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THE NATIONWIDE AIRPORT NOISE IMPACT MODEL AND ITS APPLICATION TO REGULATORY ALTERNATIVES

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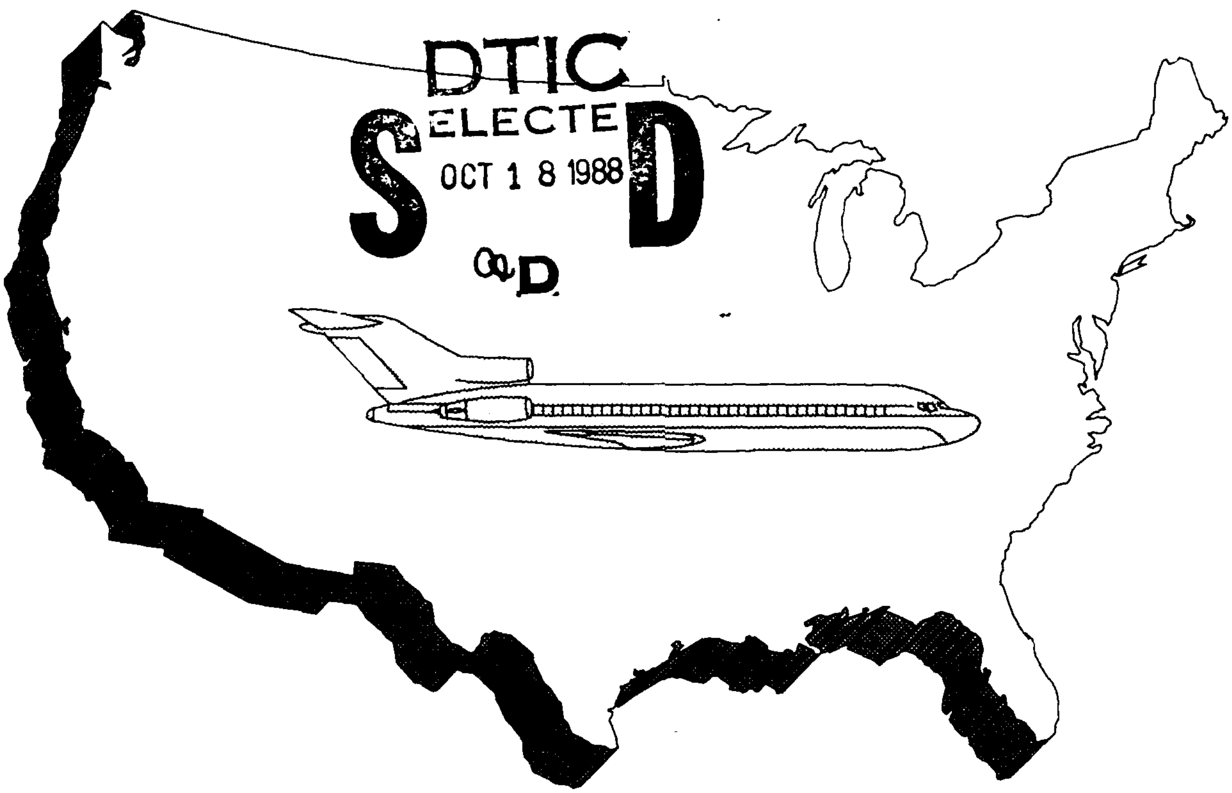

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16. Abstract

The Nationwide Airport Noise Impact Model enables estimates of the future (to 2010) noise impact for various regulatory alternatives. It enables calculation of the population, total housing unit value and area in the United States exposed to various L_{dn} values above L_{dn} 65 dB from operations of civil air carrier aircraft. It contains a population and demographic data base derived from Census data at 247 airports and the 1985 baseline aircraft fleet mix derived from the Official Airline Guide for the week of October 12, 1985. It contains area versus L_{dn} functions for five avports that are used to represent the diverse sizes and types of commercial airports in the United States.

The report contains the results of applying the model to a baseline and two regulatory scenarios. The regulatory scenarios are the phaseout of operations by Stage 2 aircraft in 1995 and in 2000. Population and economic impact data are estimated for four study years 1985, 1990, 1995 and 2000. The results indicate that both alternatives lead to significant reductions of impact over the baseline case, with the earlier phaseout bringing earlier reductions.

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SUMMARY

Background

This report is the latest in a series going back to 1974 in which the potential impact of airport noise has been analyzed, and alternatives for airport noise reduction have been evaluated. The report immediately preceding this one was the FAA's "Report to Congress" of April 11, 1986 which identified a number of alternatives available to accelerate commercial aircraft fleet modernization. The FAA Report to Congress did not attempt to measure the current noise impact, as some studies had done, stating that ". . .a more rigorous analysis of the alternatives was not possible within the time constraints" but that "Over the next several months, the FAA will examine the options. . .". This study is part of that examination.

Purpose and Scope

The purpose of this study was to estimate the total noise impact around the nation's airports for three alternative scenarios:

1) No federal action,
2) Implementation of an operating ban on Stage 2 (older, noisier) aircraft in 1995, and
3) Implementation of an operating ban on Stage 2 aircraft in 2000.

The scope included all U.S. airports with jet transport operations. The measures of "noise impact" include the area, population, and value of the housing exposed to certain noise levels, that is to say lying within certain noise "contours" or lines of equal sound exposure. This study is the first to try to put a value on the nation's total stock of housing in the areas exposed to airport noise. The base year for this study is 1985. The noise impact for that year was compared with the impact in 1990, 1995 and 2000 for the three scenarios indicated herein.

Method and Approach

The basic tool used in this study was the FAA's Integrated Noise Model, version 3.8. This complex computer model was designed to permit the drawing of noise contours at individual airports from inputs such as aircraft mix, number of operations, flight tracks, number of night operations, etc. Based on special FAA forecasts of aircraft mix and operations, and on generalized flight tracks, the model was used in this study to draw the noise contours for five average airports, or "avports", in the following categories:

- Large size long-range airports
- Large size medium-range airports
- Large size short-range airports
- Medium size short-range airports
- Small size short-range airports with few jet transport flights.

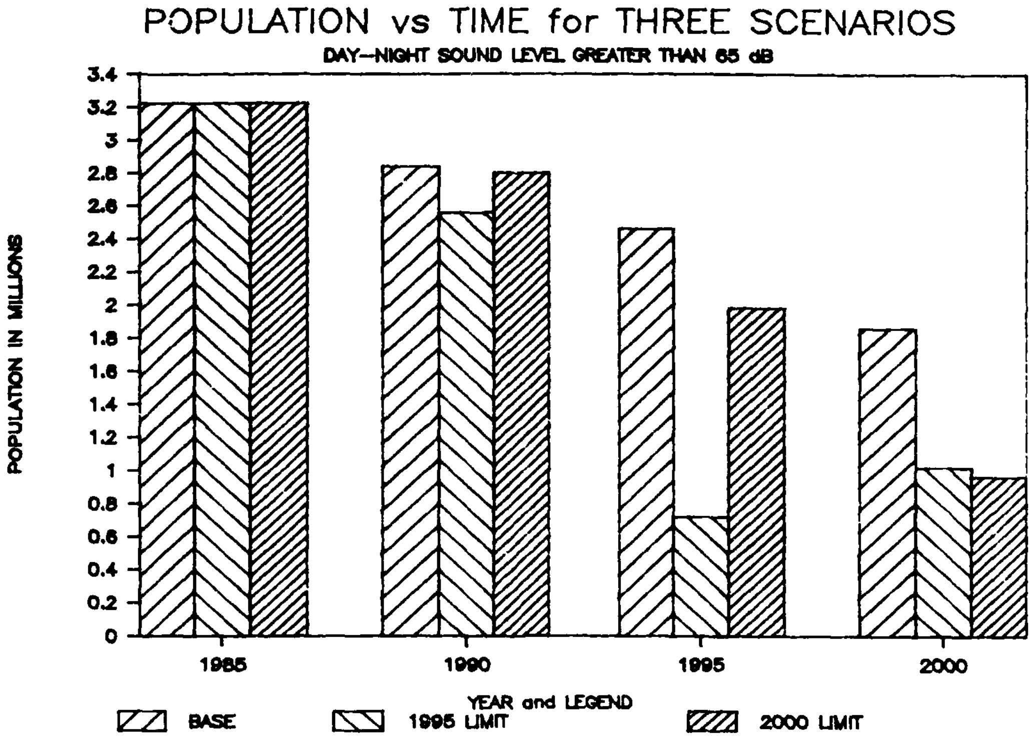
From these contours it was possible to measure the areas between individual noise contours which lay within evenly-spaced concentric circles centered on the airport's reference point. These areas were measured for each of the avports, for each of the four years of interest, and for each of the three scenarios.

The next step was to obtain the population densities and property values within one-mile concentric circles around the airports in the United States with scheduled civil jet operations. The 1980 Census data on population, households and property values, together with forecasts of population and households for 1985 and 1990, were obtained from CACI, Inc.-Federal. These data were extrapolated, as required, to the four study years, 1985, 1990, 1995 and 2000. From these data it was possible to calculate the number of people and the property value in the areas between each successive set of noise contours which lay between each set of concentric circles. The numbers of people and the property values for the airports in each category could then be summed for each year and for each scenario.

Findings

The findings of this study, summarized by the bar graphs in Figures 1 and 2 and the data in Table 1, are:

- Noise impact around the nation's airports will continue to decline, even without additional regulation, simply through the introduction of newer, quieter aircraft into the fleets and retirement of older, noisier aircraft.
- However, the prohibition of Stage 2 aircraft operations, either in 1995 or 2000, greatly accelerates the decrease in noise. Without



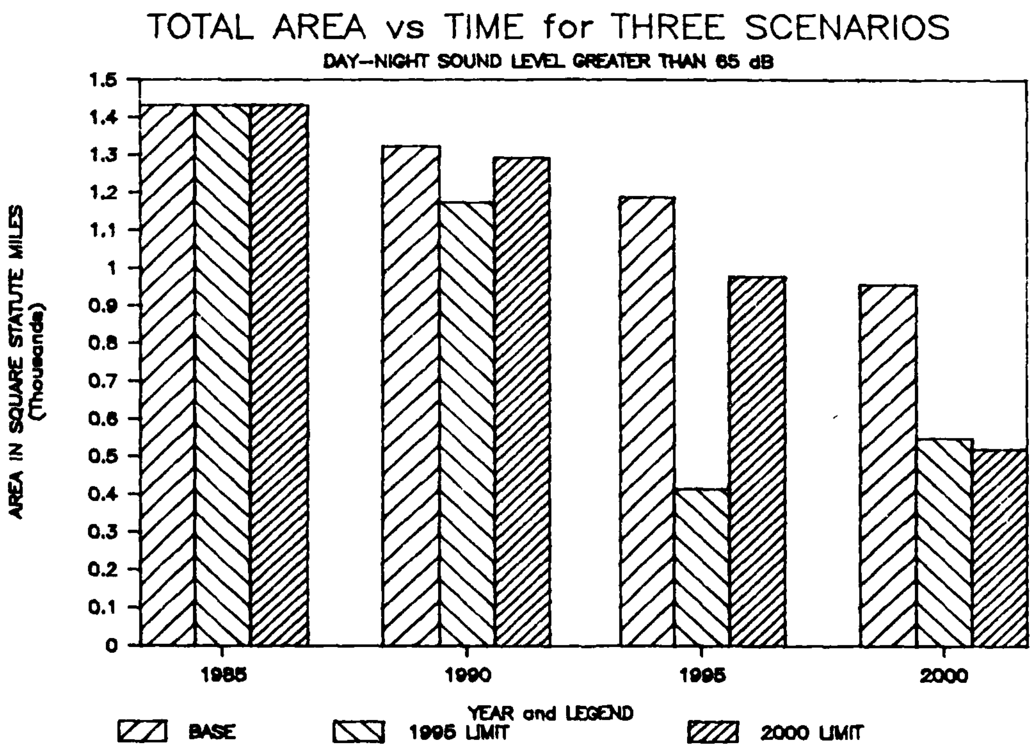
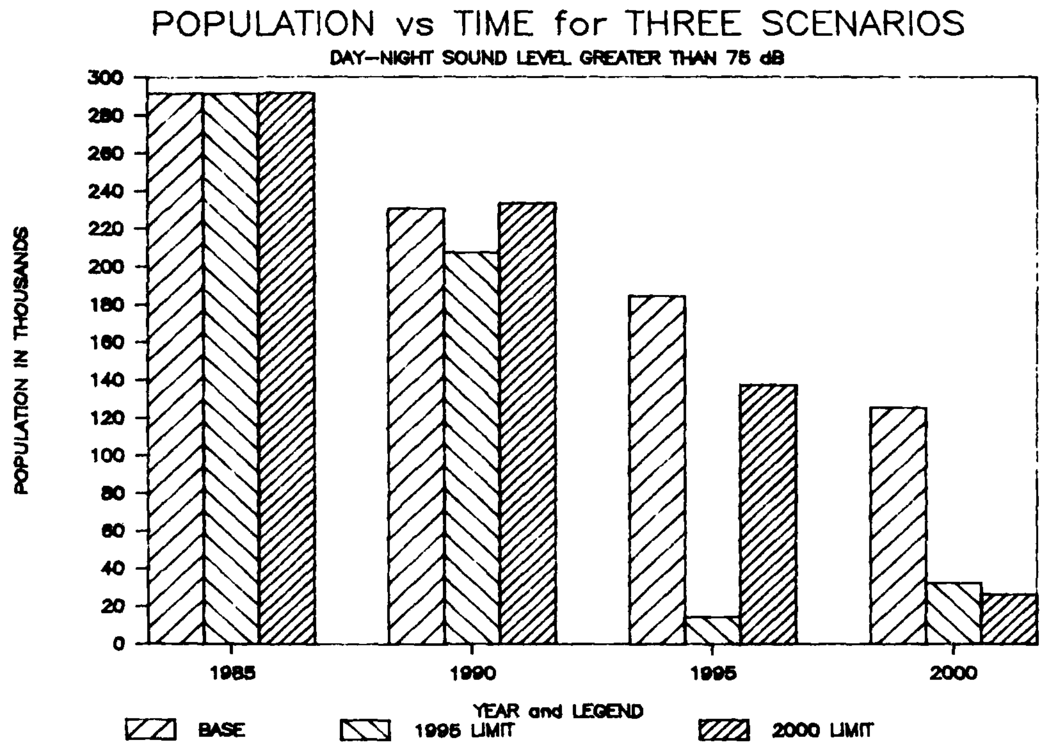


FIGURE 1. ESTIMATED NATIONAL POPULATION AND AREA EXPOSED TO L_{dn} 65 dB OR MORE



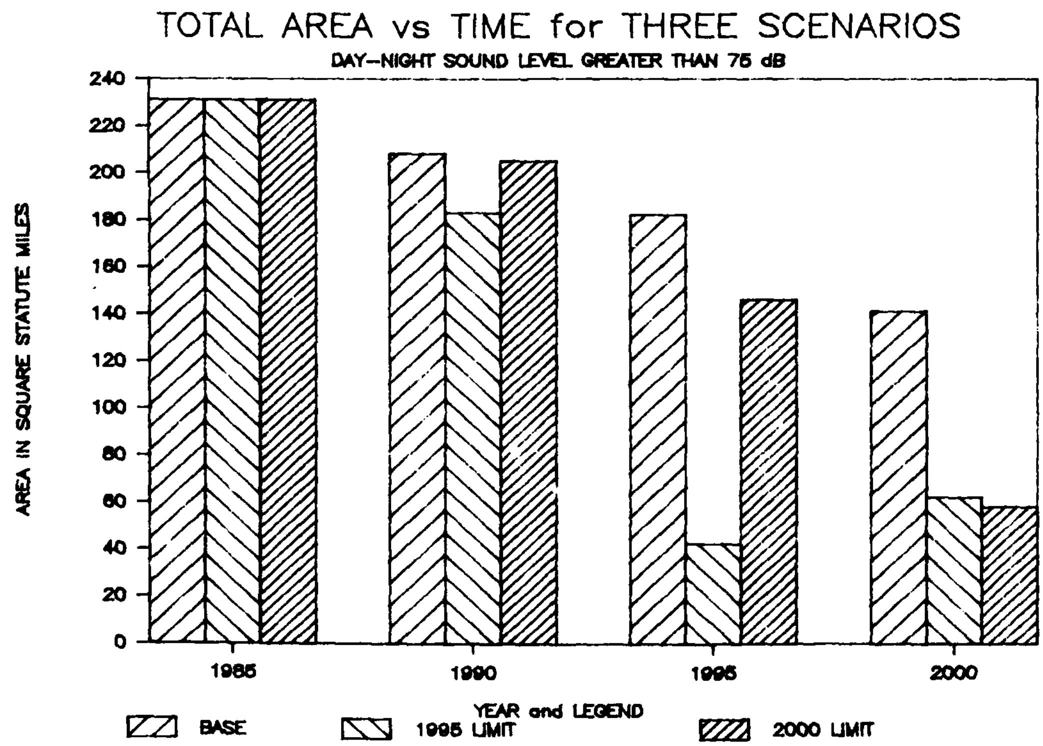


FIGURE 2. ESTIMATED POPULATION AND AREA EXPOSED TO L_{dn} 75 dB OR MORE

TABLE 1

SUMMARY OF FORECASTS OF NOISE IMPACTS[1]

	1985	1990	1995	2000
Area Within L_{dn} 65 dB (square miles)				
Baseline	1,432	1,321	1,186	956
1995 Phase-Out	1,432	1,172	414	549
2000 Phase-Out	1,432	1,291	976	520
Population Within L_{dn} 65 dB (000's)				
Baseline	3,220	2,836	2,458	1,856
1995 Phase-Out	3,220	2,553	716	1,017
2000 Phase-Out	3,220	2,795	1,980	960
Value of Property Within L_{dn} 65 dB (billions of constant 1985 dollars)				
Baseline	$75	$70	$60	$47
1995 Phase-Out	75	61	18	27
2000 Phase-Out	75	68	50	26

[1] The L_{dn} 65 dB noise contour (line of equal noise) is the generally accepted line dividing urban residential areas in which noise problems may be expected and those in which they are not.

regulation it would be 2010 or later before noise impact would be reduced to the noise impact made possible, through regulation, by 1995 or 2000.

- Regardless of whether Stage 2 aircraft are prohibited from operating in 1995 or 2000, the reduction in noise impact is about the same by 2000 (given the estimated changes in fleet size) - a 63% reduction in the area exposed to L_{dn} 65 dB in 1985, a 69% reduction in the population exposed, and a 65% decrease in the real value of the residential property suffering noise impact.[1]
- Corresponding decreases without regulation are 33%, 42% and 37%.
- The big difference in the impact of a prohibition on Stage 2 aircraft in 1995, as opposed to 2000, is felt in the years between 1990 and 2000.
- In 1995 the people exposed to L_{dn} 65 dB or greater equal 716 thousand with a 1995 phase-out, versus 1,980 thousand with a 2000 phase-out. These figures represent a 78% versus a 39% reduction over 1985 when 3,220 thousand were exposed.

[1] Property values were first forecast in current dollars and were then converted to constant 1985 dollars. A value is said to be expressed in "real" or "constant" terms when its value has been adjusted for changes in the purchasing power of money. Values expressed in "current" dollars refer to the purchasing power of the dollar in the current year.

1. INTRODUCTION

The development of regulatory strategies, and the promulgation of regulations for the control of airport noise and the reduction of its impact, require estimates of costs and benefits of regulatory alternatives. One measure of benefit is the change in the number of people in the U.S. who live in areas exposed to various cumulative levels of aircraft noise, such as L_{dn} 65, 70 or 75 dB. Another measure of benefit is the amount of land which has a use that is incompatible with the cumulative level of noise from aircraft operations. These measures are being carefully estimated for an ever-increasing number of airports under the FAA-sponsored FAR Part 150 Program and through the environmental impact statement processes required for many airport projects. However, there is no way to incorporate these new data into models of national noise impact that can be used in policy analyses.

The purpose of this study is to estimate the change in potential noise impact around the nation's airports between 1985 and 2000 under three alternative scenarios:

- No new federal regulations
- Implementation of an operating ban on all Stage 2 aircraft in 1995, or
- Implementation of an operating ban on all Stage 2 aircraft in 2000.

These estimates will assist the Federal Aviation Administration (FAA) in meeting its 1986 commitment to Congress (Ref. 1) to prepare more accurate comparisons of the relative benefits of these regulatory alternatives. In these alternatives, "Stage 2 aircraft" refers to aircraft that meet the initial (1969) noise requirements for turbojet and large transport category aircraft as defined in Part 36 of the Federal Aviation Regulations (Ref. 2).

This report provides estimates of the magnitude of potential noise impact around the nation's airports. The estimates of impact are presented in terms of the population, land area and housing stock value calculated to be within contours of equal noise. These bounding noise contours are contours of equal cumulative noise based on the A-weighted Day-Night Sound Level (L_{dn}).

Section 2 of this report contains a discussion of the background of national estimates of noise impacts. Section 3 summarizes the principal features of the Nationwide Airport Noise Impact Model (NANIM) developed by KEE in this study. Section 4 summarizes the external data acquired for input to the model and methods used to extrapolate the data to the time period of the study. Section 5 gives the major results of the study together with comparison with earlier studies.

Additional detailed data and methodologies are described in a series of seven appendices. Appendix A contains detailed tabular summaries of the main results of the study. Appendix B lists all of the airports which had scheduled civil jet operations in October 1985, and gives data on the nature of those operations. Appendix C provides additional detail on the avport tracks and contours. Appendix D gives the forecast methodology for aircraft operations. Appendix E contains a summary of the four engined narrow body aircraft which have received a "hush kit" retrofit to meet FAR Part 36 Stage 2 requirements (Ref. 2). Appendix F gives the detailed methodology used by CACI, Inc.-Federal, to maintain and update the demographic data base that was used in this study. Appendix G gives the detailed methodology used to derive the value of the residential housing stock within stated noise contours in both current and constant 1985 dollars. Appendix H contains information on comparisons of estimates of noise impact.

2. BACKGROUND

The FAA defines the noise from aircraft operations in the vicinity of airports in terms of a cumulative noise level known as L_{dn}. The L_{dn} represents an energy summation of the time-varying weighted mean square sound pressures resulting from aircraft operations throughout a 24-hour day with a weighting factor for sounds occurring during nighttime (2200-0700 hours). The L_{dn} may be calculated by summing the time integrated weighted mean square pressures associated with each single event aircraft flyby and applying the appropriate nighttime weighting.

L_{dn} was developed by the EPA (Ref. 3) as its primary descriptor of outdoor environmental noise. Subsequently it was adopted by the FAA in FAR Part 150 (Ref. 4) as the descriptor of cumulative noise from aircraft in the vicinity of airports. Currently, the contours of cumulative noise around civil airports are calculated in L_{dn} using the FAA's Integrated Noise Model (INM) version 3.8. The L_{dn} 65 dB contour is the generally accepted line dividing urban residential areas in which noise problems may be expected and those in which they are not.

The size and shape of the noise contours at any specific airport and the potential associated impacts are dependent on seven principal factors: three of the factors describe the airport's "total noise", while the other four factors describe the airport's potential for noise impact. The seven factors are:

Airport Total Noise

a) Noise versus distance by aircraft type

b) Number of operations by aircraft type

c) Proportion of nighttime operations by aircraft type

Airport Potential for Noise Impact

d) Flight procedures (throttle and flap management) used for departures and approaches by aircraft type

e) Stage lengths (departure and approach weights) by aircraft type

f) Flight track spatial configuration and relative utilization by aircraft type

g) Residential population and compatible land use spatial distribution with respect to flight tracks

All of these seven factors, except (g), the spatial distribution of residential population and incompatible land use, are -- or could be -- a function of aircraft type. Also, all of these factors with the exception of (a), noise versus distance, are -- or could be -- specific to an airport. Therefore, the various intercorrelations among these factors must be considered in developing generalized models of potential noise impact.

There is a strong correlation between the size of an airport, measured by its number of total air carrier operations, and the size of the population to be served. There is a strong correlation between number of operations and the mix of aircraft types and the size and shape of the contours produced. Also, for a given aircraft mix the shape of the contours may be altered by changing the stage lengths (aircraft operating weights), the flight procedures, and/or the locations of the ground tracks and their relative utilizations. However, whenever the factors that affect contour shape remain fixed, changes in the factors making up the airport total noise affect only the contour sizes. This means that for many studies, changes in noise impact may be modeled by evaluating only the changes in airport total noise, as long as the study does not include scenarios that change the relative shape of contours and as long as the correlation between the number of airport operations and the amount of its associated population is accounted for.

For this analysis the FAA used 247 civil airports in the United States which have known scheduled turbo-jet aircraft air carrier operations. Most of these airports are relatively small and are located in areas of low population density. The larger airports are located in areas of higher population density. In determining the change in noise impact on a national basis that might be expected from a proposed regulatory action or other type of operations change, it is necessary to find some way to add up the changes of noise impact at all of the affected airports. Two methods have been used in the past. One is the direct approach (Ref. 5) in which a set of airports is studied, their individual impacts determined, and the results added together to obtain a total result applicable to the chosen set of airports. The second is the avport approach (Refs. 6-9) in which one or more average airports (avports) is developed to represent the nation's airports and is studied to determine the effect of changes in noise on national impact.

The direct approach of modeling a large sample of airports with their actual operations, flight tracks and population distribution is extremely expensive. However, useful estimates of the relative impact of regulatory alternatives can be obtained from examining the changes at the airports having the highest impact potential. The 23 Airport Study (Ref. 5) used this direct approach to assess the potential benefits from adding sound absorption material to the engines or re-engining the first generation Stage 1 aircraft. Most of the 23 airports were picked from a group of airports which had the highest number of operations and largest potentially impacted residential areas, excluding those thought not to have a noise problem and other special cases. The airport selection process was made such as to assure that each of the 23 airports would be able to contribute measurable changes in impact for the various alternatives. However, it is difficult to use this 23 airport study as a basis for a national model since the airport selection was not designed as a national sample.

A more economical approach than direct summation of results at individual airports is the use of one or more average airports (avports) where the operations are derived from national operations (or from subsets). This technique enables the modeling to be accomplished in as much detail as desired. However, it presents problems in defining "avport populations" and compatible land use areas, and cannot account directly for situations where flight tracks are designed to minimize potential noise impact. Most avport studies have been performed to answer specific questions (Refs. 6-8) and each study has involved direct computation using an aircraft noise computer model.

This study utilizes the avport approach, including all airports with scheduled air carrier operations in turbojet aircraft. The models were designed with regard to the seven factors governing noise impact, particularly assuring high correlation between the number of operations and the associated population at each airport.

3. DESCRIPTION OF THE NOISE IMPACT MODEL DESIGN

Overview

The Nationwide Airport Noise Impact Model (NANIM) estimates the areas, populations and housing values in the vicinity of U.S. airports with scheduled commercial jet operations. The model consists of a collection of computer programs and algorithms for sorting and calculating a variety of data to accomplish its function. The model is illustrated in a simplified block diagram in Figure 3.

The model contains a standard set of data files regarding individual airports, their surrounding demographics and their 1985 scheduled civil jet operations. The demographic data are contained in a concentric set of rings, each one mile wide, centered on the airport center. For the purpose of analysis, the nation's airports are subdivided into five categories which have similar size and aircraft fleet mix characteristics. The model contains a set of detailed L_{dn} contours for each category, and the areas within contour intervals which intersect each of the rings.

The model computes outputs for each scenario based on the fleet forecast for that scenario in 1990, 1995 and 2000. The model calculations use the 1985 Baseline noise contour areas and the change in these areas resulting from a change in the input fleet mix and size. The Area Equivalent Method (AEM) (Refs. 10 and 11) is used to determine the magnitude of the change associated with each fleet mix and size.

Airport Categories and 1985 Operations

The number of average daily operations at airports in this study ranges from less than one to more than one thousand. The fleet mix tends to vary with airport size, with small airports generally having predominately small two-engined aircraft and the largest airports having a complete fleet mix. Also, for a given airport size the fleet mix varies with the amount of long haul operations. For example, 747 aircraft operations are found predominately at airports with a high percentage of long haul operations.

In order to account for the changes of fleet mix with size and long haul operation, the airports have been subdivided into five categories - each represented by an avport. The categories are:

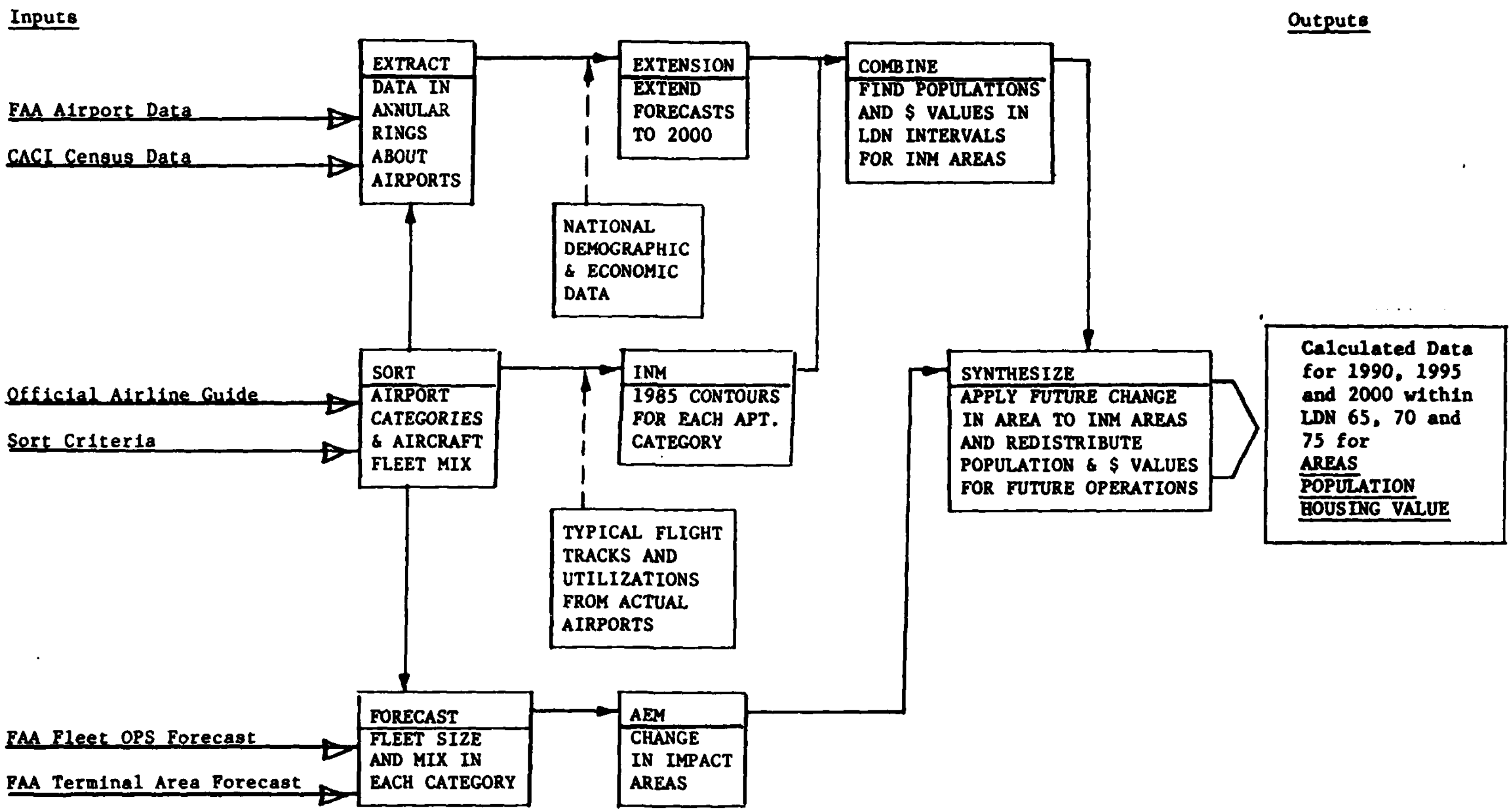


FIGURE 3. NATIONWIDE AIRPORT NOISE IMPACT MODEL FLOW DIAGRAM

- Large size Long-Range airports (LLR)
- Large size Medium-Range airports (LMR)
- Large size Short-Range airports (LSR)
- Medium size Short-Range airports (MSR)
- Small size Short-Range airports (SSR)

The criterion used for "airport size" is the number of operations (landings plus takeoffs) per annual average day. Large size airports were defined to have more than 100 operations per day, medium size airports between 10 and 100 operations per day, and small size airports have less than 10 operations per day.

The divisions between long-, medium- and short-range airports were based on the percentage of departures with stage lengths greater than 1,500 miles. The long-range category is defined to consist of airports with more than 15% long-range operations. Medium-range airports are defined to have between 5% and 15% long range departures and short-range airports to have less than 5%.

There are 6 airports in the long-range airport category, including JFK with 47% long-range and LAX, SFO, SEA, HNL and ANC. There are 22 airports in the medium-range category, including ORD, ATL, DEN, EWR, BOS and IAD. All of the airports in the long- and medium-range categories had more than 100 operations per day in 1985.

The subdivision of airports, based on this percentage of long-range operations, enables the model to account for the different types of aircraft that are most associated with long-range operations. Thus, for example, rather than spread the 747 operations across a large number of airports that have few or no 747 operations, they are concentrated in the fleet mix of the medium- and long-range category airports at which they operate.

Table 2 contains a summary of the airport categories. It also shows a breakdown by element within each category, based on number of operations. The number of operations within each category has a range of a factor of ten (e.g., 100-1000 operations). Each category is subdivided into four elements, each with a range in number of operations equal to the fourth root of 10 (or 2.5 decibels). This grouping of airports within elements enables closer association of the number of operations in each element with the actual populations associated with the airports within the element. This provides for the high correlation between population and number of operations at airports.

TABLE 2. NATIONWIDE AIRPORT NOISE IMPACT MODEL

Summary of Matrix of Airport Categories and Elements Indicating in Each Element the Number of Airports and the Percentage of Total Average Daily Jet Operations

Airport Size	Element	Range*					
		Short		Medium		Long	
		No. of Airports	Avg. Daily Ops.**	No. of Airports	Avg. Daily Ops.**	No. of Airports	Avg. Daily Ops.**
Large		Category LSR (40.60% Ops)***		Category LMR (36.14% Ops)		Category LLR (10.87% Ops)	
>100 Ops/day	1	5	628	7	791	1	789
	2	8	383	4	414	4	425
	3	11	275	6	262	-	-
	4	20	139	5	153	1	166
Medium		Category MSR (11.33% Ops)					
10-100 Ops/day	5	14	72				
	6	33	43				
	7	36	24				
	8	28	14				
Small		Category SSR (1.06% Ops)					
<10 Ops/day	9	29	8				
	10	21	4				
	11	8	2				
	12	6	1				

*Subdivision by range is based on the percentage of the departures that have a stage length greater than 1,500 miles. Short range is less than 5%, medium range is 5-15% and long range is greater than 15%.

**Actual average daily operations for the airports in element.

***Percent of total jet operations found in the category.

The nominal number of operations used by the model within each element is the geometric mean of the operations range for the element. For the large-size airport, element 1 has a range of 562 to 1,000 average daily operations. The geometric mean of this range is 750 average daily operations. For elements 2, 3 and 4 the geometric mean values are 422, 237 and 133, respectively. Similarly, the nominal number of operations for element 5, the highest element in the medium-size airport, is one-tenth that of element 1, or 75 operations. Finally, the nominal number of operations for the highest element (9) in the small-size airport is 7.5. These geometric mean values are a good representation of the actual values given in Table 2.

Table 2 also gives the percentage of total operations for each category. The majority of jet operations occurs at short- and medium-range airports with over 100 operations per day. The 6 large size long-range airports have 11% of the jet operations. The large airports with short- and medium-range airports account for 77% of jet operations, and the remaining 12% is distributed amongst 175 medium- and small-size airports. Medium- and small-size airports have different fleet mixes than larger airports; thus regulation strategies will not affect all the airport categories equally.

As a basis for this report the Official Airline Guide (OAG) schedules for the week of October 12, 1985 provided the primary input for aircraft mix and number of operations. It was supplemented by some additional data on package express operations. The data were sorted to place the inputs in the proper airport categories. The list of airports and their assignment to categories is contained in Appendix B. These OAG data were used to develop the airport category fleet mix by adding up all of the operations for each type aircraft in each airport category. The resulting fleet mixes are tabulated in Appendix D. The ground tracks and utilizations for the five avports were developed by reviewing similar data from ?9 airports. These definitions and the five avport contours are contained in Appendix C.

Airport Demographics

The FAA Landing Facility Data Base was accessed to obtain the coordinates of the airport centroids. These coordinates were used to define the center of the rings around each of the 247 airports for the purposes of obtaining demographic data. The rings are at one mile intervals and extend either 5 or

10 miles from the center, depending on the airport's size. The demographic data within each ring represents the total found within the ring. The average density within the ring gives a uniform angular distribution around the airport center for each ring, whereas the actual angular distribution is usually non-uniform, containing water, commercial or industrial areas where no population resides. This assumption of uniform angular distribution of demographic values will lead to similar results as those obtained with a non-uniform distribution of demographic values but with a uniform angular probability distribution for aircraft tracks. Thus, the results of these analyses may be conservative to the extent that aircraft tracks are tailored to areas which have the lowest population densities.

The census data for each airport obtained from the CACI, Inc.-Federal (CACI) data base included:

- 1980 population with CACI extensions to 1985 and 1990
- 1980 households with CACI extensions to 1985 and 1990
- 1980 average value of owner-occupied homes
- 1980 number of owner-occupied homes
- 1980 average rent of apartment units
- 1980 number of apartment units
- 1980 average value of owner-occupied condos
- 1980 number of owner occupied condos

These data were used to develop estimates of the population and the total value of housing units in 1980. These data were extended through the study period to the year 2000, using both the local trends in population and housing units through 1990 and other data on national demographic and economic trends (see Section 5 on Forecasting Methodology). All of these data were developed for each ring around each airport, then summed to obtain the total value for each airport category in each study year.

Base Noise Contours and Areas

The FAA Integrated Noise Model (INM) version 3.8 was used to develop 1985 baseline noise contours in 2.5 dB intervals for the avport that represents each airport category and its fleet mix. The use of 2.5 dB intervals enables the contour data to be scaled to match the nominal number of operations in each element within the category.

The tracks for the five avports were synthesized from an analysis of the tracks at 29 airports which had been previously documented, see Appendix C for details. The runway lengths for the main runway on each avport represent the average length of the longest runway at each airport within the category.

The small sized avport was assumed to have only one runway with traffic off both ends. The other four avports were assumed to have two runways with traffic off all four runway ends. The program was designed so that the added impact from the utilization of a second runway could be calculated from the results of a single main-runway contour, see Appendix C.

A few of the largest airports are designed with widely spaced parallel runways, with nearly one mile separation. This separation allows the airports to operate its parallels fairly independently with a significant increase of capacity. Because the flight tracks associated with these parallels are widely spaced, it is more appropriate to model them as two airports, each with one-half of the total operation and each located at its own "Airport Center". In this study six airports were found in this classification. They are ORD, ATL, LAX, JFK, DFW and MIA.

For each avport contour set the "L_{dn}-annular interval area" is determined to be the intersection of adjacent contours and rings. Figure 4 shows an illustration of the interval area between 65 and 67.5 dB within the 3 and 4 mile radius rings. These "L_{dn}-annular interval areas" were then multiplied by the various demographic values (e.g., population density) in the corresponding rings to obtain the amount of the demographic value (e.g., population) in the L_{dn} interval. For example, assume that the total area between L_{dn} 65 dB and L_{dn} 67.5 dB in the 3-4 mile ring is one-half square mile. Then assume that the population density in an element of the category and in this ring is 20,000 people. With these assumptions, the population in the interval L_{dn} 65-67.5 dB, 3-4 miles would be 20,000 x 1/2 = 10,000. The total population between L_{dn} 65 and 67.5 dB for the airport category is obtained by adding all of the populations in the interval L_{dn} 65-67.5 dB for all of the rings and all of the elements (4) in the category.

The interval areas are used directly to determine total contour area. However, the interval areas used to compute housing unit current dollar values and population have been adjusted to subtract out a modest runway area in which it is assumed no residences would exist. For this purpose the runway area for each avport was defined to equal the length of the avport's runways times 1,000 feet width (e.g., 500 feet each side of the runway).

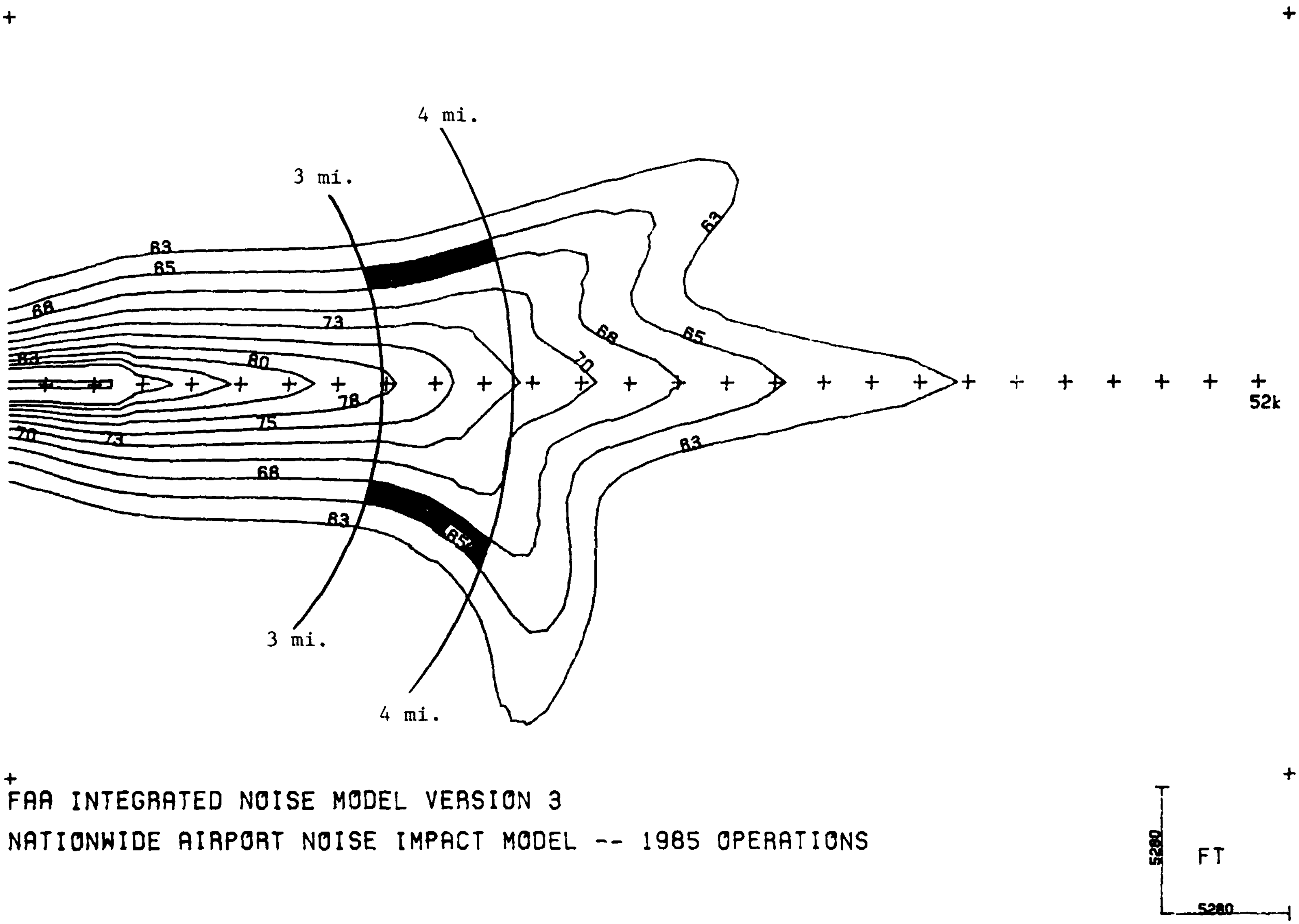


FIGURE 4. SHADED AREAS ILLUSTRATE THE AREA IN THE LDN INTERVAL 65 TO 67.5 dB WITHIN THE 3-4 MILE RING

4. INPUTS TO THE MODEL

A number of exogenous variables had to be entered into the model in order, first, to determine the size and shape of the contours, and, second, to measure the noise impact in terms of area, population, and property value affected.

Forecast of Operations

One of the major determinants of the size and shape of noise contours are the number of aircraft operations and the aircraft mix. Therefore, the first task was to derive forecasts of these variables for each of the five airport categories.

There are three major sources of information available for forecasting the number of operations by aircraft type for each of the five airport categories. The first is the FAA official forecast of departures by aircraft type through 1996 at the national level. The second is the Official Airline Guide (OAG) scheduled operations during the week of October 12, 1985. The third source, the FAA's Terminal Area Forecasts, made it possible to determine the growth in total air carrier operations in each of the airport categories.

The FAA official forecast was made for the baseline and the 1995 and 2000 phase-outs of Stage 2 aircraft. The FAA forecasts for the 1995 and 2000 phase-outs of Stage 2 aircraft recognized that an accelerated fleet change would result in increased costs to the air carrier industry. It was anticipated that these cost increases would be passed on to the traveling public in the form of higher fares. The imposition of higher fares would lead to a reduction of demand for air travel and consequently a reduction in the number of aircraft needed to provide the lift capacity. For example, if the fare increase were 10% and the elasticity of demand were -0.8, it would be expected that demand would be reduced by 8%.

The forecast approximates the probable trend of these consequences on annual revenue passenger miles (RPM's) by reducing the baseline RPM growth rate by 1 percentage point per year after 1988, and by allowing the average load factor to increase to 65% from the 63% assumed in the baseline. The result of these assumptions is an 8.3% reduction in RPM's in the forecast year of 1998 for both phase-out alternatives relative to the RPM's in the baseline case. As a result, the forecast number of operations is lower for the two phase-out cases than for the baseline case. In addition, the phase-out forecasts appear to account for the impracticality of immediately replacing all aircraft in the year of phase-out or in its anticipation. Consequently, the 1995 phase-out alternative has the smallest fleet in both 1990 and 1995 and the 2000 phase-out has the smallest fleet in 2000. These reductions of fleet size and operations associated with the phase-out alternatives account for only a small fraction of the associated impact reductions.

The following methodology was used to forecast operations out to the year 2000. The first step was to determine, from the OAG data base, the distribution of the operations for each broad aircraft type by airport category (Table 3). These percentages are assumed to remain constant over the forecast period and are then applied to the FAA official forecast of national operations by aircraft type to give forecasts for each airport category.

To better define the forecasted operations for each airport category, Terminal Area Forecast growth rates were applied to the total operations in each airport category and were then normalized to the forecast for operations for all airports. The forecasts for operations by broad aircraft category in each airport group were then adjusted to arrive at the expected total. Finally, forecasts of operations by broad aircraft category were then separated into operations by individual aircraft type.

For purposes of comparison with the April, 1986 "Report to Congress" (Ref. 1), tables for the approximate fleet composition used in this report are attached (Tables 4, 5 and 6). These data are calculated from the FAA official forecast of departures by using a constant number of operations per aircraft type appropriate to the mid-1990's. The departure operations data from the forecast that was used to derive the results in this report and further details of the methodology related to operations are contained in Appendix D.

Forecast of Population

The method of determining the area lying within each set of contours was described in Section 3. The next measure of noise impact is the number of people living within these contours.

TABLE 3

DISTRIBUTION OF FLEET MIX BY AIRPORT AND AIRCRAFT TYPE CATEGORIES

1985

Aircraft Type[1] Category	Airport Category LLR	LMR	LSR	MSR	SSR	Total
Long Range/SSC	87.50%	12.50%	-	-	-	100.00%
Long Range / A[2]	55.00	40.00	5.00%	-	-	100.00
Long Range / B	48.98	33.91	16.88	0.23%	-	100.00
Long Range / C	75.21	24.79	-	-	-	100.00
Long Range / D	9.29	63.48	19.65	5.44	2.14%	100.00
Category Total	46.30	38.80	12.87	1.49	0.54	100.00
Medium Range/A	8.64	39.96	41.20	9.97	0.23	100.00
Medium Range/B	17.04	53.12	29.49	0.35	-	100.00
Category Total	9.29	40.97	40.30	9.22	0.22	100.00
Short Range / A	16.58	53.90	28.39	1.13	-	100.00
Short Range / B	16.10	37.72	40.56	5.41	0.21	100.00
Short Range / C	5.90	31.64	45.76	14.87	1.83	100.00
Short Range / D	15.06	24.22	32.54	24.14	4.04	100.00
Category Total	8.35	32.48	43.66	13.81	1.70	100.00
TOTAL	10.87	36.14	40.60	11.33	1.06	100.00

[1] Aircraft assigned to categories are identified in Table D-1 on page D-5.

[2] Estimated. No 1985 data available.

Source: Official Airline Guide, October, 1985.

TABLE 4

FLEET MIX FOR 1985, 1990, 1995, and 2000

Baseline

	1985	1990	1995	2000
Stage 2				
DC-8-50/61	9	-	-	
DC-8-62/63	36	38	19	3
DC-9-10	91	42	13	4
DC-9-30/50	390	359	268	149
B707	27	45	22	-
B727-100	343	115	44	18
B727-200	854	784	576	317
B737-100/200	401	401	327	235
B747 SP	13	12	12	8
B747-100	13	13	6	2
B747-200	108	114	96	67
BAC-111	37	-	-	-
F-28	33	43	39	28
	2,355	1,936	1,422	831
Stage 3				
MD-80	147	365	386	386
MD-87	-	15	22	22
MD-89	-	-	-	-
MD-150	-	-	85	206
MD-120	-	-	70	150
DC-8-70	77	86	86	53
DC-10-10/30/40	175	183	157	101
MD-11	-	6	25	25
L-1011	111	117	107	74
A-300	42	50	51	45
A-310	3	22	23	23
A-320	-	16	73	74
A-330	-	-	3	9
A-340	-	-	14	36
F-100	-	14	30	30
BAE-146	22	47	47	47
B737-300	38	392	446	456
B737-400/500	-	62	121	121
B747-200[1]	27	29	29	29
B747-300/400	-	24	88	163
B757	36	149	210	293
B767	56	136	327	526
B7J7	-	-	167	611
	734	1,713	2,567	3,480
GRAND TOTAL	3,089	3,649	3,989	4,311

[1]Based on "Report to Congress" estimate of Stage 3 747-200's.

TABLE 5

FLEET MIX FOR 1985, 1990, 1995, and 2000

1995 Phase-Out

	1985	1990	1995	2000
Stage 2				
DC-8-50/61	9	-	-	-
DC-8-62/63	36	38	-	-
DC-9-10	91	9	-	-
DC-9-30/50	390	319	-	-
B707	27	45	-	-
B727-100	343	33	-	-
B727-200	854	678	-	-
B737-100/200	401	338	-	-
B747 SP	13	12	3	-
B747-100	13	12	1	-
B747-200	108	94	12	-
BAC-111	37	-	-	-
F-28	33	25	2	-
	2,355	1,603	18	-
Stage 3				
MD-80	147	381	436	436
MD-87	-	21	39	39
MD-89	-	-	-	-
MD-150	-	-	123	231
MD-120	-	-	134	246
DC-8-70	77	86	86	52
DC-10-10/30/40	175	183	161	99
MD-11	-	6	31	34
L-1011	111	117	107	74
A-300	42	50	51	43
A-310	3	22	23	23
A-320	-	20	96	98
A-330	-	-	3	9
A-340	-	-	18	48
F-100	-	23	47	47
BAE-146	22	47	47	47
B737-300	38	415	519	519
B737-400/500	-	80	181	181
B747-200[1]	27	29	29	29
B747-300/400[2]	-	26	145	205
B757	36	154	246	341
B767	56	138	340	539
B7J7	-	-	248	756
	734	1,798	3,110	4,096
GRAND TOTAL	3,089	3,401	3,128	4,096

[1]Based on "Report to Congress" estimate of Stage 3 747-200's.

[2]Some of these aircraft are probably retrofits of the Stage 2 747-200's and 747-SP's.

TABLE 6

FLEET MIX FOR 1985, 1990, 1995, and 2000

2000 Phase-Out

	1985	1990	1995	2000
Stage 2				
DC-8-50/61	9	-	-	-
DC-8-62/63	36	38	19	-
DC-9-10	91	25	4	-
DC-9-30/50	390	352	204	-
B707	27	45	22	-
B727-100	343	58	-	-
B727-200	854	755	405	-
B737-100/200	401	375	198	-
B747 SP	13	12	12	-
B747-100	13	13	5	-
B747-200	108	114	96	-
BAC-111	37	16	-	-
F-28	33	43	23	1
	2,355	1,782	988	1
Stage 3				
MD-80	147	363	384	384
MD-87	-	15	25	25
MD-89	-	-	-	-
MD-150	-	-	83	233
MD-120	-	-	73	163
DC-8-70	77	86	86	53
DC-10-10/30/40	175	183	157	100
MD-11	-	5	22	22
L-1011	111	117	107	75
A-300	42	50	51	44
A-310	3	22	23	23
A-320	-	16	66	68
A-330	-	-	3	9
A-340	-	-	13	33
F-100	-	14	30	30
BAE-146	22	47	47	47
B737-300	38	387	442	452
B737-400/500	-	58	116	116
B747-200[1]	27	29	29	29
B747-300/400[2]	-	19	76	220
B757	36	149	211	297
B767	56	135	324	496
B7J7	-	-	170	633
	734	1,695	2,538	3,552
GRAND TOTAL	3,089	3,477	3,526	3,553

[1] Based on "Report to Congress" estimate of Stage 3 747-200's.
[2] Some of these aircraft are probably retrofits of the Stage 2 747-200's and 747-SP's.

Population data for 1980, 1985 and 1990 were provided by CACI, Inc.-Federal[1]. Forecasts for 1995 and 2000 are made on the basic assumption that the individual local growth ratios for each airport were proportional to the nationally predicted rates as provided by the Bureau of the Census and to local conditions. U.S. Bureau of the Census produces an "official" population forecast for the nation periodically; the current forecast is shown in Table 7. From this table it is possible to derive ratios between the national population in a year and the population five years previously. Similarly, the CACI data can be made to yield local ratios of the population in each of their rings for 1985 with respect to 1980, and for 1990 with respect to 1985. These CACI local ratios were then normalized by the corresponding national growth ratios and the average of these two ratios was then used to forecast population in CACI rings for years beyond 1990. For example, to obtain the 1995:1990 local growth ratio the following formula would be used:

Estimated 1995:1990 population ratio =

$$\frac{\dfrac{\text{Local Ratio 1985:1980}}{\text{Nat'l Ratio 1985:1980}} + \dfrac{\text{Local Ratio 1990:1985}}{\text{Nat'l Ratio 1990:1985}}}{2} \times \text{Nat'l Ratio 1995:1990.}$$

Forecasting Housing Units and Values

The procedure used to forecast numbers of housing units and their value is similar to that used in forecasting population. An example of the CACI housing data for 1980 is shown on page G-5.

The U.S. Bureau of the Census makes forecasts of households, but not of housing units, although the Census Bureau does count the current number of housing units (Table 8). By assuming that the number of housing units equals the number of households, it is possible to forecast the number of housing units in each CACI band, beyond 1990, by using the "ratio of ratios" technique for the years beyond 1990. That is to say the average of the ratio of the local 1985:1980 ratio to the national 1985:1980 ratio and the local 1990:1985 ratio to the national 1990:1985 ratio is applied to the national ratio for the years beyond 1990.

---

[1] See Appendix F for their methodology.

TABLE 7

NATIONAL POPULATION FORECAST

	Population (000)	Absolute Change	% Change	Ratio
1980	226,546			
		12,085	5.33%	1.053
1985	238,631			
		11,026	4.62	1.046
1990	249,657			
		9,902	3.97	1.040
1995	259,559			
		8,396	3.23	1.032
2000	267,955			
		15,283	5.70	1.057
2010	283,238			

Assumptions: Lifetime births per woman: 1.9

Life expectancy at birth, 2080: 81.0

Net immigration: 450,000

Source: <u>Projections of the Population of the United States by Age, Sex, and Race, 1983-2080</u>. (Middle Series), U.S. Department of Commerce, Bureau of the Census, P-25 Series. (Ref. 12)

TABLE 8

U.S. CENSUS BUREAU FORECASTS OF POPULATION, HOUSEHOLDS AND HOUSING UNITS
(thousands)

	Population	Households	Housing Units
1980	226,546	80.776	88,411
1985	238,631	86,789	94,992
1990	249,657	94,227	103,133
1995	259,559	100,308	109,789
2000	267,955	105,933	115,946

Source: Population: Projections of the Population of the United States by Age, Sex and Race, 1983-2080. (Middle Series) (Ref. 12)

Housing Units: 1983 Annual Housing Survey, H-150-83, Part A. Projected at rate forecast for households. (Ref. 13)

The values of housing units are also calculated by the Bureau of the Census, but only for each decennial census year. No forecasts are made. However, it is possible to obtain a history of the sales prices in current dollars of existing single-family houses, from the National Association of Realtors, and of median rents, from the Census Bureau. There is only a short history of the values of condos. The values of single-family houses were projected directly, but the values of rental apartments and condos were forecast by making projections using the E. H. Boeckh building cost index for apartments, hotels and offices (see Appendix G for details). To obtain local values in each element, a weighted average was calculated from the CACI data for 1980. To calculate 1985 values the 1980 weighted average value for each of the three types of housing was multiplied by the actual national 1985:1980 ratio and the three weighted values were summed and multiplied by the forecast for total housing units. Beyond 1985 the national ratios were then projected for existing single-family houses and for the E. H. Boeckh index. Property values were first forecast in current dollars and then converted to constant 1985 dollars.[1] Details of this methodology are set forth in Appendix G.

[1] See footnote on page 6.

5. DISCUSSION OF RESULTS AND COMPARISONS

This section summarizes the principal results of this study for the three scenarios: baseline, 1995 limit and 2000 limit. It also gives comparisons of these results with those from other studies. The detailed results are presented in Appendix A in a series of standard tables for each scenario for each study year, and additional comparative data may be found in Appendix H.

Results

The results for the 1985 Baseline are given in Table 9 which contains the estimates of area, population and housing stock value for each of the five "avports" and the totals for the category. For each attribute, data are given for the total amount of the attribute that was estimated to be within the bounding L_{dn} contour. Thus the value of total population of 3,220,000 in "greater than 65" includes all of the population within L_{dn} 65 dB.

Housing unit value is given in both current year dollars and constant 1985 dollars. The latter include forecast increases in unit value based on size, quality and other factors, but assumes that the dollar retains its 1985 purchasing power. The former (current dollars) includes all contained in constant dollars plus inflation.

Figure 5 illustrates the population and area data from Table 9 for the 1985 baseline and L_{dn} 65 dB. The majority of the population is clearly in the large size medium- and short-range airport categories, as are the majority of operations. The land area is somewhat less concentrated in these two categories, with a relatively greater amount in the medium size medium-range airports. This difference results from the lower value of population density at the medium size airports. Conversely, the area for the large long-range airport category is relatively smaller than its share of population. This results from the high population density near many of those airports. Similar comparative results are obtained for total housing value versus area as shown in Figure 6.

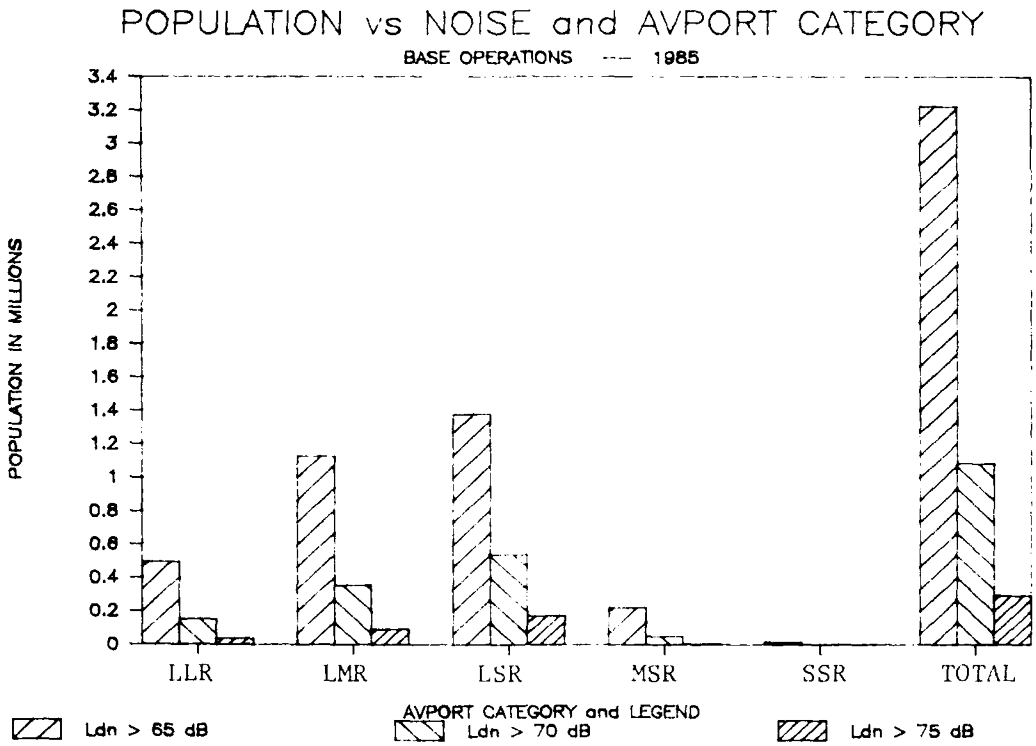
Figure 7 shows the estimated change with time for the population and area within the L_{dn} 65 dB contours. For population, the 1995 limit scenario begins to reduce the total values in 1990 relative to those of both the baseline and the year 2000 limit. In 1995, the 1995 limit scenario produces

TABLE 9.

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

BASE OPERATIONS -- 1985

LDN	AVPORT CATEGORY LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	TOTAL
	AREA IN SQUARE STATUTE MILES:					
>75	23	66	83	49	10	231
>70	59	172	225	126	18	600
>65	143	418	518	315	38	1432
	POPULATION IN THOUSANDS:					
>75	32	87	168	4	0	291
>70	149	352	536	45	1	1083
>65	491	1124	1376	218	11	3220
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	1	2	4	0	0	7
>70	5	8	12	1	0	26
>65	15	25	30	5	0	75
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	1	2	4	0	0	7
>70	5	8	12	1	0	26
>65	15	25	30	5	0	75



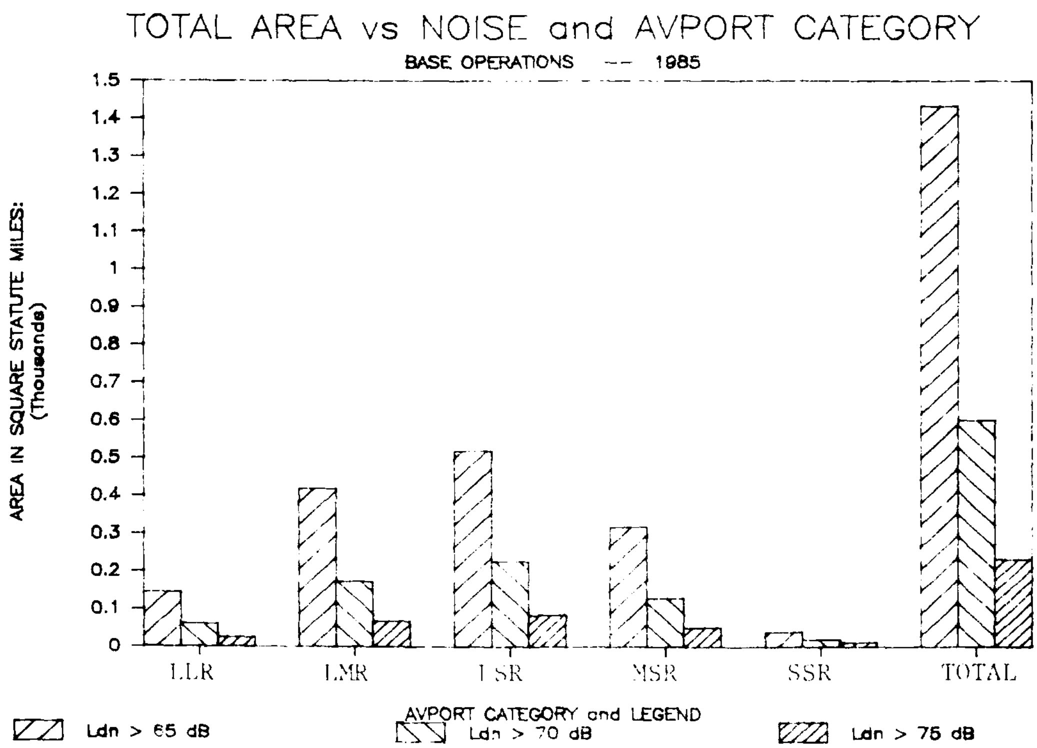
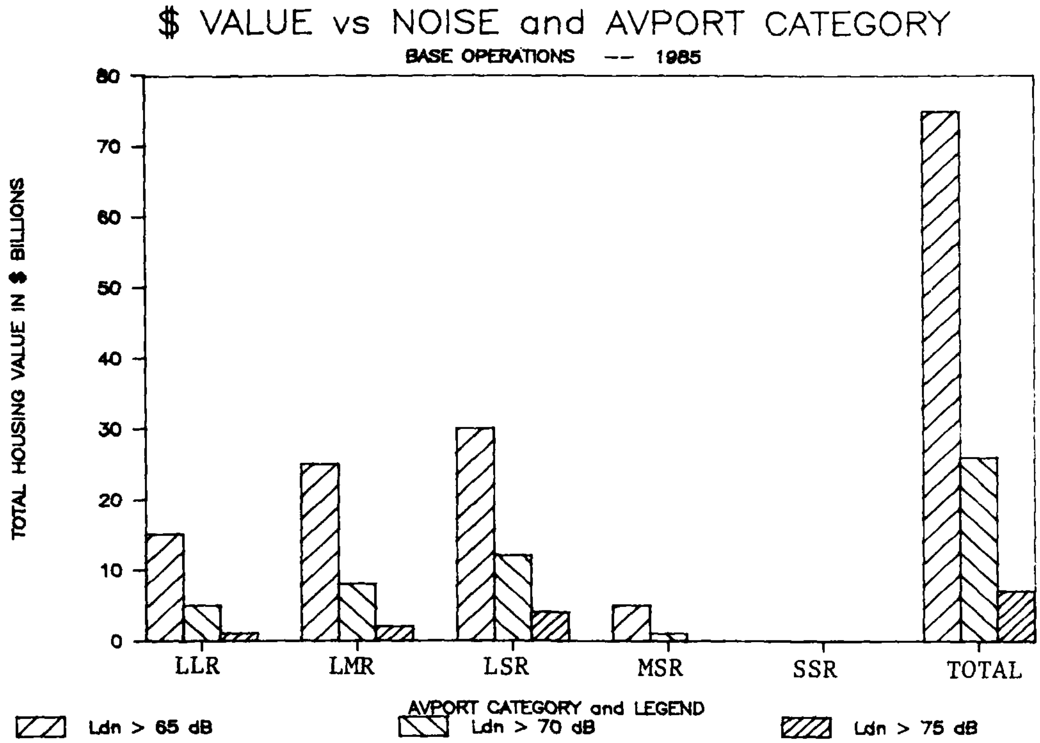


FIGURE 5. ESTIMATED POPULATION AND AREA FOR THE 1985 BASELINE



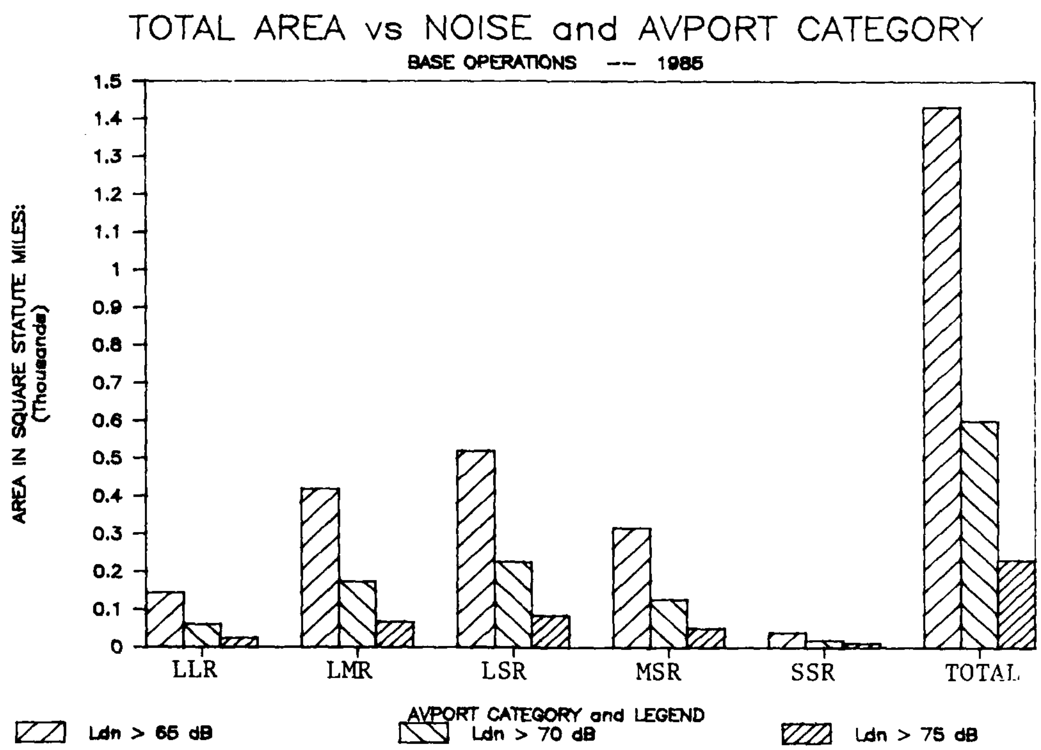
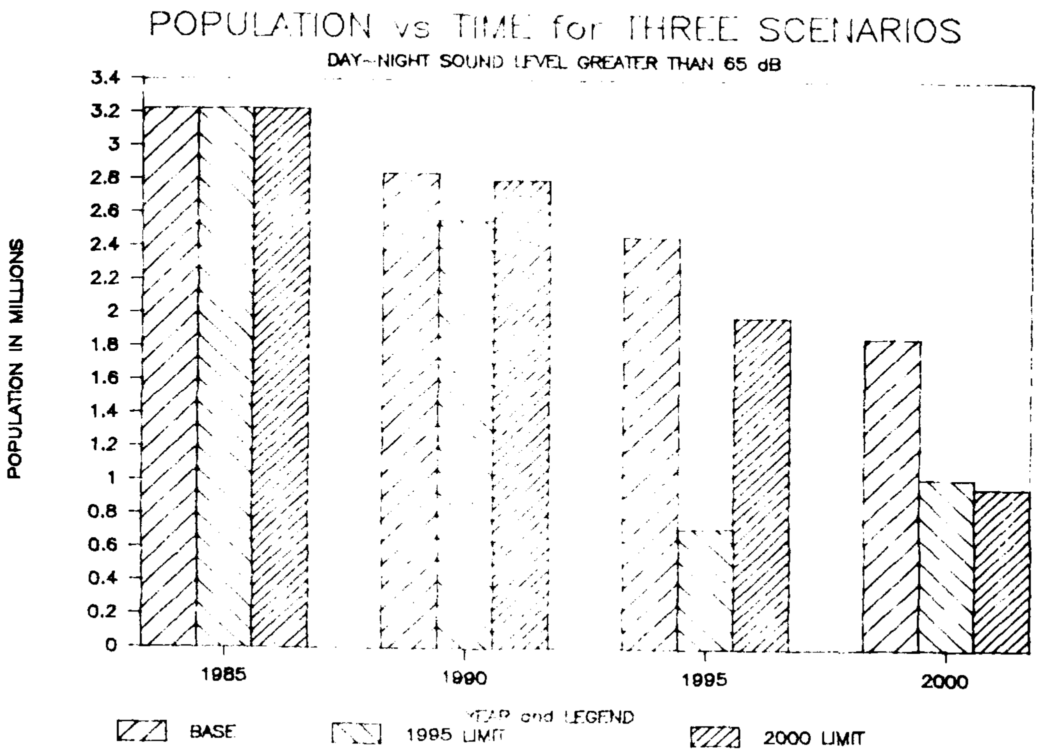


FIGURE 6. ESTIMATED HOUSING UNIT VALUE (IN CONSTANT 1985 DOLLARS) AND AREA FOR THE 1985 BASELINE



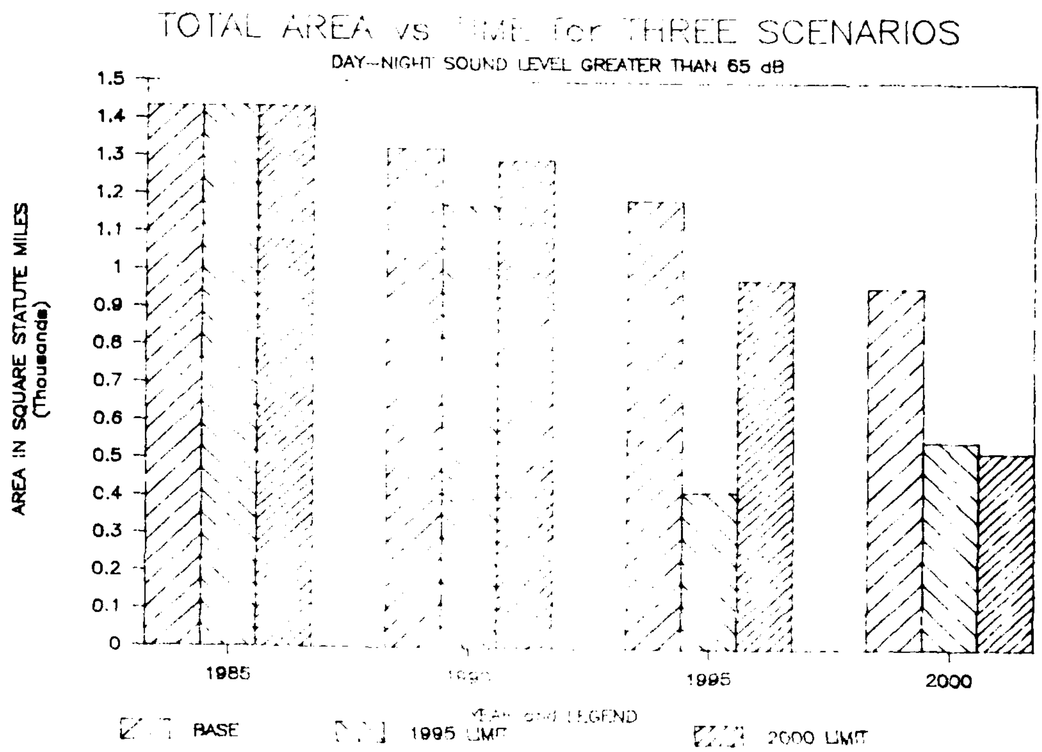


FIGURE 7. [illegible] POPULATION AND AREA EXPOSED TO [illegible]

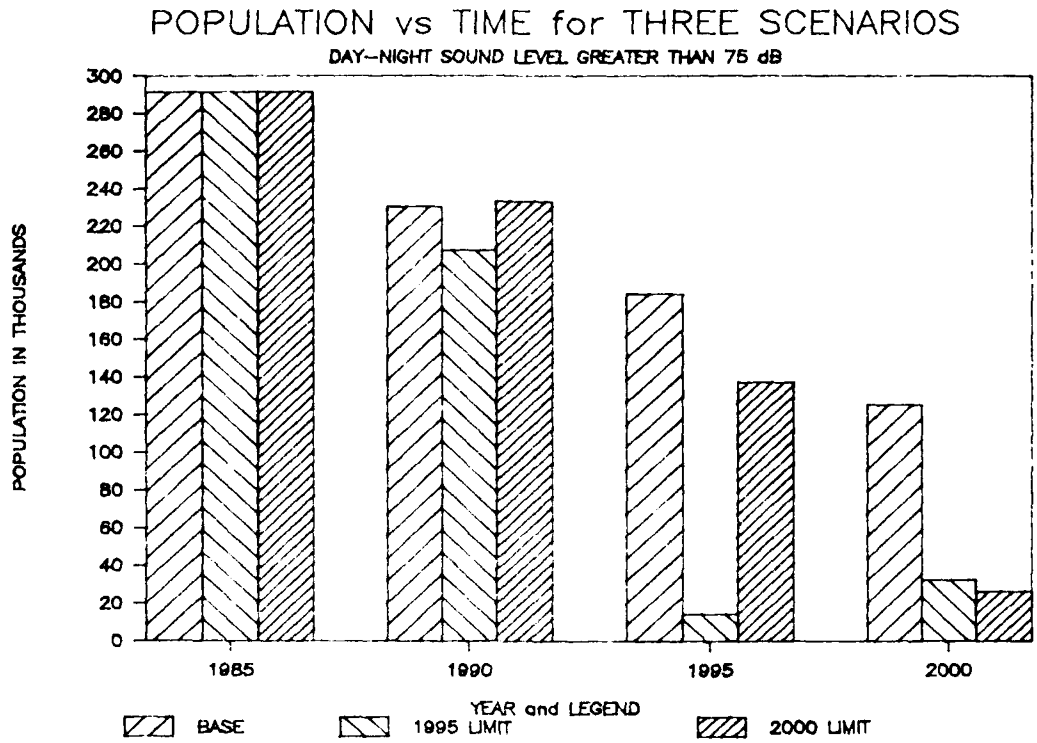
a dramatic reduction in population and the 2000 limit scenario exhibits some reduction relative to the 1995 baseline. In the year 2000, both limit scenarios show approximately the same result, a reduction of population by about 47% from the 2000 Baseline, 69% from the 1985 Baseline. The results for the areas within the L_{dn} 65 dB contours are similar to those for populations.

Figure 8 shows the same information as that in Figure 7 but within a L_{dn} 75 dB contour. The principal difference is that the decrease in population and to a lesser extent, area, is somewhat greater than that found within L_{dn} 65 dB contour. This is partly due to the fact that, as the 75 dB contour shrinks towards the airport, the area it encompasses has increasingly less population density.

Figure 9 presents the results for the estimated total housing unit value in constant 1985 dollars for both L_{dn} 65 dB and 75 dB. Again as with the case of the population, the total relative reductions are greater for the 75 dB contour than for the 65 dB contour.

Comparisons

Comparison of these results with those of past studies gives an indication of the stability of noise impact analyses and of the associated degrees of uncertainty. However, no two studies are alike in many of their major assumptions and premises. For example, past studies used an earlier noise metric, the Noise Exposure Forecast (NEF) (Ref. 5) for computing cumulative noise level. It has some similarity to the L_{dn} but has a different frequency weighting and contains a penalty for discrete tonal sounds. Other factors contributing to uncertainties in such comparisons include the projection of aircraft operations to the base year (1985) both for the nation and for individual airports, the national and airport fleet mix by aircraft type, the noise versus distance functions for "new" aircraft, the algorithms for computation in the noise models, operating procedures, flight tracks and day/night operations ratios. Similarly, the projection of population growth in specific potential impact areas around airports gives additional uncertainty in comparisons amongst studies. Yet, despite the potential difficulties these factors pose, the comparisons show generally good agreement for areas and populations associatd with L_{dn} 65 dB, and



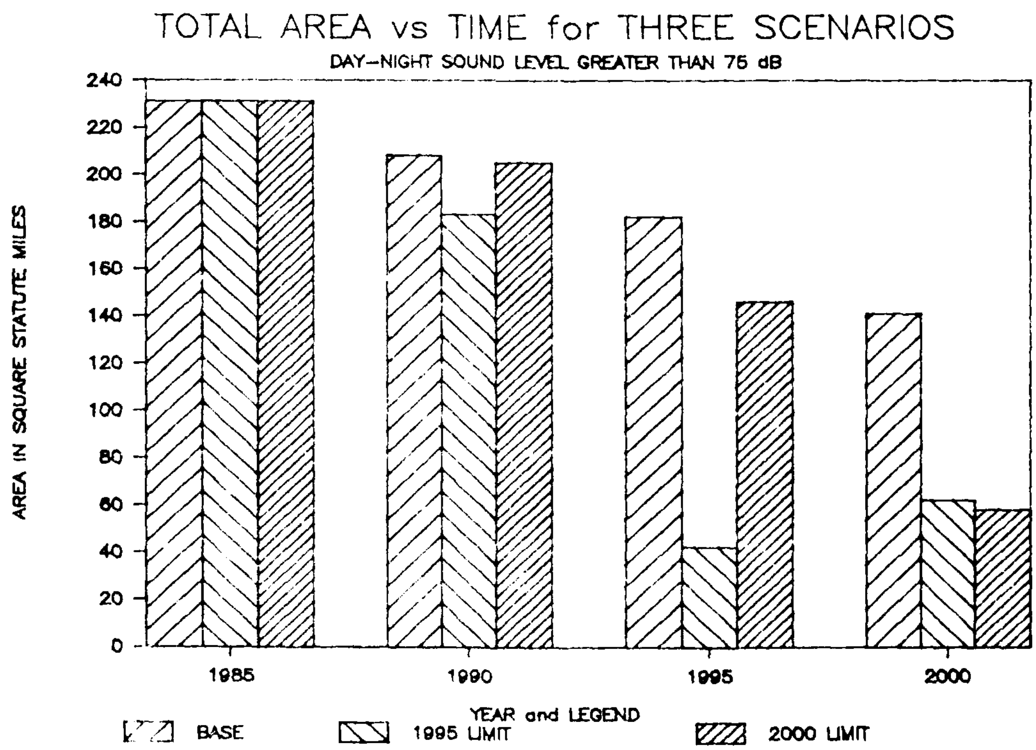
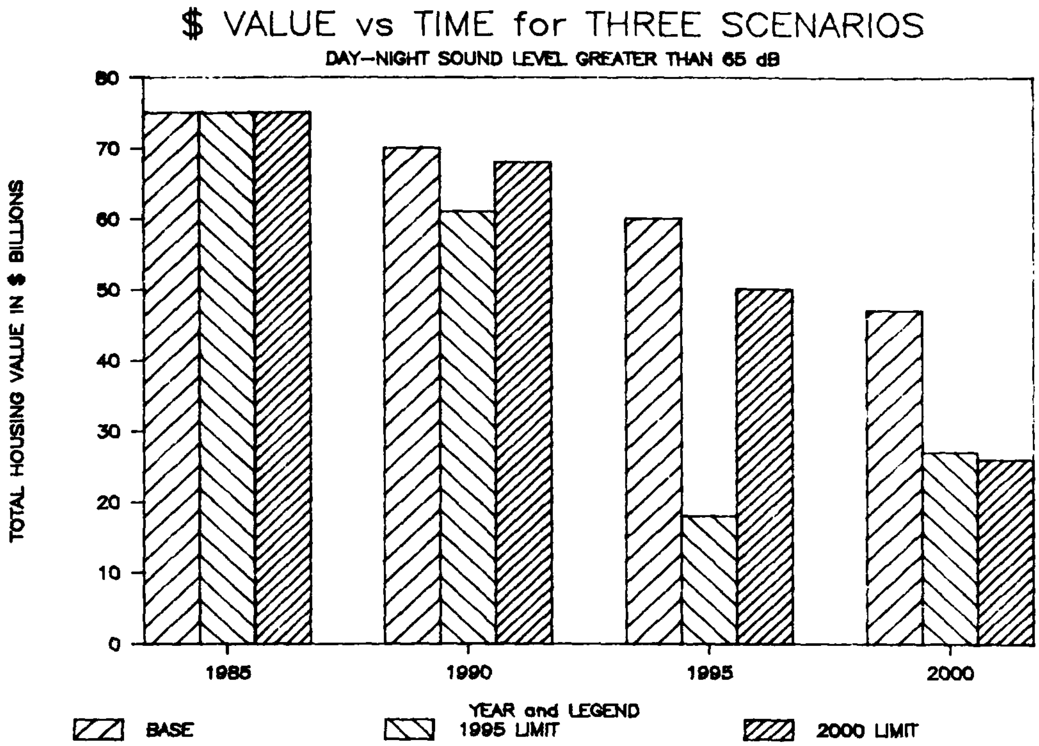


FIGURE 8. ESTIMATED POPULATION AND AREA EXPOSED TO L_{dn} 75 dB OR MORE
(Repeat of FIGURE 2)



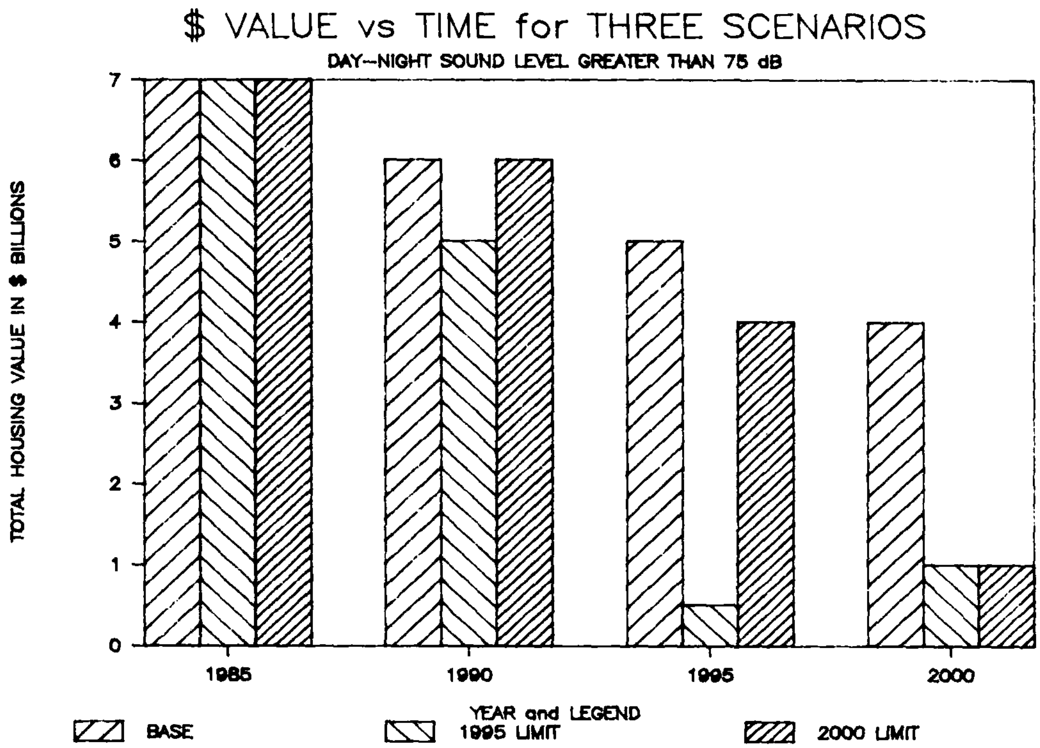


FIGURE 9. ESTIMATED HOUSING UNIT VALUE (IN CONSTANT 1985 DOLLARS) EXPOSED TO L_{dn} 65 dB OR MORE

combine to make a consistent story of the change of noise impact around the nation's airports with time.

In 1971 a joint Department of Transportation-National Aeronautics and Space Administration (DOT-NASA) study (Ref. 14) estimated that the area within the NEF 30 contours (approximately equivalent to the L_{dn} 65 dB noise contour) was 1450 square miles. In its Report to Congress on Noise (Ref. 15), the Environmental Protection Agency (EPA) estimated that about 7.5 million people were impacted within that contour. This number was based on multiplying 1,450 square miles by the average urban population density of 5,000 people per square mile.

These and other estimates of aircraft noise impact (Refs. 6-9 and 16) during the 1970's put the maximum number of people living within NEF 30 (L_{dn} 65 dB) at between 5 and 7.5 million for the early to mid-1970's.

All evidence indicates that this estimate of 5 to 7.5 million people was the maximum value for the nation as a whole and that significant reductions in that national number have been achieved. However, the amount of reduction achieved varies amongst the airports. Some have benefited considerably from the elimination of the first generation Stage 1 turbojet aircraft and their replacement with quieter Stage 2 or 3 aircraft. Other airports, which may have had few operations of the earliest turbojet aircraft, have been subjected to high growth in operations, principally with Stage 2 aircraft. This high growth of operations continued to increase their total cumulative noise. For these airports the time of maximum noise impact occurred later than for the older large long-range and large medium-range airports.

In 1972 DOT began a comprehensive study of the potential changes of noise impact from combinations of a variety of operating and aeronautical changes. The study was based on noise contours developed at 23 airports for each of the scenarios. The 23 airports were generally picked from those thought to have a large potential impact because of the size of the airport operation and the size and proximity of its neighboring population. One of the scenarios involved bringing all of the Stage 1 aircraft into Stage 2 compliance by the end of 1978 through the addition of Sound Absorption Material (SAM) to the engine nacelles. Figure 10 presents the estimated population residing within the NEF 30 (L_{dn} 65 dB) contour as a function of time. Figure 11 gives similar data for land area. The NANIM 1985 base case

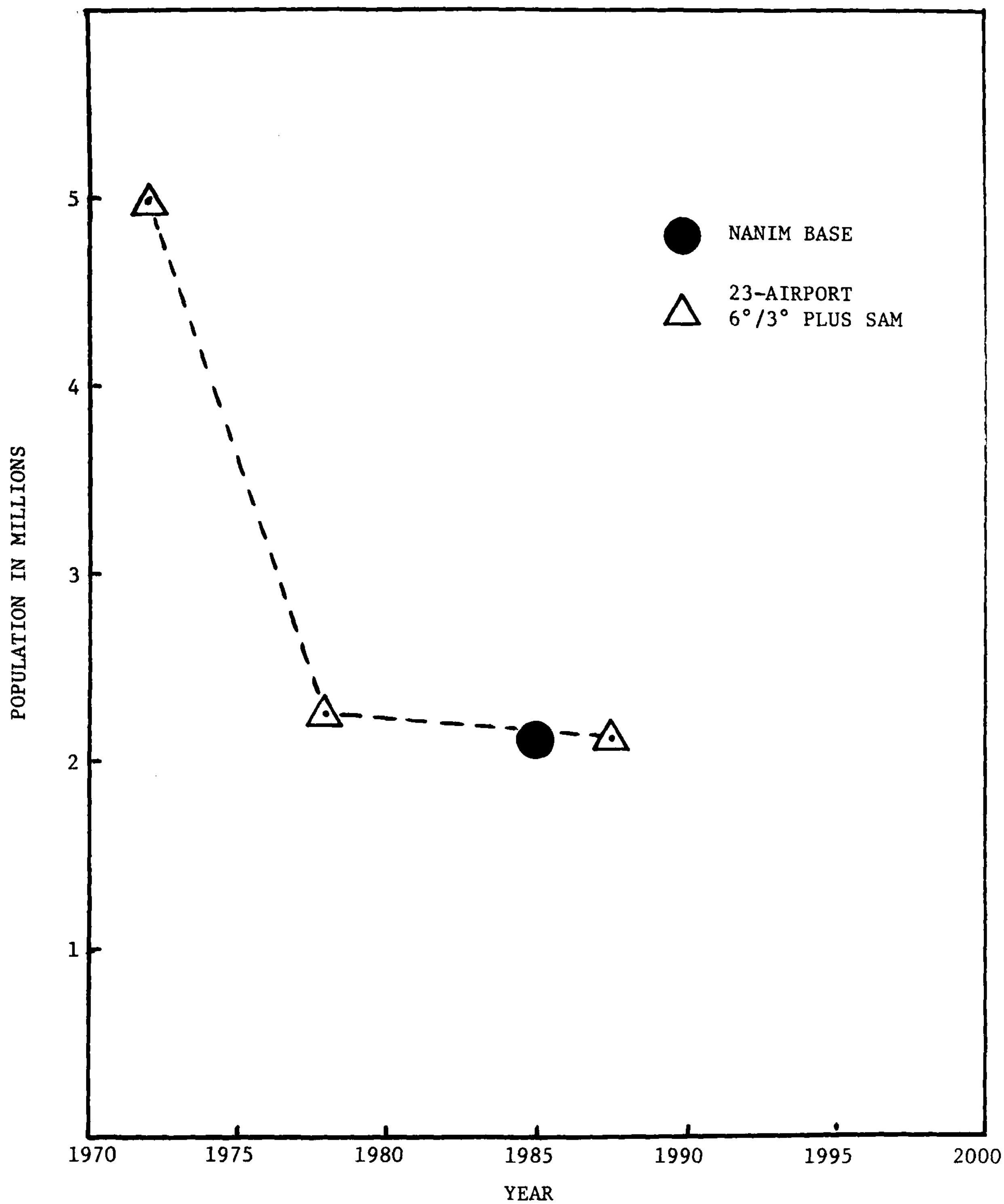


FIGURE 10. POPULATION AT 23 AIRPORTS ESTIMATED TO RESIDE WITHIN NEF 30 GIVEN A 6°/3° APPROACH GLIDE SLOPE USING JT8D AND JT3D ENGINE NACELLES RETROFITTED WITH SOUND ABSORPTION MATERIAL (SAM) IN 1978 VS. POPULATION WITHIN THE NANIM BASE L_{dn} 65 dB NOISE CONTOURS

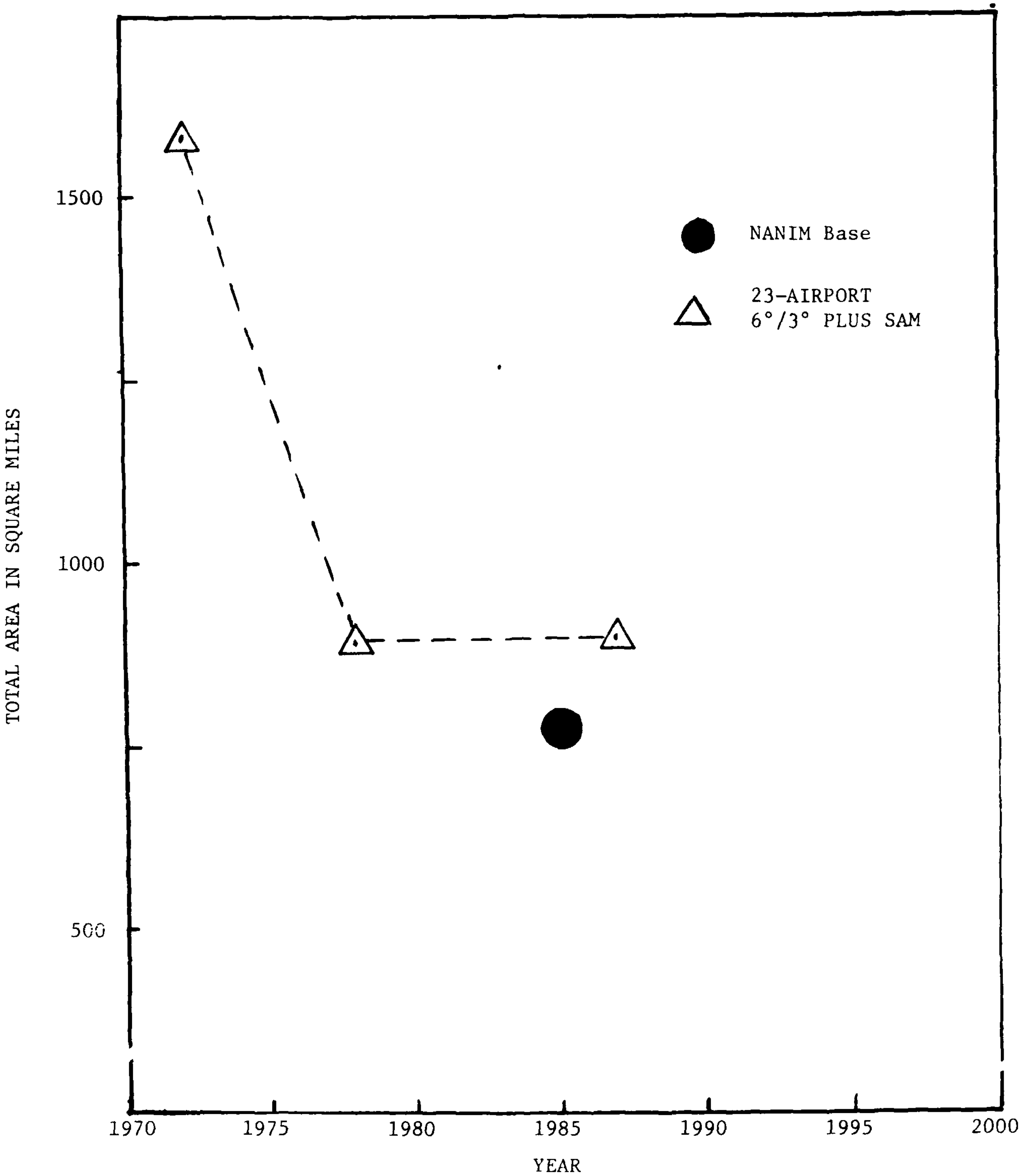


FIGURE 11. LAND AREA AT 23 AIRPORTS ESTIMATED TO BE INSIDE NEF 30 GIVEN A 6°/3° APPROACH GLIDE SLOPE USING JT8D AND JT3D ENGINE NACELLES RETROFITTED WITH SOUND ABSORPTION MATERIAL (SAM) IN 1978 VS. POPULATION WITHIN THE NANIM BASE L_{dn} 65 dB NOISE CONTOURS.

estimated total population and area for these specific 23 airports are illustrated and show reasonably agreement with the 23 airport forecast, despite vast differences in methodology.

Also, the L_{dn} 65 dB baseline data in this study for the years 1985-2000 compare closely to the results of two EPA studies of the noise impact to the year 2000. These studies (Ref. 7 and 8), were made during the late 1970's and were both based on NEF. The EPA studies used four avports to represent the nation's airports and estimated population based on the population/area functions from the 23 airport study (Ref. 5). The second study was a refinement of the first using the same avport area results but adjusting the populations to be more nearly reflective of actual population densities at airports other than the 23 airports. Comparable estimates for the 1985 population and area within L_{dn} 65 dB are:

TABLE 10.

COMPARISON OF BASELINE POPULATION AND AREA WITHIN LDN 65 dB

Source	Population (thousands)	Area Sq. Mi.
EPA Year-2000 (Ref. 7)	3,775	1,397
EPA Year-2000 Refined (Ref. 8)	2,523	1,344
Current NANIM	3,220	1,432

Figures 12 and 13 show the EPA area and population results over the period 1975-2000 in comparison with those in the current study for the period 1985-2000

This close agreement between NANIM results and those of earlier studies is probably fortuitous. However, it does indicate that reasonable comparability can be found between studies of this nature (see Appendix H for additional detail). This fact brings improved confidence in the utility of the results to forecast relative changes in noise impact as a function of regulatory strategy.

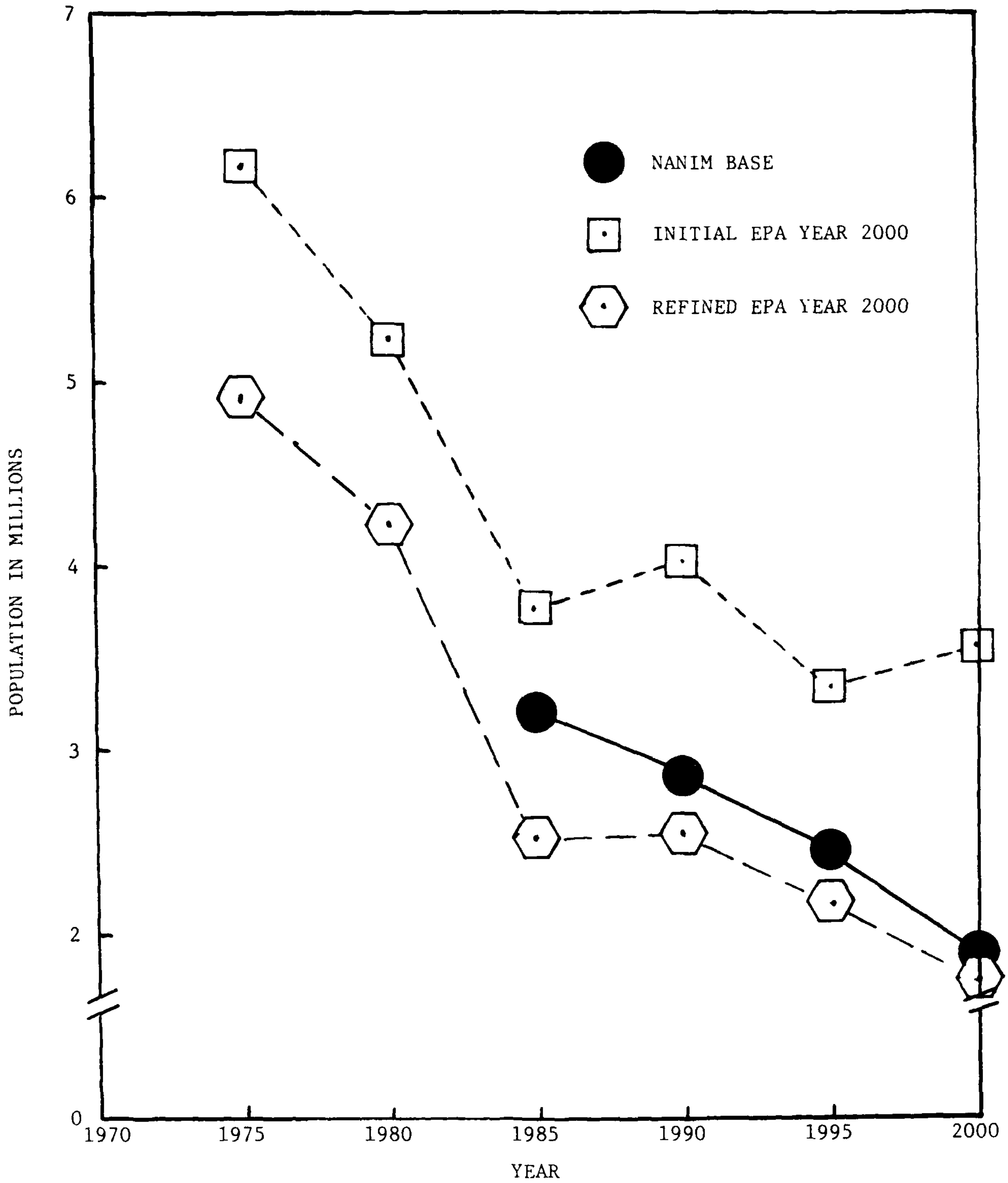


FIGURE 12. COMPARISON OF THE ESTIMATED POPULATION WITHIN L_{dn} 65 dB (RESULTS FROM THE ORIGINAL AND REFINED EPA YEAR 2000 STUDY WITH THE LAND WITHIN NANIM BASE L_{dn} 65 dB).

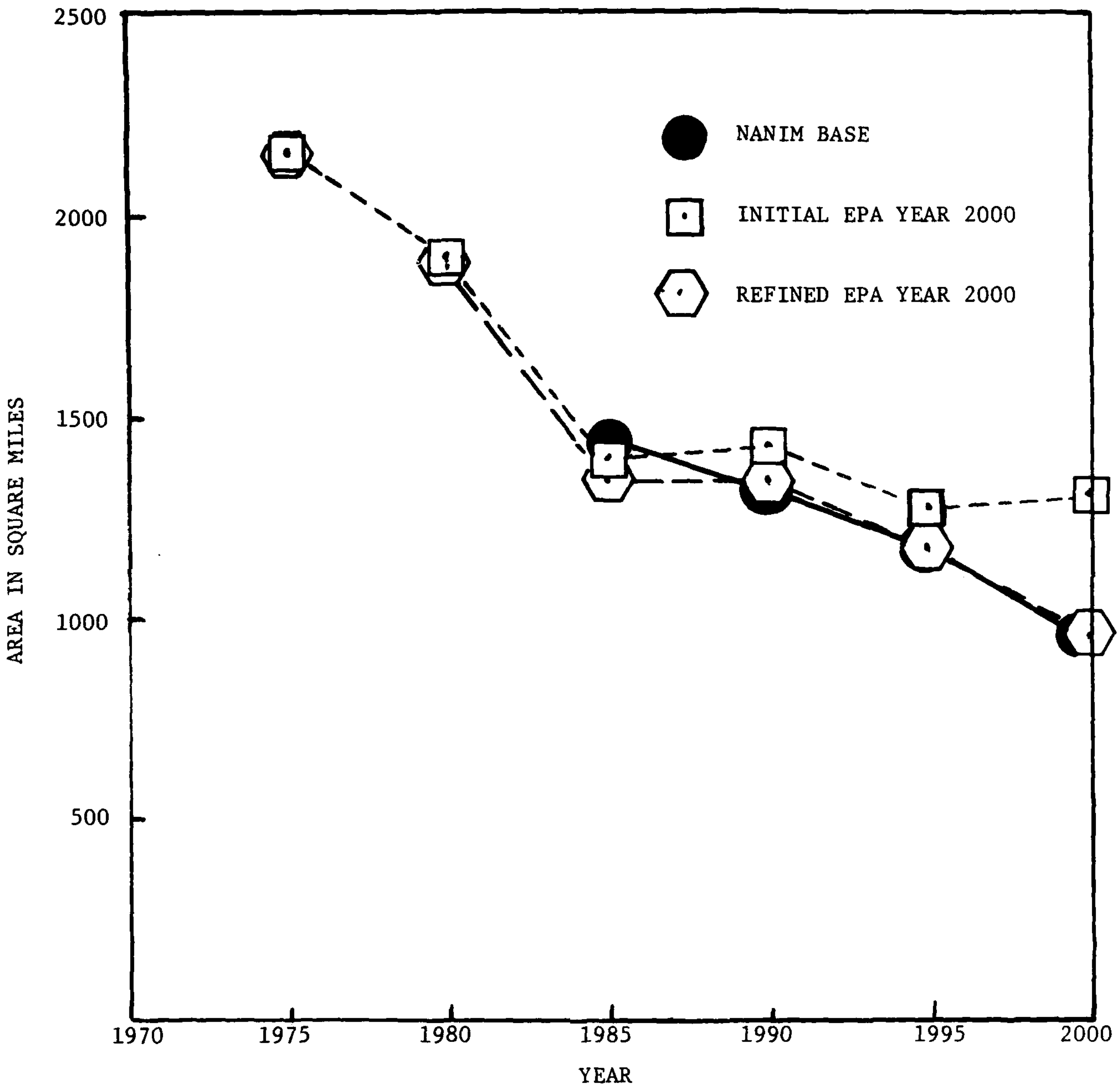


FIGURE 13. COMPARISON OF THE LAND AREAS FOUND BY THE INITIAL AND REFINED EPA YEAR 2000 STUDY WITH THE LAND WITHIN NANIM BASE L_{dn} 65 dB NOISE CONTOURS.

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APPENDIX A

TABULATED RESULTS FOR THE THREE SCENARIOS

This appendix contains 14 tables which contain the principal results of the study in terms of the three measures of the estimated magnitude of potential impact within the Day-Night Sound Levels (LDN) of 65, 70 and 75 dB:

- Total Area in Square Miles
- Total Population
- Total Housing Unit Value in both Current and Constant 1985 Dollars

Each table contains these data by Avport category for a specific scenario and year. Also included are tables which give the calculated values for static operations, i.e., the aircraft operations and potentially impacted areas are held constant, while the population and housing values are calculated for the indicated study year. In this manner the "static operations" results reflect only the changes in the demographic data with time with the noise held constant at its 1985 value.

The tables are arranged as follows:

- Base Operations: 1985, 1990, 1995 and 2000	Tables A1-A4
- 1995 Phaseout: 1990, 1995 and 2000	Tables A5-A7
- 2000 Phaseout: 1990, 1995 and 2000	Tables A8-A10
- 1985 Operations with 1980, 1990, 1995 or 2000 Demographics	Tables A11-A14

TABLE A-1

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

BASE OPERATIONS -- 1985

LDN	AVPORT CATEGORY					TOTAL
	LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	
	AREA IN SQUARE STATUTE MILES:					
>75	23	66	83	49	10	231
>70	59	172	225	126	18	600
>65	143	418	518	315	38	1432
	POPULATION IN THOUSANDS:					
>75	32	87	168	4	0	291
>70	149	352	536	45	1	1083
>65	491	1124	1376	218	11	3220
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	1	2	4	0	0	7
>70	5	8	12	1	0	26
>65	15	25	30	5	0	75
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	1	2	4	0	0	7
>70	5	8	12	1	0	26
>65	15	25	30	5	0	75

TABLE A-2

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

BASE CASE -- 1990

LDN	AVPORT CATEGORY LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	TOTAL
	AREA IN SQUARE STATUTE MILES:					
>75	18	58	69	51	12	208
>70	48	152	191	132	22	545
>65	119	372	453	328	49	1321
	POPULATION IN THOUSANDS:					
>75	19	69	138	4	0	230
>70	107	298	459	50	2	916
>65	387	977	1211	241	20	2836
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	1	2	4	0	0	7
>70	4	8	13	1	0	26
>65	15	28	34	7	1	85
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	1	2	3	0	0	6
>70	3	7	11	1	0	22
>65	12	23	28	6	1	70

TABLE A-3

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

BASE CASE -- 1995

LDN	AVPORT CATEGORY LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	TOTAL
	AREA IN SQUARE STATUTE MILES:					
>75	14	50	58	48	12	182
>70	41	133	163	124	23	484
>65	103	326	398	309	50	1186
	POPULATION IN THOUSANDS:					
>75	13	52	115	4	0	184
>70	82	245	394	44	2	767
>65	320	829	1066	220	23	2458
	HOUSING UNIT VALUE IN BILLIONS OF $:					
>75	1	2	4	0	0	7
>70	4	8	14	1	0	27
>65	15	29	36	6	1	87
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	1	1	3	0	0	5
>70	3	5	10	1	0	19
>65	10	20	25	4	1	60

TABLE A-4

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

BASE CASE -- 2000

LDN	AVPORT CATEGORY LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	TOTAL
	AREA IN SQUARE STATUTE MILES:					
>75	12	29	49	40	11	141
>70	35	86	138	103	21	383
>65	89	217	348	258	44	956
	POPULATION IN THOUSANDS:					
>75	9	20	94	2	0	125
>70	61	125	333	31	1	551
>65	258	478	921	183	18	1858
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	1	1	4	0	0	6
>70	4	5	14	1	0	24
>65	15	20	37	7	1	80
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	1	1	2	0	0	4
>70	2	3	8	1	0	14
>65	9	12	21	4	1	47

TABLE A-5

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

1995 PHASEOUT -- 1990

LDN	AVPORT CATEGORY					TOTAL
	LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	
	AREA IN SQUARE STATUTE MILES:					
>75	16	52	68	38	9	183
>70	44	136	188	98	17	483
>65	111	333	446	248	34	1172
	POPULATION IN THOUSANDS:					
>75	16	55	134	2	0	207
>70	95	255	449	26	0	825
>65	354	852	1190	157	0	2553
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	1	1	4	0	0	6
>70	4	7	13	1	0	25
>65	14	24	33	4	0	75
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	1	1	3	0	0	5
>70	3	6	11	1	0	21
>65	11	20	27	3	0	61

TABLE A-6

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

1995 PHASEOUT -- 1995

LDN	AVPORT CATEGORY					TOTAL
	LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	
	AREA IN SQUARE STATUTE MILES:					
>75	7	13	11	8	3	42
>70	19	47	54	29	8	157
>65	51	124	152	73	14	414
	POPULATION IN THOUSANDS:					
>75	3	5	6	0	0	14
>70	22	45	104	1	0	172
>65	116	222	365	13	0	716
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	0	0	0	0	0	0
>70	1	1	4	0	0	6
>65	6	7	13	0	0	26
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	0	0	0	0	0	0
>70	1	1	3	0	0	5
>65	4	5	9	0	0	18

TABLE A-7

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

1995 PHASEOUT -- 2000

LDN	AVPORT CATEGORY LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	TOTAL
	AREA IN SQUARE STATUTE MILES:					
>75	9	17	19	12	5	62
>70	26	57	78	39	10	210
>65	67	149	214	102	17	549
	POPULATION IN THOUSANDS:					
>75	5	7	20	0	0	32
>70	36	63	175	2	0	276
>65	170	283	534	30	0	1017
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	0	0	1	0	0	1
>70	2	2	7	0	0	11
>65	10	12	22	1	0	45
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	0	0	1	0	0	1
>70	1	1	4	0	0	6
>65	6	7	13	1	0	27

TABLE A-8

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

2000 PHASEOUT -- 1990

LDN	AVPORT CATEGORY LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	TOTAL
AREA IN SQUARE STATUTE MILES:						
>75	18	56	73	47	11	205
>70	48	147	199	121	19	534
>65	120	359	468	303	41	1291
POPULATION IN THOUSANDS:						
>75	20	64	146	3	0	233
>70	108	283	479	42	0	912
>65	392	934	1254	214	1	2795
HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:						
>75	1	2	4	0	0	7
>70	5	8	14	1	0	28
>65	15	27	36	6	0	84
HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:						
>75	1	2	3	0	0	6
>70	4	7	11	1	0	23
>65	12	22	29	5	0	68

TABLE A-9

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

2000 PHASEOUT -- 1995

LDN	AVPORT CATEGORY					TOTAL
	LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	
	AREA IN SQUARE STATUTE MILES:					
>75	12	40	49	36	9	146
>70	35	108	139	94	17	393
>65	89	267	349	237	34	976
	POPULATION IN THOUSANDS:					
>75	9	35	91	2	0	137
>70	64	184	330	23	0	601
>65	264	646	924	146	0	1980
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	1	1	3	0	0	5
>70	3	6	11	1	0	21
>65	13	23	32	4	0	72
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	1	1	2	0	0	4
>70	2	4	8	1	0	15
>65	9	16	22	3	0	50

TABLE A-10

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

2000 PHASEOUT -- 2000

LDN	AVPORT CATEGORY					TOTAL
	LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	
	AREA IN SQUARE STATUTE MILES:					
>75	8	18	17	11	4	58
>70	24	59	71	36	9	199
>65	61	155	195	93	16	520
	POPULATION IN THOUSANDS:					
>75	4	8	14	0	0	26
>70	32	68	154	2	0	256
>65	152	300	484	24	0	960
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	0	0	1	0	0	1
>70	2	3	6	0	0	11
>65	10	12	20	1	0	43
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	0	0	1	0	0	1
>70	1	2	3	0	0	6
>65	6	7	12	1	0	26

TABLE A-11

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

1985 OPERATIONS WITH 1980 DEMOGRAPHICS

LDN	AVPORT CATEGORY LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	TOTAL
	AREA IN SQUARE STATUTE MILES:					
>75	23	66	83	49	10	231
>70	59	172	225	126	18	600
>65	143	418	518	315	38	1432
	POPULATION IN THOUSANDS:					
>75	33	88	160	4	0	285
>70	149	352	520	43	1	1065
>65	487	1117	1348	207	12	3171
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	1	1	3	0	0	5
>70	4	6	8	1	0	19
>65	11	19	22	3	0	55
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	1	1	4	0	0	6
>70	5	8	10	1	0	24
>65	14	25	29	4	0	72

TABLE A-12

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

1985 OPERATIONS WITH 1990 DEMOGRAPHICS

LDN	AVPORT CATEGORY LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	TOTAL
	AREA IN SQUARE STATUTE MILES:					
>75	23	66	83	49	10	231
>70	59	172	225	126	18	600
>65	143	418	518	315	38	1432
	POPULATION IN THOUSANDS:					
>75	31	86	176	4	0	297
>70	147	351	551	46	1	1096
>65	493	1127	1402	228	12	3262
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	1	2	5	0	0	8
>70	6	10	15	1	0	32
>65	19	32	39	6	0	96
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	1	2	4	0	0	7
>70	5	8	12	1	0	26
>65	16	26	32	5	0	79

TABLE A-13

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

1985 OPERATIONS WITH 1995 DEMOGRAPHICS

LDN	AVPORT CATEGORY LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	TOTAL
	AREA IN SQUARE STATUTE MILES:					
>75	23	66	83	49	10	231
>70	59	172	225	126	18	600
>65	143	418	518	315	38	1432
	POPULATION IN THOUSANDS:					
>75	30	85	183	4	0	302
>70	145	348	563	46	1	1103
>65	491	1127	1420	228	12	3278
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	2	3	6	0	0	11
>70	7	12	19	1	0	39
>65	23	40	49	6	0	118
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	1	2	4	0	0	7
>70	5	8	13	1	0	27
>65	16	27	33	4	0	80

TABLE A-14

SUMMARY OF CUMULATIVE AREA, POPULATION AND HOUSING UNIT VALUE

1985 OPERATIONS WITH 2000 DEMOGRAPHICS

LDN	AVPORT CATEGORY					TOTAL
	LARGE LONG RANGE	LARGE MEDIUM RANGE	LARGE SHORT RANGE	MEDIUM SHORT RANGE	SMALL SHORT RANGE	
	AREA IN SQUARE STATUTE MILES:					
>75	23	66	83	49	10	231
>70	59	172	225	126	18	600
>65	143	418	518	315	38	1432
	POPULATION IN THOUSANDS:					
>75	29	83	188	4	0	304
>70	143	346	566	50	1	1106
>65	487	1124	1414	251	13	3289
	HOUSING UNIT VALUE IN BILLIONS OF CURRENT $:					
>75	2	3	8	0	0	13
>70	9	14	23	2	0	48
>65	27	48	57	10	1	143
	HOUSING UNIT VALUE IN BILLIONS OF CONSTANT 1985 $:					
>75	1	2	5	0	0	8
>70	5	8	13	1	0	27
>65	16	28	33	6	1	84

APPENDIX B

CATEGORIZATION OF AIRPORTS

This appendix contains a list of the airports which had scheduled commercial jet aircraft operations based on the OAG data base for the week of 12 October 1985. For each airport it gives the following information:

- LOCID
- Associated City
- Total Jet Aircraft Operations in Week
- Percent Long Range Departures (1500 miles or more)
- Percent Departures to International Destinations
- Percent Departures During Night (2200-0700 hours)
- Matrix Element (1-12)

The airports are listed in three tables. Table B-1 contains the large sized airports (100-1000 operations/day or 700-7000 operations/week). Table B-1 is subdivided into three categories:

- LLR - Large size long range (> 15% departures over 1,500 miles)
- LMR - Large size medium range (5-15% departures over 1,500 miles)
- LSR - Large size short range (< 5% departures over 1,500 miles)

Table B-2 contains the medium size (10-100 operations/day) airports and Table B-3 the small size (less than 10 operations/day) airports.

Each table also contains the average and standard deviation in each of the three columns of statistical data. With only two exceptions, all long and medium range airports were of large size, where the airports were subdivided by their range characteristic. Most of the international activity is found in the large size long and medium range airport categories. However, the percentage of nighttime operations appears to be inversely proportional to size with the small size airports ranking highest in this parameter.

TABLE B-1.

LARGE AIRPORT SUMMARY OF SELECTED OAG85 OPERATIONS STATISTICS SORTED BY LONGRANGE % OF DEPARTURES AND NUMBER OF OPERATIONS IN WEEK OF 12 OCTOBER 1985

ELEMENT	% DEPARTURES LONG RANGE	INTER-NATIONAL	NIGHT	TOTAL JETOPS	LOCID	CITY
CATEGORY LLR						
1	27.5%	5.5%	11.0%	5524	SFO	SAN FRANCISCO
2	29.5%	9.0%	10.3%	3735	LAX	LOS ANGELES *
	18.0%	5.5%	14.4%	3104	SEA	SEATTLE/TACOMA
	30.8%	9.5%	13.9%	2842	HNL	HONOLULU
	47.0%	37.4%	10.3%	2281	JFK	NEW YORK-KENNEDY *
4	36.7%	20.9%	15.6%	1166	ANC	ANCHORAGE
AVG (LLR)	31.6%	14.6%	12.6%			
STD. DEV.	8.8%	11.4%	2.1%			
CATEGORY LMR						
1	5.6%	0.5%	2.9%	6809	DEN	DENVER
	13.6%	4.1%	5.5%	5979	ORD	CHICAGO-O'HARE *
	6.4%	3.0%	11.9%	5835	EWR	NEWARK
	7.3%	0.7%	2.0%	5734	STL	ST. LOUIS
	5.5%	1.9%	8.6%	5518	ATL	ATLANTA *
	9.4%	8.1%	5.2%	4254	BOS	BOSTON
	6.1%	1.6%	3.5%	4246	MSP	MINNEAPOLIS/ST PAUL
2	5.2%	8.2%	6.3%	3740	IAH	HOUSTON-INTERNATIONAL
	5.3%	4.8%	6.8%	2973	PHL	PHILADELPHIA
	8.7%	0.6%	9.8%	2500	LAS	LAS VEGAS
	5.7%	3.2%	1.2%	2379	DTW	DETROIT-WAYNE CO.
3	8.8%	34.1%	6.4%	2087	MIA	MIAMI *
	14.9%	0.0%	10.2%	2017	SAN	SAN DIEGO
	12.9%	6.0%	5.6%	1836	IAD	WASHINGTON-DULLES
	7.0%	1.7%	5.9%	1687	SJC	SAN JOSE
	9.2%	0.0%	34.0%	1584	SDF	LOUISVILLE
	11.7%	1.0%	14.7%	1575	PDX	PORTLAND
4	13.0%	0.0%	13.8%	1228	OAK	OAKLAND
	14.0%	0.0%	13.2%	1198	ONT	ONTARIO
	6.1%	0.0%	5.0%	1142	OGG	KAHULUI, MAUI
	5.8%	0.0%	13.8%	967	SMF	SACRAMENTO
	6.6%	0.0%	7.3%	820	SNA	ORANGE COUNTY
AVG (LMR)	8.6%	3.6%	8.8%			
STD. DEV.	3.2%	7.1%	6.7%			

TABLE B-1 (continued)

CATEGORY LSR						
1	1.7%	7.3%	1.8%	4992	LGA	NEW YORK-LA GUARDIA
	3.8%	1.3%	2.0%	4380	PIT	PITTSBURGH
	4.6%	3.8%	4.6%	4313	DFW	DALLAS/FORT WORTH *
	4.8%	0.3%	6.2%	4214	PHX	PHOENIX
	3.4%	0.0%	26.0%	4170	MEM	MEMPHIS
2	0.0%	0.0%	0.7%	3709	DCA	WASHINGTON-NATIONAL
	1.2%	0.1%	1.4%	3639	CLT	CHARLOTTE
	1.3%	0.5%	4.8%	2466	MCO	ORLANDO-INTERNATIONAL
	0.0%	1.8%	8.6%	2381	TPA	TAMPA/ST. PETERSBURG
	3.3%	2.7%	2.5%	2375	BWI	BALTIMORE
	2.4%	0.0%	6.3%	2368	MCI	KANSAS CITY
	0.6%	0.0%	5.3%	2284	HOU	HOUSTON
	5.0%	1.2%	2.9%	2257	SLC	SALT LAKE CITY
3	2.2%	3.2%	5.1%	2038	CLE	CLEVELAND
	4.2%	2.3%	5.9%	2035	MSY	NEW ORLEANS
	0.0%	0.0%	6.1%	1896	DAL	DALLAS
	3.3%	0.0%	28.1%	1686	DAY	DAYTON
	3.5%	0.0%	8.2%	1580	CVG	COVINGTON/CINCINNATI,OH
	2.7%	0.0%	15.4%	1529	IND	INDIANAPOLIS
	0.0%	8.1%	6.8%	1404	SYR	SYRACUSE
	0.0%	4.3%	5.8%	1353	FLL	FT. LAUDERDALE
	0.0%	3.3%	9.0%	1286	SAT	SAN ANTONIO
	0.0%	0.0%	11.5%	1272	ABQ	ALBUQUERQUE
	1.1%	0.0%	8.0%	1248	AUS	AUSTIN
4	0.0%	9.2%	8.0%	1201	BUF	BUFFALO
	0.0%	0.0%	4.7%	1188	BNA	NASHVILLE
	0.0%	0.0%	4.9%	1156	BDL	HARTFORD
	0.0%	0.0%	8.7%	1113	ORF	NORFOLK
	0.0%	9.2%	7.0%	1086	ROC	ROCHESTER
	0.0%	0.0%	5.0%	1083	RDU	RALEIGH/DURHAM
	0.0%	0.0%	2.4%	1072	MKE	MILWAUKEE
	1.0%	0.0%	14.4%	1042	TUL	TULSA
	0.0%	0.0%	9.4%	1020	OKC	OKLAHOMA CITY
	0.0%	0.0%	4.2%	1004	JAX	JACKSONVILLE
	0.0%	0.0%	4.3%	1003	GSO	GREENSBORO/H.PT/WIN-SALEM
	0.0%	0.0%	2.9%	960	CMH	COLUMBUS
	3.0%	0.0%	2.8%	937	BUR	BURBANK
	0.4%	0.0%	0.0%	910	MDW	CHICAGO-MIDWAY
	1.7%	0.0%	15.4%	839	RNO	RENO
	0.0%	0.0%	10.3%	834	ELP	EL PASO
	1.7%	3.4%	16.2%	833	TUS	TUCSON
	0.0%	0.0%	8.8%	818	OMA	OMAHA
	0.0%	0.0%	10.5%	715	RIC	RICHMOND
	0.0%	0.0%	0.0%	707	LIH	LIHUE, KAUAI
AVG (LSR)	1.3%	1.4%	7.3%			
STD. DEV.	1.6%	2.5%	5.9%			
AVG (ALL)	6.4%	3.5%	8.2%			
SDT. DEV.	9.3%	6.6%	6.0%			

* These airports are represented twice in the model, each time with the operations indicated here, which are one-half of the actual operations.

TABLE B-2.

MEDIUM SIZE AIRPORT SUMMARY OF SELECTED OAG OPERATIONS STATISTICS SORTED BY NUMBER OF OPERATIONS IN WEEK OF 12 OCTOBER 1985

ELEMENT	DEPARTURES LONG RANGE	DEPARTURES INTER-NATIONAL	NIGHT	TOTAL JETOPS	LOCID	CITY
5	0.0%	0.0%	8.1%	694	PBI	WEST PALM BEACH
	0.0%	0.0%	9.9%	626	BHM	BIRMINGHAM
	0.0%	0.0%	3.7%	602	ALB	ALBANY
	2.5%	7.3%	6.9%	550	GEG	SPOKANE
	0.0%	0.0%	10.3%	522	ICT	WICHITA
	0.0%	0.0%	10.7%	522	DSM	DES MOINES
	0.0%	0.0%	2.8%	494	LIT	LITTLE ROCK
	0.0%	0.0%	5.0%	482	GRR	GRAND RAPIDS
	0.0%	0.0%	0.0%	458	CAE	COLUMBIA
	0.0%	0.0%	15.1%	450	TYS	KNOXVILLE
	0.0%	0.0%	13.4%	432	LBB	LUBBOCK
	0.0%	0.0%	0.0%	428	PVD	PROVIDENCE
	0.0%	0.0%	12.6%	412	MSN	MADISON
	0.0%	0.0%	3.4%	410	CHS	CHARLESTON
6	0.0%	0.0%	0.0%	392	COS	COLORADO SPRINGS
	0.0%	0.0%	13.4%	388	MAF	MIDLAND/ODESSA
	0.0%	0.0%	10.4%	384	JAN	JACKSON
	0.0%	0.0%	0.0%	378	RSW	FORT MYERS
	0.0%	0.0%	0.0%	368	GSP	GREENVILLE//SPARTENBURG
	0.0%	0.0%	7.3%	358	BIL	BILLINGS
	0.0%	0.0%	0.0%	350	SRQ	SARASOTA/BRADENTON
	4.0%	0.0%	8.0%	350	KOA	KONA
	0.0%	0.0%	17.9%	336	SHV	SHREVEPORT
	0.0%	0.0%	3.0%	336	AMA	AMARILLO
	0.0%	0.0%	10.8%	334	MOB	MOBILE/PASCAGOULA
	0.0%	0.0%	0.0%	326	LEX	LEXINGTON
	0.0%	0.0%	0.0%	312	SAV	SAVANNAH
	0.0%	0.0%	8.3%	312	BOI	BOISE
	0.0%	0.0%	23.1%	286	CRP	CORPUS CHRISTI
	0.0%	0.0%	9.2%	284	TOL	TOLEDO
	0.0%	0.0%	13.4%	284	BTR	BATON ROUGE
	0.0%	0.0%	5.0%	278	FSD	SIOUX FALLS
	0.0%	0.0%	10.1%	276	BTV	BURLINGTON
	0.0%	0.0%	14.8%	270	LNK	LINCOLN
	0.0%	0.0%	3.7%	268	MDT	HARRISBURG
	0.0%	0.0%	9.0%	268	GRB	GREEN BAY
	0.0%	0.0%	15.0%	266	ROA	ROANOKE
	0.0%	0.0%	9.0%	266	CRW	CHARLESTON
	0.0%	0.0%	0.0%	260	TLH	TALLAHASSEE
	0.0%	0.0%	0.0%	260	ISP	LONG ISLAND-MACARTHUR
	0.0%	0.0%	4.8%	250	FAT	FRESNO
	22.8%	0.0%	10.6%	246	LGB	LONG BEACH
	0.0%	0.0%	5.0%	242	HSV	HUNTSVILLE/DECATUR
	0.0%	0.0%	18.3%	240	CID	CEDAR RAPID
	0.0%	0.0%	0.0%	238	ITO	HILO
	5.1%	0.0%	27.1%	236	FAI	FAIRBANKS
	0.0%	0.0%	12.1%	232	FWA	FT. WAYNE
7	0.0%	0.0%	6.4%	220	PNS	PENSACOLA
	0.0%	0.0%	11.9%	218	FAY	FAYETTEVILLE
	0.0%	0.0%	22.4%	214	HRL	HARLINGEN

TABLE B-2 (continued)

	0.0%	0.0%	12.3%	212	MYR	MYRTLE BEACH
	0.0%	0.0%	6.7%	208	EVV	EVANSVILLE
	0.0%	0.0%	5.0%	201	AZO	KALAMAZOO
	0.0%	0.0%	7.1%	196	GTF	GREAT FALLS
	0.0%	0.0%	5.2%	192	ABE	ALLENTOWN
	26.3%	0.0%	100.0%	190	ILN	WILMINGTON
	0.0%	0.0%	0.0%	190	CPR	CASPER
	0.0%	0.0%	7.6%	184	DAB	DAYTONA BEACH
	0.0%	0.0%	7.8%	180	PWM	PORTLAND
	0.0%	0.0%	25.6%	180	MLI	MOLINE
	0.0%	15.6%	23.3%	180	BIS	BISMARCK
	0.0%	0.0%	15.7%	178	MGM	MONTGOMERY
	0.0%	0.0%	0.0%	176	TRI	TRI-CITY
	0.0%	0.0%	15.9%	176	FAR	FARGO
	0.0%	0.0%	0.0%	174	HPN	WHITE PLAINS
	0.0%	0.0%	0.0%	174	CHA	CHATTANOOGA
	0.0%	0.0%	16.7%	168	MLB	MELBOURNE
	0.0%	0.0%	15.7%	166	MSO	MISSOULA
	0.0%	0.0%	8.6%	162	RAP	RAPID CITY
	0.0%	0.0%	38.5%	161	PSC	PASCO
	0.0%	0.0%	0.0%	158	MBS	SAGINAW
	9.1%	0.0%	0.0%	154	PSP	PALM SPRINGS
	0.0%	0.0%	15.6%	154	ITH	ITHACA
	0.0%	0.0%	9.5%	148	CAK	AKRON/CANTON
	0.0%	0.0%	19.4%	144	SBN	SOUTH BEND
	0.0%	0.0%	8.3%	144	MFE	MC ALLEN
	0.0%	0.0%	0.0%	140	GNV	GAINESVILLE
	0.0%	0.0%	18.8%	138	JNU	JUNEAU
	0.0%	0.0%	29.0%	138	ILM	WILMINGTON
	0.0%	0.0%	0.0%	138	BGM	BINGHAMTON
	0.0%	0.0%	7.4%	136	PIA	PEORIA
	0.0%	0.0%	0.0%	136	GJT	GRAND JUNCTION
	0.0%	0.0%	16.4%	134	ATW	APPLETON
8	0.0%	0.0%	32.3%	124	SGF	SPRINGFIELD
	0.0%	0.0%	0.0%	124	SBA	SANTA BARBARA
	0.0%	0.0%	22.6%	124	EUG	EUGENE
	0.0%	0.0%	11.3%	124	BZN	BOZEMAN
	0.0%	0.0%	10.3%	117	RST	ROCHESTER
	0.0%	0.0%	0.0%	112	KTN	KETCHIKAN
	0.0%	0.0%	0.0%	110	MRY	MONTEREY
	0.0%	0.0%	0.0%	108	AGS	AUGUSTA
	0.0%	0.0%	0.0%	105	BFL	BAKERSFIELD
	0.0%	0.0%	11.9%	101	ELM	ELMIRA
	0.0%	0.0%	14.3%	98	MLU	MONROE
	0.0%	0.0%	42.9%	98	GFK	GRAND FORKS
	0.0%	0.0%	29.2%	96	CMI	CHAMPAIGN/URBANA
	0.0%	31.9%	0.0%	94	ERI	ERIE
	0.0%	0.0%	16.3%	86	FNT	FLINT
	0.0%	0.0%	0.0%	84	SCC	PRUDHOE BAY/DEADHORSE
	0.0%	16.7%	16.7%	84	MOT	MINOT
	0.0%	0.0%	16.7%	84	LAN	LANSING
	0.0%	0.0%	0.0%	84	DLH	DULUTH
	0.0%	0.0%	16.7%	84	BGR	BANGOR
	0.0%	0.0%	0.0%	84	AVP	WILKES-BARRE/SCRANTON
	0.0%	0.0%	0.0%	84	AVL	ASHEVILLE
	0.0%	0.0%	34.1%	82	HTS	HUNTINGTON

TABLE B-2 (continued)

	0.0%	0.0%	0.0%	82	APF	NAPLES
	0.0%	0.0%	17.9%	78	PIE	ST PETERSBURG/CLEARWATER
	0.0%	0.0%	28.6%	77	UCA	UTICA
	0.0%	0.0%	18.7%	75	MFR	MEDFORD
	0.0%	0.0%	20.0%	70	ISO	KINSTON
AVG (MSR)	0.6%	0.6%	10.9%			
STD DEV	3.4%	3.7%	12.7%			

TABLE B-3.

SMALL SIZE AIRPORT SUMMARY OF SELECTED OAG OPERATIONS STATISTICS SORTED BY NUMBER OF OPERATIONS IN WEEK OF 12 OCTOBER 1985

ELEMENT	DEPARTURES LONG RANGE	INTER-NATIONAL	NIGHT	TOTAL JETOPS	LOCID	CITY
9	0.0%	0.0%	17.6%	68	OAJ	JACKSONVILLE
	0.0%	0.0%	35.8%	67	SCK	STOCKTON
	0.0%	0.0%	18.8%	64	BRO	BROWNSVILLE
	0.0%	0.0%	19.4%	62	BET	BETHEL
	0.0%	0.0%	0.0%	62	DRO	DURANGO
	0.0%	0.0%	20.3%	59	ACV	EUREKA/ARCATA
	0.0%	0.0%	58.6%	58	YIP	DETROIT-WILLOW RUN
	0.0%	0.0%	25.0%	56	FCA	KALISPELL/GLACIER NA
	0.0%	0.0%	25.0%	56	GPT	GULFPORT/BILOXI
	0.0%	0.0%	0.0%	56	HLN	HELENA
	0.0%	0.0%	0.0%	56	IDA	IDAHO FALLS
	0.0%	0.0%	0.0%	56	JAC	JACKSON
	0.0%	0.0%	40.7%	54	ALO	WATERLOO
	0.0%	0.0%	0.0%	54	COU	COLUMBIA
	0.0%	0.0%	0.0%	54	EYW	KEY WEST
	0.0%	0.0%	22.2%	54	LYH	LYNCHBURG
	0.0%	0.0%	22.2%	54	VPS	FT. WALTON BEACH
	0.0%	0.0%	23.1%	52	CHO	CHARLOTTESVILLE
	0.0%	0.0%	0.0%	52	CSG	COLUMBUS
	0.0%	0.0%	28.6%	49	YNG	YOUNGSTOWN
	0.0%	0.0%	0.0%	48	HVN	NEW HAVEN
	0.0%	0.0%	20.8%	48	LFT	LAFAYETTE
	0.0%	0.0%	0.0%	48	SIT	SITKA
	0.0%	0.0%	25.5%	47	RDD	REDDING
	0.0%	0.0%	33.3%	42	BTM	BUTTE
	0.0%	0.0%	0.0%	42	CWA	MOSINEE/WAUSAU-CENTR
	0.0%	0.0%	0.0%	40	AZO	KALAMAZOO
	0.0%	0.0%	30.0%	40	PFN	PANAMA CITY
	0.0%	0.0%	0.0%	40	PHF	NEWPORT NEWS
	0.0%	0.0%	35.0%	40	SUX	SIOUX CITY
10	0.0%	0.0%	26.3%	38	BRW	BARROW
	0.0%	0.0%	31.6%	38	DLG	DILLINGHAM
	0.0%	0.0%	0.0%	38	OME	NOME
	0.0%	0.0%	0.0%	38	OTZ	KOTZEBUE
	0.0%	0.0%	0.0%	38	TVL	LAKE TAHOE
	0.0%	0.0%	0.0%	36	ADQ	KODIAK
	0.0%	0.0%	0.0%	28	ASE	ASPEN
	0.0%	0.0%	0.0%	28	CDV	CORDOVA
	0.0%	0.0%	0.0%	28	EAU	EAU CLAIRE
	0.0%	0.0%	0.0%	28	ILG	WILMINGTON
	0.0%	0.0%	50.0%	28	JLN	JOPLIN
	0.0%	0.0%	0.0%	28	MHT	MANCHESTER
	0.0%	0.0%	0.0%	28	ORH	WORCESTER

TABLE B-3 (continued)

	0.0%	0.0%	0.0%	28	PSG	PETERSBURG
	0.0%	0.0%	0.0%	28	TTN	TRENTON
	0.0%	0.0%	0.0%	28	WRG	WRANGELL
	0.0%	0.0%	0.0%	28	YAK	YAKUTAT
	0.0%	0.0%	0.0%	26	AKN	KING SALMON
	0.0%	0.0%	0.0%	26	DUT	DUTCH HARBOR
	0.0%	0.0%	0.0%	24	BDR	BRIDGEPORT
	0.0%	0.0%	0.0%	24	FMN	FARMINGTON
11	0.0%	0.0%	54.5%	22	GRI	GRAND ISLAND
	0.0%	0.0%	0.0%	22	MCN	MACON
	0.0%	0.0%	54.5%	22	YKM	YAKIMA
	0.0%	0.0%	22.2%	18	ACY	ATLANTIC CITY
	0.0%	0.0%	0.0%	14	CDB	COLD BAY
	0.0%	0.0%	100.0%	14	LSE	LA CROSSE
	0.0%	0.0%	0.0%	14	RFD	ROCKFORD
	0.0%	0.0%	92.3%	13	ALW	WALLA WALLA
12	0.0%	0.0%	0.0%	10	ADK	ADAK IS..
	0.0%	0.0%	0.0%	10	BFI	SEATTLE
	0.0%	0.0%	100.0%	10	MKC	KANSAS CITY
	60.0%	60.0%	0.0%	10	SWF	NEWBURGH
	0.0%	0.0%	0.0%	8	ACK	NANTUCKET
	0.0%	0.0%	0.0%	4	SYA	SHEMYA IS.
AVG (SSR)	0.9%	0.9%	15.9%			
STD DEV	7.4%	7.4%	24.3%			

APPENDIX C

AVPORT DEFINITIONS AND CONTOURS

This appendix summarizes the definitions of the avport runways and tracks and their utilizations, and presents the five avport L_{dn} contours.

The length of the main runway at each avport is the rounded average length of the longest runway at each of the airports within each category. These lengths were acquired from the FAA Landing Facility Data Base. These data also indicate that the majority of the small size short-range airport (SSR) had only one runway with sufficient length for air carrier turbojet operations.

The geometric parameters for the avport tracks and the utilizations of these tracks were derived from analyzing existing case studies at 29 airports. These 29 airports are identified in Table C-1. These airports were initially analyzed at the category level. However, when significant differences were not found between categories, they were combined.

The resulting definitions for the avports are summarized in Table C-2. All avports, except the smallest size (SSR) are assumed to have two primary runways, four runway ends. On each runway the direction used for a majority of the operations is the "major direction", the opposite direction is the "minor direction". For the SSR avport, 70% of the runway utilization is in the major traffic direction, 30% in the minor direction. For the two runway avports, 85% of the traffic is on the main runway, 59.5% (70% of 85%) is in the major direction and 25.5% (30% of 85%) is in the minor direction. The secondary runway accounts for 15% of the total traffic and has a split of utilizations similar to that of the main runway. It produces contours that are identical to those produced by operations on the main runway, except that the values of its contours are 7.5 dB less than those on the main runway ($10 \log 15/85 = -7.5$ dB). In this study the areas associated with the secondary runway are superimposed on those associated with the main runway.

The distances from the start of takeoff roll to the initiation of turns varies from 10,000 feet for the SSR avport to 17,000 feet for the LSR avport. The turn data was developed from examination of turns within six nautical miles from the start of takeoff roll; turns at greater distance were out of the range of interest. For the major direction approximately 40% of the departures were straight out with 30% turning left and 30% turning right. The two turn angles, 30 and 110 degrees, represent the rounded average values for all data, respectively, below and above the median turn angle. All approach tracks were assumed straight in with a runway utilization equal to the departure runway utilization.

The operations data for each avport are given in Appendix D in Tables D-5 through D-9. For each category the avport mix consists of the number of daily operations associated with the geometric mean of the element with the largest number of operations in the category. That is, 750 daily operations for Element #1 in the three large size airport categories; 75 daily operations for Element #5 in the medium size category, and 7.5 daily operations for Element #9 in the small size category. Intervening elements are arranged at 1/4 decade intervals, which are modeled by relabeling the contours, subtracting 2.5 dB for each 1/4 decade reduction in operations.

The operations consist entirely of scheduled air carrier operations in turbojet aircraft. They do not include scheduled operations in propeller aircraft, nor operations in general aviation propeller and business jet aircraft. These omissions probably lead to an understatement of the total impact of noise from all airport operations in the small size airport category.

The contours for the five avports are given in Figures C-1 through C-5. The contours are for the main runway only. All are drawn at a scale of 8,000 feet per inch except for the small avport which is drawn at 2,000 feet per inch. The design of the turning tracks barely affects the contours for the medium size avport and is not discernible in the small size avport. However, the turn design has a significant effect on the shape of the contours for the three large size avports. Here, the greatest effect is exhibited by the long-range avport where many of the aircraft climb slowly because they are heavily loaded to attain long range.

These contours represent 1985 base operations for each of the airport categories. For forecast years the values of the contours are recomputed by adding or subtracting the decibel change found from a comparative analysis of the forecast fleet and 1985 base fleet. The comparative analysis consists of calculating the L_{dn} 65 dB areas for both cases using the FAA Area Equivalent Model.[1]

[1] Warren, D. "Area Equivalent Method on Lotus 1-2-3™". Federal Aviation Administration, Report EE-84-12, July 1984.

The decibel change in the 1985 Base Contour L_{dn} values is calculated from the area ratios using a regression of L_{dn} versus contour area for the appropriate airport category. Thus, if the forecast fleet for an airport category is quieter, the decibel change will be negative and the L_{dn} values on the contours will be reduced. The final set of areas versus L_{dn} for the forecast fleet in each airport category is then obtained by interpolation of log area and L_{dn}.

TABLE C-1

LIST OF AIRPORTS USED IN DETERMINING AVPORT RUNWAY AND TRACK CHARACTERISTICS AND UTILIZATIONS

LOCID	Airport City	Average Daily Jet Ops
Large Size Long-Range Airports		
JFK	New York-Kennedy	652*
SEA**	Seattle-Tacoma	443
Large Size Medium-Range Airports		
ATL	Atlanta	1577*
BOS	Boston	608
ORD	Chicago-O'Hare	1708*
DTW	Detroit-Wayne County	340
MIA	Miami	596
SNA**	Orange County	117
PDY	Portland	225
SAN**	San Diego	288
STL	St. Louis	819
IAD	Washington-Dulles	262
Small Size Short-Range Airports* **		
ORH	Worcester	4

LOCID	Airport City	Average Daily Jet Ops
Large Size Short-Range Airports		
BWI	Baltimore	339
BUR	Burbank	134
CLT	Charlotte	520
BDL	Hartford	165
MKE	Milwaukee	153
BNA	Nashville	170
RDU	Raleigh-Durham	155
TPA	Tampa	340
TUL**	Tulsa	149
Medium Size Short-Range Airports		
COS	Colorado Springs	56
DAB**	Daytona Beach	26
ERT	Erie	13
ITH**	Ithaca	22
LIT	Little Rock	71
LGB**	Long Beach	35
PBI	West Palm Beach	99

*Modeled as two airports, each with one-half this number of operations.

**Primarily single runway airport for air carrier turbojet aircraft.

***Supplemented by Hyannis and Lebanon.

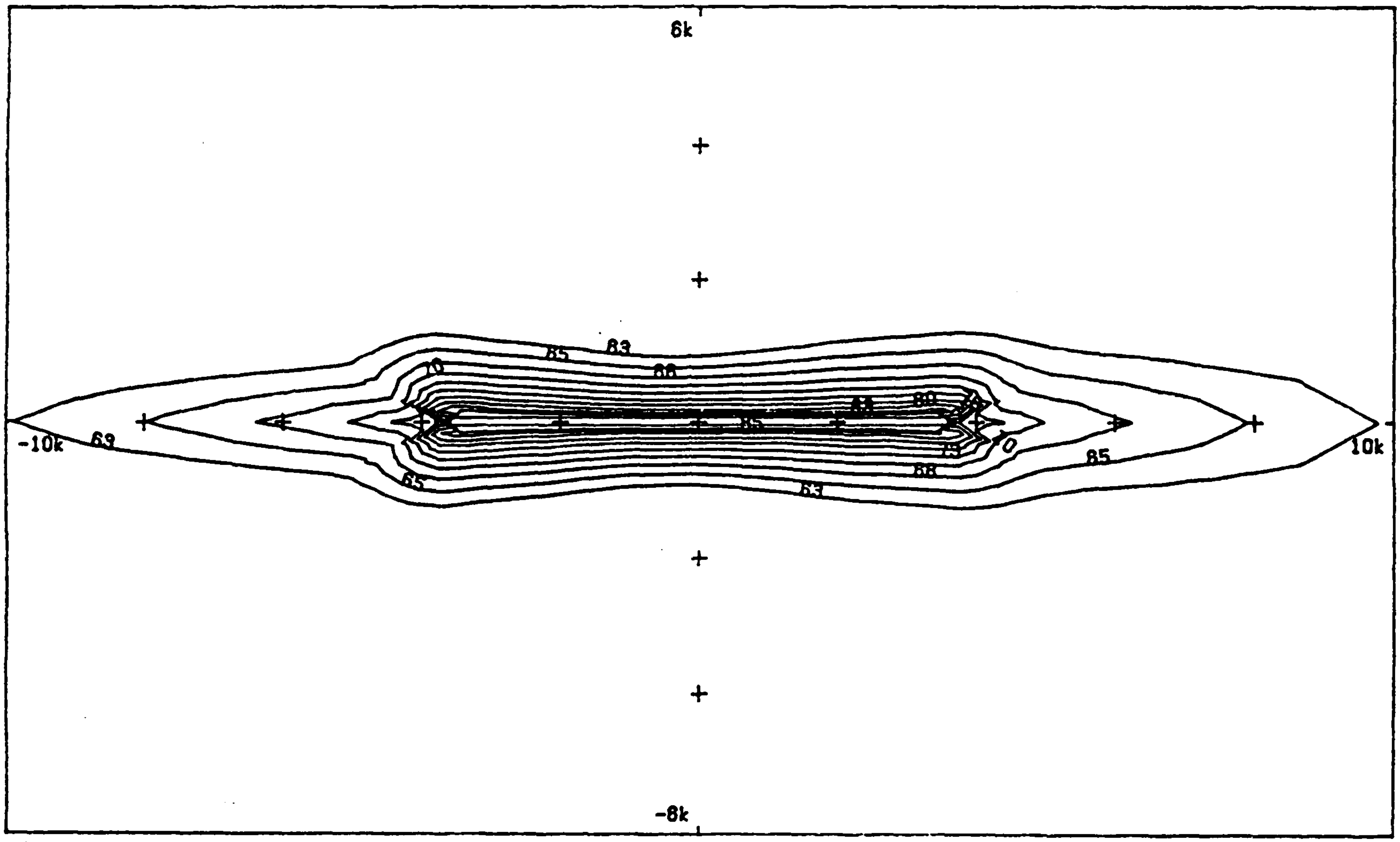
TABLE C-2

AVPORT RUNWAY AND TRACK DEFINITIONS AND UTILIZATIONS

	Avport Category				
	LLR	LMR	LSR	MSR	SSR
Number of Runways	2	2	2	2	1
Main Runway Length (ft.)	11,600	9,400	9,400	7,200	7,200
Distance to Departure Turns (ft.)[1]	11,000/ 14,500	11,000/ 14,500	17,000	17,000	10,000
Turn Angles (both directions)[1]	L30/R110	L30/R110	L30/R110	L30/R110	L30/R110
Turn Radii (INT. NM.)	1.65	1.65	1.65	1.15	1.15
Main Runway Utilization (%)					
Major Direction	59.5	59.5	59.5	59.5	70
Minor Direction	25.5	25.5	25.5	25.5	30
Secondary Runway Utilization (%)					
Major Direction	10.5	10.5	10.5	10.5	-
Minor Direction	4.5	4.5	4.5	4.5	-
Departure Track Utilization (%)[1]					
Straight	40/50	40/50	40/50	40/50	40/50
Left Turn	30/25	30/25	30/25	30/25	30/25
Right Turn	30/25	30/25	30/25	30/25	30/25
Approach Track Utilization (%)					
Straight	100	100	100	100	100

[1] Major Direction/Minor Direction.

[2] Track Utilization is 100% for each runway end. Absolute track utilization = (track utilization divided by 100) times runway utilization.

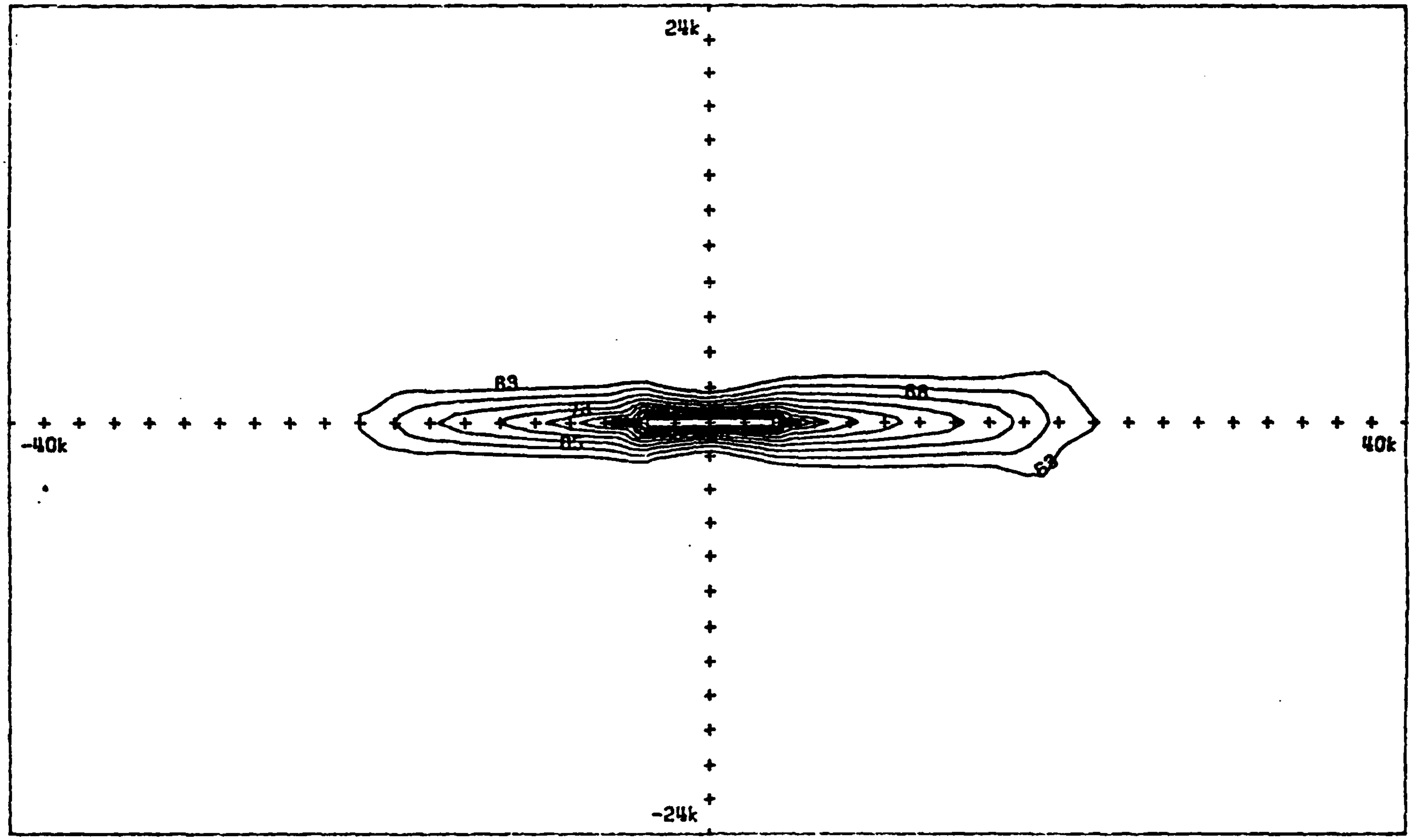


FAA INTEGRATED NOISE MODEL VERSION 3

NATIONWIDE AIRPORT NOISE IMPACT MODEL -- 1985 OPERATIONS

FT
2000

FIGURE C-1. LDN CONTOURS FOR SMALL SIZE SHORT-RANGE AVPORT



FAA INTEGRATED NOISE MODEL VERSION 3

NATIONWIDE AIRPORT NOISE IMPACT MODEL -- 1985 OPERATIONS

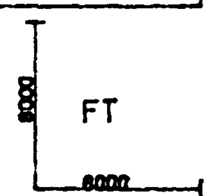
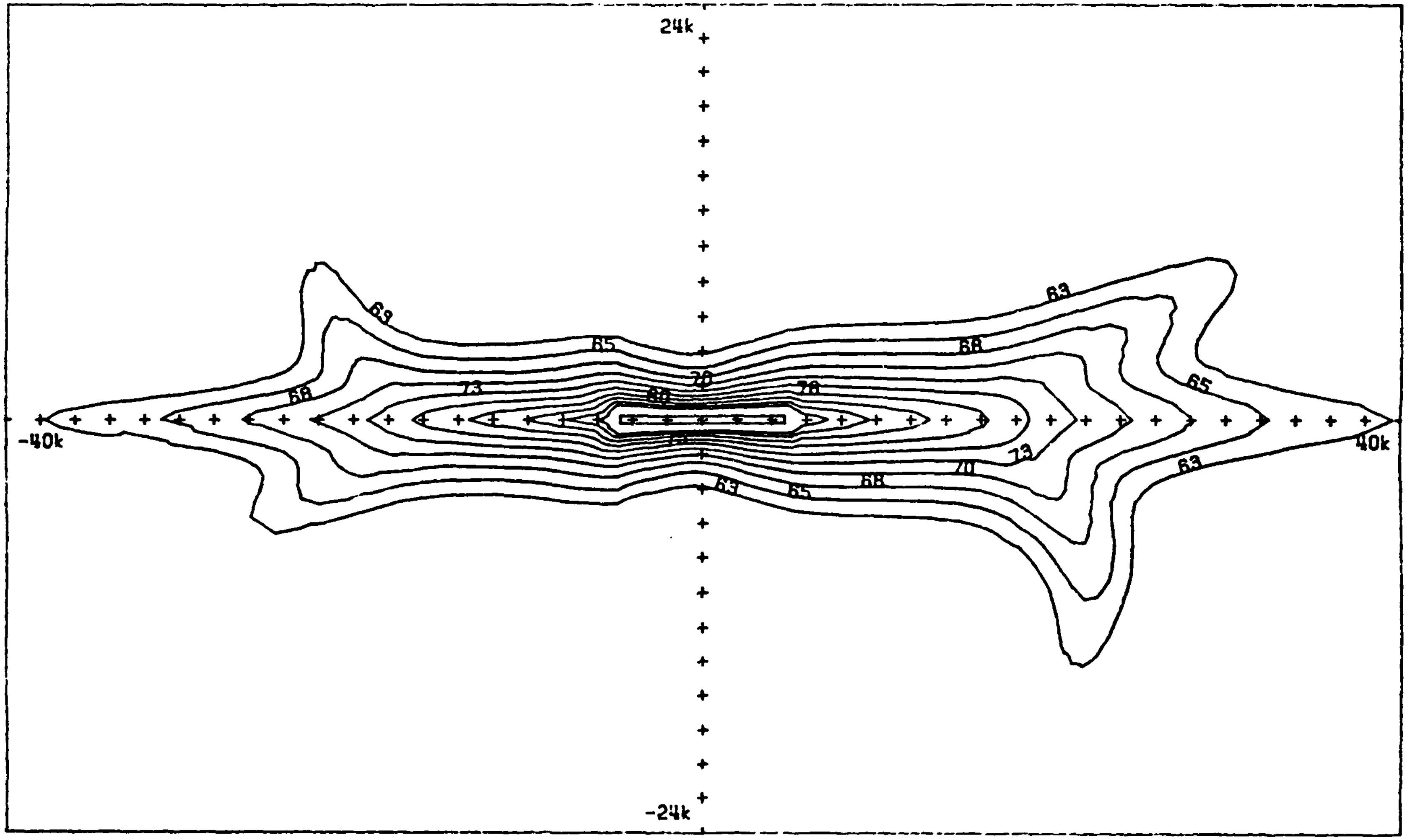


FIGURE C-2. LDN CONTOURS FOR MEDIUM SIZE SHORT-RANGE AVPORT MAIN RUNWAY



FAA INTEGRATED NOISE MODEL VERSION 3

NATIONWIDE AIRPORT NOISE IMPACT MODEL -- 1985 OPERATIONS

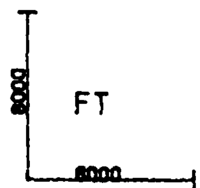
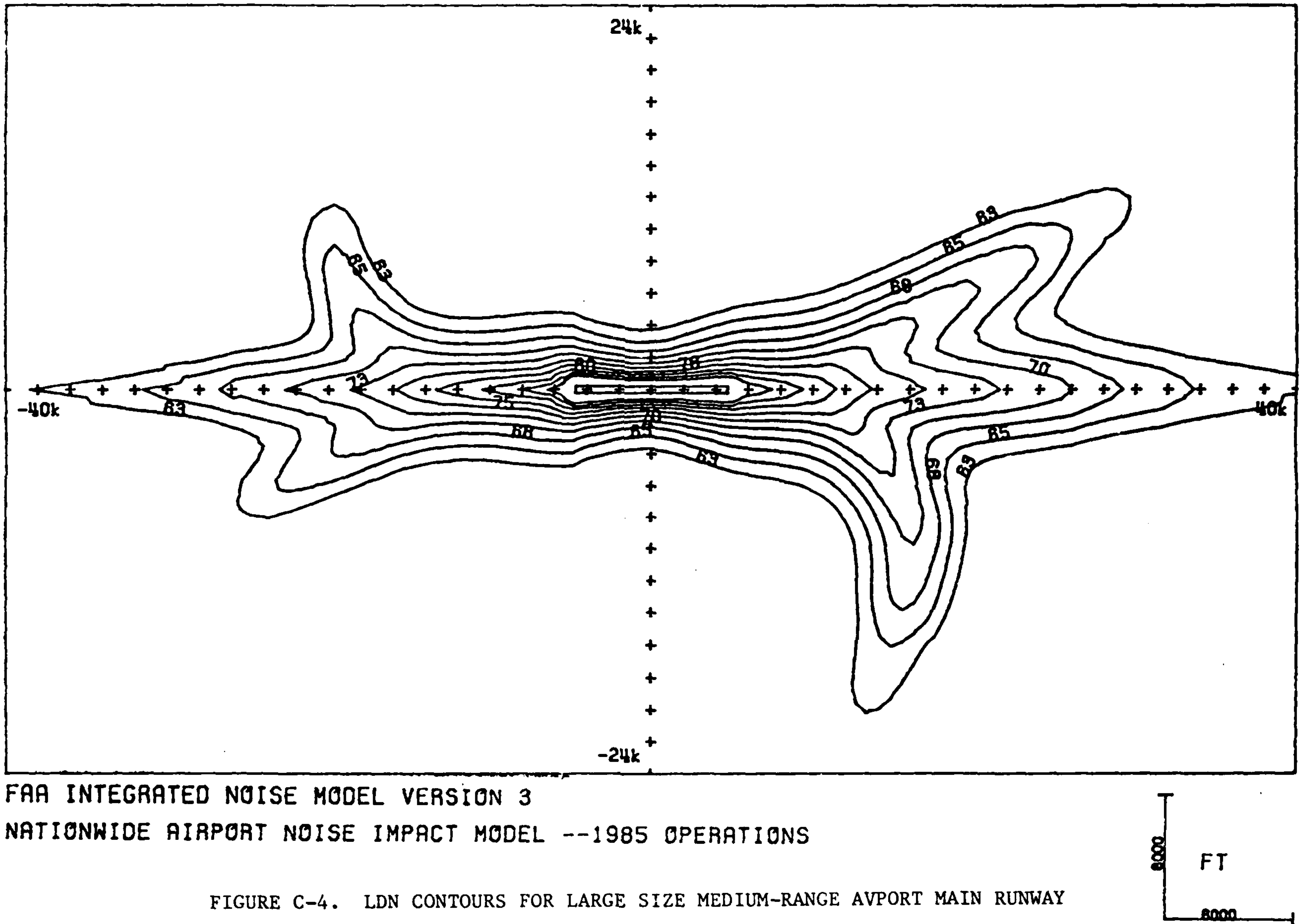


FIGURE C-3. LDN CONTOURS FOR LARGE SIZE SHORT-RANGE AVPORT MAIN RUNWAY



FAA INTEGRATED NOISE MODEL VERSION 3

NATIONWIDE AIRPORT NOISE IMPACT MODEL --1985 OPERATIONS

FIGURE C-4. LDN CONTOURS FOR LARGE SIZE MEDIUM-RANGE AVPORT MAIN RUNWAY

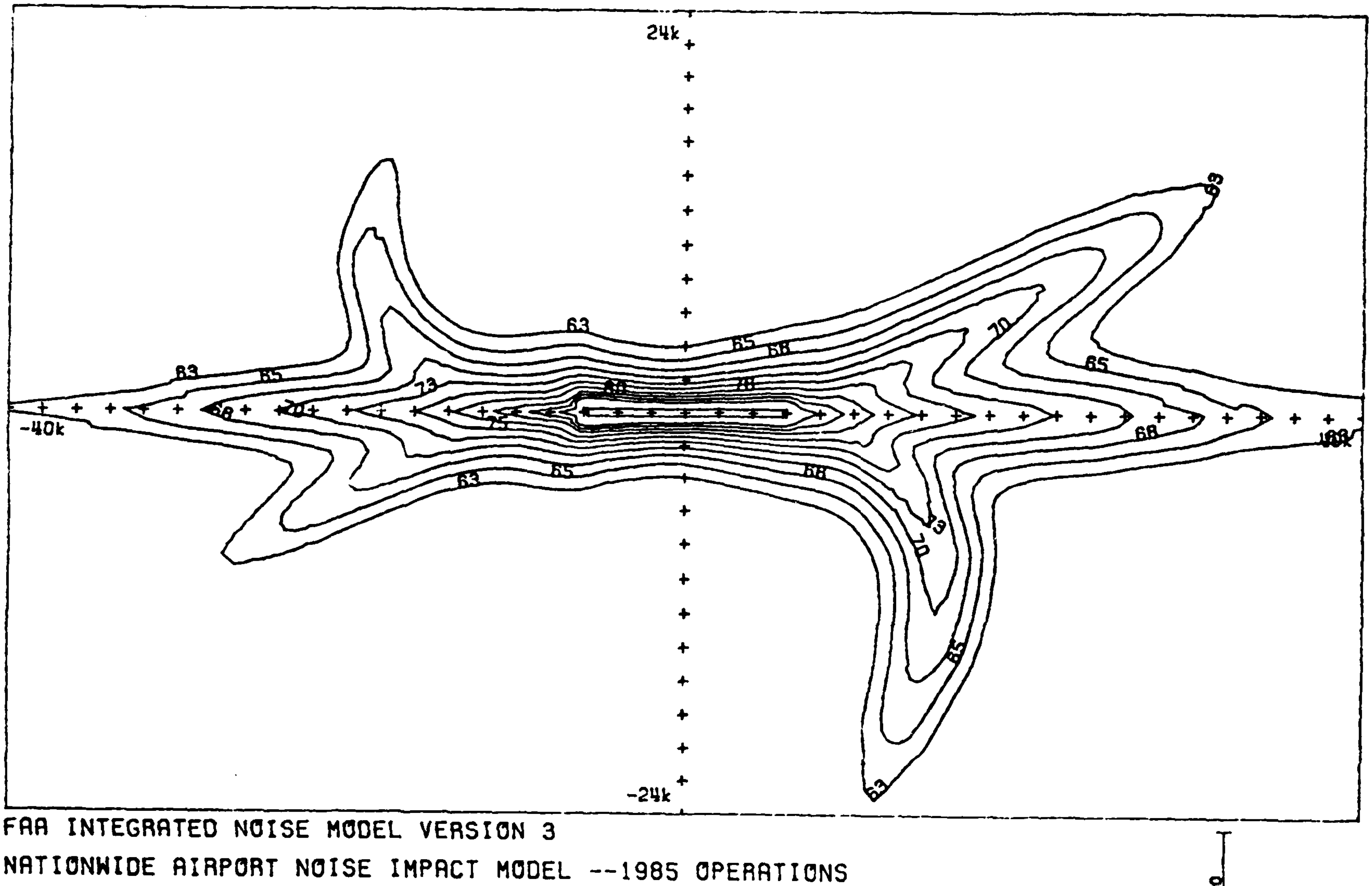


FIGURE C-5. LDN CONTOURS FOR LARGE SIZE LONG-RANGE AVPORT MAIN RUNWAY

APPENDIX D

FORECASTING METHODOLOGY FOR AIRCRAFT OPERATIONS

The following 15 steps were used to derive the forecasts of operations:

1. The FAA Office of Policy and Plans provided the official forecasts of departure operations by aircraft type through 1996 and fleet inventory through 1998 for three scenarios:
    a) Baseline
    b) 1995 phase-out of Stage 2 aircraft
    c) 2000 phase-out of Stage 2 aircraft

These forecasts are available in computer printout form.

2. These FAA forecasts were then edited to:
    - Add the year 2000. This was done by extrapolating the annual average fleet from 1998 to 2000 and departures from 1996 to 2000.
    - The 2000 fleet was then converted to departures by using the FAA standard departures-per-aircraft ratio. Departures were then multiplied by 2 to yield total operations.
    - Stage 2 aircraft were eliminated from 1995 and 2000 fleets as appropriate. (Some small numbers had been left in, but it was assumed that the ban would take effect from the beginning of the year.)
    - Those aircraft which have been identified as being hush-kitted were then added. See Appendix E.

3. The FAA operations forecast for each aircraft were then aggregated into ten major aircraft categories (Table D-1). The resulting forecasts for each of the three scenarios are shown in Tables D-2, D-3 and D-4.

4. The October 1985 OAG had been analyzed and edited to include cargo flights. The flights were then assigned to five major airport categories:

- LLR Large size long-range airport
- LMR Large size medium-range airport
- LSR Large size short-range airport
- MSR Medium size airport
- SSR Small size airport

See Tables D-5, D-6, D-7, D-8 and D-9. Part a) shows the actual weekly operations; Part b) normalizes them to 750, 75 or 7.5 operations for modelling purposes. These values are the geometric mean for the operations in the largest element of the large-, medium-, and short-range avports.

Table D-10 gives a further description of the aircraft categories used in these tables.

5. Tables D-5 through D-9 were then used to find a distribution of operations by broad aircraft category by airport category. This percentage distribution is shown in Table D-11.

   Because, in Table D-1, DC-10 aircraft appear in two aircraft forecast categories - Long-Range/B and Medium-Range/B - DC10 operations from Tables D-5 through D-8 were distributed by assigning those operating over segments of 1,000 miles or more to Long-Range/B, and the remainder to Medium-Range/B.

6. Table D-12 summarizes the 1985 data as derived from Tables D-5 through D-9 by multiplying the weekly data by 52.

7. To arrive at forecasts of operations by broad aircraft category, by airport group, i.e., for 1990, 1995 and 2000, the percentages in Table D-11 were applied to the national forecasts contained in Tables D-2, D-3 and D-4. For example, Table D-11 indicates that 75.21% of all Long Range/C aircraft take place at LLR airports. Table D-2, in turn, shows that in 1990, for the baseline case, there were 259,534[1] Long-Range/C aircraft operations nationally. Therefore, at LLR airports in 1990, in the baseline case there were

[1]including 208,004 passenger plus 51,530 freight operations.

75.21% of 259,534 or 195,196 Long-Range/C aircraft operations including freight at LLR airports. In other words, the distribution for 1985 shown in Table D-11 is expected to obtain throughout the forecast period. Table D-13 is an example of a forecast of operations, by broad aircraft category, for LLR airports, in the baseline case. However, this forecast needs to be adjusted.

8. The forecasts derived so far have to be adjusted to allow for different growth rates which are expected to be experienced by each airport category, and to ensure that the operations in each airport group add up to the total in the (edited) FAA forecast.

9. The FAA's Terminal Area Forecast provides forecasts of air carrier operations at 354 airports and these were grouped into the five airport categories LLR, LMR, etc. The resulting growth ratios are shown in Table D-14.

10. a) Table D-15, Part A, is derived from the FAA 1985 forecast of 10,745,974 total operations from the bottom of Table D-2 which distributed operations among the five airport categories by the percentages listed in total by airport category of Table D-11, and then multiplied by the growth rates from Table D-14.

    b) The "new totals" in Table D-15, Part B, are the result of adjusting the yearly operations of each airport category in Part A by the adjusting ratio factor of the FAA forecast to the Part A totals.

11. The "new totals" in Table D-15, Part B, may then be used to adjust the totals in the unadjusted forecasts. For example, in Table D-13 the 1990 forecast for LLR airports was a total of 1,716,071 compared with the new total above of 1,497,802. Therefore, a factor of 1,497,802/1,716,071, or 0.8728, applied to the 1990 column in Table D-13 will yield a "correct" total. And when the totals for all the airport groups for that year and that scenario are added up, they will again come to the "correct" FAA total. Table D-16 is an example of an adjusted forecast.

12. The adjusted forecasts of operations by broad aircraft category were then disaggregated into operations by individual aircraft types in accordance with the national FAA forecast distribution. We had to assume that the distribution within each broad category would be the same in each of the five airport groups. For example, the breakdown of medium-range B operations, nationally, for 1995, according to the FAA forecast, was as shown in Table D-17.

13. However, these percentages in Table D-17 had to be modified because the 69 aircraft types for which forecasts were provided had to be translated into the 16 "noise equivalent" groups (plus the Concorde in 1985 only) which were used for inputs to the INM. The noise equivalencies are shown in Table D-18.

14. Table D-16 shows 152,122 operations for Medium-Range/B aircraft at airports in 1995 in the baseline case. These operations were distributed among noise- equivalent aircraft types by multiplying the percentages in Table D-17 by the equivalence factors in Table D-18. The total of 152,122 operations is then multiplied by these modified percentages to determine the numbers of operations by the noise-equivalent aircraft. This calculation is shown in Table D-19.

15. Finally the total operations by the "noise-equivalent" aircraft were normalized, in 1985, to the following totals, before insertion into the model:

Airport Category	Average Day Operations in 1985
LLR	750
LMR	750
LSR	750
MSR	75
SSR	7.5

For the forecast years these average day operations were increased by the ratio of the total operation in each category for the forecast year to the 1985 base year operations.

TABLE D-1

AIRCRAFT TYPE CATEGORIES

Long Range/A	B767-200 ER; B767-300 LR; A310 ER; MD-11
Long Range/B	DC-10-30; DC-10-40; L1011-500
Long Range/C	B747 (all); A340
Long Range/D	B707 (all) and DC-8 (all)
Medium Range/A	727 (all); 7J7-190; A320; B757
Medium Range/B	DC-10; L1011; B767; A310
Short Range/A	A300; A300-600; A330
Short Range/B	A320; MD-80; MD-87; MD-89; MD-120; MD-150; 737-300
Short Range/C	DC-9 (all); BAC-111; Fokker 100; B737-200
Short Range/D	BAe 146; Fokker 28

TABLE D-2

FAA FORECASTS OF OPERATIONS BY AIRCRAFT TYPE CATEGORY

BASELINE SCENARIO

Aircraft Type Category	1985	1990	1995	2000
Passenger				
Long Range/A	686	54,698	129,762	164,378
Long Range/B	92,672	96,700	81,334	50,527
Long Range/C	161,996	208,004	266,502	328,841
Long Range/D	135,478	151,212	126,006	58,154
	390,832	510,614	603,604	601,900
Medium Range/A	3,649,094	3,293,270	2,654,014	2,380,166
Medium Range/B	647,576	848,390	1,171,896	1,423,746
	4,296,670	4,141,660	3,825,910	3,803,912
Short Range/A	119,448	141,984	151,748	147,210
Short Range/B	714,492	3,786,402	6,108,652	8,524,882
Short Range/C	4,467,042	4,028,946	3,178,126	2,090,508
Short Range/D	323,048	528,944	500,504	434,144
	5,624,030	8,486,276	9,939,030	11,196,744
Freight				
Long Range/B	10,240	20,480	19,200	15,360
Long Range/C	48,334	51,530	55,458	65,242
Long Range/D	57,786	67,812	50,226	21,600
Medium Range/A	203,010	228,088	205,284	176,940
Medium Range/B	10,800	18,554	40,020	65,040
Short Range/B	-	34,320	68,640	111,540
Short Range/C	104,272	85,232	50,624	25,144
	434,442	506,016	489,452	480,866
TOTAL	10,745,974	13,644,566	14,857,996	16,083,422

TABLE D-3

FAA FORECASTS OF OPERATIONS BY AIRCRAFT TYPE CATEGORY

1995 PHASE-OUT SCENARIO

Aircraft Type Category	1985	1990	1995	2000
Passenger				
Long Range/A	686	54,698	137,576	174,654
Long Range/B	92,672	96,700	81,334	50,528
Long Range/C	161,996	183,882	222,048	287,018
Long Range/D	135,478	151,212	100,800	58,152
	390,832	486,492	541,758	570,352
Medium Range/A	3,649,094	2,860,128	696,128	1,298,446
Medium Range/B	647,576	848,390	1,188,180	1,440,028
	4,296,670	3,708,518	1,884,308	2,738,474
Short Range/A	119,448	141,984	151,748	142,944
Short Range/B	714,492	2,607,200	6,208,188	9,170,683
Short Range/C	4,467,042	4,876,140	1,938,850	1,941,490
Short Range/D	323,048	418,344	269,824	257,184
	5,624,030	8,043,668	8,568,610	11,512,301
Freight				
Long Range/B	10,240	20,480	19,200	14,080
Long Range/C	48,334	50,194	43,360	71,400
Long Range/D	57,786	67,812	32,640	21,120
Medium Range/A	203,010	141,090	165,138	266,146
Medium Range/B	10,800	18,556	43,122	86,754
Short Range/B	-	34,320	77,220	150,150
Short Range/C	104,272	62,832	-	-
	434,442	395,284	380,680	609,650
TOTAL	10,745,974	12,633,986	11,375,356	15,430,777

TABLE D-4

FAA FORECASTS OF OPERATIONS BY AIRCRAFT TYPE CATEGORY

2000 PHASE-OUT SCENARIO

Aircraft Type Category	1985	1990	1995	2000
Passenger				
Long Range/A	686	52,062	120,808	146,768
Long Range/B	92,672	96,698	81,334	49,458
Long Range/C	161,996	202,752	249,306	299,342
Long Range/D	135,478	151,212	126,006	58,152
	390,832	502,724	577,454	553,720
Medium Range/A	3,649,094	3,129,028	2,034,728	1,311,858
Medium Range/B	647,576	848,390	1,171,896	1,373,772
	4,296,670	3,977,418	3,206,624	2,685,630
Short Range/A	119,448	141,984	151,748	144,366
Short Range/B	714,492	2,336,738	4,573,826	7,655,010
Short Range/C	4,467,042	5,290,726	3,653,066	1,649,788
Short Range/D	323,048	528,944	402,544	263,504
	5,624,030	8,298,392	8,781,184	9,712,668
Freight				
Long Range/B	10,240	20,480	19,200	14,080
Long Range/C	48,334	51,530	55,458	65,240
Long Range/D	57,786	67,812	50,226	21,600
Medium Range/A	203,010	151,794	149,450	131,145
Medium Range/B	10,800	18,554	40,020	65,040
Short Range/B	-	34,320	81,510	124,410
Short Range/C	104,272	75,152	40,712	-
	434,442	419,642	436,576	421,515
TOTAL	10,745,974	13,198,176	13,001,838	13,373,533

TABLE D-5

CATEGORY LLR: LARGE SIZE LONG RANGE AIRPORT 1985 WEEKLY OPERATIONS

a) Total Weekly Operations in Category

ACTYP	ARDA	ARNT	ARTOT	DA05	NT05	DA10	NT10	DA15	NT15	DA25	NT25	DA35	NT35	DA45	NT45	DA45+	NT45+	DATOT	NTTOT	DEPTOT	TOTAL OPS
747	1143	201	1344	44	13	7	19	24	5	119	42	329	65	312	34	261	58	1096	236	1332	2676
SSC	21	0	21	0	0	0	0	0	0	0	0	14	0	7	0	0	0	21	0	21	42
DC8	26	18	44	10	5	0	10	1	0	7	5	5	0	2	0	0	0	25	20	45	90
D8S	82	25	107	14	0	35	7	7	0	29	5	9	0	1	0	0	0	95	12	107	214
146	203	21	224	211	13	6	0	0	0	0	0	0	0	0	0	0	0	217	13	230	454
D10	1385	284	1669	58	7	102	21	203	34	681	115	244	37	94	28	34	9	1416	251	1667	3336
727	3049	364	3413	892	110	925	62	632	86	557	124	0	0	0	0	0	0	3006	382	3388	6801
767	337	58	395	41	14	14	7	21	0	129	39	108	14	7	0	0	0	320	74	394	789
757	91	32	123	7	14	7	0	21	0	56	7	4	7	0	0	0	0	95	28	123	246
AB3	170	35	205	16	9	14	0	21	0	101	21	21	2	0	0	0	0	173	32	205	410
M80	1233	94	1327	951	84	195	17	53	0	65	14	0	0	0	0	0	0	1264	115	1379	2706
733	177	31	208	99	7	65	12	0	0	28	0	0	0	0	0	0	0	192	19	211	419
737	2172	126	2298	1727	127	396	26	53	13	7	0	0	1	0	0	0	0	2183	167	2350	4648
DC9	89	8	97	78	0	18	0	0	0	0	0	0	0	0	0	0	0	96	0	96	193
D9S	385	8	393	226	16	51	5	62	0	5	0	0	0	1	0	0	0	345	21	366	759
F28	473	0	473	371	70	12	0	0	0	0	0	0	0	0	0	0	0	383	70	453	926
TOTAL	11036	1305	12341	4745	489	1847	186	1098	138	1784	372	734	126	424	62	295	67	10927	1440	12367	24709

b) Avport Fleet Mix for 750 Daily Operations

ACTYP	ARDA	ARNT	ARTOT	DA05	NT05	DA10	NT10	DA15	NT15	DA25	NT25	DA35	NT35	DA45	NT45	D45+	N45+	DATOT	NTTOT	DEPTOT	TOTAL OPS
747	34.73	6.11	40.84	1.33	0.39	0.21	0.58	0.73	0.15	3.61	1.27	9.98	1.97	9.46	1.03	7.91	1.76	33.23	7.16	40.39	81.23
SSC	0.64	0.00	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.21	0.00	0.00	0.00	0.64	0.00	0.64	1.27
DC8	0.79	0.55	1.34	0.30	0.15	0.00	0.30	0.03	0.00	0.21	0.15	0.15	0.00	0.06	0.00	0.00	0.00	0.76	0.61	1.36	2.70
D8S	2.49	0.76	3.25	0.42	0.00	1.06	0.21	0.21	0.00	0.88	0.15	0.27	0.00	0.03	0.00	0.00	0.00	2.88	0.36	3.24	6.50
146	6.17	0.64	6.81	6.40	0.39	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.58	0.39	6.97	13.78
D10	42.09	8.63	50.72	1.76	0.21	3.09	0.64	6.16	1.03	20.65	3.49	7.40	1.12	2.85	0.85	1.03	0.27	42.94	7.61	50.55	101.26
727	92.65	11.06	103.71	27.05	3.34	28.05	1.88	19.16	2.61	16.89	3.76	0.00	0.00	0.00	0.00	0.00	0.00	91.15	11.58	102.73	206.44
767	10.24	1.76	12.00	1.24	0.42	0.42	0.21	0.64	0.00	3.91	1.18	3.27	0.42	0.21	0.00	0.00	0.00	9.70	2.24	11.95	23.95
757	2.77	0.97	3.74	0.21	0.42	0.21	0.00	0.64	0.00	1.70	0.21	0.12	0.21	0.00	0.00	0.00	0.00	2.88	0.85	3.73	7.47
AB3	5.17	1.06	6.23	0.49	0.27	0.42	0.00	0.64	0.00	3.06	0.64	0.64	0.06	0.00	0.00	0.00	0.00	5.25	0.97	6.22	12.45
M80	37.47	2.86	40.32	28.84	2.55	5.91	0.52	1.61	0.00	1.97	0.42	0.00	0.00	0.00	0.00	0.00	0.00	38.33	3.49	41.81	82.14
733	5.38	0.94	6.32	3.00	0.21	1.97	0.36	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.82	0.58	6.40	12.72
737	66.00	3.83	69.83	52.37	3.85	12.01	0.79	1.61	0.39	0.21	0.00	0.00	0.03	0.00	0.00	0.00	0.00	66.19	5.06	71.26	141.09
DC9	2.70	0.24	2.95	2.37	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.91	0.00	2.91	5.86
D9S	11.70	0.24	11.94	6.85	0.49	1.55	0.15	1.88	0.00	0.15	0.00	0.00	0.00	0.03	0.00	0.00	0.00	10.46	0.64	11.10	23.04
F28	14.37	0.00	14.37	11.25	2.12	0.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.61	2.12	13.74	28.11
TOTAL	335.35	39.65	375.00	143.88	14.83	56.01	5.64	33.29	4.18	54.10	11.28	22.26	3.82	12.86	1.88	8.95	2.03	331.34	43.66	375.00	750.00

TABLE D-6

CATEGORY LMR: LARGE SIZE MEDIUM RANGE AIRPORT 1985 OPERATIONS

a) Total Weekly Operations in Category

ACTYP	ARDA	ARNT	ARTOT	DA05	NT05	DA10	NT10	DA15	NT15	DA25	NT25	DA35	NT35	DA45	NT45	D45+	N45+	DATOT	NTTOT	DEPTOT	TOTAL OPS
747	336	100	436	29	5	41	28	19	16	35	29	60	22	124	16	16	4	324	122	446	882
SSC	3	0	3	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	3	6
DC8	56	56	112	3	10	8	20	9	23	21	9	0	6	4	8	0	0	45	76	121	233
D8S	763	114	877	159	0	329	32	100	44	180	51	24	45	0	3	0	0	792	175	967	1844
146	568	25	593	546	27	12	0	0	0	0	0	0	0	0	0	0	0	558	27	585	1178
D10	1985	242	2227	376	26	755	47	322	9	497	10	46	4	87	11	37	2	2120	109	2229	4456
727	14110	1472	15582	5405	507	5886	442	2118	83	1033	91	0	0	0	0	0	0	14442	1123	15565	31147
767	534	78	612	106	7	242	14	25	0	163	7	26	0	15	0	7	0	584	28	612	1224
757	631	96	727	207	43	231	20	89	0	105	21	11	0	0	0	0	0	643	84	727	1454
AB3	501	168	669	159	21	117	70	135	42	91	21	8	0	0	0	0	0	510	154	664	1333
M80	2654	304	2958	1410	109	595	26	319	41	404	35	0	0	0	0	0	0	2728	211	2939	5897
733	651	57	708	428	29	131	9	110	0	7	0	0	0	0	0	0	0	676	38	714	1422
737	5395	383	5778	3403	292	1720	88	229	3	0	0	0	0	0	0	0	0	5352	383	5735	11513
DC9	1446	58	1504	1069	41	378	13	10	0	0	0	0	0	0	0	0	0	1457	54	1511	3015
D9S	7321	427	7748	5022	202	2049	96	343	11	46	0	0	0	0	0	0	0	7460	309	7769	15517
F28	495	22	517	494	8	17	5	0	0	0	0	0	0	0	0	0	0	511	13	524	1041
TOTAL	37449	3602	41051	18816	1327	12511	910	3828	272	2582	274	175	77	233	40	60	6	38205	2906	41111	82162

b) Avport Fleet Mix for 750 Daily Operations

ACTYP	ARDA	ARNT	ARTOT	DA05	NT05	DA10	NT10	DA15	NT15	DA25	NT25	DA35	NT35	DA45	NT45	D45+	N45+	DATOT	NTTOT	DEPTOT	TOTAL OPS
747	3.07	0.91	3.98	0.26	0.05	0.37	0.26	0.17	0.15	0.32	0.26	0.55	0.20	1.13	0.16	0.15	0.04	2.96	1.11	4.07	8.05
SSC	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.03	0.00	0.03	0.05
DC8	0.51	0.51	1.02	0.03	0.09	0.07	0.18	0.08	0.21	0.19	0.08	0.00	0.05	0.04	0.07	0.00	0.00	0.41	0.69	1.10	2.13
D8S	6.97	1.04	8.01	1.45	0.00	3.00	0.29	0.91	0.40	1.64	0.47	0.22	0.41	0.00	0.03	0.00	0.00	7.22	1.60	8.82	16.83
146	5.19	0.23	5.42	4.98	0.25	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.09	0.25	5.34	10.75
D10	18.13	2.21	20.34	3.43	0.24	6.89	0.43	2.94	0.08	4.53	0.09	0.42	0.04	0.79	0.10	0.34	0.02	19.34	0.99	20.33	40.68
727	128.89	13.45	142.34	49.30	4.62	53.69	4.03	19.32	0.76	9.42	0.83	0.00	0.00	0.00	0.00	0.00	0.00	131.73	10.24	141.98	284.32
767	4.88	0.71	5.59	0.97	0.06	2.21	0.13	0.23	0.00	1.49	0.06	0.24	0.00	0.14	0.00	0.06	0.00	5.33	0.26	5.58	11.17
757	5.76	0.88	6.64	1.89	0.39	2.11	0.18	0.81	0.00	0.96	0.19	0.10	0.00	0.00	0.00	0.00	0.00	5.87	0.77	6.63	13.27
AB3	4.58	1.53	6.11	1.45	0.19	1.07	0.64	1.23	0.38	0.83	0.19	0.07	0.00	0.00	0.00	0.00	0.00	4.65	1.40	6.06	12.17
M80	24.24	2.78	27.02	12.86	0.99	5.43	0.24	2.91	0.37	3.69	0.32	0.00	0.00	0.00	0.00	0.00	0.00	24.88	1.92	26.81	53.83
733	5.95	0.52	6.47	3.90	0.26	1.19	0.08	1.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.17	0.35	6.51	12.98
737	49.28	3.50	52.78	31.04	2.66	15.69	0.80	2.09	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	48.82	3.49	52.31	105.09
DC9	13.21	0.53	13.74	9.75	0.37	3.45	0.12	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.29	0.49	13.78	27.52
D9S	66.88	3.90	70.78	45.81	1.84	18.69	0.88	3.13	0.10	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	68.05	2.82	70.87	141.64
F28	4.52	0.20	4.72	4.51	0.07	0.16	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.66	0.12	4.78	9.50
TOTAL	342.10	32.90	375.00	171.63	12.10	114.12	8.30	34.92	2.48	23.55	2.50	1.60	0.70	2.13	0.36	0.55	0.05	348.49	26.51	375.00	750.00

TABLE D-7

CATEGORY LSR: LARGE SIZE SHORT RANGE AIRPORT 1985 OPERATIONS

a) Total Weekly Operations in Category

ACTYP	ARDA	ARNT	ARTOT	DA05	NT05	DA10	NT10	DA15	NT15	DA25	NT25	DA35	NT35	DA45	NT45	D45+	N45+	DATOT	NTTOT	DEPTOT	TOTAL OPS
DC8	6	0	6	0	0	0	5	0	0	0	0	0	0	1	0	0	0	1	5	6	12
D8S	248	64	312	138	0	108	0	43	0	26	0	1	1	0	0	0	2	316	3	319	631
146	141	6	147	143	5	0	0	0	0	0	0	0	0	0	0	0	0	143	5	148	295
D10	921	208	1129	296	31	254	38	329	18	58	17	0	0	44	0	44	0	1025	104	1129	2258
727	14408	1978	16386	7142	842	5009	403	2236	134	625	24	0	0	0	0	0	0	15012	1403	16415	32801
767	348	41	389	84	14	137	0	91	0	56	0	0	0	7	0	0	0	375	14	389	778
757	360	41	401	126	20	152	7	89	7	7	7	0	0	0	0	0	0	374	41	415	816
AB3	240	112	352	143	7	65	42	44	28	7	14	0	0	0	0	0	0	259	91	350	702
M80	2232	282	2514	1250	95	529	35	513	21	49	0	0	0	0	0	0	0	2341	151	2492	5006
733	1308	121	1429	1005	48	247	7	102	0	28	0	0	0	0	0	0	0	1382	55	1437	2866
737	9678	765	10443	7298	521	2124	76	376	4	0	0	0	0	0	0	0	0	9798	601	10399	20842
DC9	2411	154	2565	1788	148	577	50	10	0	0	0	0	0	0	0	0	0	2375	198	2573	5138
D9S	8219	511	8730	5956	335	2112	68	238	11	7	0	0	0	0	0	0	0	8313	414	8727	17457
F28	1219	122	1341	1250	46	24	25	0	0	0	0	0	0	0	0	0	0	1274	71	1345	2686
TOTAL	41739	4405	46144	26619	2112	11338	756	4071	223	863	62	1	1	52	0	44	2	42988	3156	46144	92288

b) Avport Fleet Mix for 750 Daily Operations

ACTYP	ARDA	ARNT	ARTOT	DA05	NT05	DA10	NT10	DA15	NT15	DA25	NT25	DA35	NT35	DA45	NT45	D45+	N45+	DATOT	NTTOT	DEPTOT	TOTAL OPS
DC8	0.05	0.00	0.05	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.04	0.05	0.10
D8S	2.02	0.52	2.54	1.12	0.00	0.88	0.00	0.35	0.00	0.21	0.00	0.01	0.01	0.00	0.00	0.00	0.02	2.57	0.02	2.59	5.13
146	1.15	0.05	1.19	1.16	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.16	0.04	1.20	2.40
D10	7.48	1.69	9.18	2.41	0.25	2.06	0.31	2.67	0.15	0.47	0.14	0.00	0.00	0.36	0.00	0.36	0.00	8.33	0.85	9.18	18.35
727	117.09	16.07	133.16	58.04	6.84	40.71	3.28	18.17	1.09	5.08	0.20	0.00	0.00	0.00	0.00	0.00	0.00	122.00	11.40	133.40	266.56
767	2.83	0.33	3.16	0.68	0.11	1.11	0.00	0.74	0.00	0.46	0.00	0.00	0.00	0.06	0.00	0.00	0.00	3.05	0.11	3.16	6.32
757	2.93	0.33	3.26	1.02	0.16	1.24	0.06	0.72	0.06	0.06	0.06	0.00	0.00	0.00	0.00	0.00	0.00	3.04	0.33	3.37	6.63
AB3	1.95	0.91	2.86	1.16	0.06	0.53	0.34	0.36	0.23	0.06	0.11	0.00	0.00	0.00	0.00	0.00	0.00	2.10	0.74	2.84	5.70
M80	18.14	2.29	20.43	10.16	0.77	4.30	0.28	4.17	0.17	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.02	1.23	20.25	40.68
733	10.63	0.98	11.61	8.17	0.39	2.01	0.06	0.83	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.23	0.45	11.68	23.29
737	78.65	6.22	84.87	59.31	4.23	17.26	0.62	3.06	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	79.63	4.88	84.51	169.38
DC9	19.59	1.25	20.85	14.53	1.20	4.69	0.41	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.30	1.61	20.91	41.76
D9S	66.79	4.15	70.95	48.40	2.72	17.16	0.55	1.93	0.09	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	67.56	3.36	70.92	141.87
F28	9.91	0.99	10.90	10.16	0.37	0.20	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.35	0.58	10.93	21.83
TOTAL	339.20	35.80	375.00	216.33	17.16	92.14	6.14	33.08	1.81	7.01	0.50	0.01	0.01	0.42	0.00	0.36	0.02	349.35	25.65	375.00	750.00

TABLE D-8

CATEGORY MSR: MEDIUM SIZE SHORT RANGE AIRPORT 1985 OPERATIONS

a) Total Weekly Operations in Category

	ARRIVALS			DEPARTURES														DEPARTURE TOTALS		
ACTYP	ARDA	ARNT	ARTOT	DA05	NT05	DA10	NT10	DA15	NT15	DA25	NT25	DA35	NT35	DA45	NT45	DA45+	NT45+	DATOT	NTTOT	DEPTOT
146	277	18	295	273	22	0	0	0	0	0	0	0	0	0	0	0	0	273	22	295
727	3385	605	3990	2713	344	681	35	203	14	7	6	0	0	0	0	0	0	3604	399	4003
733	113	13	126	108	13	1	0	0	0	0	0	0	0	0	0	0	0	109	13	122
737	2986	424	3410	2702	269	374	18	35	0	0	0	0	0	0	0	0	0	3111	287	3398
757	70	0	70	42	0	7	0	21	0	0	0	0	0	0	0	0	0	70	0	70
767	12	0	12	5	0	7	0	0	0	0	0	0	0	0	0	0	0	12	0	12
AB3	14	0	14	0	0	0	0	14	0	0	0	0	0	0	0	0	0	14	0	14
D10	0	7	7	0	0	0	0	7	0	0	0	0	0	0	0	0	0	7	0	7
DBS	62	12	74	35	0	20	7	0	5	7	0	0	0	0	0	0	0	62	12	74
D9S	2346	342	2688	2286	189	151	36	14	0	0	5	0	0	0	0	0	0	2451	230	2681
DC8	0	15	15	0	0	0	0	0	15									0	15	15
DC9	854	114	968	858	74	15	20	0	0	0	0	0	0	0	0	0	0	873	94	967
F28	687	126	813	655	116	22	16	0	0	0	0	0	0	0	0	0	0	677	132	809
NBO	384	21	405	261	19	33	0	49	0	28	7	0	0	0	0	0	0	371	26	397
TOTAL	11190	1697	12887	9938	1046	1311	132	343	34	42	18	0	0	0	0	0	0	11634	1230	12864

b) Avport Fleet Mix for 750 Daily Operations

	ARRIVALS			DEPARTURES														DEPARTURE TOTALS			TOTAL
ACTYP	ARDA	ARNT	ARTOT	DA05	NT05	DA10	NT10	DA15	NT15	DA25	NT25	DA35	NT35	DA45	NT45	D45+	N45+	DATOT	NTTOT	DEPTOT	OPS
146	0.81	0.05	0.86	0.80	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.06	0.86	1.72
727	9.85	1.76	11.61	7.91	1.00	1.99	0.10	0.59	0.04	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	10.51	1.16	11.67	23.30
733	0.33	0.04	0.37	0.31	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.04	0.36	0.72
737	8.69	1.23	9.92	7.88	0.78	1.09	0.05	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.07	0.84	9.91	19.85
757	0.20	0.00	0.20	0.12	0.00	0.02	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.20	0.41
767	0.03	0.00	0.03	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.03	0.07
AB3	0.04	0.00	0.04	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.08
D10	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.04
DBS	0.18	0.03	0.22	0.10	0.00	0.06	0.02	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.03	0.22	0.43
D9S	6.83	1.00	7.82	6.66	0.55	0.44	0.10	0.04	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	7.14	0.67	7.82	15.65
DC8	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.09
DC9	2.49	0.33	2.82	2.50	0.22	0.04	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.54	0.27	2.82	5.64
F28	2.00	0.37	2.37	1.91	0.34	0.06	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.97	0.38	2.36	4.73
NBO	1.12	0.06	1.18	0.76	0.06	0.10	0.00	0.14	0.00	0.08	0.02	0.00	0.00	0.00	0.00	0.00	0.00	1.08	0.08	1.16	2.34
TOTAL	32.56	4.94	37.50	28.97	3.05	3.82	0.38	1.00	0.10	0.12	0.05	0.00	0.00	0.00	0.00	0.00	0.00	33.91	3.59	37.50	75.00

TABLE D-9

CATEGORY SSR: SMALL SIZE SHORT RANGE AIRPORT 1985 OPERATIONS

a) Total Weekly Operations in Category

	ARRIVALS			DEPARTURES														DEPARTURE TOTALS			TOTAL
ACTYP	ARDA	ARNT	ARTOT	DA05	NT05	DA10	NT10	DA15	NT15	DA25	NT25	DA35	NT35	DA45	NT45	D45+	N45+	DATOT	NTTOT	DEPTOT	OPS
DC8	10	25	35	2	10	10	10	0	0	2	0	0	0	1	0	0	0	15	20	35	70
146	98	6	104	81	5	18	0	0	0	0	0	0	0	0	0	0	0	99	5	104	208
727	83	9	92	79	1	11	1	7	0	0	0	0	0	0	0	0	0	97	2	99	191
MBO	7	0	7	7														7	0	7	14
733	13	0	13	13	0	0	0	0	0	0	0	0	0	0	0	0	0	13	0	13	26
DC9	87	12	99	68	30	0	0	0	0	0	0	0	0	0	0	0	0	68	30	98	197
D9S	196	33	229	185	44	0	0	0	0	0	0	0	0	0	0	0	0	185	44	229	458
F28	75	6	81	67	14	0	0	0	0	0	0	0	0	0	0	0	0	67	14	81	162
737	441	98	539	427	64	43	5	0	0	0	0	0	0	0	0	0	0	470	69	539	1078
TOTAL	1010	189	1199	929	168	82	16	7	0	2	0	0	0	1	0	0	0	1021	184	1205	2404

b) Avport Fleet Mix for 750 Daily Operations

ACTYP	ARDA	ARNT	ARTOT	DA05	NT05	DA10	NT10	DA15	NT15	DA25	NT25	DA35	NT35	DA45	NT45	D45+	N45+	DATOT	NTTOT	DEPTOT	TOTAL OPS
DC8	0.03	0.08	0.11	0.01	0.03	0.03	0.03	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.06	0.11	0.22
146	0.31	0.02	0.33	0.25	0.02	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.02	0.32	0.65
727	0.26	0.03	0.29	0.25	0.00	0.03	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.01	0.31	0.59
MBO	0.02	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.04
733	0.04	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.04	0.08
DC9	0.27	0.04	0.31	0.21	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.09	0.30	0.61
D9S	0.61	0.10	0.72	0.58	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.14	0.71	1.43
F28	0.23	0.02	0.25	0.21	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.04	0.25	0.50
737	1.38	0.31	1.69	1.33	0.20	0.13	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.46	0.21	1.68	3.35
TOTAL	3.15	0.59	3.74	2.90	0.52	0.26	0.05	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.19	0.57	3.76	7.50

TABLE D-10

AIRCRAFT INCLUDED IN THE OAG GENERIC CODES

Code	Aircraft
SSC	Concorde
DC8	For 1985 all old 4-engine aircraft, including 707's and IL-2's. Not retrofitted. We assume no retrofitted aircraft in fleet in 1985.
D8S	DC-8-70's only
747	All types
146	All BAE146
D10	All D-10's and L-1011's
727	All 727's and TU5's
767	767's
757	757's
AB3	All Airbusses
M80	MD-80's
733	737-300's
737	All other 737's
DC9	DC-9-10 and BAC-111's
D9S	All other DC-9's
F28	F-28's, DFL's, and L86's

TABLE D- 11

DISTRIBUTION OF AIRCRAFT TYPE CATEGORY OPERATIONS BY AIRPORT CATEGORY (%)

1985

Aircraft Type Category	Airport Category LLR	LMR	LSR	MSR	SSR	Total
Long Range/SSC	87.50	12.50	-	-	-	100.00
Long Range/A[1]	55.00	40.00	5.00	-	-	100.00
Long Range/B	48.98	33.91	16.88	0.23	-	100.00
Long Range/C	75.21	24.79	-	-	-	100.00
Long Range/D	9.29	63.48	19.65	5.44	2.14	100.00
All Categories	46.30	38.80	12.87	1.49	0.54	100.00
Medium Range/A	8.64	39.96	41.20	9.97	0.23	100.00
Medium Range/B	17.04	53.12	29.49	0.35	-	100.00
All Categories	9.29	40.97	40.30	9.22	0.22	100.00
Short Range/A	16.58	53.90	28.39	1.13	-	100.00
Short Range/B	16.10	37.72	40.56	5.41	0.21	100.00
Short Range/C	5.90	31.64	45.76	14.87	1.83	100.00
Short Range/D	15.06	24.22	32.54	24.14	4.04	100.00
All Categories	8.35	32.48	43.66	13.81	1.70	100.00
TOTAL	10.87	36.14	40.60	11.33	1.06	100.00

[1] Estimated No. 1985 data available.

Source: Official Airline Guide, October, 1985.

TABLE D-12

OPERATIONS BY AIRCRAFT TYPE BY AIRPORT CATEGORY - 1985

	LLR	LMR	LSR	MSR	SSR	Total
Long Range/SSC	2,184	312				2,496
Long Range/A	-	-	-	-	-	-
DC-10	153,920	106,548	53,040	728	-	314,236
Long Range/B	153,920	106,548	53,040	728	-	314,236
B747	139,152	45,864	-	-	-	185,016
Long Range/C	139,152	45,864	-	-	-	185,016
DC-8	4,680	12,116	624	1,560	3,640	22,620
DC-8S	11,128	95,888	32,812	7,696	-	147,524
Long Range/D	15,808	108,004	33,436	9,256	3,640	170,144
All Long Range	311,064	260,728	86,476	9,984	3,640	671,892
B727	353,652	1,619,644	1,705,652	415,636	9,932	4,104,516
B757	12,792	75,608	42,432	7,280	9,932	194,168
Medium Range/A	366,444	1,695,252	1,748,084	422,916	65,988	4,298,684
DC-10	19,552	125,164	64,376	-	-	209,092
B767	41,028	63,648	40,456	1,248	-	146,380
Medium Range/B	60,580	188,812	104,832	1,248	-	355,472
All Medium Range	427,024	1,884,064	1,852,916	424,164	65,988	4,654,156
A300	21,320	69,316	36,504	1,456	-	128,596
Short Range/A	21,320	69,316	36,504	1,456	-	128,596
MD-80	140,712	306,644	260,312	41,704	728	750,100
737-300	21,788	73,944	149,032	12,896	1,352	259,012
Short Range/B	162,500	380,588	409,344	54,600	2,080	1,009,112
DC-9	10,036	156,780	267,176	100,620	10,244	544,856
DC-9S	39,468	806,884	907,764	279,188	23,816	2,057,120
B737	241,696	598,676	1,083,784	354,016	56,056	2,278,172
Short Range/C	291,200	1,562,340	2,258,724	733,824	90,116	4,880,148
BAE146	23,608	61,256	15,340	30,680	10,816	141,700
F-28	48,152	54,132	139,672	84,344	8,424	334,724
Short Range/D	71,760	115,388	155,012	115,024	19,240	476,424
All Short Range	546,780	2,127,632	2,859,584	904,904	55,380	6,494,280
TOTAL	1,284,868	4,272,424	4,798,976	1,339,052	125,008	11,820,328

Source: Official Airline Guide, October, 1985 (Edited).

TABLE D-13

SAMPLE UNADJUSTED FORECAST

AIRPORTS LLR - SCENARIO BASELINE

Aircraft Type Category	1985	1990	1995	2000
Long Range/SSC	2,184	-	-	-
Long Range/A[1]	377	30,084	71,369	90,408
Long Range/B	50,406	57,395	49,241	32,271
Long Range/C	158,189	195,196	242,146	296,390
Long Range/D	17,954	20,348	16,372	7,410
All Categories	229,110	303,023	379,128	426,479
Medium Range/A	332,822	304,246	247,044	220,934
Medium Range/B	112,187	147,728	206,510	253,689
All Categories	445,009	451,974	453,554	474,623
Short Range/A	19,804	23,541	25,160	24,407
Short Range/B	115,033	615,137	994,544	1,390,464
Short Range/C	269,708	242,737	190,496	124,823
Short Range/D	48,651	79,659	75,376	65,382
All Categories	453,196	961,074	1,285,576	1,605,076
TOTAL	1,127,315	1,716,071	2,118,258	2,506,178

TABLE D-14

FAA GROWTH RATIO FOR TERMINAL AREA FORECAST BASED ON AIR CARRIER OPERATIONS

	1990: 1985	1995: 1990	2000: 1995
Large Airports			
LLR	1.1026	1.0371	1.0336
LMR	1.0306	1.0858	1.0873
LSR	1.1250	1.0859	1.0797
Medium Airports			
MSR	1.1345	1.1064	1.1133
Small Airports			
SSR	1.3421	1.1716	1.0962

Source: FAA Terminal Area Forecasts

TABLE D-15

FORECAST OF OPERATIONS BY AIRPORT CATEGORY

PART A

Airport Category	Base[1] 1985	Base times Growth Rates in Table 14 1990	1995	2000
LLR	1,168,087	1,287,933	1,335,715	1,380,595
LMR	3,883,595	4,002,433	4,345,842	4,725,234
LSR	4,362,865	4,908,223	5,329,839	5,754,628
MSR	1,217,519	1,381,275	1,528,243	1,701,393
SSR	113,907	152,875	179,108	196,338
Total	10,745,973	11,732,739	12,718,747	13,758,188
FAA Fleet Forecast Total	10,745,974	13,644,566	14,857,996	15,746,732
Adjustment Factor[2]	1.00000	1.16295	1.16820	1.14454

PART B

		Adjusted Totals from Part A		
LLR	1,168,087	1,497,802	1,560,382	1,580,146
LMR	3,883,595	4,654,629	5,076,813	5,408,219
LSR	4,362,865	5,708,018	6,226,318	6,586,402
MSR	1,217,519	1,606,354	1,785,293	1,947,312
SSR	113,907	177,786	209,234	224,717
	10,745,973	13,644,589	14,858,040	15,746,796

[1] Base 1985 derived from total operations in Table D-2 times total percentages for airport category in Table D-12.

[2] Adjustment factor is ratio of FAA national fleet forecast total to total obtained using terminal area forecast growth rates (Table D-14).

TABLE D-16

SAMPLE ADJUSTED FORECAST

AIRPORTS LLR - SCENARIO BASELINE

Aircraft Type Category	1985	1990	1995	2000
Long Range/SSC	2,184	-	-	-
Long Range/A[1]	377	26,258	52,573	57,002
Long Range/B	50,406	50,095	36,273	20,347
Long Range/C	158,189	170,369	178,373	186,874
Long Range/D	17,954	17,760	12,060	4,672
All Categories	229,110	264,482	279,279	268,895
Medium Range/A	332,822	265,549	181,991	139,299
Medium Range/B	112,187	128,938	152,122	159,951
All Categories	445,009	394,487	334,113	299,250
Short Range/A	19,804	20,547	18,534	15,389
Short Range/B	115,033	536,897	732,615	876,688
Short Range/C	269,708	211,863	140,326	78,701
Short Range/D	48,651	69,527	55,525	41,223
All Categories	453,196	838,834	947,000	1,012,001
TOTAL	1,127,315	1,497,803	1,560,383	1,580,146

NOTE: Includes Freight.

TABLE D-17

NATIONAL DISTRIBUTION OF OPERATIONS BY INDIVIDUAL AIRCRAFT TYPE
WITHIN MEDIUM RANGE/B AIRCRAFT CATEGORY - 1995, BASELINE CASE

DC-10-10	17.74%
L-1011-1	20.49
A310	1.60
767-200	22.43
767-300	22.22
767-XX	12.22
DC-10-10CF	0.74
767-F	2.56
	100.00%

Source: FAA Forecasts.

TABLE D-18

AIRCRAFT NOISE EQUIVALENTS

Aircraft Type	Noise Equivalent[1]
Long Range/A	
MD-11	1 x DC1040
A310-ER	1.1 x A310
767-200-ER	2.6 x DC980
767-300-ER	3 x DC980
Long Range/B	
DC-10-30	
DC-10-40	1 x DC1040
DC-10-30-CF	
L-1011-500	
Long Range/C	
747-SP	
747-200B	
747-300	
747-400	1 x 747200
747-100F	
747-200F	
747-400F	
A340	6.8 x DC8CFM
Long Range/D	
DC-8-62	
DC-8-63	
DC-8-50F	1 x DC8QN
DC-8-63F	
707-320B	
707-320C	
DC-8-71	1 x DC8CFM
DC-8-73F	
Medium Range/A	
757-200	
757-X	1 x 757JT
757-F	
727-100	
727-100C	
727-200	1.0 x 727[2]
727-100QC	
727-200F	
7J7-190	1.8 x DC980
A320-180	1.7 x DC980

Aircraft Type	Noise Equivalent[1]
Medium Range/B	
DC-10-10	
DC-10-10CF	1.0 x DC1010
L-1011-1	
A310	1.0 x A310
767-200	1.0 x 767
767-F	
767-300	2.6 x DC980
767-XX	3.0 x DC980
Short Range/A	
A300-8	1.0 x A300
A300-600	1.2 x A300
A330	1.6 x A300
Short Range/B	
737-300	
737-400	0.5 x DC980
737-300F	
7J7	1.4 x DC980
7J7-120	1.1 x DC980
MD-80	1.0 x DC980
MD-87	1.0 x DC980
MD-89	1.2 x DC980
MD-150	1.5 x DC980
MD-120	1.4 x DC980
A320	1.5 x DC980
Short Range/C	
737-200	1.0 x 737QN
737-200C	
DC-9-10	1.0 x DC910
DC-9-10F	
DC-9-30	
DC-9-50	1.0 x DC9Q9
DC-9-30F	
BAC-111	1.0 x DC910
Fokker 100	1.0 x DC980
Short Range/D	
F-28	1.0 x F28
BAe 146-200	2.0 x CL600

[1] Aircraft designations are Integrated Noise Model Version 3.8 aircraft types.

[2] 1 - 727 is split into .28 - 727Q7 + .24 - 727Q9 + .48 - 727Q15 based on noise characteristics of 1985 727 fleet.

TABLE D-19

OPERATIONS BY NOISE-EQUIVALENT AIRCRAFT GROUPS
LLR AIRPORTS, 1995, BASELINE CASE

Aircraft Type	Percentages from Table D-17	Equivalencies from Table D-18	Revised Percentage	Equivalent Operations[1]	Noise-Equivalent Aircraft Type
DC-10-10	17.74%	1.0 x D10	17.74%	26,986	D10
L-1011-1	20.49	1.0 x D10	20.49	31,170	D10
A310	1.60	1.0 x A310	1.60	2,434	A310
767-200	22.43	1.0 x 767	22.43	34,121	767
767-300	22.22	2.6 x MD-80	67.77	87,881	MD-80
767-XX	12.22	3.0 x MD-80	36.66	55,768	MD-80
DC-10-10CF	0.74	1.0 x D10	0.74	1,126	D10
767-F	2.56	1.0 x 767	2.56	3,894	767
	100.0%				

SUMMARY OF OPERATIONS BY NOISE-EQUIVALENT AIRCRAFT TYPE

D10	59,282
A310	2,434
767	38,015
DC980	143,649

[1]Based on original total of 152,122 operations.

APPENDIX E

THE HUSH-KITTED FLEET

FAA records show that a total of 118 hush-kitted aircraft were delivered in 1985 and 1986; see Table E-1. Of this total, 83 aircraft were added to U.S. Registry; the remainder entered foreign registry.

TABLE E-1

HUSH-KITTED DELIVERIES FOR U.S. REGISTRY

	1985	1986	Total
707	17	28	45
DC-8-62/63	20	18	38
	37	46	83

Source: FAA Office of Environment and Energy.

The FAA operations forecast shows no more 707 operations, passenger or cargo, after 1986, and DC-8-62's are also phased out by the end of 1986. Only the DC-8-63 remained as a freighter, gradually declining in numbers from 20 freighters in 1985 to 3 in 1998.

New estimates were made, therefore, to account for the fleet of hush-kitted aircraft after 1985, and these estimates are summarized in Table E-2. Note that the FAA forecasts for 1985 are retained.

Table E-3 shows the estimates of total operations (both departures and arrivals) per year for each of these aircraft, and Table E-4 is a forecast of operations made from Tables E-2 and E-3. Table E-5 contains the raw data.

TABLE E-2

HUSH-KITTED AIRCRAFT

FORECAST OF AVERAGE ANNUAL FLEET

Baseline and 2000 Phase-Out

	1985[1]	1990[2]	1995	2000
DC-8-62 Passenger	10	6	3	-
DC-8-63 Passenger	6	4	2	-
707-300/300B Passenger	16.5	28	14	-
DC-8-62/63 Cargo	20.5	28	14	-
707-300/300C Cargo	10	17	8.5	-
	63	83	41.5	-

1995 Phase-Out

	1985	1990	1995	2000
DC-8-62 Passenger	10	6	-	-
DC-8-63 Passenger	6	4	-	-
707-300/300B Passenger	16.5	28	-	-
DC-8-62/63 Cargo	20.5	28	-	-
707-300/300C Cargo	10	17	-	-
	63	83	-	-

[1] From FAA Forecast.

[2] From Hush-Kit data - Table E-5.

TABLE E-3

HUSH-KITTED AIRCRAFT

ANNUAL OPERATIONS PER AIRCRAFT

	Operations per Year
All 707's Passenger	1,606
All 707's Cargo	900
DC-8-62 Passenger	850
DC-8-62 Cargo	736[1]
DC-8-63 Passenger	1,400
DC-8-63 Cargo	736

[1]Estimated to be the same as the DC-8-63 Cargo Aircraft.

Source: FAA Forecast.

TABLE E-4

HUSH-KITTED AIRCRAFT

FORECAST OF ANNUAL OPERATIONS

Baseline and 2000 Phase-Out

	1985	1990	1995	2000
DC-8-62 Passenger	8,500	5,100	2,550	-
DC-8-63 Passenger	8,400	5,600	2,800	-
707-300/300B Passenger	26,499	44,968	22,484	-
DC-8-62/63 Cargo	15,088	20,608	10,304	-
707-300/300C Cargo	9,000	15,300	7,650	-
		91,576	65,788	

1995 Phase-Out

	1985	1990	1995	2000
DC-8-62 Passenger	8,500	5,100	-	-
DC-8-63 Passenger	8,400	5,600	-	-
707-300/300B Passenger	26,499	44,968	-	-
DC-8-62/63 Cargo	15,088	20,608	-	-
707-300/300C Cargo	9,000	15,300	-	-
		91,576		

TABLE E-5

"HUSH-KITTED" AIRCRAFT RESULTING FROM FAR PART 91 11/20/86

OPERATOR	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
ABCO (COASTAL)	B707-312B	N600CS	19739	08/13/85
AER TURAS	DC-8-63	EI-BNA	45989	09/17/85
AFRICAN SAFARI	DC-8-63	57-515	46141	09/23/86
AIR CANADA	DC-8-63	C-FTIV	46126	07/17/86
	DC-8-63	C-FTIU	46113	08/18/86
AIR TRAFFIC	DC-8-62	N728PL	45918	04/09/86
AIRBORNE EXPRESS	DC-8-62	N801AX	46077	03/19/86
	DC-8-62	N802AX	46134	06/27/86
	DC-8-62	N803AX	45917	09/16/86
ARROW	DC-8-63	N941JW	45988	12/19/85
	DC-8-62F	N1803	45895	06/02/86
	DC-8-63	N6161A	45969	10/10/86
	DC-8-62 -	N1807	45904	10/10/86
ATASCO	B707-300	N864BX	19375	11/19/85
	B707-300	N865BX	19280	12/09/85
	DC-8-63	N870BX	46036	12/11/85
	B707-300	N863BX	19270	12/13/85
	B707-300	N862BX	19625	12/22/85
	DC-8-63	N868BX	46034	12/23/85
	DC-8-63F	N869BX	46035	01/03/86
	B707-300	N861BX	19293	01/13/86
BUFFALO AIRWAYS	B707-300	N106BV	19415	05/23/85 -
	B707-300	N8404	19584	09/30/85
BURLINGTON	DC-8-63	N870BX	46036	12/12/85
	DC-8-63	N868BX	46034	12/23/85
	B707-300	N8405	19585	12/30/85
	DC-8-63	N869BX	46035	01/03/86
CARICARGO	B707-331C	8P-CAC	19412	11/14/86
CHALLENGE	- B707-330C	N707HE	20124	08/30/85

TABLE E-5 (continued)

OPERATOR	AIRCRAFT INFORMATION			
CORANOR	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	G-BDEA	19296	11/01/86
CROIX	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	N1475P	20085	06/27/86
	B707-300	N1465P	20016	07/17/86
	B707-300	N1445P	19209	07/31/86
	B707-331	N227VV	19212	08/23/86
	B707-300	N1455P	20174	09/05/86
	B707-300	N228VV	18714	11/01/86
ECUATBRIANA	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	HC-BHY	20033	02/27/86
	B707-300	HC-BFC	19277	04/20/86
	B707-300	HC-BGP	19273	06/17/86
ÉMERY	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	DC-8-63	N959R	46143	08/29/85
	DC-8-63	N957R	46137	09/06/85
	DC-8-63	N964R	46000	09/12/85
	DC-8-63	N951R	46092	09/26/85
	DC-8-63	N921R	46145	10/02/85
	DC-8-63	N865F	46088	10/09/85
	DC-8-63	N950R	45903	11/20/85
	DC-8-63F	N906R	46087	04/10/86
	DC-8-63	N929R	45901	05/23/86
	DC-8-63	N952R	46061	09/09/86
EQUATOR	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	5N-ASY	18922	11/01/86
FAST AIR	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	CC-CAF	19435	02/07/86
FLORIDA WEST	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-331C	N700FW	18711	04/16/86
	B707-300	N710FW	20017	08/23/86
GREYFIN	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	G-BNGH	18718	05/03/86
HAWAIIAN	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	DC-8-62	N8970U	46071	06/14/86
	DC-8-63	N4934Z	46074	07/20/86
	DC-8-62	N8969U	46070	08/17/86
ICELANDAIR	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	DC-8-63	TF-FLV	46121	12/12/85
	DC-8-63	TF-FLT	46075	03/07/86
	DC-8-63	TF-FLU	45999	04/01/86
INDEPENDENT AIR	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-331B	N7231T	19572	05/02/86
JET24	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	DC-8-63	N810BN	45905	05/30/86

TABLE E-5 (continued)

OPERATOR	AIRCRAFT INFORMATION			
JETRAN	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	N731Q	20031	01/30/86
LAB	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-323CF	CP-1365	18692	04/01/86
	B707-323CF	CP-1698	19586	05/11/86
LAC	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	N5245J	19789	08/29/86
LAN CHILE	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-385C	CC-CEB	19000	04/26/86
LAP	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	DC-8-63	ZP-CCH	46115	08/01/86
LOWA	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	N88ZL	18928	11/16/85
MINERVE	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	DC-8-62F	F-GDJM	45960	04/30/86
MME FARMS	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	N8414	19577	01/08/86
NAUTILUS	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	N8402	19581	08/16/85
PAN AVIATION	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	N722GS	19373	07/05/86
	B707-300	N723GS	19986	11/01/86
PORTS OF CALL	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	N708PC	20170	09/14/85
	B707-300	N711PC	20172	01/25/86
	B707-300	N457PC	20178	03/10/86
	B707-300	N705PC	19587	03/17/86
	B707-300	N709PC	20175	05/26/86
	B707-300	N454PC	18839	06/12/86
	B707-300	N712PC	20176	07/17/86
	B707-300	N706PC	20177	08/10/86
RICH	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	DC-8-62	N1805	45899	06/27/86
	DC-8-62	N1808E	46105	08/14/86
SAS	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	DC-8-63	OY-KTF	46041	11/19/85
	DC-8-62	SE-DDU	45906	06/04/86
	DC-8-62	OY-SMB	45924	07/01/86
SENTER AIR	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	N729Q	20029	07/10/86
SKYSTAR	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	N728Q	20025	04/10/85
	B707-300	N732Q	20034	08/28/85

TABLE E-5 (continued)

OPERATOR	AIRCRAFT INFORMATION			
	B707-300	N2215Y	19631	11/30/85
	B707-300	N8955Y	20032	01/31/86
SKYWORLD	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	N702PC	17645	09/08/86
	B707-300	N703PC	19335	10/03/86
SOUTHERN AIR	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-320C	N5235J	20546	10/09/85
	B707-300	N5255J	20084	12/18/85
	B707-300	N5245J	19789	08/29/86
SPIA	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-323B	N1455P	20174	09/05/86
STERLING	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	DC-8-63	OY-SBK	45923	05/14/86
	DC-8-63	OY-SBL	46054	06/14/86
SURINAM	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	DC-8-63	N4935C	45931	10/22/86
TAMPA	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	HK-3232X	18717	10/09/85
	B707-320	HK-3030X	18808	03/14/86
TAR	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-338C	LV-MZE	19297	06/07/86
TRANSCORP	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	VR-HTC	18937	09/14/86
VARIG	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-320C	PP-VLP	18940	08/07/85
	B707-320C	PP-VJS	19321	10/16/85
	B707-320C	PP-VLI	19433	06/01/86
ZANTOP	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	DC-8-62	N813ZA	46139	08/09/85
	DC-8-62	N810ZA	46162	08/14/85
	DC-8-62	N811ZA	46154	10/18/85
	DC-8-62	N814ZA	45956	11/04/85
	DC-8-62	N815ZA	46024	11/08/85
	DC-8-62	N812ZA	46028	11/27/85
	DC-8-62	N816ZA	46068	12/20/85
ZAS	TYPE/MODEL	REGISTRATION NO.	SERIAL NO.	DELIVERED
	B707-300	SU-DAA	19916	11/17/85
	B707-328C	SU-DAB	19521	08/17/86
	B707-300	5Y-AXA	19621	11/01/86

TOTAL AIRCRAFT HUSH-KITTED 118

Source: FAA Office of Environment and Energy.

APPENDIX F

CACI'S POPULATION AND HOUSEHOLD FORECASTING AND GEOMETRIC RETRIEVAL METHODOLOGY

Forecasts of population and of households in the concentric rings around airports were produced for the study by CACI, Inc.-Federal. A summary of their methodology follows.[1]

Population Forecasts

Population forecasts begin with county updates of Bureau of the Census data. Every year Census makes population estimates for every county based on real data such as IRS returns and counts of people in institutions. Population estimates are made through multiple regressions based on the relationship of population to these indicators. These Census estimates are useful because they are recent, are uniform across the country, and are based on actual counts of the independent variables.

Demographers in all but three states also make county population estimates and project them into the future for up to thirty years. They base their forecasts on assumptions about migration rates and birth and death rates. These projections have the advantage of being made with local knowledge, but they are not made every year. CACI attempts to combine the advantages of both the Census and the state data.

The CACI method is to compare the state projections with Census estimates and adjust them. For example, if a state population projection for 1985, made in 1980, is 5% higher than the Census estimate for 1985, then the state estimates for that county beyond 1985 are reduced by 5%.

Finally CACI adds up all the county projections and compares them with the Census Bureau's Middle Series population projection for the nation. The county forecasts are then adjusted so that they add up to the national forecast.

The forecasts of population in the airport rings used in this study were based on population forecasts for census tracts and minor civil divisions (MCD's) which were then adjusted to add up to the county totals described above. Tract

[1] Based on CACI's "1986/2000 Update Methodology" and "Geometric Retrieval Methodology", received from CACI, Inc.-Federal in January 1987.

and MCD forecasts up until 1985 had been made by fitting their population's historical growth into one of seventy different patterns. From 1986, projections were made by averaging the results of four different methods:

- Linear population change
- Exponential population change
- Trended share of county population
- Constant share of county population

Extremely high or low growth rates are attenuated. From these forecasts population projections for 66,000 areas can be obtained. A method similar to that used for tract forecasts is used for the three states which do not make county forecasts.

Household Forecasts

CACI first defines a "household" as an occupied housing unit - a house, condo or apartment with people living in it. They then note the three trends which have resulted in smaller households:

(1) the baby boom generation which has delayed marriage and had smaller families
(2) the rapidly growing elderly component of the population whose family may have left home or who may be widowed
(3) the high divorce rate

CACI uses the 1980 Census tabulations for detailed household characteristics and updates them from Census's Current Population Surveys for their nine Divisions. Divisional changes, supplemented by its own and other projections of household size, are used to forecast households at the local level.

CACI continually checks the accuracy of its forecasts by comparing them with actual Census data when they become available. They also have a Board of Demographers to advise them, and a demographer would be available to discuss forecasting methodology on the telephone if more information were needed.

Geometric Retrieval Methodology

The geometric retrieval is based on the location of population within a defined search area. Each census tract, minor civil division, block group and enumeration district (ED) has a single latitude and longitude location associated with it called a population centroid. These population centroids are assigned by the Census Bureau, and represent the location where population is the most dense for the geographic unit. The population centroid is usually not located in the geographic center of the tract, MCD, block group, or ED.

Before any data for a geometric area is actually retrieved by CACI, a search takes place to determine which population centroids lie within the geometric shape specified. This search takes place at the block group/ED level. If it is determined that only some of the block groups or ED's within a tract or MCD lie within the specified area, the data will be retrieved at block group/ ED level. If it is determined that all the block groups or ED's within a tract or MCD lie within the specified area, the data will be retrieved at tract level for maximum processing efficiency. Otherwise if it is determined that all the tracts or MCD's within a county lie within the specified area, the data will be retrieved at county level.

If the defined search area is very small or if it is in a rural region where the census divisions are larger and the centroids are further apart than in a metropolitan area, a "No Areas Found" condition can occur. This means that no population centroids were found within the defined search area. (This does not mean that no population actually resides in the area, just that the population centroid is not in the defined search area.)

APPENDIX G

METHODOLOGY FOR COMPUTING GROSS PROPERTY VALUE IN EACH CACI ELEMENT FOR 1985, 1990, 1995 AND 2000

The methodology used to forecast housing units and housing values is similar to that used on forecasting population beyond the years provided by CACI. The CACI data provide:

- Population 1980, 1985 and 1990
- Households 1980, 1985 and 1990
- Owner-occupied housing in units, 1980
- Average value of this housing in dollars, 1980
- Number of rental units, 1980
- Average rent in dollars, 1980
- Owner-occupied condos in units, 1980
- Average value of condos in dollars, 1980

A sample of the information provided by CACI is shown in Table G-1.

Housing Units

It was assumed that housing units would equal households in the forecast years, and CACI provided forecasts of households through 1990. However, it was necessary to provide forecasts beyond 1990 to 1995 and 2000. At the national level the Bureau of the Census provides forecasts of households as shown in Table G-2. In order to obtain forecasts of housing units/households for each CACI element local (CACI) ratios of household changes 1985:1980 and 1990:1985 are compared with the corresponding national (Census Bureau) ratios for these periods. These ratios of ratios are then averaged for the two periods and applied to the national ratios 1995:1990 and 2000:1995 to yield local ratios for these two more future years.

The formulae may be written as follows:

Estimated local ratio 1995:1990 =

$$\frac{\dfrac{\text{Local ratio 1985:1980}}{\text{Nat'l ratio 1985:1980}} + \dfrac{\text{Local ratio 1990:1985}}{\text{Nat'l ratio 1990:1985}}}{2} \times \text{Nat'l ratio 1995:1990}$$

Similarly:

Estimated local ratio 2000:1995 =

$$\frac{\dfrac{\text{Local ratio 1985:1980}}{\text{Nat'l ratio 1985:1980}} + \dfrac{\text{Local ratio 1990:1985}}{\text{Nat'l ratio 1990:1985}}}{2} \times \text{Nat'l ratio 2000:1995}$$

With reference to Table G-2, these formulae may be re-written:

Estimated local ratio 1995:1990 =

$$\frac{\dfrac{\text{Local ratio 1985:1980}}{1.074} + \dfrac{\text{Local ratio 1990:1985}}{1.086}}{2} \times 1.065$$

and

Estimated local ratio 2000:1995 =

$$\frac{\dfrac{\text{Local ratio 1985:1980}}{1.074} + \dfrac{\text{Local ratio 1990:1985}}{1.086}}{2} \times 1.056$$

These local ratios may then be applied first to the CACI 1990 housing units to get a 1995 number, and then to the 1995 calculation to reach a 2000 number. The distribution of the three housing types - owner-occupied, rentals and condos - is assumed to remain constant throughout the forecast period.

Value of Housing Units

Two sources were used to determine trends in future housing values: the sales prices of Existing Single-Family Houses Sold (compiled by the National Association of Realtors - Table G-3) and the E. H. Boeckh Building Cost Index (compiled by the American Appraisal Co., Milwaukee, WI - Table G-4). This index ". . .is a simple average of indices for apartments, hotels and office buildings constructed with: (1) brick and wood, (2) brick and concrete, (3) brick and steel. The individual indexes take into account prices for selected building materials, common and skilled labor and wage rates, and sales and social security payroll taxes. They are also adjusted to reflect the effect of labor shortages and labor efficiency, as determined by monthly studies in each of the 20 pricing areas."[1]

In Table G-4 projections have been to these series through 2000, using a least squares regression with high r^2's (coefficients of regression).

Sales prices of new single-family houses are tabulated by the National Association of Home Builders from the Construction Reports, Series C-25, of the Bureau of the Census. A history of these prices is shown in Table G-3 with projection through 2000.

[1] Construction Review, U.S. Department of Commerce, June/July 1977, p. 16.

The median, as opposed to average, price of existing single-family houses sold, Table G-3, was projected by a least squares regression to give indices for the forecast years and was used to forecast the values of owner-occupied houses. The Boeckh index for apartments, hotels and office buildings was also regressed and projected to give indices for the forecast years. The forecast of the Boeckh index was used to forecast the values of rentals and condos. But first it was necessary to find some formula for converting the monthly rent of rentals, as provided by CACI, to property value.

Rented Apartments

The prices or values of rented property are calculated on the basis of various assumptions. The Bureau of Census produces data on the national median rent of new unfurnished apartments, and a history of these median rents is shown in Table G-5, with projections through 2000.

The real estate industry thinks in terms of the capitalization or "cap" rate. This is the rate of return after account has been taken of vacancies, a management fee, and a reserve. The calculation could look like this:

Vacancy of 2-7%, say 5%

Management fee - 3% of rental revenue

Reserve - 1% of revenue

Thus the rate of return would be on a base of 91.2% of the maximum rental income: $(100 - 5)(100 - (3 + 1))\%$. Suppose you decide you want a cap rate of $8\frac{1}{2} - 9\frac{1}{2}\%$, say 9%, per year, then you would want your annual income to equal 9% of 91.2% of maximum rent. The value of the property, therefore, can be found from the formula:

$$9\% \text{ of value} = 91.2\% \text{ of annual rent}$$

or

$$\text{Value} = \frac{91.2}{100} \times \frac{100}{9} \times \text{annual rent}$$

or

$$\text{Value} = 10.13 \times \text{annual rent}$$

or

$$\text{Value} = 121.6 \times \text{monthly rent}$$

There are two things to remember: (1) the cap rate will vary widely from place to place, generally speaking being lower in a neighborhood that is on the way up, and higher where the neighborhood is stagnating; (2) the median rents in

Table G-5 are for new unfurnished apartments; older apartments can be expected to be rented for less.

The result of the above reasoning is that in less desirable neighborhoods the rent multiplier needed to estimate a reasonable property value will be lower than that needed for the same purpose in a booming neighborhood, because the rents themselves will have had to be higher and/or the property will have had less value because of its location.

It is believed that the values used in the calculation above are approximately correct for the nation as a whole, and therefore a multiplier of 122 times the monthly rent will be used to estimate the value of rental property. This multiplier will be applied to the average monthly rent obtained by CACI from the 1980 Census.

The Forecasting Routine

First a weighted average housing value for each demographic area was calculated for each CACI element for 1980. For example, suppose a given area had a total of 100 housing units - 60 owner-occupied houses, 30 rental apartments, and 10 condos. Then assume the owner-occupied houses have an average value of $100,000 each, the average rent is $300 for the rentals or a value of 122 x $300 = $36,600, and the condos have an average value of $80,000. The weighted average value of all the units is $78,980 made up as follows:

Owner-occupied	(60% of $100,000)	$60,000	
Rentals	(30% of $36,600)	10,980	$18,980 (combined apartment/ condo value)
Condos	(10% of $80,000)	8,000	
		$78,980	

To determine 1985 values actual 1985:1980 national ratios (Table G-6) were applied to the weighted averages for each of the areas. They were then summed and multiplied by the total 1985 housing units to arrive at a total value for all three types of housing in that element. Beyond 1985, as noted above, it was decided to forecast the change in value of owner-occupied houses at the projected national rate for the median price of existing single-family houses from Table G-3. Similarly, the value of rentals and condos is forecast at the same rate as the projection of the E. H. Boeckh index for Apartments, Hotels and Office Buildings in Table G-4. These ratios are shown in Table G-6. Forecasts in constant 1985 dollars were obtained by dividing the current dollar forecasts by the numbers given in Table G-7.

TABLE G-1

EXAMPLE OF CACI DEMOGRAPHIC DATA FOR TWO ANNULAR RINGS
AT NEWBURGH, NEW YORK AND NEW HAVEN, CONNECTICUT

267 - SWF
NEWBURGH, NY
4 - 5 MILES

	1980	1985	1990
POPULATION	33178	35170	36924
HOUSEHOLDS	11932	12896	13752
TOTAL OWNER OCC HSG	4617		
AVG. VAL OWNER OCC HSG	38953		
TOTAL RENTAL 1980	5713		
AVG. VAL OF RENTAL 1980	248		
TOTAL OWNER OCC. CONDO	22		
AVG. VAL OWNER OCC CONDO	29938		

238-HVN
NEW HAVEN, CT
0 - 1 MILES

	1980	1985	1990
POPULATION	8360	8439	8441
HOUSEHOLDS	3029	3114	3161
TOTAL OWNER OCC HSG	1845		
AVG. VAL OWNER OCC HSG	54631		
TOTAL RENTAL 1980	816		
AVG. VAL OF RENTAL 1980	300		
TOTAL OWNER OCC. CONDO	44		
AVG. VAL OWNER OCC CONDO	35164		

TABLE G-2

NATIONAL HOUSEHOLD FORECAST

Year	No. of Households (000)	Five-Year Ratio
1980	80,776	
		1.074
1985	86,789	
		1.086
1990	94,227	
		1.065
1995	100,308	
		1.056
2000	105,933	

Source: Projections of the Population of the United States by Age, Sex and Race, 1983-2080 (middle series), U.S. Bureau of the Census.

TABLE G-3

SALES PRICES OF EXISTING SINGLE-FAMILY HOUSES SOLD
(CURRENT DOLLARS)

Year	Median	Average
1970	$ 23,000	$ 25,700
1971	24,800	28,000
1972	26,700	30,100
1973	28,900	32,900
1974	32,000	35,800
1975	35,300	39,000
1976	38,100	42,200
1977	42,900	47,900
1978	48,700	55,500
1979	55,700	64,200
1980	62,200	72,800
1981	66,400	78,300
1982	67,800	80,500
1983	70,300	83,100
1984	72,400	86,000
1985	75,500	90,800
1990[1]	97,184	116,100
1995[1]	116,782	140,300
2000[1]	136,381	164,400

[1] Lease squares regression. $r^2 = 0.98$ (median); $r^2 = 0.97$ (average).

Source: Existing Home Sales, National Association of Realtors.

TABLE G-4

E. H. BOECKH INDICATORS[1]

Year	Small Residential Structures	Apartments, Hotels, and Office Buildings	Commercial and Factory Buildings
1970	122.4	124.4	123.1
1971	132.8	135.0	133.9
1972	145.8	145.4	144.8
1973	159.2	154.5	154.4
1974	172.0	168.4	172.0
1975	183.8	184.9	189.8
1976	199.0	199.6	206.0
1977	217.0	216.0	222.5
1978	236.5	230.0	239.2
1979	258.2	247.8	260.5
1980	279.7	270.2	284.1
1981	295.1	296.8	311.7
1982	320.1	326.0	338.0
1983	339.0	344.7	361.8
1984	358.3	360.3	369.8
1985	358.4	366.1	376.2
1990	452.4	452.1	473.4
1995	538.7	538.6	565.5
2000	624.9	625.2	657.7
	$r^2 = 0.99$	$r^2 = 0.98$	$r^2 = 0.99$

[1] U.S. Department of Commerce, International Trade Administration, "Construction Review". 1967 = 100.0

TABLE G-5

MEDIAN RENTS - NEW UNFURNISHED APARTMENTS, >5 UNITS

(CURRENT DOLLARS)

Year	
1970	$188
1971	187
1972	191
1973	191
1974	197
1975	211
1976	219
1977	232
1978	251
1979	272
1980	308
1981	347
1982	385
1983	386
1984	393
1985	432
1990[1]	494
1995[1]	582
2000[1]	670

[1]Lease squares. $r^2 = 0.92$

Source: Current Housing Reports - Market Absorption of Apartments Report H-130. U.S. Department of Commerce, Bureau of the Census.

TABLE G-6

FORECAST RATIOS OF HOUSING VALUES

	Owner-Occupied Houses	Rentals	Condominia
1985: 1980	1.247 (actual)	1.402 (actual)	1.367 (actual)
1990: 1985	1.279	1.235	1.235
1995: 1990	1.208	1.191	1.191
2000: 1995	1.172	1.161	1.161

Note: Beyond 1985 the ratios for owner-occupied houses come from Table G-3; those for rentals and condominia come from Table G-4.

TABLE G-7

DIVISORS OF CURRENT DOLLARS TO OBTAIN CONSTANT 1985 DOLLARS

Year	Divisor
1980	0.766
1985	1.000
1990	1.224
1995	1.466
2000	1.724

APPENDIX H

STATISTICAL COMPARISON OF NANIM RESULTS WITH OTHER MODELS AND DATA

This appendix compares NANIM 1985 baseline results with U.S. Environmental Protection Agency (EPA) models which were developed in the late 1970's and with current data obtained at individual airports, primarily from Part 150 study results.

Comparison With EPA Model

In 1979 the EPA published a study of the Noise Exposure of Civil Air Carrier Airplanes Through the Year 2000.[1] This study used four avports to represent the nation's airports, 1975 operations, modified FAA fleet and operations forcasts and the population contour area functions from earlier studies at 23 airports.[2] The study estimated the populations and areas within L_{dn} 65-80 dB at five year intervals from 1975-2000 for a variety of scenarios.

In 1980, a refinement of this study[3] was made for the EPA. This refinement used most of the basic avport areas developed in the initial report but refined the population functions, to better account for the population density around many of the nation's airports. The results for the population and area within L_{dn} 65 dB for both the initial and refined EPA studies and the NANIM for the NANIM Base Year of 1985 are given below in Table H-1.

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[1] Bartel, et al., "Noise Exposure of Civil Air Carrier Airplanes Through the Year 2000", EPA 550/9-79-313-1, Feb. 1979.

[2] Bartel, et al., "Airport Noise Reduction Forecast, Vol. 1, Summary for 23 Airports", DOT-TST-75-3, Oct. 1974.

[3] Eldred, K., "Estimate of the Impact of Noise From Jet Aircraft Air Carrier Operations", BBN Report 4237 for the U.S. Environmental Protection Agency under Contract EPA 68-0105014, Sept. 1980.

TABLE H-1

COMPARISON OF 1985 BASELINE POPULATION AND AREA WITHIN LDN 65 dB

Source	Population (thousands)	Area Sq. Mi.
EPA Year 2000	3,775	1,397
EPA Year 2000 Refined	2,523	1,344
Current NANIM	3,220	1,432

It is clear from this comparison that the NANIM contour areas are consistent with the EPA results and that its estimate of population is neatly bracketed by those two earlier estimates.

Statistical Comparison of NANIM Impact Estimates With Airport Data Base

It was noted in the Background discussion that a national noise impact model could be constructed either by adding airport specific impacted areas or populations together or by using the more generalized avport approach. Clearly, the superposition of impacts, calculated at each of the nation's airports, should give the best estimate of impact in a base year when all the controlling input data are known. However, it is very difficult to forecast the operations mix at specific airports into a distant future, keeping a proper relation to a national forecast of operations mix. If this method were to be attempted for 50-100 airports, it would not only be technically difficult and subject to uncertainties in future forecasts, but it would also be costly since it takes considerable effort to obtain the necessary base year input data and forecasts for each airport. Therefore, the avport model offers the greatest flexibility and efficiency for estimating changes in future national impacts based on changes in national forecast operations.

The two methods can be combined, such that the base year avport results are statistically compared with "actual" values obtained by adding up the impacts calculated for each of the airports in each airport category. If substantially all airports in a category were represented by actual values it should be possible to use them to calibrate the base year avport to account for airport actions to minimize impact (e.g., ground tracks away from populations and preferential runway use). Such a calibration would be expected to improve the absolute accuracy of the estimates for any given scenario and year, but have little effect on the relative accuracies of estimates, either by year or amongst scenarios. This type of comparison will become increasingly practicable in the future when the majority of airports have completed Noise Exposure Maps under the FAA Part 150 program. Subsequently, the Part 150 process should provide a continuous flow of consistent data that should enable updating the nation's airport noise impact base on a regular basis.

At this time only a few airports have completed the Part 150 process. Therefore, to make a comparison with the current results, the Part 150 data (23 airports) were supplemented with other contour based population data available to the FAA Office of Environment and Energy (6 airports). These estimated populations data were based on operations in the period of 1983-1986 and the L_{dn} contours developed with the INM. Table H-2 identifies the 29 airports used in this comparison to test for statistical confidence at the 95% confidence level. No appropriate data were available for the fifth airport category, the small size short-range airport which contained 64 airports. Therefore, the statistical comparison is limited to four categories, which contain a total of 183 airports.

Table H-3 summarizes various statistical comparisons between the sample airport data and NANIM results. For each of the four airport categories and the total 29 airport sample it gives:

- number of airports in the sample
- mean
- standard deviation
- 95% confidence interval
- NANIM mean value for the sample airports

The table also gives the NANIM mean values for all airports in each category and the total value for the four categories. The results indicate that the NANIM estimates are generally within the 95% confidence interval based on the sample airports.

The results from the 29 airports were scaled by category to obtain an estimate of the total population in each category within L_{dn} 65 dB. The total population for these four categories is 2,080,000 with a 95% confidence interval of 331,174 to 3,861,475. Similarly, the results for the total

TABLE H-2

LIST OF AIRPORTS USED IN COMPARING THE POPULATION RESIDING WITHIN THE L_{dn} 65 dB AIRPORT NOISE CONTOUR

LOCID	City Name	No. Airports in NANIM Category
Large Size Long-Range		6
LAX	Los Angeles[3]	
SFO	San Francisco[3]	
SEA	Seattle/Tacoma[1]	
Large Size Medium-Range		22
ATL	Atlanta[3]	
BOS	Boston[4]	
SAN	San Diego[2]	
SJC	San Jose[1]	
PDX	Portland[1]	
Large Size Short-Range		44
PIT	Pittsburgh[3]	
CLT	Charlotte[2]	
SLC	Salt Lake City[2]	
CLE	Cleveland[3]	
MSY	New Orleans[2]	
DAL	Dallas-Love[2]	
DAY	Dayton[2]	
SAT	San Antonio[2]	
ABQ	Albuquerque[2]	

LOCID	City Name	No. Airports in NANIM Category
Medium Size Short-Range		111
PBI	West Palm Beach[1]	
LIT	Little Rock[2]	
PVD	Providence[1]	
MAF	Midland/Odessa[2]	
SRQ	Sarasota/Bradenton[1]	
AMA	Amarillo[2]	
BOI	Boise[2]	
BTR	Baton Rouge[1]	
HSV	Huntsville/Decatur[1]	
MSO	Missoula[2]	
PSP	Palm Springs[2]	
GNV	Gainesville[1]	
Small Size Short-Range		64
	None available	

Notes:

[1] 9 Airports: Completed Part 150 Noise Exposure Map or recent ANCLUC study.

[2] 14 Airports: Data obtained in verbal communications within FAA on Part 150 study in process.

[3] 5 Airports: Special FAA studies using the INM.

[4] 1 Airport: Airport Initiated Noise Contour Update.

TABLE H-3

STATISTICAL COMPARISONS BY AIRPORT CATEGORY BETWEEN AIRPORT SAMPLE DATA AND NANIM ESTIMATE FOR THE POPULATION ESTIMATED TO RESIDE WITHIN L_{dn} 65 dB FOR 1985 BASE OPERATIONS

	Sample Airports					All Airports	
Airport Category	No. of Airports	Mean	Standard Deviation	95% Confidence Interval for the Mean*	NANIM Mean Value for Sample Airports	Total No. of Airports in Category	NANIM Mean Value For All Airports in Category
LLR	3	42,115	31,756	0 - 87,810	78,700	6	81,800
LMR	5	32,947	24,999	7,510 - 58,383	64,400	22	51,100
LSR	9	14,728	16,105	3,141 - 26,315	18,200	44	31,300
MSR	12	4,095	6,429	250 - 8,039	1,900	111	2,000
TOTAL**	29	16,302	20,825	8,293 - 24,311	25,700	183	17,500

* Based on "t" statistic applicable to small samples

$$C.I. = \bar{x} \pm t_{.05} s/\sqrt{n-1}$$

where $\bar{x}$ = the sample mean

$t_{.05}$ = 2.035 (the value of t for the upper bound of a 95% interval)

s = sample standard deviation

and n = number of samples

**Ensemble totals: All 29 data points are considered to belong to one sample.

sample of 29 airports were scaled tothe 183 airports. This results in an estimated population within Ldn 65 dB of 2,983,000 (183 x 16,302) with a 95% confidence interval of 1,518,000 to 4,449,000. This estimate compares very favorably with the NANIM estimate of 3,220,000 people.

The statistical comparisons between the 29 airport sample data and NANIM are supportive of the NANIM results. More specific conclusions would require the availability of a significantly large smaple of airport data with careful attention to balance. It would be desirable that the New York airports. paritcularly LaGuardia, be included in an improved sample because of the size of their potential impacts. In the 1972 23 airport study, for example, LaGuardia alone was estimated to have over one million people within Ldn 65 dB, and is responsible for 460,000 people out of the total of 3,220,000 in the 1985 NANIM baseline.

Supplemental statistical analysis for validation

As was previously stated, at the time this report was prepared only a few airports completed a Part 150 program, including the noise exposure map and compatibility program. Consequently, the FAA delayed publication of this report until enough Part 150 studies were available to perform a more detailed comparison of NANIM versus actual Part 150 studies which used INM. Because of the mix of airports involved in the Part 150 process and the manner in which avports are developed, this comparison only includes large long, medium, and short range airports. These 65 Part 150 airport studies account for 90% of all enplanements and 85% of all operations within the United States. This compares to NANIM which utilizes data from 247 civil airports in the United States which have known scheduled turbo-jet aircraft air carrier operations. Using only large airports, NANIM estimates that 2,991,000 people are within 65 Ldn encompasing an area of 1079 sq. miles. This compares to 2,732,387 people from the Part 150 studies available to the FAA. In comparing the number of people within the 75 Ldn, NANIM estimates 287,000 people with a land area of 172 sq. miles versus 136,845 people and 205 sq. miles from the Part 150 studies.

The difference in population within the 65 Ldn is primarily attributed to the fact that some of the Part 150 studies are still in progess and the data are not available. The population counts and land area reported in the Part 150 studies are based on a detailed analysis of airport operations, specific fleet characteristics, flight tracks, aircraft operations restrictions and populations counts undertaken by the airport operator while NANIM uses an avport for various classes of airports.

In conclusion, NANIM results appear to accurately portray the number of people and land area within the 65 Ldn but not the number of people and land area within the 75 Ldn. The unique nature of the land use patterns and flight tracks at each of the airports overpowers the models ability to derive a representative average avport which can accurately assess the number of people and land area within the 75 Ldn.