Appendix D: Noise Analysis

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U.S. Department
of Transportation
**Federal Aviation
Administration**

Office of Environment and Energy

800 Independence Ave., S.W.
Washington, D.C. 20591

7/19/2023

Kristi Ponozzo
Environmental Protection Specialist
Alaska Region
Federal Aviation Administration
222 West 7th Avenue, MS #14
Anchorage, AK 99513

Dear Kristi,

The Office of Environment and Energy (AEE) has received the memo from Northlink Aviation dated July 17th, 2023, referencing the Ted Stevens Anchorage International Airport South Airpark Cargo Improvements Environmental Assessment (EA). The memo requests approval for the use of mathematical methodology along with the CadnaA software that supports the conservativeness of the mathematical methodology for the aircraft taxiing operations within the proposed project site.

AEE reviewed the provided technical report and agreed the methodologies and results of the analysis. AEE approves the use of mathematical methodology along with the CadnaA software that supports the conservativeness of the mathematical.

Please understand that this approval is limited to this particular Environmental Assessment for the Ted Stevens Anchorage International Airport. Further non-standard methodology for additional projects at this or any other site will require separate approval.

Sincerely,

David Senzig (acting AEE-100 manager) for
Donald Scata
Manager
AEE-100/Noise Division

cc: ARP Contacts (Jean Wolfers-Lawrence, APP-400, Susan Staehle, APP-400)

Tenor Elevating acoustical design.

ANC SOUTH AIRPARK CARGO TERMINAL

Environmental Noise Impact Study

Revised – July 13, 2023

Submitted to:

MCG Explore Design
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Anchorage, AK 99501

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July 15, 2023

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1 Executive Summary

This report is a summary of the environmental noise testing, impact analysis, predictive methods, and noise control measures for the Ted Stevens Anchorage International Airport South Airpark Cargo Terminal addition for cargo plane staging, off-loading, and on-loading (proposed site operations).

The arithmetic calculation and 3-dimensional computer-aided sound propagation and noise abatement model show that the proposed site operations will not be contributing to the current noise environment from the normal daytime and nighttime operations of the Anchorage International Airport during east-west flow operations. The east-west aircraft flow of the Anchorage International Airport was documented in the 2015 Federal Aviation Administration (FAA) FAR Part 150 Noise Compatibility Study to have the quietest Day-Night Average Sound Levels (DNL) for the residential community to the south, compared to the north and south flow patterns. The predicted DNL from the new Airpark operations only (21 planes completing 42 trips) is **53 dBA** when assuming planes taxi for 10 minutes at the Airpark and immediate vicinity.

The Airpark will include a 25'-0" high landscaped berm on the south side of the site and replant large sections of trees along the south property line to reduce the high-frequency noise from the taxiing engines.

The June 20th, 2023, Northlink noise impact study submission used an arithmetic analysis to estimate the DNL similar to the original February 2022 analysis. Upon further review, it was discovered that the February 2022 noise analysis used the CadnaA barrier geometry that had a topography error for the Airpark; namely, the Airpark ground was not properly flattened at the noted elevation. With the topography corrected the barrier effectiveness improved by 4 dB to the noted residences and to the nearest north edge property line. The effectiveness of the 25'-0" high earthen berm was corrected using the barrier effect methods (arithmetical, using Fresnel calculations, and CadnaA).

This version of the Environmental Noise Impact Study adds a new section related to the use of CadnaA to develop DNL values and revised contour diagrams to address the topography error noted in the prior paragraph. [1] Sections 3.3.1 through 3.3.3 describe how CadnaA was applied for the noise contour depictions and calculation of DNL values. Figure 8 through Figure 10 are new and depict CadnaA results after the topography error correction, noted above.

Finally, this noise impact study has also included specific calculations that relied upon in making the arithmetic calculations. The additional level of arithmetic detail is provided at the request of the FAA.

In summary, this Environmental Noise Impact Study uses the same arithmetic approach as provided previously with additional details noted, correction of a topography assumption, and applying CadnaA developed DNL values as a check of the arithmetic results.

[1] CadnaA-developed DNL values were the topic of a June 22, 2023, submission to the FAA. That analysis is incorporated herein but only as a check on the arithmetic calculation, discussed more below.

2 Noise Impact Criteria

The following are the code or noise criteria used to evaluate the impact from the future aircraft taxiing and air cargo operations.

2.1 Anchorage Chapter 15.70 Noise Control

15.70.060 Prohibited acts and conditions.

A. No person shall unreasonably make, continue or cause to be made or continued any noise disturbance except noncommercial public speaking or public assembly activities conducted on any public space or public right-of-way.

B. The following acts and conditions and the causing thereof are declared to be in violation of this chapter:

1. *Aircraft and airport operations.* No person shall operate aircraft engines while the aircraft is on the ground or operate an airport facility in such a manner as to cause a noise disturbance across a residential real property boundary, on a public space or within a noise-sensitive zone. The department shall consult with the airport proprietor to recommend changes in airport operations to minimize any noise disturbance that the airport owner may have the authority to control in its capacity as proprietor. Nothing in this section shall be construed to prohibit, restrict, penalize, enjoin or in any manner regulate the movement of aircraft that are in all respects conducted in accordance with or pursuant to applicable federal laws or regulations, including but not limited to takeoff, landing or overflight procedures.

2.2 Federal Aviation Administration (FAA)

The Federal Aviation Administration (FAA) Order 1050.1F Chapter **4-3.3 Significance Thresholds** defines the specific indicators for significant impact for some environmental impact categories, including noise.

The order states:

> *The FAA uses thresholds that serve as specific indicators of significant impact for some environmental impact categories. FAA proposed actions that would result in impacts at or above these thresholds require the preparation of an EIS, unless impacts can be reduced below threshold levels. In these instances, a conclusion of significance can be determined based on the factors to consider even if the impacts do not meet the significance threshold criteria. Depending on the proposed action and potential impacts, other factors may also need to be evaluated to make a determination of significance. After consideration of all relevant factors, the FAA determines whether there would be a significant impact.*
>
> *Exhibit 4-1 shows the FAA's significance thresholds and factors to consider for each relevant environmental impact category.*

Exhibit 4-1. Significance Determination for FAA Actions.

Environmental Impact Category	Significance Threshold	Factors to Consider
Noise and Noise-Compatible Land Use	The action would increase noise by DNL[7] 1.5 dB or more for a noise sensitive area that is exposed to noise at above the DNL 65 dB noise exposure level, or that will be exposed at or above the DNL 65 dB level due to a DNL 1.5 dB or greater increase, when compared to the no action alternative for the same timeframe. For example, an increase from DNL 65.5 dB to 67 dB is considered a significant impact, as is an increase from DNL 63.5 dB to 65 dB.	Special consideration needs to be given to the evaluation of the significance of noise impacts on noise sensitive areas within Section 4(f) properties (including, but not limited to, noise sensitive areas within national parks; national wildlife and waterfowl refuges; and historic sites, including traditional cultural properties) where the land use compatibility guidelines in 14 CFR part 150 are not relevant to the value, significance, and enjoyment of the area in question. For example, the DNL 65 dB threshold does not adequately address the impacts of noise on visitors to areas within a national park or national wildlife and waterfowl refuge where other noise is very low and a quiet setting is a generally recognized purpose and attribute.

[7] Day-Night Average Sound Level (DNL). The 24-hour average sound level, in decibels, for the period from midnight to midnight, obtained after the addition of ten decibels to sound levels for the periods between midnight and 7 a.m., and between 10 p.m., and midnight, local time. The symbol for DNL is Ldn (See 14 CFR § 150.7).

The order also notes the following definition for noise sensitive area:

> 11-5. Definitions.
>
> (10) Noise Sensitive Area. An area where noise interferes with normal activities associated with its use. Normally, noise sensitive areas include residential, educational, health, and religious structures and sites, and parks, recreational areas, areas with wilderness characteristics, wildlife and waterfowl refuges, and cultural and historical sites. For example, in the context of noise from airplanes and helicopters, noise sensitive areas include such areas within the DNL 65 dB noise contour. Individual, isolated, residential structures may be considered compatible within the DNL 65 dB noise contour where the primary use of land is agricultural and adequate noise attenuation is provided. Also, transient residential use such as motels should be considered compatible within the DNL 65 dB noise contour where adequate noise attenuation is provided. A site that is unacceptable for outside use may be compatible for use inside of a structure, provided adequate noise attenuation features are built into that structure (see table 1 in Appendix A of 14 CFR part 150, Airport Noise Planning, Land Use Compatibility Guidelines). The FAA recognizes that there are settings where the DNL 65 dB standard may not apply. In these areas, the responsible FAA official should determine the appropriate noise assessment criteria based on specific uses in that area (see also the 1050.1F Desk Reference for further guidance). In the context of facilities and equipment, such as emergency generators or explosives firing ranges, but not including aircraft, noise sensitive areas may include such sites in the immediate vicinity of operations, pursuant to the Noise Control Act of 1972, 42 U.S.C. §§ 4901–4918 (see state and local ordinances, which may be used as guidelines for evaluating noise impacts from operation of such facilities and equipment).

3 Environmental Noise Assessment

The following sections outline the measurement, analysis, and predictions completed to quantify the noise impact from the proposed South Airpark expansion to the residences south of Raspberry Road.

For this study and analysis, daytime is defined as the hours between 7:00 AM and 10:00 PM and nighttime is defined to be between 10:00 PM and 7:00 AM of the next day.

3.1 Background Noise

3.1.1 Hourly Measurements & Day-Night Average Sound Level (DNL)

To quantify the background noise from current aircraft activities and traffic, the existing average noise level within the neighboring residential community was documented (short-duration measurements). The 24-hour noise measurements were conducted at the southwest corner of the Anchorage Airport (noise monitor locations).

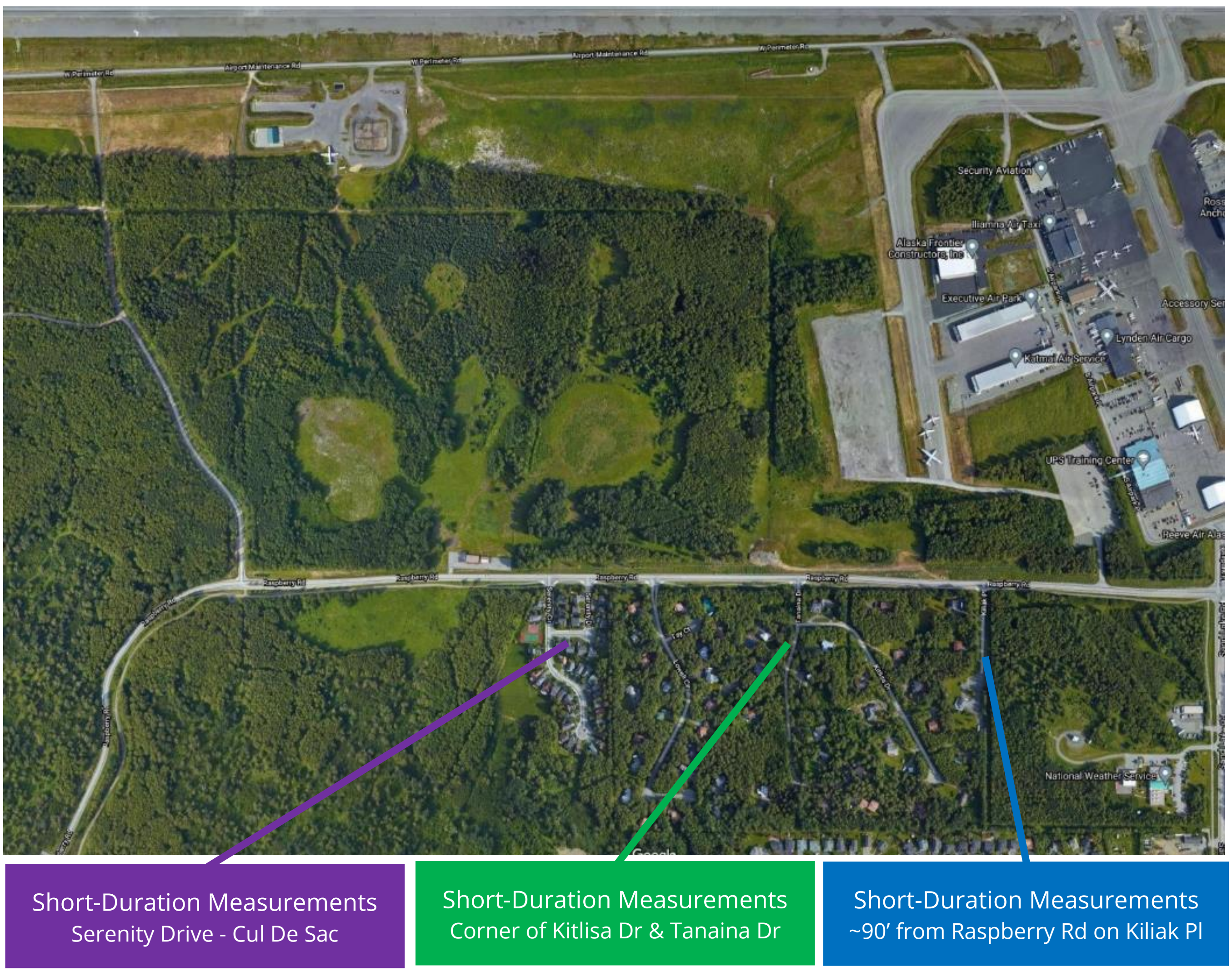


Figure 1: Measurement Locations

The temperatures dropped to 5-degrees Fahrenheit, which is below the performance limit of the noise monitoring equipment batteries. As a result, 12 hours of continuous noise monitoring were recorded, but the evaluation was supplemented with short-duration measurements on the south side of Raspberry Road at the three locations noted.

The estimated DNL used in this analysis was **62 dBA** based on the published FAR 150 yearly average sound exposure and confirmed by the noise measurements near the residential community. The DNL contours used for this estimate were published in the DNL Contours for the east, west, and north flow contours. The predicted background noise and existing DNL did not include any noise documented from south flow flights directly over this community, which can occur based on wind and FAA requirements. Each of the published 2015 FAR Part 150 DNL maps is included in Appendix B of this report.

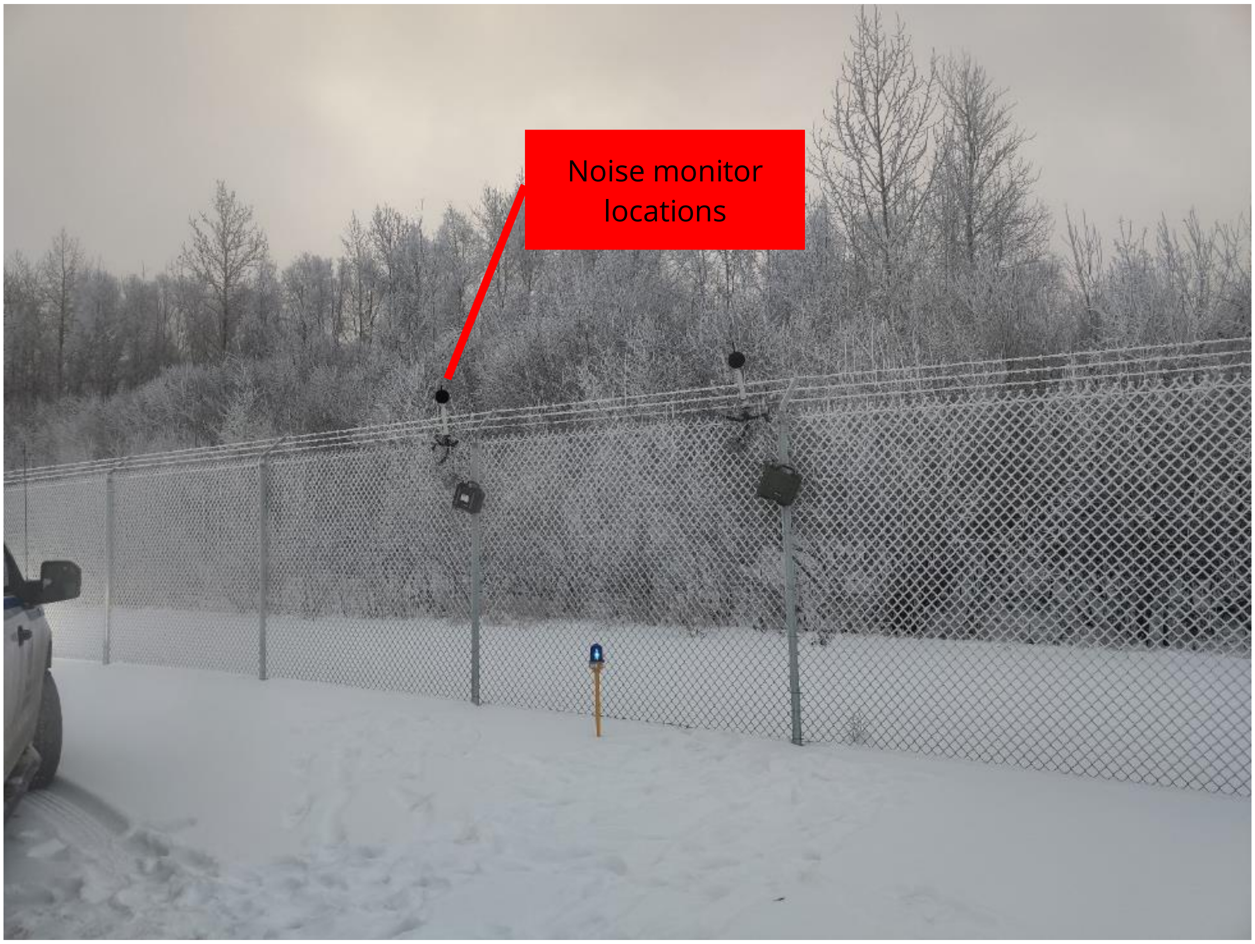


Figure 2: Noise Monitor Locations

3.1.2 Short-Duration Measurements

To supplement the hourly average measurements, short-duration measurements were completed for 15-minutes at four different times of day (9:30 PM on November 15th; 10:30 AM, 3:00 PM, 5:30 PM on November 16th) at the location marked by a **blue** star in Figure 1. Short-duration measurements were also completed on December 23, 2021, at 2:30 PM at the intersection of Kitlisa Dr and Tanaina Dr (location marked by a **green** star in Figure 1) and at 2:50 PM at the cul-de-sac at the mid-point of Serenity Dr (location marked by a **purple** star in Figure 1). The octave band sound levels for each of these locations are shown in Figure 3.

Corner of Kitlisa Dr and Tanaina Dr

Cul-de-Sac of Serenity Drive

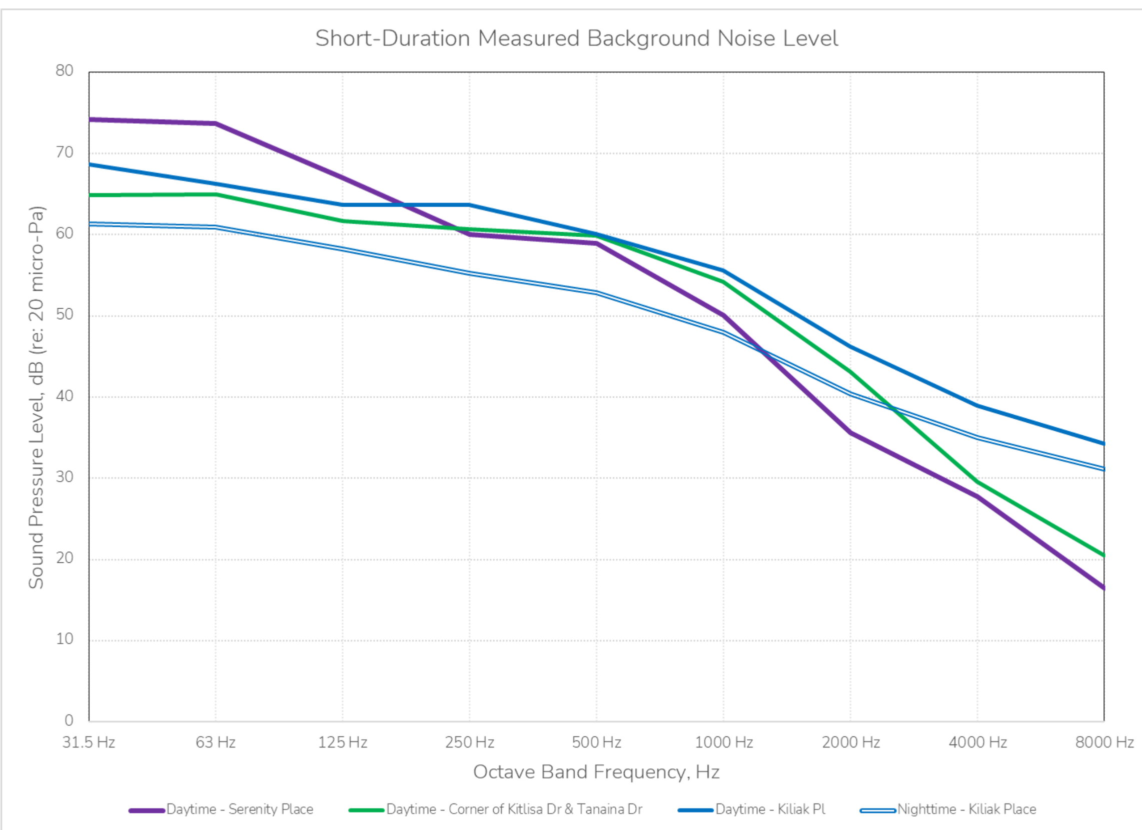


Figure 3: Short-Duration Handheld Measurement Results (Octave Band Unweighted Sound Pressure Levels)

The overall A-weighted sound levels at each of these locations for the noted times are shown in Table 1 below.

Table 1: Average Sound Levels within Community

Measurement Location	LA_{eq},15-minute Average Sound Pressure Level, dBA
Kitlisa Dr and Tanaina Dr (Daytime)	59.6 dBA
Serenity Dr (Daytime)	58.7 dBA
Kiliak Pl (Daytime)	60.4 dBA
Kiliak Pl (Nighttime)	53.5 dBA

All of these measurements were completed using Svantek 971 (Type 1) precision sound level analyzers that were calibrated to 1,000 Hz at 114 dB before and following each measurement period.

The background noise measurements were conducted with at least 12-inches of snow on the ground between the airport and the residential community, which increases ground attenuation when compared with summer conditions (without snow on the ground). Therefore, the measured background noise levels during winter conditions are likely quieter than they would be during the spring and summer months.

3.2 Arithmetic Approach

This methodology used aircraft taxi source data and noise attenuation based on the distance, vegetation, and 25’ berm. The following sections describe the details of the values used for the calculations.

3.2.1 Source – Aircraft Taxiing

The sound power levels for the aircraft used in this analysis are based on detailed measurements noted in the ***Aircrafts’ taxi noise emission***[2] paper from the Grupo de Investigación en Instrumentación from 2008. This study is the most thorough evaluation and accounting of engine noise during aircraft taxiing.

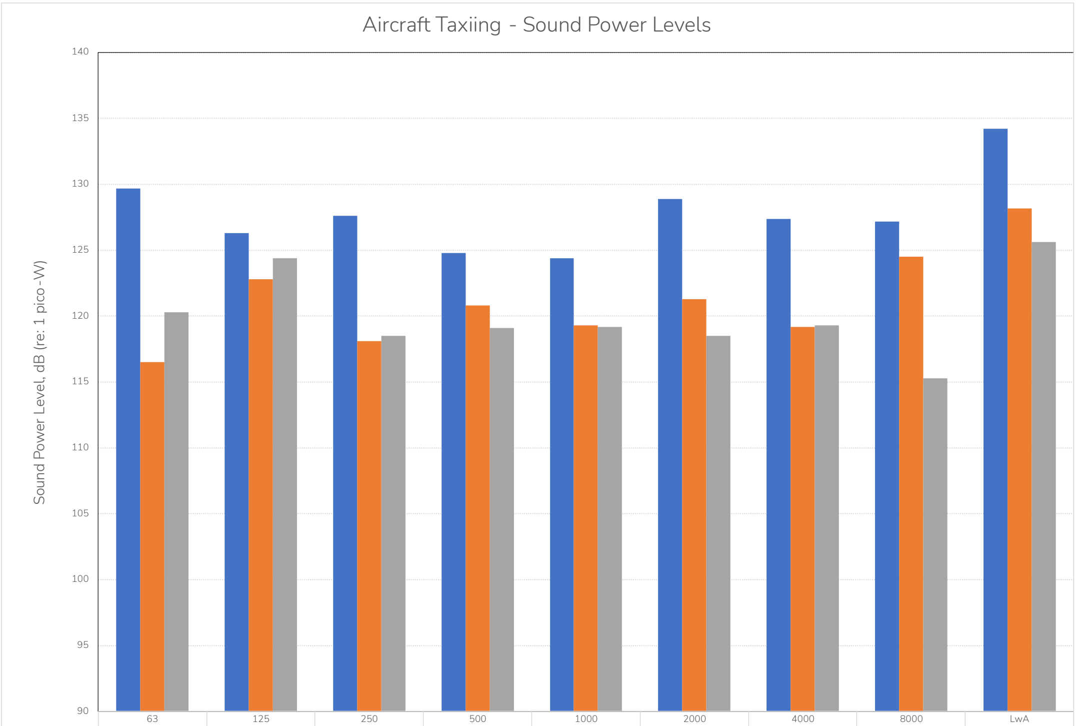
The researchers measured the noise along a 200-meter length area/runway where operations are representative of aircrafts taxiing in a straight line with constant speed. In this paper, five microphone positions uniformly distributed parallel to the runway were used; two different heights were used (2m and 4m above ground). For each family of aircraft, and each microphone location, sound pressure level spectra were averaged and used to calculate sound power levels. For directivity, the measured time histories were used to calculate the directivity index of noise sources where a function relating time history and the angle between the axis of the aircraft and each microphone were used to express measured levels against time or its related angle then calculated per ISO 9613. Their study evaluated 19 airframes.

For the South Airpark analysis, the Boeing 747-400 sound data was used from the paper because it is the most common cargo aircraft at Anchorage International Airport and based on the research paper, the Boeing 747-400 is the loudest airframe with a calculated sound power level of 134.2 LwA.

	Octave Band Frequency, Hz								
Airframe	*63*	*125*	*250*	*500*	*1000*	*2000*	*4000*	*8000*	**LwA**
747-400	129.7	126.3	127.6	124.8	124.4	128.9	127.4	127.2	**134.2**

Note: Octave band noise levels are unweighted

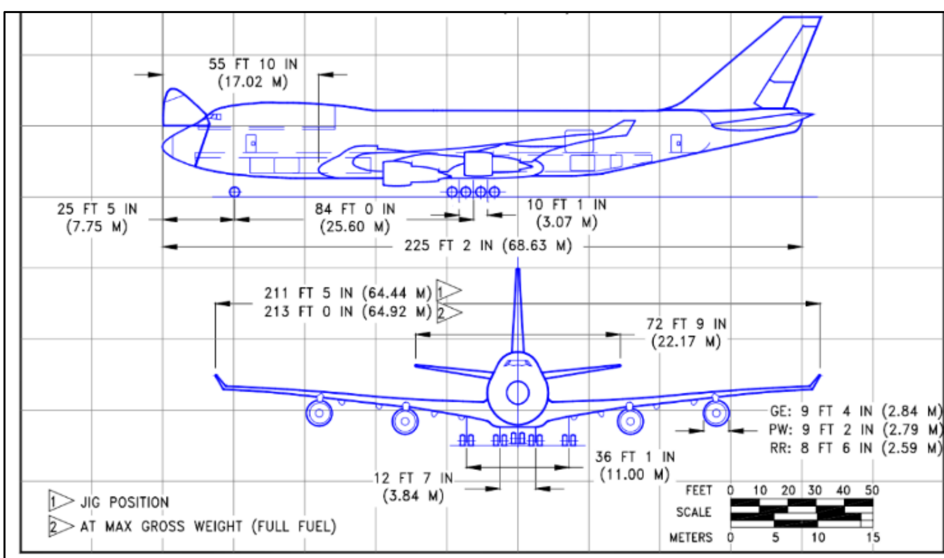
[2] Asensio, C., Pagan R., Lopez, J.M., Noise and Vibration Worldwide, 2008.



	63	125	250	500	1000	2000	4000	8000	LwA
Boeing 747-400	130	126	128	125	124	129	127	127	134
MD 88	117	123	118	121	119	121	119	125	128
Airbus A320	120	124	119	119	119	119	119	115	126

Figure 4: Sound Power Levels for Aircraft Taxiing

The average height of the center of the engine is approximately 9'-0" above the ground as shown in the following schematic of a Model 747-400. This representative engine center height of 9'-0" was used in the analysis to estimate the potential noise impact at the nearest residential community.



2.2.2 GENERAL DIMENSIONS
MODEL 747-400 FREIGHTER, -400ER FREIGHTER

Source: [Airplane Characteristics for Airport Planning, Boeing, December 2002]

3.2.2 Operating Conditions

Figure 5 illustrates the proposed project layout. For the purpose of this analysis, noise sources were placed on the southernmost taxiway and the middle taxiway representing distances of 1,050-feet and 1,650-feet from the nearest residential area, respectively.

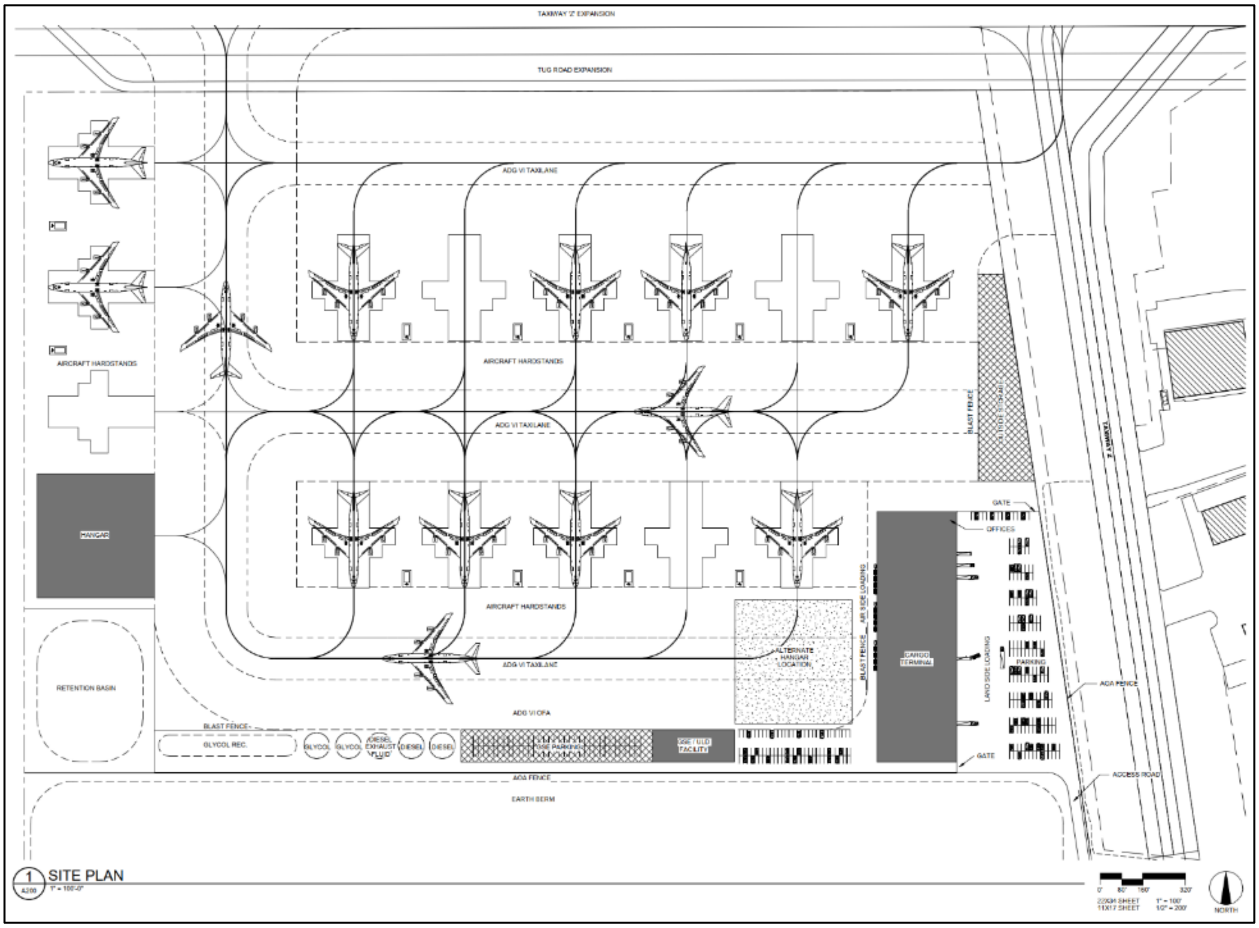


Figure 5: Noise Modeled Airpark Development Plan

Total Daytime Aircraft: 15 planes = 30 Trips

- Each arrival, unload, refueling, reloading takes approximately 90 minutes
- Based on turn-around time, the limited area of the taxiway, and expected airframe safety operation protocols, the maximum number of estimated daytime planes moving concurrently within this area was predicted to be 3 and a maximum of 12 movements within a single hour. With the start-up and taxiing lasting approximately 5 to 10 minutes within the Airpark.

Total Nighttime Aircraft: 6 planes = 12 Trips

- Based on the limited number of trips within the 9-hour nighttime window, the maximum number of estimated nighttime planes moving concurrently within this area was predicted to be 2 with the start-up and taxiing lasting approximately 5 to 10 minutes within the Airpark.

3.2.3 Noise Attenuation

Distance

The distance reduction is calculated based on hemispherical radiation, directivity factor Q = 2, and the equation associated with distance in feet, r, shown in Eq. 1. The distance was estimated based on the site design layout drawing shown in Figure 6.

Eq. 1: $Distance\ Reduction\ (dB) = -10 * \log\left(\frac{Q}{4\pi r^2}\right) - 10.3$

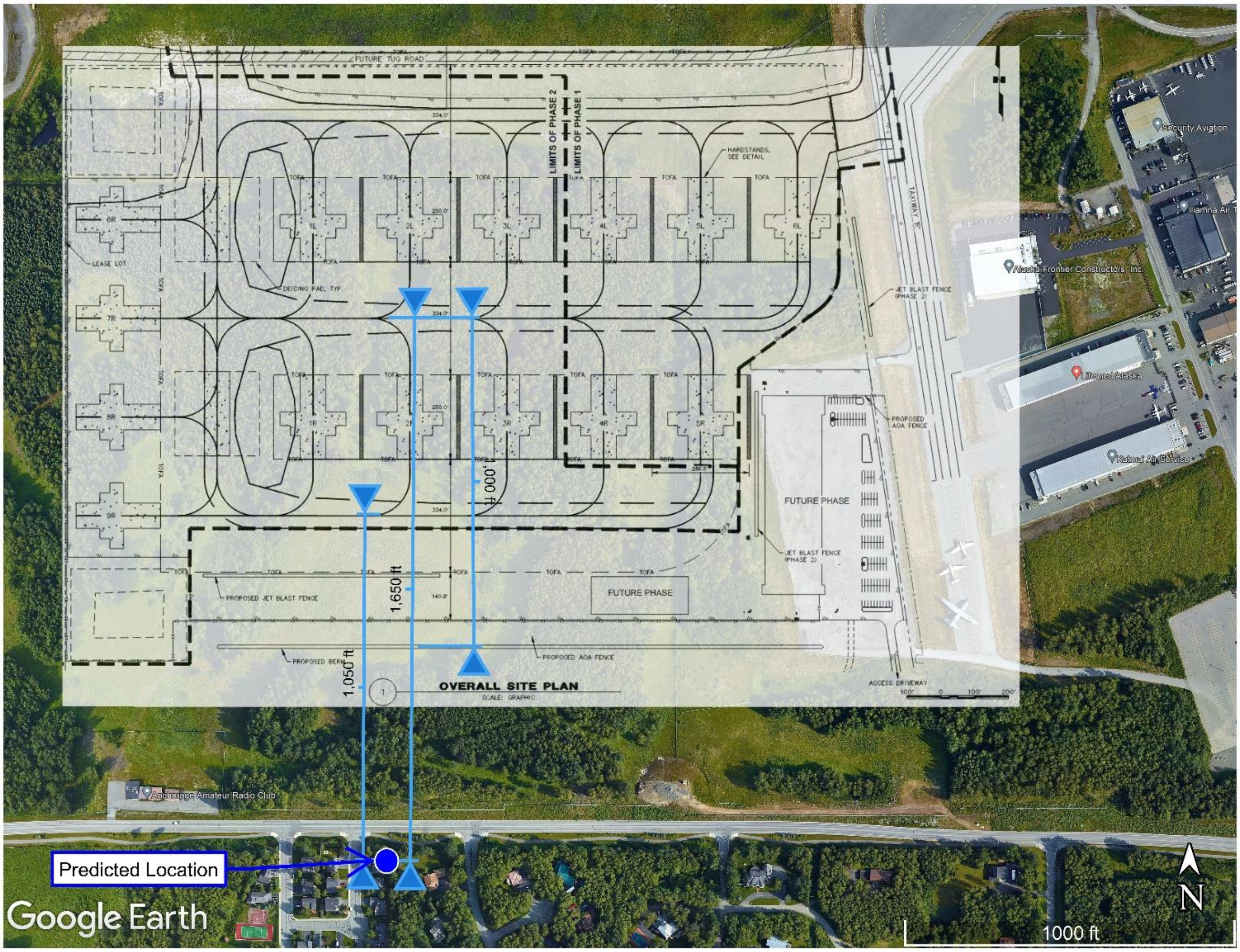


Figure 6: Site Plan Scaled Drawing

Vegetation

The arithmetic analysis used calculations based on the estimated thickness of the vegetation between the Airpark and nearest residential community based on the calculations due to general vegetation types from ISO 9613-3 (1996).

Octave Band Frequency	63	125	250	500	1000	2000	4000	8000	NR, dBA
ISO 9613-2 (1996) - Annex A.1 Foliage: 350-feet thick	2.1	3.2	4.3	5.3	6.4	8.5	9.6	12.8	**8.4**

Barrier Effect from 25'-0" berm

The arithmetic analysis used the geometry from the middle row of the airpark (1,650-feet) to the highest predicted window height (16.5-ft) at the nearest northern residence. The insertion loss is calculated by frequency based on the sound diffraction derived from the Fresnel equation for diffraction. The estimated noise reduction is based on the noise data for the proposed Boeing 747-400 cargo aircraft.

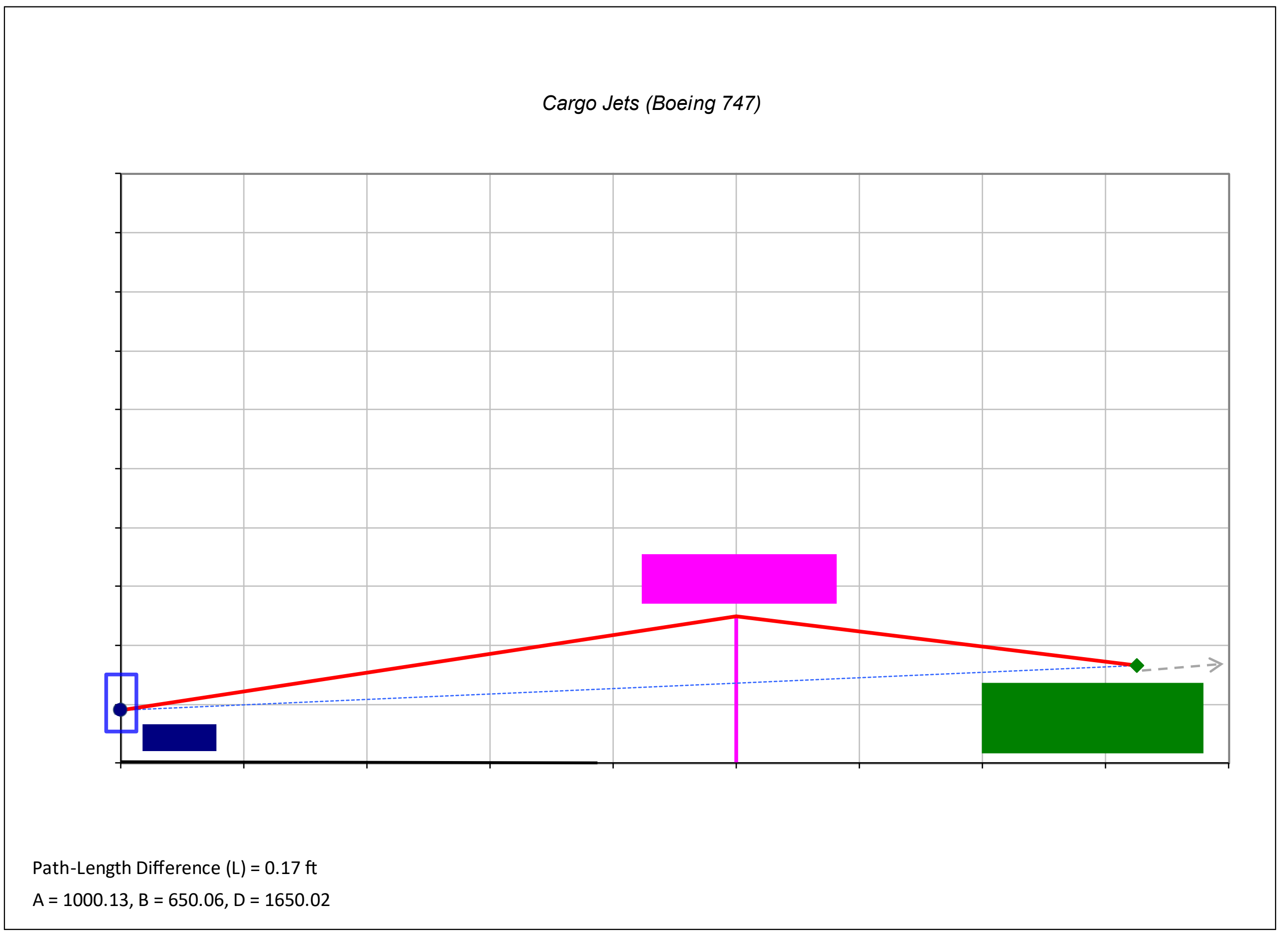


Figure 7: Sketch of Barrier Geometry

Octave Band Frequency	63	125	250	500	1000	2000	4000	8000	NR, dBA
Insertion Loss @ Receiver due to Barrier	8.3	8.6	9.2	10.2	11.8	14.1	16.8	19.7	**14.1**

3.2.4 Arithmetic DNL Calculations

The predicted DNL was derived based on the predicted number of plane movements in a given hour, the time of day, and the type of movement. The following assumptions were made for this analysis and incorporated into estimates for the hourly average sound levels.

1) Maximum of 42 plane movements per day from 21 airframes
   - 30 movements during daytime hours (7:00 AM – 10:00 PM)
   - 12 movements during nighttime hours (10:00 PM – 7:00 AM the next day)
2) Plane noise used the published sound power level from 2008 Aircrafts' taxi noise emission publication for 747-400 (four engine aircraft)
3) Plane noise was predicted to be static for the predicted duration of movement at the nearest predicted point to the northern most edge of the south residential community.
   a. This was done to simplify the calculations, but does not take into account the additional distance caused by the plane taxiing out to the north and east (away from this community) to the nearest runway or taxiing in from the north to a parked position.
4) When more than one aircraft are operating within one hour, two safe operating distances were used in the prediction. The estimated average sound level from concurrent activities and with time correction are noted in the tables below.
5) All aircraft will be on shore power for the duration of loading and unloading with APUs off.

Estimated DNL from 10-minute Taxiing Activities.

The predicted sound pressure levels are converted to hourly average noise levels (Leq(h)) by using the fraction of an hour for the activities that will occur in a given hour as shown in Eq. 2.

Eq. 2: $Time\ Factor\ (dB) = 10 * \log\left(\frac{t}{60}\right)$

t = minutes

$Time\ Factor\ (dB) = 10 * \log\left(\frac{10}{60}\right) =$ **-7.8 dB**

t = 10 minutes

Table 2: One Plane Movement (10-minutes)

	Source	Sound Power, L_WA	Distance Reduction (ft)	Vegetation Reduction	25-ft Berm Noise Reduction	Sound Pressure, dB(A)	Hourly Average from 10-minutes of Taxiing
1	Aircraft Taxiing OUT	134.2	-58.1 (1050')	-8.4	-14.1	53.6	45.8
		Combined SPL at Property Line (dBA)				**53.6**	**45.8**

Table 3: Two Plane Movement (10-minutes)

	Source	Sound Power, L_WA	Distance Reduction (ft)	Vegetation Reduction	Reduction Factors	Sound Pressure, dB(A)	Hourly Average from 10-minutes of Taxiing
1	Aircraft Taxiing IN	134.2	-62.0 (1650')	-8.4	-14.1	49.7	41.9
1	Aircraft Taxiing OUT	134.2	-58.1 (1050')	-8.4	-14.1	53.6	45.8
		Combined SPL at Property Line (dBA)				**55.1**	**47.3**

Table 4: Three Plane Movement (10-minutes)

	Source	Sound Power, L_WA	Distance Reduction (ft)	Vegetation Reduction	Reduction Factors	Sound Pressure, dB(A)	Hourly Average from 10-minutes of Taxiing
1	Aircraft Taxiing OUT	134.2	-62.0 (1650')	-8.4	-14.1	49.7	41.9
1	Aircraft Taxiing OUT	134.2	-58.1 (1050')	-8.4	-14.1	53.6	45.8
1	Aircraft Taxiing IN	134.2	-62.0 (1650')	-8.4	-14.1	49.7	41.9
		Combined SPL at Property Line (dBA)				**56.2**	**48.4**

Table 5: Predicted DNL from 10-minute Aircraft Movements over 24-hour Period

Starting of Hour	Estimated Hourly Average SPL from Aircraft Movements	Aircraft Movements Per Hour	DNL Adjusted
12:00:00 PM	45.8	1	45.8
1:00:00 PM	48.4	3	48.4
2:00:00 PM	47.3	2	47.3
3:00:00 PM	45.8	1	45.8
4:00:00 PM	45.8	1	45.8
5:00:00 PM	47.3	2	47.3
6:00:00 PM	48.4	3	48.4
7:00:00 PM	47.3	2	47.3
8:00:00 PM	45.8	1	45.8
9:00:00 PM	47.3	2	47.3
10:00:00 PM	45.8	1	55.8
11:00:00 PM	45.8	1	55.8
12:00:00 AM	47.3	2	57.3
1:00:00 AM	45.8	1	55.8
2:00:00 AM	47.3	2	57.3
3:00:00 AM	45.8	1	55.8
4:00:00 AM	47.3	2	57.3
5:00:00 AM	45.8	1	55.8
6:00:00 AM	45.8	1	55.8
7:00:00 AM	48.4	3	48.4
8:00:00 AM	47.3	2	47.3
9:00:00 AM	47.3	2	47.3
10:00:00 AM	48.4	3	48.4
11:00:00 AM	47.3	2	47.3
		Estimated DNL	52.9

3.3 CadnaA Approach

A 3-dimensional computer-aided sound propagation and noise abatement model was created using DataKustik's CadnaA software. This software predicts the environmental noise impact based on ISO 9613 standards for sound propagation based on topography (elevations, buildings, barriers, berms, etc.), foliage, and other common environmental noise impact variables. It should be noted that CadnaA as applied herein is being used in limited fashion to validate the conservativeness of the Arithmetic DNL.

3.3.1 CadnaA Modeled Conditions and Variables

The predicted maximum sound levels and DNL values were derived based on the predicted number of plane movements in a given hour, the time of day, and the type of movement. The following variables were modeled with CadnaA using ISO 9613 standard and incorporated into estimates for the hourly average sound levels.

- Four engines operating on Boeing 747-400 freighter for all taxiing movement, but no APU because the aircraft will arrive and depart under their own power and will not require a tug pushback.
  - Predicted noise used a simplified source model:
    - Airframes and wings are not assumed to provide any noise barrier effect.
    - Directionality of noise emissions from the engine nacelle not included in the analysis.
    - The full 10-minute duration is static at the locations shown in the model and does not account for the movement of the aircraft away from the Airpark
  - Maximum of 42 plane movements per day from 21 airframes
    - 30 movements during daytime hours (7:00 AM – 10:00 PM)
    - 12 movements during nighttime hours (10:00 PM – 7:00 AM the next day)
  - When more than one aircraft are operating within one hour, two safe operating distances were used in the prediction. The estimated average sound level from concurrent activities and with time correction are noted in the DNL estimation tables.
  - All aircraft will be on shore power for the duration of loading and unloading with APUs off.

- 25'-0" high earthen berm at south edge of South Airpark property
- 80'-0" high heavy trees, denoted in CadnaA as Foliage
- 40'-0" high cargo building to east, no effect on noise impact to south
- Ground Absorption (G)
  - G, site = 0.02 (concrete)
  - G, outside footprint of South Airpark and taxiway = 1.0 (porous soil)
- Receiver grid (contour map), height = 5'-0"
- Point receiver height = 5'-0"
- Air absorption based on warmest average month, September (NOAA, Wunderground) [3]
  - 55-degrees Fahrenheit

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[3] NOAA – National Weather Service Monthly Normals between 1991 – 2020 (https://www.weather.gov/wrh/Climate?wfo=afc) and Wunderground Daily Average Humidity, September 2021 (https://www.wunderground.com/history/monthly/us/ak/anchorage/PANC/date/2021-9)

- 70% Relative Humidity

3.3.2 CadnaA Model Results

Within a given hour, there can be three, two, or one aircraft movements in the proposed project area. CadnaA was used to predict noise levels at the three northern residences (depicted as D1, D2, and D3 in Figure 8 through Figure 10) near Raspberry Road for the southern residential community from those plane movements.

Figure 8 through Figure 10 present the noise contours from the aircraft taxiing at a moment in time while planes are taxiing within the Airpark predicted to the northern most point of the residential community with the Airpark topography flattened to represent the paved ground-plane. Table 6 presents the results of each case at each receiver location. It should be noted that the noise levels included in Table 6 are the instantaneous noise levels when those cases occur.

Table 6: Predicted Sound Pressure Level (dBA)

Cases	D1	D2	D3
Three Aircraft Taxiing	41.4	42.6	43.3
Two Aircraft Taxiing	38.5	39.9	40.7
One Aircraft Taxiing	34.6	35.9	36.2

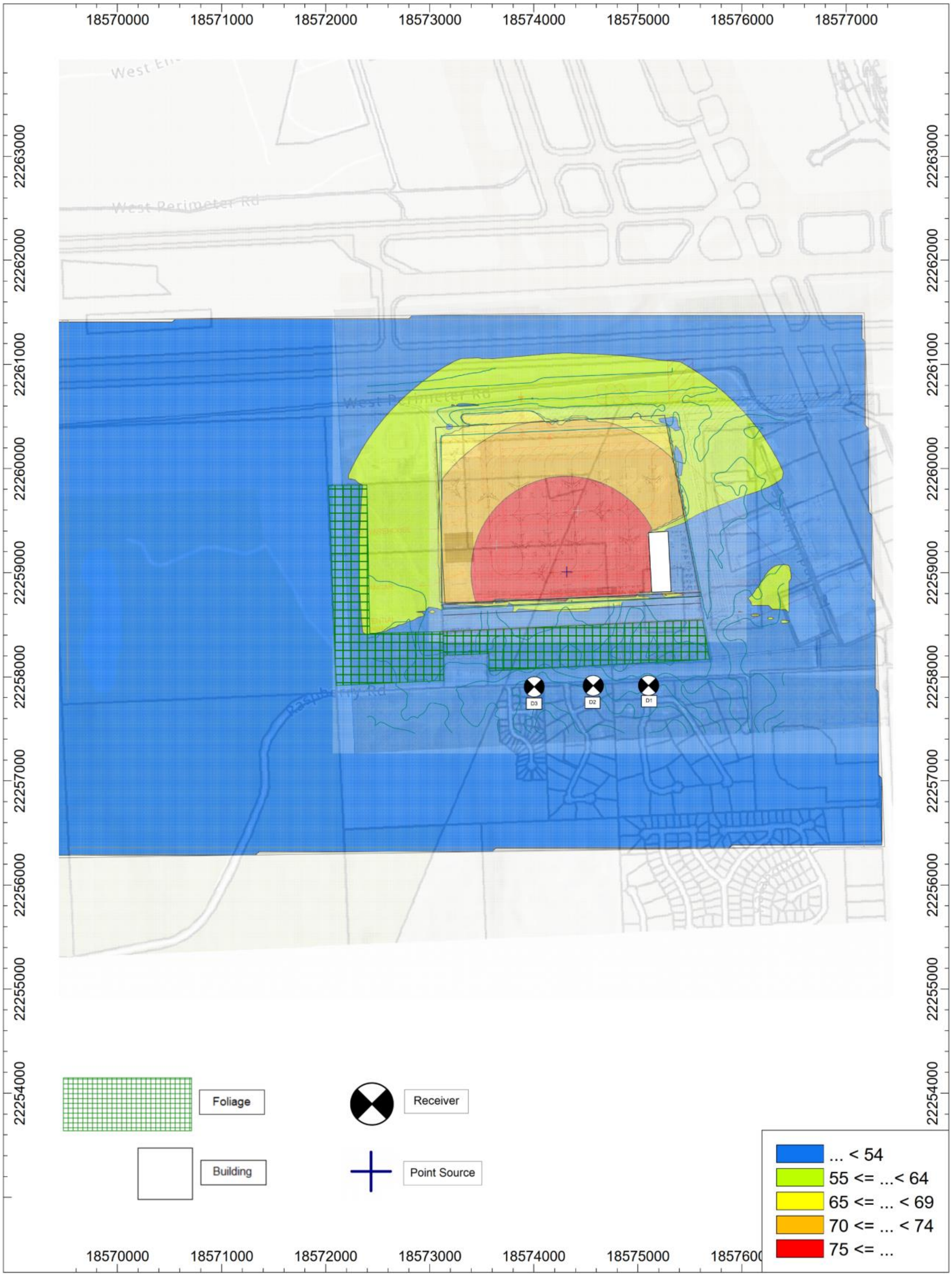

Figure 8: One Aircraft Taxiing

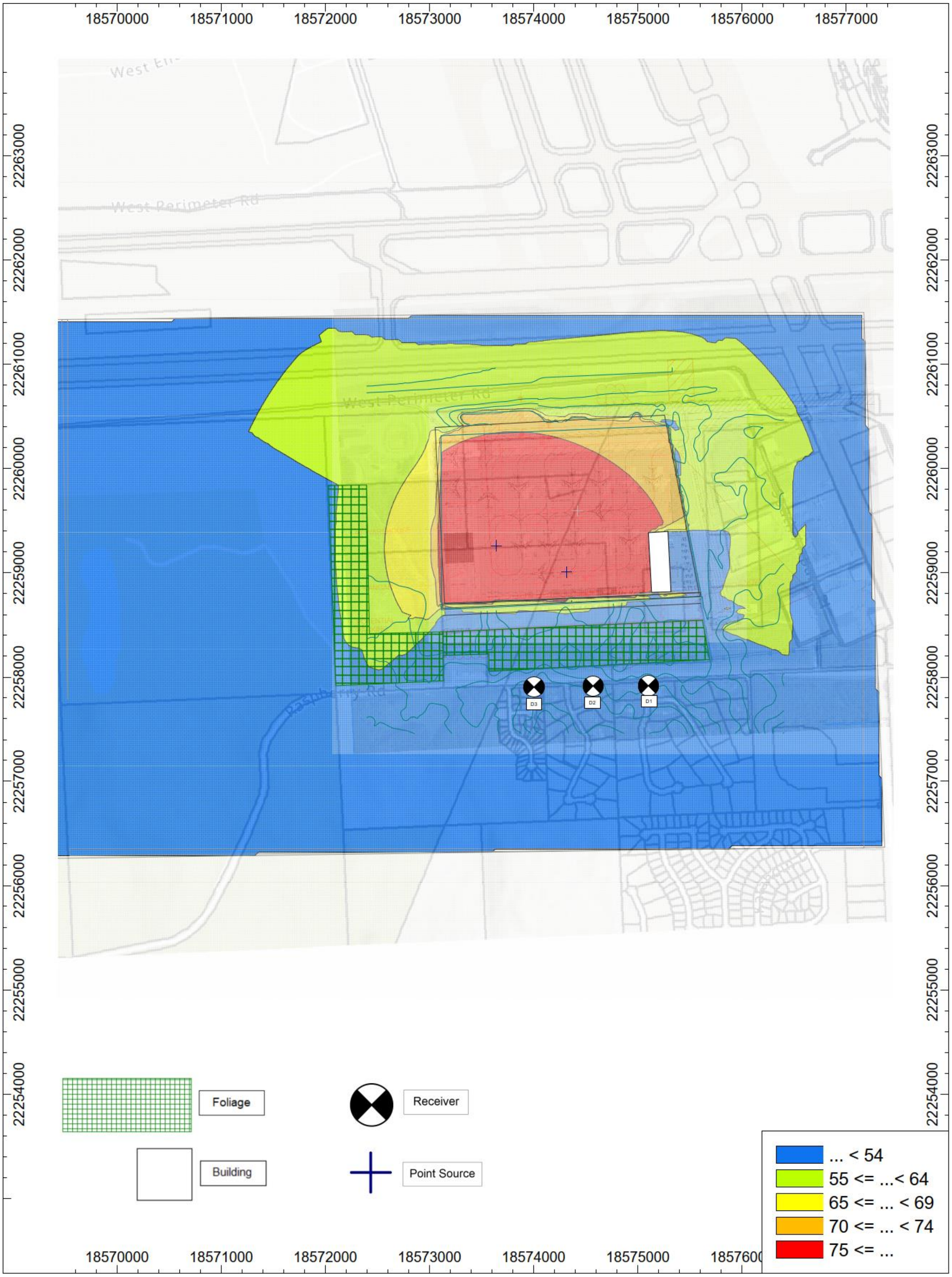

Figure 9: Two Aircraft Taxiing

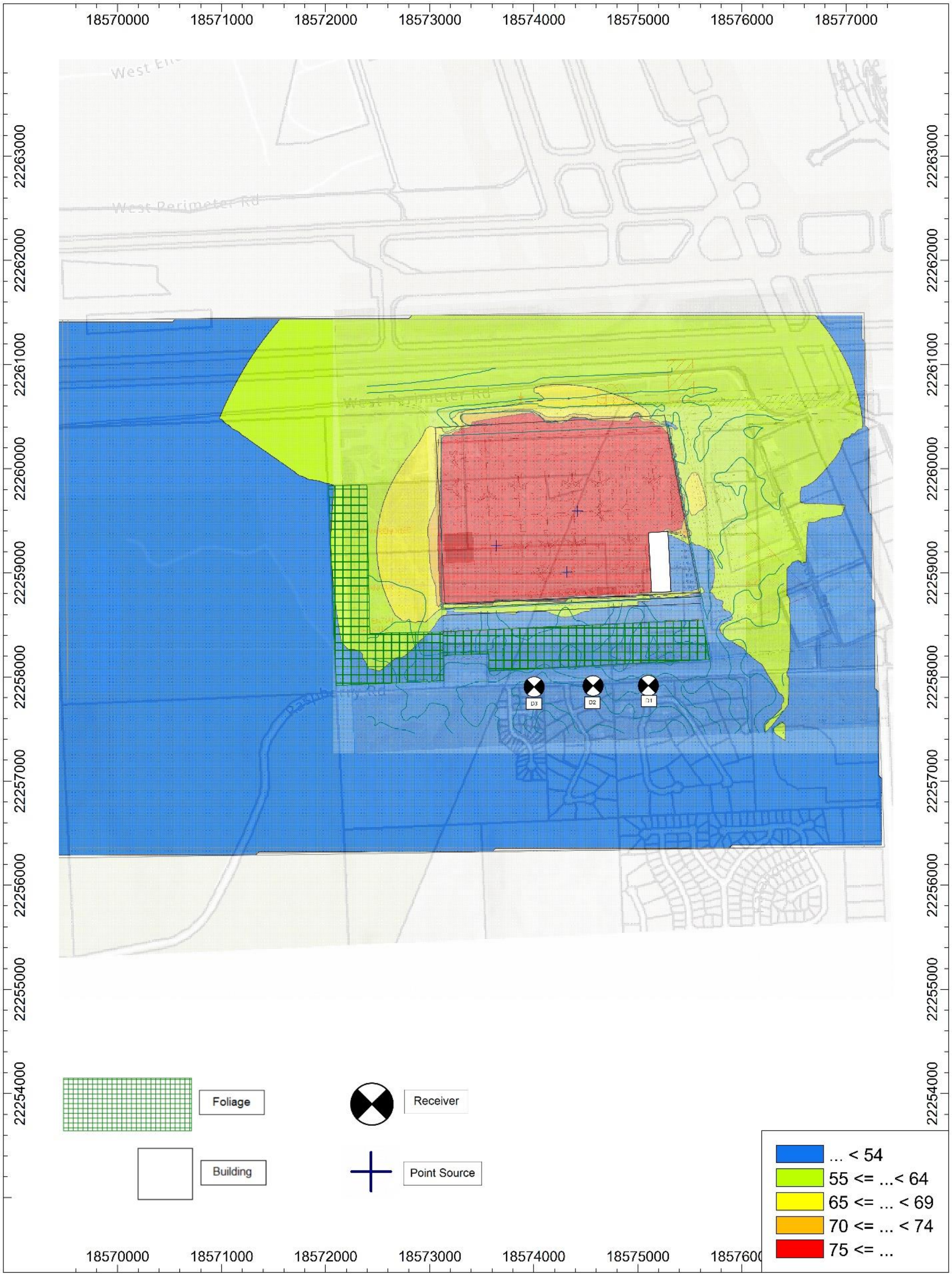

Figure 10: Three Aircraft Taxiing

3.3.3 CadnaA DNL Calculations

The results in Table 6 represent the noise levels when a specific number of aircraft are taxiing at each receiver. Since an aircraft is assumed to be operated for 10 minutes in a given hour, the noise levels in Table 6 are translated to hourly noise level (Leq(h)) by using the below equation.

Eq. 2: $Time\ Factor\ (dB) = 10 * \log\left(\frac{t}{60}\right)$

t = minutes

$Time\ Factor\ (dB) = 10 * \log\left(\frac{10}{60}\right) =$ **-7.8 dB**

t = 10 minutes

Table 7 includes the Leq(h) per aircraft movement case at each receiver location.

Table 7: Hourly Noise Level (dBA)

Cases	D1	D2	D3
Three Aircraft Taxiing	41.4	42.6	43.3
Two Aircraft Taxiing	38.5	39.9	40.7
One Aircraft Taxiing	34.6	35.9	36.2

The hourly noise levels included in Table 7 are used to calculate the DNL values in Table 8, which includes aircraft movement by hour and associated Leq(h) per receiver. DNL values are calculated by averaging all hours of aircraft movement noise levels.

Table 8: DNL Calculation

Starting of Hour	Aircraft Movements Per Hour	D1		D2		D3	
		Leq(h) from Aircraft Movements	DNL Adjusted	Leq(h) from Aircraft Movements	DNL Adjusted	Leq(h) from Aircraft Movements	DNL Adjusted
12:00:00 PM	1	34.6	34.6	35.9	35.9	36.2	36.2
1:00:00 PM	3	41.4	41.4	42.6	42.6	43.3	43.3
2:00:00 PM	2	38.5	38.5	39.9	39.9	40.7	40.7
3:00:00 PM	1	34.6	34.6	35.9	35.9	36.2	36.2
4:00:00 PM	1	34.6	34.6	35.9	35.9	36.2	36.2
5:00:00 PM	2	38.5	38.5	39.9	39.9	40.7	40.7
6:00:00 PM	3	41.4	41.4	42.6	42.6	43.3	43.3
7:00:00 PM	2	38.5	38.5	39.9	39.9	40.7	40.7
8:00:00 PM	1	34.6	34.6	35.9	35.9	36.2	36.2
9:00:00 PM	2	38.5	38.5	39.9	39.9	40.7	40.7
10:00:00 PM	1	34.6	44.6	35.9	45.9	36.2	46.2
11:00:00 PM	1	34.6	44.6	35.9	45.9	36.2	46.2
12:00:00 AM	2	38.5	48.5	39.9	49.9	40.7	50.7
1:00:00 AM	1	34.6	44.6	35.9	45.9	36.2	46.2
2:00:00 AM	2	38.5	48.5	39.9	49.9	40.7	50.7
3:00:00 AM	1	34.6	44.6	35.9	45.9	36.2	46.2
4:00:00 AM	2	38.5	48.5	39.9	49.9	40.7	50.7
5:00:00 AM	1	34.6	44.6	35.9	45.9	36.2	46.2
6:00:00 AM	1	34.6	44.6	35.9	45.9	36.2	46.2
7:00:00 AM	3	41.4	41.4	42.6	42.6	43.3	43.3
8:00:00 AM	2	38.5	38.5	39.9	39.9	40.7	40.7
9:00:00 AM	2	38.5	38.5	39.9	39.9	40.7	40.7
10:00:00 AM	3	41.4	41.4	42.6	42.6	43.3	43.3
11:00:00 AM	2	38.5	38.5	39.9	39.9	40.7	40.7
Estimated DNL (dBA)			43.2		44.6		45.2

Notes:
DNL Adjusted values represent 10 dB addition for nighttime hours, between 10pm - 7am, to account for additional sensitivity during normal sleeping hours.

The DNL values ranged from 43.2 dBA at D1 to DNL 45.2 dBA at D3. The results were well below the predicted DNL from arithmetic calculation and confirm the conservativeness of the arithmetic DNL calculations.

4 Noise Control Plan

The project plan will include a 25'-0" earthen berm that will be landscaped. The planned 25'-0" high earthen berm was included in the acoustical models.

The operational plan notes that the aircraft will be on engine power during start-up and taxiing. The site will include shore power for all other auxiliary requirements.

5 Conclusion

This noise analysis concludes based on the application of an Arithmetic DNL Calculation that the new cargo operations (21 aircraft completing 42 trips) would be **53 dBA** when assuming aircraft taxi for 10 minutes at the Airpark and immediate vicinity. CadnaA DNL value calculations and contour modelling, as corrected for topography, supports this conclusion as a conservative estimate.

Please contact us with any questions and additional coordination.

All the best,

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APPENDIX A. 2020 ANC Predicted DNL Noise Contour Map

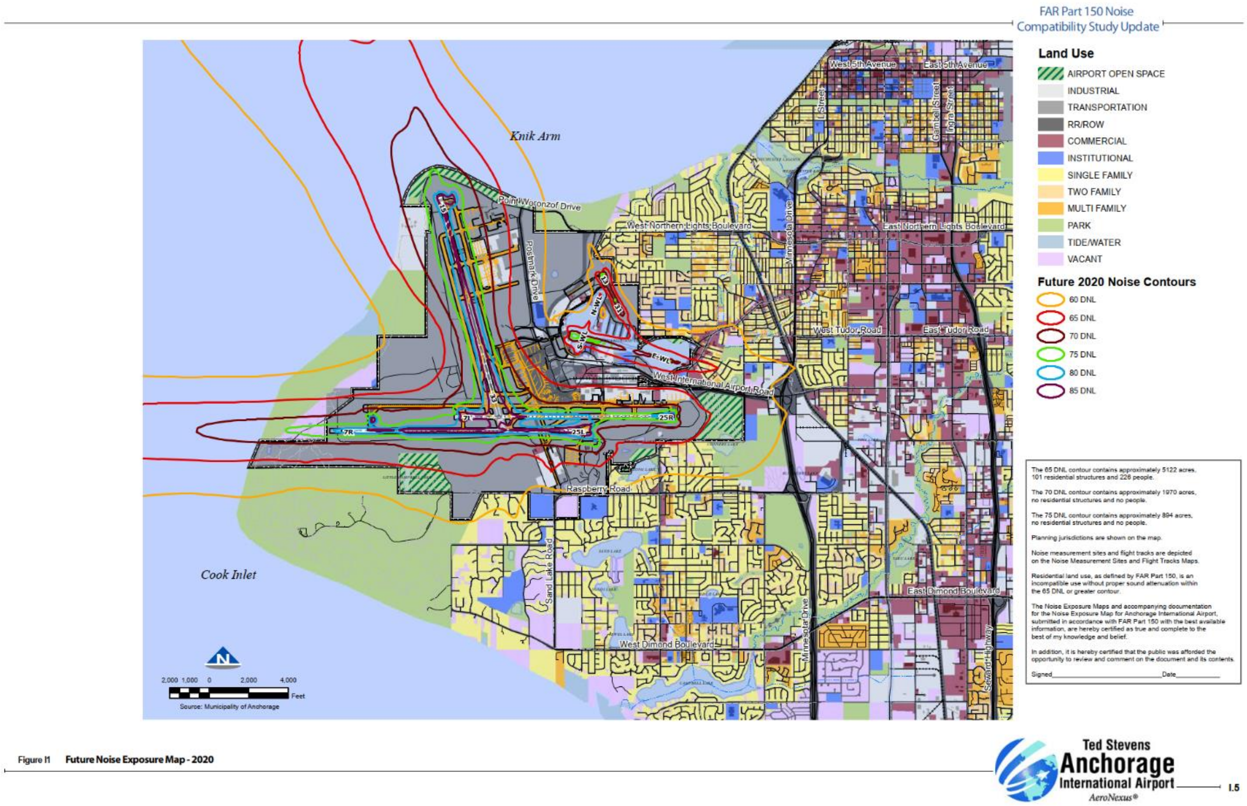
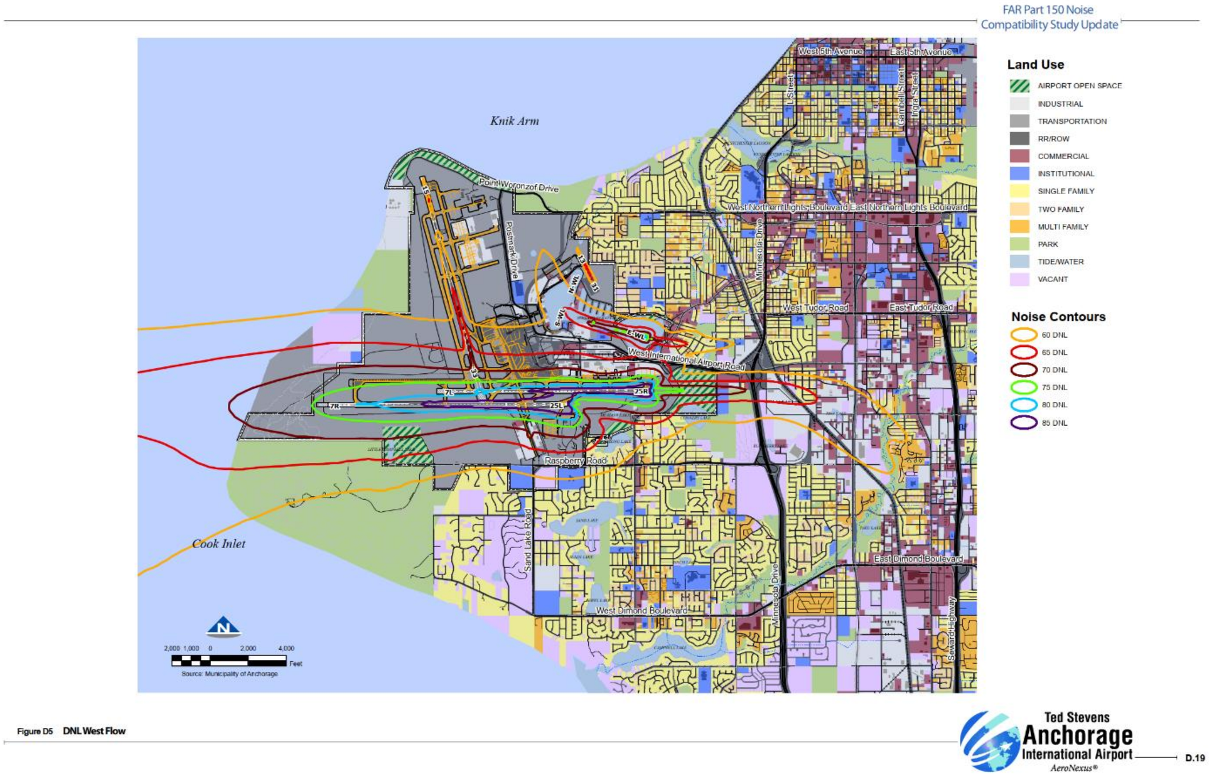
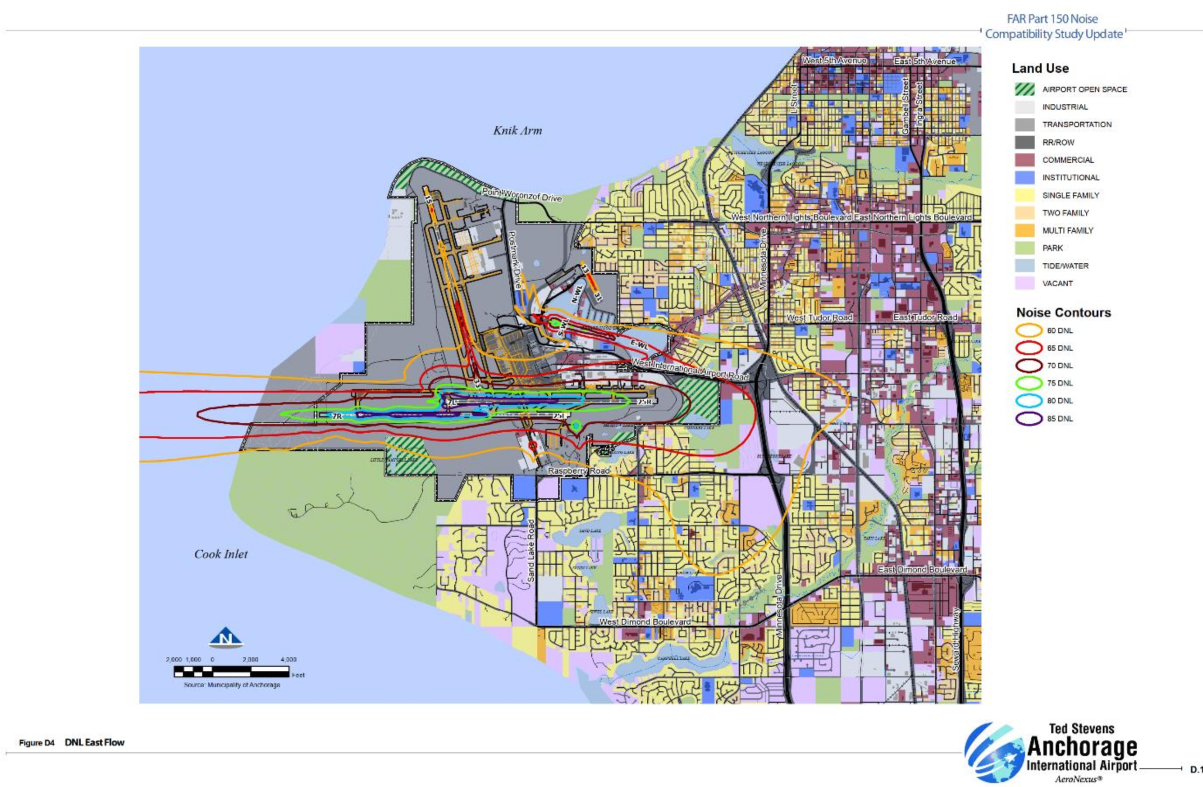


Figure I1 Future Noise Exposure Map - 2020

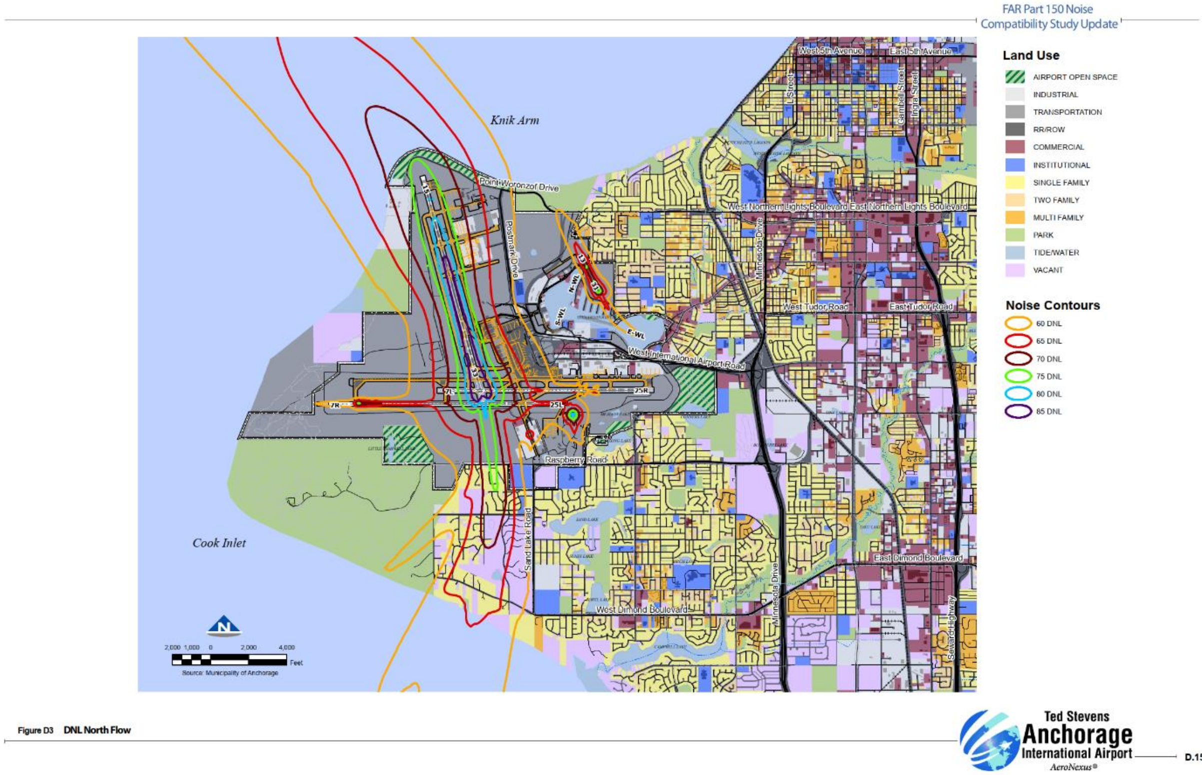
APPENDIX B. 2015 ANC DNL Noise Contour Map by Flow Direction



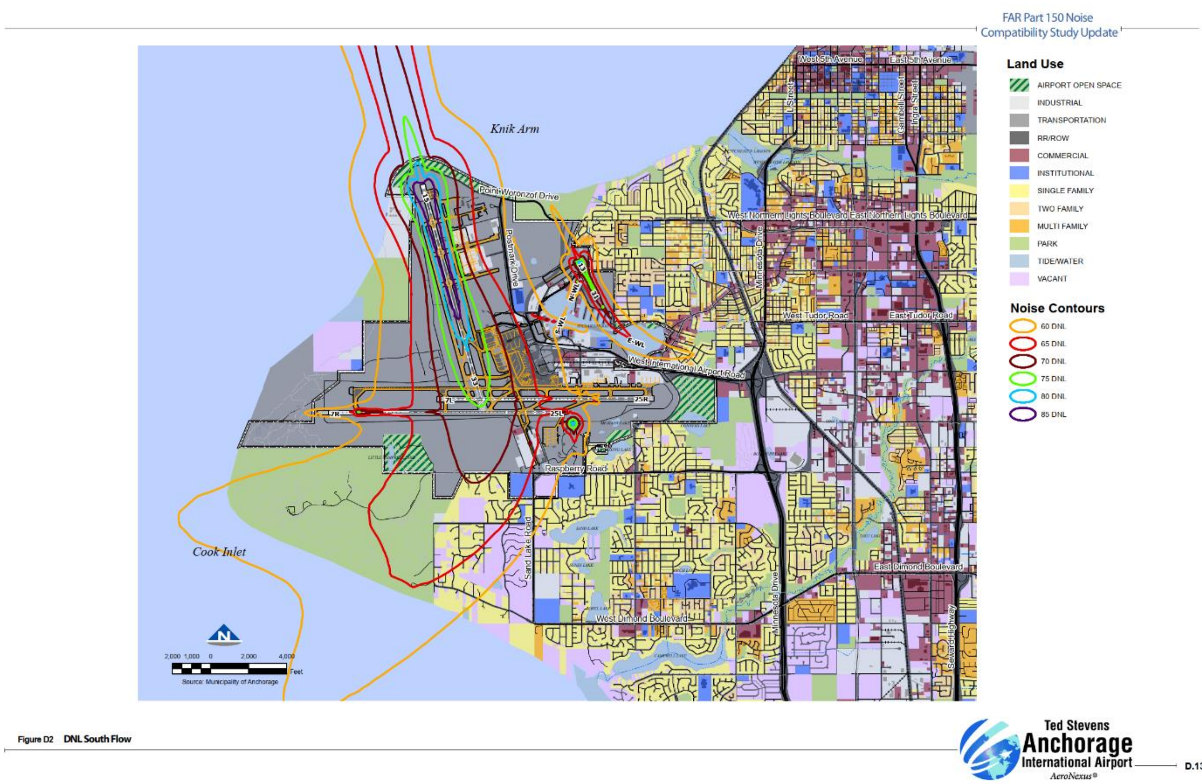
West Flow



East Flow



North Flow



South Flow

APPENDIX C. Descriptors

Sound Pressure Level, L_p – specifies the perceived sound at a receiver or measurement location that is dependent on distance and environmental conditions. This is what a person hears or microphone measures in a location in space, referenced to 20 micro-Pascals.

Sound Power Level, L_w – specifies the sound emission from a source independent of distance and environmental conditions. It is the potential acoustic energy of a source that is calculated and measured based on sound emission and emitting area, referenced to one picowatt.

Average Noise Level (Leq) – is the time-average sound level documented in decibels that is noted with the measured time interval.

Maximum Sound Level (Lmax) – is the highest sound level measured during a single noise event and is documented with the time response (Slow – 1 second, Fast – 0.125 second, Impulse – 0.035 second).

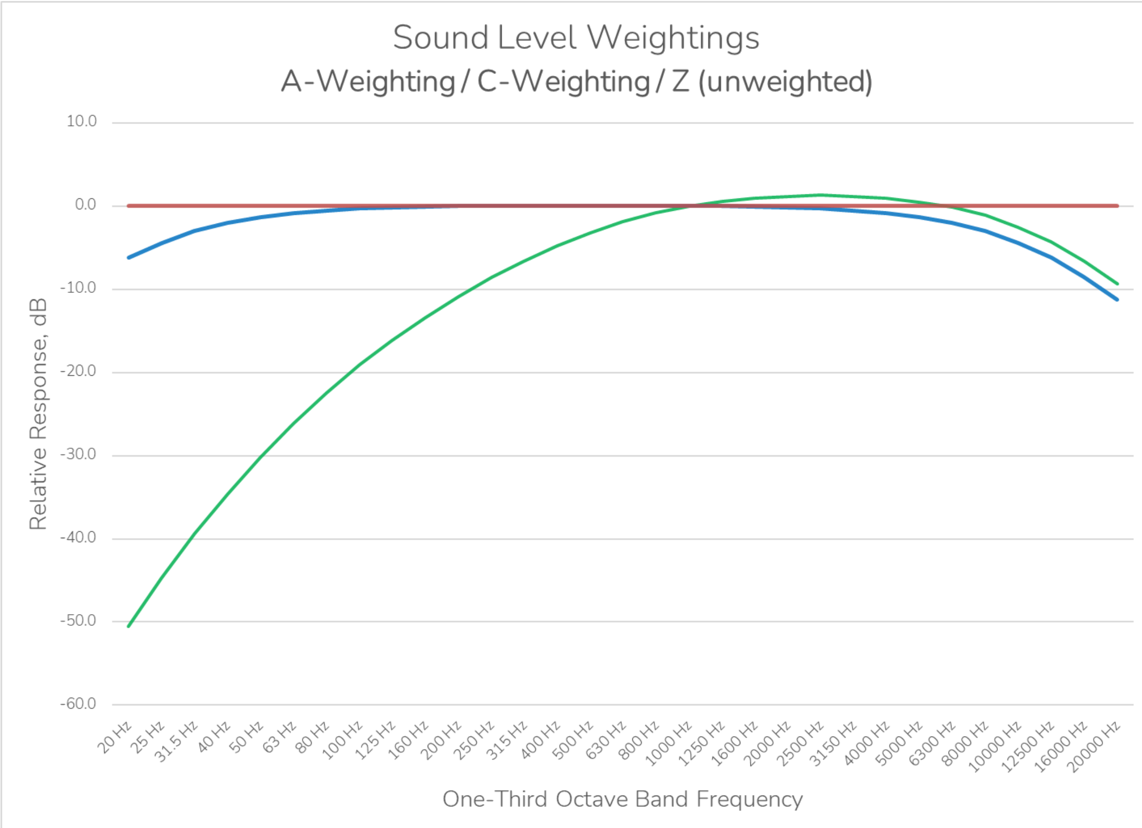
Day-Night Average Noise Level (Ldn / DNL) – is the average A-weighted sound level for a 24-hour period of time that applies a 10 dB penalty during nighttime (sleeping hours) between 10:00 PM and 7:00 AM the next day. This metric is used to approximate the noise impact from environmental noise on residential communities and multi-family properties/buildings.

A-Weighting (dBA) – is the summed sound level that weighs for the sensitivity of the human ear as a function of frequency for relatively quiet levels of sound. In effect, the A-weighting is based on the 40-phon Fletcher–Munson curves which represented an early determination of the equal-loudness contour for human hearing.

C-Weighting (dBC) – is the summed sound level that weighs for the sensitivity of human hearing for loud sound levels. This weighting follows the inverted shape of the equal-loudness contour passing through 100 dB at 1 kHz. It effectively describes the contribution of low-frequency noise with a single summed value.

Z-Weighting / Unweighted (dBZ) – is the non-weighted summed sound level and is usually used for sound level reporting for one-third and single octave bands.

Graph of Weightings defined on page 27.



ATADS : Airport Operations : Standard Report

From 01/2005 To 06/2023 | Facility=ANC

		Itinerant					Local			
Facility	Calendar Year	Air Carrier	Air Taxi	General Aviation	Military	Total	Civil	Military	Total	Total Operations
ANC	2005	133,314	87,761	82,274	5,982	309,331	6,895	16	6,911	316,242
ANC	2006	131,963	86,714	72,865	4,116	295,658	7,450	0	7,450	303,108
ANC	2007	129,453	86,449	73,741	4,843	294,486	5,512	56	5,568	301,215
ANC	2008	115,854	84,016	70,609	5,105	275,584	5,278	14	5,292	284,777
ANC	2009	99,065	71,612	73,941	4,385	249,003	7,629	0	7,629	256,632
ANC	2010	114,452	74,937	74,815	4,401	268,605	6,173	0	6,173	274,778
ANC	2011	108,299	78,399	78,101	2,401	267,200	6,047	56	6,103	273,303
ANC	2012	102,348	80,569	77,107	2,250	262,274	8,715	8	8,723	270,997
ANC	2013	100,992	77,883	74,361	2,294	255,530	8,814	46	8,860	264,390
ANC	2014	101,135	78,905	83,332	2,165	265,537	11,424	50	11,474	277,011
ANC	2015	107,026	81,636	78,455	2,153	269,270	9,381	33	9,414	278,684
ANC	2016	105,611	84,827	78,860	2,393	271,691	8,128	42	8,170	279,861
ANC	2017	106,195	82,602	73,773	2,549	265,119	11,258	30	11,288	276,407
ANC	2018	108,403	82,513	73,039	2,581	266,536	8,585	68	8,653	275,189
ANC	2019	107,623	78,513	71,505	2,930	260,571	9,275	56	9,331	269,902
ANC	2020	111,896	50,303	69,717	3,166	235,082	10,177	24	10,201	245,283
ANC	2021	132,749	63,043	75,021	3,533	274,346	11,541	0	11,541	285,887
ANC	2022	131,006	69,556	64,704	4,003	269,269	7,852	0	7,852	277,121
ANC	2023	60,128	31,589	26,021	3,144	120,882	5,049	0	5,049	125,931
Sub-Total for ANC		2,107,512	1,431,827	1,372,241	64,394	4,975,974	155,183	499	155,682	5,136,718
Total:		**2,107,512**	**1,431,827**	**1,372,241**	**64,394**	**4,975,974**	**155,183**	**499**	**155,682**	**5,136,718**

Report created on Fri Jul 21 14:59:01 EDT 2023

Sources: Air Traffic Activity System (ATADS)

Show data notices.

Chapter B - Forecasts

INTRODUCTION. Ted Stevens Anchorage International Airport (ANC) is a vital part of the Alaska International Airport System (AIAS). Concurrent to this Part 150 Study Update, the Alaska International Airport System was conducting an update to the system-wide forecasts including Ted Stevens Anchorage International Airport, Lake Hood Seaplane Base and Fairbanks International Airport. Forecasts were developed for 2015, 2020, 2025, and 2030. These forecasts are presented in detail in the *Alaska International Airport System Plan Forecast Tecnhical Report*. Because these forecasts were completed concurrent with the start of the Part 150 Study Update, it was decided to use these forecasts as a basis for the Part 150 Study to keep the Study consistent with the other planning studies.

Background

Projections of aviation demand that were developed as part of the *AIAS Forecast Technical Report* were prepared in accordance with guidance found in Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5070-6B, Airport Master Plans. These forecasts were then used to provide the basis for several operational inputs into the Integrated Noise Model (INM) for this Part 150 Noise Study. The forecasts were approved by the FAA on September 13, 2012. The approval letter can be found in the **Forecast Appendix** of this Study.

In preparing a Federal Aviation Regulation (FAR) Part 150 Noise Compatibility Plan, one of the key products is the preparation of the Noise Exposure Maps (NEMs). The NEMs identify the existing and future noise exposure (typically five years into the future from the date of submission of the NEMs), and are prepared using the FAA's INM. For this case, 2009 was used as the existing base case year because it was the last full year of operations without operational changes (such as runway closures due to maintenance). This information was pulled from airport tower counts. The future base case examined will be 2020, which is approximately five years from the date of expected submission of the contours to FAA. Additionally, a 2030 scenario will be developed for planning/informational purposes only.

To prepare a noise exposure contour map for a particular year, the INM requires information concerning the number of aircraft operations, the types of aircraft (fleet mix), and the time of day (day or night) that the activity occurs. As stated above, the 2009 data was pulled from airport tower counts and flight track data. For 2020 and 2030, the methods of the forecast development can be found within the *Alaska International Airport System Plan Forecast Technical Report*. The results are summarized here with respect to those operations that provide the basis for the Part 150 Noise Compatibility Study contours (2009, 2020, and 2030).

Existing Operations and Forecasts Summary

This section presents the summary of the existing operations for the year 2009. At the onset of this study, 2009 provided the last full year of data available that represented "normal" operations, without major operational changes (such as runway closures due to maintenance). The breakdown for Ted Stevens Anchorage International Airport and Lake Hood Seaplane Base are included in Table B1 below.

Additionally, this section presents the summary of the forecasts developed in the *Alaska International Airport System Plan Forecast* for the years 2020 (Future), and 2030 (Out-Year for informational purposes). These are included in Table B1 below for reference. These operations are further broken down by aircraft type for the INM analysis.

Table B1
SUMMARY OF 2009, 2020, AND 2030 AIRCRAFT OPERATIONS BY TYPE

Year	Air Carrier Operations	Cargo Operations	Air Taxi Operations	General Aviation Operations	Military Operations	Total Operations
2009						
ANC	91,092	65,014	2,280	35,685	4,385	198,456
LHD	-	-	12,291	45,885	-	58,176
Total	***91,092***	***65,014***	***14,571***	***81,570***	***4,385***	***256,632***
2020						
ANC	101,540	95,812	2,793	39,863	2,267	242,275
LHD	-	-	15,793	49,667	-	65,460
Total	***101,540***	***95,812***	***18,586***	***89,530***	***2,267***	***307,735***
2030						
ANC	111,212	118,714	2,036	47,713	2,267	281,942
LHD		-	18,902	59,446	-	78,348
Total	***111,212***	***118,714***	***20,938***	***107,159***	***2,267***	***360,290***

Source: 2009 data from Airport tower counts; 2020, 2030 forecasts from the Alaska International Airport System Forecast Technical Report, 2012.