Jackson Hole Airport

2015 Annual Noise Report

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1.0 Introduction

The purpose of this report is to present the final results from the 2015 noise measurement survey at Jackson Hole Airport. This report also includes data from the Fall 2014 – Winter 2015 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 2015. 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.

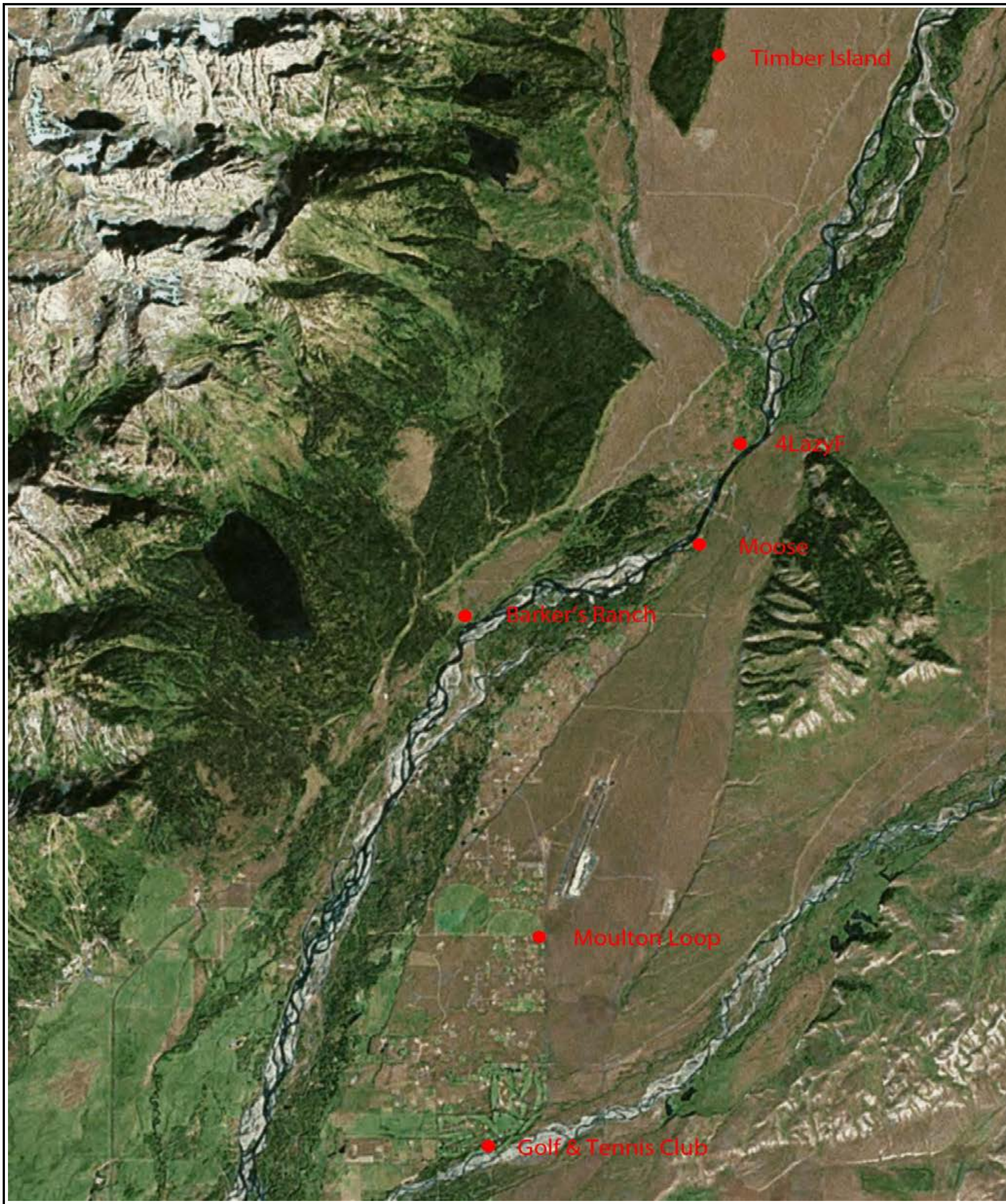
From 1984 to 2003, noise monitors were stationed at the same three sites for each measurement period. Each site is monitored for approximately one week during both the winter and summer season. The three sites that were monitored during this survey are Moulton Loop, the Village of Moose, and Barker Ranch. In 2003, Jackson Hole Airport installed six (6) permanent noise monitors located in the Grand Teton National Park that collect data continuously year round. 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	-110.747130	43.591520
2	Golf Course	Jackson Hole Golf & Tennis Club	-110.753640	43.562150
3	Barker Ranch	Circle H Ranch (Barker's Residence)	-110.758650	43.638030
4	Moose	Moose Entrance	-110.716280	43.648470
5	4 Lazy F Ranch	4 Lazy F Ranch	-110.709010	43.662930
6	Timber Island	East of Timber Island	-110.713490	43.718484

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 2015 Annual Report
Noise Measurement Location Sites: ●



2.0 Background and Information on Noise

2.1 Background

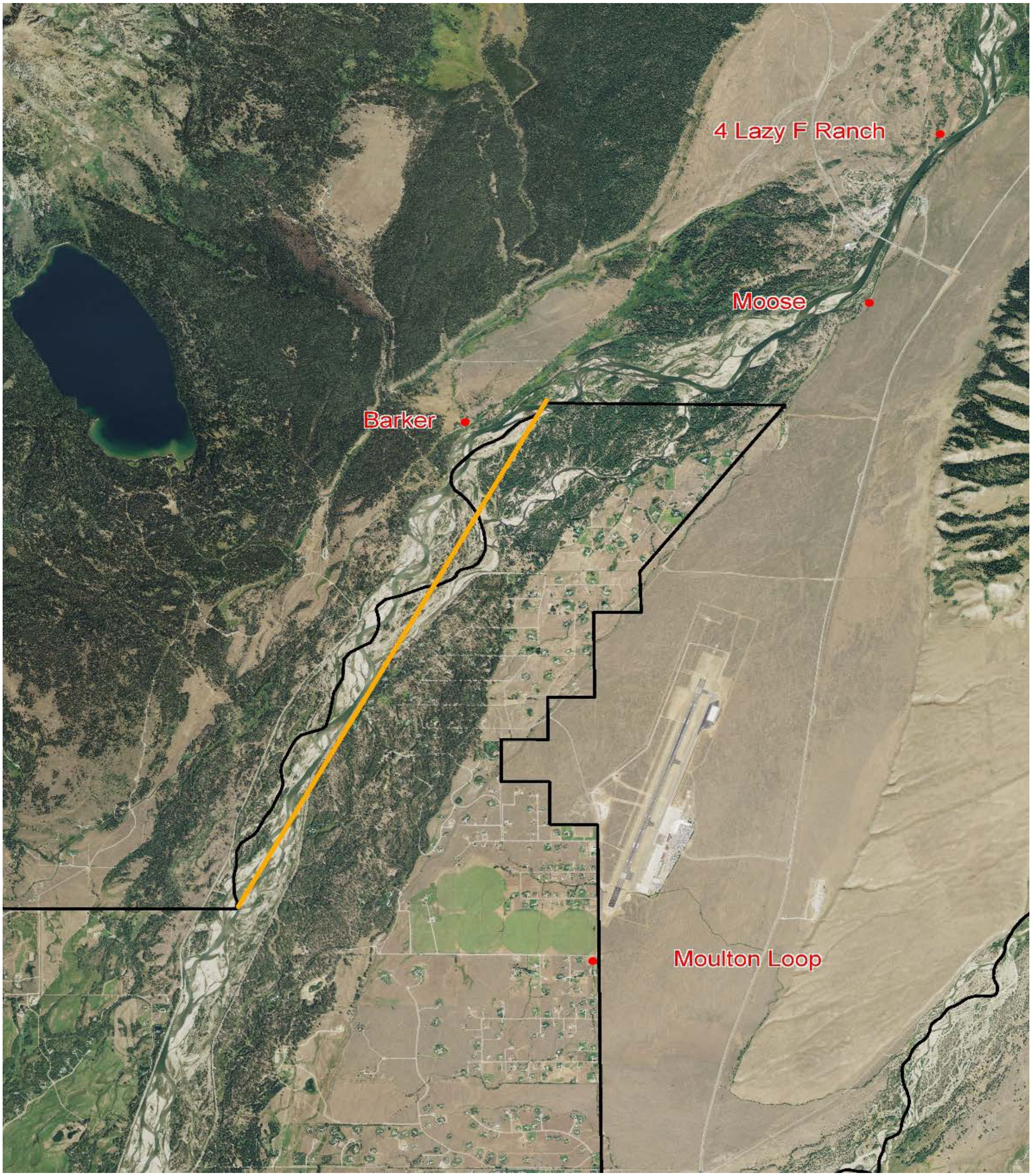
Jackson Hole Airport is the only commercial airport in the country that is located within a system area that is designated a National Park. Subsequently, it has had a long history of controversy concerning its operation and development. As a result of this, the airport operates under a number of special 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 2015 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 Integrated Noise Model (INM) 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 2014 - 2015 aircraft operations were derived directly from the airport summary of daily logs. The 2014 - 2015 analysis season is presented for the operations between October 1, 2014 and September 30, 2015. The total number of operations during the twelve month period was 28,937 or 79.3 average daily operations. An operation is either 1 departure or 1 arrival. This included an average of 11.8 commercial jet operations per day, 7.9 regional jet operations per day and 29.2 corporate jet operations per day. The fall 2014 – summer 2015 operations are presented in Table 3-1. Comparison of Average Daily Operations for Seasons 2014 and 2015 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 2014 - 2015 season, there were 310,702 enplaned passengers.

Table 3-1
Aircraft Operational Summary
Jackson Hole Airport 2015 Annual Noise Report
October 1, 2014 - September 30, 2015

Monthly Operations By:		Fall			Winter			Spring			Summer			Totals	Average Daily Operations		
Aircraft	**Airlines**	*Oct*	*Nov*	*Dec*	*Jan*	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*		*Fall/Winter*	*Spring/Summer*	*Annual*
Commercial Jets																	
A319	American			32	72	60	68	12		116	132	134	114	**740**	1.3	2.8	2.0
	Delta	62	2	66	84	98	138	22	4	172	210	226	172	**1,256**	2.5	4.4	3.4
	United	40	2	40	14	30	56	16	90	72	92	124	126	**702**	1.0	2.9	1.9
A320	*United*	60	4	30	98	120	138	22	16	68	90	48	32	**726**	2.5	1.5	2.0
B737/8/9	*Delta*					12	36							**48**	0.3		0.1
	United							2		114	106	84	10	**316**		1.7	0.9
B757-200	*American*	6												**6**	0.0		0.0
	Delta			34	22	16	20		4	42	66	60	8	**272**	0.5	1.0	0.7
	United			62	38	18	24				44	30	36	**252**	0.8	0.6	0.7
Regional Jets																	
CRJ7	*SkyWest*	144	252	354	372	276	260	242	240	90	218	252	168	**2,868**	9.1	6.6	7.9
E135	*Misc*					4	2		2	6	2	10		**26**	0.0	0.1	0.1
Commuter																	
DH8B	*Republic*				2		8	28	12	14	36	22	4	**126**	0.1	0.6	0.3
Air Taxi Turbo Props																	
BE19	*Ameriflight*	48	48	62	44	42	46	48	44	46	48	42	42	**560**	1.6	1.5	1.5
BE99	*Ameriflight*	54	52	54	46	46	54	54	50	46	52	40	46	**594**	1.7	1.6	1.6
SW4	*Ameriflight*	6		6	2	4		2		4	6	4	4	**38**	0.1	0.1	0.1
Other	*Misc*	282	76	114	176	156	194	149	197	276	444	522	382	**2,967**	5.5	10.8	8.1
General Aviation																	
Corporate Jet		635	486	987	942	673	808	310	498	926	1,308	1,825	1,254	**10,652**	24.8	33.6	29.2
GA Other		905	360	407	444	593	599	320	329	638	699	654	502	**6,449**	18.1	17.3	17.7
Military																	
C-21		8	2	18	11	13	52	30	22	45	43	54	40	**338**	0.6	1.3	0.9
	TOTAL	2,250	1,284	2,266	2,367	2,161	2,503	1,256	1,507	2,675	3,596	4,131	2,940	28,937	70.1	88.5	79.3
Enplaned Passengers		14,823	7,249	17,053	27,620	27,922	30,572	8,929	12,294	32,961	47,053	51,413	32,813	310,702	Passengers 684	Passengers 1019	Passengers 851

Average Daily Operations

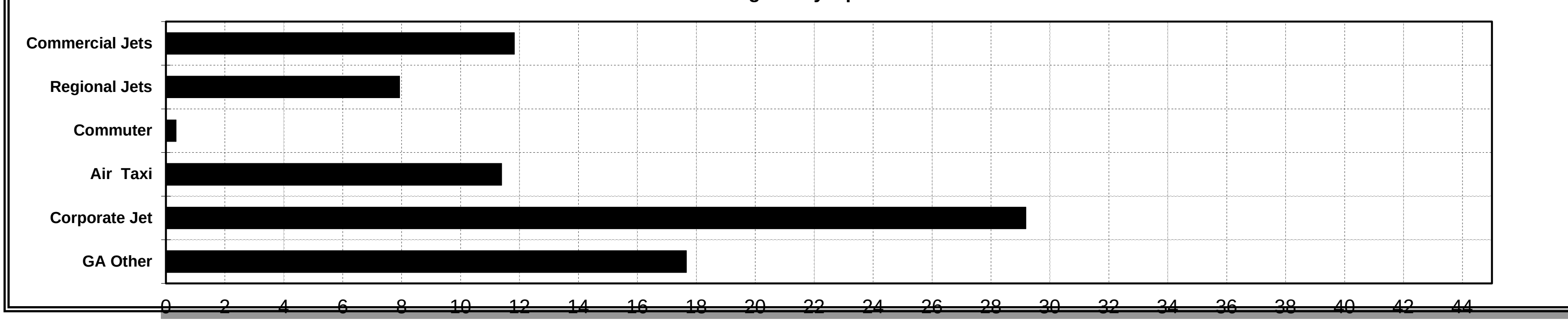


Table 3-2
Comparison of Average Daily Operations for Seasons 2014 and 2015 using OPSNET Data
Jackson Hole Airport 2015 Annual Noise Report

Date	IFR Itinerant Air Carrier	IFR Itinerant Air Taxi	IFR Itinerant General Aviation	IFR Itinerant Military	IFR Itinerant Total	VFR Itinerant Air Carrier	VFR Itinerant Air Taxi	VFR Itinerant General Aviation	VFR Itinerant Military	VFR Itinerant Total	Local Civil	Local Military	Local Total	Total Operations
Oct-2013	304	362	457	0	1,123	0	27	309	4	340	36	0	36	1,499
Nov-2013	235	275	284	8	802	0	30	199	18	247	62	4	66	1,115
Dec-2013	472	594	532	8	1,606	0	19	143	10	172	8	0	8	1,786
Jan-2014	640	545	581	10	1,776	3	36	198	3	240	14	0	14	2,030
Feb-2014	639	500	480	5	1,624	2	10	55	3	70	0	0	0	1,694
Mar-2014	679	565	436	0	1,680	1	28	163	7	199	12	0	12	1,891
Apr-2014	240	237	227	7	711	0	49	139	19	207	30	0	30	948
May-2014	376	262	315	8	961	0	45	251	24	320	110	0	110	1,391
Jun-2014	601	520	525	3	1,649	1	43	433	16	493	82	0	82	2,224
Jul-2014	969	697	819	9	2,494	2	21	875	3	901	62	0	62	3,457
Aug-2014	1,047	1,028	835	9	2,919	3	22	913	7	945	111	0	111	3,975
Sep-2014	638	742	554	4	1,938	2	32	657	5	696	73	0	73	2,707
Total	6,840	6,327	6,045	71	19,283	14	362	4,335	119	4,830	600	4	604	24,717

Date	IFR Itinerant Air Carrier	IFR Itinerant Air Taxi	IFR Itinerant General Aviation	IFR Itinerant Military	IFR Itinerant Total	VFR Itinerant Air Carrier	VFR Itinerant Air Taxi	VFR Itinerant General Aviation	VFR Itinerant Military	VFR Itinerant Total	Local Civil	Local Military	Local Total	Total Operations
Oct-2014	305	459	353	2	1,119	0	51	568	6	625	506	0	506	2,250
Nov-2014	239	358	281	0	878	0	21	219	0	240	164	2	166	1,284
Dec-2014	624	776	505	5	1,910	2	25	170	9	206	146	4	150	2,266
Jan-2015	694	686	551	5	1,936	0	47	178	6	231	28	0	28	2,195
Feb-2015	629	637	515	6	1,787	1	61	271	1	334	34	6	40	2,161
Mar-2015	744	614	456	12	1,826	6	95	390	28	519	144	12	156	2,501
Apr-2015	360	284	217	7	868	0	60	179	9	248	42	14	56	1,172
May-2015	368	397	333	8	1,106	0	58	218	10	286	200	4	204	1,596
Jun-2015	653	563	516	21	1,753	0	76	660	22	758	380	2	382	2,893
Jul-2015	966	957	775	22	2,720	3	118	769	21	911	266	0	266	3,897
Aug-2015	973	1,114	668	8	2,763	0	96	687	32	815	116	14	130	3,708
Sep-2015	643	816	610	12	2,081	2	70	574	20	666	259	8	267	3,014
Total	7,198	7,661	5,780	108	20,747	14	778	4,883	164	5,839	2,285	66	2,351	28,937

Percentage Change in Operations from 2014 to 2015

	IFR Air Carrier	IFR Air Taxi	IFR General Aviation	IFR Military	IFR Total	VFR Air Carrier	VFR Air Taxi	VFR General Aviation	VFR Military	VFR Total	Local Civil	Local Military	Local Total	Total Operations
% Change	5.2%	21.1%	-4.4%	52.1%	7.6%	0.0%	114.9%	12.6%	37.8%	20.9%	280.8%	1550.0%	289.2%	17.1%

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 of 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 2015 season as well as the 2014 - 2015 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 August 26, 2015 and September 9, 2015.

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

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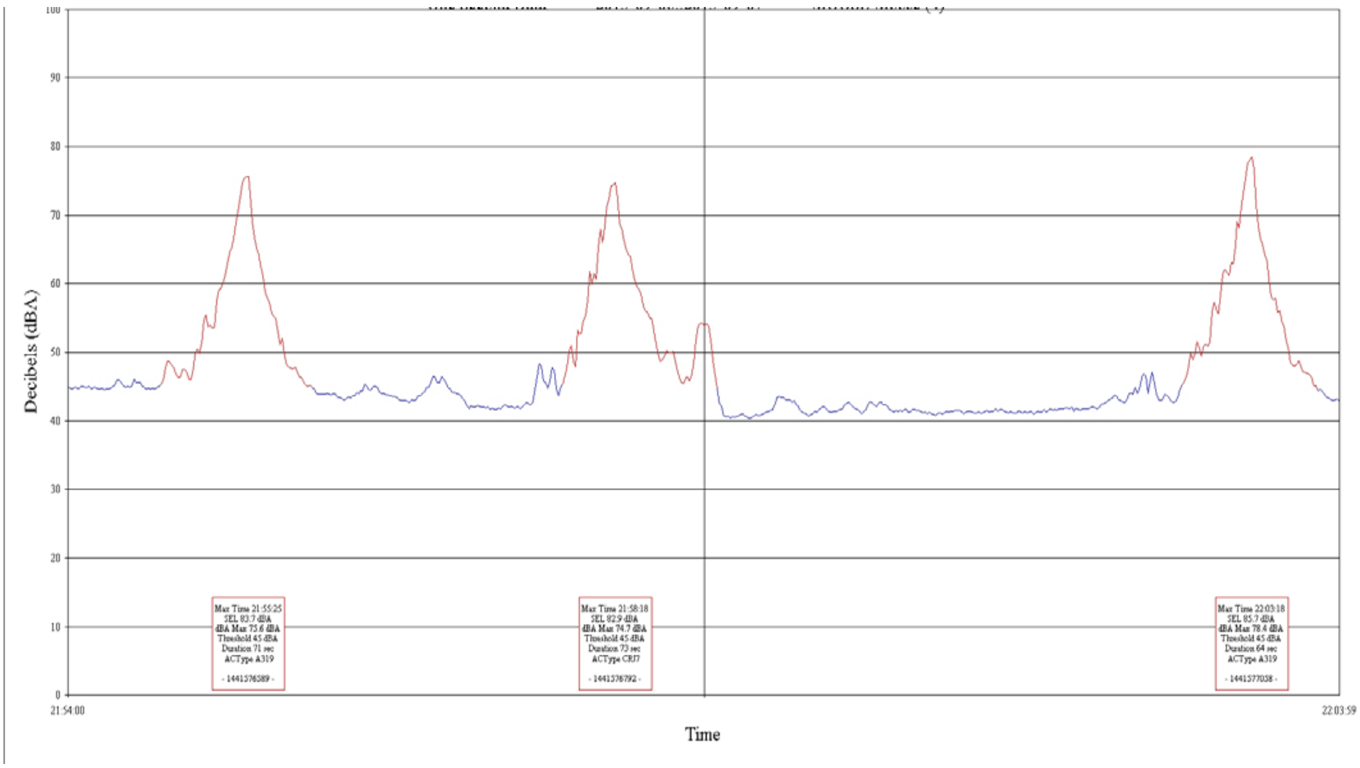
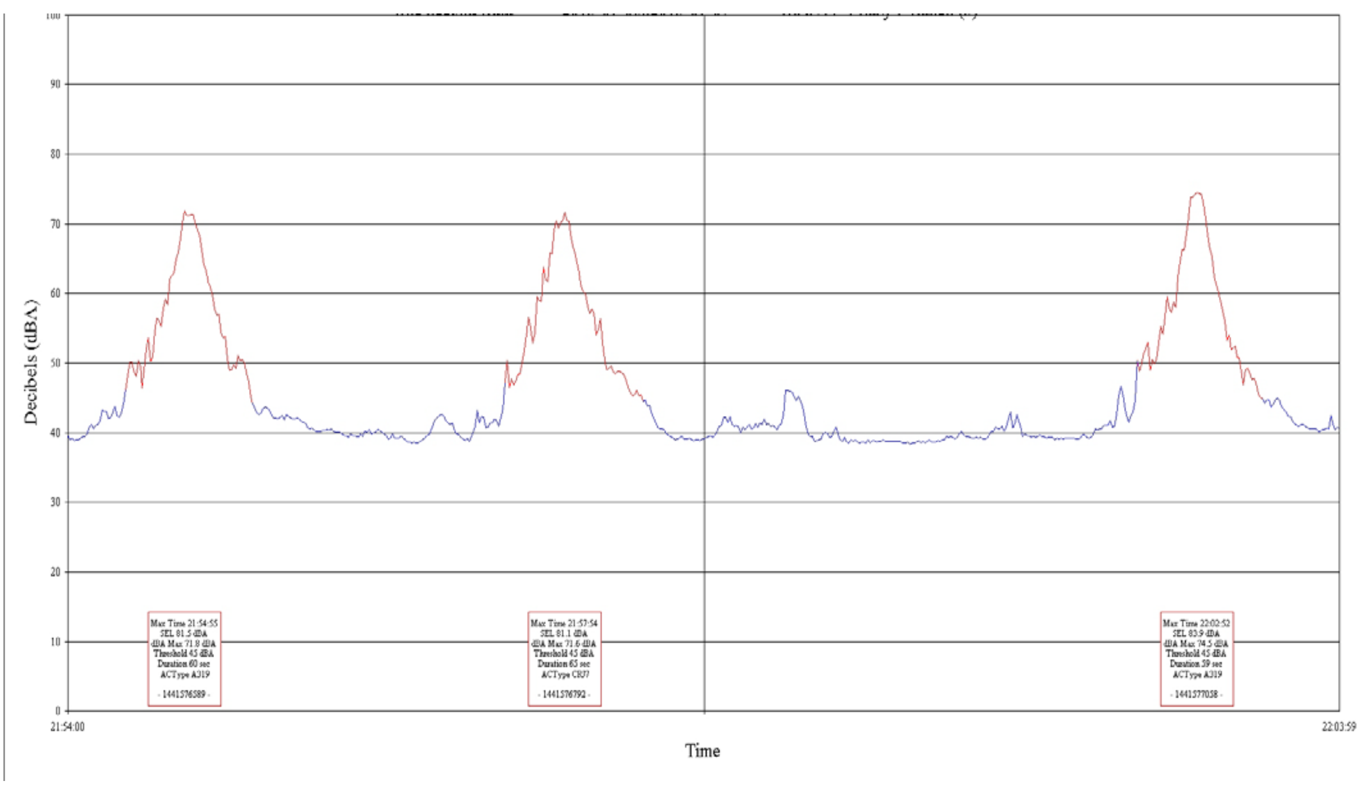
Period: September 06, 2015 21:54:00 to September 06, 2015 22:03:59

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 2015 Annual Report
Period: August 27, 2015 and September 9, 2015

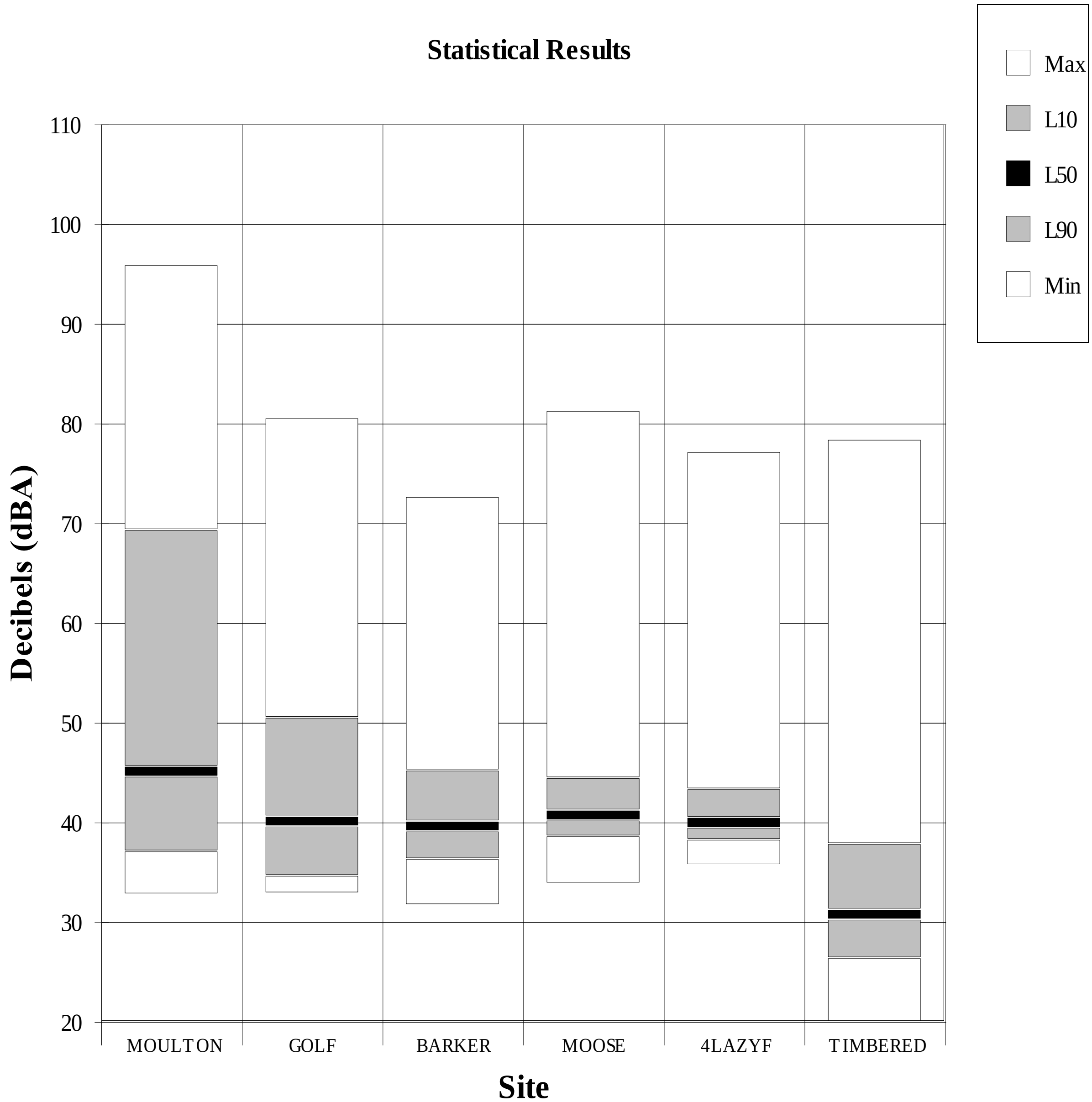


Table 4-1
Ambient Noise Measurement Results
Jackson Hole Airport 2015 Annual Report

Site#	Name	Description	Statistical Noise Levels (dBA)				
			LMax	L10	L50	L90	LMin
1	Moulton Loop	Zenith Drive and Spring Gulch	96	69	45	37	33
2	Golf Course	Jackson Hole Golf & Tennis	81	50	40	35	33
3	Barker Ranch	Circle H Ranch	73	45	40	36	32
4	Moose	Moose Entrance	81	44	41	39	34
5	4 Lazy F Ranch	4 Lazy F Ranch	77	43	40	38	36
6	Timber Island	East of Timber Island	78	38	31	26	19

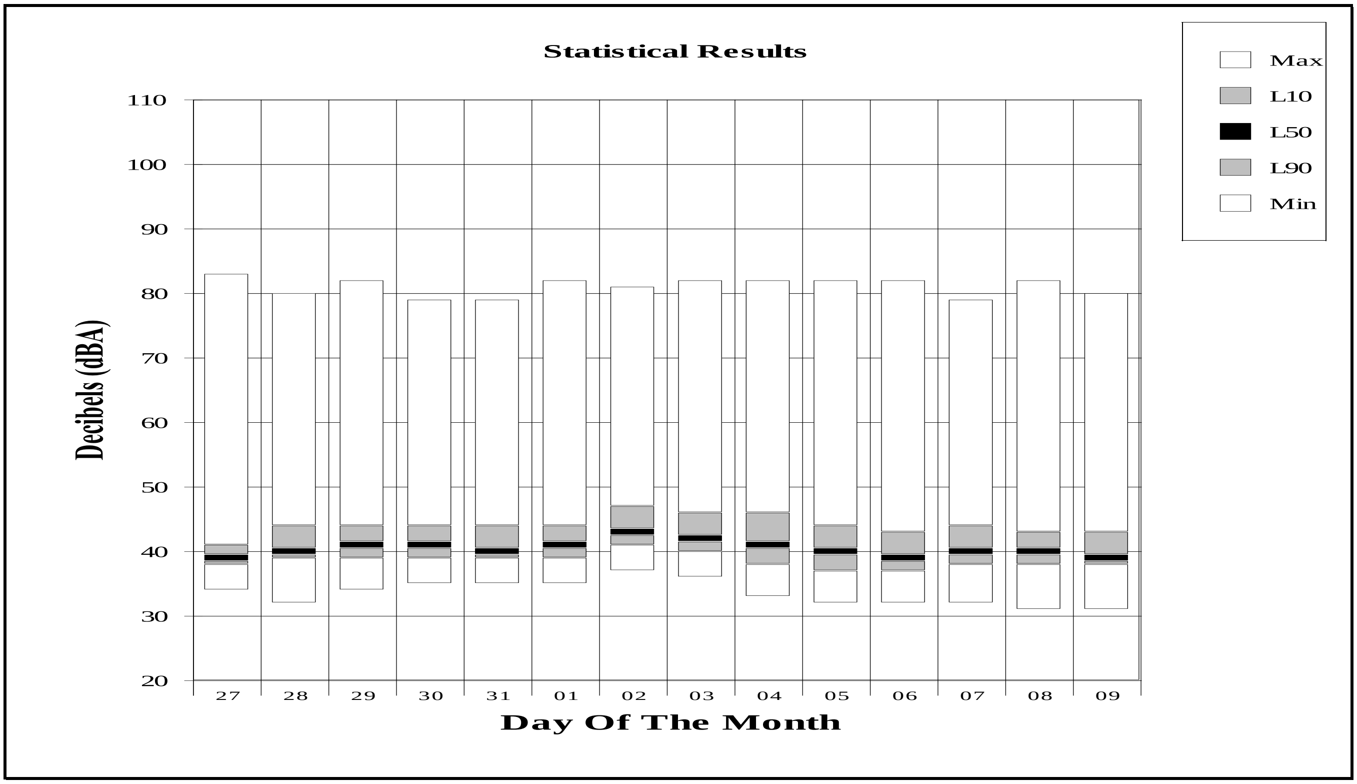
Industry practices indicate that L90 is a good representation of the background noise level and L50 the ambient noise level. These represent the levels that are exceeded 90 percent of the time and 50 percent of the time, respectively. The L90 is referred to as the residual noise, when other sources of 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 19 dBA to a high of the mid 30s dBA. Most sites had an average L90 noise level right around the low 30s dBA. The ambient L50 noise levels ranged from the mid 20s dBA to the high 30s 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.

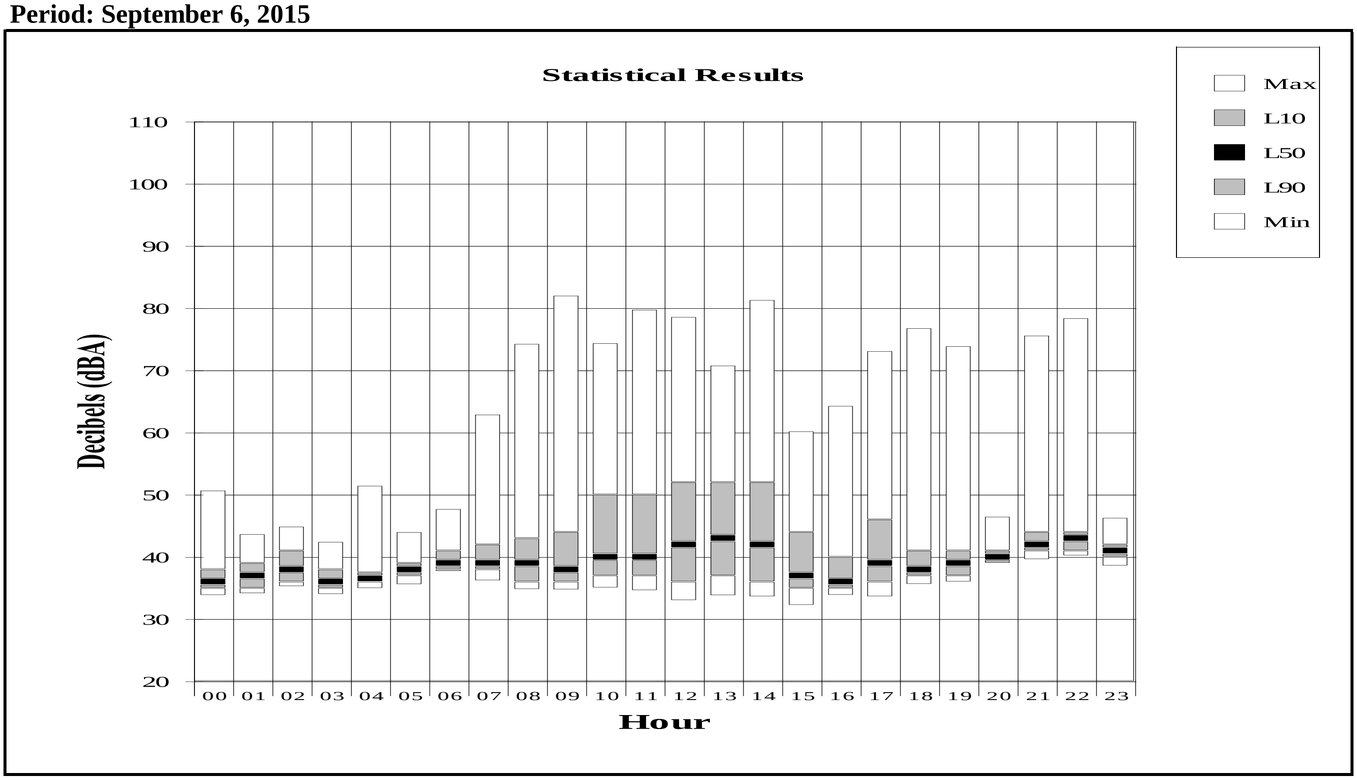
Ambient noise levels vary by day and time of day as summarized in the data from the Moose site which is presented in Figure 4-3. The top portion of this figure presents the day-to-day ambient measurement results. The bottom portion of the figure shows each hour of ambient measurement data for one typical day (September 6). 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 2015 Annual Report
Site: Moose

Period: August 27, 2015 to September 9, 2015



Period: September 6, 2015



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 2015 Annual Report
Period: September 7, 2015
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																								
9																								
8																								
7													74.8											
6													72.9											
5										80.4			76.5		78.1									
4										79.7		76.5	80.0	69.9	73.0				77.5	79.2				
3										79.5		77.5	82.7	64.2	82.8		80.6	78.2	69.7	68.1	82.0			
2										80.0	77.7	79.7	75.5	73.9	81.2		76.4	76.2	82.9	81.1	77.1			
1										67.7	80.1	76.5	78.9	76.3	79.1	73.6	79.2	76.8	71.3	77.5	81.2	83.2		

Hour Of The Day

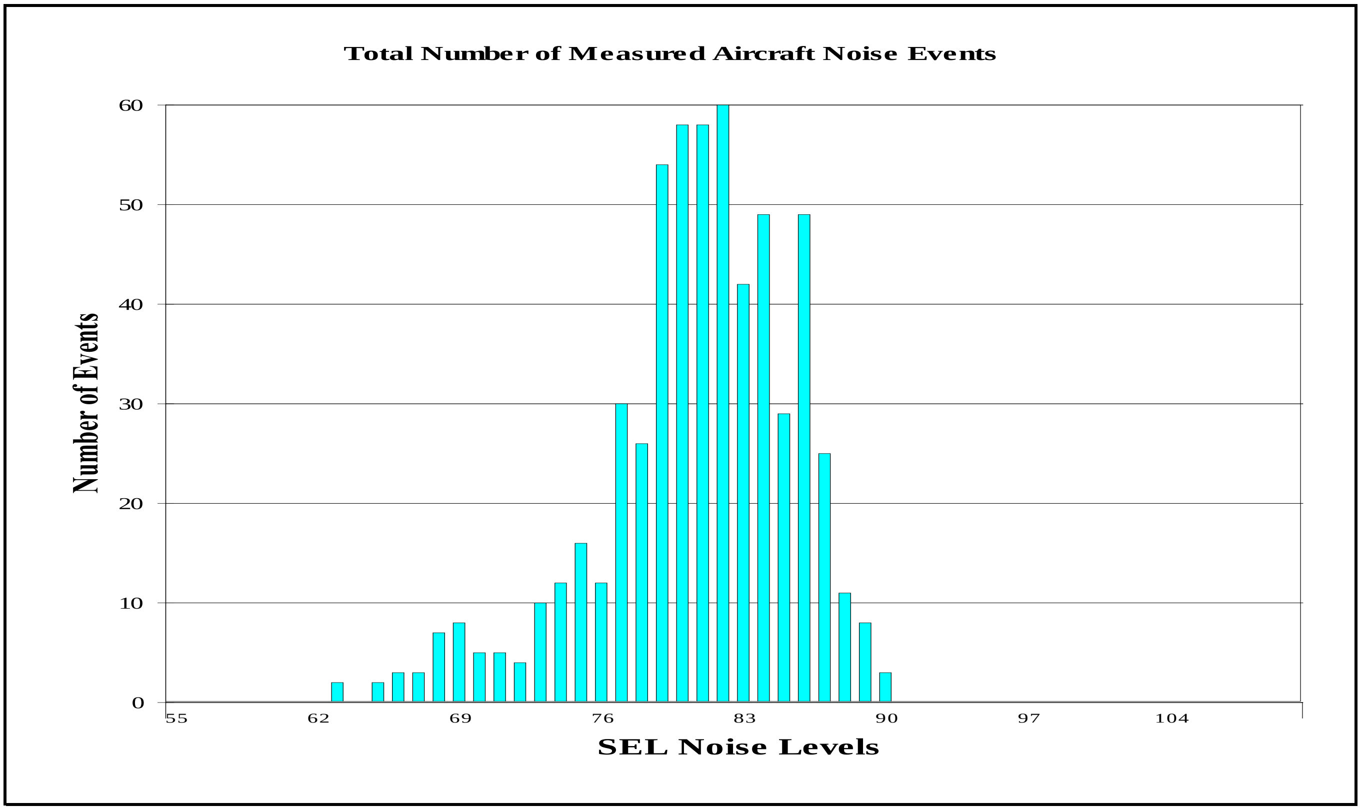
Figure 4-5

Range of Noise and Number of Events Histrograms

Jackson Hole Airport 2015 Annual Report

Period: August 27, 2015 to September 9, 2015

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



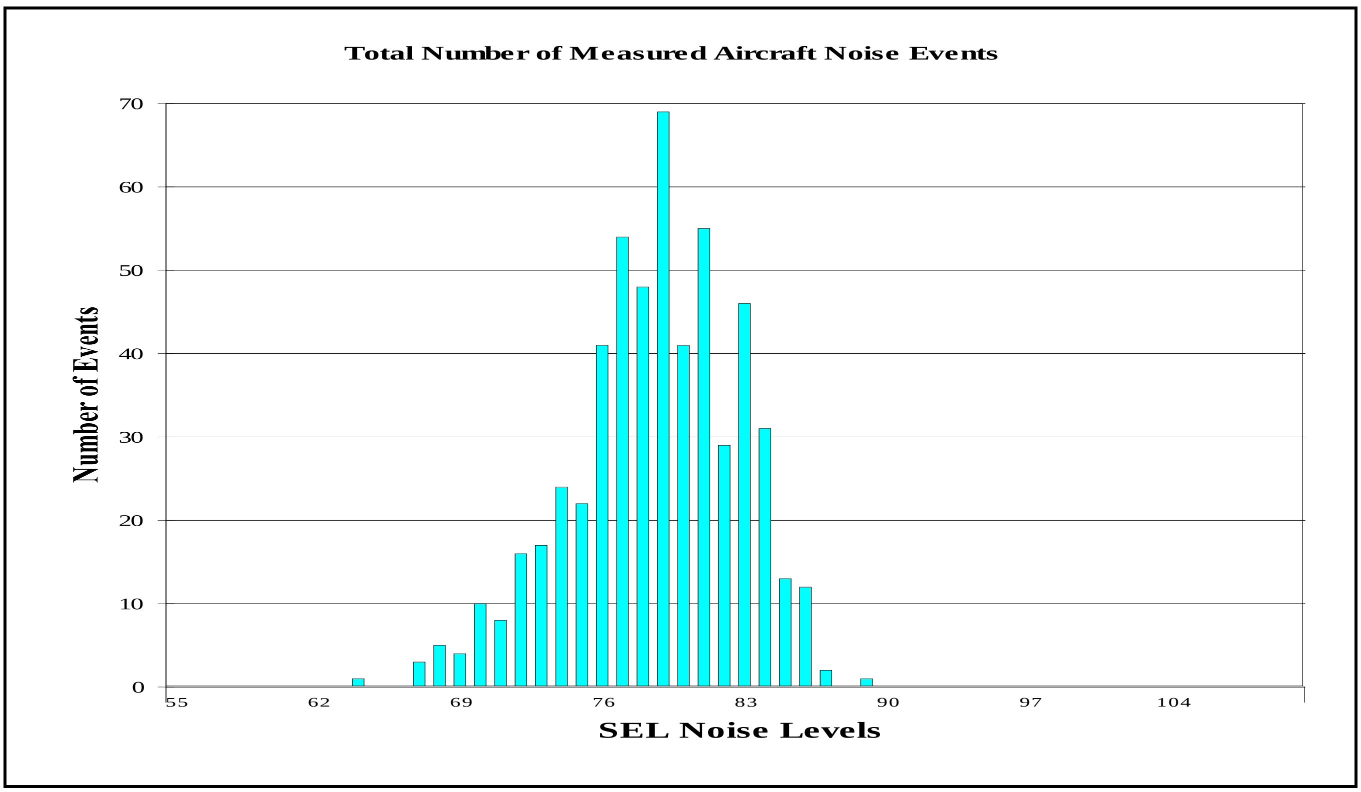
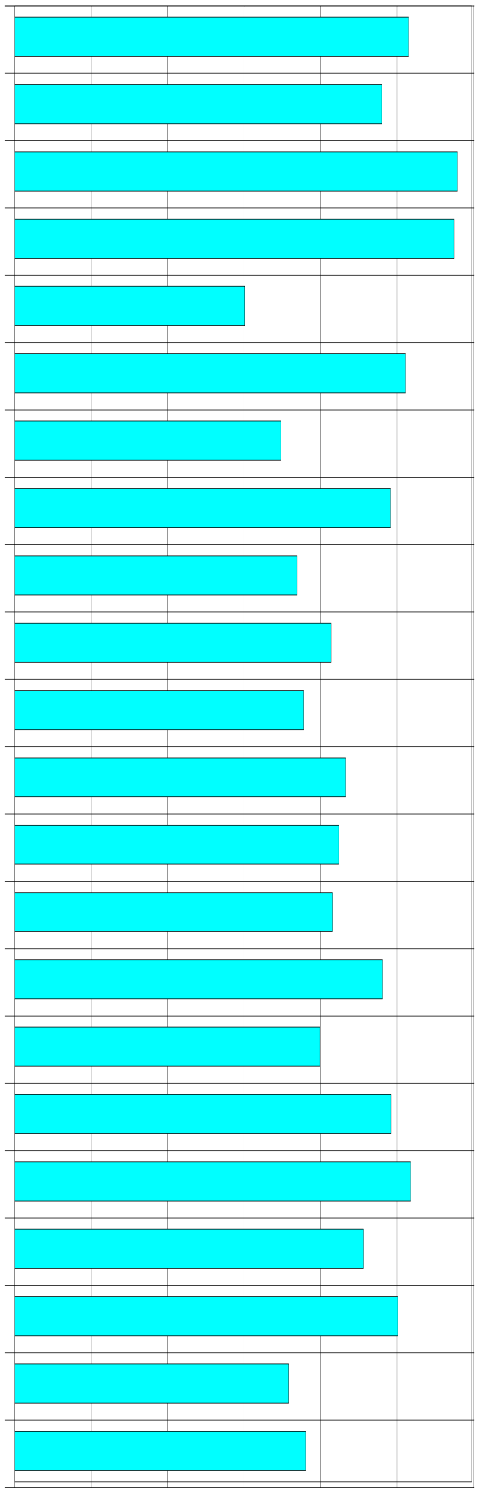


Figure 4-6
Single Event Noise Level by Aircraft Report
Jackson Hole Airport 2015 Annual Report
Period: August 27, 2015 to September 9, 2015
Site: Moulton Loop - Zenith Drive and Spring Gulch Road
Operations: Departure Runway: 19 Tracks: ALL

Aircraft		Event Count	Energy Average SEL
	A319	83	95.9
	A320	3	94.1
	B737	3	99.1
	B752	14	98.8
	BE20	12	85.2
	BE40	4	95.7
	BE99	3	87.5
	C560	15	94.7
	C56X	20	88.6
	C680	13	90.8
	C750	19	89.0
Other Corporate Aircraft	CJ	36	91.8
	CL30	17	91.3
	CL60	8	90.9
	CRJ7	41	94.2
	E55P	10	90.1
	FA50	1	94.7
	GLF4	6	96.0
	GLF5	3	92.9
	H25B	11	95.2
	PC12	19	88.0
Other Aircraft		165	89.2

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 2015 Annual Report

Period: August 27, 2015 to September 9, 2015

Site: Moose

Operations: Arrivals Runway: 19 Tracks: ALL

Aircraft	Event Count	Energy Average SEL
A319	140	85.5
A320	5	86.0
B737	4	86.9
B752	20	87.8
BE20	19	77.1
BE40	18	78.9
BE99	8	76.4
C560	31	79.4
C56X	36	81.0
C680	14	79.1
C750	27	80.1
Other Corporate Aircraft	69	80.5
CL30	24	80.0
CL60	15	81.6
CRJ7	72	83.8
E55P	22	79.1
FA50	2	83.5
GLF4	10	84.3
GLF5	7	81.3
H25B	19	82.3
PC12	26	81.1
Other Aircraft	154	78.7

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 48 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 2015 Annual Report

Period: August 27, 2015 to September 9, 2015

Site: Moulton Loop - Zenith Drive and Spring Gulch Road

Aircraft	Airline	Event Time	Aircraft	Ops	Rwy	Lmax	SEL	Graph Of SEL
	U	Sep 06, 09:59	G150	D	19	93.3	104.2	
	DAL	Aug 30, 08:43	B752	D	19	99.7	103.4	
	Delta Air Lines	Sep 02, 13:33	A319	D	19	90.4	100.9	
	AA American	Sep 05, 07:07	A319	D	19	95.2	100.3	
	U	Aug 31, 07:54	C560	D	19	94.9	100.3	
	AA American	Sep 07, 07:21	A319	D	19	95.6	100.1	
	OPT	Aug 28, 10:00	BE40	D	19	97.7	100.1	
	United	Sep 01, 07:42	B752	D	19	94.9	100.0	
	United	Aug 29, 07:40	B752	D	19	95.8	100.0	
	Delta Air Lines	Sep 01, 08:11	B752	D	19	94.1	99.8	
	U	Aug 30, 11:58	G150	D	19	96.0	99.8	
	U	Aug 29, 11:38	H25B	D	19	98.1	99.7	
	United	Aug 30, 07:51	B737	D	19	95.1	99.7	
		Sep 01, 12:50	B734	D	19	94.9	99.6	
	U	Aug 30, 15:57	C650	D	19	97.7	99.6	
	Delta Air Lines	Aug 28, 08:49	A319	D	19	94.4	99.3	
	United	Sep 02, 07:37	B737	D	19	94.9	99.3	
	Delta Air Lines	Sep 06, 08:14	B752	D	19	93.1	99.1	
	United	Aug 28, 07:39	B752	D	19	93.2	98.9	
	AA American	Sep 08, 07:16	A319	D	U	93.6	98.9	
	U	Sep 04, 14:15	U	D	U	89.8	98.8	
	Delta Air Lines	Sep 05, 07:14	A319	D	19	93.4	98.6	
	Delta Air Lines	Sep 09, 07:06	A319	D	19	94.3	98.6	
	SkyWest	Sep 08, 07:20	CRJ7	D	19	95.8	98.5	
	United	Sep 07, 07:30	A319	D	19	94.4	98.4	

Figure 4-9

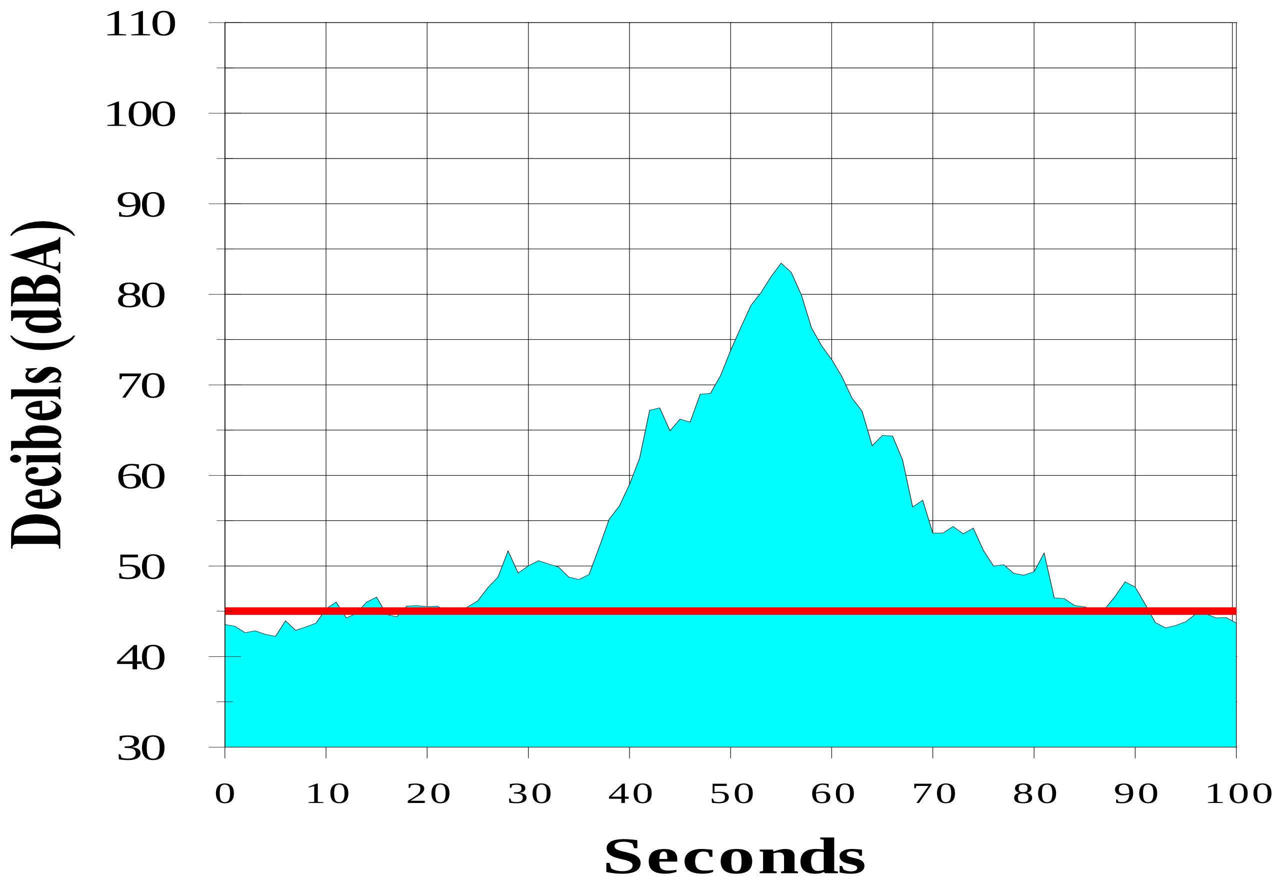
Noise Event Plot Report

Jackson Hole Airport 2015 Annual Report

Period: August 27, 2015 6:39:18 PM

Site: Moose

Start time:	18:38:33	**Lmax time:**	18:39:18
SEL (dBA):	90.3	**Max (dBA):**	83.4
Duration (seconds):	82	**Start to peak (seconds):**	45
SEL threshold (dBA):	45		
Filght No:	AAL1437		
Aircraft Type:	B752	Boeing B757-200 Series	
Operation:	Arrival		
Runway:	19		
Destination:	KORD	Chicago O'hare Intl - IL - 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 (August 27, 2015 to September 9, 2015).

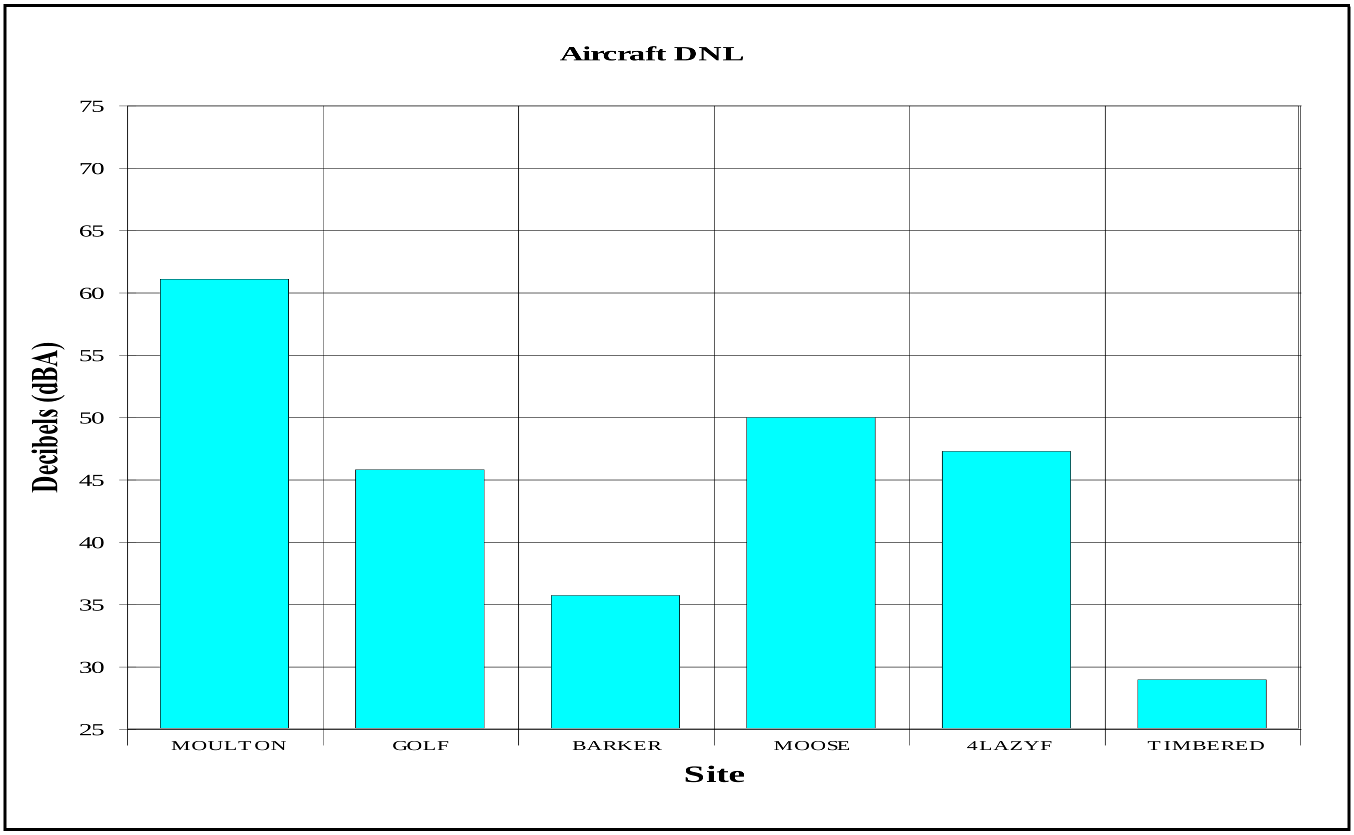
Figure 4-10 shows the same results of the DNL noise measurements at the noise-monitoring locations in a graphical format. The top portion of the graph shows the average DNL noise level measured at each noise monitoring location. The bottom portion of the graph shows the range of daily DNL values along 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 2015 Annual Report

Site #	Name	Description	Aircraft DNL
1	Moulton Loop	Zenith Drive and Spring Gulch Rd.	62
2	Golf Course	Jackson Hole Golf & Tennis Club	48
3	Barkers Ranch	Circle H Ranch (Barker's Residence)	36
4	Moose	Moose Entrance	50
5	4 Lazy F Ranch	4 Lazy F Ranch	47
6	Timber Island	East of Timber Island	29

Figure 4-10
Aircraft DNL
Jackson Hole Airport 2015 Annual Report
Period: August 27, 2015 to September 9, 2015



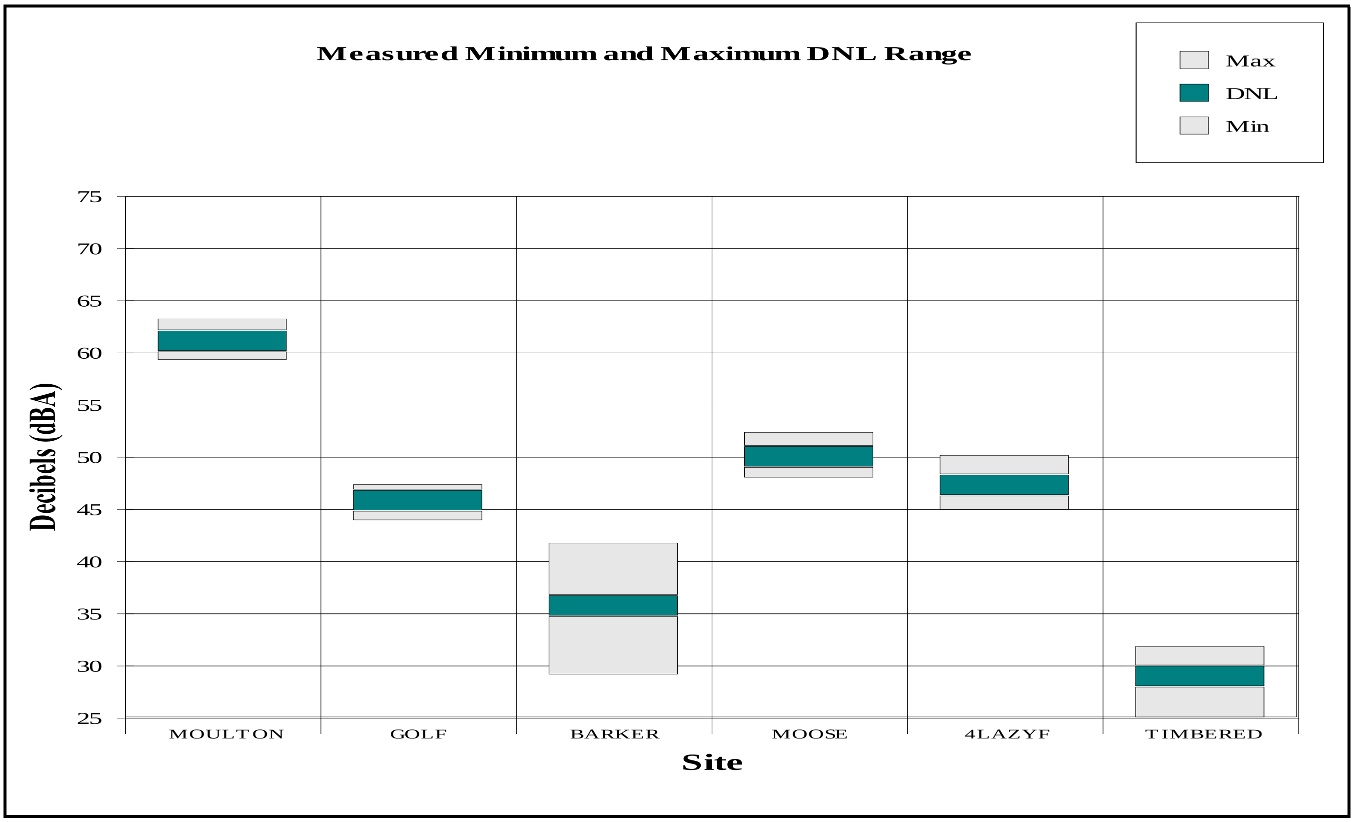


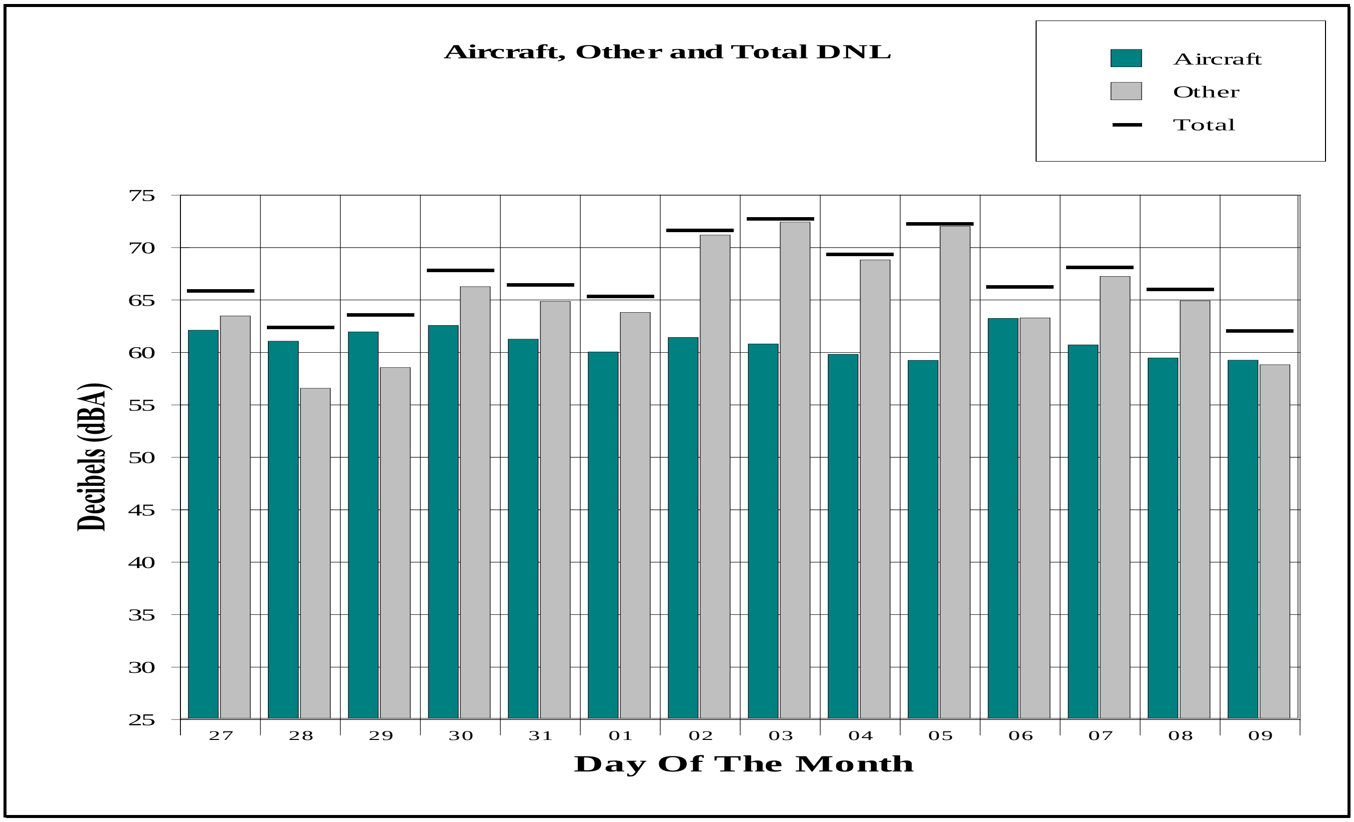
Figure 4-11

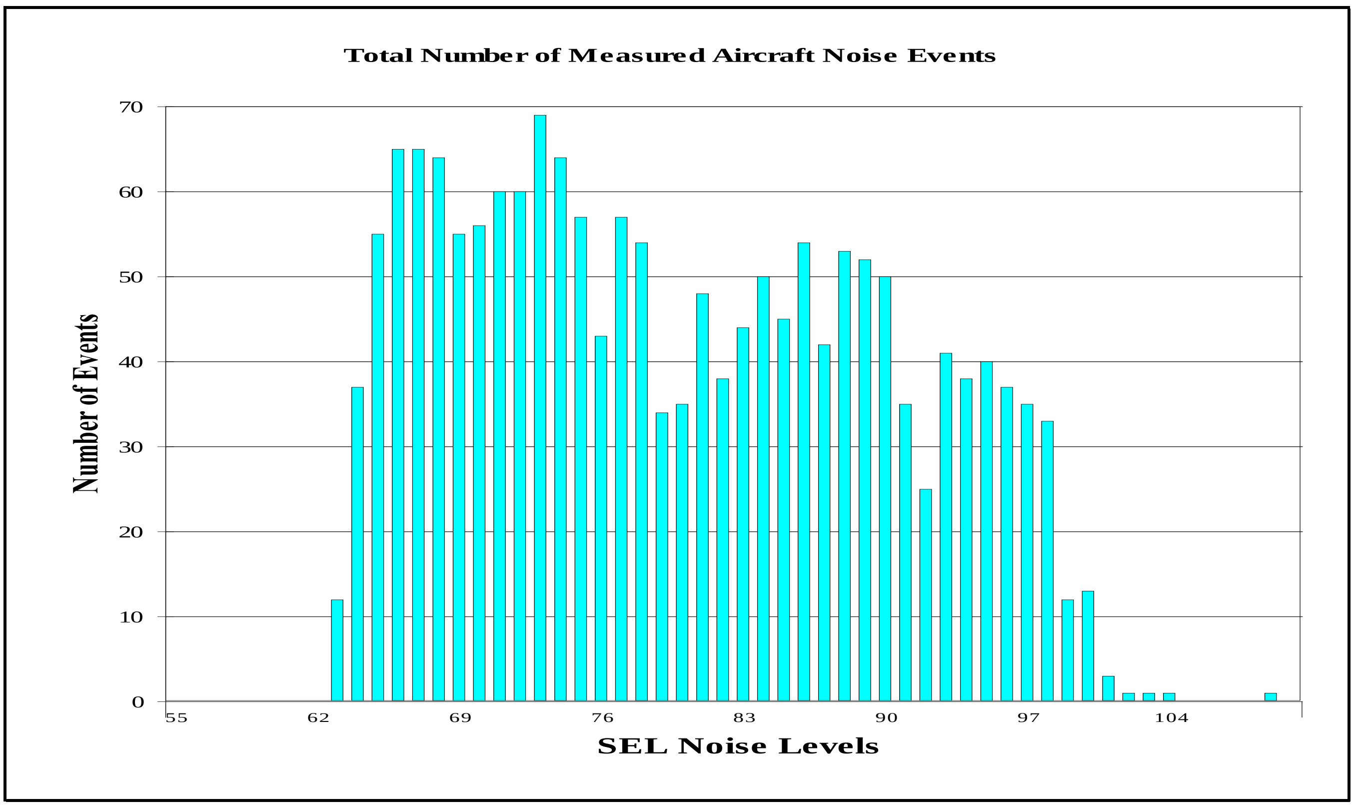
DNL Contribution and SEL Distribution Results

Jackson Hole Airport 2015 Annual Report

Period: August 27, 2015 to September 9, 2015

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 2015 Annual Report

Period: August 27, 2015 to September 9, 2015

Site: 4 Lazy F Ranch

Metric: Aircraft LEQ

DATE	Hour Of The Day																								DNL
	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Aug 27	0	0	0	0	0	0	0	50	47	51	0	51	54	47	52	31	50	51	52	52	52	0	0	0	48
Aug 28	0	0	0	0	0	0	0	47	49	48	42	48	51	46	50	48	47	44	50	50	51	50	0	0	47
Aug 29	0	0	0	0	0	0	0	0	51	47	52	53	52	50	50	48	46	47	54	49	53	49	0	0	48
Aug 30	0	0	0	0	0	0	0	0	46	48	0	50	50	0	51	50	48	46	53	48	52	48	0	0	47
Aug 31	0	0	0	0	0	0	38	32	0	41	48	49	50	45	50	41	--	48	--	47	49	47	0	0	45
Sep 1	0	0	0	0	0	0	0	49	0	53	0	47	47	42	48	0	47	47	49	44	52	48	0	0	46
Sep 2	0	0	0	0	0	0	0	0	47	50	46	44	48	42	37	0	49	44	43	0	54	48	0	0	45
Sep 3	0	0	0	0	0	0	0	45	45	51	45	49	50	47	49	45	48	46	46	53	54	49	44	50	50
Sep 4	0	0	0	0	0	0	0	44	0	51	50	50	52	45	51	50	48	51	52	49	52	51	0	0	48
Sep 5	0	0	0	0	0	0	0	47	47	50	0	55	54	51	52	0	47	47	47	52	52	50	0	0	48
Sep 6	0	0	0	0	0	0	0	0	42	52	50	50	50	41	50	0	0	45	47	46	0	49	48	0	48
Sep 7	0	0	0	0	0	0	0	0	0	50	46	48	51	43	51	38	48	46	49	49	50	48	0	0	46
Sep 8	0	0	0	0	0	0	39	0	54	49	33	46	48	46	44	49	51	39	0	50	37	51	0	0	46
Sep 9	0	0	0	0	0	0	0	36	49	48	42	51	50	46	52	45	50	45	51	0	49	49	0	0	46
Energy Average	0	0	0	0	0	0	30	44	47	50	46	50	51	46	50	45	48	47	50	49	51	49	38	39	47

Metric: Total LEQ

DATE	Hour Of The Day																								DNL
	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
Aug 27	38	38	38	38	37	37	38	50	48	51	38	52	54	47	52	39	50	51	53	52	52	40	41	40	50
Aug 28	40	40	40	41	40	41	43	49	50	48	44	49	52	47	51	48	47	46	50	51	52	50	42	41	50
Aug 29	41	41	41	41	41	41	42	44	52	47	52	53	52	50	50	49	47	49	54	50	53	50	41	40	51
Aug 30	45	42	44	39	38	39	40	41	47	49	42	51	51	42	51	51	50	48	53	48	52	48	39	40	50
Aug 31	39	40	39	40	39	41	43	44	41	44	49	51	51	48	51	48	--	49	--	51	50	48	41	41	50
Sep 1	40	40	40	40	40	42	43	52	44	53	38	48	48	46	50	41	48	48	50	46	53	49	41	41	50
Sep 2	41	41	40	40	41	41	42	43	48	50	48	50	52	51	54	46	52	49	45	41	55	49	41	41	51
Sep 3	41	42	41	47	42	42	43	48	49	51	48	51	52	53	51	50	50	48	47	53	54	51	45	50	53
Sep 4	39	39	39	39	39	40	42	48	42	51	51	51	53	49	53	51	51	54	53	51	53	52	46	43	51
Sep 5	42	43	40	41	43	39	46	48	48	51	47	56	55	52	53	48	50	49	48	53	52	50	40	40	52
Sep 6	40	40	39	39	39	39	40	41	45	52	51	52	51	46	51	41	40	48	48	47	39	49	49	41	50
Sep 7	40	39	39	39	39	40	41	43	42	51	48	49	52	45	52	43	49	48	49	49	51	48	41	41	49
Sep 8	41	41	41	40	41	41	44	44	54	50	40	48	49	47	46	50	51	42	38	50	45	51	41	45	50
Sep 9	40	40	41	41	41	41	43	46	50	49	44	51	50	47	53	46	50	46	51	39	49	50	41	41	50
Energy Average	41	41	40	41	40	40	43	47	49	50	48	51	52	49	52	48	50	49	51	50	52	50	43	43	51

4.7 Summary of Spring/Summer Noise Measurements

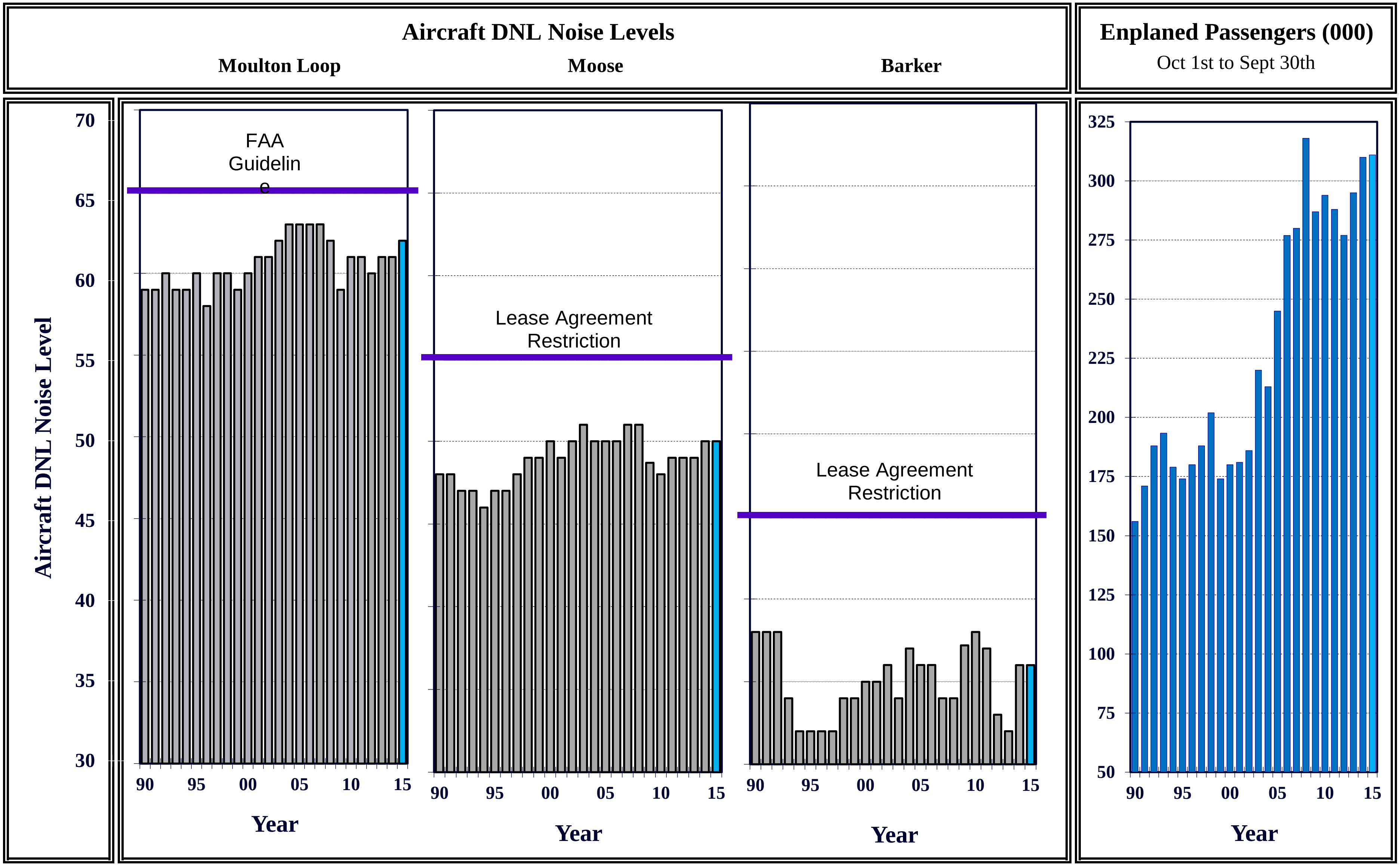
The results of the annual noise measurements show that the airport is in compliance with the requirements of the airport Agreement. The measured noise levels are below the limits contained within the agreement. The requirements are that the annual DNL noise levels from aircraft noise at the Moose measurement 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 2015 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 4-13 presents the annual aircraft DNL noise levels from 1984 through 2015 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.

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 50 dBA and 36 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 62 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
2015 Annual DNL Noise Report
Jackson Hole Airport 2015 Annual Report
October 1st 2014 to September 30th 2015



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 Integrated Noise Model (INM) Version 7.0d was used to model the flight operations at Jackson Hole Airport. The INM has an extensive database of civilian aircraft noise characteristics and this most recent version of INM 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 INM Version 7.0d. The original INM was released in 1977. The latest version, INM Version 7.0d, was released for use in May 30, 2013 and is the state-of-the-art in airport noise modeling. The INM 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 7.0d 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 INM 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, 2014 to September 30, 2015). 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, 2014 through September 30, 2015 there were a total of 28,937 annual operations, or an average of 79.3 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 2015 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 INM model was based upon a compilation of all 28,937 operations at the airport.

Table 5-1
SUMMARY OF OPERATIONS, (October 1, 2014 thru September 30, 2015)
Jackson Hole Airport 2015 Annual Report

Category Type	Annual Operations	Daily Operations	Percent Nighttime
Commercial Jet	4,318	11.8	1.1%
Regional Jet	2,894	7.9	3.2%
Small Commuter	126	0.3	0.0%
Air Taxi (Prop)	4,159	11.4	1.0%
General Aviation			
Business Jet	10,652	29.2	2.7%
Turbo Engine	3,996	11.0	1.3%
Piston Engine	2,294	6.2	0.7%
Helicopter	204	0.6	0.0%
Military	339	0.9	0.0%
Total Operations	**28,937**	**79.3**	**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 2015 Annual Report
October 1, 2014 thru September 30, 2015

Operations Category	INM Type	Daily Arrivals Day	Daily Arrivals Night	Daily Departures Day	Daily Departures Night	Daily Touch & Goes Day	Daily Touch & Goes Night	Annual Operations
Commercial Jets	A319-131	3.61	0.09	3.68	0.01			2,698
	A320-211	0.98	0.02	0.99				726
	737400	0.01		0.01				8
	737700	0.48	0.00	0.48				350
	737800	0.01		0.01				6
	757PW	0.71	0.01	0.72				524
	757RR	0.01		0.01				6
Regional Jets	CRJ701	3.63	0.20	3.78	0.05			2,796
	EMB135	0.03	0.00	0.03	0.00			26
	EMB145	0.10		0.10				72
Itinerant Air Carrier Jet Operations (Total)								**7,212**
Business Jets	CIT3	0.45	0.01	0.45	0.01			341
	CL600	1.55	0.04	1.55	0.04			1,165
	CNA501	0.03	0.00	0.03	0.00			20
	CNA510	0.20	0.01	0.20	0.01			152
	CNA525C	0.49	0.01	0.50	0.01			371
	CNA550	0.26	0.01	0.26	0.01			193
	CNA55B	0.16	0.00	0.16	0.00			118
	CNA560	0.93	0.03	0.93	0.03			700
	CNA560	1.13	0.03	1.13	0.03			850
	CNA650	0.47	0.01	0.47	0.01			353
	CNA750	2.69	0.08	2.70	0.07			2,021
	CRJ701	0.16	0.00	0.17	0.00			124
	ECLIPSE500	1.08	0.03	1.09	0.03			814
	F10062	0.21	0.01	0.21	0.01			154
	FAL10	0.05	0.00	0.05	0.00			39
	FAL20	0.01	0.00	0.01	0.00			4
	FAL20A	0.59	0.02	0.59	0.02			442
	FAL900	0.29	0.01	0.29	0.01			219
	G150	0.11	0.00	0.11	0.00			85
	G200	0.22	0.01	0.22	0.01			168
	GIIB	0.01	0.00	0.01	0.00			10
	GIV	0.75	0.02	0.75	0.02			564
	GV	0.37	0.01	0.37	0.01			278
	HK4000	0.07	0.00	0.07	0.00			51
	HS1258	0.76	0.02	0.77	0.02			574
	IA1124	0.03	0.00	0.03	0.00			20
	IA1125	0.12	0.00	0.12	0.00			91
	LEAR35	0.20	0.01	0.20	0.01			150
	MU3001	0.59	0.02	0.59	0.02			442
	R390	0.08	0.00	0.08	0.00			58
	SABR80	0.11	0.00	0.11	0.00			80
Business Jets (Total)								**10,652**
Small Commuter	DHC830	0.17		0.17				126
Multi Engine Turbo	1900D	0.74	0.02	0.74	0.03			557
	AC95	0.02		0.02				14
	BEC100	0.10		0.10				74
	BEC200	1.31	0.02	1.31	0.00			965
	BEC300	0.05		0.05				40
	BEC99	0.80	0.02	0.80	0.03			605
	BEC9F	0.19		0.19				136
	CNA425	0.07		0.07				52
	CNA441	0.23		0.23				166
	MU2	0.01		0.01				10
	P180	0.02		0.02				14
	SAMER3	0.02		0.02				16
	SAMER4	0.14		0.14				102
Twin Turbo (Total)								**2,877**
	Sub Totals	**27.62**	**0.79**	**27.90**	**0.51**	**0.00**	**0.00**	**20,741**

Table 5-2b

INM Case Summary Report

Jackson Hole Airport 2015 Annual Report

October 1, 2014 thru September 30, 2015

Contuned from Table 5-2a

Operations Category	INM Type	Daily Arrivals Day	Daily Arrivals Night	Daily Departures Day	Daily Departures Night	Daily Touch & Goes Day	Daily Touch & Goes Night	Annual Operations
Sub Totals from Table 5-2a		**27.62**	**0.79**	**27.90**	**0.51**	**0.00**	**0.00**	**20,741**
Single Engine Turbo	CNA208	0.18		0.18				128
	CNA208	0.11		0.11				80
	PC12	1.06	0.02	1.06	0.00			780
	STBM7	0.10		0.10				74
	CNA208	0.08		0.08				56
Single Turbo (Total)								**1,118**
Multi Engine Piston	AC50	0.03		0.03				19
	PA60	0.05		0.05				38
	BEC55	0.05		0.05				38
	BEC58P	2.71	0.08	2.75	0.03			2,033
	CNA340	0.07		0.07				53
	CNA414	0.18		0.18				134
	CNA421	0.47	0.00	0.47				346
	PA31	0.08		0.08				58
	PA34	0.05		0.05				38
	PA44	0.03		0.03				19
Twin Engine Piston (Total)								**2,777**
Single Engine Piston	AA5A	0.03		0.03				19
	BEC33	0.13		0.13				96
	GASEPV	0.88	0.00	0.88				641
	CNA150	0.03		0.03				19
	CNA172	0.16		0.16				115
	CNA182	0.37		0.37				269
	CNA185	0.03		0.03				19
	CNA206	0.16		0.16				115
	CNA210	0.39		0.39				288
	M20K	0.18		0.18				134
	PA28	0.05		0.05				38
	PA32C6	0.08		0.08				58
Single Engine Piston (Total)								**1,811**
Touch and Goes	GASEPV					0.23		171
	SR22					2.31		1,685
	PA46					0.59		428
Touch and Goes (Total)								**2,285**
Military	C130	0.06		0.06				44
	C17	0.01		0.01				7
	C21A	0.30		0.30				219
	KC-135	0.01		0.01				7
	P3C	0.04		0.04				29
	CNA208	0.04		0.04				32
Military (Total)								**339**
Helicopter	A109	0.07		0.07				51
	SA365N	0.05		0.05				37
	EC130	0.11		0.11				80
	R44	0.05		0.05				37
Helicopter (Total)								**204**
	Grand Totals	**36.09**	**0.89**	**36.42**	**0.54**	**3.13**	**0.00**	**28,937**

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

Category Type	Percentage Utilization Rwy 19	Rwy 1
Arrivals		
General Aviation		
Single Engine	85%	15%
Multi-Engine	85%	15%
Business Jet	83%	17%
Air Taxi	85%	15%
Small Commuter	85%	15%
Regional Jet	79%	21%
Commercial Jet	83%	17%
Military	85%	15%
Departures		
General Aviation		
Single Engine	85%	15%
Multi-Engine	85%	15%
Business Jet	83%	17%
Air Taxi	85%	15%
Small Commuter	90%	10%
Regional Jet	86%	14%
Commercial Jet	83%	17%
Military	90%	10%

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

Category Type	Percentage Utilization Rwy 19	Rwy 1
Arrivals		
General Aviation		
Single Engine	85%	15%
Multi-Engine	85%	15%
Business Jet	83%	17%
Air Taxi	85%	15%
Small Commuter	50%	50%
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	85%	15%
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.

The flight paths developed for use in the INM model 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 1.

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 2015 Annual Report
Arrival, Departure and Touch & Goes Tracks for Runway 19

Legends: Arrivals Departures T&GO's VOR/DME Locations

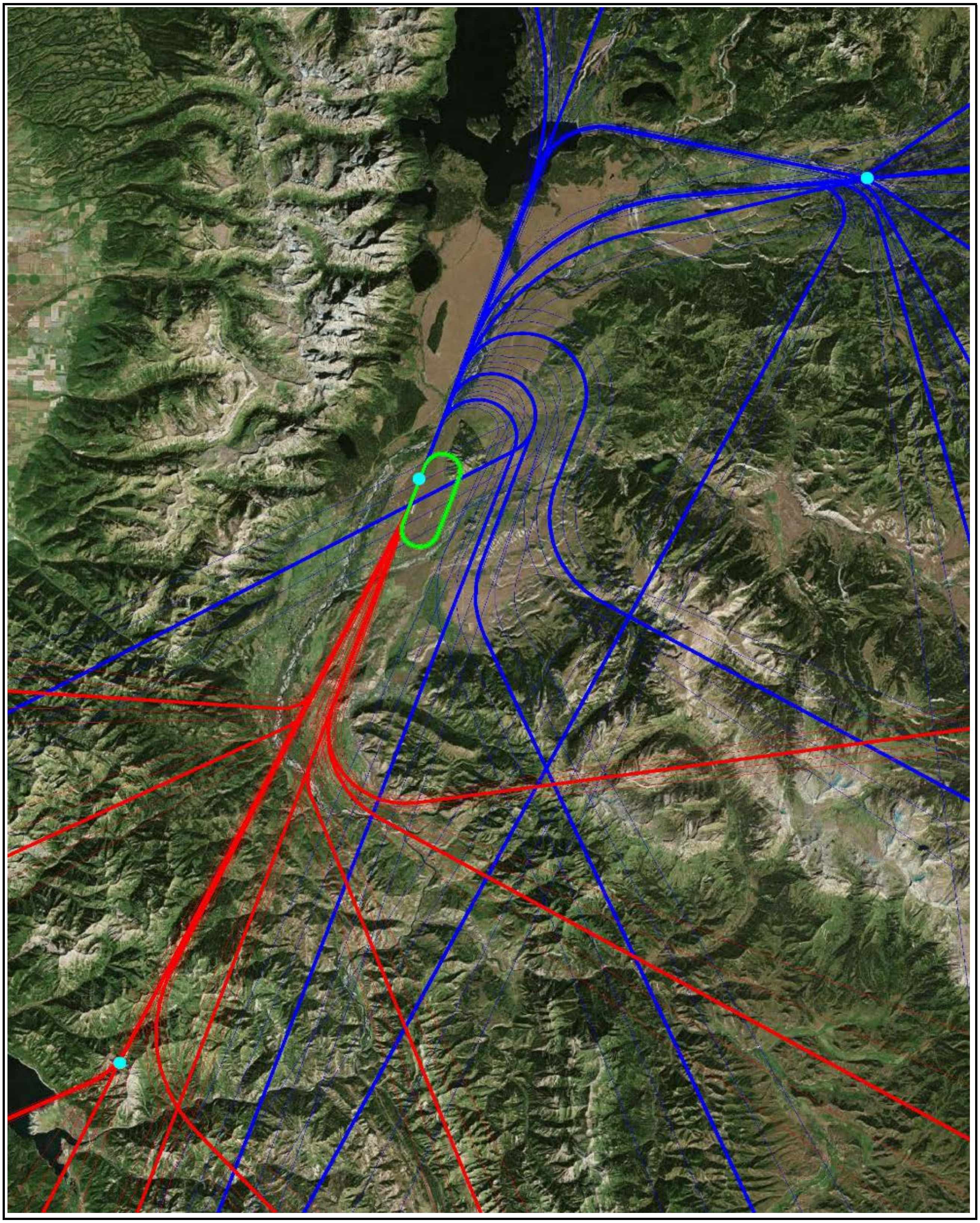
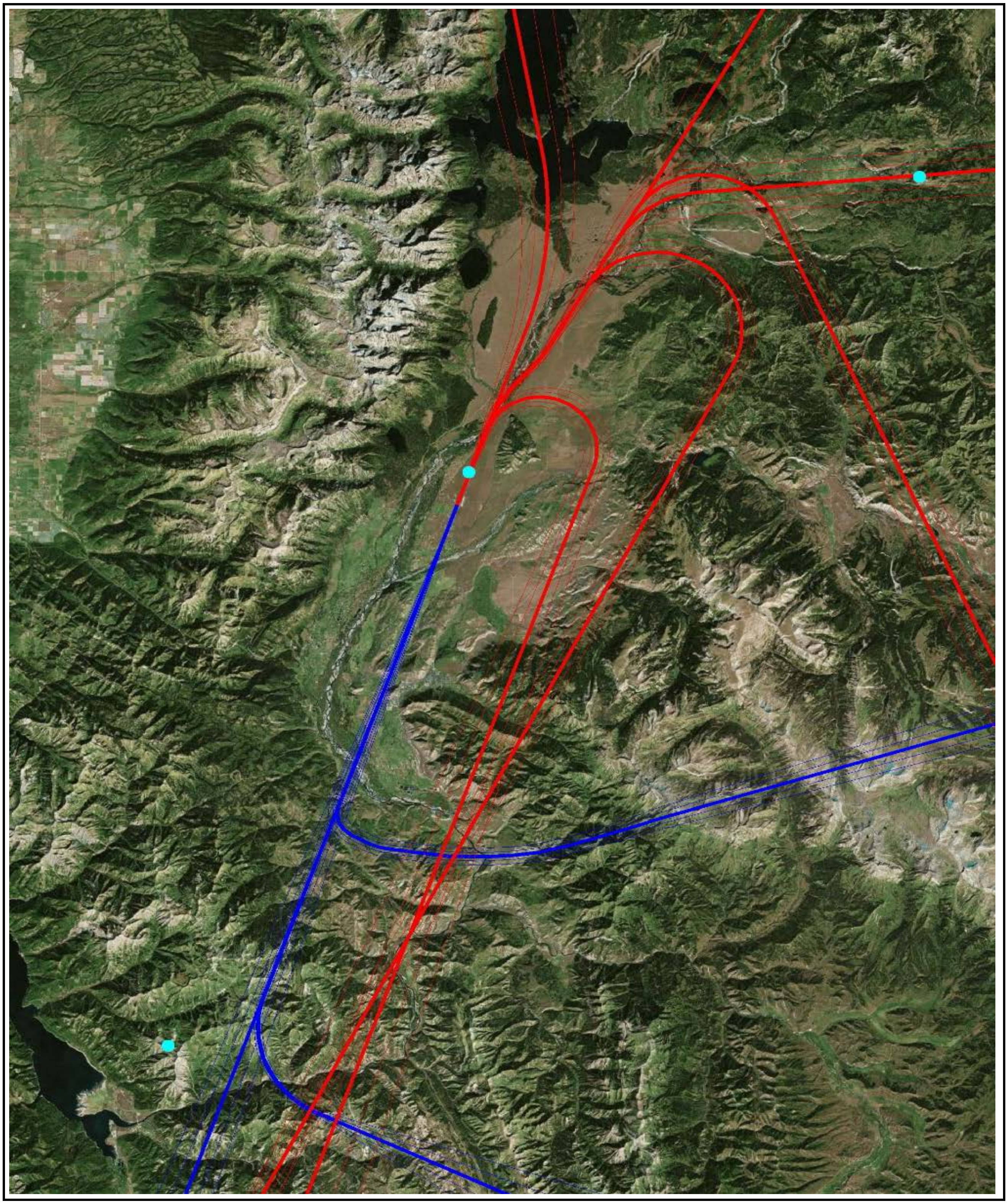


Figure 5-2
Flight Tracks for North Flow
Jackson Hole Airport 2015 Annual Report
Arrival and Departure Tracks for Runway 01
Legends: Arrivals Departures VOR/DME Locations



5.4 INM Modeling Results

Noise metric used. The noise metric used to assess the 2015 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 INM contours are presented in Figure 5-3.

Figure-5-3

The airport is conducting an FAR Part 150 Study that will contain an annual DNL noise contour approved by the FAA, therefore this annual report does not contain the DNL noise contour. This annual report contains all of the standard measurement analysis and results for 2014 – 2015.

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.