SAN DIEGO International Airport

AIRPORT MASTER PLAN
SAN DIEGO INTERNATIONAL AIRPORT

CHAPTER 6

Noise Contours

HNTB

SAN DIEGO INTERNATIONAL AIRPORT

MAY 2008

6. NOISE CONTOURS

Noise contours are estimates of future noise exposure levels, which are based upon projected forecasts and fleet mix as well as operational trends such as runway and flight track use. Essentially, this information is used to estimate how many aircraft will operate, what direction they will go, and how quickly an aircraft will descend or climb. The intent of the noise analysis task is to estimate potential future noise exposure levels to aid in the management of aircraft noise and land use non-compatibility. Individual operational factors for generation of the noise contours are described in the following sections.

Figure 6-1 shows the 2020 CNEL contours and **Figure 6-2** shows the 2030 CNEL contours with both the low and high forecast levels.

6.1 Noise Model, Weather, and Terrain

Noise contours are generated using the FAA's Integrated Noise Model (INM). INM version 6.1 was utilized for this study. During aircraft certification, aircraft manufacturers develop extensive data on aircraft flight performance, such as takeoff and climb performance and arrival procedures. The noise generated during these maneuvers is integrated into the INM.

INM uses annual average daily operations to compute existing and forecast noise. Annual average daily operations are representative of all aircraft operations that occur over the course of a year. The total annual operations are divided by 365 days to determine the annual average daily operations. Runway and flight track use is also averaged over one year.

Noise exposure is expressed in terms of the Community Noise Equivalent Level (CNEL), a metric that applies a 3-decibel (dB) penalty to aircraft that operate during the evening (7:00 PM to 9:59 PM) and a 10-dB penalty during the nighttime (10:00 PM to 6:59 AM). The evening and nighttime penalties are intended to address the added intrusiveness of aircraft noise during these periods, when ambient noise levels are typically lower and people are sleeping. CNEL is used in the State of California to represent aircraft noise exposure levels, which are shown in the form of noise contours. CNEL does not represent the sound level heard at any particular time, but rather represents the total (and partially weighted) sound exposure.

Weather conditions are a factor in calculating noise exposure and can affect aircraft performance and the distance that noise travels through the air. The average temperature (60.4-degrees Fahrenheit), humidity (72.7 percent), and pressure values (28.44 in-Hg) were calculated using a 10-year sample of National Climatic Data Center (NCDC) hourly weather data at SDIA. For the purpose of calculating the average headwind for each runway end, hourly weather data was matched to the three-month sample of Airport Noise and Operations Monitoring System (ANOMS) data for the fourth quarter of 2003. Typical headwinds for Runway 27 operations are 3.5 miles per hour, while Runway 9 has typical headwinds of 0.9 miles per hour. Higher headwinds will shorten the takeoff distance and increase the climb rate of departing aircraft, which will reduce noise on the ground as compared to calm wind conditions.

Terrain data at 10-foot intervals was used in the noise model in order to calculate the distance between aircraft flights and locations on the ground. The displaced landing thresholds on Runways 9 and 27 are also included in the noise model.

6.2 Fleet Mix

Detailed fleet mix information was estimated for both year 2020 and 2030 levels, including use of both low and high capacity constrained forecast levels. This provides for comparison of the range of potential future noise exposure levels, given the projected traffic volumes with the future capacity constraints at

SDIA. The 2004 Aviation Activity forecast served as the basis for development of the fleet mix and total flight operations.[4]

Table 6-1 summarizes the fleet mix by aircraft group and aircraft type; the total distribution of daytime, evening, and nighttime operations is also shown. The stage length and time of day distributions for passenger aircraft are developed from the gated flight schedule based on the 2004 Aviation Activity forecast. The stage length is a surrogate to typical aircraft weights. Aircraft that are flying longer distances (i.e., stage lengths) require more fuel and hence weigh more on takeoff. As aircraft weight increases, takeoff distance increases, climb rate decreases, and noise on the ground typically increases as a result. The use of stage length data permits aircraft takeoff weights to be factored into the noise model. The stage length and time of day distributions for cargo and general aviation (GA) operations are developed from a three-month sample (i.e., fourth quarter of 2003) of ANOMS data.

6.3 Runway Use

Runway use is the proportion of aircraft that use a runway for departure or arrival, expressed as a percent. From an operational perspective, runway use is determined by several factors, including safety, weather, traffic demand, runway capacity, direction of flight, runway length requirements, and prescribed runway use procedures. ATC assigns runway use with consideration of all of these factors.

Data for annual average runway use was obtained from a three-month sample (i.e., fourth quarter of 2003) of ANOMS data. Runway use was categorized by arrival/departure, time of day, and one of the following aircraft groups: GA/military jets, GA propeller, cargo large jets, cargo heavy jets, mainline passenger large jets, mainline passenger heavy jets, or regional jets. **Table 6-2** illustrates the overall average runway use.

[4] The aviation activity forecast included fleet mixes for the unconstrained forecast. HNTB rebalanced the fleet mix in order to average aircraft size assumptions for a constrained forecast.

Table 6.1-1

Annual Average Daily Fleet Mix

Group	ICAO Aircraft Type	2020 Low Constrained	2020 High Constrained	2030 Low Constrained	2030 High Constrained
Cargo	A306	2.6	3.4	5.2	6.6
	B762	6.2	8.1	9.9	12.6
	DC10	2.4	3.2	2.0	2.5
	DC87	0.6	0.7	-	-
	MD10	3.4	4.5	6.9	8.8
	B72Q	2.4	3.2	-	-
	B752	0.8	1.0	0.7	0.9
General Aviation	CL60	7.1	7.6	7.3	7.6
	GLF4	17.7	18.9	18.2	18.9
	H25B	10.6	11.4	10.9	11.4
	BE20	11.8	12.6	12.1	12.6
Military	HU25	3.1	3.1	3.1	3.1
Mainline Pax	A340	2.7	3.3	3.2	3.7
	B762	-	-	-	-
	B763	7.5	8.5	6.1	7.1
	B764	-	-	-	3.7
	B772	6.6	9.5	7.7	18.6
	A319	36.3	38.7	38.4	37.3
	A320	76.3	86.7	151.2	147.6
	A321	5.7	6.5	8.3	3.7
	B733	34.0	38.9	-	-
	B734	11.9	13.5	23.8	2.8
	B735	23.7	26.8	28.5	18.6
	B737	160.6	183.4	229.7	251.3
	B738	44.0	50.0	80.0	93.2
	B739	0.7	0.8	3.4	3.7
	B752	22.4	25.5	7.4	29.8
	MD83	48.5	55.2	7.6	9.3
	MD90	12.1	13.8	-	-
Regional Pax	CRJ2	34.5	36.2	26.6	29.8
	CRJ7	25.8	27.5	25.3	24.2
	E145	39.2	41.1	30.2	18.6
	E190	25.1	26.6	24.5	29.8
	E120	-	-	-	-
	SF34	-	-	-	-
Total Daily Ops		**686.4**	**770.1**	**778.4**	**818.4**
Time of Day	Day	74.5%	74.3%	72.5%	72.6%
	Evening	15.7%	15.9%	16.8%	16.4%
	Night	9.8%	9.9%	10.7%	11.0%
	Total	100.0%	100.0%	100.0%	100.0%

Note: FAA INM 6.1 pre-approved substitution list was used for aircraft not in INM.

Source: Aviation Activity Forecasts (February 2004) and ANOMS (Fourth Quarter 2003)

Table 6.2-2

Average Annual Runway Use

Operations Type	Time of Day	Runway 9	Runway 27	Total
Arrival	Daytime	3.7%	96.3%	100.0%
	Evening	2.9%	97.1%	100.0%
	Nighttime	9.1%	90.9%	100.0%
	Total (EDO[1])	**5.9%**	**94.1%**	**100.0%**
Departure	Daytime	2.2%	97.8%	100.0%
	Evening	1.9%	98.1%	100.0%
	Nighttime	2.1%	97.9%	100.0%
	Total (EDO)	**2.1%**	**97.9%**	**100.0%**
Overall	Daytime	2.9%	97.1%	100.0%
	Evening	2.5%	97.5%	100.0%
	Nighttime	5.3%	94.7%	100.0%
	Total (EDO)	**4.0%**	**96.0%**	**100.0%**

[1] EDO = Equivalent Daily Operations Derived with 2030 High Constrained forecast fleet mix

Source: ANOMS (Fourth Quarter 2003).

6.4 Flight Tracks

Modeled flight tracks depict the approximate paths, or ground tracks, that aircraft use for departure or arrival at SDIA. Flight track layout was developed from a 15-day sample of radar data from October 11 to 25, 2003. This sample was identified for flight track analysis based on the near-average temperature spreads prevailing during the period and the availability of operations data for both Runways 9 and 27.

Figures 6-3 and **6-4** show modeled flight tracks for west flow (i.e., operations to/from Runway 27) and east flow (i.e., operations to/from Runway 9), respectively. **Table 6.3-3** shows the average daily percent of operations by runway end on each modeled flight track. Modeled departure flight tracks were developed for the 250, 275, 290, and 305/310-degree headings off Runway 27, as well as for the 090-degree heading and left turn tracks off Runway 9. Multiple sub-tracks were developed to the left and right of the primary flight tracks in order to model the dispersion of typical aircraft flight paths that occur as a result of weather and varying aircraft performance. Modeled arrival flight tracks were developed for the approaches to Runways 9 and 27 (e.g., the ILS RWY 9 and LOC RWY 27 IAPs) with dispersion and turns onto the final approach path as indicated by the radar data. The modeled flight tracks were developed to depict typical flight paths in the vicinity of SDIA (i.e., within a few miles of the Airport to include the extents of the CNEL contours).

Flight track use, including dispersion about the primary and sub-tracks, has been developed with reference to the modeled flight tracks and the 15-day sample of aircraft operations. Similar to runway use data, the flight track use data is categorized by reference to arrival/departure, time of day, and aircraft group.

Table 6.3-3

Average Annual Flight Track Use

Operation Type	Runway	Track[1]	Time of Day: Daytime	Time of Day: Evening	Time of Day: Nighttime	Total (EDO[2])
Arrivals	09	A09A0	79.2%	85.9%	83.3%	82.8%
		A09A1	3.2%	1.7%	0.2%	1.0%
		A09A2	17.1%	12.4%	13.9%	14.3%
		A09A3	0.0%	0.0%	0.0%	0.0%
		A09A4	0.5%	0.0%	2.6%	1.9%
Total			**100.0%**	**100.0%**	**100.0%**	**100.0%**
	27	A27A0	91.2%	92.7%	92.4%	92.1%
		A27A1	2.4%	2.5%	3.0%	2.7%
		A27A2	2.9%	1.2%	1.7%	1.9%
		A27A3	0.6%	0.5%	0.2%	0.4%
		A27A4	0.7%	0.5%	0.6%	0.6%
		A27B0	0.1%	0.2%	0.0%	0.1%
		A27B1	0.1%	0.0%	0.0%	0.0%
		A27B2	0.1%	0.3%	0.9%	0.5%
		A27B3	0.1%	0.0%	0.0%	0.0%
		A27B4	0.2%	0.0%	0.1%	0.1%
		A27C0	0.3%	1.1%	0.3%	0.5%
		A27C1	0.1%	0.2%	0.5%	0.3%
		A27C2	0.4%	0.5%	0.1%	0.3%
		A27C3	0.2%	0.3%	0.0%	0.1%
		A27C4	0.3%	0.1%	0.0%	0.1%
		A27C5	0.0%	0.0%	0.0%	0.0%
		A27C6	0.2%	0.0%	0.0%	0.1%
Total			**100.0%**	**100.0%**	**100.0%**	**100.0%**
Departure	09	D09A0	12.1%	0.0%	0.0%	4.1%
		D09A1	0.0%	24.7%	0.0%	3.7%
		D09A2	40.7%	42.8%	53.7%	47.7%
		D09A3	0.0%	0.0%	21.6%	11.1%
		D09A4	31.9%	10.4%	2.4%	13.6%
		D09B0	2.9%	0.0%	0.0%	1.0%
		D09B1	4.7%	0.0%	0.3%	1.8%
		D09B2	0.0%	0.0%	21.6%	11.1%
		D09B3	0.0%	0.0%	0.3%	0.2%
		D09B4	7.6%	0.0%	0.0%	2.6%
		D09B5	0.0%	0.0%	0.0%	0.0%
		D09B6	0.0%	22.2%	0.0%	3.3%
Total			**100.0%**	**100.0%**	**100.0%**	**100.0%**
	27	D27A0	0.0%	0.0%	0.0%	0.0%
		D27A1	0.0%	0.0%	0.0%	0.0%
		D27A2	0.0%	0.0%	0.0%	0.0%
		D27A3	0.0%	0.0%	0.0%	0.0%
		D27A4	0.0%	0.0%	0.0%	0.0%
		D27A5	0.0%	0.0%	0.0%	0.0%
		D27A6	0.0%	0.0%	0.0%	0.0%
		D27B0	15.0%	17.3%	12.0%	13.9%
		D27B1	14.3%	22.2%	23.6%	20.3%
		D27B2	4.5%	2.5%	0.5%	2.2%
		D27B3	4.3%	12.8%	17.6%	12.5%
		D27B4	0.6%	0.4%	0.1%	0.3%
		D27B5	0.4%	1.1%	1.0%	0.8%

Table 6.3-3

Average Annual Flight Track Use

Operation Type	Runway	Track[1]	Time of Day: Daytime	Time of Day: Evening	Time of Day: Nighttime	Total (EDO[2])
		D27B6	0.2%	0.0%	0.0%	0.1%
		D27C0	20.0%	9.3%	19.9%	18.1%
		D27C1	6.3%	11.7%	5.3%	6.7%
		D27C2	26.6%	17.4%	15.7%	19.5%
		D27C3	1.0%	3.1%	1.1%	1.4%
		D27C4	6.3%	1.7%	3.0%	3.9%
		D27C5	0.2%	0.4%	0.0%	0.1%
		D27C6	0.1%	0.0%	0.2%	0.1%
		D27C7	0.0%	0.0%	0.0%	0.0%
		D27C8	0.0%	0.0%	0.0%	0.0%
		D27D0	0.0%	0.0%	0.0%	0.0%
		D27D1	0.0%	0.0%	0.0%	0.0%
		D27D2	0.0%	0.0%	0.0%	0.0%
		D27D3	0.0%	0.0%	0.0%	0.0%
		D27D4	0.0%	0.0%	0.0%	0.0%
		D27D5	0.0%	0.0%	0.0%	0.0%
		D27D6	0.1%	0.0%	0.0%	0.0%
Total			**100.0%**	**100.0%**	**100.0%**	**100.0%**

[1] Slight variations in total flight track use will occur with different operational levels per aircraft groups.
[2] EDO = Equivalent Daily Operations Derived with 2030 High Constrained forecast fleet mix.

Source: HNTB analysis of 15-day sample of radar data from October 11 to 25, 2003.

6.5 Results and Limitations

The CNEL contours developed for 2020 and 2030 represent a reasonable forecast of future noise exposure due to aircraft operations to and from SDIA. Due to the predominant west flow runway use with arrivals to and departures from Runway 27, the CNEL contours to the east of SDIA are relatively narrow, thus reflecting the concentration of arrival aircraft on the approach path. Conversely, the wider CNEL contours to the west of SDIA reflect the dispersion of departure tracks that occur as aircraft are routed in different directions towards their destinations.

However, variances in factors such as the fleet mix and time of day of operations will affect actual future noise exposure levels, including the contour shape and extent. Additionally, there are limitations and constraints with INM that are important to consider, as discussed in the following paragraphs.

Due to terrain, the approaches into SDIA are flown at steeper angles than the standard 3.0-degree approach that is used at most airports. The standard profiles used in INM are modeled at a 3.0-degree approach angle. As a result, aircraft in the noise model are at a slightly lower altitude and higher thrust setting than actual operations, and so INM slightly overestimates noise exposure in the aircraft approaches.

Noise monitoring efforts by SDIA staff indicates that lateral attenuation due to takeoff noise in the vicinity of the Runway 27 approach end, as measured by noise monitors, differs from that calculated by INM. The INM-calculated noise exposure levels in the vicinity of the runway end could be overstated or understated, depending on the location. This is due to the terrain (including buildings) in the vicinity of SDIA, and the prevalence of both hard and soft ground coverage. INM assumes that surfaces are soft and absorb some sound energy; however, the hard surfaces (such as water, streets, etc.) in the vicinity of

SDIA tend to reflect and increase noise exposure. As a result of these differences, SDIA staff adjusts the CNEL contours published in the quarterly noise reports based upon the noise monitoring data. SDIA staff also adjusted the CNEL contours in the vicinity of the Runway 27 approach end for the purpose of the SDIA ALUCP. However, for the purposes of federal environmental documentation, adjustments to INM-generated contours are not permitted. The CNEL contours in this chapter were developed using FAA approval requirements (per FAA Order 1050.1E) in order to maintain consistency with the upcoming federal environmental documentation for the SDIA Master Plan projects.

This page intentionally left blank.