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Introduction

The Centennial Airport Federal Aviation Regulation (FAR) Part 150 Study is a five-year program. The baseline year for this Study is 1999 with the future baseline being 2005. The purposes of an FAR Part 150 Program are: to assess the noise environment, to prepare forecasts of aviation operations, to identify land uses within the airport environs, and to explore ways to mitigate land use compatibility conflicts.

FAR Part 150 requires the development of Noise Exposure Maps that depict the existing aircraft noise levels, expressed in terms of the Day-Night Noise Level (DNL) metric, and the five year future noise levels in terms of DNL. Thus the Study has a five-year planning horizon. The threshold DNL used for compatibility purposes is the 65 DNL noise contour. In addition to the Noise Exposure Maps, a Noise Compatibility Program (NCP) can also be prepared. The NCP contains the recommendations for noise mitigation and abatement that the sponsoring agency, the Arapaho County Public Airport Authority in this case, is recommending for implementation. A generalized schedule for implementation, along with the parties responsible for that implementation, is also presented.

Summary

This document contains a review of the existing land use controls available for implementation, future land uses, and existing zoning in the airport environs. A review of historical aviation activity is also presented and a forecast of activity for the study period. The Forecasts are consistent with the Terminal Area Forecasts prepared by the Federal Aviation Administration. The existing and future noise contours associated with the aviation activity is presented along with the noise measurement program and analysis used to develop these contours. Using these contours as a base, the noise compatibility process discusses the development of

realistic and effective operational alternatives to mitigate the noise exposure. In addition to operational alternatives, a wide range of feasible land use alternatives, noise control actions, and noise impact patterns are evaluated and potential solutions which accommodate both airport users and inhabitants of the airport's environs within acceptable safety, economic and environmental parameters are discussed.

The various measures are listed and described, and each is evaluated in terms of its appropriateness with, and relationship to, Centennial Airport. In addition, recommendations are made as to which alternatives should be implemented at the Airport. The document then presents a schedule for review and updating of the elements contained in this FAR Part 150 Plan and Program to ensure success of the program.

This document, in terms of content and recommendations, has culminated from many meetings, with the Citizens Advisory Committee, the Technical Advisory Committee, Airport Staff and Management, the Authority, the Federal Aviation Administration and other interested parties.

All proposals contained in this document are consistent with the Approved Airport Layout Plan and the Airport Master Plan and the State System Plan.

FAR Part 150 Noise Exposure Map Checklist

I. **IDENTIFICATION AND SUBMISSION OF MAP DOCUMENT:**	**Page Number**
A. Is this submittal appropriately identified as one of the following, submitted under FAR Part 150:	Cover, Cover Letter
1. A NEM only	N/A
2. A NEM and NCP	Yes
3. A revision to NEMs which have previously been determined by FAA to be in compliance with Part 150?	N/A
B. Is the airport name and the qualified airport operator identified?	Cover
C. Is there a dated cover letter from the airport operator which indicates the documents are submitted under Part 150 for appropriate FAA determination?	Yes
II. **CONSULTATION:** [150.21 (b), A150.(a)]	
A. Is there a narrative description of the consultation accomplished, including opportunities for public review and comment during map development?	H.1-H.4, Appendix
B. Identification:	
1. Are the consulted parties identified?	H.1-H.4, Appendix
2. Do they include all those required by 150.21 (b) and A150.105 (a)?	Yes, H.1-H.4, Appendix
C. Does the documentation include the airport operator's certification, and evidence to support it, that interested persons have been afforded adequate opportunity to submit their view, data, and comments during map development and in accordance with 150.21 (b)?	Cover Letter, H.1-H.4, Appendix
D. Does the document indicate whether written comments	

were received during consultation and, if there were comments, that they are on file with the FAA region? H.1-H.4, Appendix

III. **GENERAL REQUIREMENTS:** [150.21]

A. Are there two maps, each clearly labeled on the face with year (existing condition year and 5-year)? C.57, G.4

B. Map currency:
1. Does the existing condition map year match the year on the airport operator's submittal letter? No, C.57
2. Is the 5-year map based on reasonable forecasts and other planning assumptions and is it for the fifth calendar year after the year of submission? No, G.4
3. If the answer to 1 and 2 above is no, has the airport operator verified in writing that data in the documentation are representative of existing condition and 5-year forecast conditions as of the date of submission? Cover Letter, Yes

C. If the NEM and NCP are submitted together:
1. Has the airport operator indicated whether the 5-year map is based on 5-year contours without the program vs. contours if the program is implemented? Cover Letter
2. If the 5-year map is based on program implementation:
   a. are the specific program measures which are reflected on the map identified? Yes, G.1-G.28
   b. does the documentation specifically describe how these measures affect land use compatibilities depicted on the map? Yes, G.1-G.28
3. If the 5-year NEM does not incorporate program implementation, has the airport operator included an additional NEM for FAA determination after the program is approved which show program implementation conditions and which is intended to replace the 5-year NEM as the new official 5-year map? N/A

IV. **MAP SCALE, GRAPHICS, AND DATA REQUIREMENTS:** [A150.101, A150.105, 150.21 (a)]

A. Are the maps of sufficient scale to be clear and readable (they must not be less than 1" to 8,000') and is the scale indicated on the maps? Yes, C.57, G.4

B. Is the quality of the graphics such that required information is clear and readable?	Yes, C.57, G.4
C. Depiction of the airport and its environs.	
1. Is the following graphically depicted to scale on both the existing condition and 5-year maps:	
a. Airport boundaries	Yes, C.57, G.4
b. Runway configurations with runway end numbers	Yes, C.57, G.4
2. Does the depiction of the off-airport data include:	
a. A land use base map depicting streets and other identifiable geographic features	Yes
b. The area within the 65 Ldn (or beyond, at local discretion)	Yes
c. Clear delineation of geographic boundaries and the names of all jurisdictions with the 65 Ldn (or beyond, at local discretion)	Yes
D. 1. Continuous contours for at least the Ldn 65, 70, and 75?	Yes, C.57, G.4
2. Based on current airport and operational data for the existing condition year NEM, and forecast data for the 5-year NEM?	C.57, G.4
E. Flight tracks for the existing condition and 5-year forecast time frames (these may be on supplemental graphics which must use the same land use base map as the existing conditioned and 5-year NEM), which are numbered to correspond to accompanying narrative?	C.37-C.40
F. Locations of any noise monitoring sites (these may be on supplemental graphics which must use the same land use base map as the official NEMs)	C.25-C.27
G. Noncompatible land use identification:	
1. Are noncompatible land uses within at least the 65 Ldn depicted on the maps?	Yes, C.57, G.4
2. Are noise sensitive public buildings identified?	Yes
3. Are the noncompatible uses and noise sensitive public buildings readily identifiable and explained on the map legend?	Yes
4. Are compatible land uses, which would normally be considered noncompatible, explained in the accompanying narrative?	N/A

V. **NARRATIVE SUPPORT OF MAP DATA:**
[150.21 (a), A150.1, A150.103]

A. 1. Are the technical data, including data sources, on which the NEMs are based adequately described in the narrative? Yes, A.6-A.35

2. Are the underlying technical data and planning assumptions reasonable? Yes, A.6-A.35, G.1-G.3

B. Calculation of Noise Contours:

1. Is the methodology indicated? Cover Letter, C.23-C.74
   a. Is it FAA approved? Yes, C.29
   b. Was the same model used for both maps? Yes
   c. Has AEE approval been obtained for use of a model other than those which have previous blanket FAA approval? N/A
2. Correct use of noise models:
   a. Does the documentation indicate the airport operator has adjusted or calibrated FAA-approved noise models or substituted one aircraft type for another? No
   b. If so, does this have written approval from AEE? N/A
3. If noise monitoring was used, does the narrative indicate that Part 150 guidelines were followed? C.24
4. For noise contours below 65 Ldn, does the supporting documentation include explanation of local reasons? (Narrative explanation is highly desirable but not required by the Rule.) N/A

C. Noncompatible Land Use Information:

1. Does the narrative give estimates of the number of people residing in each of the contours (Ldn 65, 70 and 75, at a minimum) for both the existing condition and 5-year maps? D.1-D.5, G.2
2. Does the documentation indicate whether Table 1 of Part 150 was used by the airport operator? Cover Letter, C.20, D.3
   a. If a local variation to Table 1 was used:
      (1) does the narrative clearly indicate which adjustments were made and the local reasons for doing so? N/A
      (2) does the narrative include the airport operator's complete substitution for Table 1? N/A

3. Does the narrative include information of self-generated or ambient noise where compatible/ noncompatible land use identifications consider non-airport/aircraft sources? N/A
4. Where normally noncompatible land uses are not depicted as such on the NEMs, does the narrative satisfactorily explain why, with reference to the specific geographic areas? N/A
5. Does the narrative describe how forecasts will affect land use compatibility? D.4, G.2

VI. **MAP CERTIFICATIONS:** [150.21 (b), 150.21 (e)]

A. Has the operator certified in writing that interested persons have been afforded adequate opportunity to submit views, data, and comments concerning the correctness and adequacy of the draft maps and forecasts? Cover Letter

B. Has the operator certified in writing that each map and description of consultation and opportunity for public comment are true and complete? Cover Letter, C.57, G.4

FAR Part 150 Noise Compatibility Program Checklist

I. **IDENTIFICATION AND SUBMISSION OF PROGRAM:**	**Page Number**
A. Submission is properly identified:	
1. FAR 150 NCP? Cover, Cover Letter	
2. NEM and NCP together?	Yes
3. Program revision?	N/A
B. Airport and Airport Operator's name identified?	Cover, Flysheet
C. NCP transmitted by airport operator cover letter?	Yes
II. **CONSULTATION:**	
A. Documentation includes narrative of public participation and consultation process?	H.1-H.4, Appendix
B. Identification of consulted parties:	
1. All parties in 150.23(c) consulted?	H.1-H.4, Appendix
2. Public and planning agencies identified?	H.1-H.4, Appendix
3. Agencies in 2., above, correspond to those indicated on the NEM?	H.1-H.4, Appendix
C. Satisfies 150.23(d) requirements:	
1. Documentation shows active and direct participation of parties in B, above?	H.1-H.4, Appendix
2. Active and direct participation of general public?	H.1-H.4, Appendix
3. Participation was prior to and during development of NCP and prior to submittal to FAA?	H.1-H.4, Appendix
4. Indicates adequate opportunity afforded to submit views, data, etc.?	H.1-H.4, Appendix
D. Evidence included of notice and opportunity for	

a public hearing on NCP? Appendix

E. Documentation of comments:
1. Includes summary of public hearing comments, if hearing was held? H.1-H.4, Appendix
2. Includes copy of all written material submitted to operator? Appendix
3. Includes operator's responses/disposition of written and verbal comments? Appendix

F. Informal agreement received from FAA on flight procedures? Yes, Appendix

III. **NOISE EXPOSURE MAPS:** [150.23, B150.35 (f)]
(This section of the checklist is not a substitute for the Noise Exposure Map checklist. It deals with maps in the context of the Noise Compatibility Program submission.)

A. Inclusion of NEMs and supporting documentation:
1. Map documentation either included or incorporated by reference? C.57, G.4
2. Maps previously found in compliance by FAA? N/A
3. Compliance determination still valid? N/A
4. Does 180-day period have to wait for map compliance finding? N/A

B. Revised NEMs submitted with program: N/A
(Review using NEM checklist if map revisions included in NCP submittal)
1. Revised NEMs included with program?
2. Has airport operator requested FAA to make a determination on the NEM(s) when NCP approval is made?

C. If program analysis used noise modeling:
1. INM or HNM, or FAA-approved equivalent? C.29
2. Monitoring in accordance with A150.5? C.24

D. Existing condition and 5-year maps clearly identified as the official NEMs? C.57, G.4

IV. **CONSIDERATION OF ALTERNATIVES:**

[B150.7, 150.23 (e)]

A. At a minimum, are the alternatives below considered?
   1. Land acquisition and interest therein, including air rights, easements, and development rights? E.8-E.9

   2. Barriers, acoustical shielding, public building soundproofing E.8, E.12
   3. Preferential runway system E.14, F.9, G.16
   4. Flight procedures E.14, F.8-F.9, G.9-G.15
   5. Restrictions on type/class of aircraft (as least one restriction below must be checked)
      a. deny use based on Federal standards E.4, F.2, G.5-G.8
      b. capacity limits based on noisiness E.5
      c. noise abatement takeoff/approach procedures E.14
      d. landing fees based on noise or time of day E.6
      e. nighttime restrictions E.6, F.4
   6. Other actions with beneficial impact E.1-E.15
   7. Other FAA recommendations F.13

B. Responsible implementing authority identified for each recommendation? G.5-G.28

C. Analysis of measures:
   1. Measure clearly described? E.1-E.15, G.5-G.28
   2. Measures adequately analyzed? E.1-E.15, G.5-G.28
   3. Adequate reasoning for rejecting alternatives? E.1-E.15, F.1-F.20

D. Other actions recommended by the FAA:
   Should other actions be added? N/A

V. **ALTERNATIVES RECOMMENDED FOR IMPLEMENTATION:**
[150.23 (e), B150.35 (b), B150.5]

A. Document clearly indicates:
   1. Alternatives recommended for implementation? G.5-G.28
   2. Final recommendations are airport operator's, not those of consultant or third party? Cover Letter

B. Do all program recommendations:
   1. Relate directly or indirectly to reduction of noise and noncompatible land uses? G.5-G.28

2. Contain description of contribution to overall effectiveness of program?	G.5-G.28
3. Noise/land use benefits quantified to extent possible?	G.2
4. Include actual/anticipated effect on reducing noise exposure within noncompatible area shown on NEM?	G.5-G.28
5. Effects based on relevant and reasonable expressed assumptions?	G.5-G.28
6. Have adequate supporting data to support its contribution to noise/land use compatibility?	G.2
C. Analysis appears to support program standards set forth in 150.35 (b) and B150.5?	G.2, G.4
D. When use restrictions are recommended:	N/A
1. Are alternatives with potentially significant noise/ compatible land use benefits thoroughly analyze so that appropriate comparisons and conclusions can be made?	
2. Use restriction coordinated with APP-600 prior to making determination on start of 180-days?	N/A
E. Do the following also meet Part 150 analytical standards:	
1. Formal recommendations which continue existing practices?	G.5-G.28
2. New recommendations or changes proposed at end of Part 150 process?	G.5-G.28
F. Documentation indicates how recommendations may change previously adopted plans?	G.18
G. Documentation also:	
1. Identifies agencies which are responsible for implementing each recommendation	G.5-G.28
2. Indicates whether those agencies have agreed to implement?	N/A
3. Indicates essential government actions necessary to implement recommendations?	G.5-G.28
H. Timeframe:	
1. Includes agreed-upon schedule to implement alternatives?	G.5-G.28
2. Indicates period covered by the program?	Cover Letter, G.5-G.28
I. Funding/Costs:	

1.	Includes costs to implement alternatives?	G.5-G.28
2.	Includes anticipated funding source?	G.5-G.28

VI. **PROGRAM REVISION:** [150.23 (e) (g)]

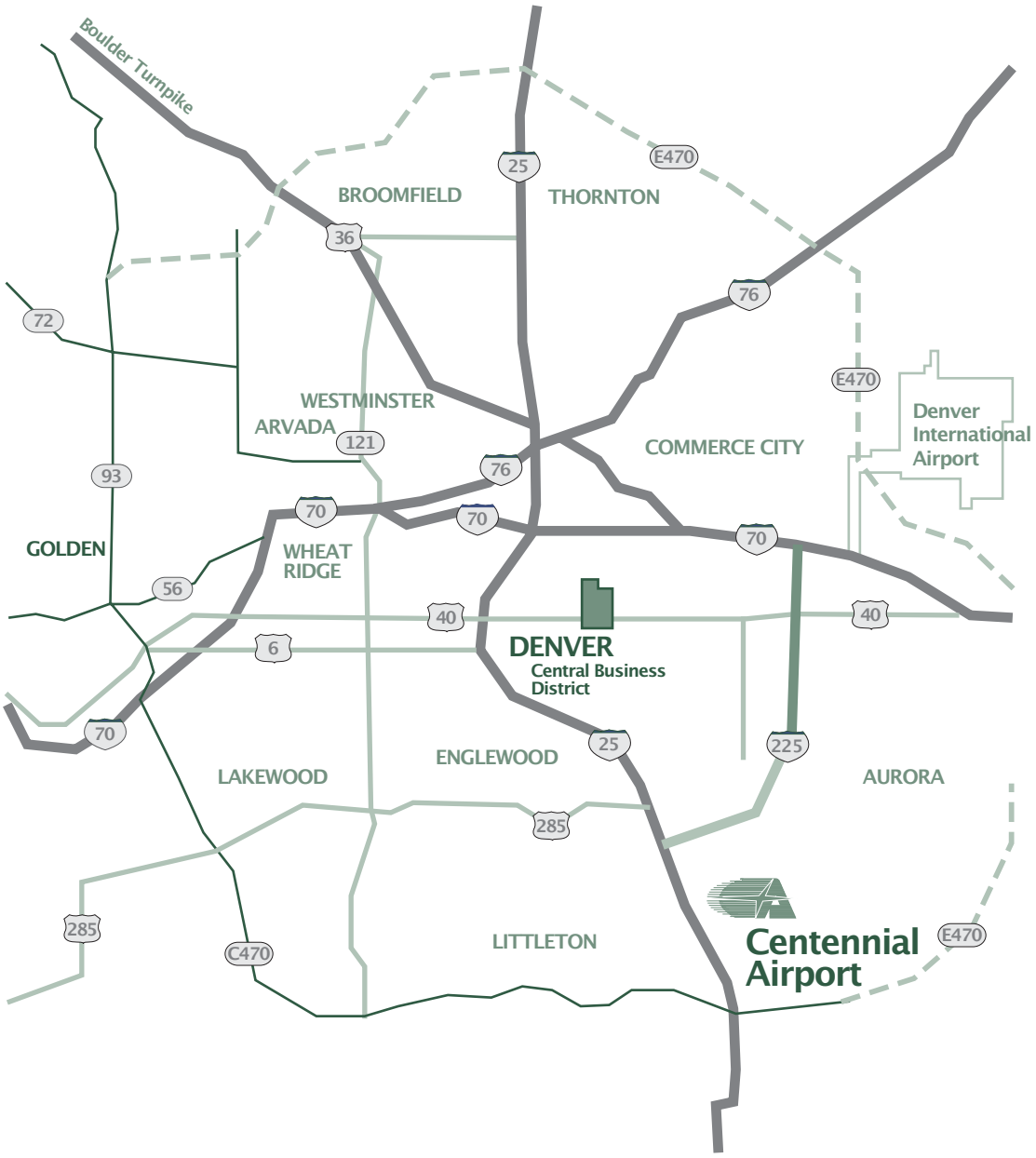
	Supporting documentation includes provision for revision?	N/A

Inventory

Introduction

Centennial Airport (APA) is a reliever airport to Denver International Airport and is located in the southern portion of the Denver Metropolitan Area, approximately thirteen miles south of Downtown Denver, in the southern portion of Arapahoe County and the northern portion of Douglas County. The airport accommodated approximately 466,000 operations in 1998, making it the second busiest general aviation airport in the United States. The Airport has no scheduled commercial service operations, although there are charter service operators based on the airport. There are two full service Fixed Base Operators on the airport; Denver jetCenter and Signature. The generalized airport location is illustrated on Figure A1, *AIRPORT LOCATION MAP.*

Centennial Airport is a public airport, owned and operated by the Arapahoe County Public Airport Authority. There is a full time airport manager and staff that run the airport on a day-to-day basis. The airport consists of three runways; Runway 17L/35R which is 10,001 feet in length, Runway 17R/35L which is 7,003 in length and Runway 10/28 which is 4,903 feet in length. There are associated taxiways, lighting and navigational aids associated with the runways. Runway 10 is equipped with medium intensity runway lights (MIRLs) and visual approach slope indicators (VASI). Runway 28 is equipped with MIRLs, VASIs and Runway End Identifier Lights (REILs) and VOR/DME RNAV. Runway 17R is equipped with MIRLs and Runway End Identifier Lights (REILs), and Runway 35L is equipped with MIRLs, Precision Approach Path Indicators (PAPIs) and REILs. Runway 17L is equipped with MIRLs and VASIs, and Runway 35R is equipped with MIRLs, VASIs, a Non Directional Beacon (NDB), a Medium Intensity Approach Lighting System with RAILs [Runway Alignment Indicator Lights] (MALSR) and an Instrument Landing System (ILS).



Approximate Scale 1"=6 Miles

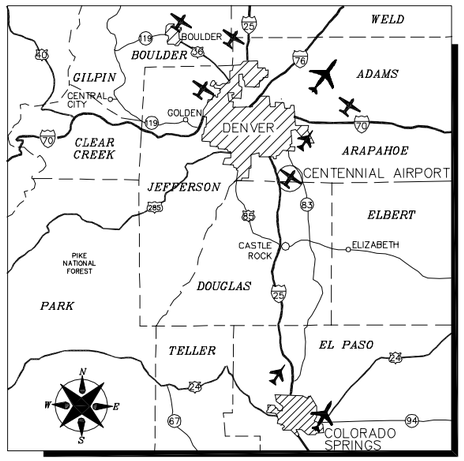
Figure A1 ***Airport Location Map***

Evaluation of Existing Documents

In 1996 the Airport completed and adopted an Airport Master Plan for Centennial Airport. That Master Plan contained many recommendations over a twenty-year planning period. However, there are no recommendations contained in the first phase, the first five years, that would effect this Study. In fact, there are no runway extensions, new runways or other airside facility improvements that would effect aircraft noise. There Airport Layout Plan does show the relocation of the west threshold of Runway 10/28 approximately one hundred feet to the east, resulting in a runway length of 4,800 feet. The Airport Layout Plan is presented in Figure A2.

Also in 1996, the airport prepared the Centennial Airport Noise and Land Use Study. The Study was conducted subsequent to opening of Denver International Airport and was intended to present accurate flight track data, noise contours for an existing (1995) and future (2000) condition. The Study was also intended to update the Land Use Guidelines based on actual aircraft flight tracks from the radar data. That Study utilized the Integrated Noise Model (INM) Version 4.11 to prepare the noise modeling. Using radar data, aircraft fleet mix data and operations numbers, the two contours were generated. The existing (1995) 65 DNL contour contained approximately 222 dwellings and 670 people. The future (2000) 65 DNL noise contour contained approximately 1,010 dwellings and 3,046 people. For both contours, there were no dwellings within the 70 or greater DNL contours.

The Study evaluated several alternatives, most of which would require an FAR Part 161 Study. There were procedure recommendations as well as land use recommendations. The airport currently has Land Use Guidelines which defines and identifies an Airport Influence Area (AIA), FAR Part 77 surfaces and a Traffic Pattern Area. The Land Use Guideline is depicted on Figure A3, *LAND USE PLAN*. The AIA is defined as an area that is subject to frequent overflight by low flying aircraft. The boundaries of the AIA generally correspond to several of the major roads near the airport and is an area where all projects are recommended to be reviewed for land use compatibility and compliance with FAR Part 77 criteria. Residential and other noise sensitive development should be limited. Permitted development requires public disclosure to prospective buyers, residential noise test evaluation, plat notes regarding airport activity and an avigation easement. The Study recommended no changes to the AIA as defined.



LOCATION MAP

NO SCALE

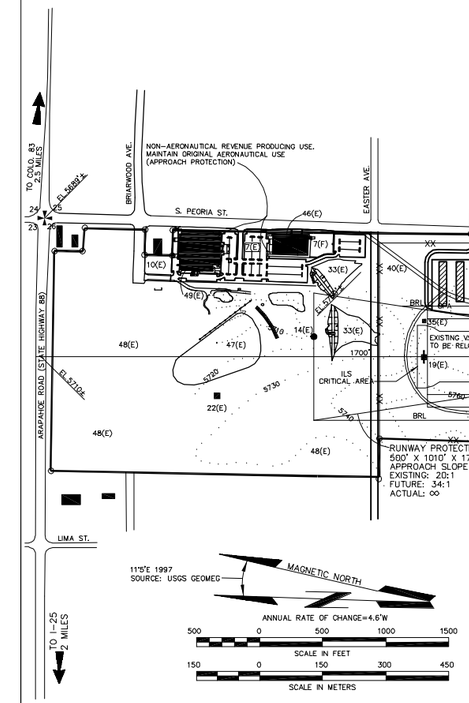
AIRPORT FACILITIES LIST

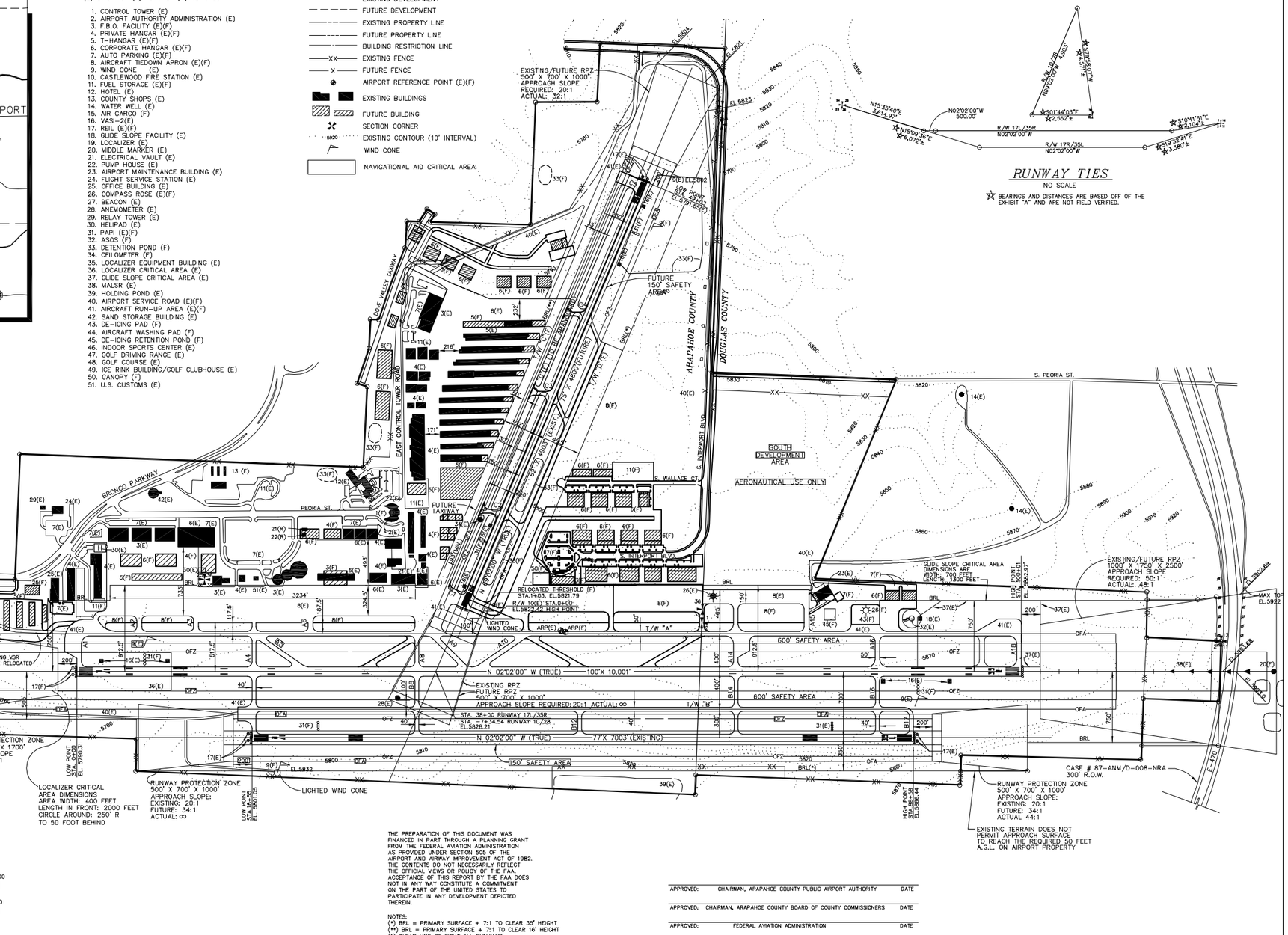
(E) EXISTING (F) FUTURE (R) REMOVED

1. CONTROL TOWER (E)
2. AIRPORT AUTHORITY ADMINISTRATION (E)
3. F.B.O. FACILITY (E)(F)
4. PRIVATE HANGAR (E)(F)
5. T-HANGAR (E)(F)
6. CORPORATE HANGAR (E)(F)
7. AUTO PARKING (E)(F)
8. AIRCRAFT TIEDOWN APRON (E)(F)
9. WIND CONE (E)
10. CASTLEWOOD FIRE STATION (E)
11. FUEL STORAGE (E)(F)
12. HOTEL (E)
13. COUNTY SHOPS (E)
14. WATER WELL (E)
15. AIR CARGO (F)
16. VASI-2(E)
17. REIL (E)(F)
18. GLIDE SLOPE FACILITY (E)
19. LOCALIZER (E)
20. MIDDLE MARKER (E)
21. ELECTRICAL VAULT (E)
22. PUMP HOUSE (E)
23. AIRPORT MAINTENANCE BUILDING (E)
24. FLIGHT SERVICE STATION (E)
25. OFFICE BUILDING (E)
26. COMPASS ROSE (E)(F)
27. BEACON (E)
28. ANEMOMETER (E)
29. RELAY TOWER (E)
30. HELIPAD (E)
31. PAPI (E)(F)
32. ASOS (F)
33. DETENTION POND (F)
34. CEILOMETER (E)
35. LOCALIZER EQUIPMENT BUILDING (E)
36. LOCALIZER CRITICAL AREA (E)
37. GLIDE SLOPE CRITICAL AREA (E)
38. MALSR (E)
39. HOLDING POND (E)
40. AIRPORT SERVICE ROAD (E)(F)
41. AIRCRAFT RUN-UP AREA (E)(F)
42. SAND STORAGE BUILDING (E)
43. DE-ICING PAD (F)
44. AIRCRAFT WASHING PAD (F)
45. DE-ICING RETENTION POND (F)
46. INDOOR SPORTS CENTER (E)
47. GOLF DRIVING RANGE (E)
48. GOLF COURSE (E)
49. ICE RINK BUILDING/GOLF CLUBHOUSE (E)
50. CANOPY (F)
51. U.S. CUSTOMS (E)

LEGEND

- EXISTING DEVELOPMENT
- FUTURE DEVELOPMENT
- EXISTING PROPERTY LINE
- FUTURE PROPERTY LINE
- BUILDING RESTRICTION LINE
- XX EXISTING FENCE
- X FUTURE FENCE
- AIRPORT REFERENCE POINT (E)(F)
- EXISTING BUILDINGS
- FUTURE BUILDING
- SECTION CORNER
- 5820 EXISTING CONTOUR (10' INTERVAL)
- WIND CONE
- NAVIGATIONAL AID CRITICAL AREA:





RUNWAY TIES

NO SCALE

☆ BEARINGS AND DISTANCES ARE BASED OFF OF THE EXHIBIT "A" AND ARE NOT FIELD VERIFIED.

THE PREPARATION OF THIS DOCUMENT WAS FINANCED IN PART THROUGH A PLANNING GRANT FROM THE FEDERAL AVIATION ADMINISTRATION AS PROVIDED UNDER SECTION 505 OF THE AIRPORT AND AIRWAY IMPROVEMENT ACT OF 1982. THE CONTENTS DO NOT NECESSARILY REFLECT THE OFFICIAL VIEWS OR POLICY OF THE FAA. ACCEPTANCE OF THIS REPORT BY THE FAA DOES NOT IN ANY WAY CONSTITUTE A COMMITMENT ON THE PART OF THE UNITED STATES TO PARTICIPATE IN ANY DEVELOPMENT DEPICTED THEREIN.

NOTES:
(*) BRL = PRIMARY SURFACE + 7:1 TO CLEAR 35' HEIGHT
(**) BRL = PRIMARY SURFACE + 7:1 TO CLEAR 16' HEIGHT
(1) CLEAR LINE OF SIGHT ALL RUNWAYS

APPROVED:	CHAIRMAN, ARAPAHOE COUNTY PUBLIC AIRPORT AUTHORITY	DATE
APPROVED:	CHAIRMAN, ARAPAHOE COUNTY BOARD OF COUNTY COMMISSIONERS	DATE
APPROVED:	FEDERAL AVIATION ADMINISTRATION	DATE

ISBILL ASSOCIATES
Raytheon Infrastructure Inc.
AIRPORT CONSULTANTS · ENGLEWOOD COLORADO
PHONE (303) 843-2200 FAX (303) 843-2700

CENTENNIAL AIRPORT
ARAPAHOE COUNTY, COLORADO

REV. NO.	DATE	DESCRIPTION	APP.

APA-2045 | APA-ALP

DES. J.P.T.
DR. K.A.C.
CH. J.W.F.
APP. H.G.I.

AIRPORT LAYOUT PLAN

DATE DECEMBER 1998 | **EXHIBIT I**

11X17 SCALE 1" = 1200'

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Figure A.2 **Airport Layout Plan by Isbill Associates**

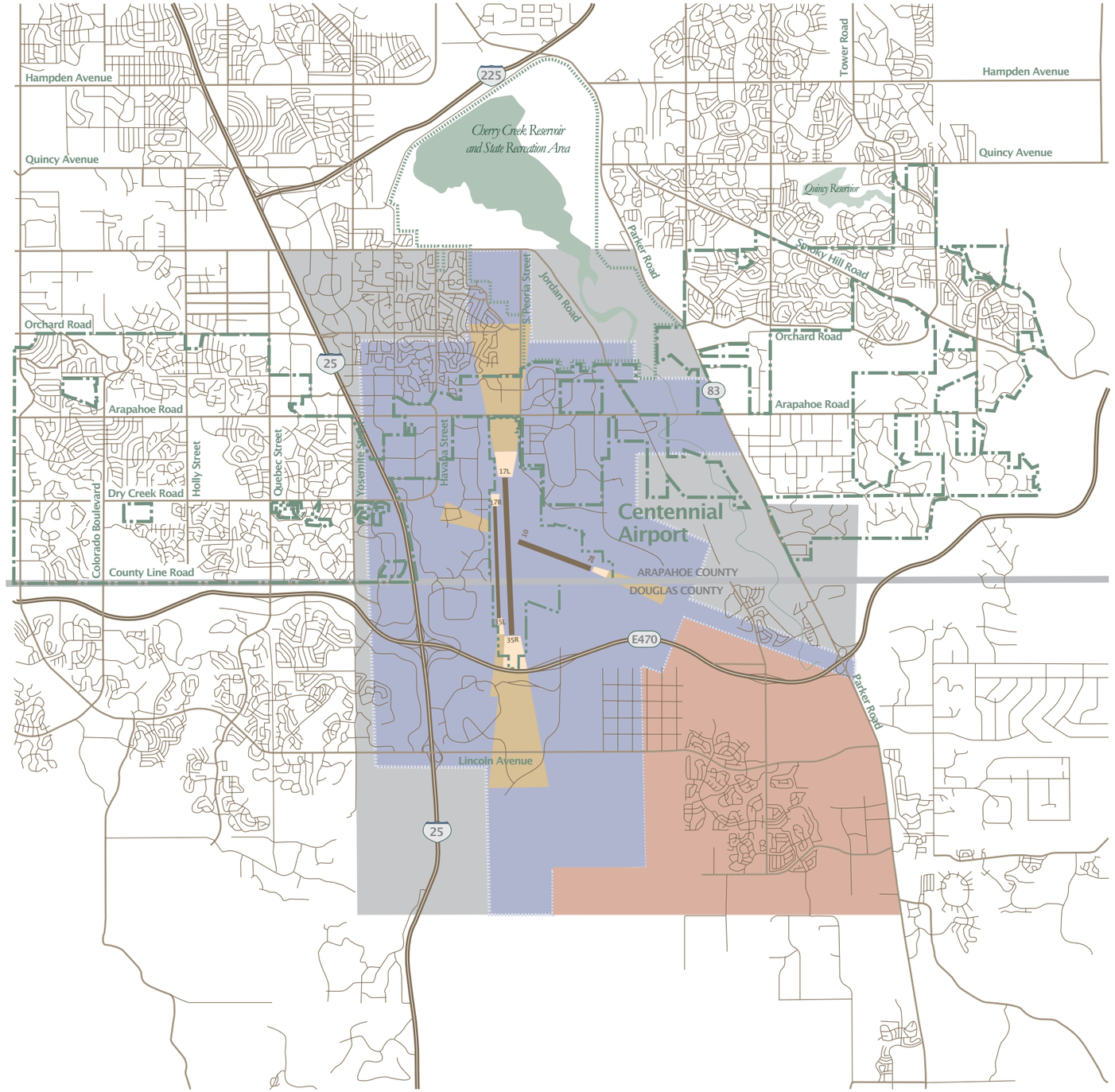


Figure A3 ***Recommended Land Use Plan***

- *Airport Boundary*
- *Approach Zones*
- *Traffic Pattern Area*
- *Clear Zones*
- *Airport Influence Area*
- *Southeast Egress/Ingress Zone*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Landiscor Aerial Information - 1998.*

The Airport has also established a Traffic Pattern Area which indicates areas that are subject to very frequent, low-flying aircraft. The recommendations of the Land Use Guideline prohibit new residential and other noise sensitive development within the traffic Pattern Area and restricts building height to comply with FAR Part 77. This area was recommended for expansion in the Study based on more definitive flight track information obtained from radar.

Airport Physical Facilities

As stated earlier, the Airport currently consists of two parallel runways, Runway 17L/35R and Runway 17R/35L and a crosswind runway, Runway 10/28. Runway 17L/35R is the longest runway, 10,001 feet in length and 100 feet in width. Runway 17R/35L is 700 feet to the west and is 7,003 feet in length and 75 feet in width. Runway 10/28 is 4,903 feet in length and 62 feet in width. The west threshold is approximately 750 feet east of Runway 17L/35R, at about the midpoint of that runway. All of the runways have a parallel taxiway associated with them, although aircraft using Runway 17R/35L must cross Runway 17L/35R on one of the connecting taxiways to get to or from the hangar area. The majority of the landside facilities are located in the northeast quadrant of the airport, north of Runway 10/28 and east of Runway 17L/35R. These consist of T-hangars, corporate hangars, FBO hangars and other aviation related structures. The airport has a twenty-four hour Air Traffic Control Tower, which is also located in the northeast quadrant of the airport. Major ground access is provided by South Peoria Street off of Arapahoe Road (State Highway 88), which is just to the north of the airport. Access from the south is provided by Peoria and E470.

Air Traffic Operations Activity

Centennial Airport has shown steady growth in operations, as a trend and considering normal fluctuations, over the past several years. As shown in the following table, overall operations (an operation is either a take-off or a landing) have increased from approximately 365,000 in 1990 to approximately 466,000 in 1998.

Table A1
SUMMARY OF HISTORICAL OPERATIONS, 1992-1998
Centennial Airport FAR Part 150 Study

Year	Operations
1987-91 Average	364,999
1992	376,417
1993	415,453
1994	422,463
1995	402,325
1996	359,704
1997	408,602
1998	466,267
1999	157,510*

***** Through May, 1999
Source: Airport Activity Reports

There are no historical records of aircraft operations by type of aircraft for the airport. However, the *Centennial Airport Noise and Land Use Study* discussed above presented a breakdown of aircraft operations by aircraft type for the period July 1, 1994 to June 30, 1995. Combining both itinerant and local aircraft operations, the report presented the following breakdown. Stage 3 business jets accounted for approximately four (4) percent of the total operations, Stage 2 business jets approximately two (2) percent, turboprop piston aircraft approximately five (5) percent, piston aircraft approximately eighty-eight (88) percent and helicopters approximately one (1) percent

Airspace/Air Traffic Control

The Federal Aviation Administration is responsible for the safe and efficient use of the national air space. This airspace is divided into three specific types; enroute, terminal and tower. When an aircraft departs an airport it is located in the airspace being handled by air traffic controllers working in an air traffic control tower. When the aircraft is approximately five miles away from the Airport, the aircraft is handed off to controllers working the Terminal Radar Approach Control Facility (TRACON). These controllers are responsible for the airspace extending out twenty-five to thirty miles from the Airport in all directions. The aircraft then enters the third type of airspace and becomes the responsibility of enroute controllers working in an Air Route Traffic Control Center (ARTCC). The enroute controllers retain control until the aircraft nears it intended destination. The process is then reversed for landings.

Airspace

Local airspace surrounding Centennial Airport is designated as Class D airspace. The configuration of each Class D airspace is tailored to the individual airport. Generally, Class D airspace consists of the immediate airspace within a horizontal radius of five statute miles from the geographic center of airports with control towers and extends from the surface up to an altitude of approximately 2,500 feet above ground level. The ceiling of the Class D airspace at Centennial Airport extends up to but not including 8,000 feet AMSL. Class D airspace is in effect whenever the ATCT at an airport is operational (24 hours a day at Centennial Airport). In order to operate on the airport or within Class D airspace, pilots must establish two-way radio communications with air traffic control personnel.

There is an area of Class E airspace defined as *that airspace extending upward from the surface within 2.5 miles each side of the 178 degree bearing from the Centennial Airport extending form the 4.4 mile radius to 14 miles south of the airport and within two miles each side of the 111 degree bearing from the Centennial Airport extending from the 4.4 mile radius to 4.8 miles southeast of the airport. This Class E airspace area is effective during the specific dates and time established in advance by a Notice to Airmen. The effective dates and times will thereafter be continuously published in the Airport/Facility Directory.* FAA Order 7400.9F

The primary airspace influence in the vicinity of Centennial Airport is the Denver Class B Airspace, which is irregularly shaped and extends in concentric circles around Denver International Airport. The Denver Class B Airspace consists of controlled airspace extending upward from various floor elevations to a ceiling of 12,000 feet AMSL, within which all aircraft are subject to specific operating rules (an ATC clearance must be obtained to enter the airspace) and specified requirements on pilot qualifications (a pilot must have a private pilot certificate or better) and aircraft equipment (a transponder with automatic altitude reporting and a two-way radio). Centennial Airport is beneath the Denver Class B Airspace in an area where the Class B Airspace has a floor of 8,000 feet.

Military airports, military operations areas, and restricted areas can also impact airspace use in the vicinity of a civil airport. There is only one military airport within a 30-nautical mile (NM) radius of Centennial Airport, Buckley Air National Guard Base (ANGB). Buckley ANGB is located approximately 9-NM northeast of Centennial Airport. There are no Military Operations Areas (MOAs) or Restricted Areas in the vicinity of Centennial Airport.

According to FAA personnel, there are no static routes used when routing aircraft into and out of Centennial Airport. Air traffic controllers use random vectors depending upon existing traffic, wind and weather conditions at the time, which is know as dynamic routing. When conditions permit, IFR aircraft are cleared direct to their approved flight plan as soon as possible. During periods of heavy traffic around Denver International, aircraft into and out of Centennial may be routed around Denver before being cleared to their final destination. Due to terrain constraints to the west and south of Centennial Airport, aircraft are not directly routed in these directions until they attain sufficient altitude to clear the mountains. IFR flights into and out of Centennial Airport are, by agreement, controlled by Denver TRACON for departure and arrival control from a distance of approximately four nautical miles (NM) from the end of the runways out to a distance of fifteen NM from the airport. Beyond the fifteen mile radius, IFR aircraft above 12,000 feet mean sea level (MSL) are controlled from Denver Center for routing to their final destination.

Navigational Aids

A variety of navigational facilities are currently available to pilots around Centennial Airport, whether located at the airport or at other locations in the region. Many of these navigational aids are available to enroute air traffic as well. In addition, there is a compliment of navigational aids (NAVAIDS) that allow a variety of instrument approaches to the airport.

Airport and regional navigational and landing aids available for Centennial Airport include an Instrument Landing System (ILS), a VHF Omnidirectional Range/with Distance Measuring Equipment (VOR/DME), and Area Navigation (RNAV).

Presently, there are three published instrument approach procedures at Centennial Airport. These are listed in the following table, Table A2, entitled *INSTRUMENT APPROACH PROCEDURES*.

Table A2
INSTRUMENT APPROACH PROCEDURES
Centennial Airport FAR Part 150 Study

Approach	Designated Runway(s)	**Ceiling** Minimum	**Visibility** Minimums[1]
ILS	Runway 35R	200 Feet (AGL)	½ Mile
VOR/DME	Runway 28	610 Feet (AGL)	1 - 2 Miles
RNAV or GPS			
NDB or GPS	Runway 35R	997 Feet (AGL)	¾ -2 ¾ Miles

Source: U.S. Terminal Procedures, Southwest (SW) Vol. 1 of 2.

1 Depending on category of aircraft.

As stated above, Centennial Airport has a twenty-four hour, continuously operating Air Traffic Control Tower (ATCT) that has a designated Airport Traffic Area (ATA). Aircraft which operate within an ATA must be in contact, at all times, with the tower controllers, especially to receive approval for take-offs and landings. Standard ATA's are designated to include all airspace within five miles of the Airport from the surface of the ground up to (but not including) 3,000 feet.

ANOMS© Radar Data

Denver International Airport has a flight track data collection and analysis program called ANOMS© (Airport Noise and Operational Monitoring System). This program collects and processes radar data from the FAA's ARTS (Aircraft Radar Tracking System). Once collected, the ANOMS© program performs a number of processes, including determining if the track is a departure or arrival and assigning a runway to the track. Operations from Centennial Airport are generally collected by this system. These are classified as overflights.

The ANOMS© program exports a file that consists of flight information about the aircraft that is operating on each track and position information as to the location of the flight. The flight information includes data such as the ARTS aircraft type, ARTS airline code, flight number, and type of operation and runway. The position information includes the X and Y position of each radar strike for the flight track for every four seconds of the flight as well as the altitude of the aircraft at each point and the time that the aircraft was at that point. The position information is given in distance relative to the ARTS radar antenna that is on the Airport property.

These files can be exported to the Consultants Bridge Reports programs for analysis on the Centennial Airport. The software will then reassign the operation as a departure or arrival as well as the runway. Note that the data used is based upon the information from ANOMS©, which is derived from the FAA's radar system. It does not get radar data for all aircraft. Generally this is for the larger aircraft that are flying in instrument flight rules. Aircraft in the local pattern are not available in this data. The Consultant will collect radar data for the period of time of the noise measurement survey, as well as other random periods throughout the year.

Current Noise Abatement Program

Centennial Airport has a long history of addressing noise abatement programs. These programs include voluntary IFR noise abatement procedures, voluntary VFR noise abatement procedures, helicopter noise abatement procedures, nighttime preferential runway use, land use development guidelines, and a pilot awareness program.

The voluntary IFR noise abatement procedures are as follows:

- For aircraft departing Runway 17L continue to fly 150 degrees, runway heading or 190 degrees for 4 DME, then turn on course. Due to antennae placement , 4 DME places the aircraft approximately two miles south of the airport.
- Aircraft arriving from the north are kept higher for longer periods of time. Aircraft are kept at or above 8,000 MSL as they turn to the airport. When aircraft turn to the airport, they are generally around the Cherry Creek Reservoir.

VFR pilots operating at Centennial Airport are asked to avoid the following long-standing residential areas: Cherry Creek Area, just north of the airport, Grandview Estates area to the southeast of the airport, and the Cottonwood area east of the airport.

There are four arrival and departure routes for helicopters. These routes are intended to separate rotor aircraft and fixed wing aircraft from flying the same routes and places helicopters away from residential areas. The four main routes are; the Reservoir Route, the Arapahoe Route, the Bronco Bubble Route and the Lincoln Route.

The nighttime preferential runway use program is designed to minimize overflights over the populated area just north of the airport. The procedure states: between 10:00 pm (2200L) and 6:00 am (0600L) aircraft are requested to use Runway 35 for arrivals and Runway 17 for departures, but only if there is a tailwind component less than 6 knots and a crosswind component less than 20 knots.

The airport has established a set of Land Use Guidelines that define the Airport Influence Area, Restricted Development Area, Buffer Aones, Approach Zones and Runway Protection Zones for each of the three runways. It must be remembered that these are just guidelines and the Airport Authority has no land use control authority. It is up to the local jurisdictions to adopt and implement the same or similar guidelines.

- Airport Influence Area: Refers all plats and development plans to the Airport Authority for review. Comply with FAR Part 77. Requires an Avigation Easement by landowner and Public Disclosure to prospective buyers and tenants. Residential and other noise sensitive development requires a 7-day noise test and development is prohibited/not recommended in areas at DNL 65 or above.

- Restricted Development Area: Prohibit new residential and other noise sensitive development. Building height must comply with FAR Part 77 surface criteria, existing or future, whichever is more restrictive.
- Buffer Zone: Recommend no new residential or other noise sensitive development. Governmental entity with zoning and building permit authority to develop specific restrictions.
- Approach Zone: Prohibit new residential and other noise sensitive development. Building height must comply with FAR Part 77 surface criteria, existing or future, which ever is more restrictive.
- Runway Protection Zone: No structures permitted.

Noise Complaint History

The Centennial Airport Operations Department operates a noise complaint hotline. The purpose of the complaint hotline is to provide the public with a means of contacting the airport concerning aircraft noise and giving airport staff insight into the issues that are important to the community. Citizens may call concerning particular incidents.

A recent sampling of the noise complaint data, which has been collected since 1995, has been reviewed in order to help identify current issues that are important to citizens that have contacted the hotline. The noise complaint calls received between January 2nd, 1998 and April 22nd, 1999 were obtained from the airport in electronic format. The complaint data were then processed in order to GEO code each complaint address for mapping purposes, to categorize the complaints and to correlate the complaint data with flight track data during the time period that flight track data is being analyzed.

The complaint data have been analyzed according to several variables: hour of the day, the day of week, daytime-nighttime split, and location for each call. The hotline calls received between January 2nd, 1998 and April 22nd, 1999 are summarized in the following tables and figure.

Table A3 presents the number of calls by hour of the day during this 16-month time frame. The hour with the highest number of calls is at 6 a.m. and the next highest hours are 7 a.m. and 4 p.m. These hours correspond to times that most people are at home.

For that same period, Figure A4 presents a plot of the location of the noise complaints. Please note that not all callers provide an address, or sufficient

information for which an exact position can be determined. This map displays only those calls for which the location can be determined.

Table A3
TOTAL HOTLINE CALLS, per hour of the day
Centennial Airport FAR Part 150 Study

Hour of Day	Total Calls	Percent of Total
12:00 AM	112	1.1%
1:00 AM	35	0.4%
2:00 AM	49	0.5%
3:00 AM	104	1.0%
4:00 AM	170	1.7%
5:00 AM	161	1.6%
6:00 AM	759	7.6%
7:00 AM	670	6.7%
8:00 AM	641	6.4%
9:00 AM	608	6.1%
10:00 AM	627	6.3%
11:00 AM	578	5.8%
12:00 PM	559	5.6%
1:00 PM	529	5.3%
2:00 PM	583	5.8%
3:00 PM	551	5.5%
4:00 PM	642	6.4%
5:00 PM	549	5.5%
6:00 PM	548	5.5%
7:00 PM	384	3.8%
8:00 PM	312	3.1%
9:00 PM	338	3.4%
10:00 PM	270	2.7%
11:00 PM	212	2.1%
Total	9,991	100.0%

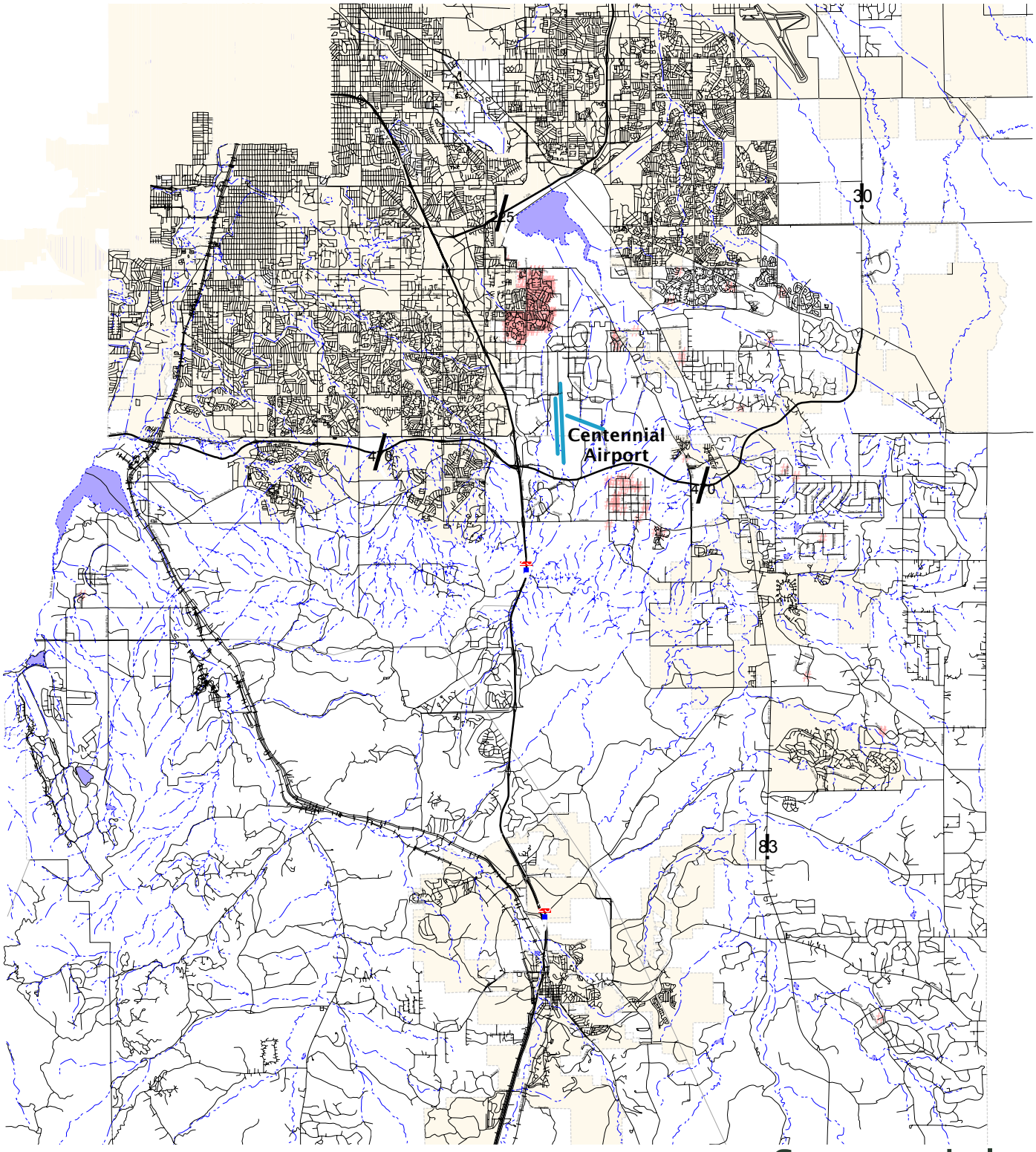


Figure A4 **Noise Complaint Map**

● Noise Complaint Locations

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Table A4 presents the number of calls per day of the week. Typically one expects more calls during weekends, but that is not the case for Centennial. All days are about equal, with Thursday having the highest number of calls and Saturday the lowest. This is most likely due to lower corporate jet operations on the weekends.

Table A4
TOTAL HOTLINE CALLS per day of the week
Centennial Airport FAR Part 150 Study

Day of Week	Total Calls	Percent of Total
Sunday	1,149	11.5%
Monday	1,390	13.9%
Tuesday	1,701	17.0%
Wednesday	1,765	17.7%
Thursday	1,956	19.6%
Friday	1,265	12.7%
Saturday	765	7.7%
Total	9,991	100.0%

Table A5 lists the number of noise complaints by the month received. The data is further broken down by the number of complaints that were received during the daytime hours (6:00 a.m. to 10:00 p.m.) and the number received during the nighttime hours (10:00 p.m. to 6:00 a.m.). The data shows that the number of complaints rise noticeably during the spring and summer months. This rise is normally due to fact that during warmer weather, windows are kept open more often and more time is spent outdoors. These factors cause people to notice more flight operations then when spending time inside the home with the windows closed.

Table A6 lists the total number of noise complaints received between January 1998 and April 1999 by the community from which they came. As would be expected, the greatest number of complaints originate from the communities located closest to the airport. The greatest number came from the neighborhoods located to the northwest of the airport (3,614), the second greatest number came from the neighborhoods directly to the north (2,837), while the third greatest number came from the neighborhoods to the southeast (1,037).

Table A5
NOISE COMPLAINTS BY MONTH (1998)
Centennial Airport FAR Part 150 Study

Month	Daytime Complaints	Nighttime Complaints	Total Complaints
January	130	13	143
February	303	30	333
March	660	53	713
April	1,090	93	1,183
May	797	152	949
June	503	72	575
July	1,285	125	1,410
August	1,085	114	1,199
September	613	124	737
October	326	48	374
November	302	53	355
December	300	8	308
Totals	**7,394**	**885**	**8,279**

Table A6
NOISE COMPLAINTS BY COMMUNITY (1998)
Centennial Airport FAR Part 150 Study

Zone	Subdivision	Complaints
East	Antelope	2
	Chapparal	1
	Chennango	1
	Cottonwood	3
North	Cherry Creek Hills	187
	Cherry Creek Village	194
	Cherry Creek Vista	1,881
	Greenwood Gardens	74
	Hills East	460
	Village on the Lake	1
	Vintage	40
Northeast	Algonquine Acres	4
	Piney Creek	26
	Smokey Hill	6
	Villas at Valley	52
Northwest	Arapahoe Lakes	200
	Cherry Creek Farms	43
	Orchard Gate	528
	Sundance Hills	2,843
Southeast	Grandview Estates	601
	Pinewood Knoll	280
	Stonegate	156
Southwest	Acres Green	43
	Lone Tree	7
West	Foxridge	9
	Hillcrest	1
	Hunters Hill	25
	Walnut Hills	157
	Willow Creek	152

Table A6 (cont.)
NOISE COMPLAINTS BY COMMUNITY
Centennial Airport FAR Part 150 Study

Zone	Subdivision	Complaints
Zone 2	Pinery	12
	Ponderosa Hills	20
	Unknown Aurora	26
	Unknown Castle Rock	2
	Unknown Denver	39
	Unknown Englewood	61
	Unknown Greenwood	13
	Unknown Littleton	83
	Unknown Parker	39
	Wild Cat Ridge	8
Total		8,280

Airport Environs

Centennial Airport is not within the city limits of any incorporated community. Several incorporated communities are, or could be, influenced by noise associated with aircraft operations at Centennial Airport. These include Greenwood Village, Aurora, Parker and Lone Tree, along with portions of unincorporated Arapahoe and Douglas Counties.

Existing Land Use. Centennial Airport is located in Arapahoe and Douglas Counties, in the southern portion of the Denver Metropolitan Area. The airport is surrounded by unincorporated and incorporated communities. Within the airport environs, there are several incorporated communities that are influenced by the airport and aircraft operations. These communities are indicated on Figure A5, *GENERALIZED EXISTING LAND USE,* along with generalized existing land use. A more detailed land use analysis will be presented for the area within each of the noise contours that will be generated in subsequent chapters.

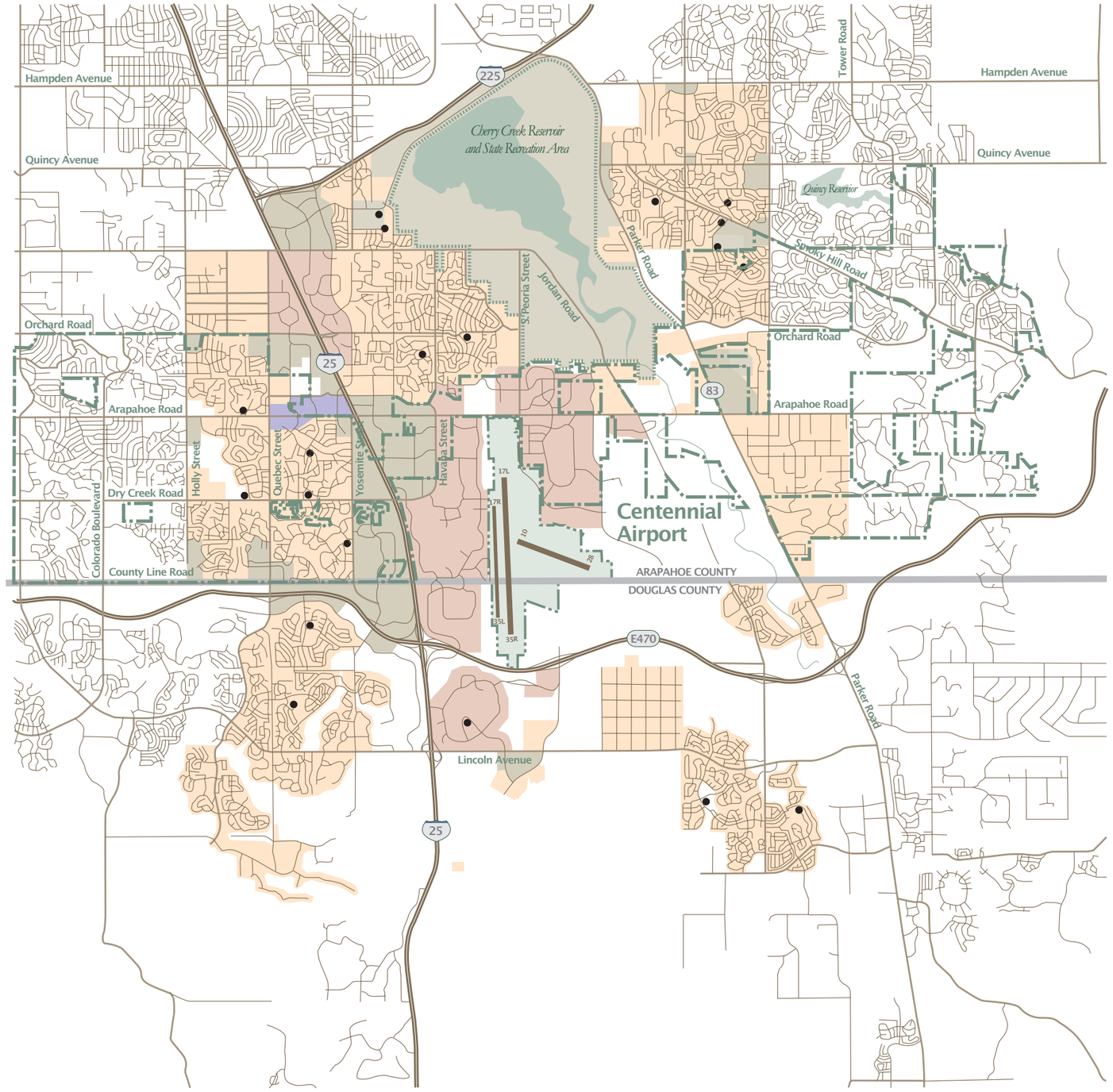


Figure A5 ***Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Aerial Information, June - 2001.*

Interstate 25 is approximately one mile west of the airport and E-470 is on the southern boundary of the airport. Arapahoe Road is on the northern boundary of the airport. Generally speaking, the area north of the airport presently is more densely developed than the area south of the airport, although development is rapidly occurring in all directions. Existing land use to the north of the airport is a mixture of commercial/retail/office development along Arapahoe Road and higher density similar uses along I-25. East of I-25 and north of Arapahoe Road are several medium to high density residential developments, with associated schools and churches. Directly north/northeast of the airport beyond the residential development is Cherry Creek Reservoir and it's associated recreation area. Northeast of the airport south of Arapahoe Road is mostly business park development to the intersection with Parker Road. North of Arapahoe Road closest to the airport is business/industrial development, with residential development farther east to the intersection of Parker Road. Extensive residential development occurs northeast and southeast of the intersection of Arapahoe Road and Parker Road.

The area immediately east and southeast of the airport is relatively undeveloped up to both E-470 and Parker Road except for an area of relatively dense residential development just beyond the northwest intersection of Parker Road and E-470. The southeast intersection of Parker Road and E-470, and beyond, is composed mostly of both large lot and small lot residential development with associated ancillary development. South of E-470 and west of Parker Road, to the southeast of the airport, is dense residential development and large lot residential development, with associated schools and churches. Directly south of the airport and south of E-470 is undeveloped except for office park development on the southeast interchange of I-25 and E-470. To the southwest of the airport, west of I-25 and south of E-470 are areas of large lot residential development, although dense residential development is occurring west of the interstate between E-470 and approximately Lincoln Avenue.

West and northwest of the airport, along the I-25 corridor are intense business, commercial and retail developments from E-470 on the south to I-225 on the north. The Denver Technological Center is located in this corridor. West of the interstate are predominantly residentially developed areas with ancillary commercial and retail support uses.

In summary, there are significant areas of existing, and some potential, residential non-compatible land uses within the immediate airport environs. The vast majority of these residential units are single family homes, with some multi-family structures. There are no known mobile homes parks within the immediate airport environs. However, close-in to the airport and immediately adjacent

airport boundary is compatible business/industrial/office type development. Cherry Creek Reservoir and the adjacent recreation area may present future Section 4(f) issues concerning significant flight track changes.

Future Land Use. Each of the jurisdictions within the vicinity of Centennial Airport have adopted future land use plans or guidelines to help guide land use development within their respective jurisdictions.

City of Greenwood Village

Greenwood Village is generally located north and northwest of the Airport The majority of the community is located west of Interstate 25. The city limits are generally defined as Belleview Avenue to I-255 on the north, Havana Street to Orchard Road on the east, then Dayton Street to Arapahoe Road on the southeast to Quebec Street then north to Orchard Road, then west to approximately one mile west of University. The City of Greenwood Village adopted a Comprehensive Plan in 1991. The Plan is generally a policy driven plan to guide future development.

The focus of the Plan is mainly oriented toward the preservation and encouragement of quality residential development. The Future Land Use Section states:

> "Greenwood Village resolves to accept reasonable growth in an orderly manner consistent with the low density, open space concept that is supported by its citizens. Sound principles of urban design are embraced by the City when reviewing development. That is, the form of the City, aesthetic considerations, functional inter-relationships of land uses, and community identity all should be considered when reviewing the merits of growth proposals."

In addition to this general statement concerning future land use development, there are several development goals;

1. Promote a compatible and functional system of land uses.
2. Promote superior site utilization through regulation and site plan review.
3. The neighborhood is recognized as the basic social and service unit of the City.
4. Promote the creation of a unique City identity by encouraging such features as coordinated City boundary markers on streets and trails, and distinctive street lighting.

The Plan does not contain any direct policy statements or goals addressing the airport or development within the airport environs.

City of Aurora

Aurora is generally located north/northeast of the airport, with the southwest boundary of the City generally being Parker Road to Belleview Avenue. In addition, there is an unattached area of the City directly east of the airport south of Arapahoe Road between Jordan Road and Parker Road. The City of Aurora adopted the City of Aurora Comprehensive Plan in January, 1998. The Plan is both a policy and physical plan. The Plan does address airports, compatible land use and noise issues, as the City is affected by Denver International Airport, Buckley Air National Guard, Front Range Airport and Centennial Airport.

Included in the Environmental Quality Section of the Plan, Noise is addressed as follows;

> "Noise is an important environmental and land use issue. Airport and automobile noise can negatively impact land use and, in particular, residential area. Note Map 4 in Chapter 5 for areas impact by aviation noise.
>
> Opportunities
>
> - The city has taken a proactive approach to protecting residential land uses from excessive airport noise by using zoning controls which prohibit this development in high noise areas. In locations of moderate noise, additional building code regulations for noise insulation apply to new construction."

The Plan also addresses Noise Sensitive Areas in conjunction with Map 4 in Chapter 5.

> "The zoning ordinance defines various areas that are subject to development restrictions because of their proximity to airport noise flight corridors. Map 4 on the following page illustrates the Airport Noise Sectors.
>
> As development encroaches around airports, including DIA, Buckley Air National Guard (ANG), Front Range Airport, and Centennial Airport, concerns about noise impacts on land use increase.

Recommendations

Aurora needs to continue to proactively work with airports in and adjacent to the city to effectively plan for the location of noise corridors so that prime development areas are not impacted.
Procedures for designing neighborhoods and streets should include methods for mitigating the noise impacts of traffic on streets and highways."

Town of Parker

The Town of Parker is located east/southeast of the airport generally south of the Arapahoe/Douglas County line, on both sides of Parker Road, west to approximately half the distance between Parker Road and I-25. The Town adopted a Master Plan in 1997. The Plan is both a policy and physical plan for future development.

Under the Land Use and Development Chapter of the Plan, it states;

> "Parker is fortunate today that a majority of the Town has not been developed. There currently exists the opportunity to guide and direct quality growth, reinforcing this area as a desirable place to live, work and play…… Parker should take full advantage of this opportunity to start with a clean slate in terms of land use and development, and take the initiative to guide and direct growth to achieve all of the goals and objectives set forth by this community."

The Plan graphically illustrates the intended land use pattern for the community for the next twenty years. The Plan addresses Centennial Airport in the Transportation Chapter and makes the following statement;

> "An area surrounding Centennial Airport has been defined within which major impacts of airport operations will occur. The Airport Influence Area (AIA) in the Parker area includes the area two miles south of Lincoln Avenue and west of Parker Road. Land-Use Guidelines have been prepared which recommend certain limitations to development in this area. These guidelines generally discourage or prohibit residential uses and restrict building heights within further defined areas of the AIA for noise and safety reasons. Avigation easements are requested on any development with the AIA."

The Plan contains Goals and Policies that address the airport and compatibility issues;

Goal:

- Ensure compatibility among transportation systems, surrounding land uses, and environmental conditions.

Centennial Airport Policies

1. The Town will be involved in airport planing, flight paths, and noise abatement procedures.
2. The Town will continue to monitor expansion plans and activities at Centennial Airport. Appropriate action will be taken when the Town's residents and businesses may be adversely affected by proposed expansion.
3. Development proposals within the AIA of Centennial Airport shall be consistent with the land use guidelines established for the AIA. The Town will work with the Airport Authority to ensure consistency with these guidelines.
4. The Town shall require avigation easements for development within the AIA and easements will be required as part of the platting process.

City of Lone Tree

The City of Lone Tree is located southwest of the Airport, in Douglas County. The city limits generally coincide with the Arapahoe/Douglas County line on the north, Yosemite Street on the east, Lincoln Avenue on the south and Quebec Street on the west. It appears that the City adopted the City of Lone Tree Comprehensive Plan in 1997. The Plan is a policy and physical plan, with Transportation/Centennial Airport policies very similar to the Town of Parker.

The Transportation Chapter contains the following statement;

> "Land surrounding Centennial Airport is an area within which major impacts of airport operations may occur. The Airport Influence Area (AIA) in the Lone Tree vicinity includes an area south of Lincoln Avenue and east of I-25. New Land-Use Guidelines are being prepared that will recommend certain limitations to development in this area. These guidelines are apt to discourage or prohibit residential uses and restrict building heights within further defined areas of the AIA for noise and safety reasons."

The Plan contains Goals and Policies that address the airport and compatibility issues;

Goal:

- Ensure compatibility among transportation systems, surrounding land uses, and environmental conditions.

Centennial Airport Policies

1. The City will be involved in airport planing, flight paths, and noise abatement procedures.
2. The City should monitor expansion plans and activities at Centennial Airport. Appropriate action shall be taken when the City's residents and businesses will be adversely affected by proposed expansion.
3. Development proposals within the AIA of Centennial Airport shall be consistent with the land use guidelines established for the AIA. The City should work with the Airport Authority to ensure consistency with these guidelines.

Arapahoe County

Arapahoe County is located in the northern half of the airport, with unincorporated portions of the county surrounding the airport to the north, east and west. The southern half of the airport and the unincorporated area to the south is within the jurisdiction of Douglas County. Arapahoe County adopted the Arapahoe County Comprehensive Plan in 1985 with amendments through 1994. The Plan is generally a policy plan, which identifies goals and policies to guide future land use development.

The Plan addresses airports and airport noise in two chapters, Transportation and Environmental Quality. In the Transportation Chapter, the following statement concerning Centennial Airport can be found;

"Centennial Airport is recognized as one of the largest and busiest general aviation airports in the northwest Rocky Mountain region. It is now acquiring additional land and expanding its facilities in conformance with its 1981 Master Plan.

All airports affect surrounding land uses because of their need for large areas of land, adequate ground access, plus the problems of plane noises and potential crash hazards. Residential uses and tall buildings are discouraged within each airport's influence area. As a result, office, commercial, and industrial uses are usually recommended for avigation impact areas, as determined by an airport's day/night average sound levels (Ldn) contours, accident potential zones (APZ), and runway configuration."

Long Term Objective

"To ensure compatibility between airport operations and vicinity land uses."

Policy

"**The County should continue to work with each individual airport to establish and support airport influence area land use guidelines.** Each airport listed above {Centennial, Front Range and Buckley ANG Base} has a unique set of facility users, runway patterns, and noise contours. These differences should be recognized and planned for. As further plans are finalized for each airport, the Comprehensive Plan should be reviewed for compatibility and amended as appropriate."

The Environmental Quality Chapter contains the following objective and policies concerning aircraft noise;

Long Term Objective

"To protect, preserve, and promote peace and quiet for its citizens through the reduction control, and prevention of noise.

Policies

1. **The County should investigate maximum noise levels, land use standards, and mitigation methods to guide land use decisions in reducing noise impacts.** Noise abatement and mitigation techniques, including the use of noise barriers such as landscaping and fences, the appropriate modification of the County building and zoning codes, and establishment of noise abatement programs for high-noise generating areas such as the airport and along freeways and arterial streets, should be explored.

2. **Conversions of nonresidential zoning to residential zoning should be strongly discouraged where noise levels equal or exceed Ldn 65**. Particular attention should be paid to the locations relationship between high-noise generating activities (industrial operations and transportation facilities) and noise sensitive uses (housing, schools, parks, and hospitals).
3. **Existing undeveloped residential zoning should be developed only if the planned buildings will demonstrate an interior noise level not to exceed Ldn 45 given maximum forecasted exterior noise levels.** Noise measurement and soundproofing techniques, developed for land uses near airports, are available to help anticipate potential problems before they occur.

Douglas County

Douglas County is located in the southern half of the airport, and has jurisdiction over the unincorporated areas south of the airport. The northern half of the airport and the unincorporated area to the north is within the jurisdiction of Arapahoe County. Douglas County adopted the Douglas County Master Plan in 1992 with amendments through 1998. The Plan is generally a policy plan, which identifies goals and policies to guide future land use development, along with a future land use map.

The Plan addresses airports and airport noise in several chapters, ***Land Use, Transportation and Natural Environment.*** There is a section which addresses Centennial Airport, called the Centennial Airport Review Area, under Land Use which states;

> "An area surrounding Centennial Airport has been identified as a location where impacts of airport operations could occur. The Centennial Airport Review Area (CARA) is bounded roughly by Castle Rock to the south, Lone Tree to the west, Parker to the east, and County Line Road to the north. Within this general area, Land-Use Guidelines have been developed to encourage compatibility of land uses and airport operations. These guidelines generally discourage residential uses in areas closer to the airport, and restrict building height for safety reasons. Avigation easements are required by the County for any development within the CARA."

Policies: Centennial Airport Review Area

1. Development proposals within the CARA shall conform to the Land-Use Guidelines established for the CARA. Through the development-review referral process, the County will work with developers and the FAA to ensure conformance with these guidelines.
2. The County shall require avigation easements for development within the CARA. These easements should be noted on plats.

In the Transportation Chapter, there is a specific reference to Centennial Airport under the heading Airports.

"Centennial Airport (formerly the Arapahoe County Airport) is located at the Douglas-Arapahoe County line, approximately one mile east of I-25. The airport provides facilities and services for general aviation aircraft and is a general aviation reliever for Stapleton International Airport in Denver. The airport is owned and operated by the Arapahoe County Public Airport Authority.

General aviation activity in the Denver metro area has steadily increased in recent years and is expected to increase in the future. Centennial Airport is expected to absorb its share of this increased general aviation activity. To meet projected aviation demands in the area, expansion of airport facilities is proposed by the Authority. The service area of Centennial Airport includes Douglas County. The operational and expansion plans of Centennial Airport and the potential impacts of such operations and plans are a concern to County residents and officials. (For policies related to Centennial Airport, see the Centennial Airport Review Area, Section 2, Chapter 3.)"

The Natural Environment Chapter contains specific reference to Noise.

"As Douglas County's population increases, noise will become a greater problem for all County residents. The effects of noise on health are both physiological and psychological, though primarily psychological. Consequently, governmental agencies have established limits of noise volume and duration. Exposure above these limits can result in hearing damage. The five principal sources of noise affecting Douglas Count residents area as follows:

- Airports or heliports
- Vehicular noise from highway traffic or off-road recreational vehicles
- Railroads

- Industrial noise created through the fabrication, manufacturing , or processing of manufactured goods
- Noise generated by large groups of people out-of-doors

Effectively dealing with noise is complicated by the varied character and amount of noise in any particular area. In most cases, noise is a localized problem, requiring specific local land-use regulations or design solutions. Because noise is a threat to the public health, safety and welfare, land-use controls are considered a valid means of combating noise problems.

Measures which can be used to mitigate undesirable noises include:
- Abatement of noise at the source
- Buffering
- Protecting noise-sensitive uses from uses generating excessive, undesirable noise level.

These three measures can be implemented to a great extent by land-use controls or site planning measures allowable through existing Douglas County Regulations. Other areas of source noise abatement, including regulating off-road recreational vehicles or noise from industrial processes or domestic animals, may necessitate the need for other regulatory measures.
Policies: Noise

1. Land uses that generate significantly higher levels of noise than the surrounding areas may be considered incompatible, unless actions are taken that effectively mitigate noise levels. Such noise mitigation measures as adequate right-of-way width, increased setbacks, berms along streets, or solid walls or berms around industrial land uses are encouraged.

2. The use of construction materials and design techniques to reduce outside or inside noise levels are encouraged.

3. The use of existing and manmade topography or vegetation to help reduce noise levels are encouraged.

4. The creation of residential subdivision covenants that limit or prohibit activities producing excessive or annoying noise is encouraged.

5. For land uses or activities generating excessive or annoying noise levels, noise studies that address noise levels and mitigation techniques may be required."

Zoning. All of the jurisdictions in the vicinity of Centennial Airport have adopted traditional land use zoning ordinances to control the types of land uses on specific parcels. The ordinances divide a jurisdiction into districts and prescribe certain requirements for allowable uses within those districts. The various zoning codes pertaining to airport related activities, are presented in the following paragraphs.

City of Greenwood Village

The City of Greenwood Village adopted an ordinance and map in 1995, amended in 1996. The ordinance is a typical type ordinance for a community it's size. It has several residential districts, both single family and multi-family residential along with several business districts. Manufactured (mobile) homes are not permitted by right in any district. There are two Commercial districts along with Open Space and Agricultural districts. The ordinance addresses noise only as it is associated with business or commercial operations. There are no airport specific requirements or conditions contained in the ordinance.

City of Aurora

The City of Aurora adopted an ordinance and map, as amended, in 1998. The ordinance is a typical ordinance, with a variety of zoning districts, including manufactured housing districts. In addition to the base zoning ordinance, the City has adopted a variety of overlay zones that address airports; Buckley ANG Base, Stapleton and "the new international airport", and Centennial and Front Range Airports. The section for Centennial Airport was adopted in 1991. In addition, the code also requires and defines sound attenuation procedures for areas defined in the Airport Influence District.

The Airport Influence District for Centennial Airport is the same as recommended by Centennial Airport. The City refers development plans to the airport for comment. An avigation easement is obtained from the developer and recorded with the County. New residential development is not allowed within the 60 DNL contour. Air conditioning and 25 decibel sound attenuation are required for residential development in the 55 to 60 DNL contour. Any grandfathered residential inside the 60 DNL contour, 30 decibels of noise reduction construction and air conditioning are required. The avigation easement is required at time of sale. Sellers are required to provide a noise notice to property buyers. The City has also adopted FAR Part 77 height hazard restrictions.

Town of Parker

The Town of Parker adopted an ordinance and map in 1998. The ordinance is a typical ordinance with several development districts ranging from residential through industrial, including agricultural. The ordinance does include a Section on Airport Regulations. The Airport regulations are a combination of FAR Part 77 height requirements and land use requirements. The section defines an Airport Influence Area, states that "acceptable land use means those nonresidential land uses by right or special review…… which are with the area of influence and are not noise sensitive; and which Parker or the Airport Authority has been granted an avigation easement", and requires an avigation easement for all areas within the Airport Influence Area. However, the ordinance does not define the boundary of the Airport Influence Area for Centennial Airport.

City of Lone Tree

The City of Lone Tree adopted an ordinance and map in 1997, with subsequent amendments. The ordinance defines land use districts including single and multi-family residential, several business/commercial districts and industrial. Mobile homes are not allowed in any of the residential districts. There is no mention of the airport or any airport related requirements.

Arapahoe County

Arapahoe County adopted an ordinance and map, as revised, in 1996, and is in the process of updating. The ordinance defines many land use districts ranging from various residential districts, business/commercial, industrial, mixed use and agricultural. The ordinance does include a manufactured/mobile home district. It also contains an Airport Influence Area overlay district. The Airport Influence Area requirements pertain to Centennial Airport, Buckley ANG Base and Front Range Airport in Adams County. The Airport Influence Area is defined on the zoning map for Arapahoe County. The requirements for Centennial Airport generally contain the following provisions: within the Airport Influence Area avigation easements are required, with a note of such on all plans and plat and compliance with FAR Part 77 requirements; within the Traffic Pattern Area requires compliance with the above plus new residential and other noise sensitive development is prohibited with building height restricted to 100 feet; within the Approach Zone requires compliance with the above plus requires a minimum 200 foot by 2,500 foot clear strip along the runway centerline extended, and building height is restricted to 50 feet; the Clear Zone is contained on airport property; within the 65 Ldn Noise Zone requires compliance with the above plus prohibits residential and other noise sensitive uses regardless of density.

Douglas County

Douglas County adopted an ordinance and map in 1994 and amended through 1998. The ordinance defines several land use districts including several residential, business/commercial, industrial, open space and agricultural. The ordinance does have a specific mobile home district. The ordinance also contains a special overlay district, the Centennial Airport Review Area. The Centennial Airport Review Area overlay zone contain two safety zones, two noise zones and general height limitations which follow FAR Part 77 criteria. In addition, the overlay zone requires the granting of an avigation easement for all development within the Centennial Airport Review Area as identified on included maps and discourages the use of land which encourages large concentrations of birds or waterfowl from within 10,000 feet of airport runways. It also prohibits landfills from within 10,000 feet of airport runways.

The two safety zones are the Runway Safety Zone (RSZ) and the Fan Safety Zone (FSZ). The Runway Safety Zone is generally along the extended centerline of the runway and generally allows certain non-noise sensitive and open space uses. The Fan Safety Zone is generally associated with the southwest end of the west runway and allows all uses allowed in the RSZ, plus industrial uses. In addition, certain restrictions apply to all uses permitted prior to adopting of this section.

The two noise zones include the Noise Sensitive Zone and the Noise Mitigation Zone. Generally, residential and other noise sensitive uses are not allowed in the Noise Sensitive Zone, and sleeping rooms in other uses shall be sound attenuated. The ordinance contains a table listing permitted and prohibited land uses by zone. The Noise Mitigation Zone allows all uses permitted in the underlying zone except outdoor amphitheaters, and sleeping rooms or other uses must be sound attenuated. Sound attenuation requirements are contained in the County Building Code.

Aircraft Activity Forecasts

Introduction

The forecasting of future aviation activity in terms of general aviation, air taxi operations and military aircraft operations at Centennial Airport serves as a significant basis for analyzing existing aircraft noise levels and identifying future noise levels. There are no scheduled commercial service operations at the airport. Forecasting, by its very nature, is not exact; however, it does establish some general parameters for aircraft operations and, when soundly established, provides a defined rationale for various noise mitigation scenarios.

Forecasting generally commences by utilizing the present time as an initial point, supplemented with historical trends obtained from previous year's activity and recorded information. This data has evolved from a comprehensive examination of historical airport records and recent planning documents relative to the airport. The intent of this section is to review the forecasts presented in the recent airport master plan; i.e., the 1996 *Centennial Airport Master Plan Update* , and update those forecasts as necessary for the short-term, five-year, planning horizon of this FAR Part 150 Study. It must be remembered that an airport master plan utilizes a twenty-year planning period but an FAR Part 150 Study, by regulation, utilizes a five-year planning period for determining future noise exposure. Therefore, the forecast period for this study will be five years after the date of submittal of the document, which translates into the year 2005 operations.

The 1996 *Centennial Airport Master Plan Update* utilized 1995 base data to forecast aviation activity at the airport. Fluctuations in both the nation and region's economy since that time have influenced aircraft activity since that document was produced, resulting in a need to update those forecasts. Several forecasting elements are pertinent to the aircraft noise and land use planning efforts at Centennial Airport. These forecasting categories include air charter operations, military aircraft operations and general aviation operations by aircraft type.

In developing the forecasts, the 1996 *Centennial Airport Master Plan Update* made several assumptions to help formulate the forecasts. These are presented below:

- With the closure of Stapleton International Airport and the opening of Denver International Airport, a greater portion of general aviation users will want to use Centennial Airport.

- Air charter operations were two percent (2%) of total operations in 1995 and will increase to three percent (3%) of total activity by 2015.

- Military operations are mostly US Air Force Academy cadets performing touch-and-go operations, with those operations remaining at 6,000 per year.

- General aviation operations will continue to account for approximately ninety-five percent (95%) of the total operations.

- Local operations are expected to level off at 205,000 through out the planning period, with itinerant activity increasing so that local operations account for forty-five percent (45%) of total operations by 2015.

These assumptions may or may not hold true for this forecast evaluation process. A determination concerning the assumptions will be made as more information from the noise monitoring sequence becomes available.

Historical Airport Activity

A tabulation of Centennial Airport's historical aviation activity since 1992, with average operations for 1987-1991, is presented in Table B1, entitled *HISTORICAL AVIATION ACTIVITY, 1992-1999.*

Table B1
SUMMARY OF HISTORICAL OPERATIONS, 1992-1999
Centennial Airport FAR Part 150 Study

Year	Operations
1987-91 Average	364,999
1992	376,417
1993	415,453
1994	422,463
1995	402,325
1996	359,704
1997	408,602
1998	466,267
1999	436,081

Source: Airport Activity Reports

As can be seen, operations for 1999 are less than 1998 levels but greater than other years shown.

Operations Forecast

In evaluating the 1996 *Airport Master Plan Update* forecasts, a comparison of forecasted operations with comparable actual operations would be informative. This would determine past or current realization of forecasted operations which would aid in any adjustments to forecasted activity levels. However, the time period has been very short since the Master Plan was completed and the Master Plan forecasts were presented in five year increments, starting in 2000. Therefore, there is no data to compare forecasted levels with actual levels of operations. In this instance, a comparison of forecast activity levels for extended years with actual levels that have occurred since 1995 is a helpful starting point. In 1998 there were 466,267 operations at the airport. The Master Plan only forecast 461,000 by the year 2015, thus the airport has already exceeded the twenty year forecast presented in the Master Plan.

However, in 1996 operations were less than in 1995 and in 1997 they were only slightly greater than in 1995. This is very common at general aviation airports where operations vary greatly between years. In these instances it is the overall trend in operations that is important. The operations forecasts presented in the 1996 *Airport Master Plan Update* are presented in the following table, Table B2, entitled *COMPARISON OF MASTER PLAN FORECASTS AND OTHER FORECASTS*, along with the actual number of such operations that occurred for comparable years and the adjusted forecast. The adjusted forecast reflects the *averaged* difference in actual and forecasted operations for 1995 through 1998 carried forward to 2015. In addition, the table also presents two "trend projections" and the Federal Aviation Administration's *Terminal Area Forecasts*. The trend projections assume that whatever occurred in the past will occur in the future. Trend 1 is utilizes historical operations since 1991 to determine the straight line trend. Trend 2 utilizes historical operations since 1995 to determine the straight line trend. The *Terminal Area Forecasts* (TAF) are updated yearly by the FAA and represent the official forecasts used by the FAA for planning purposes. As can be seen, each trend line results in a significantly different number of operations when carried out to 2015, which is obviously dependent upon which year is picked as the starting point.

For the FAR Part 150 forecasting purposes, the fifth year after submittal of the document is the end of the planning horizon. Thus, the 2005 forecasts will be used for this FAR Part 150 Study. In evaluating the various forecasts presented below, several factors need to be considered. The first is that operations are always fluctuating at a general aviation airport due to many contributing factors. These

include the price of fuel, the ability to finance pilot training activities, economic growth specific to the area, congested facilities at other airports, congestion at this airport, navigational aids and airport services, and landside operating cost. It is also unreasonable to assume that whatever conditions occurred in the past will continue to occur in the future. In other words, the airport experienced a significant increase in operations in 1998 (approximately fourteen percent increase), with similar increases not expected to occur every year. In addition, the theoretical annual capacity of the airport is approximately 525,000 operations. Once this number of operations is achieved, delay becomes such that aircraft will normally use another airport in the vicinity, with all things being equal. Therefore, the number of operations indicated by Trend 2 is considered to be unreasonable for the short-term planning period. It is recommended that the TFA be used as the forecasts for this Study. The TAF is a reasonable projection, very similar to Trend 1, which reflects fluctuations in actual operations but represents a growing trend in overall operations. This projection is significantly higher than the Master Plan forecast and higher than the Adjusted Forecast, but is lower than the trend projection based on historical operations since 1995.

Table B2
COMPARISON OF MASTER PLAN FORECASTS AND OTHER FORECASTS
Centennial Airport FAR Part 150 Study

Year	Master Plan	Actual	Adjusted [b]	TAF	Trend 1	Trend 2
1995	402,325	402,325				
1996 [a]	405,140	359,704				
1997 [a]	407,955	408,602		406,704		
1998 [a]	410,770	466,267		422,937		
1999 [a]	413,585	436,081	424,293	429,942	432,126	469,406
2000	416,400		427,108	436,947	438,655	493,478
2001 [a]	419,320		430,028	443,954	445,184	517,550
2002 [a]	422,240		432,948	450,959	451,713	541,623
2003 [a]	425,160		435,868	457,966	458,243	565,695
2004 [a]	428,080		438,788	464,971	464,772	589,768
2005	431,000		441,708	471,977	471,301	613,840
2010	446,000		456,708	507,006	503,984	734,202
2015	461,000		471,708	542,037	536,594	854,564

[a] BD&C Extrapolation

[b] These are adjusted based on the average difference between actual and forecast, 1995-1998.

Trend One Trend projection from 1991

Trend Two Trend projection from 1995

As can be noted by the TAF, total annual operations are anticipated to increase moderately through the five-year planning period. Overall, total annual operations are expected to increase moderately (approximately one percent) by the year 2005 over 1998 figures. This also represents an increase of approximately sixteen (16) percent over 1997 figures and an increase in approximately eight (8) percent over 1999 figures, again illustrating the dramatic increase in operations that occurred in 1998.

Operations Forecast By Aircraft Type

Although total annual operations are very important in generating noise contours, of equal if not greater importance, is the aircraft mix that is represented in the forecast. The aircraft mix refers to the *type* of aircraft that make up the annual forecast; for example, 150,000 single engine piston aircraft operations generate a much different noise contour than 150,000 business jet operations. There are no records of aircraft operations by type of aircraft, other than category, such as air charter/taxi, military and general aviation. The 1996 *Airport Master Plan Update* did make an attempt to generate a fleet mix, by aircraft type, for both the existing and future operations. This information is presented in the following table, Table B3, *SUMMARY OF AIRCRAFT OPERATIONS BY AIRCRAFT TYPE, 1995-2015, AIRPORT MASTER PLAN, 1996*. In addition, the 1996 *Noise and Land Use Study* also presented similar, but different, information. That Study contains a breakdown of both existing and future aircraft operations by specific aircraft types, which are presented in Table B5, along with the percentage of the total operations for each type.

As can be seen, both documents contain a different fleet mix, by percentage, for both the existing and future forecast conditions. Even though they are different, this is useful information and can be used as a starting point for additional refinement. During the noise monitoring program, additional and more detailed information concerning aircraft types will be collected. Subsequent to the noise monitoring, an updated aircraft fleet mix will be presented for consideration.

Table B3
SUMMARY OF OPERATIONS BY AIRCRAFT TYPE, BY PERCENT, 1995-2015 AS PRESENTED IN THE AIRPORT MASTER PLAN, 1996
Centennial Airport FAR Part 150 Study

Operations By Type	1995 [a]	2000	2005	2010	2015
Business Jets	8.5	11.9	13.3	14.5	16.6
Turboprop	4.0	4.9	5.0	5.2	5.5
Piston	84.5	80.8	79.2	77.8	75.5
Helicopter	2.0	2.4	2.5	2.5	2.4

[a] Actual Source: Table IV.1, Centennial Airport Master Plan Update (Revised 11/7/96)

Table B4
SUMMARY OF OPERATIONS BY AIRCRAFT TYPE, 1995-2000
AS PRESENTED IN THE NOISE AND LAND USE STUDY, 1996
Centennial Airport FAR Part 150 Study

Operations By Type	**1995** [a]		**2000**	
Business Jets				
Stage 3	16,093	4%	24,948	6%
Business Jets				
Stage 2	8,047	2%	8,328	2%
Turboprop	20,116	5%	29,148	7%
Piston	354,046	88%	349,776	84%
Helicopter	4,023	1%	4,164	1%
TOTAL OPERATIONS	402,325		416,400	

[a] Actual

Table B5 shows the actual aircraft operations that occurred at the airport in 1999. The breakdown of aircraft types is based on tower counts, observations during the noise monitoring sequence and several months worth of radar tracking of aircraft. This information will be used to generate the existing noise contour.

Table B5

SUMMARY OF OPERATIONS, EXISTING 1999
Centennial Airport FAR Part 150 Study

Category Type	Annual Operations	Daily Operations	Percent Nighttime
Business Jets			
Stage 3	27,406	75.1	25%
Business Jets			
Stage 2	5,594	15.3	19%
General Aviation			
Single Engine Piston	330,081	904.6	5%
Multi-Engine Piston	37,000	101.4	5%
Turboprop	24,000	65.7	5%
Helicopter	12,000	32.9	5%
Total Operations	**436,081**	**1,195**	

Revised Forecasts Scenarios

Based on discussions with the Advisory Committee, the Federal Aviation Administration and Airport staff, it seems reasonable that the FAA Terminal Area Forecasts be used for the five-year future operation forecasts. However, the mix of aircraft contained in this forecast, especially the allocation of Stage 2 and Stage 3 business jets, can result in potentially significant differences in overall noise levels. Therefore, prior to identifying one forecast of aircraft operations for noise contour modeling, several Stage 2/Stage 3 business jet allocations will be examined and modeled. The first scenario will be based on the Stage 2/Stage 3 business jet percentages remaining at the same level as occurred in 1999, 17 percent Stage 2

and 83 percent Stage 3. The second scenario will increase the Stage 3 business jet percentage to 87 percent of the business jet fleet, which is industry estimate for the national business jet fleet in the near future. The third scenario assumes the same number of Stage 2 operations as in 1999 with Stage 3 business jets experiencing the increase. In each scenario, the Terminal Area Forecasts showing a total of 471,977 operations will be used, with the growth in operations over 1999 levels will all be a result of the business jet aircraft. The other general aviation aircraft operations are forecasted to remain the same. This will result in the most aggressive forecast and most significant aircraft noise levels. The business jet operations dominate the noise contours, the other general aviation aircraft operations could almost double and they would not impact the size of the contours. The results of this analysis is presented it the Noise Analysis Chapter.

Noise Analysis

This report is presented in five major sections including this introduction. Section Two presents background information on sound, noise, and how noise affects people. Section Three describes the methodology used for this study. Section Four describes the existing noise setting in the environs of Centennial Airport. Section Five presents a description of the base-conditions future noise environment. The analyses presented in this working paper address existing aircraft noise and the predicted five-year future aircraft noise impacts.

Background/Introduction

The purpose of this section is to present background information on the characteristics of noise as it relates to Centennial Airport and summarize the methodologies that were used to study the noise environment. This section is intended to give the reader a greater understanding of the noise metrics and methodologies used to assess noise impacts. This section is divided into the following sub-sections:

- Characteristics of Sound
- Factors Influencing Human Response to Sound
- Health effects of Noise
- Sound rating scales
- Noise/Land Use Compatibility Standards and Guidelines

Characteristics of Sound

Sound Level and Frequency. Sound can be technically described in terms of the sound pressure (amplitude) and frequency (similar to pitch). Sound pressure is a direct measure of the magnitude of a sound without consideration for other factors that may influence its perception.

The range of sound pressures that occur in the environment is so large that it is convenient to express these pressures as sound pressure levels on a logarithmic scale. The standard unit of measurement of sound is the Decibel (dB). The sound pressure level in decibels describes the pressure of a sound relative to a reference

pressure. The logarithmic scale compresses the wide range in sound pressures to a more usable range of numbers.

The frequency of a sound is expressed as Hertz (Hz) or cycles per second. The normal audible frequency range for young adults is 20 Hz to 20,000 Hz. The prominent frequency range for community noise, including aircraft and motor vehicles, is between 50 Hz and 5,000 Hz. The human ear is not equally sensitive to all frequencies, with some frequencies judged to be louder for a given signal than others. As a result of this, various methods of frequency weighting have been developed. The most common weighting is the A-weighted noise curve (dBA). The A-weighted decibel scale (dBA) performs this compensation by discriminating against frequencies in a manner approximating the sensitivity of the human ear. In the A-weighted decibel, every day sounds normally range from 30 dBA (very quiet) to 100 dBA (very loud). Most community noise analyses are based upon the A-weighted decibel scale. Examples of various sound environments, expressed in dBA, are presented in Figure C1.

Propagation of Noise. Outdoor sound levels decrease as a function of distance from the source, and as a result of wave divergence, atmospheric absorption, and ground attenuation. If sound is radiated from a source in a homogeneous and undisturbed manner, the sound travels as spherical waves. As the sound wave travels away from the source, the sound energy is distributed over a greater area dispersing the sound power of the wave. Spherical spreading of the sound wave reduces the noise level at a rate of 6 dB per doubling of the distance.

Atmospheric absorption also influences the levels that are received by the observer. The greater the distance traveled, the greater the influence of the atmosphere and the resultant fluctuations. Atmospheric absorption becomes important at distances of greater than 1,000 feet. The degree of absorption is a function of the frequency of the sound as well as the humidity and temperature of the air. For example, atmospheric absorption is lowest at high humidity and higher temperatures. Sample atmospheric attenuation graphs are presented in Figure C2. Turbulence and gradients of wind, temperature and humidity also play a significant role in determining the degree of attenuation. Certain conditions, such as inversions, can also result in higher noise levels than would result from spherical spreading as a result of channeling or focusing the sound waves.

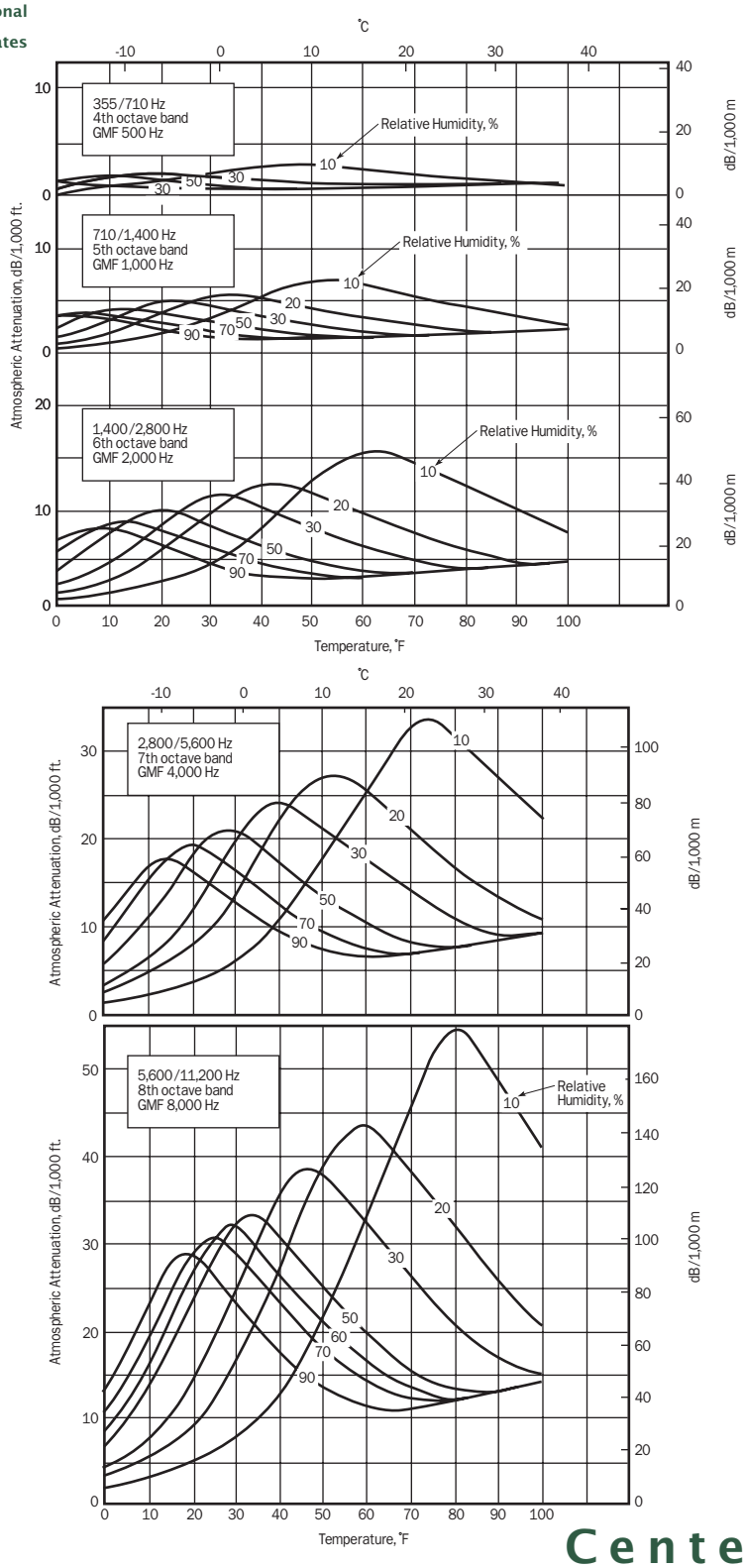
Absorption effects in the atmosphere vary with frequency. The higher frequencies are more readily absorbed than the lower frequencies. Over large distances, the lower frequencies become the dominant sound as the higher frequencies are attenuated.

Duration of Sound. The annoyance from a noise event increases with increased duration of the noise event, i.e., and the longer the noise event lasts the more annoying it is. The "effective duration" of a sound is the time between when a

dB(A)	OVER-ALL LEVEL Sound Pressure Level Approx. 0.0002 Microbar	COMMUNITY (Outdoor)	HOME or INDUSTRY	LOUDNESS Human Judgement of Different Sound Levels
130	UNCOMFORTABLY	Military Jet Aircraft Take-Off with Afterburner from Aircraft Carrier @ 50 ft. (130)	Oxygen Torch (121)	120 dB(A) 32 Times as Loud
120	LOUD	Turbo-Fan Aircraft @ Take-Off Power @ 200 ft. (90)	Riveting Machine (110) Rock and Roll Band (108-114)	110 dB(A) 16 Times as Loud
110				
100	VERY	Boeing 707 @ 1000 ft. (103) DC-8 @ 6080 ft. (106) Bell J2A Helicopter @ 100 ft. (100)		100 dB(A) 8 Times as Loud
90	LOUD	Power Mower (96) Boeing 737. DC-9 @ 6080 ft. (97) Motorcycle @ 25 ft. (90)	Newspaper Press (97)	90 dB(A) 4 Times as Loud
80		Car Wash @ 20 ft. (89) Prop. Airplane Flyover @ 1000 ft. (88) Diesel Truck, 40 mph @ 50 ft. (84)	Food Blender (88) Milling Machine (85) Garbage Disposal (80)	80 dB(A) 2 Times as Loud
70	MODERATELY LOUD	High Urban Ambient Sound (80) Passenger Car, 65 mph @ 25 ft. (77) Freeway @ 50 ft., 10:00am (76)	Living Room Music (76) TV-Audio, Vacumn Cleaner	70 dB(A)
60		Air Conditioning Unit @ 100 ft. (60)	Cash Register @ 10 ft. (65-70) Electric Typewriter @ 10 ft. (64) Conversation (60)	60 dB(A) 1/2 Times as Loud
50	QUIET	Large Transformers @ 100 ft. (50)		50 dB(A) 1/4 Times as Loud
40		Bird Calls (44) Low Urban Ambient Sound (40)		40 dB(A) 1/8 Times as Loud
	JUST AUDIBLE	(dB(A) Scale Interrupted)		
10	THRESHOLD OF HEARING			

SOURCE : Reproduced from Melville C. Branch and R. Dale Beland, "Outdoor Noise in the Metropolitan Environment". Published by the City of Los Angeles. 1970. p2.

Figure C1 ***Examples of Various Sound Environments***



SOURCE: Beranek, 1981

Figure C2 ***Atmospheric Attenuation Graphs***

sound rises above the background sound level until it drops back below the background level. Psycho-acoustic studies have determined a relationship between duration and annoyance. These studies determined the amount a sound must be reduced to be judged equally annoying for increased duration. Duration is an important factor in describing sound in a community setting.

The relationship between duration and noise level is the basis of the equivalent energy principal of sound exposure. Reducing the acoustic energy of a sound by one-half results in a 3 dB reduction. Doubling the duration of the sound increases the total energy of the event by 3 dB. This equivalent energy principal is based upon the premise that the potential for a noise to impact a person is dependent on the total acoustical energy content of the noise [1]. CNEL, DNL, LEQ and SENEL are all based upon the equal energy principle and defined in subsequent sections of this study.

Change in Noise. The concept of change in ambient sound levels can be understood with an explanation of the hearing mechanism's reaction to sound. The human ear is a far better detector of relative differences in sound levels than absolute values of levels. Under controlled laboratory conditions, listening to a steady unwavering pure tone sound that can be changed to slightly different sound levels, a person can just barely detect a sound level change of approximately one decibel for sounds in the mid-frequency region. When ordinary noises are heard, a young healthy ear can detect changes of two to three decibels. A five-decibel change is readily noticeable while a 10-decibel change is judged by most people as a doubling or a halving of the loudness of the sound.

Recruitment of Loudness. Recruitment describes the perception of loudness in situations where masking elevates the threshold of hearing of a sound from a background sound. A listener's judgment of the loudness of a sound will vary with different levels of background noise. In low level background situations that are near the threshold of hearing, the loudness level of a sound increases gradually. In these situations, a desired sound, such as music that is a level of 40 to 60 dB above the background, would be judged as comfortable. In loud background settings, a sound that is approximately 20 dB above the masking threshold will be perceived as the same loudness as the sound would have been if no masking sound were present.

Masking Effect. A characteristic of sound is the ability of a sound to interfere with the ability of a listener to hear another sound. This is defined as the masking effect. The presence of one sound effectively raises the threshold of audibility for the hearing of a second sound. For a signal to be heard, it must exceed the threshold of hearing for that particular individual and exceed the masking threshold for the background noise.

The masking characteristics of sound is dependent upon many factors, including the spectral (frequency) characteristics of the two sounds, the sound pressure levels and the relative start time of the sounds. The masking affect is greatest when the masking frequency is closest to the frequency of the signal. Low frequency sounds can mask higher frequency sounds, however, the reverse is not true

Factors Influencing Human Response to Sound

Many factors influence how a sound is perceived and whether or not it is considered annoying to the listener. This includes not only physical characteristics of the sound but also secondary influences such as sociological and external factors. Molino, in the Handbook of Noise Control [2] describes human response to sound in terms of both acoustic and non-acoustic factors. These factors are summarized in Table C1.

Table C1
FACTORS THAT AFFECT INDIVIDUAL ANNOYANCE TO NOISE
Centennial Airport FAR Part 150 Study

Primary Acoustic Factors
Sound Level
Frequency
Duration
Secondary Acoustic Factors
Spectral Complexity
Fluctuations in Sound Level
Fluctuations in Frequency
Rise-time of the Noise
Non-Acoustic Factors
Physiology
Adaptation and Past Experience
How the Listener's Activity Affects Annoyance
Predictability of When a Noise will Occur
Is the Noise Necessary?
Individual Differences and Personality

Source: C. Harris, 1979

Sound rating scales are developed to account for the factors that affect human response to sound. Nearly all of these factors are relevant in describing how sounds

are perceived in the community. Many of the non-acoustic parameters play a prominent role in affecting individual response to noise. Background sound, an additional acoustic factor not specifically listed, is also important in describing sound in rural settings. Fields [4], in his analysis of the effects of personal and situation dependent variables on noise annoyance, has identified a clear association of reported annoyance and fear of an accident. In particular, Fields has stated that there is firm evidence that noise annoyance is associated with: (1) the fear of an aircraft crashing or of danger from nearby surface transportation; (2) the belief that aircraft noise could be prevented or reduced by designers, pilots or authorities related to airlines; and (3) an expressed sensitivity to noise generally. Thus, it is important to recognize that non-acoustic factors such as the ones described above as well as acoustic factors contribute to human response to noise.

Health Effects of Noise

Noise, often described as unwanted sound, is known to have several adverse effects on people. From these known adverse effects of noise, criteria have been established to help protect the public health and safety and prevent disruption of certain human activities. These criteria are based on effects of noise on people such as hearing loss (not a factor with typical community noise), communication interference, sleep interference, physiological responses and annoyance. Each of these potential noise impacts on people are briefly discussed in the following narrative:

- *Hearing Loss* is generally not a concern in community noise problems, even very near a major airport or a major freeway. The potential for noise induced hearing loss is more commonly associated with occupational noise exposures in heavy industry, very noisy work environments with long term exposure, or certain very loud recreational activities such as target shooting, motorcycle or car racing, etc. The Occupational Safety and Health Administration (OSHA) identifies a noise exposure limit of 90 dBA for 8 hours per day to protect from hearing loss (higher limits are allowed for shorter duration exposures). Noise levels in neighborhoods, even in very noisy neighborhoods, are not sufficiently loud to cause hearing loss.

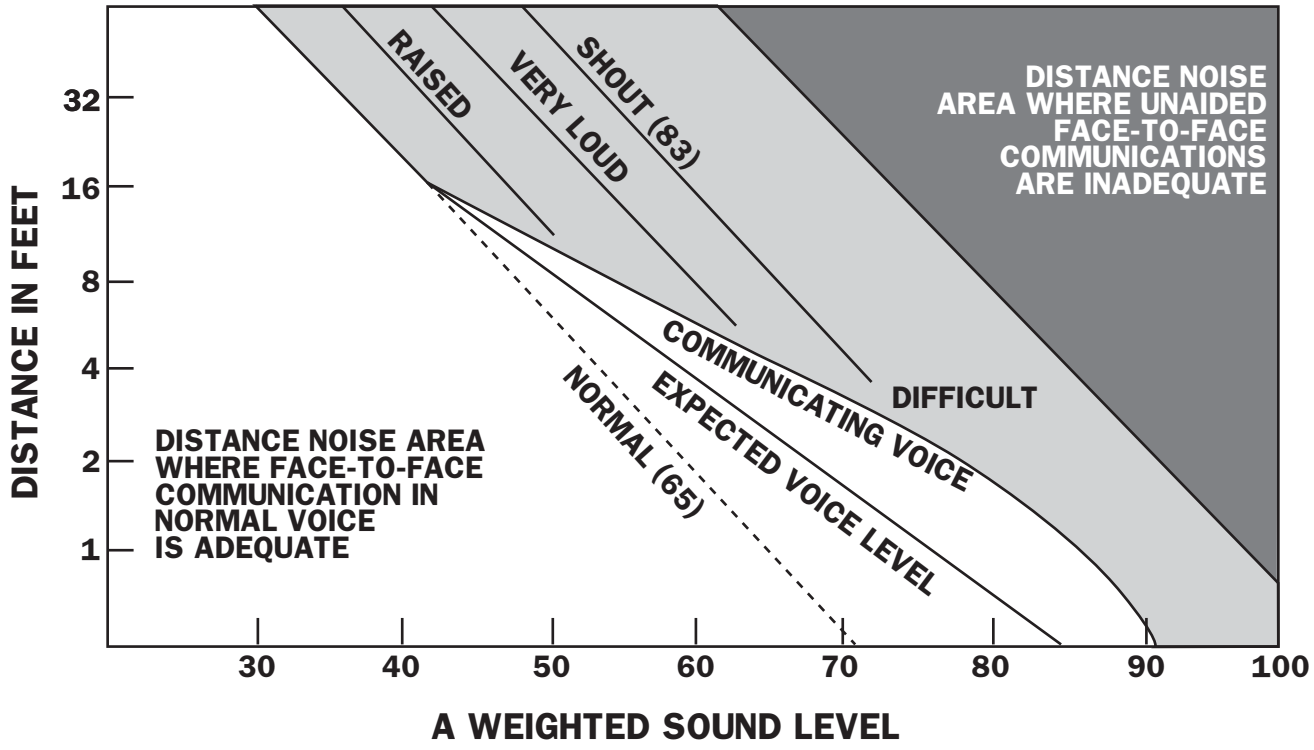
- *Communication Interference* is one of the primary concerns in environmental noise problems. Communication interference includes speech interference and interference with activities such as watching television. Normal conversational speech is in the range of 60 to 65 dBA and any noise in this range or louder may interfere with speech. There are specific methods of describing speech interference as a function of distance between speaker and listener and voice level. Figure C3 shows the relation of quality of speech communication with respect to various noise levels.

- *Sleep Interference* is a major noise concern in noise assessment and, of course, is most critical during nighttime hours. Sleep disturbance is one of the major causes of annoyance due to community noise. Noise can make it difficult to fall asleep, create momentary disturbances of natural sleep patterns by causing shifts from deep to lighter stages and cause awakening. Noise may even cause awakening, which a person may or may not be able to recall.

  Extensive research has been conducted on the effect of noise on sleep disturbance. Recommended values for desired sound levels in residential bedroom space range from 25 to 45 dBA, with 35 to 40 dBA being the norm. The National Association of Noise Control Officials [3] has published data on the probability of sleep disturbance with various single event noise levels. Based on experimental sleep data as related to noise exposure, a 75-dBA interior noise level event will cause noise induced awakening in 30 percent of the cases. A summary of these data is presented in Figure C4.

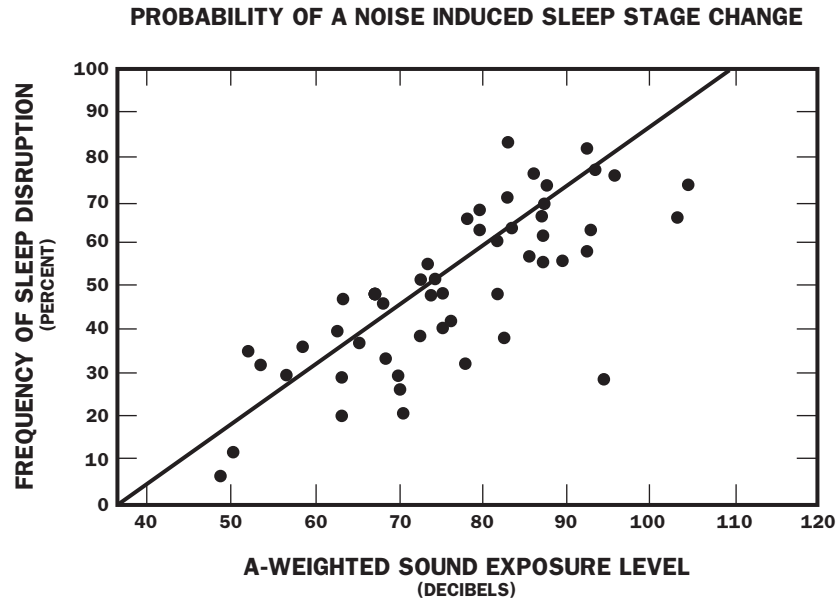
  It is important to note that recent research from England [4] has shown that the probability for sleep disturbance is less than what had been reported in earlier research. This research showed that once a person was asleep, it is much more unlikely that they will be awakened by a noise. The significant difference in the recent English study is the use of actual in-home sleep disturbance patterns as opposed to laboratory data that had been the historic basis for predicting sleep disturbance. It is therefore likely that the data shown in Figure C4 overestimates the sleep disturbance at a given noise level.

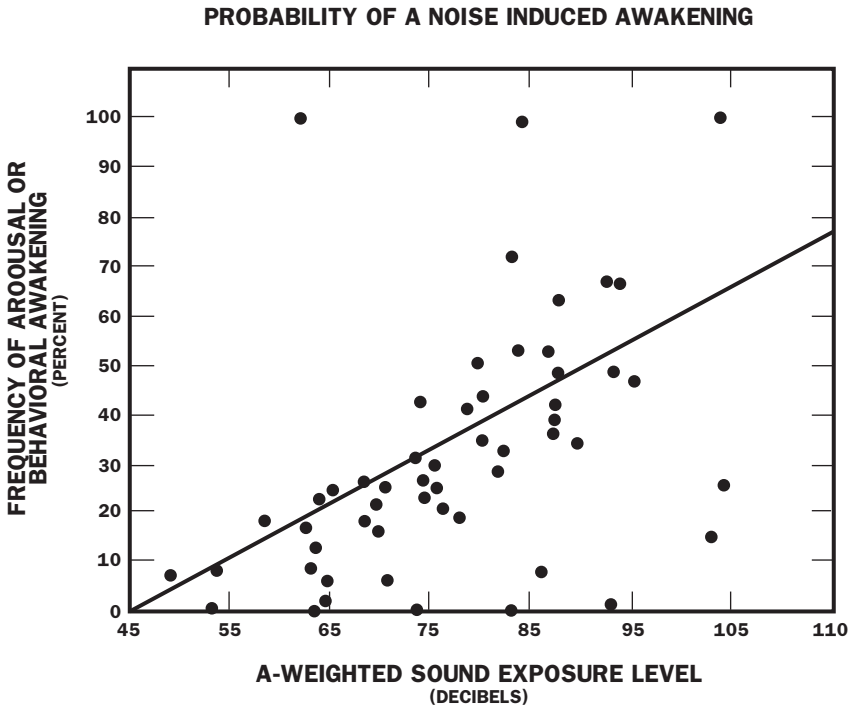
- *Physiological Responses* are those measurable effects of noise on people, which are realized as changes in pulse rate, blood pressure, etc. While such effects can be induced and observed, the extent is not known to which these physiological responses cause harm or are a sign of harm. Generally, physiological responses are a reaction to a loud short-term noise such as a rifle shot or a very loud jet overflight.



SOURCE: Noise Effects Handbook, EPA

Figure C3 ***Quality of Speech Communication in Relation to Distance Between the Talker and the Listener***





SOURCE: NANCO "Noise Effects Handbook", 1981

Figure C4 ***Sample Sleep Interference***

- Annoyance is the most difficult of all noise responses to describe. Annoyance is a very individual characteristic and can vary widely from person to person. What one person considers tolerable can be quite unbearable to another of equal hearing capability. The level of annoyance, of course, depends on the characteristics of the noise (i.e.; loudness, frequency, time, and duration), and how much activity interference (e.g. speech interference and sleep interference) results from the noise. However, the level of annoyance is also a function of the attitude of the receiver. Personal sensitivity to noise varies widely. It has been estimated that 2 to 10 percent of the population is highly susceptible to annoyance from noise not of their own making, while approximately 20 percent are unaffected by noise. Attitudes are affected by the relationship between the person and the noise source. (Is it our dog barking or the neighbor's dog?) Whether we believe that someone is trying to abate the noise will also affect our level of annoyance.

Sound Rating Scales

The description, analysis, and reporting of community sound levels is made difficult by the complexity of human response to sound and the myriad of sound-rating scales and metrics that have been developed for describing acoustic effects. Various rating scales have been devised to approximate the human subjective assessment to the "loudness" or "noisiness" of a sound. Noise metrics have been developed to account for additional parameters such as duration and cumulative effect of multiple events.

Noise metrics can be categorized as single event metrics and cumulative metrics. Single event metrics describe the noise from individual events, such as an aircraft flyover. Cumulative metrics describe the noise in terms of the total noise exposure throughout the day. Noise metrics used in this study are summarized below:

Single Event Metrics

- *Frequency Weighted Metrics (dBA*). In order to simplify the measurement and computation of sound loudness levels, frequency weighted networks have obtained wide acceptance. The A-weighting (dBA) scale has become the most prominent of these scales and is widely used in community noise analysis. Its advantages are that it has shown good correlation with community response and is easily. measured. The metrics used in this study are all based upon the dBA scale

- *Maximum Noise Level*. The highest noise level reached during a noise event is, not surprisingly, called the "Maximum Noise Level," or Lmax. For example, as an aircraft approaches, the sound of the aircraft begins to rise above ambient noise levels. The closer the aircraft gets the louder it is until the aircraft is at its closest point directly overhead. Then as the aircraft passes, the noise level decreases until the sound level again settles to ambient levels. Such a history of a flyover is plotted at the top of Figure C5. It is this metric to which people generally instantaneously respond when an aircraft flyover occurs.

- *Sound Exposure Level (SEL)*. Another metric that is reported for aircraft flyovers is the Sound Exposure Level (SEL) metric. It is computed from dBA sound levels. Referring again to the top of Figure C5 the shaded area, or the area within 10 dB of the maximum noise level, is the area from which the SEL is computed. The SEL value is the integration of all the acoustic energy contained within the event. Speech and sleep interference research can be assessed relative to Single Event Noise Exposure Level data.

  This metric takes into account the maximum noise level of the event and the duration of the event. For aircraft flyovers, the SEL value is typically about 10 dBA higher than the maximum noise level. Single event metrics are a convenient method for describing noise from individual aircraft events. This metric is useful in that airport noise models contain aircraft noise curve data based upon the SEL metric. In addition, cumulative noise metrics such as LEQ, CNEL and DNL can be computed from SEL data.

Cumulative Metrics

- *Equivalent Noise Level (LEQ)*. LEQ is the sound level corresponding to a steady-state A-weighted sound level containing the same total energy as a time-varying signal over a given sample period. LEQ is the "energy" average noise level during the time period of the sample. It is based on the observation that the potential for a noise to impact people is dependent on the total acoustical energy content of the noise. It is the energy sum of all the sound that occurs during that time period.

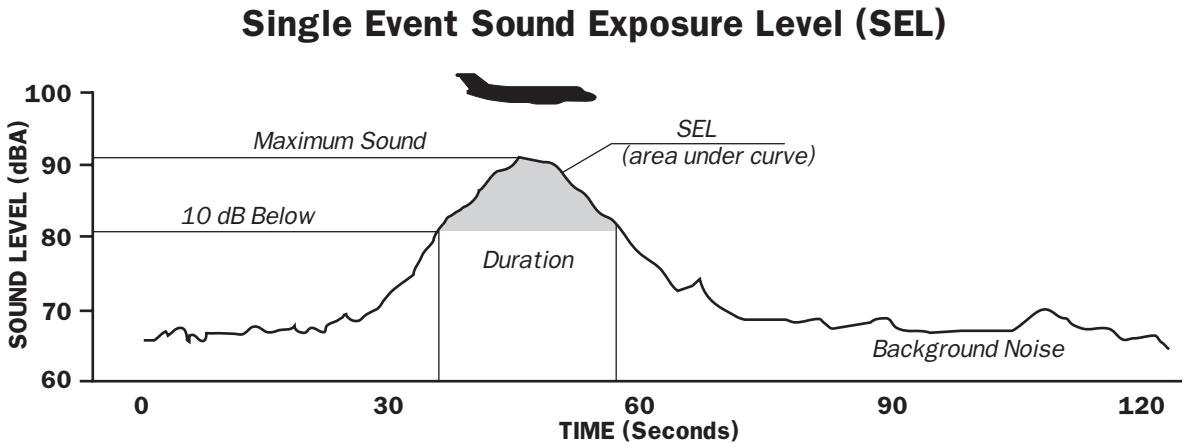
  This is graphically illustrated in the middle graph of Figure C5. LEQ can be measured for any time period, but is typically measured for 15 minutes, 1 hour or 24-hours. Leq for one hour is called Hourly Noise Level (HNL) in the California Airport Noise Regulations [6] and is used to develop the Day Night Noise Level (DNL) values for aircraft operations.

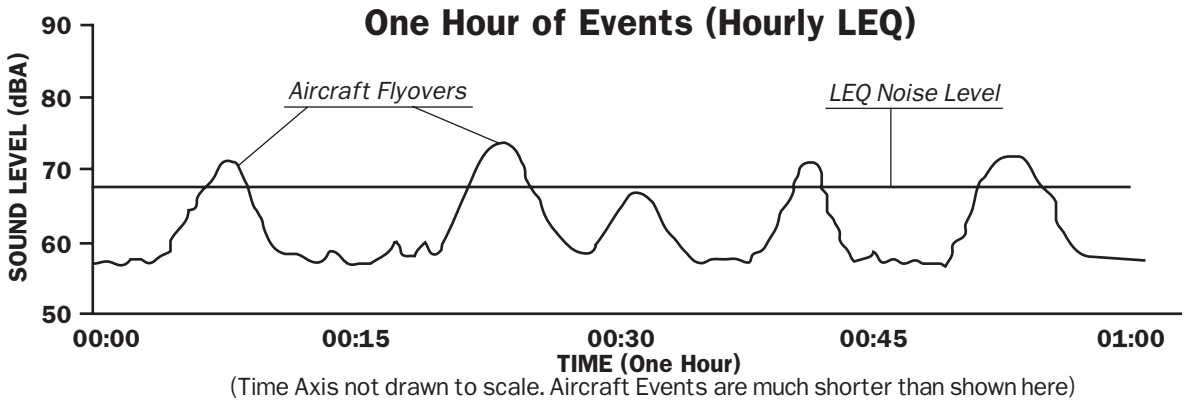
- Cumulative noise metrics have been developed to assess community response to noise. They are useful because these scales attempt to include the loudness of the noise, the duration of the noise, the total number of noise events and the time of day these events occur into one single number rating scale. They are designed to account for the known health effects of noise on people described earlier.

- Day Night Noise Level (DNL). The DNL index is a 24-hour, time-weighted energy average noise level based on the A-weighted decibel. It is a measure of the overall noise experienced during an entire day. The time-weighted refers to the fact that noise that occurs during certain sensitive time periods is penalized for occurring at these times. In the DNL scale, noise occurring between the hours of 10 p.m. to 7 a.m. is penalized by 10 dB. This penalty was selected to attempt to account for the higher sensitivity to noise in the nighttime and the expected further decrease in background noise levels that typically occur in the nighttime. The FAA for airport noise assessment specifies DNL, and the Environmental Protection Agency (EPA) specifies DNL for community noise and airport noise assessment. DNL, also referred to as LDN, is graphically illustrated in the bottom of Figure C5. Examples of various noise environments in terms of LDN are presented in Figure C6.

Supplemental Metrics

- *Time Above (TA).* The FAA has developed the Time Above metric as a second metric for assessing impacts of aircraft noise around airports. The Time Above index refers to the total time in seconds or minutes that aircraft noise exceeds certain dBA noise levels in a 24-hour period. It is typically expressed as Time Above 75 and 85 dBA sound levels. While this index is not widely used, it may be used by the FAA in environmental assessments of airport projects that show a significant increase in noise levels. There are no noise/land use standards in terms of the Time Above index.





(Time Axis not drawn to scale. Aircraft Events are much shorter than shown here)

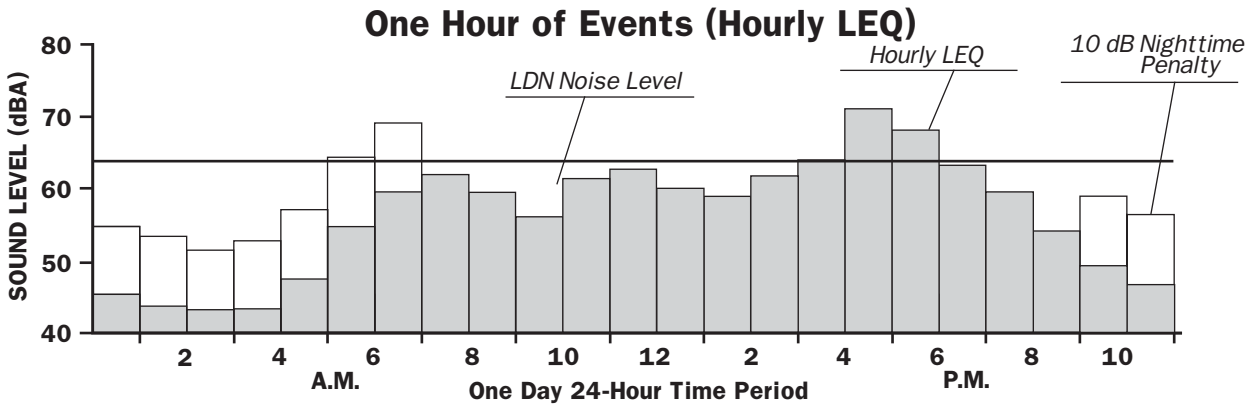
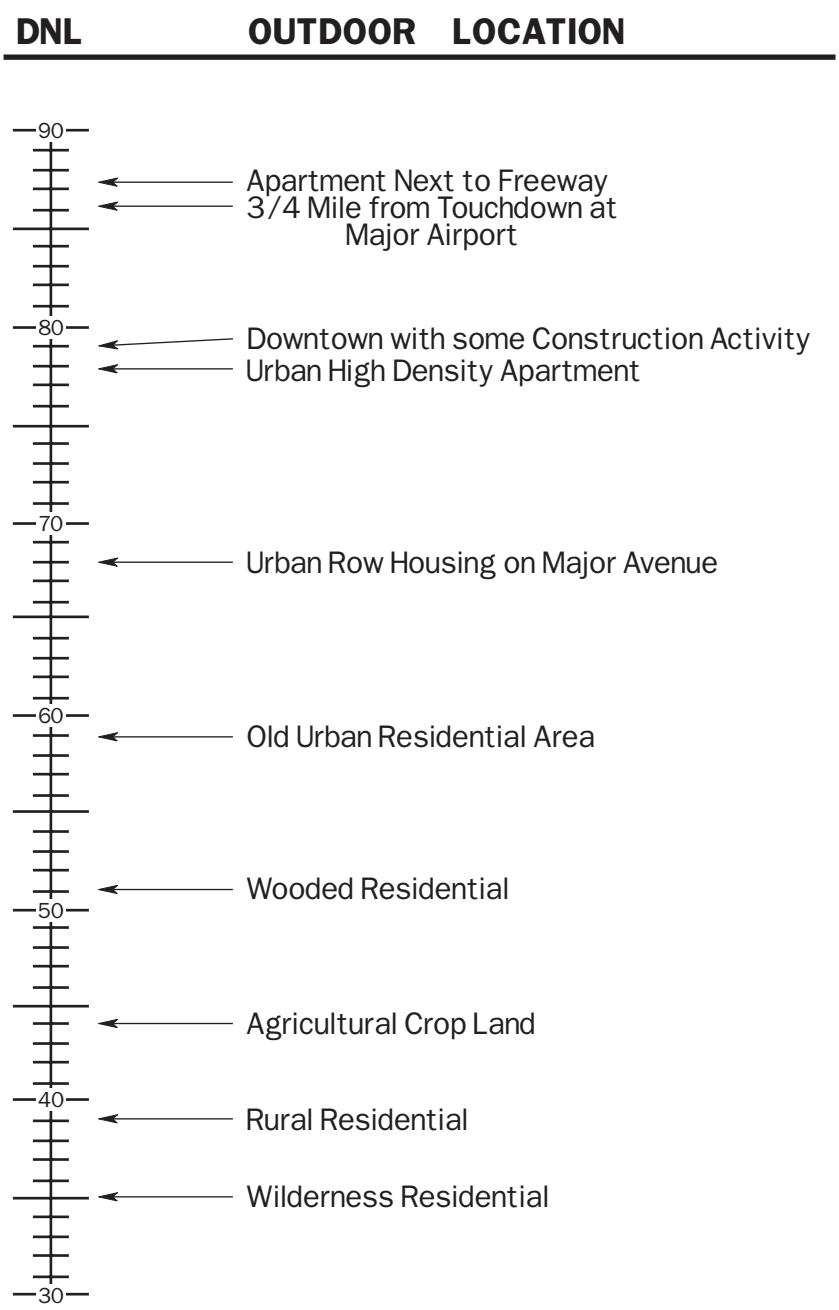


Figure C5 ***SEL, LEQ, and DNL Illustrations***



SOURCE: EPA Levels Document, 1974

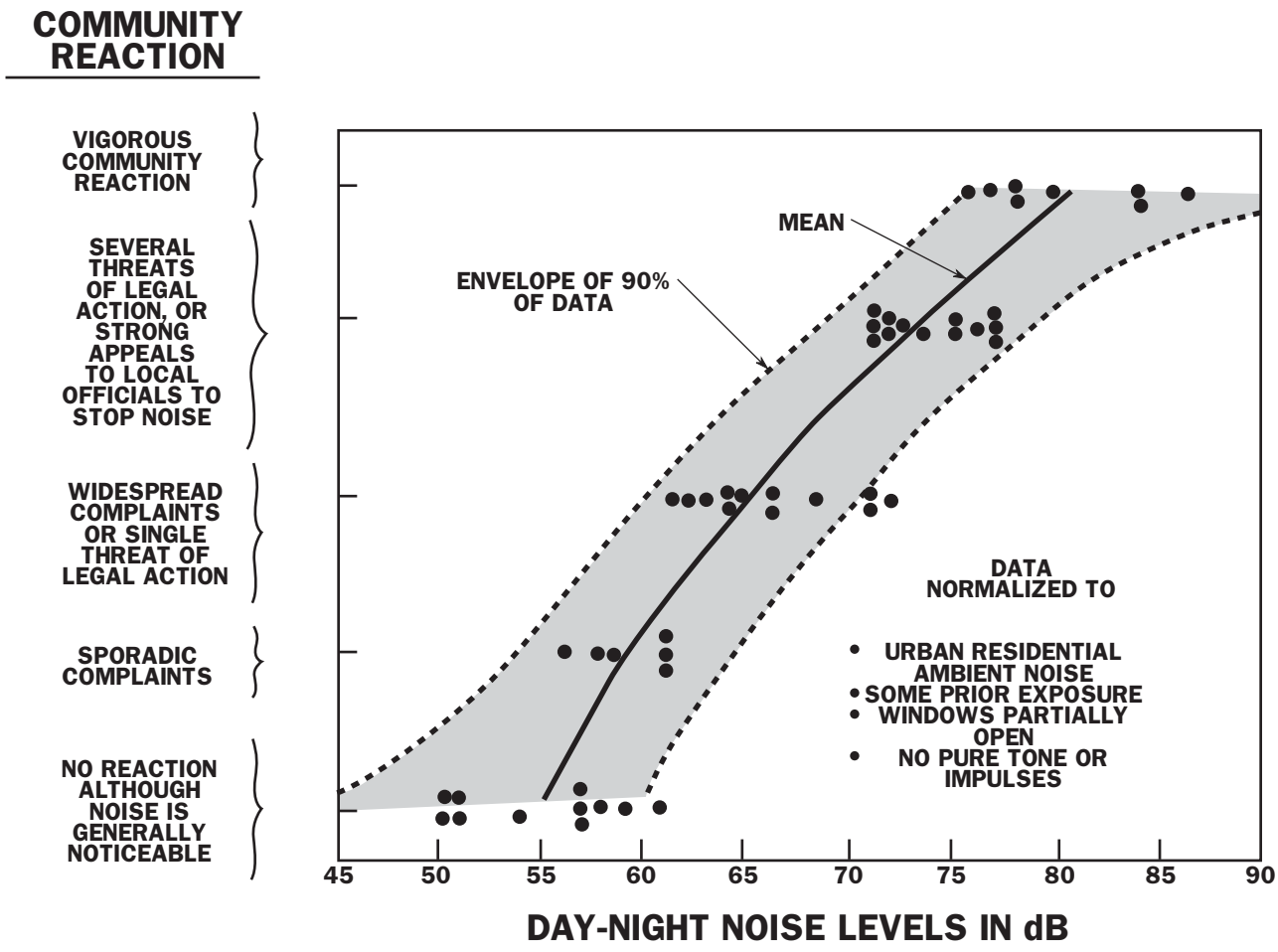
Figure C6 ***Typical Outdoor Noise Environments***

- *Percent Noise Level (Ln).* To account for intermittent or fluctuating noise, another method to characterize noise is the Percent Noise Level (Ln). The Percent Noise Level is the level exceeded n% of the time during the measurement period. It is usually measured in the A-weighted decibel, but can be an expression of any noise rating scale. Percent Noise Levels are another method of characterizing ambient noise where, for example, L90 is the noise level exceeded 90 percent of the time, L50 is the level exceeded 50 percent, and L10 is the level exceeded 10 percent of the time. L90 represents the background or minimum noise level, L50 represents the median noise level, and L10 the peak or intrusive noise levels. Percent noise level is commonly used in community noise ordinances which regulate noise from mechanical equipment, entertainment noise sources, and the like. It is not normally used for transportation noise regulation (although the FHWA Leq criterion for roadways was originally stated as an L10 criterion).

Noise/Land Use Compatibility Standards and Guidelines

The use of noise metrics is an attempt to quantify community response to various noise exposure levels. The public reaction to different noise levels has been estimated based upon extensive research on human responses to exposure of different levels of aircraft noise. Figure C7 relates DNL noise levels to community response from one of these surveys. Community noise standards are derived from tradeoffs between community response surveys, such as this, and economic considerations for achieving these levels. These standards generally are in terms of the DNL 24-hour averaging scale that is based upon the A-weighted decibel. Utilizing these metrics and surveys, agencies have developed standards for assessing the compatibility of various land uses with the noise environment.

The purpose of this section is to present information regarding noise and land use criteria that may be useful in the evaluation of noise impacts. With respect to airports, the Federal Aviation Administration has a long history of publishing noise/land use assessment criteria. These laws and regulations provide the basis for local development of airport plans, analyses of airport impacts, and the enactment of compatibility policies. Other agencies, including the EPA and the Department of Defense, have developed noise/land use criteria. The most common noise/land use compatibility standard or criteria used is 65 dB DNL for residential land use with outdoor activity areas. At 65 dB DNL the Schultz curve predicts approximately 14% of the exposed population to be highly annoyed. At 60 dB DNL this decreases to approximately 8% of the population highly annoyed. It should be further pointed out that the data upon which the Schultz curve and the more recent updates are based include a very wide range of scatter among the data with communities near some airports



SOURCE: EPA Levels Document, 1974

Figure C7 ***Community Reaction to Intrusive Noises***

reporting a much higher percentage of the population highly annoyed at these noise exposure levels. A summary of some of the more pertinent regulations and guidelines are presented in the following paragraphs.

Federal Aviation Administration

Federal Aviation Regulations, Part 36, "Noise Standards: Aircraft Type and Airworthiness Certification".

Originally adopted in 1960, FAR Part 36 prescribes noise standards for issuance of new aircraft type certificates. Part 36 prescribes limiting noise levels for certification of new types of propeller-driven, small airplanes as well as for transport category, large airplanes. Subsequent amendments extended the standards to certain newly produced aircraft of older type designs. Other amendments have at various times extended the required compliance dates. Aircraft may be certified as Stage 1, Stage 2, or Stage 3 aircraft based on their noise level, weight, number of engines and in some cases number of passengers. Stage 1 aircraft are no longer permitted to operate in the U.S. Stage 2 aircraft over 75,000 pounds are being phased out of the U.S. fleet as discussed in a later paragraph on the Airport Noise and Capacity Act of 1990. Although aircraft meeting Part 36 standards are noticeably quieter than many of the older aircraft, the regulations make no determination that such aircraft are acceptably quiet for operation at any given airport.

U.S. Department of Transportation Aviation Noise Abatement Policy.

This policy, adopted in 1976, sets forth the noise abatement authorities and responsibilities of the Federal Government, airport proprietors, State and local governments, the air carriers, air travelers and shippers, and airport area residents and prospective residents. The basic thrust of the policy is that the FAA's role is primarily one of regulating noise at its source (the aircraft) plus supporting local efforts to develop airport noise abatement plans. The FAA will give high priority in the allocation of ADAP (now AIP) funds to projects designed to ensure compatible use of land near airports, but it is the role of State and local governments and airport proprietors to undertake the land use and operational actions necessary to promote compatibility.

Aviation Safety and Noise Abatement Act of 1979.

Further weight was given to the FAA's supporting role in noise compatibility planning by congressional adoption of this legislation. Among the stated purposes of this act is "To provide assistance to airport operators to prepare and carry out noise compatibility programs". The law establishes funding for noise compatibility planning and sets the requirements by which airport operators can apply for funding. The law does not require any airport to develop a noise compatibility program.

Federal Aviation Regulations, Part 150, "Airport Noise Compatibility Planning".

As a means of implementing the Aviation Safety and Noise Abatement Act, the FAA adopted Regulations on Airport Noise Compatibility Planning Programs. These regulations are spelled out in FAR Part 150. As part of the FAR Part 150 Noise Control program, the FAA published noise and land use compatibility charts to be used for land use planning with respect to aircraft noise. An expanded version of this chart appears in Aviation Circular 150/5020-1 (dated August 5, 1983) and is reproduced in Figure C8. These guidelines represent recommendations to local authorities for determining acceptability and permissibility of land uses. The guidelines specify a maximum amount of noise exposure (in terms of the cumulative noise metric DNL) that will be considered acceptable or compatible to people in living and working areas.

These noise levels are derived from case histories involving aircraft noise problems at civilian and military airports and the resultant community response. Note that residential land use is deemed acceptable for noise exposures up to 65 dB DNL. Recreational areas are also considered acceptable for noise levels above 65 dB DNL (with certain exceptions for amphitheaters that are recommended not to exceed 65 dB DNL). Several important notes appear for the FAA guidelines including one which indicates that ultimately "the responsibility for determining the acceptability and permissible land uses remains with the local authorities."

Federal Aviation Order 5050.4 and Directive 1050.1 for Environmental Analysis of Aircraft Noise Around Airports.

The FAA has developed guidelines (Order 5050.4D) for the environmental analysis of airports. Federal requirements now dictate that increases in noise levels in noise sensitive land uses of over 1.5 dB DNL within the 65 dB DNL contour are considered significant (1050.1A, 12.21.83). The FAA only considers noise impacts that occur at the 65 dB DNL or greater. No analysis is required beyond the 65 dB DNL. However, the FAA is now being revised and comments have been solicited, through the Federal Register, on proposed changes to the Order.

Land Use	Yearly Day-Night Noise Level (DNL) 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)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
Governmental 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

Numbers in parentheses refer to notes.

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

Key to Table 1

SLUCM Standard Land Use Coding Manual.
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 or 35 Land Use and related structures generally compatible; measures to achieve NLR of 25, 30 or 35 dB must be incorporated into design and construction of structure.

Notes

(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 to 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 that special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

SOURCE: FAR Part 150

Figure C8 ***FAR Part 150 Land Use Compatibility Matrix***

Centennial Airport
FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Airport Noise and Capacity Act of 1990

The Airport Noise and Capacity Act of 1990 (PL 101-508, 104 Stat. 1388), also known as ANCA or the Noise Act, established two broad directives to the FAA; (1) establish a method to review aircraft noise, and airport use or access restrictions, imposed by airport proprietors, and (2) institute a program of phase-out Stage 2 aircraft over 75,000 pounds by December 31, 1999. Stage 2 aircraft are older, noisier aircraft (B-737-200, B-727 and DC-9); Stage 3 aircraft are newer, quieter aircraft (B-737-300, B-757, MD-80/90). To implement ANCA, FAA amended Part 91 and issued a new Part 161 of the Federal Aviation Regulations. Part 91 addresses the phase-out of large Stage 2 aircraft and the phase-in of Stage 3 aircraft. Part 161 establishes a stringent review and approval process for implementing use or access restrictions by airport proprietors.

Part 91 generally states that all Stage 2 aircraft, over 75,000 pounds, will be out of the domestic fleet by December 31, 1999. There are a few exceptions, but for the most part, only Stage 3 aircraft greater than 75,000 pounds will be in the domestic fleet after that date. The airlines have options on how and when to phase-out Stage 2 aircraft, but it is anticipated that the domestic fleet in the mainland will be all Stage 3 by the year 2000.

Part 161 sets out the requirements and procedures for implementing new airport use and access restrictions by airport proprietors. Proprietors must use the DNL metric to measure noise effects, and that the Part 150 land use guideline table, including 65 dB DNL as the threshold contour, be used to determine compatibility, unless there is a locally adopted standard more stringent.

The regulation identifies three types of use restrictions and treats each one differently: negotiated restrictions, Stage 2 aircraft restrictions and Stage 3 aircraft restrictions. Generally speaking, any use restriction which affects the number or times of aircraft operations will be considered an access restriction. Even though the Part 91 phase-out does not apply to aircraft under 75,000 pounds, FAA has determined that Part 161 limitations on proprietors authority applies as well to the smaller aircraft.

Negotiated restrictions are more favorable from the FAA's standpoint, but still require unwieldy procedures for approval and implementation. They must be agreed upon by all airlines, and public notice must be given.

Stage 2 restrictions are more difficult, as one of the major reasons for ANCA was to discourage local restrictions more stringent that the ANCA's 1999 phase-out. To comply with the regulation and institute a new Stage 2 restriction, the proprietor must generally do two things. It must prepare a cost/benefit analysis of the proposed restriction and give proper notice. The cost/benefit analysis is extensive and entails considerable evaluation. Stage 2 restrictions require approval by the FAA.

Stage 3 restrictions are especially difficult to implement. A Stage 3 restriction involves considerable additional analysis, justification, evaluation and financial discussion. In addition, a Stage 3 restriction must result in a decrease in noise exposure of the 65 dB DNL to noise sensitive land uses (residences, schools, churches, parks). The regulation requires both public notice and FAA approval.

ANCA applies to all local noise restrictions that are proposed after October, 1990. It also applies to amendments to existing restrictions proposed after October, 1990. There have not been any Part 161 evaluations approved by the FAA to date.

Environmental Protection Agency Noise Assessment Guidelines

Environmental Protection Agency, "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety".

In March 1974 the EPA published a very important document [1] entitled "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety" (EPA 550/9-74-004). In this document, 55 dB DNL is described as the requisite level with an adequate margin of safety for areas with outdoor uses, this includes residences, and recreational areas. This document does not constitute EPA regulations or standards. Rather, it is intended to "provide State and local governments as well as the Federal Government and the private sector with an informational point of departure for the purpose of decision-making". Note that these levels were developed for suburban type uses. In some urban settings, the noise levels will be significantly above this level, while in some wilderness settings, the noise levels will be well below this level. The EPA "levels document" does not constitute a standard, specification or regulation, but identifies safe levels of environmental noise exposure without consideration for economic cost for achieving these levels.

Federal Interagency Committee on Noise

Federal Interagency Committee on Noise (FICON) Report of 1992 [13]

The use of the DNL metric and the 65 dB CNEL criteria has been subject to criticism from various interest groups concerning its usefulness in assessing aircraft noise impacts. As a result, at the direction of the EPA and the FAA, the Federal Interagency Committee On Noise (FICON) was formed to review specific elements of the assessment of airport noise impacts and to make recommendations regarding potential improvements. FICON is composed of representatives from the Departments of Transportation, Defense, Justice, Veterans Affairs, Housing and

Urban Development, the Environmental Protection Agency, and the Council on Environmental Quality.

FICON was formed to review Federal policies that are used in the assessment of airport noise impacts. The FICON review focused primarily on the manner in which noise impacts are determined, including whether aircraft noise impacts are fundamentally different from other transportation noise impacts; the manner in which noise impacts are described; and the extent of impacts outside of Day-Night Average A-Weighted Sound Level (DNL) 65 decibels (dB) that should be reviewed in a National Environmental Policy Act (NEPA) document.

The committee determined that there are no new descriptors or metrics of sufficient scientific standing to substitute for the present DNL cumulative noise exposure metric. The methodology employing DNL as the noise exposure metric and appropriate dose-response relationships to determine noise impact is considered the proper one for civil and military aviation scenarios in the general vicinity of airports. The report does support agency discretion in the use of supplemental noise analysis. The report does recommend improvement in public understanding of the DNL, supplemental methodologies and aircraft noise impacts.

The report states that if the screening analysis shows that noise-sensitive areas that are exposed to noise levels at or above DNL 65 dB and have an increase of DNL 1.5 dB or more, then further analysis should be conducted. For noise sensitive areas between DNL 60-65 dB and an increase of DNL 3 dB or more due to the proposed airport noise exposure then further analysis should also be conducted.

Methodology

The existing noise environment at Centennial Airport was determined through a comprehensive noise measurement survey and modeling assessment. The foundation of a Part 150 Noise Study is the accurate prediction of airport noise levels. The noise environment at Centennial Airport has been depicted through the employment of noise measurement surveys of aircraft events and ambient noise levels, collection of aircraft operational data, and the incorporation of this information into an airport noise computer model.

The methods used here for forecasting the future noise environment rely heavily on computer noise modeling. These noise contours are supplemented here with specific noise data for selected points on the ground. The noise environment is commonly depicted in terms of lines of equal noise levels, or noise contours. Generating accurate noise contours is largely dependent upon the use of a reliable, validated, and updated noise model. Testing the validity of the computer model results using on-site noise measurements is one of the most effective methods of ensuring accurate noise contours. The following section details the methodology that was used in the measurement survey and the computer modeling of these

results into noise contours. The operational data used in the analysis is also presented.

Noise Measurement Survey

Purpose of Measurement Survey. A noise measurement survey is an integral part of the Part 150 Noise Study. The purpose of the noise survey includes:

- Determine aircraft noise levels specific to the local environment
- Validate the computer model using the measurement results
- Determine the noise level at example locations around the Airport
- Give confidence to the community in the accuracy of the results of the study

Noise Measurement Locations. Noise measurements were recently conducted at selected locations around the airport. The measurement locations were selected on the basis of: (1) proximity to aircraft flight tracks, (2) the proximity to noise sensitive land use areas, and (3) ambient noise levels.

The measurement locations are presented in Figures C9 and C10. Each of the sites are also described in Table C2. The measurement sites are divided into two classes. Figure C9 presents the semi-permanent locations that were used for continuous measurement of the aircraft noise. Figure C10 presents the temporary locations that were used for short-term spot measurement and ambient noise measurements.

Measurement Procedures. Noise measurements were conducted at various sites over several days for each site between July 26th, 1999 and August 21st, 1999. The equipment was checked and calibrated on a regular basis. The noise measurement survey was in compliance with FAR Part 150 guidelines

Aircraft identification was determined from on-site field observations by the acoustical engineer, flight strip information, night aircraft logs, Aircraft Situational Display (ASD) data, and aircraft radar tracking system (ARTS) flight track data. The ARTS collected during the survey identified included the time of the operation, the type of aircraft, and the runway and flight track used.

Table C2
NOISE MEASUREMENT LOCATIONS
Centennial Airport FAR Part 150 Study

Sites	Address	Neighborhood
Semi-Permanent Sites		
1	9766 Edgewater Place	Lone Tree
2	12270 Orchard Avenue	Cherry Creek State Park
3	9880 E. Chenango Avenue	Village on the Lake
4	9672 S. Meridian Blvd.	Meridian Golf Club
5	16701 E. Costilla Avenue	Foxfield
6	12577 N. 2nd Street	Grand View Estates
7	15603 E. Chenango Avenue	Aurora
8	S. Yosemite & Crooked Stick Tr.	Heritage Estates
9	6090 Nome Street	Cherry Creek Vista
10	10026 E. Berry Drive	Sundance Hills
Temporary Sites		
11	Cottonwood Creek Elem. School	Cherry Creek Vista
12	9819 Ida Circle	Sundance Hills
13	8851 Xanthia Street	Hunter's Hill
14	West Shade Shelters	Cherry Creek State Park
15	East Shade Shelters	Cherry Creek State Park

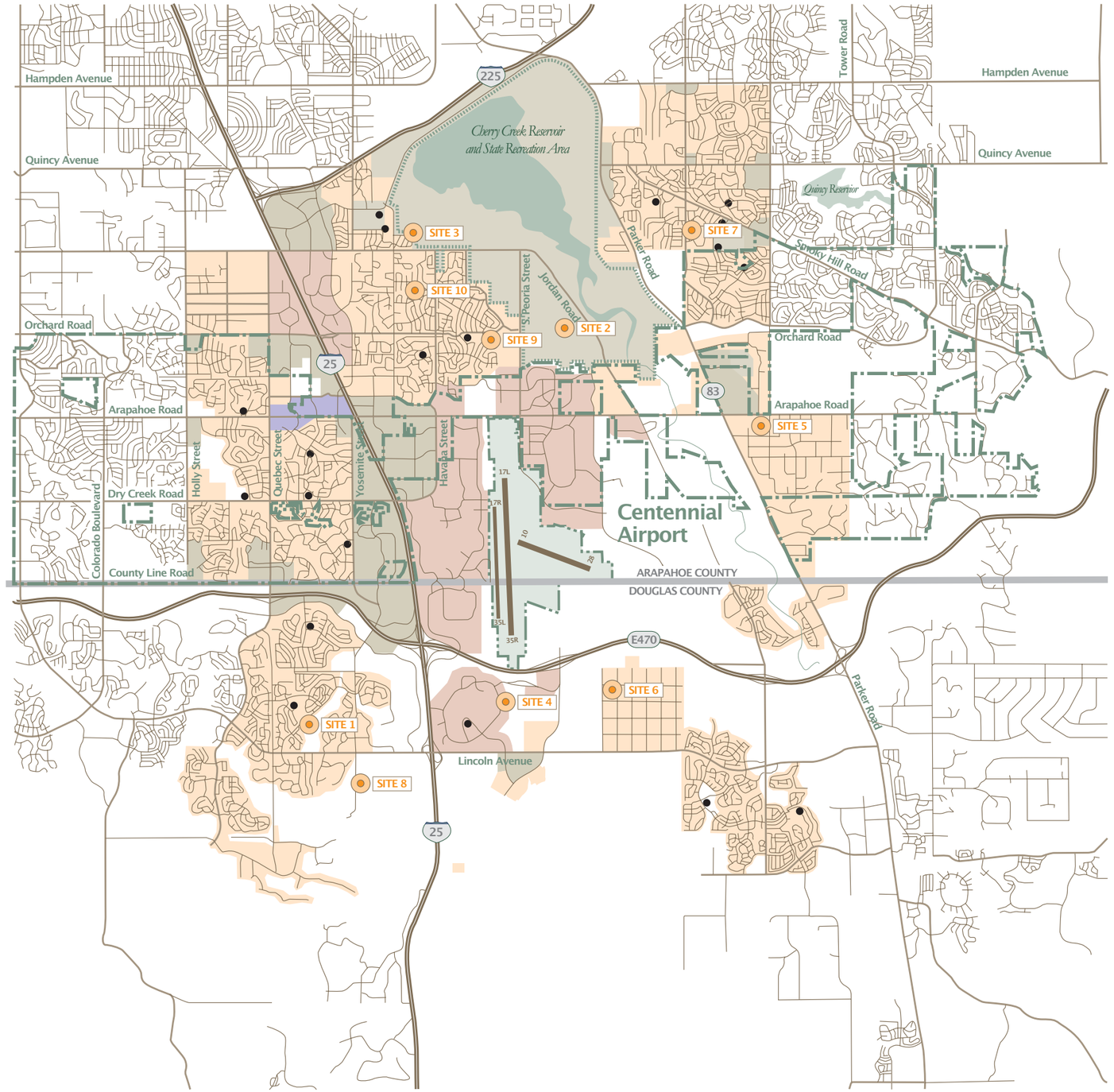


Figure C9 ***Semi-Permanent Noise Monitoring Locations*** *(Sites 1-10)*

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *Semi-Permanent Noise Monitoring Site*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Landiscor Aerial Information - 1998. Noise Monitoring Sites, BCS International Noise Analysis - 1999.*

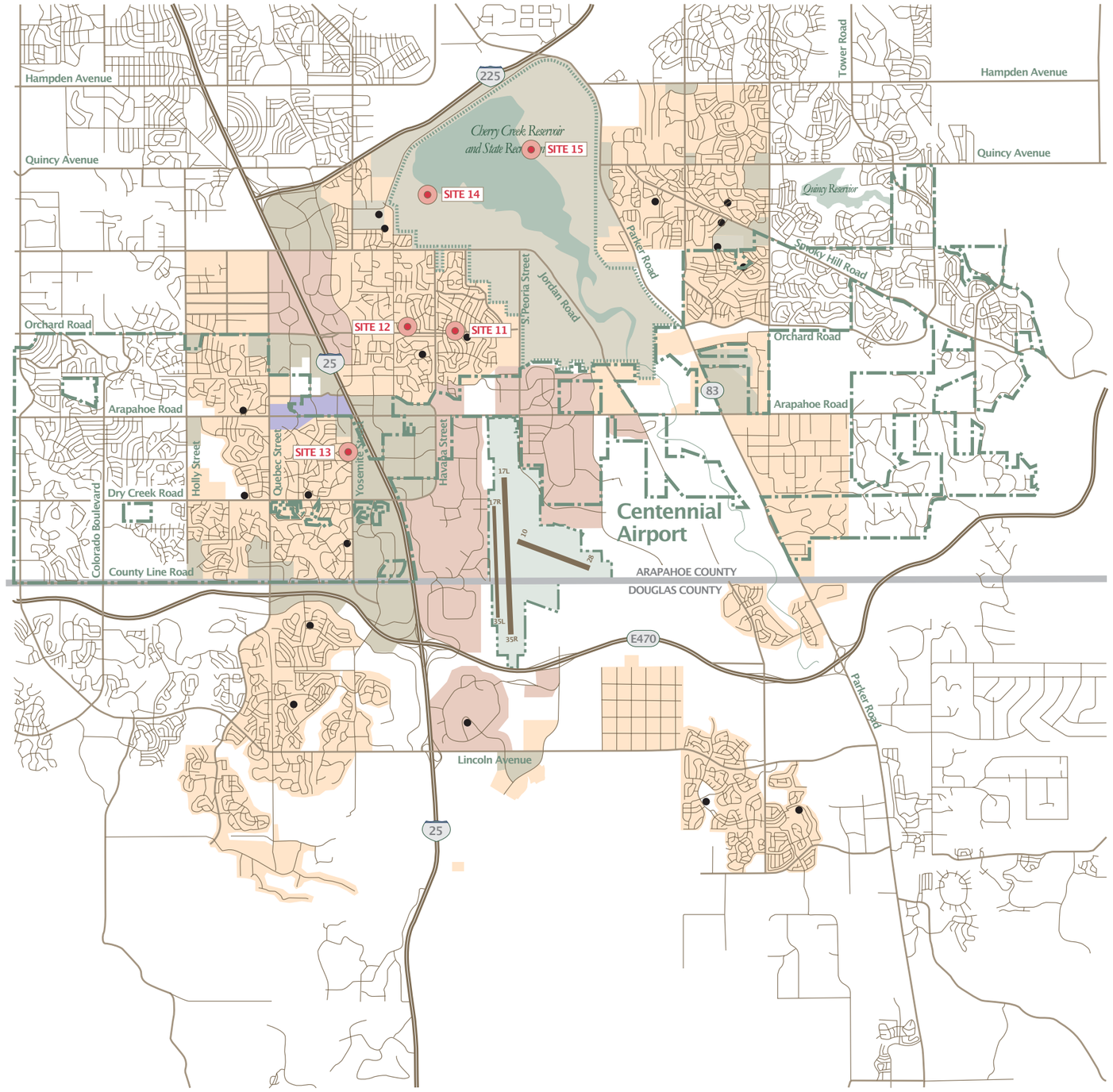


Figure C10 ***Temporary Noise Monitoring Locations***
(Sites 11-15)

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban Temporary Noise Monitoring Site*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Landiscor Aerial Information - 1998. Noise Monitoring Sites, BCS International Noise Analysis - 1999.*

Acoustic Data. The noise measurement survey utilized specialized noise monitoring instrumentation that allowed for the measurement of aircraft single event data and ambient noise levels. The noise data that was determined from each of the semi-permanent noise measurement sites is listed below:

- Daily DNL Noise Level
- Hourly Noise Data (LEQ, Level Percent, Time Above)
- Single Event Data (SEL, Lmax and Duration) for Individual Aircraft
- Correlation of Noise Data with Aircraft Identification
- Non-aircraft Ambient Sound Level (Level Percent)

For portions of the noise measurement the survey utilized instrumentation that included software that provide continuous measurement and storage of the 1 second LEQ noise level. From this data the above noise descriptors could be calculated. In addition, this data could be used to plot the time histories of any of the noise events of interests. Examples of the time histories of various noise events are presented throughout the report.

The temporary sites were used to measure aircraft single event noise levels (SEL) and ambient noise level descriptors.

Instrumentation. The monitoring program was consistent with state-of-the-art noise measurement procedures and equipment. The measurements consisted of monitoring the A-weighted decibel in accordance with procedures and equipment which comply with specific International Standards (IEC), and measurement standards established by the American National Standards Institute (ANSI) for Type 1 instrumentation.

These sites utilized Brüel and Kjaer 2236 Sound Level Meters. The analyzers automatically calculate the various single event data. The Brüel and Kjaer system includes software that provides storage of the data for later retrieval and analysis.

During the survey the noise monitoring instrumentation was calibrated at the start and end of each measurement cycle. This calibration was traceable to the National Institute of Standards and Technology, formerly the National Bureau of Standards. An accurate record of the meteorological conditions that existed during the time of the measurements was kept.

Computer Modeling

Contour modeling is a very key element of this noise study. Generating accurate noise contours is largely dependent on the use of a reliable, validated, and updated noise model. It is imperative that these contours be accurate for the meaningful analysis of airport and roadway noise impacts. The computer model can then be

used to predict the changes to the noise environment as a result of any of the development alternatives under consideration.

The FAA's Integrated Noise Model (INM) Version 6.0 was used to model the flight operations contours at Centennial Airport. The INM has an extensive database of civilian aircraft noise characteristics and this most recent version of INM incorporates the advanced plotting features that are part of the Air Forces Noisemap computer model.

Airport noise contours were generated in this study using the INM Version 6.0. The original INM was released in 1977. The latest version, INM Version 6.0, was released for use in late 1999 and is the state-of-the-art in airport noise modeling. The INM is a large computer program developed to plot noise contours for airports. The program is provided with standard aircraft noise and performance data for over 200 aircraft types that can be tailored to the characteristics of the airport in question. Version 6.0 includes an updated data base that includes some newer aircraft, the ability to include run-ups in the computations, the ability to include topography in the computations, and the provision to vary aircraft profiles in an automated fashion.

One of the most important factors in generating accurate noise contours is the collection of accurate operational data. The INM programs require the input of the physical and operational characteristics of the airport. Physical characteristics include runway coordinates, airport altitude, and temperature and optionally, topographical data. Operational characteristics include various types of aircraft data. This includes not only the aircraft types and flight tracks, but also departure procedures, arrival procedures and stage lengths that are specific to the operations at the airport. Aircraft data needed to generate noise contours include:

- Number of aircraft operations by type
- Types of aircraft
- Day/Evening/Night time distribution by type
- Flight tracks
- Flight track utilization by type
- Flight profiles
- Typical operational procedures
- Average Meteorological Conditions

INM Modeling Assumptions

The Integrated Noise Model Version 6.0 was used to develop DNL contours for the existing conditions and each of the alternatives. Operations data in existing conditions section describe the runway use percentages, aircraft types, and time of day of operations used in the INM to develop the DNL contours. Topographic effects were not included in the DNL computations, however average wind effects were included. These are described in the following paragraphs:

Topographic Effects - The effect of topography on noise levels near an airport may be important where there are significant elevation differences between the airport and surrounding environs. The INM Version 6.0 has the optional capability to include topographic effects on sound propagation from aircraft. The INM modeling completed for these analyses did not include using the topographic feature of the INM, since the changes in the elevation surrounding the airport is relatively insignificant.

Average Wind Effects - The Integrated Noise Model includes standard takeoff and approach profiles. The takeoff and approach profiles include a description of the aircraft altitude and airspeed along the flight path. These profiles are based on an assumed 8-knot headwind for all operations. INM Version 6.0 allows the use of other headwind assumptions that result in changes in aircraft profiles. The Centennial Airport site has no unique runway, topographic, and winds characteristics that will result in aircraft operating into headwinds significantly different than 8 knots. Therefore, for all approach and departure profiles, it was assumed that the average headwind for all operations on all runways was 8 knots.

Existing Aircraft Operations

The existing noise environment for Centennial Airport was analyzed based upon 1999 operational conditions. The data was derived from various sources. This includes aircraft tower counts, night traffic counts, review of aircraft flight strips, ASD data, ARTS flight track data, field observations and a review of the results of the noise measurement survey. A variety of operational data is necessary in order to determine the noise environment around the airport. This data includes the following summary information and is discussed in detail in the following paragraphs:

- Aircraft Activity Levels
- Fleet Mix
- Time of Day
- Runway Use
- Flight Path Utilization

Aircraft Activity Levels. The total aircraft operational levels were derived directly from the Centennial Airport air traffic control tower counts. The tower count data showed that for the year 1999 there were a total of 436,081 operations, or an average of 1,195 operations per day (an operation is one takeoff or one landing). The breakdown by aircraft category was determined from a variety of sources this includes:

- Review of the aircraft based at Centennial
- Percentages presented in the 1996 Noise and Land Use Study
- Radar flight data from July 26th, 1999 through August 21st, 1999
- Aircraft Situational Display (ASD) Radar data for 1999

The 1999 aircraft operations for each category of operation are summarized in Table C3. These operations are categorized as business jets, turboprop, and general aviation aircraft. The total number of annual corporate jet aircraft was determined from the ASD data source. The ASD provides information on aircraft that file an instrument flight plan. It accounts for nearly all larger aircraft including corporate jets. Larger twin engine propeller aircraft are also counted in ASD. But smaller visual flight aircraft are not included.

Table C3
SUMMARY OF OPERATIONS, EXISTING 1999
Centennial Airport FAR Part 150 Study

Category Type	Annual Operations	Daily Operations	Percent Nighttime
Business Jets			
Stage 3	27,406	75.1	25%
Business Jets			
Stage 2	5,594	15.3	19%
General Aviation			
Single Engine Piston	330,081	904.6	5%
Multi-Engine Piston	37,000	101.4	5%
Turboprop	24,000	65.7	5%
Helicopter	12,000	32.9	5%
Total Operations	**436,081**	**1,195**	

Fleet Mix. The fleet mix of aircraft that operate at the airport is one of the most important factors in terms of the aircraft noise environment. The corporate jet fleet mix data was determined from an extensive review of the ASD database. The fleet mix assumptions for the corporate jets are presented in Table C4.

The mix of corporate jet aircraft is an important consideration. There are a wide variety of corporate jets that operate at Centennial Airport and these aircraft generate a wide range in noise. The analysis was based upon a compilation of over 25,000 corporate jet aircraft operations at the airport. Table C4 presents the percentage of operations by type for corporate jets. The operations were grouped into multiple categories of corporate jets.

The airport has a number of Stage II corporate jet aircraft. Stage II refers to the FAA's Federal Aircraft Regulations 36 that categorizes jet aircraft based upon noise levels. Stage II refers to the older louder aircraft. Stage III refers to the newer generation quieter aircraft. For corporate jet aircraft the fleet was calculated to be 17 percent Stage II.

Table C4
PERCENTAGE OF OPERATIONS BY TYPE FOR CORPORATE JETS
EXISTING 1999
Centennial Airport FAR Part 150 Study

Aircraft Type	Stage	INM Type	Annual Operations				Total	Percent Night
			Arrivals Day	*Arrivals Night*	*Departures Day*	*Departures Night*		
Astra Jet	3	IA1125	445	46	473	18	983	7%
Beech Jet	3	LEAR35	299	28	313	14	654	6%
Cessna 500/501	3	CNA500	424	33	442	15	914	5%
Cessna 525	3	CNA500	367	22	355	34	779	7%
Cessna 550/551	3	MU3001	415	233	589	60	1298	23%
Cessna 560	3	MU3001	807	51	759	98	1715	9%
Cessna 650	3	CIT3	469	34	462	41	1005	7%
Cessna 750	3	CL601	245	19	235	29	528	9%
Challenger	3	CL601	779	79	805	53	1715	8%
Diamond	3	MU3001	68	18	82	4	172	12%
Falcon 10	3	LEAR35	150	22	161	11	344	10%
Falcon 20	2/3	FAL20	134	12	135	11	292	8%
Falcon 20/200	3	FAL20	118	15	125	7	265	8%
Falcon 200	3	LEAR35	452	57	440	69	1017	12%
Falcon 2000	3	CL601	155	15	163	6	339	6%
Falcon 50	3	GIV	351	29	356	25	762	7%
Falcon 900	3	GIV	226	16	219	23	484	8%
Gulfstream II/III	2	GIIB	550	49	573	26	1199	6%
Gulfstream IV/V	3	GIV	340	22	337	26	725	7%
Hawker A	3/2	SABR80	285	14	259	39	597	9%
Hawker A/B/C	3/2	SABR80	106	10	107	9	231	8%
Hawker B	3/2	SABR80	731	54	738	47	1570	6%
Hawker C	3	SABR80	192	7	183	16	398	6%
Jet Commander	2	LEAR25	25	1	24	1	52	5%
Jet Star	2	LEAR25	29	-	28	1	59	2%
Lear 23/24/25/28	2	LEAR25	1,113	453	1,084	483	3133	30%
Lear 31/35/36	3	LEAR35	2,433	2,705	2,445	2,693	10277	53%
Lear 45/55/60	3	GIV	587	36	572	51	1246	7%
Saberlinear	2/3	SABR80	122	-	113	8	243	3%
Total			**12,419**	**4,081**	**12,578**	**3,922**	**33,000**	**24%**

Time of Day. In the DNL metric, any operations that occur after 10 p.m. and before 7 a.m. are considered more intrusive and are weighted by 10 dBA. Therefore, the number of nighttime operations is very critical in determining the DNL noise environment and is also very important to the residences around Centennial Airport. The nighttime operations assumptions was estimated from a variety of sources. This included a review of the ASD data, radar data and the noise measurement survey data. The nighttime operational assumption data was summarized in Table C3 and C4. Table C4 presents the actual nighttime operations by each type of corporate jet for the entire year of 1999. This is based upon the ASD data information. Operations per each hour of the data is presented in Appendix A.

Runway Use. An additional important consideration in developing the noise contours is the percentage of time each runway is utilized. The speed and direction of the wind dictate the runway direction that is utilized by an aircraft. From a safety and stability standpoint, it is desirable, and usually necessary, to arrive and depart an aircraft into the wind. When the wind direction changes, the operations are shifted to the runway that favors the new wind direction.

The wind is generally calm with predominate wind direction from the south. Therefore, Runways 17L and 17R are utilize more than the reverse runway direction (Runways 35R and 35L). In addition, Centennial Airport has one crosswind runway that is also used to a lessor degree by small aircraft. The airport also has a preferential runway use program to use south flow departures during the nighttime hours (10 pm to 6 am). The runway utilization assumptions used in the study are presented in Tables C5 and C6. These tables present the percentage of operations by category utilizing each of the runways, for daytime and nighttime hours, respectively. A graphical presentation of this data is presented in the Appendix.

Table C5
DAYTIME RUNWAY UTILIZATION
Centennial Airport FAR Part 150 Study
(7 am to 10 pm)

Aircraft Type	Percentage Utilization					
	35R	**17L**	**35L**	**17R**	**10**	**28**
Arrivals						
Single Engine Local	4%	6%	33%	51%	1%	5%
Single Engine Itinerant	33%	51%	4%	6%	1%	5%
Multi Engine Prop	34%	53%	4%	6%	1%	2%
Corporate Jets	38%	60%	0%	0%	1%	1%
Departures						
Single Engine Local	4%	6%	33%	51%	5%	1%
Single Engine Itinerant	33%	51%	4%	6%	5%	1%
Multi Engine Prop	34%	53%	4%	6%	2%	1%
Corporate Jets	38%	60%	0%	0%	1%	1%

Table C6
NIGHTTIME RUNWAY UTILIZATION
Centennial Airport FAR Part 150 Study
(10 pm to 7 am)

Aircraft Type	Percentage Utilization					
	35R	**17L**	**35L**	**17R**	**10**	**28**
Arrivals						
Single Engine Local	3%	7%	26%	61%	1%	2%
Single Engine Itinerant	26%	61%	3%	7%	1%	2%
Multi Engine Prop	26%	61%	3%	7%	1%	2%
Corporate Jets	30%	68%	0%	0%	1%	1%
Departures						
Single Engine Local	3%	7%	21%	66%	2%	1%
Single Engine Itinerant	21%	66%	3%	7%	2%	1%
Multi Engine Prop	21%	66%	3%	7%	2%	1%
Corporate Jets	24%	74%	0%	0%	1%	1%

Flight Path Utilization. The airport and tower have established paths for aircraft arriving and departing from Centennial Airport. These paths are not precisely defined ground tracks, but represent a broad area over which the aircraft will generally fly. The modeling analysis includes a total of 19 departure flight tracks and 16 arrival flight tracks to model the aircraft flight paths at Centennial Airport. Aircraft flight tracks were obtained by observations during the measurement survey, discussions with airport staff and air traffic control personnel, review of aeronautical charts, and actual radar data plots of the aircraft departures and arrivals. The flight tracks presented in Figures C11 show the departure and arrival jet tracks for a typical south flow day, and flight tracks presented in Figure C12 show the departure and arrival jet tracks for a typical north flow day. The departure and arrival flight tracks for each day during the noise monitoring survey are show in the Appendix A.

The flight track data was used to help define the location of the aircraft flight paths and in the correlation of the noise measurement data with the aircraft operational data.

The flight paths developed for use in the INM model are presented in Figures C13 and Figure C14. Figure C13 presents departure flight paths. Figure C14 presents arrival flight paths.

Figure C11 -- Example South Flow Jet Tracks
Centennial Airport
Arrivals Departures

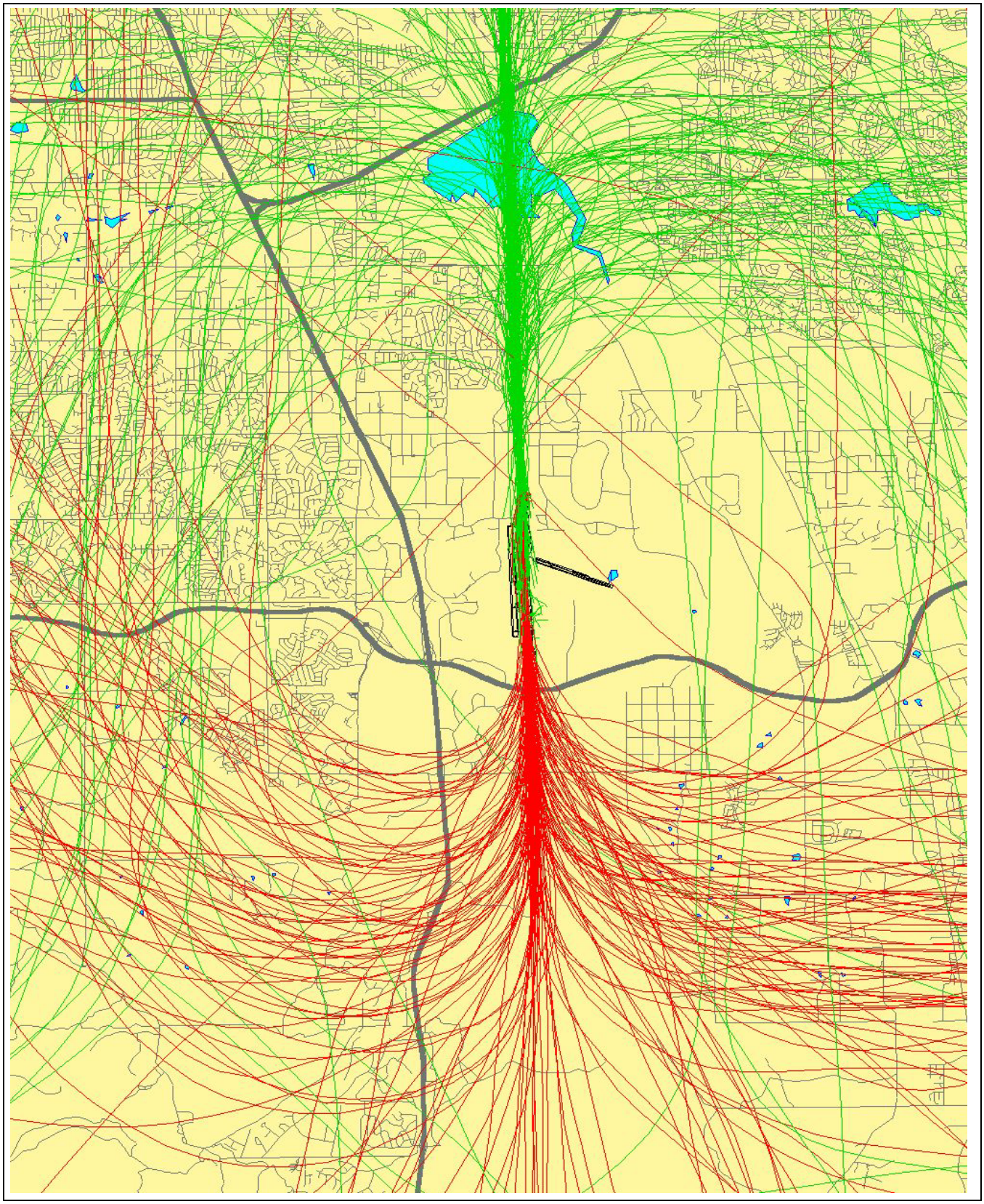
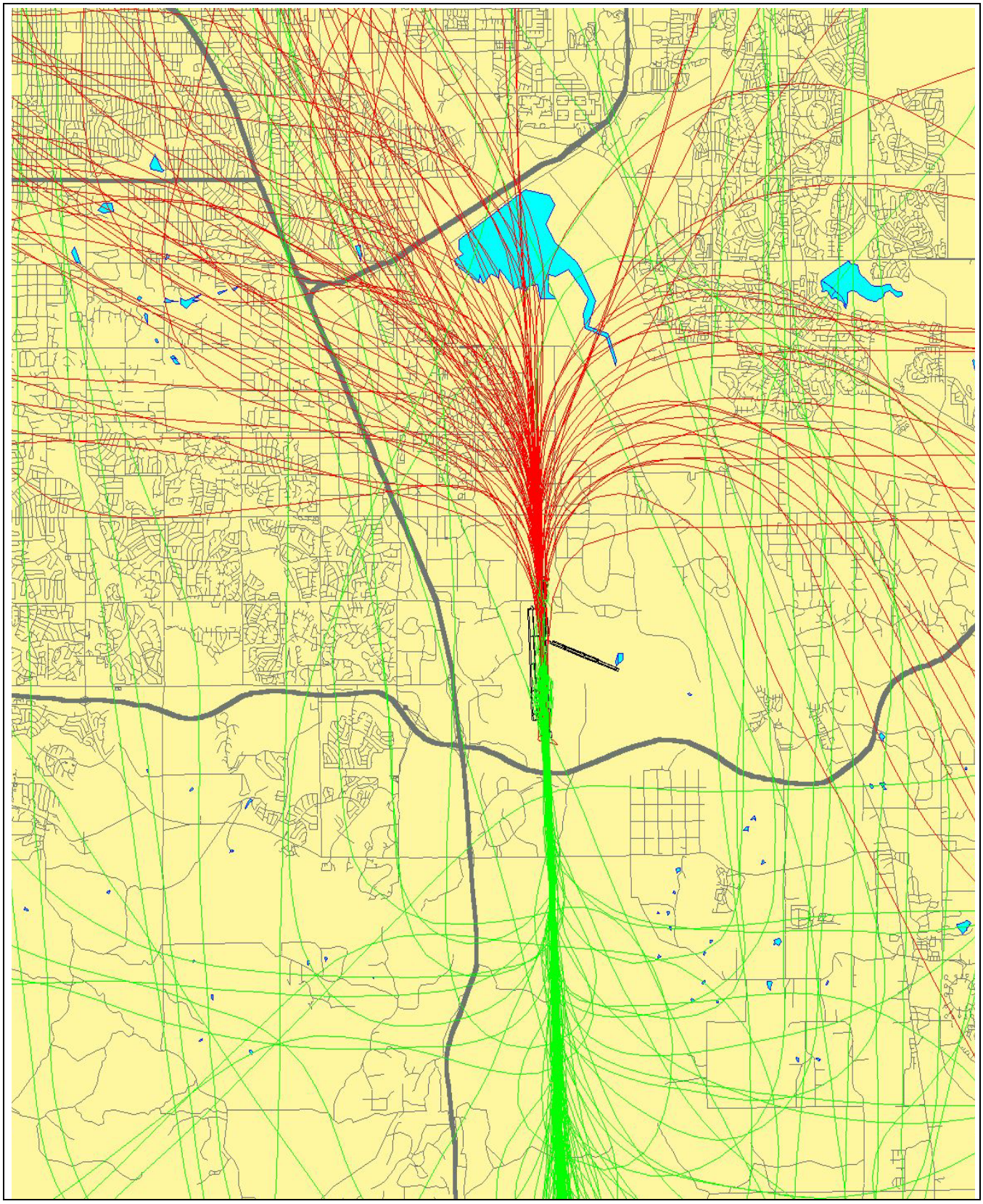


Figure C12 -- Example North Flow Jet Tracks
Centennial Airport
Arrivals Departures



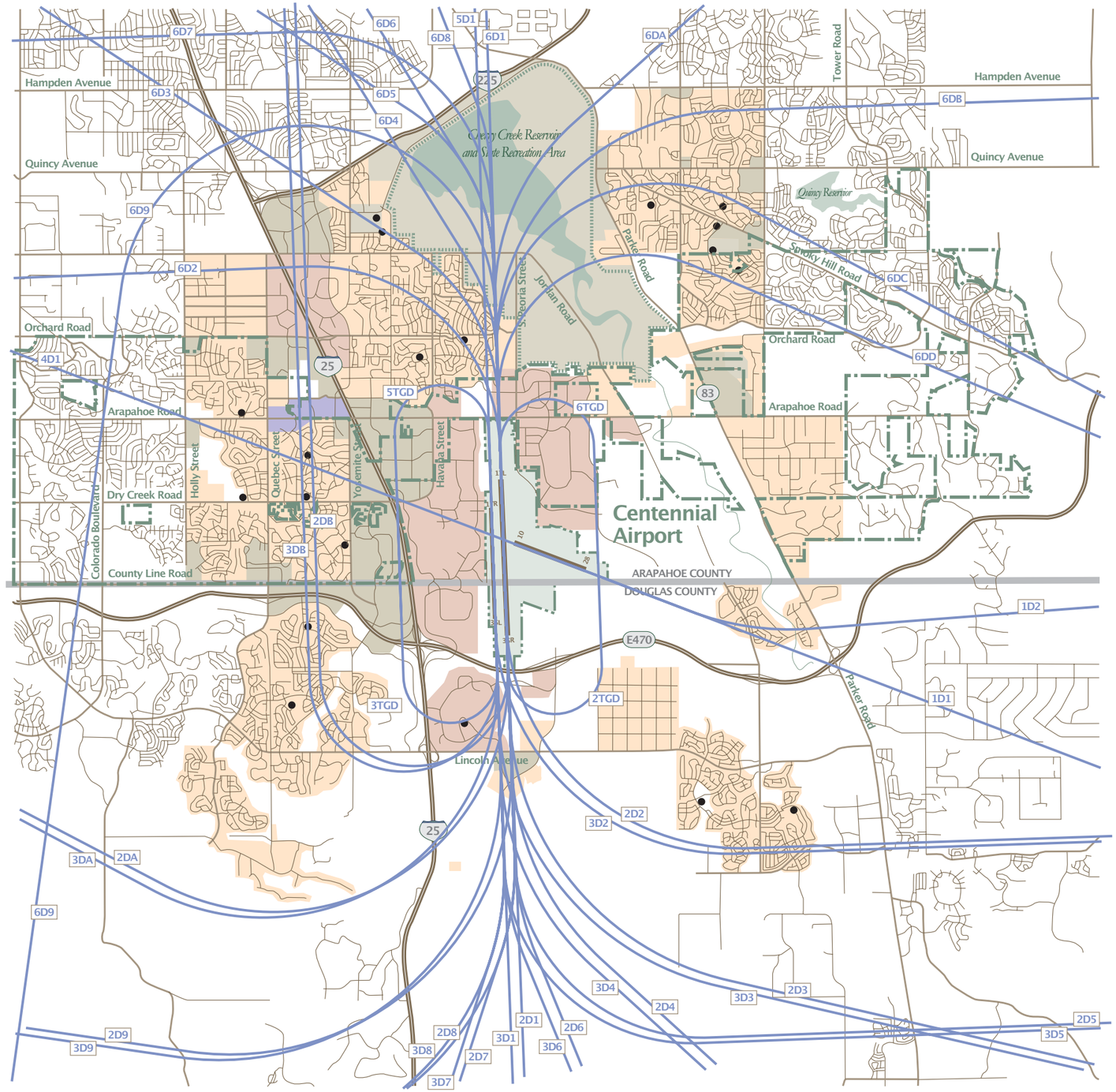


Figure C13 ***INM Departure Flight Tracks***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Landiscor Aerial Information - 1998. Departure Filght Tracks, BCS International Noise Analysis - 1999.*

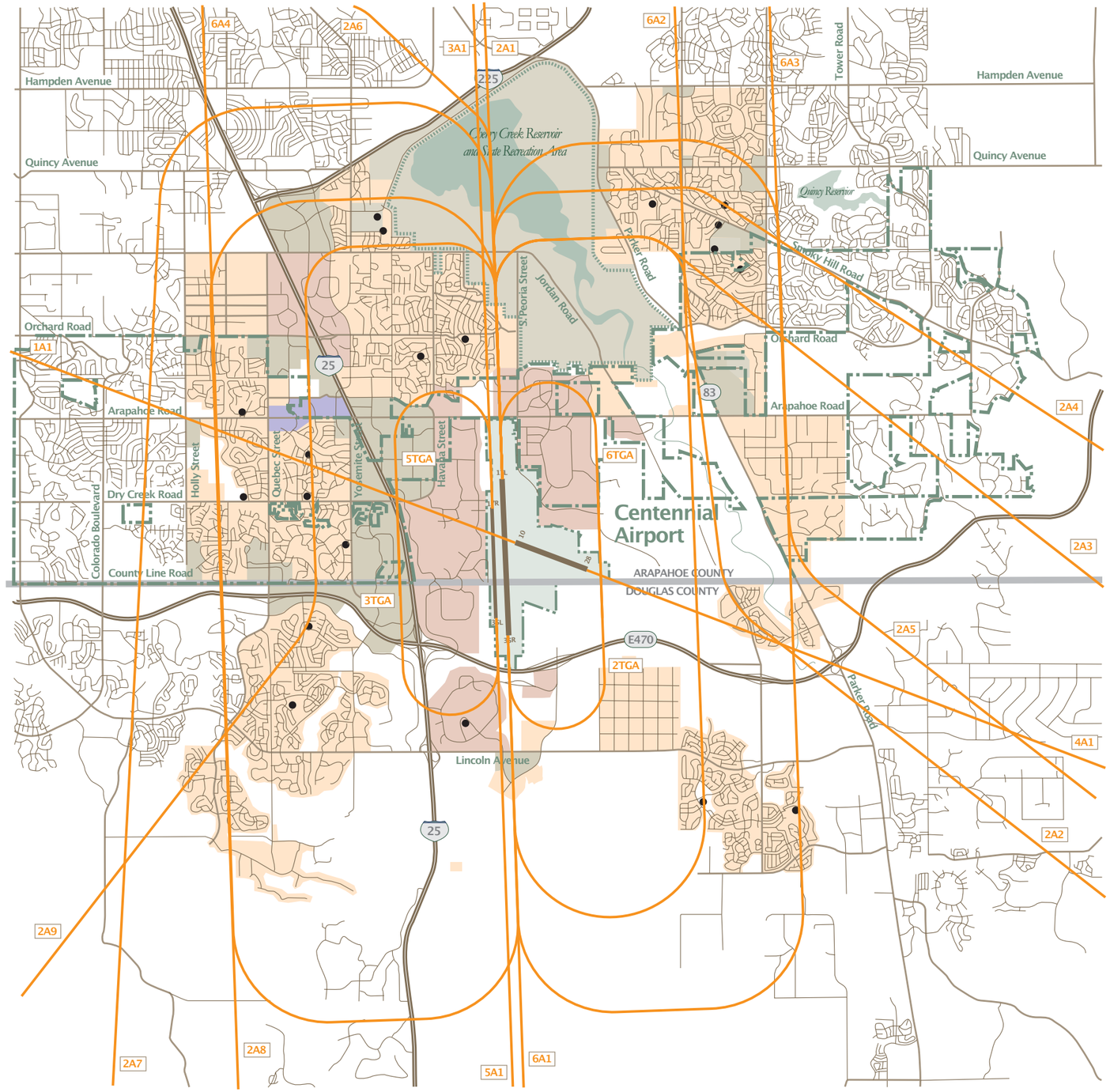


Figure C14 ***INM Arrival Flight Tracks***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Landiscor Aerial Information - 1998. Arrival Filght Tracks, BCS International Noise Analysis - 1999.*

Future 2005 Aircraft Operations

The future noise environment for Centennial Airport was analyzed based upon 2005 forecast operational conditions. The forecasts were presented in Chapter Two.

Aircraft Activity Levels. The forecasts estimates that there will be 472,000 operations during that time period, or an average of 1,293 operations per day (an operation is one takeoff or one landing). The 2005 aircraft operations for each category of operation are summarized in Table C7.

Table C7
SUMMARY OF PRELIMINARY OPERATIONS, FUTURE 2005
Centennial Airport FAR Part 150 Study

Category Type	Annual Operations	Daily Operations	Percent Nighttime
Business Jets			
Stage 3	34,860	95.5	25%
Business Jets			
Stage 2	7,140	19.6	19%
General Aviation			
Single Engine Piston	340,000	931.5	5%
Multi-Engine Piston	43,000	117.8	5%
Turboprop	35,000	95.9	5%
Helicopter	12,000	32.9	5%
Total Operations	**472,000**	**1,293**	

All remaining assumptions are the same as with the existing conditions except for the mix of aircraft for the future year. The corporate jet fleet mix and night time percentages are assumed to remain the same.

These are Preliminary Forecasts, which will be refined based upon input from the committee. The total numbers are based on the Terminal Area Forecasts and the fleet mix existing fleet mix which also were used to identify the Stage 2/Stage 3 business jet fleet mix. Alternative forecasts with different fleet mix assumptions are presented in the future noise contour analysis section of this report.

Existing Noise Environment

The following section presents information concerning the existing noise environment at Centennial Airport. The existing noise environment was determined through a noise measurement and modeling assessment. Operational data used to describe the existing conditions was summarized in the previous subsection. The results of the noise measurement survey and contour modeling are presented in the following paragraphs. The analysis presents noise data in terms of the DNL metric and supplemental Single Event noise data. More detailed information is presented in the Appendices.

Noise Measurement Results

Noise measurements were conducted between July 26, 1999 and August 21, 1999 at various locations around the airport. A total of ten (10) sites were monitored around Centennial Airport using semi-permanent noise monitors. These sites were presented in Figure C9 and included noise monitors that measured around the clock for as long as the monitors were present. These sites were measured from 10 to 27 days during the time period of the survey.

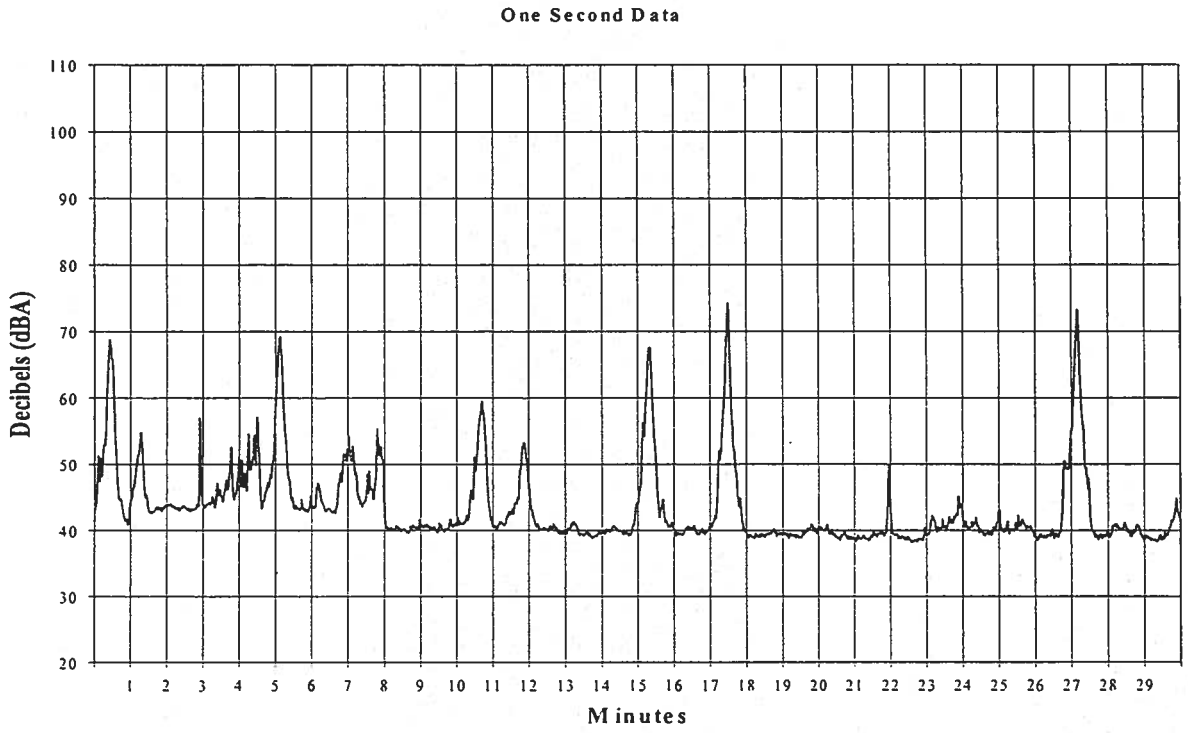
The measurements consisted of: (1) single event noise levels from individual aircraft flyovers, (2) cumulative 24-hour continuous measurements, and (3) ambient non-aircraft noise sources. The survey also utilized specialized equipment that allowed for the recording and display of the compete time history of the noise.

The survey also included temporary event noise measurements at five (5) additional monitoring sites. These sites were short-term measurements that also included some spot measurements of aircraft single event noise levels, and were presented in Figure C10. The DNL noise level was not measured at these sites. The results of the measurement survey are presented in the following paragraphs.

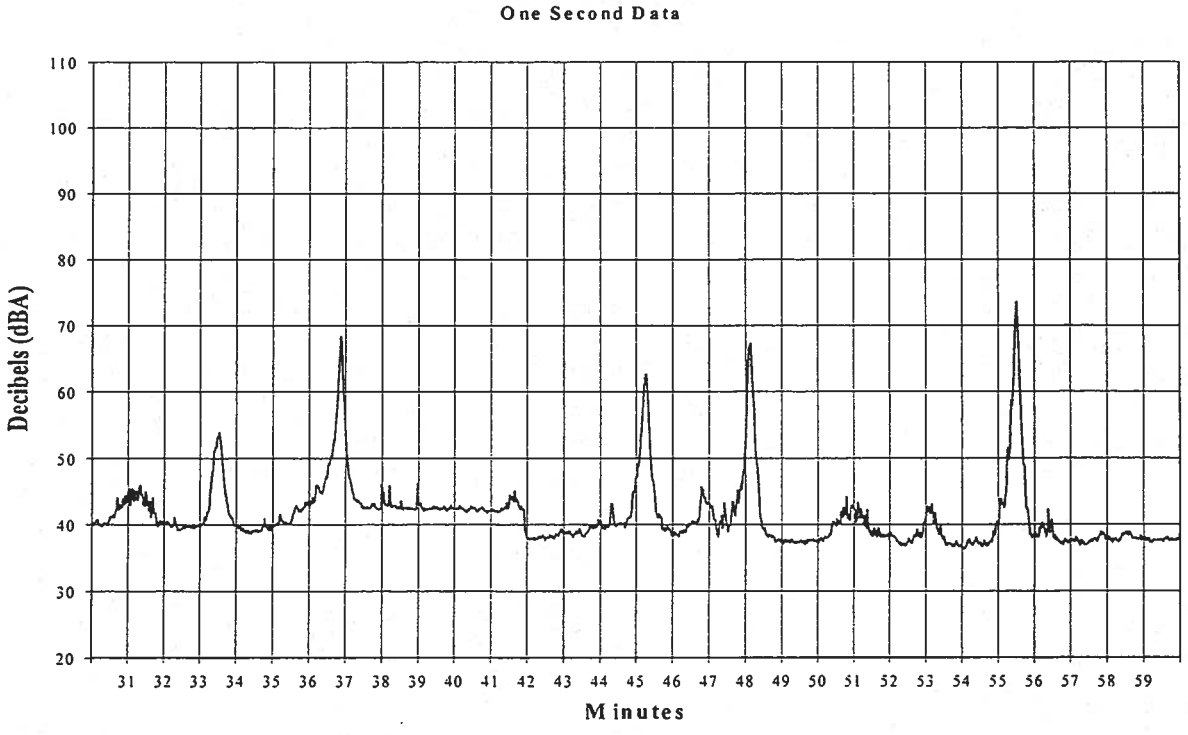
The noise level was continuously recorded at each of the ten noise monitoring sites. In addition to recording the noise events from aircraft, the monitors also recorded the ambient noise level of the community surrounding the monitoring site. An example of this is presented in Table C8 where one hour of continuous noise data is shown for one site. The difference between an aircraft event and the ambient noise can be easily distinguished in this plot. Sample one-hour noise plots for each of the noise monitoring sites is presented in Appendix B.

Table C8 - Hourly Noise Graph by Site
Centennial Airport
Site: 09 - Cherry Creek Vista

Period: Aug 9 1999 08:00:00 to Aug 9 1999 08:30:00



Period: Aug 9 1999 08:30:00 to Aug 9 1999 09:00:00



Single Event Noise Measurement Results. Aircraft single event noise levels were determined from this continuous noise data at each of the measurement sites. The acoustic data included the maximum noise level (Lmax), Sound Exposure Level (SEL), and the time duration of the aircraft events. The noise data was correlated to the aircraft that caused the event using the flight track data that was simultaneously collected. The aircraft data included the aircraft type, type of operation and runway. The single event noise level data measured in the field was reduced and coded into a microcomputer-based data management program. This program includes a list of all of the aircraft events that can be analyzed in order to present various types of aircraft noise event information.

The daily number of noise events measured at each site is presented graphically in Table C9. This table presents one day of events for one measurement site. The table presents the SEL noise value plotted as a histogram. The vertical axis presents the number of events in each hour. The horizontal axis is the hour of the day. The SEL values are plotted vertically for each event in each hour. This data is presented for additional days and additional sites in Appendix B.

The noise measurement data was used to determine the SEL noise levels for different types of aircraft operations. The ARTS data and the ASD were then used to correlate the measured noise levels to the specific aircraft operation that generated them. The noise events from each monitoring sites that were correlated to specific aircraft departures or arrivals were grouped by aircraft type. Table C10 lists the departing corporate jets correlated to noise levels measured at Site 9. In this table the aircraft type "C560" represents the group of all Citation jets correlated to noise events measured at this site, where in this case there were 72. The aircraft type "LJ25" represents all of the Stage 2 Lear jets measured at the site, while the type "LJ35" represent all of the Stage 3 Lear jets measured at the site. The tables listing the correlated events measured at each of the monitoring sites and grouped by aircraft type are presented in Appendix B.

The correlated events at each of the monitoring sites were sorted to determine which operations produced the loudest events. Table C11 lists the date, time, aircraft type, aircraft noise stage, operation, runway, and measured noise levels for the ten loudest events measured at Site 9. The tables listing the loudest ten events and associated aircraft for all of the noise monitoring sites are presented in Appendix B. The measured 1-second data from one of the loudest events at each of the monitoring sites was plotted to show the characteristic profile of an aircraft event at that location. Table C12 lists the measured parameters and shows the plot of the 1-second data for one of the loudest ten events measured at Site 1. The tables showing time history plots for one of the loudest events at all of the monitoring sites are presented in Appendix B.

Table C9 - Daily Noise Events Histogram Report
Centennial Airport
Period: August 9, 1999
Site: CCV - Cherry Creek Vista - 6090 Nome St.

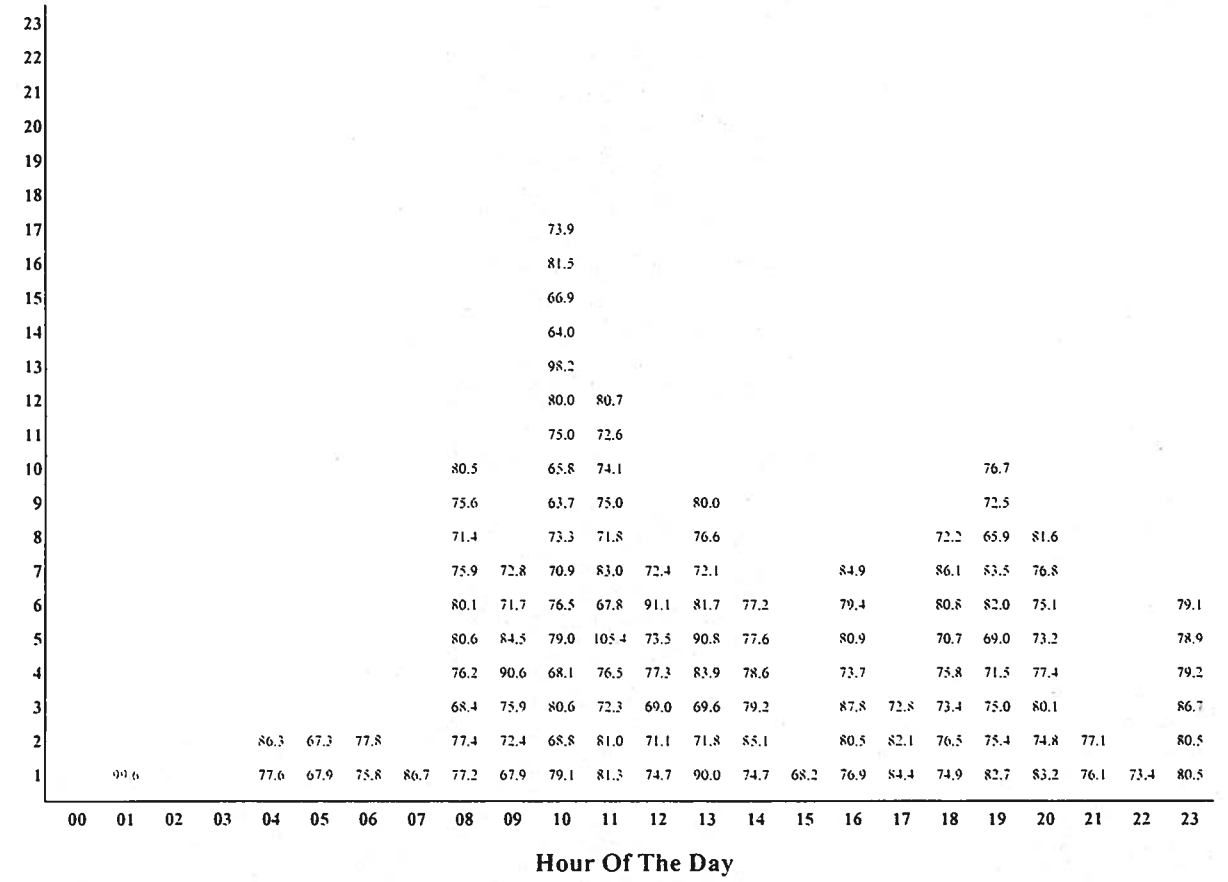


Table C10 - Single Event Noise Level by Aircraft Report
Centennial Airport
Period: July 1999 to August 1999
Site: 09 - Cherry Creek Vista
Operations: D Runways: 35L;35R Tracks: ALL

Aircraft	FAR 36 Stage	Event Count	Energy Average SEL	Graph of Energy Average SEL
BE40	3	8	85.7	
C560	3	72	82.8	
CL60	3	17	81.1	
F900	3	5	83.2	
FA20	2/3	21	85.4	
FA50	3	11	81.8	
GLF2	2	19	95.7	
GLF4	3	5	81.9	
H25B	3	30	92.2	
JCOM	2	2	102.0	
L29B	2	1	86.7	
LJ25	2	23	96.4	
LJ35	3	82	83.2	
SBR1	2	6	91.0	
WW24	3	10	87.7	
Other Aircraft		199	81.2	

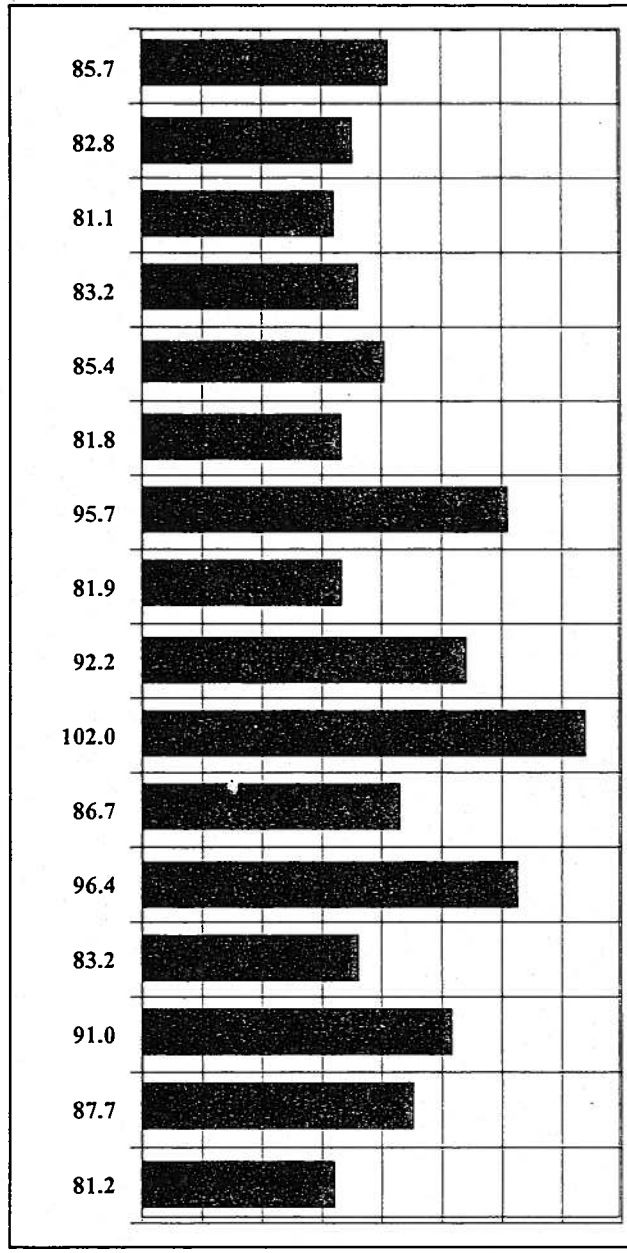


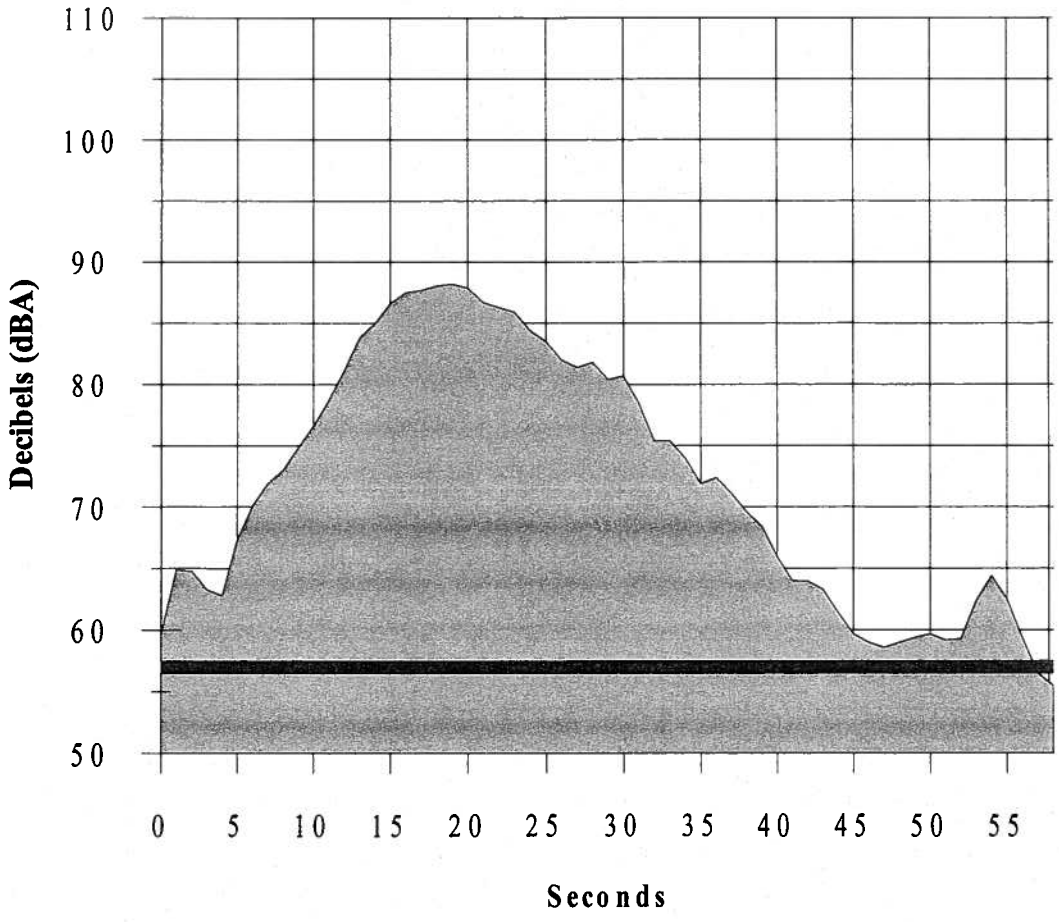
Table C11 - Loudest Aircraft Noise Events Site Report
Centennial Airport
Period: July 26, 1999 to August 20, 1999
Site: 01 - Lone Tree

Aircraft	Event Time	Aircraft	Stage	Ops	Rwy	Lmax	SEL	Graph Of SEL
	Aug 18, 05:07	LJ25	2	D	17L	88.2	98.5	
	Aug 09, 04:57	LJ24	2	D	17L	83.5	94.4	
	Aug 17, 09:02	LJ25	2	D	17L	83.3	93.3	
	Jul 27, 16:14	GLF3	2	D	17L	83.5	93.1	
	Aug 17, 11:00	LJ25	2	D	17L	77.3	90.2	
	Jul 29, 05:09	LJ25	2	D	17L	78.8	89.9	
	Aug 10, 18:41	GLF3	2	D	17L	77.2	89.0	
	Aug 10, 14:40	GLF2	2	D	17L	74.0	85.3	
	Aug 20, 15:31	FA20	2	D	17L	72.2	85.1	
	Aug 08, 23:17	LJ25	2	D	17L	75.1	84.8	

Table C12 - Noise Event Plot Report
Centennial Airport
Site: 01 - Lone Tree

DateTime:	8/18/99 5:06:23 AM	
Aircraft Type:	LJ25	Gates Learjet Corp. Learjet 25
Operation:	Departure	
Runway:	17L	
Destination:	IFP	

SEL (dBA):	98.5	**Max (dBA):**	88.2
Duration (seconds):	57	**Start to peak (seconds):**	19
SEL threshold (dBA):	57		



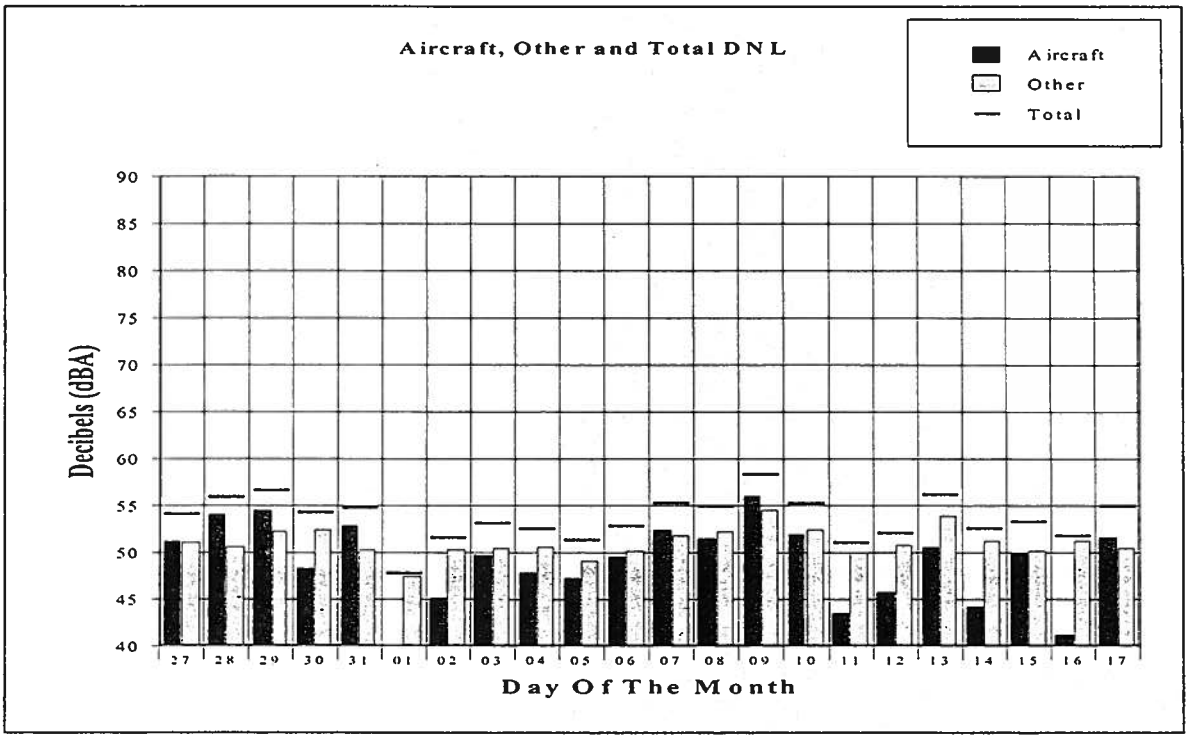
The results of the departure noise analysis show that that many of the operations generate single event noise levels in excess of 95 SEL, up to a level of 110 SEL. These results show the wide range in aircraft events that occur at each site as well as some very high noise events. The noise levels generated by the corporate jet aircraft varies significantly for each type of aircraft. The older low-bypass-ratio engines (Stage II) generate significantly higher noise levels than the newer generation high-bypass-ratio engines (Stage III).

An analysis of the data showed that the average SEL for Stage II aircraft is 10 to 15 dBA higher than for Stage III aircraft. All of the very loud noise events were the Stage II corporate jets. The results show that the arrival noise for Stage III aircraft is quieter than for Stage II aircraft. This difference is less than with the departures. The difference between the energy average Stage II and Stage III aircraft SEL noise for arrival operations is approximately 5 dBA.

DNL Noise Levels. Once the aircraft noise and ambient noise were calculated at each monitoring site, the total noise level was determined. Table C13 lists the noise level due to the aircraft events, the noise due to the everything other than aircraft, and the total DNL for each day the noise level was monitored at Site 9. This table also includes a histogram of the noise levels of all of the events measured at the site. This helps illustrate the range in the single event noise levels measured at the site and the relative number of events. Additional tables presenting this information for the other sites is presented in Appendix B.

Table C14 lists the results of the DNL noise measurements at the 10 semi-permanent noise monitoring locations. This table lists the DNL due to aircraft events for the period the noise level was monitored at each site. The measurement results show that nearly all of these locations are exposed to noise levels ranging from 49 to 64 DNL. The major contributor to the DNL noise level at most of these sites is the corporate jet activity, especially the Stage 2 jets and those jets that occur during the nighttime hours. Sites 5 and 7 are exposed to more noise from traffic on local roadways than from aircraft operations. Table C15 shows the results of the DNL noise measurements at the 10 semi-permanent noise monitoring locations in a graphical format. The top portion of the table shows the range of daily DNL values along with the overall DNL for the entire measurement period. The bottom portion of the table shows the total DNL level as well as the amount of aircraft noise and ambient noise that contributed to the overall level.

Table C13 - Periodic Site Noise Report
Centennial Airport
Period: July 27, 1999 to August 17, 1999
Site: 01 - Lone Tree



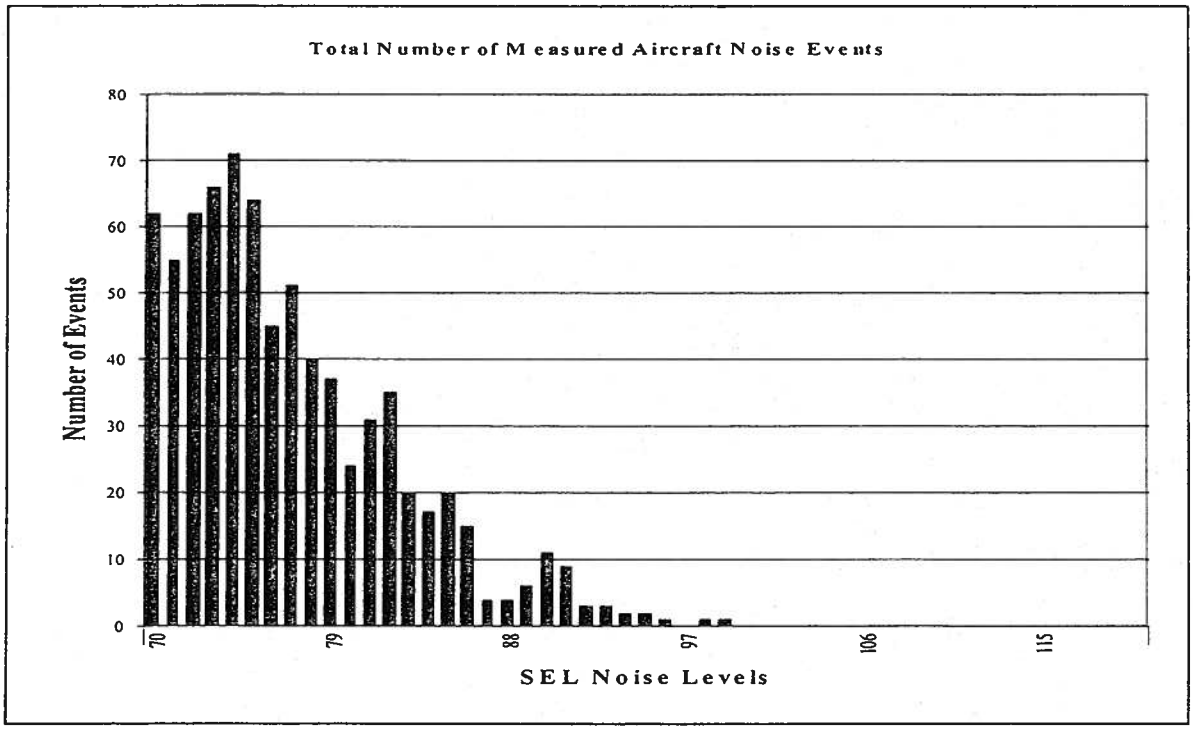
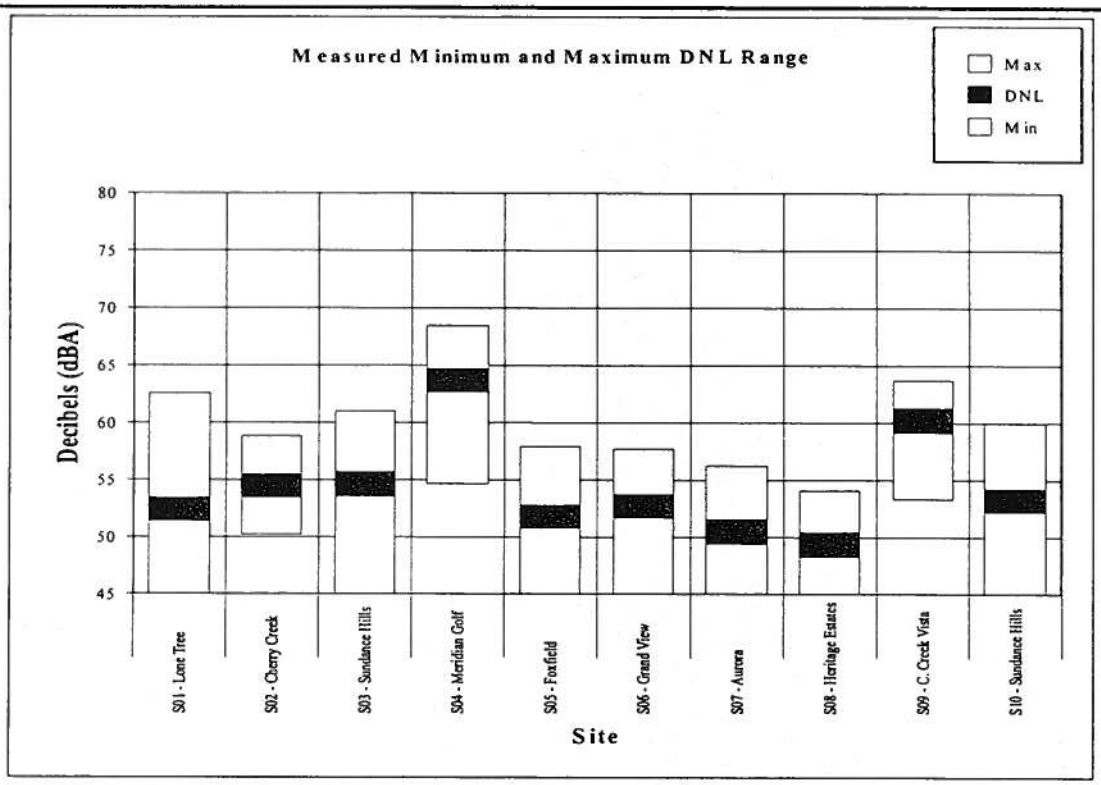
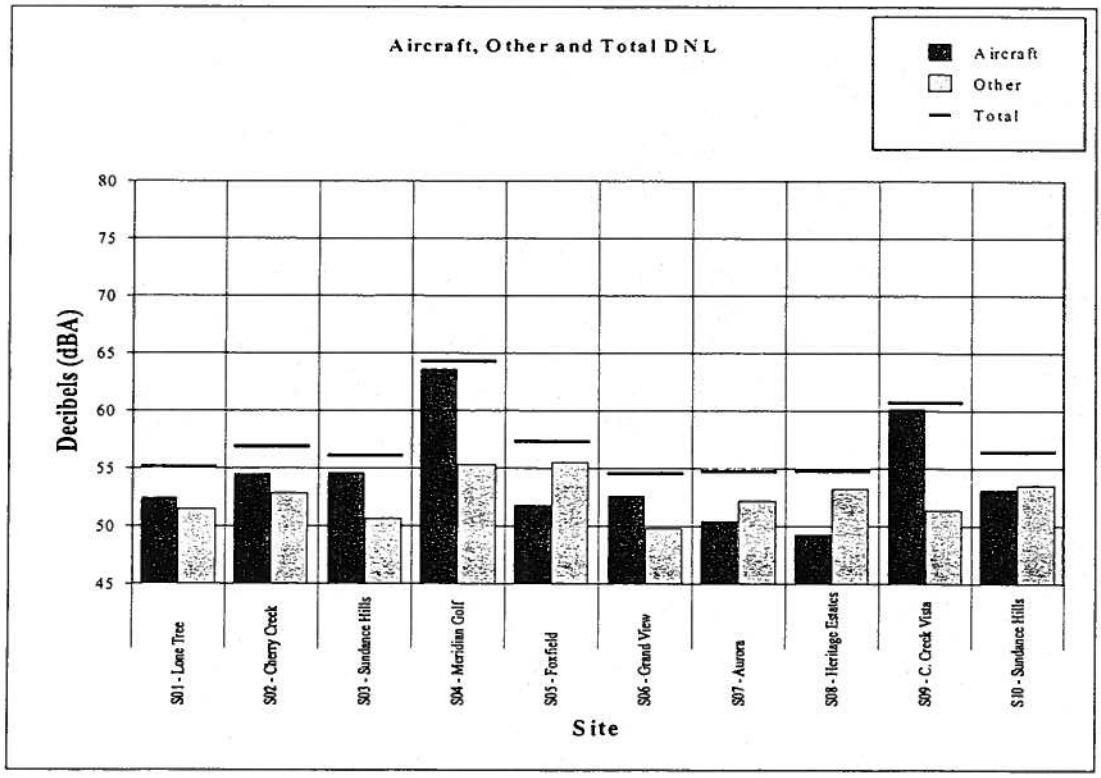


Table C14
MEASURED DNL NOISE LEVELS
Centennial Airport FAR Part 150 Study

Site	Description	Date of Measurements	Measured DNL Noise Level
1	Lone Tree	July 26th – Aug 21st	52
2	Cherry Creek State Park	July 28 – Aug 6th	55
3	Village on the Lake	Aug 5th – Aug 21st	55
4	Meridian Golf Club	July 26th – Aug 21st	64
5	Foxfield	July 27th – Aug 6th	52
6	Grand View Estates	July 26th – Aug 5th	53
7	Aurora	July 27th – Aug 5th	51
8	Heritage Estates	Aug 5th – Aug 21st	49
9	Cherry Creek Vista	July 26th – Aug 21st	60
10	Sundance Hills	July 27th – Aug 21st	53

Table C15 - Periodic Airport Noise Report
Centennial Airport
Period: July 26, 1999 to August 21, 1999
Neighborhood: Permanent Sites





Ambient Noise Measurement Results. The ambient noise environment was also determined from the measurement survey. The ambient noise levels were determined at each of the measurement sites. The ambient noise levels were determined for all sources of noise affecting the sites. The quantities measured were the Hourly LEQ noise level and the Percent Noise Levels (Ln). These metrics were described in the background section. The data was used to help establish the ambient noise environment for all other sources other than airport operations in order to serve as an aid in assessing how intrusive the aircraft noise is on the ambient environment. This includes all other sources of noise including roadway, commercial sources and the residual background noise.

The results of the ambient noise measurement survey at the semi-permanent sites are presented graphically in Table C16. An example of data from one of the sites for each day of the measurements is presented in Table C17. These results for the other sites are presented in Appendix B. This exhibit presents a summary of the noise levels for each of the sites. This exhibit presents the statistical noise data (*the L(minimum), L_{90}, L_{50}, L_{10} and L(maximum)*) and graphically illustrating the range in noise. This illustrates the range in noise levels that exist at the sites. The L(*maximum*) is presented for the peak dBA measurement. Aircraft noise is included in this data. These metrics were defined on page C.16.

Table C16 - Ambient Airport Noise Report
Centennial Airport
Period: July 26, 1999 to August 21, 1999
Neighborhood: Permanent Sites

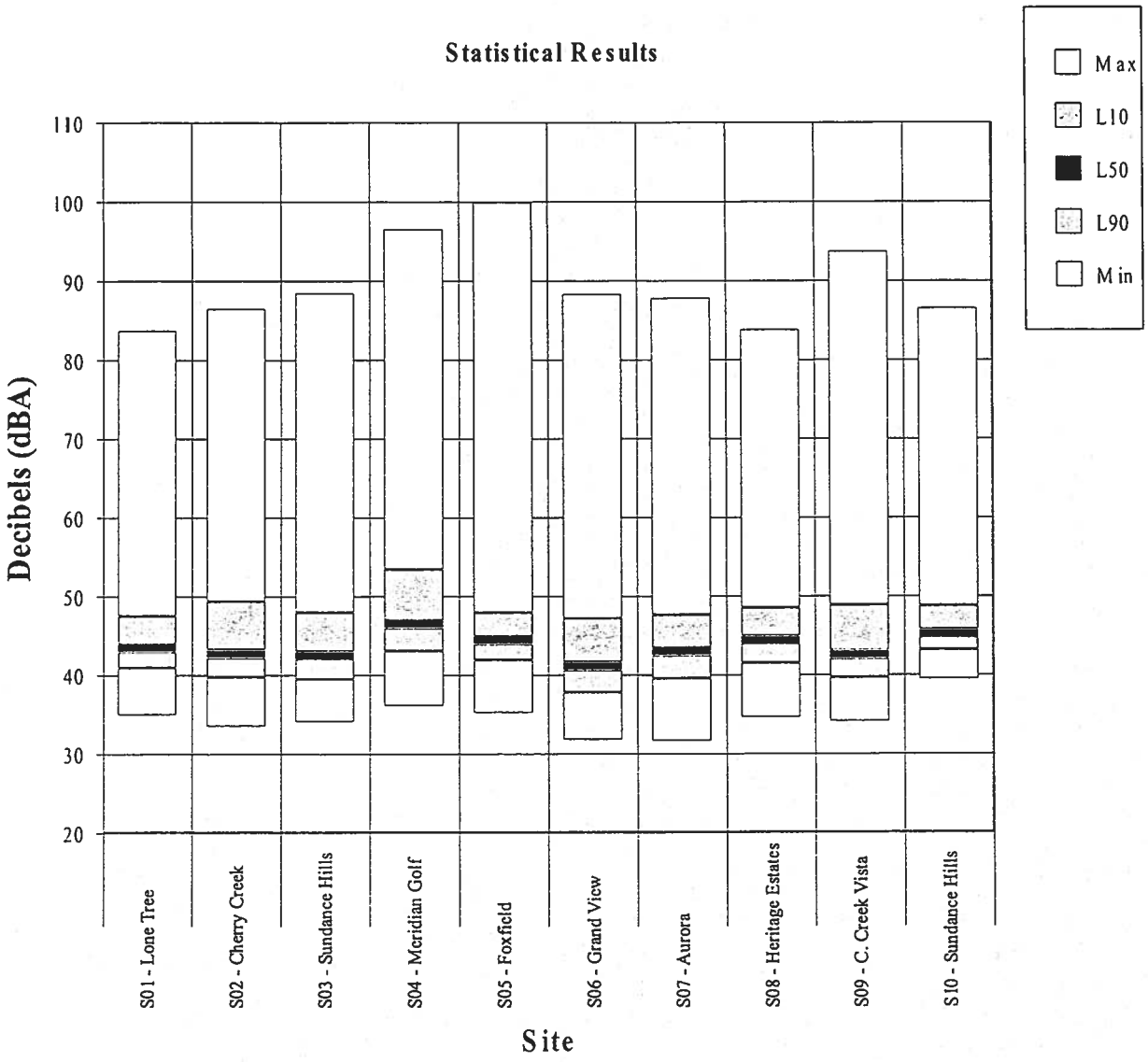
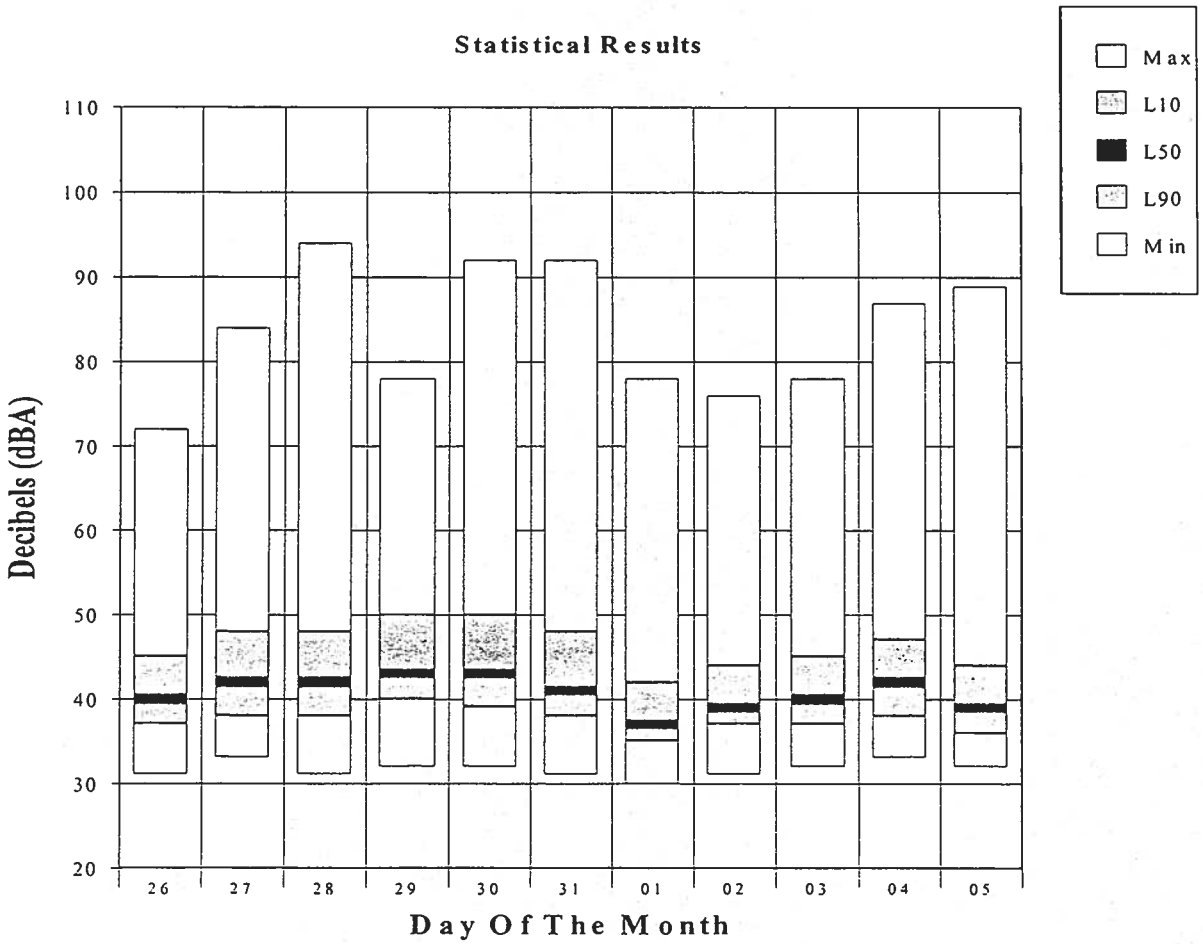


Table C17 - Ambient Site Noise Report
Centennial Airport
Period: July 26, 1999 to August 5, 1999
Site: GVE - Grand View Estates - 12577 N. 2nd



Noise Contour Modeling Results

The noise contour were generated using the INM Noise Model version 6.0. A description of the noise model and the operational data used to develop these contours was presented in previous sections. The existing noise contours are based upon 1999 operational conditions.

Noise contours were developed for both cumulative noise levels and single event noise levels. The cumulative noise levels were determined in terms of DNL. The single event analysis is in terms of SEL. The computer model was used to determine the SEL, DNL.

The primary noise criteria that will be used in the Part 150 Noise Study to describe the existing noise environment is DNL. DNL is the metric that is required by the FAA to be used in the Part 150. The SEL data will be used to supplement the DNL analysis.

The noise contours presented in this report where based upon the use of the FAA INM noise model, with modeling assumptions validated through use of the noise measurements. During the time period of the survey, the jet operations where lower than the annual average levels. Therefore, these modeled levels are higher than the noise levels measured during the survey. Data on measured versus predicted noise levels are presented in Appendix B.

DNL Noise Contours. While single event noise levels can be useful to help anticipate a community's response to noise, community noise standards are expressed in terms of cumulative noise exposure metrics such as the DNL. Therefore, the aircraft single event noise level data are combined with aircraft operational data to develop cumulative noise exposure levels over the full 24-hours. This combination of data generates the DNL noise level value. The existing annual 1999 DNL noise contours for Centennial Airport are presented in Figure C15. This exhibit presents the 55, 60, 65, 70 and 75 DNL noise contours.

As a means of implementing the Aviation Safety and Noise Abatement Act, the FAA adopted Regulations on Airport Noise Compatibility Planning Programs. The guidelines specify a maximum amount of noise exposure (in terms of the cumulative noise metric DNL) that will be considered acceptable to or compatible with people in living and working areas. Residential land use is deemed acceptable for noise exposures up to 65 DNL. However, at levels below 65 DNL there can still be adverse community reaction to aircraft noise.

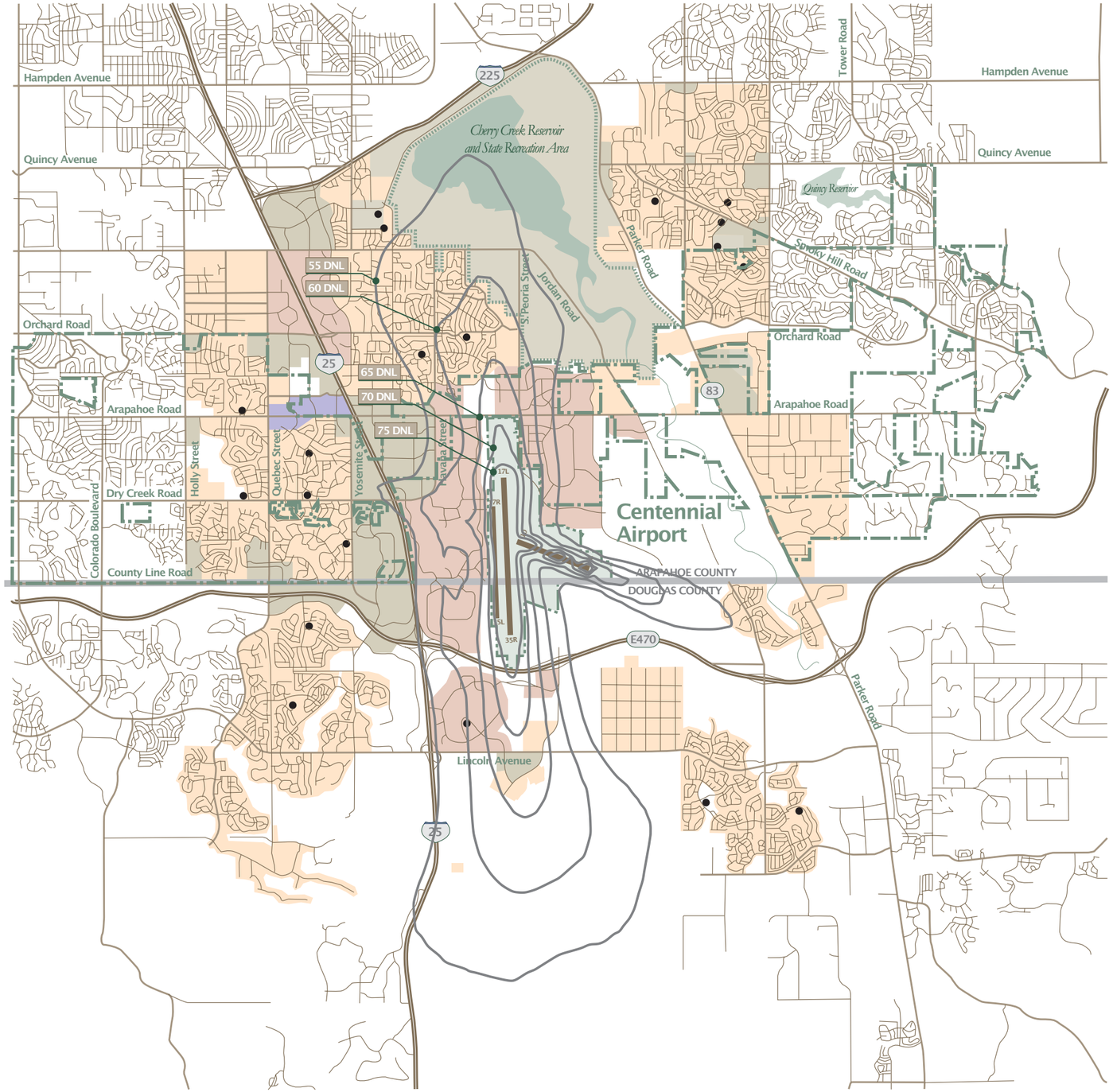


Figure C15 ***Existing 1999 Noise Exposure Map***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

*The **65 DNL** Noise Contour Contains Approximately **2,458 Acres** and **62 People**.*

*The **70 DNL** Noise Contour Contains Approximately **1,065 Acres** and **0 People**.*

*The **75 DNL** Noise Contour Contains Approximately **522 Acres** and **0 People**.*

> ***Planning jurisdictions are as shown on map.***

> ***Noise measurement sites and flight tracks are depicted on the Noise Measurement Sites and Flight Tracks Map.***

> ***Residential land use is defined as incompatible within the 65 DNL Noise Contours or greater by the FAR Part 150.***

The Noise Exposure Map and accompanying documentation for the Noise Exposure Map for Centennial Airport, submitted in accordance with the FAR Part 150 with the best available information, are hereby certified as true and complete to the best of my knowledge and belief. In addition, it is hereby certified that the interested persons were afforded adequate opportunity to submitt their views, data, and comments concerning the correctness and adequacy of the draft maps and the description of forecasts of aircraft operations.

Signed _____

Dated _____

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Land Use Information 1998. Noise Contours, BCS International Noise Analysis - 1999.*

The noise modeling results can also be expressed in terms of the DNL noise level at the noise monitoring locations. The INM version 6.0 was used to determine the noise levels at each of these locations. Table C8 presented the measured DNL noise levels at each of the ten noise monitoring locations. A table comparing the modeled annual average DNL noise level for 1999 at each of the measurement sites with the measured values will be presented in a future version of this report.

The number of operations picked up during the noise measurements were much fewer than those modeled for two reasons. First, the noise monitoring survey covered a few weeks of time while the noise modeling covers an entire years worth of the operations, and during he monitoring on the east side of the airport many of the departure operations were away from the microphone locations. Second, the existing operations tend to lean toward the conservative side during the modeling process.

Single Event Noise Contours. Single event noise levels are often a predictor of when annoyance from aircraft noise is likely to occur or other factors such as sleep interference. Single event noise contours are also useful in illustrating the various differences in the noise generated by different aircraft types. Single event noise contours were developed for Centennial Airport. These were developed using specific aircraft types and their associated flight procedures.

The single event analysis presents the single event noise levels along a typical flight track for a number of sample commercial aircraft. The INM noise model was used to generate the single event noise contours. Corporate Jets generate a wide range in noise levels. To illustrate the range in single event noise from corporate jets three aircraft were selected for modeling purposes. These aircraft are listed below:

- Lear 25
- Lear 35
- Citation III

The Lear 25 aircraft represents the old generation Stage II corporate jets that generate the highest noise levels. The Lear 35 is representative of typical Stage III corporate jets, while the Citation III is representative of the quietest Stage III corporate jets. Note that there are many different variations of the flight tracks. Different flight tracks will result in a different noise exposure to different areas of the community. These contours are intended to reflect the single event noise levels from one typical departure and arrival track.

Single event contours for these three different corporate jet aircraft are presented in Figures C16 through C21. These exhibits present the Lmax noise contour for the Lear 25, Lear 35 and Citation III respectively for both north and south flight operations. Each aircraft is departing and arriving on a typical track for operations on either Runway 17L or Runway 35R. These exhibits present the Lmax noise

contours for 100, 95, 90 and 85 dBA. The results illustrate the wide range in noise generated by corporate jet aircraft. The older Stage II aircraft generate significantly higher noise levels than the newer generation jet aircraft. This is most pronounced on departure. Note also that the sideline noise is significantly higher on the older Stage II aircraft than any of the other corporate jets.

There are no standards in terms of single event criteria. An Lmax level of 85 is approximately equal to an SEL level of 95 which represents the level at which sleep disturbance starts to occur in the general population with the probability of awaking increasing with the noise level. An Lmax level of 75 is approximately equal to an SEL level of 85 which represents the level at which speech interference starts to takes place. For windows closed situations, SEL levels above 95 will typically result in conversation interruption within a home.

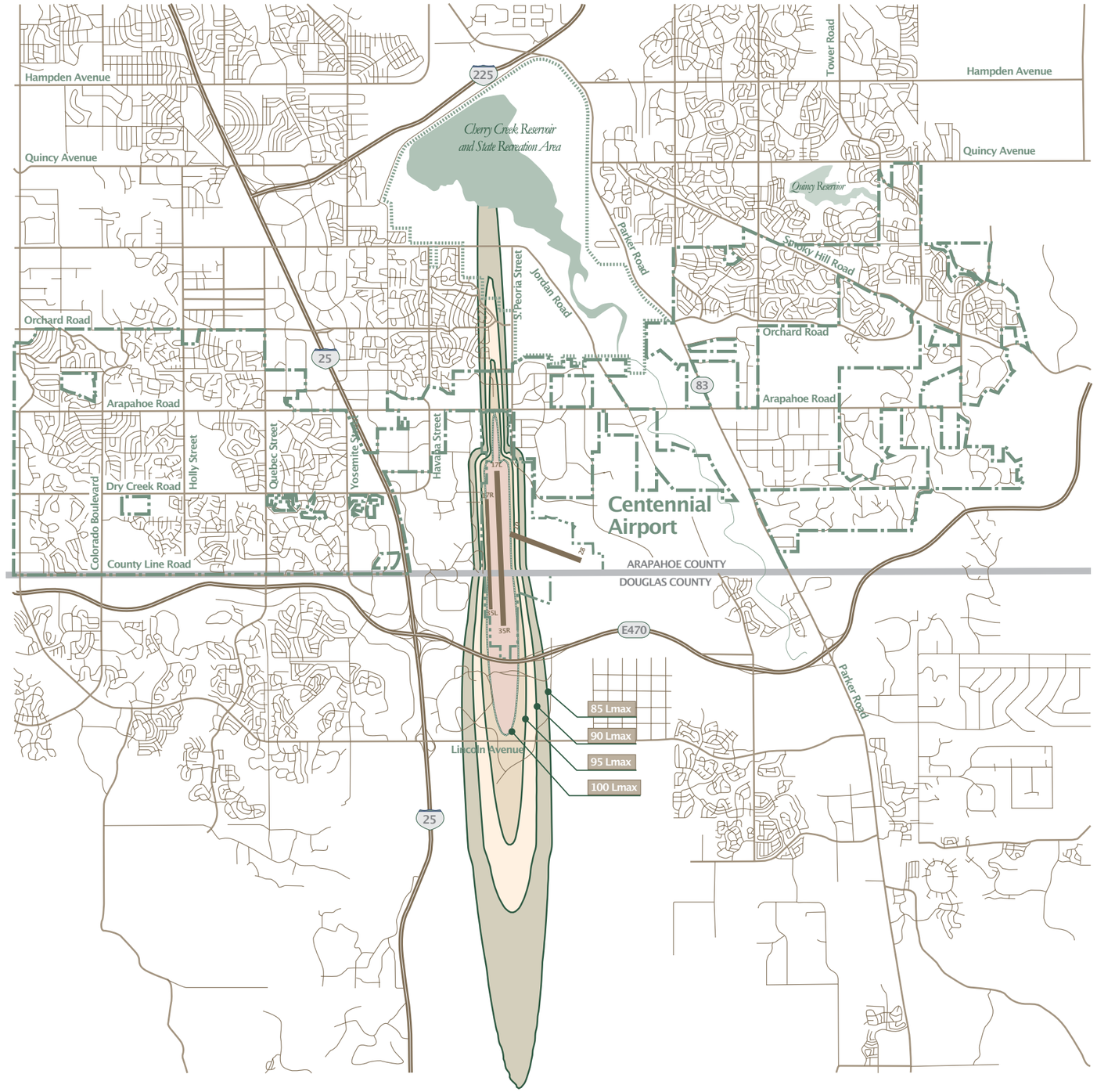


Figure C16 ***LMAX Noise Contours—***
Learjet 25 Departure Runway 17L

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure
& Land Use Compatibility
Study Program

Source: *Base Map, Landiscor Aerial Information - 1998. LMAX Noise Contours, BCS International Noise Analysis - 1999.*

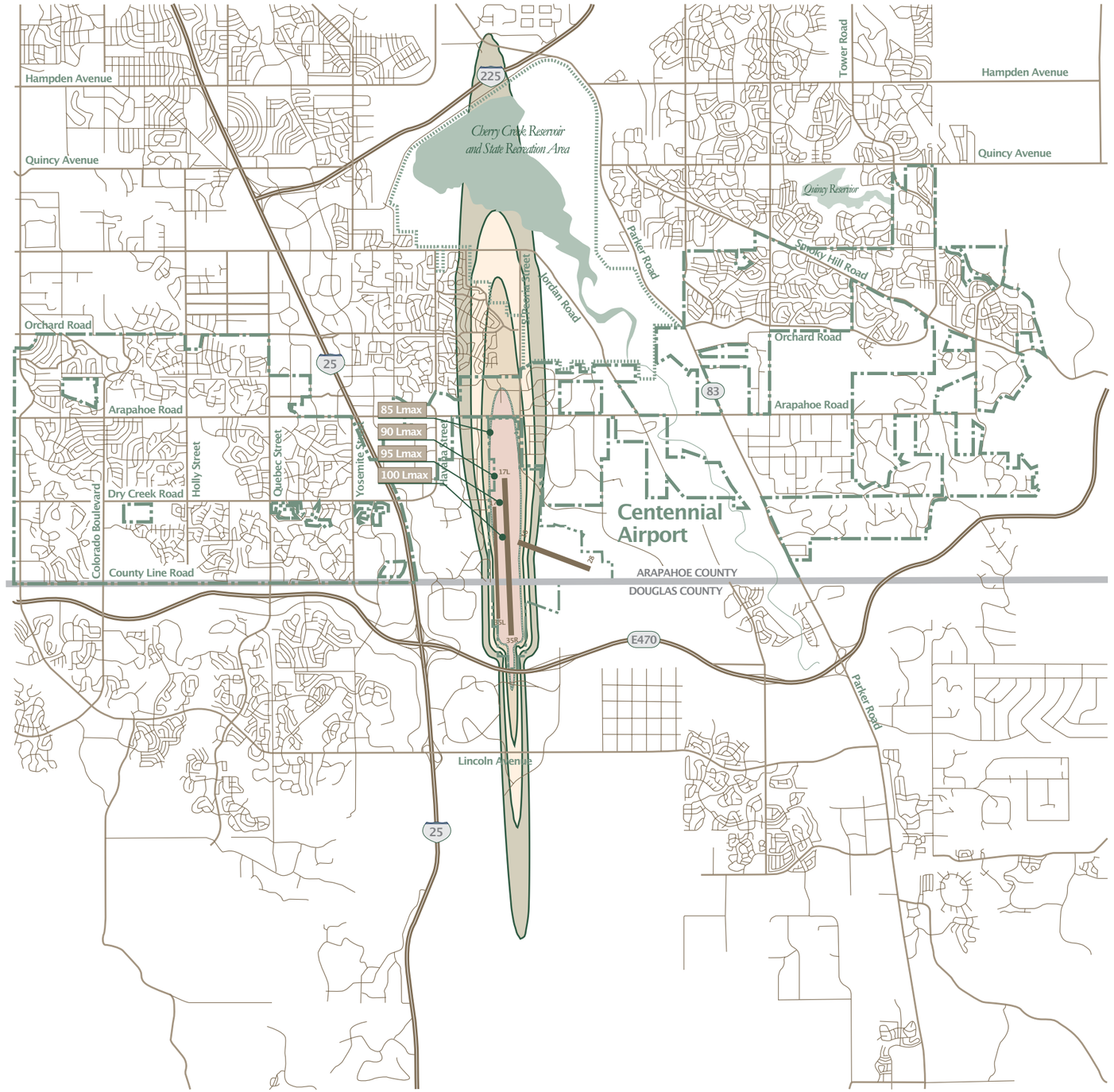


Figure C17 ***LMAX Noise Contours—***
Learjet 25 Departure Runway 35R

Centennial Airport
FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Landiscor Aerial Information - 1998. LMAX Noise Contours, BCS International Noise Analysis - 1999.*

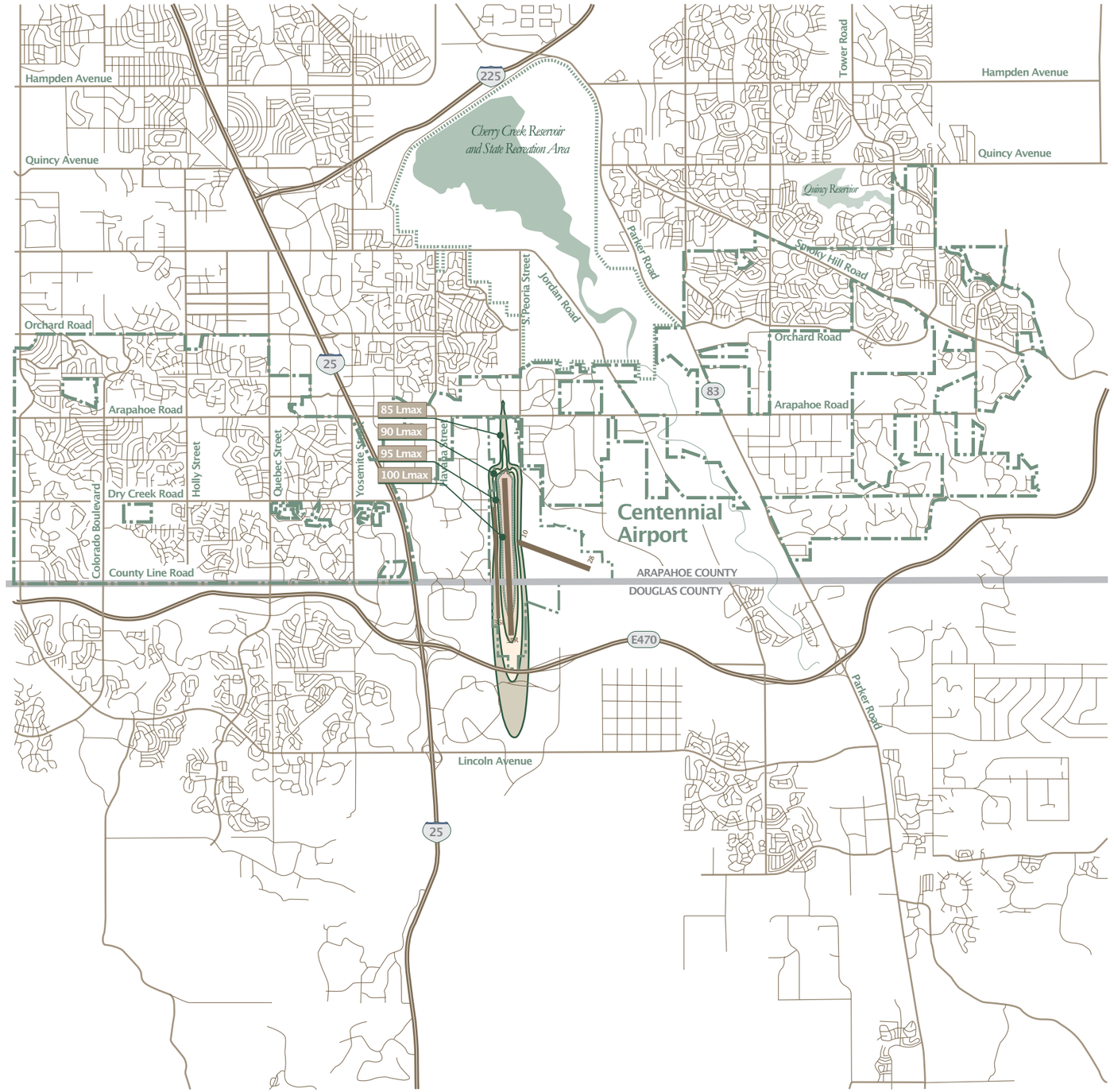


Figure C18 ***LMAX Noise Contours—***
Learjet 35 Departure Runway 17L

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure
& Land Use Compatibility
Study Program

Source: *Base Map, Landiscor Aerial Information - 1998. LMAX Noise Contours, BCS International Noise Analysis - 1999.*

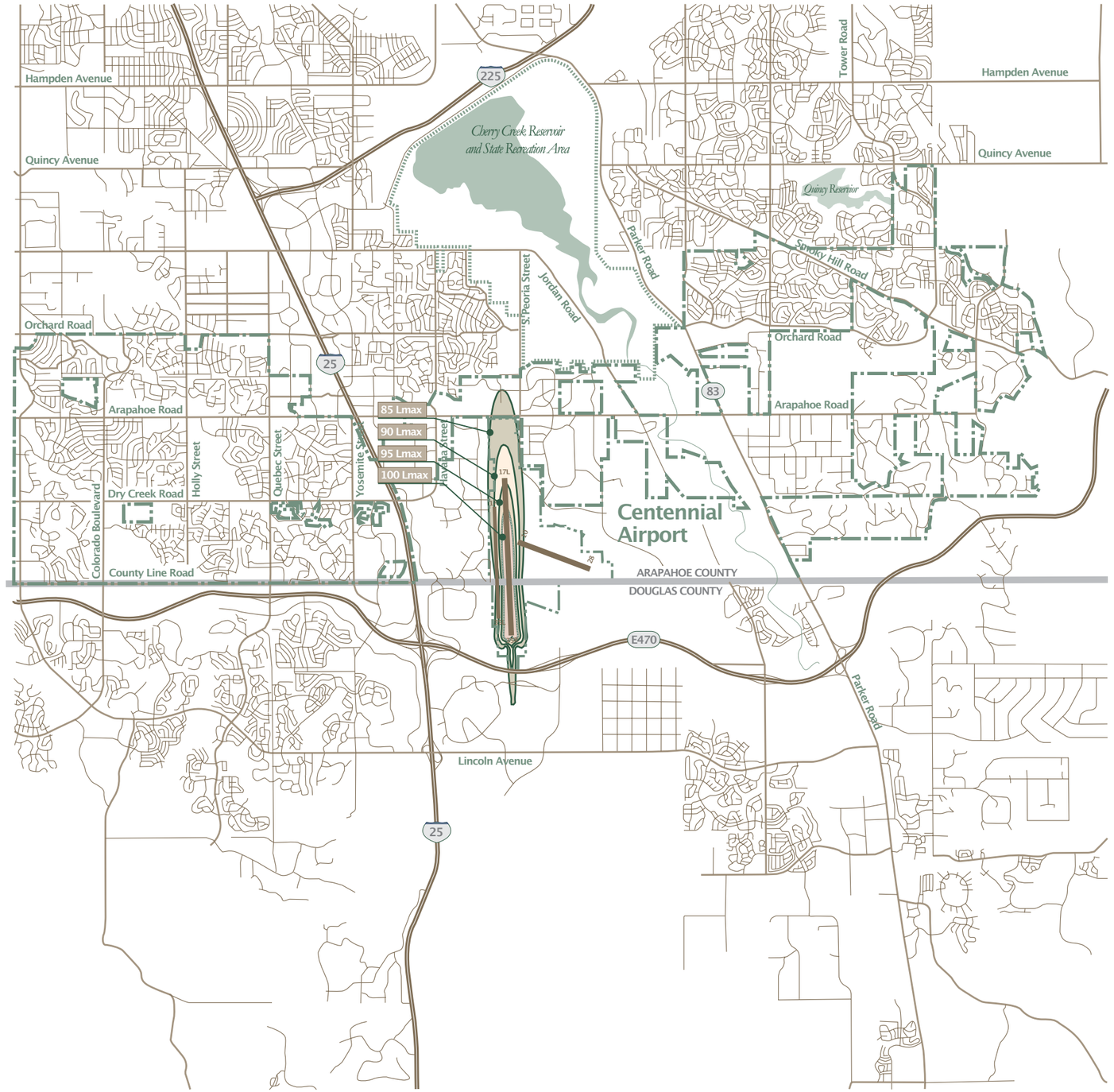


Figure C19 ***LMAX Noise Contours—Learjet 35 Departure Runway 35R***

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Landiscor Aerial Information - 1998. LMAX Noise Contours, BCS International Noise Analysis - 1999.*

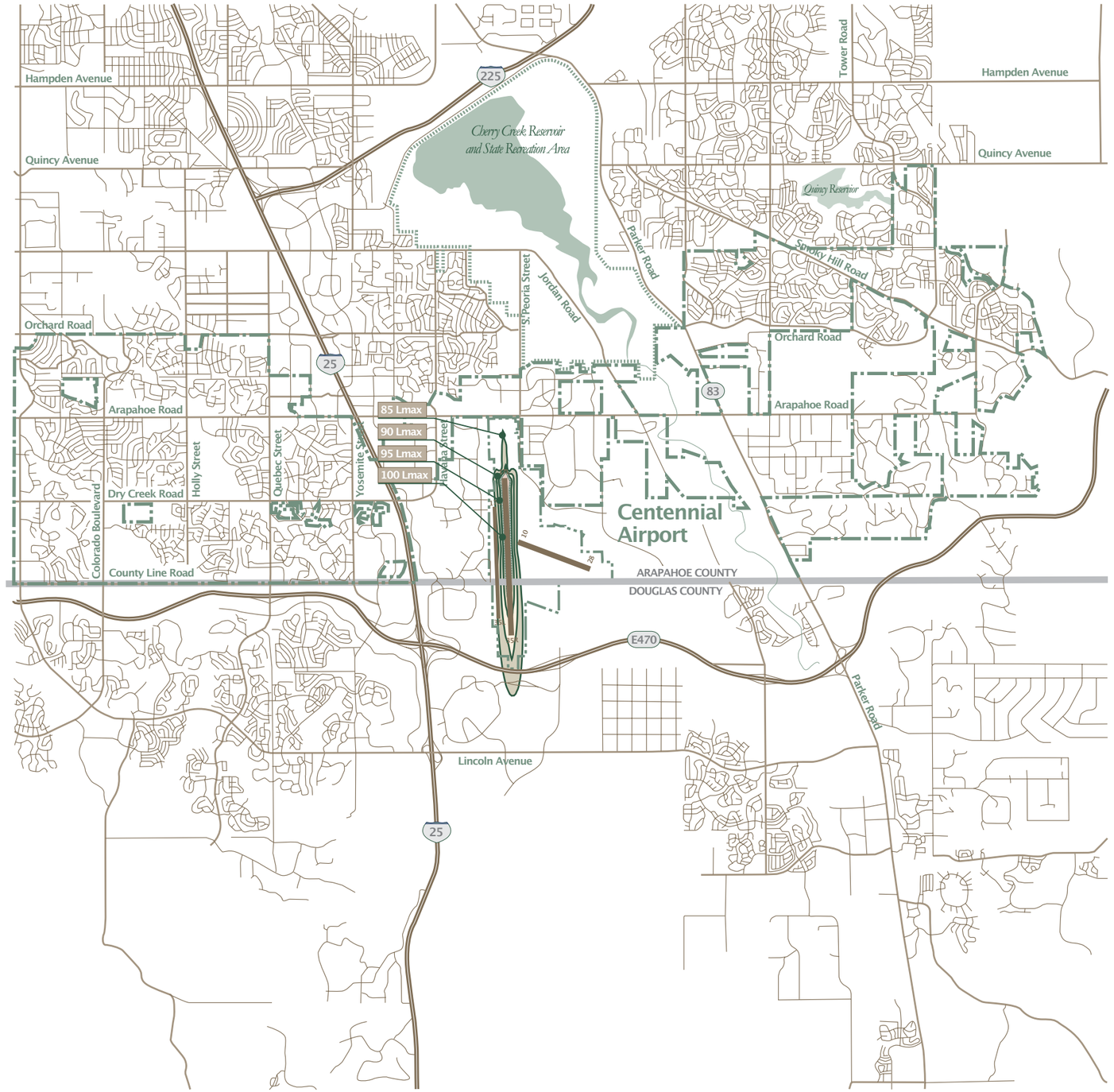


Figure C20 ***LMAX Noise Contours—Citation 3 Departure Runway 17L***

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Landiscor Aerial Information - 1998. LMAX Noise Contours, BCS International Noise Analysis - 1999.*

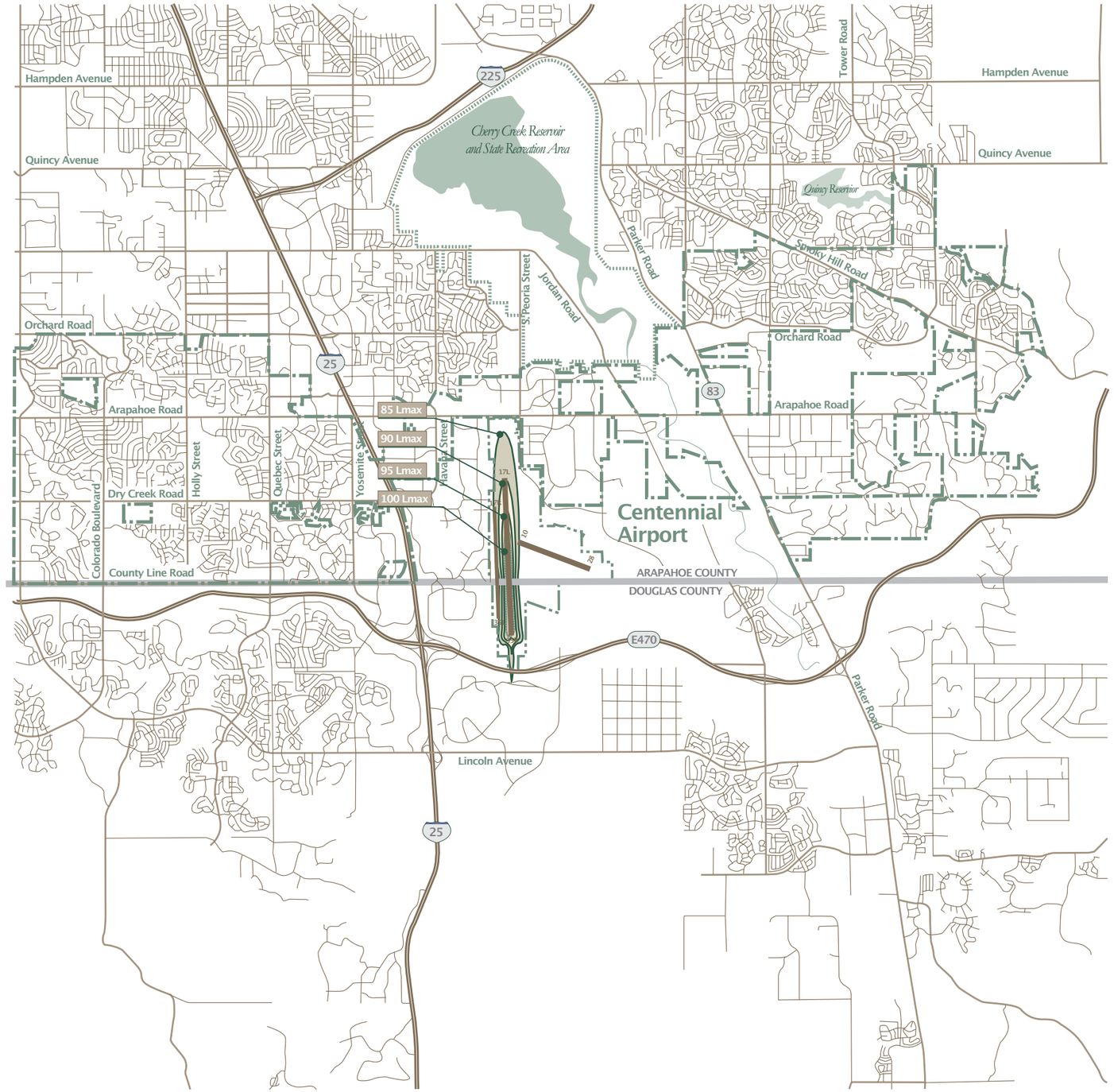


Figure C21 ***LMAX Noise Contours—Citation 3 Departure Runway 35R***

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Landiscor Aerial Information - 1998. LMAX Noise Contours, BCS International Noise Analysis - 1999.*

Future Base Case (2005) DNL Contours

Various scenarios where modeled to predict the future base conditions noise levels at the airport. These are all based upon 472,000 annual operations. The different scenarios involves changes to the fleet mix and time of day assumptions. Each of these Scenarios are described below.

The 2005 DNL contours for Centennial Airport were prepared using Integrated Noise Model (INM) version 6.0. These base case conditions will be used to develop future noise abatement alternatives at the airport. No noise abatement alternatives are included in these contours.

Scenario 1 – Existing Fleet Mix for Jet Aircraft

Scenario 1 assumes that the annual corporate jet aircraft increases from 33,000 to 42,000 operations. The mix of Stage 2 and Stage 3 aircraft remains the same as with existing conditions. The percentage of operations in the nighttime hours is also assumed to remain the same as with existing conditions. Scenario 1 assumptions are presented in Table C18.

Table C18
SUMMARY OF PRELIMINARY OPERATIONS, FUTURE 2005
Centennial Airport FAR Part 150 Study

Category Type	Annual Operations	Daily Operations	Percent Nighttime
Business Jets			
Stage 3	34,860	95.5	25%
Business Jets			
Stage 2	7,140	19.6	19%
General Aviation			
Single Engine Piston	340,000	931.5	5%
Multi-Engine Piston	43,000	117.8	5%
Turboprop	35,000	95.9	5%
Helicopter	12,000	32.9	5%
Total Operations	**472,000**	**1,293**	

Scenario 1 Noise contours for calendar year 2005 that depict the noise exposure in terms of DNL are shown in Figure C22. The contours shown are the 55, 60, 65, 70 and 75 dBA DNL. The results of the analysis show that these future contours are slightly larger than the existing conditions contours. These contours are approximately 1.4 dBA louder than the existing conditions contour.

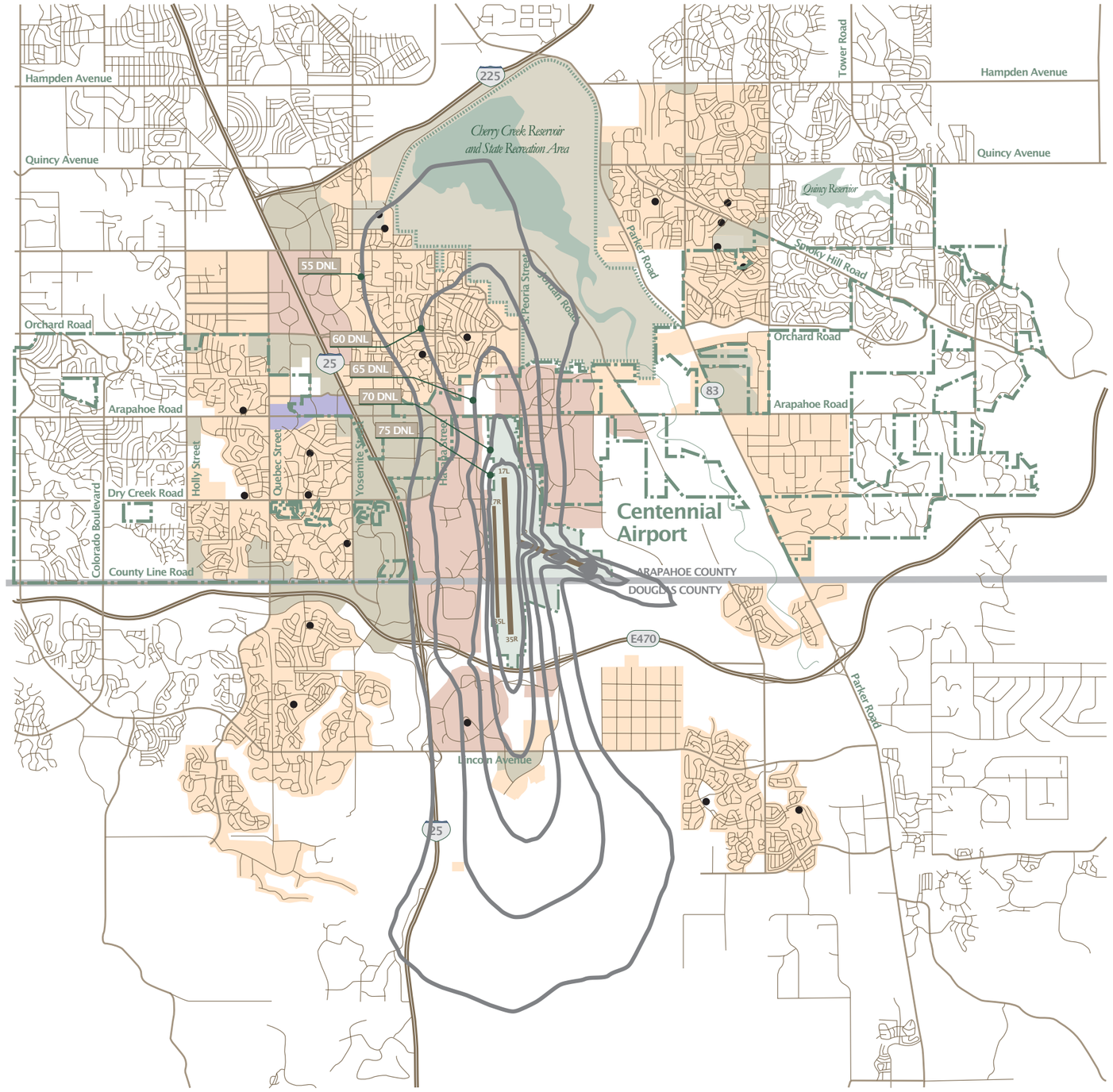


Figure C22 ***Future DNL Noise Contours (Scenario 1) with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Aerial Information, June - 2001.*

Scenario 2 – Increases in Jet Aircraft with Stage 3 Only

Scenario 2 assumes that the annual corporate jet aircraft increases from 33,000 to 42,000 operations. The mix of Stage 2 and Stage 3 aircraft is assumed to change, with the increase in Corporate Jet aircraft all from Stage 3 aircraft. The number of Stage 2 aircraft would remain the same as with existing conditions. The percentage of operations in the nighttime hours is also assumed to remain the same as with existing conditions. Scenario 2 assumptions are presented in Table C19.

Table C19
SUMMARY OF PRELIMINARY OPERATIONS, FUTURE 2005
Centennial Airport FAR Part 150 Study

Category Type	Annual Operations	Daily Operations	Percent Nighttime
Business Jets			
Stage 3	36,406	99.8	25%
Business Jets			
Stage 2	5,594	15.3	19%
General Aviation			
Single Engine Piston	340,000	931.5	5%
Multi-Engine Piston	43,000	117.8	5%
Turboprop	35,000	95.9	5%
Helicopter	12,000	32.9	5%
Total Operations	**472,000**	**1,293**	

Scenario 2 Noise contours for calendar year 2005 that depict the noise exposure in terms of DNL are shown in Figure C23. The contours shown are the 55, 60, 65, 70 and 75 dBA DNL. The results of the analysis show that these future contours are about the same as the existing conditions contour

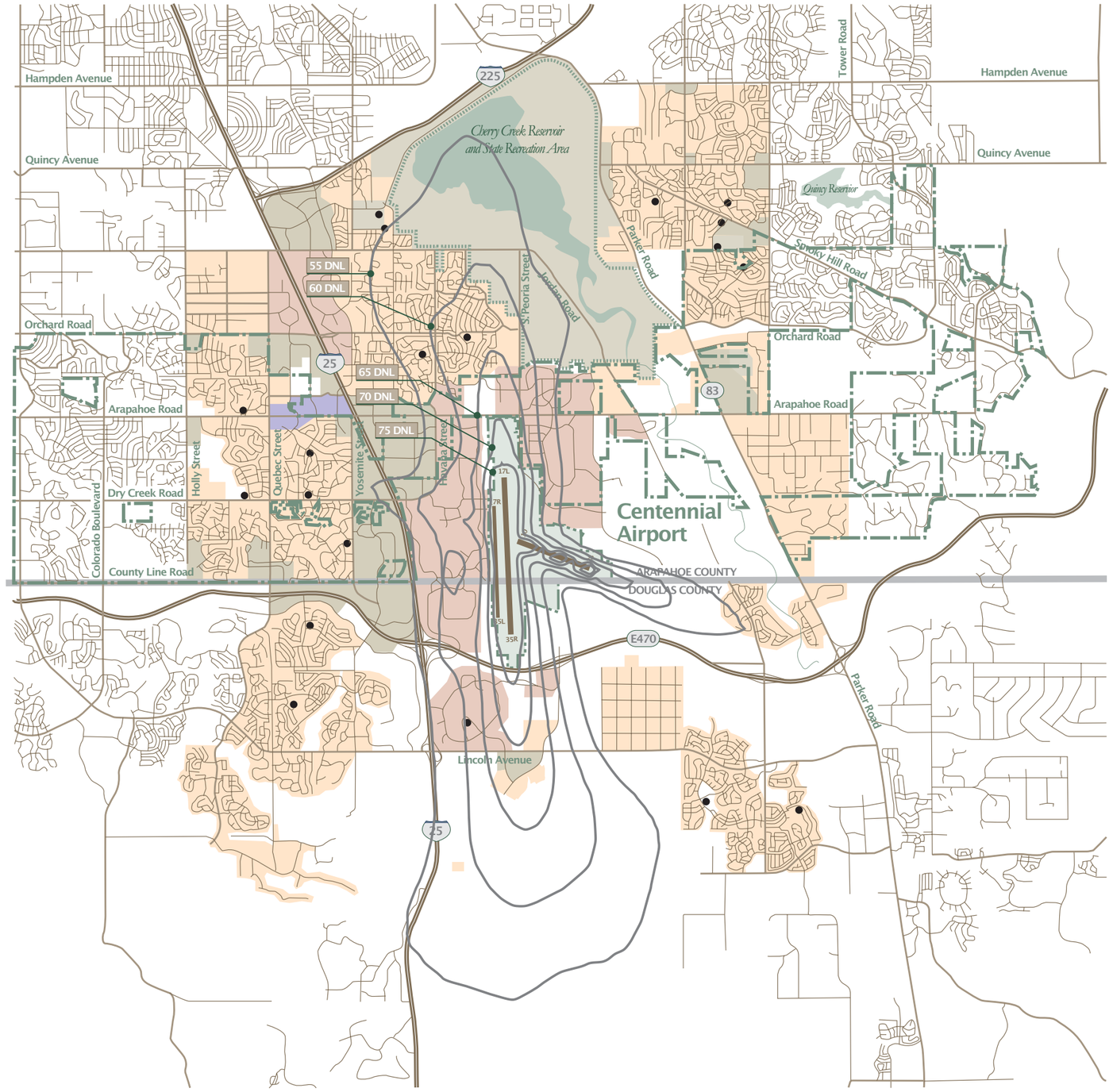


Figure C23 ***Future DNL Noise Contours (Scenario 2) with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Aerial Information, June - 2001.*

Scenario 3 - Increases in Jet Aircraft with Stage 3 and Hushkit Stage 2

Scenario 3 assumes that the annual corporate jet aircraft increases from 33,000 to 42,000 operations. The mix of Stage 2 and Stage 3 aircraft is assumed to change, with the increase in Corporate Jet aircraft all from Stage 3 aircraft. The number of Stage 2 aircraft would remain the same as with existing conditions, except that these aircraft have been hush-kitted to meet Stage 3 limits. The percentage of operations in the nighttime hours is also assumed to remain the same as with existing conditions. Scenario 3 assumptions are presented in Table C20.

Table C20
SUMMARY OF PRELIMINARY OPERATIONS, FUTURE 2005
Centennial Airport FAR Part 150 Study

Category Type	Annual Operations	Daily Operations	Percent Nighttime
Business Jets			
Stage 3	36,423	99.8	25%
Business Jets			
Huskitted Stage 2	5,570	15.3	19%
General Aviation			
Single Engine Piston	340,000	931.5	5%
Multi-Engine Piston	43,000	117.8	5%
Turboprop	35,000	95.9	5%
Helicopter	12,000	32.9	5%
Total Operations	**472,000**	**1,293**	

Scenario 3 noise contours for calendar year 2005 that depict the noise exposure in terms of DNL are shown in Figure C24. The contours shown are the 55, 60, 65, 70 and 75 dBA DNL. The results of the analysis show that these future contours are smaller than the existing conditions contour.

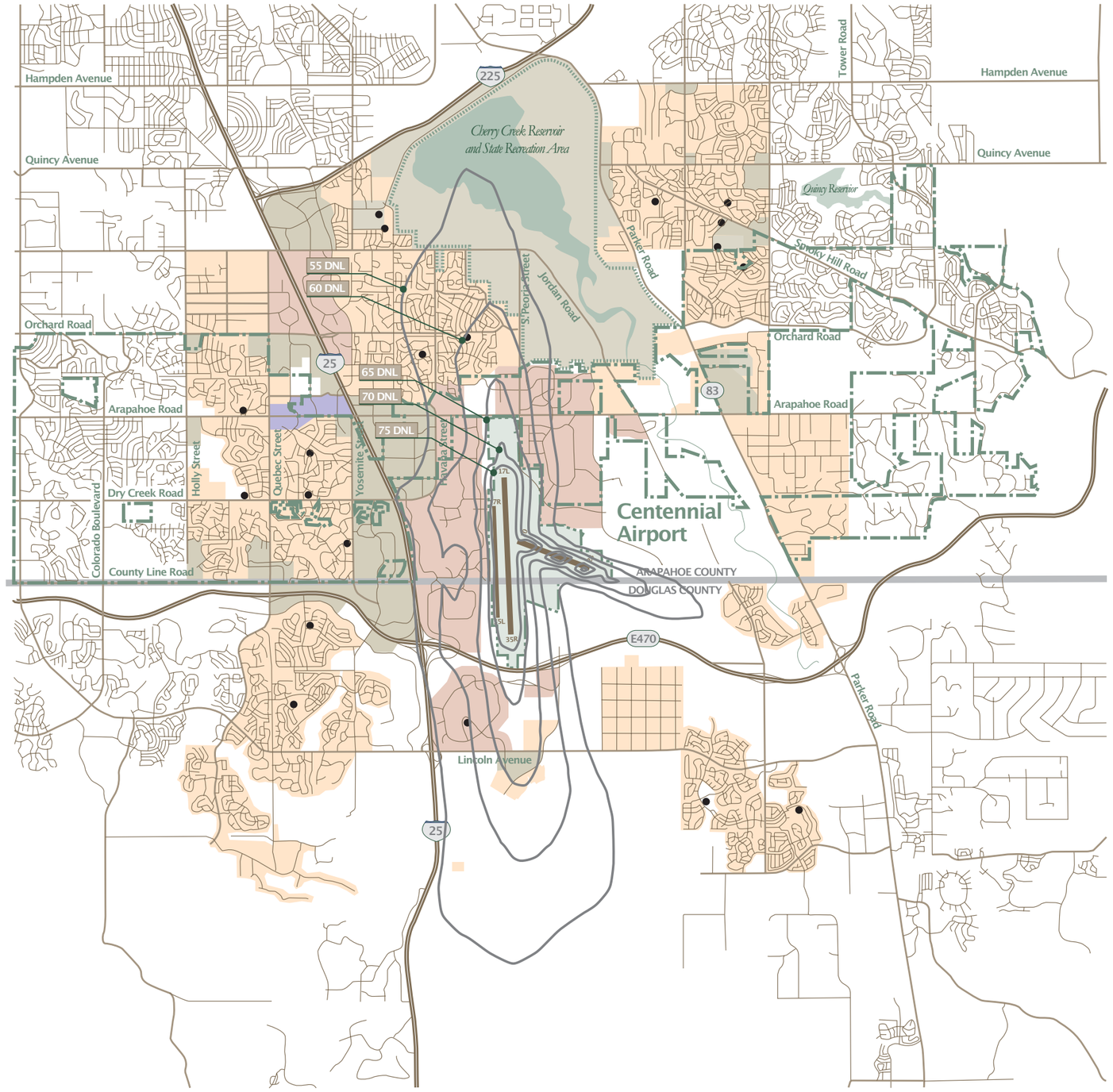


Figure C24 ***Future DNL Noise Contours (Scenario 3) with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Aerial Information, June - 2001.*

Scenario 4 – Existing Fleet Mix for Jet Aircraft and additional Night Stage 2

Scenario 4 assumes that the annual corporate jet aircraft increases from 33,000 to 42,000 operations. The mix of Stage 2 and Stage 3 aircraft remains the same as with existing conditions. The percentage of operations in the nighttime hours is assumed to increase. For this Scenario, 4 additional Stage 2 Lear 25 operations (2 departures and 2 arrivals) are assumed to occur in the nighttime hours. Scenario 4 assumptions are presented in Table C21.

Table C21
SUMMARY OF PRELIMINARY OPERATIONS, FUTURE 2005
Centennial Airport FAR Part 150 Study

Category Type	Annual Operations	Daily Operations	Percent Nighttime
Business Jets			
Stage 3	34,860	95.5	25%
Business Jets			
Stage 2	7,140	19.6	39%
General Aviation			
Single Engine Piston	340,000	931.5	5%
Multi-Engine Piston	43,000	117.8	5%
Turboprop	35,000	95.9	5%
Helicopter	12,000	32.9	5%
Total Operations	**472,000**	**1,293**	

Scenario 4 Noise contours for calendar year 2005 that depict the noise exposure in terms of DNL are shown in Figure C25. The contours shown are the 55, 60, 65, 70 and 75 dBA DNL. The results of the analysis show that these future contours are the largest of all the scenarios. These contours are larger than the existing conditions contours.

Selected Forecast/Fleet Mix Scenario

The Selected Scenario to be used for generating future noise contours has been determined to be most reasonable is Scenario 1. This forecast fleet mix will be used throughout the remainder of the document.

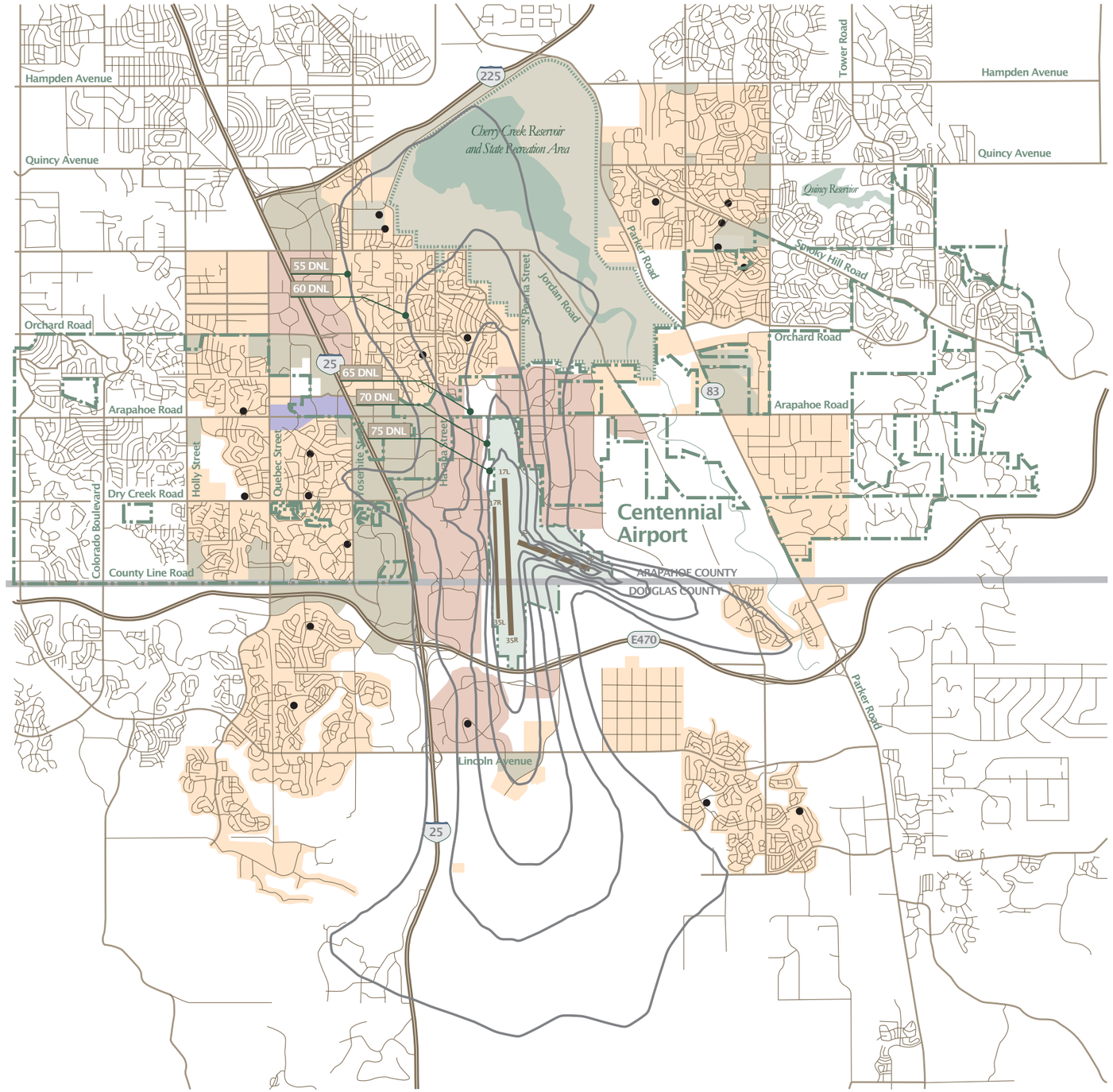


Figure C25 ***Future DNL Noise Contours (Scenario 4) with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Aerial Information, June - 2001.*

Land Use Analysis

Introduction

This section of the FAR Part 150 Noise Exposure and Land Use Compatibility Study for Centennial Airport deals with the evaluation of land uses within both the existing (1999) and future noise contours (2005).

The development of realistic and effective alternatives is the focus of the FAR Part 150 noise compatibility planning process, with the overall objective being to explore a wide range of feasible alternatives of land use patterns, noise control actions and noise impact patterns. Solutions are explored which may accommodate both airport users and inhabitants, as well as environmental parameters. As a prelude to analyzing future noise exposure impacts resulting from changes in noise contours, an examination of existing conditions in terms of areas and persons affected by the existing noise contours is presented here. The following section deals with the types of land uses affected by the existing noise contours and the approximate number of persons within the designated noise contours. A subsequent section deals with these same items, but as they are affected by the future noise contours.

Existing Land Use Analysis/Existing Noise Contours, 1999

This section discusses the land use types found within the existing noise contours generated by aircraft utilizing Centennial Airport. The existing situation is represented by five contours, the DNL 55, 60, 65, 70 and 75 contours. An FAR Part 150 Study utilizes the DNL 65 contour as the threshold contour for land use analysis. However, this Study will present very generalized housing units and population information for the 55 and 60 also. It must be remembered that the total figures given below are cumulative. The figures for the larger contours contain the area within all smaller contours; i.e., the DNL 65 contour area includes the area representing the 70 and 75 contours. The population and housing information was obtained from 1995 updated Census data.

The DNL 55 contour is the largest and contains approximately thirteen thousand one hundred ninety-two (13,192) acres. There are approximately three thousand one hundred ninety-four (3,194) housing units representing approximately nine thousand eight hundred eighty-three (9,883) persons within the contour. There are three schools within the contour.

The DNL 60 contour is the next largest and contains approximately five thousand eight hundred ninety-nine (5,899) acres. There are approximately one thousand one hundred sixty-four (1,164) housing units representing approximately three thousand eight hundred forty-three (3,843) persons within the contour. This does not include the new apartments south of the airport. There are two schools within the contour.

The DNL 65 contour is the next largest and contains approximately two thousand five hundred forty-eight (2,548) acres. There are approximately eighteen (18) housing units representing approximately sixty-two (62) persons within the contour. This represents approximately one hundred (115) acres of residential development. The residential land use is located to both the north and south of the airport, with additional new residential units under construction to the north of the airport that will be within the contour. There are approximately eighty-eight (88) acres of mixed non-residential development, approximately three hundred forty-three (343) acres of business/office park development within the contour. In addition, there are approximately eight hundred seventy-five (875) acres of open space within the contour. The remaining property consists of approximately one thousand thirty-seven (1,037) acres are on airport property. There are no schools or historical sites listed on the National Register within the 65 DNL noise contour.

The DNL 70 is the next largest noise contour and contains approximately one thousand sixty-five (1,065) acres. There are no residential land uses within this contour. The contour is generally all on airport property except for approximately fifty-three (53) acres to the south that encompass portions of the Meridian Office Park and approximately two hundred forty-eight (248) acres of open space. There are no noise sensitive uses or historical sites listed on the National Register within the contour.

The DNL 75 is the smallest contour. It contains approximately five hundred twenty-two (522) acres. There is no residential development within the contour. The contour is entirely on airport property except for a small area (32 acres) that crosses E470 to the south over the treatment ponds associated with the Meridian Office Park.

The existing table, entitled *EXISTING LAND USE WITHIN EXISTING NOISE CONTOURS, 1998* summarizes the above land use information.

Table D1
EXISTING LAND USE WITHIN EXISTING NOISE CONTOURS, 1999
Centennial Airport FAR Part 150 Study

Land Use	DNL 55 Contour	DNL 60 Contour	DNL 65 Contour	DNL 70 Contour	DNL 75 Contour
Residential	NA Ac	NA Ac	115 Ac	0 Ac	0 Ac
People	9,883	3,843	62	0	0
House. Units	3,193	1,164	18	0	0
Schools	3	2	0	0	0
Bus/Off. Park	NA Ac	NA Ac	343 Ac	53 Ac	0 Ac
Open Space	NA Ac	NA Ac	875 Ac	248 Ac	32 Ac
Govt./Public	NA Ac	NA Ac	0 Ac	0 Ac	0 Ac
Airport	NA Ac	NA Ac	1,037 Ac	764 Ac	490 Ac
Mixed Non-Res.	NA Ac	NA Ac	88 Ac	0 Ac	0 Ac
Total	**13,192 Ac**	**5,899 Ac**	**2,458 Ac**	**1,065 Ac**	**522 Ac**

The total figures for each contour are cumulative. The figures for the larger contours contain the area -within all smaller contours.

SOURCE: BCS International Contours, BDC Analysis

Existing Land Use Inconsistencies

Land use incompatibility is an area of determination and regulation that is to be resolved solely at the discretion of the local community or by the state. To determine what constitutes land use incompatibility, the individual land use types within particular noise contours need to be defined. The Federal Aviation Administration, through the FAR Part 150 Study, has developed generalized guidelines for land use compatibility for land use planning purposes, as presented earlier. However, these are guidelines and do not automatically define incompatible land uses. Based on these guidelines, the residential land uses and churches within the 65 or greater DNL noise contours, unless sound attenuated, are inconsistent with the Federal guidelines. However, each jurisdiction can determine and identify land use compatibility based on local conditions and policy.

Existing Land Use Analysis/ Future (Base Case, 2005) Noise Contours

This section will discusses the land use types found within the agreed upon base case future (2005) noise contours generated by aircraft utilizing Centennial Airport, assuming that all land uses will remain the same. This is the "base case" which assumes that no operational or facility modifications will occur at the airport, and is reflective of the forecast operations and aircraft types presented in Scenario Four in the previous chapter. Scenario Four reflects the same percentage of Stage 2 and Stage 3 aircraft as the existing noise contour, with a slight increase in the percentage of night time operations. This is the situation with which future alternative scenarios will be measured to quantify impacts as compared with the impacts that would occur if not mitigation measures were implemented.

Table D2
EXISTING LAND USE WITHIN FUTURE NOISE CONTOURS, 2005
Centennial Airport FAR Part 150 Study

Land Use	DNL 55 Contour	DNL 60 Contour	DNL 65 Contour	DNL 70 Contour	DNL 75 Contour
Residential	NA Ac	NA Ac	225 Ac	71 Ac	5 Ac
People	17,568	8,032	1,591	143	34
House. Units	6,044	2,581	544	117	29
Schools	5	2	0	0	0
Bus/Off. Park	NA Ac	NA Ac	582 Ac	104 Ac	10 Ac
Open Space	NA Ac	NA Ac	916 Ac	265 Ac	43 Ac
Govt./Public	NA Ac	NA Ac	0 Ac	0 Ac	0 Ac
Airport	NA Ac	NA Ac	908 Ac	722 Ac	502 Ac
Mixed Non-Res.	NA Ac	NA Ac	75 Ac	9 Ac	0 Ac
Total	**14,077 Ac**	**6,554 Ac**	**2,706 Ac**	**1,170 Ac**	**560 Ac**

The total figures for each contour are cumulative. The figures for the larger contours contain the area -within all smaller contours.

Future Base Case (2005) Land Use Inconsistencies

Based on the Federal guidelines, the residential land uses and schools within the 65 or greater DNL noise contours, that are not sound attenuated, are inconsistent with these guidelines. The forecast aircraft aviation activity forecasts result in the contours that are reflected in the above table.

Initial Noise Abatement Alternatives

Introduction

The responsibility for evaluating alternative noise abatement and mitigation measures and taking the steps which are essential to minimizing the number of people who are adversely affected by noise does not rest with one individual, one governmental entity or agency, or one community. To the contrary, the authority and responsibility lie with a wide variety of federal, state, local and private entities. A coordinated approach to noise abatement and the sometimes difficult task of resolving noise impacts was outlined in the Department of Transportation/Federal Aviation Administration (DOT/FAA) Noise Abatement Policy of November 18, 1976. The need for noise compatibility programs has been nationally recognized since that time through passage of the Aviation Safety and Noise Abatement (ASNA) Act in 1979, the statutory authority for Federal Aviation Regulation (FAR) Part 150. Responsibility for the coordinated effort to abate noise impacts rests with the airport users, aircraft manufacturers, airport proprietors, federal, state and local governments, and residents within the environs of the airport.

The Federal government has the authority and responsibility to control aircraft noise sources, implement and enforce flight operational procedures and manage the air traffic control system in ways that minimize noise impacts on people. State and local governments have the responsibility to provide for land use planning, zoning and development controls that will encourage development or redevelopment of land that is compatible with both present and projected airport operations. In order to accomplish this task, the state must provide enabling legislation which grants authority to the local units of government to implement land use controls which are not confiscatory or discriminatory, based on the police power to protect the public health, safety and welfare.

In addition, the local units of government must work closely with airport management and staff, for it is the responsibility of the governmental unit having land use controls to ensure land use compatibility planning beyond the airport's boundary. The airport management has no authority to control the types of land uses outside the airport ownership boundary; this is the responsibility of the appropriate local unit of government.

The aircraft noise standards established by the Federal government must be met by the aircraft manufacturers through newly-designed engines and aircraft. The airlines are then responsible for replacing or retrofitting their fleet with these new aircraft and/or engines. The government established a timetable with which the airlines must comply, and full compliance was established in January 1, 1988 (FAR Part 36). Subsequent to this timeframe, Congress passed the Noise Act (The Airport Noise and Capacity Act of 1990 [ANCA], PL 101-508, 104 Stat. 1388) which established two broad directives for the FAA. The first directive established a method to review aircraft noise and airport use or access restrictions imposed by airport proprietors, and the second was to institute a program of phase-out of Stage II aircraft over 75,000 pounds by December 31, 1999. To implement ANCA, FAA amended FAR Part 91 and issued a new FAR Part 161. Part 91 addresses the phase-out of large Stage II aircraft and the phase-in of Stage III aircraft. The airlines are responsible for meeting this deadline by whatever method they can.

FAR Part 161 was established to work in conjunction with Part 91, in that it establishes a stringent review and approval process for implementing use or access restrictions by airport proprietors. This is in keeping with one of the major reasons for the Act, which was to discourage local restrictions more stringent than the Act's 1999 phase-out. Part 161 makes it more difficult for airport proprietors to implement use or access restrictions, especially those associated with Stage III aircraft. These difficulties are so significant that to date there have been no Part 161 plans approved by the FAA.

The Airport Proprietor is responsible for planning and implementing airport development actions designed to reduce noise. Such actions include improvements in airport design and noise abatement ground procedures, in addition to evaluating and recommending restrictions on airport use that do not unjustly discriminate against any user, impede the federal interest in safety and management of the air navigation system, unreasonably interfere with interstate commerce and are consistent with the provisions of ANCA. The proprietor of a public airport may establish restrictions, as long as the airport is available for public use, that do not unjustly discriminate among or between classes of aircraft; do not create an exclusive right; are reasonably related to a demonstrated noise problem; do not regulate aircraft safety or flight operations; do not regulate rates, routes or services of air carrier aircraft; and

do not create an undue burden on interstate commerce (Airport Sponsor Grant Assurances; Airport and Airway Improvement Act of 1982, as amended; Federal Aviation Act of 1958, as amended; and the U.S. Constitution).

Basically, an airport proprietor, and state and local governments, are preempted from regulating the operations of aircraft, with one exception. They may exclude aircraft from an airport for noise reasons as long as the exclusion is reasonable and nondiscriminatory. In addition, it must comply with the provisions of the Airport Noise and Capacity Act of 1990, through FAR Part 161, and it must not attempt to regulate military aircraft.

Residents and prospective residents in areas surrounding the airport should seek to understand the existing and projected aircraft noise environment and what steps can be taken to minimize its effect on people. Prospective residents of areas impacted by aircraft-generated noise should be aware of the effect of noise on their prospective residences and allow this to influence any decision to move into the area.

The development of reasonable alternatives is the focus of the FAR Part 150 noise compatibility planning process. The objective is to explore a wide range of feasible alternatives of land use patterns, noise control actions and noise impact patterns, seeking optimum accommodation of both airport users and airport neighbors within acceptable safety, economic and environmental parameters. Consideration of alternatives should address both physical planning and the implementation aspects of proposed solutions. Some alternatives may have little or no value in the particular situation, especially if used alone. Each alternative considered should: 1) have the potential of resolving the problem; 2) be implementable within acceptable economic, environmental and social costs; and, 3) be legally implementable within existing federal, state and local legislation, regulations, and ordinances.

This section contains a description of potential noise abatement and mitigation measures or actions for Centennial Airport. A general evaluation of each is made on the basis of the three factors listed above, and will be presented in three different categories: a) those alternatives available to the airport proprietor; b) those alternatives available to the state or local unit of government; and, c) those alternatives dependent upon Federal government concurrence for implementation.

In addition, the Regulation identifies several alternatives that are required for evaluation. These required alternatives are:

- Acquisition of land or interest therein;
- Construction of barriers and acoustical shielding, including soundproofing of public buildings;
- Implementation of a preferential runway system;
- The use of flight procedures (including modification of flight tracks) to control operation of aircraft to reduce exposure to individuals;
- The implementation of any restriction on the use of airport by any type or class of aircraft based on the noise characteristics of those aircraft;
- Other actions or combination of actions which would have a beneficial noise control or abatement impact on the public; and
- Other actions recommended by the FAA.

These are explained in greater detail in the following sections.

A. Options Available to the Airport Proprietor

A.1. Denial of Use of Airport to Aircraft Not Meeting FAR Part 36 Standards.

This alternative is implemented by limiting access to the airport to allow aircraft that conform with certain FAR Part 36, Stage II, noise level requirements. Most turboprops and other large aircraft produced after 1964 were required to meet those standards. Older, noncomplying (Stage I) turbojets over 75,000 pounds maximum gross takeoff weight, which have standard airworthiness certificates, were required to be retrofitted with quieter engines and/or nacelles or cease operating in U. S. airspace as of January 1, 1985 (Part 91, Subpart E). Two provisions of Part 91, Subpart E, allow the operation of noncomplying two engine airplanes after the January 1, 1985, deadline. The "Replacement Plan" provisions allowed a one year extension (January 1, 1986) and the "Small Community Exemption" provision allowed a three year extension (January 1, 1988) for two engine aircraft with one hundred passenger seats or fewer. These dates have all been achieved and there is now full compliance.

Denying such Stage I aircraft use of the airport is a feasible option, provided the action is not unjustly discriminatory, does not constitute a burden on interstate and foreign air commerce, and does not conflict with any airport policy or requirement. In addition, military aircraft do not have to comply with these regulations during the same timeframe. This alternative is feasible

where the majority of the aircraft fall within the parameters of FAR Part 36. However, to restrict heavy Stage II aircraft from the airport prior to 2000 or to restrict Stage III or Stage II aircraft under 75,000 pounds any time, the provisions of Part 161 must be complied with. This includes a cost/benefit analysis of the proposed restriction (with FAA approval of the methodology or results) and proper notice must be given, not only to the public but to all affected parties. This is a very difficult task, which can be very expensive and time consuming. To date, no such plans have been approved.

A.2. Capacity Limits Based on Noise.

Restrictions on airport use may be based upon noise limits. However, such restrictions often have uneven economic consequences and should be implemented only after careful consideration of other alternatives. The implementation of this type of restriction can take three broad forms. These are outlined below.

A.2.1. Restrictions Based on Cumulative Impact. With this alternative, a maximum cumulative impact (such as the total area within the existing DNL 65, 70 or 75 contour) is established as the baseline cumulative impact and then the airport's operations are adjusted or limited so as not to exceed that maximum in the future. This is accomplished through "capacity limitations", whereas either the aircraft types, based upon their "noisiness", or the numbers and mix of aircraft, are limited or adjusted so as not to exceed the existing noise impact. One variation of this alternative can be referred to as a "noise budget".

A.2.2. Restrictions Based on Certificated Single Event Noise Levels. Most aircraft today have been certificated for noise by the FAA, as part of the FAR Part 36 process explained earlier. These levels are published as part of Advisory Circular 36-1C and 36-3C, and it is possible to devise limitations based upon those certificated data. This alternative can be formulated so as to set a threshold noise level which cannot be exceeded, or different levels can be implemented for either day or night operations. An aircraft's compliance with this limit would be determined from the published FAA certification data. It should be noted that aircraft can be operated at less than certificated noise levels under certain operational conditions.

A.2.3. Restrictions Based on Measured Single Event Noise Levels. Although aircraft noise levels vary widely with changes in operational procedures as well as with atmospheric conditions, it is possible to set limits on estimated single event noise levels. Aircraft which exceed this

limit can be prohibited from using the airport. This does not mean that the airport, the community or citizen group can set up a microphone and noise level limit and challenge the pilots to "beat the box". Compliance with the single event level should be measured over an extended period of time for many single events, and violation is determined from repeated excess noise.

These are also the types of restrictions that are under the jurisdiction of Part 161 and are historically used in place of a general Stage II aircraft restriction. In addition, military aircraft are not subject to such restrictions.

A.3. Landing Fees Based on Noise.

This alternative is based on the premise that all or part of the landing fee for each aircraft focuses on the noise emitted by that individual aircraft. This would apportion the "cost" of producing the noise to those aircraft which contribute the most to it. This alternative would encourage the use of quieter aircraft while generating additional revenue for the airport. In order to avoid discrimination, the noise fee should be based upon a published standard for single event noise levels, such as those contained in Advisory Circular 36-3C. As a corollary to this, the opposite strategy can also be used. In other words, quieter aircraft could be apportioned a lesser fee than noisier aircraft, thus serving as an incentive for quieter aircraft. In this manner, operators which go to extra lengths to reduce noise generated by their aircraft are rewarded.

The cost of implementing this alternative, in terms of manpower, finances and public relations, many times is not offset by the revenue or benefit derived from it. The administrative cost involved in maintaining records of aircraft types and numbers, and billing statements are not commensurate with the noise reduction achieved. In addition, this does not apply to military aircraft as they do not pay landing fees.

A.4. Complete or Partial Curfews.

Airport curfews are an effective but costly means of controlling noise intrusion into areas adjacent or close to the airport. Curfews can have a very significant negative effect on both aviation and the community, having economic impacts upon airport users, those providing airport-related services, and upon the community as a whole. In addition, other communities may also be impacted through curtailment of service. Thus there is a concern of an unreasonable burden to interstate or foreign commerce. A curfew can take various forms, from restrictions upon some or all flights during certain times of the day or night, or restrictions based upon noise thresholds and certificated aircraft noise levels contained in AC 36-3C. Curfews are usually implemented to restrict

operations during periods when people are most sensitive to noise intrusion, which most often occurs between the hours of 11:00 p.m. to 7:00 a.m., and are effective if there is a significant night noise problem. Curfews have been upheld by a Federal Court in California for a general aviation airport (Santa Monica Airport Assoc. v. City of Santa Monica, 659 F. 2d. 100,[9th Cir., 1981]), while at the same time, they have been denied by a Federal District Court in New York (Westchester County v. United States of America, 571 F. Supp. 786 [Southern District of New York, 1983]).

A.5. Noise Barriers (Shielding).

Noise generated from ground-level sources on an airport can be a result of engine run-up and maintenance operations, taxiways, thrust reverse on landing and warehouse activities. Noise intrusion from these sources is usually only significant to those areas close to the airport. One method of mitigating this type of noise is through the use of noise barriers or earthen berms. These can protect adjacent areas from the unwanted noise. Another method is through the strategic and well planned location of airport structures that can provide shielding to adjacent areas to prevent noise intrusion. Run-up and maintenance areas can also be moved to locations which are away from noise sensitive uses adjacent the airport, and if necessary "hush houses" can be constructed to absorb sound for specific run-up and maintenance operations.

A.6. Ban All Jet Aircraft.

This alternative is sometimes proposed at airports to relieve noise intrusion, but it has been well settled and documented by case law that this is not legally possible (Santa Monica Airport Assoc. v. City of Santa Monica, 659 F. 2d. 100,[9th Cir. 1981]). It not only puts an unreasonable burden on interstate commerce, which is an area of regulation reserved for the federal government, but it also results in a discriminatory regulation and which is violative of the U.S. Constitution, along with violating the equal protection clause. An outright ban on all jet aircraft cannot be legally implemented, and therefore, is not recommended.

A.7. Acquisition of Land or Interest Therein.

The most complete method to totally control and mitigate noise intrusion is to purchase the impacted property in fee simple, but it is also the most costly and it removes the property from the tax rolls of the community. However, certain land areas are more critical than others and can be purchased to mitigate severe noise intrusion where purchase of the full or partial interest may be the only means of achieving compatibility.

An alternative to purchasing land in fee simple is to purchase an easement, which is the right to do something (positive easement) or the right to preclude the owner of the rest of the property from doing something (negative easement). An easement is sometimes preferred because it keeps property on the tax roles, but may cost as much as the entire fee. There are two main types of easements associated with airports, the clear zone easement and a noise easement (an avigation easement sometimes combines portions of both), which was discussed in an earlier section of this report. Easements can be purchased, condemned or dedicated through the subdivision process.

One method of keeping the area on the tax rolls is to purchase the property and then resell it for a compatible use or to resell it for residential use but retain a portion of the "bundle of rights" that are part of property ownership. In other words, the airport can resell the property to the original homeowner or anyone else, but retain a covenant or easement which identifies the airport's right to fly over the property and to create noise. This results in the property owner giving up his/her right to initiate litigation against the airport for noise intrusion. In addition, this method allows the market to set the price and value of the noise easement which is retained by the airport. The airport could also develop or resell the property to another government agency to develop it as a compatible use (golf course, nature area, cemetery, etc.), or the agency could purchase the property outright for their own use. This would have to be coordinated with the airport staff and management to ensure redevelopment with a compatible use.

As an alternative to land purchase, sound attenuation is many times recommended. Sound attenuation is the process of adding structural components to a structure to reduce the inside noise levels to a specific degree. Normally, a 25 to 30 dB(A) reduction from outside to inside noise levels is recommended. Such noise reductions are normally achieved through such activities as double paned windows, solid core doors, special ventilation systems and some wall treatments. Many residents prefer this alternative because it reduces the inside noise levels and allows the homeowner to remain in his/her home.

No matter what interest of land is purchased, if federal assistance is used, the provisions of the Uniform Relocation Assistance and Real Property Acquisition Policy Act of 1970 (URARPAPA, PL 91-646) must be followed.

A.8. Construct a New Runway in a Different Orientation.

Often the construction of a new runway with a different orientation will shift noise impacts away from noise sensitive uses to more tolerant and less populated areas. The orientation of a runway is dependent upon many factors, including prevailing winds, topography, obstacles and other conditions. A new runway cannot be constructed if wind direction and topographic conditions are such that safety criteria cannot be met. In addition, both existing and future land uses must be considered so that the noise is not shifted to other populated areas. This is an expensive endeavor which must be beneficial to both the airport users and the surrounding community.

A.9. Runway Extensions.

Often a runway extension, coupled with other noise abatement procedures can mitigate noise impacts on areas in close proximity to the airport. The extension can allow aircraft to gain altitude sooner and produce less noise impact at ground level. In addition, noise abatement turns are sometimes possible with an extension as a result of enhanced altitude position. Many times, with an extension, the area off the end of the runway with the extension can experience greater amounts of noise due to lower approach altitudes at this end of the runway. This can sometimes be corrected by establishing a displaced threshold so that aircraft land farther down the runway and maintain altitude over the area beyond the extension. This practice is not generally recommended by the FAA. An additional factor to consider with a runway extension is that many times heavier, larger aircraft can be accommodated at the airport which were unable to operate in a safe manner previously. This may not necessarily be undesirable, however, because many of the larger, heavier aircraft are new generation aircraft and are actually quieter than those smaller aircraft presently operating. Runway extensions can also be used as a noise abatement measure to help reduce the need for using reverse thrust upon landing, which can generate a considerable amount of ground-level noise to areas close to the airport.

A.10. Touch and Go Restrictions.

Restrictions on training flights performing touch-and-go operations can mitigate noise impacts at airports where there are a significant number of such operations, especially jet training. This alternative is also effective if the operations are occurring during the nighttime and early morning hours, for the

restriction may be for certain time periods. However, such restrictions may not be legal as it may be interpreted as a capacity restriction.

A.11. High Speed Taxiways.

High speed taxiways can help reduce noise intrusion by allowing aircraft to exit the runway quicker and reducing the need for extended use of reverse thrust. This alternative is only viable with a runway of sufficient length to allow aircraft the opportunity to slow down to a speed sufficient enough to exit the runway. This alternative does little good as an independent measure, and must be implemented along with other alternatives.

A.12. Noise Monitoring Program.

Noise monitoring programs can enhance the effectiveness of noise compatibility programs. Continuous noise monitoring systems have been used as a part of aircraft noise abatement programs at airports experiencing severe encroachment. These airports have used the system to demonstrate how they were reducing noise impact. The noise monitoring of aircraft operations is a means of showing progress toward reducing the problem. At airports with less intense problems, the purchase of noise monitoring equipment and manpower is generally less justified. Most of the systems have several remote microphone units that sample the weighted sound level once or twice per second, code the samples, and transmit the data to a minicomputer system with printouts. Any FAA approved noise monitoring system would have the following minimum capabilities to provide: continuous measurement of dBA at each site, hourly Leq data, daily Ldn data, and single event maximum A-weighted sound level data. This is an expensive system that is recommended for airports with significant noise/land use compatibility concerns.

A.13. Noise Complaint/Citizen Liaison Program.

A comprehensive noise complaint handling system has many advantages, including identification of and notice to aberrant pilots, public accessibility, data collection to identify sensitive areas and positive public relations. The airport management will usually identify one person to handle noise complaints from citizens. The complaint officer then keeps a file on each complaint, noting the time, place, type of complaint, type of aircraft and N-number or other identifying characteristic of the aircraft. This will help identify problem areas and can be used to notify pilots of the noise abatement program, what they did to generate a noise complaint and why noise abatement is of particular concern at that airport. This will give the citizens of the community one central location to lodge noise complaints and to gain

information concerning aircraft operations or changes in flight procedures. The airport currently has such a system in place and is keeping records of noise complaints. This program will be reviewed and revised as necessary.

B. Options Available to State or Local Governments

B.1. Land Use Controls.

Federal guidelines contained in FAR Part 150 indicate that residential development, along with other noise sensitive uses such as schools, churches, hospitals, rest homes, etc. should be prohibited from siting within areas with annual noise levels in excess of the DNL 65. These guidelines are recognized not only by the FAA but also by the Department of Housing and Urban Development, Department of Defense and the Environmental Protection Agency, as well as numerous state and local agencies. Land use and development controls are one method of ensuring such uses will be controlled within the noise contours. It should be remembered that it is within the discretion and authority of the local unit of government to determine what are incompatible land uses and to define their own threshold of sensitivity.

Land use and development controls which are based on a well defined and thoroughly documented comprehensive plan are among the easiest and most powerful tools available to the local unit of government to ensure land use compatibility. It is very important for the local unit of government to exercise these controls, for they are beyond the authority of the airport management to implement. It is the responsibility of the local unit of government having land use jurisdiction to implement these controls to protect it's residents from impacts and the airport from encroachment of incompatible land uses. Traditionally, even if the airport is managed by the same unit of government that has land use control authority for the land area beyond the airports boundary, there has been little coordination and discussion as to what land use controls should be implemented and which land uses are compatible with airport development. This is very important and cannot be over-emphasized to ensure coordination of development plans for all parties involved. This is particularly important where more than one unit of government has land use control authority for the area outside the airport's boundary. It is extremely critical that the local unit of government accept the responsibility for ensuring land use compatibility in their planning and development actions. It is also important that the state government provide the necessary enabling legislation that will allow the local unit of government to institute land use controls. The most common forms of land use controls available to the local governments

include: zoning, easements, transfer of development rights, building code modifications, capital improvement programs, subdivision regulations and comprehensive planning. These forms of land use controls have all been discussed earlier in this report, and will only be briefly outlined in the following paragraphs.

B.1.1. Zoning. Zoning is the most common and traditional form of land use control used in the United States today. It controls the type and placement of different land uses within designated areas. It is used to encourage land use compatibility while leaving property ownership in the hands of private individuals or business entities, thus leaving the land on the tax roles. Zoning is not applied retroactively and is not necessarily permanent. It is most effective in areas which are not presently developed and which can be encouraged to develop with compatible uses. As stated earlier, all jurisdictions have typical zoning ordinances in effect.

B.1.2. Easements. An easement is a right held by one to make use of the property of another for a limited purpose. Two specific types of easements are usually referenced in airport planning, a positive easement which would allow the generation of noise over the land and a negative easement to prevent the creation of a hazard or obstacle on the property of another.

B.1.3. Transfer of Development Rights. The transfer of development rights involves separate ownership of the "bundle of rights" associated with property ownership. The concept involves the transfer of the right to develop a certain parcel of property to a certain density/intensity to another parcel of property under separate ownership. This would allow the property that obtains the added development rights to develop to an intensity/density that is beyond that which would normally be allowed. The airport could also purchase these rights from the landowner and retain them or sell them to another landowner. This concept can be used to retain property in compatible uses and still compensate the landowner for his loss of development. The idea depends upon market conditions of the area and (there is some disagreement on this point) upon the availability of state enabling legislation authorizing the development of the concept at the local level.

B.1.4. Building Code Modifications. This alternative is to modify existing or potential building codes to include specific sound attenuation provisions for structures within areas impacted by aircraft noise. Such sound attenuation measures are currently required by both counties and the City of Aurora.

B.1.5. Capital Improvements Program. This is a document that establishes priorities and costs on the funding and development of public facilities (roads, streets, sewers, libraries, etc.). It can be used very successfully, in concert with subdivision regulations and a comprehensive plan, to control not only the areas of development but the timing of development by controlling the timing and location of public facilities construction.

B.1.6. Subdivision Regulations. Subdivision regulations are used to control the design and placement of public and private facilities in the conversion of raw land to developed property. The surrounding jurisdictions have adopted subdivision regulations.

B.1.7. Comprehensive Planning. Comprehensive future land use planning, when it is coordinated with the zoning ordinance, subdivision regulations and the capital improvements program, can reduce or avoid land use incompatibilities in the future. The surrounding jurisdictions have an adopted comprehensive plan for their areas of jurisdiction.

All of the land use controls mentioned above will be analyzed in greater depth as to their feasibility for implementation when the final noise contours are produced and a Future Noise Exposure Map is presented.

C. Options Dependent Upon the Federal Government

C.1. Departure Thrust Cutback.

This alternative would involve the imposition of thrust cutbacks following take-off. Because of system-wide needs, each operator has developed its own standardized take-off procedure. This alternative is recommended where the operators have the opportunity to utilize a different departure thrust setting and still be within safety limits as per the particular type of aircraft they are flying given the characteristics of the particular airport concerned. It is better for aircraft to climb faster and turn earlier than to fly over noise sensitive uses at lower power. In addition, this alternative cannot be implemented without the direct concurrence of the Federal Aviation Administration taking into account operational, safety and airspace considerations. The Federal Aviation Administration has recently revised AC 91-53 to identify two standard departure procedures for aircraft, a “close in” departure and a “distant” departure.

C.2. Noise Abatement Take-off/Approach Procedures (Flight Tracks).

This alternative is very similar to the previous one, except that it concerns take-off/approach procedures that dictate the location of aircraft during certain altitude and turning procedures. These procedures are dictated by considerations of operational safety and air traffic control procedures. Generally, the air traffic control procedures can be resolved, perhaps with penalties involving reductions in airport and airspace capacity. However, aircraft turns at low altitudes, when the aircraft are in a low-speed, high-drag configuration, can cut deeply into aircraft operating margins. Turns during the last three to four miles of the final approach in good weather, and within the final six to seven miles during poor weather, are undesirable for safety reasons because they do not allow pilots to establish and maintain a stabilized approach. Aircraft bank angles near the ground need to be restricted to no more than 15-20 degrees. These procedures cannot be implemented without the concurrence of the Federal Aviation Administration, taking into account both operational, safety and airspace considerations.

C.3. Preferential Runway System.

This alternative is to utilize one runway the majority of the time, establishing operations in a certain direction, with operations occurring in the opposite direction held to a minimum. This alternative is very closely related to wind direction and airspace safety considerations. The FAA has the responsibility to implement this alternative through air traffic routing, with aircraft safety being the prime concern. This is only available for use during certain wind conditions and is only recommended when there is a severe noise compatibility problem directly off one end of the runway. The airport has a voluntary runway use program in effect for specific runways during specific periods.

C.4. Power and Flap Settings.

A variety of operating procedures are possible for implementation at the airport. These include minimum flap landings and delaying flap and gear deployment. To help minimize fuel costs and flight time, most operators of large jet aircraft have adopted procedures for reduced flap setting and delaying flap and gear extension, consistent with safety and current aircraft and air crew capabilities. During VFR weather conditions and low traffic conditions, large jet aircraft generally land with minimum flap settings at the airport. More sophisticated delayed flap procedures have not been considered safe with current air traffic control procedures and safety criteria.

C.5. Microwave/GPS Landing System.

A global positioning satellite (GPS) system is a new type of instrument landing system which, when fully installed, could allow new noise abatement landing procedures. The GPS system uses satellites to determine exact locations, and with the addition of a ground unit, can determine altitude. It is being considered as the precision instrument landing system of the future, as it is less expensive to equip and maintain both onboard and ground facilities. This system seems more likely to be installed at airports in place of the microwave landing system. The airport currently has precision instrument landing systems one of the runway ends.

Final Abatement Alternatives Evaluation

Introduction

Based on comments received subsequent to the last Advisory Committee meeting, the various alternatives potentially available for noise abatement presented at that Advisory Committee meeting have been refined. The Federal Aviation Administration discussed several options that they felt could be implemented which might mitigate the impacts of aircraft noise on surrounding persons. Several options were removed form consideration because they were not capable of implementation. In addition, they reviewed the recommended Alternatives and determined that one of the Alternatives, *Alternative 6—Noise Abatement Procedures (Flight Tracks, North)* was not an Alternative that they could provide "informal agreement" on as required by FAR Part 150. As such, they recommended that we not model that Alternative. Informal agreement on flight track or procedure changes is required by FAR Part 150 prior to submittal of the document to the FAA for acceptance and approval. Alternative 6 was intended to evaluate a new north departure track that would generally be a 010-degree departure route over Cherry Creek State Park. They did recognize the void of departures over the east side of Cherry Creek State Park and stated that this was due to the layout of the metro area airport system. They concluded that Alternative 6 would conflict with other airports flight corridors too often to comfortably consider it to fill in this sector.

In addition, the FAA also requested that we evaluate two additional Alternatives, Alternative 9 and Alternative 10. Alternative 9 would consist of modeling all departing jets remaining on runway heading until reaching 8,000 feet AMSL or higher. Alternative 10 would consist of placing eighty percent of south and southeast jet arrivals on a twenty mile final when landing north and on an extended twenty-one mile downwind when landing south.

Subsequent to receiving the letter from the FAA, and after discussion with airport Staff and Management, it was decided that there was value in modeling Alternative 6 to identify what the potential noise reduction would be. If there were the potential for significant noise reduction to residences, then discussions with the FAA would continue to investigate implementation options. Therefore, Alternative 6 is modeled and presented in the following discussion.

The following discussion presents the evaluation of each of the Alternatives as they were modeled. The modeled Alternatives are compared for land use types and numbers of persons, and evaluated against the future Base Case contour. After much discussion by the Committee and the Consultants, it was determined that the noise contours associated with aircraft operations as presented in Scenario 1 be used to determine future noise levels and would be used to generate contours associated with each Alternative. Scenario 1 presented the future aircraft operations based on the Federal Aviation Administration approved Terminal Area Forecasts (TAF) indicating an increase is business jet activity. The mix of Stage 2 and Stage 3 aircraft remains the same as with existing conditions, approximately 17% Stage 2 (7,140 ops) and approximately 83% Stage 3 (34,860 ops). The percentage of operations in the nighttime hours is also assumed to remain the same as with existing conditions, along with the Stage 2 and Stage 3 use at night.

Alternative 1-Total Restriction on Stage 2 Operations.

This Alternative modeled the future operations at the airport with a restriction ***on all Stage 2 aircraft.*** It assumes that all Stage 2 aircraft, except those exempt such as military, emergency flights and state and Federal government aircraft would be prohibited from using the airport. It assumes the same number of business jet operations as the future Base Case forecast; however, all Stage 2 jets have been replaced by Stage 3 jets. All are under 75,000 pounds in weight. As stated earlier, to implement such a restriction, an FAR Part 161 Study would have to be prepared. This Alternative was modeled and shown on Figure F1, entitled *ALTERNATIVE ONE, TOTAL RESTRICTION ON STAGE 2 OPERATIONS.* As can be seen, the noise contours are significantly smaller than the Base Case contours presented in Scenario 4, as they would be with any of the future Scenarios.

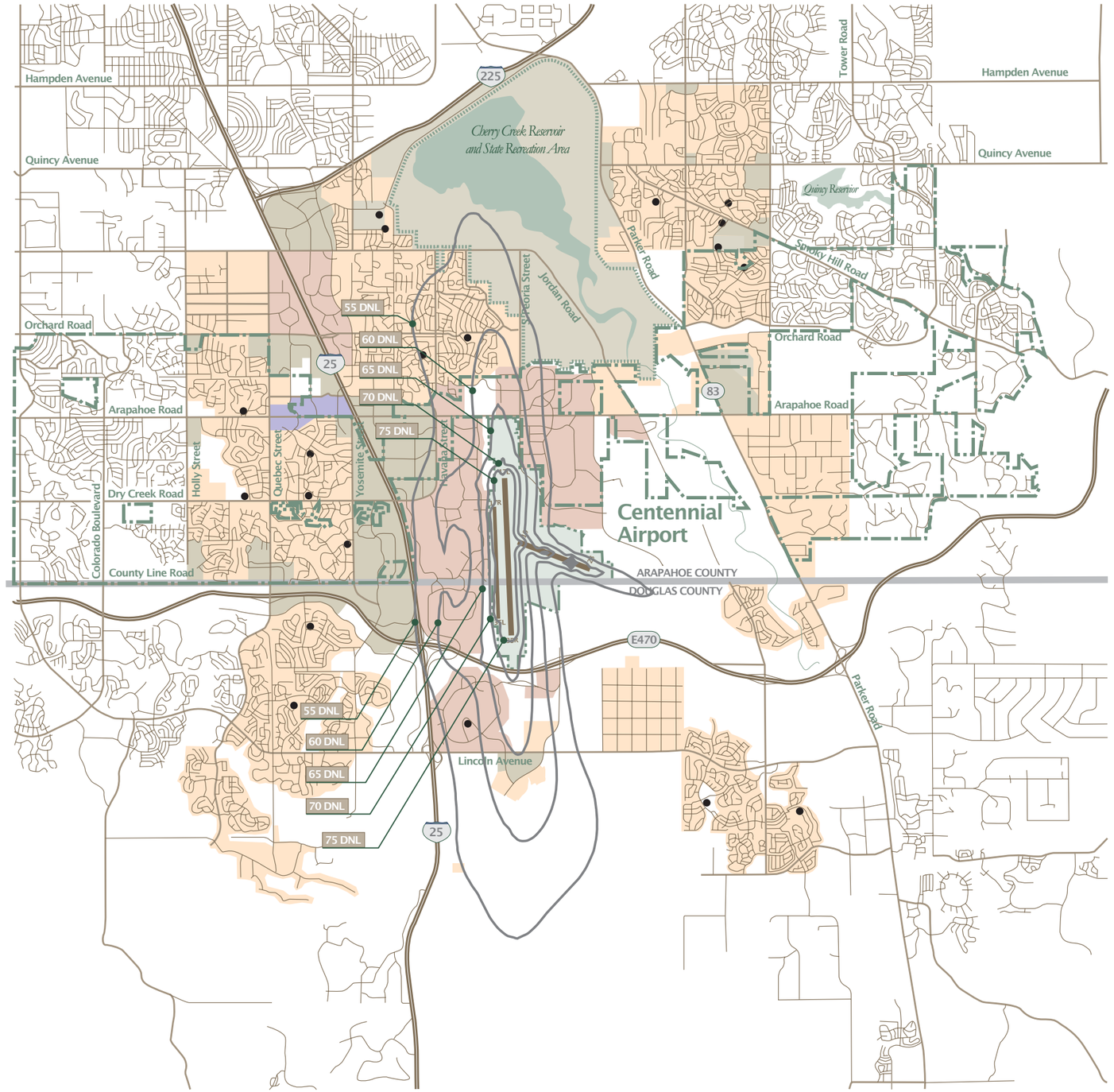


Figure F1 ***Alternative One, Total Restriction on Stage 2 Operations with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Landata, Aerial Information 1998. Noise Contours, BCS International Noise Analysis - 2000.*

Alternative 2-Nighttime Restriction on Stage 2 Operations.

This Alternative is a derivative of the previous Alternative. Instead of a total ban on Stage 2 aircraft, this Alternative would entail ***a nighttime restriction on Stage 2 operations***. This Alternative pertains to the nighttime hours (10 pm to 7 am) and would restrict the use of the airport during this time period to Stage 3 aircraft only. The restriction would also require the preparation of an FAR Part 161 Study. As with the previous Alternative, the same number of business jet operations would occur, except that all operations occurring during the nighttime hours would be Stage 3 aircraft. As this is just a partial curfew, it maybe easier to implement than a total ban of Stage 2 aircraft. A partial curfew may not generate the same conflicts as a total ban on Stage 2 aircraft and may result in a better cost/benefit analysis. This Alternative was modeled and is shown on Figure F2, entitled *ALTERNATIVE TWO, NIGHTTIME BAN OF STAGE 2 AIRCRAFT.* As can be seen, the noise contours are smaller than the Base Case contours presented in Scenario 1, as they would be with any of the future Scenarios.

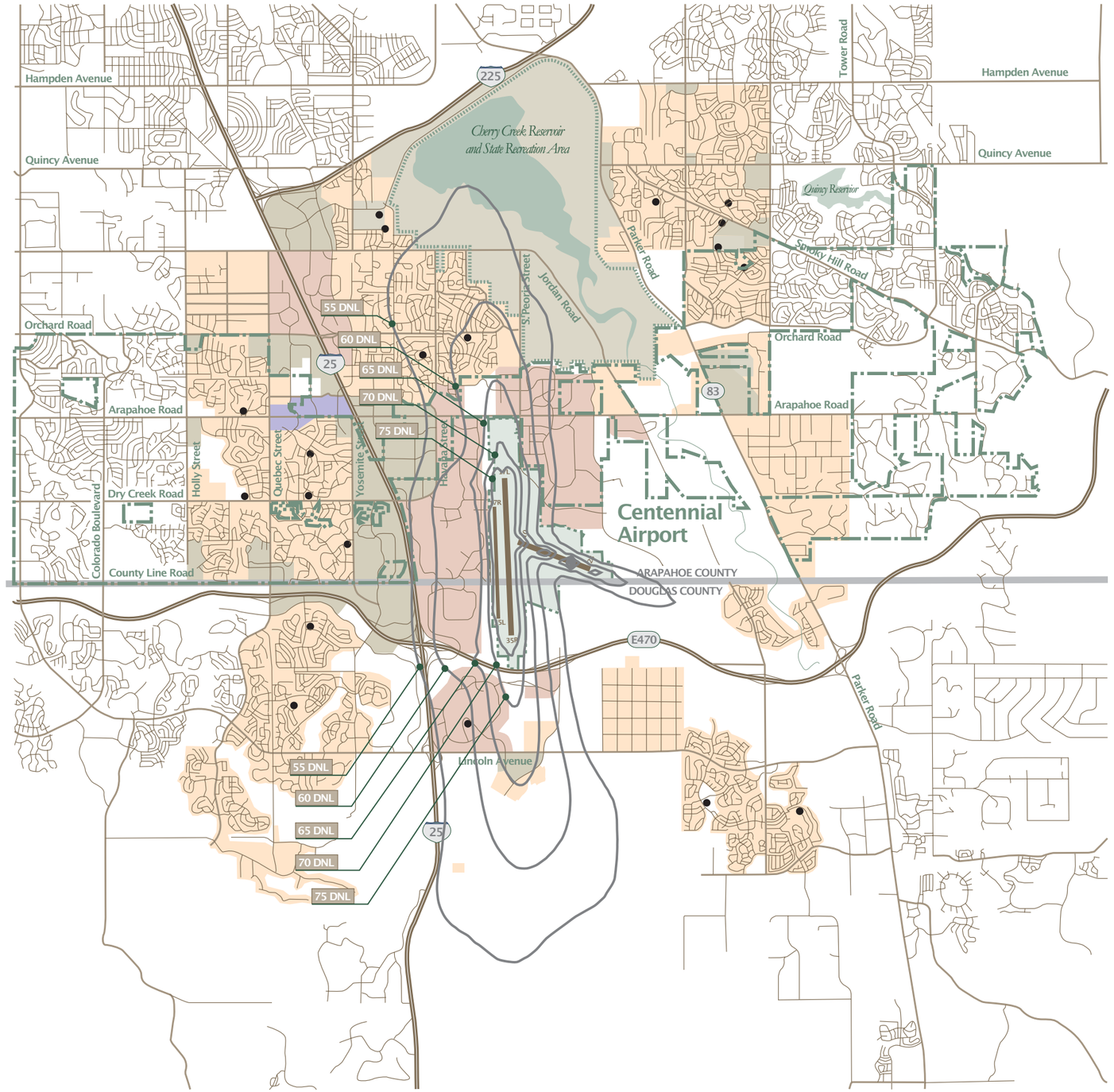


Figure F2 ***Alternative Two, Nighttime Ban on Stage 2 Aircraft with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Landata Aerial Information 1998. Noise Contours, BCS International Noise Analysis - 2000.*

Alternative 3-Fly Quiet Noise and Compliance Monitoring Program

This Alternative is to initiate a number of programs to measure the noise levels and compliance with the noise abatement programs that are being developed at the airport. The FAR 150 study along with efforts by the Airport and the FAA include a number of programs that are designed to minimize noise levels in the communities surrounding the airport. This includes programs such as runway use and flight tracks. Given the complexity of these programs and the varying conditions under which they are utilized, it is difficult to determine if these measures are effective and are actually being implemented to the maximum extend that is feasible. Such a program is commonly referred to as a Fly Quiet Program.

The Fly Quiet Program is a family of programs encouraging pilots to operate aircraft as quietly as possible for people living around a airport. As a voluntary program, Fly Quiet has the advantage of reinforcing desirable flight procedures without going through the time consuming regulatory requirement of FAR Part 161 filing process. The Fly Quiet program is most successful when coupled with on-site noise monitoring of some type. A Fly Quiet Program has the potential of reducing single event noise levels and encouraging greater compliance with preferential flight corridors and procedures. The program could potentially result in continued overall reductions in cumulative noise levels for areas around the airport. Identification of how individual aircraft operate at specific locations compared to the way the majority of aircraft operate, can help encourage the noisier operations to lower noise levels and /or adhere to established flight tracks. Potential elements of a Fly Quiet Program could include;

- Noise abatement flight compliance
- Tracking adherence to noise abatement departure climb profiles
- Late night departure procedures
- Analysis of noisiest single event flights/aircraft

Many of these Fly Quiet Program elements will have to be refined as the Noise Compatibility Program is finalized. In addition, this type of program is most effective with a permanent noise monitoring system and at a scheduled service airport. However, the program can be successful at a general aviation airport with seasonal noise monitoring.

This alternative also includes seasonal on-site noise monitoring. The only noise monitoring that has been conducted at the airport was done in conjunction with this FAR Part 150 Study, which was conducted over a relatively short period of time. The intent of this recommendation is to perform on-site noise monitoring at the same or similar locations as were used during this Study. The monitoring would be used to help verify adherence to the flight track recommendation for the airport, would determine the success of implemented noise abatement programs and would build a data base for future updates of the FAR Part 150 Study. It could also be used to identify aircraft that consistently operate in a manner not consistent with other aircraft that may be a significant irritant to the community. Aircraft tend to perform differently at higher altitude airports during different seasons due to the elevation of the airport and the temperature changes associated with seasonal changes. Noise monitoring would identify and verify any such performance differences and aid in the modeling of future aircraft operations. It is recommended that a contractor be utilized to install the noise monitoring equipment, to provide monthly or quarterly reports of the results and post the information on a Web Site for easy access for all interested parties. This Alternative was not modeled due to the nature of the recommendation**.**

Alternative 4-Noise Complaint/Citizen Liaison Program and Other Administrative Actions

This Alternative involves the continuation of the Operations Department Noise Complaint system in place at the airport. The objective of this system is to record all noise concerns received from citizens. This will assure that personnel can explain the nature of the concern and, in most instances, what caused the concern. In addition, the Department would take a record of all concerns received, which identifies the location, and circumstances of each. This will assist in the annual review of the FAR Part 150 Study to determine the effectiveness of the noise abatement recommendations. In addition, this Action should continue independently of what ever other operational modifications are recommended as part of this planning effort, and is not contingent upon the implementation of any other action. This is especially important in relationship to the noise monitoring program, and the implementation and adherence to recommended flight track changes.

An additional administrative action is recommended for consideration. The Study Advisory Committee should remain in place subsequent to the completion of this study and meet on a bi-monthly basis to discuss noise abatement issues at the airport. This Committee may be combined with the existing Noise Committee at the airport. This is especially true concerning the county and community planning representatives and their role in keeping the airport, citizens, communities, counties and others informed on land use issues that concern the airport environs as well as Air Traffic Control tower personnel in discussing aircraft procedures. This on-going committee structure has been successful

elsewhere in the form of a "Planners Forum" that involves both citizens and staff representatives. Considerable time and effort has been expended, by both the airport and the Committee, in the development of this study, especially in the "learning curve" effort, that is too valuable a tool for communication to risk loosing at the end of this process. It is envisioned that a Operations Department person chair the committee and present the results of the noise monitoring program, noise complaint data and other pertinent noise related information. Naturally, this Alternative will not be computer modeled.

Alternative 5-Land Use Controls/Planning

Some residents living within the environs of the airport have expressed significant concern with aircraft over-flights and the noise intrusion associated with them. This is true even though they are outside the 65 DNL noise contour, as they are experiencing noise intrusion associated with single event operations. The communities and counties should be cognizant of this fact and take aircraft noise levels, and over flight patterns, into consideration in the land use planning and development actions taken by these entities. It is evident from historical data that these residents are annoyed beyond the 65 DNL noise contour, and future noise sensitive uses should be avoided within the approach and departure paths of the runways or in close proximity to the airport. It is much easier to avoid problems in the future than to solve them once they have occurred. Specific land use recommendations will be made subsequent to the identification of the Future Noise Exposure Map, which will consider any flight track or operational changes.

Alternative 6-Noise Abatement Procedure (Flight Track Changes, North)

The Federal Aviation Administration has direct control over each aircraft as it leaves the ground and proceeds to its destination. The direction and orientation that an aircraft takes as it departs or arrives at an airport, as projected on the ground, is referred to as the aircraft flight track. This Alternative evaluates the implementation of a new flight track for north flow departures that would entail a more easterly direction than is presently flown. This procedure was modeled so that the departures would generally follow a 010-degree heading with a turn on course at 2 DME (Distance Measuring Equipment) with a ceiling of 8,000 AMSL (the DME is co-located with the existing localizer north of Runway 17/34. DME is measured in nautical miles and allows the pilot to know how far or close his aircraft is from this navigational reference point. Currently, the DME reference point is co-located with localizer off the north end of Runway 17/35). This would result in aircraft departing over undeveloped property and the gun range northeast of the airport until they are 2 DME and then turning on course to reach their destination. It is recognized that this would also result in aircraft over flying the

Cherry Creek Reservoir. The change of a flight track would require environmental documentation by the Federal Aviation Administration, including a Section 4 (f) analysis. The entire environmental and airspace process could take up to two or three years to accomplish. However, this Alternative could provide relief to residents beyond the 65 DNL noise contour who are experiencing significant single event over flight levels. As such, this Alternative is presented on the following figure, Figure F3, entitled *ALTERNATIVE SIX, NORTHERN DEPARTURE FLIGHT TRACK CHANGE.*

Alternative 7-Noise Abatement Procedure (Flight Track Change, South)

This Alternative evaluates the implementation of a new flight track for south flow departures that would entail a aircraft departing to the south fly on a near runway heading (plus or minus up to 20 degrees) until reaching four (4) DME (Distance Measuring Equipment) or one mile south of Lincoln Boulevard (as previously mentioned, the DME is co-located with the existing localizer north of Runway 17/35. DME is measured in nautical miles and allows the pilot to know how far or close his aircraft is from this navigational reference point). Aircraft currently departing to the south essentially fly runway heading until reaching a safe turning altitude and then are directed by Air Traffic Control to turn on a given heading. This turn can occur at various locations depending upon aircraft capability, traffic patterns and destination. This Alternative was modeled using the same forecasts and mix as the future Base Case condition and is presented on the following figure, Figure F4, entitled *ALTERNATIVE SEVEN, SOUTHERN DEPARTURE FLIGHT TRACK CHANGE.*

Alternative 8-Preferential Runway System

This Alternative evaluates the effect of revising the existing nighttime (10PM to 6AM) preferential runway system at the airport. Essentially this program is voluntary in nature and recommends that all arrivals and departures during the nighttime hours (10PM to 6AM) occur over the southern end of the airport. Thus, those residents living south of the airport, and west to some extent, experience both arrivals and departures during the nighttime hours. At one time, this was a very desirable procedure due to the sparsely developed nature of the area south of the airport. However, Douglas County and the incorporated areas to the south are experiencing significant growth demands and the nighttime preferential runway system may not be as beneficial as it once was. This Alternative evaluates the effects of eliminating the preferential runway system at night and is presented on the following figure, Figure F5, entitled *ALTERNATIVE EIGHT, NIGHTTIME PREFERENTIAL RUNWAY SYSTEM MODIFICATION.* The contours were generated

based on the normal operating conditions at the airport and shows a slight increase in the size of the contour to the north.

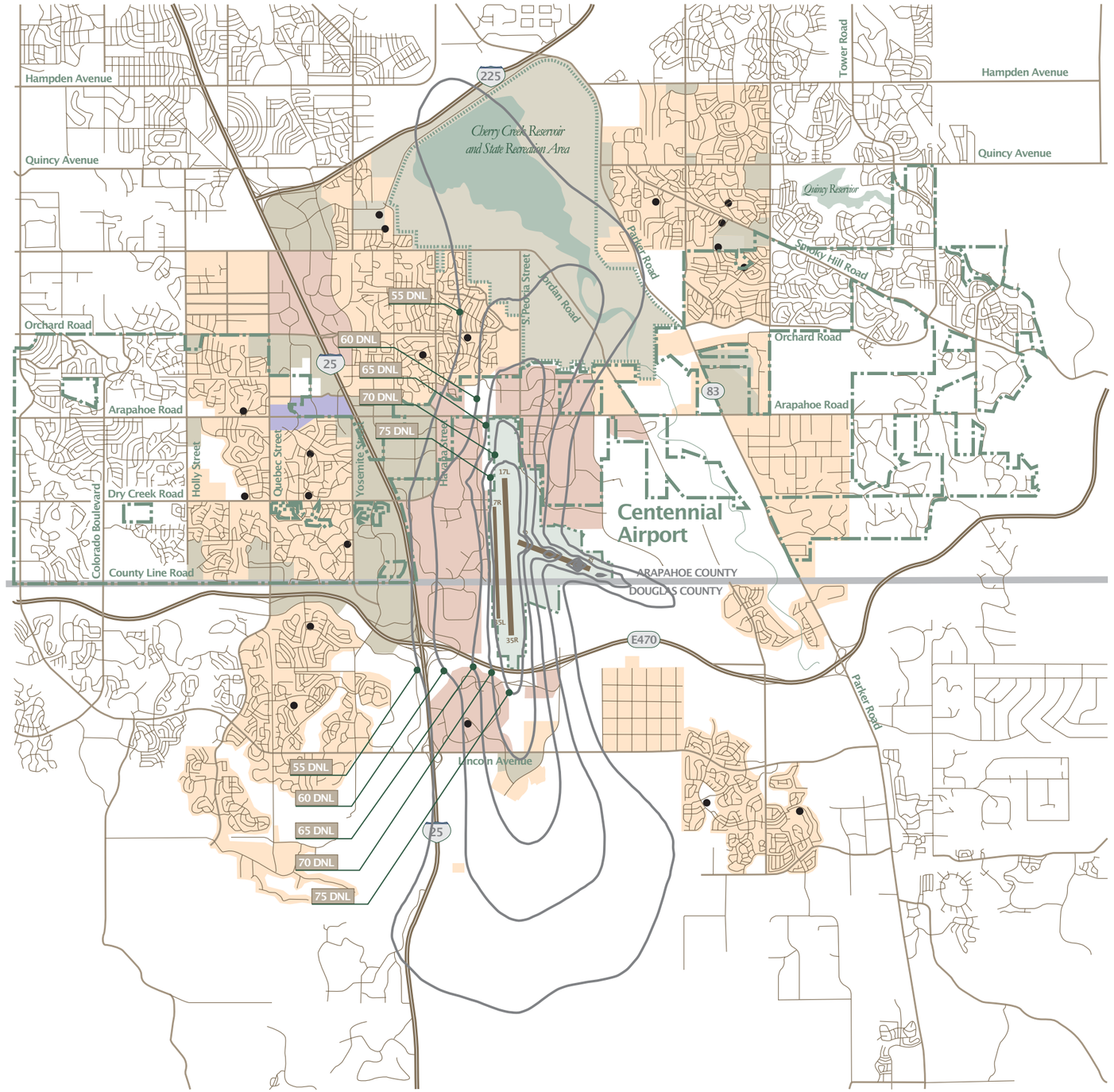


Figure F3 ***Alternative Six, North Departure Flight Track Change with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Land Use Information 1998. Noise Contours, BCS International Noise Analysis - 2000.*

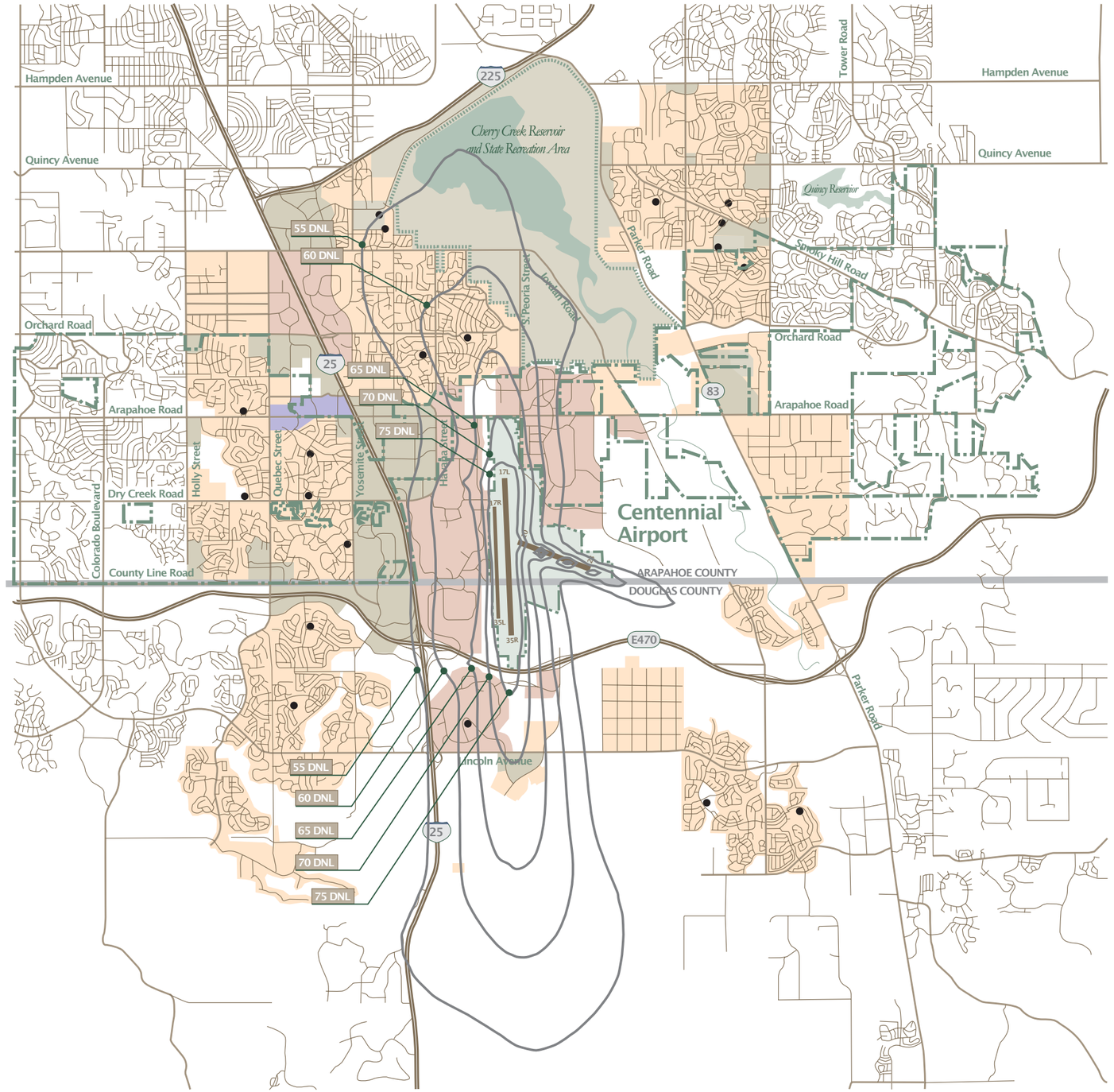


Figure F4 ***Alternative Seven, Southern Departure Flight Track Change with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Land Use Information 1998. Noise Contours, BCS International Noise Analysis - 2000.*

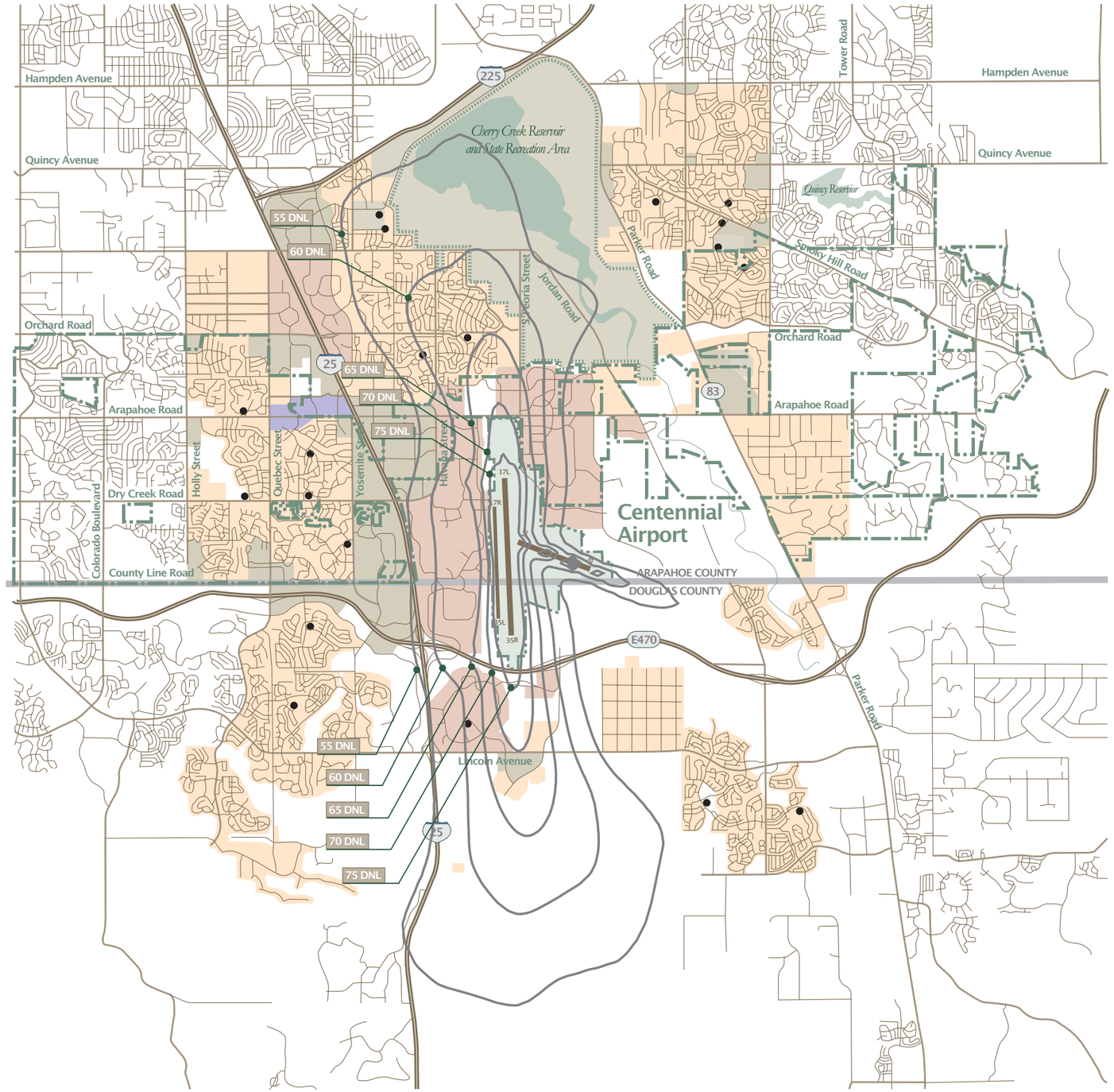


Figure F5 ***Alternative Eight, Nighttime Preferential Runway Modification System with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Land Use, Aviation Information 1998. Noise Contours, BCS International Noise Analysis - 2000.*

Alternative 9-Fly Runway Heading Until Reaching 8,000 feet or Higher

This Alternative was suggested by the FAA and is based on all departing jet aircraft flying essentially runway heading (generally 170 degrees [south] or 350 degrees [north]) until reaching 8,000 feet above mean sea level (AMSL) or higher and then proceeding to their destination. A typical departure clearance presently is to climb and maintain 8,000, expect FL 230 in ten minutes. A typical north take-off clearance is cleared for take-off Runway 35R turn left to 330, climb and maintain 8,000, contact Denver departure. The implementation of this Alternative would narrow the resulting noise contours and elongate them somewhat. This also concentrates the aircraft departures in a more defined flight track, resulting in somewhat higher noise levels for residents living directly under the flight paths. The full implementation of this Alternative is somewhat limited under certain conditions when departing south due to rising terrain and minimum vectoring altitudes. This Alternative was modeled and is presented in Figure F6, entitled *ALTERNATIVE NINE, FLY RUNWAY HEADING UNTIL 8,000 AMSL.*

Alternative 10-South and Southeast Jet Arrivals on Long Final and Downwind

This Alternative would model the effects of placing eighty percent of south and southeast jet arrivals on a twenty mile final when landing north and on an extended twenty-one mile downwind when landing south. This would result in similar aircraft over flights as the previous Alternative, except they would be arrivals instead of departures. The arrivals would be lined up on an extended approach, which would concentrate the approaches into a single arrival stream. The extended downwind would result in aircraft lining up for the downwind leg of the landing approximately twenty-one miles south of the airport. These aircraft would slowly descend to reach pattern altitude at approximately the midpoint of the airport. They would then fly the downwind leg at pattern altitude until reaching the approximate same location to turn base leg and intercept the approach path as they do currently. This Alternative would result in concentrating the south and southeast jet arrivals on a extended southern downwind pattern instead of using a “fan” approach to the downwind as is presently done. This Alternative was modeled and is illustrated on Figure F7, entitled *ALTERNATIVE TEN, SOUTH/SOUTHEAST ARRIVALS*.

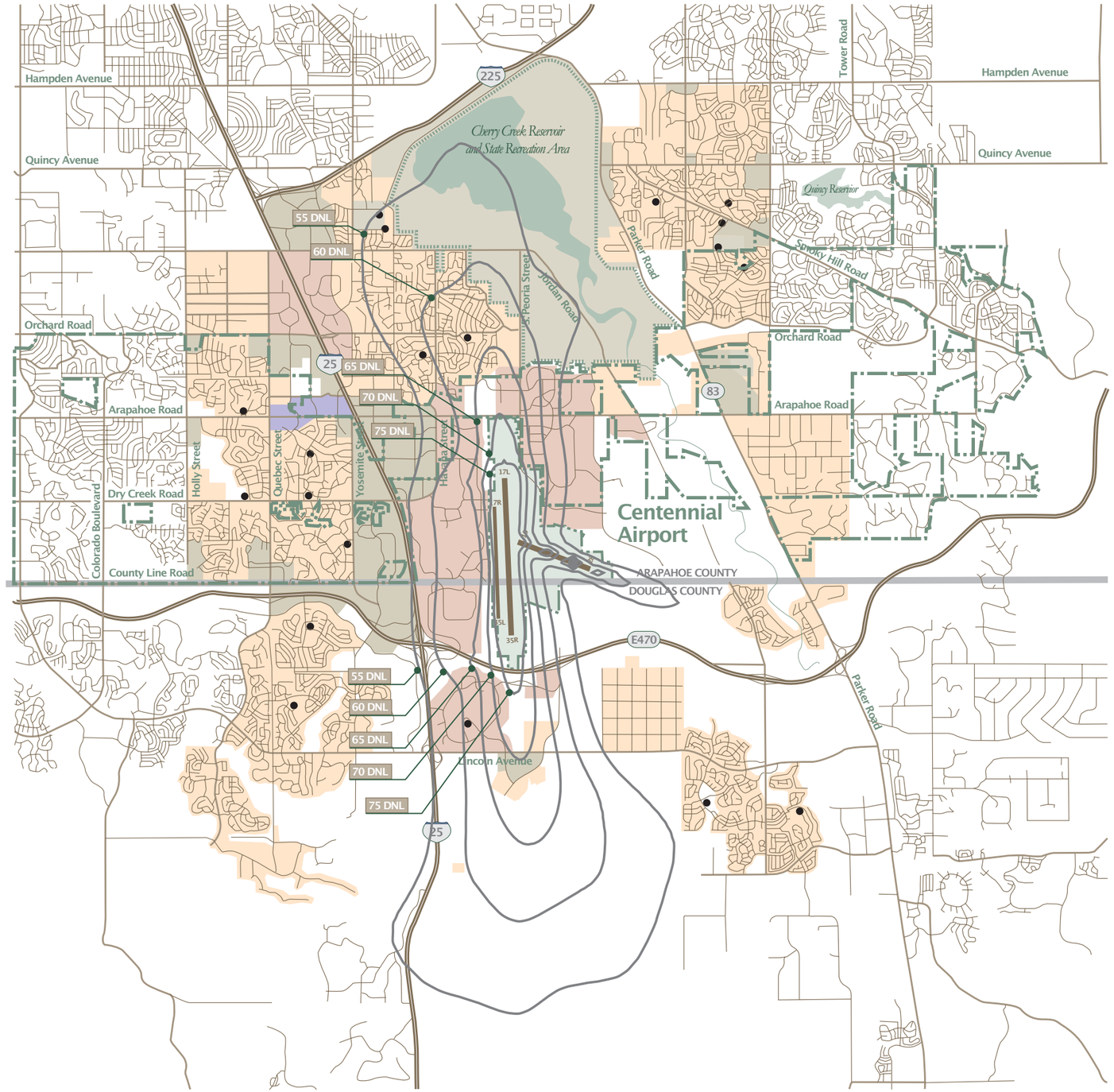


Figure F6 ***Alternative Nine, Fly Runway Heading until 8,000' AMSL with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Land Use Information 1998. Noise Contours, BCS International Noise Analysis - 2000.*

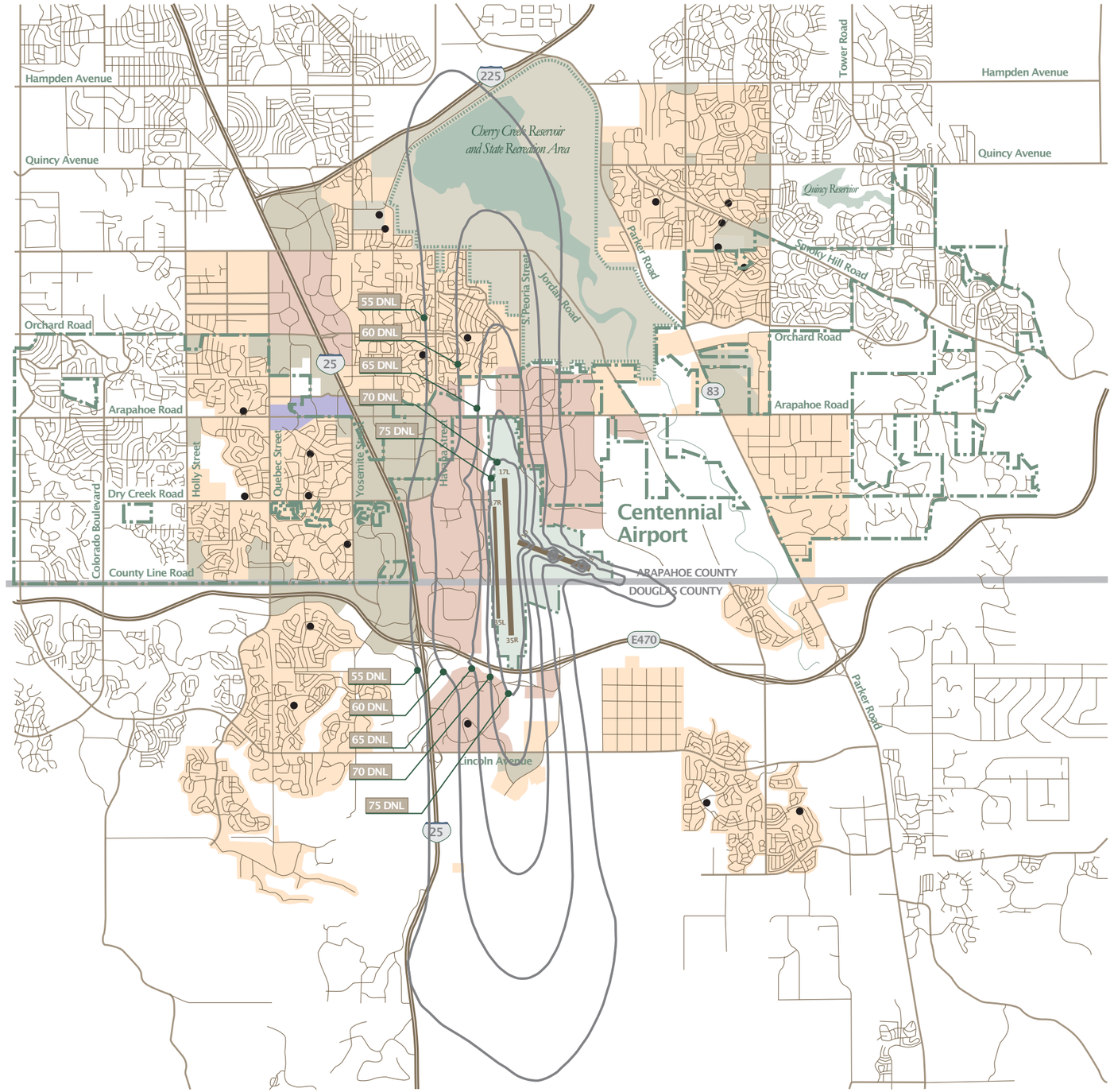


Figure F7 ***Alternative Ten, South/Southeast Arrivals with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Land Use Information 1998. Noise Contours, BCS International Noise Analysis - 2000.*

Revised Base Case Contour

Based on comments received at the last Committee meeting and subsequent to the meeting, the Future Base Case contour has been revised. The revised Future Base Case contour is presented in Figure F8.

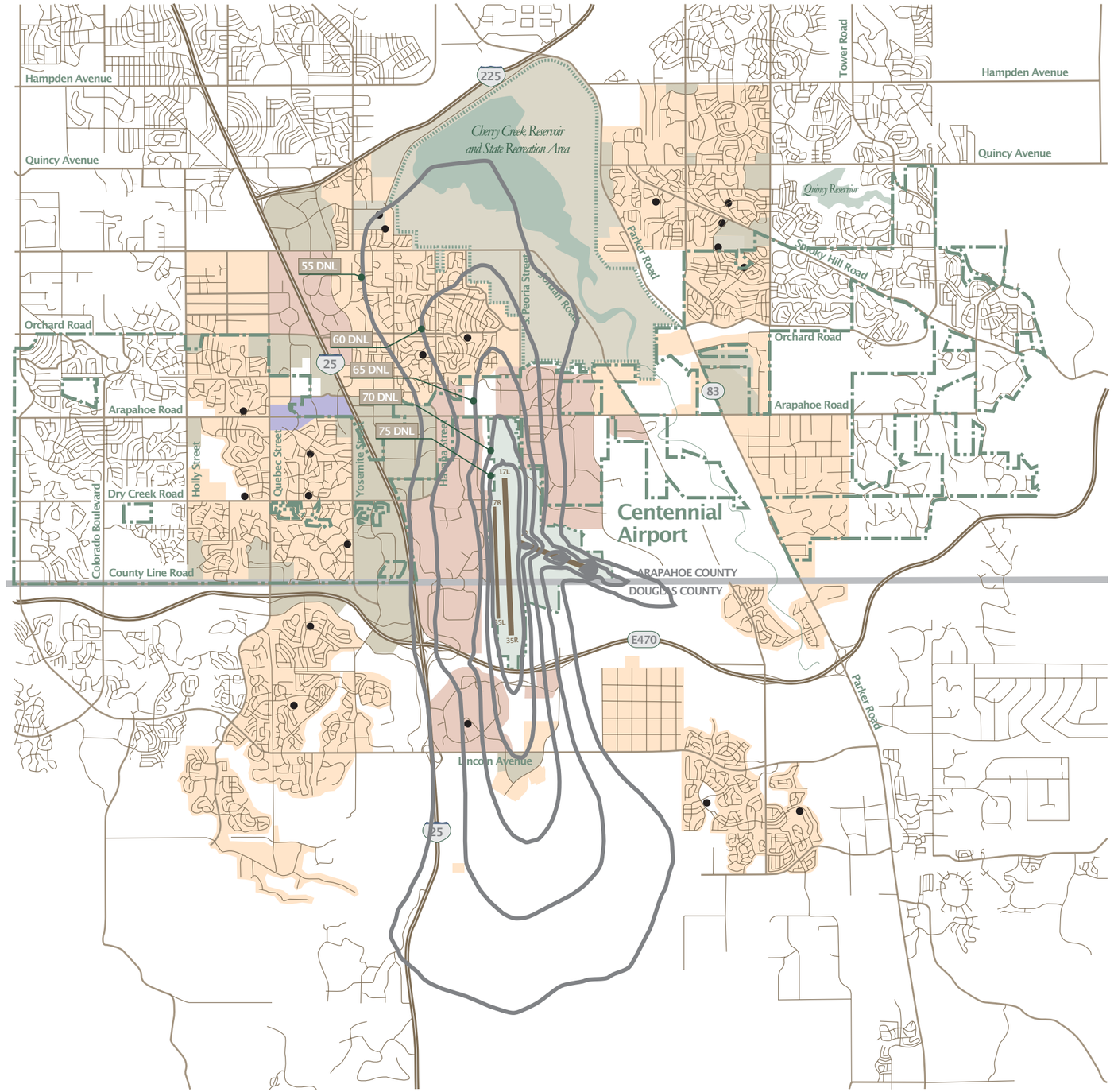


Figure F8 ***Revised Base Case (2005) Noise Contour with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Aerial Information, June - 2001.*

Contour Evaluation

Each modeled alternative was evaluated and compared not only to each other, but also to the Base Case Future noise contours. The evaluation compared the number of residents and acres of residential land uses within the 55 and greater noise contours, other noise sensitive uses within those contours and the resultant DNL levels at each of the noise monitoring sites. Table F1 shows the DNL comparison and Table F2 shows the Land Use comparison. Table F3 shows the Delta (change) in DNL for each Alternative at each measurement site. Table F4 shows the information in Time Above and Table F5 shows the Lmax comparison.

Table F1
DNL COMPARISON FOR EACH MODELED ALTERNATIVE BY MEASUREMENT SITE
Centennial Airport FAR Part 150 Study

Site	Community	BASE	A1	A2	A6	A7	A8	A9	A10
1	Lone Tree	41.3	40.0	40.5	41.3	41.3	41.2	41.3	41.2
2	Cherry Creek Park	55.7	51.5	53.5	62.8	55.7	56.9	55.7	53.3
3	Village on the Lake	56.8	53.3	55.0	52.0	56.8	57.7	56.8	54.7
4	Meridian Golf Club	73.7	68.1	70.1	73.7	74.3	73.1	73.7	74.3
5	Foxfield	45.4	42.7	43.9	45.4	45.4	46.3	45.4	43.2
6	Grand View Estates	49.9	47.4	48.2	49.9	49.1	49.6	49.9	49.1
7	Aurora	46.9	43.7	45.1	48.2	46.9	47.9	46.9	47.1
8	Heritage Estates	57.4	54.8	55.7	57.4	58.2	57.1	57.4	58.2
9	Cherry Creek Vista	64.5	60.8	62.4	62.3	64.5	65.4	64.5	65.6
10	Sundance Hills	59.5	55.2	57.3	52.0	59.5	60.5	59.5	54.7

A1 Ban Stage 2 Aircraft **A2** Ban Stage 2 Aircraft at Night **A6** Northern Departure Track Change **A7** Southern Departure Track Change **A8** Preferential Runway System **A9** Fly Runway Heading Until Reaching 8,000 **A10** Southern Approach Changes

Table F2
CONTOUR COMPARISON FOR EACH MODELED ALTERNATIVE
Centennial Airport FAR Part 150 Study

Land Use	Existing	Base Case	A1	A2	A6	A7	A8	A9	A10
DNL 55									
Residences	3,193	6,044	2,742	3,596	1,821	4,371	4,924	2,782	4,382
People	9,883	17,568	8,440	10,996	5,531	13,187	14,517	8,603	13,218
Schools	3	5	3	3	2	5	5	2	5
Total Acres	13,192	14,077	8,240	10,284	14,931	13,708	14,273	14,077	13,994
DNL 60									
Residences	1,164	2,581	432	1,100	625	2,055	2,520	1,490	2,056
People	3,843	8,032	1,266	3,337	1,900	6,356	7,829	4,573	6,350
Schools	2	2	0	1	1	2	3	2	2
Total Acres	5,899	6,554	3,470	4,653	6,606	6,628	6,663	6,554	6,874
DNL 65									
Residential	115	225	71	90	180	227	286	225	290
Residences	18	544	90	116	135	259	530	389	260
People	62	1,591	111	143	167	601	1,194	1,084	602
Schools	0	0	0	0	0	0	0	0	0
Bus/Off. Park	343	582	171	334	693	604	617	582	611
Open Space	875	916	297	421	857	995	832	916	984
Airport	1,037	908	775	861	910	910	910	908	907
Mixed Non-Res.	88	75	4	57	75	75	75	75	75
Total Acres	2,458	2,706	1,318	1,763	2,714	2,808	2,719	2,706	2,867
DNL 70									
Residential	0	71	0	4	71	70	67	71	70
Residences	0	117	0	22	95	105	85	105	94
People	0	143	0	26	115	127	103	127	113
Schools	0	0	0	0	0	0	0	0	0
Bus/Off. Park	53	104	4	27	104	123	103	104	124
Open Space	248	265	38	114	263	244	237	265	244
Airport	764	722	556	620	723	718	753	722	727
Mixed Non-Res.	0	9	0	0	9	19	0	9	0
Total Acres	1,065	1,170	598	765	1,170	1,174	1,160	1,170	1,185

Table F2 Continued
CONTOUR COMPARISON FOR EACH MODELED ALTERNATIVE
Centennial Airport FAR Part 150 Study

Land Use	Existing	Base Case	A1	A2	A6	A7	A8	A9	A10
DNL 75									
Residential	0	5	0	0	1	1	1	1	1
Residences	0	29	0	0	6	7	2	7	6
People	0	34	0	0	8	8	2	8	7
Schools	0	0	0	0	0	0	0	0	0
Bus/Off. Park	0	10	0	0	11	9	7	9	10
Open Space	32	43	0	1	48	51	36	52	48
Airport	490	502	348	409	508	502	506	506	501
Mixed Non-Res.	0	0	0	0	0	0	0	0	0
Total Acres	522	560	348	410	568	563	550	568	560

A1 Ban Stage 2 Aircraft **A2** Ban Stage 2 Aircraft at Night **A6** Northern Departure Track Change
A7 Southern Departure Track Change **A8** Preferential Runway System **A9** Fly Runway Heading Until Reaching 8,000
A10 Southern Approach Changes

Based on 2000 Census Data and existing land use.

Issues/Actions and Recommendations

Introduction

This Section presents the recommended noise abatement plan, which includes the issues to be addressed, the actions/recommendations to be taken to address those issues, the responsible parties involved for implementing those actions and recommendations, the Airport action to be taken, the time frame for implementation and the effectiveness of each. The issues and actions will become the recommended Noise Compatibility Program. This Section also recommends which Noise Exposure Map should be used for the basis of the Noise Compatibility Program. In addition, the Future Noise Exposure Map is presented, along with the impacts associated with it.

A recommended implementation schedule and sequence, in both narrative and graphic form, indicating the roles and responsibilities of the many parties involved in the Noise Compatibility Program for Centennial Airport will be presented in a subsequent chapter.

Noise Compatibility Program Map

The Future Noise Exposure Map (2005) reflects the implementation of the various Recommendations presented in this chapter. It represents a reduction in the number of residents exposed to the 65 or greater DNL noise contour compared to the future Base Case noise contour. As such, the Future Noise Exposure Map will be used to define the boundaries for all programs recommended in this Study.

Future Noise Exposure Map

The Future Noise Exposure Map is based on the Future Base Case Noise Contour and reflects the implementation of the recommendations that follow. The following table presents the number of acres of different land use types that would be found within the Future Noise Exposure Map contours, based upon the existing land use and the recommendations implemented.

The Future Noise Exposure Map is illustrated on Figure G1, *FUTURE NOISE EXPOSURE MAP, 2005*. The specific noise abatement recommendations are contained on the pages following the Future Noise Exposure Map. They are categorized as Amended Actions and New Actions for each specific noise abatement recommendation. The Amended Actions are those Actions which the Airport currently has in place but are recommended

for some changes and the New Actions are those which would be implemented for the first time. Some are administrative in nature while others are land use or operational in nature. Table G2 shows the population and housing units within the 2005 Base Case contour, using 2000 census data, for comparative purposes.

Table G1
FUTURE NOISE EXPOSURE MAP WITH EXISTING LAND USE (With Recommendations)
Centennial Airport FAR Part 150 Study

Land Use	DNL 55 Contour	DNL 60 Contour	DNL 65 Contour	DNL 70 Contour	DNL 75 Contour
Residential	NA Ac	NA Ac	71 Ac	0 Ac	0 Ac
People	9,391	1,494	154	0	0
House. Units	3,046	520	125	0	0
Schools	3	2	0	0	0
Bus/Off. Park	NA Ac	NA Ac	360 Ac	46 Ac	2 Ac
Open Space	NA Ac	NA Ac	355 Ac	90 Ac	2 Ac
Govt./Public	NA Ac	NA Ac	0 Ac	0 Ac	0 Ac
Airport	NA Ac	NA Ac	876 Ac	611 Ac	410 Ac
Mixed Non-Res.	NA Ac	NA Ac	38 Ac	0 Ac	0 Ac
Total	**10,485 Ac**	**4,659 Ac**	**1,701 Ac**	**747 Ac**	**414 Ac**

SOURCE: 2001 Aerial, 2000 Census and BDC Analysis

Table G2
FUTURE BASE CASE NOISE CONTOURS WITH EXISTING POPULATION/HOUSING (Without Recommendations)
Centennial Airport FAR Part 150 Study

Land Use	DNL 55 Contour	DNL 60 Contour	DNL 65 Contour	DNL 70 Contour	DNL 75 Contour
People	17,568	8,032	1,591	143	34
House. Units	6,044	2,581	544	117	29
Schools	5	2	0	0	0
Total Acres	**14,077 Ac**	**6,554 Ac**	**2,706 Ac**	**1,170 Ac**	**560 Ac**

SOURCE: 2001 Aerial, 2000 Census and BDC Analysis

The Recommendations are summarized as follows.

Recommendation 1	**Ban Stage 1 Aircraft**
Recommendation 2	**Ban Stage 2 Jet Aircraft Under 75,000 lbs. At Night**
Recommendation 3	**Implement 010 Degree Departure Heading for Jet Aircraft At Night**
Recommendation 4	**Test 24-Hours Flight Tracks Between 350 and 010 Degree Headings**
Recommendation 5	**Eliminate Preferential Runway Use Procedure**
Recommendation 6	**Implement 170 Degree Departure to 4 DME or 8,000 MSL (+/- 20 degrees)**
Recommendation 7	**Amend Community Plans and Zoning Ordinances**
Recommendation 8	**Update and Establish Environmental/Noise Abatement Liaison/Office**
Recommendation 9	**Install Noise Monitoring System and Develop Program**
Recommendation 10	**Development/Implementation of Fly Quiet Program**
Recommendation 11	**Operations Review and Part 150 Updates**
Recommendation 12	**Establish Follow-up Roundtable/Committee**

It is the intent of the Airport to implement future noise mitigation programs as quickly as possible. However, it must be remembered that this will depend very heavily on the availability of funds and resources, especially the availability of Federal funding.

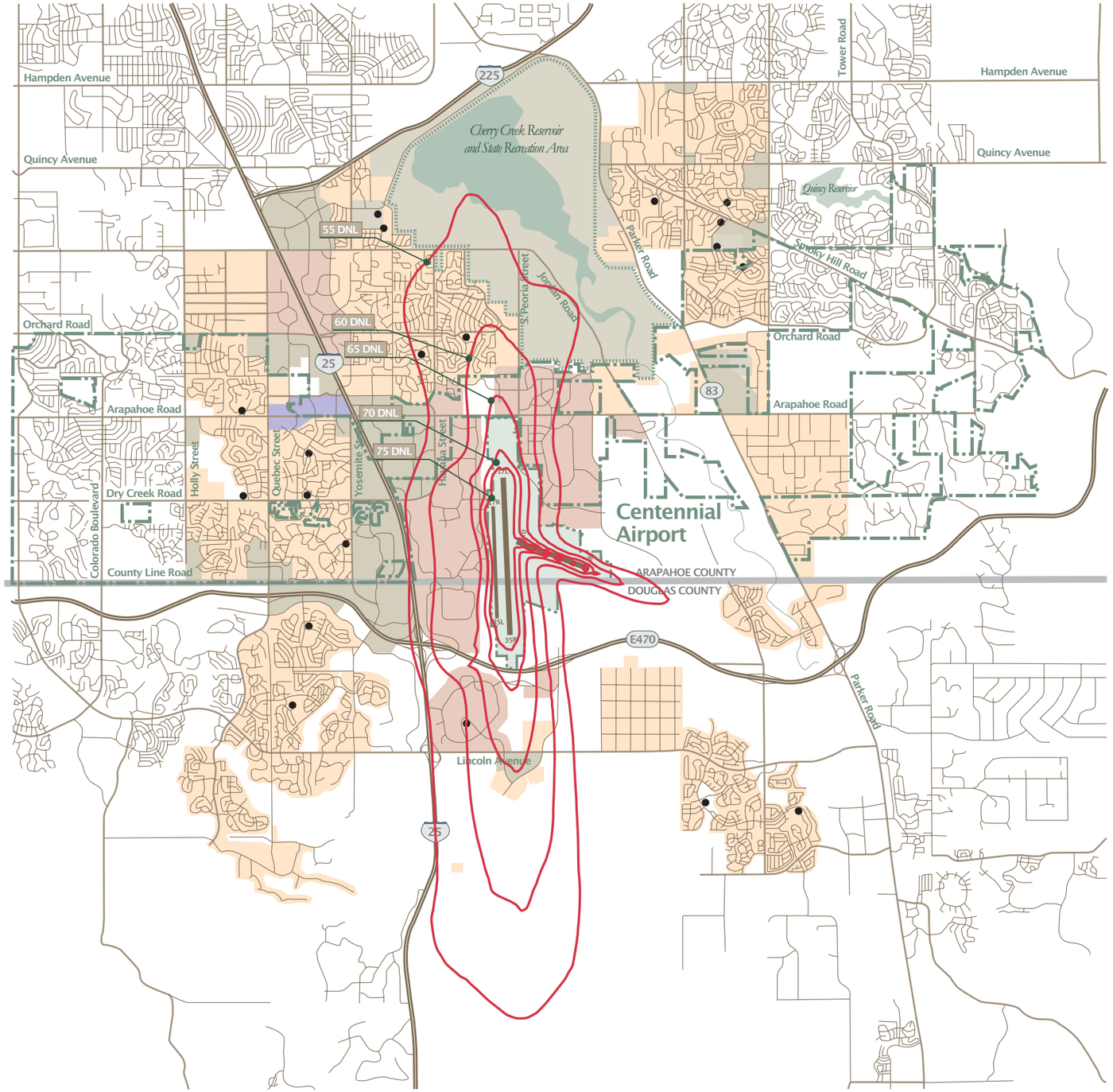


Figure G1 ***Future 2005 Noise Exposure Map***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

The ***65 DNL*** *Noise Contour Contains Approximately* ***1,701 Acres*** *and* ***154 People****.*

The ***70 DNL*** *Noise Contour Contains Approximately* ***747 Acres*** *and* ***0 People****.*

The ***75 DNL*** *Noise Contour Contains Approximately* ***414 Acres*** *and* ***0 People****.*

> ***Planning jurisdictions are as shown on map.***

> ***Noise measurement sites and flight tracks are depicted on the Noise Measurement Sites and Flight Tracks Map.***

> ***Residential land use is defined as incompatible within the 65 DNL Noise Contours or greater by the FAR Part 150.***

The Noise Exposure Map and accompanying documentation for the Noise Exposure Map for Centennial Airport, submitted in accordance with the FAR Part 150 with the best available information, are hereby certified as true and complete to the best of my knowledge and belief. In addition, it is hereby certified that the interested persons were afforded adequate opportunity to submitt their views, data, and comments concerning the correctness and adequacy of the draft maps and the description of forecasts of aircraft operations.

Signed _____

Dated _____

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Aerial Information, June - 2001.*

RECOMMENDATION 1--BAN STAGE 1 JETS

ISSUE	Reduce noise impacts from loud jets.
NEW ACTION	This Action will provide funding to study and evaluate the prohibition of Stage 1 jets at the Airport. This *can* be accomplished without completing a FAR Part 161 Study, and can be implemented immediately.
COMMENTS	This Action will reduce the number of operations by very noisy jets. There are very few of these aircraft in the overall business jet fleet, but many are still operating in the United States and this Action will restrict them from operating at the Airport. There is one Stage 1 jet based on the Airport. Airport management and the aircraft operator have agreed to a phase-out period for this one aircraft, although new Stage 1 operators would be prohibited from operating at the Airport.
COST	The cost to implement such a restriction is minimal.
RESPONSIBLE PARTIES	The Airport is responsible for preparing and implementing such a restriction, and publishing it in various aviation publications to provide notice to pilots.
AIRPORT ACTION	The Airport will prepare and implement such a restriction as soon as possible. Airport management will present the restriction to the Airport Authority for approval and then will implement it immediately.
TIME FRAME	This can be started and implemented immediately and is not dependent upon other Actions or parties.

RECOMMENDATION 2--BAN STAGE 2 JETS AT NIGHT

ISSUE

Reduce noise impacts from loud jets.

NEW ACTION

This Action will provide additional funding to study and evaluate the prohibition of Stage 2 jets at the Airport during the nighttime hours (10:00 pm to 7:00 am). This cannot be accomplished without completing a FAR Part 161 Study, and this Recommendation requests approval to prepare and funding for such a Study.

COMMENTS

This Action will reduce the number of residents within the 65 DNL noise contour and will remove significant noise intrusion during the most noise sensitive time. This Action will reduce the 65 DNL noise contour over the area that is directly north of the Airport and will reduce loud single events for residents all around the Airport. Figure G2 on the following page illustrates the Future Noise Exposure Map with and without the Stage 2 Ban in an attempt to visually indicate the incremental benefit this Recommendation has to the overall noise environment. Please refer to Table F2, as it indicates that there would be considerably less people inside the 65 or greater DNL if this Recommendation is implemented.

It is recognized that such a restriction cannot be implemented without completing a FAR Part 161 Study. The Airport is requesting approval for such a study so that AIP funding may be made available.

COST

The cost to prepare such a Study is estimated to be in the range of $500,000-2,000,000 including legal fees.

RESPONSIBLE PARTIES

The Airport is responsible for preparing such a Study through the use of consultants. The FAA is responsible for approving the Recommendation and providing funding, if such funding is available and the number of people removed from the contour is significant.

AIRPORT ACTION

The Airport will select consultants to prepare such a Study and submit an application to the FAA upon approval of the Recommendation by the FAA.

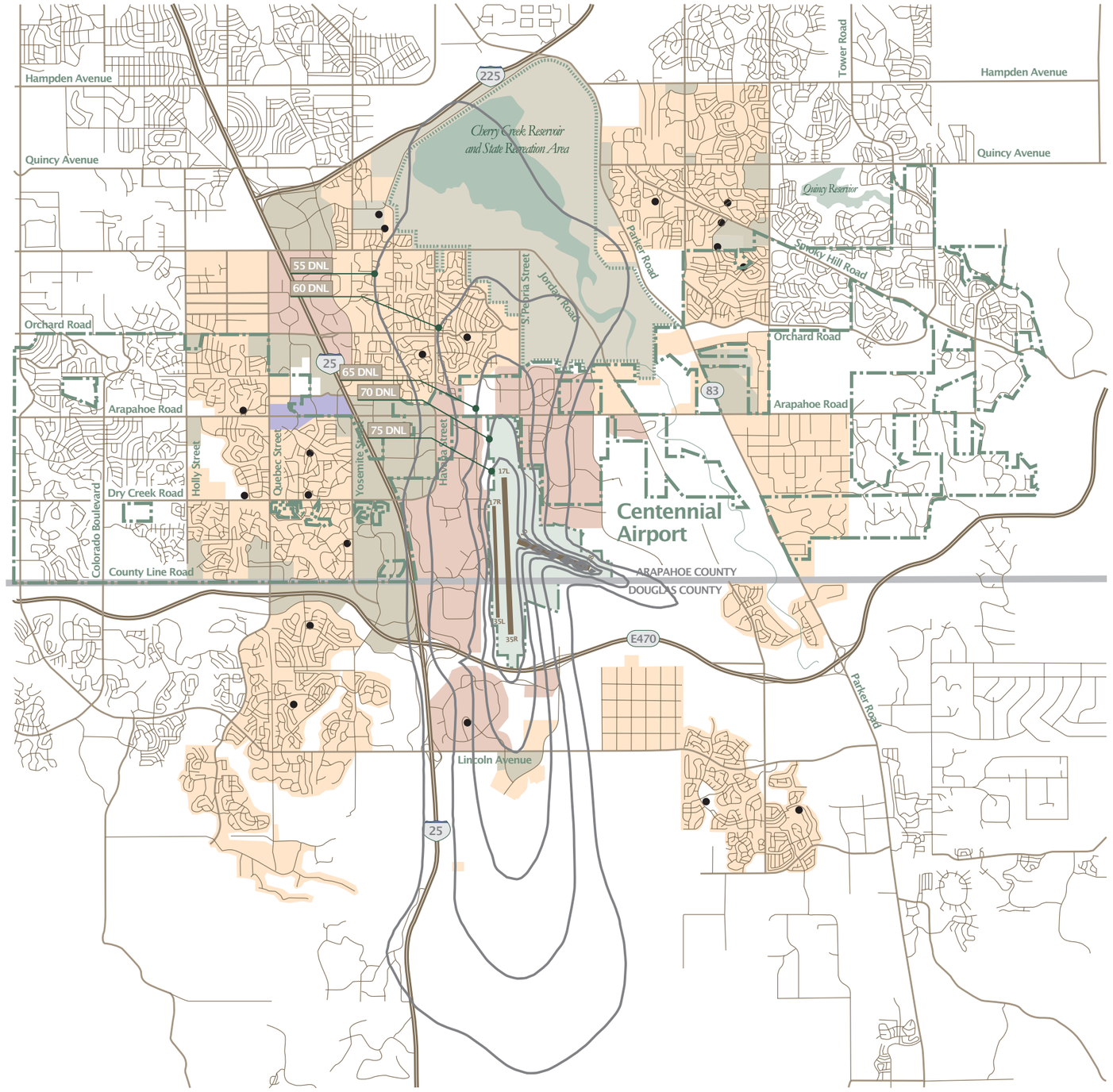


Figure G2 ***Future Noise Exposure Map with and without Stage 2 Ban with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Aerial Information, June - 2001.*

TIME FRAME

The consultant could be selected and an application submitted within 90 days of approval of the Recommendation by the FAA. The Study itself will take approximately two years to complete. Implementation of the restriction will take approximately six to nine months after approval of the Study.

RECOMMENDATION 3--IMPLEMENT A 010 DEGREE DEPARTURE HEADING FOR JET AIRCRAFT AT NIGHT

ISSUE

Reduce Nighttime Over Flights of Noisy Aircraft.

NEW ACTION

Implement a 010 degree departure procedure for departures off of Runways 35R and L between 10:00 pm and 6:00 am flying routes to north and west destinations to reduce nighttime over flights of the neighborhoods just north of the Airport. This will reduce the number of people within the 65 DNL noise contour north of the Airport.

COMMENTS

This Action was tested during the Spring and early Summer of 2001 and has been shown feasible by the TRACON and local Airport Traffic Control (see letter in Appendix). The departure procedure is to fly the departure heading until reaching 2 DME and then resume destination heading. This will put such aircraft over the Cherry Creek State Park (Park). The 65 DNL contour shrinks and does not impact the Park. In fact, the 65 DNL noise contour will not encroach on the Park with this Recommendation. The Colorado State Parks, Metro Region is concerned about the over flights that would result from this Recommendation and the effect they may have on the Park. Prior to implementing such a procedure on a permanent basis, the FAA would be required to prepare environmental documentation to examine the effects of implementing such a procedure. This would take anywhere from three to twelve months to complete.

Figure G3 on the following page illustrates the Future Noise Exposure Map with and without the 010 degree departure procedure in an attempt to visually indicate the incremental benefit this Recommendation has to the overall noise environment. Figure G4 indicates grid points evaluated to indicate the difference in noise levels with and without the departure procedure, and with and without the Stage 2 Ban. Table G2 indicates the results of the grid analysis and the affect on the Park of the two Recommendations.

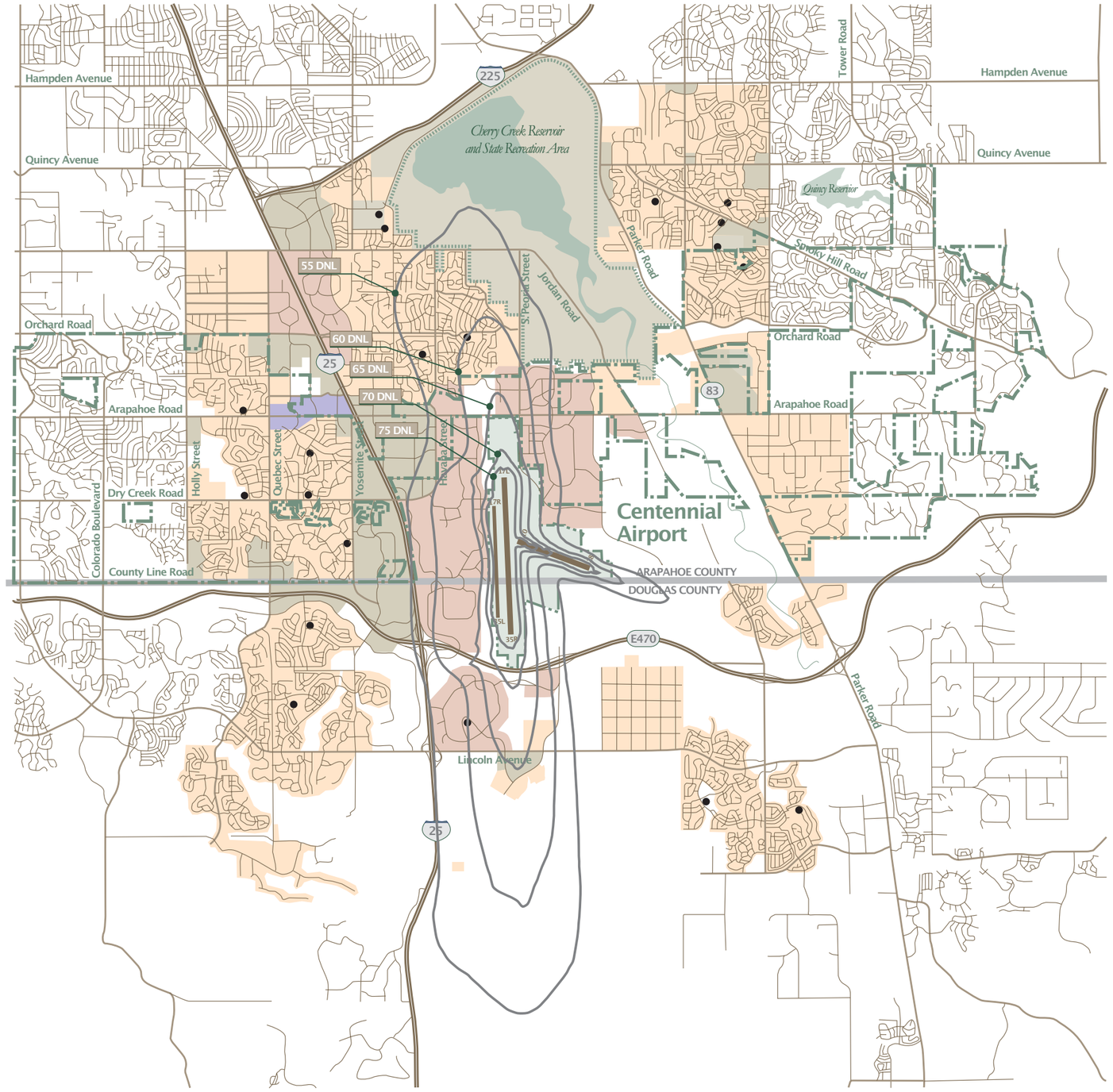


Figure G3 ***Future 2005 Noise Exposure Map Without 010 Departure with Generalized Existing Land Use***

- *Airport Boundary*
- *Airport*
- *Residential*
- *Mixed Non-Residential*
- *Commercial Retail*
- *Business/Office Park*
- *Public Use*
- *Schools*
- *With Stage 2 Ban*
- *Without Stage 2 Ban*

Approximate Scale 1"=8,000'

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Source: *Base Map, Aerial Information, June - 2001.*

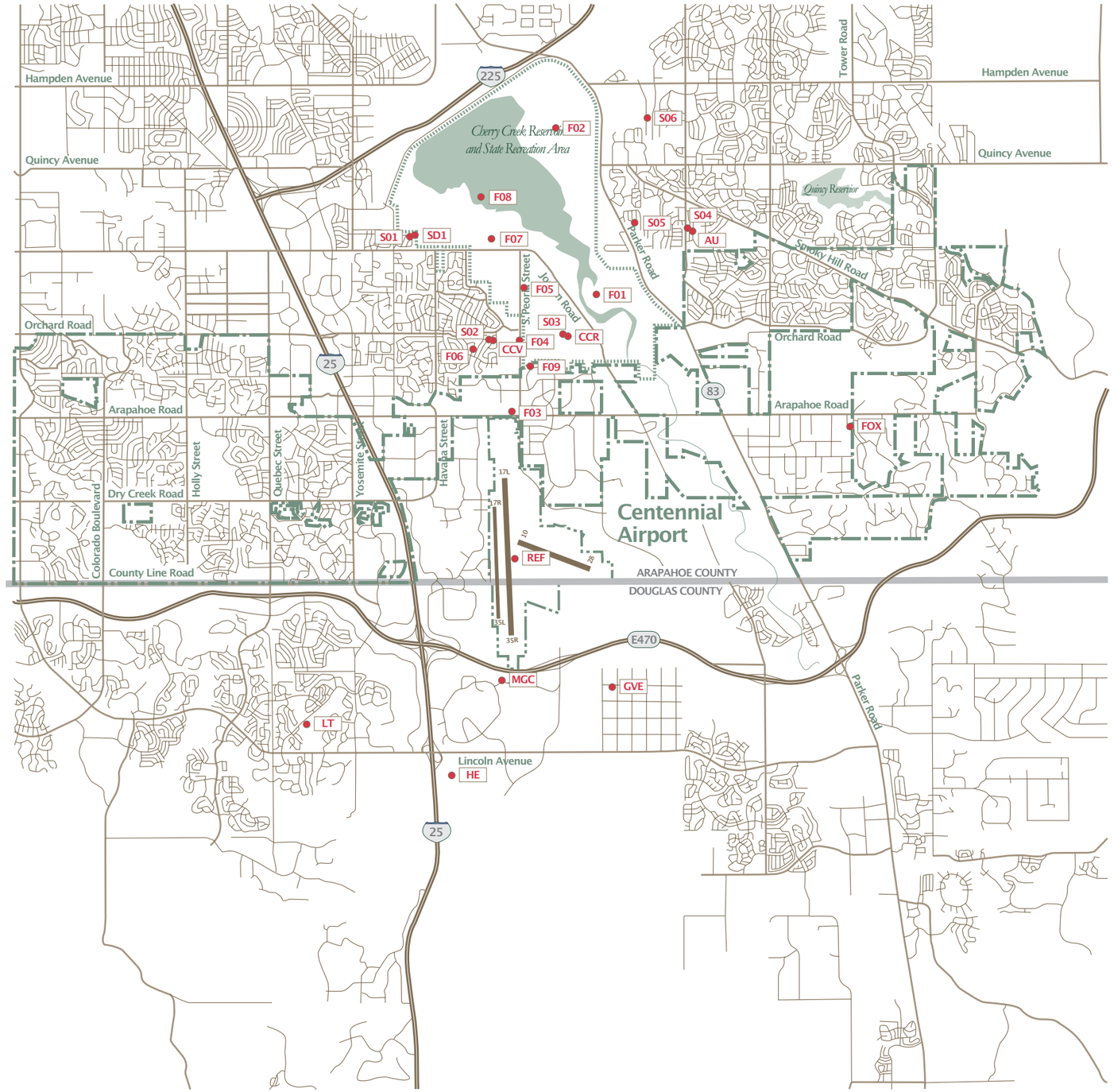


Figure G4 ***Grid Point Analysis Map***

Grid Point

Centennial Airport

FAR Part 150 Noise Exposure & Land Use Compatibility Study Program

Table G3

GRID POINT MEASUREMENT RESULTS

Centennial Airport FAR Part 150 Study

Location	Base 2006	NAP No Night St2 Restriction	NAP No 010	NAP All Alts	NAP No Night St2 Restriction	NAP No 010	NAP All Alts
AU	46.9	47.0	45.1	44.7	0.1	-1.8	-2.2
CCR	55.4	60.9	53.2	56.1	5.5	-2.2	0.7
CCV	63.9	63.7	61.4	60.9	-0.2	-2.5	-3.0
F01	53.3	58.5	51.0	53.6	5.2	-2.3	0.3
F02	46.4	50.7	45.5	47.3	4.3	-0.9	0.9
F03	67.7	69.0	64.9	65.1	1.3	-2.8	-2.6
F04	61.2	62.9	58.9	59.3	1.7	-2.3	-1.9
F05	57.3	59.0	55.1	55.6	1.7	-2.2	-1.7
F06	63.5	62.7	60.9	59.9	-0.8	-2.6	-3.6
F07	57.7	58.4	55.7	55.8	0.7	-2.0	-1.9
F08	56.2	57.5	54.6	55.0	1.3	-1.6	-1.2
F09	61.2	64.4	58.9	60.1	3.2	-2.3	-1.1
FOX	45.5	44.9	44.2	43.6	-0.6	-1.3	-1.9
GVE	49.9	49.2	47.3	47.3	-0.7	-2.6	-2.6
HE	57.6	58.9	56.6	56.6	1.3	-1.0	-1.0
LT	41.5	41.6	40.5	40.5	0.1	-1.0	-1.0
MGC	74.4	74.2	69.5	69.5	-0.2	-4.9	-4.9
REF	80.2	80.3	77.5	77.5	0.1	-2.7	-2.7
S01	56.4	55.7	54.2	53.6	-0.7	-2.2	-2.8
S02	63.9	63.6	61.5	60.9	-0.3	-2.4	-3.0
S03	55.7	61.2	53.5	56.4	5.5	-2.2	0.7
S04	46.8	47.2	45.0	44.8	0.4	-1.8	-2.0
S05	47.5	51.9	45.7	47.6	4.4	-1.8	0.1
S06	38.2	41.4	37.7	38.8	3.2	-0.5	0.6
SD1	56.5	55.8	54.3	53.7	-0.7	-2.2	-2.8
SD2	59.2	58.2	56.7	55.8	-1.0	-2.5	-3.4

COST

The cost for the Action will be minimal as it will not require additional personnel or significant amounts of fuel. The cost to prepare the environmental documentation could range from $10,000 to $50,000.

RESPONSIBLE PARTIES

The Airport is responsible for informing based and transient pilots about the departure procedure, the FAA is responsible for implementing such a procedure, when conditions allow, and the pilots are responsible for following the procedure when safe to do so. The Airport and the FAA will enter into a Letter of Agreement concerning the procedure. The operators are responsible for helping to implement the procedure during favorable conditions. The FAA will ask for assistance from the Sponsor to complete the required environmental documentation.

AIRPORT ACTION

The Airport will notify based and transient pilots of the procedure and work with the FAA during implementation.

TIME FRAME

This Action can be implemented as soon as the FAA has prepared sufficient environmental documentation regarding the procedure. This is anticipated to require up to a year to complete once this Recommendation is approved.

RECOMMENDATION 4--TEST 24 HOUR FLIGHT TRACK FAN BETWEEN 350 AND 010 DEGREE HEADINGS

ISSUE

Reduce noise impacts to residents from concentrated over flights north of the Airport.

NEW ACTION

This New Action would test the feasibility of "fanning" aircraft northern departures between 350 and 010 degree headings on a 24 hour basis, weather and traffic permitting.

COMMENTS

Residents north of the Airport experience straight out departures 24 hours a day. It is recognized that Recommendation 3 includes a 010 departure heading will be evaluated for implementation during the night time hours. However, this Recommendation is to test the feasibility of spreading the north flow flight tracks over a larger area during those hours when a 010 departure heading is not feasible. This would help reduce noise impacts to the residents north of the Airport. Air traffic considerations, weather conditions and pilot preference will affect the feasibility of this Recommendation and the times when such a fanning of departures could occur. However, the feasibility of implementing such a procedure should be tested in the same manner that the 010 night time departure procedure was tested.

COST

The cost to test these departure tracks would be negligible

RESPONSIBLE PARTIES

The Airport is responsible for coordinating with the FAA as to the feasibility of such a test and for publishing notice of the test to the pilots. The FAA is responsible for implementing the test to test its feasibility. The operators are responsible for helping to implement the procedure during favorable conditions.

AIRPORT ACTION

The Airport would coordinate with the TRACON and Tower concerning the exact procedure and times to implement the test. The FAA and Sponsor are responsible for publishing notice of the test so that the pilots and citizens are aware of the test.

TIME FRAME

This Action can be initiated immediately and is not dependent upon any other Action.

RECOMMENDATION 5--ELIMINATION OF PREFERENTIAL RUNWAY USE

ISSUE

Decrease aircraft over flights to residents south of the Airport during nighttime hours.

NEW ACTION

This New Action would eliminate the use of the nighttime preferential runway procedure. Operations would take place based on destination, traffic and weather as they do at other times of the day.

COMMENTS

This Action will help reduce the number of residents south of the Airport exposed to aircraft noise impacts during critical nighttime hours (Please refer to Table F2, which indicated the number of people reduced). The Airport currently has a nighttime preferential runway program in effect that requests arrivals from the south and departures to the south, which results in traffic over residential development south of the Airport. When the preferential runway program was implemented, there was little residential development that was affected by the program. However, over the years substantial residential development has occurred that is affected by the nighttime preferential runway program.

COST

The cost to implement this Action is minimal.

RESPONSIBLE PARTIES

The Airport is responsible for requesting that the FAA/ATC eliminate this nighttime preferential procedure and the FAA/ATC is responsible for directing traffic in a normal manner.

AIRPORT ACTION

The Airport will request that the FAA/ATC implement this procedure. The Airport will notify operators that it is no longer a part of the Airport Noise Abatement Procedures.

TIME FRAME

This Action can be implemented immediately and is not contingent upon other Actions.

RECOMMENDATION 6--IMPLEMENT 170 DEGREE DEPARTURE HEADING TO 4 DME OR 8,000 MSL, PLUS OR MINUS 20 DEGREES

ISSUE

Decrease aircraft over flights to residents south of the Airport.

AMENDED ACTION

This Amended Action would require southern departures to fly runway heading until reaching 4 DME or 8,000 MSL, with a deviation of plus or minus 20 degrees. This would help maintain departures over compatible land uses and reduce the deviation of such departures over non-compatible land use.

COMMENTS

This Action will help reduce the number of residents south of the Airport exposed to aircraft over flights. Aircraft currently tend to turn away from the extended runway centerline departure early and over fly residential development. There is a corridor of open space and compatible development south of the Airport that aircraft are requested to use to the extent possible. However, some practice approaches occur utilizing northern approaches to Runway 17 during times of favorable winds. Thus to avoid conflicts during these times, there is a plus or minus 20 degree deviation recognized with these southern departures.

COST

The cost to implement this Action is minimal.

RESPONSIBLE PARTIES

The Airport is responsible for requesting that the FAA/ATC utilize this procedure whenever possible, and the FAA/ATC is responsible for directing traffic to achieve this procedure whenever possible. The Airport is responsible for notifying operators of this Noise Abatement Procedure and the operators are responsible for following this procedure to the extent possible. The FAA will ask for assistance from the Sponsor to complete the required environmental documentation

AIRPORT ACTION

The Airport will request that the FAA/ATC implement this procedure. The Airport will notify operators that it is a part of the Airport Noise Abatement Procedures.

TIME FRAME

This Action can be implemented immediately and is not contingent upon other Actions.

RECOMMENDATION 7--AMEND COMMUNITY PLANS AND ZONING ORDINANCES

ISSUE

Compatibility of community plans and ordinances with Airport activities.

NEW/AMENDED ACTION

The Airport will work with the jurisdictions to amend zoning maps, comprehensive plans and development regulations, as necessary, to minimize new non-compatible land uses and to take into consideration FAR Part 77 height requirements. Such changes shall work towards discouraging the location of additional non-compatible land use and to require sound attenuation of new construction in existing development to be compatible with Airport operations.

COMMENTS

The jurisdictions surrounding the Airport have existing Comprehensive Plans, Zoning Maps and building code requirements. It is strongly recommended that compatible land use planning be consistent among jurisdictions, including use of the Part 150 contours and recommendations. In addition, any infill development occurring within at least the 60 DNL noise contour should meet sound attenuation guidelines. The implementation of the Future Noise Exposure Map and the Noise Compatibility Recommendations will reduce the number of people in the 65 or greater DNL contours; however, new or infill development, or changes in land use should be premised on avoiding additional non-compatible land uses.

COST

The cost for implementing these recommendations by both the Airport and the jurisdictions is within the normal planning activities of these entities.

RESPONSIBLE PARTIES

The Airport and jurisdictions are responsible for working together on compatible planning. The jurisdictions are responsible for updating the Plans, Maps and development regulations, as necessary.

AIRPORT ACTION

The Airport will consult with the jurisdictions concerning the updating of the Plans, Maps and development codes, and will coordinate with the jurisdictions on Airport development activities or changes.

TIME FRAME

These Actions can be initiated immediately and are not contingent upon other Recommendations.

RECOMMENDATION 8--UPDATE AND ESTABLISH ENVIRONMENTAL/NOISE ABATEMENT LIAISON OFFICE

ISSUE

Establish better communication concerning noise complaints and other environmental issues between the Airport and the citizens.

AMENDED ACTION

Update the existing noise complaint system, establish new procedures and establish a new office at the Airport to address all Airport related environmental issues.

COMMENTS

This Action will upgrade the existing noise complaint/community liaison office to better address not only noise issues but other environmental issues which are of concern to the public and users of the Airport. Such issues as aircraft noise, air quality, water quality and development issues can be addressed through this office. In addition, this office would be responsible for the implementation, administration and maintenance of the recommended Noise Monitoring System and would be responsible for addressing specific aircraft related noise questions through the use of the noise monitoring system and flight track system.

COST

The cost to implement this Action would be minimal at first but as conditions develop, an additional staff person may be necessary. This could be in the range of $45-60,000.

RESPONSIBLE PARTIES

The Airport is responsible for developing and setting up the office, the FAA is responsible for assisting the Airport when they can in providing information and data that may be within their purview.

AIRPORT ACTION

The Airport will initiate the development of the Office as soon as possible. Procedures and processes will be developed and duties assigned to existing personnel.

TIME FRAME

This Action can be implemented immediately and is not contingent upon other Actions.

RECOMMENDATION 9--INSTALL NOISE MONITORING SYSTEM AND DEVELOP PROGRAM

ISSUE

Verification of Noise Abatement Program and Flight Track Adherence.

NEW ACTION

It is recommended that the Airport install a permanent noise monitoring system to monitor noise levels and compliance with the noise abatement measures, and in the interim initiate seasonal on-site noise monitoring. The noise monitors should be placed as near as possible to the locations used for monitoring with this Study. Interim seasonal monitoring should take place at least twice a year, during the summer and winter seasons.

COMMENTS

This Action is intended to be used to help verify the runway use program recommended for the Airport, would determine the success of recommended noise abatement programs and would build a data base to be used for future updates to the FAR Part 150 Study. It could be used to identify aircraft that tend to operate in a manner inconsistent with other aircraft. This is an integral part to the Fly Quiet program and is necessary for the success of such a volunteer program.

A committee could help identify the potential noise monitoring sites and review the specifications for the system. This process takes approximately two years to complete. The noise monitoring sites must be owned or long-term leased by the Airport, be secure and have electrical power/telephone access.

COST

The cost to implement the seasonal monitoring is approximately $100,000 per year, and the cost to implement the permanent monitoring is approximately $600,000-1,500,000.

RESPONSIBLE PARTIES

The Airport is responsible for hiring the consultant, identifying the sites, budgeting for the equipment and installing the equipment through a contractor. The Airport is responsible for hiring the consultant to do seasonal monitoring until the permanent system is in place. The FAA is responsible for assisting the Airport with funding if such funding is available.

AIRPORT ACTION

The Airport will budget for seasonal monitoring, hire the consultant and initiate the process as soon as possible. They will apply for Federal funds for the permanent system when such funds become available.

TIME FRAME

The seasonal monitoring can begin whenever funds are available and the permanent system will take approximately two years to install, once funds are available.

RECOMMENDATION 10-DEVELOPMENT/IMPLEMENTATION OF FLY QUIET PROGRAM

ISSUE

Reduce single event noise levels, encourage greater compliance with noise abatement procedures, and continue to raise awareness of citizens noise concerns with the FAA and operators.

NEW ACTION

The Fly Quiet Program should be developed to:

- Monitor adherence to ideal noise abatement flight tracks
- Evaluate success of operators, aircraft types and other variables
- Establish goals and track level of improvement over time
- Offer incentives for improvement

The Fly Quiet Program should include the following elements:

- Aircraft noise should be related to its effects on people including such factors as annoyance, speech interference and sleep disturbance
- Comparative fleet quality between operators should also be included
- The program should utilize measured data from the Airport's noise monitoring system
- Incentives of sufficient importance that operators will take notice of the results, and
- Pilots and air traffic controllers should be included, if possible.

COMMENTS

A Fly Quiet Program has the potential of reducing single event noise levels and encouraging greater compliance with preferential flight corridors and procedures recommended in this Study. The program could potentially result in overall reductions in cumulative noise levels in some focused areas around the Airport as well. Identification of how individual aircraft operate at specific locations compared to the way the majority of aircraft operate, can help encourage the noisier operations to lower noise levels and/or adhere to established flight tracks. The specific elements and reporting techniques will be developed with the follow-on committee. The Fly Quiet Program cannot become fully

implemented until the new Noise Monitoring System has been tested and is operational.

COST

The cost for this Action will be part of existing staff functions.

RESPONSIBLE PARTIES

The Airport is responsible, through consultation with the follow-on committee, for developing the final elements of the Program, for obtaining the relevant data from the Noise Monitoring System and for preparing reports. The follow-on committee is responsible for helping develop the elements and working with the Airport in evaluating the results. FAA and operators are responsible for trying to follow the Fly Quiet recommendations after they are developed.

AIRPORT ACTION

The Airport will evaluate and identify, in conjunction with the follow-on committee, the elements of the Fly Quiet Program, evaluate the Noise Monitoring System, initiate the Program and continue to market the Plan and Program.

TIME FRAME

The elements of the Fly Quiet Program can be identified and developed as soon as the follow-on committee is established, and initiated soon afterward. The Program cannot be fully implemented and tested until installation of the Noise Monitoring System is completed.

RECOMMENDATION 11--OPERATIONS REVIEW AND PART 150 UPDATES

ISSUE

Update and Review of the FAR Part 150 Study.

CONTINUED ACTION

The FAR Part 150 Study is a five-year program recommended to be reevaluated at the end of the five-year period. In addition, if there is a significant change in either aircraft types or numbers of operations, or significant new facilities, then it is recommended that the Study be reevaluated prior to the end of the five-year time frame.

COMMENTS

It is recommended that Airport management undertake a yearly review of the aircraft types and numbers, along with the actual number of operations occurring at the Airport, and determine if they are consistent with the projections contained in the FAR Part 150 document. FAR Part 150 defines the level of change necessary to trigger a revision of the Noise Exposure Map to be when any change in the operation of the Airport would create any substantial new non-compatible use in any area depicted on the map beyond that which is forecast for the fifth calendar year after the date of approval. That is, if that change results in an increase in the yearly day-night average sound level of 1.5 DNL or greater in either an area which was formerly compatible but is hereby made non-compatible or in a land area which was previously determined to be non-compatible and whose non-compatibility is not significantly increased. The various recommendations will also be reviewed as to their ability to mitigate the projected noise intrusion and the overall effectiveness of the program.

At the end of the five-year study all of the forecasts and aircraft mix are to be reevaluated to determine the extent to which they have changed from those projected in this study, and are to be undated to reflect the following five years. If necessary, new mitigation measures are to be evaluated. Contingent upon Federal funds, the Noise Compatibility Program is to be reevaluated, and public review of documents will be incorporated.

COST

The cost of monitoring the information set forth in this section will be borne out of the normal Airport operating budget. Consultant assistance for various elements would be approximately $30,000.

RESPONSIBLE PARTIES

The Airport would be responsible for updating and monitoring the FAR Part 150 Study at the five-year increments or when there is a significant change in aircraft types or numbers of operations. The Federal Aviation Administration could help fund the update if there are funds available for such planning.

AIRPORT ACTION

Based on the monitoring activities described, the Airport will reevaluate the program when there is a significant change in operations, aircraft types or at the end of the five-year timeframe.

TIME FRAME

The Airport will continue its monitoring program and plan for a full update at the end of the fifth-year after submittal or earlier if necessary as per FAR Part 150.

RECOMMENDATION 12--ESTABLISH FOLLOW-UP ROUNDTABLE/ COMMITTEE

ISSUE

Formulation of Fly Quiet Program and Evaluation of other Noise Abatement Programs.

AMENDED ACTION

The Study Advisory Committee established for this Study has been instrumental in establishing these Recommendations. It is recommended that a similar committee continue to monitor programs implemented as a result of the Part 150 Study after its completion, establish the Fly Quiet Program guidelines and the Noise Monitoring Program.

COMMENTS

Considerable time and effort has been expended, by both the Airport and the Committee, in the development of this study, especially the "learning curve" effort and the building of relationships, that is too valuable a tool for communication to risk loosing at the end of this process. In addition, on-going aircraft operational procedures evaluation should be discussed through the Committee.

It is very difficult to foster a feeling of trust in many Airport planning efforts. Such a feeling can be developed through the members of this or a similar Committee. Both sides of most issues are represented and all interests are heard. This is very important for the continued successful implementation of the noise abatement program and operation of the Airport. A model for such continued committee activity is the San Francisco International Airport Roundtable.

COST

The cost for the Committee could be included in the normal operating expenses of the Airport, with Federal funding, if available.

RESPONSIBLE PARTIES

The Airport is responsible for determining the formulation of the committee and committee administration. Other parties may be responsible for appointing members of the committee. Committee members are responsible for attending and participating in committee functions.

AIRPORT ACTION

The Airport will hold committee meetings, on at least a quarterly basis, as a means of disseminating information and gathering input on noise abatement issues. The Committee will help the Airport in developing the Fly Quiet Program and the Noise Monitoring Program.

TIME FRAME

This Action can occur within the first few months of approval of the FAR Part 150 Study. It can also be implemented without regard to any other recommendation.

Consultation

Introduction

The Centennial Airport FAR Part 150 Noise Exposure and Land Use Compatibility Study involved an extensive public participation process, with several components exceeding the requirements of the regulation. An inclusive tone was set by the Airport Authority from the very beginning by requesting that the Community and Technical Advisory Committees membership be broadly representative of all stakeholders.

The elements of the public involvement process were:

- Public Involvement Program
- Technical Advisory Committee
- Community Advisory Committee
- Initial Public Information Meeting
- Three Open Houses
- Meetings with Individual Citizens
- Project Information Brochure
- Project Newsletters
- Project Website
- Numerous Working Papers
- Project Workbooks
- Public Hearing

The Public Involvement Plan is found in Appendix Ten. The following is a brief description of the activities conducted in each of those categories

Advisory Committee

The public involvement process began with the establishment of two committees: Community and the Technical Advisory Committees. Composition of the Community Advisory Committee (CAC) was developed to include representative from neighborhoods surrounding the Airport, business interests and civic organizations. Members of the CAC are listed in Appendix Eleven. Composition of the Technical Advisory Committee (TAC) was developed to include associated agencies, representatives of the jurisdictions immediately surrounding the airport,

airport users, airport staff, the Cherry Creek School District, public health interests, and Cherry Creek State Park. Members of the TAC are also listed in Appendix Ten.

These two committees met separately at the beginning of the Study. Then, in order to facilitate information exchange, the decision was made to have joint meetings for the remainder of the process. The committees met seven times. All meetings were open to the public.

One of the major components of the Part 150 Study is the evaluation of reasonable alternatives, both land use and operational/facility alternatives, to reduce noise impacts and achieve greater land use compatibility. Alternatives were developed based on several factors:

- FAR Part 150 requirements,
- Input from the Committee members,
- Input from the public during open houses,
- Consultant recommendations.

Each alternative was presented to the Advisory Committees for evaluation and comments. Members of the committees considered technical papers and presentations carefully on each subject matter. The type of analysis conducted was heavily influenced by the comments and questions from the committee members.

Summaries of all Advisory Committees meetings appear in Appendix Nine.

Initial Public Information Meeting

A public information meeting was held at the beginning of the Part 150 Study to let members of the community know the purpose and elements of the study and the study schedule. Members of the consultant team were introduced and those attending were encouraged to make comments and ask questions. Handout material was available. A summary of the meeting appears in Appendix Nine.

Project Brochure

A brochure was published and made available at all public meetings that explained the purpose and process of the study, outlined the schedule and named the participants and sponsors.

Open Houses

Three Open Houses were held during the Study where members of the public were able to interact directly with Airport and consulting staff on their noise related concerns. Display boards were available to present information being discussed among the advisory committees. At each Open House, members of the public were afforded the opportunity to have their questions answered and provide written comments. Public input from these Open Houses was influential in prioritizing issues during the Study.

The Open Houses took place at Holiday Inn Centennial, across the street from the Airport and were advertised in local daily and weekly newspapers and announced on the Study's Website.

In addition to the scheduled Open Houses, Airport Staff and Consultants attended numerous community and civic meetings to update and explain the Study findings, recommendations and process. These meetings were attended by citizens, elected officials, civic groups, and community organizations, and were organized to present the Study findings to date.

Newsletters

Three Project Newsletters were developed to distribute information concerning important Study milestones to the public.

Website

Early in the Study a website was created to provide broad access to technical data, meeting summaries, schedules, and other pertinent information. Among the items posted on this website were:

- Questions and answers
- Public Involvement Plan
- Technical Papers
- CAC/TAC meeting summaries
- Schedules
- Notices of Open Houses
- Public Meeting summaries

Working Papers

Several Working Papers were prepared and presented throughout the course of the Study. These Working Papers were presented as Chapters to the final document and were discussed at the committee meetings. Input was obtained from both the committee members and the general public on the Working Papers.

Public Hearing

A public hearing was held in conjunction with this Study on October 11, 2001 at the Holiday Inn Centennial. An open house was held prior to the hearing from 5:00 pm to 7:00 pm. A review of the process was presented. Approximately ninety-one (91) people attended the hearing with twenty-seven (27) people providing public testimony. A transcript of the Hearing is found in Appendix Six, along with Proof of Publication. Written comments were taken for two weeks after the hearing and are found in Appendix Seven. Reponses to these comments are found in Appendix Eight.

The Arapahoe County Public Airport Authority continued the Hearing on November 15, 2001. At that time the Authority considered the Recommendations and unanimously adopted them on that date. See Agenda in Appendix Twelve.