INNER SAFETY ZONE
OSZ OUTER SAFETY ZONE
ETZ EMERGENCY TOUCHDOWN ZONE
HORIZONTAL SURFACE
CONICAL SURFACE
EL. 883' MSL
PRADO FLOOD CONTROL BASIN
CONICAL SURFACE 20:1
CITY OF NORCO
CITY OF CORONA
4,000'
R=5,000'
EL. 515'
EL. 533'
60 dB CNEL
CORONA MUNICIPAL AIRPORT
PERCOLATION PONDS
AVIATION DRIVE
BUTTERFIELD PARK
WASTEWATER TREATMENT PLANT
HORIZONTAL SURFACE EL. 683' MSL
MAPLE STREET
SMITH STREET
AUBURNDALE STREET
LINCOLN AVENUE
RIVER ROAD
PARKRIDGE AVENUE
HAMNER AVENUE
SECOND STREET
FIRST STREET
RINCON STREET
RAILROAD STREET
COTA STREET
MAIN STREET
SIXTH STREET
AUTO CENTER DRIVE
AUTO CENTER
RIVERSIDE FREEWAY
VICTRESS BOWER SCHOOL
WASHINGTON SCHOOL
AUBURNDALE JR. HIGH SCHOOL
YMCA
VAC
PARKRIDGE SCHOOL
BUENA VISTA HIGH SCHOOL CONTINUING EDUCATION CENTER
CIVIC CENTER
CORONA SENIOR HIGH SCHOOL
CORONITA SCHOOL
TRUE NORTH
MAGNETIC NORTH 13°46'E(1993)
0 500 2000 4000
GRAPHIC SCALE IN FEET
1993
FIGURE 12
CORONA MUNICIPAL AIRPORT RIVERSIDE COUNTY, CALIFORNIA
AIRPORT INFLUENCE AREA
ARIES CONSULTANTS LTD.

Table B6 -- continued
SUGGESTED LAND USE COMPATIBILITY GUIDELINES

## NOTES

1. a) Although local conditions may require residential use, it is discouraged in C-1 and strongly discouraged in C-2. The absence of viable alternative development options should be determined and an evaluation indicating that a demonstrated community need for residential use would not be met if development were prohibited in these zones should be conducted prior to approvals.

   b) Where the community determines that residential uses must be allowed measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB (Zone C-1) and 30 dB (Zone C-2) should be incorporated into building codes and be considered in individual approvals. Normal construction can be expected to provide a NLR of 20 dB, thus the reduction requirements are often stated as 5, 10, 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. Additional consideration should be given to modifying NLR levels based on peak noise levels.

   c) NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, design and use of berms and barriers can help mitigate outdoor noise exposure particularly from ground level sources. Measures that reduce noise at a site should be used wherever practical in preference to measures which only protect interior spaces.

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

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

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

5. If noise sensitive use indicated NLR; if not use is compatible.

6. No buildings.

7. Land Use compatible provided special sound reinforcement systems are installed.

| LAND USE | COMMUNITY NOISE EQUIVALENT LEVEL (CNEL) IN DECIBELS | | | | |
|---|---|---|---|---|---|
| **RESIDENTIAL** | **60-65** | **65-70** | **70-75** | **75-80** | **80+** |
| RESIDENTIAL, OTHER THAN MOBILE HOMES AND TRANSIENT LODGINGS | N | N | N | N | N |
| MOBILE HOME PARKS | N | N | N | N | N |
| TRANSIENT LODGINGS | Y | Y[1] | N | N | N |
| **PUBLIC/INSTITUTIONAL** | | | | | |
| SCHOOLS | Y | N | N | N | N |
| HOSPITALS AND NURSING HOMES | Y | N | N | N | N |
| CHURCHES, AUDITORIUMS, AND CONCERT HALLS | Y | N | N | N | N |
| GOVERNMENTAL SERVICES | Y | Y | Y[2] | Y[3] | N |
| TRANSPORTATION | Y | Y | Y[2] | Y[3] | N |
| PARKING | Y | Y | Y[2] | Y[3] | N |
| **COMMERCIAL USE** | | | | | |
| OFFICES, BUSINESS AND PROFESSIONAL | Y | Y | Y[2] | Y[3] | N |
| WHOLESALE AND RETAIL-BUILDING MATERIALS, HARDWARE AND FARM EQUIPMENT | Y | Y | Y[2] | Y[3] | N |
| RETAIL TRADE-GENERAL | Y | Y | Y[2] | Y[3] | N |
| UTILITIES | Y | Y | Y[2] | Y[3] | N |
| COMMUNICATION | Y | Y | Y[2] | Y[3] | N |
| **INDUSTRIAL** | | | | | |
| MANUFACTURING | Y | Y | Y | Y[3] | N |
| MINING, FISHING, RESOURCE EXTRACTION | Y | Y | Y | Y | Y |
| **RECREATION/OPEN SPACE/AGRICULTURE** | | | | | |
| OUTDOOR SPORTS ARENAS | Y | Y | Y | N | N |
| OUTDOOR MUSIC SHELLS, AMPHITHEATERS | Y | N | N | N | N |
| WILDLIFE EXHIBITS AND ZOOS | Y | Y | N | N | N |
| PARKS, RESORTS, AND CAMPS | Y | Y | Y | N | N |
| GOLF COURSES, RIDING STABLES, AND WATER RECREATION | Y | Y | Y | N | N |
| LIVESTOCK, FARMING AND BREEDING | Y | Y | Y | N | N |
| CROP RAISING | Y | Y | Y | Y | Y |

SEE OTHER SIDE FOR KEY TO TABLE

FIGURE 13

RIVERSIDE COUNTY LAND USE STANDARDS FOR NOISE COMPATIBILITY

CORONA MUNICIPAL AIRPORT

## KEY TO FIGURE 13

| | |
|---|---|
| Y (Yes) | Land use and related structures compatible and permitted (subject to other local land use controls). |
| N (No) | Land use and related structures not compatible and not permitted within designated CNEL range. |
| $Y^1$ | Land use and related structures generally compatible provided that measures to achieve an outdoor to indoor noise level reduction (NLR) of 25 dB are incorporated into design and construction of sleeping rooms. |
| $Y^2$ | Land use and related structures generally compatible provided that measures to achieve an outdoor to indoor noise level reduction (NLR) of 30 dB are incorporated into design and construction of office areas and public reception and gathering areas within buildings. |
| $Y^3$ | Land use and related structures generally compatible provided that measures to achieve an outdoor to indoor noise level reduction (NLR) of 35 dB are incorporated into design and construction of office areas and public reception and gathering areas within buildings. |
| $N^4$ | Residences for caretakers or security personnel may be permitted as accessory uses to commercial or industrial uses. Measures to achieve the required outdoor to indoor noise level reduction (NLR) shall be incorporated into the design of the residences as follows:<br><br>in the 60-70 dB CNEL range — 25 dB NLR<br>in the 70-75 dB CNEL range — 30 dB NLR |

Element of its General Plan. The principal difference is that Figure 13 represents a suburban standard where residential uses should not be allowed in noise-impacted areas over 60 dB CNEL, while the City's guidelines represent an urban standard where residential uses are allowed in areas up to 65 dB CNEL.

Wherever uses are described as "not compatible," the Airport Land Use Commission shall disapprove development applications which would introduce those uses into areas impacted by noise above the designated level. The 60 dB CNEL noise contour for the Corona Municipal Airport, which shall be used to define the area within which these standards apply, is illustrated on Figure 12.

With the exception of transient lodgings (e.g., hotels and motels) and caretaker residences, all residential uses are considered incompatible with noise above 60 dB CNEL. Residences for caretakers or security personnel may be permitted as accessory uses to commercial or industrial uses in areas subject to noise up to 75 dB CNEL, if appropriate soundproofing measures are taken. Transient lodgings are compatible within the 60 to 65 dB CNEL range. Between 65 and 70 dB CNEL, they may be permitted provided that measures are taken to ensure sound insulation to achieve a 25 dB outdoor to indoor noise level reduction. Transient lodgings are not compatible with noise above 70 dB CNEL.

Schools, hospitals, nursing homes, churches, auditoriums, and concert halls shall be considered noise-sensitive institutions. While they are compatible with noise levels between 60 and 65 dB CNEL, they are not compatible with noise levels above 65 dB CNEL.

Other public and institutional uses, as well as commercial uses, are compatible with noise as high as 80 dB CNEL, although steps to ensure noise level reductions shall be taken when these uses are subject to aircraft noise above 70 dB CNEL.

Manufacturing is considered compatible with noise levels up to 80 dB CNEL. Noise level reduction measures, however, shall be taken when manufacturing uses are proposed for areas impacted by noise above 75 dB CNEL.

Mining and other resource extraction uses, as well as crop raising, are compatible with all aircraft noise levels.

Most recreation and open space uses are compatible with noise levels up to 75 dB CNEL. These include outdoor sports arenas, parks, resorts, and camps, in addition to livestock feeding and breeding. Outdoor music shells and amphitheaters are not compatible with noise levels above 65 dB CNEL, and wildlife exhibits and zoos are not compatible with noise above 70 dB CNEL.

A noise easement, in combination with an avigation easement, is an effective mechanism to protect the Airport from noise challenges by a land owner when aircraft overfly the owner's property. In addition to establishing the land use noise compatibility guidelines presented on Figure 13, the Airport Land Use Commission shall require avigation and noise easements for any uses in the area circumscribed by the Traffic Pattern Zone (Horizontal Surface) and where the 60 dB CNEL noise contour illustrated on Figure 12 extends beyond the Traffic Pattern Zone.

### 7.3.2 Safety Compatibility Standards

Table 9 describes the safety compatibility standards at Corona Municipal Airport. These are based on the guidelines discussed in Section 3, as refined based on subsequent consultations with local officials. The airport safety zones at Corona Municipal Airport are shown on Figure 12. A detailed drawing showing the dimensions of the safety areas is provided in Figure 14. The boundaries of the safety zones shall be defined based on the ultimate airfield layout as shown on the airport layout plan for the Airport.

The safety zones are discrete and separate zones, rather than cumulative zones. The regulations applying in each zone shall be as described for that zone in Table 9.

Within the Emergency Touchdown Zone (ETZ), no structures and no land uses involving concentrations of people shall be permitted. Neither shall significant obstructions be permitted in this area. This area is 500 feet wide, centered on the extended runway centerline, and extends 5,000 feet off the end of the primary surface at both ends of Runway 7-25. At present there are no structures in the ETZ.

The Inner Safety Zone (ISZ) extends 2,500 feet off the end of the primary surface and is 1,500 feet wide, centered on the extended runway centerline.

Within this zone, no structures are permitted nor are uses involving concentrations of people. No petroleum or explosives or above ground powerlines shall be permitted. There are no structures in the ISZ at present.

The Outer Safety Zone (OSZ) extends outward from the ISZ for 2,500 feet. Within this zone, a variety of land uses shall be prohibited. These include residential, hotels, motels, various uses involving large concentrations of people, public utility stations and communications facilities, and industries processing flammable materials.

Lot coverage by structures shall not exceed 25 percent of the lot area. The intent of limiting structural coverage is to reduce the risk of an aircraft colliding with a building

Table 9

## LAND USE COMPATIBILITY STANDARDS FOR AIRPORT SAFETY ZONES[1, 2]

### Corona Municipal Airport

| Safety Zone | Maximum Population Density | Maximum Coverage By Structures | Land Use |
|---|---|---|---|
| ETZ — Emergency Touchdown Zone | 0[3] | 0[3] | No significant obstructions[4] |
| ISZ — Inner Safety Zone | 0[3] | 0[3] | No petroleum or explosives<br>No above-grade powerlines |
| OSZ — Outer Safety Zone | Uses in structures:[5]<br>25 persons/ac.<br>OR<br>150 persons/bldg.<br>(see text for explanation)<br>Uses not in structures:<br>50 persons/ac. | 25% | No residential<br>No hotels, motels<br>No restaurants, bars<br>No schools, hospitals, government services<br>No concert halls, auditoriums<br>No stadiums, arenas<br>No public utility stations, plants<br>No public communications facilities<br>No uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials |
| TPZ — Traffic Pattern Zone | Not Applicable | 50% of gross area or 65% of net area, which-ever is greater | Discourage schools, auditoriums, amphitheaters, stadiums[5]<br>Discourage uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials.[6] |

[1]The following uses shall be prohibited in all airport safety zones:

a. Any use which would direct a steady light or flashing light of red, white, green, or amber colors associated with airport operations toward an aircraft engaged in an initial straight climb following takeoff or toward an aircraft engaged in a straight final approach toward a landing at an airport, other than an FAA-approved navigational signal light or visual approach slope indicator.

b. Any use which would cause sunlight to be reflected towards an aircraft engaged in an initial straight climb following takeoff or towards an aircraft engaged in a straight final approach towards a landing at an airport.

c. Any use which would generate smoke or water vapor or which would attract large concentrations of birds, or which may otherwise affect safe air navigation within the area.

d. Any use which would generate electrical interference that may be detrimental to the operation of aircraft and/or aircraft instrumentation.

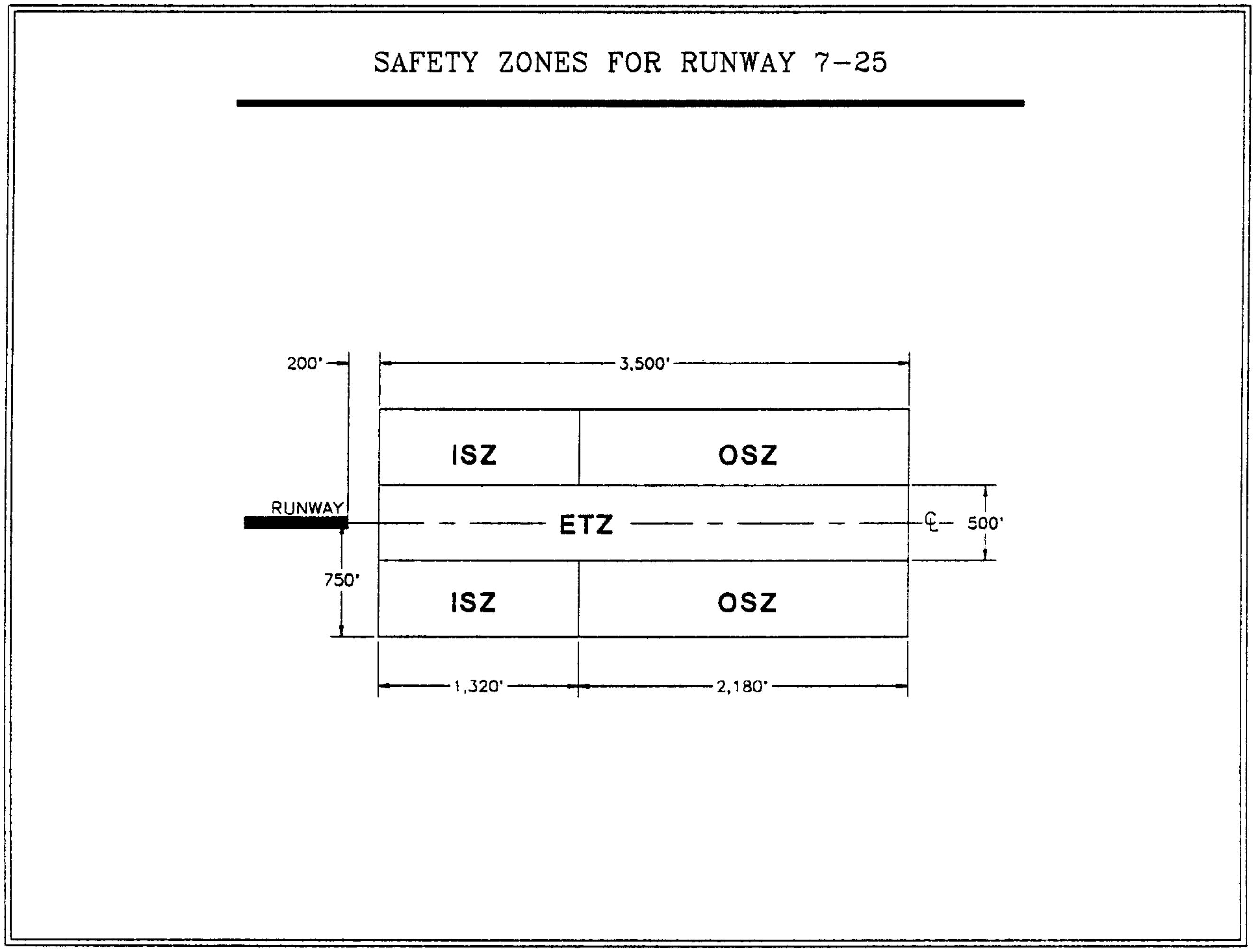
[2]Avigation easements shall be secured through dedication for all land uses permitted in any safety zones.

[3]No structures permitted in ETZ or ISZ.

[4]Significant obstructions include but are not limited to large trees, heavy fences and walls, tall and steep berms and retaining walls, non-frangible street light and sign standards, billboards.

[5]A "structure includes fully enclosed buildings and other facilities involving fixed seating and enclosures limiting the mobility of people, such as sports stadiums, outdoor arenas, and amphitheaters.

[6]This does not apply to service stations involving retail sale of motor vehicle fuel if fuel storage tanks are installed underground.




SOURCE: Airport Land Use Planning: A Reference and Guide for Local Agencies, prepared for California Department of Transportation, Division of Aeronautics, by the Metropolitan Transportation Commission and Association of Bay Area Governments.

**LEGEND**

OSZ – OUTER SAFETY ZONE
ISZ – INNER SAFETY ZONE
ETZ – EMERGENCY TOUCHDOWN ZONE

FIGURE 14

RUNWAY SAFETY ZONE DIMENSIONS
CORONA MUNICIPAL AIRPORT

while also improving the chance that a pilot could find an open area in case of a controlled forced landing.

The maximum population density for uses within the OSZ zone shall not exceed 25 persons per acre or 150 persons per building for uses in structures, whichever is less. The maximum population density for uses not in structures shall be 50 persons per acre. Existing land uses in the OSZ are compatible. However, there is insufficient information to determine if these uses meet structural lot coverage and population density criteria.

The following methodology shall be used in determining whether a proposed structure complies with the population density requirements of the OSZ. (This is based on Appendix G of the Airport Land Use Planning Handbook, California Department of Transportation, July 1983.)

Step 1. Determine the net area, in acres, of the lot proposed for development.

Step 2. Divide the square footage of the proposed structure by the square footage per occupant required by the building code. This defines maximum building occupancy.

Step 3. Multiply the maximum occupancy (from Step 2) by 50 percent to determine the maximum number of persons actually expected to be present at any one time. If this exceeds 150, the use is inconsistent with the standards and shall be revised. If this is less than 150, go to the next step.

Step 4. Divide the "number of persons expected" (from Step 3) by the net lot area in acres (from Step 1). If this is less than 25 persons per acre, the use is consistent and permissible. If it exceeds 25 persons per acre, the use is inconsistent and shall be revised.

The Traffic Pattern Zone (TPZ) extends to the outer edge of the FAR Part 77 horizontal surface. This is an area of lesser hazard compared with the other areas. No population or dwelling unit density limits apply within the TPZ. Maximum lot coverage shall be limited to 50 percent of the gross development area or 65 percent of the net lot area, whichever is greater.

Uses involving very large concentrations of people, such as schools, auditoriums, amphitheaters, and stadiums, shall be discouraged from being developed in this area. Uses involving the manufacture, storage, or distribution of explosives or flammable materials also shall be discouraged in the TPZ. (This shall not be applied to service stations involving retail sale of motor vehicle fuel where the fuel tanks are underground.) It is recognized that within the large area of the TPZ, it may not always be possible to prevent these uses given the practical constraints that often exist with facility siting. Where it is necessary to permit these uses, avigation easements shall be secured as a condition of development approval.

As noted in Table 9, several other uses posing risks to aircraft in flight shall also be prohibited within all safety zones. These involve uses which would cause confusing or blinding lights and reflections to be directed to aircraft in flight, uses causing smoke, water vapor, or gatherings of birds, or those causing electrical interference. Rather than straight-forward land use restrictions, these may be considered performance standards. Only a few kinds of land uses have inherent attributes that would make them necessarily violate these standards. Landfills and power generating plants are examples. The power generating plant at Lincoln Avenue and Rincon Street apparently poses no problem to current aircraft operations. Many uses which might cause conflicts can be designed to avoid these problems. For example, businesses could design their lighting systems to avoid confusion with airfield lighting.

In addition to these land use restrictions, avigation easements shall be secured for all uses receiving development approval within any safety zone inclusive of the Traffic Pattern Zone which is the area circumscribed by the "horizontal surface" as defined in FAR Part 77.

### 7.3.3 Height Standards

The criteria defined in FAR Part 77 shall constitute the airport vicinity height standards at Corona Municipal Airport. FAR Part 77 imaginary surfaces for the Airport are shown on Figure 11 in Section 6. The imaginary surfaces defined by this figure constitute height limits which shall not be exceeded by structures proposed for development beneath them.

## 7.4 RELATED LAND USE POLICIES

### 7.4.1 Findings as to Similar Uses

Cases may arise where the Airport Land Use Commission must review a proposal for development of a land use which is not explicitly provided for by the land use standards of Figure 13 (noise compatibility) or Table 9 (safety compatibility). In such cases, the ALUC shall apply conventional rules of reason in determining whether or not the subject land use is substantially similar to any land use which is subject to regulation. In making these determinations, the ALUC shall review the background analysis presented in this Comprehensive Land Use Plan document, including the technical appendices.

With respect to noise compatibility, the ALUC shall refer to the "Suggested Land Use Compatibility Guidelines: of the Federal Interagency Committee on Urban Noise, presented in Table B6 of Appendix B, for assistance in making findings as to similar uses.

### 7.4.2 Findings for Land Uses Which are to be Discouraged

Within the TPZ safety zone, a variety of land uses are to be discouraged from being developed. When development of these uses is proposed, the Airport Land Use Commission shall require the applicant to show that alternative locations have been considered and are not feasible. The applicant shall then be directed to consider a development plan that will minimize the exposure to hazard as much as possible. This might involve reducing structure heights, reducing lot coverage, reducing the overall scale of the project, or considering satellite locations for some of the proposed functions of the facility.

Land uses described as "uses to be discouraged," which were lawfully established prior to the adoption of this Comprehensive Land Use Plan, shall be permitted to be modified or enlarged without being subject to any special reviews or approvals under the policies of the TPZ safety zone.

## Section 8.0

## IMPLEMENTATION PLAN

### 8.1 ADOPTION OF PLAN

The adopted Comprehensive Land Use Plan will become the ALUC's official land use policy document within the Airport Influence Area for Corona Municipal Airport. ALUC decisions and recommendations on development actions proposed within the Airport Influence Area shall be based on the policies of the CLUP.

### 8.2 UPDATE AND AMENDMENT OF PLAN

The Riverside County Airport Land Use Commission and its staff should take care to keep the CLUP up-to-date. It should review the plan as often as necessary, although according to state law, it may not be amended more than once per year.

It will be especially important to review the plan whenever the Airport Master Plan or Airport Layout Plan is amended. At the same time, it is important for the ALUC to ensure that the CLUP is considered during any future master plan update studies.

The ALUC also should review the CLUP when new guidance documents are prepared by the California Department of Transportation. The Department of Transportation is now updating its "Airport Land Use Planning Handbook." It is important for the CLUP to consider the latest relevant information and research on noise, safety, and height compatibility issues, particularly when that information has been evaluated and weighed through an authoritative consultation process.

The CLUP also should be reviewed by the ALUC and staff whenever experience indicates that unanticipated difficulties are being encountered that might be solved through appropriate amendments to the plan.

### 8.3 ADMINISTRATION OF PLAN

#### 8.3.1 Scope of ALUC Development Review Responsibilities

The State Aeronautics Law (Public Utilities Code Chapter 4, Article 3.5) encourages local general plans and specific plans to be consistent with the adopted Comprehensive Land Use Plans of County Airport Land Use Commissions. It also authorizes the Airport Land Use Commission to review local development actions to ensure consistency with the Comprehensive Land Use Plan.

Where the local general plans or specific plans are not consistent with the Airport Comprehensive Land Use Plan, the local agency shall be notified by the ALUC. The local agency may overrule the ALUC after holding a public hearing and after making specific findings that the existing plans are compatible with the purposes of the aeronautics law. A two-thirds majority vote of the governing body is required. (see Section 21676(a).)

If the ALUC finds that the local agencies have not revised their general or specific plans, or overruled the ALUC with the required two-thirds vote, State law enables the ALUC to require that the local agencies submit to the ALUC for review all development actions, regulations, and permits within the Airport Influence Area. If the ALUC finds that the proposed action is not consistent with the Comprehensive Airport Land Use Plan, the local agency shall be so notified and shall hold a public hearing to reconsider its plan. The local agency may overrule the ALUC with a two-thirds vote of its governing body if it makes specific findings that the proposed action is consistent with the purposes of Section 21670 of the Aeronautics Law. (See Section 21676.5(b).)

Where the local agencies have amended their general and specific plans to be consistent with the Comprehensive Land Use Plan, or where they have overruled the ALUC's finding of inconsistency, then only general plan and specific plan amendments, new specific plan proposals, or zoning ordinance and building regulation proposals need to be referred to the ALUC for review. If the ALUC determines that the proposed action is not consistent with the Comprehensive Airport Land Use Plan, it shall inform the referring agency. After a public hearing, the local agency may overrule the ALUC with a two-thirds note of the governing body. If it makes specific findings that the proposed action is consistent with the purposes of Section 21670 of the Aeronautics Law. (See Section 21676(b).)

### 8.3.2 Coordination with Local Governments

The ALUC should ensure that proper coordination is established between its staff and local governments to ensure the efficient administration of the development review process. The City of Corona and the Riverside County Planning Department must understand the boundaries of the Airport Influence Area and have clear maps available to them. The City and County are usually the first point of contact with a developer. It is important that they be able to relay information as to whether a project is subject to review by the Airport Land Use Commission.

It is also important that the local government agencies be kept informed as to the appropriate staff contact at the County Aviation Division when information about the ALUC's development review process is desired.

### 8.3.3 County Geographic Information System

Riverside County has established a geographic information system (GIS) for the entire County. The system is managed by the County Transportation and Land Management Agency, Information Systems Division. The GIS is essentially an intelligent computerized mapping system. Geographic data can be analyzed and mapped in many different ways.

Among the data in the system are existing land use, topography, and zoning. The GIS can be a helpful planning tool as it can quickly provide planners with information and maps of various areas in the County.

Administration of the CLUP would be enhanced if the boundaries of the regulatory areas were added to the GIS. The system could be used in various helpful ways. For example, if the boundaries of a development project were encoded into the system, the GIS could be queried to determine whether the parcel was inside a CLUP regulatory area. If it was, a map and an estimate of the affected land area could be produced.

The GIS could be especially helpful in the administration of height standards. If the FAR Part 77 surfaces were entered into the system in a three-dimensional format, it would be possible to produce a high quality structural penetration analysis quickly and easily. As long as the structure location, height, and surface topography were known, the system could easily determine whether a penetration of a FAR Part 77 surface would occur. It could also produce three-dimensional maps of the area.

For the GIS system to be effective, it would be necessary to encode the Airport Layout Plans into the system as well as the guidelines associated with the various regulatory areas. This would ensure the proper definition of runway coordinates, bearings and elevations, and provide the foundations for defining the regulatory area boundaries.

### 8.3.4 Criteria for ALUC Review of General Plan Amendments

The City of Corona and Riverside County may consider amendments of their general plans from time to time. The major consideration of the ALUC as it reviews future general plan amendments is to ensure that the standards of the CLUP are complied with. There is ample opportunity for changes in general plans over the years without compromising the objectives of the CLUP.

In some noise and safety zones, the policies of this Plan prohibit or limit the density of residential development. This Plan has suggested the use of "density transfer" techniques to allow a developer to balance the needs of the Airport and the needs of a specific development project. "Density transfer" is defined herein as a credit for unused residential development potential within the particular noise/safety zone which can be transferred to a part of the property outside the noise/safety zone. From the standpoint of airport compatibility, the ALUC would encourage and support future amendments to the Riverside County General Plan, or the general plans of the Cities of Corona and Norco, or to any approved or pending specific plan application, which incorporates the density transfer concept to achieve compatibility. This shall not be interpreted as acceptance of any waivers from the land use compatibility policies of this plan. Density transfers shall be acceptable only if all land use policies within the Airport Influence Area are complied with.

For specific guidance in the review of general plan amendments, the ALUC shall consult Sections 4, 5, and 6 of the CLUP where noise, safety, and height issues and alternatives are discussed.

## 8.4 RECOMMENDED ACTION BY LOCAL GOVERNMENTS

### 8.4.1 General Plan Amendments

The Airport Land Use Commission should encourage the City of Corona and Riverside County to amend their general plans to ensure compatibility with the CLUP.

### 8.4.2 Noise and Avigation Easements

The Airport Land Use Commission should require noise and avigation easements be dedicated to the Airport for those areas that fall within the 60 dB CNEL noise contour as depicted on Figure 8, presented in Section 4. This is considered an interim measure pending completion of an amended Master Plan for the Corona Municipal Airport.

The Airport Land Use Commission's current policy regarding avigation easements in the Traffic Patten Zone (TPZ) should be continued.

### 8.4.3 Airport Height Restrictions Overlay Zoning

Overlay zoning involves the adoption of an amendment to the City of Corona and City of Norco zoning ordinances establishing an airport height restriction overlay zone. The overlay zone would impose height restriction standards supplementing those of the underlying zoning districts.

While overlay zoning is a simple concept, it can become somewhat complicated in practice. In order to facilitate coordination and understanding, it would be desirable to establish a uniform model ordinance for use by all affected jurisdictions in the

County. A lead agency for such an effort should be designated. The County Planning Department would be an appropriate agency as would the Aviation Division of the Economic Development Agency.

### 8.4.4 Building Code Amendments

Amendments should be made to the Corona city building codes setting forth sound insulation standards. The standards should describe the construction techniques to be used to achieve the desired sound level reduction.

There are model regulations available for use. Some are included in the California Department of Transportation, "Airport Land Use Planning Handbook," published in 1983. It would be desirable if a uniform model ordinance could be agreed upon for used by all affected agencies in the County.

### 8.4.5 Subdivision Regulations

The subdivision regulations of the City of Corona should be amended to require the dedication of noise and avigation easements for future subdivisions of land within the 60 dB CNEL noise contour. The easement should include a non-suit covenant waiving the property owner's right to sue the airport operator for disturbances related to use of the airport. This is a separate action from the interim measures described in Section 8.4.2.

It would be helpful if a model form of easement was established and agreed to by all affected agencies in the County.

**Section 9.0**

**REFERENCES**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3. U.S. Army Corps of Engineers, Los Angeles District. Review Report on the Santa Ana River Main Stem and Santiago Creek, Draft Environmental Statement. August 1975.

4. City of Corona, California. Corona Municipal Code, Title 16, Subdivisions, and Title 17, Zoning. March 1990.

5. City of Corona, California. City of Corona General Plan. December 1989.

6. Mestre Greve Associates. Noise Element for the City of Corona. Prepared for the City of Corona, California. October 1990.

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# APPENDIX A

# GLOSSARY

## Appendix A

## GLOSSARY[1]

A-Weighted Sound Level — A sound pressure level, often noted as DBA, which has been frequency filtered or weighted to quantitatively reduce the effect of the low frequency noise. It was designed to approximate the response of the human ear to sound.

Above Ground Level (AGL) — An elevation given in feet above a ground level datum.

Air Taxi — A classification of air carriers which directly engage in the air transportation of persons, property, mail, or in any combination of such transportation and which do not directly or indirectly utilize large aircraft (over 30 seats or a maximum payload capacity of more than 7,500 pounds) and do not hold a certificate of Public Convenience and Necessity or economic authority issued by the Department of Transportation. (See also Commuter Air Carrier and Demand Air Taxi)

Air Traffic Control (ATC) — A service operated by appropriate authority (normally, the Federal Government) to promote the safe, orderly, and expeditious flow of air traffic.

Airport Traffic Control Tower (ATCT) — A terminal facility that uses air/ground communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity of an airport or on the movement area.

Aircraft Accident — An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight until such time as all such persons have disembarked, and in which any person suffers death or serious injury as a result of being in or upon the aircraft or by direct contact with the aircraft or anything attached thereto, or in which the aircraft receives substantial damage.

Aircraft Operation — The airborne movement of aircraft in controlled or uncontrolled airport terminal areas and about given en route fixes or at other points where counts can be made. There are two types of operations - local and itinerant.

Airport — An area of land or water that is used or intended to be used for the landing of and taking off of aircraft, and includes its buildings and facilities, if any.

Airport Elevation — The highest point of an airport's usable runways, measured in feet above mean sea level.

Airport Layout Plan — A scale drawing of existing and proposed airport facilities, their location on the airport, and the pertinent clearance and dimensional information required to demonstrate conformance with applicable standards.

Airport Reference Code (ARC) — A coding system used to relate airport design criteria to the operational and physical characteristics of the airplanes intended to operate at the airport.

Airway / Federal Airway — A control area or portion thereof established in the form of a corridor, the centerline of which is defined by radio navigational aids.

Alert Area — A special use airspace which may contain a high volume of pilot training activities or an unusual type of aerial activity, neither of which is hazardous to aircraft.

Ambient Noise — The totality of noise in a given place and time — usually a composite of sounds from varying sources at varying distances.

[1]Source: Aries Consultants Ltd.

Approach Light System (ALS) — An airport lighting system which provides visual guidance enabling a pilot to align the aircraft with the extended runway centerline during a final approach to landing. Among the specific types of systems are:

- LDIN — Sequenced Flashing Lead-in Lights
- ODALS — Omnidirectional Approach Light System, a combination of LDIN and REILS
- SSALR — Simplified Short Approach Light System with Sequenced Flashing Lights.

Approach Speed — The recommended speed contained in aircraft manuals used by pilots when making an approach to landing. This speed will vary for different segments of an approach as well as for aircraft weight and configuration.

Attenuation — Acoustical phenomenon whereby a reduction in sound energy is experienced between the noise source and receiver. This energy loss can be attributed to atmospheric conditions, terrain, vegetation, and man-made and natural features.

Avigation Easement — A type of land acquisition (land use control) that involves less-thanfee purchase. One form of avigation easement grants an airport the right to perform aircraft operations over the designated property, including operations that might cause noise, vibration, and other effects. A stronger form of easement is deed restriction that may include (1) the right to perform aircraft operations over the property, and (2) public acquisition of a landowners rights restricting future development of the property for any use more intensive then that existing at the time of the transaction. This easement may also include specific prohibitions on the uses for which the property may be developed. Maximum heights of structures and other objects may also be specified.

Azimuth — Horizontal direction expressed as the angular distance between magnetic north and the direction of a fixed point (as the observer's heading).

Back Course Approach — A nonprecision instrument approach utilizing the rearward projection of the ILS localizer beam.

Base Leg — A flight path at right angles to the landing runway off its approach end. The base leg normally extends from the downwind leg to the intersection of the extended runway centerline.

Based Aircraft — Aircraft stationed at an airport on a long-term basis.

Building Restriction Line (BRL) — A line, beyond which defines suitable building locations on the airport away from the runway.

Ceiling — Height above the earth's surface to the lowest layer of clouds reported as "broken" or "overcast" or obscuring phenomena.

Circling Approach / Circle-to-Land Maneuver — A maneuver initiated by the pilot to align the aircraft with a runway for landing when a straight-in landing from an instrument approach is not possible or not desirable.

Clearway — For turbine engine powered airplanes certificated after August 29, 1959, an area beyond the runway, not less than 500 feet wide, centrally located about the extended centerline of the runway, and under the control of airport authorities. The clearway is expressed in terms of a clearway plane, extending from the end of the runway with an upward slope not exceeding 1.25 percent, above which no object nor any terrain protrudes. However, threshold lights may protrude above the plane if their height above the end of the runway is 26 inches or less and if they are located to each side of the runway.

Compass Locator — A low power, low or medium frequency, radio beacon installed at the site of the outer or middle marker of an instrument landing system (ILS).

Community Noise Equivalent Level (CNEL) —

The noise rating adopted by the State of California for measurement of airport noise. It represents the average daytime noise level during a 24-hour day, measured in decibels and adjusted to an equivalent level to account for the lower tolerance of people to noise during evening and nighttime periods.

Commuter Air Carrier — An air taxi operator which performs at least five round trips per week between two or more points and publishes flight schedules which specify the times, days of the week and places between which such flights are performed.

Control Zone — Controlled airspace surrounding one or more airports, normally a circular area having a radius of five statute miles plus extensions to include instrument arrival and departure paths; up to, but not including, 3,000 feet AGL. Most control zones surround airports with air traffic control towers and are in effect only for the hours the tower is operational.

Controlled Airspace — Any of several types of airspace within which some or all aircraft may be subject to air traffic control.

Crosswind Leg — A flight path at right angles to the landing runway off its departure end.

Day-Night Average Sound Level (Ldn) — The noise descriptor adopted by the U.S. Environmental Protection Agency for measurement of environmental noise. It represents the average daytime noise level during a 24-hour day, measured in decibels and adjusted to account for the lower tolerance of people to noise during nighttime periods.

Decibel (dB) — The physical unit commonly used to describe noise levels. The decibel represents a relative measure or ratio to a reference power. This reference value is a sound pressure of 20 micropascals which can be referred to as 1 decibel or the weakest sound that can be heard by a person with very good hearing in an extremely quiet room.

Declared Distance — Distances effectively available for aircraft operations on a runway. There are four types of declared distances Takeoff Run Available (TORA), Takeoff Distance Available (TODA), Accelerated Stop Distance Available (ASDA), and Landing Distance Available (LDA).

Demand Air Taxi — Use of an aircraft operating under Federal Aviation Regulations, Part 135, passenger and cargo operations, including charter and excluding commuter air carrier.

Displaced / Relocated Threshold — A threshold that is located at a point on the runway other than the physical end of the runway. The length of runway to a displaced threshold is unavailable for landing. The length of runway to a relocated threshold is unavailable for either takeoff or landing.

Distance Measuring Equipment (DME) — Equipment (airborne and ground) used to measure, in nautical miles, the slant range distance of an aircraft from the DME navigational aid. (See TACAN) (See VORTAC) (See Microwave Landing System)

Downwind Leg — A flight path parallel to the landing runway in the direction opposite to landing. The downwind leg normally extends between the crosswind leg and the base leg.

Easement — The legal right of one party to use a portion of the total rights in real estate owned by another party. This may include the right of passage over, on, or below the property; certain air rights above the property, including view rights; and the rights to any specified form of development or activity, as well as nay other legal rights in the property that may be specified in the easement document.

FAR Part 77 — The part of Federal Aviation Regulations which deals with objects affecting navigable airspace.

FAR Part 77 Surfaces — Imaginary surfaces established with relation to each runway of an airport. There are five types of surfaces (1) primary; (2) approach; (3) transitional; (4) horizontal; (5) conical.

FAR Part 121 — The part of the Federal Aviation Regulations that deal with certification and operational requirements for domestic, flag and supplemental air carriers and commercial operators of large aircraft.

FAR Part 135 — The part of the Federal Aviation Regulations that deals with air taxi operators and commercial operators.

Federal Aviation Administration (FAA) — The United States government agency which is responsible for insuring the safe and efficient use of the nations airspace.

Fixed Base Operator (FBO) — A business operating at an airport that provides aircraft services to the general public, including but not limited to sale of fuel and oil; aircraft sales, rental, maintenance, and repair; parking and tiedown or storage of aircraft; flight training; air taxi/charter operations; and specialty services, such as instrument and avionics maintenance, painting, overhaul, aerial application, aerial photography, aerial hoists, or pipeline patrol.

Flight Service Station (FSS) — Air traffic facilities which provide pilot briefing, en route communications and VFR search and rescue services, assist lost aircraft and aircraft in emergency situations, relay ATC clearances, originate Notices to Airmen, broadcast aviation weather and NAS information, receive and process IFR flight plans, and monitor NAVAID's. In addition, at selected locations, FSS's provide En Route Flight Advisory Service (Flight Watch), take weather observations, issue airport advisories, and advise Customs and Immigration of transborder flights.

General Aviation — That portion of civil aviation which encompasses all facets of aviation except air carriers.

Glide Slope — An electronic signal radiated by a component of an ILS to provide descent path guidance to approaching aircraft.

Ground Effect — The excess attenuation attributed to absorption or reflection of noise by man-made or natural features on the ground surface.

Helipad — A small, designated area, usually with a prepared surface, on a heliport, airport, landing/takeoff area, apron/ramp, or movement area used for takeoff, landing, or parking of helicopters.

Hourly Noise Level (HNL) — A noise summation metric which considers primarily those single events which exceed a specified threshold or duration during one hour.

Instrument Approach Procedure — A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually. Also includes a segment to allow the pilot to continue to fly to a predetermined point if a landing can not be accomplished. It is prescribed and approved for a specific airport by competent authority.

Instrument Flight Rules (IFR) — Rules governing the procedures for conducting instrument flight. Generally, IFR applies when meteorological conditions are below basic visual flight rules (VFR) minimums, as defined in FAR Part 91.155, in terms of visibility and distance from clouds.

Instrument Landing System (ILS) — A precision instrument approach system which normally consists of the following electronic components and visual aids (1) Localizer; (2) Glide Slope; (3) Outer Marker; (4) Middle Marker; (5) Approach Lights.

Instrument Operation — An aircraft operation in accordance with an IFR flight plan or an operation where IFR separation between aircraft is provided by a terminal control facility.

Instrument Runway — A runway equipped with electronic and visual navigation aids for which a precision or nonprecision approach procedure having straight-in landing minimums has been approved.

Itinerant Operation — An arrival or departure performed by an aircraft from or to a point beyond the local airport area including training areas.

Large Aircraft — An aircraft of more than 12,500 pounds maximum certificated takeoff weight.

Ldn — The 24-hour average sound level, in decibels, for the period from midnight to midnight, obtained after the addition of ten decibels to sound levels for the periods between midnight and 7 a.m. and between 10 p.m. and midnight, local time, as averaged over a span of one year. It is the FAA standard metric for determining the cumulative exposure of individuals to noise.

Leq — Equivalent Sound Level. The steady A-weighted sound level over any specified period (not necessarily 24 hours) that has the same acoustic energy as the fluctuating noise during that period (with no consideration of a nighttime weighting). It is a measure of cumulative acoustical energy. Because the time interval may vary, it should be specified by a subscript (such as $Leq_8$ for an 8-hour exposure to work place noise) or be clearly understood.

Localizer (LOC) — The component of an ILS which provides course guidance to the runway.

Localizer Type Directional Aid (LDA) — navigational aid used for nonprecision instrument approaches with utility and accuracy comparable to a localizer but which is not a part of a complete ILS and is not aligned with the runway.

Local Operation — An arrival or departure performed by an aircraft (1) operating in the traffic pattern, (2) known to be departing or arriving from flight in local practice areas, or (3) executing practice instrument approaches at the airport.

Marker Beacon (MB) — The component of an ILS which informs pilots that they are at a significant point on the approach course.

Mean Sea Level (MSL) — An elevation given in feet above mean sea level datum.

Microwave Landing System (MLS) — A precision instrument approach system providing a function similar to an ILS, but operating in the microwave spectrum. It normally consists of three components azimuth station, elevation station, and precision distance measuring equipment.

Military Operations Area (MOA) — A type of special use airspace established to separate certain military activities from IFR traffic and to identify for VFR traffic where these activities are conducted.

Minimum Descent Altitude (MDA) — The lowest altitude, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard instrument approach procedure where no electronic glide slope is provided.

Missed Approach — A maneuver conducted by a pilot when an instrument approach cannot be completed to a landing.

Navigational Aid / NAVAID — Any visual or electronic device airborne or on the surface which provides point-to-point guidance information or position data to aircraft in flight.

Noise Contour — A continuous line on a map of the airport vicinity connecting all points of the same noise exposure level.

Nondirectional Beacon (NDB) — A radio beacon transmitting nondirectional signals whereby the pilot of an aircraft equipped with direction finding equipment can determine his bearing to or from the radio beacon and "home" on or track to or from the station.

Nonprecision Approach Procedure — A standard instrument approach procedure in which no electronic glide slope is provided.

Nonprecision Instrument Runway — A runway with an instrument approach procedure utilizing air navigation facilities, with only horizontal guidance, or area-type navigation equipment for which a straight-in nonprecision instrument approach procedure has been approved or planned, and no precision approach facility or procedure is planned.

Object Free Area (OFA) — A two-dimensional ground area surrounding runways, taxiways, and taxilanes which is clear of objects except for objects whose location is fixed by function.

Obstacle — an existing object, object of natural growth, or terrain, at a fixed geographical location, or which may be expected at a fixed location within a prescribed area, with reference to which vertical clearance is or must be provided during flight operation.

Obstacle Free Zone (OFZ) — The airspace defined by the runway OFZ and, as appropriate, the inner-approach OFZ and the innertransitional OFZ, which is clear of object penetrations other than frangible navigation aids.

Obstruction — An object, including a mobile object, which penetrates an imaginary surface described in FAR Part 77.

Outer Marker — A marker beacon at or near the glide slope intercept position of an ILS approach.

Precision Approach Path Indicator (PAPI) — An airport landing aid similar to a VASI, but which has light units installed in a single row rather than multiple rows.

Precision Approach Procedure — A standard instrument approach procedure in which an electronic glide slope is provided.

Precision Instrument Runway — A runway with an instrument approach procedure utilizing an instrument landing system (ILS), microwave landing system (MLS), or precision approach radar (PAR).

Profile — The physical position of the aircraft during landings or takeoffs in terms of altitude in feet above the runway and distance from the runway end.

Propagation — Sound propagation refers to the spreading or radiating of sound energy from the noise source. Propagation characteristics of sound normally involve a reduction in sound energy with an increased distance from source. Sound propagation is affected by atmospheric conditions, terrain, and man-made and natural objects.

Restricted Area — Designated airspace within which the flight of aircraft, while not wholly prohibited, is subject to restriction.

Runway End Identifier Lights (REIL) — Two synchronized flashing lights, one on each side of the runway threshold, which provide a pilot with a rapid and positive visual identification of the approach end of a particular runway.

Runway Protection Zone (RPZ) — The RPZ's function is to enhance the protection of people and property on the ground. This is achieved through airport owner control over RPZs. Such control includes clearing RPZ areas (and maintaining them clear) of incompatible objects and activities. Control is preferably exercised through the acquisition of sufficient property interest in the RPZ.

Runway Safety Area (RSA) — A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway.

Single Event — An occurrence of audible noise usually above a specified minimum noise level caused by an intrusive source such as an aircraft overflight, passing train, or ship's horn.

Slant-Range Distance — The straight line distance between the aircraft and the monitoring site.

Small Aircraft — An aircraft of 12,500 pounds or less maximum certificated takeoff weight.

Sound Exposure Level (SEL) — SEL expressed in dB, is a measure of the effect of duration and magnitude for a single-event measured in A-weighted sound level above a specified threshold which is at least 10 dB below the maximum value. In typical aircraft noise model calculations, SEL is used in computing aircraft acoustical contribution to the Equivalent Sound Level (Leq), the Day-Night Sound Level (Ldn), and the Community Noise Equivalent Level (CNEL).

Special Use Airspace — Airspace of defined horizontal and vertical dimensions wherein activities must be confined because of their nature and/or wherein limitations may be imposed upon aircraft operations that are not a part of those activities.

Standard Instrument Departure (SID) — A preplanned instrument flight rules (IFR) air traffic control departure procedure printed for pilot use in graphic and/or textural form. SID's provide transition from the terminal to the appropriate en route structure.

Stopway — An area beyond the takeoff runway, no less wide than the runway and centered upon the extended centerline of the runway, able to support the airplane during an aborted takeoff, without causing structural damage to the airplane, and designated by the airport authorities for use in decelerating the airplane during an aborted takeoff.

Straight-in Instrument Approach — An instrument approach wherein final approach is begun without first having executed a procedure turn; it is not necessarily completed with a straight-in landing or made to straight-in landing weather minimums.

Tactical Air Navigation (TACAN) — An ultra-high frequency electronic air navigation system which provides suitably-equipped aircraft a continuous indication of bearing and distance to the TACAN station.

Taxiway — A defined path, from one part of an airport to another, selected or prepared for the taxiing of aircraft.

Terminal Control Area (TCA) — Controlled airspace extending upward from the surface or higher to specified altitudes, within which all aircraft are subject to operating rules and pilot and equipment requirements specified in FAR Parts 61 and 91.

Terminal Instrument Procedures (TERPS) (Also referred to as: *United States Standard for Terminal Instrument Procedures*) — Procedures for instrument approach and departure of aircraft to and from civil and military airports. There are four types of terminal instrument procedures precision approach, nonprecision approach, circling, and departure.

Terminal Radar Service Area (TRSA) — Airspace surrounding designated airports wherein ATC provides radar vectoring, sequencing, and separation on a full-time basis for all IFR and participating VFR aircraft.

Threshold — The beginning of that portion of the runway usable for landing. (Also see Displaced Threshold)

Time Above (TA) — Expressed in minutes per 24-hour period. The 24-hour TA noise metric provided the duration in minutes for which aircraft-related noise exceeds specified A-weighted sound levels.

Touch-and-Go — A practice maneuver consisting of a landing and a takeoff performed in one continuous movement. A touch-and-go is defined as two operations.

Touchdown Zone Lighting (TDZ) — Two rows of transverse light bars located symmetrically about the runway centerline normally at 100 foot intervals. The basic system extends along the first 3,000 feet of the landing runway.

Traffic Pattern — The traffic flow that is prescribed for aircraft landing at, taxiing on, or taking off from an airport. The components of a typical traffic pattern are upwind leg, crosswind leg, downwind leg, and final approach.

Transient Aircraft — Aircraft not based at the airport.

Transport Airport — An airport designed, constructed, and maintained to serve airplanes having approach speeds of 121 knots or more.

UNICOM (Aeronautical Advisory Station) — A nongovernmental air/ground radio communication facility which may provide airport information at certain airports.

Utility Airport — An airport designed, constructed, and maintained to serve airplanes having approach speeds less than 121 knots.

Vector — A heading issued by ATC to an aircraft to provide navigational guidance by radar.

Very-High-Frequency Omnidirectional Range (VOR) — The standard navigational aid used throughout the airway system to provide bearing information to aircraft. When combined with distance measuring equipment (DME), the facility is referred to as a VOR/DME which provides distance as well as bearing information.

VHF Omnidirectional Range/Tactical Air Navigation (VORTAC) — A navigation aid providing VOR azimuth, TACAN azimuth, and TACAN distance-measuring equipment (DME) at one site.

Victor Airway — A control area below 18,000 feet mean sea level (MSL) or portion thereof established in the form of a corridor, the centerline of which is defined by radio navigational aids. Above 18,000 feet, MSL is a system of jet routes.

Visual Approach — An approach wherein an aircraft on an IFR flight plan, operating in VFR conditions under the control of an air traffic control facility and having an air traffic control authorization, may proceed to the airport of destination in VFR conditions.

Visual Approach Slope Indicator (VASI) — An airport landing aid which provides a pilot with visual descent (approach slope) guidance while on approach to landing. Also see PAPI.

Visual Flight Rules (VFR) — Rules that govern the procedures for conducting flight under visual conditions. VFR may be applied when meteorological conditions are equal to or greater than basic visual flight rules (VFR) minimums, as defined in FAR Part 91.155, in terms of visibility and distance from clouds.

Visual Glide Slope Indicator (VGSI) — A generic term for the group of airport visual landing aids which includes Visual Approach Slope Indicators (VASI), precision Approach Path Indicators (PAPI), and Pulsed Light Approach Slope Indicators (PLASI).

Visual Runway — A runway intended solely for the operation of aircraft using visual approach procedures, with no straight-in instrument approach procedure and no instrument designation indicated on an FAA-approved airport layout plan.

# APPENDIX B

# NOISE EXPOSURE AND LAND USE COMPATIBILITY

## Appendix B

## NOISE EXPOSURE AND LAND USE COMPATIBILITY[1]

Aircraft noise is often the most noticeable environmental effect an airport will produce on the surrounding community. If the sound is sufficiently loud or frequent in occurrence, it may interfere with various activities or be considered objectionable. Before discussing the potential effects of noise exposure, it is appropriate to review some important principles of noise measurement.

### MEASURES OF SOUND

A person's ability to perceive a specific sound depends on its magnitude and character, as differentiated from the magnitude and character of all other sounds in the environment. Several qualitative descriptions may be used to describe the attributes of a sound, such as:

- Magnitude — loud or faint;
- Broadband frequency content — high pitched hiss or rumble;
- Discrete frequency content — tonal or broadband;
- Intermixing of pure tones — harsh or melodic;
- Time variation — intermittent, fluctuating, steady, impulsive;
- Duration — long or short.

Conventional measures of sound attempt to determine its magnitude with respect to human perception, especially trying to account for the frequency response characteristics of the ear, and secondarily to the time integration characteristics of the ear. They do not account for most of the other subjective attributes. These are difficult to measure individually, and it is even more difficult to combine them in a single measure. However, one or more of these attributes may be important to enabling a human to perceive a specific sound. For example, an intermittent, impulsive "rat-tat-tat" is more easily distinguishable than a steady sound. To account for these attributes which are not easily measured, some noise rating scales have defined penalties that are applied to the measured magnitude of the sound to increase or decrease its value.

[1]Source: Coffman Associates with additional editing by Aries Consultants Ltd.

## MAGNITUDE

The unit used to measure the magnitude of sound is the decibel. Decibels are used to measure loudness in the same way that "inches" and "degrees" are used to measure length and temperature. However, unlike the scales of length and temperature, which are linear, the sound level scale is logarithmic. By definition, the level of a sound which has ten times the mean square sound pressure of the reference sound is 10 decibels (dB) greater that the reference sound. A sound which has 100 times (10 x 10 or $10^2$) the mean square sound pressure of the reference sound is 20 dB greater (10 x 2).

The logarithmic scale is convenient because sound pressures of normal interest extend over a range of 10 million to one. Since the mean square sound pressure is proportional to the square of sound pressure, it extends over a range of 100 million (100 trillion) to one. This huge number (a one followed by 14 zeros or $10^{14}$) is much more conveniently represented on the logarithmic scale as 140 dB (10 x 14).

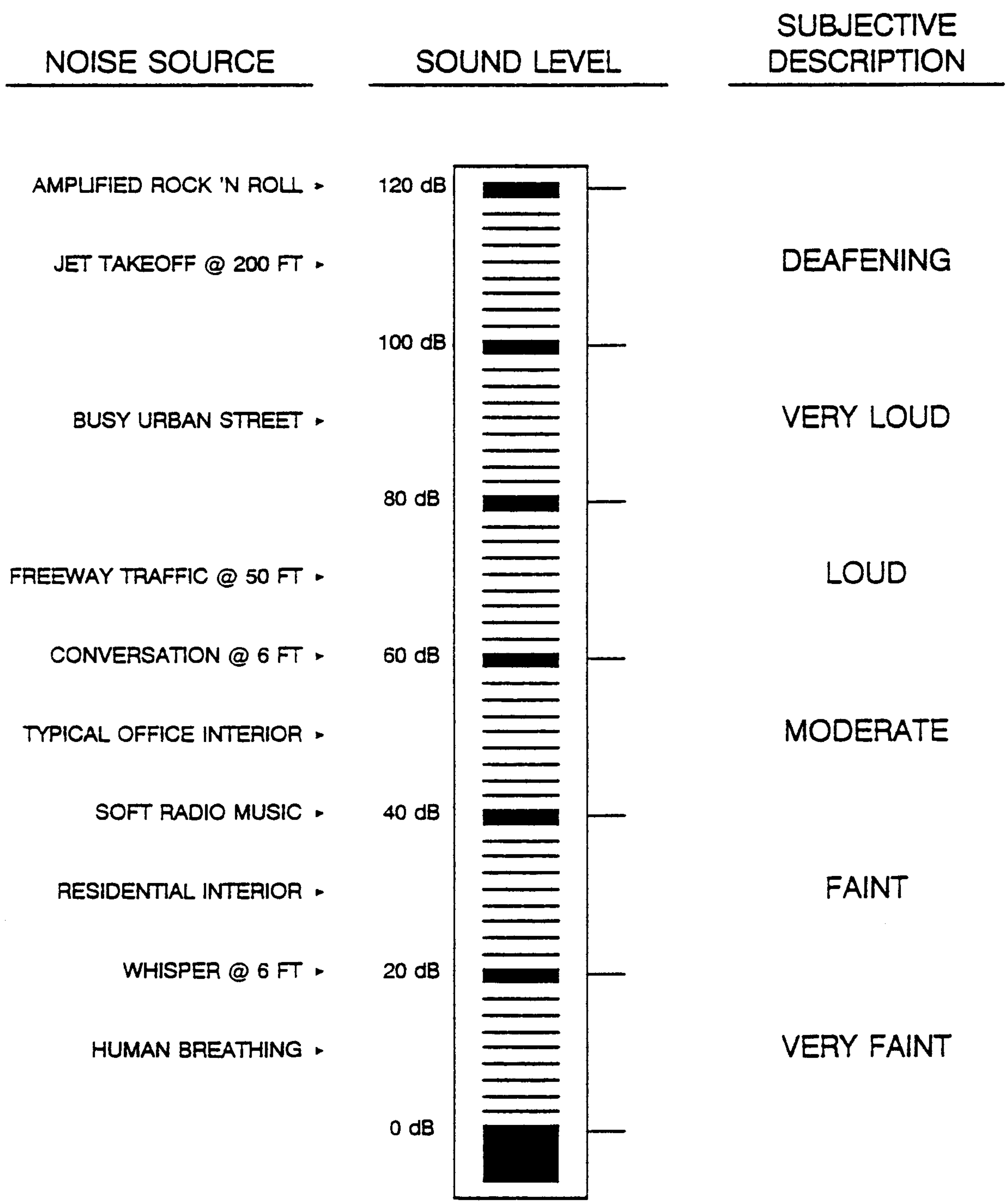
The use of the logarithmic decibel scale requires somewhat different arithmetic that we are accustomed to using with linear scales. For example, if two equally loud but independent noise sources operate simultaneously, the measured mean square sound pressure from both sources will be twice as great as either source operating alone. When expressed on the decibel scale, however, the sound pressure level from the combined sources is only 3 dB higher than the level produced by either source alone. (The logarithm of 2 is 0.3 and 10 times 0.3 is 3.) In other words, if we have two sounds of different magnitude from independent sources, then the level of the sum will never be more than 3 dB above the level produced by the greater source alone.

Another interesting attribute of sound is the human perception of loudness. Scientists researching human hearing have determined that most people perceive a 10 dB increase in sound energy over a given frequency range as roughly a doubling of the loudness. Recalling the logarithmic nature of the decibel scale, this means that most people perceive a ten-fold increase in sound energy as a two-fold increase in loudness (Kryter 1984, p. 118). Furthermore, when comparing sounds over the same frequency range, most people cannot distinguish between sounds varying by less than two or three decibels.

Exhibit B1 presents examples of various noise sources at different noise levels, comparing the decibel scale with the relative sound energy and the human perception of loudness.

Exhibit B1

# EXAMPLES OF SOUND LEVELS



## FREQUENCY WEIGHTING

Two sounds which have the same sound pressure level may "sound" quite different (e.g. a rumble versus a hiss) because of differing distributions of sound energy in the audible frequency range. The distribution of sound energy as a function of frequency is termed the "frequency spectrum". The spectrum is important to the measurement of the magnitude of sounds because the human ear is more sensitive to sounds at some frequencies than others. Specifically, the human ear hears best in the frequency range of 1,000 to 5,000 cycles per second (Hertz) than at very much lower or higher frequencies. Therefore, in order to determine the magnitude of a sound on a scale that is proportional to its magnitude as perceived by a human, it is necessary to weight that part of the sound energy spectrum humans hear most easily more heavily when adding up the total sound magnitude as perceived.

Scientists who work in acoustics have attempted for many years to find the ideal method to weight the frequency spectrum just as does the human ear. These attempts have produced many different scales of sound measurement, including the A-weighted sound level (and also the B, C, D, and E-weighted scales). A-weighting, developed in the 1930's for use in a sound level meter, accomplishes the weighting by an electrical network which works in a manner similar to the bass and treble controls on a hi-fi set.

A-weighting has been used extensively throughout the world to measure the magnitudes of sounds of all types. Because of its universality, it was adopted by the U.S. Environmental Protection Agency and other government agencies for the description of sound in the environment. A newer weighting, such as the D or E weightings which are based on the decade of research leading to the perceived noise level scale, might eventually supplant A-weighting as the universal method. Until one of these newer scales is in common use and its superiority over A-weighting for measuring environmental sounds is demonstrated, A-weighting is expected to dominate.

The zero value on the A-weighted scale is the reference pressure of 20 micro-newtons per square meter (or micro-pascals). This value was selected because it approximated the smallest sound pressure that can be detected by a human. The average sound level of a whisper at a distance of 1 meter is 40 dB; the sound level of a normal voice at 1 meter is 57 dB; a shout at 1 meter is 85 dB.

## TIME VARIATION OF SOUND LEVEL

Generally, the magnitude of sound in the environment varies in a random fashion with time. Of course, there are many exceptions. For example, the sound of a waterfall is steady with time, as is the sound of a room air conditioner or the sound inside a car or airplane cruising at a constant speed. But in most places, the outdoor sound is ever-changing in magnitude because it is influenced by sounds from many sources.

In one sense, the temporal variation of the magnitude of sound is analogous to the variation in shade (light to dark) in a picture or one's surroundings. Similarly, the changing characteristics of the subjective attributes and frequency spectrum to the ear might be analogous to change in color to the eye. It may be that the temporal changes in magnitude and character of sound in the environment add richness to the human environmental experience, as do visual changes in intensity or color. Certainly the varying sounds of bird song and rustling leaves in the forest are more rewarding than the utter silence that precedes a storm or the steady hum of a noisy ballast transformer in a fluorescent light. Changing patterns of normal sound make humans continually aware of life going on around them and assure them that all is well. However, if the fluctuation in magnitude of sound exceeds the range which is acceptable in a specific context, if the average sound level is high enough to interfere with speech or some other activity, or if a sound of unusual character or undesirable connotation is perceived, the subconscious feeling of well-being may be replaced with annoyance or alarm.

It is generally easy to measure the continuously changing magnitude of the sound level. It may be displayed on a graphic level recorder in which a pen traces a line on a sheet of moving paper, and the displacement of the pen is proportional to the sound level. Over time, the printout will reveal an approximate background noise level and the magnitude and duration of sound events which were louder than the background. The data in these continuous recordings of sound are very instructive in understanding the nature of the outdoor sound environment at any location. However, to quantify an outdoor sound environment at one location so that it can be compared with others, it is necessary to simplify its description by eliminating much of the temporal detail.

There are three ways to accomplish this simplification:

(1) Values for background or residual sound and specific single event sounds can be sampled at various times during the day using a sound level meter or a continuous graphic level recording of the sound level.

(2) Statistical properties of the sound level can be determined. A statistical analyzer can be attached to the output of the sound level meter. This allows one to determine the amount of time that the sound level exceeds a given base sound level, or, conversely, the sound level which is exceeded to a stated percentage of the time.

(3) The value of a steady-state sound with the same average value of A-weighted sound energy as the time-varying sound can be calculated. This value is termed the Equivalent Sound Level (Leq).

Each of these descriptors has its own usefulness. Residual and maximum sound levels are easily measured by a hand-held sound level meter or a sophisticated computer-based monitoring system. However, such measurements give no indication of the duration of the various single events nor a notion of the average state of the environment.

The statistical method can be crudely accomplished by a hand-held sound level meter, but it is a time-consuming and tedious process and often not very accurate. It is best accomplished with a sophisticated instrument or monitoring system designed for the purpose. It can give the complete detailed statistical distribution curve of sound level versus time for any desired duration. For example, each hour of the day, daytime or nighttime, or 24-hour day. Such a curve is often a most useful reduction of the detail contained in a graphic level recording, although it eliminates all information about specific events. However, if a single value is required for convenience, it is necessary to make an arbitrary choice of a point (level and duration) on the curve, eliminating most of the statistical information.

The Equivalent Sound Level is best measured with an instrument or monitoring system designed specifically for this purpose — an Integrating Sound Level Meter. It can provide directly a single value for any desired durations, a value which includes all of the time-varying sound in the measurement period. As such, it is a more complete description than a statistical description. For example, if the "level which is exceeded 10 percent of the total time" is used as the descriptor of the time-varying sound, its value remains constant regardless of the magnitude of the sound levels which occur during that 10 percent time period. In contrast, all sounds, regardless of magnitude, are fully accounted for in the Equivalent Sound Level descriptor.

The major virtue of the equivalent sound level is that its magnitude correlates well with the effects on humans that result from a wide variation in types of environmental sound levels and time patterns. It has been proven to provide good correlation between noise and speech interference and noise and risk of hearing loss. It also is the basis for measures of the total outdoor noise environment, the Day/Night Sound Level (Ldn) and the Community Noise Equivalent Level (CNEL), which correlate well with community reaction to noise and to the results of social surveys of annoyance to aircraft noise.

## KEY DESCRIPTORS OF SOUND

For purposes of quantifying environmental sound, four descriptors or metrics listed in Table B1 are useful. All are based on the logarithmic decibel (dB) scale and incorporate A-weighting to account for the frequency response of the ear.

The sound level (L) in decibels is the quantity read on an ordinary sound level meter. It fluctuates with time following the fluctuations in magnitude of the sound. Its maximum value (Lmax) is one of the descriptors often used to characterize the sound of an airplane flyby.

## Table B1

## PRINCIPAL DESCRIPTORS OF ENVIRONMENTAL SOUND

| Descriptor | Symbol Abbreviation | Definition | Uses |
|---|---|---|---|
| Sound Level | L | Mean Square value of A-weighted sound pressure level at any time relative to a reference pressure. | Describes magnitude of a sound at a specific position and time. |
| Sound Exposure Level (SEL) | Le | Time integral of the mean square A-weighted sound pressure relative to mean square reference pressure and 1 second duration. | Describes magnitude of all of the sound at a specific position accumulated during a specific event, or for a stated time interval. |
| Equivalent Sound Level | Leq | Level of a steady sound which has the same sound exposure level as does a time-varying sound over a stated time interval. | Describes average sound (energy) state of environment. Usually employed for duration of: 1 hr. [Leq(1)], 8 hr. [Leq(8)], or 24 hr. [Leq(24)]. |
| Day/Night Sound Level | Ldn | Equivalent sound level for a 24 hr. period with a +10 dB weighting applied to all sounds occurring between 10 p.m. and 7 a.m. | Describes average environment in residential situations accounting for effect of nighttime noises often is averaged over a 365-day year (YDNL). |
| Community Noise Sound Level | CNEL | Equivalent sound level for a 24 hr. period with a +10 dB weighting applied to all sounds occurring between 10 p.m. and 7 a.m. [and a +4.8 dB weighting applied between 7:00 p.m. and 10:00 p.m.] | Same uses as Ldn. Accounts for effect of evening as well as nighttime noise. |

However, Lmax only gives the maximum magnitude of a sound — it does not convey any information about the duration of the sound. Clearly if two sounds have the same maximum sound level, the sound which lasts longer will generally cause more interference with human activity.

Both of these factors are included in the sound exposure level (SEL), which adds up all sound occurring in a stated time period or during a specific event. The SEL is read from integrating sound level meters and is the quantity that best describes the totality of the noise from an aircraft flyby.

The equivalent sound level (Leq) is simply the logarithm of the average value of the sound exposure during a stated time period. It is often used to describe sounds with respect to their potential for interfering with human activity, e.g. speech interference.

A special form of Leq is the day-night sound level (Ldn). Ldn is calculated by adding up all the sound exposure during daytime (0700 - 2200 hours) plus 10 times the sound exposure occurring during nighttime (2200 - 0700 hours) and averaging this sum by the number of seconds during a 24-hour day. The multiplication factor of 10 applied to nighttime sound is often referred to as a 10 dB penalty. It is intended to account for the increased annoyance attributable to noise during the night when ambient levels are lower and people are trying to sleep.

Another descriptor intended to enable an understanding of the potential annoyance of sound is the community noise equivalent level (CNEL). In wide use only in California, where its use is required, it is very similar to Ldn, except that it also includes a 4.8 dB penalty (often rounded to 5 dB) for noise occurring in the evening (1900-2200 hours).

Exhibit B2 graphically shows how the noise occurring during a 24-hour period is weighted and averaged by the CNEL descriptor (or metric). In that example, the noise occurring during the period, including aircraft noise and background noise, yields a CNEL value of 66. As a practical matter, this is a reasonably close estimate of the aircraft noise alone because, in this example, the background noise is low enough to contribute only a little to the overall CNEL value during the period of observation (Kryter 1984, p. 582).

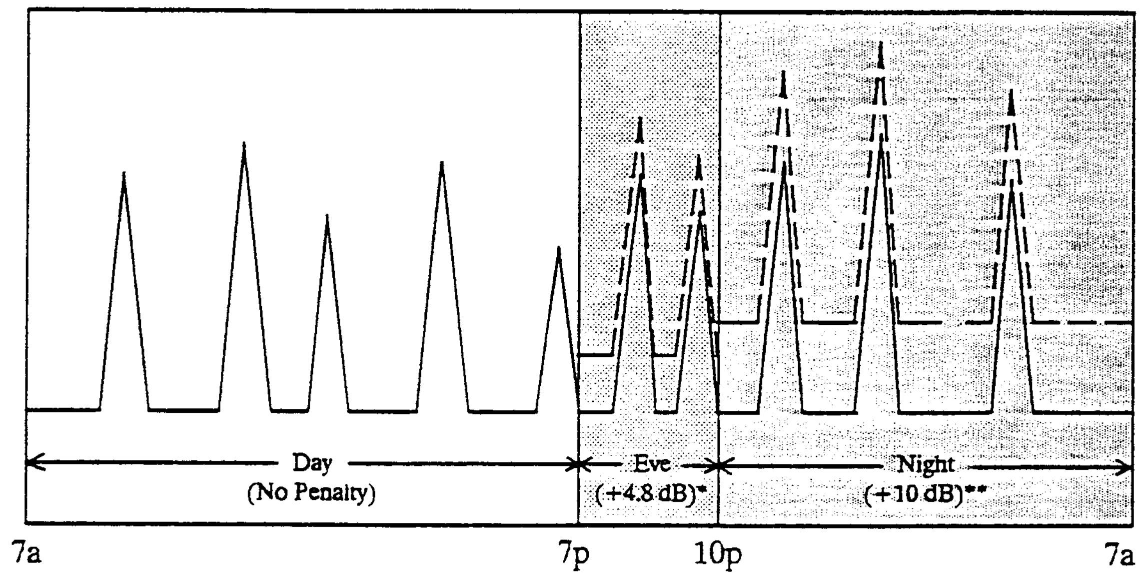
## AIRCRAFT NOISE ANALYSIS METHODOLOGY

The standard methodology for analyzing the prevailing noise conditions at airports involves the use of a computer simulation model. The Federal Aviation Administration (FAA) has approved two models for use in FAR Part 150 Noise Compatibility Studies — NOISEMAP and the Integrated Noise Model (INM). NOISEMAP is used most often at military airports, while the INM is most commonly used at civilian airports.

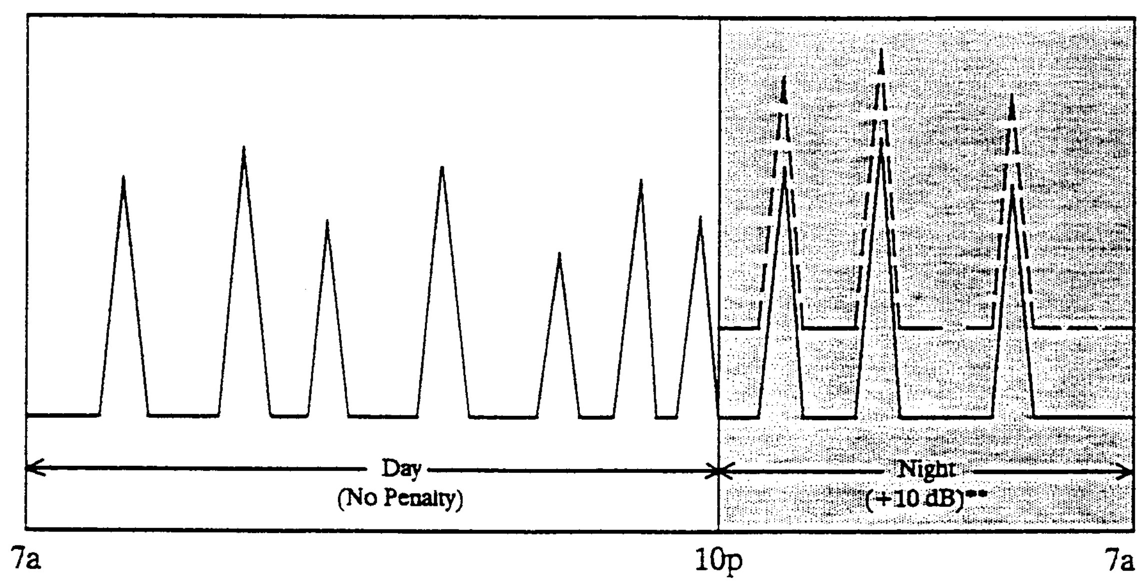
**Exhibit B2**

## Comparison of CNEL and $L_{dn}$ Descriptors

Community Noise Equivalent Level (CNEL)




Day/Night Average Level ($L_{dn}$)




* Equivalent to a three-fold increase in the number of events.

** Equivalent to a ten-fold increase in the number of events.

BBA

The Integrated Noise Model (INM) was developed by the Transportation Systems Center of the U.S. Department of Transportation at Cambridge, Massachusetts. It is undergoing continuous refinement. Version 3.9 is the most current version of the model at this time.

The INM works by defining a network of grid points at ground level around the airport. It then selects the shortest distance from each grid point to each flight track and computes the noise exposure for each aircraft operation, by aircraft type and engine thrust level, along each flight track. Corrections are applied for air-to-ground acoustical attenuation, acoustical shielding of the aircraft engines by the aircraft itself, and aircraft speed variations. The noise exposure levels for each aircraft are then summed at each grid location. The cumulative noise exposure levels at all grid points are then used to develop noise exposure contours for selected values (e.g. 65, 70, and 75 CNEL). Noise contours can be plotted using the Leq, Ldn, or CNEL descriptors. When the Ldn or CNEL descriptors are specified, the model applies the appropriate weighting factors to evening and nighttime aircraft operations. Exhibit B3 graphically shows this calculation process.

In addition to the mathematical procedures defined in the model, the INM contains another very important element. This is a data base containing tables correlating noise, thrust settings, and flight profiles for most of the civilian aircraft, and many common military aircraft, operating in the United States. This data base, often referred to as the noise curve data, has been developed under FAA guidance based on rigorous noise monitoring in controlled settings.

A variety of user-supplied input data is required to use the Integrated Noise Model. This includes the airport elevation, a mathematical definition of the airport runways, the mathematical description of ground tracks above which aircraft fly, and the assignment of specific aircraft with specific engine types at specific takeoff weights to individual flight tracks. This is summarized in Exhibit B3. In addition, aircraft not included in the model's data base may be defined for modeling.

## EFFECTS OF NOISE EXPOSURE

Aircraft noise can affect people both physically and psychologically. It is difficult, however, to make sweeping generalizations about the impacts of noise on people because of the wide variations in individual reactions. While much has been learned in recent years, some physical and psychological responses to noise are not yet fully understood and continue to be debated by researchers.

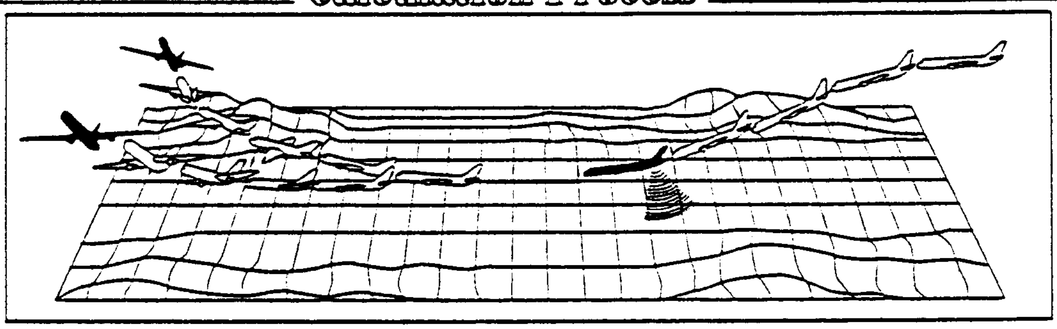
91SP04-B3-3/10/92

# INM PROCESS

## Input

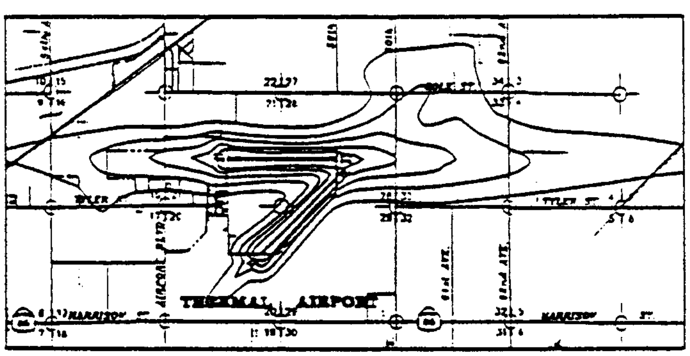
| | |
|---|---|
| Airport Description | Runway Use |
| Flight Tracks | Fleet Mix |
| Departure Tracks | Engine Types |
| Approach Profiles | Runway Utilization |
| Noise Curves | Directional Traffic |

## Calculation Process



- Computer Accesses Stored Noise Curve Data for Aircraft Types Specified in Input.
- Model Determines Noise Contribution at Nodes from each Aircraft operation along each Flight Track.
- Model Sums All Contributions at Node.

## Output



**Contours and Plots**

**Simple and Detailed Grid Analysis**

Exhibit B3
INTEGRATED NOISE
MODEL PROCESS

## EFFECTS ON HEARING

Hearing loss is the major health danger posed by noise. A study published by the U.S. Environmental Protection Agency (EPA) found that exposure to noise of 70 Leq or higher on a continuous basis, over a very long time, at the human ear's most damage-sensitive frequency may result in a very small but permanent loss of hearing (U.S.E.P.A. 1974). In a recent literature review, three studies are cited which examined hearing loss among people living near airports (Newman and Beattie 1985, pp. 33-42). The studies found that, under normal circumstances, people in the community near an airport are at no risk of suffering hearing damage from aircraft noise.

The Occupational Health and Safety Administration (OSHA) has established standards for permissible noise exposure in the work place. The standards are intended to guard against the risk of hearing loss. Protection against the effects of noise exposure is required when noise levels exceed the legal limits. The standards, shown in Table B2, establish a sliding scale of permissible noise levels by duration of exposure. The standards permit noise levels of up to 90 dBA for 8 hours per day without requiring hearing protection. The regulations also require employers to establish hearing conservation programs, however, where noise levels exceed 85 Leq during the 8-hour workday. This involves the monitoring of work place noise, the testing of employees' hearing, the provision of hearing protectors to employees at risk of hearing loss, and the establishment of a training program to inform employees about the effects of work place noise on hearing and the effectiveness of hearing protection devices.

Based on noise monitoring data gathered by the consultant in numerous airport noise compatibility studies, noise levels of this magnitude and duration are rarely, if ever, found in airport environs. Rather, they tend to be confined to the ramp and runway areas of the airport. Aircraft noise levels in the environs of a general aviation airport, or even a military or commercial airport, are far too low to be considered as potentially damaging to hearing.

In a recent summary of the research on the health effects of noise, Taylor and Wilkins (1987, p. 4/10) conclude: "Those most at risk [of hearing loss] are personnel in the transportation industry, especially airport ground staff. Beyond this group, it is unlikely that the general public will be exposed to sustained high levels of transportation noise sufficient to result in hearing loss. Transportation noise control in the community can therefore not be justified on the grounds of hearing protection."

## NON-AUDITORY HEALTH EFFECTS

It is sometimes claimed that aviation noise can harm the general physical and mental health of airport neighbors. Effects on the cardiovascular system, mortality rates, birth weights, achievement scores, and psychiatric admissions have been examined in the research literature. These questions remain unsettled because of conflicting findings based on differing

**Table B2**

**PERMISSIBLE NOISE EXPOSURES, OSHA STANDARDS**

| Duration per day, hours | Sound Level dBA slow response |
|---|---|
| 8 | 90 |
| 6 | 92 |
| 4 | 95 |
| 3 | 97 |
| 2 | 100 |
| 1 1/2 | 102 |
| 1 | 105 |
| 1/2 | 110 |
| 1/4 or less | 115 |

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Source: 29 CFR Ch. XVII, Section 1910

methodologies and uneven study quality. It is quite possible that the contribution of noise to pathological effects is so low that it has not been isolated. While research is continuing, there is insufficient scientific evidence to support these concerns (Newman and Beattie 1985, pp 59-62).

Taylor and Wilkins (1987, p. 4/10) offer the following conclusions in their review of the research.

> The evidence of non-auditory effects of transportation noise is more ambiguous, leading to differences of opinion regarding the burden of prudence for noise control. There is no strong evidence that noise has a direct causal effect on such health outcomes as cardiovascular disease, reproductive abnormality, or psychiatric disorder. At the same time, the evidence is not strong enough to reject the hypothesis that noise is in some way involved in the multi-causal process leading to these disorders.... But even with necessary improvements in study design, the inherent difficulty of isolating the effect of a low dose agent such as transportation noise within a complex aetiological system will remain. It seems unlikely, therefore, that research in the near future will yield findings which are definitive in either a positive or negative direction. Consequently, arguments for transportation noise control will probably continue to be based primarily on welfare criteria such as annoyance and activity disturbance.

## SLEEP DISTURBANCE

There is a large body of research documenting the effect of noise on sleep disturbance, but the long-range effects of sleep disturbance caused by nighttime airport operations are not well understood. It is clear that sleep is essential for good physical and emotional health, and noise can interfere with sleep, even when the sleeper is not consciously awakened. While the long-term effect of sleep deprivation on mental and physical function is not clear, it is known to be harmful. It is also known that sleepers do not fully adjust to noise disruption over time. Although they may awaken less often and have fewer conscious memories of disturbance, noise-induced shifts in sleep levels continue to occur.

Newman and Beattie (1985, pp. 51-58) review the literature on sleep disturbance and note that the level of noise which can interfere with falling asleep or waking from sleep ranges from 35 to 70 dB, depending on sleep stage and variability among individuals. They note that studies show only slight habituation to noise.

Karl D. Kryter (1984, pp. 422-431) also reviews the literature on sleep disturbance. He reports the threshold level for awakening from sleep as ranging from 35 dB to 80 dB, depending on sleep stage and individual variability. Older people tend to be much more sensitive to noise-induced awakenings than younger people. Research has shown that, when measured through awakenings, people tend to become somewhat accustomed to noise. On the other hand, electro-encephalograms, which reveal information about sleep stages, show little habituation to noise. Kryter describes these responses to noise as "alerting responses." He adds that, because they occur unconsciously, they are apparently reflexive, reflecting normal physiological functions which may not be a cause of stress to the organism.

Most studies of sleep disturbance have been conducted under controlled laboratory conditions. The laboratory studies do not allow generalizations to be made about the potential for sleep disturbance in an actual airport setting, and more importantly, the impact of these disturbances on the residents. Only a few studies have examined the effect of nighttime noise on sleep disturbance in actual community settings. A recent report summarizes the results of eight such studies, most of which were done in Europe (Fields 1986). Four of the studies examined aircraft noise and the others examined highway noise. In all of them, sleep disturbance was correlated with cumulative noise exposure metrics such as Leq and L10. All studies showed a distinct tendency for increased sleep disturbance to be reported as cumulative noise exposure increased. The reviewer notes however, that sleep disturbance was very common, regardless of noise levels, and that many factors contributed to it. He points out that, "the prevalence of sleep disturbance in the absence of noise means that considerable caution must be exercised in interpreting any reports of sleep disturbance in noisy areas."

The findings of many of these sleep disturbance studies, while helping to answer basic research questions, are of little usefulness to policy makers and airport residents. For them, the important question is, "When does sleep disturbance caused by environmental noise become severe enough to constitute a problem in the community?" Kryter (1984) reviews in detail one very important study that sheds light on this question. The Directorate of Operational Research and Analysis (DORA) of the British Civil Aviation Authority conducted an in-depth survey of 4,400 residents near London's Heathrow and Gatwick Airports over a four-month period in 1979. The study was intended to answer two policy-related questions: "What is the level of aircraft noise which will disturb a sleeping person?" and "What level of aircraft noise prevents people from getting to sleep?"

Analysis of the survey results indicated that the best correlations were found using cumulative energy dosage metrics, namely Leq. Kryter notes that support for the use of the Leq metric is provided by the finding that some respondents could not accurately recall the time association of a specific flight with an arousal from sleep. This suggests that the noise from successive overflights increased the general state of arousability from sleep.

With regard to difficulty in getting to sleep, the study found 25 percent of the respondents reporting this problem at noise levels of 60 Leq, 33 percent at 65 Leq, and 42 percent at 70 Leq. The percentage of people who reported being awakened at least once per week by aircraft noise was 19 percent at 50 Leq, 24 percent at 55 Leq, and 28 percent at 60 Leq. The percentage of people bothered "very much" or "quite a lot" by aircraft noise at night when in bed was 22 percent at 55 Leq and 30 percent at 60 Leq. Extrapolation of the trend line would put the percentage reporting annoyance at 65 Leq well above 40 percent. (See DORA 1980; cited in Kryter 1984, p. 434.)

DORA concluded with the following answers to the policy-related questions: (1) A significant increase in reports of sleep arousal will occur at noise levels at or above 65 Leq; (2) A significant increase in the number of people reporting difficulty in getting to sleep will occur at noise levels at or above 70 Leq. Kryter disagrees with these conclusions. He believes that the data indicate that noise levels approximately 10 decibels lower would represent the appropriate thresholds.

At any airport, the 65 CNEL contour developed from total daily aircraft activity will be larger than the 55 Leq developed from nighttime activity only. (At an airport with only nighttime use, the 65 CNEL contour would be identical with the 55 Leq contour because of the effect of the 10 dB penalty in the CNEL metric.) Thus, the 65 CNEL contour defines a noise impact envelope which encompasses all of the area within which significant sleep disturbance may be expected based on Kryter's interpretation of the DORA findings discussed above.

## STRUCTURAL DAMAGE

Structural vibration from aircraft noise in the low frequency ranges is sometimes a concern of airport neighbors. While vibration contributes to annoyance reported by residents near airports, especially when it is accompanied by high audible sound levels, it rarely carries enough energy to damage safely constructed structures. High-impulse sounds such as blasting, sonic booms, and artillery fire are more likely to cause damage than continuous sounds such as aircraft noise.

A document published by the National Academy of Sciences suggested that one may conservatively consider noise levels above 130 dB lasting more than one second as potentially damaging to structures (CHABA 1977). Aircraft noise of this magnitude occurs on the ramp and runway and seldom, if ever, occurs beyond the boundaries of a commercial or general aviation airport.

The risk of structural damage from aircraft noise was studied as part of the environmental assessment of the Concorde supersonic jet transport. The probability of damage from Concorde overflights was found to be extremely slight. Actual overflight noise levels from the Concorde at Sully Plantation near Dulles International Airport in Fairfax County, Virginia were recorded at 115 dBA. No damage to the historic structures was found, despite their age (Hershey et al. 1975). Since the Concorde causes significantly more vibration than conventional commercial jet aircraft, the risk of structural damage caused by aircraft noise near airports is considered to be negligible. (See Wiggins 1975.)

## OTHER ANNOYANCES

The psychological impact of aircraft noise is a more serious concern than direct physical impact. Studies conducted in the late 1960's and early 1970's found that the interruption of communication, rest, relaxation, and sleep are among the most important causes for complaints about aircraft noise. Interference with telephone conversations, radio listening, and television viewing are often mentioned as particular sources of annoyance.

The sound of approaching aircraft may cause fear in some people about the possibility of a crash. This fear is a factor motivating some complaints of annoyance in neighborhoods near airports around the country. (See, for examples, Richards and Ollerhead 1973; Federal Aviation Administration 1977; and Kryter 1984, p. 533.) This effect tends to be most pronounced in areas directly beneath frequently used flight tracks.

The EPA has also found that continuous exposure to high noise levels can affect work performance, especially in high-stress occupations. Based on the various land use compatibility guidelines discussed below, these adverse affects are most likely to occur in an airport area within the 75 Ldn, or 75 CNEL, contour.

Individual human response to noise is highly variable and is influenced by many factors. These include emotional variables, feelings about the necessity or preventability of the noise, judgments about the value of the activity creating the noise, an individual's activity at the time the noise is heard, general sensitivity to noise, beliefs about the impact of noise on health, and feelings of fear associated with the noise. Physical factors influencing an individual's reaction to noise include the background noise in the community, the time of day, the season of the year, the predictability of the noise, and the individual's control over the noise source.

## AVERAGE COMMUNITY RESPONSE TO NOISE

Although individual responses to noise can vary greatly, the average response among a group of people is much less variable. This enables us to make reasonable evaluations of the average impacts of aircraft noise on a community despite the wide variations in individual response.

Several studies have examined average community response to noise, focusing on the relationship between annoyance and noise exposure. (See, for examples, Richards and Ollerhead 1973; U.S.E.P.A. 1974; DORA 1980; Kryter 1970; and Great Britain Committee on the Problem of Noise 1963.) Particularly good reviews of this research are presented in Newman and Beattie 1985, p. 19, and Kryter 1984, p. 525. These studies have produced similar results, finding that annoyance is most directly related to cumulative noise exposure, rather than single-event exposure. Annoyance has been found to increase along either an exponential or an S-shaped curve as cumulative noise exposure increases. While these studies have shown curves that vary somewhat in their slope, they tend to be similar to the annoyance curve shown in Exhibit B4.

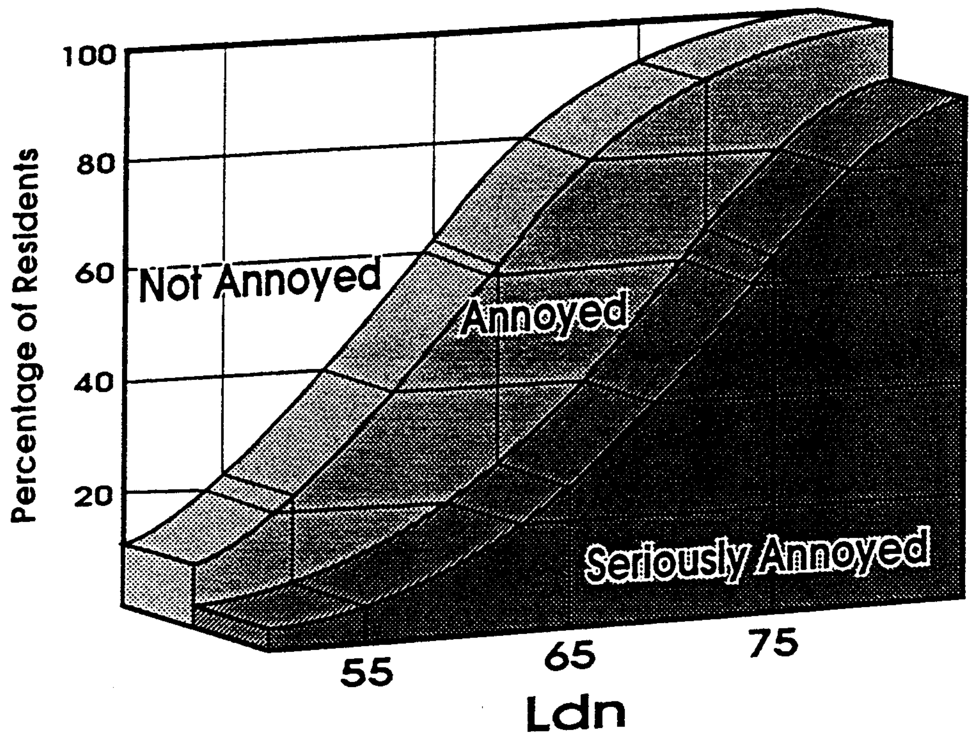
For research purposes, annoyance is usually measured through blind social surveys using random sampling techniques where people are asked to describe their feelings about the noise. Consistently, the best correlations have been found using cumulative noise exposure, or noise dosage, metrics. Indeed, cumulative noise metrics have been found consistently to provide the best explanatory power for all manner of noise effects, excluding the drastic effects of high-impulse sounds. The reason is that human response to broadband sound such as aircraft noise is related to two different dimensions of the sound — energy level and frequency of occurrence. To put it in common sense terms, a person will tolerate a rare and very loud noise event, but as the number of events increases, the person's tolerance decreases. Across the country, one often hears this kind of comment from airport area residents: "I know jets have flown in and out of the airport for years, but they never really bothered me until the airport started expanding." Cumulative noise exposure metrics have been developed to quantify the combined effects of sound energy level and the frequency of occurrence.

A variety of cumulative noise exposure metrics have been used in research studies over the years. In the United States, the Ldn metric has been widely used, while in California, the CNEL metric is used. They are very similar. Ldn accumulates the total noise occurring during a 24-hour period, with a 10 decibel penalty applied to noise occurring between 10:00 p.m. and 7:00 a.m. The CNEL metric is the same except that it adds a 4.8 dB penalty for noise occurring between 7:00 p.m. and 10:00 p.m. There is little practical difference between the two metrics in practice. Calculations of CNEL and Ldn from the same data generally yield values with less than a .7 dB difference (CalTrans 1983, p. 37). Both metrics correlate well with average community response to noise.

## EFFECT OF BACKGROUND NOISE

It has been speculated that the overall ambient noise level in an environment determines to what degree people will be annoyed by aircraft noise of a given level. That is, in a louder environment, it takes a louder level of aircraft noise level to generate complaints than it does in a quieter environment. Both common sense and the consultants experience in the field would indicate there is validity in this assumption.

Kryter (1984, p. 582) reviews some of the research on this question. He notes that the effects of laboratory tests and attitude surveys on this question are somewhat inconclusive. A laboratory test he reviews found that recordings of aircraft noise was judged to be less intrusive as the background road traffic noise was increased. He reviews an attitude survey in the Toronto Airport area where the effects of background noise were not significant.




Source: Richards and Ollerhead 1973.

Exhibit B4
ANNOYANCE CAUSED BY AIRCRAFT
NOISE IN RESIDENTIAL AREAS

The studies reviewed by Kryter were intended to see if background noise provided some degree of masking of aircraft noise. They did not, however, take into consideration the subjects' rating of the overall quality of the noise environment.

The U.S. Environmental Protection Agency has provided guidelines to address the question of background noise and its relationship to aircraft noise. EPA has determined that complaints can be expected when the intruding CNEL exceeds the background CNEL by more than 5 dB (U.S. EPA 1974). The California Department of Transportation (CalTrans 1983, p. 52) notes that some Airport Land Use Commissions in California consider the effects of background noise in determining the aircraft noise contour of significance. Specifically, adjustments have been made in areas with quiet background noise levels of 50 to 55 CNEL. In those cases, aircraft CNEL contours are prepared down to the 55 or 60 CNEL level, and land use compatibility criteria are adjusted to apply to those areas.

## LAND USE COMPATIBILITY GUIDELINES

The degree of annoyance which people suffer from aircraft noise varies depending on their activities at any given time. People rarely are as disturbed by aircraft noise when they are shopping, working, or driving as when they are at home. Transient hotel and motel residents seldom express as much concern with aircraft noise as do permanent residents of an area.

The concept of "land use compatibility" has arisen from this systematic variation in humantolerance to aircraft noise. Studies by governmental agencies and private researchers have defined the compatibility of different land uses with varying noise levels. Since the 1960's, many different sets of land use compatibility guidelines have been proposed and used. This section reviews some of the more well known guidelines.

### FAA-DOD Guidelines

In 1964, the Federal Aviation Administration (FAA) and the U.S. Department of Defense (DOD) published similar documents setting forth guidelines to assist land use planning in areas subjected to aircraft noise from nearby airports. These guidelines are presented in Table B3. The guidelines establish three zones, describing the expected responses to aircraft noise from residents of each zone. In Zone 1, corresponding to areas exposed to noise below 65 Ldn, essentially no complaints would be expected, although noise could be an occasional nuisance. In Zone 2, corresponding to 65 to 80 Ldn, individuals may complain, perhaps vigorously. In Zone 3, corresponding to 80 Ldn and above, vigorous complaints would be likely and concerted group action could be expected.

## Table B3

## CHART FOR ESTIMATING RESPONSE OF COMMUNITIES EXPOSURES TO AIRCRAFT NOISE

| Noise Rating | Zone | Description of Expected Response |
|---|---|---|
| Less than 65 Ldn<br>100 CNR | 1 | Essentially no complaints would be expected. The noise may, however, interfere occasionally with certain activities of the residents. |
| 65 to 80 Ldn<br>100 to 115 CNR | 2 | Individuals may complain, perhaps vigorously. Concerted group action is possible. |
| Greater than 80 Ldn<br>115 CNR | 3 | Individual reactions would likely include repeated, vigorous complaints. Concerted group action might be expected. |

Note: CNR stands for "community noise rating", a cumulative noise descriptor similar to Ldn which is no longer in general use.

Sources: U.S. DOD 1964. Cited in Kryter 1984, p. 616.

## HUD Guidelines

In 1971, the U.S.Department of Housing and Urban Development published noise assessment guidelines for use in evaluating the acceptability of sites for housing assistance. The guidelines, shown in Table B4, establish four classes of noise impact. The first two categories refer to areas outside the 65 Ldn contour, the first at a distance exceeding the distance between the 65 and 75 Ldn contours, the second at a lesser distance. Housing is considered clearly acceptable in the first category and "normally acceptable" in the second. Housing is considered "normally unacceptable" in the 65 to 75 Ldn range and clearly unacceptable inside the 75 Ldn contour.

## EPA Guidelines

The U.S. Environmental Protection Agency published a document in 1974 suggesting maximum noise exposure levels to protect public health with an adequate margin of safety. These are shown in Table B5. They note that the risk of hearing loss may become a concern with exposure to noise above 74 Ldn. Interference with outdoor activities may become a problem with noise levels above 55 Ldn. Interference with indoor residential activities may become a problem with interior noise levels above 45 Ldn. If we assume that standard construction attenuates noise by about 20 dB, with doors and windows closed, a standard estimate, this corresponds to an exterior noise level of 65 Ldn.

## Federal Interagency Committee on Urban Noise

In 1979, the Federal Interagency Committee on Urban Noise, including representatives of the Environmental Protection Agency, the Department of Transportation, the Housing and Urban Development Department, the Department of Defense, and the Veterans Administration, was established to coordinate various Federal programs relating to the promotion of noise-compatible development (Federal Interagency Committee on Urban Noise 1980). In 1980, the Committee published a report, "Guidelines for Considering Noise in Land Use Planning and Control," which contained detailed land use compatibility guidelines for varying Ldn noise levels. These guidelines are presented in Table B6. The work of the Interagency Committee was very important as it brought together for the first time all Federal agencies with a direct involvement in noise compatibility issues and forged a general consensus on land use compatibility for noise analysis on Federal projects.

The Interagency guidelines describe the 65 Ldn contour as the threshold of significant impact for residential land uses and a variety of noise-sensitive institutions (such as hospitals, nursing homes, schools, cultural activities, auditoriums, and outdoor music shells). Within the 55 to 65 Ldn contour range, the guidelines note that cost and feasibility factors were considered in defining residential development and several of the institutions as compatible. In other words,

## Table B4

## SITE EXPOSURE TO AIRCRAFT NOISE

| Distance from Site to the center of the area covered by the principal runways | Acceptability category |
|---|---|
| Outside the Ldn - 65(NEF=30, CNR-100) contour at a distance greater than or equal to the distance between the contours Ldn = 65 and Ldn = 75 | Clearly acceptable |
| Outside the Ldn = 65 contour, at a distance less than the distance between the Ldn =65 and Ldn =75 | Normally acceptable |
| Between the Ldn =65 and Ldn =75 contours | Normally acceptable |
| Within the Ldn =75 contour | Clearly unacceptable |

Note: CNR and NEF stand for "community noise rating", and "noise exposure forecast", cumulative noise descriptors which are no longer in general use.

Source: Schultz and McMahon 1971. Cited in Kryter 1984, p. 617.

**Table B5**

**SUMMARY OF NOISE LEVELS IDENTIFIED AS REQUISITE TO PROTECT PUBLIC HEALTH AND WELFARE WITH AN ADEQUATE MARGIN OF SAFETY**

| Effect | Level | Area |
|---|---|---|
| Hearing Loss | 74 Ldn + | All areas |
| Outdoor activity interference and annoyance | 55 Ldn + | Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use. |
| | 59 Ldn + | Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc. |
| Indoor activity interference and annoyance | 45 Ldn + | Indoor residential areas |
| | 49 Ldn + | Other indoor areas with human activities such as schools, etc. |

Note: All Leq values from EPA document converted by FAA to Ldn for ease of comparison (Ldn = Leq(24) + 4 dB).

Source: U.S. EPA 1974. Cited in FAA 1977, p. 26.

# Table B6

## SUGGESTED LAND USE COMPATIBILITY GUIDELINES

| | | Noise Zones/DNL Levels in Ldn | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SLUCM No. | Land Use Name | A 0-55 | B 55-65 | C-1 65-70 | C-2 70-75 | D-1 75-80 | D-2 80-85 | D-3 85+ |
| **10** | **Residential** | | | | | | | |
| 11 | Household Units | Y | Y* | 25[1] | 30[1] | N | N | N |
| 11.11 | Single Units - detached | Y | Y* | 25[1] | 30[1] | N | N | N |
| 11.12 | Single Units - semi-detached | Y | Y* | 25[1] | 30[1] | N | N | N |
| 11.13 | Single Units - attached row | Y | Y* | 25[1] | 30[1] | N | N | N |
| 11.21 | Two Units - side by side | Y | Y* | 25[1] | 30[1] | N | N | N |
| 11.22 | Two Units - one above the other | Y | Y* | 25[1] | 30[1] | N | N | N |
| 11.31 | Apartments - walk up | Y | Y* | 25[1] | 30[1] | N | N | N |
| 11.32 | Apartments - elevator | Y | Y* | 25[1] | 30[1] | N | N | N |
| 12 | Group Quarters | Y | Y* | 25[1] | 30[1] | N | N | N |
| 13 | Residential Hotels | Y | Y* | 25[1] | 30[1] | N | N | N |
| 14 | Mobile Home Park or Courts | Y | Y* | N | N | N | N | N |
| 15 | Transient Lodgings | Y | Y* | 25[1] | 30[1] | 35[1] | N | N |
| 16 | Other Residential | Y | Y* | 25[1] | 30[1] | N | N | N |
| **20** | **Manufacturing** | | | | | | | |
| 21 | Food and kindred products - manufacturing | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 22 | Textile mill products - manufacturing | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 23 | Apparel and other finished products made from fabrics, leather, and similar materials - manufacturing | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 24 | Lumber and wood products (except furniture) - manufacturing | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 25 | Furniture and fixtures - manufacturing | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 26 | Paper and allied products - manufacturing | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 27 | Printing, publishing, and allied industries | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 28 | Chemicals and allied products manufacturing | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 29 | Petroleum refining and related industries | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 31 | Rubber and misc. plastic products - manufacturing | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 32 | Stone, Clay and glass products - manufacturing | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 33 | Primary metal industries | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 34 | Fabricated and Metal products manufacturing | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 35 | Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks - manufacturing | Y | Y | 25 | 30 | N | N | |
| 39 | Miscellaneous manufacturing | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |

## Table B6 -- continued
## SUGGESTED LAND USE COMPATIBILITY GUIDELINES

| SLUCM No. | Land Use Name | A 0-55 | B 55-65 | C-1 65-70 | C-2 70-75 | D-1 75-80 | D-2 80-85 | D-3 85+ |
|---|---|---|---|---|---|---|---|---|
| | | | | Noise Zones/DNL Levels in Ldn | | | | |
| **40** | **Transportation, communication and utilities** | | | | | | | |
| 41 | Railroad, rapid rail transit and street railway transportation | Y | Y | Y | Y[2] | Y[2] | Y[4] | Y |
| 42 | Motor vehicle transportation | Y | Y | Y | Y[2] | Y[3] | Y[4] | Y |
| 43 | Aircraft transportation | Y | Y | Y | Y[2] | Y[3] | Y[4] | Y |
| 44 | Marine craft transportation | | | | | | | |
| 45 | Highway and street right-of-way | Y | Y | Y | Y[2] | Y[3] | Y[4] | Y |
| 46 | Automobile parking | Y | Y | Y | Y[2] | Y[3] | Y[4] | Y |
| 47 | Communication | Y | Y | Y | 25[5] | 30[5] | N | N |
| 48 | Utilities | Y | Y | Y | Y[2] | Y[3] | Y[4] | Y |
| 49 | Other transportation, communication and utilities | Y | Y | Y | 25[5] | 30[5] | N | N |
| **50** | **Trade** | | | | | | | |
| 51 | Wholesale trade | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 52 | Retail trade - building materials, hardware and farm equipment | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 53 | Retail trade - general merchandise | Y | Y | Y | 25 | 30 | N | N |
| 54 | Retail trade - food | Y | Y | Y | 25 | 30 | N | N |
| 55 | Retail Trade - automotive, marine craft, aircraft and accessories | Y | Y | Y | 25 | 30 | N | N |
| 56 | Retail trade - apparel and accessories | Y | Y | Y | 25 | 30 | N | N |
| 57 | Retail trade - furniture, home furnishings and equipment | Y | Y | Y | 25 | 30 | N | N |
| 58 | Retail trade - eating and drinking establishments | Y | Y | Y | 25 | 30 | N | N |
| 59 | Other retail trade | Y | Y | Y | 25 | 30 | N | N |
| **60** | **Services** | | | | | | | |
| 61 | Finance, insurance and real estate services | Y | Y | Y | 25 | 30 | N | N |
| 62 | Personal services | Y | Y | Y | 25 | 30 | N | N |
| 62.4 | Cemeteries | Y | Y | Y | Y[2] | Y[3] | Y[4,11] | Y[6,11] |
| 63 | Business services | Y | Y | Y | 25 | 30 | N | N |
| 64 | Repair services | Y | Y | Y | Y[2] | Y[3] | Y[4] | N |
| 65 | Professional services | Y | Y | Y | 25 | 30 | N | N |
| 65.1 | Hospitals, nursing homes | Y | Y* | 25* | 30* | N | N | N |
| 65.2 | Other medical facilities | Y | Y | Y | 25 | 30 | N | N |
| 66 | Contract construction services | Y | Y | Y | 25 | 30 | N | N |
| 67 | Governmental services | Y | Y* | Y* | 25* | 30* | N | N |
| 68 | Educational services | Y | Y* | 25* | 30* | N | N | N |
| 69 | Miscellaneous | Y | Y | Y | 25 | 30 | N | N |
| **70** | **Cultural, entertainment and recreational** | | | | | | | |
| 71 | Cultural activities (including churches) | Y | Y* | 25* | 30* | N | N | N |
| 71.2 | Nature exhibits | Y | Y* | Y* | N | N | N | N |
| 72 | Public assembly | Y | Y | Y | N | N | N | N |
| 72.1 | Auditoriums, concert halls | Y | Y | 25 | 30 | N | N | N |

## Table B6 -- continued
## SUGGESTED LAND USE COMPATIBILITY GUIDELINES

| SLUCM No. | Land Use Name | Noise Zones/DNL Levels in Ldn A 0-55 | B 55-65 | C-1 65-70 | C-2 70-75 | D-1 75-80 | D-2 80-85 | D-3 85+ |
|---|---|---|---|---|---|---|---|---|
| 72.11 | Outdoor music shells, amphitheaters | Y | Y* | N | N | N | N | N |
| 72.2 | Outdoor sports arenas, spectator sports | Y | Y | Y[7] | Y[7] | N | N | N |
| 73 | Amusements | Y | Y | Y | Y | N | N | N |
| 74 | Recreational activities (including golf courses, riding stables, water recreation) | | | | | | | |
| 75 | Resorts and group camps | Y | Y* | Y* | Y* | N | N | N |
| 76 | Parks | Y | Y* | Y* | Y* | N | N | N |
| 79 | Other cultural, entertainment | Y | Y* | Y* | Y* | N | N | N |
| **80** | **Resource Production and extraction** | | | | | | | |
| 81 | Agriculture (except livestock | Y | Y | Y[8] | Y[9] | Y[10] | Y[10,11] | Y[10,11] |
| 81.5 to 81.7 | Livestock farming and animal breeding | Y | Y | Y[8] | Y[9] | N | N | N |
| 82 | Agricultural related activities | Y | Y | Y[8] | Y[9] | Y[10] | Y[10,11] | Y[10,11] |
| 83 | Forestry activities and related services | Y | Y | Y[8] | Y[9] | Y[10] | Y[10,11] | Y[10,11] |
| 84 | Fishing activities and related services | Y | Y | Y | Y | Y | Y | Y |
| 85 | Mining activities and related services | Y | Y | Y | Y | Y | Y | Y |
| 89 | Other source production and extraction | Y | Y | Y | Y | Y | Y | Y |

Table B6 -- continued
SUGGESTED LAND USE COMPATIBILITY GUIDELINES

8. Residential buildings require a NLR of 25.

9. Residential buildings require a NLR of 30.

10. Residential buildings not permitted.

11. Land use not recommended, but if community decides use is necessary, hearing protection devices should be worn by personnel.

KEY

| | |
|---|---|
| SLUCM | Standard Land Use Coding Manual (U.S. Urban Renewals Administration and Bureau of Public Roads, 1965). |
| Y (Yes) | Land use and related structures are compatible without restrictions. |
| N (No) | Land use and related structures are not compatible and should be prohibited. |
| NLR (Noise Level Reduction) | Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure. |
| $Y^x$ (Yes, with restrictions) | Land use and related structures generally compatible; see Notes 2 through 4. |
| 25, 30 or 35 | Land use and related structures generally compatible; measures to achieve NLR of 25, 30 or 35 must be incorporated into design and construction of structure. |
| 25*, 30* or 35* | Land use generally compatible with NLR; however, measures to achieve an overall noise reduction do not necessarily solve noise difficulties and additional evaluation is warranted. |

Table B6 -- continued
SUGGESTED LAND USE COMPATIBILITY GUIDELINES

| | |
|---|---|
| Y* | The designation of these uses as "compatible" in this zone reflects individual Federal agencies consideration of general cost and feasibility factors as well as past community experiences and program objectives. Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider... |

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Source: Guidelines for Considering Noise in Land Use Planning and Control, Federal Interagency Committee on Urban Noise, June 1980, p.6.

the guidelines are based not solely on the effects of noise. They also consider the cost and feasibility of noise control.

**ANSI Guidelines**

In 1980, the American National Standards Institute (ANSI) published recommendations for land use compatibility with respect to noise (ANSI 1980). Kryter (1984, p. 621) notes that no supporting data for the recommended standard is provided.

The ANSI guidelines are shown in Exhibit B5. While generally similar to the Federal Interagency guidelines, there are some important differences. First, ANSI's land use classification system is less detailed. Second, the ANSI standard acknowledges the potential for noise effects below the 65 Ldn level, describing several uses as "marginally compatible" with noise below 65 Ldn. These include single-family residential (from 55 to 65 Ldn), multi-family residential, schools, hospitals, and auditoriums (60 to 65 Ldn), and music shells (50 to 65 Ldn). Other outdoor activities, such as parks, playgrounds, cemeteries, and sports arenas, are described as marginally compatible with noise levels as low as 55 or 60 Ldn.

**FAR Part 150 Guidelines**

The FAA adopted a revised and simplified version of the Federal Interagency guidelines when it promulgated FAR Part 150 in the early 1980's. (The Interim Rule was adopted on January 19, 1981. The final rule was adopted on December 13, 1984, published in the Federal Register on December 18, and became effective on January 18, 1985.) Among the changes made by FAA include the use of a coarser land use classification system and the deletion of any reference to any potential for noise impacts below the 65 Ldn level. The determination of the compatibility of various land uses with various noise levels, however, is very similar to the Interagency determinations.

Exhibit B6 lists the FAR Part 150 land use compatibility guidelines. These are only guidelines. Part 150 explicitly states that determinations of noise compatibility and regulation of land use are purely local responsibilities. Lacking any specific guidance provided by State law or regulation, local airport sponsors around the country typically use the Part 150 Land Use guidelines as is when developing noise compatibility studies under FAR Part 150.

**California Guidelines**

In the "Airport Land Use Planning Handbook" (CalTrans 1983, p. 50) land use compatibility guidelines are suggested for use in the preparation of comprehensive airport land use plans. These guidelines were developed after considering the guidelines of the State Office of Noise Control, HUD, and the FAA. They were also based on a review of all available comprehensive airport land use plans in California.

91SP04-B5-3/12/92

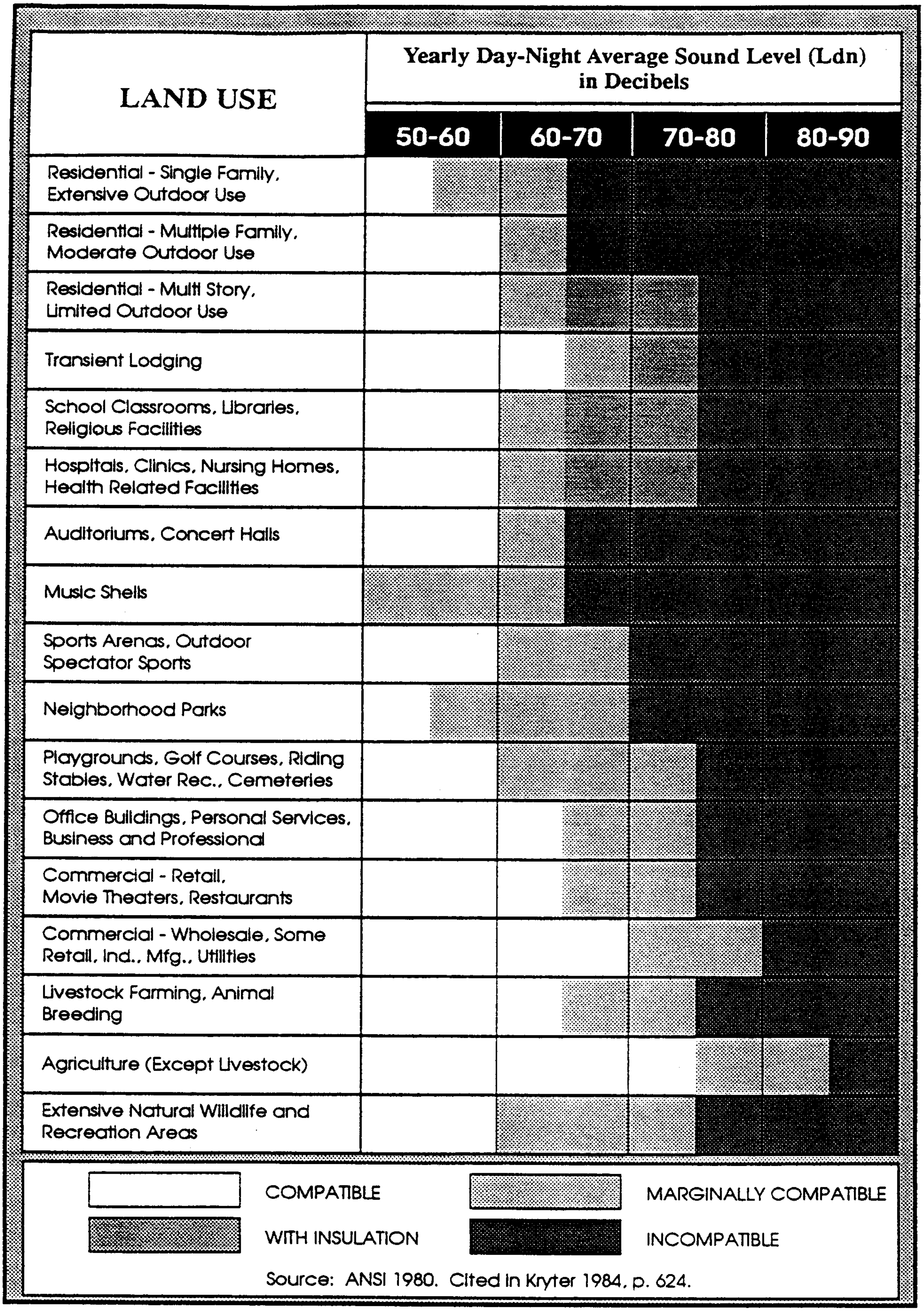


Exhibit B5
LAND USE COMPATIBILITY WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVEL AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED

## Exhibit B6

## FAA LAND USE COMPATIBILITY GUIDELINES

| LAND USE | Yearly Day-Night Average Sound Level (Ldn) in Decibels | | | | | |
|---|---|---|---|---|---|---|
| | Below 65 | 65-70 | 70-75 | 75-80 | 80-85 | Over 85 |
| **RESIDENTIAL** | | | | | | |
| Residential, other than mobile homes and transient lodgings | Y | N[1] | N[1] | N | N | N |
| Mobile home parks | Y | N | N | N | N | N |
| Transient lodgings | Y | N[1] | N[1] | N[1] | N | N |
| **PUBLIC USE** | | | | | | |
| Schools | Y | N[1] | N[1] | N | N | N |
| Hospitals and nursing homes | Y | 25 | 30 | N | N | N |
| Churches, auditoriums, and concert halls | Y | 25 | 30 | N | N | N |
| Government services | Y | Y | 25 | 30 | N | N |
| Transportation | Y | Y | Y[2] | Y[3] | Y[4] | Y[4] |
| Parking | Y | Y | Y[2] | Y[3] | Y[4] | N |
| **COMMERCIAL USE** | | | | | | |
| Offices, business and professional | Y | Y | 25 | 30 | N | N |
| Wholesale and retail-building materials, hardware and farm equipment | Y | Y | Y[2] | Y[3] | Y[4] | N |
| Retail trade-general | Y | Y | 25 | 30 | N | N |
| Utilities | Y | Y | Y[2] | Y[3] | Y[4] | N |
| Communication | Y | Y | 25 | 30 | N | N |
| **MANUFACTURING AND PRODUCTION** | | | | | | |
| Manufacturing, general | Y | Y | Y[2] | Y[3] | Y[4] | N |
| Photographic and optical | Y | Y | 25 | 30 | N | N |
| Agriculture (except livestock) and forestry | Y | Y[6] | Y[7] | Y[8] | Y[8] | Y[8] |
| Livestock farming and breeding | Y | Y[6] | Y[7] | N | N | N |
| Mining and fishing, resource production and extraction | Y | Y | Y | Y | Y | Y |
| **RECREATIONAL** | | | | | | |
| Outdoor sports arenas and spectator sports | Y | Y[5] | Y[5] | N | N | N |
| Outdoor music shells, amphitheaters | Y | N | N | N | N | N |
| Nature exhibits and zoos | Y | Y | N | N | N | N |
| Amusements, parks, resorts, and camps | Y | Y | Y | N | N | N |
| Golf courses, riding stables, and water recreation | Y | Y | 25 | 30 | N | N |

The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

See other side for notes and key to table.

## KEY

| | |
|---|---|
| **Y (Yes)** | Land Use and related structures compatible without restrictions. |
| **N (No)** | Land Use and related structures are not compatible and should be prohibited. |
| **NLR** | Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure. |
| **25, 30, 35** | Land Use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure. |

## NOTES

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

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

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

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

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

6 Residential buildings require a NLR of 25.

7 Residential buildings require a NLR of 30.

8 Residential buildings not permitted.

*Source: F.A.R. Part 150, Appendix A, Table 1.*

These standards, shown in Table B7, differ from the Federal guidelines in three important respects. First, they use a much less detailed land use classification system. Application of the guidelines through a zoning ordinance or similar local regulation, may necessitate refinement in the classification system. The Federal Interagency guidelines would be appropriate as a reference.

Second, they propose different standards for residential land use in the vicinity of air carrier and military airports than for general aviation airports. A third difference is that land use compatibility below the 65 CNEL level, down to 55 CNEL, is specifically addressed. At air carrier and military airports, residential development within the 65 CNEL contour should be discouraged and mobile homes should be prohibited. It is strongly recommended that no residential development be permitted within the 70 CNEL contour. At general aviation airports, these land use guidelines are recommended to apply to the next lower CNEL ranges — the 60-65 and 65-70 CNEL, respectively. This is because at most general aviation airports, "the 65 CNEL noise contour ... does not sufficiently explain the annoyance area. The frequency of operations from some airports, visibility of aircraft at low altitudes and typically lower background noise levels around many general aviation airports are all believed to create a heightened awareness of general aviation activity and hence, potential for annoyance outside of the 65 CNEL contour." (See CalTrans 1983, p. 49.)

At general aviation airports, the potential for annoyance is noted within the 55 to 60 CNEL contours. The guidelines suggest that noise easements should be acquired for new construction and the potential need for sound insulation should be examined.

At all airports, institutional uses should be discouraged within the 65 CNEL contour. Commercial development is considered compatible with noise up to 70 CNEL and industrial land use with noise up to 75 CNEL.

## CONCLUSION

This technical appendix has described the measurement of sound and the analysis of aircraft noise, reviewed the research on noise effects, and presented information on land use compatibility guidelines with respect to noise. It is intended to serve as a reference for the development of policy guidelines for the Riverside County Airport Land Use Commission as it develops comprehensive land use plans for the airports in the County.

**Table B7**

# LAND USE GUIDELINES FOR NOISE COMPATIBILITY

| Type of Airport/ Land Use | 55–60 CNEL | 60–65 CNEL | 65–70 CNEL | 70–75 CNEL | 75–80 CNEL | 80+ CNEL |
|---|---|---|---|---|---|---|
| **Air Carrier and Military** | | | | | | |
| Residential/Lodgings | | ▪ Potential for annoyance exists; identify high complaint areas.<br>▪ Determine whether sound insulation requirements should be established for these areas.<br>▪ Require acoustical reports for all new construction.<br>▪ Noise easements should be required for new construction. | ▪ Discourage new single family dwellings<br>▪ Prohibit mobile homes.<br>▪ New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation is included in the design.<br>▪ Noise easements should be required for new construction.<br>▪ Develop policies for "infill". | ▪ New construction or development of residential uses should not be undertaken.<br>▪ New hotels and motels may be permitted after an analysis of noise reduction requirements is made and needed noise insulation is included in the design. | ▪ New hotels and motels should be discouraged. | |
| **General Aviation** | | | | | | |
| Residential/Lodgings | ▪ Potential for annoyance exists; identify high complaint areas.<br>▪ Determine whether sound insulation requirements should be established for these areas.<br>▪ Noise easements should be required for new construction.<br>▪ Discourage residential use underneath the flight pattern. | ▪ Discourage new single family dwellings.<br>▪ Prohibit mobile homes.<br>▪ New construction or development should be undertaken only after analysis of noise reduction an requirements is made and needed noise insulation is included in the design.<br>▪ Noise easements should be required.<br>▪ Develop policies for "infill." | ▪ New construction or development of residential uses should not be undertaken.<br>▪ New hotels and motels may be permitted after an analysis of noise reduction requirements is made and needed noise insulation is included in the design. | ▪ New hotels and motels should be discouraged. | | |
| **All Airports** | | | | | | |
| Public/Institutional | | ▪ Satisfactory with little noise impact and requiring no special noise insulation requirements for new construction. | ▪ Discourage institutional uses.<br>▪ If no other alternative location is available, new construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation is included in the design. | ▪ No new institutional uses should be undertaken. | | |
| Commercial | | | ▪ Satisfactory with little noise impact and requiring no special noise insulation. Requirements for new construction. | ▪ New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed insulation features included in the design. Noise reduction levels of 25–30 dB will be required. | ▪ New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation features included in the design. Noise reduction levels of 25–30 dB will be required. | ▪ New construction or development should not be undertaken unless related to airport activities or services. Conventional construction will generally be inadequate and special noise insulation features should be included in the construction. |
| Industrial | | | | ▪ Satisfactory with little noise impact and Requiring no special noise insulation requirements for new construction. | ▪ New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation features included in the design.<br>▪ Measures to achieve noise reduction of 25–35 dB must be incorporated in Portions of building where the public is received and in office areas. | ▪ New construction or development should not be undertaken unless related to airport activities or services. Conventional construction will generally be inadequate and special noise insulation features should be included in the construction. |
| Recreation/ Open Space | | | ▪ Satisfactory, with little noise impact and requiring no special noise insulation for new construction.<br>▪ Outdoor music shells and amphitheater should not be permitted. | ▪ Parks, spectator sports, golf courses and agricultural generally satisfactory with little noise impact.<br>▪ Nature areas for wildlife and zoos should not be permitted. | ▪ Land uses involving concentrations of people (spectator sports and some recreational facilities) or of animals (livestock farming and animal breeding) should not be permitted. | |

Source: Airport Land Use Planning Handbook, A Reference Guide for Local Agencies, prepared for California Department of Transportation, Division of Aeronautics, by Metropolitan Transportation Commission and Association of Bay Area Governments, 1983, p.5

# APPENDIX C

# SAFTEY CONSIDERATIONS IN THE VICINITY OF AIRPORTS

## Appendix C

# SAFETY CONSIDERATIONS IN THE VICINITY OF AIRPORTS[1]

## INTRODUCTION

This technical appendix presents an overview of the important considerations regarding safety of persons on the ground and in the air in the vicinity of airports. It begins with a brief discussion of basic flight procedures. Aircraft accident data are then reviewed. Safety standards proposed in various advisory documents and regulations around the country are reviewed. The appendix concludes with a review of the safety standards proposed for use in California by the Department of Transportation, Division of Aeronautics.

## FLIGHT PROCEDURES

In order to more fully understand the significance of aircraft accident data, it is important to have a basic understanding of basic flight procedures.

## FLIGHT RULES

The Federal Aviation Administration has defined two sets of flight rules governing aircraft flight. Under Visual Flight Rules (VFR), pilots operate visually. It is their responsibility to maintain separation between aircraft. The FAA has defined a variety of flight procedures to facilitate coordination among VFR aircraft.

Instrument Flight Rules (IFR) govern aircraft operating under instrument control. IFR procedures are required when poor visibility limit the ability of a pilot to navigate visually. IFR procedures are also often used by qualified pilots in good weather conditions. Under IFR, pilots rely on cockpit instruments, navigational aids, and air traffic control services.

## TRAFFIC PATTERN

An airport traffic pattern is a generalized route defined for aircraft to approach and depart the active runway. The pattern is typically defined in terms of altitude and a general path around the airport. The standard pattern altitude is 1,000 feet AGL, but variations are sometimes made. The typical pattern altitude for all public airports is published in the Airport/Facility Directory (NOAA 1992).

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[1]Source: Aries Consultants Ltd.

Exhibit C1 shows a typical lefthand traffic pattern. Although the lefthand pattern is the norm, in certain circumstances righthand patterns are observed at airports. In the case of parallel runways, for example, a lefthand pattern will be observed on the left runway and a righthand pattern on the right runway.

Aircraft approaching the airport enter the pattern on the downwind leg, turn left to the base leg perpendicular to the runway, then turn left to the final approach. Aircraft on departure leave the pattern via a straight-out track or a 45-degree left turn. The turn is not to be started until clearing the end of the runway and reaching pattern altitude. In practice there are many possible variations for entering and leaving the pattern, depending on pilot technique, the volume of traffic at the airport, and on air traffic control instructions (at airports with control towers). Exhibit C1 shows some of the potential variations.

A common part of pilot training involves the touch-and-go procedure where the pilot makes repeated approaches or landings. In this case, the aircraft remains in the pattern throughout the procedure.

The size of the traffic pattern varies widely from airport to airport and even from time to time at any given airport. This is especially true at very busy airports and at those without air traffic control towers. The base leg may extend anywhere from one-quarter mile to one or even two miles depending on pilot technique and the volume of traffic in the pattern. The base leg may be displaced from the runway end from one to two miles for typical visual approaches. For runways with precision instrument approaches, the base leg may be extended even further, as aircraft seek to line up on the final approach beyond the outer marker (typically located about 5 miles off the runway end).

## RUNWAY APPROACHES

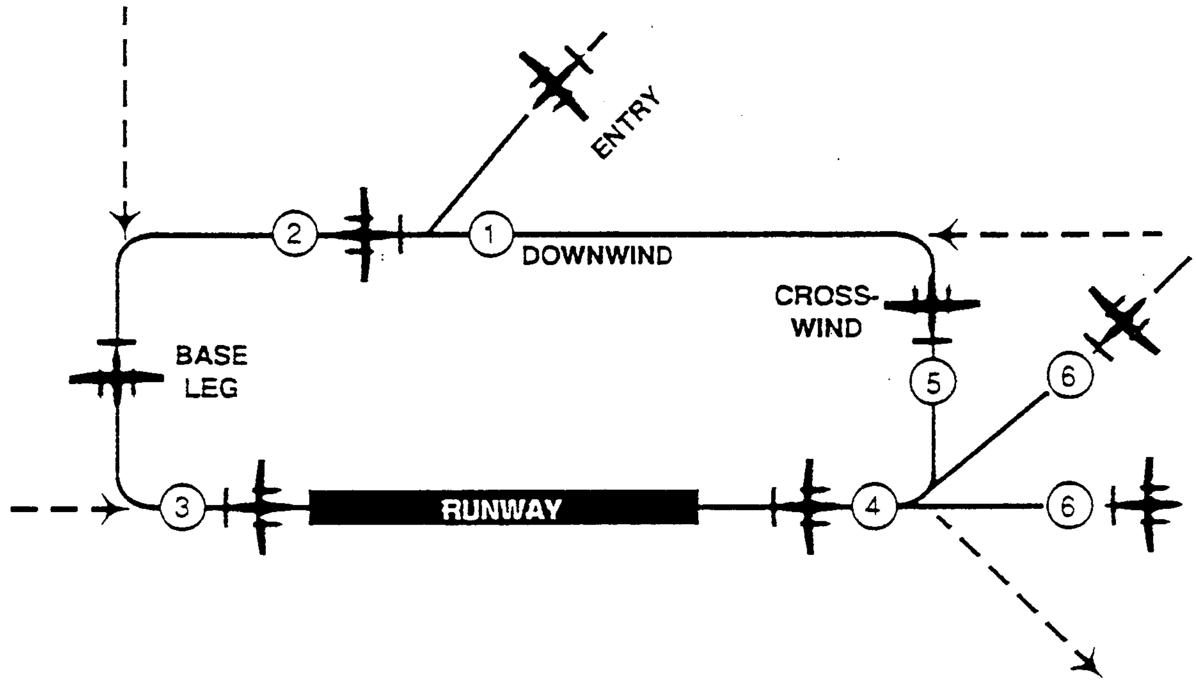
There are two categories of runway approaches: visual and instrument. Visual approaches require the pilot to sight the runway and establish a final approach without aid of any special instrumentation. Certain lighting aids may be involved to make it easier to identify the runway and establish the proper rate of descent. These may include runway end identifier lights (REIL), and visual approach slope indicators (VASI), or precision approach path indicators (PAPI). Obviously, visual approaches can only be used when visibility is good.

Instrument approaches are defined using electronic navigational aids. They include non-precision and precision approaches. Non-precision approaches provide course guidance to align the aircraft with the runway. Precision approaches provide for course guidance directly

**Exhibit C1**

**RECOMMENDED STANDARD LEFT-HAND TRAFFIC PATTERN**

91SP04-C1-3/11/92




KEY:

(1) Enter pattern in level flight, abeam the midpoint of the runway, at pattern altitude. (1000' AGL is recommended pattern altitude unless established otherwise.)

(2) Maintain pattern altitude until abeam approach end of the landing runway, or downwind leg.

(3) Complete turn to final at least 1/4 mile from the runway.

(4) Continue straight ahead until beyond departure end of runway.

(5) If remaining in the traffic pattern, commence turn to crosswind leg beyond the departure end of the runway, within 300 feet of pattern altitude.

(6) If departing the traffic pattern, continue straight out, or exit with a 45° left turn beyond the departure end of the runway, after reaching pattern altitude.

NOTE: Dashed lines indicate variations that are sometimes observed.

SOURCE: Airman's Information Manual 1991, Aviation Supplies & Academics, Inc., Renton, WA., p.119.

aligned with the runway in addition to providing a glide slope to aid the descent. Instrument approaches can be used when the visibility is poor. Precision approaches permit operations with lower landing minimums than non-precision approaches. The Category I precision instrument approach, the most common, can be used with a runway visual range of approximately one-half mile and a ceiling as low as 200 feet. Typical non-precision approaches can be used with a runway visual range of no less than three-quarters of a mile and a ceiling of 400 feet.

## AIRCRAFT ACCIDENTS

The most frequently cited cause of general aviation accidents is pilot error. Based on data compiled by the National Transportation Safety Board (NTSB) for 1979, almost 88 percent of all fatal general aviation accidents were caused, at least in part, by pilot error. Weather was a contributing factor in 40 percent of general aviation accidents, and terrain contributed to 21 percent. Other factors, including equipment failure, were far less prevalent as contributing causes.

Table C1 shows the frequency of aircraft accidents by phase of operation. Landing accidents are especially common, accounting for 41.5 percent of all general aviation accidents between 1974 and 1979. Almost 34 percent of accidents occurred in flight, and almost 20 percent during takeoff.

Table C2 presents more detail on the takeoff and landing accidents. Over twice as many occurred during landing as during takeoff (10,983 versus 5,053). Most of the difference is accounted for by the on-airport accidents. When only the accidents occurring near the airport (generally within one mile) are considered, the numbers of takeoff and landing accidents are almost the same.

Of the takeoff accidents during the period, over three-fifths occurred near the airport. The near-airport takeoff accidents all occurred during the initial climb.

Approximately 30 percent of landing accidents occurred near the airport. Most of the rest occurred on the airport. Over half of the near-airport landing accidents occurred while making VFR final approaches.

Table C3 lists the ten most prevalent types of general aviation aircraft accidents. Engine failure or malfunction is the most common, accounting for almost 24 percent of all accidents and 12 percent of fatal accidents. Uncontrolled collisions with the ground or water accounted for almost 17 percent of fatal accidents, while controlled collisions with the ground accounted for nearly 14 percent of fatal accidents. Collisions with trees and poles accounted for 8 percent of all accidents and over 14 percent of fatal accidents.

## Table C1

## GENERAL AVIATION ACCIDENTS BY PHASE OF OPERATION (1974-1979)

| Phase of Operation | Percent of Total Accidents | | Proportion Involving Serious/Fatal Injury |
|---|---|---|---|
| Static | 0.8% | | 51% |
| Taxi | 3.7% | | 4% |
| Takeoff | 19.5% | | 23% |
| Run | | 4.8% | 7% |
| Initial Climb | | 12.3% | 31% |
| Other | | 2.4% | 12% |
| In Flight | 33.7% | | 45% |
| Landing | 41.5% | | 14% |
| in traffic pattern | | 2.1% | 46% |
| final approach - VFR | | 6.6% | 28% |
| final approach - IFR | | 0.9% | 68% |
| roll | | 12.6% | 2% |
| go-around/missed approach | | 2.7% | 30% |
| other | | 3.4% | 31% |
| Unknown | 0.8% | | 77% |
| TOTAL | 100.0%[1] | | 27% |

[1]Total Accidents - 25,963.

Source: National Transportation Safety Board, *Annual Review of Aircraft Accident Data - U.S. General Aviation*, Calendar Years 1974-1979. Cited in Hodges & Shutt 1990, p.47.

## Table C2

## MAJOR GENERAL AVIATION ACCIDENTS (1974-1979)

| Landing or Takeoff | Location | Detailed Phase of Operation | Number of Accidents | % |
|---|---|---|---|---|
| Takeoff | On-Airport | Run | 1,251 | |
| | | Aborted Takeoff | 384 | |
| | On-Airport Subtotal | | 1,635 | |
| | Near Airport | Initial Climb | 3,182 | 100% |
| | Other | | 236 | |
| | Take off - Total | | 5,053 | |
| Landing | On-Airport | Level Off-Touchdown | 3,909 | |
| | | Roll | 3,336 | |
| | On-Airport Subtotal | | 7,245 | |
| | Near Airport | Traffic Pattern-Circling | 542 | 16.7% |
| | | Final Approach-VFR | 1,706 | 52.6% |
| | | Initial Approach | 61 | 1.9% |
| | | Final Approach-IFR | 228 | 7.0% |
| | | Go Around-VFR | 653 | 20.2% |
| | | Missed Approach-IFR | 51 | 1.6% |
| | Near Airport Subtotal | | 3,241 | 100.0% |
| | Other | | 497 | |
| | Landing - Total | | 10,983 | |

Note: Major accidents are accidents in which the aircraft was destroyed or substantially damaged.

Source: National Transportation Safety Board, *Annual Review of Aircraft Accident Data - U.S. General Aviation,* annual reports from 1974 to 1979. Cited in CalTrans 1983, p. 74.

## Table C3

## TEN MOST PREVALENT TYPES OF GENERAL AVIATION ACCIDENTS (1974-1978) (percentage of total accidents)

| Type of Accident | All Accidents | Fatal Accidents |
|---|---|---|
| Engine Failure or Malfunction | 23.8% | 12.4% |
| Ground/Water Loop Swerve | 12.2 | -- |
| Hard Landing | 6.5 | -- |
| Stall Mush | 4.4 | -- |
| Stall | -- | 6.5 |
| Stall Spin | -- | 9.9 |
| Collision with Ground/ Water Controlled | 4.8 | 13.8 |
| Collision with Ground/ Water Uncontrolled | 3.9 | 16.9 |
| Collided with Trees | 4.1 | 8.5 |
| Overshoot | 4.4 | -- |
| Collided with Wires/Poles | 3.8 | 5.6 |
| Nose Over/Down | 3.3 | -- |
| Airframe Failure in Flight | -- | 6.3 |
| Midair Collisions | -- | 5.1 |
| Missing Aircraft, Not Recovered | -- | 1.8 |

Source: National Transportation Safety Board, *Annual Review of Aircraft Accident Data - U.S. General Aviation Calendar Year 1979*, NTSB-ARG-81-1, November 1981. Cited in CalTrans 1983, p. 75.

Table C4 shows data for all general aviation accidents involving collisions. During the period of observation (1974 through 1981), collisions accounted for 51 percent of all accidents. Collisions with the ground and water were the most common, accounting for nearly 21 percent of all accidents. The next most common were collisions with trees or crops (11.7 percent) followed by collisions with wires, poles, and fences (9.5 percent). The other categories of objects collided with were much less frequent in occurrence. It is interesting to note that collisions with houses and other buildings were quite rare, accounting for only 0.6 percent of the accidents, for an annual average of 26 accidents.

Table C5 presents additional detail on accidents involving collisions with buildings, presenting data for 1964 through 1982. Collisions with buildings are rare events. Even rarer are collisions resulting in harm to building occupants. During the 19-year period, 563 collisions occurred, including 240 with buildings off-airport. A total of 116 residences were involved. Thirty-five of the collisions resulted in injuries to persons in the buildings; 24 involved residences.

Weather has been cited as a contributing factor in as many as 22 percent of all general aviation accidents, and 40 percent of fatal accidents. Poor visibility caused by fog and cloud cover reduce safety margins. Frequently, dense cloud cover is also accompanied by stormy conditions.

Table C6 shows general aviation accidents for the 1974-1979 period classified by type of weather conditions. VFR conditions generally apply when visibility is at least three miles and the ceiling is at least 1,000 feet AGL. IFR conditions apply when visibility is reduced below these levels. "Below minimums" applies to conditions where visibility is so poor that IFR landings cannot be made. By far most accidents occur during VFR conditions. Only 8 percent of accidents occurred during IFR or "below minimum" conditions. One reason clearly is because there is far less traffic during IFR weather. Many general aviation pilots are only rated for VFR flying. Accidents during IFR are much more likely to cause serious or fatal injuries, however. Two-thirds of all IFR accidents result in serious injuries or fatalities.

## LOCATION OF ACCIDENTS

For purposes of airport safety compatibility planning, the location of accidents is the most important consideration. Unfortunately, only limited information is available. Before reviewing the empirical data on accident location, a discussion of aircraft operating characteristics during emergencies is offered.

Table C4

GENERAL AVIATION ACCIDENTS INVOLVING COLLISIONS (1974-1981)

| Object Struck | Annual Average | Percentage of All Accidents |
|---|---|---|
| Ground (uncontrolled), Ground (controlled), Ditches, Dirt Banks, Water, Etc. | 861 | 20.9% |
| Trees, Crops | 483 | 11.7% |
| Wires, Poles, Fences | 389 | 9.5% |
| Houses, Other Buildings | 26 | 0.6% |
| Automobiles | 25 | 0.6% |
| Airport Hazards (e.g., runway approach lights) | 36 | 0.9% |
| Aircraft (one or both on ground) | 36 | 0.9% |
| Aircraft (both in air) | 66 | 1.6% |
| Other | 167 | 4.0% |
| **Total Collision Accidents** | **2,097** | **51.0%** |
| **Total General Aviation Accidents** | **4,114** | **100.0%** |

Notes: Data includes both primary accident types (i.e., accident began with the collision) and secondary accident types (i.e., something else happened which then resulted in a collision). A collision can be both a primary and a secondary accident type in the same accident – a few of these instances are included in the data, but others (especially ones in which a mid-air collision was the primary accident type) appear not to be.

Source: National Transportation Safety Board, *Annual Review of Aircraft Accident Data - U.S, General Aviation,* Calendar Years 1974 to 1981. (Cited in Hodges & Shutt 1991, p. 5-11). Data is not published in this format for later years.

## Table C5

## GENERAL AVIATION ACCIDENTS INVOLVING BUILDINGS

| | General Aviation Accidents Involving Buildings | | | Accidents Involving Injuries to People in Buildings | |
|---|---|---|---|---|---|
| | Total | Off Airport | Residences | Total | Residences |
| 1964 | 54 | 17 | 4 | 0 | 0 |
| 1965 | 37 | 16 | 3 | 2 | 1 |
| 1966 | 42 | 11 | 6 | 2 | 2 |
| 1967 | 37 | 12 | 5 | 0 | 0 |
| 1968 | 26 | 10 | 2 | 0 | 0 |
| 1969 | 25 | 9 | 4 | 0 | 0 |
| 1970 | 29 | 17 | 10 | 3 | 1 |
| 1971 | 21 | 8 | 6 | 1 | 1 |
| 1972 | 25 | 11 | 3 | 3 | 2 |
| 1973 | 32 | 16 | 3 | 3 | 0 |
| 1974 | 18 | 5 | 2 | 0 | 0 |
| 1975 | 30 | 10 | 6 | 1 | 1 |
| 1976 | 21 | 10 | 4 | 1 | 0 |
| 1977 | 34 | 18 | 12 | 4 | 4 |
| 1978 | 27 | 16 | 9 | 4 | 4 |
| 1979 | 27 | 15 | 8 | 3 | 3 |
| 1980 | 24 | 9 | 8 | 5 | 3 |
| 1981 | 23 | 10 | 4 | 1 | 0 |
| 1982 | 31 | 20 | 17 | 2 | 2 |
| Total | 563 | 240 | 116* | 35 | 24 |
| *Annual Average* | 29.6 | 12.6 | 6.1 | 1.8 | 1.3 |

* Includes 13 on-airport residences.

Note: Published data not available for more recent years.

Source: AOPA - 1985, **Airports Good Neighbors to Have.** Cited in Hodges & Shutt 1991, p. 5-13.

Table C6

## GENERAL AVIATION ACCIDENTS BY TYPE OF WEATHER CONDITIONS

| Type of Weather Conditions | Percent of Total Accidents | Proportion Involving Serious/Fatal Injury |
|---|---|---|
| Visual Flight Rules | 90.6% | 23% |
| Instrument Flight Rules | 7.4% | 67% |
| Below Minimums | 0.6% | 70% |
| Unknown | 1.4% | 52% |
| Total | 100.0%[1] | 27% |

[1]Total accidents - 25,963.

Source: National Transportation Safety Board, *Annual Review of Aircraft Accident Data - U.S. General Aviation,* Calendar Years 1974-1979. Cited in Hodges & Shutt 1990, p. 50.

## Aircraft Operating Characteristics in Emergencies

Perhaps the most catastrophic event for a pilot to experience is the loss of engine power. That does not necessarily lead to the immediate loss of control, however. With careful technique, the pilot can maintain control of the aircraft as it descends. It has been calculated that an aircraft can glide as far as 1,000 feet for every 100 feet of altitude (Hodges & Shutt 1991, p. 5-4.) The key, of course, is to maintain control. Without power, this is no easy task, especially if turns are necessary. In the turn, the rate of descent increases.

An extremely important factor which cannot be measured is the skill, experience, and personality of the pilot confronting such a life-threatening circumstance. Needless to say, panic or incorrect decisions at the controls may increase the rate of descent or cause a loss of control.

Particularly critical phases of a flight are takeoff and landing. As the next section shows, most accidents occur during the landing phase and several during the takeoff. As a guide to planning, Hodges & Shutt (1991, p. 5-10) have calculated the "maximum takeoff trajectories" of aircraft assuming loss of an engine. For single-engine aircraft, the engine failure was assumed to occur at 400 feet above ground level (AGL), the minimum altitude at which a turn should be initiated. For the aircraft analyzed, the distance from start of takeoff roll to the end of motion after landing was 6,500 to 9,000 feet. The mean for the aircraft analyzed was 7,450 feet.

For twin-engine aircraft, the analysis assumed the failure of one engine just before the aircraft reaches $V_{se}$, the minimum airspeed needed to maintain a climb with only a single engine. That was assumed to occur at about 50 feet AGL. The maximum takeoff trajectory ranged from 3,750 to 5,150 feet. The mean was 4,350 feet.

## Accidents Near Airports

The NTSB records general accident location information, including the distance from the airport. It does not, however, record accident coordinates, so it is not possible to plot the locations of accidents with respect to the runways.

Table C7 shows the percentage of general aviation accidents by distance from the airport. On-airport accidents were far more numerous but tended to be less serious, accounting for almost 45 percent of all accidents, but only 17 percent of serious and fatal accidents. Accidents near the airport (within one mile) accounted for about 15 percent of all accidents, but 22 percent of fatal accidents. Accidents within one to two miles were less frequent, accounting for just under 3 percent of all accidents and almost 5 percent of fatal accidents.

## Table C7

# LOCATION OF GENERAL AVIATION ACCIDENTS (1974-1979)
(percentage of accidents)

| Location | Accidents: All Accidents | Accidents: Near Airport Accidents | Serious & Fatal Accidents: All Accidents | Serious & Fatal Accidents: Near Airport Accidents | Collisions Between Aircraft: All Accidents | Collisions Between Aircraft: Near Airport Accidents |
|---|---|---|---|---|---|---|
| On Airport | 44.8% | – | 16.6% | – | 54.5% | – |
| Near Airport | | | | | | |
| In Traffic Pattern | 4.2% | 28.6% | 5.8% | 26.4% | 7.8% | 56.9% |
| Within 1/4 mile | 4.9% | 33.8% | 7.2% | 32.7% | 1.9% | 13.6% |
| Within 1/2 mile | 2.7% | 18.3% | 4.4% | 19.9% | 2.2% | 15.9% |
| Within 3/4 mile | .7% | 4.5% | 1.3% | 6.1% | .9% | 6.8% |
| Within 1 mile | 2.1% | 14.8% | 3.3% | 14.9% | .9% | 6.8% |
| Subtotal | 14.6% | 100.0% | 22.0% | 100.0% | 13.7% | 100.0% |
| Within 2 miles | 2.8% | – | 4.9% | – | 3.1% | – |
| Over 2 miles | 32.2% | – | 50.4% | – | 26.2% | – |
| Unknown | 5.6% | – | 6.1% | – | 2.5% | – |
| Total | 100.0% | – | 100.0% | – | 100.0% | |

Note: The NSTB defines an accident as occurrences incident to flight in which "as a result of the operation of an aircraft, any person (occupant or nonoccupant) receives fatal or serious injury or any aircraft receives substantial damage." Substantial damage means damage or structural failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component. Accident reports are filed for all accidents, both on and off airports. "On-airport" means on airport property. Distance from the airport is measured from airport boundary. Table excludes helicopter accidents and accidents due to sabotage.

Source: National Transportation Safety Board, *Annual Review of Aircraft Accident Data - U.S. General Aviation*, annual reports from 1974 to 1979. Cited in CalTrans 1983, p. 74.

The locations of near-airport accidents are broken down in the table. Accidents in the traffic pattern are noted, as are accidents for each quarter mile increment. Accidents are most common in the traffic pattern or within one-quarter mile of the airport. The most striking thing about this information relates to the location of collisions between aircraft. Nearly 57 percent of all near-airport aircraft collisions occur in the traffic pattern.

A study conducted for the California State Assembly Committee on Natural Resources and Conservation, prepared in 1973, reviewed the NTSB accident location data for 1970, noting the same general relationships discussed above (Hodges & Shutt 1990, p. 36). The report concluded:

> [The one-mile distance]... is a reasonable measure of the region of influence between an airport and its surrounding community. It encloses the entire traffic pattern and most departing aircraft have made their initial power reduction and assumed normal climb attitude within that distance. On instrument approaches, the minimum descent altitude is usually reached within that area. In this region, the aircraft is at a critical transition between ground and flight with both the aircraft and pilot under significant stress. On takeoff, the aircraft is at maximum gross weight and fuel load with the engine(s) producing maximum power. This increases the likelihood of power failure while at the same time decreasing the chances of a successful emergency landing. On the landing approach, the pilot is under great stress, particularly under instrument conditions, thus increasing the probability of pilot error.

### Accident Location Survey

Hodges & Shutt (1990, p. 40) present the results of an interesting study of aircraft accident locations based on data provided by fourteen airports. Although the sample is limited and care should be taken in the interpretation of the data, it is one relatively recent source of accident location data in a field of study which is sorely lacking for detailed and current information. Airports providing data are listed in Table C8. Exhibit C2 shows the location of these accidents with respect to the runway. Accidents are categorized by departure versus approach.

Departure accidents tend to fan out fairly evenly as distance from the runway increases. Approach accidents tend to be clustered along the extended runway centerline, although there is considerable scatter. Some of the accidents off the centerline and off the sides of the runway may be accounted for by failed attempts at making short approaches or by accidents on missed approaches or go-arounds.

Exhibit C3 plots the location of accidents with respect to distance from the runway centerline and distance from the landing threshold. It shows that accidents tend to be clustered along the centerline and tend to be spread out some distance from the threshold. Approximately

## Table C8

## AIRPORTS SURVEYED FOR ACCIDENT LOCATION DATA

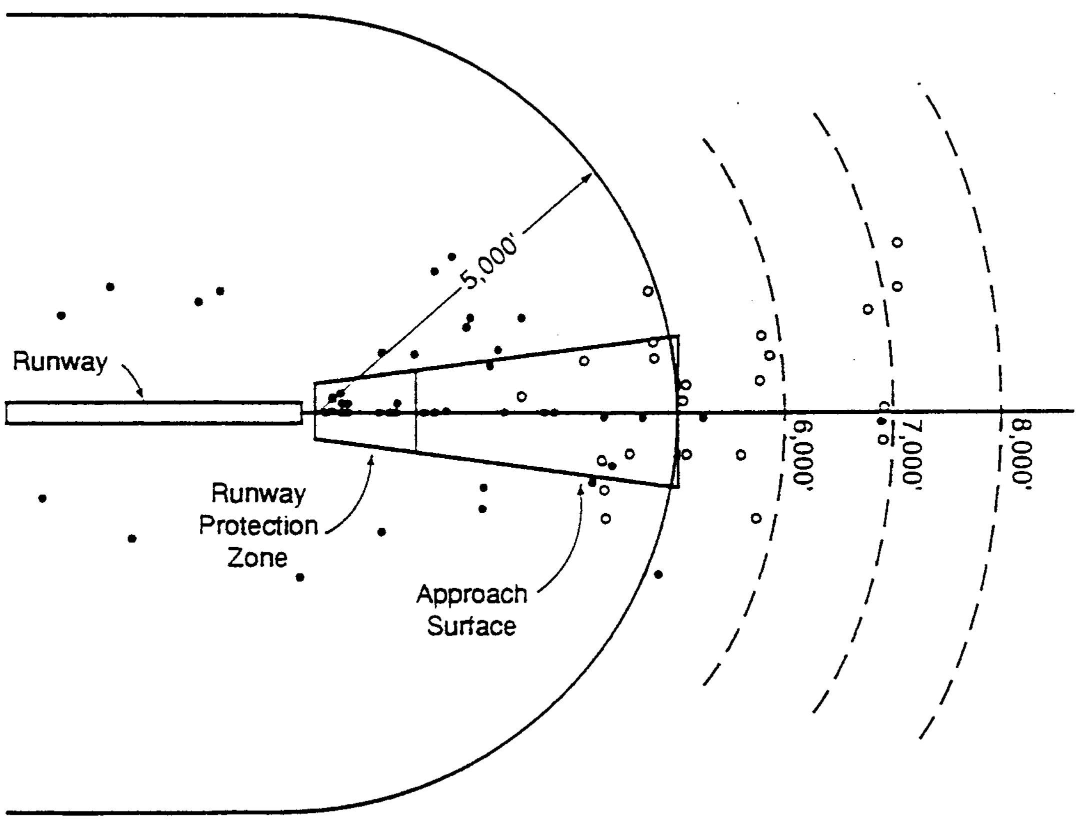
| | *Airport* | *Associated City* |
|---|---|---|
| California | John Wayne Airport | Santa Ana |
| | Torrance Municipal Airport | Torrance |
| | Buchanan Field | Concord |
| | Fullerton Municipal Airport | Fullerton |
| | Reid Hillview Airport | San Jose |
| | Palo Alto Airport | Palo Alto |
| | South County Airport | Martinez |
| | Chino Airport | Chino |
| | Hayward Air Terminal | Hayward |
| Florida | Opa Locka Airport | Opa Locka |
| | North Perry Airport | Ft. Lauderdale |
| Kentucky | Bowman Field | Louisville |
| Louisiana | Lakefront | New Orleans |
| Missouri | Spirit of St. Louis Airport | St. Louis |

Source: Hodges & Shutt 1990, p. 37.

91SP04-C2-3/11/92

# Exhibit C2

## AIRCRAFT ACCIDENT SITES AT GENERAL AVIATION AIRPORTS




○ Accident Site - Departure
• Accident Site - Approach

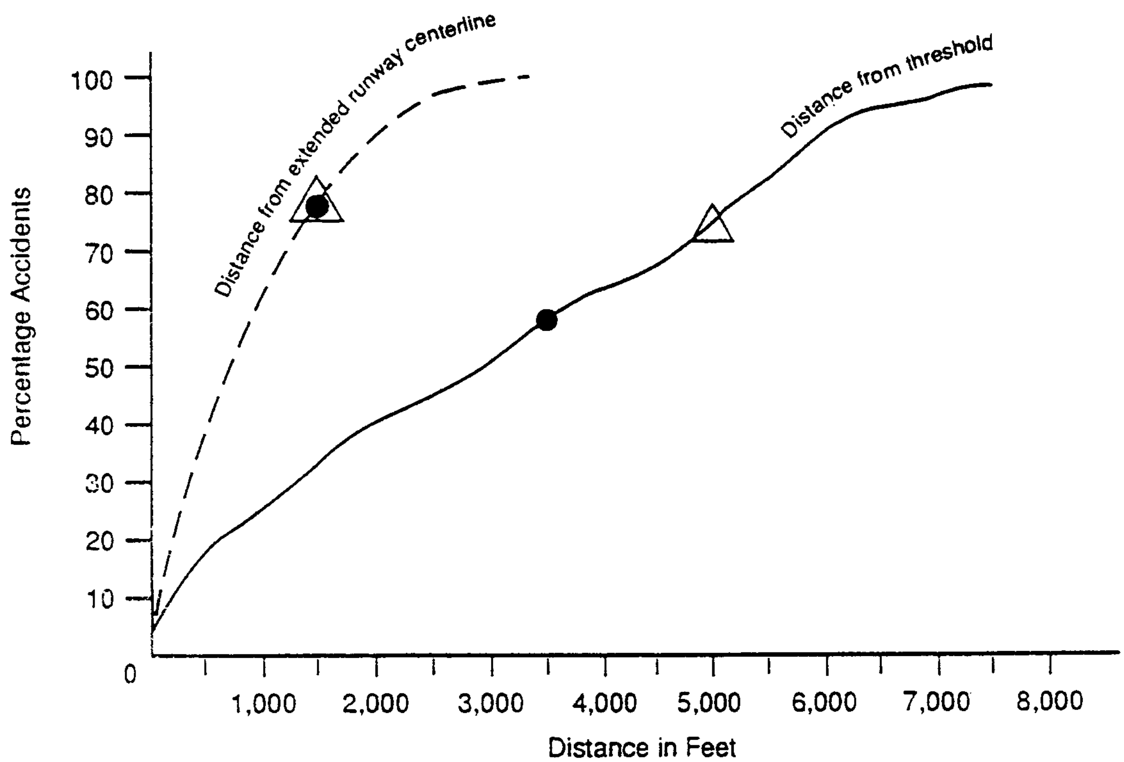
NOTE: Data compiled from 14 general aviation airports.
Runway protection zone and approach surface assumes a nonprecision approach to a utility runway.

SOURCE: Airport Land Use Compatibility Handbook, Version 1.1, Hodges & Shutt, August 1990, p. 40.

Exhibit C3

# DISTANCE OF ACCIDENTS FROM RUNWAY THRESHOLD AND CENTERLINE

91SP04-C3-3/11/92




● State's suggested safety zone boundaries for twin-engine propeller aircraft.

△ State's suggested safety zone boundaries for jet aircraft and precision instrument approach runways.

NOTE: Data compiled for 14 general aviation airports with annual operations ranging from 150,000 to 300,000.
All airports had air traffic control towers.

SOURCE: Airport Land Use Compatibility Handbook, Version 1.1, Hodges & Shutt, August 1990, p.42.

60 percent of the accidents occurred within 1,000 feet of the extended centerline, 75 percent within 1,500 feet, and 90 percent within 2,000 feet. With respect to the threshold, just under 60 percent occurred within 3,500 feet, 75 percent within 5,000 feet, and 90 percent within 6,000 feet.

## SAFETY GUIDELINES AND STANDARDS - EXAMPLES

This section presents selected examples of safety compatibility guidelines and regulations from around the country. This is based on a spot check by the consultant rather than a comprehensive survey.

### Federal Government

The Federal Aviation Administration has defined areas in the immediate runway environment which must be kept free of obstructions. The largest is the Runway Protection Zone (RPZ), a trapezoidal area off the runway end. The size of the RPZ varies depending on the type of approach to the runway. It is smallest for visual approaches and largest for precision instrument approaches. Exhibit C4 shows the basic configuration of the RPZ. FAA recommends that the area within the RPZ be kept free of structures and people and advises airport proprietors to secure title to the area.

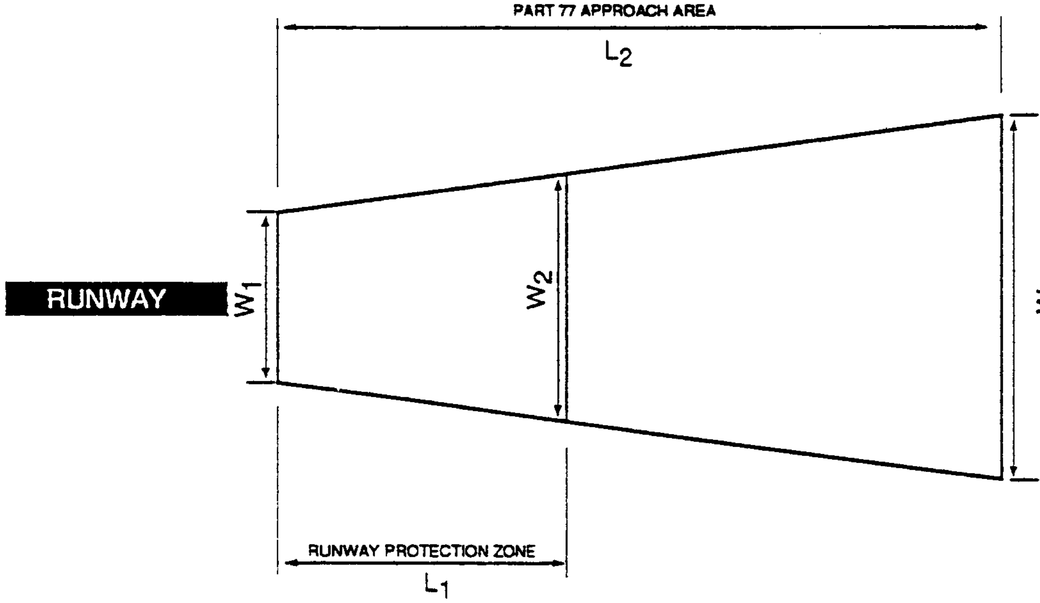
Exhibit C4 also shows the runway approach area. Within this area, FAA is concerned only that objects not be allowed to penetrate an imaginary surface sloping upward from the runway end. FAA has no official policies regarding the use of the land beneath the approaches, although its policies permit the use of Airport Improvement Program funds for property acquisition up to 5,000 feet off the end of the runway (FAA 1989, Par. 602.b(2), p.70). This is a clear, although implicit, acknowledgement of the need for compatible use of this property to protect the interests of the airport and the general public. An old edition of the Airport Improvement Program Handbook went so far as to define property acquisition eligibility boundaries by type of runway approach and use (FAA 1979, Par. 602.c, p. 108). It established the following criteria:

> At airports serving ... turbojet aircraft, such areas of land may extend up to 1,250 feet laterally from the runway centerline, extending 5,000 feet beyond the end of the primary surface.
>
> On existing or planned nonprecision instrument runways, such areas of land may extend up to 750 feet laterally from the runway centerline, extending 3,400 feet beyond each end of the primary surface.

## Exhibit C4

## RUNWAY PROTECTION ZONES AND APPROACH AREAS

91SP04-C4-3/11/92




| CATEGORY | $W_1$ | $W_2$ | $W_3$ | $L_1$ | $L_2$ |
|---|---|---|---|---|---|
| 1. Precision instrument | 1,000 | 1,750 | 16,000 | 2,500 | 50,000 |
| 2. Nonprecision instrument for larger than utility with visibility minimums as low as 3/4 mi. | 1,000 | 1,510 | 4,000 | 1,700 | 10,000 |
| 3. Nonprecision instrument for larger than utility with visibility minimums greater than 3/4 mi. | 1,000 | 1,425 | 3,500 | 1,700 | 10,000 |
| 4. Visual approach for larger than utility | 1,000 | 1,100 | 1,500 | 1,000 | 5,000 |
| 5. Nonprecision approach for utility | 500 | 800 | 2,000 | 1,000 | 5,000 |
| 6. Visual approach utility | 250 | 450 | 1,250 | 1,000 | 5,000 |

SOURCE: Federal Aviation Administration

For an existing or planned visual runway, such areas of land may extend up to 500 feet laterally from the runway centerline, extending 2,000 feet beyond each end of the primary surface.

While this is no longer official FAA policy, it serves as a guideline in determining how to apply the more general policy which is now in force.

**Arizona - Pima County**

Pima County, Arizona, has adopted airport environs zoning establishing compatible use zones around each airport within its jurisdiction. (See Pima County Code, Chapter 18.57.) The ordinance establishes three zones based on safety concerns: the RSZ runway safety zone, the CUZ-1 compatible use zone, and the CUZ-2 compatible use zone.

The RSZ zone is immediately off the runway ends. Development is strictly limited in this zone as the land must remain in open space. At general aviation airports, this area is typically 1,500 feet long and 1,500 feet wide.

The CUZ-1 zone is applied off the end of the RSZ zone at air carrier and military airports. Dimensions of the CUZ-1 zone at air carrier airports are 1,500 feet wide by 2,000 to 3,500 feet long, depending on the runway approach. At military airports, the zone is 3,000 feet wide by 5,000 feet long. Potentially hazardous land uses are prohibited as are uses attracting large numbers of people. Structures are not permitted to occupy over 35 percent of the lot area.

The CUZ-2 zone is applied off the end of the RSZ zone at smaller general aviation airports. It has similar use restrictions as the CUZ-1 zone, but permits structures to occupy up to 45 percent of the lot area. Off non-precision runways, it is 2,000 feet long and 1,500 feet wide. Off precision runways, it is 3,500 feet long and 1,500 feet wide.

**Louisiana**

The State of Louisiana has prepared a model airport hazard zoning ordinance for use at larger than utility airports in the state. the ordinance proposes height control standards generally based on FAR Part 77. It also proposes standards for three land use safety zones.

Safety Zone A is defined as the area within the approach zone which extends outward from the primary surface a distance equal to two-thirds of the planned length of the runway. In this area only open space uses are permitted. Structures and above-ground obstructions are not permitted, nor are uses which would attract a group of persons.

Safety Zone B extends outward from the end of Zone A a distance equal to one-third of the planned length of the runway. Certain uses are specifically prohibited, including churches, hospitals, schools, theaters, stadiums, hotels and other places of public assembly. The building and population densities of other uses are restricted.

Safety Zone C is subject only to height limitations. It includes all that area within the horizontal zone. This corresponds to the FAR Part 77 horizontal surface.

### Oregon

The State of Oregon has suggested that local communities use the inner part of the approach area, extending from 2,500 to 5,000 feet off the end of the primary surface, as an area within which land use controls should be considered. The State adds that "local conditions may require additional areas of land use controls...", although it does not provide specific guidance (OrDOT 1981, p. 67).

### Wisconsin - Brown County

Brown County has established airport protection zoning in the vicinity of Austin Straubel Airport near Green Bay (Coons 1989, p. 30). The ordinance establishes three overlay zones. Zone A is referred to as the "noise cone/crash hazard zone". It extends off the end of each runway and includes the 65 Ldn contour area. Residential development is not permitted in the area. Neither are hospitals, churches, schools, theaters and other places of public assembly or uses attracting large populations of birds. Zone B is the overflight noise zone. Residential density limits are established and sound insulation is required. Zone C establishes only height limits.

### California Safety Guidelines

The California Airport Land Use Planning Handbook (CalTrans 1983) reviews the airport land use plans which were then in force in the State. The State developed guidelines for use in safety compatibility planning.

In its discussion of the need for appropriate land use restrictions in safety zones, it notes (CalTrans 1983, p. 93):

> The purpose for establishing land use restrictions in safety zones is to minimize the number of people exposed to aircraft crash hazards. The two principal methods for reducing the risk of injury and property damage on the ground are: 1) limit the number of persons in an areas and 2) limit the area covered by structures occupied by people so that there is a higher chance of aircraft landing (in a controlled situation) or crashing (in an uncontrolled situation) on vacant land... While the chance of an

aircraft injuring someone on the ground is historically quite low, planners must remember that an aircraft crash is a high consequence event.

## SAFETY AREA BOUNDARIES

The State has proposed the establishment of up to five safety zones around airports: inner safety zone/runway protection zone; outer safety zone; emergency touchdown area; traffic pattern/overflight zone; and extended runway centerline zone (CalTrans 1983, p. 96).

The boundaries of these areas, except for the traffic pattern/overflight zone, are shown in Exhibit C5. Two different sizes of zones are proposed, depending on the type of approach and aircraft using the runway. For visual runways and those serving only single and twin-engine aircraft, smaller areas are proposed. Larger areas are suggested for precision instrument runways or those serving jet aircraft.

### Inner Safety Zone/Runway Protection Zone

This area either corresponds to the actual runway protection zone or to a rectangular area roughly the same size as the runway protection zone. The rectangular area is 1,500 feet wide, and 1,320 long for visual runways and 2,500 feet long for instrument runways. While the nominal alignment of this area is along the extended runway centerline, it is suggested that if early turns are prescribed for noise abatement or air traffic control purposes, the safety area should be aligned with the commonly used departure path.

Within the inner safety zone, structures should be discouraged, especially within the runway protection zone. No activities involving assemblies of people should be permitted.

### Outer Safety Zone

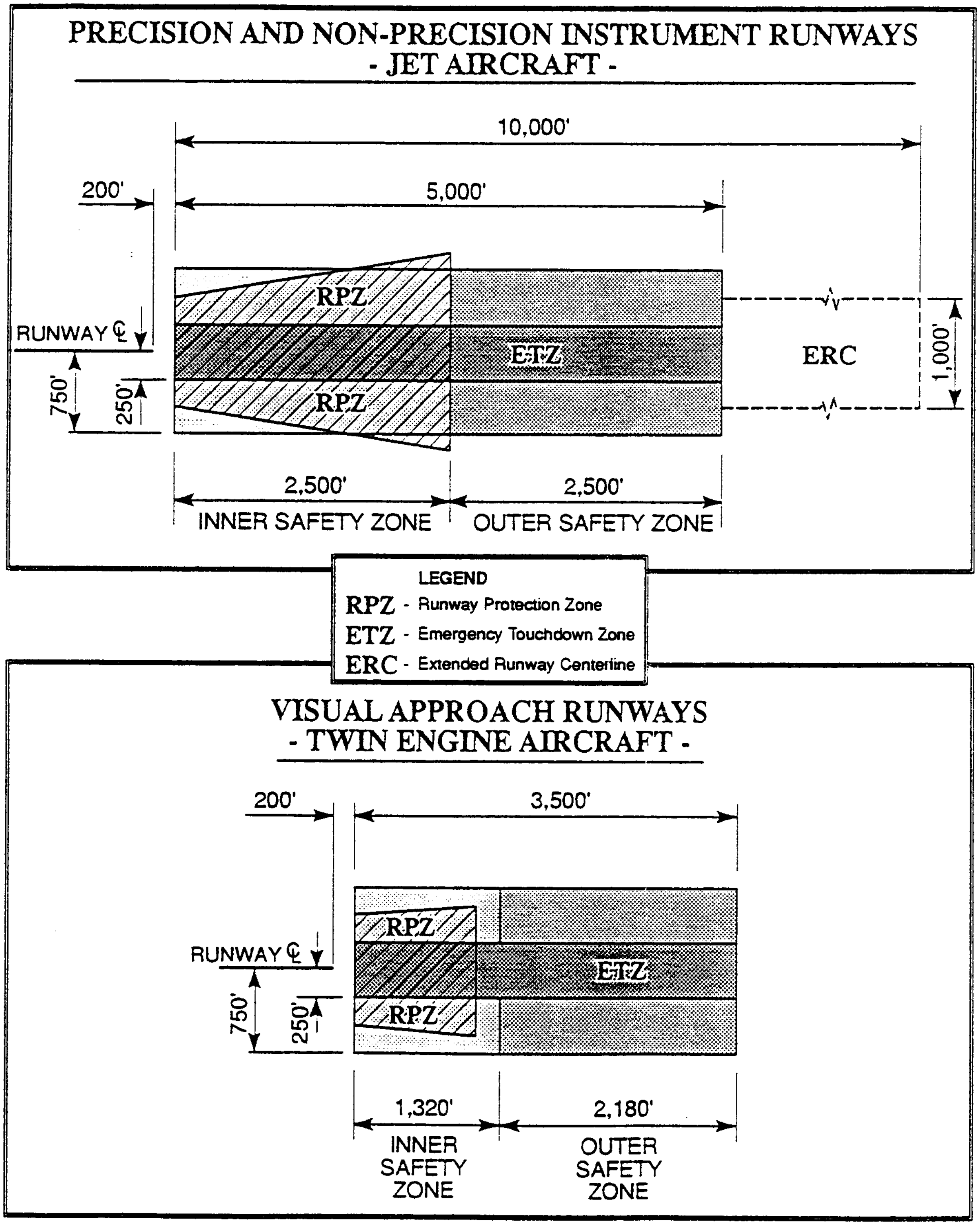
The outer safety zone extends another 2,180 to 2,500 feet beyond the inner safety zone. The State also suggests that these zones should be shifted to conform with the primary flight tracks used for departures from the primary runway. If desired, the outer safety zone can be defined based on the FAR Part 77 approach surface. (See Exhibit C4.)

The guidelines recommend that residential development should be strongly discouraged in this area. They also discourage other land uses including industries handling flammable materials, hotels and motels, and other commercial and institutional uses involving large concentrations of people. (One class of land use which should probably be added to this list is public utilities and facilities of vital interest. These include uses which would cause significant public inconvenience or harm if damaged or destroyed in an aircraft accident. Examples include power substations, water and sewage treatment plants, and power generating stations.)

91SP04-C5-6/18/92

# Exhibit C5

## SUGGESTED AIRPORT SAFETY ZONES OFF RUNWAY ENDS




SOURCE: Airport Land Use Planning Handbook: A Reference and Guide for Local Agencies, prepared for California Department of Transportation, Division of Aeronautics by Metropolitan Transportation Commission and Association of Bay Area Governments, 1983, p. 97.

The guidelines suggest density limits for uses in structures involving not more than 25 persons per acre at any one time or 150 people in any one building. For uses not in structures, density limits of 50 persons per acre are suggested.

Lot coverage requirements are also suggested to ensure that a disabled aircraft has sufficient opportunity to miss inhabited areas and structures. It is suggested that the density limits could be based on an assessment of the current densities within the area. It is suggested that it would not be unreasonable to require that 50 percent to 75 percent of the safety area be kept as open space, including streets and parking areas.

### Emergency Touchdown Areas

The emergency touchdown zone is 500 feet wide, extending the length of the combined inner and outer safety zones. This is suggested as a emergency landing area for aircraft on takeoff or for aircraft on approach that fail to reach the runway. The accident location data discussed above and shown in Exhibit C2 lend support to the advisability of such a zone.

In order to be effective, this area would have to be kept free of structures and significant obstructions.

### Traffic Pattern Zone

This zone is intended to apply to the area beneath the traffic pattern and commonly used flight tracks in the airport vicinity. It is noted that the FAR Part 77 horizontal surface is a reasonable approximation of the boundaries of this area.

The guidelines note that strict land use control in this area may be difficult or impractical given the large size of the area. The guidelines imply the need for careful evaluation of the existing land use situation in the area and the prospects for future development in order to set reasonable standards. It is suggested that large assemblages of people should be excluded from this area if it is possible to locate these uses elsewhere. Limits on the density of people in the area are discussed. Residential density limits of 3 units per acre are discussed as an example. Limits on lot coverage ranging from 20 percent to 50 percent are discussed.

### Extended Runway Centerline

This is proposed only for precision and non-precision instrument runways, or runways serving jet aircraft. It is 1,000 feet wide, extending 10,000 feet off the end of the runway. The guidelines suggest that land uses involving large concentrations of people in this area be carefully reviewed. On page 99, the guidelines state, "Large concentrations of people directly on the runway centerline should be strongly discouraged."

## LAND USE GUIDELINES WITHIN ALL SAFETY AREAS

Uses which would cause smoke, water vapor, or light interference should be prohibited from all safety areas. These could impair the pilot's ability to see the airfield. Visual hazards include lights that can be confused with airfield and runway lights. Particular confusion can be caused by steady or flashing lights of red, white, green or amber directed at aircraft making a final approach to a runway or making a straight climb after takeoff. Similarly, uses causing the reflection of sunlight onto aircraft engaged in the same maneuvers should be prohibited.

Other important safety hazards are those which attract large numbers of birds. Examples include landfills and perhaps some types of food processing plants involving outdoor storage of grain and other raw materials or food by-products.

Uses which cause electrical interference with aircraft navigational and communications equipment also should be prohibited in the airport vicinity.

## SHIELDING OF POPULATION IN SAFETY AREAS

The State provides guidelines for shielding people on the ground to minimize the crash hazard. These actions are not encouraged. Rather they are characterized as last resort options which should be considered only if incompatible projects must be permitted in a safety area. Unfortunately, actions taken to shield people on the ground result in structures which greatly increase the risk of fatality to occupants of aircraft making emergency landings.

The State suggests general performance standards and design criteria to assist in the design of structures and barriers strong enough to withstand the impact of an aircraft crash. As it is apparently considered infeasible cost-effectively to shield structures from the largest aircraft, the guidelines offer guidance only for protection from relatively light aircraft under 12,500 pounds (CalTrans 1983, p. 101).

## APPENDIX C REFERENCES


CalTrans, 1983, *Airport Land Use Planning Handbook: A Reference and Guide of Local Agencies*, prepared for the California Department of Transportation, Division of Aeronautics by the Metropolitan Transportation Commission and the Association of Bay Area Governments, July 1983.

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NOAA 1992, *Airport/Facility Directory, Southwest US*, Washington, DC: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Ocean Service. (Published every eight weeks. Edition cited effective January 9, 1992 through March 5, 1992.)

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OrDOT 1981, *Oregon Aviation System Plan, Volume VI, Airport Compatibility Guidelines*, Salem: Oregon Department of Transportation, Aeronautics Division.