Appendix D. Helicopter Noise Analysis

Appendix D. Helicopter Noise Analysis

D.1 General Characteristics of Helicopter Noise

Helicopter noise originates from three components of the helicopter: the rotors, engine, and transmission.

Generally speaking helicopters are equipped with two rotors. The main rotor is located on the top of the cabin and is used to generate lift. The other rotor (tail rotor) is located in the tail and is used to produce a sideways force that prevents the body of the helicopter from rotating and is also used to steer the helicopter. Two types of helicopters – the AS350 and EC130 are used by Grand Canyon tour operators based in Clark County. Almost all helicopters are equipped with one of two types of tail rotors: a conventional tail rotor or a Fenestron tail rotor. By nature of its construction, the Fenestron tail rotor is quieter than the conventional tail rotor. The AS350 is equipped with a conventional tail rotor and the EC130 is equipped with the Fenestron tail rotor.

Power is transferred to the rotors from the engine via a main gearbox. The engine's revolutions per minute (RPMs) are reduced from thousands to hundreds by increasing the torque and slowing the rotation to an acceptable level for the rotors. Noise generated by the engine depends on the type/model of engine powering the helicopter. The transmission drives the mast, which provides direct rotation to the rotors. Noise generated by the transmission depends on the type/model of engine and transmission powering the helicopter.

D.2 Definition of Noise

Loudness, measured in decibels (dB), is the most commonly used characteristic to describe noise. The A-weighted decibel (dBA) is used in aircraft[1] noise analyses because it incorporates a frequency-dependent rating scale that more closely associates sounds and sound frequencies with the sensitivity of the human ear. Some common sounds on the dBA scale, relative to ordinary conversation, are listed in **Table D-1**. As shown in the table, the relative perceived loudness of a sound doubles for each increase of 10 dBA, although a 10-dBA change corresponds to a factor of 10 in relative sound energy. Generally, sounds with differences of 2 dBA or less are not perceived to be noticeably different by most listeners. A noise event produced by a helicopter flyover is usually characterized by a buildup to a maximum noise level as the helicopter approaches, and then a decrease in the noise level through a series of lesser peaks or pulses after the aircraft passes and the noise recedes.

[1] As used in report, "aircraft" includes helicopters

Table D-1
Common Sounds on the A-Weighted Decibel Scale

Sound	Sound Level (dBA)	Relative Loudness (approximate)	Relative Sound Energy
Rock music, with amplifier	120	64	1,000,000
Thunder, snowmobile (operator)	110	32	100,000
Boiler shop, power mower	100	16	10,000
Orchestral crescendo at 25 feet, noisy kitchen	90	8	1,000
Busy street	80	4	100
Interior of department store	70	2	10
Ordinary conversation, 3 feet away	60	1	1
Quiet automobiles at low speed	50	½	0.1
Average office	40	¼	0.01
City residence	30	1/8	0.001
Quiet country residence	20	1/16	0.0001
Rustle of leaves	10	1/32	0.00001
Threshold of hearing	0	1/64	0.000001

Source: U.S. Department of Housing and Urban Development, *Aircraft Noise Impact—Planning Guidelines for Local Agencies*, 1972.
Prepared by: Ricondo & Associates, Inc., April 2008

D.3 Noise Analysis Methodology

The methodology used for this helicopter noise analysis included the: (1) use of noise descriptors developed for helicopter noise analyses, (2) application of a computer model that provides estimates of helicopter noise levels, and (3) development of basic data and assumptions as input to the computer model.

D.3.1 Noise Descriptors

Noise is measured using a variety of scientific metrics. As a result of extensive research into the characteristics of aircraft noise and human response to that noise, a standard system of descriptors has been developed for use in aircraft noise exposure analyses. These descriptors, as used for this helicopter noise analysis, are described in the following subsections.

D.3.1.1 A-Weighted Sound Pressure Level

The decibel is used to describe sound pressure level. A-weighting approximates the human ear's sensitivity to sounds of different frequencies. Without this filtering, calculated and measured sound levels would include sounds that the human ear cannot hear, such as dog whistles (high frequency) and sounds made by large buildings with changes in temperature and wind (low frequency).

D.3.1.2 Maximum A-Weighted Sound Level

The maximum A-weighted sound level (L_{max}) is the loudest part of a noise event, measured in decibels. As an aircraft overhead passes an observer, the noise increases to a maximum level and then decreases as the aircraft passes. Some sound level meters measure the maximum, or L_{max}, level.

D.3.1.3 Equivalent Sound Level (Leq)

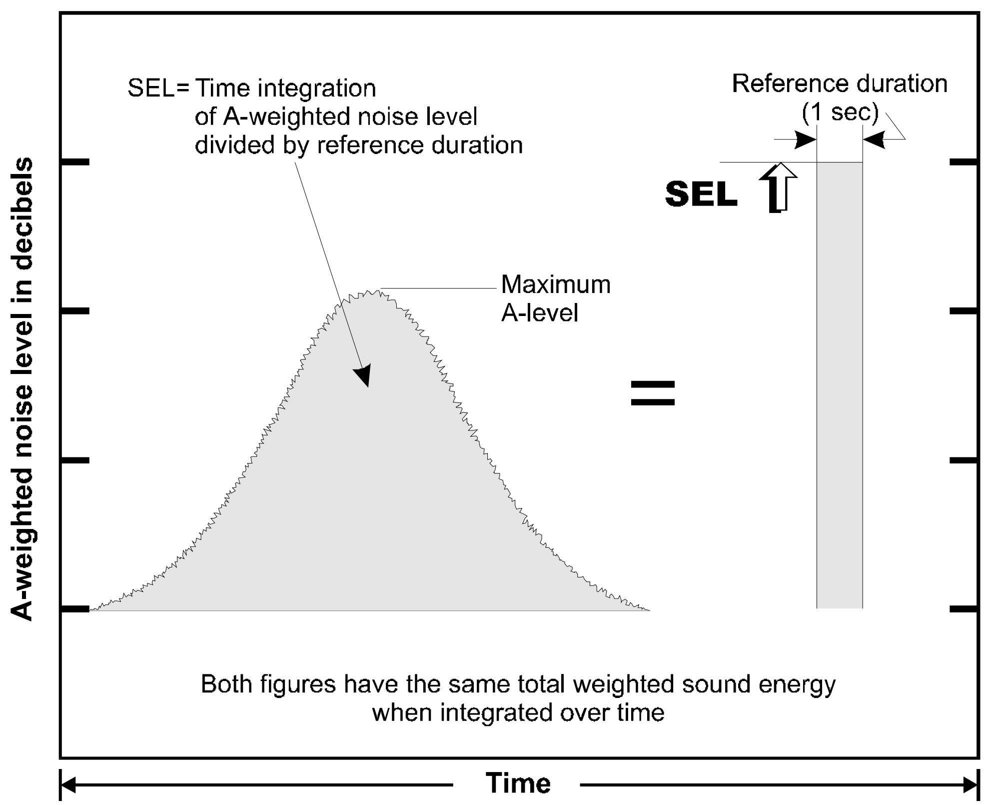
Leq is a standard measure of sound energy averaged over a specified time period. This metric indicates the constant sound level in decibels which is equivalent to the amount of sound energy produced by a series of events having fluctuating sound levels during the specified time period.

D.3.1.4 Sound Exposure Level

Sound exposure level (SEL) is a time-integrated measure, expressed in decibels, of the sound energy of a single noise event at a reference duration of one second. The sound level is integrated over the period that it exceeds a threshold. Therefore, SEL accounts for both the maximum sound level and the duration of the sound. The SEL for a particular aircraft noise event is a numerically higher value than the (L_{max}) for the same event. This is because the SEL consolidates the energy of the entire noise event into a reference duration of one second. The SEL is not "heard", but is a derived value used for calculation of cumulative aircraft noise exposure as defined by the DNL. SELs for aircraft noise events depend on the location of the aircraft relative to the noise receptor, the type of operation (landing, takeoff, or overflight), and the type of aircraft. The SEL concept is depicted on **Exhibit D-1**.

Exhibit D-1

Sound Exposure Level Concept



Source: Brown-Buntin Associates, Inc.
Prepared by: Ricondo & Associates, Inc., April 2008

D.3.1.5 Background Sound Level (L_{90})

L_{90} describes the noise level exceeded 90 percent of the time during the sample period. L_{90} is useful for describing the background (or residual) noise level in the absence of any easily defined noise events, such as those caused by occasional traffic, barking dogs, or aircraft overflights.

D.3.1.6 Day-Night Average Sound Level

Day-night average sound level (DNL) is a method used to describe the existing and predicted cumulative noise exposure from aircraft operations in the vicinity of an airport or a heliport. The DNL is expressed in dBA and represents the time-weighted average noise level over a 24-hour period. The DNL is used to estimate the effects of specific noise levels on land uses. The U.S. Environmental Protection Agency (EPA) introduced the DNL metric in 1976 as a single number measurement of community noise exposure. The Federal Aviation Administration (FAA) adopted DNL as the noise metric for measuring cumulative aircraft noise under Title 14, Code of Federal Regulations, Part 150 (14 CFR Part 150), *Airport Noise Compatibility Planning*. DNL has also been adopted for measuring cumulative noise exposure by several other government agencies, including the Department of Housing and Urban Development, the Veterans Administration, the Department of Defense, the Coast Guard, and the Federal Transit Administration. DNL is widely accepted as the best available method to describe aircraft noise exposure and is the noise descriptor required for use in aircraft noise exposure analyses, land use compatibility planning, environmental assessments, and environmental impact statements for airport/heliport improvement projects. Although additional noise metrics may be used to characterize aircraft noise and environmental impacts, neither Clark County nor the State of Nevada mandates the use of metrics other than DNL.

In calculating DNL, for each hour during the nighttime period (10:00 p.m. to 6:59 a.m.), sound levels are increased by a 10-decibel-weighting penalty before the 24-hour value is computed. The weighting penalty accounts for the more intrusive nature of noise during nighttime hours.

DNL is expressed as an average noise level on the basis of annual aircraft operations for a calendar year, not on the average noise levels associated with different aircraft operations. To calculate the DNL at a specific location, the SELs at that location associated with each aircraft operation (landing or takeoff) are determined. Using the SEL for each noise event and applying the 10-decibel penalty for nighttime operations as appropriate, a partial DNL is then calculated for each aircraft operation. The partial DNLs for each aircraft operation are added logarithmically to determine the total DNL.

The logarithmic addition process, whereby the partial DNLs are combined, can be approximated by the following guidelines:

When two DNLs differ by:	Add the following amount to the higher value:
0 or 1 dBA	3 dBA
2 or 3 dBA	2 dBA
4 to 9 dBA	1 dBA
10 dBA or more	0 dBA

For example:

70 dBA + 70 dBA (difference: 0 dBA) = 73 dBA
60 dBA + 70 dBA (difference: 10 dBA) = 70 dBA

Adding the noise from a relatively quiet event (60 dBA) to a relatively noisy event (70 dBA) results in a value of 70 dBA because the quieter event has only one-tenth the sound energy of the noisier event. As a result, the quieter noise event is "drowned out" by the noisier one, and there is no increase in the overall noise level as perceived by the human ear.

DNL is used to describe existing and predicted noise exposure in communities in an airport/heliport vicinity based on the average number of daily operations over the year and the average annual operational conditions at the airport/heliport. Therefore, at a specific location near an airport/heliport, the noise exposure on a particular day is likely to be higher or lower than the annual average noise exposure, depending on the specific operations at the airport/heliport that day.

D.3.2 Integrated Noise Model

The Integrated Noise Model (INM) was developed by the FAA, and is the computer model required for use in developing aircraft/helicopter noise exposure maps. The INM contains aircraft operational and noise data in a database that reflects average aircraft operating conditions. The INM was originally designed for modeling noise from fixed-wing aircraft. However, with the introduction of Version 7.0[2] of the INM, the FAA incorporated the noise modeling capabilities of its Helicopter Noise Model (HNM). INM Version 7.0 is the latest accepted state-of-the-art tool for determining the total effect of aircraft noise at and around airports and heliports, and is the model that was used to determine potential helicopter noise impacts for this analysis

Because the DNL is fundamentally based on the noise levels produced by individual aircraft operations, selection of appropriate aircraft-type designations from the INM database is of critical importance. The INM Version 7.0 database contains both of the helicopter types that are used by Grand Canyon tour operators based in Clark County. Those helicopter types are designated within the INM database as the SA350D (AS350) and the EC130. The SA350D and EC130 helicopter types were used without modification to model helicopter noise levels for this analysis.

D.3.2.1 DNL and Noise Exposure Ranges

A noise exposure value of DNL 65 was used as the criterion level for the noise analysis. Two specific ranges of noise exposure were estimated: (1) DNL 65 and higher and (2) DNL 60 to 65. DNL 65 and higher is the FAA's standard threshold for land use compatibility planning purposes in areas surrounding a heliport or airport. Although the FAA considers aircraft noise exposure lower than DNL 65 to be compatible with residential land uses, persons residing outside the DNL 65 noise exposure area may still be annoyed by aircraft noise. However, Clark County agencies use information regarding noise exposure between DNL 60 and DNL 65 for local planning purposes and therefore DNL 60 noise contours are depicted on exhibits in this EA.

D.3.2.2 The DNL Descriptor

The validity and accuracy of DNL calculations depend on the basic information used in the calculations. For future heliport activities, the reliability of DNL calculations is affected by a number of variables:

- Future aviation activity—the number of helicopter operations, the types of helicopters in the fleet mix, the times of operations (daytime and nighttime), and helicopter flight tracks—are estimates or forecasts, the achievement of which cannot be assured.

- Although new helicopter types may be introduced in the future, current models were used as input to the INM to estimate future activity.

- The noise descriptors used as the basis for calculating DNL represent typical human response (and reaction) to aircraft/helicopter noise. Because people vary in their responses to noise and because the physical measure of noise accounts for only a portion of an individual's reaction to that noise, DNL can be used only to obtain an average response to aircraft noise that might be expected in a community.

- Single flight tracks used in computer modeling represent a wider band of actual flight tracks.

These uncertainties aside, DNL mapping was developed as a tool to assist in land use planning around airports/heliports. Mapping is best used for comparative purposes rather than to provide absolute values. DNL calculations provide valid comparisons between different potential conditions, so long as consistent assumptions and data are used for all calculations.

Thus, sets of DNL calculations can show anticipated changes in aircraft/helicopter noise exposure over time, or can indicate which of a series of simulated situations would be better, and generally how much better, from the standpoint of noise exposure. However, a line drawn on a map is not meant to imply that a particular noise condition exists on one side of that line and not on the other. DNL calculations are a means for comparing noise effects, not for precisely defining them relative to specific parcels of land.

Nevertheless, DNL contours can be used to (1) highlight an existing or potential aircraft noise problem that requires attention, (2) assist in the preparation of noise compatibility programs, and (3) provide guidance in developing land use controls, such as zoning ordinances, subdivision regulations, and building codes. DNL has been, and is still, considered to be the best methodology available for depicting aircraft/helicopter noise exposure.

D.3.2.3 Graphic Representation of DNL

Contours are lines on a map that connect points of equal DNLs, much like topographic contour lines are drawn on a map to indicate ground elevations. For example, a contour is drawn to connect all points exposed to DNL 65; another may be drawn to connect all points exposed to DNL 70; and so forth. Generally, noise contours are plotted at 5-DNL intervals. Noise contours were developed for this analysis in conformance with FAA guidelines included in FAA Orders 5050.4B and 1050.1E and 14 CFR Part 150. For this analysis, the INM was used to produce DNL 65 and DNL 60 helicopter noise exposure contours.

D.3.3 Basic Data and Assumptions for Developing Noise Exposure Maps

The primary data required to develop helicopter noise exposure maps using INM Version 7.0 are:

- The existing and forecast number of helicopter operations, by helicopter type, and with daytime or nighttime flight characteristics.

- Operational information, including use of the runways or touchdown and liftoff areas, location and use of flight tracks (the paths that pilots fly to arrive at and depart from the airport or heliport), departure profiles, and existing noise abatement procedures.

D.3.3.1 Helicopter Operations

To determine existing and projected noise exposure, helicopter operations associated with the average day of the year are used in the INM. Helicopter operations data for an average day in 2004 were used to represent existing conditions in this environmental assessment. The 2004 average annual day condition is based on actual helicopter operations data collected by AirScene[2]. Forecasts of operations for the average day in 2011 and 2017 were derived from the annual forecasts presented in Chapter III of this EA.

Existing and forecast levels of helicopter operations under the Proposed Action are presented in **Table D-2**. Existing and forecast levels of helicopter operations under the No Action alternative are presented in **Table D-3**. As shown in Table D-2, the number of Grand Canyon tour departures at the Heliport site under the Proposed Action is projected to be 29,500 in 2011 and 37,300 in 2017. It was assumed that the operators of Las Vegas Strip tours would not relocate to the proposed Heliport site from McCarran. Las Vegas Strip tours would continue to be accommodated at McCarran under the Proposed Action – 8,400 annual tour departures in 2011 and 9,100 annual tour departures in 2017. Under the Proposed Action there would be 9,800 Grand Canyon tour departures at McCarran in 2011 and 12,400 annual Grand Canyon tour departures in 2017. Under the Proposed Action it is anticipated that some helicopter operations, both Grand Canyon tours and Las Vegas Strip tours, would be accommodated at other locations in the region (11,100 annual tour departures in 2011 and 15,600 annual tour departures in 2017). These helicopter movements were not assessed or evaluated in this environmental assessment.

As shown in Table D-3, the number of Grand Canyon tour departures at McCarran under the No Action alternative is projected to be 29,500 in 2011 and 37,300 in 2017. Las Vegas Strip tours would continue to be accommodated at McCarran under the No Action alternative – 8,400 annual tour departures in 2011 and 9,100 annual tour departures in 2017. It is anticipated that some helicopter operations, both Grand Canyon tours and Las Vegas Strip tours, would be accommodated at other locations in the region under the No Action alternative (20,900 annual tour departures in 2011 and 28,000 annual tour departures in 2017).

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[2] AirScene is a proprietary software package developed and licensed by Rannoch Corporation that provides data to the CCDOA regarding aircraft and helicopter operations at McCarran. The CCDOA has used the software package since July 2000.

Table D-2

Helicopter Air Tour Departures – Proposed Action

Year	McCarran International Airport		Heliport Site [1/]		Other Facility [2/]		Total	
	Annual Grand Canyon Tour Departures	Annual Las Vegas Strip Tour Departures	Annual Grand Canyon Tour Departures	Annual Las Vegas Strip Tour Departures	Annual Grand Canyon Tour Departures	Annual Las Vegas Strip Tour Departures	Annual Grand Canyon Tour Departures	Annual Las Vegas Strip Tour Departures
Historical								
2004	33,190	11,501	-	-	-	-	33,190	11,501
2005	37,595	12,775	-	-	-	-	37,595	12,775
2006	36,865	12,045	-	-	-	-	36,865	12,045
Forecast								
2011	9,800	8,500	29,500	-	4,400	6,700	43,700	15,200
2012	10,200	8,600	30,700	-	4,500	7,200	45,400	15,800
2013	10,600	8,700	31,900	-	4,700	7,700	47,200	16,400
2014	11,000	8,800	33,200	-	4,900	8,300	49,100	17,100
2015	11,500	8,900	34,500	-	5,100	8,900	51,100	17,800
2016	11,900	9,000	35,900	-	5,300	9,500	53,100	18,500
2017	12,400	9,100	37,300	-	5,500	10,100	55,200	19,200

Notes:

1/ It was assumed that Las Vegas Strip tours would not be accommodated at the proposed Heliport site.

2/ Not evaluated in the environmental assessment.

Sources: Clark County Department of Aviation using data from AirScene (2004 departures); Ricondo & Associates, Inc.

Prepared by: Ricondo & Associates, Inc., April 2008

Table D-3

Helicopter Air Tour Departures – No Action Alternative

Year	McCarran International Airport		Other Facility [1/]		Total	
	Annual Grand Canyon Tour Departures	Annual Las Vegas Strip Tour Departures	Annual Grand Canyon Tour Departures	Annual Las Vegas Strip Tour Departures	Annual Grand Canyon Tour Departures	Annual Las Vegas Strip Tour Departures
Historical						
2004	33,190	11,501	-	-	33,190	11,501
2005	37,595	12,775	-	-	37,595	12,775
2006	36,865	12,045	-	-	36,865	12,045
Forecast						
2011	29,500	8,500	14,200	6,700	43,700	15,200
2012	30,600	8,600	14,800	7,200	45,400	15,800
2013	31,900	8,700	15,300	7,700	47,200	16,400
2014	33,100	8,800	16,000	8,300	49,100	17,100
2015	34,500	8,900	16,600	8,900	51,100	17,800
2016	35,800	9,000	17,300	9,500	53,100	18,500
2017	37,300	9,100	17,900	10,100	55,200	19,200

Note:

1/ Not evaluated in the environmental assessment.

Sources: Clark County Department of Aviation using data from AirScene (2004 departures); Ricondo & Associates, Inc.

Prepared by: Ricondo & Associates, Inc., April 2008

Helicopter Fleet Mix

The helicopter fleet mix consists of two helicopter types – the AS350 and the EC130. The percentages of departures by helicopter type and year are shown in **Table D-4**. These fleet mix percentages were applied to the operations data used in the INM analysis for the Proposed Action and No Action alternative.

Table D-4

Percentage of Departures by Helicopter Type

	Helicopter Type	
Year	AS350	EC130
2004	80.0%	20.0%
2011	53.2%	46.8%
2017	42.9%	57.1%

Source: Ricondo & Associates, Inc., based on helicopter air tour operator surveys.
Prepared by: Ricondo & Associates, Inc., April 2008

Time of Day

AirScene data were used to determine the number of helicopter operations at McCarran International Airport during the daytime hours (7:00 a.m. to 9:59 p.m.) and nighttime hours (10:00 p.m. to 6:59 a.m.) in 2004. These data indicated that 1 percent of helicopter operations occurred during nighttime hours. As mentioned earlier, the calculation of DNL includes a 10-decibel weighting penalty for those operations occurring during the nighttime hours. It was assumed that the split between daytime and nighttime operations for each helicopter type would be the same in 2011 and 2017 as that recorded in 2004.

D.3.3.2 Heliport Operational Information

The assumed future uses of the flight tracks to and from the airport or heliport are important in determining where helicopters are flying and, consequently, the noise levels generated on the ground.

Helipad Use and Design Criteria

Helipad use was determined based on several factors, including: historical wind analysis, conversations with helicopter operators at McCarran International Airport, air traffic control procedures in the vicinity of McCarran, Federal Aviation Regulations pertaining to helicopter operations, FAA Advisory Circulars pertaining to heliports and air traffic patterns, and observations of helicopter activities in the Las Vegas region.

Specific criteria that were applied to the airspace analysis around the sites were referenced from FAA Advisory Circular 150/5390-2A, *Heliport Design*, 14 CFR Part 77 *Objects Effecting Navigable Airspace*, FAA Order 8260.42A *Helicopter Global Positioning System (GPS) Non-Precision Approach Criteria*, and data acquired from the Las Vegas TRACON and the FAA Digital Obstruction File.

The wind analysis for the Heliport site utilized historical weather data from January 1992 to January 2001 collected at the McCarran International Airport weather station. Helipad use was calculated by assuming that helicopters would use helipads aligned with prevailing winds when winds are above three knots and would use the helipads providing the most direct route during calm winds.

According to FAA criteria, the design of helicopter approach paths should be based on prevailing wind direction, crosswind component (150 degrees minimum), and clear approach and transitional surfaces at the heliport site. The Heliport Approach Surface for each landing area at a heliport is defined in 14 CFR Part 77 as the area beginning at the end of the take off and landing area with the same width, extending outward and upward for a horizontal distance of 4,000 feet, where its width is 500 feet. The slope of the approach surface rises at a ratio of 8 to 1 eight feet horizontal to one foot vertical). The Heliport Transitional Surface is defined in 14 CFR Part 77 as that area that extends outwards and upward from the lateral boundaries of the heliport landing and takeoff area and from the Heliport Approach Surfaces for a distance of 250 feet from the centerline of the approach surface. The slope of this surface is 2 to 1.

Design of the heliport landing areas was based on Visual Flight Rules (VFR) operations. However, intermediate and final missed approach design criteria as specified in FAA Order 8260.42A, *Helicopter Global Positioning System Non Precision Approach Criteria*, were considered in the design of the approach lighting area orientation in the event that an Instrument Flight Rules (IFR) approach is desired in the future. The optimum design for an instrument approach includes a three-mile intermediate segment, a 3-mile final approach segment, and a clear missed approach area. Planning data for the proposed Heliport is presented on **Exhibit D-2**.

Generalized Aircraft Flight Tracks

Flight track information is another important input to the INM. However, inputting the individual tracks for each aircraft operation is not practical and the FAA suggests that flight tracks be consolidated into a set of generalized flight tracks that are representative of all flight tracks into and out of the airport/heliport. Deviations from the generalized flight tracks occur because of weather conditions, pilot technique, air traffic control procedures, and aircraft weight. However, the generalized flight tracks do provide representative tracks for arrivals and departures at the airport/heliport.

The potential flight corridors and the local routes for the Heliport site are shown on **Exhibits D-3** through **D-5**. The local routes represent generalized flight paths for transitioning between the site and the flight corridor. Each exhibit depicts the noise model inputs for each flight track scenario within the Proposed Action, including the flight corridors, the percentage of traffic on each corridor, and each local route.

Exhibit D-3, Flight Corridors for Heliport site – Scenario A (Henderson), shows the Henderson departure flight corridor being used 100 percent of the time. Arrivals are split, with 80 percent arriving via the Henderson flight corridor and 20 percent arriving via the Charleston and Strip Railroad flight corridors. Exhibit D-4, Flight Corridors for Heliport Site – Scenario B (McCullough), shows the McCullough departure flight corridor being used 100 percent of the time. Arrivals are split, with 80 percent arriving via the McCullough flight corridor and 20 percent arriving via the Charleston and Strip Railroad flight corridors. Exhibit D-5, Flight Corridors for the Heliport site – Scenario C (Jean), shows the Jean flight corridor being used 100 percent of the time. Arrivals are split, with 80 percent arriving via the Jean flight corridor and 20 percent arriving via the Charleston and Strip Railroad flight corridors.

Exhibit D-2

Coordinates

Exhibit D-2 presents a tabular summary of the coordinates for the final approach and takeoff areas (FATOs) at the proposed heliport site. Coordinates are provided in latitude/longitude and also in the State Plane projection (NAD 83 Nevada East).

Exhibit D-3

Flight Corridors for South of Sloan Site – Scenario A (Henderson)

Exhibit D-3 shows local helicopter arrival and departure routes for the proposed South of Sloan heliport and the potential helicopter flight corridor named Henderson.

Exhibit D-4

Flight Corridors for South of Sloan Site – Scenario B (McCullough)

Exhibit D-4 shows local helicopter arrival and departure routes for the proposed South of Sloan heliport and the potential helicopter flight corridor named McCullough.

Exhibit D-5

Flight Corridors for South of Sloan Site – Scenario C (Jean)

Exhibit D-5 shows local helicopter arrival and departure routes for the proposed South of Sloan heliport and the potential helicopter flight corridor named Jean.

D.4 Ambient Noise Level Monitoring

The ambient noise environment in the vicinity of McCarran International Airport and the Heliport site and in the vicinity of potential helicopter flight corridors associated with each site was evaluated through a noise-monitoring program. Continuous noise monitoring for a minimum of 24 hours was conducted at 10 locations[3] as shown on Exhibit III-6 in Chapter III. Two of the noise-monitoring sites represent alternative heliport sites and eight of the noise monitoring sites are located underneath or near existing or potential helicopter flight corridors. **Exhibits D-6** through **D-15** summarize the hourly noise levels measured at each site, along with the measured DNL for the 24-hour noise-monitoring period. A photograph of each noise monitoring site and the noise monitoring equipment set up at each site is included with each exhibit. The exhibits demonstrate that noise levels vary during the day and night, with the lowest noise levels generally occurring during the late night and early morning hours.

Ambient noise level measurements were recorded during July and October 2004. Noise monitoring equipment consisted of Larson-Davis Laboratories (LDL) Model 820 sound level analyzers equipped with Bruel & Kjaer (B&K) Type 4176 0.5-inch microphones. The instrumentation was calibrated prior to use with a B&K Type 4230 acoustic calibrator, and complies with applicable requirements of the American National Standards Institute (ANSI) for Type 1 (precision) sound level meters.

The LDL Model 820 sound level analyzers run continuously with a sampling rate of 32 per second. The analyzers calculate various statistical descriptors of noise and DNLs for each 24-hour noise measurement period. As discussed previously, DNL is the average sound pressure level in A-weighted decibels for an average day of the year. DNL is calculated using the sound energy generated by individual aircraft operations (arrivals or departures), the number of operations occurring during a theoretical average 24-hour period, and the time of day the operations occur. A 10-dB weighting penalty is added for aircraft or helicopter operations occurring between 10:00 p.m. and 6:59 a.m.

D.5 Noise Grid Analysis for Locations of Interest (LOIs)

Cumulative noise exposure near existing and potential helicopter flight corridors was evaluated for the eight noise monitoring locations described in Section D.4 and at seven specific points representing noise-sensitive locations in the region, such as residential areas, schools, recreation areas, and potential animal habitats. These locations, referred to as grid points, are shown on Exhibit IV-5 in Chapter IV. **Table D-5** indicates the land use or receptor represented by the grid points, and summarizes the ranges of predicted helicopter noise exposure for each grid point. These ranges in noise exposure were determined using the INM, and represent helicopter activity levels that would occur under the Proposed Action or No Action alternative.

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3 Noise monitoring sites were selected by Brown-Buntin Associates, Inc. with input from the CCDOA and the Bureau of Land Management.

Exhibit D-6

Ambient Noise Monitoring Results – South of Sloan Site

Exhibit D-6 shows the results of the noise measurement program conducted at the South of Sloan Site in the form of a chart. Exhibit D-6 also includes a photograph that shows the noise monitoring equipment at the South of Sloan Site.

Exhibit D-7

Ambient Noise Monitoring Results – McCarran International Airport

Exhibit D-7 shows the results of the noise measurement program conducted at a site near McCarran International Airport in the form of a chart. Exhibit D-7 also includes a photograph that shows the noise monitoring equipment at the site near McCarran International Airport.

Exhibit D-8

Ambient Noise Monitoring Results – Site R1

Exhibit D-8 shows the results of the noise measurement program conducted at Site R1 in the form of a chart. Exhibit D-8 also includes a photograph that shows the noise monitoring equipment at Site R1.

Exhibit D-9

Ambient Noise Monitoring Results – Site R2

Exhibit D-9 shows the results of the noise measurement program conducted at Site R2 in the form of a chart. Exhibit D-9 also includes a photograph that shows the noise monitoring equipment at Site R2.

Exhibit D-10

Ambient Noise Monitoring Results – Site R3

Exhibit D-10 shows the results of the noise measurement program conducted at Site R3 in the form of a chart. Exhibit D-10 also includes a photograph that shows the noise monitoring equipment at Site R3.

Exhibit D-11

Ambient Noise Monitoring Results – Site R4

Exhibit D-11 shows the results of the noise measurement program conducted at Site R4 in the form of a chart. Exhibit D-11 also includes a photograph that shows the noise monitoring equipment at Site R4.

Exhibit D-12

Ambient Noise Monitoring Results – Site R5

Exhibit D-12 shows the results of the noise measurement program conducted at Site R5 in the form of a chart. Exhibit D-12 also includes a photograph that shows the noise monitoring equipment at Site R5.

Exhibit D-13

Ambient Noise Monitoring Results – Site R6

Exhibit D-13 shows the results of the noise measurement program conducted at Site R6 in the form of a chart. Exhibit D-13 also includes a photograph that shows the noise monitoring equipment at Site R6.

Exhibit D-14

Ambient Noise Monitoring Results – Site R7

Exhibit D-14 shows the results of the noise measurement program conducted at Site R7 in the form of a chart. Exhibit D-14 also includes a photograph that shows the noise monitoring equipment at Site R7.

Exhibit D-15

Ambient Noise Monitoring Results – Site R8

Exhibit D-15 shows the results of the noise measurement program conducted at Site R8 in the form of a chart. Exhibit D-15 also includes a photograph that shows the noise monitoring equipment at Site R8.

Table D-5

Summary of Helicopter Noise Levels at Locations of Interest

Grid Point [1/]	Representative Land Use	Nearest Helicopter Flight Corridor(s) [2/]	Distance to Nearest Flight Corridor(s) (feet)	Ambient Noise Level (DNL) [3/]	Predicted Helicopter Noise Levels (DNL) No Action Alternative		Predicted Helicopter Noise Levels (DNL) Proposed Action	
					2011	2017	2011	2017
R1	Recreation area (trail)	Charleston	0	50.6	44-53	45-55	39-49	40-50
R2	Abandoned mine	Tropicana	3,310	59.7	34-37	34-38	29-32	30-33
R3	Undeveloped land	Henderson (Inbound/Outbound)	7,600/2,340	55.1	n.a.	n.a.	39-43	40-43
R4	Undeveloped land	Henderson (Inbound/Outbound)	21,580/16,330	56.2	n.a.	n.a.	<25	<25
R5	Sloan Canyon Petroglyphs	McCullough (Inbound/Outbound)	8,110/13,520	50.2	n.a.	n.a.	26-28	26-29
R6	Wilderness area with hiking trails	McCullough (Inbound/Outbound)	2,580/2,580	49.4	n.a.	n.a.	40-43	40-44
R7	Wilderness area with hiking trails	Jean (Inbound/Outbound)	3,170/2,090	46.8	n.a.	n.a.	42-44	42-44
R8	Electric power substation	Jean (Inbound/Outbound)	1,810/3,410	45.1	n.a.	n.a.	42-43	43-45
G1	Residential/school area	Charleston	5,300	n.a.	27-33	28-34	22-28	22-28
G2	Recreation area (campsite)	Tropicana	1,430	n.a.	43-47	44-48	38-43	39-43
G3	Residential area	Henderson (Inbound/Outbound)	8,080/2,880	n.a.	n.a.	n.a.	36-40	36-40
G4	Recreation area (trail)	Henderson (Inbound/Outbound)	22,420/17,110	n.a.	n.a.	n.a.	<25	<25
G5	Wilderness/habitat area	McCullough (Inbound/Outbound)	3,320/8,730	n.a.	n.a.	n.a.	33-37	33-37
G6	Wilderness/habitat area	Jean (Inbound/Outbound)	8,200/13,580	n.a.	n.a.	n.a.	26-28	26-29
G7	Residential area	Strip Railroad	0	n.a.	n.a.	n.a.	37-47	38-48

Notes:

n.a. = Not applicable

DNL = Day-night average sound level, expressed in A-weighted decibels

1/ Grid point locations are shown on Exhibit IV-5. Noise measurements were conducted at Sites R1 through R8 in 2004.

2/ Existing and potential helicopter flight corridors are shown on Exhibit IV-5.

3/ Ambient noise level data are from Table III-2. Ambient noise levels were not measured at Sites G1-G7.

Source: Brown-Buntin Associates, Inc.

Prepared by: Ricondo & Associates, Inc., April 2008

Noise exposure underneath or near the existing and potential helicopter flight corridors is dependent partly on the altitude at which the helicopters would be flown. For the purposes of the noise analysis, the lowest altitude analyzed for helicopter flight corridors was 300 feet AGL. This is the minimum altitude above the ground required by 14 CFR Part 135, *Operating Requirements: Commuter and On Demand Operations and Rules Governing Persons on Board Such Aircraft.*

According to the air tour operators, the minimum expected vertical distance between the helicopters and the terrain along the routes during Grand Canyon helicopter air tours would be 500 feet when feasible. This would be a voluntary action on the part of the air tour operators. [4]

Helicopter DNL values were calculated at the reference grid points using Version 7.0 of the INM. The calculation procedure consisted of using the INM to determine SEL values for individual overflights by the AS350 and EC130 helicopter types and then combining predicted SEL values with the forecast number of helicopter operations on the closest helicopter flight corridors to the grid points. Calculations were conducted for both the 2011 and 2017 helicopter activity levels. The DNL values reported in Table D-5 represent potential helicopter flight altitudes ranging from 300 to 1500 feet AGL. Typically, for receptors located directly beneath a flight corridor, the highest DNL values would occur when the helicopters are at the lowest potential altitude. However, for receptors located farther away from flight corridors, the highest DNL values may occur when the helicopters are relatively higher above the ground. This occurs because absorption of noise by the ground (referred to as lateral attenuation) increases with distance from the helicopter flight corridor and as the angle of the helicopter above the ground becomes smaller with reference to the receptor location.

Based on the INM grid point analysis, it is expected that the highest DNLs would occur at the grid points closest to the existing or potential helicopter flight corridors. The highest DNLs would occur at grid points R1 (recreation area/trail), G2 (recreation area/campsite) and G7 (residential area). The lowest DNLs (less than 25 dBA) would occur at grid points R4 (undeveloped land) and G4 (recreation area/trail). At all grid points, calculated helicopter DNLs are predicted to be below the FAA's DNL 65 significance threshold. In addition, at Sites R1 through R8, predicted helicopter noise levels for 2011 and 2017 are anticipated to be less than existing DNL values measured during ambient noise level monitoring at the same locations in 2004.

D.6 Single Event Noise Levels underneath or near Helicopter Flight Tracks

Exhibits D-16 and **D-17** depict the SEL values predicted by Version 7.0 of the INM for the AS350 and the EC130 helicopter types, respectively. Based on the information shown on the exhibits, the AS350 helicopter registers approximately 0.2 dB higher than the EC130 helicopter when the helicopters are directly overhead. As lateral distance from the helicopter flight route increases, the difference between noise levels generated by the two helicopter types becomes more pronounced. On the left side of the helicopter, the EC130 is approximately 1.0 dB quieter than the AS350 at a lateral distance of 3000 feet from the flight route. On the right side of the helicopter, the EC130 is approximately 3.5 dB quieter than the AS350 at a lateral distance of 3000 feet from the flight route.

[4] 14 CFR Part 135, *Operating Requirements: Commuter and On Demand Operations and Rules Governing Persons on Board Such Aircraft*, requires a minimum altitude of 300 feet AGL for helicopter operations when over congested areas; however, the Grand Canyon helicopter tour operators currently attempt to achieve a minimum altitude of 500 feet AGL.

Exhibit D-16

Predicted Single-Event Noise Levels – AS350

Exhibit D-16 provides information regarding sound exposure levels generated by the AS350 helicopter. Exhibit D-16 is presented in the form of a chart and shows SEL values for 5 different flight altitudes at various distances from a center point which is referred to as the ground track.

Exhibit D-17

Predicted Single-Event Noise Levels – EC130

Exhibit D-17 provides information regarding sound exposure levels generated by the EC130 helicopter. Exhibit D-17 is presented in the form of a chart and shows SEL values for 5 different flight altitudes at various distances from a center point which is referred to as the ground track.

As shown on Exhibit D-16, the highest predicted SEL for the AS350 helicopter (83.3 dB) would occur when the helicopter is 300 feet AGL and at a location of zero feet horizontally from the center of the flight track. As shown on Exhibit D-17, the highest predicted SEL for the EC130 helicopter (83.1dB) would also occur when the helicopter is 300 feet AGL and at a location of zero feet horizontally from the center of the flight track.

D.7 FAR Part 150 Noise Compatibility Study Update, McCarran International Airport

Beginning in 2005 and throughout 2006, the Clark County Department of Aviation (CCDOA) conducted an Update to the 14 CFR Part 150 Noise Compatibility Study for McCarran International Airport, located in Las Vegas, Nevada. Four Open Houses were held during the preparation of the 14 CFR Part 150 Study Update (August 2005, October 2005, May 2006, and September 2006). The public comment period for the 14 CFR Part 150 Study Update was from August 29, 2006 through October 6, 2006; a formal Public Hearing was held on October 3, 2006.

The 14 CFR Part 150 Study Update is comprised of three volumes. Volume 1: Noise Exposure Map Report contains noise exposure maps (NEMs) for 2004, 2011, and 2017 and associated documentation. The 2004, 2011, and 2017 noise exposure maps are included herein as **Exhibits D-18** through **D-20**. The Noise Exposure Map Report was submitted to the FAA in December 2006 for review and acceptance. Volume 2: Noise Compatibility Program (NCP) Report, describes 13 noise abatement measures and nine noise mitigation measures proposed for McCarran. The NCP report was submitted to the FAA in March 2007. It is anticipated that the FAA will complete its review of the NCP report in 2008. Volume 3 of the 14 CFR Part 150 Study Update includes a compilation of public comments regarding the 14 CFR Part 150 Study Update and responses to those comments, and details the extensive outreach programs undertaken during the development of the 14 CFR Part 150 Study Update. Volume 3 was submitted to the FAA in December 2006.

Pursuant to Section 107(a) & (b) [Title 49, United States Code, Section 47506] of the Airport Safety and Noise Abatement Act of 1979, as amended, on July 10, 2007, the FAA completed its evaluation of, and has formally accepted, the 2004 and 2011 NEMs included in the Noise Exposure Map Report.

Exhibit D-18

2004 Noise Exposure Map – McCarran International Airport

Exhibit D-18 shows calendar year 2004 aircraft noise exposure contours for McCarran International Airport superimposed on a map of generalized existing land uses.

Exhibit D-19

2011 Noise Exposure Map – McCarran International Airport

Exhibit D-18 shows calendar year 2011 aircraft noise exposure contours for McCarran International Airport superimposed on a map of generalized existing land uses.

Exhibit D-20

2017 Noise Exposure Map – McCarran International Airport

Exhibit D-18 shows calendar year 2017 aircraft noise exposure contours for McCarran International Airport superimposed on a map of generalized existing land uses.