Appendix L – Noise Analysis

Ann Arbor Municipal Airport Runway 6/24 Runway Extension Noise Analysis

A. Aircraft Noise Analysis

This section addresses aircraft noise exposure and describes the methods used to analyze aircraft noise, the metrics used to quantify aircraft noise exposure levels, and the resulting noise contours used to visually depict the noise levels at and from the Ann Arbor Municipal Airport (Airport or ARB).

Aircraft Noise

Understanding the characteristics of sound is essential in understanding airport noise and its effects on people. Sound is a type of energy that travels in the form of a wave and creates minute pressure differences in the air that are recognized by the human ear or microphones. Sound waves can be measured using decibels (dB) to measure the amplitude or strength of the wave and Hertz (Hz) to measure the frequency or pitch of the wave.

The strength, or loudness, of a sound wave is measured using decibels on a logarithmic scale. The range of audibility of a human ear is 0 dB (threshold of hearing) to 120 dB (threshold of pain). The use of a logarithmic scale can be confusing as it does not directly correspond to the perception of relative loudness. A common misconception is that if two noise events occur at the same time, the result will be twice as loud. Realistically, the event doubles the sound energy, but only results in a 3 dB increase in magnitude. In person, a sound event needs to be 10 dB higher to be observed as twice as loud as another.

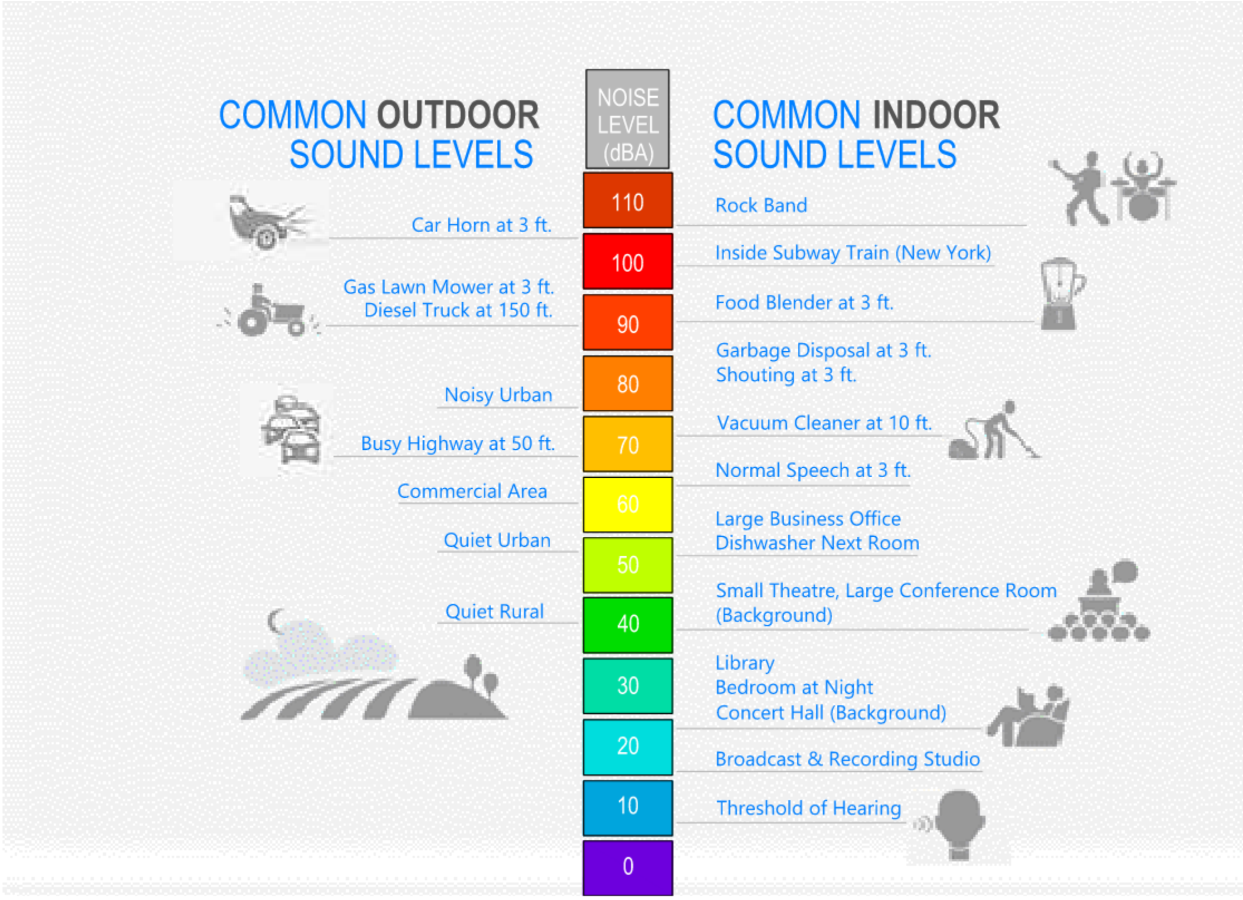
Scientific studies have shown that people do not interpret sound the same way a microphone does. For example, humans are biased and sensitive to tones within a certain frequency range. The A-weighted decibel (dBA) scale was developed to correlate sound tones with the sensitivity of the human ear. It emphasizes the sound components within the frequency range where most speech occurs. A comparative sound scale for dBA is illustrated in **Figure 1**, which lists typical sound levels of common indoor and outdoor sound sources.

Noise Metrics

Noise metrics can be categorized as cumulative metrics and single event metrics. Cumulative noise metrics have been developed to assess community response to noise. They are useful because these scales attempt to include the loudness and duration of the noise, the total number of noise events, and the time of day these events occur into one rating scale. Day-night average sound level (DNL), expressed in decibels (dB), is the standard federal metric1 for determining cumulative exposure of individuals to noise. The DNL is the annual, 24-hour average sound level, obtained from the accumulation of all noise events, with the addition of 10 decibels to weighed sound levels from 10:00 p.m. to 7:00 a.m. The 10 dB weighting of nighttime events accounts for the fact that noise events at night are more intrusive when ambient levels are lower, and people are trying to sleep. The 24-hour DNL is annualized to reflect noise generated by aircraft operations for an entire year and is identified by noise contours showing levels of aircraft noise.

[1] In 1981, the FAA formally adopted the DNL as the primary measure for determining exposure of individuals to airport noise.

Figure 1: Comparative Noise Levels (dBA)



Source: FAA Fundamentals of Noise and Sound. https://www.faa.gov/regulations_policies/policy_guidance/noise/basics/#contours

Single event metrics describe noise from individual events, such as an aircraft flyover. An example of this kind of metric is the maximum sound level (L_{max}), which identifies the highest noise level reached during a particular noise "event" and ignores the duration of the event.

B. Noise Modeling Methodology

Existing aircraft noise environments for ARB were analyzed using the Federal Aviation Administration (FAA) designated Aviation Environmental Design Tool (AEDT). The following sections explain the methodology and inputs used to generate the cumulative DNL contours for the Airport.

Operational data used to generate the base year noise contours were sourced from the Runway 6/24 Extension Justification Study which also included an operations forecast. Additional data regarding runway and track usage were derived from information provided by the Airport and air traffic control tower personnel.

Computer Modeling

Computer modeling generates maps or tabular data of an airport's noise environment expressed in the applicable metric, such as DNL. Computer models are most useful in developing contours that depict areas of equal noise exposure, such as elevation contours on a topography map. Noise contour accuracy is dependent on having reliable, validated, and updated noise models and collection of accurate aircraft operational data.

The AEDT software used to determine existing and future aircraft noise environments for ARB models civilian aviation operations and is required by the FAA to be used for 14 CFR Part 150 Study aircraft noise analysis as well as National Environmental Policy Act (NEPA) noise analysis. The program includes standard aircraft noise and performance data for hundreds of aircraft types that can be tailored to the characteristics of specific individual airports.

Noise Model Inputs

The AEDT model requires a variety of operations-related inputs to model the noise environment around an airport. These following inputs included:

- Aircraft Activity Levels
- Aircraft Fleet Mix
- Runway Utilization
- Time of Day
- Surrounding Terrain
- Flight Tracks

Airport Activity Levels and Fleet Mix

The operations count used in the AEDT are categorized by aircraft model. The number of operations per aircraft type for the base year and the forecasted years are based on the data provided in the Runway 6/24 Extension Justification Study. The percentage of total operation by aircraft type was calculated with the 2019 total Instrument Flight Rules (IFR) itinerant operations data. This fleet mix percentage was then applied to the base and forecasted years' itinerant operations provided in the Justification Study. Local general aviation touch-and-go operations were divided equally between the three representative piston aircraft types listed in the Justification Study. **Table 1** shows the total operations by aircraft type and year used for the AEDT inputs.

The Jet 1, Jet 2, Turbine 1, Turbine 2, Piston, and Helicopter aircraft type designations were used to extrapolate total operations from IFR itinerant operations data from the Runway 6/24 Extension Justification Study. The percentage of total operations for each aircraft type was calculated and applied to the total forecasted operation numbers.

Table 1: AEDT Input – Total Annual Operations by Representative Aircraft

Aircraft	Aircraft Type	Base (2019)		5 Year (2024)		10 Year (2029)	
		Itinerant	Local	Itinerant	Local	Itinerant	Local
C56X - Excel XLS	Jet 1	134		145		155	
Cessna 680 Citation Sovereign	Jet 1	134		145		155	
Pilatus PC24	Jet 1	134		145		155	
E55P - Phenom 300	Jet 2	74		80		86	
Cessna CJ4	Jet 2	74		80		86	
TBM8 - TBM-850	Turbine 1	492		533		569	
TBM9	Turbine 1	492		533		569	
Pilatus PC12	Turbine 2	1,624		1,755		1,873	
Beech B350	Turbine 2	1,584		1,715		1,833	
Piper Meridian P46T	Turbine 2	1,584		1,715		1,833	
Cessna Caravan C208	Turbine 2	1,584		1,715		1,833	
C172 - Cessna 172/182	Piston	6,665	15,884	7,219	15,831	7,712	15,755
Piper Cherokee PA32	Piston	6,665	15,884	7,219	15,831	7,712	15,755
Cirrus SR22	Piston	6,665	15,884	7,219	15,831	7,712	15,755
EC55 - EC-155	Heli	813		881		941	
Dornier 328	Jet 1	29		29		29	
Beechjet 400	Jet 1	30		30		30	
Total		28,775	47,653	31,160	47,494	33,282	47,264
		76,428		78,654		80,546	

Table 2 breaks out the military only operations. Military operations were held constant through the forecast period with the Pilatus PC12, Dornier 328, and Beechjet 400 all having military operations with the same track and runway utilization as the itinerant and local operations.

Table 2: AEDT Input – Military Operations

Aircraft	Aircraft Type	Base (2019)	5 Year (2024)	10 Year (2029)
Pilatus PC12	Turbine 2	40	40	40
Dornier 328	Jet	29	29	29
Beechjet 400	Jet	30	30	30

Runway Utilization

The frequency of use for each runway is important to generating accurate noise contours. The data was provided by the Airport and the airport control tower. The runway use percentage is grouped by aircraft type. **Table 3** describes the runway use percentage by aircraft type. Based on runway utilization data, all jet and helicopter operations were limited to runway 6/24 with runway 12/30 only being used for a few piston operations.

Table 3: **Runway Utilization by Aircraft Type**

Runway Use Percentage	Runway				
Aircraft Group	**6**	**24**	**12**	**30**	**Total**
Jet/Turbine	45%	55%	0%	0%	100%
Piston	40%	50%	5%	5%	100%
Helicopter	45%	55%	0%	0%	100%

Operations by Time of Day

The time of day or night that aircraft operate is an important component to the AEDT model. Every aircraft operation that occurs between 10 p.m. and 7 a.m. has 10 dB added to the aircraft noise level. This effectively doubles the noise level as noise is quantified using the logarithmic scale. This addition is due to noise being perceived as more intrusive at night.

The ratio between daytime and nighttime activity was also provided by the Airport and the airport control tower. **Table 4** shows the time-of-day split provided by the Airport for itinerant operations. Like the runway utilization information, the time-of-day percentages are based on aircraft type. Based on the provided data, 95 percent of operations for all aircraft type occur in the day. Touch-and-go operations were modeled to occur only during the day.

Table 4: Operations by Time of Day

GA Time of Day	Day (7AM – 10PM)	Night (10PM - 7AM)	TOTAL
Jet/Turbine	95%	5%	100%
Piston	95%	5%	100%
Helicopter	95%	5%	100%

Flight Tracks

Flight paths represent where aircraft fly in relation to the ground. These paths are approximations of the average path that aircraft take while operating at the Airport as aircraft do not fly exact or precise "tracks", but rather a wider "path" that represents some dispersion due to several factors, including weather (temperature, wind, barometric pressure), pilot proficiency, aircraft performance, other air traffic, and separation requirements.

The tracks used for the noise analysis not only include straight in, straight out, and touch and go tracks but also accounts for the various turns and heading aircraft are likely to take when departing and landing. Track input was received using tracks drawn over an aerial map. **Table 5** shows the operational tracks and their utilization used as noise model inputs.

Table 5: ARB Track Utilization

Runway 06 Arrivals	
South Approach	30%
Downwind Approach	40%
Straight in	30%
Runway 06 Departures	
East Freeway Departure	10%
Southeast Freeway Departure	30%
Straight out	20%
Left turn north/northwest	40%
Runway 24 Arrivals	
Freeway Approach	40%
Straight in	20%
Downwind approach from northwest	40%
Runway 24 Departures	
North Departure	50%
South Departure	30%
Straight out	20%
Runway 12 Arrivals	
Straight-in flight track	30%
Downwind pattern	70%
Runway 12 Departures	
Straight-out flight track	10%
Left turn north/northwest	45%
Right turn south	45%
Runway 30 Arrivals	
Straight-in flight track	20%
Downwind pattern	80%
Runway 30 Departures	
Straight-out flight track	30%
Left turn south	35%
Right turn north	35%

C. Resulting Noise Contours

The maps found at the end of this report depict the following noise contours generated incorporating the data described above. The maps include the following scenerios:

- Baseline (2019)
- 5 Year (2024) No Project
- 5 Year (2024) With Project
- 10 Year (2029) No Project
- 10 Year (2029) With Project

D. Sensitive Noise Analysis

A noise sensitive analysis was conducted in compliance with 14 CFR Part 150 *Airport Noise Compatibility Planning,* FAA Order 1050.1F, and FAA Order 5050.4B. The threshold for significant aircraft noise impacts are defined using the DNL metric. According to the Land Use Guidance Table in 14 CFR Part 150, the DNL 65 dB is the generally accepted threshold to determine land use compatibility impacts for noise-sensitive land uses (e.g., residences, schools, places of worship, etc.). In general, commercial, industrial, and outdoor recreational land uses are compatible with aircraft noise. For this noise analysis, the 65 DNL contour remains completely within ARB owned property or over commercial property not considered noise sensitive under all noise scenarios. Noise impacts within the 65 DNL are not expected. See noise contour maps at the end of this report for a comparison of future scenarios.

To determine and depict the extent of the potential noise impact around the Airport, ARB is presenting noise contours for DNL levels of 65 dB, 70 dB, and 75 dB in accordance with 14 CFR Part 150, Appendix A, Section A150.101 as well as additional contours, such as the DNL 60 dB as part of presenting compatible and noncompatible land uses.

A 60 DNL receptor point analysis was completed for the only area where future noise contours extend off Airport property and onto a potential noise sensitive land use. This area is shown in **Figure 2** below. This receptor point is in a residential area at the southwest corner of the Airport. Potential noise levels were developed for the noise sensitive location and are shown in **Table 6**. Potential noise impacts between the 60 DNL and the 65 DNL are defined as an increase of 3.0 dB or more due to the implementation of the project. Given that no increase above 3.0 dB occurs between the 60 DNL and the 65 DNL under any future scenario, noise impacts are not expected at this location.

Figure 2 – Sensitive Receptor Analysis Location

Table 6: Sensitive Receptor Analysis

Scenario	Noise Levels at Receptor Point	Change within 60 DNL to 65 DNL
5 Year – No Project	57.95 dB	2.15 db
5 Year – With Project	60.10 dB	
10 Year – No Project	58.10 dB	2.15 db
10 Year – With Project	60.25 dB	

ANN ARBOR MUNICIPAL AIRPORT

BASELINE NOISE CONTOUR (2019)

ANN ARBOR MUNICIPAL AIRPORT

5 YEAR (2024) NOISE CONTOUR
(NO PROJECT)

ANN ARBOR MUNICIPAL AIRPORT

5 YEAR (2024) NOISE CONTOUR
(WITH PROJECT)

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10 YEAR (2029) NOISE CONTOUR
(NO PROJECT)

ANN ARBOR MUNICIPAL AIRPORT

10 YEAR (2029) NOISE CONTOUR
(WITH PROJECT)