Jackson Hole Airport

2017 Annual Noise Report

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1.0 Introduction

The purpose of this report is to present the final results from the 2017 noise measurement survey at Jackson Hole Airport. This report also includes data from the Fall 2016 – Winter 2017 interim report. Noise measurements are conducted during the winter and summer seasons in order to determine the annual noise exposure levels from the airport. This year-end report summarizes the results from winter and summer noise measurements for 2017. These results are compared and summarized with respect to the noise limits established at the airport. The results are also compared to previous noise measurements conducted since 1984, presenting the changes in noise levels at the airport that have occurred over time.

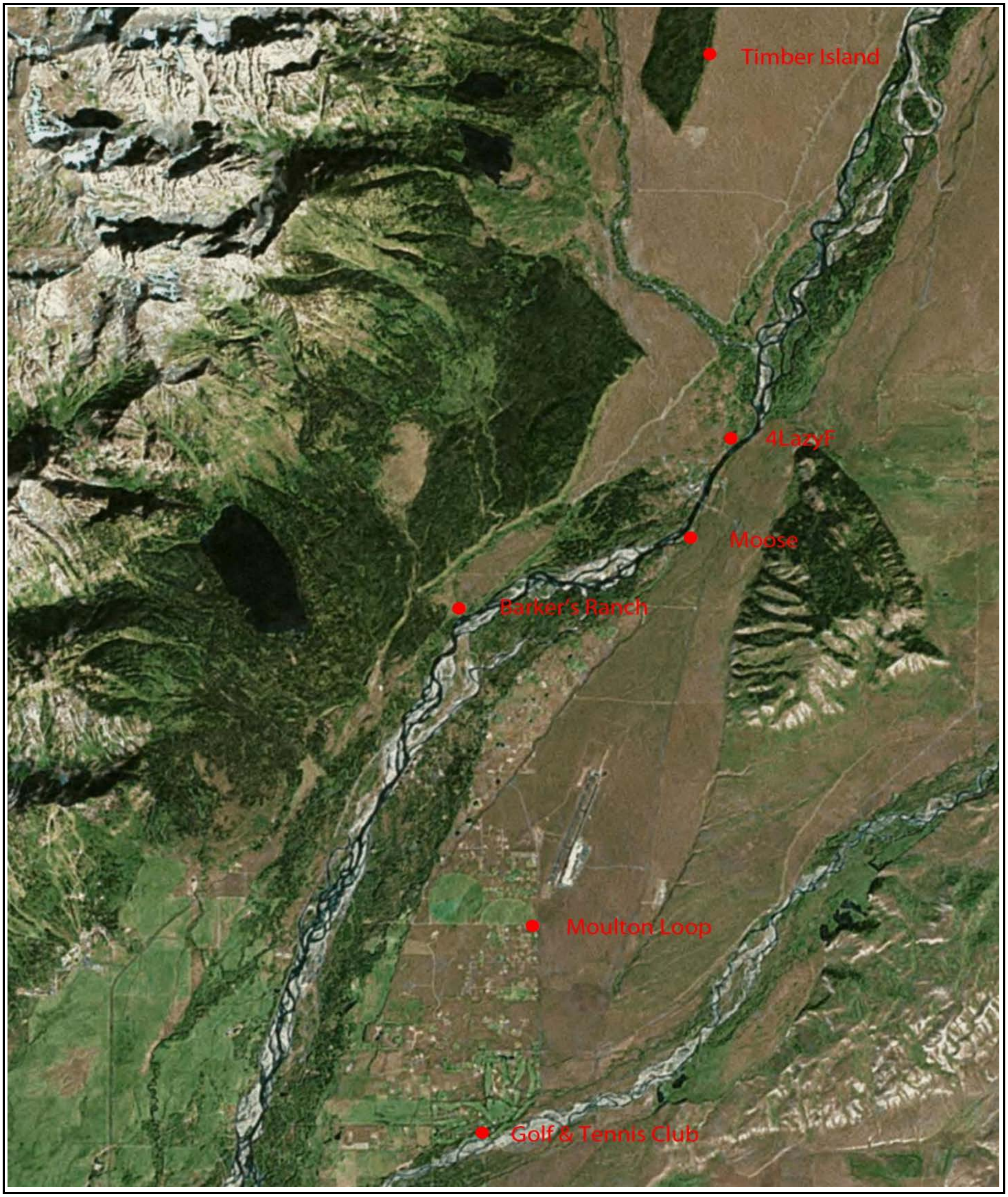
From 1984 to 2003, noise monitors were stationed at the same three sites for each measurement period. Each site is monitored for approximately one week during both the winter and summer season. The three sites that were monitored during this survey are Moulton Loop, the Village of Moose, and Barker Ranch. In 2003, Jackson Hole Airport installed six (6) permanent noise monitors located in the Grand Teton National Park that collect data continuously year around. Moulton Loop, the Village of Moose, and Barker Ranch have been permanently monitored sites since 2003. These measurement locations and the three additional sites are presented in Table 1-1 and Figure 1-1.

Table 1-1
Noise Measurement Sites

Sites	Name	Location	Longitude	Latitude
1	Moulton Loop	Zenith Drive and Spring Gulch Road	-110.744542	43.592342
2	Golf Course	Jackson Hole Golf & Tennis Club	-110.753580	43.562232
3	Barker Ranch	Circle H Ranch (Barker's Residence)	-110.758610	43.637980
4	Moose	Moose Entrance	-110.716753	43.648249
5	4 Lazy F Ranch	4 Lazy F Ranch	-110.708956	43.662913
6	Timber Island	East of Timber Island	-110.713525	43.714844

The primary purpose of the measurements is to determine if the airport is in compliance with the Agreement between the U.S. Department of the Interior and the Jackson Hole Airport Board (Agent). The results of the measurements show that the airport is in compliance with the requirements of the airport Agreement. Aircraft noise levels within the Park are calculated to be greater than 5 dBA below the levels specified within the airport Agreement with the Department of the Interior. In addition, the 65 DNL noise contours do not extend into residential land uses.

Figure 1-1
Location Map
Jackson Hole Airport 2017 Annual Report
Noise Measurement Location Sites: ●



2.0 Background and Information on Noise

2.1 Background

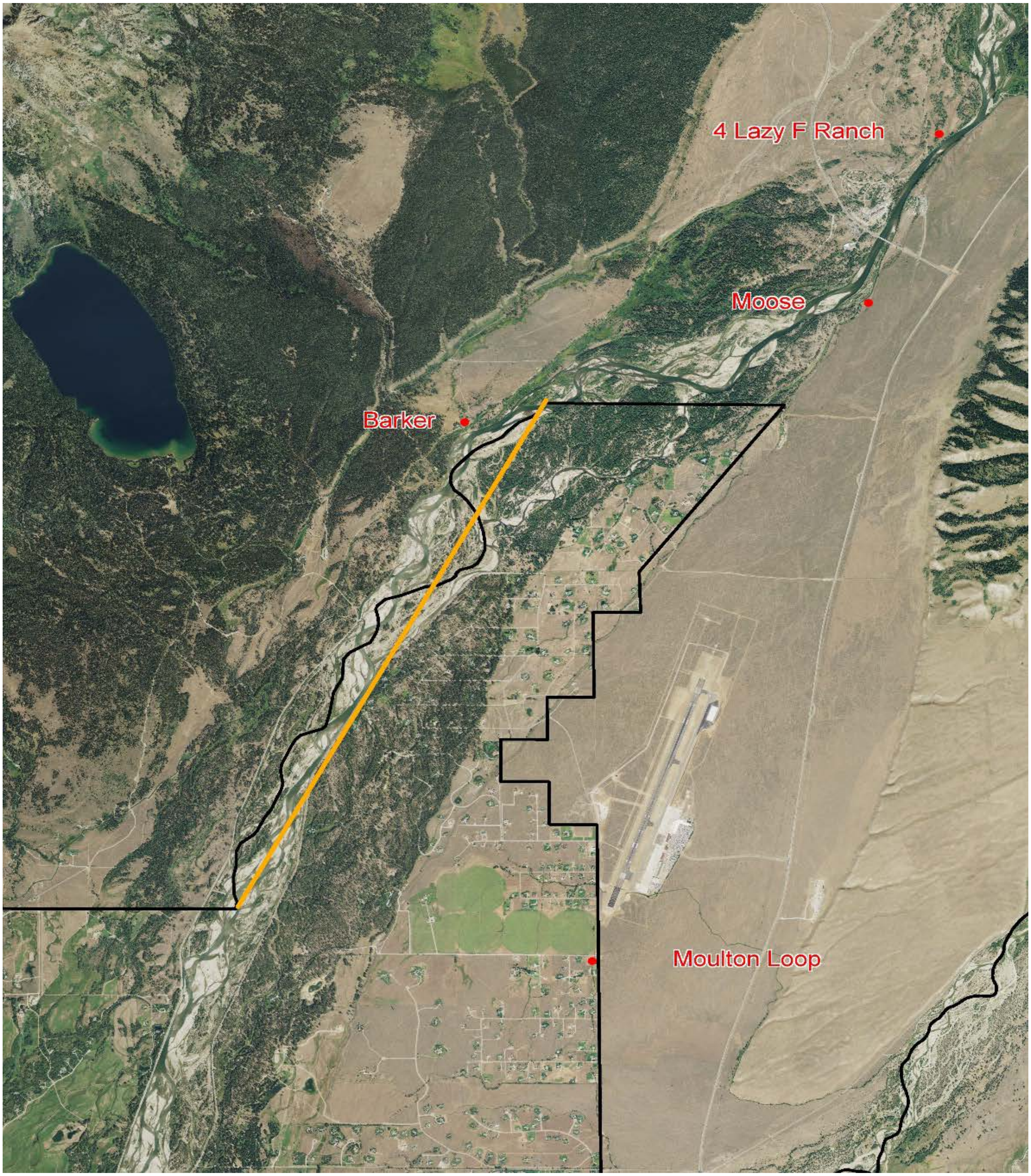
Jackson Hole Airport is the only commercial airport in the country that is located within a system area that is designated a National Park. Subsequently, it has had a long history of controversy concerning its operation and development. As a result of this, the airport operates under a number of special restrictions and the Airport Board has developed a number of special noise abatement measures to minimize the impacts from aircraft noise. These procedures and a brief history of their development are presented in the following section.

In the early 1980s the Airport Board and the Department of the Interior entered into negotiations for a new agreement for the continued operation of the airport. The Agreement required that a revised noise control plan be developed which "*... utilizes the latest in noise mitigation technology and procedures. The revised plan will be developed in a comprehensive study to consider all of the relevant environmental, economic, and operational considerations.*" The primary objectives of the noise control plan as stated in the Agreement were "*to ensure that future airport operations are controlled in such a manner that aircraft noise exposure will remain compatible with the purposes of Grand Teton National Park and will result in no significant increase in cumulative or single event noise impacts on noise sensitive areas of the Park.*" As a result, the Airport Board initiated a study to investigate methods of mitigating the aircraft noise levels resulting in the development of a new comprehensive noise control program for the airport.

The Agreement contains several key restrictions in terms of cumulative and single event noise levels. The primary restriction is that the airport cannot exceed specific Day-Night Level (DNL) noise levels at critical locations within the Park boundary. Another requirement is that the annual level from aircraft noise at the Moose measurement location cannot exceed 55 DNL. In addition, there is a restriction line within the Park where the aircraft annual noise levels cannot exceed 45 DNL. The 45 DNL limit is shown as the Critical Area Boundary as presented in Figure 2-1.

In order to meet the requirements of the Agreement, the Airport Board developed an Airline Access Plan. This Access Plan placed a limit on the number of operations of commercial jet aircraft that was then adopted by all the airlines at the airport. The limit on operations was determined to be 6.5 Average Daily Departures of the 737-200/D17. Increases in operations could only be accomplished by substituting these aircraft with the quieter, new generation of aircraft which at that time were just entering service.

Figure 2-1
Critical Area Boundary:
Grand Teton National Park Boundary:
Jackson Hole Airport 2017 Annual Report



The Agreement also included a single event limit provision. The single event limit restricted the operations of any aircraft that generated sound levels above the specified limit. This single event limit was 92 dBA as defined by the approach dBA level from FAR 36 regulations *(Note: this numeric value should not be compared to noise levels shown in this report in that the measurements utilized a different noise metric at different locations from the airport).* This essentially eliminated aircraft from operating at the airport that generated higher noise levels than the 737-200/D17 aircraft. The Noise Control Program at Jackson Hole also includes a number of additional elements. The major elements of the program are summarized below:

- Limit on the level of overall noise that can be generated at the airport. This is enforced through an Airline Access Plan.
- Limitation on the single event aircraft noise level for all aircraft operating at the airport. This noise abatement measure is designed to limit the single event noise levels over the park as well as eliminating the higher noise level aircraft from operating at the airport.
- Limitation on night operations by turbojet air carrier aircraft.
- A preferential runway program that requests that all aircraft depart to the south and arrive from the south when wind conditions permit. Monitoring of this provision is documented for every commercial jet operation.
- A request that all aircraft departing to the south make an immediate left turn, weather conditions permitting. Monitoring of this provision is documented for every commercial jet operation.
- A request that aircraft arriving from the south perform a left downwind turn near Black Tail Butte, when 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.

In order to ensure compliance with the Agreement restrictions, the Jackson Hole Airport Board conducts a semi-annual noise measurement survey. These measurements are conducted for approximately a one week period during the peak winter and summer seasons. The purpose of this report is to present the results of the winter noise measurement survey which documents compliance with the noise limits contained in the Agreement between the Airport Board and the Department of Interior.

2.2 Noise Metrics

The description, analysis and reporting of community sound levels from aircraft is made difficult by the complexity of human response to sound and the myriad of noise metrics that have been developed for describing acoustic impacts. This analysis utilizes the two major noise metrics for analysis of aircraft noise impacts: Day Night Noise Level (DNL), and Sound Exposure Level (SEL). Both of these metrics are based on the A-weighted decibel (dBA).

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 have been developed to assess community response to noise. They 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. They are also designed to account for the known health effects of noise on people. The FAA, the EPA, and various other agencies use DNL in assessing noise and land use compatibility.

SEL 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. SEL also includes the effect of the duration of the noise event. There are no noise and land use compatibility standards in terms of SEL. Disturbances from aircraft noise (i.e., speech and sleep interference) however can be related to SEL levels.

2.3 Noise Assessment Guidelines

Noise/Land use guidelines have been developed by a number of agencies including the Federal Aviation Administration. 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 noise metric DNL) 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.

As part of the Agreement with the Department of Interior, Jackson Hole Airport is required to comply with certain noise limits within Grand Teton National Park. These limits are in terms of the DNL noise levels. One requirement is that the annual noise level from aircraft measured at the Moose location cannot exceed 55 DNL. In addition, the Critical Area Boundary Line, shown in Figure 2-1 sets the limit beyond which the aircraft annual noise level cannot exceed 45 DNL.

2.4 Methodology in Determining the Noise Environment

The noise environment at Jackson Hole Airport was determined through the employment of comprehensive noise measurement surveys of aircraft and ambient noise sources, then incorporating these results into the FAA's airport noise computer model. The noise measurement surveys determine the DNL noise level, the SEL levels from each aircraft flyover, and the background or non-aircraft ambient noise environment.

The measurement of aircraft noise is limited by duration and the time of the survey, and may not exactly reflect the operational levels that exist at the airport on an annual basis. Thus, the measurements are annualized by correlating these results with the average annual airport operations. 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 (6) locations around the airport. These locations include Moulton Loop, the Village of Moose, and Barker Ranch and are illustrated in Figure 1-1. The Moulton Loop measurement site is indicative of the residential area directly south of the airport. This site is directly under the extended runway centerline approximately 2,200 feet south of the runway end, and is one of the areas exposed to the highest noise levels. *Note: In 2003, the Moulton Loop site was moved approximately 200 feet closer to the runway end than the old temporary site. This results in slightly higher noise level readings.* This location falls under the Federal Aviation Administration noise and land use compatibility guidelines, which recommend that residential land uses should not be exposed to noise levels in excess of 65 DNL.

The Village of Moose measurement site is located in the National Park, south of Teton Park Road and directly under the extended runway centerline. The Lease Agreement with the National Park requires that the aircraft noise levels at this location not exceed 55 DNL. The Barker Ranch measurement site is also within the National Park, 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 2016 - 2017 aircraft operations were derived directly from the airport summary of daily logs, the Airport's BI-6 radar data and the FAA's OPSNET data. The 2016 - 2017 analysis season is presented for the operations between October 1, 2016 and September 30, 2017. The total number of operations during the twelve-month period was 29,444 or 80.7 average daily operations. An operation is either 1 departure or 1 arrival. This included an average of 14.9 commercial jet operations per day, 7.2 regional jet operations per day and 31.4 corporate jet operations per day. The fall 2016 – summer 2017 operations are presented in Table 3-1. Comparison of Average Daily Operations for Seasons 2016 and 2017 using OPSNET Data are presented in Table 3-2.

3.2 Enplaned Passengers

The total number of enplaned passengers is also presented in Table 3-1. For the 2016 - 2017 season, there were 350,488 enplaned passengers.

Table 3-1
Aircraft Operational Summary
Jackson Hole Airport 2017 Annual Noise Report
October 1, 2016 - September 30, 2017

Monthly Operations By: Aircraft	Airlines	Fall Oct	Fall Nov	Fall Dec	Winter Jan	Winter Feb	Winter Mar	Spring Apr	Spring May	Spring Jun	Summer Jul	Summer Aug	Summer Sep	Totals	Average Daily Operations Fall/Winter	Spring/Summer	Annual
Commercial Jets																	
A319	*American*	28		134	92	38	70	8		232	240	228	180	**1,250**	2.0	4.9	3.4
	Delta	62	14	122	110	138	200	56	98	160	244	256	188	**1,648**	3.5	5.5	4.5
	United	52		24	100	64	62		8	50	106	110	90	**666**	1.7	2.0	1.8
A320	*United*	90	4	34	80	114	92	20	106	188	194	182	160	**1,264**	2.3	4.7	3.5
B737-700	*Delta*					12	28							**40**	0.2		0.1
	United			70	36	58	66				72	26	2	**330**	1.3	0.5	0.9
B757-200	*American*					22	24							**46**	0.3		0.1
	Delta			34	24	20	20			22	30	32		**182**	0.5	0.5	0.5
Regional Jets																	
CRJ7	*GoJet*	120	142	234	226	138	110	106	70	98	70	36	72	**1,422**	5.3	2.5	3.9
	SkyWest	22	112	124	64	50	54	108	84	88	226	220	38	**1,190**	2.3	4.2	3.3
Commuter																	
DH8B	*Republic*																
Air Taxi																	
Turboprop		186	297	258	231	315	260	190	273	292	351	393	280	**3,326**	8.5	9.8	9.1
General Aviation																	
Corporate Jet		823	564	1,188	1,116	979	1,060	420	546	892	1,230	1,682	970	**11,470**	31.3	31.5	31.4
GA Other		222	322	150	216	289	320	164	508	936	1,225	1,141	790	**6,283**	8.3	26.2	17.2
Military																	
C-21		29	19	37	16	8	25	10	31	55	40	26	31	**327**	0.7	1.1	0.9
	TOTAL	1,634	1,474	2,409	2,311	2,245	2,391	1,082	1,724	3,013	4,028	4,332	2,801	**29,444**	68.1	93.3	80.7
Enplaned Passengers		19,334	8,652	22,398	34,404	28,303	34,588	9,636	14,529	37,275	53,580	51,936	35,853	**350,488**	Passengers 807	Passengers 1,114	Passengers 960

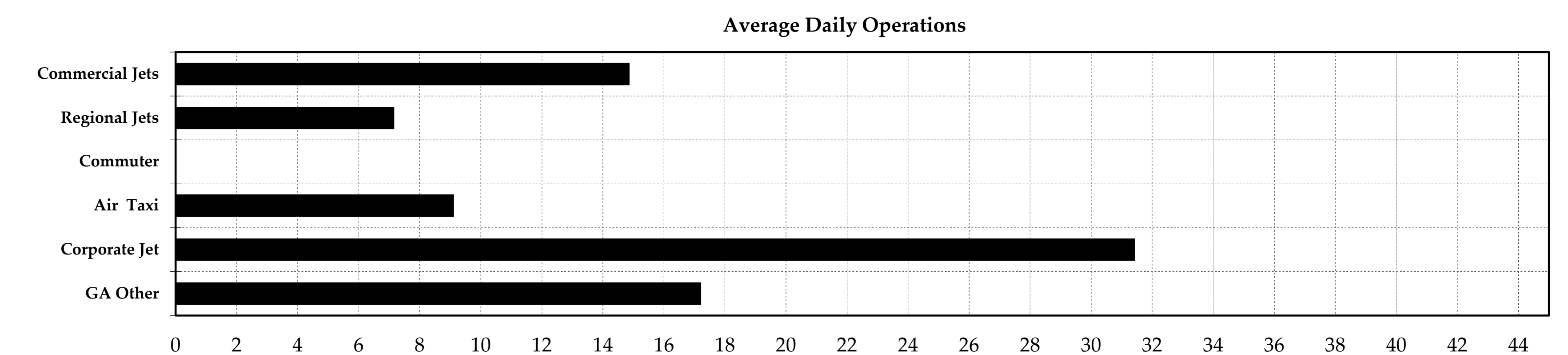


Table 3-2
Comparison of Average Daily Operations for Seasons 2016 (Top) and 2017 (Bottom) using OPSNET Data
Jackson Hole Airport 2017 Annual Noise Report

Date	IFR Itinerant					VFR Itinerant					Local			Total Operations
	Air Carrier	Air Taxi	General Aviation	Military	Total	Air Carrier	Air Taxi	General Aviation	Military	Total	Civil	Military	Total	
Oct-2015	315	444	420	11	1,190	1	46	318	24	389	76	10	86	1,665
Nov-2015	264	381	244	20	909	0	26	97	23	146	50	18	68	1,123
Dec-2016	707	848	421	7	1,983	0	18	175	5	198	34	0	34	2,215
Jan-2016	792	737	444	8	1,981	0	7	122	3	132	78	10	88	2,201
Feb-2016	804	725	448	14	1,991	0	18	247	24	289	148	0	148	2,428
Mar-2016	825	695	429	1	1,950	0	27	185	7	219	120	0	120	2,289
Apr-2016	302	379	188	2	871	1	45	210	1	257	221	6	227	1,355
May-2016	345	433	289	3	1,070	1	47	301	10	359	244	0	244	1,673
Jun-2016	650	654	752	20	2,076	3	89	719	72	883	375	25	400	3,359
Jul-2016	1,076	889	915	8	2,888	0	72	901	13	986	138	26	164	4,038
Aug-2016	1,027	957	926	14	2,924	6	108	1,005	23	1,142	304	6	310	4,376
Sep-2016	684	698	819	3	2,204	5	26	590	12	633	300	6	306	3,143
Total	7,791	7,840	6,295	111	22,037	17	529	4,870	217	5,633	2,088	107	2,195	29,865

Date	IFR Itinerant					VFR Itinerant					Local			Total Operations
	Air Carrier	Air Taxi	General Aviation	Military	Total	Air Carrier	Air Taxi	General Aviation	Military	Total	Civil	Military	Total	
Oct-2016	365	491	480	8	1,344	1	24	212	19	256	32	2	34	1,634
Nov-2016	248	403	389	9	1,049	9	10	177	8	204	219	2	221	1,474
Dec-2016	774	761	595	14	2,144	1	7	160	14	182	74	9	83	2,409
Jan-2017	719	685	637	7	2,048	0	9	183	9	201	62	0	62	2,311
Feb-2017	695	717	566	3	1,981	0	15	134	5	154	110	0	110	2,245
Mar-2017	699	725	636	11	2,071	0	17	207	14	238	82	0	82	2,391
Apr-2017	276	305	300	6	887	0	8	115	4	127	58	0	58	1,072
May-2017	327	375	470	15	1,187	2	27	403	16	448	79	0	79	1,714
Jun-2017	767	650	676	13	2,106	5	23	555	30	613	284	12	296	3,015
Jul-2017	1,113	888	901	4	2,906	1	35	700	30	766	356	6	362	4,034
Aug-2017	1,020	1,233	1,096	9	3,358	7	41	734	13	795	201	4	205	4,358
Sep-2017	718	693	823	11	2,245	3	26	339	13	381	154	7	161	2,787
Total	7,721	7,926	7,569	110	23,326	29	242	3,919	175	4,365	1,711	42	1,753	29,444

Percentage Change in Operations from 2016 to 2017

% Change	-0.9%	1.1%	20.2%	-0.9%	5.8%	70.6%	-54.3%	-19.5%	-19.4%	-22.5%	-18.1%	-60.7%	-20.1%	-1.4%

3.3 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 employed in this study uses the continuously recorded one second LEQ noise levels at each of the six permanent measurement locations. From this data different noise metrics can be calculated. This includes the aircraft single event noise event level, cumulative daily noise levels, time above levels, and the ambient levels. Since all the noise is collected during the measurements, it is possible to process the data and calculate different metrics of interest that may arise. The process of calculating noise events from this data uses a floating threshold methodology. This allows for the measurement and identification of lower noise level events. The parameters are adjustable and can be modified so that it is possible to recalculate noise events from raw data any time in the future.

3.4 Operational Data

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. The upgrade consisted of numerous components, including; access to the BI-6 radar data, weather data, and the additional 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 follows along the Volpe Center's 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 more accurately measure the aircraft noise levels at the noise measurement points and to also quantify the aircraft audibility levels at these locations.

BI-6 radar is the primary source for aircraft operational information. However, the airport maintains a live feed of all the IFR aircraft activity in the United States directly from FAA center data as a secondary information source. This data source is the Aircraft Situational Display (ASD). This provides data on all domestic civilian IFR aircraft, and the data stream includes aircraft type, position and altitude by time. VFR aircraft are not included in this data source. When possible, this data is correlated with the noise event data using custom software.

The ASD radar data includes IFR flight information for every flight, as well as position information as to the location of the flight. Each flight is also assigned a unique identification track number so all of the data for any particular flight can be compiled. The flight information includes data such as the ARTS aircraft type, ARTS airline code, departing and arriving airport codes, and flight number. The position information includes the X and Y coordinates as well as the altitude of the aircraft at each point. The location information given provides the information necessary to determine the direction of flow for runway usage.

Correlation of Noise and Flight Data

Custom noise monitoring software was used to help correlate aircraft flight activity to the noise data. This software utilizes such methods as aircraft position information, noise event sequencing, and noise event profiling to correlate noise data to the aircraft activity. The 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 custom computer program 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.

4.0 Spring/Summer Noise Measurement Results

4.1 Introduction

The existing noise environment for Jackson Hole Airport was determined through a noise measurement survey. The results of the measurement survey are summarized in the following paragraphs. This section presents noise survey information for the Spring & Summer 2017 season as well as the 2016 - 2017 annual noise measurement results. Additional data, which includes more detailed results for each measurement site, is presented in the Appendices. This section presents the overall findings from the noise measurement survey. This includes an explanation of the results and is divided into the following sub-sections:

<u>Noise Measurement Results</u>

Continuous noise measurement data
Ambient noise measurement results
Single event noise measurement results (SEL)
DNL noise measurement results
Hourly noise measurement results (LEQ)

The airport's permanent noise monitoring system utilizes 01dB Opera noise monitors at all of the measurement sites. The permanent 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 permanent monitors includes the continuous measurement of 1-second average or equivalent (LEQ), noise levels. This type of measurement system allows for the measurement and identification of SEL noise events at a lower threshold than the equipment previously used at this site. 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 SEL noise levels from each individual flyover, the hourly LEQ noise levels, and the daily DNL noise levels for the measurement period.

Although the airport installed a permanent noise monitoring system that monitors noise year-round, for the purposes of this agreement, the periodic noise studies will continue to be conducted for two weeks a year, one week in the summer and one week in the winter. In keeping the study to the original two weeks, the consistency of the noise measurement is intact; in addition, the period of correlation focuses on the times when operations are at their highest levels. The time period chosen for detailed analysis was the period between July 15, 2017 and July 28, 2017.

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 the top portion of Figure 4-1 which displays a 10-minute segment of continuous noise data that was measured at Site 4, at Moose. 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.

The bottom portion of Figure 4-1 presents corresponding data measured at Site 5, 4 Lazy F Ranch, for the same time period. Given the relative close proximity of the noise measurement sites, aircraft overflights are generally measurable in all areas around the airport. This graphic also illustrates the pattern of the noise event that can be used in separating aircraft noise from other noise sources. Sample time history plots measured at each of the other noise monitoring sites is presented in Appendix A.

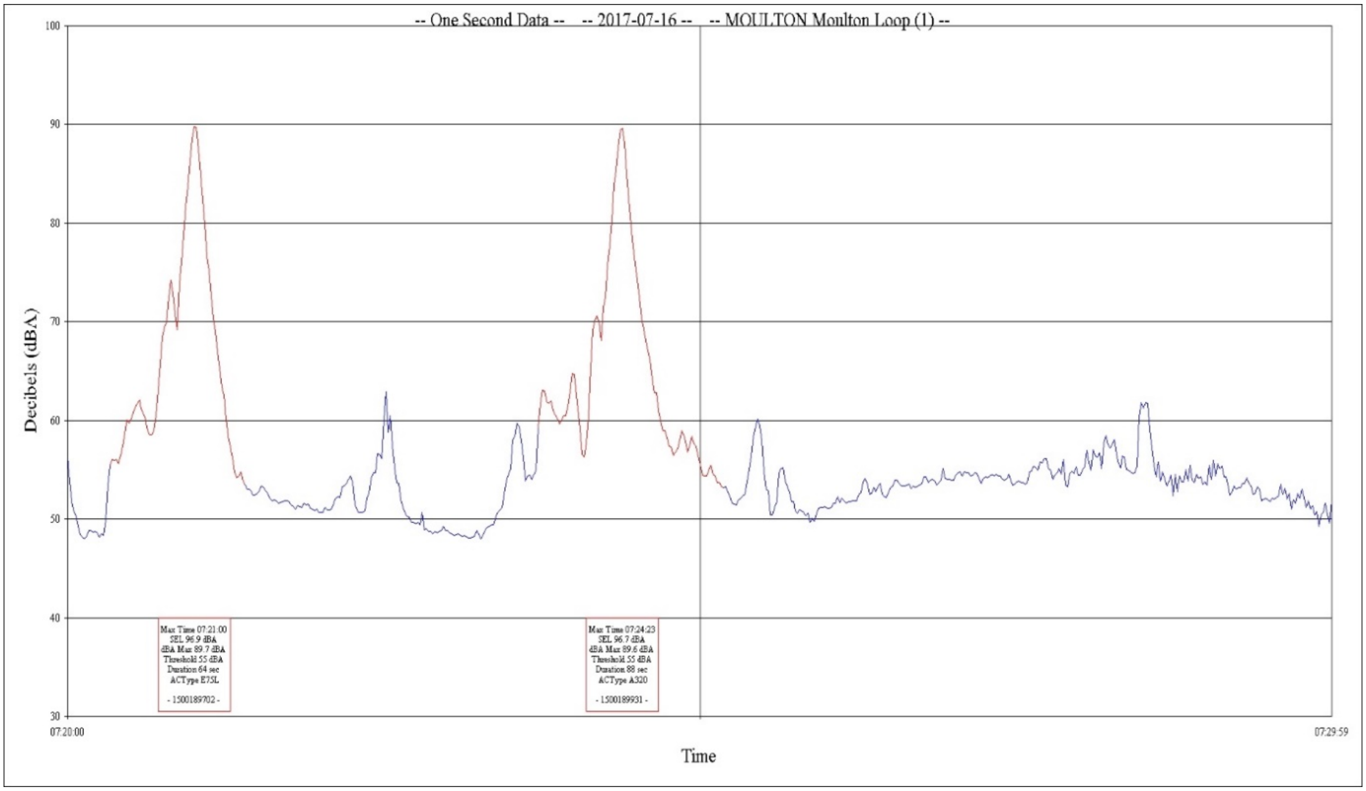
Figure 4-1

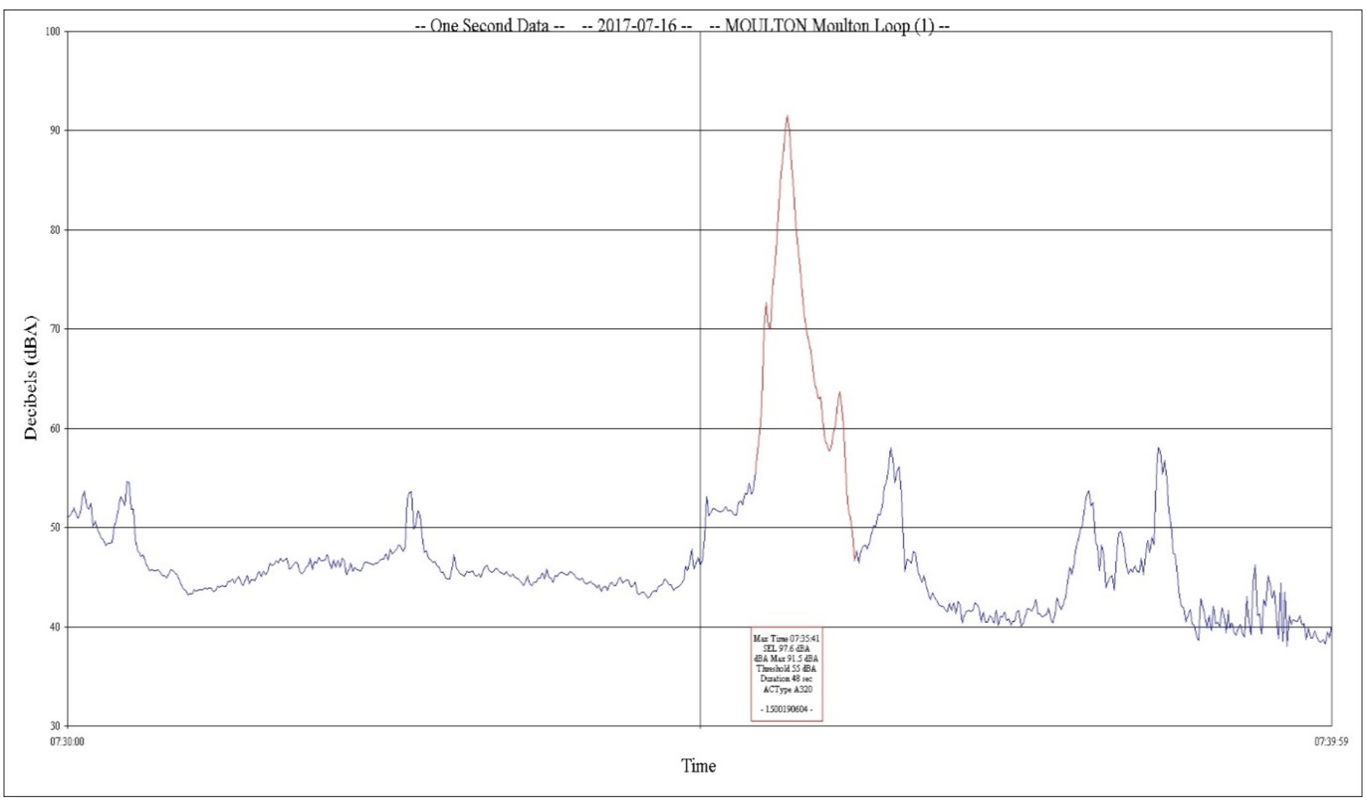
Sample Time History Noise Plot of Aircraft and Ambient Noise

Jackson Hole Airport 2017 Annual Report

Period: July 16, 2017 07:20:00 to July 16, 2017 07:39:59

Site: Moose (top) - 4 Lazy F Ranch (bottom)





4.3 Ambient Noise Measurement Results

Background, or ambient noise levels, (those without aircraft noise) are measured at each of the monitoring locations, and these results are presented using Percent Noise Levels (Ln). Percent Noise Level characterizes intermittent or fluctuating noise by showing the noise level that is exceeded during a significant percent 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 the most intrusive noise levels.

Other noise sources that are part of the background noise environment include roadway, wind in the trees, and people 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 in the following figures and tables. Table 4-1 presents the statistical summary of the ambient measurements for the entire measurement period at each site using the Ln noise levels for the Lmin, L90, L50, L10 and Lmax. The Lmax (Maximum Noise Level) is presented for the loudest 1-second dBA value that was measured while the Lmin (Minimum Noise Level) is the lowest 1-second dBA value that was measured. This table illustrates the range in noise levels that exist at each site. Note that aircraft noise events are included in this data and are typically the source of the peak or maximum noise levels. A graphic depiction of the same information is presented in Figure 4-2.

Figure 4-2
Ambient Noise Measurement Results for All Sites
Jackson Hole Airport 2017 Annual Report
Period: July 15, 2017 to July 28, 2017

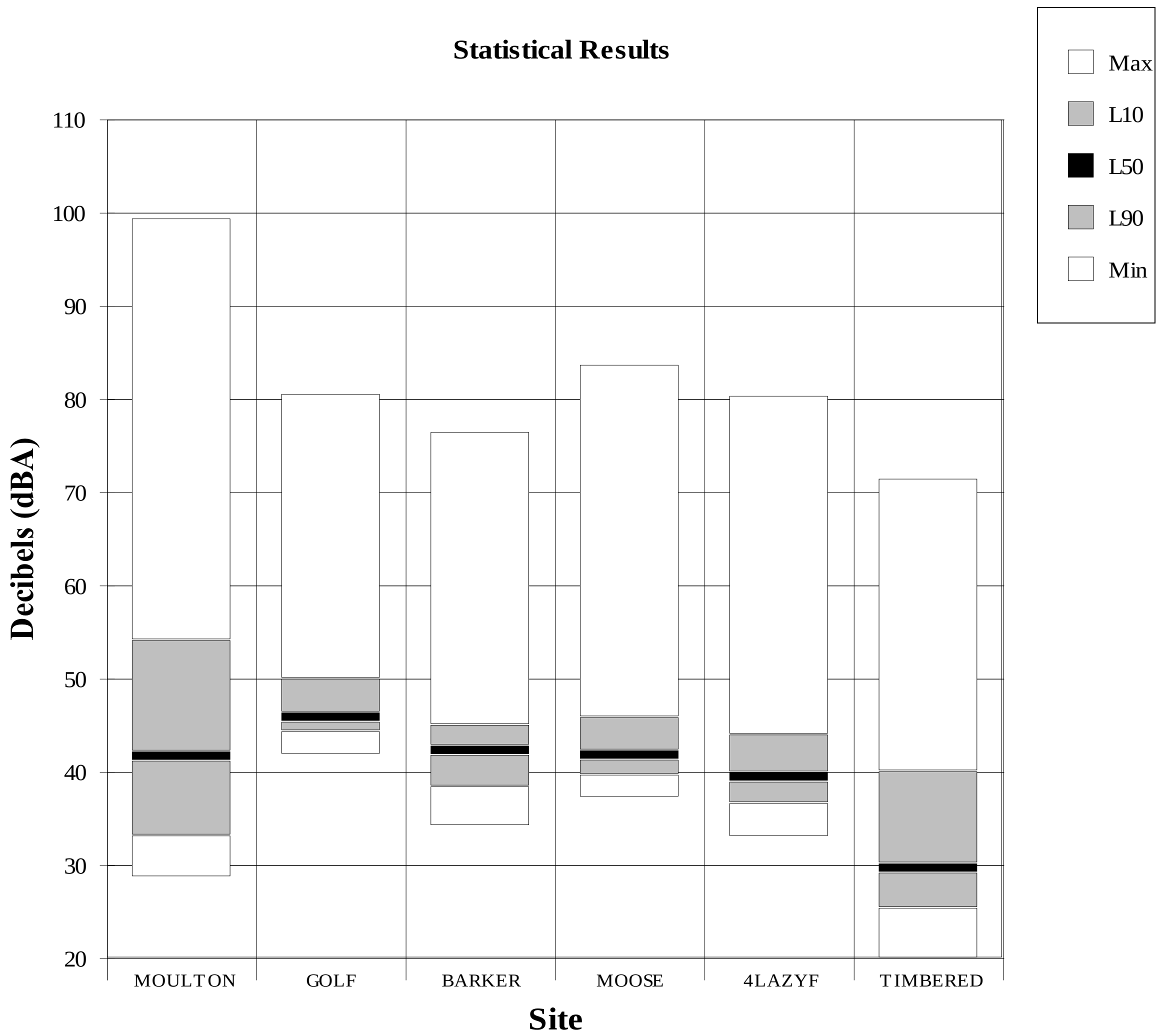


Table 4-1
Ambient Noise Measurement Results
Jackson Hole Airport 2017 Annual Report

Site#	Name	Description	Statistical Noise Levels (dBA)				
			LMax	L10	L50	L90	LMin
1	Moulton Loop	Zenith Drive and Spring Gulch	99	54	42	33	29
2	Golf Course	Jackson Hole Golf & Tennis	81	50	46	44	42
3	Barker Ranch	Circle H Ranch	76	45	42	38	34
4	Moose	Moose Entrance	84	46	42	40	37
5	4 Lazy F Ranch	4 Lazy F Ranch	80	44	39	37	33
6	Timber Island	East of Timber Island	71	40	30	25	20

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. The 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 the time the noise is below this level, and half the time it is above this level. Even during peak hours of aircraft activity, the L50 noise level would not be influenced by the aircraft noise. On a 24-hour basis, this level is generally reflective of ambient noise levels.

The measurements show that background L90 noise levels ranged from a low of 25 dBA to a high of the mid 40s dBA. Most sites had an average L90 noise level right around the mid 30s dBA. The ambient L50 noise levels ranged from the low 30s dBA to the mid 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 people activities.

Ambient noise levels vary by day and time of day as summarized in the data from the Moulton Loop site which is presented in Figure 4-3. The top portion of this figure presents the day-to-day ambient measurement results. The bottom portion of the figure shows each hour of ambient measurement data for one typical day (July 17). 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 levels range from 5 to 10 dBA lower than average hours. The ambient noise data from the remaining sites is presented in Appendix B.

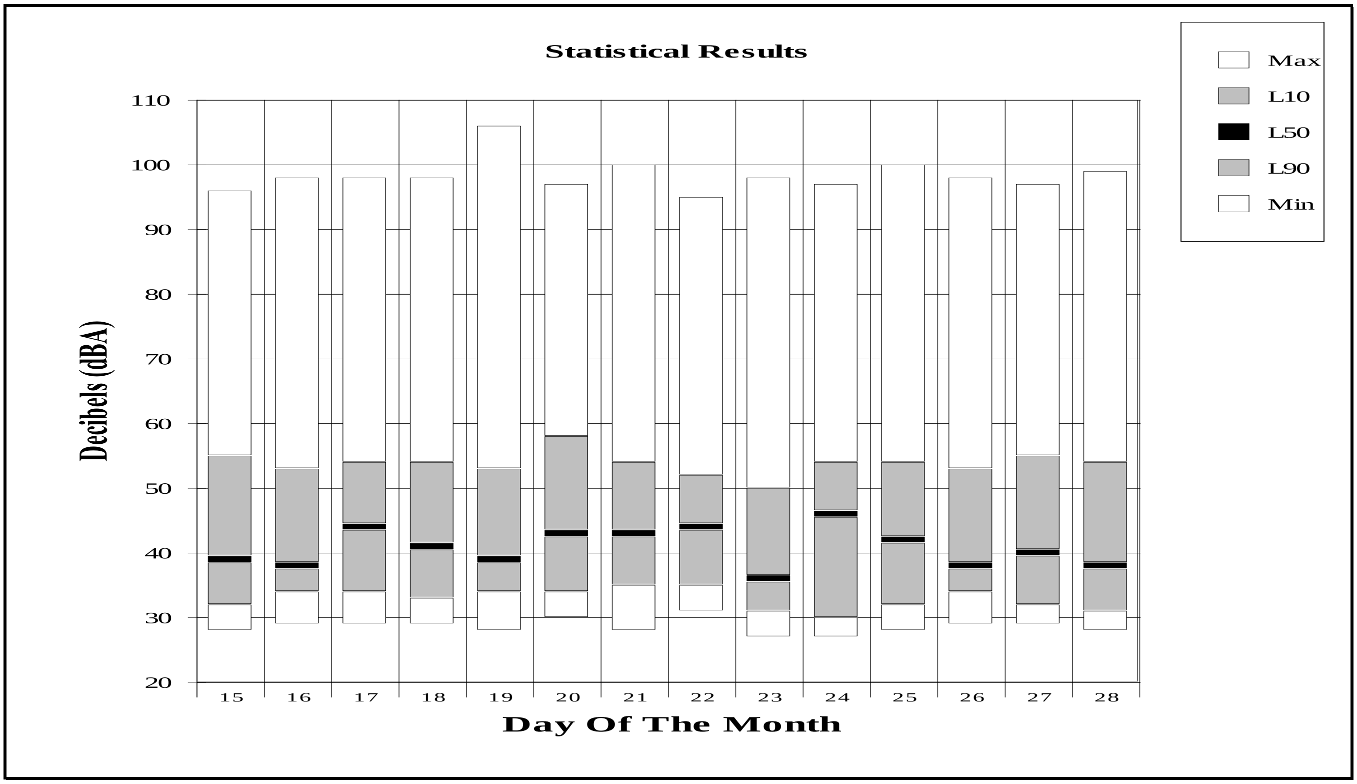
Figure 4-3

Site Specific Ambient Noise Measurement Results

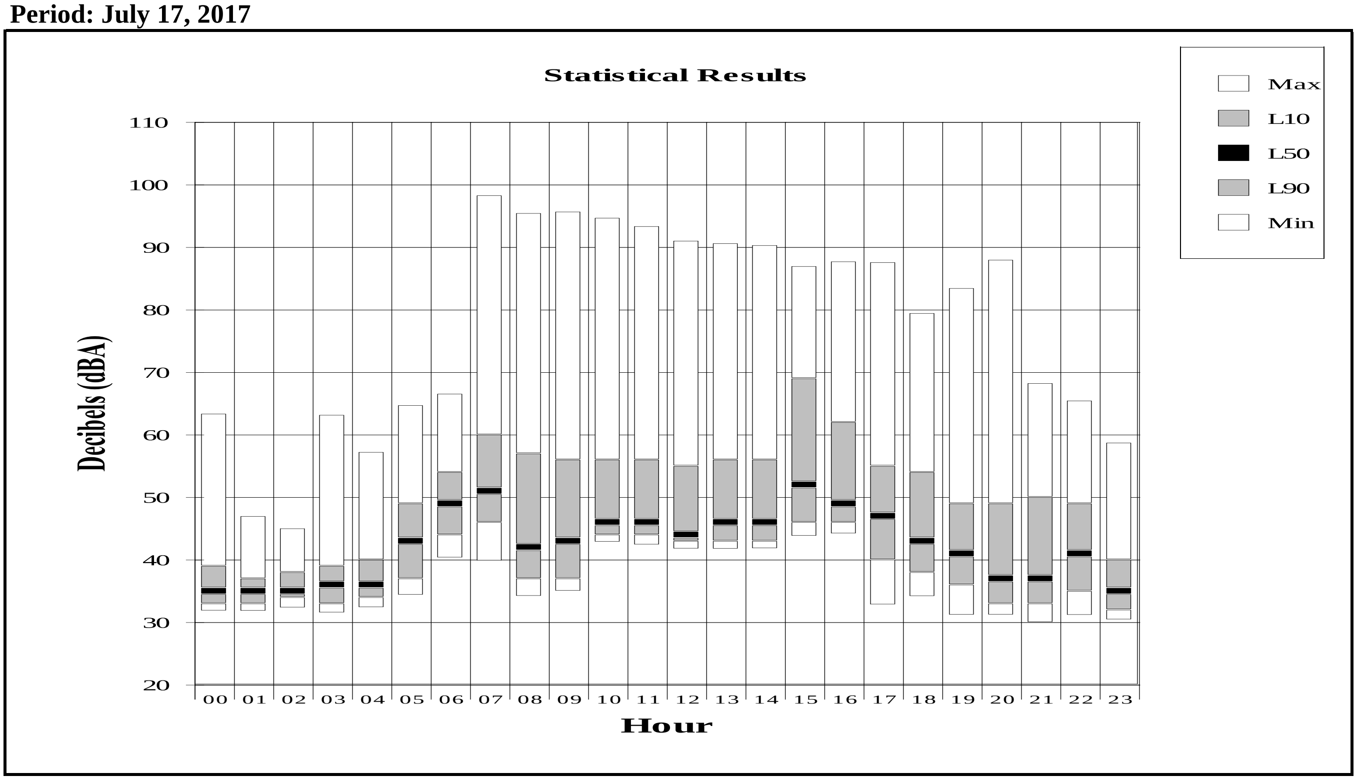
Jackson Hole Airport 2017 Annual Report

Site: Moulton Loop

Period: July 15, 2017 to July 28, 2017



Period: July 17, 2017



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), the Sound Exposure Level (SEL), and the time duration of aircraft events. The single events measured during the survey were correlated with flight operations 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 results are summarized in the following paragraphs.

The number of aircraft noise events measured daily at a site is presented graphically in Figure 4-4. This figure presents one day of events for the 4 Lazy F Ranch Site. The table presents the SEL noise values plotted as a histogram. The vertical axis presents the number of events that occurred in each hour; the horizontal axis reports the hour of the day. The SEL values are plotted vertically for each event in each hour. Graphs showing the number of aircraft noise events measured at the other sites are presented in Appendix C.

The single event data were analyzed in terms of the distribution of events by calculated single event noise level. An example of the range in noise data is presented for two sites in Figure 4-5. This figure presents a histogram of SEL values for all the aircraft events that were measured at the Moose site and at the 4Lazy F Ranch site. The histogram shows the measured SEL noise level on the horizontal axis and the number of measured aircraft events with that SEL level on the vertical axis. The Moose Loop site is representative of a location close to the airport while the 4Lazy F Ranch site is representative of a location more distant from the airport. These results show the wide range in noise level generated by aircraft events that occur at each site as well as the number of noise events.

Once correlated to the operational information, the single event data were analyzed in terms of noise level per aircraft type. Examples of the single event noise level by aircraft type are presented in Figures 4-6 and 4-7. Figure 4-6 displays the average single event noise level by aircraft type for departures measured at Moulton Loop. Figure 4-7 displays the average SEL by aircraft type for arrivals measured at Moose. These figures show the type of aircraft, the number of measured noise events correlated to that aircraft type, and the average single event noise level measured for that aircraft type. The longer bar graph illustrates those aircraft with the loudest events. The louder events were generally produced by older generation corporate 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 per the different aircraft types. Single event noise level exhibits for the other sites are presented in Appendices D and E for departures and arrivals, respectively.

Figure 4-4
One Day of Measured Aircraft Noise Events
Jackson Hole Airport 2017 Annual Report
Period: July 28, 2017
Site: 4 Lazy F Ranch

This table presents one day of events for one measurement site. The table presents the SEL noise value plotted as a histogram. The vertical axis presents the number of events in each hour. The horizontal axis is the hour of the day. The SEL values are plotted vertically for each event in each hour. The data shows that the noise events generally occur during peak times of the day. This peak period varies from day to day and is not always the same hours. Numbers in Red are higher noise level events when the SEL exceeds 94.5 dBA.

	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
23																								
22																								
21																								
20																								
19																								
18																								
17																								
16																								
15																								
14																								
13																								
12																								
11																								
10															82.4									
9															75.1									
8															58.5									
7															70.2									
6												77.8			60.2	73.2								
5								85.4				82.0	83.8	77.5	79.2	78.0		75.9						
4								86.2	84.5	67.5	82.7	81.4	71.7	74.0	78.8	75.1		77.1	80.4					
3								85.0	87.2	82.5	83.2	78.7	78.9	76.0	82.9	82.2	78.4	78.8	80.0	87.4				
2								85.0	83.9	85.6	64.2	79.6	76.5	77.1	79.2	82.6	77.4	75.7	80.1	83.8		81.5		
1								81.3	81.2	68.1	77.7	65.4	84.2	75.1	82.6	76.1	81.6	79.6	74.8	84.2	70.8	84.0		

Hour Of The Day

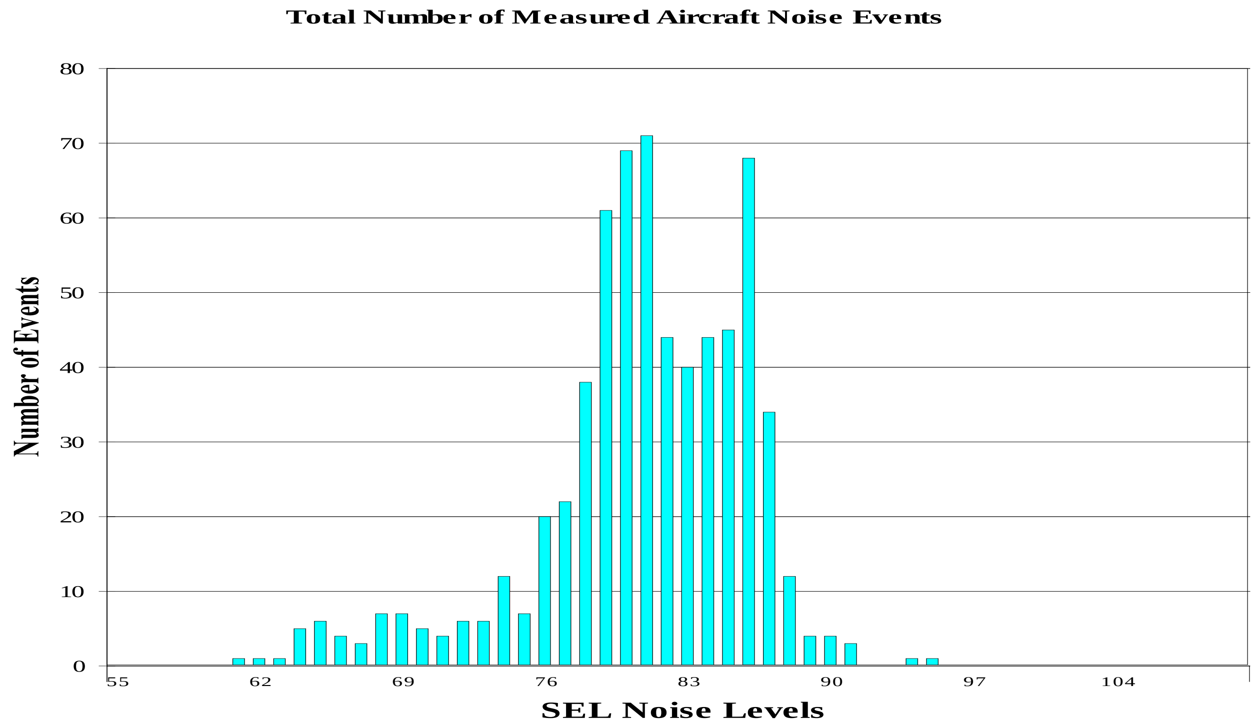
Figure 4-5

Range of Noise and Number of Events Histrograms

Jackson Hole Airport 2017 Annual Report

Period: July 15, 2017 to July 28, 2017

Sites: Moose (top) - 4 Lazy F Ranch (bottom)



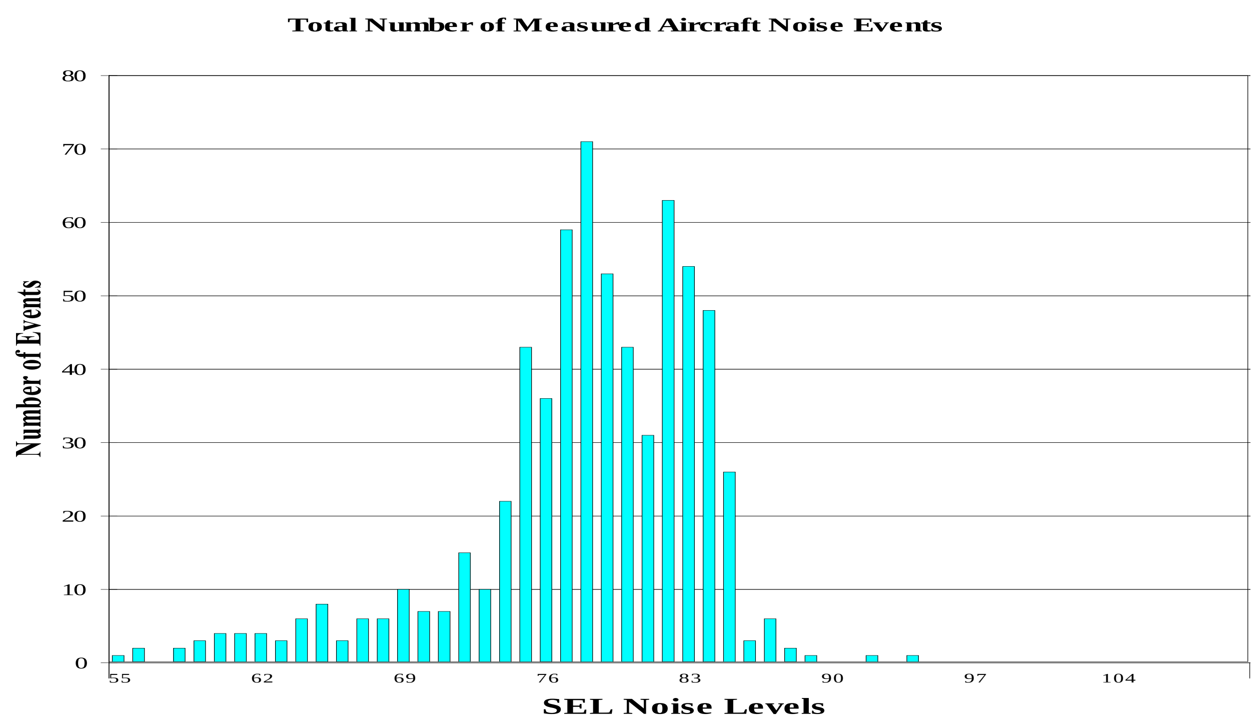
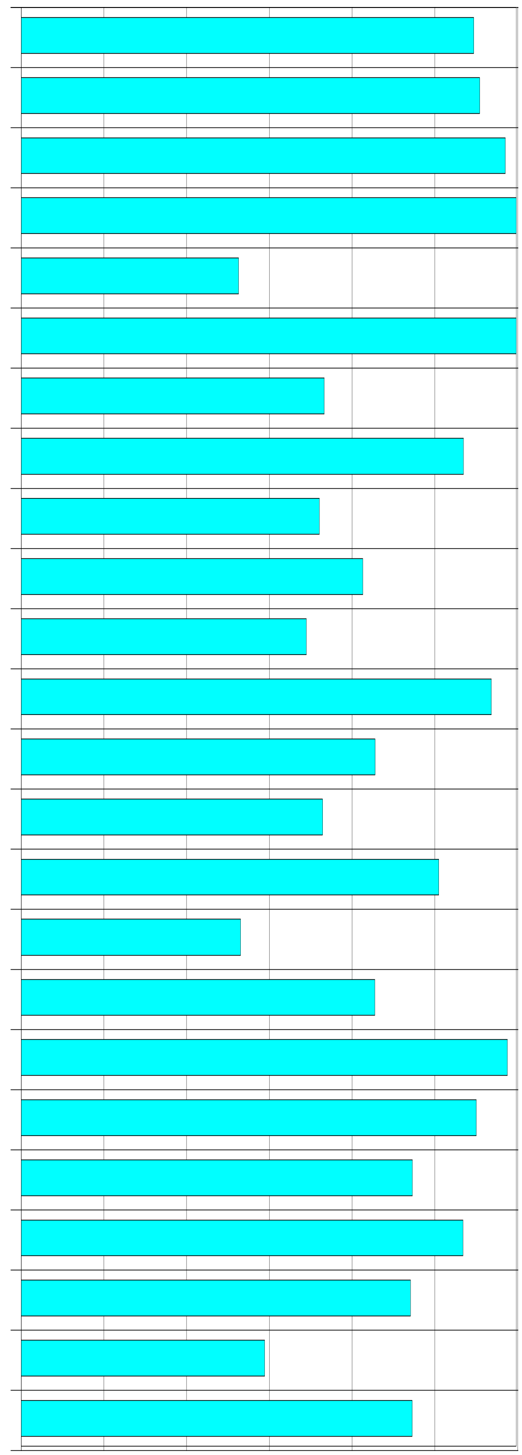


Figure 4-6
Single Event Noise Level by Aircraft Report
Jackson Hole Airport 2017 Annual Report
Period: July 15, 2017 to July 28, 2017
Site: Moulton Loop - Zenith Drive and Spring Gulch Road
Operations: Departure Runway: 19 Tracks: ALL

Aircraft	Event Count	Energy Average SEL
A319	98	97.4
A320	27	97.8
B737	8	99.3
B752	6	101.6
BE20	3	83.2
BE40	4	100.4
BE99	3	88.4
C560	19	96.8
C56X	13	88.1
C680	13	90.7
C750	6	87.3
CJ	37	98.5
CL30	18	91.5
CL60	4	88.3
CRJ7	38	95.3
E120	5	83.3
E55P	15	91.5
FA50	5	99.5
GLF4	13	97.6
GLF5	3	93.7
H25B	9	96.8
LJ35	1	93.6
PC12	11	84.8
Other Aircraft	77	93.7

Graph of Energy Average SEL



Note: Energy Average is average of all events on a noise energy basis.

Figure 4-7
Single Event Noise Level by Aircraft Report
Jackson Hole Airport 2017 Annual Report
Period: July 15, 2017 to July 28, 2017
Site: Moose
Operations: Arrivals Runway: 19 Tracks: ALL

Aircraft	Event Count	Energy Average SEL
A319	198	**84.8**
A320	66	**86.0**
B737	16	**86.3**
B752	11	**93.1**
BE20	28	**78.2**
BE40	11	**80.6**
BE99	2	**80.8**
C560	39	**78.5**
C56X	49	**80.8**
C680	26	**79.5**
C750	34	**80.2**
CJ	87	**81.7**
CL30	51	**80.3**
CL60	18	**81.6**
CRJ7	68	**83.4**
E120	12	**81.1**
E55P	29	**79.3**
FA50	8	**85.1**
GLF4	37	**84.6**
GLF5	11	**81.1**
H25B	19	**82.8**
LJ35	1	**78.8**
P180	1	**90.8**
PC12	17	**79.4**
Other Aircraft	213	**79.2**

Graph of Energy Average SEL

Note: Energy Average is average of all events on a noise energy basis.

To better illustrate which aircraft generate the highest noise events, the 25 loudest single event noise levels at each measurement site were identified. These events were then correlated with an aircraft type and plotted. The results are shown in Figure 4-8 for the Moulton Loop. The figure includes the date and time of the event, the aircraft type, the operation, and the associated single event noise levels. For most of the measurement locations, the loudest identified aircraft were typically older generation corporate jets. Per the agreement between the airport and the U.S. Department of Interior, older generation Stage 2 aircraft with higher noise levels are not permitted to operate at Jackson Hole Airport. It is uncommon for an older aircraft to operate at Jackson Hole, however occasionally one operates without permission. The other sites are presented in Appendix F.

Once the single event data is correlated with the aircraft type and operation, the individual events can then be displayed. One such correlated event is displayed in Figure 4-9 for an aircraft measured at the Moose site. The figure shows the measured noise level from the time it exceeds the ambient threshold noise level, which was 44 dBA in this case, until it dropped below that threshold. The duration of the event in seconds is displayed along the horizontal axis while the noise level in dBA is displayed on the vertical axis. All of the acoustical data relating to the event, along with the correlated aircraft data, is shown in the event summary. Specific event data measured at the other measurement sites is presented in Appendix G.

Figure 4-8

Loudest Aircraft Noise Events Site Report

Jackson Hole Airport 2017 Annual Report

Period: July 15, 2017 to July 28, 2017

Site: Moulton Loop - Zenith Drive and Spring Gulch Road

Aircraft	Airline	Event Time	Aircraft	Ops	Rwy	Lmax	SEL	Graph Of SEL
	U	Jul 19, 12:17	GLF3	D	19	106.1	109.9	
	U	Jul 21, 14:32	GLF2	D	19	100.0	103.9	
	Delta Air Lines	Jul 18, 08:12	B752	D	19	98.1	102.6	
	Delta Air Lines	Jul 25, 08:15	B752	D	19	97.5	102.5	
	U	Jul 20, 10:47	FA50	D	19	97.3	101.8	
	U	Jul 20, 14:47	U	D	19	96.2	101.7	
	SWD	Jul 26, 07:38	F900	D	19	98.8	101.5	
	U	Jul 21, 08:41	U	D	01	97.5	101.4	
	Delta Air Lines	Jul 23, 08:18	B752	D	19	96.0	101.4	
	U	Jul 28, 15:16	F900	D	19	99.5	101.2	
	U	Jul 18, 10:04	G150	D	19	97.2	101.2	
	American	Jul 16, 07:59	A319	D	19	97.2	101.1	
	Delta Air Lines	Jul 26, 08:12	B752	D	19	95.6	100.8	
	United	Jul 16, 08:08	B737	D	19	97.4	100.8	
	United	Jul 23, 08:24	B737	D	19	97.3	100.7	
	LXJ	Jul 27, 11:25	GLF4	D	19	97.6	100.6	
	U	Jul 15, 17:12	C560	D	19	96.6	100.5	
	U	Jul 23, 11:59	U	D	19	93.3	100.3	
	U	Jul 21, 11:58	C560	D	19	94.2	100.3	
	U	Jul 27, 13:47	F900	D	19	96.7	100.3	
	U	Jul 15, 11:16	FA50	D	19	96.2	100.3	
	U	Jul 17, 07:52	GALX	D	19	98.3	100.2	
	Delta Air Lines	Jul 27, 13:18	A319	D	19	95.7	100.1	
	JEV	Jul 17, 07:58	C650	D	19	96.8	100.0	
	United	Jul 15, 12:11	A320	D	19	95.6	99.8	

Figure 4-9

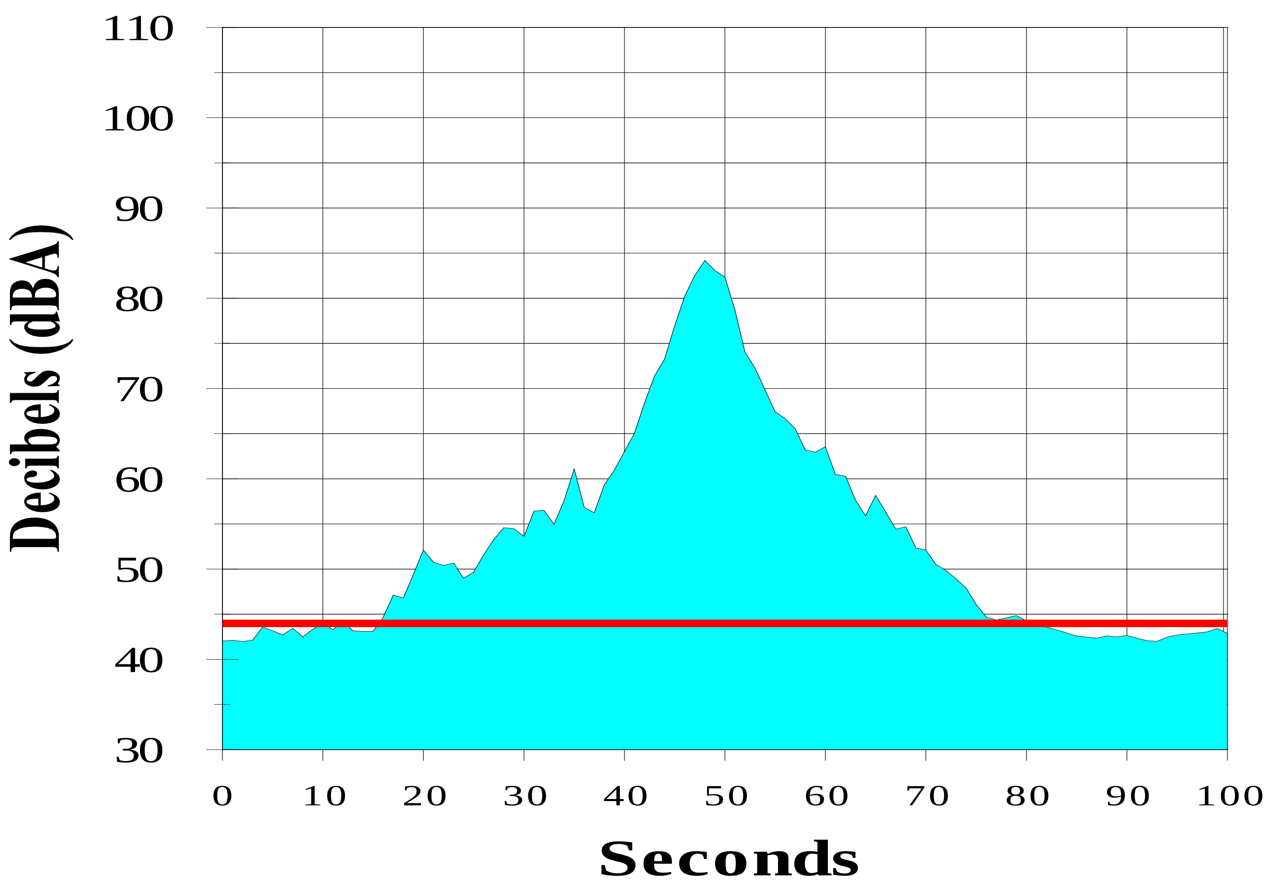
Noise Event Plot Report

Jackson Hole Airport 2017 Annual Report

Period: July 15, 2017 10:33:20

Site: Moose

Start time:	10:31:45	**Lmax time:**	10:32:23
SEL (dBA):	90.7	**Max (dBA):**	84.2
Duration (seconds):	76	**Start to peak (seconds):**	38
SEL threshold (dBA):	44		
Filght No:	UAL1536		
Aircraft Type:	A320	Airbus Industries A320	
Operation:	Arrival		
Runway:	19		
Destination:	KSFO	San Francisco Intl - CA - USA	



4.5 DNL Noise Measurement Results

Aircraft-related DNL levels were calculated for each of the six long-term noise monitoring locations. Table 4-2 presents the results of the DNL noise measurements at the six noise-monitoring locations. This table lists the average aircraft-related DNL for the Spring/Summer measurement survey monitored at each site (July 15, 2017 to July 28, 2017).

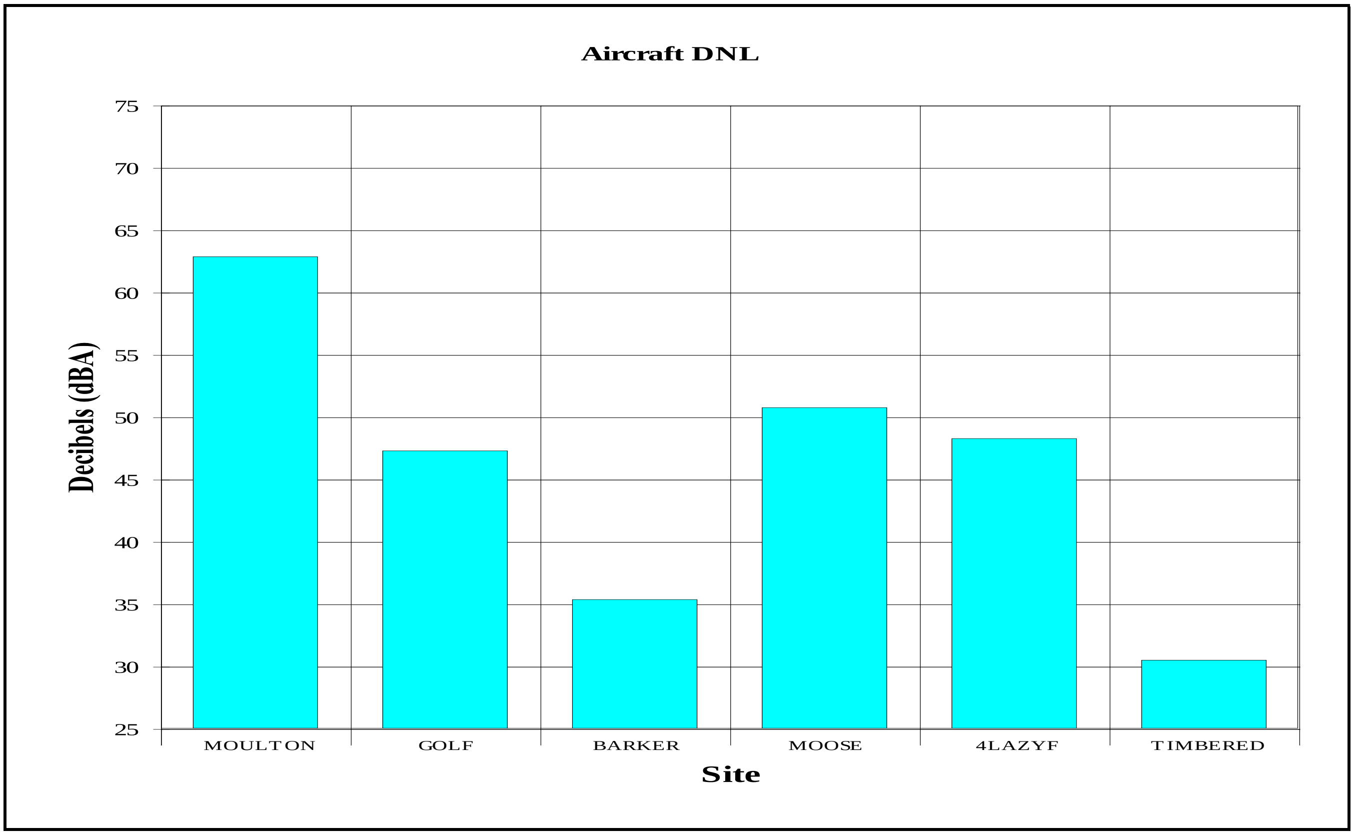
Figure 4-10 shows the same results of the DNL noise measurements at the noise-monitoring locations in a graphical format. The top portion of the graph shows the average DNL noise level measured at each noise monitoring location. The bottom portion of the graph shows the range of daily DNL values along with the overall DNL for the entire measurement period. The results show the average noise exposure level at each site stays fairly consistent, with the range of DNL values at any given site being less than 10 dB, which is a narrow range in noise levels experienced at each location. While the number of operations measured at each site varies with the distance from the airport, the peak DNL days were an average of only 3 to 4 dBA higher than the average day. At the Moulton Loop site, the noise levels are nearly all as a result of aircraft noise. At the park sites, where the aircraft noise levels are lower, other sources of noise were a significant contributor to the DNL level.

Figure 4-11 graphically presents the DNL noise level due to the aircraft events as well as the ambient environment for each day the noise level was monitored at the Moulton Loop site. This figure presents the day-to-day change in noise levels. The top portion of the exhibit shows the total DNL level at the site for the day as well as the contribution due to aircraft noise events. The bottom portion of the graphic shows the distribution of measured SEL noise levels during the measurement period. Additional figures presenting this information for the other noise measurement sites are presented in Appendix H.

Table 4-2
Aircraft DNL Noise Measurement Results
Jackson Hole Airport 2017 Annual Report

Site #	Name	Description	Aircraft DNL
1	Moulton Loop	Zenith Drive and Spring Gulch Rd.	63
2	Golf Course	Jackson Hole Golf & Tennis Club	47
3	Barkers Ranch	Circle H Ranch (Barker's Residence)	35
4	Moose	Moose Entrance	51
5	4 Lazy F Ranch	4 Lazy F Ranch	48
6	Timber Island	East of Timber Island	31

Figure 4-10
Aircraft DNL
Jackson Hole Airport 2017 Annual Report
Period: July 15, 2017 to July 28, 2017



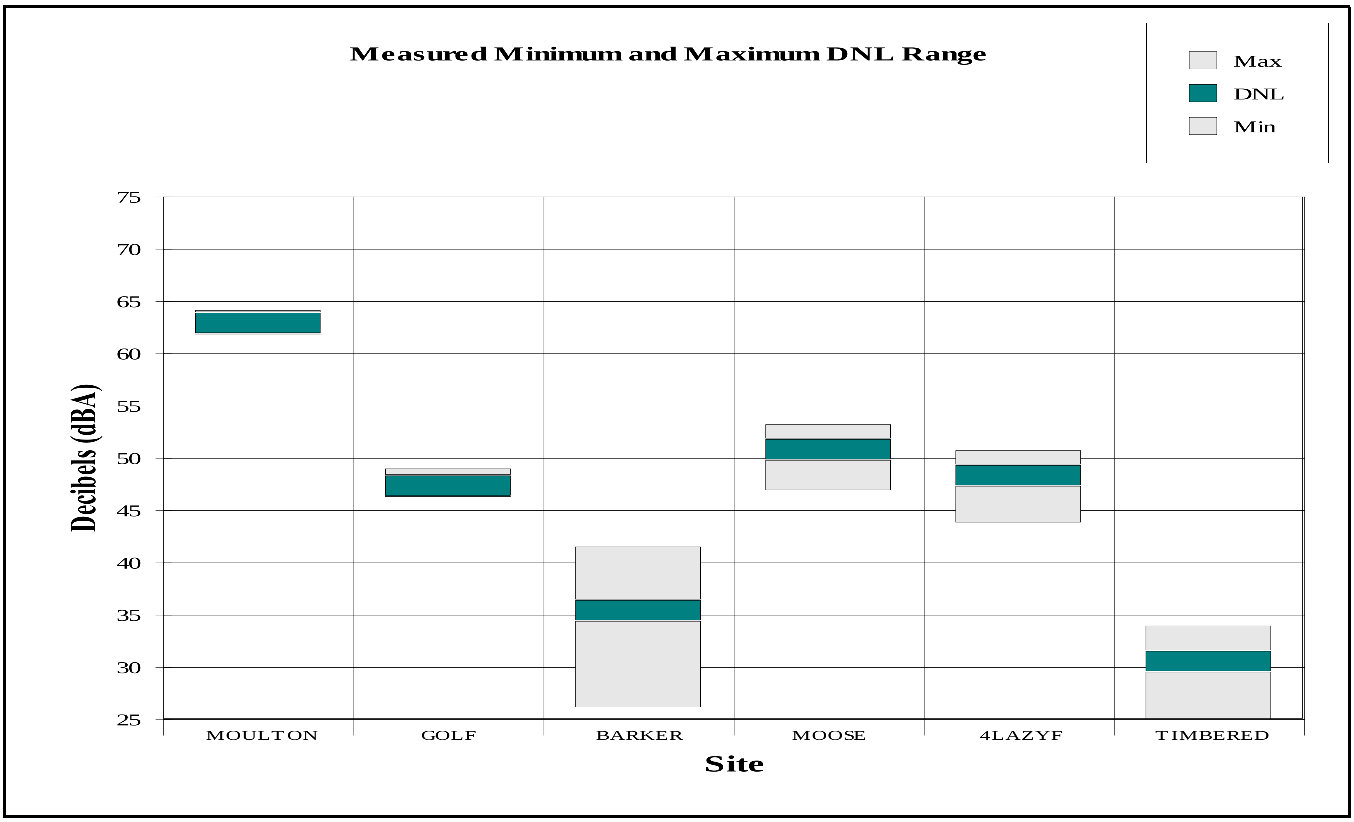


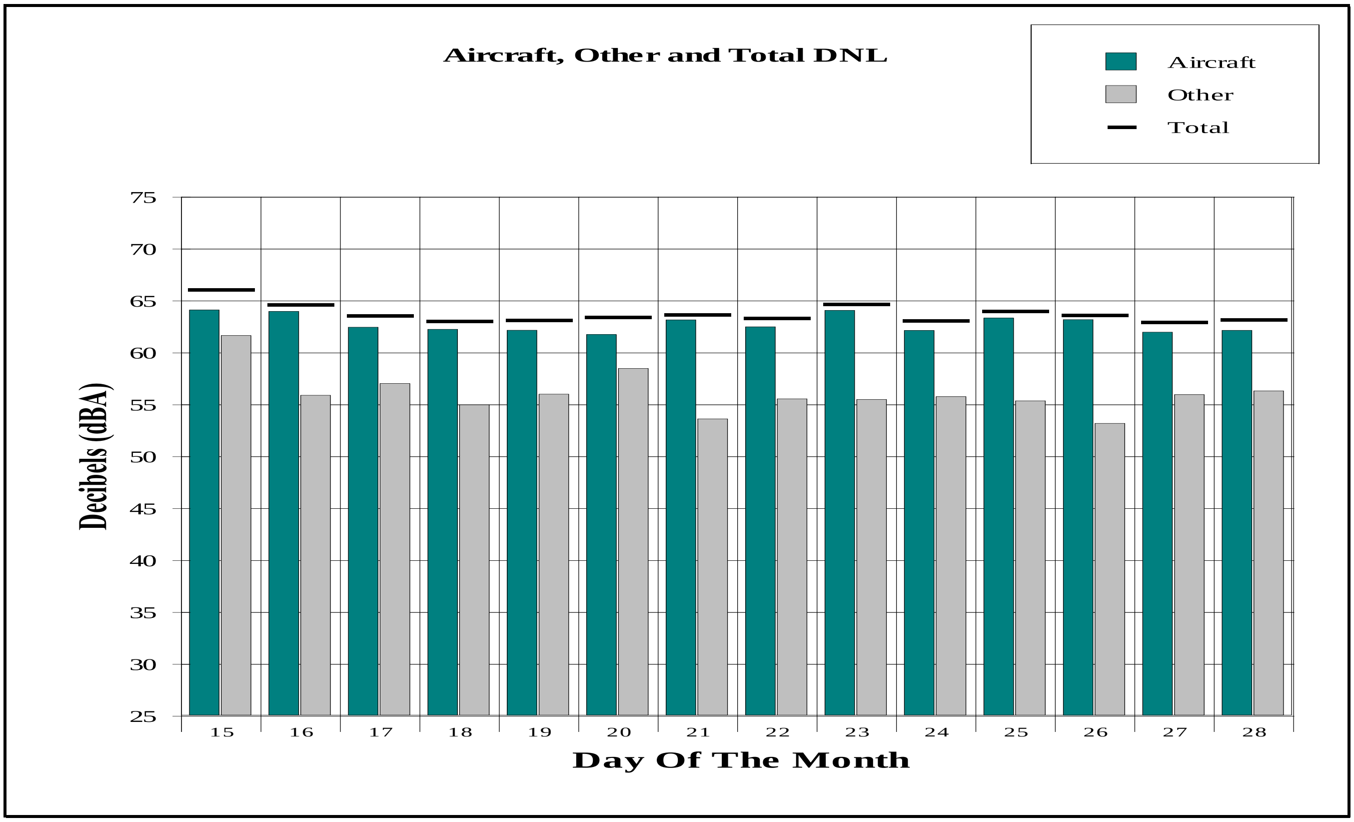
Figure 4-11

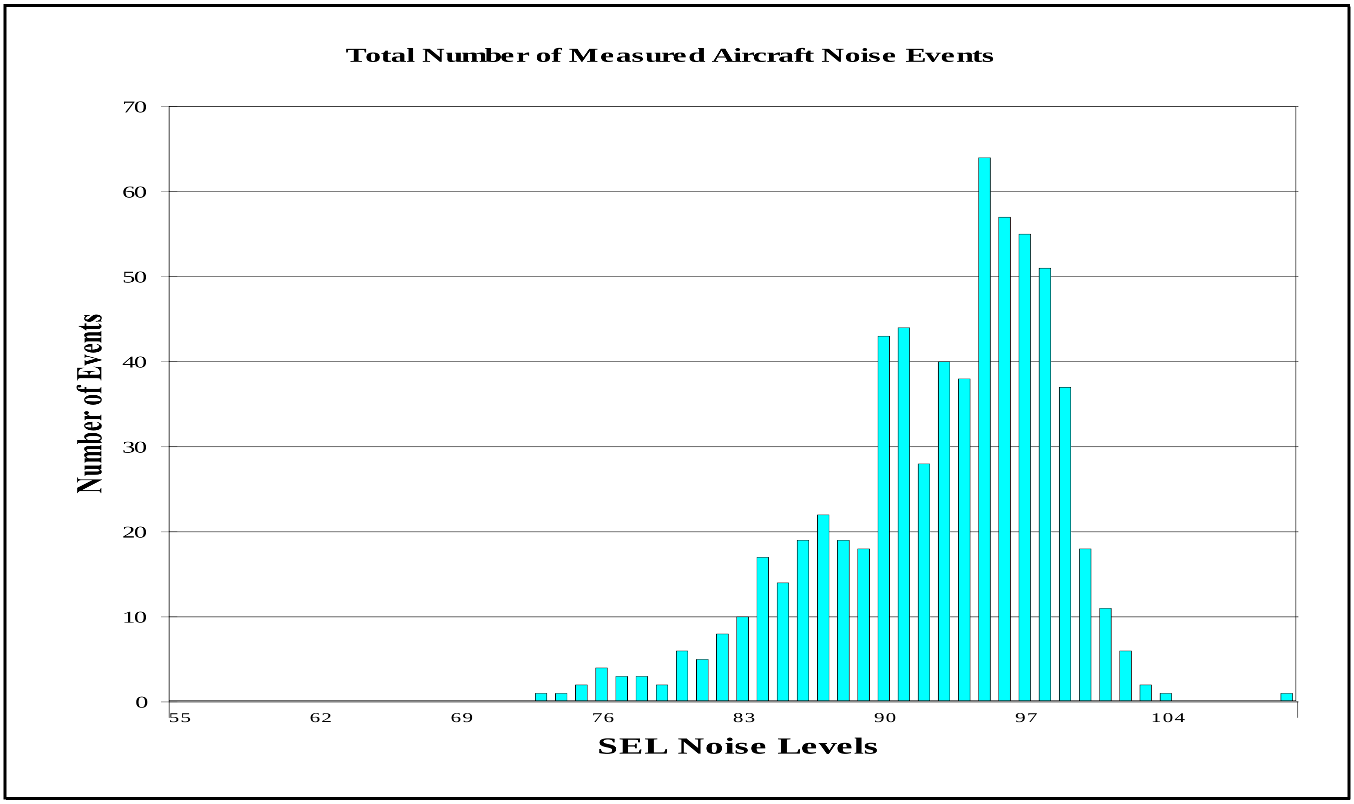
DNL Contribution and SEL Distribution Results

Jackson Hole Airport 2017 Annual Report

Period: July 15, 2017 to July 28, 2017

Site: Moulton Loop - Zenith Drive and Spring Gulch Road





4.6 Hourly LEQ Noise Measurement Results

Hourly average noise level values were calculated for each of the measurement locations. Hourly values include the aircraft LEQ, non-aircraft LEQ, and total LEQ. An example of the hourly aircraft LEQ and total LEQ noise data for the 4 Lazy F Ranch site is presented in Table 4-3. The total LEQ noise level includes all sources of noise, including aircraft, other man made, and natural sources. This table shows that the hourly LEQ noise level varies throughout the day. Tables listing the calculated hourly LEQ noise levels for the remaining sites during each hour of measurement are presented in Appendix I.

Table 4-3

Hourly Noise Level Site Report

Jackson Hole Airport 2017 Annual Report

Period: July 15, 2017 to July 28, 2017

Site: 4 Lazy F Ranch

Metric: Aircraft LEQ

DATE	Hour Of The Day 00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	DNL
Jul 15	0	0	0	0	0	0	0	49	46	49	54	52	53	46	50	46	49	47	50	37	0	0	0	0	47
Jul 16	0	0	0	0	0	0	48	46	58	48	53	51	53	51	51	51	50	51	50	50	50	0	0	0	51
Jul 17	0	0	0	0	0	0	0	48	41	51	49	52	52	48	47	48	0	0	0	0	0	0	0	0	45
Jul 18	0	0	0	0	0	0	0	0	45	48	49	48	52	47	39	49	45	40	51	44	55	50	0	0	47
Jul 19	0	0	0	0	0	0	47	54	56	50	48	47	51	41	51	34	0	0	0	0	0	0	0	0	48
Jul 20	0	0	0	0	0	0	0	56	55	50	50	48	53	52	53	53	48	43	0	0	0	0	0	0	49
Jul 21	0	0	0	0	0	42	48	45	44	44	49	48	53	51	51	49	40	51	48	48	49	50	39	0	49
Jul 22	0	0	0	0	0	0	0	47	43	47	54	51	54	45	51	50	49	46	49	50	50	0	0	0	48
Jul 23	0	0	0	0	0	0	0	0	44	49	51	51	54	54	56	51	47	45	50	51	50	47	0	0	49
Jul 24	38	0	0	0	0	0	0	51	40	48	50	0	0	47	44	45	45	47	38	34	0	0	0	0	44
Jul 25	0	0	0	0	0	0	0	45	50	49	50	47	53	49	49	0	0	0	0	0	0	0	0	0	45
Jul 26	0	0	0	0	0	0	0	0	46	49	52	52	53	51	51	51	47	50	49	52	42	52	0	0	48
Jul 27	0	0	0	0	0	0	0	60	55	47	50	53	54	49	53	51	50	46	49	51	51	0	0	0	51
Jul 28	0	0	0	0	0	0	0	56	55	52	51	52	52	48	54	51	49	49	50	55	35	50	0	0	50
Energy Average	27	0	0	0	0	31	41	52	52	49	51	50	53	49	51	49	47	47	48	48	48	46	28	0	48

Metric: Total LEQ

DATE	Hour Of The Day 00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	DNL
Jul 15	39	39	38	39	40	41	43	50	47	50	55	52	53	47	50	50	49	48	52	42	40	45	52	42	52
Jul 16	37	38	39	39	38	40	62	59	60	49	53	51	53	51	52	52	50	51	51	50	50	41	41	40	59
Jul 17	39	39	40	39	40	42	45	56	47	51	50	52	53	49	48	53	50	46	43	52	56	52	39	38	51
Jul 18	38	38	38	39	39	42	45	46	47	48	49	50	54	48	43	50	46	45	51	45	55	50	41	39	50
Jul 19	40	39	40	39	40	42	50	55	56	50	49	48	51	43	51	46	48	50	45	51	47	51	49	49	53
Jul 20	41	40	40	40	40	42	46	57	55	51	51	49	54	52	60	55	51	46	52	51	44	50	50	50	54
Jul 21	39	38	38	38	39	44	49	47	46	46	49	48	54	51	51	50	42	51	48	48	50	51	44	41	51
Jul 22	40	40	40	40	40	43	44	49	45	48	54	51	54	47	51	50	49	46	49	51	51	42	43	40	51
Jul 23	40	40	39	40	40	41	44	42	45	49	52	52	54	54	56	51	47	46	51	51	50	48	43	42	51
Jul 24	42	41	41	40	40	43	45	52	45	49	51	53	53	51	45	47	46	49	49	44	40	42	40	40	50
Jul 25	40	40	39	39	40	41	44	48	51	49	50	50	54	50	53	48	51	48	44	40	40	44	40	39	50
Jul 26	38	37	38	40	39	40	45	44	56	49	53	52	57	51	51	51	48	50	50	53	48	53	40	41	52
Jul 27	42	38	39	40	40	41	44	60	54	48	51	53	54	51	53	51	50	47	50	51	51	44	40	41	52
Jul 28	40	40	40	40	41	41	42	56	55	52	51	52	53	48	54	54	49	50	50	55	41	51	40	40	52
Energy Average	40	39	39	40	40	42	52	55	54	50	52	51	54	50	53	51	49	49	50	50	50	49	45	44	53

4.7 Summary of Spring/Summer Noise Measurements

The results of the annual noise measurements show that the airport is in compliance with the requirements of the airport Agreement. The measured noise levels are below the limits contained within the agreement. The requirements are that the annual DNL noise levels from aircraft noise at the Moose measurement location cannot exceed 55 DNL. The Barker site measurement cannot exceed 45 DNL. Aircraft noise levels within the park are calculated to be greater than 5 dBA below the levels specified within the airport Agreement with the Department of Interior.

4.8 Summary of Annual Noise Levels

The results of the annual 2017 DNL noise measurement results are presented in Figure 4-12 (includes both summer and winter measurement results). The results of these noise measurements were also compared with the measurement data from previous studies. Figure 4-12 presents the annual aircraft DNL noise levels from 1984 through 2017 for each of the measurement sites. (Note: the accuracy of the results diminishes at DNL levels below 40). The annual enplaned passengers for each of these years is also presented. Figure 4-13 presents the historical trend for passengers and noise environment since 2001.

The results show that the airport is in compliance with the Use Agreement restrictions with the Department of Interior. The annual aircraft DNL noise levels were measured to be 51 dBA and 35 dBA at the Moose and Barker sites respectively. This is significantly less than the 55 DNL limit at Moose and the 45 DNL limit at Barker that is contained in the use agreement restriction. The noise level at the Moulton Loop site was measured to be 61 DNL. This is less than the 65 DNL criteria used by the FAA as a guideline for the acceptability of residential land use.

Figure 4-12
2017 Annual DNL Noise Report
Jackson Hole Airport 2017 Annual Report
October 1st 2016 to September 30th 2017

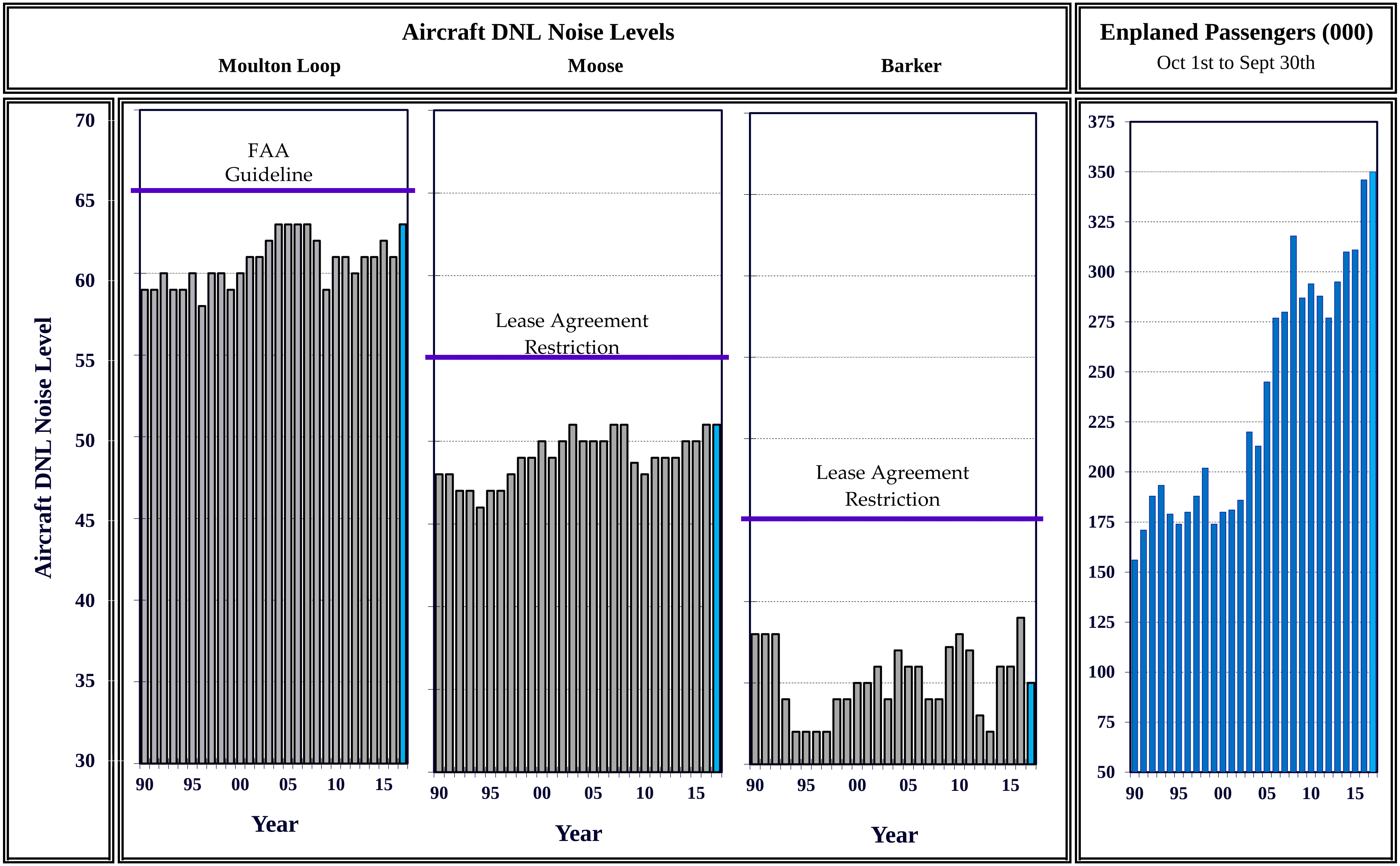
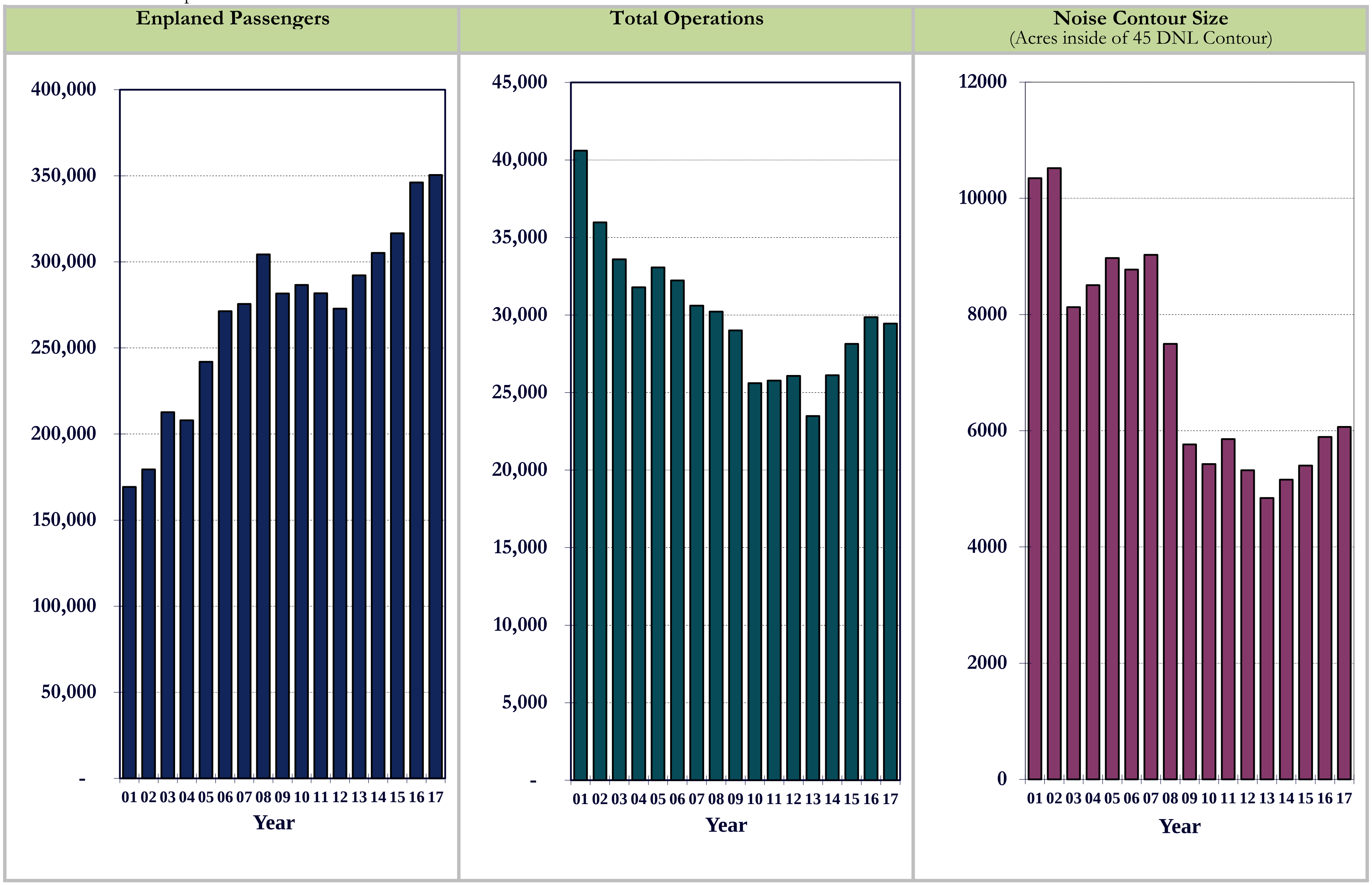


Figure 4-13
Historical Trend for Passengers, Operations and Noise Environment
Jackson Hole Airport 2017 Annual Report
October 1st 2016 to September 30th 2017



5.0 Computer Modeling

5.1 Introduction

Contour modeling is a very key element of this noise study. Generating accurate noise contours is largely dependent on the use of a reliable, validated, and updated noise model. It is imperative that these contours be accurate for the meaningful analysis of airport noise impacts. The computer model can then be used to predict the changes to the noise environment as a result of any of the development alternatives under consideration.

The FAA's Aviation Environmental Design Tool (AEDT) was used to model the flight operations at Jackson Hole Airport. The AEDT has an extensive database of civilian aircraft noise characteristics and this most recent version of AEDT incorporates the advanced plotting features that are part of the Air Force’s Noisemap computer model.

Airport noise contours were generated in this study using the FAA’s AEDT 2d. The latest version, Version 2d, was released for use on September 27, 2017 and is the state-of-the-art in airport noise modeling. The AEDT is a large computer program developed to plot noise contours for airports. The program is provided with standard aircraft noise and performance data for over 200 aircraft types that can be tailored to the characteristics of the airport in question. Version 2d includes updated databases that include some newer aircraft, the ability to include run-ups in the computations, the ability to include topography in the computations, and the provision to vary aircraft profiles in an automated fashion.

One of the most important factors in generating accurate noise contours is the collection of accurate operational data. The AEDT program requires the input of the physical and operational characteristics of the airport. Physical characteristics include runway coordinates, airport altitude, temperature and optionally, topographical data. 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 that are specific to the operations at the airport. Aircraft data needed to generate noise contours include:

- Number of aircraft operations by type
- Types of aircraft
- Day/Evening/Night time 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 Jackson Hole airport was analyzed based upon the 2015 analysis season (October 1, 2016 to September 30, 2017). The data was derived from various sources, which include aircraft tower counts and aircraft situation display (ASD) data. A variety of operational data is necessary in order 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 the period from October 1, 2016 through September 30, 2017 there were a total of 29,444 annual operations, or an average of 80.7 operations per day (an operation is one takeoff or one landing). The breakdown by aircraft category was determined from a variety of sources that include:

- Airport Radar
- Review of the aircraft based at Jackson Hole
- Operations Network (OPSNET)

The 2017 season aircraft operations for each category of operation are summarized in Table 5-1. These operations are categorized as general aviation, business jets air taxi, commuters, regional and commercial jets. The total number of annual corporate jet aircraft was determined from the airport radar data source. The airport radar provides information on aircraft that file an instrument flight plan. It accounts for nearly all larger aircraft including corporate jets. Larger twin-engine propeller aircraft are also counted in airport radar, but smaller aircraft flying under visual flight rules are not always included. The AEDT model was based upon a compilation of all 29,444 operations at the airport.

Table 5-1
SUMMARY OF OPERATIONS, (October 1, 2016 thru September 30, 2017)
Jackson Hole Airport 2017 Annual Report

Category Type	Annual Operations	Daily Operations	Percent Nighttime
Commercial Jet	5,426	14.9	1.1%
Regional Jet	2,634	7.2	3.2%
Small Commuter	0	0	0.0%
Air Taxi (TurboProp)	3,326	9.1	1.0%
General Aviation			
Business Jet	11,470	31.4	2.7%
Turbo Engine	1,272	3.5	1.3%
Piston Engine	4,737	13.0	0.7%
Helicopter	252	0.7	0.0%
Military	327	0.9	0.0%
Total Operations	**29,444**	**80.7**	**1.8%**

Fleet Mix. The fleet mix of aircraft that operate at the airport is one of the most important factors in terms of the aircraft noise environment. The corporate jet fleet mix data was determined from an extensive review of the airport radar database.

The airport has a restriction that bans Stage 2 corporate jet aircraft. Stage 2 refers to the FAA's Federal Aircraft Regulation Part 36 that categorizes jet aircraft based upon noise levels. Stage 2 refers to the older louder aircraft. Stage 3 refers to the newer generation quieter aircraft. For corporate jet aircraft the fleet was calculated to be 100% percent Stage 3.

Time of Day. 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 very critical in determining the DNL noise environment and is also very important to the residences around Jackson Hole Airport. The nighttime operations assumptions were estimated from a variety of sources. This included a review of the airport radar data. The nighttime operational assumption data are summarized in Table 5-1.

Runway Use. An additional important consideration in developing the noise contours is the percentage of time each runway is utilized. The speed and direction of the wind dictate the runway direction that is utilized by an aircraft. From a safety and stability standpoint, it is desirable, and usually necessary, to arrive and depart an aircraft into the wind. When the wind direction changes, the operations are shifted to the runway that favors the new wind direction.

For the Jackson Hole Airport, wind is generally calm with the predominate wind direction being from the south. Runway 19 is utilized more than the reverse runway direction, Runway 1. The airport also has a preferential runway use program to use Runway 19 when wind conditions permit. The runway utilization assumptions used in the study are presented in Tables 5-3 and 5-4. These tables present the percentage of operations by category utilizing each of the runways, for daytime and nighttime hours, respectively.

Table 5-2a

INM Case Summary Report

Jackson Hole Airport 2017 Annual Report

October 1, 2016 thru September 30, 2017

Operations Category	ICAO Type	ANP ID	ANP Description	Annual Operations
Commercial Jets	A319	A319-131	A319-131\IAE V2522-A5	3,564
	A320	A320-211	A320-211\CFM56-5A1	1,264
	B737	737700	BOEING 737-700/CFM56-7B24	370
	B752	757PW	BOEING 757-200/PW2037	182
	B752	757RR	BOEING 757-200/RB211-535E4	46
Regional Jets	CRJ7	CRJ9-ER	CL-600-2D15/CL-600-2D24/CF34-8C5	2,532
	E75L	EMB175	ERJ170-200	88
	E190	EMB190	ERJ190-100	14
Commuter Turboprop	DHC8	DHC830	DASH 8-300/PW123	0
Commercial Air Carrier Operations (Total)				**8,060**
Business Jets				
	GLEX	BD-700-1A10	BD-700-1A10\BR700-710A2-20	124
	GL5T	BD-700-1A11	BD-700-1A11\BR700-710A2-20	60
	C650	CIT3	CIT 3/TFE731-3-100S	104
	CL30, CL35, CL60	CL600	CL600/ALF502L	1,842
	C25A, C25B, C501, C525	CNA500	CIT 2/JT15D-4	772
	C510, E50P	CNA510	510 CITATION MUSTANG	212
	C25C, C52M	CNA525C	Cessna Model 525C CJ4	280
	C550, E55P	CNA55B	CESSNA 550 CITATION BRAVO / PW530A	946
	C560	CNA560E	Cessna Citation Encore 560 / PW535A	672
	C56X	CNA560XL	Cessna Citation Excel 560 / PW545A	924
	C680, C68A	CNA680	Cessna Model 680 Sovereign / PW306C	884
	C750, F2TH, FA50			
	GALX, HA4T, J328			
	LJ60, LJ75	CNA750	CITATION X / ROLLS ROYCE ALLISON AE3007C	1,574
	F900	COMJET	1985 BUSINESS JET	194
	EA50, HDJT	ECLIPSE500	Eclipse 500 / PW610F	88
	E135, E35L	EMB145	EMBRAER 145 ER/ALLISON AE3007	42
	FA20	FAL20	FALCON 20/CF700-2D-2	18
	GLF2	GII	GULFSTREAM GIIB/GIII - SPEY 511-8	6
	GLF3	GIIB	GULFSTREAM GIV-SP/TAY 611-8	6
	G280, GLF4, FA7X	GIV	GULFSTREAM GIV-SP/TAY 611-8	974
	GLF5, GLF6	GV	GULFSTREAM GV/BR 710	278
	ASTR, G150, WW24	IA1125	ASTRA 1125/TFE731-3A	178
	SBR1	LEAR25	LEAR 25/CJ610-8	18
	FA10, H25B, H25C, LJ31			
	LJ35, LJ40, LJ45, LJ55	LEAR35	LEAR 36/TFE731-2	992
	BE40, PRM1	MU3001	MU300-10/JT15D-5	282
Business Jets (Total)				**11,470**
Multi Engine Turbo	B190	1900D	BEECH 1900D / PT6A67	114
	C425, C441	CNA441	CONQUEST II/TPE331-8	52
	D328	DO328	Dornier 328-100 / PW119C	6
	AC90, AC95, B350, BE10			
	BE20, BE30, BE99, BE9L			
	BE9T, MU2, P180			
	SW3, SW4, TBM8	DHC6	DASH 6/PT6A-27	2,304
	E120	EMB120	EMBRAER 120 ER/ PRATT & WHITNEY PW118	522
	PAY1, PAY2, PAY3			
	PAY4, TBM8	PA42	Piper PA-42 / PT6A-41	276
	SF34	S340F	SF340B/CT7-9B	4
Twin Turbo (Total)				**3,278**
Single Engine Turbo	C208, PC12, TBM7	CNA208	Cessna 208 / PT6A-114	1,320
Single Turbo (Total)				**1,320**
			Sub Total	**24,128**

Table 5-2b

INM Case Summary Report

Jackson Hole Airport 2017 Annual Report

October 1, 2016 thru September 30, 2017

Contuned from Table 5-2a

Operations Category	ICAO Type	ANP ID	ANP Description		Annual Operations
Sub Totals from Table 5-2a					**24,128**
Multi Engine Piston	AC50, AC80, BE55, BE58				
	BE60, C310, C340, C421				
	PA23, PA34	BEC58P	BARON 58P/TS10-520-L		678
	PA30, PA31	PA30	PIPER TWIN COMANCHE PA-30 / IO-320-B1A		130
Twin Engine Piston (Total)					**808**
Single Engine Piston	BE17, C172,	CNA172	CESSNA 172R / LYCOMING IO-360-L2A		252
	C182	CNA182	CESSNA 182H / CONTINENTAL O-470-R		196
	C206	CNA206	CESSNA 206H / LYCOMING IO-540-AC		308
		COMSEP	1985 1-ENG COMP		
	C150, P28A, P46T	GASEPF	1985 1-ENG FP PROP		985
	AT5T, PA32, TBM7	GASEPV	1985 1-ENG VP PROP		476
Single Engine Piston (Total)					**2,217**
Touch and Goes	SR22	COMSEP	1985 1-ENG COMP		1,122
	AT5T, PA32, TBM7	GASEPV	1985 1-ENG VP PROP		440
	PA32	BEC58P	BARON 58P/TS10-520-L		150
Touch and Goes (Total)					**1,712**
Military		C130	C-130H/T56-A-15		25
		C21A	LEARJET 35 TFE731-2-2B	NM	180
		CNA208	CESSNA 208 / PT6A-114		92
		S76	SIKORSKY S-76 SPIRIT		30
Military (Total)					**327**
Helicopter		B206L	Bell 206L Long Ranger		22
		EC130	Eurocopter EC-130 w/Arriel 2B1		152
		SA365N	Aerospatiale SA-365N Dauphin (AS-365N)		48
		R44	Robinson R44 Raven / Lycoming O-540-F1B5		30
Helicopter (Total)					**252**
			Grand Totals		**29,444**

Table 5-3
DAYTIME RUNWAY UTILIZATION *(7 a.m. to 10 p.m.)*

Category Type	**Percentage Utilization Rwy 19**	**Rwy 01**
Arrivals		
General Aviation		
Single Engine	88%	12%
Multi-Engine	83%	17%
Business Jet	89%	11%
Air Taxi	86%	14%
Small Commuter		
Regional Jet	83%	17%
Commercial Jet	86%	14%
Military	90%	10%
Departures		
General Aviation		
Single Engine	84%	16%
Multi-Engine	85%	15%
Business Jet	89%	11%
Air Taxi	85%	15%
Small Commuter		
Regional Jet	87%	13%
Commercial Jet	89%	11%
Military	90%	10%

Table 5-4
NIGHTTIME RUNWAY UTILIZATION *(10 p.m. to 7 a.m.)*

Category Type	**Percentage Utilization Rwy 19**	**Rwy 01**
Arrivals		
General Aviation		
Single Engine	85%	15%
Multi-Engine	85%	15%
Business Jet	83%	17%
Air Taxi	85%	15%
Small Commuter	0%	0%
Regional Jet	29%	71%
Commercial Jet	67%	33%
Military	0%	0%
Departures		
General Aviation		
Single Engine	85%	15%
Multi-Engine	85%	15%
Business Jet	63%	37%
Air Taxi	85%	15%
Small Commuter	0%	0%
Regional Jet	73%	27%
Commercial Jet	85%	15%
Military	0%	0%

Flight Path Utilization. The Airport Board has established paths for aircraft arriving and departing Jackson Hole Airport. 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 Jackson Hole Airport. Aircraft flight tracks were obtained by observations during the measurement survey, discussions with airport staff and air traffic control personnel, and a review of aeronautical charts.

A sample of the 2017 flight tracks use in AEDT modeling are presented in Figure 5-1 and 5-2. Figure 5-1 presents departure and arrival flight paths for Runway 19. Figure 5-2 presents departure and arrival flight paths for 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
Flight Tracks for South Flow
Jackson Hole Airport 2017 Annual Report
1,000 Arrival and Departure Tracks for Runway 19
Legends: Arrivals Departures

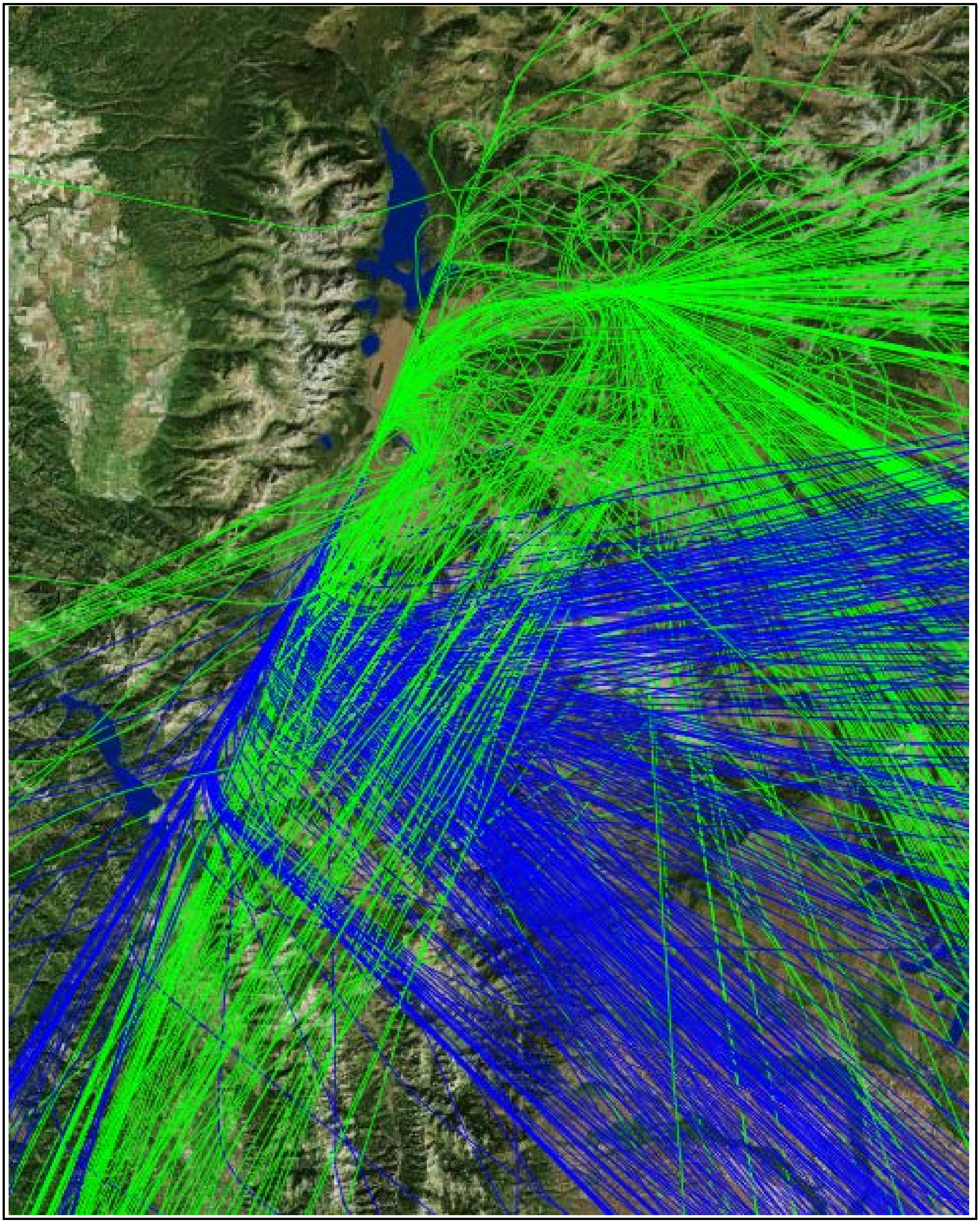
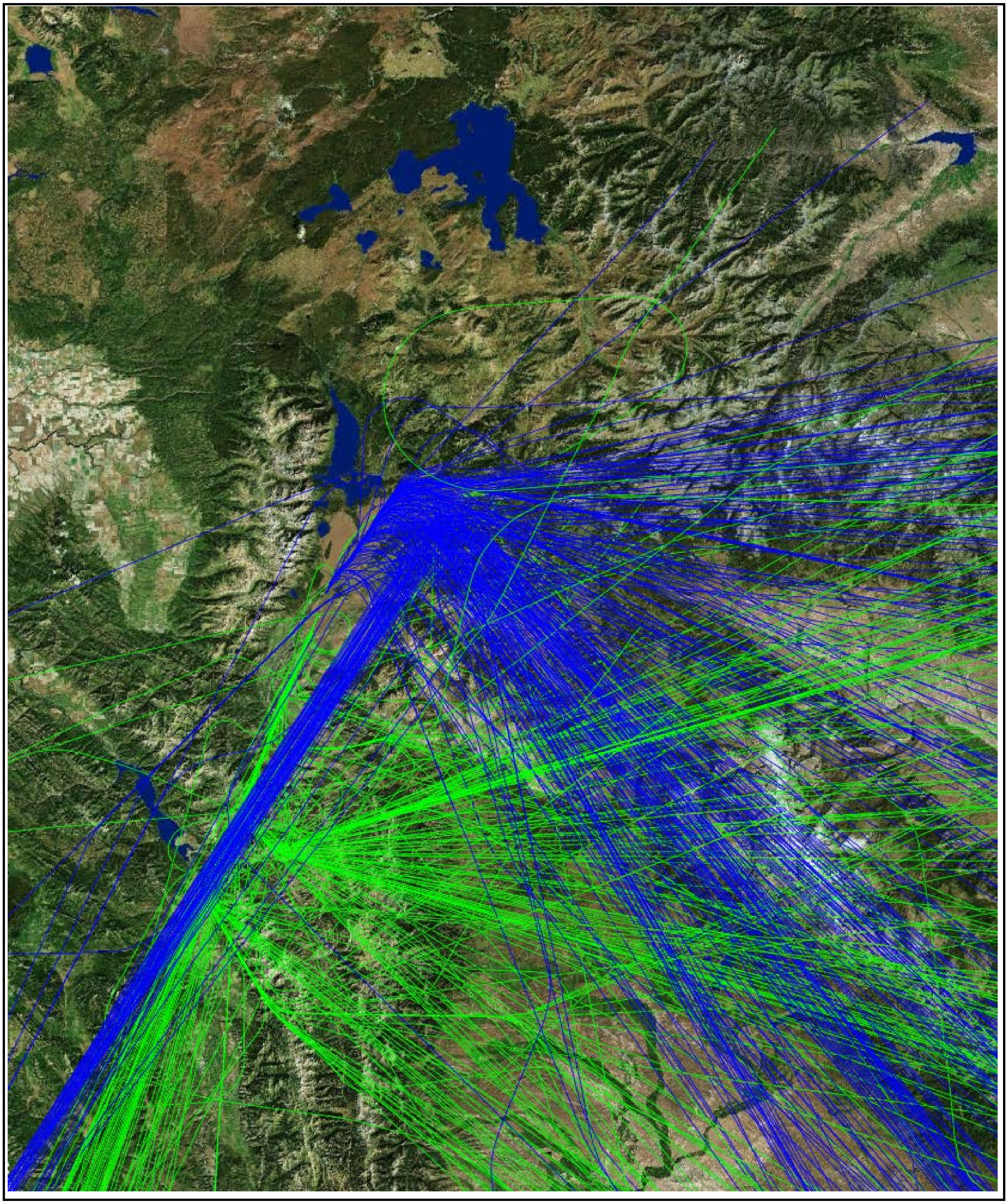


Figure 5-2
Flight Tracks for North Flow
Jackson Hole Airport 2017 Annual Report

Arrival and Departure Tracks for Runway 01

Legends: Arrivals Departures



5.4 AEDT Modeling Results

Noise metric used. The noise metric used to assess the 2017 annual noise contour is the Day Night Noise Level (DNL). The DNL index 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 time-weighted refers to the fact that noise that occurs during certain sensitive time periods is penalized for occurring at these times. In the DNL scale, noise occurring between the hours of 10 p.m. to 7 a.m. is penalized by 10 dB. This penalty was selected to attempt to account for the higher sensitivity to noise in the nighttime and the expected decrease in background noise levels that typically occurs in the nighttime. The AEDT contours are presented in Figure 5-3.

6.0 Summary

6.0 Summary

The principal reason for the reduction in noise that has occurred at the airport since 1984 is the increased utilization of new generation Stage III, IV and now V aircraft that are substantially quieter than the aircraft that predominantly served the airport in the past. The results of the noise measurements show that the airport is in compliance with the requirements of the Airport Use Agreement. The measured noise levels are below the limits contained within the agreement. The requirements are that the annual DNL noise levels from aircraft noise at the Moose measurement location cannot exceed 55 DNL and at the Barker site cannot exceed 45 DNL. Aircraft noise levels within the park are calculated to be greater than 5 dBA below the levels specified within the Airport use agreement with the Department of Interior. The 65 DNL noise contours do not extend beyond the airport boundary. There are no residential land uses exposed to noise levels in excess of 65 DNL. The location of the new permanent Moulton Loop monitoring site is located closer to the airport than the temporary site used in the past. This is reflected in a 0.4 dBA increase reading at Moulton Loop.