Appendix D
Noise Measurements

AIRCRAFT NOISE MEASUREMENT PROGRAM

A supplemental noise measurement program was conducted over a two-day period from August 25, 1999 through August 26, 1999. The supplemental field measurement program was undertaken to re-measure two monitor sites in which technical problems occurred with the noise monitor equipment.

It must be recognized that field measurements made over a 24-hour period are applicable only to that period of time and may not -- in fact in many cases, do not -- reflect the average conditions present at the site over a much longer period of time. The relationship between field measurements and computer-generated noise exposure forecasts is analogous to the relationship between weather and climate. While an area may be characterized as having a cool climate, many individual days of high temperatures may occur. In other words, the modeling process derives overall average annual conditions (climate), while field measurements reflect daily fluctuations (weather).

Information collected during the noise monitoring program included 24-hour measurements for comparison with computer-generated DNL values. DNL -- day-night sound level -- is a measure of cumulative sound energy during a 24-hour period. In addition, all noise occurring from 10:00 p.m. to 7:00 a.m. is assigned a 10 dB penalty because of the greater annoyance typically caused by nighttime noise. Use of the DNL noise metric in airport noise compatibility studies is required by F.A.R. Part 150. Additional information collected on single event measurements is used as an indicator of typical dBA and Sound Exposure Levels (SEL) within the study area as well as comparative ambient noise measurements in areas affected by aircraft noise.

ACOUSTICAL MEASUREMENTS

This section provides a technical description of the acoustical measurements which were performed for the Williams Gateway Airport F.A.R. Part 150 Noise Compatibility Study. Described here are the instrumentation, calibration procedures, general maturement procedures, and related data collection items and procedures.

Instrumentation

Two sets of acoustical instrumentation, the components of which are listed in **Table D1**, were used to measure noise. Each set consisted of a high quality microphone connected to a 24-hour environmental noise monitor unit. Each unit was calibrated to assure consistency between measurements at different locations. A calibrator, with an accuracy of 0.5 decibels, was used for all measurements. At the completion of each field measurement, the calibration was rechecked, the accumulated output data was downloaded to a portable computer.

TABLE D1
Acoustical Measurement Instrumentation

2	Larson Davis 820 Portable Noise Monitors and Preamplifiers
2	Larson Davis Model 2559 - ½ Microphones
1	Model CA250 Sound Level Calibrator
1	Portable Computer

The equipment indicated in the table was supplemented by accessory cabling, windscreens, tripods, security devices, etc., as appropriate to each measurement site.

Two methods were used to attempt to minimize the potential for non-aircraft noise sources to unduly influence the results of the measurements. First, for single-event analysis, minimum noise thresholds of five to ten decibels (dB) greater than ambient levels were programmed. This procedure resulted in the requirement that a single noise event exceed a threshold of 60 dB at each site. Second, a minimum event duration longer than the time associated with ambient single events above the threshold (for example, road traffic) was set (generally at five seconds). The combination of these two factors limited the single events analyzed in detail to those which exceeded

Measurement Procedures

the preset threshold for longer than the preset duration. In spite of these efforts, contamination of the single event data is always possible.

Although only selected single events were specially retained and analyzed, the monitors do, however, cumulatively consider all noise present at the site, regardless of its level, and provide hourly summations of Equivalent Noise Levels (Leq). Additionally, the equipment optionally provides information on the hourly maximum decibel level, SEL values for each event which exceeds the preset threshold and duration, and distributions of decibel levels throughout the measurement period.

Weather Information

The noise measurements taken during this study were obtained during a period of average summer weather for the Williams Gateway area. Conditions were generally clear throughout the program with only one intermittent rain shower during the monitor period. Winds were generally light and from the north in the mornings, switching to the south in the afternoons. Daily temperatures ranged from high of 105 degrees to lows in the low 80s.

Aircraft Noise Measurement Sites

Noise measurement sites are shown on **Exhibit D1**. Both sites were measured for 24-hours periods.

Site E is located at 21787 E. Nightingale in Queen Creek. This home is approximately 13,000 feet southeast of the airport. The area is a single-family residential area of contemporary homes on large lots. The site is in an area that would likely receive regular arrival and departure overflight noise from all three runways.

The equipment was set up at the side yard of the house. A small dog was present in the backyard. There were no overflights during the equipment setup.

The 24-hour equivalent sound level (Leq) for the 24-hour period at Site E was 45.4. The DNL level for this site was computed for the period was 51.5. The mode noise level, that is, the most commonly recorded level, was 39.9 for the 24-hour measurement period.

Site F is located at 17208 E Sagosa in Gilbert approximately 12,000 feet west of the airport. The area is a large single-family residential area of contemporary homes on large lots.

The equipment was set up at the rear of the house near a horse stable. Horses and a large dog were present during the monitor setup. The Southern Pacific Railroad tracks are approximately 2,000 feet from the monitor location. There were no aircraft overflights during the monitor setup.

The 24-hour Leq for Site F was 47.2. The DNL level for this site was computed to be 62.2 for the measurement period. The most commonly recorded level was 43.7 for the 24-hour measurement period.

MEASUREMENT RESULTS SUMMARY

The noise data collected during the measurement period are presented in **Table D2**. The information includes the average 24-hour Leq for each site. The Leq metric is derived by accumulating all noise during a given period and logarithmically averaging it. It is similar to the DNL metric except that no extra weight is attached to nighttime noise.

Three DNL values are presented for each site. DNL(24) represents the DNL from all noise sources. DNL(t) is developed only from noise exceeding the loudness and duration thresholds defined at each measurement site. The DNL(t) is a reasonable approximation of the DNL attributable to aircraft noise alone. Aircraft noise events are usually the only ones exceeding these thresholds if the site and the thresholds are carefully selected. It is this DNL(t)

TABLE D2
Measurement Results Summary
Williams Gateway Airport

	Site E	**Site F**
Measurement Dates	8/25 -85/26	8/25 -85/26
Cumulative Data		
LEQ(24)	45.4	47.2
DNL(24)	51.6	62.2
DNL(t)	46.0	50.6
DNL(b)	50.2	61.7
MODE dB	39.9	43.7
L(50)	42.4	50.8
Single Event Data		
L(max)	86.2	78.4
SEL(max)	88.3	98.5
Max Duration (sec)	38	2396
Number of Single Events above 60 dB (Lmax)	67	175
Number of Single Events Above		
SEL 70 dB SEL	45	92
SEL 80 dB	5	32
SEL 90 dB	0	4
SEL100 dB	0	0

Source: Coffman Associates Analysis

value against which modeled noise may be compared to assess the adequacy of the computer predictive model in describing actual conditions. DNL(b) provides a measure of the residual background noise resulting from subtracting the DNL(t) value from the DNL(24) value.

In addition, the L(50) values for each site are presented. These values represent the sound levels above which 50 percent of the samples were recorded. All of the cumulative data presented represents the average values for the duration of the measurements at each site.

The table also presents data on other measures of noise that may be useful for comparisons. These include:

- Maximum recorded noise level in dB (Lmax);
- Maximum recorded sound exposure level (SELmax);
- Longest single-event duration in seconds (Dur max);
- Most frequently recorded decibel level (Mode dB);
- Number of single events above sound exposure levels (SEL) 70, 80, 90, and 100.

For comparative purposes, normal conversation is generally at a sound level of 60 decibels while a busy street is approximately 70 decibels along the adjacent sidewalk.

The program resulted in a total of two 24-hour periods from two sites south and west of the Airport. A total of 242 single events were recorded during the program.

COMPARATIVE MEASUREMENT ANALYSIS

A comparison of the measured versus the computer-predicted cumulative DNL noise values for each measurement site has been developed. In this case, it is important to remember what each of the two noise levels indicates. The computer-modeled DNL contours are analogous to the climate of an area and represent the noise levels on an average day of the period under consideration. In contrast, the field measurements reflect only the noise levels on the specific day of measurement. Additionally, the field measurements consider all of the noise events that exceed a prescribed threshold and duration (DNL(t)), while the computer model only calculates the noise due to the aircraft events. As previously discussed, the field measurements can easily be contaminated by ambient noise sources other than aircraft around the measurement sites. With this understanding in mind, it is useful to evaluate the comparative aircraft DNL levels of the measurement sites.

DNL Comparison

This analysis provides a direct comparison of the measured and predicted average daily DNL values for both 24-hour noise measurement site. In order to facilitate such a comparison, it is necessary to ensure that the computer model input is representing the observed reality as accurately as possible within the capabilities of the model.

During the measurements, the airport operated in both a south flow and a north flow. The flow tended to vary throughout the day during the program. Consequently, in order to evaluate the INM based on this field data, it is reasonable to look at the average annual noise contours developed as a requirement of F.A.R. Part 150.

A difference of three to four DNL is generally not considered a significant deviation between measured and calculated noise, particularly at levels above 65 DNL. Additional deviation is expected at levels below 65 DNL. For comparison, the average human ear cannot distinguish changes in sound levels of less than two or three decibels. The measured and predicted noise levels are presented for each aircraft noise measurement site in **Table D3**.

For the most part, the measurements reflect the predicted sound levels in the area surrounding the airport. As seen in **Table D3**, in both cases the predicted sound levels fall within the three to four decibel deviation. Measured values at Site E, southeast of the Airport, were 4.0 DNL below the INM predicted values. Measured values at Site F, located west of the Airport, are slightly higher (4.4 DNL) than predicted. The nearby Southern Pacific Railroad tracks and horse stable are possible contributors to the higher DNL values measured at this location. There were several events recorded at Site F that lasts longer than a typical aircraft overflight (20 to 60 seconds). The longest event recorded lasted almost 40 minutes.

TABLE D3
Noise Measurement vs. Predicted DNL Values

	Site #E Day 1	Site #F Day 1
INM-Predicted Values	50.4	46.2
Measured Values	46.0	50.2
Difference	+4.4	-4.0

Source: Coffman Associates Analysis

SUMMARY

The noise measurement values recorded at Sites E and F are within acceptable deviation between measured and calculated noise levels. It must be recognized, however, that field measurements made over a one-day period are applicable only to that period of time and may not -- in fact, in many cases, do not -- reflect the average conditions at the site over a much longer period of time. The computer-modeled contours represent noise levels on an average day of the year. In contrast, the measurements reflect only the noise levels present at the time of measurement. In other words, the modeling process derives overall average annual conditions, while field measurements reflect daily fluctuations.