Jackson Hole Airport

Annual Noise Report

2023

Jackson Hole Airport Board
Jackson Hole Airport
1250 East Airport Road
Jackson, Wyoming 83001

BridgeNet International | A Tetra Tech Company | 20201 SW Birch Street, Ste 150, Newport Beach, CA 92660

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Prepared:
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Prepared For:

Jackson Hole Airport Board

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1250 East Airport Road
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Executive Summary

This report summarizes the measured and modeled noise environment at Jackson Hole Airport for calendar year 2022. One purpose of the measurements and modeling is to determine if the Airport is in compliance with the Airport Use Agreement (Agreement) between the U.S. Department of the Interior and the Jackson Hole Airport Board (Sponsor). The 2022 results of the measurement and modeling survey show that the Airport is in compliance with the requirements of the Airport Use Agreement.

One purpose of the measurements is to determine if the Airport is in compliance with the Airport Use Agreement (Agreement) between the U.S. Department of the Interior and the Jackson Hole Airport Board (Sponsor). The 2022 results of the measurement and modeling survey show that the Airport is in compliance with the requirements of the Airport Use Agreement. Aircraft noise levels within the Park were measured and modeled below the levels specified within the Use Agreement. In addition to the Agreement specific to the Airport, the Federal Aviation Administration (FAA) has established a national guideline of 65 Day Night Average Sound Level (DNL) as the goal for compatibility with residential land use. The 65 DNL noise level does not extend into residential land uses and continues to be contained within Airport property.

1.0 Introduction

The purpose of this report is to present the results from the 2022 noise measurement and modeling survey at Jackson Hole Airport (Airport). Noise measurements are conducted year-round to determine the annual noise exposure levels from aircraft operations at the Airport. This year-end report summarizes the results from the annual measurements for 2022. The cumulative results are analyzed to determine if the airport is in compliance with the Airport Use Agreement.

Historically from 1984 to 2003, noise monitoring was conducted for seasonal periods at three locations north and south of the Airport. Each site was monitored for one to three weeks during both the winter and summer peak season. The three sites that were monitored historically were Moulton Loop Road to the south of the Airport, Moose, and Barker Ranch to the north in Grand Teton National Park (GTNP or Park). In 2003, Jackson Hole Airport installed six noise monitors to continuously collect noise data. The existing sites at Moulton Loop, Moose, and Barker Ranch were upgraded with new noise monitors, and new sites were added at the Golf Course to the south, and 4 Lazy F Ranch and Timber Ridge to the north in GTNP. These measurement locations are presented in **Table 1-1** and **Figure 1-1**. In the fall of 2021, a new site was installed in the Bar B Bar Ranch (Oatgrass) neighborhood and has continuously operated since; the results from 2022 for this monitor are also presented in this report.

In 2008, a BI-6 radar data collection system was installed to allow the Airport's noise system to store flight track information, which provides correlation of flight tracks to recorded aircraft noise events. Prior to that, it was not possible to always correlate a noise event to the aircraft that caused the event; this was a manual process based on flight logs. Often, aircraft were not picked up on radar until they reached approximately 3,500 feet above ground level. This system was upgraded again in 2014. Additionally, in 2020 the Federal Aviation Administration's (FAA) Automatic Dependent Surveillance-Broadcast (ADS-B) radar became fully operational, and the Airport installed a local ground station that now provides radar coverage at areas close to the Airport.

The historical annual reports provided information about the seasonal measurement results; with the installation of the system to record year-round, the reports still presented seasonal data to continue to show the peak period activities in summer and winter. The report format was updated in 2020 to show both seasonal and annual data with the focus on the annual results. The report also switched to reporting calendar year results, eliminating the split-year reporting that was October to September.

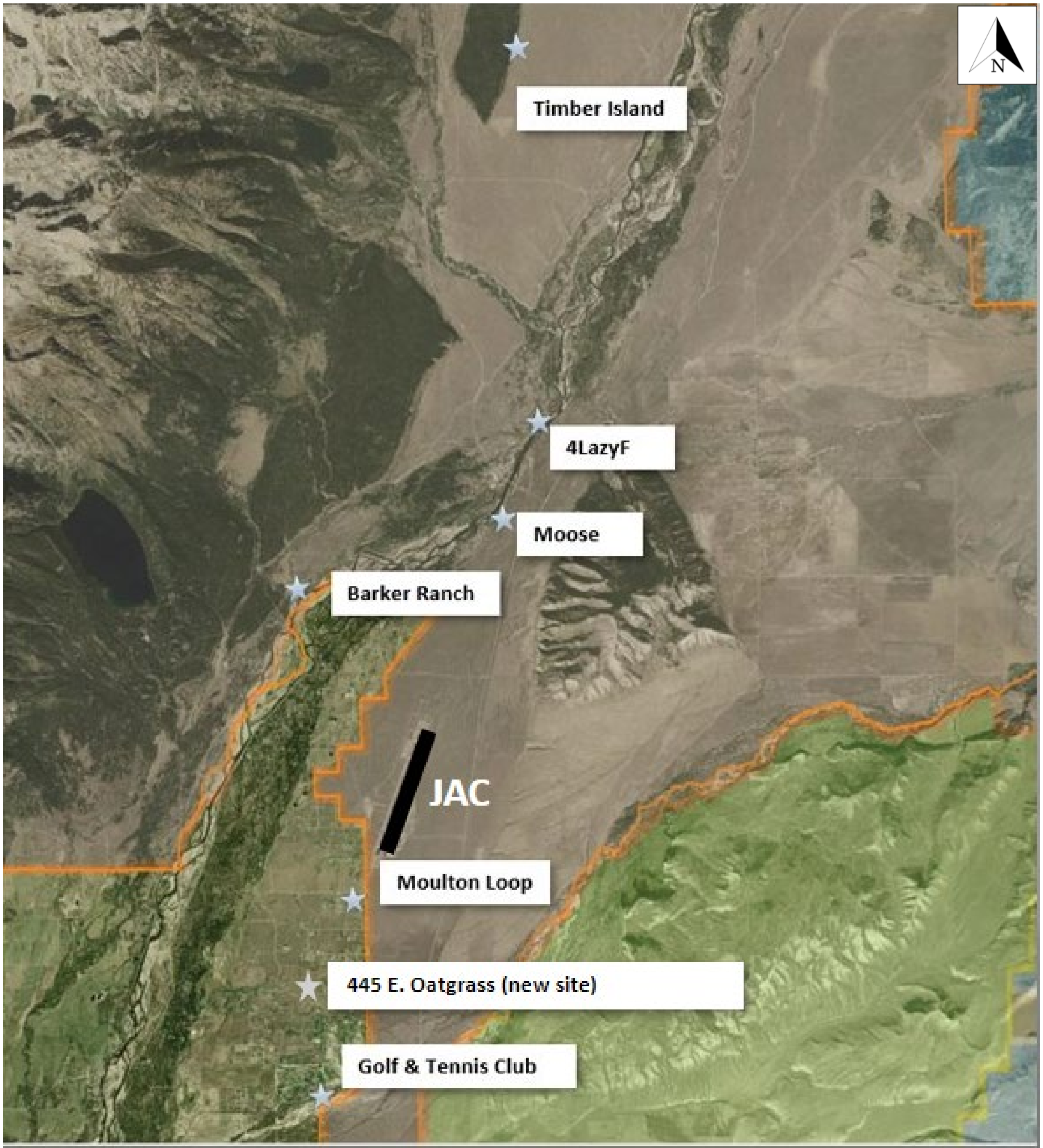
Table 1-1
Noise Measurement Site Locations

Site	Name	Location	Area	Latitude	Longitude
1	Moulton Loop	Zenith Drive and Spring Gulch Road	South Residential	43.592342	-110.744542
2	Golf Course	Jackson Hole Golf & Tennis Club	South Residential	43.562232	-110.753580
3	Barker Ranch	Circle H Ranch (Former Barker Residence)	GTNP	43.637980	-110.758610
4	Moose	Moose along Snake River	GTNP	43.648249	-110.716753
5	4 Lazy F Ranch	4 Lazy F Ranch	GTNP	43.662913	-110.708956
6	Timber Island	East of Timber Island	GTNP	43.714844	-110.713525
53	Oatgrass	445 E. Oatgrass (Bar B Bar Ranch) – New Site	South Residential	43.578046	-110.754271

Source: BridgeNet International, 2023

One purpose of the measurements is to determine if the Airport is in compliance with the Airport Use Agreement (Agreement) between the U.S. Department of the Interior and the Jackson Hole Airport Board (Sponsor). The 2022 results of the measurement and modeling survey show that the Airport is in compliance with the requirements of the Airport Use Agreement. Aircraft noise levels within the Park were measured and modeled below the levels specified within the Use Agreement. In addition to the Agreement specific to the Airport, the Federal Aviation Administration (FAA) has established a national guideline of 65 Day Night Average Sound Level (DNL) as the goal for compatibility with residential land use. The 65 DNL noise level does not extend into residential land uses and continues to be contained within Airport property.

Figure 1-1
Noise Measurement Location Map



Source: BridgeNet International, 2023

2.0 Background and Information about Noise

2.1 Background

Jackson Hole Airport is the only commercial service airport in the country that is located entirely within a national park. Accordingly, it has had a long history of addressing noise. The Airport Board has also developed several special noise measures to minimize intrusions from aircraft noise. These measures and a brief history of their development are presented in this section.

2.2 Noise Metrics

The description, analysis, and reporting of community sound levels from aircraft are difficult given the complexity of human response to sound. This analysis utilized the two major noise metrics for analysis of aircraft noise impacts: Day Night Average Sound Level (DNL) and the Maximum A-Weighted Noise Level (Lmax). Both metrics are based on the A-weighted decibel (dBA), which most closely replicates how the human ear hears sound.

Day Night Average Sound Level. DNL, the primary metric for analysis, is a cumulative noise metric because it represents a measure of the total noise over a 24-hour period. Cumulative noise metrics are useful because these scales attempt to combine the loudness of each event, the duration of these events, the total number of events, and the time of day these events occur into a single number rating scale. The DNL also considers the loudness of the events and how often and when they occur. Aircraft events occurring between 10 p.m. and 7 a.m. are penalized 10 dBA to account for lower ambient noise levels at night. The FAA, the Environmental Protection Agency (EPA), and other government agencies use DNL in assessing noise and land use compatibility.

Maximum Sound Level. Lmax is a measure of single-event noise that describes the loudness of a single flyover regardless of the time of day or the number of such events. Lmax is the peak or loudest sound reached during an aircraft flyover. There are no noise and land use compatibility standards in terms of Lmax. In general, it is the metric that is more easily related to by the public because it is what the public hears on a per-event basis.

Sound Exposure Level. SEL is calculated by summing the dB level at each second during a noise event and compressing that noise into one second. It is the level the noise would be if it all occurred in one second and allows different noise events to be compared in a uniform manner. The SEL value is the integration of all the acoustic energy contained within an event and considers the maximum noise level and duration of the event.

2.3 Federal and Local Noise Assessment Guidelines

Noise/Land use guidelines have been developed by several agencies, including the FAA. As a means of implementing the Aviation Safety and Noise Abatement Act, the FAA adopted regulations on airport noise compatibility planning programs. The guidelines specify a maximum amount of noise exposure (in terms of the cumulative DNL noise metric) that will be considered acceptable to or compatible with people in both living and working areas. Residential land use is deemed compatible for noise exposures up to 65 DNL.

2.3.1 Airport Access Plan

As part of the Agreement with the U.S. Department of the Interior, Jackson Hole Airport is required to comply with certain noise limits within GTNP. The primary restrictions are that the Airport cannot exceed specific DNL cumulative noise levels at critical locations within the Park boundary. The annual cumulative level from aircraft noise at the Moose measurement location, in the southeastern corner of the noise sensitive areas of the Park, cannot exceed 55 DNL. In addition, there is a Critical Area Boundary within the Park where annual aircraft noise levels cannot exceed 45 DNL. These areas are shown in **Figure 2-1**.

In 1983, the Airport Board and the U.S. Department of the Interior entered into a new agreement for the continued operation of the Airport in GTNP. To facilitate meeting the cumulative noise limits of the Agreement, the Airport Board developed an Airline Access Plan. This Access Plan places a limit on the number of commercial jet aircraft operations necessary to meet the cumulative standards associated with the "base class" aircraft at the time. Operations of the Boeing 737-200 D-17 base class aircraft were limited to 6.85 Average Daily Departures (ADD). Increases in the number of operations may only be accomplished by substituting quieter, new generations of aircraft, which at that time were just entering into service.

The Agreement also included a single-event noise limit that restricted the operation of any aircraft that generated sound levels above 92 dBA, as defined by the approach dBA level from 14 CFR FAR Part 36 regulations (*Note: This numeric value is based on the effective perceived noise level (EPNdB), which is a different metric than the annual noise levels shown in this report. Therefore, this single-event noise limit and the annual average noise levels shall be analyzed separately.)* This essentially eliminated aircraft from operating at the Airport that generated higher noise levels than the Boeing 737-200 D-17 aircraft.

The following points summarize the noise abatement best practices at the Airport:

- Limit on the scheduling of night operations by commercial turbojet aircraft and general aviation night operations using a voluntary curfew.

- A preferential runway program that requests that all aircraft depart to the south and arrive from the south when wind/weather conditions permit.

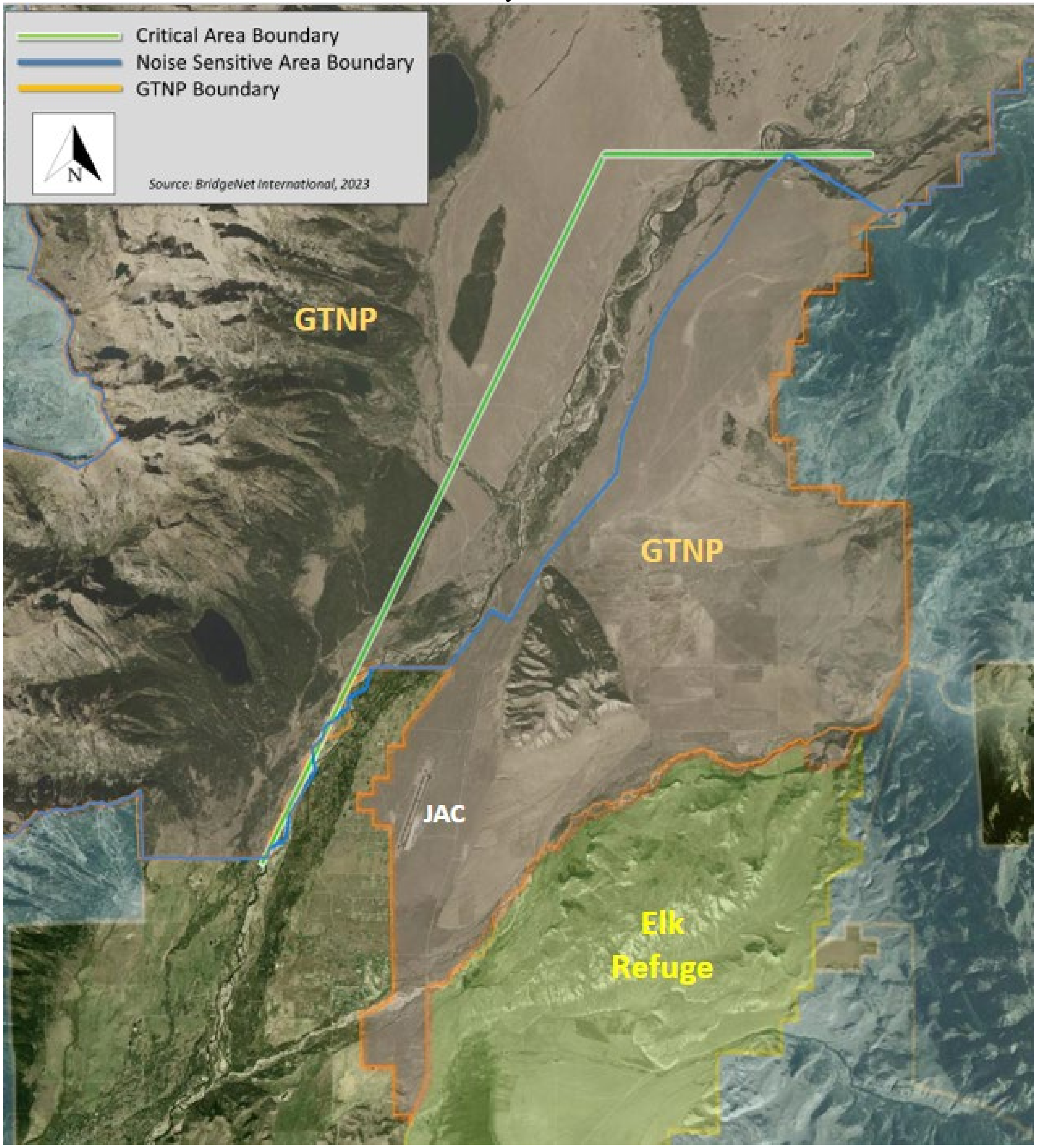
- A request that all aircraft departing to the south make a left turn, as weather conditions permit. This procedure is seldom utilized today because it is no longer a published procedure.

- A request that aircraft entering the area from the south but landing from the north perform a left downwind turn near Blacktail Butte, as weather conditions permit. Right downwind turns over the Park are discouraged.

- A comprehensive operational and noise monitoring program that documents the level of compliance with these noise abatement procedures.

- A voluntary Fly Quiet Program.

Figure 2-1
Critical Area and Noise Sensitive Area Boundary



Source: BridgeNet International, 2023

2.4 Methodology in Determining the Noise Environment

The noise environment at Jackson Hole Airport was determined through the employment of comprehensive noise measurements from the Airport's monitoring system. This system records ambient and aircraft noise sources. The noise measurement surveys determine DNL, Lmax levels from each aircraft flyover, SEL, and background or non-aircraft ambient noise environment.

The measurements are annualized by correlating measured noise events with flight radar. The results of the measurements, in conjunction with annual airport operational data, are incorporated into the FAA's Aviation Environmental Design Tool (AEDT) software program through which annual average noise levels at any location around the Airport can be predicted. The noise environment is commonly depicted in terms of lines of equal noise levels, or noise contours.

Noise measurements are conducted at six locations around the Airport, shown in **Figure 1-1**. The Moulton Loop measurement site is indicative of the residential area directly south of the Airport, which is directly under the extended runway centerline, approximately 2,200 feet south of the runway's end and is one of the areas exposed to the highest noise levels. In 2003, the Moulton Loop site was moved approximately 200 feet closer to the runway's end than the old site. This results in slightly higher noise-level readings.

The Moose measurement site is in GTNP, south of Teton Park Road and directly under the extended runway centerline. The Agreement requires that the aircraft noise levels at this location not exceed 55 DNL. The Barker Ranch measurement site is also within GTNP, along Moose-Wilson Road northwest of the Airport. This site is on the restriction line that requires that aircraft noise levels not exceed 45 DNL.

3.0 Operational and Flight Data

3.1 Aircraft Operations

The 2022 aircraft operations were derived directly from the Airport summary of daily logs, the Airport's noise monitoring system radar data, and FAA Operations Network (OPSNET) data. The breakdown in the category of operations is based on the FAA's Traffic Flow Management System Counts (TFMSC) data. The 2022 annual operations along with data from 2001 to the most recent period are presented in **Table 3-1**. The total number of operations during the 12-month period was 28,848. The total operations showed a decrease in all categories of operations, even removing the 78 days that the Airport was closed due to runway construction. An operation is one departure or one arrival. This included 5,888 commercial jet operations, 3,574 regional jet operations, 15,164 corporate jet operations, and 4,222 operations classified as other.

The operations have seasonable differences with more activity during the summer and winter months. **Figure 3-1** presents the monthly activity broken down by total operations, commercial/regional, and corporate jet activity. As shown in this figure, activity levels are highest in the summer and winter months; for 2022, August had the highest number of operations. The data from **Figure 3-1** is derived from the Airport's noise monitoring system data and will not exactly match the FAA counts.

3.2 Enplaned Passengers

The total number of enplaned passengers is also presented in **Table 3-1**. For 2022, there were 405,693 enplaned passengers, which is a decrease from 2021, which is a result of decreased commercial operations and runway closure.

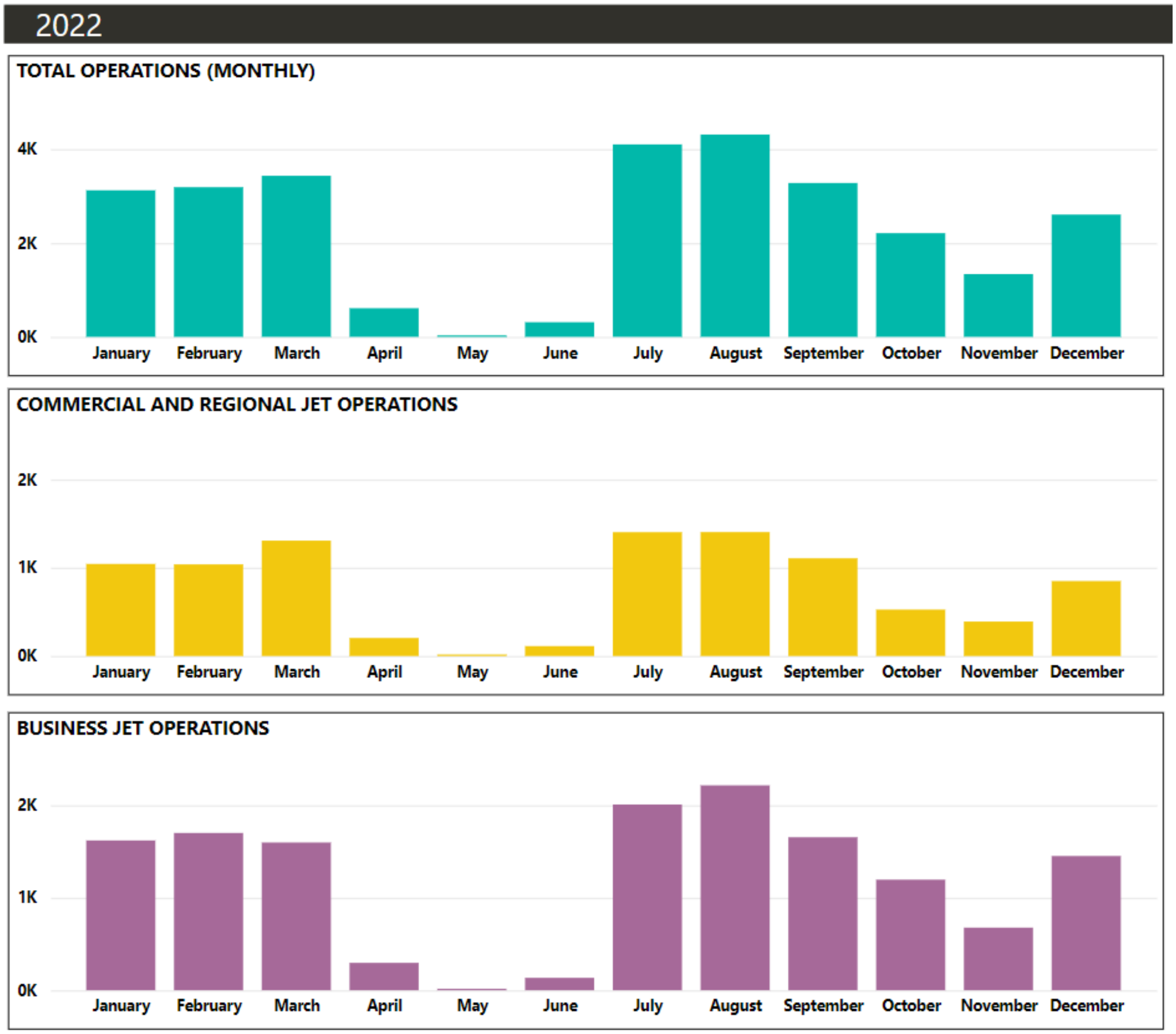
Table 3-1
Annual Operations and Enplaned Passengers, 2001–2022

YEAR	AIRCRAFT ANNUAL OPERATIONS					ENPLANED PASSENGERS
	COMMERCIAL JET	REGIONAL JET	CORPORATE JET	OTHER	TOTAL	
2022*	5,888	3,574	15,164	4,222	28,848	405,693
2021	9,310	3,592	18,730	8,996	40,628	508,838
2020	5,854	1,934	14,628	6,706	29,122	284,433
2019	7,096	2,480	11,346	6,403	27,325	454,629
2018	6,018	2,670	11,972	6,303	26,963	391,353
2017	5,632	2,322	11,794	9,241	28,989	353,776
2016	5,212	3,008	10,422	11,737	30,379	346,127
2015	4,582	2,798	10,104	10,656	28,140	316,674
2014	4,062	3,100	9,372	9,583	26,117	305,186
2013	3,592	2,530	8,822	8,549	23,493	292,176
2012	3,586	2,698	8,440	11,354	26,078	272,888
2011	3,868	2,840	8,484	10,584	25,776	281,808
2010	4,112	2,722	7,904	10,869	25,607	286,660
2009	3,738	2,736	7,702	14,826	29,002	281,674
2008	4,110	2,648	9,252	14,209	30,219	304,393
2007	3,514	2,358	10,862	13,871	30,605	275,569
2006	3,676	2,506	10,204	15,848	32,234	271,416
2005	3,774	592	10,510	18,196	33,072	241,925
2004	3,106	50	9,744	18,893	31,793	208,000
2003	3,646	334	8,844	20,769	33,593	212,731
2002	2,304	12	8,240	25,422	35,978	179,510
2001	1,666	584	7,374	30,974	40,598	169,249

Source: FAA OPSNET and TFMS data

Note: The Airport was closed between April 11, 2022, and June 27, 2022 for runway construction.*

Figure 3-1
Month-to-Month Operations for 2022



Source: Jackson Hole Airport Noise Monitoring System Data, 2023

3.3 Noise Measurement and Analysis Procedures

The following section outlines the methodology used to measure and quantify noise levels from aircraft operations and ambient noise-level conditions. Measurement methodology and analysis techniques used in the study are also included.

Continuous Measurement of the Noise

The methodology used in this study uses the continuously recorded one-second equivalent sound level (LEQ) noise levels at each of the six measurement locations. From this data, different noise metrics can be calculated. This includes the aircraft Lmax, DNL, and the ambient levels. The noise monitors collect continuous 1-second data; therefore, it is possible to post-process the data and calculate different metrics of interest. The process of calculating noise events from this data uses a floating threshold methodology, which allows for the measurement and identification of lower noise-level aircraft events. The parameters are adjustable and can be modified to recalculate noise events from raw data any time in the future.

3.4 Aircraft Operational and Radar Track Data

Historically, radar data was not available at the Airport. In fall of 2008, the FAA installed a BI-6 radar system at the Airport. With the installation of radar, the noise monitoring system was also upgraded to obtain this data. The upgrade consisted of numerous components, including access to the BI-6 radar data, weather data, and the addition of new features to the remote noise monitoring stations. The BI-6 radar data connection allows for the noise monitoring system to correlate an aircraft noise event to the aircraft causing the event. At the same time, the noise monitoring sites were also upgraded to measure detectability. Detectability approximates the U.S. Department of Transportation's Volpe Center standards for measuring aircraft noise in a park setting. The audible contribution of aircraft and other noise sources to the Park's natural quiet can be approximated using the detectability metric. The upgrade allows the noise monitoring system to measure aircraft noise levels more accurately at the noise measurement points and to also quantify the aircraft audibility levels at these locations.

The BI-6 radar was the primary source for aircraft operational information; however, the data was initially just radar tracks without aircraft identification. In 2014, a national radar feed subscription became available that provides both radar track and flight information data. The Airport maintains a live feed of all the Instrument Flight Rules (IFR) aircraft activity in the United States directly from FAA center data. This provides data on all domestic civilian IFR aircraft; the data stream includes aircraft type, position, and altitude by time. Visual Flight Rules (VFR) aircraft are often tracked, but typically there is no identifying information, such as a unique N-number. The radar coverage in the valley does not reach the Airport surface, so operations near the Airport and low-altitude flights were not typically tracked by this data source.

In 2020, the FAA's Automatic Dependent Surveillance – Broadcast (ADS-B) radar system became operational nationwide and greatly increased the coverage and accuracy of the radar data. The Airport also installed an ADS-B ground station at the Airport that allowed for better coverage of operations at low altitudes. The ADS-B radar data includes flight information for every ADS-B equipped aircraft, as well as position information along the flight track. Each flight is also assigned a unique identification number so all the data for any flight can be collected and stored. The flight information includes data such as aircraft type, airline code, departing and arriving airport codes, unique aircraft N-number, and flight ID number. The position information includes the *X* and *Y* coordinates, as well as the altitude of the aircraft at each point with greater accuracy than conventional radar information. The location information provides the information necessary to determine the direction of flow for runway usage.

ADS-B surveillance requires an aircraft to be equipped with an ADS-B transponder and that it is turned on. All commercial and large general aviation aircraft have this equipment, and it is turned on during flight. Smaller propeller aircraft are not required to have this equipment to operate in non-busy airspaces, but most aircraft are equipped. There will be some VFR aircraft that are not tracked by ADS-B due to the above reasons.

Correlation of Noise and Flight Data

The noise monitoring system was used to help correlate aircraft flight activity to the noise data. This software utilizes such methods as aircraft position information (the position of the aircraft at the time of the noise event to correlate the aircraft to the noise event), noise event sequencing, and noise event profiling to correlate noise data to the aircraft activity. Noise event profiling is used to identify characteristics of both the aircraft and non-aircraft noise events.

Calculation of Aircraft Noise Metrics

Once the collection and correlation of the noise and flight data is complete, the various noise metrics can be calculated. A computer process is used to calculate the single-event, cumulative, and ambient noise metrics of interest from the data collected at each of the noise monitoring sites. This includes the ambient background noise levels (dBA), the single-event noise levels (Lmax), and the cumulative noise levels (DNL).

4.0 Annual Noise Measurement Results

4.1 Introduction

The existing noise environment for the Airport was determined through a noise measurements and modeling. The results of the are summarized in the following paragraphs, presenting the overall findings from the measurements and modeling, including an explanation of the results, and is divided into the following subsections:

Noise Measurement Results

- Continuous noise measurement data
- Ambient noise measurement results by hour (dBA)
- Single-event noise measurement results (Lmax)
- Annual average measurement results (DNL)

The Airport's noise monitoring system utilizes ACOEM 01dB Opera and CUBE noise monitors at all measurement sites. The monitoring system is state of the art and complies with all specific International Standards (IEC) and measurement standards established by the American National Standards Institute (ANSI) for Type 1 instrumentation.

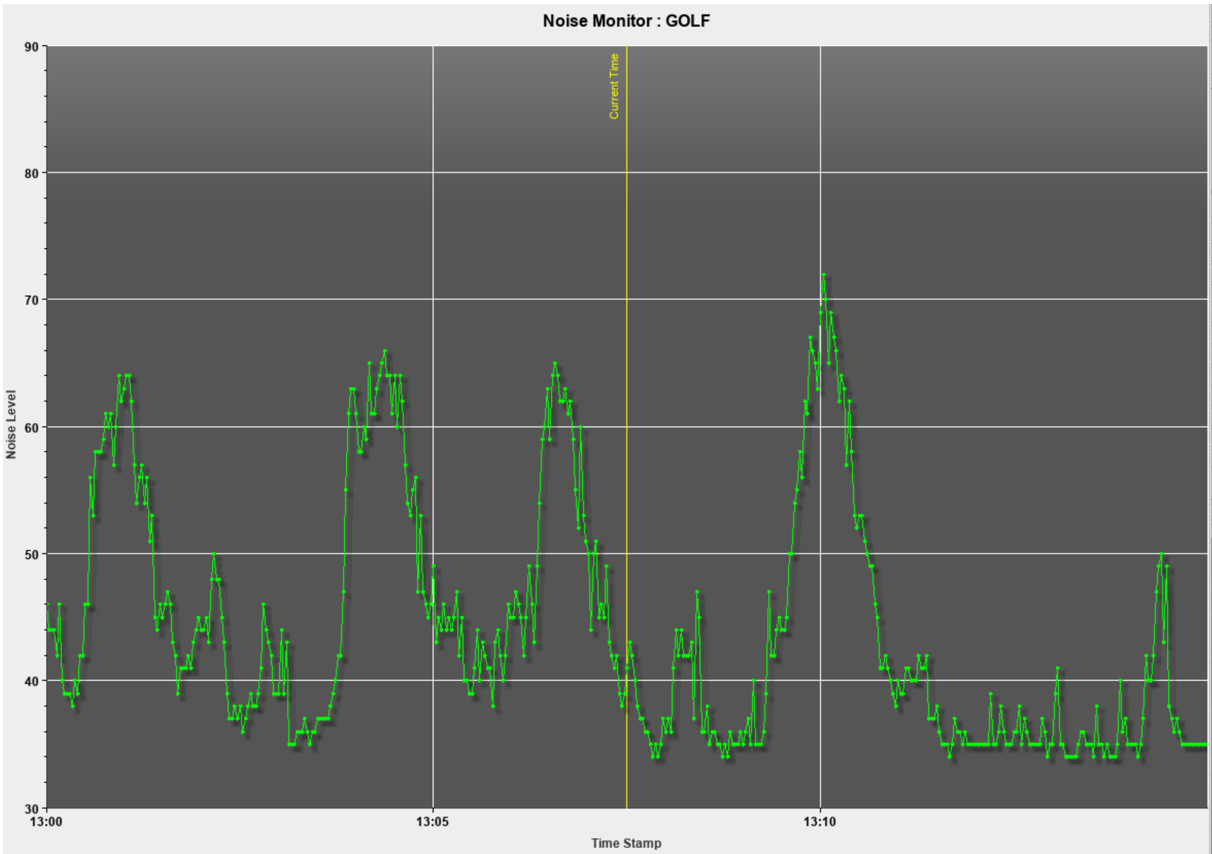
The data collected by the monitors includes the continuous measurement of 1-second average equivalent sound levels (LEQ). This type of measurement system allows for the measurement and identification of Lmax noise events at a lower threshold. This allows for a more accurate measurement of lower aircraft noise levels that are typical of the sites in the Park. Analysis of this data resulted in the single-event noise levels from each individual flyover, hourly data, and the daily DNL noise levels for the measurement period.

The report presents data for the annual levels and during peak periods in the summer and winter seasons. Presenting seasonal data along with the annual data is in keeping with the original reporting periods and focuses on the times when operations are at their highest levels.

4.2 Continuous Noise Measurement Data

Noise levels are continuously recorded at each of the noise monitoring sites. In addition to recording the noise events from aircraft, monitors also record the ambient noise level of the community surrounding the site. A sample of this data is presented in **Figure 4-1,** which displays a 15-minute segment of continuous noise data that was measured at Site 2 – Golf Course. The measured A-weighted noise level value is shown on the vertical axis; and time of day, in minutes, is displayed on the horizontal axis. The difference between an aircraft event and the ambient noise can be easily distinguished in this plot, with each of the peaks generated by an aircraft overflight. For this example, the peak noise levels from the aircraft flyovers were in the mid-60s and low 70s dBA. The ambient levels between aircraft events were in the mid-30s dBA.

Figure 4-1
Sample Time History Noise Plot of Aircraft and Ambient Noise - Golf Course



Source: Jackson Hole Airport Noise Monitoring System, 2022

4.3 Ambient Noise Measurement Results

Background, or ambient noise levels, (not including aircraft noise) are measured at each monitoring location, and these results are presented using Percent Noise Levels (Ln). Ln characterizes intermittent or fluctuating noise by showing the noise level that is exceeded during a significant percentage of time during the noise measurement period. Ln is most often used to characterize the statistical distribution of measured noise levels. For example, L90 is the noise level exceeded 90 percent of the time, L50 is the level exceeded 50 percent of the time, and L10 is the level exceeded 10 percent of the time. Typically, L90 represents the background noise level, L50 represents the median or ambient noise level, and L10 represents the most intrusive noise levels.

Other noise sources that are part of a background noise environment include roadway, wind in the trees, and community activities. This data aids in assessing how intrusive aircraft noise is on the ambient environment.

Results of the ambient noise measurement survey at each measurement site are displayed **Table 4-1,** which presents the annual statistical summary of the ambient measurements at each site using the Ln noise levels for L99, L90, L50, L10, and L1. L1 is presented for the loudest 1-second dBA value measured, while the L99 is the lowest 1-second dBA value measured. This table illustrates the range in noise levels that exist at each site. Aircraft noise events are included in this data and are typically the source of the peak or maximum noise levels.

Table 4-1
Annual Ambient Noise Measurement Results

Site	Name	Statistical Noise Levels (dBA)				
		L1	L10	L50	L90	L99
1	Moulton Loop	66	53	40	30	27
2	Golf Course	59	48	40	37	35
3	Barker Ranch	52	44	39	36	34
4	Moose	58	44	38	34	32
5	4 Lazy F Ranch	57	43	37	34	33
6	Timber Island	52	41	28	22	20
53	Oatgrass	59	42	34	29	27

Source: BridgeNet International, 2023

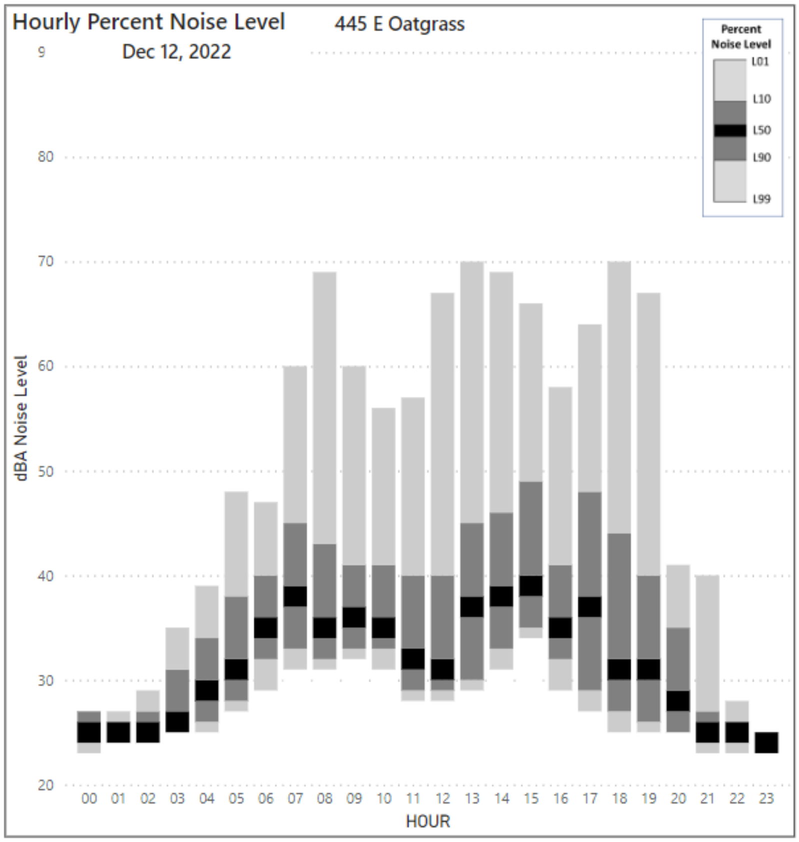
Industry practices indicate that L90 is a good representation of the background noise level and L50 the ambient noise level. These represent the levels that are exceeded 90 percent of the time and 50 percent of the time, respectively. L90 is referred to as the residual noise when other sources of noise are not present and is the level above which noise events occur, such as an aircraft overflight or a vehicle pass-by. Aircraft noise would have very little, if any, contribution to this noise level because of the relatively short duration of these noise events. The L50 noise level is referred to as the median or ambient noise level. Half of the time, the noise is below this level, and half of the time it is above. Even during peak hours of aircraft activity, the L50 noise level would not be influenced by aircraft noise. This level is generally reflective of background sound levels when other sounds are not present.

The measurements show that background L90 noise levels ranged from a low of 20 dBA to a high in the mid-30s dBA. Most sites had an average L90 noise level right around the mid-30s dBA. The ambient L50 noise levels ranged from the high 20s dBA to 40s dBA. The majority of these sites are located in relatively quiet settings that are not exposed to other noise sources, such as highways or community activities. However, a number of the sites are near the Snake River or Gros Ventre River, which does influence the background and ambient noise levels.

Ambient noise levels vary by day, and time of day as summarized in the data from the Oatgrass site, which is presented in **Figure 4-2**. The figure shows each hour of ambient measurement data for a typical day (December 12, 2022) at that site. Day-to-day ambient noise levels are generally similar, with higher levels occurring during high wind conditions. Ambient noise levels vary by time of day, with quieter levels typically occurring during night and early-morning hours, and with higher levels occurring during daytime hours. Typical quiet ambient noise hours range from 5 to 10 dBA lower than average hours.

Figure 4-2
Site-Specific Ambient Noise Measurement Results - Oatgrass
December 12, 2022

Hour	L01	L10	L50	L90	L99
00	27	26	24	24	23
01	28	26	25	24	24
02	30	27	25	24	24
03	36	31	26	25	25
04	40	34	29	26	25
05	49	38	31	28	27
06	48	40	35	32	29
07	61	45	38	33	31
08	70	43	35	32	31
09	61	41	36	33	32
10	57	41	35	33	31
11	58	40	32	29	28
12	68	40	31	29	28
13	71	45	37	30	29
14	70	46	38	33	31
15	67	49	39	35	34
16	59	41	35	32	29
17	65	48	37	29	27
18	71	44	31	27	25
19	68	40	31	26	25
20	42	35	28	25	25
21	41	27	25	24	23
22	28	25	24	24	23
23	26	25	24	23	23
Daily	52	37	31	28	27



Source: Jackson Hole Airport Noise Monitoring System, 2023

4.4 Aircraft Single-Event Noise Measurement Results

Aircraft single-event noise levels were identified at each measurement site. The acoustic data included the maximum noise level (Lmax), as well as other noise metrics used in noise model validation. The single events measured during the survey were correlated with flight operation information. With this correlated single-event noise data, it was possible to separately identify the single-event noise levels from the different sources of aircraft noise.

The single-event data were analyzed to determine the distribution of events. An example of the range in noise data is presented for the Moose and 4 Lazy F sites in **Figure 4-3** and **Figure 4-4**, respectively. These figures present the average Lmax noise level by category of jet and a histogram of Lmax values for all measured aircraft events colored by aircraft category. These noise events are all jet arrivals to the south on Runway 19. The Moose site is representative of a location closest to the Airport to the north, and the 4 Lazy F Ranch site is representative of farther to the north of the Airport. These results show the wide range in noise level generated by aircraft events that occur at each site and the difference in noise by category of aircraft, which are all jet arrivals to the south on Runway 19.

Figures 4-5 through **Figure 4-7** present the same results for the Moulton Loop, Golf Course, and Oatgrass sites to the south, which are primarily exposed to departure noise on Runway 19. This data also shows the ranges in single-event noise levels organized by total category of jet aircraft.

Additionally, single-event data was also analyzed by noise level per aircraft type shown on the right side of **Figures 4-5** through **4-7**. The longer bar graph illustrates those aircraft with the loudest events, which were generally produced by older-generation aircraft. These data illustrate the difference in noise levels generated by departure operations versus arrival operations. The data shows that departure events generate higher noise levels and a wider range in noise by different aircraft types. The data shows that the commercial/regional jet aircraft generate noise events about 5 dBA higher than the business jets on average.

Figure 4-3
Noise Event Summary, Moose
Operation: Runway 19 Arrivals

Site: MOOSE **AVERAGE MAXIMUM LEVEL BY TYPE OF AIRCRAFT**

Year: 2022 Operation: Arrival Runway: 19

Average Maximum Noise Level by Jet Category

Jet Category	Lmax (Avg)
Commercial	77
Regional	76
Business	71
Average	73

Average Maximum Noise Level by Commercial/Regional Jets

Aircraft	Jet Category	Lmax (Avg)
B737	Commercial	78
B752	Commercial	78
E75S	Regional	78
A320	Commercial	77
A319	Commercial	77
E75L	Regional	76
CRJ7	Regional	74
Average		77

Average Maximum Noise Level by 10 loudest Business Jets

Aircraft	Jet Category	Lmax (Avg)
FA50	Business	75
GLF4	Business	75
FA7X	Business	75
H25B	Business	73
G150	Business	73
GALX	Business	73
C25A	Business	73
E35L	Business	73
H25C	Business	73
GA5C	Business	73
Average		71

Figure 4-4
Noise Event Summary, 4 Lazy F Ranch
Operation: Runway 19 Arrivals

Site: 4LAZYF — **AVERAGE MAXIMUM LEVEL BY TYPE OF AIRCRAFT**

Year: 2022 **Operation:** Arrival **Runway:** 19

Average Maximum Noise Level by Jet Category

Jet Category	Lmax (Avg)
Commercial	71
Regional	69
Business	66
Average	68

Average Maximum Noise Level by Commercial/Regional Jets

Aircraft	Jet Category	Lmax (Avg)
A320	Commercial	71
A319	Commercial	71
B752	Commercial	71
B737	Commercial	70
E75L	Regional	70
CRJ7	Regional	68
Average		70

Average Maximum Noise Level by 10 loudest Business Jets

Aircraft	Jet Category	Lmax (Avg)
GLF4	Business	70
LJ45	Business	69
C650	Business	69
FA7X	Business	69
C25A	Business	68
FA50	Business	68
GA5C	Business	68
GLF5	Business	68
GLEX	Business	67
F2TH	Business	67
Average		66

Figure 4-5
Noise Event Summary, Moulton Loop
Operation: Runway 19 Departures

Site: MOULTON — **AVERAGE MAXIMUM LEVEL BY TYPE OF AIRCRAFT**

Year: 2022 **Operation:** Departure **Runway:** 19

Average Maximum Noise Level by Jet Category

Jet Category	Lmax (Avg)
Commercial	90
Regional	88
Business	85
Average	86

Average Maximum Noise Level by Commercial/Regional Jets

Aircraft	Jet Category	Lmax (Avg)
B752	Commercial	92
B737	Commercial	91
A320	Commercial	90
A319	Commercial	89
E75L	Regional	88
CRJ7	Regional	87
Average		89

Average Maximum Noise Level by 10 loudest Business Jets

Aircraft	Jet Category	Lmax (Avg)
FA50	Business	94
H25B	Business	90
BE40	Business	90
GLF4	Business	89
C560	Business	89
FA7X	Business	88
F900	Business	88
GALX	Business	87
GLEX	Business	87
F2TH	Business	86
Average		84

Figure 4-6
Noise Event Summary, Golf Course
Operation: Runway 19 Departures

Site: GOLF — **AVERAGE MAXIMUM LEVEL BY TYPE OF AIRCRAFT**

Year: 2022 Operation: Departure Runway: 19

Average Maximum Noise Level by Jet Category

Jet Category	Lmax (Avg)
Regional	70
Commercial	70
Business	66
Average	68

Average Maximum Noise Level by Commercial/Regional Jets

Aircraft	Jet Category	Lmax (Avg)
B737	Commercial	72
E75L	Regional	70
B752	Commercial	70
CRJ7	Regional	70
A319	Commercial	70
A320	Commercial	69
Average		70

Average Maximum Noise Level by 10 loudest Business Jets

Aircraft	Jet Category	Lmax (Avg)
FA50	Business	75
C650	Business	73
BE40	Business	71
C560	Business	69
FA7X	Business	69
GALX	Business	69
LJ40	Business	68
LJ75	Business	68
H25B	Business	68
CL35	Business	68
Average		66

Figure 4-7
Noise Event Summary and Histogram Report, Oatgrass
Operation: Runway 19 Departures

Site: 445 E Oatgrass — AVERAGE MAXIMUM LEVEL BY TYPE OF AIRCRAFT

Year: 2022 Operation: Departure Runway: 19

Average Maximum Noise Level by Jet Category

Jet Category	Lmax (Avg)
Commercial	79
Regional	78
Business	75
Average	77

Average Maximum Noise Level by Commercial/Regional Jets

Aircraft	Jet Category	Lmax (Avg)
B752	Commercial	80
B737	Commercial	80
A319	Commercial	79
E75L	Regional	79
A320	Commercial	78
CRJ7	Regional	78
Average		79

Average Maximum Noise Level by 10 loudest Business Jets

Aircraft	Jet Category	Lmax (Avg)
FA50	Business	85
C650	Business	83
G150	Business	81
BE40	Business	80
H25B	Business	79
F900	Business	79
FA7X	Business	79
C560	Business	78
GALX	Business	78
GLEX	Business	78
Average		75

4.5 DNL Noise Measurement Results

Aircraft-related DNL levels were calculated for each of the six long-term noise monitoring locations and the new site in Bar B Bar Ranch called Oatgrass. **Table 4-2** presents the results of the DNL noise measurements at the seven noise monitoring locations. This table lists the average aircraft-related DNL for annual noise levels for 2022.

Table 4-2
Annual Aircraft DNL Noise Measurement Results (2022)

Site #	Name	Description	Aircraft Annual DNL
1	Moulton Loop	Zenith Drive and Spring Gulch Road	62
2	Golf Course	Jackson Hole Golf & Tennis Club	50
3	Barkers Ranch	Circle H Ranch (Barker Residence)	33
4	Moose	Moose Entrance	51
5	4 Lazy F Ranch	4 Lazy F Ranch	48
6	Timbered Island	East of Timber Island	33
53	Oatgrass	Bar B Bar Ranch	54

Source: Jackson Hole Airport Noise Monitoring System, 2023

5.0 Annual Noise Contours

5.1 Introduction

Contour modeling is a key element of the report. Generating accurate noise contours is largely dependent on the use of a reliable, validated, and updated noise model. The FAA's Aviation Environmental Design Tool (AEDT) was used to model the flight operations at Jackson Hole Airport and is the accepted industry standard software to model aircraft noise at airports in the United States as well as for international environmental analysis. The AEDT has an extensive database of civilian aircraft noise characteristics.

Airport noise contours were generated using AEDT Version 3e. Version 3e, the latest version, was released for use on May 9, 2022, and is state-of-the-art airport noise modeling. AEDT is a computer program developed to plot noise contours for airports. The program includes standard aircraft noise and performance data for more than 200 aircraft types and can be tailored to the characteristics of the airport in question.

One of the most important factors in generating accurate noise contours is the collection of accurate operational data. AEDT requires the input of the physical and operational characteristics of the airport. Physical characteristics include runway coordinates, airport altitude, temperature, and topographical data, optionally. Operational characteristics include various types of aircraft data. This includes not only the aircraft types and flight tracks but also departure procedures, arrival procedures, and stage lengths specific to the operations at the airport. While AEDT contains a wealth of information, there were minor adjustments made to these inputs to better reflect local conditions. Aircraft data needed to generate noise contours include:

- Number of aircraft operations by type
- Types of aircraft
- Daytime/nighttime distribution by type
- Flight tracks
- Flight track utilization by type
- Flight profiles
- Typical operational procedures
- Average meteorological conditions

5.2 Existing Aircraft Operations

The existing noise environment for the Airport was analyzed based upon the 2022 annual operations. The data was derived from various sources, which include aircraft tower counts and noise monitoring system operational data. A variety of operational data is necessary to determine the noise environment around the airport. This data includes the following summary information and is discussed in detail in the following paragraphs:

- Aircraft activity levels
- Fleet mix
- Time of day
- Runway use
- Flight path utilization

The tower count data showed that for 2022, there was a total of 28,848 annual operations. The breakdown by aircraft category was determined from a variety of sources that include:

- Airport radar
- FAA Operations Network (OPSNET) and TFMSC

The 2022 aircraft operations for each category of operation are summarized in **Table 5-1.** These operations are categorized as commercial jets, regional jets, small commuters, general aviation, business jets, turbo- and piston-propeller, helicopter, and military. The total number of annual corporate jet aircraft was determined from the Airport's radar data, which provides information on aircraft that file IFR flight plans, accounting for nearly all larger aircraft including business jets. Larger twin-engine propeller aircraft are also counted in airport radar, but smaller aircraft flying VFR are not always included. The AEDT model was based upon a compilation of all 28,848 operations at the Airport.

Table 5-1
Summary of Operations - 2022

Category Type	Annual Operations	Daily Operations	Percent Nighttime
Commercial Jet	5,888	16.1	0.7%
Regional Jet	3,574	9.8	0.3%
Small Commuter	0	0	0.0%
General Aviation			
Business Jet	15,162	41.5	1.1%
Turbo-/Piston-Propeller	3,536	9.7	3.1%
Helicopter	556	1.5	0.1%
Military	132	0.4	0.0%
Total Operations	**28,848**	**79.0**	**1.1%**

Source: FAA OPSNET, FAA TFMS data, and Jackson Hole Airport Noise Monitoring System

<u>Fleet Mix:</u> The fleet mix of aircraft that operate at the airport is one of the most important factors of the aircraft noise environment. The business jet fleet mix data was determined from an extensive review of the airport radar database.

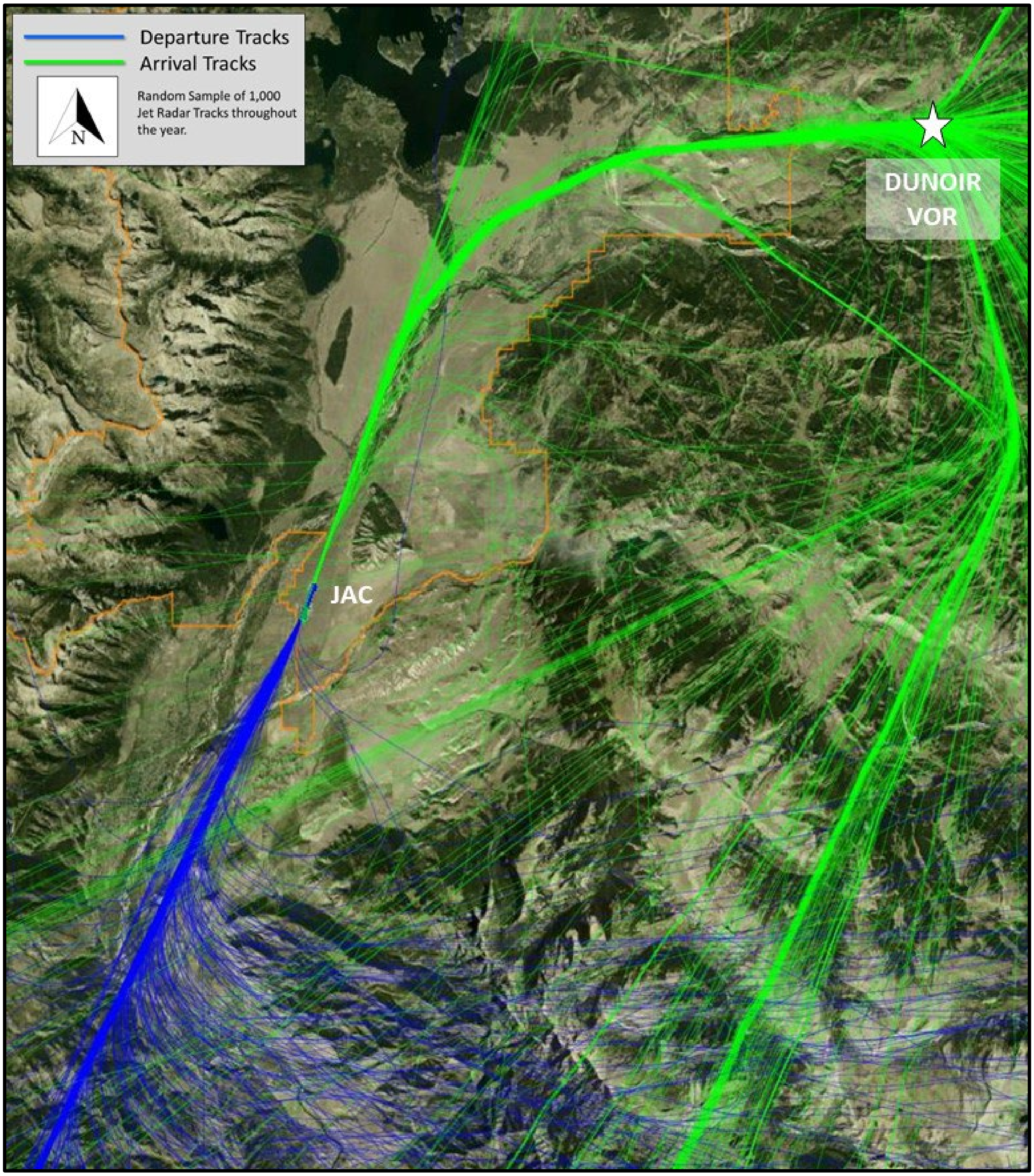
<u>Time of Day:</u> In the DNL metric, any operations that occur after 10 p.m. and before 7 a.m. are considered more intrusive and are weighted by 10 dBA. Therefore, the number of nighttime operations is critical in determining the DNL noise environment and is also important to the residences around the Airport. The nighttime operational assumption data is summarized in **Table 5-1**.

<u>Runway Use:</u> An additional important consideration in developing the noise contours is the percentage of time each runway is utilized. The speed and wind direction dictate the runway direction utilized by an aircraft. From a safety standpoint, it is safest for an aircraft to arrive and depart into the wind. When wind direction changes, operations are shifted to the runway that favors the new wind direction. For the Airport, wind is generally calm with the predominate wind direction from the south. Runway 19 is used more than the reverse runway direction, Runway 01.

<u>Flight Path Utilization:</u> These paths are not precisely defined ground tracks, but represent a broad area over which the aircraft will generally fly. The modeling analysis includes a total of eight departure flight tracks and six arrival flight tracks to model the aircraft flight paths at the Airport.

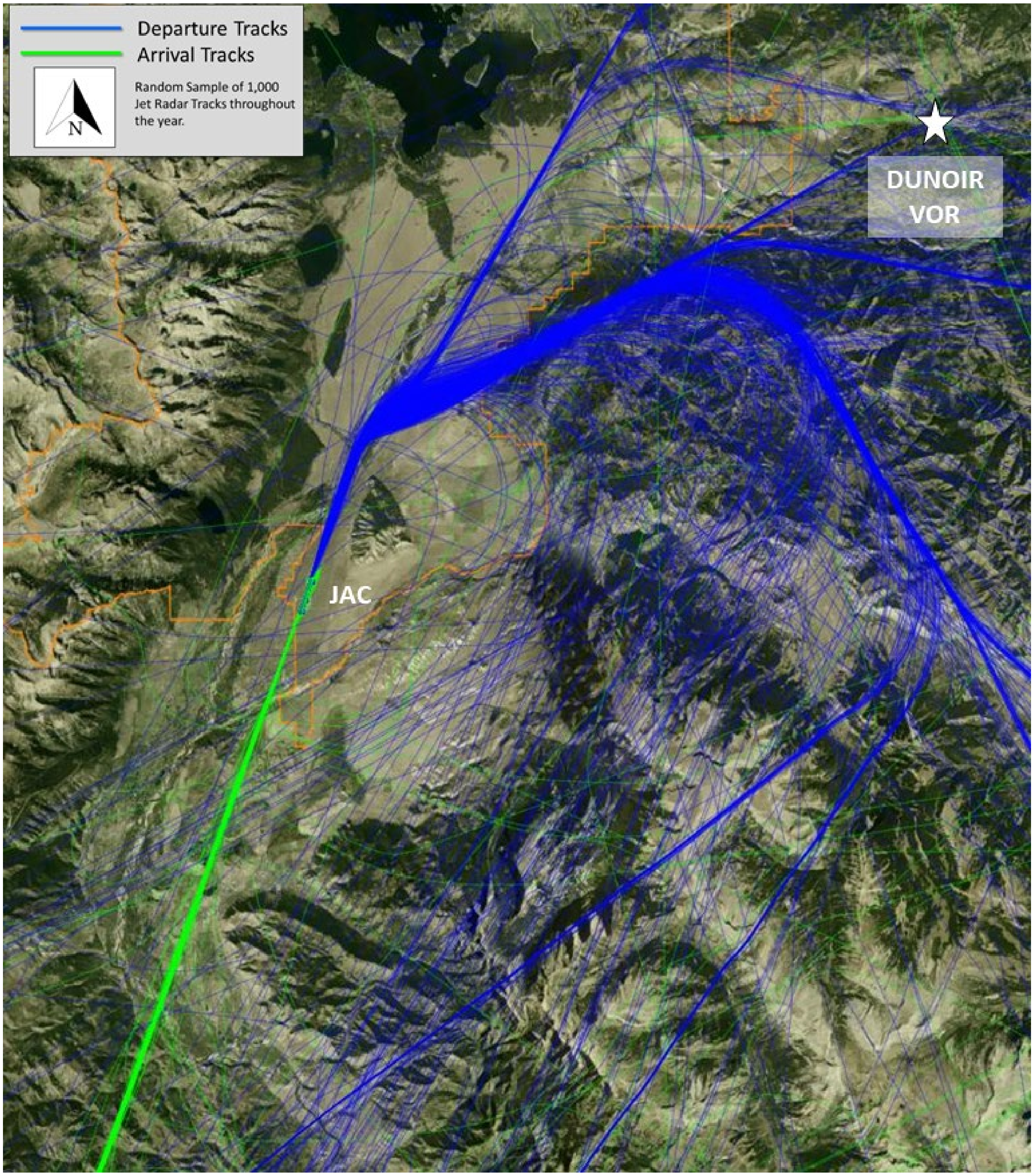
A sample of the 2022 flight tracks used in AEDT modeling are presented in **Figure 5-1** and **5-2**. **Figure 5-1** presents departure and arrival flight paths for jets in south flow on Runway 19. **Figure 5-2** presents departure and arrival flight paths for jets in north flow on Runway 01. The flight track data was used to help define the location of the aircraft flight paths and in the correlation of the noise measurement data with the aircraft operational data.

Figure 5-1
Jet Arrival and Departure Flight Tracks
Operation: Runway 19 South Flow



Source: Jackson Hole Airport Noise Monitoring System, 2023

Figure 5-2
Jet Arrival and Departure Flight Tracks
Operation: Runway 01 North Flow

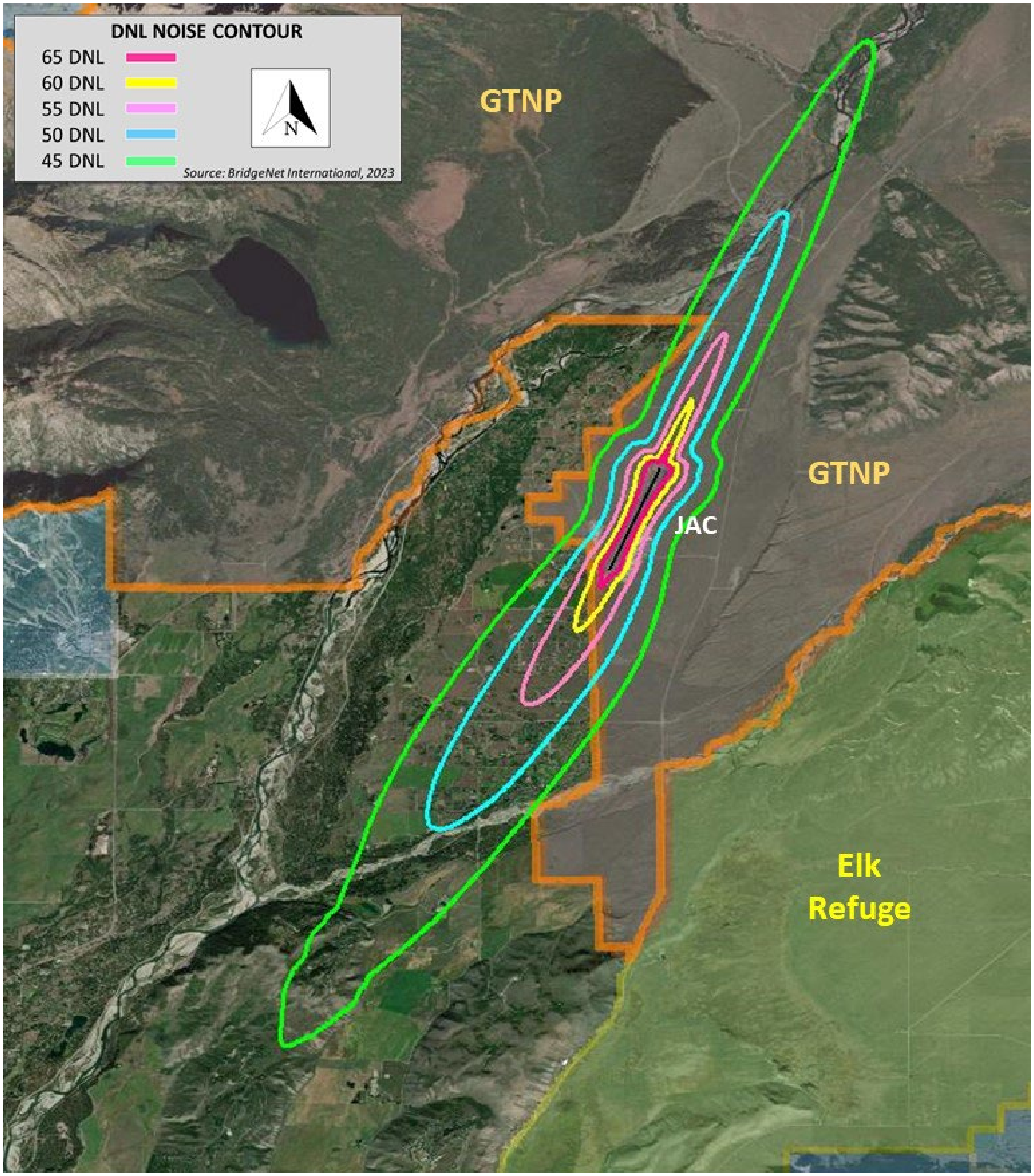


Source: Jackson Hole Airport Noise Monitoring System, 2023

5.3 Noise Modeling Results

The noise metric used to assess the 2022 annual noise contour is the Day Night Average Sound Level (DNL). This model uses FAA standard modeling assumptions that would be required within an FAA-sponsored environmental study. The DNL is a 24-hour time-weighted energy average noise level based on the A-weighted decibel. It is a measure of the overall noise experienced during an entire year of flight operations. The 2022 AEDT contours are presented in **Figure 5-3**.

Figure 5-3
2022 Annual DNL Noise Contour



Source: BridgeNet International, 2023

6.0 **Summary**

6.1 Overall Summary

The results of the noise measurements and modeling report show that the Airport is in compliance with the requirements of the Airport Use Agreement. The measured/modeled noise levels are compliant with the Agreement. The Agreement includes the annual DNL noise level contour from aircraft noise at two noise monitoring sites, Moose and Barker are required to be 55 DNL and 51 DNL, respectively. The DNL contour at both sites is below the level in the Agreement. The 65 DNL noise contour does not extend beyond the Airport boundary. There are *no* residential land uses exposed to measured/modeled noise levels more than 65 DNL.

The annual DNL noise levels at the Airport have reduced from the 2021 levels because of several factors that include the runway closure period, the reduction in overall operations, the reduction in commercial jet operations, and the trend in operation of quieter jets. An important factor for the reduction in noise that has occurred at the airport since 1984 is the increased utilization of new-generation aircraft, including Stage 4 and Stage 5 aircraft, which are substantially quieter than aircraft operated here in the past. This trend continued in 2022.

The total operations were 29 percent lower than 2021 levels, including the closure period, and down 6 percent for the non-closure months. The primary factor in the reduction in noise is the reduction in the number of commercial/regional jet operations. The reduction in commercial/regional jet operations had a similar reduction as the overall operations. The business jet operations were down 19 percent for the full year and 2 percent for the non-closure months. Business jets on average generate lower single-event noise than commercial/regional jets and do not contribute as much to the overall DNL noise levels.