Portable Noise Measurement Report

Harriet Tubman Lane, Columbia, MD 21044

Maryland Aviation Administration

October 2023

MARYLAND DEPARTMENT OF TRANSPORTATION

MARYLAND AVIATION ADMINISTRATION

BW329 Summary

? WHEN

WAS NOISE MEASURED

Saturday, September 16, 2023 to Sunday, October 1, 2023

16 DAYS

	S	M	T	W	T	F	S
September	10	11	12	13	14	15	16
	17	18	19	20	21	22	23
	measurements						
October	24	25	26	27	28	29	30
	measurements						
	1	2	3	4	5	6	7

HOW MANY

AIRCRAFT NOISE EVENTS OCCURRED AND WHAT WERE THEY

65 EVENTS / 24 HRS. ON AVERAGE

196 EVENTS / 24 HRS. AT THE MOST

0 EVENTS / 24 HRS. AT LEAST

TOP 3 MOST FREQUENT AIRCRAFT DURING THE MEASUREMENT PERIOD

Rank	Aircraft Type		Operation Type and Runway
1	Boeing 737-700		Arrival, 10
2	Boeing 737-800		Arrival, 10
3	Embraer Phenom		Arrival, 10

CONCLUSION

During the 16-day measurement period, the Day Night Average Noise Level (DNL) from aircraft noise events was 50 decibels (dB), while the DNL from community noise was 56 dB.

FAA's threshold for land use compatibility is an aircraft-only DNL of 65 dB based on annual average daily aircraft operations.

Aircraft DNL	Community DNL	Total DNL	FAA Threshold
50 dB	56 dB	57 dB	65 dB

Introduction

The purpose of the portable noise monitoring report is to summarize aircraft and community noise levels at a specific location upon request of a homeowner. The program is offered by the Maryland Aviation Administration (MAA), with technical support and report preparation provided by Harris Miller Miller & Hanson Inc. (HMMH) and Airport Design Consultants, Inc. (ADCI).

It should be noted that the noise data provided in this report represents noise and operating levels only during the period of the measurements. Noise levels associated with aircraft overflights can vary with the number of operations, wind and weather patterns, temperatures, pilot procedures and Air Traffic Control instruction, and other variables.

This report presents the measured aircraft and community noise levels from September 16, 2023, to October 1, 2023, at Harriet Tubman Ln, Columbia, MD 21044. The monitoring location is approximately 11.7 statute miles from the center of Baltimore/Washington International Thurgood Marshall (BWI Marshall) Airport. The figure to the right shows the location of the measurement site (marked as BW329) relative to BWI Marshall.

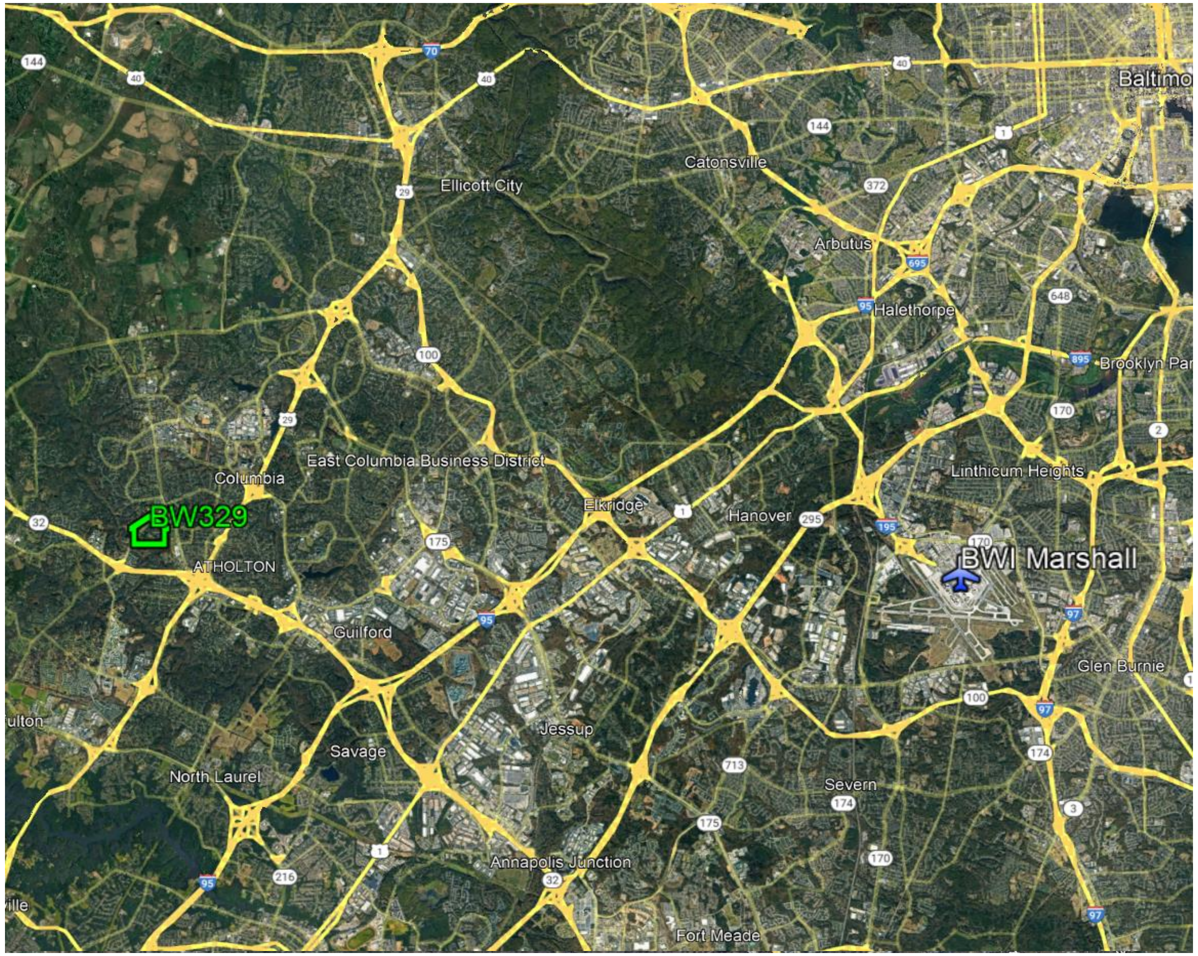

Figure 1. Noise Monitoring Location in Relation to BWI Marshall

Aircraft Operations

Operations at BWI Marshall fluctuate on a daily basis. During the measurement period, there were 10,618 flights in and out of BWI Marshall (5,299 arrivals, 5,319 departures), in addition to overflights to other airports. The number of flights per day ranged from 565 to 721. Flights in the vicinity of this site are primarily arrivals to BWI Marshall Runway 10.

BWI Marshall has three runways, designated as Runway 10/28, Runway 15R/33L, and Runway 15L/33R. Runway 10/28 is 10,502 feet in length, while Runway 15R/33L is 9,500 feet in length. Runway 15L/33R is 5,000 feet in length and is only used by certain aircraft. The figures to the right present runway use during the measurement period. As aircraft cannot arrive and depart from the same runway, BWI Marshall generally operates in two configurations – west flow (primarily departures from Runway 28 and arrivals to Runway 33L) and east flow (primarily departures from Runway 15R and arrivals to Runway 10). On an annual basis, west flow is used approximately 70% of the time while east flow is used approximately 30% of the time. During west flow, aircraft operations primarily consist of departures from BWI Marshall Runways 28 and arrivals to 33L. During east flow, aircraft operations primarily consist of departures from BWI Marshall Runway 15R and arrivals to Runway 10. Arrivals to BWI Marshall were generally 1,600 to 2,100 feet above ground level at their point of closest approach to the measurement site. Departures from BWI Marshall were generally 5,100 to 7,300 feet above ground level at their point of closest approach to the measurement site.

The figures to the right display runway use for west and east flow during the measurement period. Differences in percentages are due to rounding.

West Flow Runway Use was 53% during the measurement period
(Historical Annual Average of 70%)

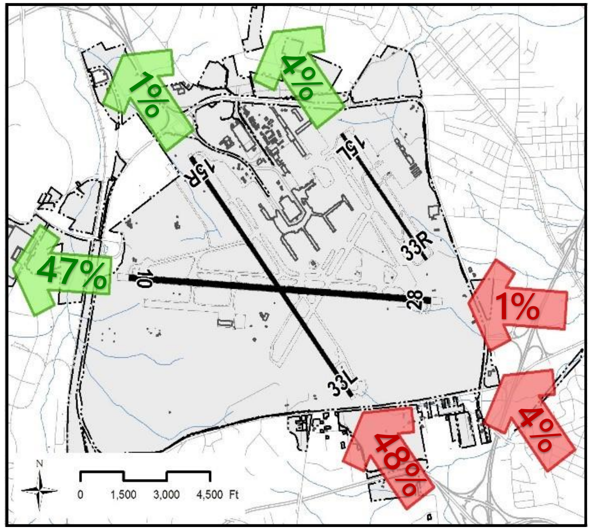

Figure 2. West Flow Runway Use During Measurement Period

East Flow Runway Use was 47% during the measurement period
(Historical Annual Average of 30%)

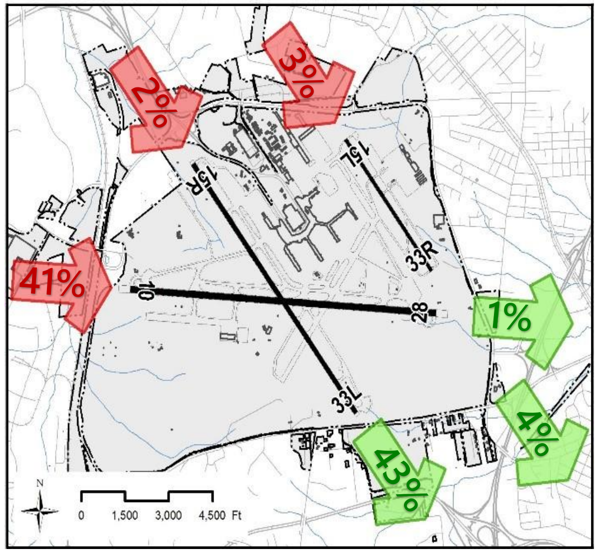

Figure 3. East Flow Runway Use During Measurement Period

Methodology & Location

Aircraft noise levels were measured from September 16, 2023, to October 1, 2023, at Harriet Tubman Lane, Columbia, MD 21044. The monitor was originally deployed on September 13, but experienced power loss briefly at the beginning of deployment. Data during this time was corrupted and therefore was removed from the analysis. The noise monitor is a Type I sound level meter and was regularly calibrated. Additionally, the system was checked every two to four days during the measurements to ensure proper operation. During setup, a baseline threshold was established for the noise monitor. Once the sound level exceeded the baseline threshold for five seconds, a noise event was recorded. The sound level meter recorded the following information about each noise event: date, time, duration and noise levels. The noise monitor was placed in the backyard of the residence. Notable noise sources at this site included aircraft overflights to and from BWI Marshall as well as overflights to and from other airports, and other typical suburban sounds such as local vehicle traffic.

Once the temporary noise monitoring period was complete, the noise event data was collected from MAA ’s Noise and Operating Monitoring System (NOMS) to analyze the times of noise events at the site to its database of aircraft radar flight paths. The NOMS conservatively attributes any noise event to an aircraft if the aircraft is within 8,000 feet of the measurement site at an altitude no greater than 10,000 ft. Noise events which occurred while aircraft were passing within the vicinity were associated with an actual aircraft flight and therefore assigned as aircraft noise events. Noise events that did not correlate with an aircraft overflight were assigned as community noise events. Using this methodology, some noise events that are correlated with aircraft overflights may include other community noise, which may or may not exceed the noise level from the aircraft overflight. Figure 4 on the next page displays all arrivals and departures to and from BWI Marshall during the measurement period. Figure 5 displays all arrivals and departures to and from BWI Marshall that were correlated with aircraft noise events.

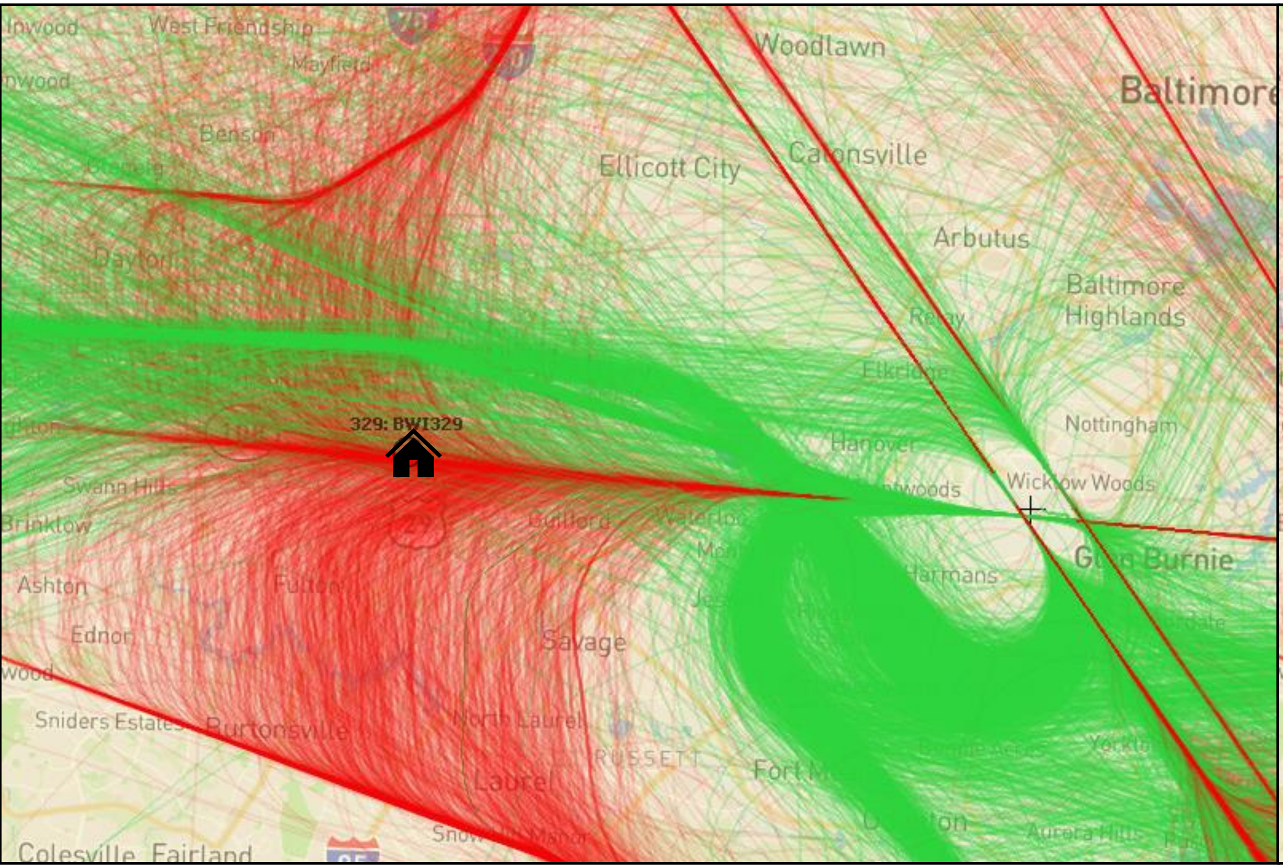

Figure 4. All BWI Marshall Arrivals and Departures During the Measurement Period (Green = Departures, Red = Arrivals)

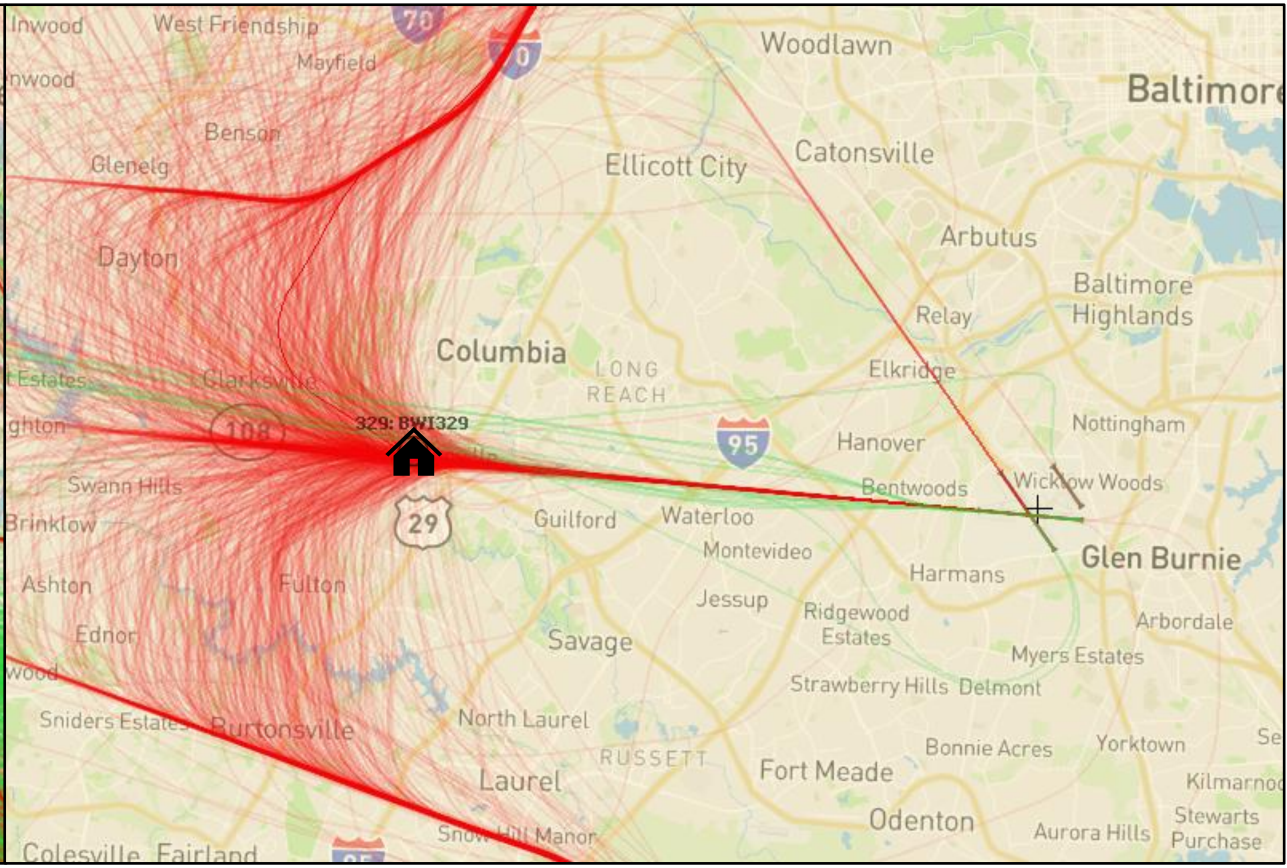

Figure 5. All BWI Marshall Arrivals and Departures Correlated to Aircraft Noise Events During the Measurement Period (Green = Departures, Red = Arrivals)

Measured Noise Levels

There are several key metrics which are used to describe aircraft and community noise on a single-event and cumulative basis. The appendix titled "How Do We Describe Aircraft Noise" provides a more detailed overview of the metrics which are discussed in this section. Single event metrics such as Maximum A-Weighted Sound Level (Lmax) are indicators of the intrusiveness, loudness, or noisiness of individual noise events while cumulative metrics like Day-Night Average Sound Level (DNL) are generally used to measure long term noise and are indicators of community annoyance and land use compatibility.

Figure 6 presents the range of maximum single event sound levels for 1,042 aircraft overflights at the measurement site for the complete measurement period. For a particular noise event, such as an aircraft overflight, the loudest level at any instant during the event is the Lmax. For typical conversational speech at approximately three feet, speech is interrupted by noise levels at or above 65 dB. Any noise events shown in this figure with a maximum level at or above 65 dB would, briefly for quieter events and longer for louder events, interrupt typical conversations outdoors. Figure 7 shows common environmental A-weighted noise levels for typical outdoor sounds.

Figure 8 on the following page shows the top 15 loudest aircraft events that occurred during the measurement period including details about the date and time the event occurred, airline, aircraft type, operation type, runway, and slant range (the line-of-sight distance between the receptor and the aircraft). Note that these events only represent the noisiest aircraft events at the measurement site and that the majority of aircraft overflights at the measurement site were less noisy than those shown in Figure 8. In some cases, community events may occur simultaneously with aircraft overflights, causing aircraft overflights to have higher recorded sound levels than were actually present.

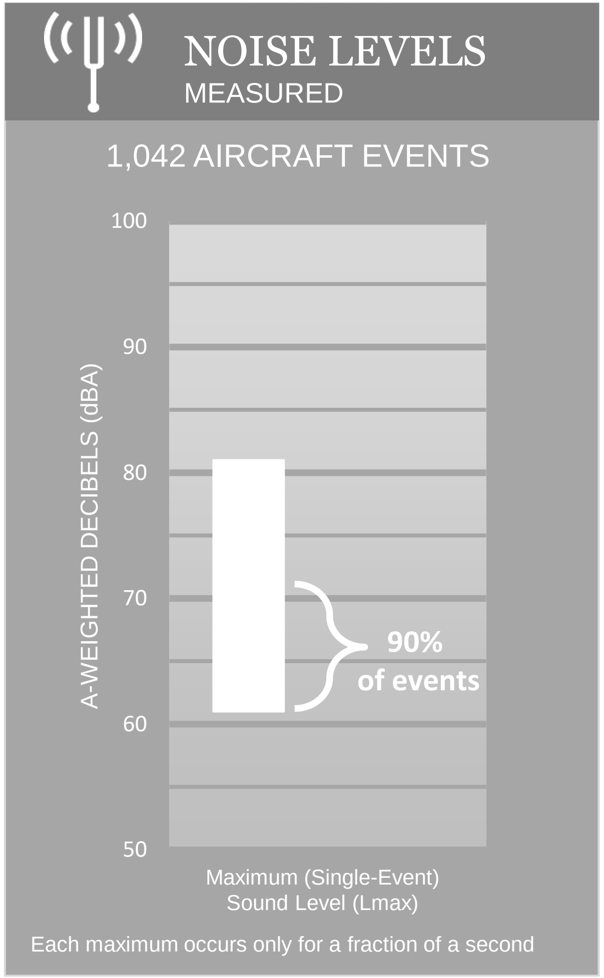

Figure 6. Maximum Single Event Aircraft Noise Levels

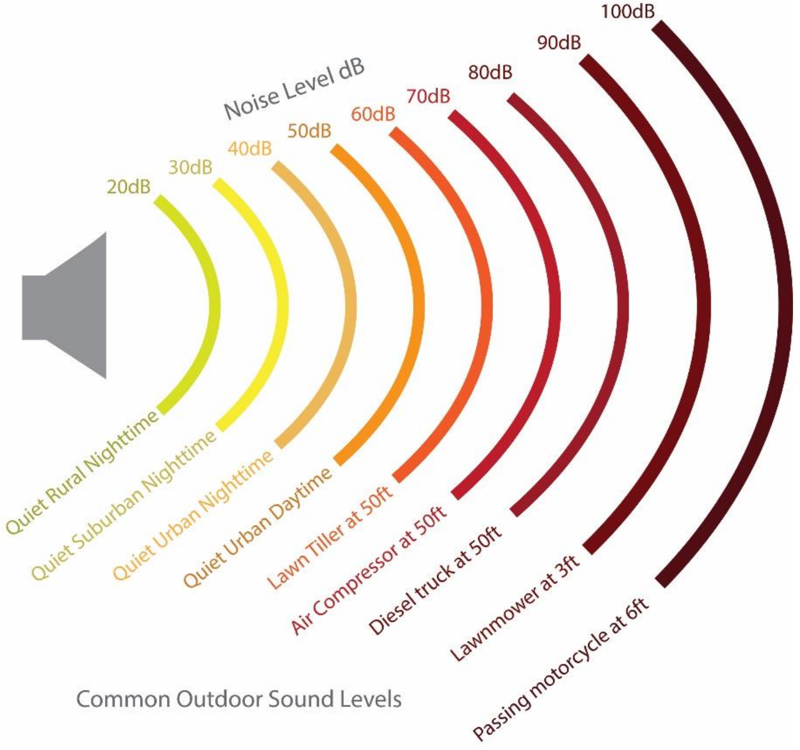

Figure 7. Common Environmental Noise Levels

Loudest Aircraft Events

Rank	Flight Time	Airline	Aircraft Type	Operation Type	Runway	Altitude (ft. AGL)	Slant Range (ft.)	Maximum Sound Level (dBA)
1	9/26/2023 16:35	ATI	Boeing 767–300	Arrival	10	1,625	3,110	81
2	9/26/2023 17:09	UNITED	Boeing 737-800	Arrival	10	1,631	1,837	80
3	9/26/2023 17:15	FedEx Express	Boeing 767–300	Arrival	10	1,629	1,932	77
4	9/28/2023 17:07	Atlas Air Worldwide	Boeing 767–300	Arrival	10	1,615	1,690	76
5	9/28/2023 9:03	ups	McDonnell-Douglas MD-11	Arrival	10	1,629	1,916	76
6	9/24/2023 19:58	Atlas Air Worldwide	Boeing 767–300	Arrival	10	1,625	2,293	75
7	9/23/2023 15:25	American Airlines	Boeing 737-800	Arrival	10	1,711	1,781	75
8	9/27/2023 9:05	ATI	Boeing 767–200	Arrival	10	1,678	2,254	75
9	9/28/2023 16:13	Delta Air Lines	Airbus A320	Arrival	10	1,917	2,208	75
10	9/23/2023 19:19	American Airlines	Airbus A321	Arrival	10	1,629	2,415	75
11	9/23/2023 18:22	spirit	Airbus A321	Arrival	10	1,612	2,510	75
12	9/28/2023 10:23	Southwest	Boeing 737-800	Arrival	10	1,625	1,670	75
13	9/24/2023 3:35	Frontier Airlines	Airbus A321	Arrival	10	1,640	1,798	74
14	9/23/2023 22:02	Delta Air Lines	Airbus A320	Arrival	10	1,631	2,067	74
15	9/27/2023 14:33	Southwest	Boeing 737-800	Arrival	10	1,629	1,778	74

Figure 8. Top Fifteen Loudest Aircraft Events During the Measurement Period

Note: In some cases, community events may occur simultaneously with aircraft overflights, causing aircraft overflights to have higher recorded sound levels

Conclusion

Figure 9 presents the cumulative DNL at the measurement site for the sixteen complete days of the measurement period for community, aircraft and total noise exposure. Figure 10 presents the daily DNL at the site. DNL sums the noise from every noise event over the day. The formula for DNL gives an extra ten decibel weighting to nighttime noise events to account for the intrusive nature of these events. The aircraft DNL ranged from 0 to 56 dB during the measurement period. The total aircraft DNL for the measurement period was 50 dB. The DNL for all recorded community noise events (wildlife, landscaping, weather, etc.) during the measurement period was 56 dB. The total DNL at the measurement site, which includes both aircraft and community noise events, was 57 dB.

Aircraft noise levels at this site are higher when BWI Marshall operates in east flow. During the measurement period, BWI Marshall operated in east flow 47% of the time and in west flow 53% of the time, which is a lower usage of west flow than the annual average of 70% west flow operations and 30% east flow operations. On September 18, all arrival flights were in west flow, resulting in zero aircraft noise events at the site for that day.

The results of the portable noise monitoring are for informational purposes only and capture the aircraft noise environment for a snapshot in time. The conditions during a monitoring period can vary greatly due to wind and weather (atmospheric conditions), the runway(s) in use at the time for arrivals and departures, and the number and type of operations occurring during the monitoring period. From the data collected, aircraft noise levels in terms of the Day-Night Average Sound Level (DNL) were calculated and resulted in a 16-day average of 50 decibels (dB). Though initially setup on September 13, the monitor suffered a power loss at the beginning of the collection period and the corrupted days of data were not used in analysis.

In Appendix A of 14 CFR Part 150, the Federal Aviation Administration provides guidelines for the compatibility of land uses with various annual DNL values. See also COMAR 11.03.03.03 which establishes limits for cumulative noise exposure for certain land uses around BWI Marshall. These guidelines consider residential land use to be noncompatible when the DNL is 75 dB or greater. For noise levels between 65 dB and 75 dB DNL, residential land use is considered noncompatible, but where the community determines that this land use must be allowed, measures to achieve greater than typical outdoor to indoor noise level reduction should be incorporated into building codes. The guidelines designate all land uses, including residential, as compatible for DNL values below 65 dB.

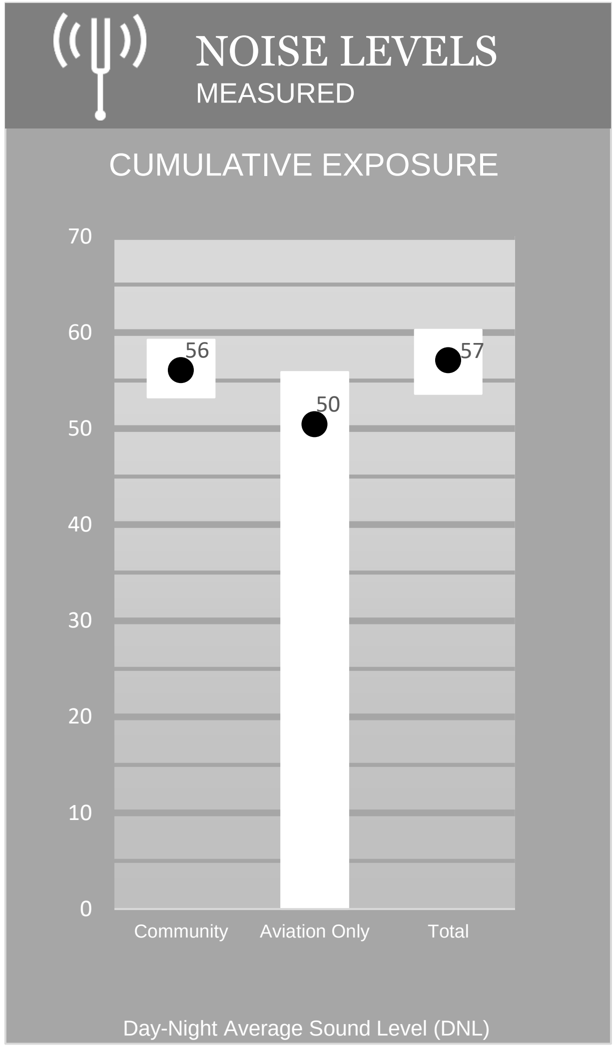

Figure 9. Cumulative Noise Exposure from Aircraft and Community Sources

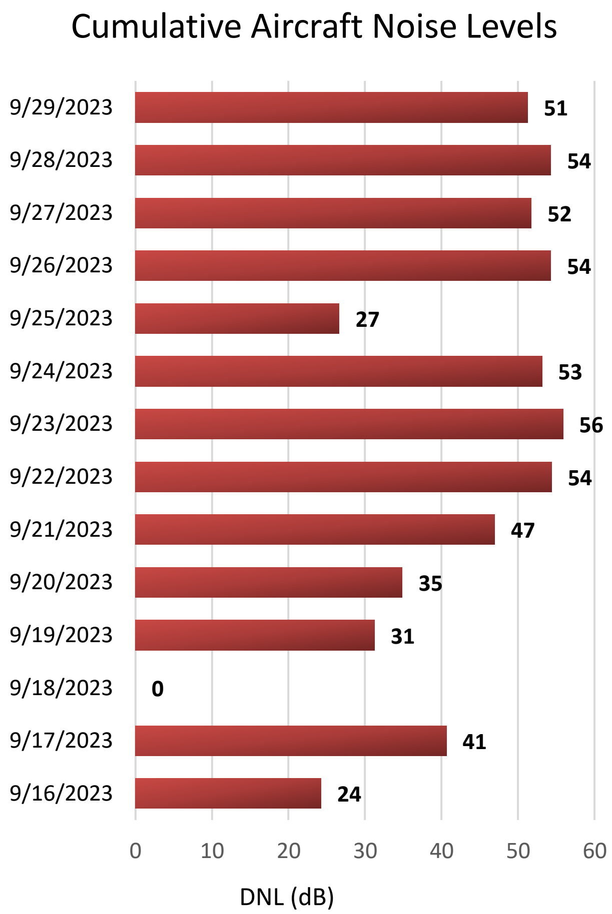

Figure 10. Measured Daily Aircraft Noise Levels

For More Information

Information about Maryland Department of Transportation Maryland Aviation Administration's (MAA) Noise Program activities can be found at https://marylandaviation.com/. Frequent topics of interest include:

Noise Complaints: MAA provides multiple methods to submit aircraft noise complaints, including an on-line form (https://marylandaviation.com/environmental/environmental-compliance-sustainability/noise-complaints/) or 24-hour noise complaint and information hotline at 410-859-7021. MAA reviews noise complaints daily, and logs, reviews, and analyzes all noise complaints on a regular basis.

Quarterly Noise Reports: Each quarter, MAA prepares and publishes a quarterly noise report. The report provides information on operational trends (including the number of jet and cargo operations, and the number of nighttime operations), runway use, flight corridors/flight density maps, noise complaints received, outreach efforts, permanent noise monitoring data and MAA's noise assistance programs.

eNews Express: Stay up-to-date on planned runway closures, as well as other important aviation topics, by subscribing to the BWI Marshall eNews Express, by sending an email to https://marylandaviation.com/environmental/environmental-compliance-sustainability/enews-express-signup/.

Airport Noise Zone: The BWI Noise Abatement Plan and Airport Noise Zone, first established in 1976, includes a wide variety of strategies that are intended to reduce noise impacts for communities around the Airport while maintaining efficient airport operations. Noise abatement at BWI includes operational procedures such as aircraft arrival and departure procedures and a preferential runway use system intended to direct aircraft operations over less populated areas, where and when possible. Other elements of the Noise Abatement Plan include land use restrictions and programs such as land acquisition and soundproofing.

Additional Resources:
Website - www.bwiairport.com
Facebook - www.facebook.com/BWIairport/
Twitter - @BWI_Airport
Instagram - @bwi_airport

How do we Describe Aircraft Noise?

We use a number of terms to describe aircraft noise. These metrics form the basis for the majority of noise analyses conducted at most airports in the U.S.

The Decibel, dB

All sounds come from a source – a musical instrument, a voice speaking, an airplane. The energy that produces these sounds is transmitted through the air in waves, or sound pressures, which impinge on the ear, creating the sound we hear.

The decibel is a ratio that compares the sound pressure of the sound source of interest (e.g., the aircraft over flight) to a reference pressure (the quietest sound we can hear). Because the range of sound pressures is very large, we use logarithms to simplify the expression to a smaller range, and express the resulting value in decibels (dB). Two useful rules of thumb to remember when comparing individual noise sources are: (1) most of us perceive a six to ten dB increase to be about a doubling of loudness, and (2) changes of less than about three dB are not easily detected outside of a laboratory.

The A-Weighted Decibel, dB(A)

Frequency, or "pitch", is an important characteristic of sound. When analyzing noise, we are interested in how much is low-, middle-, and high-frequency noise. This breakdown is important for two reasons. First, our ears are better equipped to hear mid- and high-frequencies; thus, we find mid- and high-frequency noise more annoying. Second, engineering solutions to noise problems are different for different frequency ranges. The "A" filter approximates the sensitivity of our ear and helps us to assess the relative loudness of various sounds.

Maximum A-weighted Sound Level, Lmax

A-weighted sound levels vary with time. For example, the sound increases as an aircraft approaches, then falls and blends into the background as the aircraft recedes into the distance. Figure 1 illustrates this phenomenon. We often describe a particular noise "event" by its maximum sound level (Lmax). Figure 2 shows typical Lmax values for some common noise sources. In fact, two events with identical Lmax may produce very different total exposures. One may be of very short duration, while the other may be much longer.

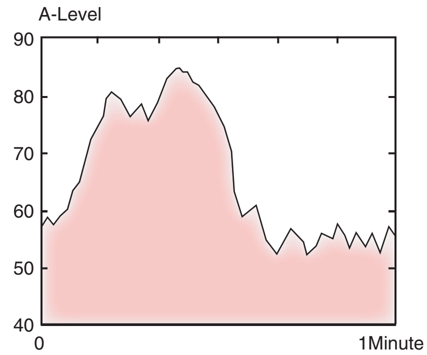

Figure 1. A-weighted Sound Levels Over Time

Sound Exposure Level, SEL

The most common measure of cumulative noise exposure for a single aircraft flyover is the Sound Exposure Level (SEL). Mathematically, it is the sum of the sound energy over the duration of a noise event – one can think of it as an equivalent noise event with a one-second duration. Figure 3 shows that portion of the sound energy included in this event. Because the SEL is normalized to one second, it will almost always be larger in magnitude than the Lmax for the event. In fact, for most aircraft events, the SEL is about 7 to 12 dB higher than the Lmax. Also, the fact that it is cumulative measure means that a higher SEL can result from either a louder or longer event, or some combination.

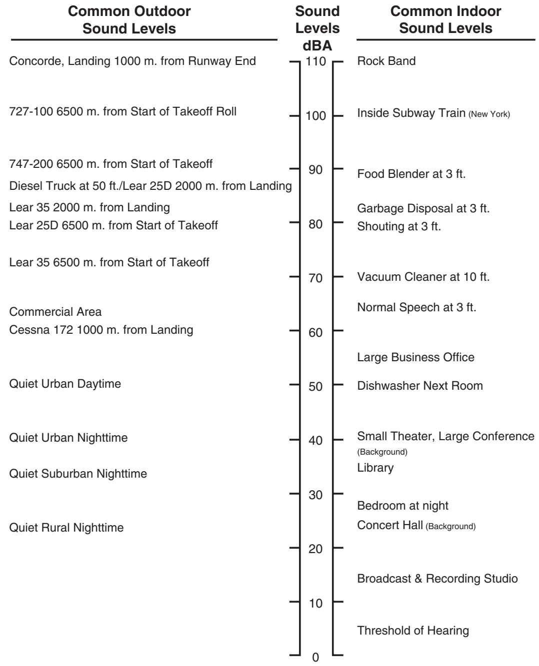

Figure 2. Common Environmental Sound Levels

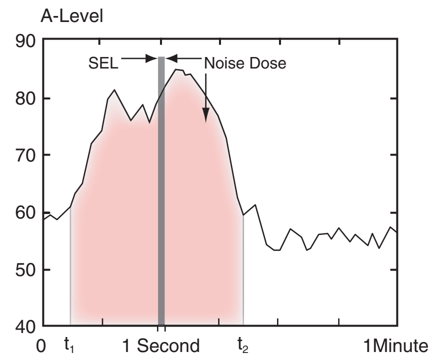

Figure 3. Sound Exposure Level

SEL provides a comprehensive way to describe noise events for use in modeling and comparing noise environments. Computer noise models base their computations on SEL values.

Day-Night Average Sound Level, DNL

The Day-Night Average Sound Level (DNL) represents noise as it occurs over a 24-hour period, with the assumption noise events occurring at night (10 p.m. to 7 a.m.) are 10 dB louder than they really are. This 10 dB penalty is applied to account for greater sensitivity to nighttime noise, and the fact that events at night are often perceived to be more intrusive because nighttime ambient noise is less than daytime ambient noise.

Figure 4 depicts a hypothetical daily noise dose. The top frame repeats the one-minute noise exposure that was shown in Figure 1. The center frame includes this one-minute interval within a full hour; now the shaded area represents the noise during that hour with 16 noise events, each producing an SEL. Finally, the bottom frame includes the one-hour interval within a full 24 hours. Here the shaded area represents the listener's noise dose over a full day.

DNL normally can be measured with standard monitoring equipment or predicted with computer models.

Most aircraft noise studies utilize computer-generated estimates of DNL, determined by accounting for all of the SELs from individual events which comprise the total noise dose at a given location on the ground.

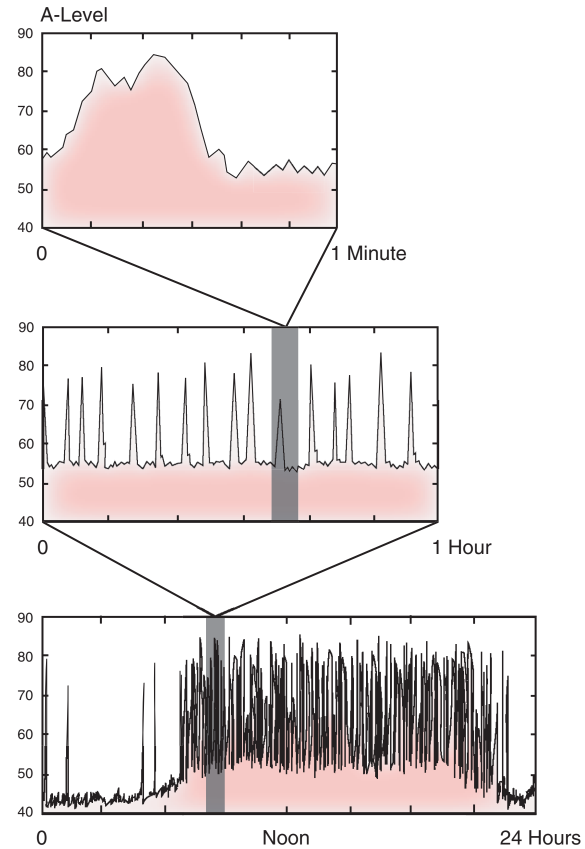

Figure 4. Daily Noise Dose

Computed values of DNL are often depicted as noise contours reflecting lines of equal exposure around an airport (much as topographic maps indicate contours of equal elevation). DNL contours usually reflect annual average operating conditions, taking into account the average number of flights each day, how often each runway is used throughout the year, and where over the surrounding communities the aircraft normally fly.