ROCKFORD

RFD

CHICAGO ROCKFORD
INTERNATIONAL AIRPORT

Appendix C

Noise Modeling Methodology

Appendix C | Noise Modeling Methodology

The following appendix describes the existing noise exposure on communities surrounding Chicago Rockford International Airport (RFD or Airport). The noise analysis for this Part 150 Noise Compatibility Study (Part 150 Study) included the development of the noise contours for the existing conditions with a base year of 2023 and the future conditions with a base year of 2028. Aircraft related noise exposure is defined through noise contours prepared using the Federal Aviation Administration's (FAA) Aviation Environmental Design Tool Version (AEDT) 3.d per Title 14 Code of Federal Regulations (14 CFR) Part 150 guidelines. Inputs into the noise model include: the number of average-annual day aircraft operations (arrivals and departures) by aircraft type and time of day, the percent of time each runway end is used for arrival and departure, and flight paths to and from the runway ends.

An explanation of the AEDT and standard noise descriptors, along with a review of the physics of noise, research regarding noise impacts on humans, social impacts of noise, and the data required to develop noise contours are explained in the sections below.

C.1 Characteristics of Sound

Sound is created by a source that induces vibrations in the air. The vibration produces alternating bands of relatively dense and sparse particles of air, spreading outward from the source like ripples on a pond. Sound waves dissipate with increasing distance from the source. Sound waves can also be reflected, diffracted, refracted, or scattered. When the source stops vibrating, the sound waves disappear almost instantly and the sound ceases.

Sound conveys information to listeners. It can be instructional, alarming, pleasant, relaxing, or annoying. Identical sounds can be characterized by different people or even by the same person at different times, as desirable or unwanted. Unwanted sound is commonly referred to as "noise."

Sound can be defined in terms of three components:

1. Level (amplitude)
2. Pitch (frequency)
3. Duration (time pattern)

C.1.1 Sound Level

The level or amplitude of sound is measured by the difference between atmospheric pressure (without the sound) and the total pressure (with the sound). Amplitude of sound is like the relative height of the ripples caused by the stone thrown into the water. Although physicists typically measure pressure using the linear Pascal scale, sound is measured using the logarithmic decibel (dB) scale. This is because the range of sound pressures detectable by the human ear can vary from 1 to 100 trillion units. A logarithmic scale allows us to discuss and analyze noise using more manageable numbers. The range of audible sound ranges from approximately 1 to 140 dB, although everyday sounds rarely rise above about 120 dB. The human ear is extremely sensitive to sound pressure fluctuations. A sound of 140 dB, which is sharply painful to humans, contains 100 trillion (1014) times more sound pressure than the least audible sound. **Exhibit C-1, *Comparison of Sound***, shows a comparison of common sources of indoor and outdoor sounds measured on the dB scale.

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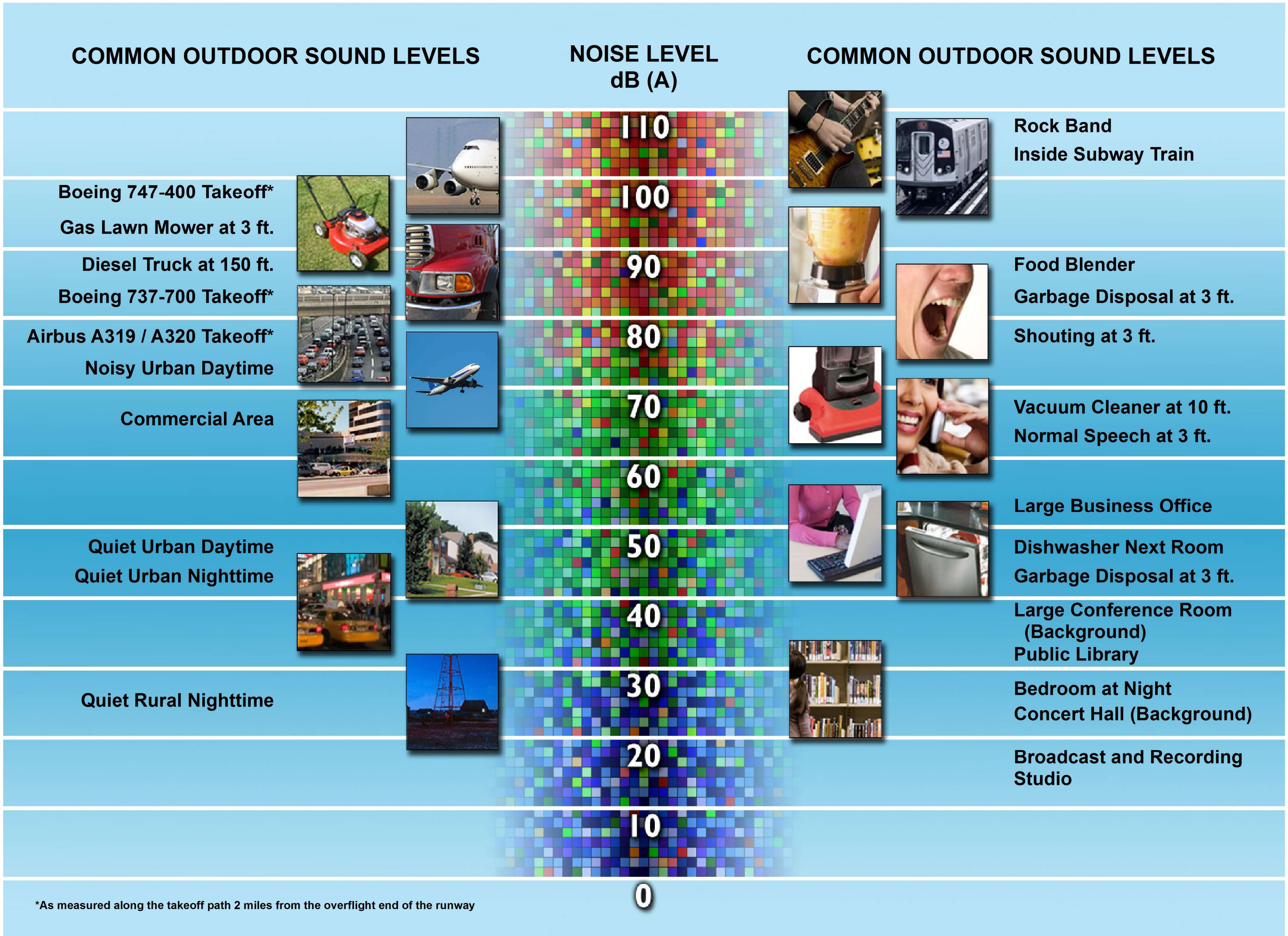
EXHIBIT C-1 | COMPARISON OF SOUND



Source: Landrum & Brown, 2023.

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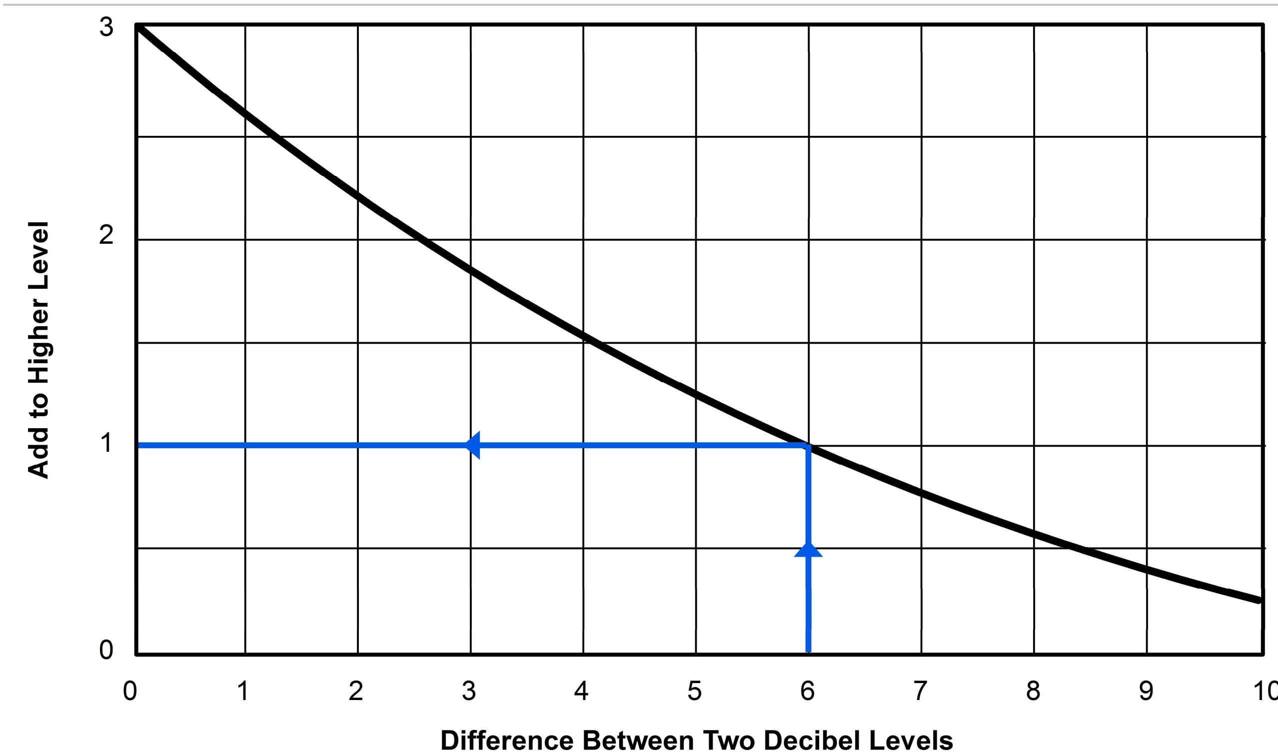
By definition, a 10 dB increase in sound is equal to a tenfold (101) increase in the mean square sound pressure of the reference sound. A 20 dB increase is a 100-fold (102) increase in the mean square sound pressure of the reference sound. A 30 dB increase is a 1,000-fold (103) increase in mean square sound pressure.

A logarithmic scale requires different mathematics than used with linear scales. The sound pressures of two separate sounds, expressed in dB, are not arithmetically additive. For example, if a sound of 80 dB is added to another sound of 74 dB, the total is a 1 dB increase in the louder sound (81 dB), not the arithmetic sum of 154 dB (See **Exhibit C-2, *Example Addition of Two Decibels***). If two equally loud noise events occur simultaneously, the sound pressure level from the combined events is 3 dB higher than the level produced by either event alone.

EXHIBIT C-2 | EXAMPLE OF ADDITION OF TWO DECIBEL LEVELS



Example:

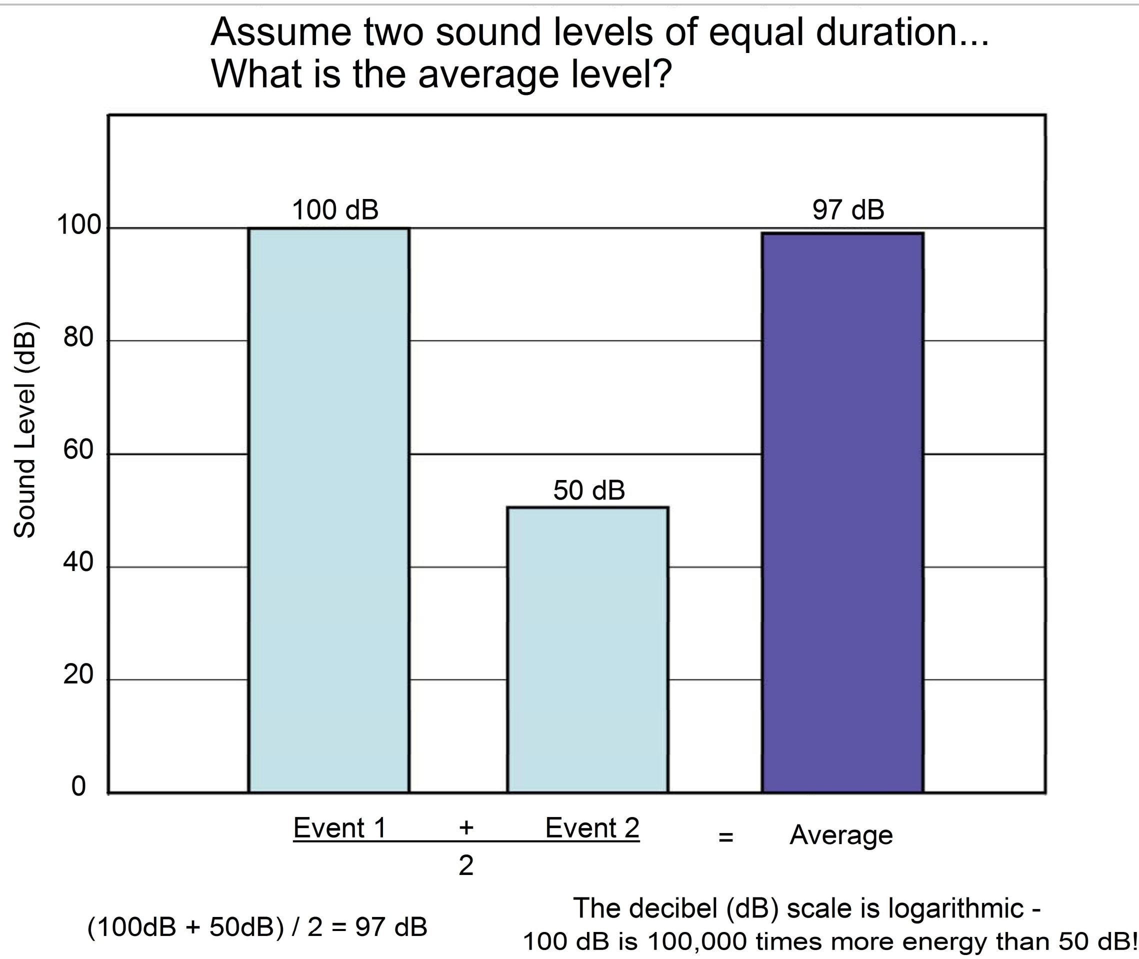
80 dB + 74 dB = 81 dB

Source: Information on Levels of Environmental Noise, USEPA, March 1974.

Logarithmic averaging also yields results that are quite different from simple arithmetic averaging. Consider the example shown in **Exhibit C-3, *Example of Sound Level Averaging***. Two sound levels of equal duration are averaged. One has a maximum sound level (Lmax) of 100 dB, the other 50 dB. Using conventional arithmetic, the average would be 75 dB. The true result, using logarithmic math, is 97 dB. This is because 100 dB has far more energy than 50 dB (100,000 times as much) and is overwhelmingly dominant in computing the average of the two sounds.

Human perceptions of changes in sound pressure are less sensitive than a sound level meter. People typically perceive a tenfold increase in sound pressure, a 10 dB increase, as a doubling of loudness. Conversely, a 10 dB decrease in sound pressure is normally perceived as half as loud. In community settings, most people perceive a 3 dB increase in sound pressure (a doubling of the sound pressure or energy) as just noticeable. In laboratory settings, people with good hearing are able to detect changes in sounds of as little as 1 dB.

EXHIBIT C-3 | EXAMPLES OF SOUND LEVEL AVERAGING



Source: Landrum & Brown, 2023.

C.1.2 Sound Frequency

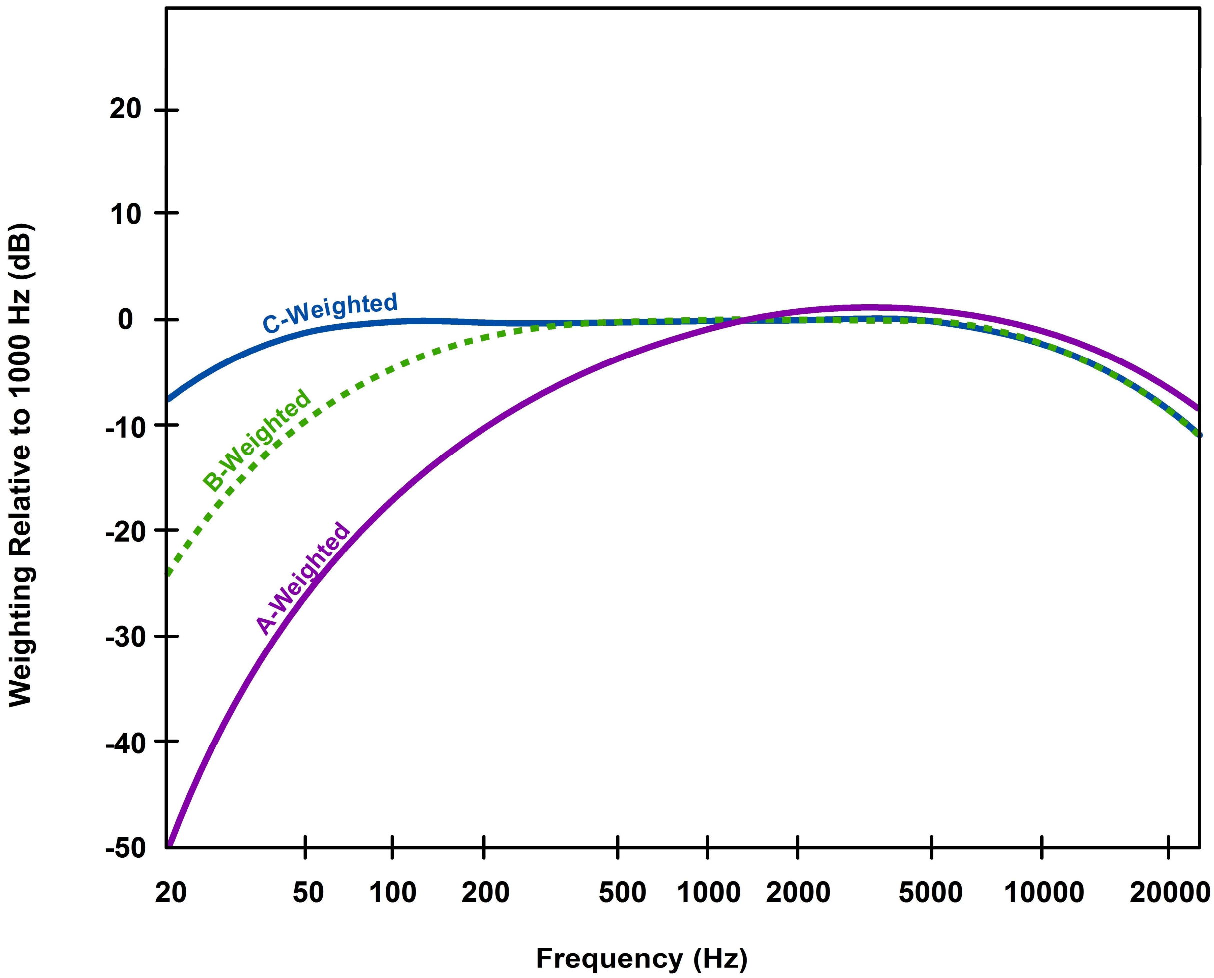
The pitch (or frequency) of sound can vary greatly from a low-pitched rumble to a shrill whistle. If we consider the analogy of ripples in a pond, high frequency sounds are vibrations with tightly spaced ripples, while low rumbles are vibrations with widely spaced ripples. The rate at which a source vibrates determines the frequency. The rate of vibration is measured in units called "Hertz" -- the number of cycles, or waves, per second. One's ability to hear a sound depends greatly on the frequency composition. Humans hear sounds best at frequencies between 1,000 and 6,000 Hertz. Sound at frequencies above 10,000 Hertz (high-pitched hissing) and below 100 Hertz (low rumble) are much more difficult to hear.

When attempting to measure sound in a way that approximates what our ears hear, we must give more weight to sounds at the frequencies we hear well and less weight to sounds at frequencies we do not hear well. Acousticians have developed several weighting scales for measuring sound. The A-weighted scale was developed to correlate with the judgments people make about the loudness of sounds. The A weighted decibel scale (dBA) is used in studies where audible sound is the focus of inquiry. **Exhibit C-4, *Sound Frequency Weighting Curves***, shows the A, B, and C sound weighting scale. The U.S. Environmental Protection Agency (USEPA) has recommended the use of the A-weighted decibel scale in studies of environmental noise.[1] Its use

[1] Information on Levels of Environmental Noise Requisite to Protect Health and Welfare with an Adequate Margin of Safety. U.S. Environmental Protection Agency, Office of Noise Abatement and Control. 1974, P. A-10.

is required by the FAA in airport noise studies.[2] For the purposes of this analysis, dBA was used as the noise metric and dB and dBA are used interchangeably.

EXHIBIT C-4 | EXAMPLES OF SOUND LEVEL AVERAGING



Source: Noise Measurement Handbook, Federal Highway Administration, 2018, Sec. 17.3.3.3.

C.1.3 Duration of Sounds

The duration of sounds – their patterns of loudness and pitch over time – can vary greatly. Sounds can be classified as continuous like a waterfall, impulsive like a firecracker, or intermittent like aircraft overflights. Intermittent sounds are produced for relatively short periods, with the instantaneous sound level during the event roughly appearing as a bell-shaped curve. An aircraft event is characterized by the period during which it rises above the background sound level, reaches its peak, and then recedes below the background level.

[2] "Airport Noise Compatibility Planning." 14 CFR Part 150, Sec. A150.3.

C.1.4 Perceived Noise Levels

Perceived noisiness is another method of rating sound that was originally developed for the assessment of aircraft noise. Perceived noisiness is the subjective measure of the degree to which noise is unwanted or causes annoyance to an individual. To determine perceived noise level, individuals are asked to judge in a laboratory setting when two sounds are equally noisy or disturbing if heard regularly in their own environment. These surveys are inherently subjective and thus subject to greater variability. For example, two separate events of equal noise energy may be perceived differently if one sound is more annoying to the listener than the other.

C.1.5 Propagation of Noise

Outdoor sound levels decrease as a function of distance from the source, and as a result of wave divergence, atmospheric absorption, and ground attenuation. If sound is radiated from a source in an homogeneous and undisturbed manner, the sound travels as spherical waves. As the sound wave travels away from the source, the sound energy is distributed over a greater area, dispersing the sound energy of the wave. Spherical spreading of the sound wave reduces the noise level at a rate of 6 dB per doubling of the distance.

Atmospheric absorption also influences the levels that are received by the observer. The greater the distance traveled, the greater the influence of the atmosphere and the resultant fluctuations. Atmospheric absorption becomes important at distances of greater than 1,000 feet. The degree of absorption is a function of the frequency of the sound as well as the humidity and temperature of the air. For example, atmospheric absorption is lowest at high humidity and higher temperatures. Sample atmospheric attenuation graphs are presented in **Exhibit C-5, *Sound Attenuation Graphs***. The graphs show noise absorption rates based on temperature, relative humidity, and distance at five different frequency ranges. For example, sounds at a frequency of 2,000 Hz, with a relative humidity of 10 percent and a temperature of 90° Fahrenheit (32° Celsius), will be dissipate by 10 dB per for every 1,000 feet (305 meters) from the source.

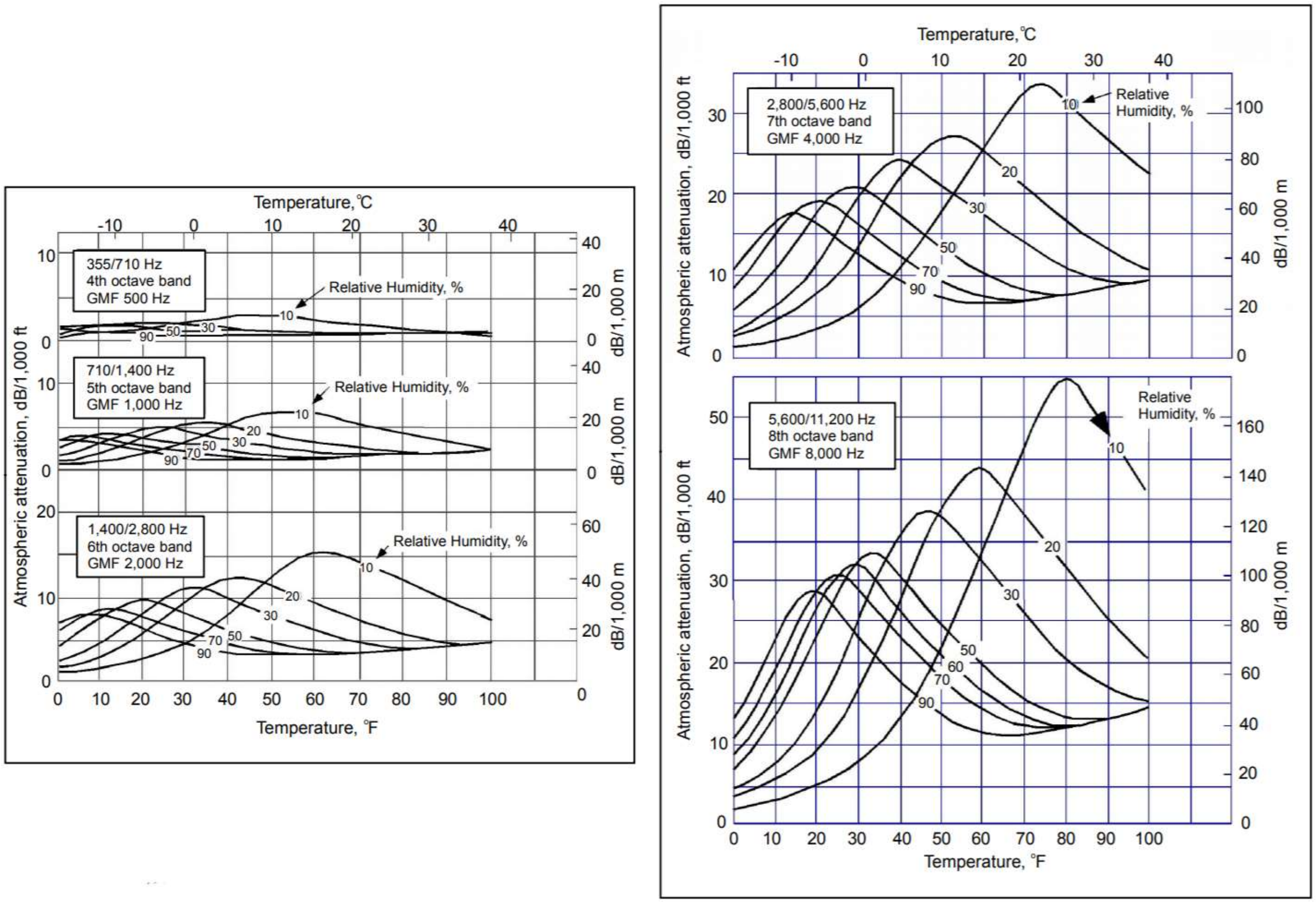
The rate of atmospheric absorption varies with sound frequency. The higher frequencies are more readily absorbed than the lower frequencies. Over large distances, the lower frequencies become the dominant sound as the higher frequencies are attenuated.

Turbulence and gradients of wind, temperature, and humidity also play a significant role in determining the degree of attenuation. Certain conditions, such as inversions, can also result in higher noise levels than would result from spherical spreading as a result of channeling or focusing the sound waves.

The effect of ground attenuation on noise propagation is a function of the height of the source and/or receiver and the characteristics of the terrain. The closer the source of noise is to the ground, the greater the ground absorption. Terrain consisting of soft surfaces such as vegetation provide for more ground absorption than hard surfaces. Ground attenuation is important for the study of noise from airfield operations (such as, thrust reversals) and in the design of noise berms or engine run-up facilities.

These factors are an important consideration for assessing in-flight and ground noise in the Rockford area. Atmospheric conditions will play a significant role in affecting the sound levels on a daily basis and how these sounds are perceived by the population.

EXHIBIT C-5 | SOUND ATTENUATION GRAPHS



Source: Baraneck, 1981.

C.2 Factors Influencing Human Response to Sound

Many factors influence how a sound is perceived and whether or not it is considered annoying to the listener. These factors include not only physical (acoustic) characteristics of the sound but also secondary (non-acoustic) factors, such as sociological and external factors.

Sound rating scales are developed to account for the factors that affect human response to sound. Nearly all of these factors are relevant in describing how sounds are perceived in the community. Many of the non-acoustic parameters play a prominent role in affecting individual response to noise. Background sound (ambient noise) is also important in describing sound in rural settings. Some non-acoustic factors that may influence an individual's response to aircraft noise include:

- Predictability of when the sound/noise will occur;
- How the noise affects certain activities;
- Fear of an aircraft crashing;
- Belief that aircraft noise could be prevented or reduced by aircraft designers, pilots, or authorities related to airlines or airports; and
- Sensitivity to noise in general.

Thus, it is important to recognize that non-acoustic factors such as those described above, as well as acoustic factors, contribute to human response to noise.

C.3 Standard Noise Descriptors

Given the multiple dimensions of sound, a variety of descriptors, or metrics, have been developed for describing sound and noise. Some of the most commonly used metrics are discussed in this section.

C.3.1 Maximum Level

Maximum level (Lmax) is simply the highest sound level, or peak level, recorded during an event or over a given period of time. It provides a simple and understandable way to describe a sound event and compare it with other events. In addition to describing the peak sound level, the Lmax can be reported on an appropriate weighted decibel scale (A-weighted, for example) so that it can disclose information about the frequency range of the sound event in addition to the loudness.

The Lmax, however, fails to provide any information about the duration of the sound event. This can be a critical shortcoming when comparing different sounds. Even if they have identical Lmax values, sounds of greater duration contain more sound energy than sounds of shorter duration. Research has demonstrated that for many kinds of sound effects, the total sound energy, not just the peak sound level, is a critical consideration.

C.3.2 Time Above Level

The time above level (TA) metric indicates the amount of time that sound at a particular location exceeds a given sound level threshold. The TA is often expressed in terms of the total time per day that the threshold is exceeded. The TA metric explicitly provides information about the duration of sound events, although it conveys no information about the peak levels during the period of observation.

C.3.3 Number of Events Above Level

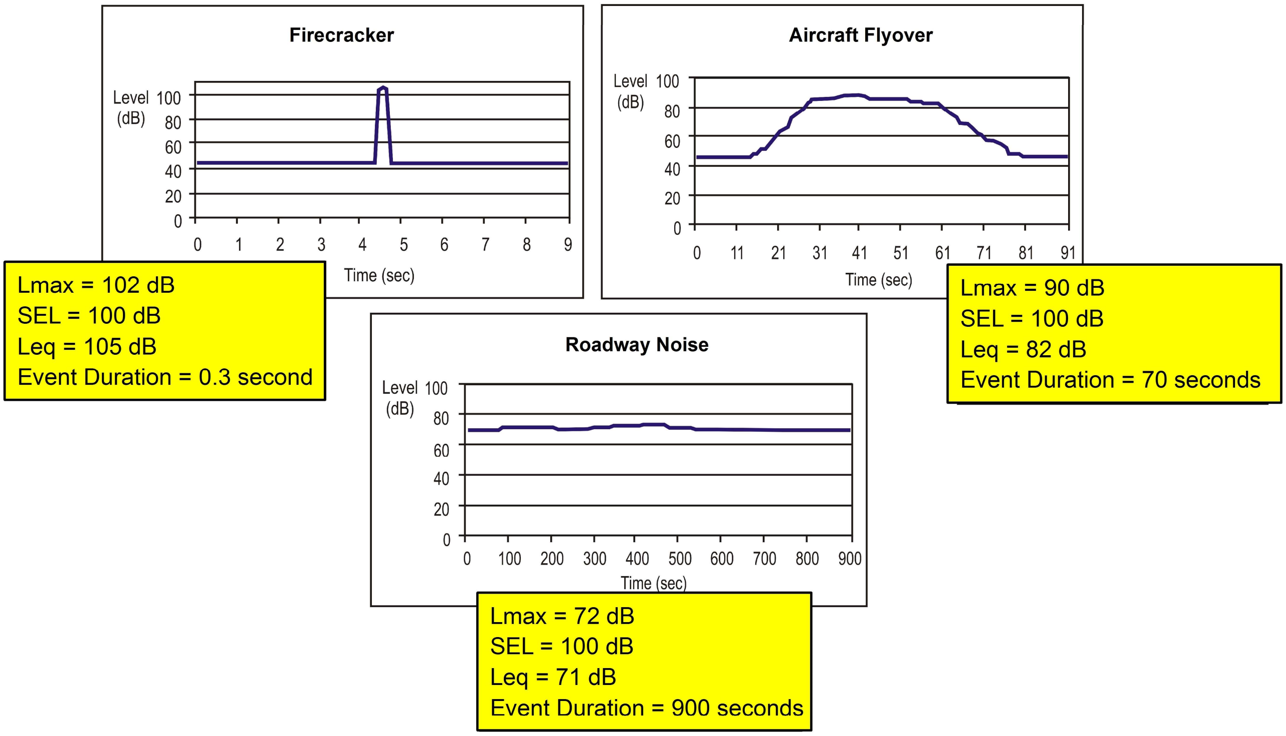
Similar to the TA, the number of events above (NA) metric indicates the total number of aircraft events at particular location that exceed a given sound level threshold in dB. The NA metric explicitly provides information about the number of sound events, although it conveys no information about the duration of the event(s).

C.3.4 Sound Exposure Level

The sound exposure level (SEL) metric provides a way of describing the total sound energy of a single event. In computing the SEL value, all sound energy occurring during the event, within 10 dB of the Lmax, is mathematically integrated over one second. (Very little information is lost by discarding the sound below the 10 dB cut-off, since the highest sound levels completely dominate the integration calculation.) Consequently, the SEL is always greater than the Lmax for events with a duration greater than one second. SELs for aircraft overflights typically range from five to 10 dB higher than the Lmax for the event.

Exhibit C-6, *Measurement of Different Types of Sound*, shows graphs of instantaneous sound levels for three different events: an aircraft flyover, steady roadway noise, and a firecracker. The Lmax and the duration of each event differ greatly. The pop of the firecracker is quite loud, 102 dB but lasts less than a second. The aircraft flyover has a considerably lower Lmax at 90 dB, but the event lasts for over a minute. The Lmax from the roadway noise is even quieter at only 72 dB, but it lasts for 15 minutes. By considering the loudness and the duration of these very different events simultaneously, the SEL metric reveals that the total sound energy of all three is identical. This can be a critical finding for studies where total noise dosage is the focus of study. As it happens, research has shown conclusively that noise dosage is crucial in understanding the effects of noise on animals and humans.

EXHIBIT C-6 | MEASUREMENT OF DIFFERENT TYPES OF SOUND



Source: Landrum & Brown, 2023.

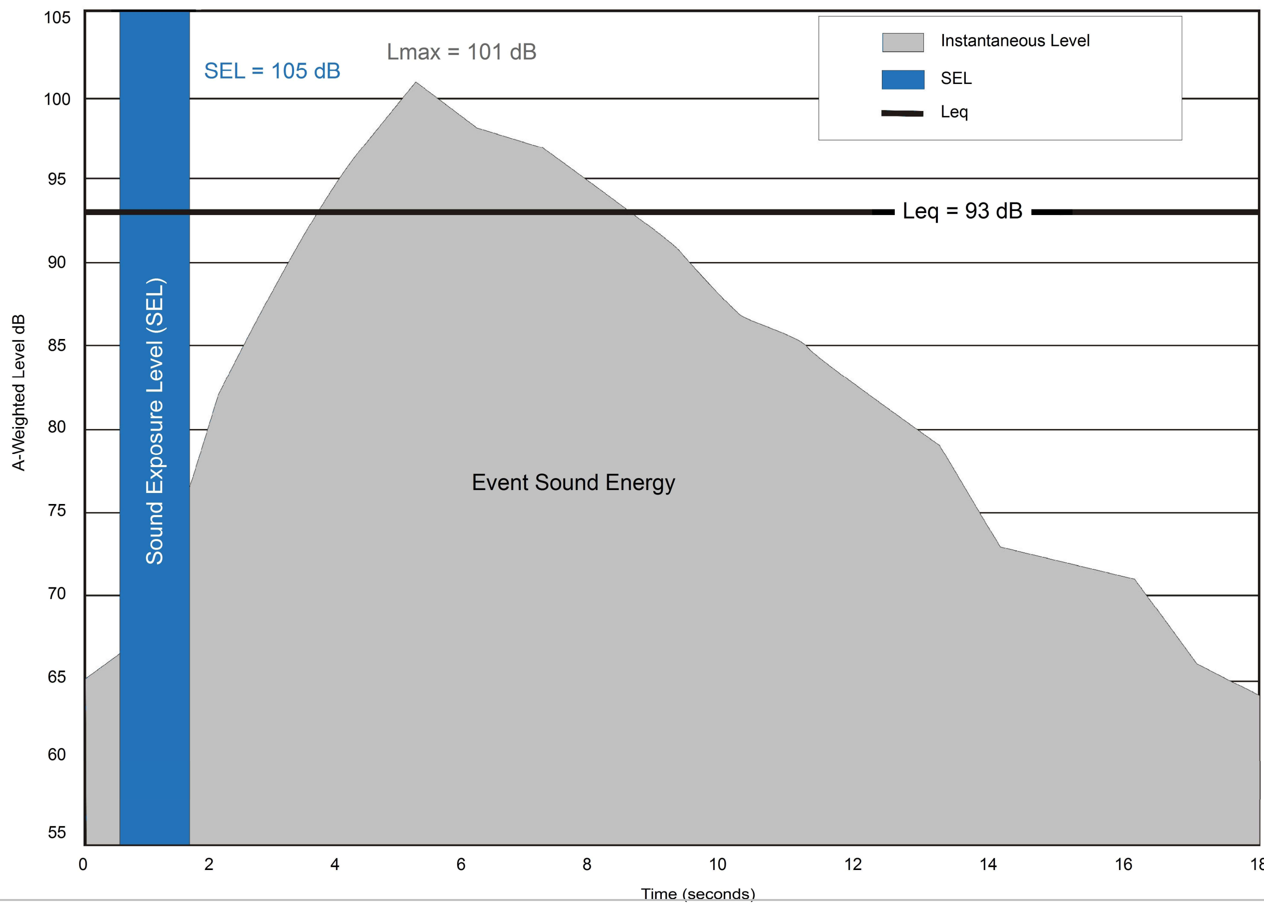
C.3.5 Equivalent Sound Level

The equivalent sound level (Leq) metric may be used to define cumulative noise dosage, or noise exposure, over a period of time. In computing Leq, the total noise energy over a given period of time, during which numerous events may have occurred, is logarithmically averaged over the time period. The Leq represents the steady sound level that is equivalent to the varying sound levels actually occurring during the period of observation. For example, an 8-hour Leq of 67 dB indicates that the amount of sound energy in all the peaks and valleys that occurred in the 8 hour period is equivalent to the energy in a continuous sound level of 67 dB. Leq is typically computed for measurement periods of 1 hour, 8 hours, or 24 hours, although any time period can be specified.

Exhibit C-7, *Relationship Among Sound Metrics*, shows the relationship of Leq to Lmax and SEL. In this example, a single aircraft event lasting 18 seconds is represented. The instantaneous noise levels for the event range from 64 to an Lmax of 101 dBA. The area under the curve represents the sound energy accumulated during the entire event. The compression of this energy into a single second, results in an SEL of 105 dBA. The Leq average of the sound energy for each second during the event would be 93 dB. If this event were the only event to occur during an hour, the aircraft sound energy for the other 3,582 seconds would be considered to be zero. When converted to an hourly LEQ, the level would be nearly 70 dB of Leq. This again indicates the dominance of loud events in noise summation and averaging computations.

The Leq is a critical noise metric for many kinds of analysis where total noise dosage, or noise exposure, is under investigation. As already noted, noise dosage is important in understanding the effects of noise on both animals and people. Indeed, research has led to the formulation of the “equal energy rule.” This rule states that it is the total acoustical energy to which people are exposed that explains the effects the noise will have on them. That is, a very loud noise with a short duration will have the same effect as a lesser noise with a longer duration if they have the same total sound energy.

EXHIBIT C-7 | RELATIONSHIP AMONG SOUND METRICS



Source: Landrum & Brown, 2023

C.3.6 Day-Night Average Sound Level

The day-night average sound level (DNL) metric is really a variation of the 24 hour Leq metric. Like Leq, the DNL metric describes the total noise exposure during a given period. Unlike Leq, however, DNL, by definition, can only be applied to a 24-hour period. In computing DNL, an extra weight of 10 dB is assigned to any sound levels occurring between the hours of 10:00 p.m. and 7:00 a.m. This is intended to account for the greater annoyance that nighttime noise is presumed to cause for most people. Recalling the logarithmic nature of the dB scale, this extra weight treats one nighttime noise event as equivalent to 10 daytime events of the same magnitude.

As with Leq, DNL values are strongly influenced by the loud events. For example, 30 seconds of sound of 100 dB, followed by 23 hours, 59 minutes, and 30 seconds of silence would compute to a DNL value of 65 dB. If the 30 seconds occurred at night, it would yield a DNL of 75 dB.

This example can be roughly equated to an airport noise environment. Recall that an SEL is the mathematical compression of a noise event into one second. Thus, 30 SELs of 100 dB during a 24-hour period would equal DNL 65 dB, or DNL 75 dB if they occurred at night. This situation could actually occur in places around a real airport. If the area experienced 30 overflights during the day, each of which produced an SEL of 100 dB, it would be exposed to DNL 65 dB. Recalling the relationship of SEL to the Lmax of an aircraft overflight, the Lmax recorded for each of those overflights (the peak level a person would actually hear) would typically range from 90 to 95 dB.

C.4 Health Effects of Noise

A considerable amount of research has been conducted to identify, measure, and quantify the potential effects of aviation noise on health. The various methods by which noise can be measured (e.g. single dose, long-term average, number of events above a certain level, etc.), and difficulties in separating other lifestyle factors from the analysis, increases the complexity of determining the health effects of noise, and has caused considerable variability in the results of past studies. The health effects of noise are often divided into the following topics: cardiovascular effects, hearing loss, sleep disturbance, and speech/communication interference.

C.4.1 Cardiovascular Effects

Several studies have suggested that increased hypertension or other cardiovascular effects, such as increased blood pressure, and change in pulse rate, may be associated with long-term exposure to high levels of environmental noise. When conducting cross-sectional studies of environmental noise exposure, it is difficult to control for other important variables. Subsequent reviews of past research have pointed out that such studies "…are notoriously difficult to interpret. They often report conflicting results, generally do not identify a cause and effect relationship, and often do not report a dose-response relationship between the cause and effect."[3] In 2018, the World Health Organization (WHO) published its Environmental Noise Guidelines report (WHO report) with reference to recent research related to aircraft noise and human response.[4] The WHO report references two ecological studies that provide information on the relationship between aircraft noise and incidence of ischemic heart disease (IHD); however, this "…evidence was rated low quality." Additionally, the WHO report references one cohort study and several cross-sectional studies of the relationship between aircraft noise and hypertension. The WHO report noted "…inconsistency across studies" and the "…evidence was rated low quality." Similar studies of the relationship between aircraft noise and cases of stroke were reviewed. The WHO report noted that this "…evidence was rated very low quality." Therefore, it is difficult to draw any conclusions about the relationship between aircraft noise exposure and cardiovascular effects.

C.4.2 Hearing Loss

The potential for noise-induced hearing loss is commonly associated with occupational noise exposure from working in a noisy work environment or recreational noise such as listening to loud music. Recent studies have concluded that "because environmental noise does not approximate occupational noise levels or recreational noise exposures…it does not have an effect on hearing threshold levels." Furthermore, "aviation noise does not pose a risk factor for child or adolescent hearing loss, but perhaps other noise sources (personal music devices, concerts, motorcycles, or night clubs) are a main risk factor."[5] This conclusion is supported by the 2018 WHO Environmental Noise Guidelines which notes that "no studies were found, and therefore no evidence was available on the association between aircraft noise and hearing impairment and tinnitus."[6] Because aviation noise levels near airports do not approach levels of occupational or recreational noise exposures associated with hearing loss, hearing impairment is likely not caused by aircraft noise for populations living near an airport.

C.4.3 Sleep Disturbance

Sleep disturbance is a common complaint from people who live in the vicinity of an airport. A large amount of research has been published on the topic of sleep disturbance caused by environmental noise. This research has produced variable results due to differing definitions of sleep disturbance, different ways for measuring sleep

[3] Airport Cooperative Research Program, Transportation Research Board, Effects of Aircraft Noise: Research Update on Selected Topics, 2008.
[4] World Health Organization, Regional Office for Europe, Environmental Noise Guidelines for the European Region, 2018.
[5] Airport Cooperative Research Program, Transportation Research Board, Effects of Aircraft Noise: Research Update on Selected Topics, 2008.
[6] World Health Organization, Regional Office for Europe, Environmental Noise Guidelines for the European Region, 2018.

disturbance (behavioral awakenings or sleep interruption), and different settings in which to measure it (laboratory setting or field setting).

In 1992, the Federal Interagency Committee on Noise (FICON) recommended an interim dose-response curve to predict the percent of the exposed population expected to be awakened (percent awakening) as a function of the exposure to single event noise levels expressed in terms of the SEL. This interim curve was based on statistical adjustment of previous analysis and included data from both laboratory and field studies. In 1997, the Federal Interagency Committee on Aviation Noise (FICAN) recommended a revised sleep disturbance relationship based on data and analysis from three field studies.

Exhibit C-8, *Sleep Disturbance Dose-Response Curves*, show the results of the 1992 and 1997 analyses. The top graph shows a comparison of the 1992 FICON and 1997 FICAN curves. The 1997 FICAN curve represents the upper limit of the observed field data and should be interpreted as predicting the "maximum percent of the exposed population expected to be behaviorally awakened", or the "maximum percent awakened" for a given residential population.

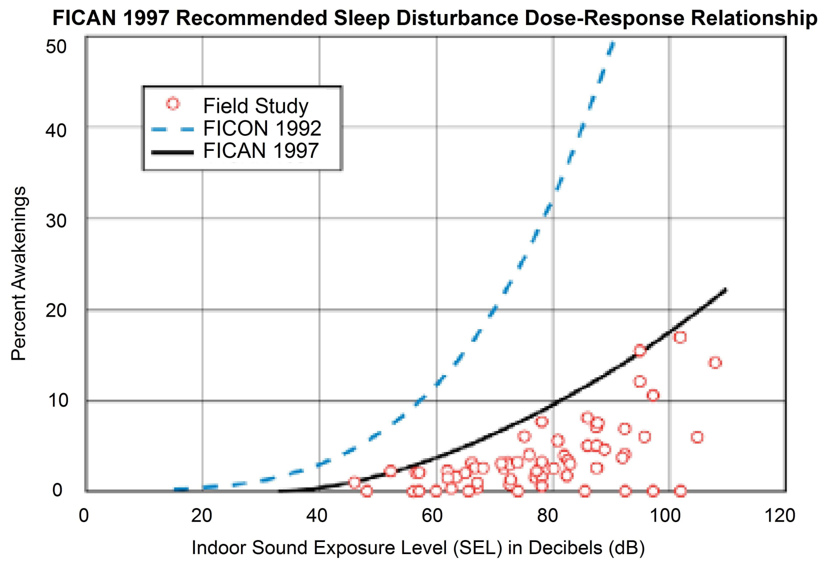
In 2008, FICAN recommended the use of a revised method to predict sleep disturbance in terms of percent awakenings based on data published by the American National Standards Institute (ANSI).[7] In contrast to the earlier FICAN recommendation, the 2008 ANSI standard indicates that the probability of awakening is lower for a single noise event in cases where the population is exposed to the given noise source for a long period of time (more than one year) compared to the probability of awakening for sound that is new to an area. In **Exhibit C-8**, the lower graph shows these two relationships, with Equation 1 (blue dotted line) representing percent awakenings from long-term noise and Equation B1 (pink dashed line) representing percent awakenings from a new noise source based on the 1997 FICAN results. As shown in this exhibit, at an indoor SEL of 100 dB, the probability of awakenings would be expected to exceed 15 percent for a new noise source; yet for long-term noise sources, the probability of awakening is expected to be less than 10 percent.

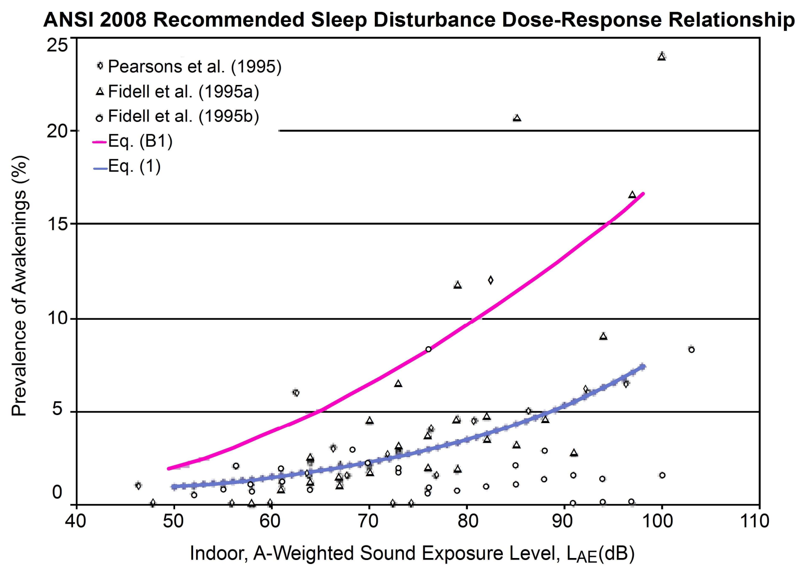
The numerous studies and reports that have been developed on the subject of sleep disturbance related to environmental noise over the past several decades have produced varied results. A review of past studies conducted by the Airport Cooperative Research Program (ACRP) suggests that in-home sleep disturbance studies clearly demonstrate that it requires more noise to cause awakenings than was previously theorized based on laboratory sleep disturbance studies.[8] The 2018 WHO Environmental Noise Guidelines references six studies that attempted to measure sleep disturbance at noise levels between 40 dB and 65 dB. Over 11% of the population was characterized as highly sleep-disturbed at nighttime levels of 40 dB. These studies were based on self-reporting and the "…evidence was rated moderate quality…" for an association between aircraft noise and probability of awakenings.[9]

Due to the variability of study methodologies, particularly studies outside of a laboratory, and other influencing factors, it is difficult to determine the noise level at which a high percentage of the population would be expected to be awakened by aircraft noise. No definitive conclusions have been drawn on the percent of a population that is estimated to be awakened by a certain level of aircraft noise and recent studies have cautioned about the over interpretation of the data.[10]

[7] ANSI S12.9-2008, Quantities and Procedures for Description and Measurement of Environmental Sound — Part 6: Methods for Estimation of Awakenings Associated with Outdoor Noise Events Heard in Homes, 2008.
[8] Airport Cooperative Research Program, Transportation Research Board, Effects of Aircraft Noise: Research Update on Selected Topics, 2008.
[9] World Health Organization, Regional Office for Europe, Environmental Noise Guidelines for the European Region, 2018.
[10] Airport Cooperative Research Program, Transportation Research Board, Effects of Aircraft Noise: Research Update on Selected Topics, 2008.

EXHIBIT C-8 | SLEEP DISTURBANCE DOSE RESPONSE CURVES





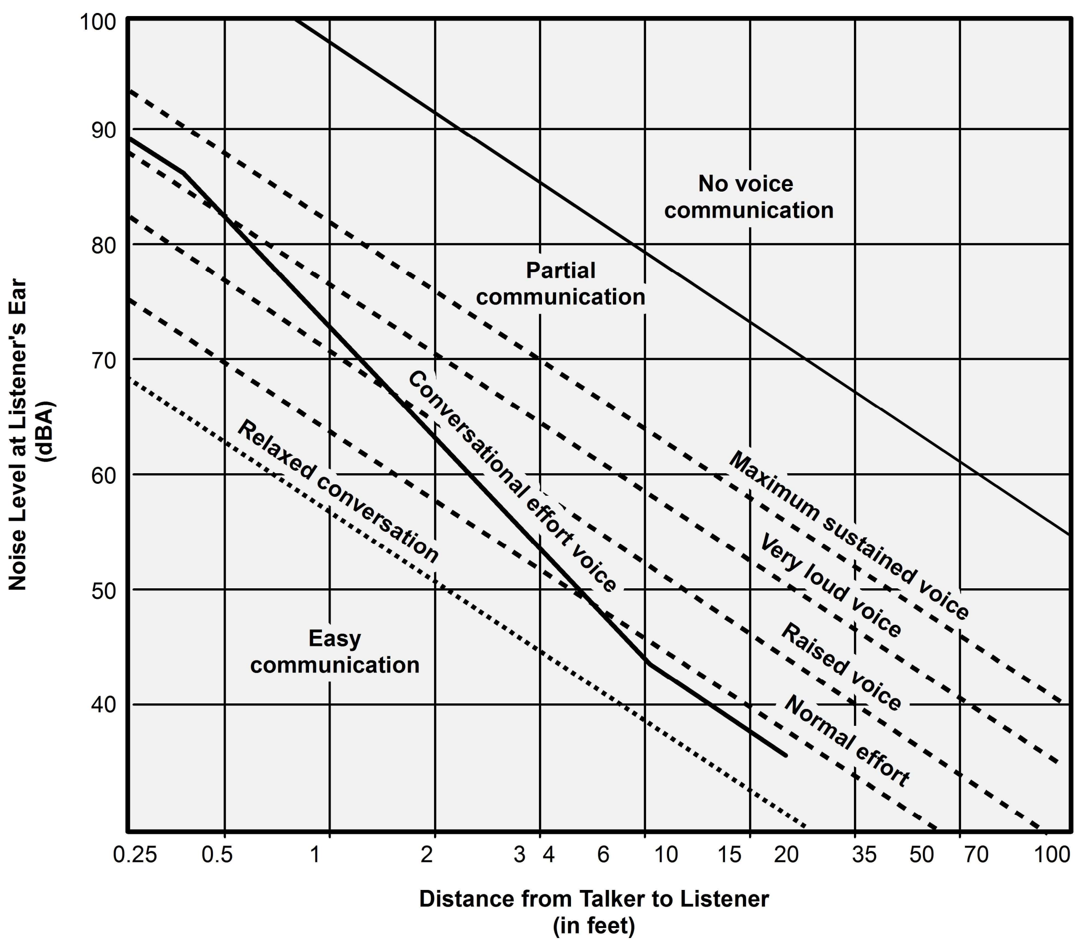
Source: FICAN, June 1997; American National standards Institute, 2008.

C.4.4 Communication Interference

Communication interference can impact activities such as personal conversations, classroom learning, and listening to radio and television. Most studies have focused on communication interference due to continual noise sources. In 1974, the USEPA published *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, which is one of the few studies to focus on intermittent noise. The study concluded that for voice communication, an indoor Leq of 45 dB allows normal conversation at distances up to 2 meters with 95 percent sentence intelligibility. **Exhibit C-9, *Noise Effects on Distance Necessary for Speech Communication***, shows the required distance between talker and listener based on the type of speech communication (normal voice, loud voice, etc.) and the environmental noise level from the 1974 USEPA report.

Noise can also impact communication between student and teacher necessary for learning in a classroom setting. It is usually accepted that noise levels above a certain Leq may affect a child's learning experiences. Research has shown a "decline in reading when outdoor noise levels equal or exceed Leq of 65 dBA."[11] Furthermore, a study conducted by FICAN in 2007 found: "(1) a substantial association between noise reduction and decreased failure (worst-score) rates for high-school students, and (2) significant association between noise reduction and increased average test scores for student/test subgroups. In general, the study found little dependence upon student group and upon test type."[12] A study of noise exposure and the effects on school test scores between 2000/01 and 2008/09 found "…statistically significant associations between airport noise and student mathematics and reading test scores, after taking demographic and school factors into account."[13] This study also found that schools that had been provided sound insulation had better test scores than schools that were not sound insulated. This Study made no recommendation regarding the noise level at which impacts upon learning may occur.

EXHIBIT C-9 | NOISE EFFECTS ON DISTANCE NECESSARY FOR SPEECH COMMUNICATION



Source: FICON, 1992; from USEPA, 1974.

11 Airport Cooperative Research Program, Transportation Research Board, Effects of Aircraft Noise: Research Update on Selected Topics, 2008.

12 Federal Interagency Committee on Aviation Noise (FICAN), Findings of the FICAN Pilot Study on the Relationship between Aircraft Noise Reduction and Changes in Standardized Test Scores, July 2007.

13 National Academies of Sciences, Engineering, and Medicine; Assessing Aircraft Noise Conditions Affecting Student Learning, Volume 1: Final Report; 2014.

C.5 Existing (2023) Baseline Noise Modeling Methodology

The following sections describe the noise modeling methodology and assumptions for the Existing (2023) Baseline Noise Exposure Contours for Chicago Rockford International Airport (RFD or Airport). Data representative of an average-annual day of operations was obtained from the Federal Aviation Administration's (FAA) Air Traffic Activity Data System (ATADS) and Traffic Flow Management System (TFMS) reports. This data included the number of arrival and departure operations by individual types of aircraft during daytime and nighttime periods, the distribution of aircraft activities among the runway ends, the departure destinations used to determine stage length and the distribution of aircraft along the flight paths leading to or from each runway.

C.5.1 Runway Definition

RFD has one east/west runway (7/25) and one north/south crosswind runway (1/19). Runway 7/25 is the longest runway on the airfield at 10,002 feet in length and is 150 feet wide. Runway 1/19 is 8,200 feet long and 150 feet wide. Runway end 1 is equipped with a CAT I ILS, runway end 07 is also equipped with CAT I, II and III ILS.

Runway	Length (feet)
01/19	8,200
07/25	10,002

Helicopter operations typically originate and terminate from two (2) locations on the airfield. For the purposes of this study these locations are called H1 and H2. H1 is located east of the terminal near the Emery Air facilities and H2 is located at the OSF Lifeline facilities. **Exhibit C-10, *Existing Airfield Layout*** shows the existing airfield layout.

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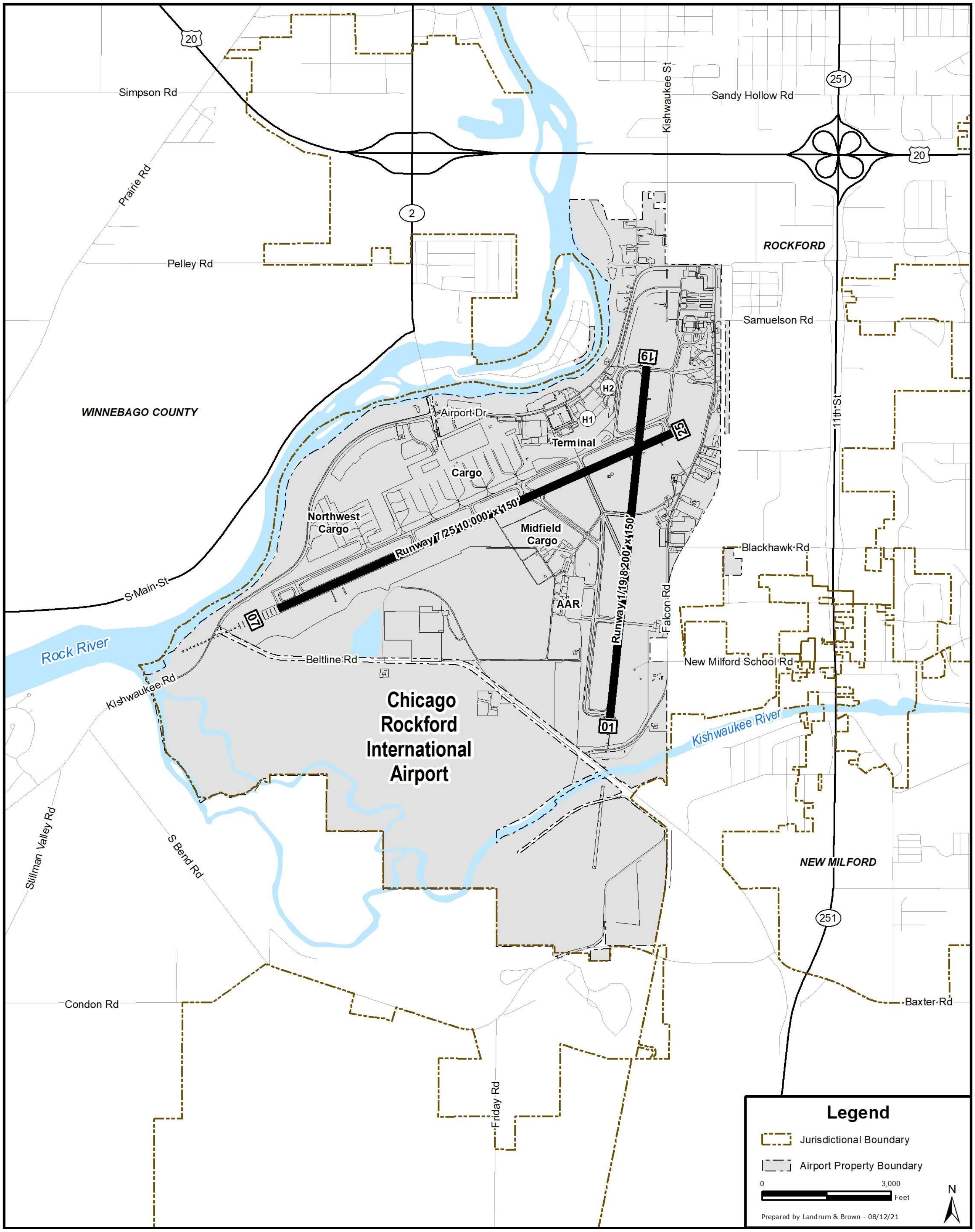
EXHIBIT C-10 | EXISTING AIRFIELD LAYOUT



Source: Landrum & Brown, 2023.

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C.5.2 Number of Operations and Fleet Mix

The number of annual operations for the Existing (2023) Baseline condition at RFD was based on Federal FAA Air Traffic Control Tower (ATCT) counts for the period from November 2021 through October 2022. These counts are made available through FAA's Operations Network (OpsNet) database and ATADS reports. This was the most recent operational data available at the time modeling started. During that time period 23,540 Air Carrier commercial and cargo operations and 22,969 Air Taxi, General Aviation and Military jet and prop operations occurred at RFD for a total of 46,509 aircraft operations. When divided by 365, the result is 127.4 average-annual daily operations.

Specific aircraft types and times of operation were developed from a combination of TFMS reports and National Offload Program (NOP) data for the same period. **Table C-1, *Existing (2023) Baseline Average-Annual Day Operations by Aircraft Category***, provides a summary of the average-annual daily operations by aircraft category and time of day. **Table C-2, *Existing (2023) Baseline Average-Annual Day Operations by Aircraft Type***, shows the average-annual daily number of arrivals and departures by the individual aircraft types for the Existing (2023) Baseline condition.

TABLE C-1 | EXISTING (2023) BASELINE AVERAGE-ANNUAL DAY OPERATIONS BY AIRCRAFT CATEGORY

Aircraft Category	Arrivals		Departures		Total	Percent of Total
	Day	Night	Day	Night		
Cargo Jets	11.16	18.51	11.62	18.05	59.33	46.6%
Commercial Jets	2.00	0.58	1.88	0.70	5.16	4.0%
General Aviation Jets	2.89	0.17	2.89	0.18	6.13	4.8%
General Aviation Props	26.91	0.67	26.79	0.79	55.16	43.3%
Military Aircraft	0.82	--	0.82	--	1.64	1.3%
Grand Total	***43.79***	***19.92***	***44.00***	***19.71***	***127.42***	***100%***

Notes: Totals may not equal sum total due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Source: Federal Aviation Administration (FAA) Operations Network (OpsNet) data, Traffic Flow Management System (TFMS) data, National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

TABLE C-2 | EXISTING (2023) BASELINE AVERAGE-ANNUAL DAY OPERATIONS BY AIRCRAFT

Aircraft Type	AEDT ID	Arrivals		Departures		Total
		Day	Night	Day	Night	
Cargo Jets						
Boeing 727-200 Series Freighter	727EM2	0.02	0.01	0.02	0.01	0.05
Boeing 737-400 Freighter	737400	0.04	--	0.04	< 0.00	0.08
Boeing 747-400 Series Freighter	747400	0.13	0.08	0.13	0.08	0.41
Boeing 757-200 Series Freighter	757PW	1.12	3.77	0.97	3.92	9.79
Boeing 757-200 Series Freighter	757RR	1.12	3.77	0.97	3.92	9.79
Boeing 767-300 ER Freighter	7673ER	4.53	5.42	4.39	5.56	19.91
Boeing 767-200 Series Freighter	767CF6	1.59	0.07	1.63	0.03	3.33
Airbus A300B4-600 Series	A300-622R	2.53	4.60	3.39	3.74	14.26
Boeing DC-9-10 Series Freighter	DC910	0.01	0.01	0.02	0.00	0.04
Boeing MD-11 Freighter	MD11GE	0.03	0.39	0.03	0.38	0.83
Boeing MD-11 Freighter	MD11PW	0.03	0.39	0.03	0.38	0.83

Aircraft Type	AEDT ID	Arrivals		Departures		Total
		Day	Night	Day	Night	
Cargo Jet Subtotal		**11.16**	**18.51**	**11.62**	**18.05**	**59.33**
Commercial Jets						
Boeing 737-700 Series	737700	0.01	--	< 0.00	< 0.00	0.01
Boeing 737-800 Series	737800	1.26	0.54	1.18	0.62	3.61
Airbus A319-100 Series	A319-131	0.21	< 0.00	0.19	0.03	0.43
Airbus A320-200 Series	A320-211	0.52	0.03	0.51	0.04	1.11
Commercial Jet Subtotal		**2.00**	**0.58**	**1.88**	**0.7**	**5.16**
General Aviation Jets						
Bombardier Global Express	BD-700-1A10	0.03	< 0.00	0.04	--	0.08
Bombardier Challenger 600	CL600	0.34	0.01	0.35	0.01	0.71
Bombardier Challenger 601	CL601	0.04	--	0.04	--	0.09
CESSNA CITATION 510	CNA510	0.09	--	0.09	--	0.18
Cessna 525 CitationJet	CNA525C	0.32	0.03	0.32	0.03	0.70
Cessna 550 Citation II	CNA55B	0.39	< 0.00	0.38	0.01	0.79
Cessna 560 Citation Excel	CNA560XL	0.22	< 0.00	0.21	0.01	0.44
Cessna 680 Citation Sovereign	CNA680	0.28	0.02	0.30	0.01	0.61
Cessna 750 Citation X	CNA750	0.11	0.00	0.09	0.02	0.22
Eclipse 500 / PW610F	ECLIPSE500	0.17	0.01	0.18	--	0.37
Dassault Falcon 20-C	FAL20	0.02	0.03	0.01	0.03	0.09
Dassault Falcon 900	FAL900EX	0.06	--	0.05	0.01	0.12
Gulfstream G650ER	G650ER	0.03	--	0.03	--	0.07
Gulfstream G400	GIV	0.07	0.01	0.07	--	0.14
Gulfstream V-SP	GV	0.03	--	0.03	--	0.06
Bombardier Learjet 35	LEAR35	0.68	0.05	0.69	0.04	1.46
General Aviation Jet Subtotal		**2.89**	**0.17**	**2.89**	**0.18**	**6.13**
General Aviation Props						
Raytheon Beech Baron 58	BEC58P	1.23	0.01	1.22	0.01	2.47
Cessna 172 Skyhawk	CNA172	8.89	0.12	8.88	0.13	18.02
Cessna 182	CNA182	1.73	0.05	1.65	0.13	3.56
Cessna 206	CNA206	0.43	--	0.43	--	0.87
Cessna 208 Caravan	CNA208	0.41	--	0.39	0.02	0.82
Cessna 441 Conquest II	CNA441	0.20	0.04	0.21	0.02	0.47
1985 1-ENG COMP	COMSEP	1.58	0.08	1.60	0.06	3.32
DeHavilland DHC-6-300 Twin Otter	DHC6	0.59	0.10	0.61	0.09	1.39
Eurocopter EC-130	EC130	0.05	0.04	0.06	0.03	0.18
Embraer EMB120 Brasilia	EMB120	0.02	0.04	0.04	0.01	0.11
Single Engine Prop	GASEPF	4.47	0.04	4.38	0.13	9.02
Single Engine Prop	GASEPV	4.66	0.16	4.67	0.16	9.65
Piper PA-28 Cherokee Series	PA28	1.98	--	1.98	--	3.97

Aircraft Type	AEDT ID	Arrivals		Departures		Total
		Day	Night	Day	Night	
Piper PA-30 Twin Comanche	PA30	0.50	--	0.50	--	0.99
Piper PA46 (Piston)	PA31	0.16	--	0.16	--	0.33
General Aviation Prop Subtotal		**26.91**	**0.67**	**26.79**	**0.79**	**55.16**
Military Aircraft						
Lockheed 130 Hercules*	C130E	0.09	--	0.09	--	0.18
Cessna 182	CNA182	0.04	--	0.04	--	0.08
Cessna 206	CNA206	0.03	--	0.03	--	0.05
1985 1-ENG COMP	COMSEP	0.05	--	0.05	--	0.11
DeHavilland DHC-6-300 Twin Otter	DHC6	0.17	--	0.17	--	0.35
Dornier 328-100 Series	DO328	0.05	--	0.05	--	0.11
Eclipse 500 / PW610F	ECLIPSE500	0.09	--	0.09	--	0.19
Embraer ERJ175	EMB175	0.04	--	0.04	--	0.08
Lockheed Martin F-16 Fighting Falcon	F16PW0	0.04	--	0.04	--	0.08
Gulfstream V/G500	GV-M	0.05	--	0.05	--	0.11
Bombardier Learjet 35	LEAR35	0.08	--	0.08	--	0.16
Sikorsky SH-60 Sea Hawk	S70	0.08	--	0.08	--	0.16
T-38 Talon	T-38A	0.03	--	0.03	--	0.07
Military Aircraft Subtotal		***0.82***	**--**	***0.82***	**--**	***1.64***
Grand Total		***43.79***	***19.92***	***44.00***	***19.71***	***127.42***

*Includes touch-and-go/closed patterns operations which are counted as one arrival and one departure.

Notes: Totals may not equal sum total due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.

Source: Federal Aviation Administration (FAA) Operations Network (OpsNet) data, Traffic Flow Management System (TFMS) data, National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

C.5.3 Runway End Utilization

Average-annual day runway end utilization was derived from analysis of sixteen (16) weeks of National Offload Program (NOP) radar data from the year 2020. Two weeks of radar data was utilized from the following months; January, February, March, April, May, October, November and December. During the months of May through September 2020, Runway 7/25 was closed, therefore data from those months was not utilized. This data provided the average annual daily runway use for each AEDT aircraft type during day and night periods at RFD. **Table C-3, *Existing (2023) Baseline Runway End Utilization***, summarizes the percentage of use by each aircraft category on each of the runways at RFD during the daytime (7:00 a.m. – 9:59 p.m.) and nighttime (10:00 p.m. – 6:59 a.m.) periods.

TABLE C-3 | EXISTING (2023) BASELINE RUNWAY END UTILIZATION

Aircraft Category	Runway End					
	01	07	19	25	H1	H2
Daytime Arrivals						
Cargo	21.6%	25.9%	14.8%	37.7%	--	--
Commercial	21.4%	23.6%	16.6%	38.4%	--	--
General Aviation Jets	24.3%	26.5%	10.1%	39.2%	--	--
General Aviation Props	27.2%	17.2%	19.4%	36.2%	--	--
GA Helicopter	--	--	--	--	--	100.0%
Military	--	56.1%	4.2%	39.7%	--	--
Military Helicopter	--	--	--	--	100.0%	--
Nighttime Arrivals						
Cargo	26.1%	40.1%	7.2%	26.6%	--	--
Commercial	22.8%	29.0%	4.3%	43.8%	--	--
General Aviation Jets	28.6%	21.4%	14.3%	35.7%	--	--
General Aviation Props	11.5%	26.9%	15.4%	46.2%	--	--
GA Helicopter	--	--	--	--	--	100.0%
Military	--	--	--	--	--	--
Military Helicopter	--	--	--	--	--	--
Daytime Departures						
Cargo	6.7%	21.8%	16.9%	54.7%	--	--
Commercial	12.9%	23.6%	23.0%	40.5%	--	--
General Aviation Jets	14.5%	17.9%	24.9%	42.8%	--	--
General Aviation Props	18.2%	16.1%	27.8%	37.9%	--	--
GA Helicopter	--	--	--	--	--	100.0%
Military	12.0%	12.0%	31.1%	44.8%	--	--
Military Helicopter	--	--	--	--	100.0%	--

Aircraft Category	Runway End					
	01	07	19	25	H1	H2
Nighttime Departures						
Cargo	2.3%	13.6%	24.4%	59.7%	--	--
Commercial	3.0%	43.8%	14.2%	39.1%	--	--
General Aviation Jets	--	10.0%	30.0%	60.0%	--	--
General Aviation Props	--	15.8%	42.1%	42.1%	--	--
GA Helicopter	--	--	--	--	--	100.0%
Military	--	--	--	--	--	--
Military Helicopter	--	--	--	--	--	--

Notes: Daytime = 7:00 a.m. – 9:59 p.m., Nighttime = 10:00 p.m. – 6:59 a.m.
Total may not equal sum total due to rounding.

Source: Federal Aviation Administration (FAA) Operations Network (OpsNet) data, Traffic Flow Management System (TFMS) data, National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

C.5.4 Flight Tracks

A flight track is the path over the ground as an aircraft flies to or from the airport. Flight track locations and percent distributions for the Existing (2023) Baseline condition were derived primarily from analysis of sixteen (16) weeks of radar data collected at RFD from January 2020 through December 2020, excluding periods of runway closure as mentioned previously. This data was analyzed to verify the location, density, and width of existing flight corridors. Consolidated flight tracks were developed from this radar data and used in the AEDT to model the flight corridors present around the Airport. **Exhibit C-11** through **Exhibit C-20** depict the arrival departure and touch and go flight tracks for jet, prop and military aircraft.

The tracks are composed of both backbone and sub-tracks that account for the dispersion of operations across a corridor of flight, rather than along a single constrained path. These types of tracks are useful at RFD where aircraft fly within wide departure flight corridors. The use of sub-tracks for the definition of baseline noise patterns allows a more definitive description of overall operating characteristics. **Table C-4, *Arrival Flight Track Utilization***, **Table C-5, *Departure Flight Track Utilization***, **Table C-6, *Touch and Go Flight Track Utilization*** and **Table C-7, *Helicopter Flight Track Utilization*** provides the proportion of operations assigned to each of the flight tracks indicated on the flight track exhibits.

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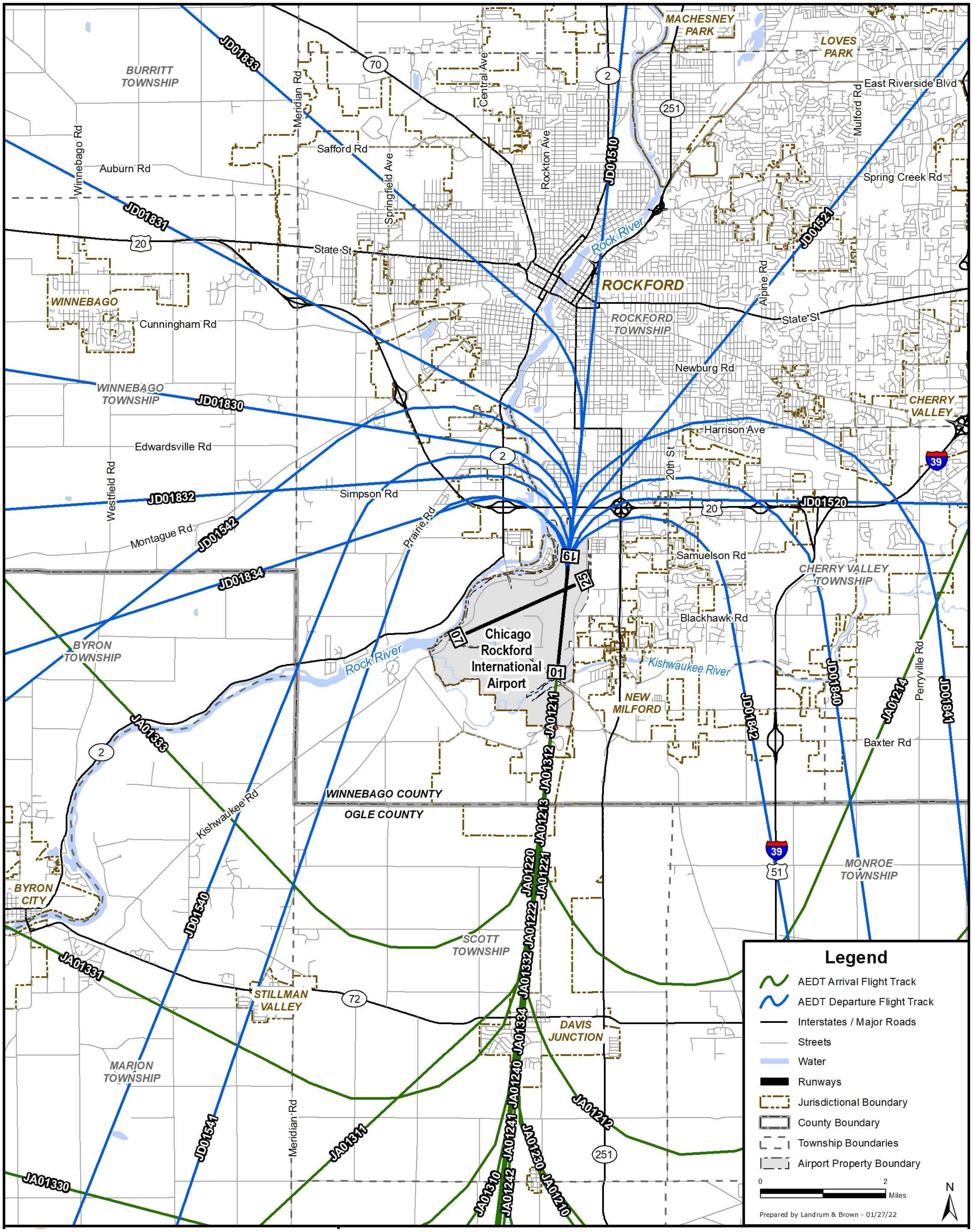
EXHIBIT C-11 | RUNWAY 01 JET FLIGHT TRACKS



Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

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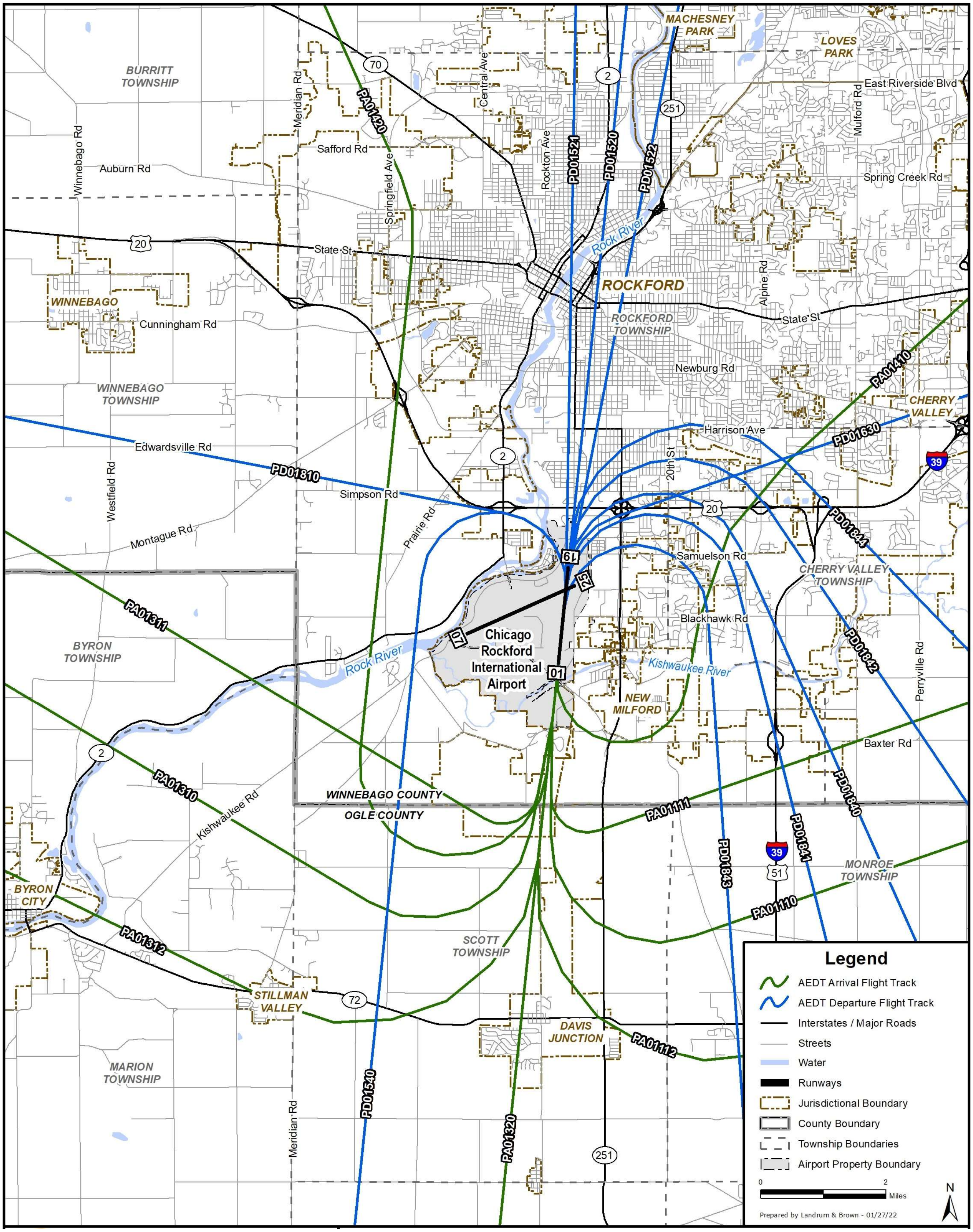
EXHIBIT C-12 | RUNWAY 01 PROPELLER FLIGHT TRACKS



Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

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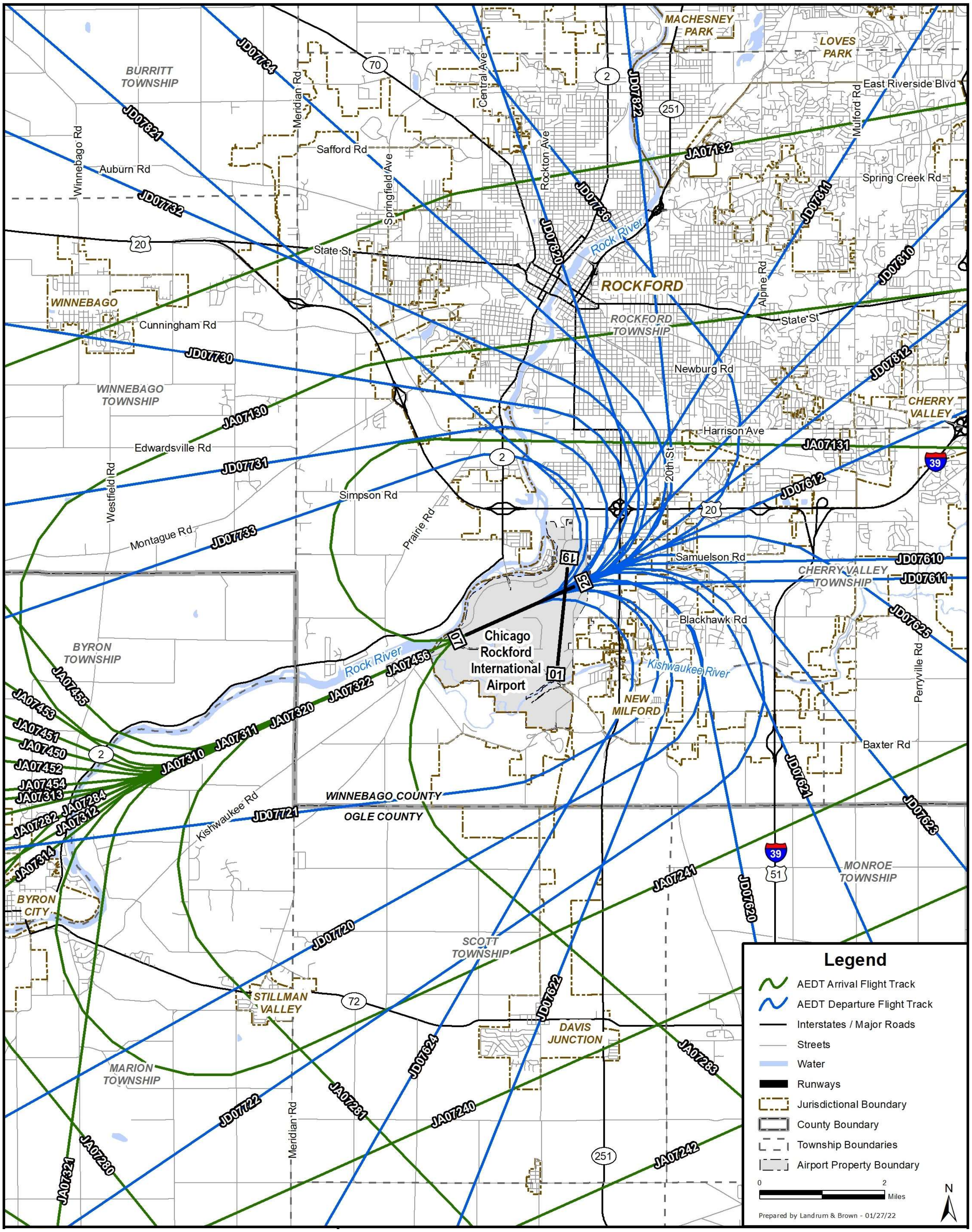
EXHIBIT C-13 | RUNWAY 07 JET FLIGHT TRACKS



Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

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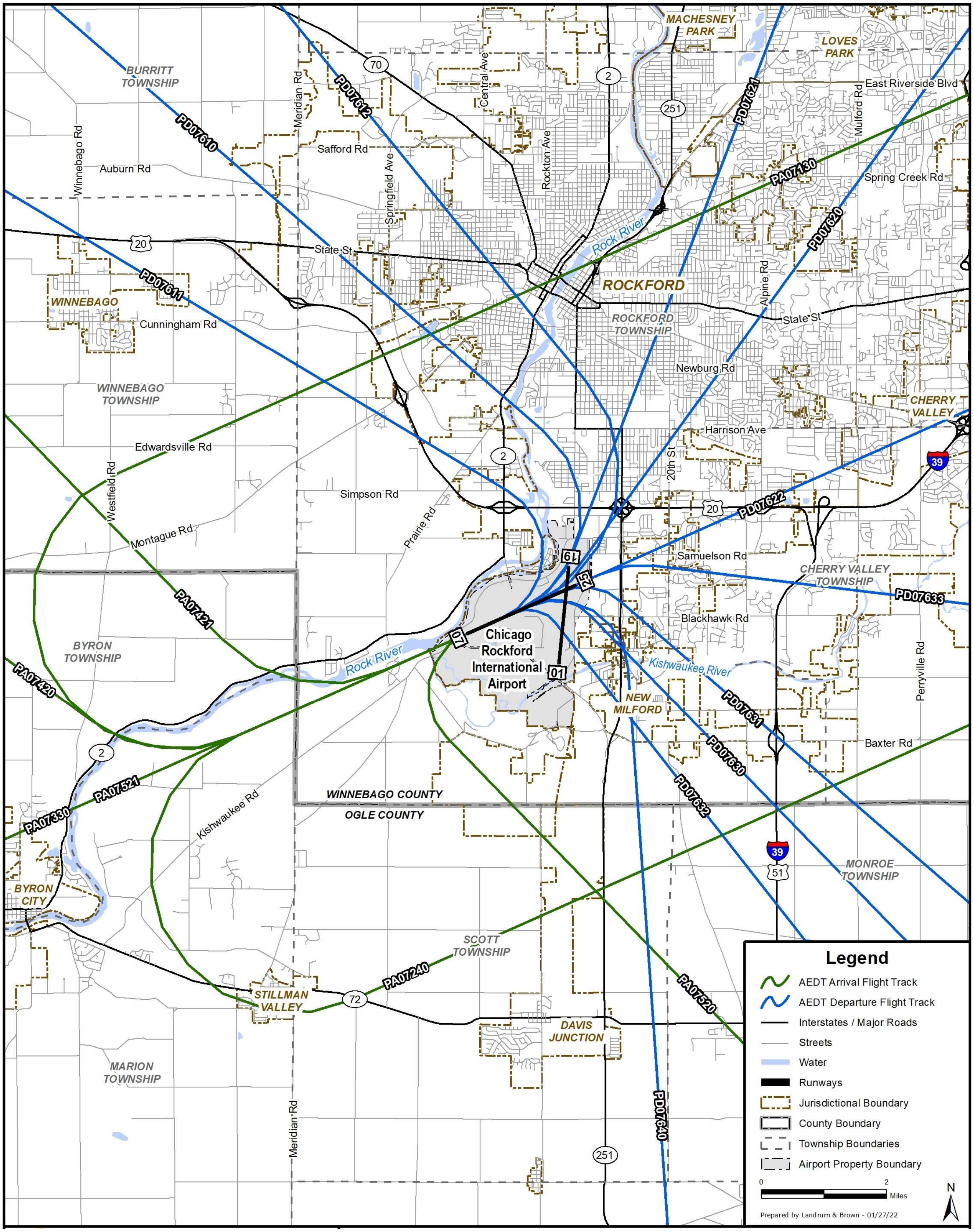
EXHIBIT C-14 | RUNWAY 07 PROPELLER FLIGHT TRACKS



Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

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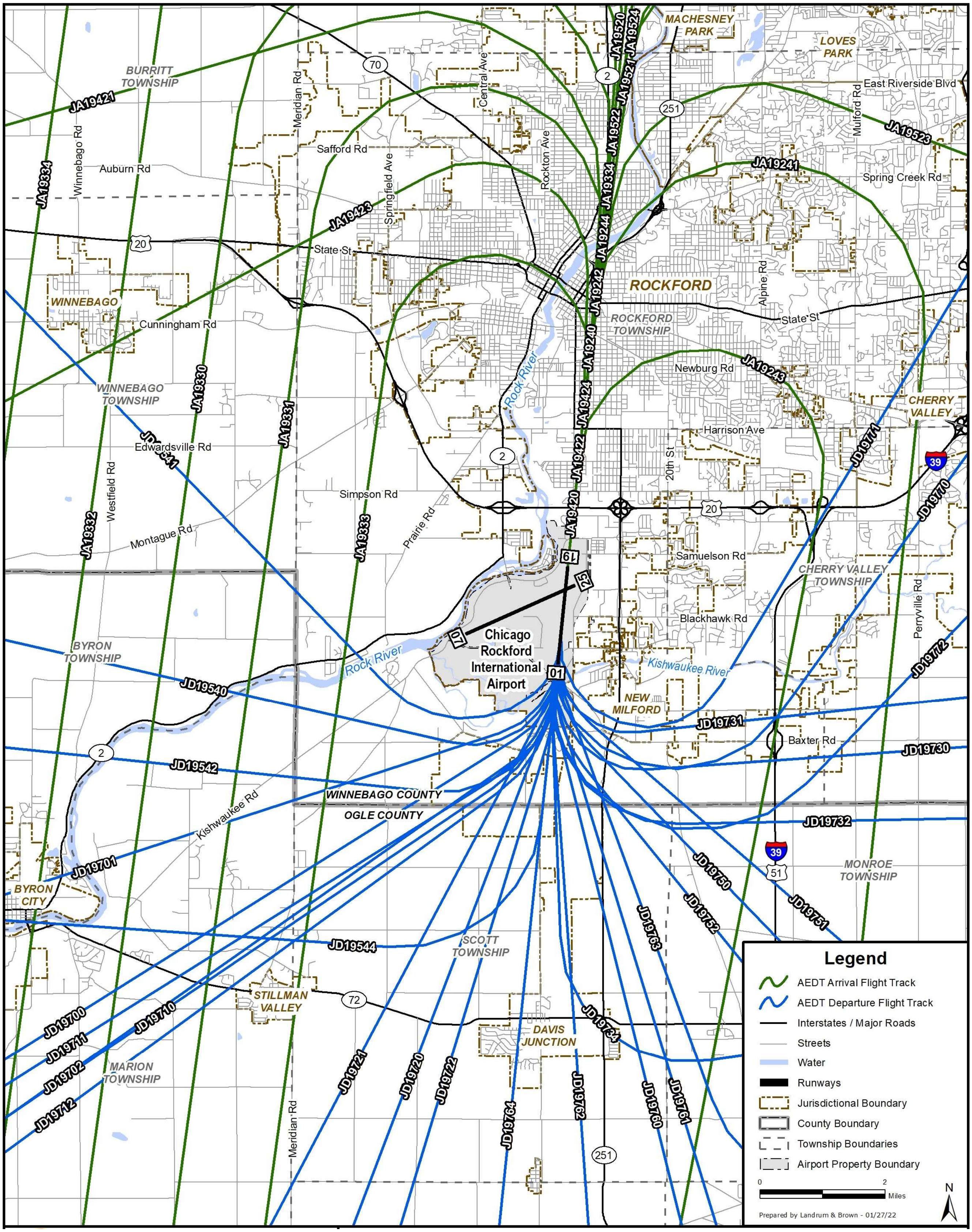
EXHIBIT C-15 | RUNWAY 19 JET FLIGHT TRACKS



Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

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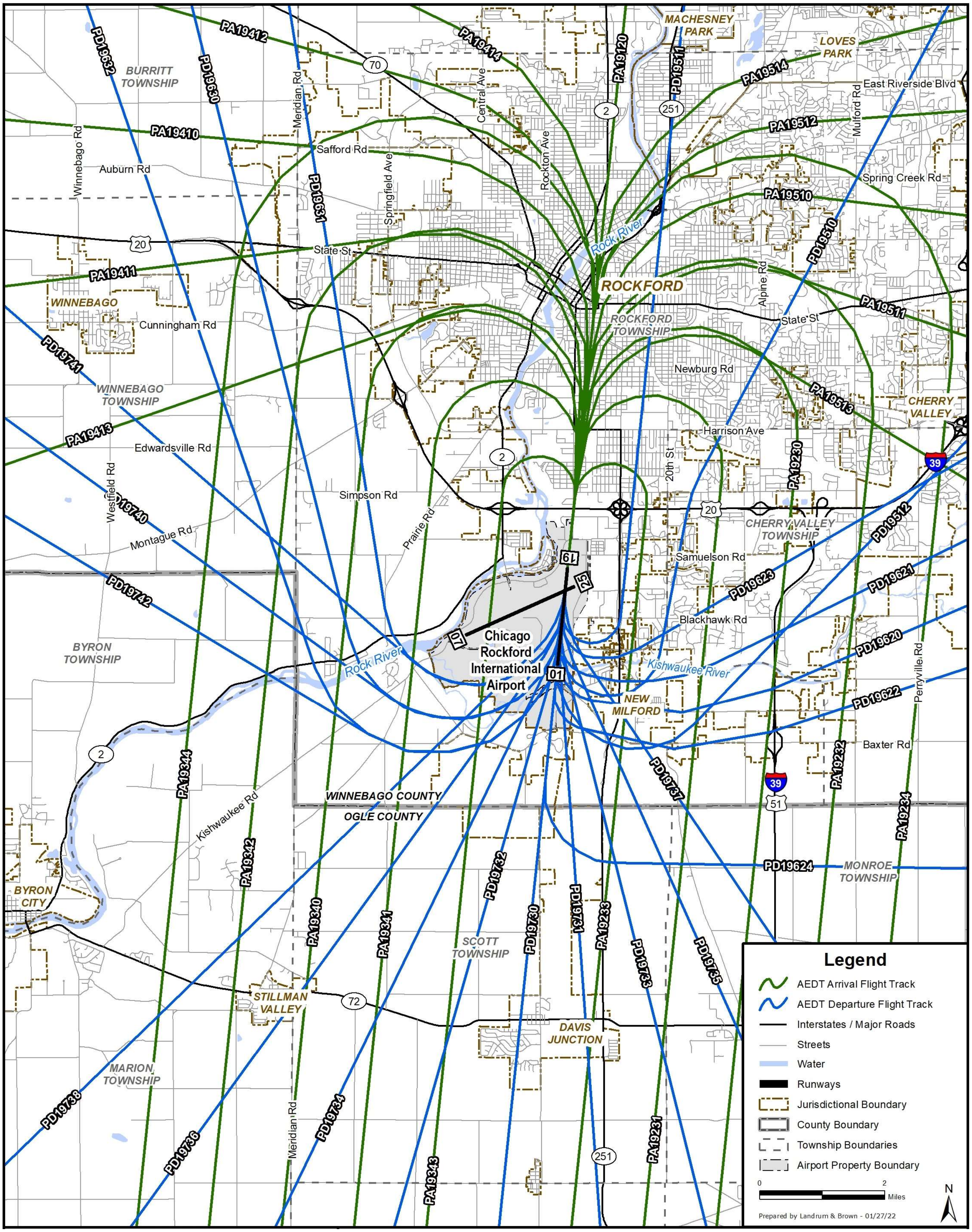
EXHIBIT C-16 | RUNWAY 19 PROPELLER FLIGHT TRACKS



Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

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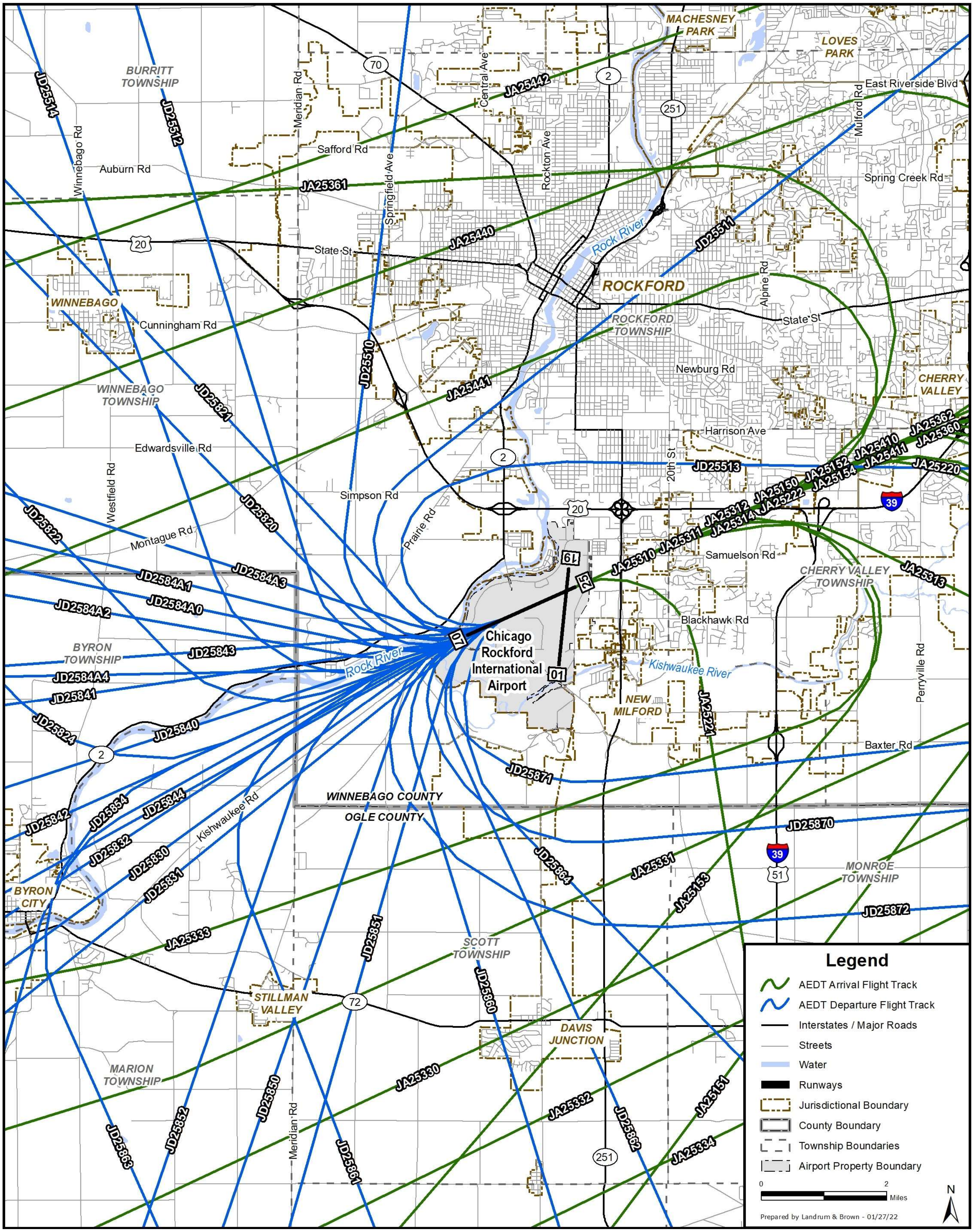
EXHIBIT C-17 | RUNWAY 25 JET FLIGHT TRACKS



Source: | National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

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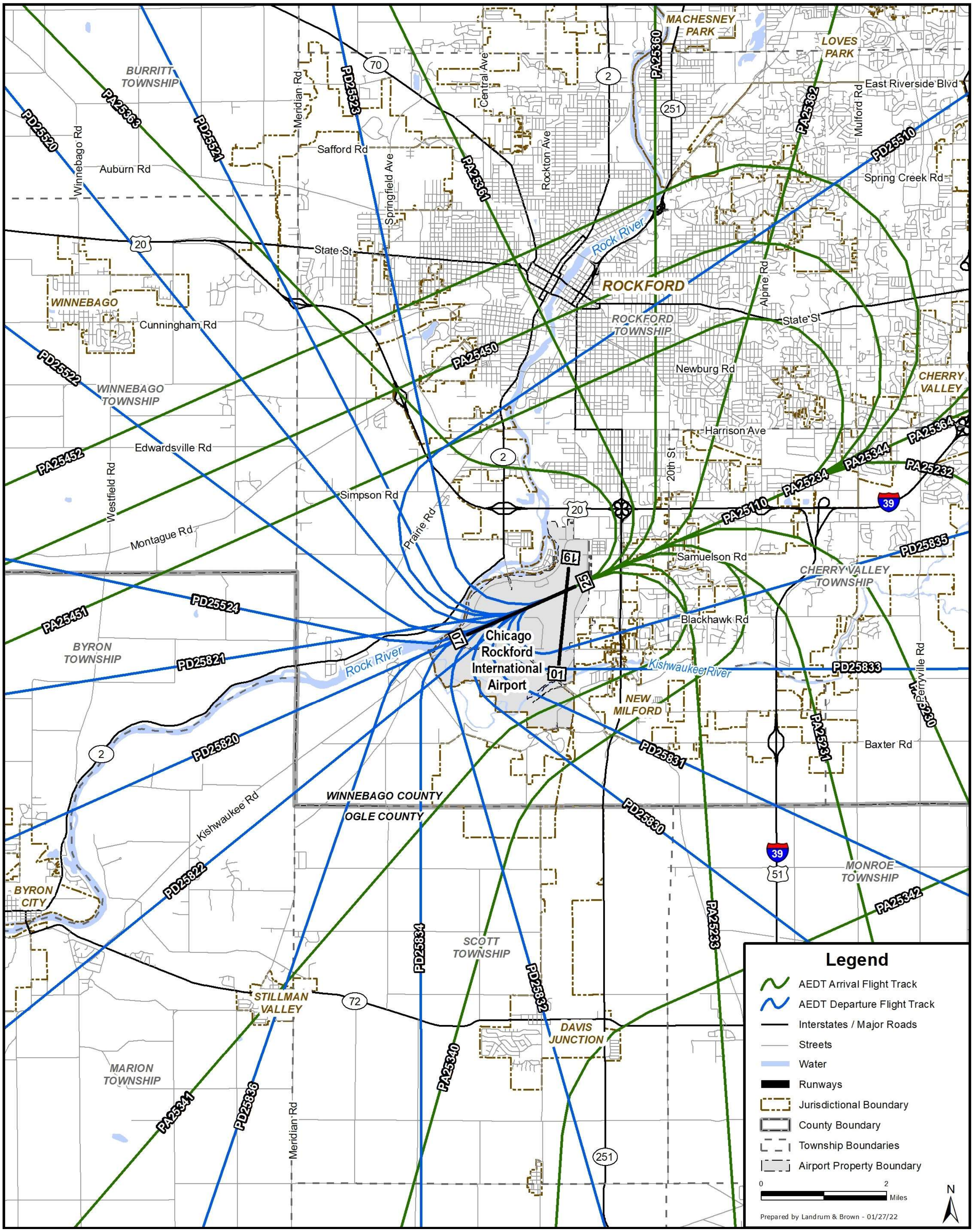
EXHIBIT C-18 | RUNWAY 25 PROPELLER FLIGHT TRACKS



Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

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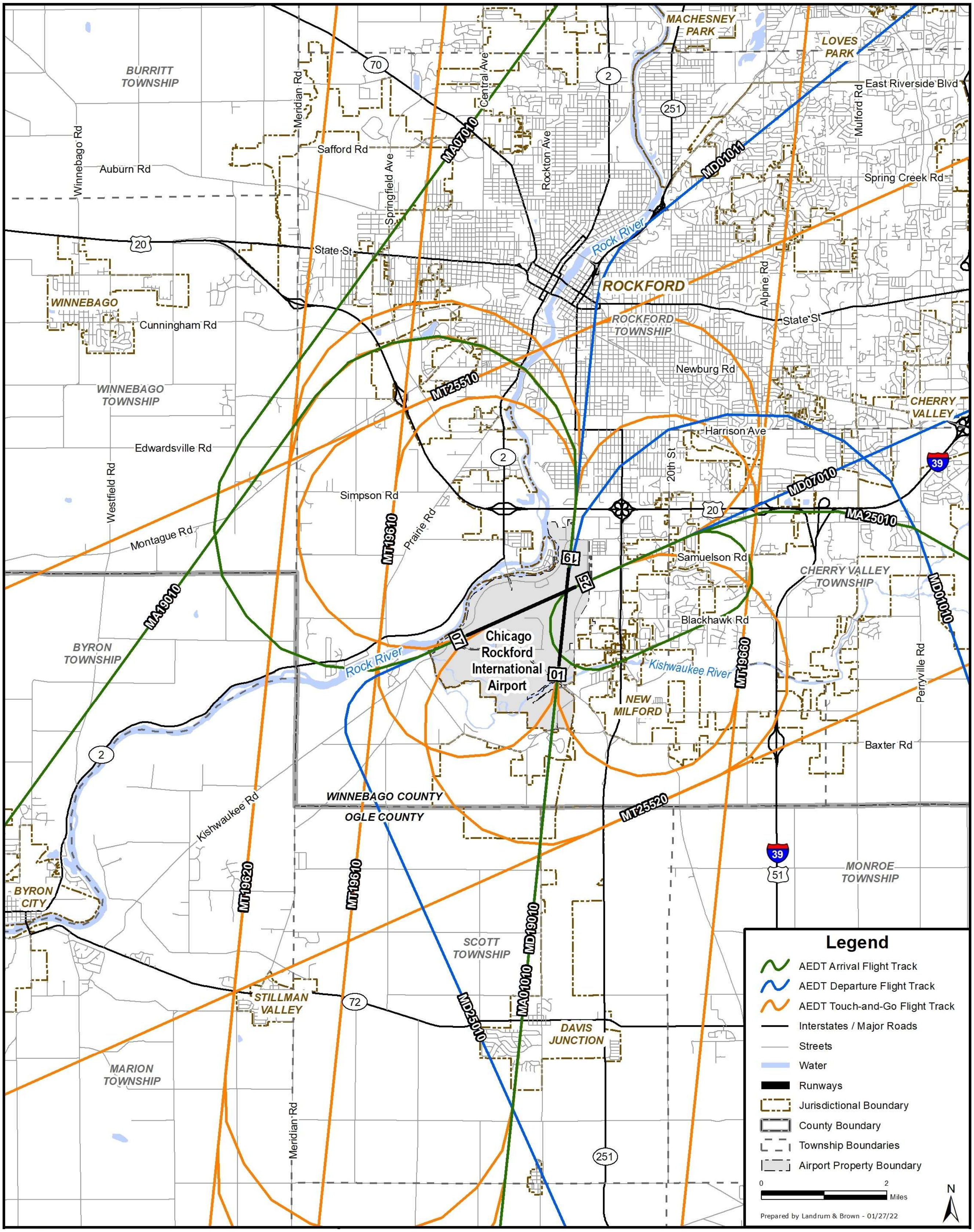
EXHIBIT C-19 | MILITARY FLIGHT TRACKS



Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

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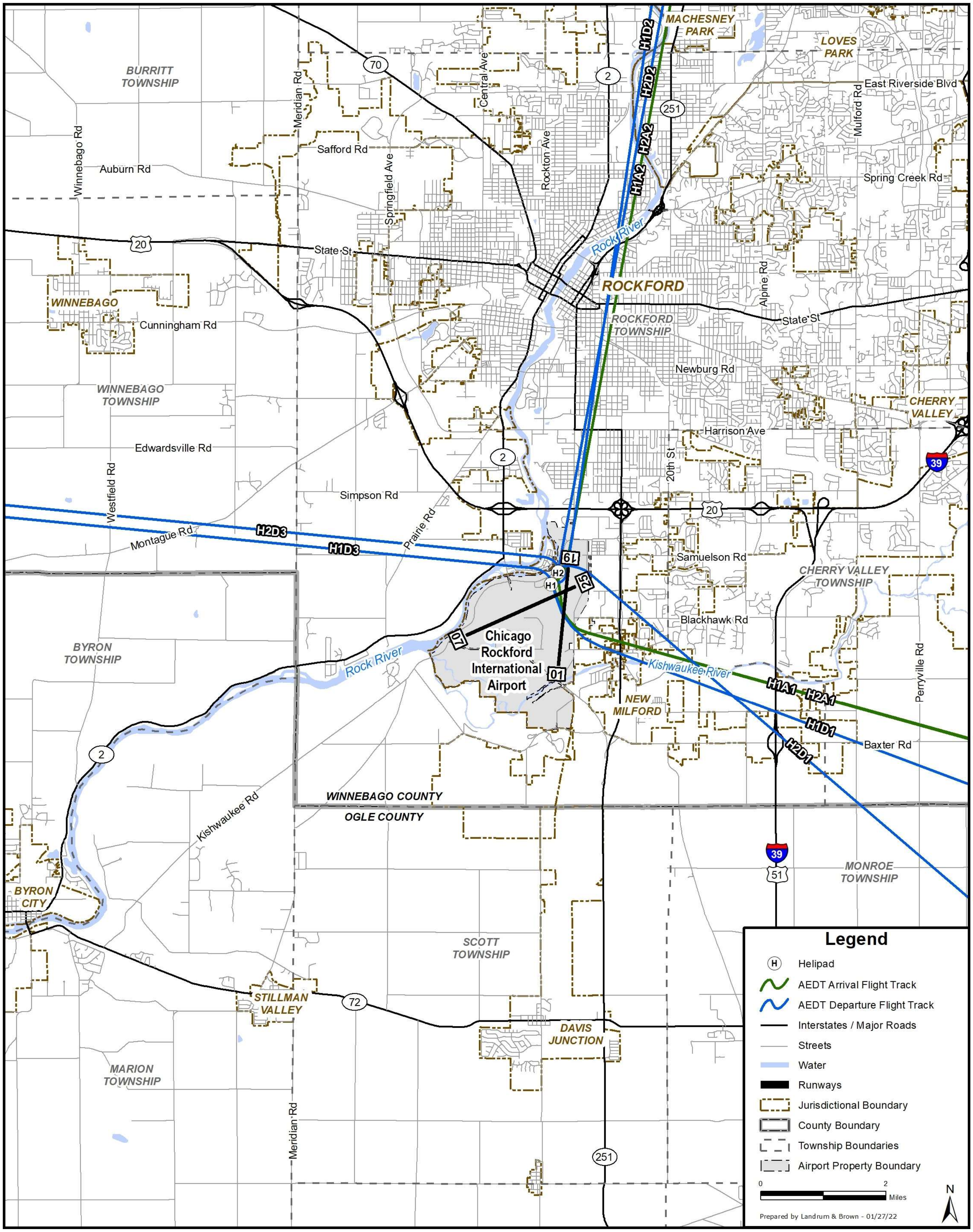
EXHIBIT C-20 | HELICOPTER FLIGHT TRACKS



Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

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TABLE C-4 | ARRIVAL AEDT FLIGHT TRACK UTILIZATION

Runway End	Track ID	Aircraft Category			
		Cargo & Commercial	General Aviation Jets	General Aviation Props	Military
01	JA01210	3.9%	3.9%	--	--
	JA01211	3.3%	3.3%	--	--
	JA01212	3.2%	3.2%	--	--
	JA01213	2.5%	2.5%	--	--
	JA01214	2.3%	2.3%	--	--
	JA01220	7.4%	7.4%	--	--
	JA01221	8.4%	8.4%	--	--
	JA01222	2.2%	2.2%	--	--
	JA01230	5.7%	5.7%	--	--
	JA01240	3.5%	3.5%	--	--
	JA01241	3.3%	3.3%	--	--
	JA01242	3.5%	3.5%	--	--
	JA01310	3.9%	3.9%	--	--
	JA01311	2.6%	2.6%	--	--
	JA01312	14.9%	14.9%	--	--
	JA01330	7.8%	7.8%	--	--
	JA01331	3.9%	3.9%	--	--
	JA01332	10.2%	10.2%	--	--
	JA01333	2.8%	2.8%	--	--
	JA01334	4.8%	4.8%	--	--
	MA01010	--	--	--	100.0%
	PA01110	--	--	4.0%	--
	PA01111	--	--	20.0%	--
	PA01112	--	--	7.2%	--
	PA01310	--	--	2.4%	--
	PA01311	--	--	11.2%	--
	PA01312	--	--	8.0%	--
	PA01320	--	--	28.8%	--
	PA01410	--	--	14.4%	--
	PA01420	--	--	4.0%	--
07	JA07130	0.7%	0.7%	--	--
	JA07131	1.8%	1.8%	--	--
	JA07132	0.7%	0.7%	--	--
	JA07240	2.2%	2.2%	--	--
	JA07241	1.0%	1.0%	--	--
	JA07242	2.0%	2.0%	--	--
	JA07280	2.7%	2.7%	--	--
	JA07281	1.7%	1.7%	--	--

Runway End	Track ID	Aircraft Category			
		Cargo & Commercial	General Aviation Jets	General Aviation Props	Military
07	JA07282	2.6%	2.6%	--	--
	JA07283	1.2%	1.2%	--	--
	JA07284	0.8%	0.8%	--	--
	JA07310	27.8%	27.8%	--	--
	JA07311	2.5%	2.5%	--	--
	JA07312	1.6%	1.6%	--	--
	JA07313	2.5%	2.5%	--	--
	JA07314	1.2%	1.2%	--	--
	JA07320	9.6%	9.6%	--	--
	JA07321	7.5%	7.5%		
	JA07322	3.2%	3.2%		
	JA07450	4.1%	4.1%	--	--
	JA07451	1.6%	1.6%	--	--
	JA07452	2.8%	2.8%	--	--
	JA07453	0.7%	0.7%	--	--
	JA07454	3.1%	3.1%	--	--
	JA07455	1.8%	1.8%	--	--
	JA07456	12.8%	12.8%	--	--
	MA07010	--	--	--	100.0%
	PA07130	--	--	20.5%	--
	PA07240	--	--	14.5%	--
	PA07330	--	--	14.5%	--
	PA07420	--	--	10.8%	--
	PA07421	--	--	16.9%	--
	PA07520	--	--	14.5%	--
	PA07521	--	--	8.4%	--
19	JA19240	2.5%	2.5%	--	--
	JA19241	2.5%	2.5%	--	--
	JA19242	3.3%	3.3%	--	--
	JA19243	1.0%	1.0%	--	--
	JA19244	1.3%	1.3%	--	--
	JA19330	8.1%	8.1%	--	--
	JA19331	7.1%	7.1%	--	--
	JA19332	6.8%	6.8%	--	--
	JA19333	5.1%	5.1%	--	--
	JA19334	6.3%	6.3%	--	--
	JA19420	10.4%	10.4%	--	--
	JA19421	9.8%	9.8%	--	--
	JA19422	9.1%	9.1%	--	--
	JA19423	4.3%	4.3%	--	--

Runway End	Track ID	Aircraft Category			
		Cargo & Commercial	General Aviation Jets	General Aviation Props	Military
19	JA19424	8.3%	8.3%	--	--
	JA19520	4.8%	4.8%	--	--
	JA19521	3.0%	3.0%	--	--
	JA19522	2.0%	2.0%	--	--
	JA19523	1.3%	1.3%	--	--
	JA19524	3.0%	3.0%	--	--
	MA19010	--	--	--	100.0%
	PA19120	--	--	10.9%	--
	PA19230	--	--	3.3%	--
	PA19231	--	--	3.3%	--
	PA19232	--	--	1.1%	--
	PA19233	--	--	12.0%	--
	PA19234	--	--	3.3%	--
	PA19340	--	--	1.1%	--
	PA19341	--	--	3.3%	--
	PA19342	--	--	1.1%	--
	PA19343	--	--	6.5%	--
	PA19344	--	--	4.3%	--
	PA19410	--	--	4.3%	--
	PA19411	--	--	3.3%	--
	PA19412	--	--	1.1%	--
	PA19413	--	--	12.0%	--
	PA19414	--	--	2.2%	--
	PA19510	--	--	3.3%	--
	PA19511	--	--	1.1%	--
	PA19512	--	--	1.1%	--
	PA19513	--	--	16.3%	--
	PA19514	--	--	5.4%	--
25	JA25150	8.8%	8.8%	--	--
	JA25151	7.1%	7.1%	--	--
	JA25152	5.4%	5.4%	--	--
	JA25153	2.3%	2.3%	--	--
	JA25154	4.7%	4.7%	--	--
	JA25220	3.4%	3.4%	--	--
	JA25221	1.1%	1.1%	--	--
	JA25222	3.9%	3.9%	--	--
	JA25310	2.1%	2.1%	--	--
	JA25311	1.1%	1.1%	--	
	JA25312	3.3%	3.3%	--	--
	JA25313	0.6%	0.6%	--	--

Runway End	Track ID	Aircraft Category			
		Cargo & Commercial	General Aviation Jets	General Aviation Props	Military
25	JA25314	9.6%	9.6%	--	--
	JA25330	3.7%	3.7%	--	--
	JA25331	2.2%	2.2%	--	--
	JA25332	2.4%	2.4%	--	--
	JA25333	1.1%	1.1%	--	--
	JA25334	2.6%	2.6%	--	--
	JA25360	4.8%	4.8%	--	--
	JA25361	1.4%	1.4%	--	--
	JA25362	5.3%	5.3%	--	--
	JA25410	6.7%	6.7%	--	--
	JA25411	2.6%	2.6%	--	--
	JA25440	5.9%	5.9%	--	--
	JA25441	2.2%	2.2%	--	--
	JA25442	5.8%	5.8%	--	--
	MA25010	--	--	--	100.0%
	PA25110	--	--	16.5%	--
	PA25230	--	--	11.4%	--
	PA25231	--	--	10.8%	--
	PA25232	--	--	3.4%	--
	PA25233	--	--	3.4%	--
	PA25234	--	--	3.4%	--
	PA25340	--	--	5.1%	--
	PA25341	--	--	5.1%	--
	PA25342	--	--	1.1%	--
	PA25344	--	--	5.7%	--
	PA25360	--	--	8.0%	--
	PA25361	--	--	4.0%	--
	PA25362	--	--	5.7%	--
	PA25363	--	--	3.4%	--
	PA25364	--	--	6.3%	--
	PA25450	--	--	2.8%	--
	PA25451	--	--	2.8%	--
	PA25452	--	--	1.1%	--

Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

TABLE C-5 | DEPARTURE AEDT FLIGHT TRACK UTILIZATION

Runway End	Track ID	Aircraft Category			
		Cargo & Commercial	General Aviation Jets	General Aviation Props	Military
01	JD01510	4.8%	4.8%	--	--
	JD01520	4.3%	4.3%	--	--
	JD01521	2.4%	2.4%	--	--
	JD01540	7.6%	7.6%	--	--
	JD01541	7.1%	7.1%	--	--
	JD01542	6.7%	6.7%	--	--
	JD01830	15.7%	15.7%	--	--
	JD01831	5.2%	5.2%	--	--
	JD01832	11.9%	11.9%	--	--
	JD01833	4.8%	4.8%	--	--
	JD01834	4.8%	4.8%	--	--
	JD01840	13.3%	13.3%	--	--
	JD01841	4.8%	4.8%	--	--
	JD01842	6.7%	6.7%	--	--
	MD01010	--	--	--	50.0%
	MD01011	--	--	--	50.0%
	PD01520	--	--	18.7%	--
	PD01521	--	--	1.3%	--
	PD01522	--	--	3.9%	--
	PD01540	--	--	7.7%	--
	PD01630	--	--	18.7%	--
	PD01810	--	--	24.5%	--
	PD01840	--	--	5.8%	--
	PD01841	--	--	4.5%	--
	PD01842	--	--	4.5%	--
	PD01843	--	--	5.8%	--
	PD01844	--	--	4.5%	--
07	JD07610	7.2%	7.2%	--	--
	JD07611	2.7%	2.7%	--	--
	JD07612	3.7%	3.7%	--	
	JD07620	12.1%	12.1%	--	--
	JD07621	11.8%	11.8%	--	--
	JD07622	10.4%	10.4%	--	--
	JD07623	4.5%	4.5%	--	--
	JD07624	4.5%	4.5%	--	--
	JD07625	2.2%	2.2%	--	--
	JD07720	3.0%	3.0%	--	--
	JD07721	1.0%	1.0%	--	--
	JD07722	2.9%	2.9%	--	--

Runway End	Track ID	Aircraft Category			
		Cargo & Commercial	General Aviation Jets	General Aviation Props	Military
07	JD07730	10.7%	10.7%	--	--
	JD07731	5.2%	5.2%	--	--
	JD07732	6.1%	6.1%	--	--
	JD07733	2.6%	2.6%	--	--
	JD07734	3.6%	3.6%	--	--
	JD07736	2.9%	2.9%	--	--
	JD07810	0.9%	0.9%	--	--
	JD07811	0.4%	0.4%	--	--
	JD07812	0.4%	0.4%	--	--
	JD07820	0.7%	0.7%	--	--
	JD07821	0.3%	0.3%	--	--
	JD07822	0.3%	0.3%	--	--
	MD07010	--	--	--	100.0%
	PD07610	--	--	9.7%	--
	PD07611	--	--	2.8%	--
	PD07612	--	--	6.9%	--
	PD07620	--	--	5.5%	--
	PD07621	--	--	2.8%	--
	PD07622	--	--	44.1%	--
	PD07630	--	--	4.8%	--
	PD07631	--	--	5.5%	--
	PD07632	--	--	2.1%	--
	PD07633	--	--	6.9%	--
	PD07640	--	--	9.0%	--
19	JD19540	7.5%	7.5%	--	--
	JD19541	1.8%	1.8%	--	--
	JD19542	3.4%	3.4%	--	--
	JD19544	2.2%	2.2%	--	--
	JD19700	4.2%	4.2%	--	--
	JD19701	0.9%	0.9%	--	--
	JD19702	2.4%	2.4%	--	--
	JD19710	0.1%	0.1%	--	--
	JD19711	0.1%	0.1%	--	--
	JD19712	0.1%	0.1%	--	--
	JD19720	9.7%	9.7%	--	--
	JD19721	1.8%	1.8%	--	--
	JD19722	1.7%	1.7%	--	--
	JD19730	17.0%	17.0%	--	--
	JD19731	2.5%	2.5%	--	--
	JD19732	3.9%	3.9%	--	--

Runway End	Track ID	Aircraft Category			
		Cargo & Commercial	General Aviation Jets	General Aviation Props	Military
19	JD19734	1.0%	1.0%	--	--
	JD19750	2.3%	2.3%	--	--
	JD19751	0.9%	0.9%	--	--
	JD19752	6.1%	6.1%	--	--
	JD19760	7.9%	7.9%	--	--
	JD19761	5.0%	5.0%	--	--
	JD19762	4.1%	4.1%	--	--
	JD19763	3.0%	3.0%	--	--
	JD19764	5.2%	5.2%	--	--
	JD19770	1.5%	1.5%	--	--
	JD19771	0.8%	0.8%	--	--
	JD19772	2.9%	2.9%	--	--
	MD19010	--	--	--	100.0%
	PD19510	--	--	6.8%	--
	PD19511	--	--	2.0%	--
	PD19512	--	--	5.2%	--
	PD19620	--	--	7.2%	--
	PD19621	--	--	5.6%	--
	PD19622	--	--	6.4%	--
	PD19623	--	--	4.8%	--
	PD19624	--	--	2.4%	--
	PD19630	--	--	3.6%	--
	PD19631	--	--	2.0%	--
	PD19632	--	--	2.0%	--
	PD19730	--	--	19.5%	--
	PD19731	--	--	6.8%	--
	PD19732	--	--	2.0%	--
	PD19733	--	--	1.6%	--
	PD19734	--	--	4.4%	--
	PD19735	--	--	1.6%	--
	PD19736	--	--	2.8%	--
	PD19737	--	--	1.6%	--
	PD19738	--	--	1.6%	--
	PD19740	--	--	5.2%	--
	PD19741	--	--	3.2%	--
	PD19742	--	--	2.0%	--
25	JD25510	1.2%	1.2%	--	--
	JD25511	0.6%	0.6%	--	--
	JD25512	1.5%	1.5%	--	--
	JD25513	0.4%	0.4%	--	--

Runway End	Track ID	Aircraft Category			
		Cargo & Commercial	General Aviation Jets	General Aviation Props	Military
25	JD25514	0.8%	0.8%	--	--
	JD25820	4.3%	4.3%	--	--
	JD25821	0.9%	0.9%	--	--
	JD25822	0.6%	0.6%	--	--
	JD25824	0.2%	0.2%	--	--
	JD25830	11.2%	11.2%	--	--
	JD25831	3.0%	3.0%	--	--
	JD25832	1.5%	1.5%	--	--
	JD25840	6.8%	6.8%	--	--
	JD25841	3.4%	3.4%	--	--
	JD25842	2.1%	2.1%	--	--
	JD25843	0.6%	0.6%	--	--
	JD25844	0.7%	0.7%	--	--
	JD2584A0	13.3%	13.3%	--	--
	JD2584A1	9.3%	9.3%	--	--
	JD2584A2	5.7%	5.7%	--	--
	JD2584A3	2.3%	2.3%	--	--
	JD2584A4	2.2%	2.2%	--	--
	JD25850	5.8%	5.8%	--	--
	JD25851	1.2%	1.2%	--	--
	JD25852	1.0%	1.0%	--	--
	JD25854	0.7%	0.7%	--	--
	JD25860	9.9%	9.9%	--	--
	JD25861	1.5%	1.5%	--	--
	JD25862	2.2%	2.2%	--	--
	JD25863	1.1%	1.1%	--	--
	JD25864	1.9%	1.9%	--	--
	JD25870	1.0%	1.0%	--	--
	JD25871	0.7%	0.7%	--	--
	JD25872	0.7%	0.7%	--	--
	MD25010	--	--	--	100.0%
	PD25510	--	--	19.6%	--
	PD25520	--	--	5.4%	--
	PD25521	--	--	3.9%	--
	PD25522	--	--	4.2%	--
	PD25523	--	--	3.3%	--
	PD25524	--	--	4.2%	--
	PD25820	--	--	12.5%	--
	PD25821	--	--	3.0%	--
	PD25822	--	--	3.0%	--

Runway End	Track ID	Aircraft Category			
		Cargo & Commercial	General Aviation Jets	General Aviation Props	Military
25	PD25830	--	--	8.9%	--
	PD25831	--	--	6.5%	--
	PD25832	--	--	7.7%	--
	PD25833	--	--	3.3%	--
	PD25834	--	--	6.2%	--
	PD25835	--	--	3.3%	--
	PD25836	--	--	5.1%	--

Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

TABLE C-6 | TOUCH AND GO FLIGHT TRACK UTILIZATION

Runway End	Track ID	Aircraft Category			
		Cargo & Commercial	General Aviation Jets	General Aviation Props	Military
19	03PTA1	N/A			20.0%
	03PTB1				20.0%
	03PTC1				20.0%
25	09PTA1				20.0%
	09PTB1				20.0%

Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

TABLE C-7 | TOUCH AND GO FLIGHT TRACK UTILIZATION

Runway End	Op Type	Track ID	Percent Utilization
H1	A	H1A1	50.0%
	A	H1A2	50.0%
	D	H1D1	20.0%
	D	H1D2	70.0%
	D	H1D3	10.0%
H2	A	H2A1	50.0%
	A	H2A2	50.0%
	D	H2D1	20.0%
	D	H2D2	70.0%
	D	H2D3	10.0%

Source: National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

C.5.5 Aircraft Weight and Trip Length

Aircraft weight upon departure is a factor in the dispersion of noise because it impacts the rate at which an aircraft is able to climb. Generally, heavier aircraft have a slower rate of climb and a wider dispersion of noise along the flight route. Where specific aircraft weights are unknown, the AEDT uses the distance flown to the first stop as a surrogate for the weight, by assuming that the weight has a direct relationship with the fuel load necessary to reach the first destination. The AEDT groups trip lengths into nine stage categories and assigns standard aircraft weights to each stage category as shown in **Table C-8, *AEDT Stage Lengths***. These categories are:

TABLE C-8 | AEDT STAGE LENGTHS

Stage Length Category	Stage Length	Sample Destination
1	0-500 nautical miles	Louisville, Minneapolis, Kansas City
2	501-1000 nautical miles	Dallas, Baltimore, Denver
3	1001-1500 nautical miles	Ontario, Miami, Seattle
4	1501-2500 nautical miles	Oakland, Anchorage
5	2501-3500 nautical miles	International
6	3501-4500 nautical miles	International
7	4501-5500 nautical miles	International
8	5501-6500 nautical miles	--
9	6500+ nautical miles	--

The stage lengths modeled for the Existing (2023) Baseline condition are based upon a review of existing schedules and typical destinations for current conditions at RFD. **Table C-9, *Existing (2023) Baseline Departure Day Stage Lengths*** and **Table C-10, *Existing (2023) Baseline Departure Night Stage Lengths*** indicates the proportion of the operations that were modeled within each of the nine stage length categories for the Existing (2023) Baseline condition during the daytime (7:00 a.m. – 9:59 p.m.) and nighttime (10:00 p.m. – 6:59 a.m.) periods.

TABLE C-9 | EXISTING (2023) BASELINE DEPARTURE DAY STAGE LENGTHS

Stage Length Category	Cargo	Commercial	General Aviation Jets	General Aviation Props	Military
1	26.48%	2.89%	99.16%	100.00%	100.00%
2	15.94%	76.62%	0.84%	--	--
3	56.26%	19.07%	--	--	--
4	0.74%	1.36%	--	--	--
5	--	--	--	--	--
6	0.56%	0.06%	--	--	--
7	0.03%	--	--	--	--
8	--	--	--	--	--
9	--	--	--	--	--
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Source: Federal Aviation Administration (FAA) Operations Network (OpsNet) data, Traffic Flow Management System (TFMS) data, National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

TABLE C-10 | EXISTING (2023) BASELINE DEPARTURE NIGHT STAGE LENGTHS

Stage Length Category	Cargo	Commercial	General Aviation Jets	General Aviation Props	Military
1	33.75%	43.63%	100.00%	100.00%	--
2	29.01%	28.55%	--	--	--
3	25.81%	27.66%	--	--	--
4	11.02%	0.15%	--	--	--
5	0.02%	--	--	--	--
6	0.40%	--	--	--	--
7	--	--	--	--	--
8	--	--	--	--	--
9	--	--	--	--	--
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***--***

Source: Federal Aviation Administration (FAA) Operations Network (OpsNet) data, Traffic Flow Management System (TFMS) data, National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

C.5.6 Engine Run-ups

Engine run-up activity was not tracked as it was minimal and unlikely to affect the location of the 65 DNL Noise Exposure Contour. Therefore, engine run-ups were not modeled as part of the Part 150 Study.

C.6 Future (2028) Baseline Noise Modeling Methodology

The following sections describe the noise modeling methodology and assumptions for the Future (2028) Baseline Noise Exposure Contours at RFD. Data representative of an average-annual day of operations was obtained from an forecast of aviation activity. This data included the number of operations by individual types of aircraft user classes.

C.6.1 Runway Definition

The runway layout is not expected to change by 2028 at RFD; therefore, the same runway layout discussed for the Existing (2023) Baseline Noise Exposure Contour will be used to model the Future (2028) Baseline Noise Exposure Contour.

C.6.2 Number of Operations and Fleet Mix

Per 14 CFR Part 150 requirements, the future conditions are to be dated five years after the date of submission. Therefore, the future year conditions are dated 2028. The number of Future (2028) Baseline condition average-annual daily operations at RFD is based on the Forecast Working Paper (FWP)14 and subsequent update to account for impacts due to the COVID-19 health emergency.15, which is summarized in **Appendix H, *Forecast***.

The Existing (2023) Baseline condition fleet mix was adjusted by reducing and or phasing out certain older aircraft types, and increasing and introducing newer aircraft to the fleet. Older aircraft that were phased out of the cargo fleet included the DC-9-10 Series Freighter, Boeing MD-11 (PW & GE versions) and the Boeing 727-200 Series Freighter. The largest increase of cargo aircraft was applied to the Boeing 767-300 ER Freighter and the Airbus A300B4-600 Series, while the Boeing 737-800BCF aircraft was added to the cargo fleet. The number of average-annual daily operations for each aircraft was scaled based on data included in the aviation forecast for the year 2028.

Based on the aviation forecast data, it is projected that there will be 63,899 total aircraft operations at RFD by 2028. When divided by 365, the result is 175.1 average-annual daily operations. **Table C-11, *Future (2028) Baseline Average-Annual Day Operations by Aircraft Category***, provides a summary of the average-annual daily operations and fleet mix at RFD, organized by aircraft type, operation type, and time of day for Future (2028) Baseline conditions. **Table C-12, *Future (2028) Baseline Average-Annual Day Operations by Aircraft Type***, shows the average-annual daily number of arrivals and departures by the individual aircraft types for the Future (2028) Baseline condition.

14 Development of Northwest Cargo Apron & Midfield Development Program, Forecast Summary, September 2018, Crawford Murphy & Tilly.
15 Chicago Rockford International (RFD) – 2018 Forecast Working Paper (FWP) Sensitivity Analysis, July 2021, Crawford Murphy & Tilly.

TABLE C-11 | FUTURE (2028) BASELINE AVERAGE-ANNUAL DAY OPERATIONS BY AIRCRAFT CATEGORY

Aircraft Category	Arrivals		Departures		Total	Percent of Total
	Day	Night	Day	Night		
Cargo Jets	18.05	24.72	18.05	24.72	85.54	48.9%
Commercial Jets	5.94	0.34	5.94	0.34	12.56	7.2%
General Aviation Jets	12.88	0.99	12.88	0.99	27.74	15.8%
General Aviation Props	21.41	0.91	21.41	0.91	44.64	25.5%
Military Aircraft	2.29	--	2.29	--	4.58	2.6%
Grand Total	***60.58***	***26.96***	***60.58***	***26.96***	***175.07***	***100%***

Notes: Total may not equal sum total due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.
Source: RFD Forecast Working Paper, 2018, RFD forecast Working Paper Sensitivity Analysis, 2021, Landrum & Brown analysis, 2023.

TABLE C-12 | FUTURE (2028) BASELINE AVERAGE-ANNUAL DAILY OPERATIONS BY AIRCRAFT TYPE

Aircraft Type	AEDT ID	Arrivals		Departures		Total
		Day	Night	Day	Night	
Cargo Jets						
Boeing 737-800BCF	737800	0.92	0.36	0.92	0.36	2.57
Boeing 747-400 Series Freighter	747400	0.38	0.05	0.38	0.05	0.86
Boeing 747-800 Freighter	7478	0.63	1.59	0.63	1.59	4.45
Boeing 757-200 Series Freighter	757PW	1.49	3.43	1.49	3.43	9.84
Boeing 757-200 Series Freighter	757RR	1.49	3.43	1.49	3.43	9.84
Boeing 767-300 ER Freighter	7673ER	8.43	9.74	8.43	9.74	36.36
Airbus A300B4-600 Series	A300-622R	4.71	6.11	4.71	6.11	21.64
Cargo Jet Subtotal		**18.05**	**24.72**	**18.05**	**24.72**	**85.54**
Commercial Jets						
Boeing 737-700 Series	737700	0.06		0.06		0.13
Boeing 737-800 Series	737800	0.15	0.03	0.15	0.03	0.35
Boeing 757-300 Series	757300	0.03		0.03		0.06
Airbus A319-100 Series	A319-131	0.03	0.01	0.03	0.01	0.08
Airbus A320-200 Series	A320-211	5.66	0.31	5.66	0.31	11.95
Commercial Jet Subtotal		**5.94**	**0.34**	**5.94**	**0.34**	**12.56**
General Aviation Jets						
Bombardier Challenger 600	CL600	0.86	0.03	0.86	0.03	1.76
Cessna 500 Citation I	CNA500	0.66	0.04	0.66	0.04	1.41
Cessna 525 Citation Jet	CNA525C	1.18	0.11	1.18	0.11	2.58
Cessna 550 Citation II	CNA55B	2.21	0.34	2.21	0.34	5.09
Cessna 560 Citation Ultra	CNA560U	0.34	0.01	0.34	0.01	0.71
Cessna 560 Citation Excel	CNA560XL	0.55	0.03	0.55	0.03	1.15
Cessna 680 Citation Sovereign	CNA680	0.28	0.01	0.28	0.01	0.59
Cessna 750 Citation X	CNA750	0.15	0.03	0.15	0.03	0.36
Eclipse 500	ECLIPSE500	1.69	0.03	1.69	0.03	3.43
Embraer ERJ-145	EMB145	0.17	0.03	0.17	0.03	0.38

Aircraft Type	AEDT ID	Arrivals		Departures		Total
		Day	Night	Day	Night	
Gulfstream V/G500	GV	0.17	0.01	0.17	0.01	0.36
Bombardier Learjet 35A/36A (C-21A)	LEAR35	4.07	0.29	4.07	0.29	8.72
Raytheon Beechjet 400	MU3001	0.56	0.04	0.56	0.04	1.20
General Aviation Jet Subtotal		**12.88**	**0.99**	**12.88**	**0.99**	**27.74**
General Aviation Props						
Beech 1900	1900D	0.17	0.01	0.17	0.01	0.36
Raytheon Beech Baron 58	BEC58P	2.36	0.04	2.36	0.04	4.81
Cessna 172 Skyhawk	CNA172	4.24	0.06	4.24	0.06	8.61
Cessna 182	CNA182	1.06	0.06	1.06	0.06	2.24
Cessna 206	CNA206	0.06	0.09	0.06	0.09	0.30
Cessna 441 Conquest II	CNA441	1.49	0.04	1.49	0.04	3.06
1985 1-ENG COMP	COMSEP	2.13	0.05	2.13	0.05	4.35
DeHavilland DHC-6-300 Twin Otter	DHC6	3.53	0.16	3.53	0.16	7.38
Eurocopter EC-130	EC130	0.05	0.04	0.05	0.04	0.18
Single Engine Prop	GASEPV	4.08	0.19	4.08	0.19	8.56
Piper PA-28 Cherokee Series	PA28	1.74		1.74		3.49
Piper PA-30 Twin Comanche	PA30	0.50	0.15	0.50	0.15	1.30
General Aviation Prop Subtotal		**21.41**	**0.91**	**21.41**	**0.91**	**44.64**
Military Aircraft						
Lockheed 130 Hercules*	C130E	0.19	--	0.19	--	0.39
Swearingen Merlin 4	DHC6	0.15	--	0.15	--	0.30
Bombardier Q-400	DHC830	0.13	--	0.13	--	0.26
Mitsubishi Regional Jet 90	EMB175	0.22	--	0.22	--	0.43
Embraer 190	EMB190	0.17	--	0.17	--	0.35
Raytheon Texan 2	GASEPV	0.24	--	0.24	--	0.47
Boeing KC-135 Stratotanker*	KC135B	0.30	--	0.30	--	0.61
Bombardier Learjet 35	LEAR35	0.13	--	0.13	--	0.26
Beechjet 400	MU3001	0.13	--	0.13	--	0.26
Sikorsky SH-60 Seahawk	S70	0.24	--	0.24	--	0.47
Northrop T-38 Talon	T-38A	0.39	--	0.39	--	0.78
Military Aircraft Subtotal		**2.29**	**--**	**2.29**	**--**	**4.58**
Grand Total		***60.58***	***26.96***	***60.58***	***26.96***	***175.07***

* Includes touch-and-go/closed patterns operations which are counted as one arrival and one departure.

Notes: Totals may not equal sum total due to rounding.
Daytime = 7:00am – 9:59pm, Nighttime = 10:00pm – 6:59am.

Source: RFD Forecast Working Paper, 2018, RFD forecast Working Paper Sensitivity Analysis, 2021, Landrum & Brown analysis, 2023.

C.6.3 Runway End Utilization

Average-annual day runway end utilization in 2028 is expected to remain the same as the Existing (2023) Baseline condition. The runway end utilization parameters presented in **Table C-3** were utilized in the Future (2028) Baseline Noise Contour input data.

C.6.4 Flight Tracks

No changes to flight track locations are expected to occur within the general study area by 2028. Therefore, flight track locations and utilization modeled for the Existing (2023) Baseline Noise Exposure Contour, and shown in **Exhibit C-11** through **Exhibit C-20** and **Table C-4** through **Table C-7** remain the same for the Future (2028) Baseline Noise Exposure Contour modeling.

C.6.5 Aircraft Weight and Trip Length

The stage length distribution for the Future (2028) Baseline condition was adjusted slightly to account for additional aircraft included in the fleet mix. **Table C-13, *Future (2028) Baseline Daytime Departure Stage Lengths*** and **Table C-14, *Future (2028) Baseline Nighttime Departure Stage Lengths***, presents the proportion of the operations that were modeled within each of the nine stage length categories for the Future (2028) Baseline condition.

TABLE C-13 | FUTURE (2028) BASELINE DEPARTURE DAY STAGE LENGTHS

Stage Length Category	Cargo	Commercial	General Aviation Jets	General Aviation Props	Military
1	26.48%	2.89%	99.89%	100.00%	100.00%
2	15.94%	76.62%	0.11%	--	--
3	56.26%	19.07%	--	--	--
4	0.74%	1.36%	--	--	--
5	--	--	--	--	--
6	0.56%	0.06%	--	--	--
7	0.03%	--	--	--	--
8	--	--	--	--	--
9	--	--	--	--	--
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***100.0%***

Source: Federal Aviation Administration (FAA) Operations Network (OpsNet) data, Traffic Flow Management System (TFMS) data, National Offload Program (NOP) data, Landrum & Brown analysis, 2023.

TABLE C-14 | FUTURE (2028) BASELINE DEPARTURE NIGHT STAGE LENGTHS

Stage Length Category	Cargo	Commercial	General Aviation Jets	General Aviation Props	Military
1	33.75%	43.63%	100.00%	100.00%	--
2	29.01%	28.55%	--	--	--
3	25.81%	27.66%	--	--	--
4	11.02%	0.15%	--	--	--
5	0.02%	--	--	--	--
6	0.40%	--	--	--	--
7	--	--	--	--	--
8	--	--	--	--	--
9	--	--	--	--	--
Total	***100.0%***	***100.0%***	***100.0%***	***100.0%***	***--***

Source: Federal Aviation Administration (FAA) Operations Network (OpsNet) data, Traffic Flow Management System (TFMS) data, National Offload Program (NOP) data, Landrum & Brown analysis, 2023.