



# **APPENDIX C**

## **NOISE ANALYSIS**

## **KBE Final - 10/11/16**

### **Existing Noise**

The extent of existing noise resulting from aircraft operations at Central Colorado Regional Airport (AEJ) was determined using the FAA-approved computer simulation model—the Aviation Environmental Design Tool (AEDT), Version 2b. The AEDT produces Day-Night Average Sound Level (DNL) contours (i.e., lines of equal noise exposure). The following provides an overview of the AEDT and the DNL metric.

The AEDT produces aircraft noise contours that delineate areas of equal day-night average sound levels (DNL). The AEDT works by defining a network of grid points at ground level around an airport. It then selects the shortest distance from each grid point to each flight track and computes the noise exposure generated by each aircraft operation, along each flight track. Corrections are applied for atmospheric acoustical attenuation, acoustical shielding of the aircraft engines by the aircraft itself, and aircraft speed variations. The noise exposure levels for each aircraft are then summed at each grid location. The cumulative noise exposure levels at all grid points are then used to develop noise exposure contours for selected values (e.g. 65, 70 and 75 DNL). Using the results of the grid point analysis, noise contours of equal noise exposure can then be plotted.

A DNL is a 24-hour (average day), time-weighted sound level that is expressed in A-weighted decibels. The FAA, and other federal agencies, use DNL as the primary measure of noise impact because: it correlates well with the results of attitudinal surveys regarding noise; it increases with the duration of noise events; and, it accounts for an increased sensitivity to noise at night by increasing each noise event that occurs during nighttime hours (10 pm to 7 am) by a factor of 10.

In Appendix A of 14 CFR Part 150, *Airport Noise Compatibility Planning*, the FAA identifies, as a function of yearly (365-day average) DNL value, land uses which are compatible and land uses which are non-compatible in an airport environs. As shown in **Table 1**, the FAA considers all land uses to be compatible with aircraft noise if the DNL is less than 65 DNL.

**Table 1. Land Use Compatibility**

Land use	DNL					
	Below 65	65–70	70–75	75–80	80–85	Over 85
Residential						
Residential, other than mobile homes and transient lodgings	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
Public Use						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Governmental services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
Commercial Use						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail—building materials, hardware and farm equipment	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade—general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
Manufacturing and Production						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

SLUCM=Standard Land Use Coding Manual. Y (Yes) = Land Use and related structures compatible without restrictions. N (No) = Land Use and related structures are not compatible and should be prohibited. NLR = Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.

25, 30, or 35=Land use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(3) Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(4) Measures to achieve NLR 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal level is low.

(5) Land use compatible provided special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.

Source: 14 CFR Part 150

## AEDT Input Data

In the development of DNL contours, the AEDT uses both default and airport-specific factors. The default factors include engine noise levels, thrust settings, aircraft arrival and departure flight profiles and aircraft speed. The airport-specific factors include the number of aircraft operations, the type of aircraft, the airport elevation, runway use, operational time (day/night), and, for departures, the distance from AEJ to destination airports. The following describes these AEJ-specific data.

### Aircraft Operations

The FAA requires the use of an annual-average day condition, which means the AEDT takes into account all operations that occurred at the airport over a 365-day period inclusive of the runways and flight paths used, the types of aircraft, and the time each operation occurred. Therefore, the AEDT outputs will not depict the noise levels on any specific day, but rather on an average day of the year. The total aircraft operations that occurred at the airport in 2015 were divided by 365 in order to generate the total operations that occurred on an average day.

An aviation activity forecast for AEJ was prepared as part of this Master Plan with a baseline year of 2015. The overall forecast of aviation activity was divided into categories of aircraft. The 2015 aircraft operations by category is provided in **Table 2**. As shown, in 2015 there were 4,392 operations at AEJ (an average of approximately 12 operations per day).

**Table 2. 2015 Annual Aircraft Operations by Category**

Aircraft Category	Operations
General Aviation Local	1,702
General Aviation Itinerant	2,690
<b>Total</b>	<b>4,392</b>

Source: Draft Central Colorado Regional Airport Master Plan Update, July, 2015

### Time of Day

As previously stated, DNL is calculated such that aircraft operations that occur after 10 pm and before 7 am (i.e., during the nighttime) are penalized by a factor of 10. For noise modeling purposes, it was estimated that approximately five percent of the operations at AEJ occur during the nighttime hours.

### Aircraft Fleet Mix

The FAA's Traffic Flow Management System Count (TFMSC) was used to develop the 2015 AEDT aircraft fleet mix for AEJ. TFMSC data provides information on traffic counts by airport and includes the specific aircraft types operating at that airport.

The AEDT includes a number of individual aircraft types as well as a number of FAA-approved substitute aircraft. The TFMSC data for AEJ was reviewed and each aircraft type was assigned an AEDT aircraft type (or approved substitute).

For the purposes of preparing DNL contours, operational data were segregated by aircraft type and by type of operation. Aircraft operations were segregated as being local or itinerant. An itinerant operation is defined as an aircraft departure where the aircraft leaves the airport vicinity and lands at another airport, or an aircraft landing where the aircraft arrives from another airport. Local operations are aircraft conducting training operations in the vicinity of the airport.

The 2015 AEDT aircraft fleet of itinerant and local aircraft operations, by time of day, are provided in **Table 3.**

**Table 3. 2015 Annual Operations and AEDT Fleet Mix**

Operation Type	Aircraft Category	Aircraft Types	AEDT Aircraft	Daytime Operations	Nighttime Operations	Total Operations
GA Itinerant	Single-Engine Piston	Piper 24/32/32R, Mooney M20K	GASEPV	413	21	434
		Cessna 206	CNA206	34	2	36
		Cessna 182	CNA182	31	2	33
		Piper Cherokee PA28/PA28R	PA28	21	1	22
		Cessna 172	CNA172	12	1	13
	Multi-Engine Piston	Beech 55/58, Cessna 310/340/404/414/421	BEC58P	399	21	420
		Piper 31	PA31	29	2	31
	Turboprop	Cessna 425/441, Piper Cheyenne 2/3/4	CNA441	304	16	320
		Cessna 208, Pilatus PC-12, Socata TBM 7/8	CNA208	93	5	98
		Piaggio P-180	DHC6	26	1	27
	Jet	Lear 31/35/40/45/55	LEAR35	303	16	319
		Cessna Citation	CIT3	292	15	307
		Cessna Citation X	CNA750	261	14	275
		Cessna Citation C560	CNA560E	104	5	109
		Cessna Citation C680	CNA680	87	5	92
		Bombardier Challenger 300/600/604, Gulfstream G200	CL600	73	4	77
		Beechjet 400	CNA500	73	4	77
<b>Itinerant Total</b>				<b>2,555</b>	<b>135</b>	<b>2,690</b>
GA Local	Single-Engine Piston	Piper 24/32/32R, Mooney M20K	GASEPV	1,455	77	1,532
		Cessna 206	CNA206	81	4	85
	Multi-Engine Piston	Beech 55/58, Cessna 310/340/404/414/421	BEC58P	81	4	85
		<b>Local Total</b>				<b>1,617</b>
<b>Grand Total</b>				<b>4,172</b>	<b>220</b>	<b>4,392</b>

Sources: FAA's Traffic Flow Management System Counts (TFMSC), Draft Central Colorado Regional Airport Master Plan Update, July, 2015, KB Environmental Sciences, Inc.

## **Runway Use**

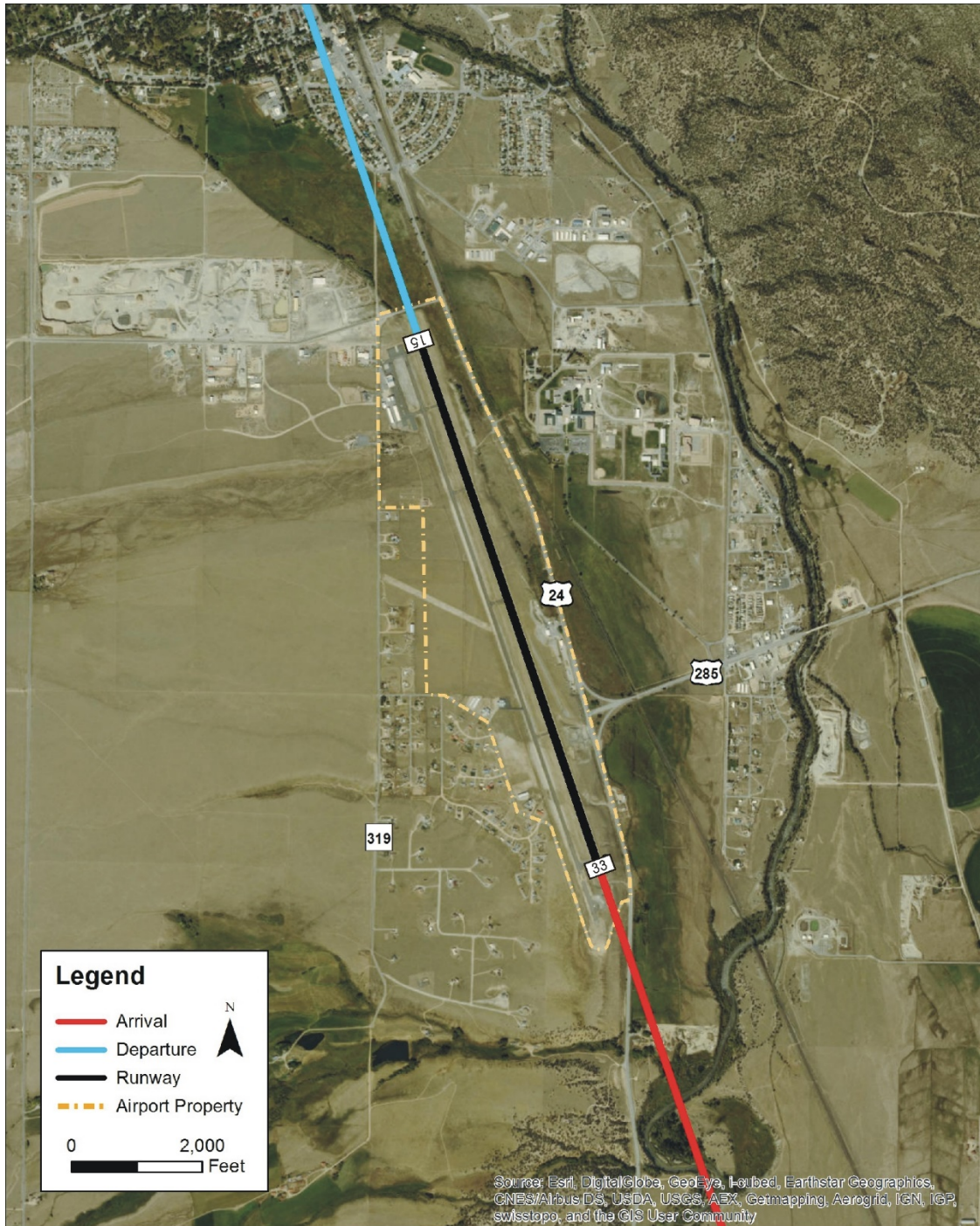
AEJ currently has one runway - 15/33 which is 8,303 feet long and 75 feet wide. Based on historic wind data, for modeling purposes, it was assumed that the airport operates in south flow approximately 95% of the time and in north flow approximately 5% of the time.

## **Flight Tracks and Profiles**

The AEDT uses airport-specific ground tracks and vertical flight profiles to compute three-dimensional flight paths for each modeled aircraft. The default AEDT vertical profiles, which consist of altitude, speed, and thrust settings, are compiled from data provided by aircraft manufacturers.

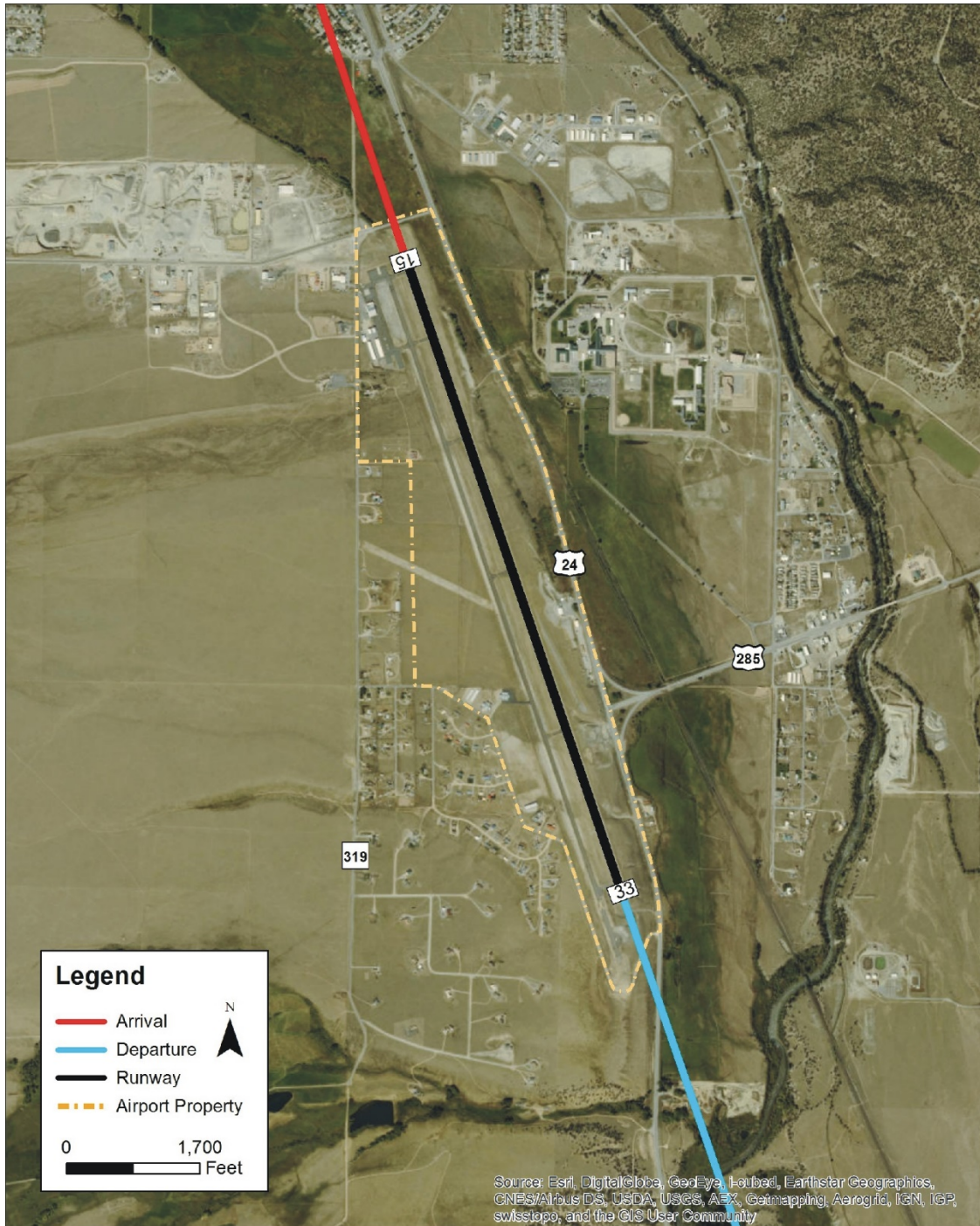
Because it was assumed that the aircraft noise contours would not extend far beyond the airport runway, the locations of the existing aircraft arrival and departure flight paths (i.e., tracks) in the immediate vicinity of AEJ were modeled straight in/out from each runway end. Local tracks were modeled following a standard left pattern from Runway 33 and a right pattern from Runway 15. The itinerant AEDT flight tracks are shown on **Figures 1 and 2**, and the local tracks are shown on **Figure 3**.

**Figure 1. AEDT Itinerant Flight Tracks – North Flow**



Source: KB Environmental Sciences, Inc.

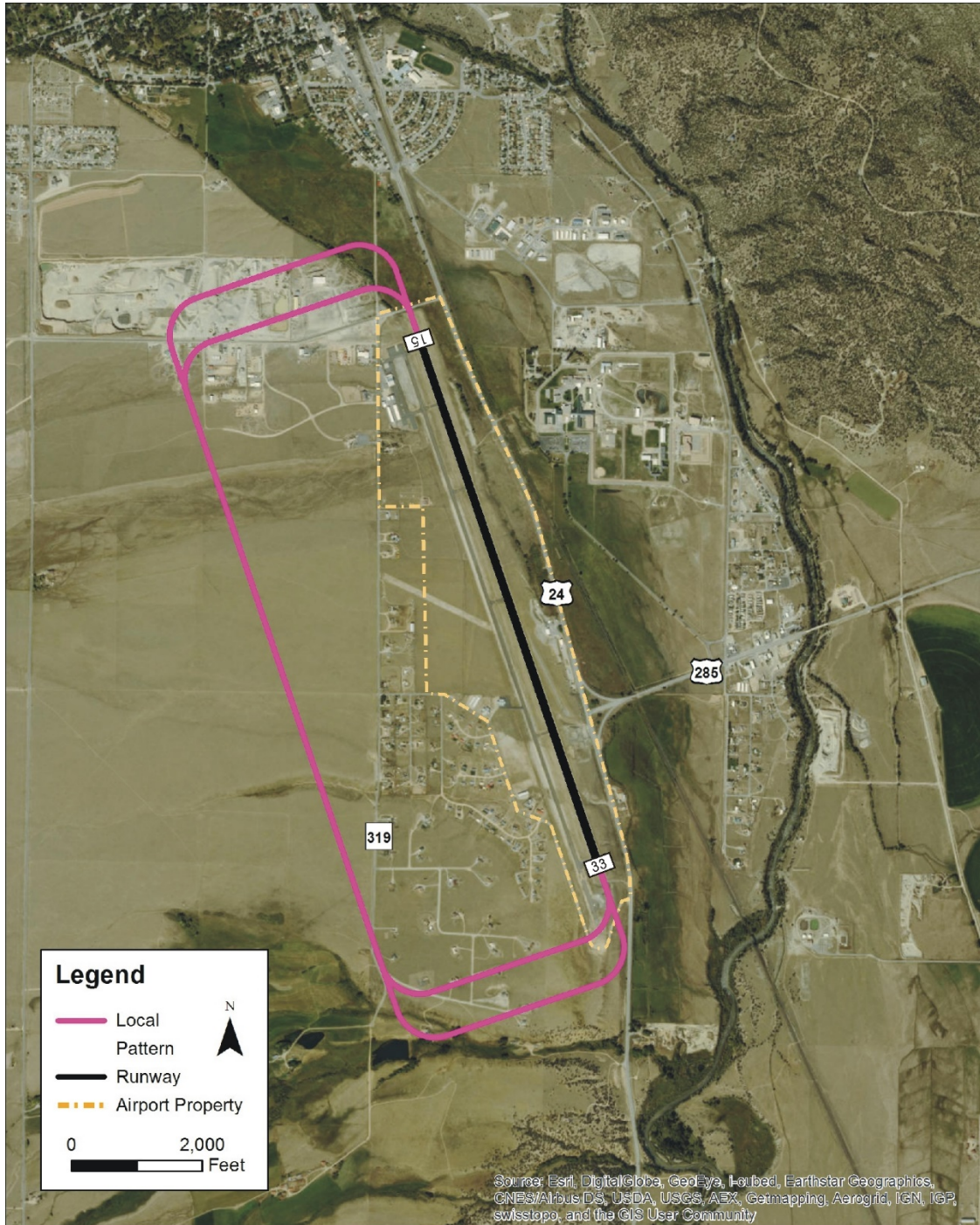
**Figure 2. AEDT Itinerant Flight Tracks – South Flow**



Source: KB Environmental Sciences, Inc.



Figure 3. AEDT Local Pattern Flight Tracks



Source: KB Environmental Sciences, Inc.

## 2015 DNL Contours

The 2015 65 DNL contour is provided on **Figure 4**. The total area encompassed by the 65 DNL contour is 72 acres. The 65 DNL contour falls within the limits of the property owned by the airport. There are no residences or other noise sensitive uses within the 2015 65 DNL contour limits.

**Figure 4. 2015 DNL Contours**



Source: KB Environmental Sciences, Inc.

NOTE: Given the minimal size of the 70 and 75 DNL contours, they are not shown graphically on the figure.

### **Future (2035) Aircraft Operations**

A forecast of aviation activity for AEJ was prepared as part of the Master Plan. The forecast of operations for the year 2035 by aircraft category is presented in **Table 4**. As shown, the 2035 forecast includes 6,859 operations at AEJ (an average of approximately 19 operations per day).

**Table 4. 2035 Annual Aircraft Operations by Category**

<b>Aircraft Category</b>	<b>Operations</b>
General Aviation Local	2,525
General Aviation Itinerant	4,334
<b>Total</b>	<b>6,859</b>

Source: Draft Central Colorado Regional Airport Master Plan Update, July, 2015

### **Future (2035) Aircraft Fleet Mix**

The 2035 aircraft fleet mix was determined by applying the percentages of the aircraft types that occurred in 2015 to the total operations forecast to occur at the airport in 2035. The 2035 aircraft fleet of itinerant and local operations, by time of day, are provided in **Table 5**.

### **Future (2035) Operational Time of Day**

The percentages of operations that were modeled during daytime/nighttime hours for 2035 were the same as those modeled for the 2015 condition.

### **Future (2035) Aircraft Flight Tracks**

The flight tracks, flight track use, and profiles modeled for 2035 were the same as those modeled for the 2015 condition.

**Table 5. 2035 Annual Operations and AEDT Fleet Mix**

Operation Type	Aircraft Category	Aircraft Types	AEDT Aircraft	Daytime Operations	Nighttime Operations	Total Daily Operations
GA Itinerant	Single-Engine Piston	Piper 24/32/32R, Mooney M20K	GASEPV	668	35	703
		Cessna 206	CNA206	55	3	58
		Cessna 182	CNA182	51	3	54
		Piper Cherokee PA28/PA28R	PA28	33	2	35
		Cessna 172	CNA172	20	1	21
	Multi-Engine Piston	Beech 55/58, Cessna 310/340/404/414/421	BEC58P	643	34	677
		Piper 31	PA31	48	2	50
	Turbo-prop	Cessna 425/441, Piper Cheyenne 2/3/4	CNA441	490	26	516
		Cessna 208, Pilatus PC-12, Socata TBM 7/8	CNA208	150	8	158
		Piaggio P-180	DHC6	41	2	43
	Jet	Lear 31/35/40/45/55	LEAR35	488	26	514
		Cessna Citation	CIT3	470	25	495
		Cessna Citation X	CNA750	421	22	443
		Cessna Citation C560	CNA560E	166	9	175
		Cessna Citation C680	CNA680	139	7	146
		Bombardier Challenger 300/600/604, Gulfstream G200	CL600	117	6	123
		Beechjet 400	CNA500	117	6	123
<b>Itinerant Total</b>				<b>4,117</b>	<b>217</b>	<b>4,334</b>
GA Local	Single-Engine Piston	Piper 24/32/32R, Mooney M20K	GASEPV	2159	114	2273
		Cessna 206	CNA206	120	6	126
	Multi-Engine Piston	Beech 55/58, Cessna 310/340/404/414/421	BEC58P	120	6	126
	<b>Local Total</b>				<b>2,399</b>	<b>126</b>
<b>Grand Total</b>				<b>6,516</b>	<b>343</b>	<b>6,859</b>

Sources: FAA's Traffic Flow Management System Counts (TFMSC), Draft Central Colorado Regional Airport Master Plan Update, July 2015, KB Environmental Sciences, Inc.

## **2035 DNL Contours**

The 2035 65 DNL contour is provided on **Figure 5**. The total area within the 65 and greater DNL contour is 107 acres. The 65 DNL contour remains within the limits of the airport property boundary. There are no residences or other noise sensitive uses within the 2035 65 DNL.

**Figure 5. 2035 DNL Contour**



**Source: KB Environmental Sciences, Inc.**

NOTE: Given the minimal size of the 70 and 75 DNL contours, they are not shown graphically on the figure.