Appendix R-G

Noise

R-G1 – Fundamentals of Noise

Fundamentals of Noise

This appendix presents the basic tools for describing and understanding sound: how it originates, moves through a medium – most frequently the atmosphere – and how it is experienced by a receiver. Understanding these fundamentals at a basic level is critical to subsequently understanding how characteristics of sound influence human perception of *noise*, which is commonly referred to as "unwanted sound." Information presented in this document relies upon a reader's understanding of the characteristics of sound, the effects noise has on persons and communities, and the metrics or descriptors most commonly used to quantify noise. This appendix presents these fundamentals to facilitate an understanding of the noise exposure setting against which land-compatibility is assessed and recommendations are made.

Fundamentals of Acoustics

Sound is a physical phenomenon consisting of minute vibrations (waveforms) that travel through a medium such as air or water. Audible sounds are those vibrations that can be sensed by the human ear. At the ear, sound waves vibrate the ear drum, which transmits the vibration via a network of bones to the cochlea. The cochlea then converts the vibration into neurological impulses that are interpreted by the brain as sound. One's experience and perception of sound depends on both the pattern of vibrations from the sound source and the way our hearing mechanism interprets these vibrations.

A sound *source* induces vibrations in the air, which spread outward from the sound source as alternating bands of dense (compression) and sparse (expansion) air particles. This results in a variation of pressure above and below the baseline atmospheric pressure. The distance between successive compressions or successive expansions is the wavelength of the sound, and the number of compressions or expansions passing a fixed location per unit of time is the frequency of the sound. Frequency is normally expressed in cycles per second or Hertz (Hz); a sound having a 1,000 Hz frequency indicates that the alternating compression and expansion occurs 1,000 times per second. A high frequency sound is shorter in wavelength and lower frequency sound is correspondingly longer in wavelength. In contrast to frequency, which describes the cycling of impulses, the overall magnitude of such impulses that is the average amplitude of the variations of the pressure above and below atmospheric pressure is called the sound pressure.

Sound travels through air at about 1,100 feet per second; however, its speed is different speeds in other media (e.g., water). Therefore, to more fully characterize sound, its three defining characteristics are typically identified: (1) magnitude, (2) frequency spectrum, and (3) the variations of these two over a time interval.

Magnitude

Telephone engineers were among the first to extensively study the ear's response to sound pressure, finding that the ear responds to a broad range of sound pressures. A healthy human ear can detect a sound tone having a frequency a 1,000 Hz at sound pressures (amplitudes) as low as 20 micropascals. (This is expressed as 20 μPa and equals to 20 x 10^{-6} Pascals (Pa). For reference, standard atmospheric pressure at sea level is 101,325 Pascals. At the other end of an amplitude scale, the threshold of pain was found to occur around a sound pressure of 200 Pascals, or ten million times as large as the barely audible 20 μPa magnitude. Whether barely audible (20 μPa) or pain-inducing (200 Pa), these pressures are comparatively small variations around atmospheric pressure (101,235 Pa).

Since a human ear is able to respond to such a large range of sound pressures, early telephone engineers had a measurement problem. At the threshold of hearing, where the ear could detect a sound pressure of 20 μPa, an increase of 40 μPa was a noticeable change; yet at 10 Pa, that same increase of 40 μPa (or 0.00004 Pascals) was undetectable. Thus, a shorthand method for expressing the magnitude of a sound was necessary. Their solution was to develop a logarithmic scale based on the ratio of the sound pressure to a reference sound pressure.

A logarithm (base 10 "common" logarithm) is simply a power of 10. For example, 100 equals 10 times 10, which equates to 10^2*. The logarithm of 100 is then 2 (log 100 = 2). Similarly,* 10^3 *equals 10 times 10 times 10, which equates to 1,000. Consequently, the log of 1,000 is 3.*

When units were standardized, the Bel, in honor of Alexander Graham Bell, was defined as the log of the square of the ratio of two sound pressures, with the decibel one tenth of that. The Bel itself proved to be too coarse of a unit, so the term decibels (dB) remained in common use. Values on the decibel scale are referred to as levels. The following equation shows the relationship of sound pressure level, L, in decibels to sound pressure where p is the pressure of the sound that is being compared and p_0 is the reference pressure against which p is compared.

$$L = 10 \log 10 \left(\frac{p^2}{p_0^2}\right)$$

The level (in decibels) equals 10 times the log of the square of the quantity of measured sound pressure divided by 20 μPa (this squared quantity is proportional to the sound power). Recall that the sound pressure that is barely detectable by the human ear is 20 μPa. By using this as a reference, the telephone engineers "zeroed" the logarithmic scale for sound at the threshold of hearing.

Sensitivity to Changes in Loudness

Under laboratory conditions, people can detect single-decibel changes in sound level. But, when comparing sounds in our everyday experience, we are less sensitive to differences in sound intensities. From a practical standpoint, a 5-dB difference is the smallest change generally noticeable to the average listener. A change in sound level of about 10 dB is usually perceived by the average person as a doubling (or halving) of the sound's loudness. This relation holds true for loud sounds and for quieter sounds across the speech frequencies.

Adding Decibels

Because of the logarithmic nature of the decibel and the fact that sound pressure is a measure of the variation in air pressure, neither sound pressure level in decibels nor sound pressures in μPa can be added directly. However, the quantity inside the parentheses in the above equation, which is proportional to the sound energy, can be added. Note that if the sound pressure levels being added are quite different in magnitude, adding the lesser value to the greater value yields relatively little change to the higher value when expressed as dB and that adding sounds with equal sound pressure levels results in a three-decibel increase.

Frequency

As noted, frequency is the rate of vibrations for a sound and is measured in Hz where one Hz indicates one vibration (or cycle) per second. As with the ability to hear events of widely ranging pressure amplitudes described above, the human ear also hears sounds having widely ranging frequencies (e.g., from about 20 Hz to about 20,000 Hz). However, not all sounds in this wide range of frequencies are heard equally well by the human ear. The ear is most sensitive to sounds having frequencies in the range of 1,000 Hz to 4,000 Hz.

Some simple sound sources, such as a tuning fork, produce sounds with a single frequency (i.e., a pure tone). Most sounds however are more complicated and their signals consist of multiple many frequencies. A sound spectrum is a representation of a sound showing the magnitude of the various frequencies present in the sound. Knowledge of the frequency spectrum of a signal is important for the following reasons:

People and animals have different hearing sensitivity and react differently to various frequencies. For instance, most people are familiar with a “dog whistle” which produces a signal that dogs can hear but humans cannot. This occurs because dog whistles produce a tone having a frequency above the range at which humans can hear but within the range of the dog’s hearing. At the other end of the frequency scale, elephants communicate at frequencies below the range of human hearing.

Structures respond to much lower frequencies (e.g., 1–30 Hz) than humans. Therefore, low-frequency sounds that people cannot hear can still create problems by inducing vibration in buildings.

Different sound sources produce signals consisting of different frequency characteristics. Engineering solutions for reducing or controlling sound are therefore frequency-dependent.

High-quality measuring devices (e.g., sound level meters) are equally sensitive to sounds across the full range of human hearing. Therefore, to approximate the human perception of common environmental sounds, the acoustical community designed a range of frequency-based adjustments to be applied to measured sound levels. Today, two of these weighting systems remain in common usage, the A-weighting and C-weighting.

These weightings are based on the response of human ears to moderate- (A-weighting) or high-level (C-weighting) sounds. For most industrial and transportation applications, A-weighting is used. For loud sounds with significant low frequency content, C-weighting is used. A-weighting applies progressively higher reductions to lower frequencies, mimicking the reduced sensitivity of human ears to low frequency sounds. However, in order to more accurately capture the low frequency energy and higher levels present, C-weighting, with its much slower roll-off at lower frequencies, is more appropriate for noise sources such as explosions and sonic booms.

In addition to representing human hearing sensitivity, A-weighted sound levels have been found to correlate better than other weighting networks with human perception of “noisiness.” One of the primary reasons for the improved correlation is the A-weighting network emphasizes the frequency range where human speech occurs, and noise in this frequency range interferes with speech communication. Another reason is the increased hearing sensitivity makes noise more annoying in this frequency range. For all of the above reasons, A-weighted sound levels are used worldwide in noise standards and regulations to address the effects and impact of noise on human activity.

Variation of Sound with Time

The third characteristic used to describe sound (after magnitude and frequency) is its relative stability over time. Sound can be classified into three categories that define its basic time pattern: steady state, intermittent, and impulsive.

Steady-state sound is a sound of consistent level and spectral content. Typical examples of steady-state sound are the sounds produced by ventilation or mechanical systems that operate more or less continuously.

Intermittent sounds are those that are produced for short periods. The sound temporarily rises above the background and then fades back into it. Intermittent sounds are typically associated with moving sound sources such as an aircraft overflight or a single-vehicle drive-by. Intermittent sound is typically a few minutes or less in duration.

Impulsive sound is of short duration (typically less than one second), low frequency, and high intensity. It has abrupt onset, rapid decay, and often a rapidly changing spectral composition. Impulsive sound is characteristically associated with such sources as large-caliber weapons, demolition activities, sonic booms, and many industrial processes (e.g., jackhammers, pile drivers). However, certain aspects of helicopter noise events are also impulsive.

Propagation of Sound

As sound travels from the source to the receiver, several factors influence the level and spectrum of the sound heard by a receiver. These factors generally result in a reduction, or *attenuation*, of the sound level:

- Spherical spreading
- Ground effects
- Attenuation through vegetation
- Attenuation due to barriers (including terrain)
- Atmospheric effects

Note that, for other than spherical spreading, all factors tend to have more effect on higher frequencies with low frequencies able to propagate over long distances with little attenuation. Hence, the “rumble” of jet departures or highway traffic can often be heard at large distances, while the higher frequency characteristics of the signal are lost.

Spherical Spreading and Noise Directivity

The sound from the point source, such as a generator, spreads in all directions like an expanding sphere. A rule of thumb in acoustics is that a spherically spreading sound decreases by 6 dB for every doubling of distance. Thus, with a reference distance of, say, 50 feet, increasing the distance from 200 feet to 300 feet does not provide as much reduction as increasing the distance from 100 to 200 feet. In practice, high-frequency sound is attenuated faster than 6 dB per doubling of the distance because some energy is lost in the medium (air) due to atmospheric effects at this frequency range. This loss, called excess attenuation, is dependent upon air temperature and humidity as well as the signal's sound frequency and is due to a process called vibrational relaxation in oxygen and nitrogen molecules.

Aircraft do not emit sound in all directions equally, i.e., omni-directionally. The sound pattern produced by an aircraft depends on many factors including the engine type (jet or propeller), the number of engines and how they are installed on the aircraft, e.g., over/under wing or rear mounted, the jet bypass ratio (engine design), wing flap configuration and mode of flight, e.g., takeoff/departure or arrival. The shape of the sound pattern around the aircraft is called its directivity. The directivity of aircraft with jet engines is typically a cardioid shape with the larger lobes of the cardioid emanating approximately 45 degrees from the tail of the aircraft relative to the aircraft's longitudinal axis. Counter-intuitively, there is less sound directly behind a jet aircraft than off to its side.

Ground Effect

When sound propagates along the surface of the earth from a source to a receiver, it follows two paths. The first is a direct path from the source to the receiver and the second is a path that starts at the source, reflects off the ground, and then travels to the receiver. If the ground is hard, such as pavement or water (lakes, oceans, etc.), the sound reflects off the surface and adds to the sound from the direct path resulting in higher levels than the direct path alone. When sound reflects off of soft ground, such freshly-plowed earth, grass, or loose snow, some frequencies of the reflected sound experience a phase reversal, where the areas of high and low pressure become reversed. Adding this phase-reversed sound with the sound from the direct pathway results in a reduction in the total sound at the receiver. Thus, sound levels are generally higher when the sound propagates over hard ground as compared to soft ground. Another way of thinking of the way so-called ground-effect attenuation works is to think of the sound waves traveling above the ground on their way from the source to the receiver. If the ground under the traveling sound wave is hard, then none of sound is absorbed by the ground along the way. However, if the ground is porous and softer, then the soft ground will absorb some of the sound along the way, reducing the overall sound level at the receiver. Generally, the longer the sound propagation path and the softer the ground, the greater the degree of additional attenuation over soft ground will be.

Attenuation from Vegetation

Wide areas of dense foliage provide some attenuation for higher frequency sound when they are located between a source and receiver. The vegetation must be dense enough to block the line of sight over even short distances and must extend well above the line of sight. The attenuation is negligible for low-frequency sound sources such as explosions, but increases with frequency. At 250 Hz, approximately 400 ft of dense foliage would be required to produce a noticeable 5 dB of attenuation for a sound source such as an aircraft run-up. At 1,500 Hz, approximately 250 ft of dense foliage would be required to produce 5 dB of attenuation for a sound source such as roadway traffic.

Attenuation Due to Barriers (Including Natural Terrain)

Barriers, berms, and natural terrain can attenuate sound when they are located in the line of sight between the source and the receiver. This attenuation, which acousticians call insertion loss, increases with height, width, and proximity to either the source or the receiver. If there are gaps in a barrier, the potential benefits of acoustical shielding will be substantially reduced.

Atmospheric Effects

Weather (or atmospheric) conditions that influence the propagation of sound include humidity, precipitation, temperature, wind, and turbulence (or gustiness). The effect of wind—turbulence in particular—is generally more important than the effects from other factors. Under calm wind conditions, the importance of temperature can increase, in particular, temperature changes occurring with altitude known as temperature gradients. This can sometimes influence propagation quite significantly. Humidity generally has little significance compared to the other effects.

The effects on propagation described below interact with each other and in some cases are additive. Specific/complex combinations of conditions influence propagation, and in order to predict how sound would propagate, it is important to understand these varied effects. This document is meant to introduce the reader to these topics.

Influence of Humidity and Precipitation

Humidity and precipitation rarely affect sound propagation in a significant manner. Humidity can reduce propagation of high-frequency noise under calm wind conditions. In very cold conditions, listeners often observe that noise sources such as aircraft sound “tinny,” because the dry air increases the propagation of high-frequency sound. Rain, snow, and fog also have little, if any, noticeable effect on sound propagation. A substantial body of empirical data supports these conclusions.

Influence of Temperature

Air temperature affects the velocity of sound in the atmosphere. As a result, if the temperature varies at different heights above the ground, sound will travel in curved paths rather than straight lines. This bending of the sound path is called refraction. During the day, temperature normally decreases with increasing height. Under such “temperature lapse” conditions, when the air temperature decreases with height, the atmosphere refracts (“bends”) sound waves upwards, and an acoustical shadow zone may exist at some distance from the noise source.

Under some weather conditions, an upper level of warmer air may trap a lower layer of cool air. Such an inversion of normal conditions (i.e., temperature gradients typically lapse with altitude) is most common in the evening, at night, and early in the morning when heat absorbed by the ground during the day radiates into the atmosphere. The effect of an inversion is just the opposite of lapse conditions: it causes sound propagating through the atmosphere to refract downward.

The downward refraction caused by temperature inversions often allows sound rays with originally upward-sloping paths to bypass obstructions and ground effects, increasing noise levels at greater distances. This type of effect is most noticeable at night, when temperature inversions are most common and when ambient sound levels are low enough that they do not otherwise mask distant noise sources.

Influence of Wind

Sound traveling in the direction of the wind (downwind) has a higher speed than sound traveling through calm air. Likewise, sound traveling against the direction of the wind (upwind) has a lower speed than sound traveling through calm air. Wind speed typically increases with the height above the ground. This gradient in wind speeds, and sound speeds, causes the sound to refract. Sound refracts downward in the downwind direction and upward in the upwind direction. In general, receivers that are downwind of a source will experience higher sound levels, and those that are upwind will experience lower sound levels. As with a temperature inversion, the downward curving paths reduce or eliminate the insertion loss of barriers in the downwind direction. Wind perpendicular to the sound path has no significant effect.

Wind turbulence (or gustiness) can also affect sound propagation. Sound levels heard at remote receiver locations will fluctuate with gustiness. In addition, gustiness can cause considerable attenuation of sound due to the effects of eddies traveling with the wind. Attenuation due to eddies is essentially the same in all directions, with or against the flow of the wind, and can mask the refractive effects discussed above.

Effects on Propagation

The foregoing effects on propagation described above interact with each other and in some cases are additive. Specific combinations of conditions influence propagation and in order to predict how sound would propagate it is important to understand these varied effects. While the basics are described in this document, for complex permutations entailing interaction of several variables, consultation with an acoustical professional for modeling support and analysis may be required.

Noise Descriptors

Noise levels are measured using a variety of scientific metrics. As a result of extensive research into the characteristics of noise and human response to that noise, standard noise descriptors have been developed for noise exposure analyses. The following provides an overview of various noise descriptors.

A-Weighted Sound Pressure Level (dBA): The decibel (dB) is a unit used to describe sound pressure level. When expressed in dBA, the sound has been filtered to reduce the effect of very low and very high frequency sounds, much as the human ear filters sound frequencies. Without this filtering, calculated and measured sound levels would include events that the human ear cannot hear (e.g., dog whistles and low frequency sounds, such as the groaning sounds emanating from large buildings with changes in temperature and wind). With A-weighting, calculations and sound monitoring equipment approximate the sensitivity of the human ear to sounds of different frequencies.

Some common sounds on the dBA scale are listed in Table 1. As shown in Table 1, the relative perceived loudness of a sound doubles for each increase of 10 dBA, and a 10-dBA change in the sound level corresponds to a factor of 10 increase or decrease in relative sound energy.

Table 1: Common Sounds on the A-Weighted Decibel Scale

Sound	Sound level (dBA)	Relative loudness (approximate)	Relative sound energy
Rock music, with amplifier	120	64	1,000,000
Thunder, snowmobile (operator)	110	32	100,000
Boiler shop, power mower	100	16	10,000
Orchestral crescendo at 25 feet, noisy kitchen	90	8	1,000
Busy street	80	4	100
Interior of department store	70	2	10
Ordinary conversation, 3 feet away	60	1	1
Quiet automobiles at low speed	50	½	.1
Average office	40	¼	.01
City residence	30	1/8	.001
Quiet country residence	20	1/16	.0001
Rustle of leaves	10	1/32	.00001
Threshold of hearing	0	1/64	.000001

Source: U.S. Department of Housing and Urban Development. Aircraft Noise Impact--Planning Guidelines for Local Agencies. Figure 2-2. 1972.

In general, humans find a change in sound level of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as a doubling or halving of sound level. Because of the logarithmic scale of the decibel unit, sound levels generally cannot be added or subtracted arithmetically. Two sounds of equal physical intensity will result in the sound level increasing by 3 dB, regardless of the initial sound level. For example, 60 dB plus 60 dB equals 63 dB, 80 dB plus 80 dB equals 83 dB. However, where ambient noise levels are high in comparison to a new noise source, there will be a small change in noise levels. For example, when 70 dB ambient noise levels are combined with a 60-dB noise source the resulting noise level equals 70.4 dB.

Maximum Noise Level (L_{max}): L_{max} is the maximum or peak sound level during a noise event. The metric accounts only for the instantaneous peak intensity of the sound, and not for the duration of the event. As a vehicle or aircraft passes by an observer, the sound level increases to a maximum level and then decreases. Some sound level meters measure and record the maximum or L_{max} level.

Single Event Metrics

Single Event Noise Exposure Level (SENEL) and Sound Exposure Level (SEL): Another metric that is reported for aircraft flyovers in the Single Event Noise Exposure Level (SENEL). This metric is essentially equivalent to the Sound Exposure Level (SEL). SEL, expressed in dBA, is a time integrated measure, expressed in decibels, of the sound energy of a single noise event at a reference duration of one second. The sound level is integrated over the period that the level exceeds a threshold. Therefore, SEL accounts for both the maximum sound level and the duration of the sound. The standardization of discrete noise events into a one-second duration allows calculation of the cumulative noise exposure of a series of noise events that occur over a period of time. Because of this compression of sound energy, the SEL of an aircraft noise event is typically 7 to 12 dBA greater than the L_{max} of the event. SELs for aircraft noise events depend on the location of the aircraft relative to the noise receptor, the type of operation (landing, takeoff, or overflight), and the type of aircraft.

Speech and sleep interference research can be assessed relative to SENEL. This metric is also useful in that airport noise models contain aircraft noise curve data based upon the SENEL metric.

Cumulative Noise Metrics

Cumulative noise metrics assess community response to noise by including the loudness of the noise, the duration of the noise, the total number of noise events and the time of day these events occur in one single number rating scale.

Equivalent Continuous Noise Level (L_{eq}): L_{eq} is the sound level, expressed in dBA, of a steady sound that has the same A-weighted sound energy as the time-varying sound over the averaging period. Unlike SEL, L_{eq} is the average sound level for a specified time period (e.g., 24 hours, 8 hours, 1 hour, etc.). L_{eq} is calculated by integrating the sound energy from all noise events over a given time period and applying a factor for the number of events. L_{eq} can be expressed for any time interval; for example, the L_{eq} representing an averaged level over an 8-hour period would be expressed as $L_{eq(8)}$. Leq for one hour is used to develop Community Noise Equivalent Level (CNEL) values.

Day-Night Average Sound Level (DNL): DNL, formerly referred to as Ldn, is expressed in dBA and represents the noise level over a 24-hour period. Because environmental noise fluctuates over time, DNL was devised to relate noise exposure over time to human response. DNL is a 24-hour average of the hourly L_{eq}, but with penalties to account for the increased sensitivity to noise events that occur during the more sensitive nighttime periods. Specifically, DNL penalizes noise 10 dB during the nighttime time period (10:00 p.m. to 7:00 a.m.), but it does not include an evening penalty (7:00 p.m. to 10:00 p.m.). Typically, DNL is about 1 dB lower than CNEL, although the difference may be greater if there is an abnormal concentration of noise events in the 7:00 p.m. to 10:00 p.m. time period.

The USEPA introduced the metric in 1976 as a single number measurement of community noise exposure. The Federal Aviation Administration (FAA) adopted DNL as the noise metric for measuring cumulative aircraft noise under Federal Aviation Regulations (FAR) Part 150, Airport Noise Compatibility Planning. The Department of Housing and Urban Development, the Veterans Administration, the Department of Defense, the United States Coast Guard, and the Federal Transit Administration have also adopted DNL for measuring cumulative noise exposure.

DNL is used to describe existing and predicted noise exposure in communities in airport environs based on the average daily operations during the year and the average annual operational conditions at an airport. Therefore, at a specific location near an airport, the noise exposure on a particular day is likely to be higher or lower than the annual average noise exposure, depending on the specific operations at an airport on that day. DNL is widely accepted as the best available method to describe aircraft noise exposure and is the noise descriptor required for aircraft noise exposure analyses and land use compatibility planning under FAR Part 150 and for environmental assessments for airport improvement projects (FAA Order 10501.F). The FAA guidelines allow for the use of CNEL as a substitute to DNL, as further discussed below.

Community Noise Equivalent Level (CNEL): CNEL, expressed in dBA, is the standard metric used in California to represent cumulative noise exposure. The metric provides a single-number description of the sound energy to which a person or community is exposed over a period of 24 hours similar to DNL. CNEL includes penalties applied to noise events occurring after 7:00 p.m. and before 7:00 a.m., when noise is considered more intrusive; it also accounts for the typically lower ambient noise levels during these hours. The penalized time period is further subdivided into evening (7:00 p.m. through 9:59 p.m.) and nighttime (10:00 p.m. to 6:59 a.m.). When a noise event occurs in the evening, a penalty of 5 dBA is added to the nominal sound level (equivalent to a three-fold increase in aircraft operations). A 10-dBA penalty is added to nighttime noise events (equivalent to a ten-fold increase in aircraft operations). Examples of typical outdoor noise levels measured in terms of CNEL decibel levels include wilderness areas at approximately 35 CNEL, rural residential areas at approximately 40 to 50 CNEL, suburban areas at approximately 60 CNEL, high-density development in downtown areas at approximately 70 CNEL, and development adjacent to a major freeway at approximately 85 CNEL.[1]

The CNEL metric used for this aircraft noise analysis is based on an Average Annual Day (AAD) of aircraft operations, generally derived from data for a calendar year. An AAD activity profile is computed by adding all aircraft operations occurring during the course of a year and dividing the result by 365. As such, AAD does not reflect activities on any one specific day, but represents average conditions as they occur during the course of the year.

The evening weighting is the only difference between CNEL and DNL. For purposes of aircraft noise analysis in the State of California, the FAA recognizes the use of CNEL. CNEL is also specified for use in the California Airport Noise Regulations and is used by local planning agencies in their General Plan Noise Element for land use compatibility planning.

Time Above (TA): TA measures the amount of time (in minutes) a source emits a noise that exceeds a designated threshold level. For instance, the threshold could be outdoor speech interference. TA is therefore both a single event and a cumulative metric.

[1] Extrapolated from U.S. Environmental Protection Agency, Impact Characterization of Noise Including Implications of Identifying and Achieving Levels of Cumulative Noise Exposure, EPA Report NTID 73.4, 1973. Available: https://nepis.epa.gov/Exe/ZyNET.exe/9101DPQN.txt?ZyActionD=ZyDocument&Client=EPA&Index=Prior%20to%201976&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&UseQField=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5CZYFILES%5CINDEX%20DATA%5C70THRU75%5CTXT%5C00000021%5C9101DPQN.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&slide.

R-G2 – Aircraft Noise Modelling Approach and Input Assumptions

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TECHNICAL MEMORANDUM

To:	Anthony Skidmore CDM Smith 111 Academy Way, Suite 150 Irvine, CA 92617
From:	Scott A. McIntosh Vincent Ma Justin W. Cook
Date:	August 9, 2019
Subject:	San Diego International Airport – Airport Development Plan (ADP) Environmental Impact Report (EIR) – Noise Modeling Approach and Input Assumptions
Reference:	HMMH Project Number 309290

1. BACKGROUND

HMMH is assisting CDM Smith and the San Diego County Regional Airport Authority in the preparation of noise analyses for the Environmental Impact Report (EIR) master planning phase in accordance with the Airport Development Plan (ADP) for San Diego International Airport (SAN).

The purpose of this technical memorandum discusses our noise modeling approach and input assumptions. HMMH requests that CDM Smith review this document to ensure that our approach and input assumptions remain consistent across team members and to provide approval prior to commencing modeling.

In accordance with the scope of work, the noise analyses will include a baseline study year plus two phases (each with two sub-phases) for a total of one (1) baseline year and five (5) forecast years. Therefore, the resulting contours and analyses will represent 2018, 2024, 2026, 2030, 2035, and 2050. Two planning scenarios – No Build (No Project) and Proposed Project – are proposed, and some analysis years repeat across both.

The subsequent sections address the FAA's Aviation Environmental Design Tool (AEDT)[1], Version 2d, inputs developed under the following categories:

- Physical description of the airport layout
- Aircraft operations
- Aircraft noise and performance characteristics
- Runway utilization
- Flight track geometry and use
- Meteorological conditions
- Terrain data

2. PHYSICAL DESCRIPTION OF THE AIRPORT LAYOUT

SAN is located within San Diego County and the City of San Diego approximately 1.5 miles south of the intersection of interstate highways 5 and 8. The Airport has one runway: 09/27. Figure 1 shows the Airport Diagram and Table 1 provides the runway specifications required for modeling.

Each end of the runways is designated by a number that, with the addition of a trailing "0", reflects the magnetic heading of the runway to the nearest 10 degrees, as seen by the pilot. The runway is oriented on approximate magnetic headings of 90º and 270º and is 9,400 feet long by 200 feet wide.

[1] https://aedt.faa.gov/

Runway length, runway width, instrumentation and declared distances may affect which aircraft might use a particular runway and under what conditions, and therefore how often a runway would be used relative to the other runways at the airport.

Figure 1. Existing Airport Diagram

Source: FAA, Effective, 23 May 2019 to 20 June 2019

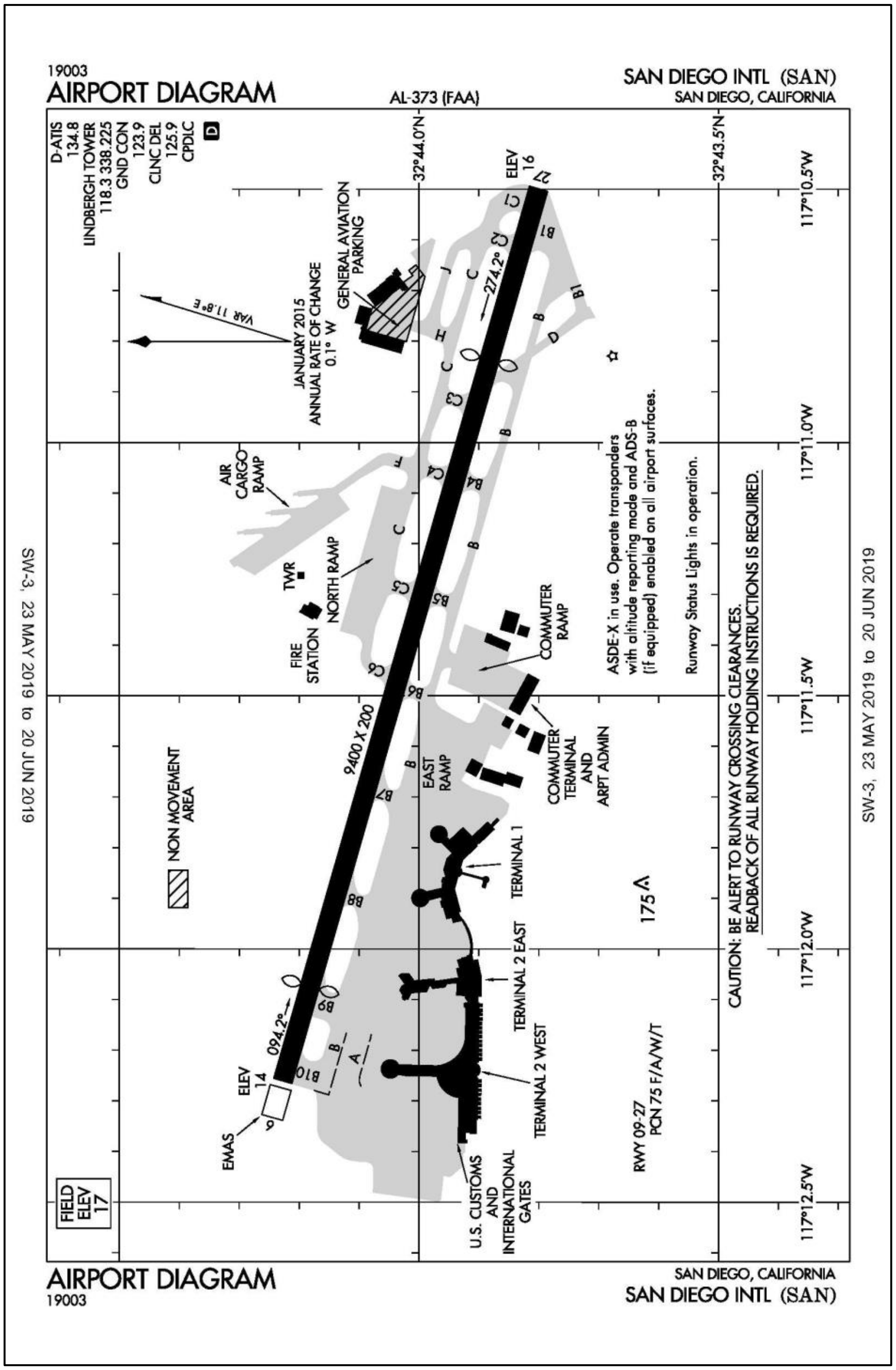


Table 1. Runway Data

Runway/ Helipad	Latitude	Longitude	Elevation (ft. MSL)	Length (ft.)	Approach Angle (degrees)	Displaced Arrival Thresholds (ft)
09	32.737123	-117.204357	13.7	9,400	3.0	1,000
27	32.730002	-117.174973	16.4	9,400	3.5	1,810
H1	32.732789	-117.182452	14.0	N/A		
Source: AEDT Version 2d						

3. AIRCRAFT OPERATIONS

Title 14 of the Code of Federal Regulations Part 150 (14 CFR Part 150) and its table of noise/land use compatibility guidelines require the calculation of "yearly Day-Night Average Sound Level (DNL)" values. In California, the Community Noise Equivalent Level, or CNEL, is the recognized noise metric and allowed to replace DNL for the purposes of airport planning. That is, the daily noise exposure (in CNEL) averaged over a year – typically a calendar year. AEDT produces these values of exposure utilizing an "average annual day" of airport operations. HMMH analyzed aircraft operations and fleet mix data obtained by Leigh Fisher to develop the average annual day's operations for all modeling scenarios. Table 2 shows the forecasted aircraft operations for all years.

It is important to note that the team has agreed that run-up operations will be omitted from the noise analyses due to negligible contributions.

Table 2. Forecast of Aircraft Operations – 2018 to 2050, Both Scenarios

Scenario	Aircraft Category	2018 Operations	2024 Operations	2026 Operations	2030 Operations	2035 Operations	2050 Operations
No Project	Commercial/Cargo	212,430	241,995	247,105	258,420	272,655	282,510
	Air Taxi/Charter	365	365	730	730	730	730
	General Aviation	11,680	10,585	9,855	9,125	8,395	5,475
	Military	730	730	730	730	730	1,095
	Helicopter	365	365	365	365	365	365
Total		**225,570**	**254,040**	**258,785**	**269,370**	**282,875**	**290,175**
Proposed Project	Commercial/Cargo	-	241,995	247,105	258,420	272,655	282,510
	Air Taxi/Charter	-	365	730	730	730	730
	General Aviation	-	10,585	9,855	9,125	8,395	5,475
	Military	**-**	730	730	730	730	1,095
	Helicopter	**-**	365	365	365	365	365
Total		**-**	**254,040**	**258,785**	**269,370**	**282,875**	**290,175**
Source: Aircraft Operations and Fleet Mix Data Prepared by Leigh Fisher							

The aircraft operations format for entering data into AEDT includes day, evening, and night arrivals, departures, and pattern/touch-and-go operations (as appropriate) expressed in terms of an annual average day. The annual average day operations are determined by dividing the annual operations by 365 days. Table 3 through Table 8 list the average annual daily operations by aircraft type, operation mode, and time of day for each scenario.

Table 3. Modeled Average Daily Aircraft Operations for 2018

Aircraft Type	Arrivals			Departures			Total
	Day	Evening	Night	Day	Evening	Night	
717200	0.9992	0.4565	0.7320	1.4557	0.7265	0.0000	**4.3699**
737300	0.0167	0.0028	0.0028	0.0195	0.0056	0.0000	**0.0473**
737400	0.0501	0.0306	0.0000	0.0223	0.0612	0.0028	**0.1670**
737500	0.0028	0.0000	0.0000	0.0028	0.0000	0.0000	**0.0056**
737700	58.9495	14.0116	8.6925	65.9080	14.3234	1.2108	**163.0958**
737800	49.4665	17.7859	14.2148	61.5771	14.0812	5.5278	**162.6533**
747400	0.3841	0.0167	0.0000	0.0000	0.3841	0.0195	**0.8044**
757300	0.7766	0.1169	0.0362	0.5817	0.1447	0.1921	**1.8482**
767300	1.7396	0.2310	1.8231	1.2024	2.1989	0.3925	**7.5875**
777200	0.0334	0.0000	0.0000	0.0000	0.0306	0.0028	**0.0668**
777300	0.0000	0.0000	0.0000	0.0028	0.0000	0.0000	**0.0028**
1900D	0.0056	0.0028	0.0000	0.0056	0.0028	0.0000	**0.0167**
7378MAX	0.7654	0.2171	0.1169	0.9324	0.1475	0.0139	**2.1933**
757PW	3.0339	0.7766	1.3499	3.9079	1.0271	0.2199	**10.3153**
767CF6	0.6096	0.0000	0.1113	0.6652	0.0529	0.0000	**1.4390**
7773ER	0.4509	0.1225	0.0000	0.0056	0.5483	0.0195	**1.1468**
7878R	1.0104	0.0000	0.0028	1.0159	0.0000	0.0000	**2.0291**
A109	0.0251	0.0000	0.0028	0.0167	0.0111	0.0000	**0.0557**
A310-304	0.0000	0.0000	0.0000	0.0056	0.0000	0.0000	**0.0056**
A319-131	4.9878	0.5817	1.0577	5.5640	1.0521	0.0056	**13.2490**
A320-211	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
A320-232	13.0486	5.1604	1.8259	14.9357	4.1389	0.8740	**39.9835**
A321-232	19.7788	6.0511	4.0610	22.0055	5.5501	2.3102	**59.7567**
A330-301	0.0084	0.1503	0.8656	1.0159	0.0028	0.0000	**2.0430**
A330-343	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
A340-211	0.6569	0.0167	0.0000	0.5539	0.1030	0.0167	**1.3472**
B206L	0.0084	0.0000	0.0000	0.0139	0.0000	0.0000	**0.0223**
BD-700-1A10	0.3201	0.0724	0.0557	0.3758	0.0696	0.0084	**0.9018**
BD-700-1A11	0.1392	0.0167	0.0084	0.1531	0.0084	0.0000	**0.3257**
BEC58P	0.2589	0.0028	0.0028	0.2366	0.0167	0.0000	**0.5177**
CIT3	0.1336	0.0084	0.0000	0.1280	0.0139	0.0000	**0.2839**
CL600	3.4653	0.5177	0.0668	3.7632	0.3117	0.0139	**8.1386**
CL601	0.8016	0.0974	0.0306	0.8656	0.0557	0.0139	**1.8649**
CNA172	0.2032	0.0334	0.0056	0.2255	0.0445	0.0000	**0.5121**
CNA182	0.1058	0.0139	0.0000	0.1197	0.0139	0.0000	**0.2533**
CNA206	0.0668	0.0000	0.0000	0.0696	0.0000	0.0000	**0.1364**
CNA208	2.7222	0.0251	0.0278	2.3826	0.4259	0.0000	**5.5835**
CNA20T	0.0445	0.0028	0.0000	0.0473	0.0000	0.0000	**0.0946**

CNA441	0.0473	0.0000	0.0000	0.0418	0.0000	0.0000	**0.0891**
CNA500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CNA510	0.7014	0.0891	0.0362	0.7237	0.1030	0.0028	**1.6561**
CNA525C	0.9241	0.0585	0.0473	0.9380	0.0946	0.0084	**2.0708**
CNA55B	1.2330	0.1364	0.0445	1.3444	0.0807	0.0028	**2.8418**
CNA560U	0.3563	0.0167	0.0306	0.3563	0.0501	0.0056	**0.8155**
CNA560XL	1.5420	0.1447	0.0334	1.6366	0.0807	0.0056	**3.4431**
CNA680	1.0187	0.0612	0.0223	1.0382	0.0724	0.0139	**2.2267**
CNA750	2.8224	0.3368	0.1141	3.0172	0.2310	0.0557	**6.5772**
COMSEP	0.3284	0.0585	0.0056	0.3674	0.0306	0.0000	**0.7905**
CRJ9-ER	4.7346	1.2136	1.5531	6.3155	1.1579	0.0167	**14.9914**
DC1030	0.2895	0.0139	0.0028	0.0111	0.2589	0.0390	**0.6151**
DC3	0.0000	0.0000	0.0000	0.0028	0.0000	0.0000	**0.0028**
DC870	0.0084	0.0028	0.0056	0.0139	0.0028	0.0000	**0.0334**
DHC6	2.2991	0.1086	0.0195	2.2657	0.3507	0.0028	**5.0463**
DHC8	0.0028	0.0000	0.0000	0.0028	0.0000	0.0000	**0.0056**
DHC830	0.9491	0.0418	0.0000	0.6096	0.3841	0.0028	**1.9873**
DO328	0.0056	0.0000	0.0000	0.0056	0.0000	0.0000	**0.0111**
ECLIPSE500	0.0473	0.0056	0.0000	0.0529	0.0028	0.0000	**0.1086**
EMB145	0.0668	0.0084	0.0056	0.0640	0.0111	0.0028	**0.1587**
EMB175	25.3400	5.5111	3.2761	29.2423	4.7763	0.0919	**68.2377**
EMB190	0.0334	0.0056	0.0000	0.0334	0.0056	0.0000	**0.0779**
GASEPF	0.0362	0.0028	0.0028	0.0779	0.0028	0.0000	**0.1225**
GASEPV	0.4620	0.0557	0.0167	0.4843	0.0696	0.0028	**1.0911**
GIIB	0.0056	0.0000	0.0028	0.0056	0.0028	0.0000	**0.0167**
GIV	1.0020	0.1364	0.0585	1.0772	0.1141	0.0056	**2.3937**
GV	0.7599	0.1113	0.0334	0.7738	0.1113	0.0278	**1.8176**
H500D	0.0084	0.0000	0.0000	0.0223	0.0000	0.0000	**0.0306**
IA1125	0.3340	0.0251	0.0139	0.3451	0.0278	0.0056	**0.7515**
LEAR25	0.0084	0.0000	0.0000	0.0056	0.0056	0.0000	**0.0195**
LEAR35	2.0959	0.1837	0.1169	2.2044	0.2115	0.0111	**4.8236**
MD11PW	0.0111	0.0028	0.0028	0.0028	0.0111	0.0028	**0.0334**
MD83	0.0418	0.0000	0.0000	0.0418	0.0000	0.0000	**0.0835**
MD9025	0.3563	0.0111	0.0000	0.3368	0.0306	0.0028	**0.7376**
MU3001	0.5288	0.0390	0.0167	0.5455	0.0445	0.0000	**1.1746**
PA28	0.0612	0.0000	0.0000	0.0390	0.0056	0.0000	**0.1058**
R44	0.0278	0.0056	0.0000	0.0418	0.0000	0.0000	**0.0752**
S76	0.0000	0.0000	0.0000	0.0028	0.0000	0.0000	**0.0028**
SA341G	0.0028	0.0028	0.0000	0.0000	0.0028	0.0000	**0.0084**
SA350D	0.0111	0.0028	0.0056	0.0306	0.0056	0.0000	**0.0557**
SA355F	0.0000	0.0000	0.0000	0.0056	0.0000	0.0000	**0.0056**

T41	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
Total	**213.5727**	**54.9136**	**40.5596**	**243.9089**	**53.8921**	**11.1531**	**618.0000**

Table 4. Modeled Average Daily Aircraft Operations for 2024

Aircraft Type	Arrivals			Departures			Total
	Day	Evening	Night	Day	Evening	Night	
CL600	4.8000	0.0000	0.0000	4.8000	0.0000	0.0000	**9.6000**
CNA500	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
CNA510	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CNA560XL	1.2000	0.0000	0.0000	1.2000	0.0000	0.0000	**2.4000**
CNA750	2.0000	0.0000	0.0000	2.0000	0.0000	0.0000	**4.0000**
DHC6	4.0000	0.0000	1.0000	3.0000	1.0000	1.0000	**10.0000**
GIV	1.8000	0.0000	0.0000	1.8000	0.0000	0.0000	**3.6000**
GV	1.2000	0.0000	0.0000	2.2000	0.0000	0.0000	**3.4000**
LEAR35	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
717200	2.0000	0.0000	0.0000	2.0000	0.0000	0.0000	**4.0000**
737300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
737700	120.8318	36.6436	31.6436	64.0000	17.0000	15.0000	**285.1190**
737800	1.1682	0.3564	0.3564	68.0000	12.0000	15.0000	**96.8810**
767300	1.0000	0.0000	4.0000	0.0000	2.0000	3.0000	**10.0000**
777300	0.0198	0.0000	0.0000	1.0000	0.0000	0.0000	**1.0198**
7378MAX	1.0000	0.0000	1.0000	2.0000	0.0000	0.0000	**4.0000**
757PW	5.0000	2.0000	1.0000	5.0000	1.0000	2.0000	**16.0000**
7773ER	0.9802	0.0000	0.0000	0.0000	0.0000	0.0000	**0.9802**
7878R	3.0000	0.0000	0.0000	2.0000	1.0000	0.0000	**6.0000**
A319-131	4.0000	0.0000	1.0000	4.0000	0.0000	1.0000	**10.0000**
A320-211	3.0000	2.0000	0.0000	3.0000	2.0000	0.0000	**10.0000**
A320-232	15.0000	8.0000	2.0000	17.0000	3.0000	5.0000	**50.0000**
A321-232	29.0000	6.0000	7.0000	31.0000	3.0000	8.0000	**84.0000**
A330-343	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	**2.0000**
A340-211	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
EMB175	22.0000	6.0000	4.0000	24.0000	4.0000	4.0000	**64.0000**
EMB190	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CRJ9-ER	4.0000	0.0000	1.0000	4.0000	0.0000	0.0000	**9.0000**
CNA208	1.3333	0.0000	0.0000	0.6667	0.0000	0.0000	**2.0000**
CNA172	0.6535	0.0000	0.0000	0.0000	0.0000	0.0000	**0.6535**
T41	0.0132	0.0000	0.0000	0.3333	0.0000	0.0000	**0.3465**
R44	0.5000	0.0000	0.0000	0.5000	0.0000	0.0000	**1.0000**
Total	**232.5000**	**61.0000**	**55.0000**	**247.5000**	**46.0000**	**54.0000**	**696.0000**

Table 5. Modeled Average Daily Aircraft Operations for 2026

Aircraft Type	Arrivals			Departures			Total
	Day	Evening	Night	Day	Evening	Night	
CL600	3.6923	0.0000	0.0000	3.6923	0.0000	0.0000	**7.3846**
CNA500	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
CNA510	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CNA560XL	1.2308	0.0000	0.0000	1.2308	0.0000	0.0000	**2.4615**
CNA750	2.0000	0.0000	0.0000	2.0000	0.0000	0.0000	**4.0000**
DHC6	4.0000	0.0000	1.0000	4.0000	1.0000	1.0000	**11.0000**
GIV	1.8462	0.0000	0.0000	1.8462	0.0000	0.0000	**3.6923**
GV	2.2308	0.0000	0.0000	2.2308	0.0000	0.0000	**4.4615**
LEAR35	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
717200	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
737300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
737700	124.7922	35.6634	34.6040	67.0000	17.0000	15.0000	**294.0596**
737800	1.2078	0.3366	0.3960	70.0000	12.0000	16.0000	**99.9404**
767300	1.0000	0.0000	4.0000	0.0000	2.0000	3.0000	**10.0000**
777300	0.0198	0.0000	0.0000	1.0000	0.0000	0.0000	**1.0198**
7378MAX	1.0000	0.0000	1.0000	2.0000	0.0000	0.0000	**4.0000**
757PW	2.0000	2.0000	1.0000	2.0000	1.0000	2.0000	**10.0000**
7773ER	0.9802	0.0000	0.0000	0.0000	0.0000	0.0000	**0.9802**
7878R	3.0000	0.0000	0.0000	2.0000	1.0000	0.0000	**6.0000**
A319-131	4.0000	0.0000	1.0000	4.0000	0.0000	1.0000	**10.0000**
A320-211	3.0000	3.0000	0.0000	3.0000	3.0000	0.0000	**12.0000**
A320-232	23.0000	8.0000	3.0000	24.0000	4.0000	6.0000	**68.0000**
A321-232	35.0000	8.0000	9.0000	39.0000	4.0000	9.0000	**104.0000**
A330-343	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	**2.0000**
A340-211	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
EMB175	13.0000	6.0000	1.0000	16.0000	3.0000	1.0000	**40.0000**
EMB190	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CRJ9-ER	2.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**3.0000**
CNA208	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
CNA172	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
T41	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
R44	0.5000	0.0000	0.0000	0.5000	0.0000	0.0000	**1.0000**
Total	**234.5000**	**63.0000**	**57.0000**	**252.5000**	**48.0000**	**54.0000**	**709.0000**

Table 6. Modeled Average Daily Aircraft Operations for 2030

Aircraft Type	Arrivals			Departures			Total
	Day	Evening	Night	Day	Evening	Night	
CL600	3.6923	0.0000	0.0000	3.6923	0.0000	0.0000	**7.3846**
CNA500	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
CNA510	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CNA560XL	1.2308	0.0000	0.0000	1.2308	0.0000	0.0000	**2.4615**
CNA750	2.0000	0.0000	0.0000	2.0000	0.0000	0.0000	**4.0000**
DHC6	5.0000	0.0000	1.0000	5.0000	1.0000	1.0000	**13.0000**
GIV	1.8462	0.0000	0.0000	1.8462	0.0000	0.0000	**3.6923**
GV	2.2308	0.0000	0.0000	2.2308	0.0000	0.0000	**4.4615**
LEAR35	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
717200	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
737300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
737700	135.2378	42.5050	30.5248	50.0000	14.0000	9.0000	**281.2676**
737800	1.7622	0.4950	0.4752	101.0000	15.0000	23.0000	**141.7324**
767300	1.0000	0.0000	4.0000	0.0000	2.0000	3.0000	**10.0000**
777300	0.0198	0.0000	0.0000	1.0000	0.0000	0.0000	**1.0198**
7378MAX	8.0000	2.0000	7.0000	10.0000	2.0000	5.0000	**34.0000**
757PW	2.0000	1.0000	0.0000	1.0000	1.0000	1.0000	**6.0000**
7773ER	0.9802	0.0000	0.0000	0.0000	0.0000	0.0000	**0.9802**
7878R	4.0000	0.0000	0.0000	2.0000	2.0000	0.0000	**8.0000**
A319-131	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
A320-211	3.0000	3.0000	0.0000	3.0000	3.0000	0.0000	**12.0000**
A320-232	14.0000	6.0000	2.0000	14.0000	4.0000	4.0000	**44.0000**
A321-232	47.0000	11.0000	12.0000	53.0000	5.0000	11.0000	**139.0000**
A330-343	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	**2.0000**
A340-211	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
EMB175	4.0000	2.0000	1.0000	6.0000	1.0000	0.0000	**14.0000**
EMB190	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CRJ9-ER	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
CNA208	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CNA172	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
T41	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
R44	0.5000	0.0000	0.0000	0.5000	0.0000	0.0000	**1.0000**
Total	**241.5000**	**68.0000**	**59.0000**	**262.5000**	**50.0000**	**57.0000**	**738.0000**

Table 7. Modeled Average Daily Aircraft Operations for 2035

Aircraft Type	Arrivals			Departures			Total
	Day	Evening	Night	Day	Evening	Night	
CL600	3.6923	0.0000	0.0000	3.6923	0.0000	0.0000	**7.3846**
CNA500	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
CNA510	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CNA560XL	1.2308	0.0000	0.0000	1.2308	0.0000	0.0000	**2.4615**
CNA750	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
DHC6	5.0000	0.0000	1.0000	5.0000	1.0000	1.0000	**13.0000**
GIV	1.8462	0.0000	0.0000	1.8462	0.0000	0.0000	**3.6923**
GV	2.2308	0.0000	0.0000	2.2308	0.0000	0.0000	**4.4615**
LEAR35	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
717200	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
737300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
737700	126.6834	40.3268	29.4852	13.0000	5.0000	5.0000	**219.4954**
737800	2.3166	0.6732	0.5148	132.0000	22.0000	24.0000	**181.5046**
767300	1.0000	0.0000	5.0000	0.0000	2.0000	4.0000	**12.0000**
777300	0.0198	0.0000	0.0000	1.0000	0.0000	0.0000	**1.0198**
7378MAX	16.0000	4.0000	8.0000	17.0000	5.0000	6.0000	**56.0000**
757PW	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000	**2.0000**
7773ER	0.9802	0.0000	0.0000	0.0000	0.0000	0.0000	**0.9802**
7878R	10.0000	3.0000	0.0000	8.0000	3.0000	3.0000	**27.0000**
A319-131	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	**2.0000**
A320-211	3.0000	3.0000	0.0000	3.0000	3.0000	0.0000	**12.0000**
A320-232	10.0000	3.0000	2.0000	12.0000	1.0000	2.0000	**30.0000**
A321-232	55.0000	17.0000	14.0000	61.0000	8.0000	15.0000	**170.0000**
A330-343	0.0000	0.0000	1.0000	1.0000	0.0000	0.0000	**2.0000**
A340-211	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
EMB175	6.0000	2.0000	1.0000	7.0000	2.0000	0.0000	**18.0000**
EMB190	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CRJ9-ER	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**1.0000**
CNA208	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CNA172	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
T41	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
R44	0.5000	0.0000	0.0000	0.5000	0.0000	0.0000	**1.0000**
Total	**251.5000**	**73.0000**	**63.0000**	**274.5000**	**53.0000**	**60.0000**	**775.0000**

Table 8. Modeled Average Daily Aircraft Operations for 2050

Aircraft Type	Arrivals			Departures			Total
	Day	Evening	Night	Day	Evening	Night	
CL600	4.0000	0.0000	0.0000	4.0000	0.0000	0.0000	**8.0000**
CNA500	0.3333	0.0000	0.0000	0.6667	0.0000	0.0000	**1.0000**
CNA510	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CNA560XL	1.3333	0.0000	0.0000	1.3333	0.0000	0.0000	**2.6667**
CNA750	0.6667	0.0000	0.0000	1.3333	0.0000	0.0000	**2.0000**
DHC6	7.0000	0.0000	1.0000	3.0000	3.0000	1.0000	**15.0000**
GIV	0.6667	0.0000	0.0000	0.6667	0.0000	0.0000	**1.3333**
GV	1.0000	0.0000	0.0000	1.0000	0.0000	0.0000	**2.0000**
LEAR35	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
717200	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
737300	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
737700	127.6438	40.3070	30.4654	13.0000	5.0000	4.0000	**220.4162**
737800	2.3562	0.6930	0.5346	133.0000	23.0000	26.0000	**185.5838**
767300	1.0000	0.0000	6.0000	0.0000	2.0000	5.0000	**14.0000**
777300	0.0198	0.0000	0.0000	1.0000	0.0000	0.0000	**1.0198**
7378MAX	20.0000	5.0000	8.0000	21.0000	6.0000	6.0000	**66.0000**
757PW	1.0000	0.0000	0.0000	0.0000	1.0000	0.0000	**2.0000**
7773ER	0.9802	0.0000	0.0000	0.0000	0.0000	0.0000	**0.9802**
7878R	11.0000	3.0000	0.0000	9.0000	3.0000	3.0000	**29.0000**
A319-131	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
A320-211	3.0000	3.0000	0.0000	3.0000	3.0000	0.0000	**12.0000**
A320-232	10.0000	3.0000	2.0000	12.0000	1.0000	2.0000	**30.0000**
A321-232	55.0000	17.0000	13.0000	60.0000	8.0000	15.0000	**168.0000**
A330-343	1.0000	0.0000	1.0000	2.0000	0.0000	0.0000	**4.0000**
A340-211	2.0000	0.0000	0.0000	2.0000	0.0000	0.0000	**4.0000**
EMB175	6.0000	4.0000	2.0000	7.0000	3.0000	2.0000	**24.0000**
EMB190	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CRJ9-ER	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**1.0000**
CNA208	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
CNA172	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
T41	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
R44	0.5000	0.0000	0.0000	0.5000	0.0000	0.0000	**1.0000**
Total	**257.5000**	**76.0000**	**64.0000**	**275.5000**	**58.0000**	**64.0000**	**795.0000**

4. AIRCRAFT NOISE AND PERFORMANCE CHARACTERISTICS

Specific noise and performance data must be entered into AEDT for each aircraft type operating at the Airport. Noise data are included in the form of Sound Exposure Level (SEL) at a range of distances (from 200 feet to 25,000 feet) from a particular aircraft with engines at a specific thrust level. Performance data include thrust, speed and altitude profiles for takeoff and landing operations. The AEDT database contains standard noise and performance data for over 300 different fixed-wing aircraft types, most of which are civilian aircraft. AEDT automatically accesses the noise and performance data for takeoff and landing operations by those aircraft.

Within the AEDT database, aircraft takeoff or departure profiles are usually defined by a range of trip distances identified as “stage lengths.” A longer trip distance or higher stagelength is associated with a heavier aircraft due to the increase in fuel requirements for the flight. Stagelength determinations were obtained from gated schedules derived from data analyzed by Leigh Fisher and KBE. Table 9 through Table 14 give the stagelength use percentages for both takeoffs and landings by aircraft for each modeling scenario.

Besides identifying the aircraft type in the database, AEDT has STANDARD and ICAO aircraft flight profiles for takeoffs, landings, and flight patterns or touch-and-go operations. HMMH recommends using these standard profiles for all aircraft types for landings to Runway 09 and takeoffs from Runways 09 and 27. For landings to Runway 27 and as recommended by the FAA, HMMH created custom profiles for every aircraft type to more accurately account for the 3.5 degree approach to Runway 27.

Table 9. Stagelength Usage by Aircraft Type for 2018

Aircraft Type	Day									Evening									Night					Total
	1	2	3	4	5	6	7	8	7+	1	2	3	4	5	6	7	8	7+	1	2	3	4	5	
717200	24%	32%	0%	0%	0%	0%	0%	0%	0%	11%	0%	0%	0%	0%	16%	0%	0%	0%	17%	0%	0%	0%	0%	100%
737300	59%	6%	6%	6%	0%	0%	0%	0%	0%	18%	0%	0%	0%	0%	0%	0%	0%	0%	6%	0%	0%	0%	0%	100%
737400	38%	3%	2%	0%	0%	0%	0%	0%	0%	53%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	2%	0%	0%	100%
737500	50%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
737700	59%	6%	6%	2%	0%	3%	0%	0%	0%	12%	1%	0%	0%	0%	4%	0%	0%	0%	6%	0%	0%	0%	0%	100%
737800	38%	9%	11%	9%	0%	2%	0%	0%	0%	13%	1%	0%	0%	0%	5%	0%	0%	0%	10%	1%	2%	0%	0%	100%
747400	48%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	20%	28%	0%	0%	0%	0%	2%	0%	0%	1%	100%
757300	42%	0%	0%	31%	0%	0%	0%	0%	0%	6%	0%	0%	0%	0%	8%	0%	0%	0%	2%	0%	10%	0%	0%	100%
767300	23%	0%	8%	8%	0%	0%	0%	0%	0%	3%	4%	10%	8%	0%	0%	6%	0%	0%	24%	1%	4%	0%	0%	100%
777200	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	12%	33%	0%	0%	0%	0%	0%	0%	0%	4%	100%
777300	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
1900D	67%	0%	0%	0%	0%	0%	0%	0%	0%	33%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7378MAX	46%	4%	14%	8%	0%	0%	0%	0%	4%	11%	1%	0%	0%	0%	2%	0%	0%	2%	5%	1%	0%	0%	0%	100%
757PW	39%	2%	1%	22%	0%	0%	4%	0%	0%	11%	0%	2%	0%	0%	0%	4%	0%	0%	13%	0%	2%	0%	0%	100%
767CF6	85%	0%	0%	1%	0%	0%	3%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0%	100%
7773ER	39%	0%	0%	0%	0%	0%	0%	0%	0%	11%	0%	0%	0%	27%	21%	0%	0%	0%	0%	1%	0%	0%	1%	100%
7878R	50%	0%	0%	0%	0%	25%	25%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
A109	75%	0%	0%	0%	0%	0%	0%	0%	0%	20%	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	100%
A310-304	0%	0%	0%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
A319-131	53%	10%	11%	4%	1%	0%	0%	0%	0%	7%	0%	0%	0%	5%	0%	0%	0%	0%	8%	0%	0%	0%	0%	100%
A320-232	48%	10%	8%	2%	2%	0%	0%	0%	0%	16%	0%	2%	2%	3%	0%	0%	0%	0%	5%	1%	1%	0%	0%	100%
A321-232	35%	2%	15%	18%	1%	0%	0%	0%	0%	11%	0%	2%	2%	5%	0%	0%	0%	0%	7%	1%	3%	0%	0%	100%
A330-301	0%	0%	0%	50%	0%	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%	0%	42%	0%	0%	0%	0%	100%
A340-211	49%	0%	0%	0%	0%	26%	15%	0%	0%	1%	0%	0%	0%	5%	3%	0%	0%	0%	0%	0%	0%	0%	1%	100%
B206L	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
BD-700-1A10	59%	3%	7%	6%	0%	1%	0%	2%	0%	10%	1%	1%	0%	1%	1%	0%	2%	0%	6%	0%	0%	0%	0%	100%

BD-700-1A11	69%	2%	5%	9%	1%	0%	3%	0%	0%	7%	0%	0%	0%	0%	1%	0%	0%	0%	3%	0%	0%	0%	0%	100%
BEC58P	96%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	100%
CIT3	92%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CL600	89%	0%	0%	0%	0%	0%	0%	0%	0%	10%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	100%
CL601	89%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	100%
CNA172	84%	0%	0%	0%	0%	0%	0%	0%	0%	15%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	100%
CNA182	89%	0%	0%	0%	0%	0%	0%	0%	0%	11%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA206	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA208	91%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA20T	97%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA441	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA510	86%	0%	0%	0%	0%	0%	0%	0%	0%	12%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	100%
CNA525C	90%	0%	0%	0%	0%	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	100%
CNA55B	91%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	100%
CNA560U	87%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%	100%
CNA560XL	92%	0%	0%	0%	0%	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	100%
CNA680	92%	0%	0%	0%	0%	0%	0%	0%	0%	6%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	100%
CNA750	89%	0%	0%	0%	0%	0%	0%	0%	0%	9%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	100%
COMSEP	88%	0%	0%	0%	0%	0%	0%	0%	0%	11%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	100%
CRJ9-ER	55%	0%	16%	0%	3%	0%	0%	0%	0%	13%	0%	0%	0%	3%	0%	0%	0%	0%	10%	0%	0%	0%	0%	100%
DC1030	47%	0%	2%	0%	0%	0%	0%	0%	0%	3%	8%	31%	0%	0%	0%	2%	0%	0%	0%	6%	0%	0%	0%	100%
DC3	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
DC870	58%	8%	0%	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0%	0%	8%	0%	0%	17%	0%	0%	0%	0%	100%
DHC6	90%	0%	0%	0%	0%	0%	0%	0%	0%	9%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
DHC8	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
DHC830	78%	0%	0%	0%	0%	0%	0%	0%	0%	21%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
DO328	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
ECLIPSE500	82%	8%	3%	0%	0%	0%	0%	0%	0%	5%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
EMB145	63%	9%	4%	7%	0%	0%	0%	0%	0%	7%	0%	2%	4%	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	100%
EMB175	61%	8%	11%	0%	0%	0%	0%	0%	0%	10%	0%	5%	0%	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	100%

EMB190	86%	0%	0%	0%	0%	0%	0%	0%	0%	11%	0%	0%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
GASEPF	93%	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	100%
GASEPV	87%	0%	0%	0%	0%	0%	0%	0%	0%	11%	0%	0%	0%	0%	0%	0%	0%	0%	2%	0%	0%	0%	0%	100%
GIIB	67%	0%	0%	0%	0%	0%	0%	0%	0%	17%	0%	0%	0%	0%	0%	0%	0%	0%	17%	0%	0%	0%	0%	100%
GIV	87%	0%	0%	0%	0%	0%	0%	0%	0%	10%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	100%
GV	84%	0%	0%	0%	0%	0%	0%	0%	0%	12%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	100%
H500D	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
IA1125	90%	0%	0%	0%	0%	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	100%
LEAR25	71%	0%	0%	0%	0%	0%	0%	0%	0%	29%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
LEAR35	89%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%	0%	0%	0%	100%
MD11PW	42%	0%	0%	0%	0%	0%	0%	0%	0%	8%	0%	33%	0%	0%	0%	0%	0%	0%	8%	8%	0%	0%	0%	100%
MD83	50%	43%	3%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
MD9025	48%	45%	1%	0%	0%	0%	0%	0%	0%	2%	4%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
MU3001	91%	0%	0%	0%	0%	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	100%
PA28	95%	0%	0%	0%	0%	0%	0%	0%	0%	5%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
R44	93%	0%	0%	0%	0%	0%	0%	0%	0%	7%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
S76	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
SA341G	33%	0%	0%	0%	0%	0%	0%	0%	0%	67%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
SA350D	75%	0%	0%	0%	0%	0%	0%	0%	0%	15%	0%	0%	0%	0%	0%	0%	0%	0%	10%	0%	0%	0%	0%	100%
SA355F	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%

Table 10. Stagelength Usage by Aircraft Type for 2024

Aircraft Type	Day					Evening						Night				Total
	1	2	3	4	7	1	2	3	4	7	9	1	2	3	4	
CL600	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA500	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA510	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CNA560XL	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA750	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
DHC6	70%	0%	0%	0%	0%	10%	0%	0%	0%	0%	0%	20%	0%	0%	0%	100%
GIV	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
GV	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
LEAR35	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
717200	50%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
737300	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
737700	55%	5%	3%	1%	0%	18%	1%	0%	0%	0%	0%	14%	1%	1%	1%	100%
737800	17%	16%	20%	19%	0%	7%	2%	2%	2%	0%	0%	0%	2%	5%	8%	100%
767300	10%	0%	0%	0%	0%	0%	0%	20%	0%	0%	0%	40%	0%	10%	20%	100%
777300	2%	0%	0%	0%	98%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7378MAX	25%	25%	25%	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%	0%	100%
757PW	38%	0%	0%	25%	0%	12%	0%	0%	6%	0%	0%	6%	0%	0%	13%	100%
7773ER	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7878R	50%	0%	0%	0%	33%	0%	0%	0%	0%	17%	0%	0%	0%	0%	0%	100%
A319-131	50%	20%	10%	0%	0%	0%	0%	0%	0%	0%	0%	20%	0%	0%	0%	100%
A320-211	40%	0%	10%	10%	0%	30%	0%	0%	10%	0%	0%	0%	0%	0%	0%	100%
A320-232	38%	12%	8%	6%	0%	16%	0%	0%	6%	0%	0%	6%	4%	4%	0%	100%
A321-232	37%	1%	15%	18%	0%	10%	0%	0%	1%	0%	0%	10%	1%	2%	5%	100%
A330-343	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	100%
A340-211	50%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
EMB175	55%	8%	9%	0%	0%	14%	0%	2%	0%	0%	0%	12%	0%	0%	0%	100%
EMB190	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CRJ9-ER	56%	0%	33%	0%	0%	0%	0%	0%	0%	0%	0%	11%	0%	0%	0%	100%
CNA208	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA172	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
T41	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
R44	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%

Table 11. Stagelength Usage by Aircraft Type for 2026

Aircraft Type	Day					Evening						Night				Total
	1	2	3	4	7	1	2	3	4	7	9	1	2	3	4	
CL600	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA500	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA510	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CNA560XL	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA750	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
DHC6	73%	0%	0%	0%	0%	9%	0%	0%	0%	0%	0%	18%	0%	0%	0%	100%
GIV	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
GV	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
LEAR35	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
717200	50%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
737300	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
737700	55%	4%	3%	2%	0%	17%	1%	0%	0%	0%	0%	15%	1%	1%	1%	100%
737800	17%	16%	18%	20%	0%	6%	2%	3%	1%	0%	0%	1%	2%	4%	10%	100%
767300	10%	0%	0%	0%	0%	0%	0%	20%	0%	0%	0%	40%	0%	10%	20%	100%
777300	2%	0%	0%	0%	98%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7378MAX	25%	25%	25%	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%	0%	100%
757PW	20%	0%	0%	20%	0%	20%	0%	0%	10%	0%	0%	10%	0%	0%	20%	100%
7773ER	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7878R	50%	0%	0%	0%	33%	0%	0%	0%	0%	17%	0%	0%	0%	0%	0%	100%
A319-131	50%	20%	10%	0%	0%	0%	0%	0%	0%	0%	0%	20%	0%	0%	0%	100%
A320-211	33%	0%	9%	8%	0%	42%	0%	0%	8%	0%	0%	0%	0%	0%	0%	100%
A320-232	41%	12%	10%	6%	0%	13%	0%	0%	5%	0%	0%	7%	3%	3%	0%	100%
A321-232	38%	1%	15%	16%	0%	10%	0%	0%	2%	0%	0%	10%	1%	3%	4%	100%
A330-343	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	100%
A340-211	50%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
EMB175	52%	7%	13%	0%	0%	20%	0%	3%	0%	0%	0%	5%	0%	0%	0%	100%
EMB190	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CRJ9-ER	67%	0%	33%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA208	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA172	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
T41	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
R44	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%

Table 12. Stagelength Usage by Aircraft Type for 2030

Aircraft Type	Day					Evening						Night				Total
	1	2	3	4	7	1	2	3	4	7	9	1	2	3	4	
CL600	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA500	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA510	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CNA560XL	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA750	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
DHC6	77%	0%	0%	0%	0%	8%	0%	0%	0%	0%	0%	15%	0%	0%	0%	100%
GIV	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
GV	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
LEAR35	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
717200	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
737300	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
737700	58%	5%	2%	1%	0%	19%	1%	0%	0%	0%	0%	12%	1%	1%	0%	100%
737800	19%	16%	19%	19%	0%	6%	1%	3%	1%	0%	0%	2%	1%	4%	9%	100%
767300	10%	0%	0%	0%	0%	0%	0%	20%	0%	0%	0%	40%	0%	10%	20%	100%
777300	2%	0%	0%	0%	98%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7378MAX	41%	3%	6%	3%	0%	12%	0%	0%	0%	0%	0%	32%	0%	0%	3%	100%
757PW	33%	0%	0%	17%	0%	17%	0%	0%	17%	0%	0%	0%	0%	0%	16%	100%
7773ER	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7878R	50%	0%	0%	0%	25%	0%	0%	0%	0%	12%	13%	0%	0%	0%	0%	100%
A319-131	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
A320-211	33%	0%	9%	8%	0%	42%	0%	0%	8%	0%	0%	0%	0%	0%	0%	100%
A320-232	41%	9%	9%	5%	0%	18%	0%	0%	4%	0%	0%	7%	5%	2%	0%	100%
A321-232	40%	4%	15%	13%	0%	9%	0%	0%	2%	0%	0%	10%	1%	2%	4%	100%
A330-343	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	100%
A340-211	50%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
EMB175	50%	7%	14%	0%	0%	15%	0%	7%	0%	0%	0%	7%	0%	0%	0%	100%
EMB190	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CRJ9-ER	50%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA208	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CNA172	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
T41	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
R44	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%

Table 13. Stagelength Usage by Aircraft Type for 2035

Aircraft Type	Day					Evening						Night				Total
	1	2	3	4	7	1	2	3	4	7	9	1	2	3	4	
CL600	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA500	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA510	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CNA560XL	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA750	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
DHC6	77%	0%	0%	0%	0%	8%	0%	0%	0%	0%	0%	15%	0%	0%	0%	100%
GIV	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
GV	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
LEAR35	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
717200	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
737300	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
737700	61%	1%	1%	1%	0%	20%	1%	0%	0%	0%	0%	14%	0%	1%	0%	100%
737800	25%	14%	16%	18%	0%	9%	1%	3%	1%	0%	0%	3%	2%	3%	5%	100%
767300	8%	0%	0%	0%	0%	0%	0%	16%	0%	0%	0%	42%	0%	17%	17%	100%
777300	2%	0%	0%	0%	98%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7378MAX	46%	7%	4%	2%	0%	12%	4%	0%	0%	0%	0%	21%	2%	0%	2%	100%
757PW	50%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	100%
7773ER	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7878R	37%	0%	7%	15%	7%	11%	0%	0%	4%	4%	4%	0%	0%	0%	11%	100%
A319-131	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	100%
A320-211	33%	0%	9%	8%	0%	42%	0%	0%	8%	0%	0%	0%	0%	0%	0%	100%
A320-232	43%	20%	3%	7%	0%	13%	0%	0%	0%	0%	0%	7%	4%	3%	0%	100%
A321-232	39%	6%	13%	10%	0%	12%	1%	0%	2%	0%	0%	10%	1%	2%	4%	100%
A330-343	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	100%
A340-211	50%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
EMB175	33%	11%	28%	0%	0%	17%	0%	6%	0%	0%	0%	5%	0%	0%	0%	100%
EMB190	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CRJ9-ER	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA208	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CNA172	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
T41	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
R44	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%

Table 14. Stagelength Usage by Aircraft Type for 2050

Aircraft Type	Day					Evening						Night				Total
	1	2	3	4	7	1	2	3	4	7	9	1	2	3	4	
CL600	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA500	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA510	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CNA560XL	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA750	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
DHC6	67%	0%	0%	0%	0%	20%	0%	0%	0%	0%	0%	13%	0%	0%	0%	100%
GIV	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
GV	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
LEAR35	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
717200	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
737300	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
737700	62%	1%	0%	0%	0%	20%	1%	0%	0%	0%	0%	14%	0%	1%	1%	100%
737800	25%	14%	16%	18%	0%	9%	1%	3%	1%	0%	0%	3%	1%	3%	6%	100%
767300	7%	0%	0%	0%	0%	0%	0%	14%	0%	0%	0%	43%	0%	14%	22%	100%
777300	2%	0%	0%	0%	98%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7378MAX	47%	6%	6%	3%	0%	12%	3%	1%	0%	0%	0%	18%	2%	0%	2%	100%
757PW	50%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	0%	0%	0%	100%
7773ER	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
7878R	38%	0%	7%	14%	10%	10%	0%	0%	4%	4%	3%	0%	0%	0%	10%	100%
A319-131	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
A320-211	33%	0%	9%	8%	0%	42%	0%	0%	8%	0%	0%	0%	0%	0%	0%	100%
A320-232	43%	20%	3%	7%	0%	13%	0%	0%	0%	0%	0%	7%	4%	3%	0%	100%
A321-232	39%	6%	14%	9%	0%	12%	1%	0%	2%	0%	0%	10%	1%	2%	4%	100%
A330-343	25%	0%	0%	25%	25%	0%	0%	0%	0%	0%	0%	25%	0%	0%	0%	100%
A340-211	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
EMB175	25%	8%	21%	0%	0%	25%	0%	4%	0%	0%	0%	13%	4%	0%	0%	100%
EMB190	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CRJ9-ER	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%
CNA208	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
CNA172	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
T41	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
R44	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%

5. RUNWAY UTILIZATION

The primary factor affecting runway use at airports is weather, in particular, the wind direction and wind speed. Additional factors that may affect runway use include the position of the facility or ramp relative to the runways or operational proficiency training for military units. There are no anticipated changes to the runway utilization expected between scenarios.

Based on interviews with airport operators and FAA ATCT personnel, the overall runway usage for this modeling will remain the same between years, employing 98.02% of operations on Runway 27 and the remaining 1.98% on Runway 09.

6. FLIGHT TRACK GEOMETRY AND USE

Model tracks were developed using a standard method, which entailed analyzing all radar data from SAN's ANOMS system and splitting the flight tracks into similar and manageable groups. This was first done by separating tracks by phase of flight (e.g., arrival or departure) and then by runway. Following this, the flights were separated by destination direction, like north, south, or west. Finally, at this point, radar flight tracks were analyzed and split into groups according to their degree of similar geometry.

Model tracks were developed for each geometrically similar group. For example, Runway 27 Departures with a northerly destination were split into a geometrically similar group, and a 'backbone' track was developed. Each of these backbone tracks were then assigned one or two 'dispersion' sub tracks on either side of the backbone, for a total of three or five tracks (one backbone and two or four dispersion) for each geometrically similar group.

Table 15 presents the utilization rates for each group of the developed model tracks. The relative ratio of flight track usage was preserved according to those ratios in the entire ANOMS dataset. Default INM dispersion percentages were used to assign utilization of the backbone and subtracks within a given track group.

Table 15. Flight Track Utilization

Runway	Arrivals		Departures	
	Track ID	Percent Use	Track ID	Percent Use
09	A09JE01	2.74%	D09JE01	15.53%
	A09JE02	1.43%	D09JE02	30.10%
	A09JE03	55.35%	D09JS01	1.84%
	A09JE04	1.30%	D09JW01	49.81%
	A09JN01	0.52%	D09PE02	1.26%
	A09JS01	0.98%	D09PW01	1.46%
	A09JW01	35.53%		
	A09PE03	1.69%		
	A09PW01	0.46%		
	Total	**100.00%**	**Total**	**100.00%**
27	A27JE01	29.05%	D27JE01	3.08%
	A27JE02	26.09%	D27JE02	2.41%
	A27JE03	0.42%	D27JE03	44.22%
	A27JN01	0.09%	D27JE04	0.20%
	A27JN02	0.02%	D27JE05	0.03%
	A27JN03	0.04%	D27JH275	0.41%
	A27JS01	1.16%	D27JN01	0.08%
	A27JW01	40.55%	D27JS01	1.45%
	A27JW02	0.06%	D27JW01	44.97%
	A27JW03	0.02%	D27JW02	0.35%
	A27PE01	0.14%	D27JW03	0.12%
	A27PE02	1.33%	D27PE01	0.05%
	A27PE03	0.01%	D27PE02	0.04%
	A27PN01	0.04%	D27PE03	0.26%
	A27PN02	0.01%	D27PE04	0.04%
	A27PN03	0.04%	D27PE05	0.12%
	A27PS01	0.01%	D27PE06	0.63%
	A27PW01	0.81%	D27PE07	0.19%
	A27PW02	0.11%	D27PN01	0.27%
			D27PS01	0.01%
			D27PW01	0.02%
			D27PW02	0.40%
			D27PW03	0.66%
	Total	**100.00%**	**Total**	**100.00%**
H1	AH1HL01	50.34%	DH1HN01	47.06%
	AH1HW01	34.01%	DH1HW01	17.65%
	AH1HW02	15.65%	DH1HW02	35.29%
	Total	**100.00%**	**Total**	**100.00%**

7. METEOROLOGICAL CONDITIONS

AEDT has several settings that affect aircraft performance profiles and sound propagation based on meteorological data. Meteorological settings include average annual temperature, barometric pressure, and relative humidity at the airport. AEDT holds the following values for annual average weather conditions at SAN:

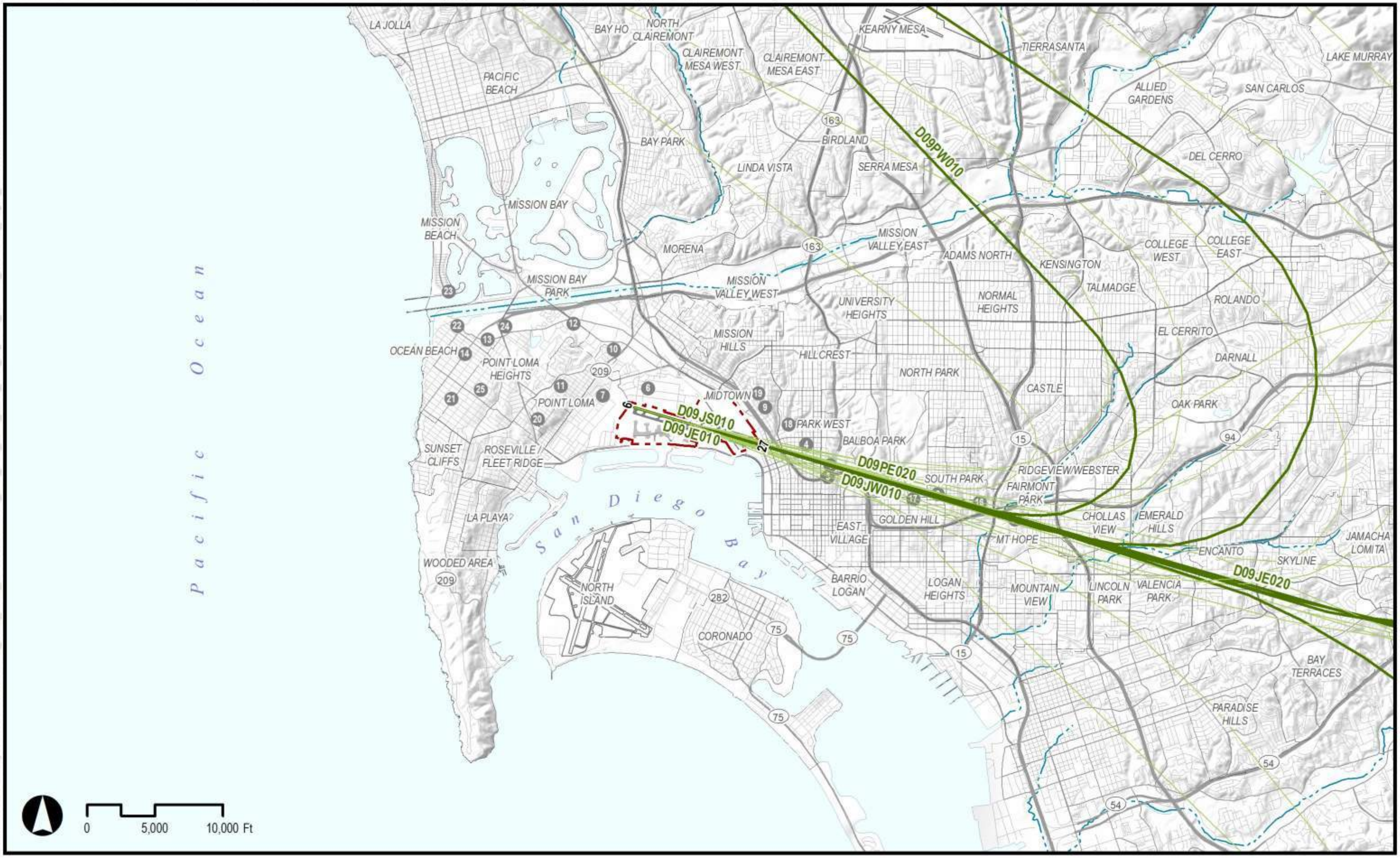
- Temperature: 64° F
- Pressure: 1014.349976 millibars
- Sea-level Pressure: 1015.75 millibars
- Relative Humidity 73.1%
- Dew Point: 53.7200001° F
- Wind Speed: 5.57 Knots

8. TERRAIN DATA

Terrain data describes the elevation of the ground surrounding the airport and on airport property. If the AEDT user selects the use of terrain data, AEDT uses terrain data to adjust the ground level under the flight paths. The terrain data does not affect the aircraft's performance or noise levels, but does affect the vertical distance between the aircraft and a "receiver" on the ground. This in turn affects noise propagation assumptions about how noise propagates over ground. The terrain data were obtained from the United States Geological Survey (USGS) National Map Viewer and will be used with the terrain feature of the AEDT in generating the noise contours for the SAN EIR.

Data Sources: San Diego International Airport; San Diego Association of Governments (SANDAG); City of San Diego and County of San Diego (SanGIS); Environmental Systems Research Institute, Inc. (ESRI); U.S. Census Blocks 2010

Path: \\fs1\vol1\Projects\309XXX\309290_SAN_ADP_EIR\GIS\309290_002_003_SAN_ADP_EIR_Figure1_DEP09_Modeled_Flight_Tracks.mxd Author: MJHamilton



Modeled Departure Tracks (Backbone)

Modeled Departure Tracks (Dispersed)

Airport Property

RMT Site Location

Roads

Runway

River / Stream

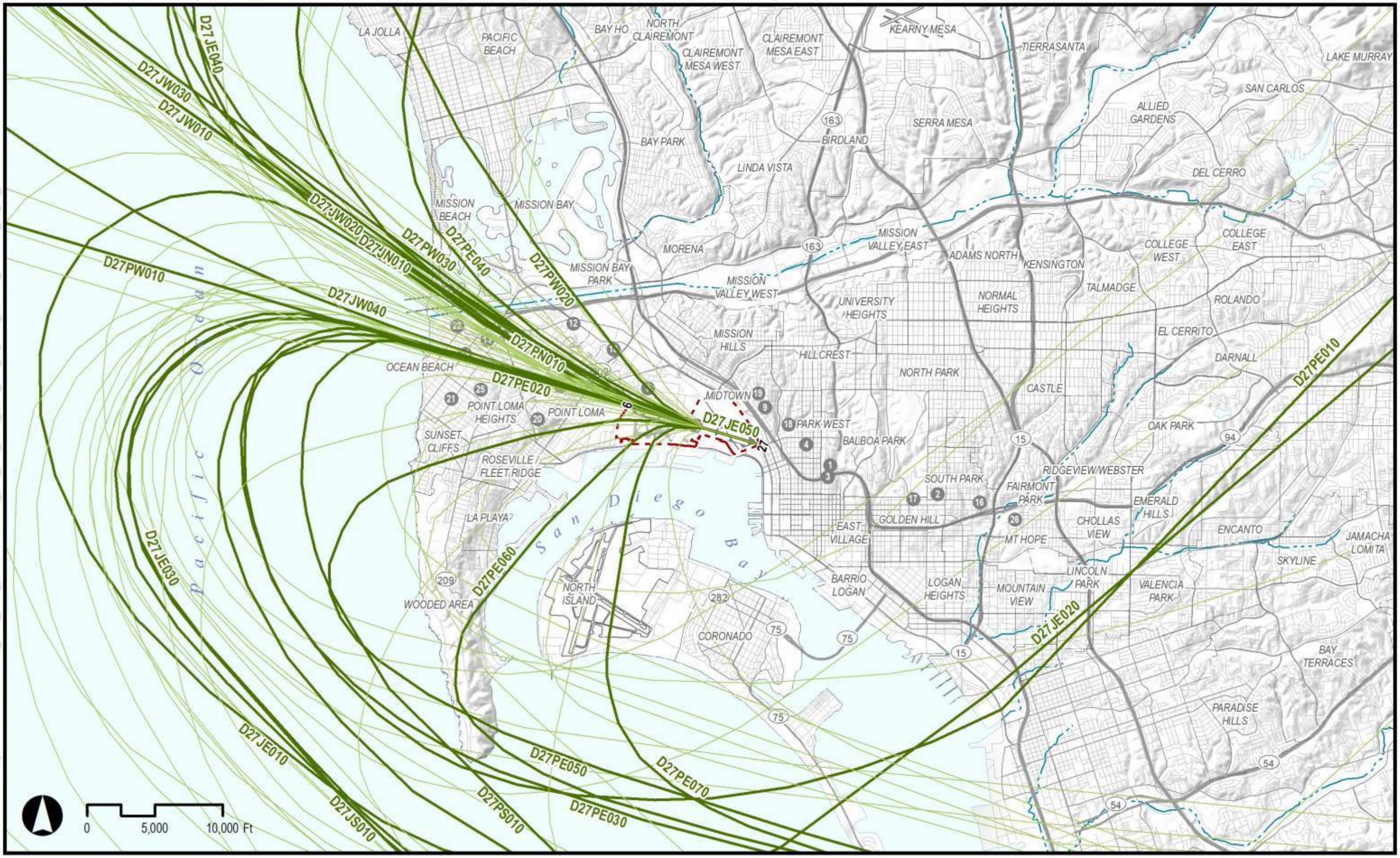
SAN DIEGO INTERNATIONAL AIRPORT

LET'S GO.

Model Tracks for Departure Operations from Runway 09

hmmh

Data Sources: San Diego International Airport; San Diego Association of Governments (SANDAG); City of San Diego and County of San Diego (SanGIS); Environmental Systems Research Institute, Inc. (ESRI); U.S. Census Blocks 2010



Modeled Departure Tracks (Backbone)

Modeled Departure Tracks (Dispersed)

Airport Property

RMT Site Location

Roads

Runway

River / Stream

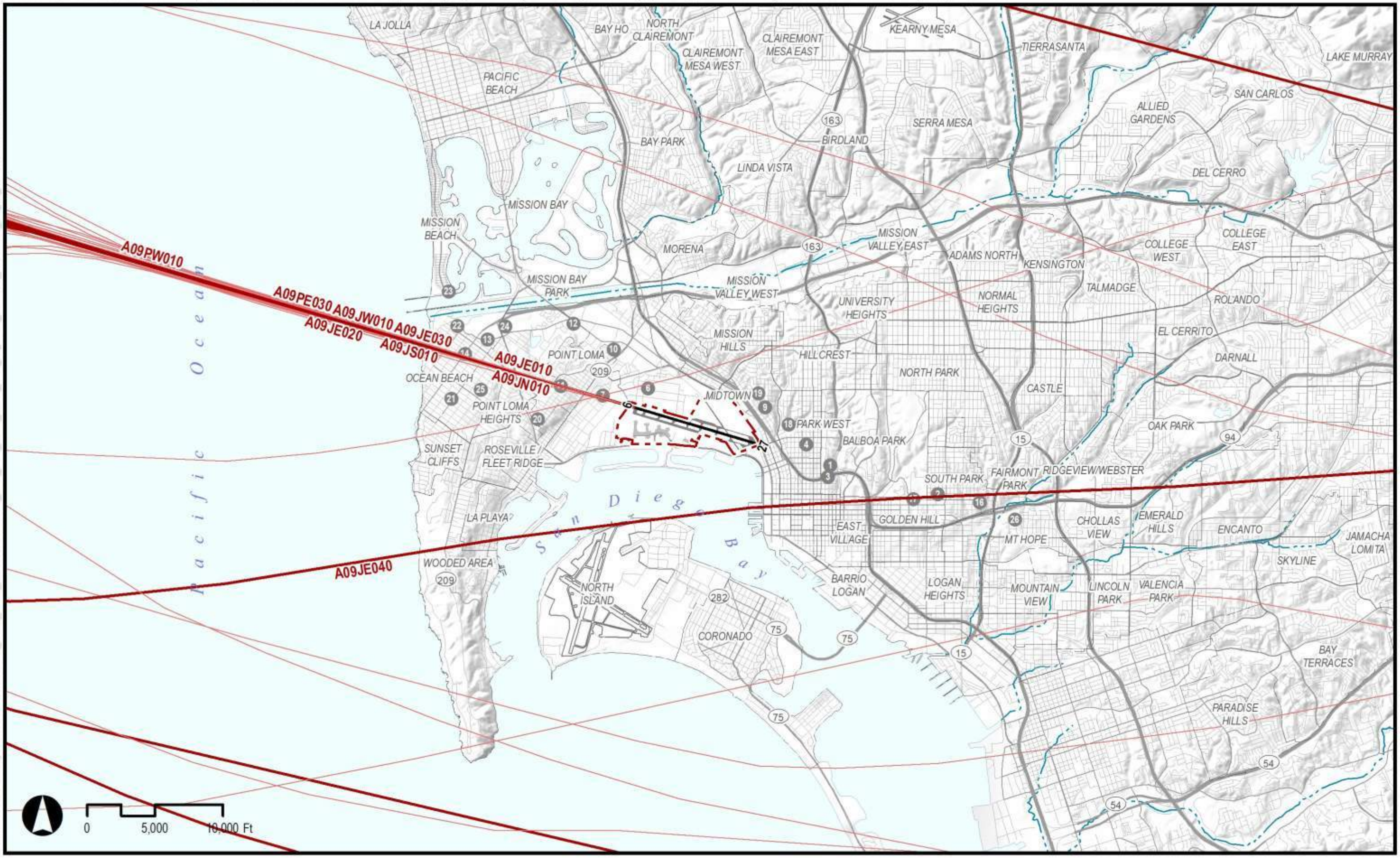
Model Tracks for Departure Operations from Runway 27

SAN DIEGO INTERNATIONAL AIRPORT

LET'S GO.

hmmh

Data Sources: San Diego International Airport; San Diego Association of Governments (SANDAG); City of San Diego and County of San Diego (SanGIS); Environmental Systems Research Institute, Inc. (ESRI); U.S. Census Blocks 2010



Modeled Arrival Tracks (Backbone)

Modeled Arrival Tracks (Dispersed)

Airport Property

RMT Site Location

Roads

Runway

River / Stream

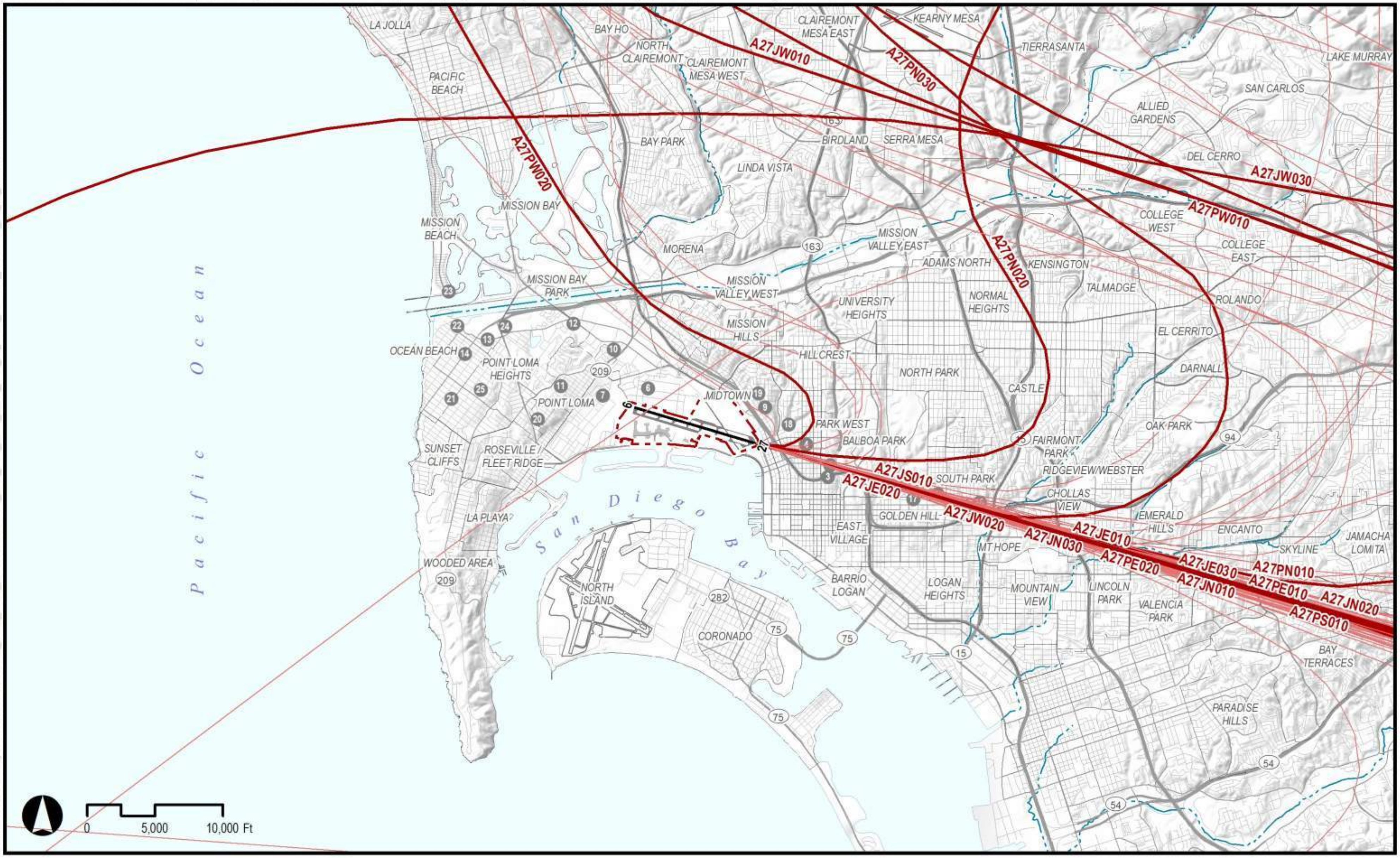
SAN DIEGO INTERNATIONAL AIRPORT

LET'S GO.

Model Tracks for Arrival Operations to Runway 09

hmmh

Data Sources: San Diego International Airport; San Diego Association of Governments (SANDAG); City of San Diego and County of San Diego (SanGIS); Environmental Systems Research Institute, Inc. (ESRI); U.S. Census Blocks 2010



Modeled Arrival Tracks (Backbone)

Modeled Arrival Tracks (Dispersed)

Airport Property

RMT Site Location

Roads

Runway

River / Stream

Model Tracks for Arrival Operations to Runway 27

R-G3 – Traffic and Construction Noise Modelling Approaches and Assumptions

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TECHNICAL MEMORANDUM

To:	Project File
Copies:	Justin Cook
From:	Christopher Bajdek, Dillon Tannler, Vincent Ma
Date:	August 30, 2019
Subject:	Update to Evaluation of Traffic and Construction Noise for the SAN ADP EIR
Reference:	HMMH Project Number 309290.000.003

This memorandum summarizes the updates to the evaluation of traffic noise on the off-airport roadway network as part of the Airport Development Plan (ADP) at San Diego International Airport (SDIA). This memorandum also provides an evaluation of construction noise associated with the proposed terminal improvements.

Please let me know if you have any questions or comments.

Contents

Figures

Tables

1. Noise from Traffic on Off-Airport Roadways

This section provides the results an analysis of traffic noise on the off-airport roadway network as part of the Airport Development Plan (ADP) at San Diego International Airport (SDIA).

1.1 General Approach and Methodology

The evaluation of project-related noise levels due to traffic on the off-airport roadway network included a noise monitoring survey and traffic noise predictions using the latest version of the Federal Highway Administration (FHWA) Traffic Noise Model (TNM Version 2.5).[1]

The methods used during the noise monitoring survey were consistent with FHWA and California Department of Transportation (Caltrans) guidance and policies. The objectives of the noise monitoring survey were to document existing ambient noise levels in noise-sensitive locations adjacent to the off-airport roadway network and to provide a means for validating the traffic-noise prediction model. Short-term noise measurements were performed using a Larson-Davis 824 (ANSI Type I, "Precision") integrating sound level meter. This noise measurement instrument is calibrated on an annual basis by an independent certification laboratory, following methods and procedures traceable to the National Institute of Standards and Technology. During the noise monitoring survey, the sound level meter was calibrated in the field using a handheld acoustic calibrator at the beginning and end of each measurement period.

Traffic noise levels for the future forecast years, with and without the Project, were computed using the latest version of the Federal Highway Administration (FHWA) Traffic Noise Model (TNM Version 2.5). Using forecast traffic volume data along with hourly vehicle mix and distributions from a site on Harbor Drive, TNM Version 2.5 was used to calculate hourly traffic noise levels expressed in terms of the hourly equivalent sound level (L_{eq}) and the Community Noise Equivalent Level (CNEL). These noise metrics were computed using a basic model (e.g. flat-earth, semi-infinite/straight roadway, no shielding due to rows of buildings or intervening terrain, etc.) of traffic noise at a representative distance of 50 feet from the edge of each off-airport roadway. The basic model took into account the width of the off-airport roadways, hourly vehicle volumes and speeds, vehicle mix, and sound propagation over different types of ground.

Potential traffic noise impacts were evaluated with respect to thresholds of significance characterized by land use compatibility guidelines for traffic noise, as well as changes in the worst noise hour L_{eq} and changes in the CNEL.

1.2 Regulatory Framework

When evaluating noise from sources other than aircraft arrivals and departures, such as noise from surface transportation improvements, the Federal Aviation Administration (FAA) directs project proponents to use methods developed by the applicable modal administration or agency.[2] In the case of highway traffic noise, FHWA has developed noise regulations that apply to Federal-aid highway construction projects, as discussed in the following section.

The evaluation of traffic noise for the SAN ADP EIR addresses the City of San Diego's regulatory framework as documented in the Noise Element of the City's General Plan. Significance criteria were developed based upon FHWA and California Department of Transportation (Caltrans) regulations and policies, as well as the Noise Element of the General Plan.

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[1] Federal Highway Administration, US Department of Transportation. January 1998. *FHWA Traffic Noise Model, Version 1.0 User's Guide*. FHWA-PD-96-009. Cambridge, MA: U.S. Department of Transportation, Research and Special Programs Administration, John A. Volpe National Transportation Systems Center, Acoustics Facility. http://www.fhwa.dot.gov/environment/noise/traffic_noise_model/old_versions/tnm_version_10/users_guide/index.cfm

[2] Federal Aviation Administration, US Department of Transportation. July 16, 2015. *FAA Order 1050.1F Environmental Impacts: Policies and Procedures*. Appendix B-1.7

1.3 Significance Criteria

Significance criteria for traffic noise impacts were developed based on two different sound level descriptors (noise metrics). The worst noise hour L_{eq} is based upon federal and state regulations and guidelines, and the CNEL is based upon the Noise Element of the City of San Diego General Plan.

1.3.1 Federal Highway Administration, 23 CFR 772

Title 23 of the Code of Federal Regulations, Part 772 (23 CFR 772) provides the framework and establishes the standards for the assessment and abatement of highway traffic noise in the United States.[3] The Federal Highway Administration (FHWA) published revised noise regulations on July 13, 2010, which then became effective on July 13, 2011. FHWA has also published a guidance document to support the new regulations.[4] The FHWA regulations in 23 CFR 772 apply to all federal or federal-aid highway projects authorized under Title 23, United State Code.

The FHWA established the Noise Abatement Criteria (NAC) shown in Table 1 for different categories of land use activity to assess the degree of impact of highway traffic and noise on human activity. The NAC are given in terms of the hourly, A-weighted, equivalent sound level in decibels (dBA). The A-weighted sound level is commonly used when measuring environmental noise to provide a single number descriptor that correlates with human subjective response to noise because the sensitivity of human hearing varies with frequency. The A-weighted sound level is widely accepted by acousticians as a proper unit for describing environmental noise. Most environmental noise (and the A-weighted sound level) fluctuates from moment to moment, and it is common practice to characterize the fluctuating level by a single number called the equivalent sound level (L_{eq}). The L_{eq} is the value or level of a steady, non-fluctuating sound that represents the same sound energy as the actual time-varying sound evaluated over the same time period. For traffic noise assessment, L_{eq} is typically evaluated over a one-hour period, and may be denoted as L_{eq}(h).

Traffic noise impact would occur for a particular activity category when predicted exterior noise levels approach or exceed the FHWA NAC during the loudest hour of the day for that category. For example, residential land use is defined as Activity Category B. So, traffic noise impact would occur where predicted exterior sound levels approach or exceed 67 dBA L_{eq}(h). FHWA requires state highway agencies to establish an approach level that is at least one decibel less than the NAC for Activity Categories A to E in Table 1. The California Department of Transportation (Caltrans) defines the word “approach” in “approach or exceed” as within 1 decibel. So for residential land use in Activity Category B, the threshold for traffic noise impact is where exterior noise levels are within 1 decibel of 67 dBA L_{eq}(h), or 66 dBA. Traffic noise impact also occurs when future with Project noise levels cause a substantial increase over existing noise levels.

Wherever the traffic noise levels approach or exceed the NAC during the loudest hour of the day or cause a substantial increase in existing noise, consideration of traffic noise abatement measures is warranted. If it is found that such mitigation measures will cause adverse social, economic or environmental effects that outweigh the benefits received, they may be dismissed from consideration. For this analysis, traffic noise levels from the off-airport roadway network were determined for Existing conditions and the future forecast years of 2024, 2026, 2030, 2035, and 2050.

[3] Federal Highway Administration, US Department of Transportation. July 13, 2010. *23 CFR Part 772, as amended 75 FR 39820, Procedures for Abatement of Highway Traffic Noise and Construction Noise.* Washington, DC: http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/
[4] Federal Highway Administration, US Department of Transportation. June 2010, revised January 2011. *Highway Traffic Noise: Analysis and Abatement Guidance*. Washington, DC: http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/revguidance.pdf

Table 1. Federal Highway Administration Noise Abatement Criteria

Activity Category	$L_{eq}(h)$[1]	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose
B[2]	67 (Exterior)	Residential
C[2]	67 (Exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E[2]	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F
F	--	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	--	Undeveloped lands that are not permitted (without building permits)

Source: 23 CFR 772.
Notes:
1.) Hourly equivalent A-weighted sound level (dBA).
2.) Includes undeveloped lands permitted for this activity category.

1.3.2 California Department of Transportation, Traffic Noise Analysis Protocol

The FHWA regulations in 23 CFR 772 require state highway agencies to prepare updated state-specific policies and procedures for applying the regulation in their state. Caltrans policies and procedures for implementing 23 CFR 772 are contained in *Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects* (the Protocol) in the State of California.[5] Caltrans also has published a guidance document that supplements the Protocol and serves to assist highway noise analysts with the technical aspects of traffic noise analysis.[6]

According to the Caltrans Protocol and consistent with 23 CFR 772, traffic noise impact also occurs when future project noise levels cause a substantial noise increase over existing noise. A substantial increase occurs when a project's predicted worst-hour design-year noise level exceeds the existing worst-hour noise level by 12 dBA or more.

[5] Division of Environmental Analysis, California Department of Transportation. *Traffic Noise Analysis Protocol for New Highway Construction, Reconstruction, and Retrofit Barrier Projects*, May 2011. http://www.dot.ca.gov/env/noise/docs/traffic-noise-protocol-may2011.pdf

[6] Division of Environmental Analysis, California Department of Transportation. *Technical Noise Supplement to the Caltrans Traffic Noise Analysis Protocol – A Guide for the Measuring, Modeling, and Abating Highway Operation and Construction Noise Impacts*, Report No. CT-HWANP-RT-13-069.25.2, September 2013. http://www.dot.ca.gov/env/noise/docs/tens-sep2013.pdf

1.3.3 City of San Diego, Noise Element of the General Plan

The City of San Diego's General Plan contains ten elements that provide guidance and policies to balance the needs of a growing City and the quality of life for its inhabitants.[7] The Noise Element of the General Plan provides goals and policies to guide compatible land uses and the incorporation of noise control (attenuation) measures for new uses to protect people living and working in the City from excessive noise levels. The primary goal of the Noise Element is to require project proponents, developers, and other stakeholders to consider existing and future noise levels when making land use planning decisions so as to minimize human exposure to excessive noise.[8]

Table 2 summaries the land use noise compatibility guidelines contained in the Noise Element. The guidelines identify exterior noise levels in terms of the Community Noise Equivalent Level (CNEL) for various land use types. A "compatible" land use indicates that standard construction methods will reduce exterior noise to an acceptable indoor level and people can conduct outdoor activities with minimal noise interference. As shown in Table 2, all land use categories are compatible with an exterior noise levels below 60 dBA CNEL. For land use that falls into a "conditionally compatible" noise environment, structures must be capable of reducing exterior noise to the indoor level shown in Table 2. As an example, a structure associated with a multiple dwelling-unit residence exposed to an exterior CNEL in the range from 60 to 65 dBA must be capable of reducing the exterior noise to a level of 45 dBA CNEL indoors. For land uses that fall into an "incompatible" noise environment, new construction should generally not be undertaken. Exterior noise levels are unacceptable for outdoor activities in an incompatible environment and extensive construction techniques or mitigation would be required to make indoor levels acceptable.

If a land use is currently at or exceeds the noise compatibility guidelines due to exposure to traffic noise and a project would result in a less than 3 dB increase, then the impact is not considered significant.[9]

1.3.4 Significance Thresholds

Traffic noise impact will be considered significant if any of the following occur as a result of the proposed project:

- If, as a direct result of the project, traffic noise levels for any existing development will exceed the noise levels considered compatible for noise-sensitive areas associated with the land use categories defined in the preceding section.
- If, as a direct result of the project, traffic noise levels which are currently at or already exceed the levels considered compatible for noise-sensitive land use associated with the applicable land use categories are increased by 3 dBA CNEL, or more.
- If, as a direct result of the project, the worst noise hour L_{eq} due to traffic on the off-airport roadways would substantially exceed the existing L_{eq} (i.e. an increase of 12 dB, or more) at noise-sensitive areas associated with the applicable land use categories.

[7] City of San Diego, *General Plan*, Adopted March 10, 2008, Resolution No. R-303473. https://www.sandiego.gov/planning/genplan/
[8] City of San Diego, *General Plan Noise Element*, updated June 29, 2015. https://www.sandiego.gov/sites/default/files/ne_2015.pdf
[9] City of San Diego, Development Services Department, *California Environmental Quality Act, Significance Determination Thresholds,* January 2011.

Table 2. City of San Diego Land Use / Noise Compatibility Guidelines

Land Use Category	Exterior Noise Exposure (CNEL in dBA) <60	60-65	65-70	70-75	>75
Parks, Active and Passive Recreation					
Outdoor Spectator Sports, Golf Courses; Water Recreational Facilities; Indoor Recreational Facilities					
Crop Raising & Farming; Community Gardens, Aquaculture, Dairies; Horticulture Nurseries & Greenhouses; Animal Raising, Maintain & Keeping; Commercial Stables					
Single Dwelling Units; Mobile Homes		45			
Multiple Dwelling Units		45	45*		
Hospitals; Nursing Facilities; Intermediate Care Facilities; Kindergarten through Grade 12Educational Facilities; Libraries; Museums; Child Care Facilities		45			
Other Educational Facilities including Vocational/Trade Schools and Colleges and Universities		45	45		
Cemeteries					
Building Supplies/Equipment; Food, Beverages & Groceries; Pets & Pet Supplies; Sundries, Pharmaceutical, & Convenience Sales; Wearing Apparel & Accessories			50	50	
Building Services; Business Support; Eating & Drinking; Financial Institutions; Maintenance & Repair; Personal Services; Assembly & Entertainment (includes public and religious assembly); Radio & Television Studios; Golf Course Support			50	50	
Visitor Accommodations		45	45	45	
Business & Professional; Government; Medical, Dental & Health Practitioner; Regional & Corporate Headquarters			50	50	
Commercial or Personal Vehicle Repair & Maintenance; Commercial or Personal Vehicle Sales & Rentals; Vehicle Equipment & Supplies Sales & Rentals; Vehicle Parking					
Equipment & Materials Storage Yards; Moving & Storage Facilities; Warehouse; Wholesale Distribution					
Heavy Manufacturing; Light Manufacturing; Marine Industry; Trucking & Transportation Terminals; Mining & Extractive Industries					
Research & Development				50	

	Compatible	Indoor Use	Standard construction methods should attenuate exterior noise to an acceptable indoor noise level.
		Outdoor Use	Activities associated with the land use may be carried out.
45 or 50	Conditionally Compatible	Indoor Use	Building structure must attenuate exterior noise to the indoor noise level indicated by the number (45 or 50) for occupied areas.
		Outdoor Use	Feasible noise mitigation techniques should be analyzed and incorporated to make the outdoor activities acceptable.
	Incompatible	Indoor Use	New construction should not be undertaken.
		Outdoor Use	Severe noise interference makes outdoor activities unacceptable.

Source: Based on Table NE-3 in the City of San Diego General Plan, Noise Element, June 2015.
https://www.sandiego.gov/sites/default/files/ne_2015.pdf
* Additional policies within the Noise Element apply to land use categories exposed to aircraft noise.

1.4 Existing Environment

A noise monitoring survey was conducted within the project study area, consistent with FHWA and Caltrans recommended procedures. The objectives of the monitoring program were to document existing ambient noise levels in noise-sensitive locations and to provide a means for validation of the traffic noise prediction model.

Noise monitoring was conducted at four short-term (15 to 20 minutes in duration) sites on January 31, 2018. Measurement sites were generally located in areas that were representative of noise-sensitive land use exposed to noise from traffic on the off-airport roadway network. Traffic classification counts on the roadways nearest each measurement site were conducted simultaneously with each noise measurement. The short-term measurements characterized existing noise levels in the study area but were not necessarily conducted during the loudest hour of the day. They included contributions from sources other than traffic, such as aircraft. Figure 1 shows the locations of the noise measurement sites within the project study area. The short-term noise monitoring locations are shown in the study area graphic, and labeled with the prefix “M.”

Short-term noise monitoring is not a process to determine design-year noise impacts or noise barrier locations. Short-term noise monitoring provides a level of consistency between what is present in real-world situations and how those situations are represented in the computer noise model. Short-term monitoring does not need to occur everywhere within the study area to validate the computer noise model.

The short-term data collection procedure involved measurement of one-second equivalent sound levels (L_{eq}s) over a period of 15 to 20 minutes. Continuous logging of events was conducted during the monitoring, so that intervals that included events that were not traffic-related could be excluded during the analysis. For each measurement period, a “Total L_{eq}” (includes non-contaminated sound level contributions from every 1-second interval) and a “Traffic-only L_{eq}” (excludes those intervals that contained noise events unrelated to traffic noise) were determined. By comparing the two totals, the significance of non-traffic events (such as aircraft operations) to the overall noise level can be determined for the measurement period.

The measured noise levels appear in Table 3 as equivalent sound levels (L_{eq}). As described above, the L_{eq} is a sound-energy average of the fluctuating sound level (in A-weighted decibels, dBA) measured over a specified time. Table 3 provides a description of the measurement location, as well as the start time and the duration of the measurement. Measured noise levels are presented both in terms of the “Total L_{eq}” and in terms of the “Traffic-only L_{eq}”.

As shown in Table 2, the Total L_{eq} ranged from a low of 62.7 dBA at Spanish Landing Park (Site M-1) to a high of 73.9 dBA near the intersection of India and Palm Streets (Site M-2). However, at each measurement site the value of the Traffic-only L_{eq} is the lower than the Total L_{eq}, which is an indication that noise from aircraft operations at SDIA contributed to the overall noise level and in some cases was the dominant source of noise. The measured Traffic-only L_{eq} at Sites M-1, M-2, and M-4, was approximately 0.3 to 3.7 dBA lower than the Total L_{eq}, while the Traffic-only L_{eq} at Site M-3 was approximately 11 dBA lower than the Total L_{eq}. Whereas Site M-3 is located within 1,400 feet of the end of Runway 9/27, aircraft arrivals to Runway 27 dominated the noise environment at the time of the measurements.

Traffic on the local off-airport roadway network and Interstate I-5 also were dominant sources of noise in the absence of aircraft operations. Other sources of noise in the existing environment included, but were not limited to biogenic sounds (birds and dogs), distant trains, and light construction. The appendix provides details of the data acquired during the noise measurement program, including noise monitor output, site sketches, photographs, noise level data with site summary results, and traffic counts with hourly totals. Figure 1 shows the locations of the measurement sites on an overview map.

Table 3. Summary of Short-term Noise Measurements

Site	Address / Location	Time Start (hh:mm:ss)	Duration (minutes)	Measured Total L_{eq} (dBA)	Measured Traffic-only L_{eq} (dBA)	Calculated L_{eq} (dBA)	Calculated – Traffic L_{eq} (dB)
ST-1	Spanish Landing Park	7:50:00	20	67.3	65.4	64.2	-1.2
		12:35:01	15	62.7	61.2	63.1	1.9
ST-2	Near the intersection of India and Palm Streets	8:53:00	15	72.2	71.9	72.5	0.6
		14:44:59	15	73.9	72.9	72.9	0.0
ST-3	2328 India Street	10:12:00	15	73.8	62.7	60.5	-2.3
		10:32:00	15	72.9	61.3	61.3	0.1
		14:05:59	15	71.9	61.1	60.5	-0.6
ST-4	Near the intersection of Hawthorn and Brant Streets	11:12:00	15	72.4	68.6	67.5	-1.1
		13:26:00	15	70.1	68.8	67.5	-1.3

Source: HMMH, 2018.

A validation of the noise prediction model was conducted using the traffic counts obtained during the noise monitoring survey. Computed noise levels based on the normalized traffic count data[10] were compared to the corresponding measured noise levels, to confirm the accuracy of the method. As necessary, the modeling assumptions were refined to obtain appropriate agreement between the computed and measured values.[11] The validated modeling assumptions at the measurement sites and for the existing geometry were then extended to the proposed project in each of the future forecast years.

Computed noise levels at the measurement sites using the normalized traffic count data as input to TNM Version 2.5 were just slightly lower by approximately 0.4 dBA compared to the measured noise levels on average, with a standard deviation of the differences of 1.2 dBA. In addition, at none of the sites were the variations between measured and computed levels greater than 3 dBA. This agreement confirms that the noise prediction model is validated. The comparison of measured versus computed sound levels at the measurement sites is shown by the values in the rightmost column of the Table 3.

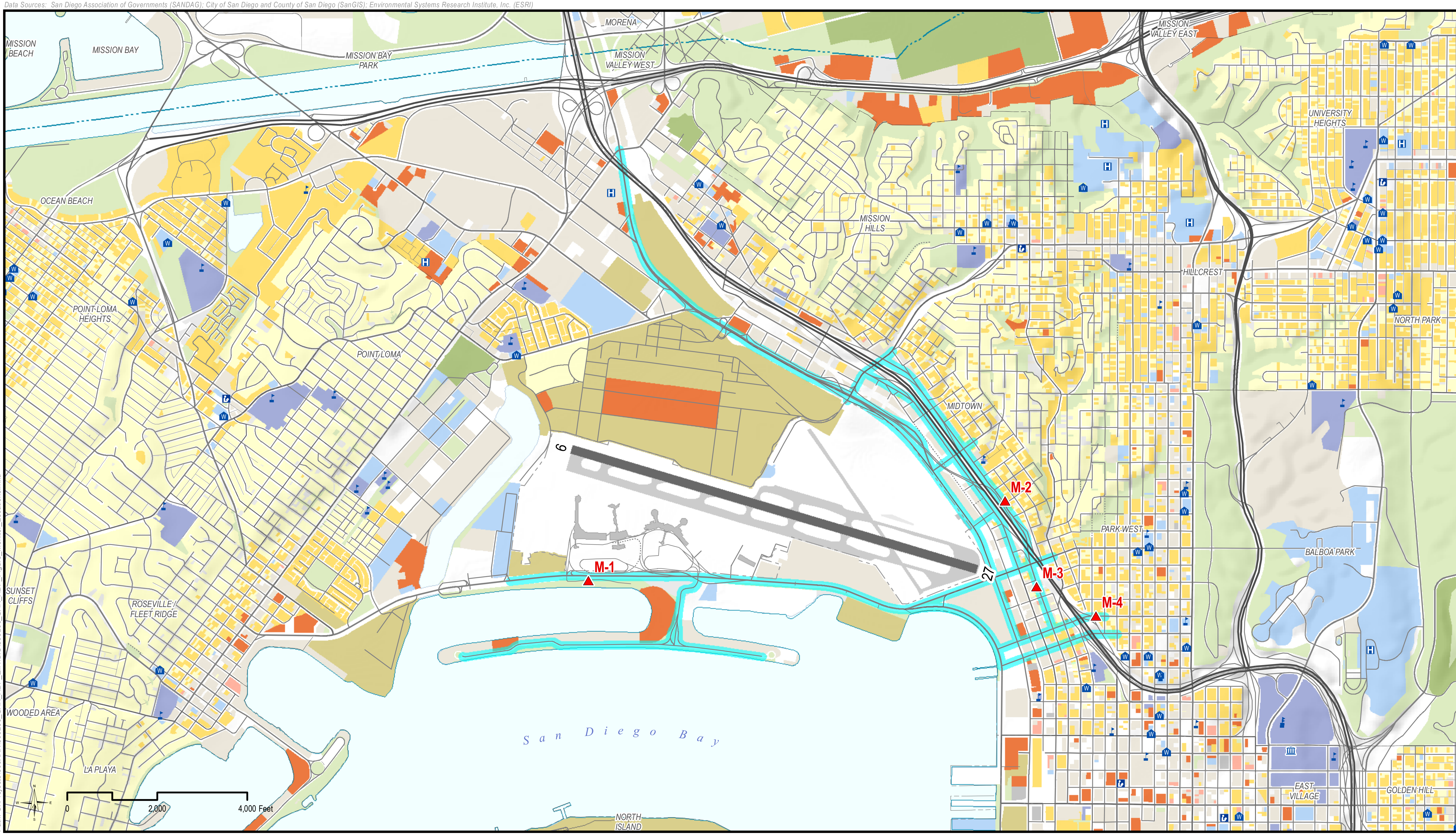
[10] Traffic counts obtained during the noise monitoring survey were normalized (scaled) to a period of one hour.

[11] During the noise monitoring survey, traffic counts were obtained for the local roadway network (i.e. North Harbor Drive, India Street, and Hawthorn Street). While traffic counts were not obtained for Interstate I-5, it became clear that the validation should account for traffic on I-5. Consequently, peak hour traffic volumes and truck volumes on I-5 were obtained from the following sources and included in the model validation:

i.) Division of Traffic Operations, State of California Department of Transportation. *2016 Traffic Volumes on the California State Highway System.* http://www.dot.ca.gov/trafficops/census/docs/2016_aadt_volumes.pdf

ii.) Traffic Data Branch, State of California Department of Transportation. *2016 Annual Average Daily Truck Traffic on the California State Highway System.* http://dot.ca.gov/trafficops/census/docs/2016_aadt_truck.pdf

Data Sources: San Diego Association of Governments (SANDAG); City of San Diego and County of San Diego (SanGIS); Environmental Systems Research Institute, Inc. (ESRI)



Single Family Residential
Multi Family Residential
Mixed Use (Residential & Commercial)
Public Use 1 (School, Library, Place of Worship)
Public Use 2 (Fire, Police, Services)
Transient Lodging

Commercial / Industrial
Military Use
Vacant Property
Parks / Open Space

Measurement Site Location
Study Roads

Roads
River / Stream

Figure 1
Overview of the Study Area and Short-term Noise Monitoring Locations

1.5 Evaluation of Traffic Noise Levels for the Future Forecast Years

This section summarizes the evaluation of noise levels due to traffic along the off-airport roadways affected by the proposed project at SDIA.

1.5.1 Input to the Model

As noted above, traffic noise levels for the future forecast years, with and without the Project, were computed with TNM Version 2.5 using existing and forecast traffic data as input to the model. Traffic data were provided as Average Daily Traffic (ADT) volumes for different sections of the study roadways for Existing, 2024, 2026, 2030, 2035, and 2050 conditions. For all of the future year scenarios, four forecast ADTs were provided for each section of roadway as follows:

- A "No Project" ADT, which is based upon the regional forecast model and growth of traffic without the project.
- A "Baseline" ADT, which is based upon the regional forecast model and cumulative project traffic.
- An "Alternative 4" ADT, which includes the growth in traffic that would occur at the airport based upon changes to airport access with the Alternative 4.
- A "Preferred Alternative Project" ADT, which includes the growth in traffic that would occur at the airport based upon changes to airport access due to the Preferred Alternative.

TNM Version 2.5 also requires information about the types of vehicles and the hourly distributions of vehicles on the roadway network. The vehicle mix and hourly distributions used for the modeling were based upon count data for North Harbor Drive between Winship Lane and Liberator Way, which were provided as vehicle volumes by each hour of the day for 13 vehicle classifications.[12] Those data were compiled into the default vehicle types for TNM Version 2.5[13] and for the time periods shown in Table 4. The distribution and mix of vehicle types in Table 4 are given in terms of the percent of ADT. Note that heavy trucks and motorcycles comprised less than 0.1% of the ADT. Consequently, heavy trucks and motorcycles were excluded from the calculation of CNEL.[14] The distributions shown in Table 4 were used for all study years and for all sections of the off-airport roadways.

Table 4. Vehicle Mix as Percent of Average Daily Traffic (ADT) for Calculation of CNEL

FHWA TNM 2.5 Default Vehicle Type	Daytime (7 am to 7 pm) Percent of ADT	Evening (7 pm to 10 pm) Percent of ADT	Nighttime (10 pm to 7 am) Percent of ADT
Automobile	63%	12%	19%
Medium Truck	3%	1%	1%
Heavy Truck	<0.1%	<0.1%	<0.1%
Bus	1%	<0.5%	<0.5%
Motorcycle	<0.1%	<0.1%	<0.1%
Total	67%	13%	20%

Source: Compiled by HMMH, 2018, based upon a summary table prepared by National Data & Surveying Services for North Harbor Drive between Winship Lane and Liberator Way, dated June 12, 2017.

[12] Based upon a summary table prepared by National Data & Surveying Services for North Harbor Drive between Winship Lane and Liberator Way, dated June 12, 2017.
[13] Federal Highway Administration, US Department of Transportation. February 1998. *FHWA Traffic Noise Model, Version 1.0: Technical Manual*, Report No. FHWA-PD-96-010 and DOT-VNTSC-FHWA-98-2. Cambridge, MA: U.S. Department of Transportation, Research and Special Programs Administration, John A. Volpe National Transportation Systems Center, Acoustics Facility. http://www.fhwa.dot.gov/environment/noise/traffic_noise_model/old_versions/tnm_version_10/tech_manual/index.cfm
[14] Based on the traffic count data used to develop the vehicle mix for this assessment, heavy trucks account for less than 0.1% of the daily traffic and generally contribute less than 0.1 dBA to the CNEL.

The count data for North Harbor Drive between Winship Lane and Liberator Way also was used to develop volumes and vehicle mix for the Peak Hour of the day. Based on the data provided, the AM Peak Hour was found to occur for the period starting at 9:00 am with the following vehicle mix: 93.6% automobile, 4.7% medium truck, and 1.7% bus. The count data for North Harbor Drive suggested that the AM Peak Hour volume was approximately 7% of the ADT.

A basic model of traffic noise was developed using TNM Version 2.5 to calculate the hourly equivalent sound level (L_{eq}) and the Community Noise Equivalent Level (CNEL) at a representative distance of 50 feet from the edge of each off-airport roadway. The basic model assumed flat-earth, semi-infinite/straight roadways, and no shielding due to rows of buildings or intervening terrain. The basic model took into account the width of the off-airport roadways, hourly vehicle volumes and speeds, vehicle mix, and sound propagation over different types of ground.

1.5.2 Computed Traffic Noise Levels – Results

Table 5 provides the TNM-computed L_{eq} for Existing conditions during the AM Peak Hour for different sections of the study roadways. Table 5 also summarizes the change in the AM Peak Hour L_{eq} for each future forecast year relative to Existing conditions. The change in the hourly L_{eq} ranges from -5.3 to +8.4 dB relative to Existing conditions. The largest increases in hourly traffic noise levels are expected to occur along Palm Street from Pacific Highway to Kettner Boulevard, and along Harbor Island Drive, east of parking lot.

All of the increases in the future hourly L_{eq} relative to Existing conditions are less than 12 dB, which is one of the thresholds of significance. Consequently, the potential noise impact based on this criterion is not considered significant.

Table 6 provides a summary of the change in the AM Peak Hour L_{eq} for the No Project Alternative, Alternative 4, and the Preferred Alternative relative to the future Baseline (i.e. growth of traffic over time) for each forecast year. The results shown in Table 6 are presented for informational purposes, since there is no significance threshold based on these comparisons.

Table 7 provides the computed CNEL for Existing conditions based on the ADTs developed for this analysis for different sections of the study roadways. Table 7 also summarizes the change in the CNEL for each future forecast year relative to Existing conditions. There are several instances in which the future CNEL with the Project ("Alternative 4" or "Preferred Alternative") and the No Project Alternative exceeds the existing CNEL by 3 dB, or more:

- Along Admiral Boland Way from the parking lot to the rental car access, the No Project Alternative the Alternative 4 and the Preferred Alternative CNELs due to road traffic would exceed the existing CNEL by more than 3 dBA for three of the five future forecast years. However, in each future forecast year, the Alternative 4 CNEL is only 1.6 to 2.6 dB higher than the future Baseline CNEL. The Preferred Alternative CNEL is only 1.7 to 2.9 dB higher than the future Baseline CNEL. The Existing CNEL due to traffic along this stretch of road is 64.5 dB. The existing land use along this stretch of roadway is airport property.
- Along Grape Street for all roadway segments, the No Project Alternative, the Alternative 4, and the Preferred Alternative CNEL due to road traffic would exceed the Existing CNEL by 3.0 to 4.4 dB in 2030, 2035, 2050 (for Albatrass Street to Front segment) 2035 and 2050 for all other segments, which is an increase of only 0.2 to 0.5 dB above the 2035 and 2050 Baseline CNEL. The existing land use in this corridor, consisting of commercial and both single- and multi-family residential, is exposed to an Existing CNEL of 68.9 dBA, which is conditionally compatible for commercial and multiple-family residential land use, but incompatible with single-family dwellings. In all of the future forecast years, both the Alternative 4 CNEL and the Preferred Alternative CNEL are expected to exceed 70 dBA, which is incompatible with residential land use; however, in each of these future forecast years the Baseline CNEL is also expected to exceed 70 dBA.
- Along India Street from Sassafras Street to Laurel Street, the No Project Alternative and the Preferred Alternative CNEL due to road traffic would exceed the Existing CNEL by 1.9 to 3.8 dB in 2024, 2026,

2030, 2035, and 2050. The Alternative 4 CNEL due to road traffic would exceed the Existing CNEL by 1.6 to 3.4 dB in 2024, 2026, 2030, 2035, and 2050. In 2030, 2035, and 2050, the, No Project Alternative, Alternative 4 and the Preferred Alternative CNELs are only 0.4 to 1.1 dB higher than the Baseline CNEL. The Existing CNEL along this section of India Street is 66.1 dB. For each scenario in each of the future forecast years, predicted CNELs are expected to range from 67.7 to 69.9 dBA. These levels of existing and future noise exposure are incompatible with single-family residential land use. Note that in each of the future forecast years, the Baseline CNEL due to traffic is incompatible with single-family dwellings.

- Along all segments of Harbor Island Drive, the No Project Alternative, the Alternative 4, and the Preferred Alternative CNEL due to road traffic would exceed the existing CNEL by 3 to 5.3 dB in 2030, 2035, and 2050. However this is only an increase of 0.1 dB increase over the future Baseline CNEL. For all of the future forecast scenarios except 2050, the predicted CNEL due to traffic noise is expected to be below 65 dBA.
- Along Palm Street from Pacific Highway to Kettner Boulevard, the No Project Alternative, the Alternative 4, and the Preferred Alternative CNEL due to road traffic would exceed the existing CNEL by 6.0 to 8.4 dB in 2024, 2026, 2030, 2035, and 2050. However for 2024, 2026, 2030, and 2035 this is only a change of between -0.2 to +0.3 dB compared to the future Baseline CNEL. In 2050 the No Project Alternative, Alternative 4, and the Preferred Alternative CNEL increases 7.2 to 7.4 dB over the future Baseline CNEL. However, for all of the future forecast scenarios, the predicted CNEL due to traffic noise is expected to be below 65 dBA.
- Along Laurel Street from Harbor Drive to Pacific Highway, the No Project Alternative, the Alternative 4, and the Preferred Alternative CNEL due to road traffic would excel the existing CNEL by 1.2 to 3.5 dB in 2024, 2026, 2030, 2035, and 2050. In 2035 and 2050 the No Project Alternative, the Alternative 4, and the Preferred Alternative CNEL increases by 3.1 to 3.5 over the Existing CNEL. However, in all future year scenarios there is only a change of between -0.1 to +0.9 dB over the future Baseline CNEL.
- Along Harbor Drive from Laurel Street to Hawthorn Street, the No Project Alternative, Preferred Alternative CNEL would exceed the Existing CNEL of 71.1 dB by 3.3 dB in 2050. In 2050, the Baseline CNEL due to traffic is expected to exceed 75 dBA, which is a level of exposure that is incompatible with all land use categories contained in the Noise Element of the City's General Plan. In 2050, both the Alternative 4 and the Preferred Alternative CNEL due to road traffic would be below 75 dBA. In the other future forecast years, land use along the corridor is either compatible with or conditionally compatible with the predicted levels of exposure to traffic noise.
- Along Pacific Highway from Witherby Street to Washington Street, the Existing CNEL due to traffic noise is 73.4 dBA, a level of exposure that is conditionally compatible with visitor accommodations/transient lodging.[15] For each of the future scenarios, the CNEL due to traffic noise is expected to be below 75 dBA, which is conditionally compatible with this type of land use.
- Along the Pacific Highway from Washington Street to Sassafrass Street, for each of the future scenarios, sound levels exceed the Existing CNEL by 4.4 dBA in 2050 due to road traffic increases, but would be below 75 dBA. Land use along the corridor is either compatible with or conditionally compatible with the predicted levels of exposure to traffic noise.
- Along Sassafras Street, the No Project Alternative and Preferred Alternative CNEL due to traffic noise would exceed the Existing CNEL by 3.2 dB and 3.5 dB in 2035 and 2050, respectively. In 2035, the No Project and Preferred Alternative CNEL would exceed the Baseline CNEL by 2.0 dBA. In 2050, the Baseline CNEL and the Alternative 4 CNEL would increase by 1.5 dB and 3.2 dBA, respectively, relative to the Existing CNEL. The change in both the 2050 Alternative 4 CNEL and the 2050 Preferred Alternative CNEL would be approximately 1.7 dB and 2.0 dB respectively, relative to the 2050 Baseline CNEL.

[15] The land use of interest is the Veterans Village of San Diego, shown as "Transient Lodging" on the Land Use Plan, rather than as "Multiple-family Residential."

- Along Washington Street west of Pacific Highway, the No Project and Preferred Alternative CNEL is expected to exceed the Existing CNEL by 3.1 dB in 2050. This change in exposure is 1.6 dB greater than the 2050 Baseline CNEL due to traffic.

Table 8 provides a summary of the change in the CNEL for Alternative 4 and the Preferred Alternative scenarios relative to the future Baseline for each forecast year. The changes in the future Alternative 4 or Preferred Alternative CNEL relative to Baseline range from -3.3 to +7.2 dB. The results shown in Table 8 are presented for informational purposes, since there is no significance threshold based on these comparisons. The largest increases in the future CNEL relative to Baseline are expected to occur in 2035 and 2050 along the following sections of roadway:

- Admiral Boland Way from the parking lot to the rental car access; and
- Admiral Boland Way from Terminal link Road to Pacific Highway'; and
- Sassafras Street, from Pacific Highway to Kettner Boulevard; and
- Harbor Drive from Spanish Landint to Harbor Island Drive; and
- Palm St from Pacific Highway to Kettner Boulevard.; and
- Washington Street, west of Pacific Highway.

Table 5. Change in Peak Hour Traffic L_{eq} by Alternative Compared to Existing Condition

ROADWAY SEGMENT	Existing Leq at 50 ft from Edge of Road	2024 AM Peak Hour Leq re: Existing (dB)				2026 AM Peak Hour Leq re: Existing (dB)				2030 AM Peak Hour Leq re: Existing (dB)				2035 AM Peak Hour Leq re: Existing (dB)				2050 AM Peak Hour Leq re: Existing (dB)			
		Baseline	No Project	Alt 4 Project	Preferred Alt Project	Baseline	No Project	Alt 4 Project	Preferred Alt Project	Baseline	No Project	Alt 4 Project	Preferred Alt Project	Baseline	No Project	Alt 4 Project	Preferred Alt Project	Baseline	No Project	Alt 4 Project	Preferred Alt Project
Pacific Highway																					
Kurtz St to Barnett Ave	66.7	0.2	0.3	0.2	0.2	0.3	0.4	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.7	0.6	0.7	1.0	1.2	1.1	1.2
Barnett Ave to Washington St	70.5	0.7	0.8	0.2	0.2	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.2	1.1	1.2	1.2	1.4	1.4	1.4
Washington St to Sassafras St	63.4	0.4	0.3	0.1	0.2	0.4	0.5	0.3	0.5	0.5	0.8	0.6	0.8	1.3	1.6	1.5	1.6	4.2	4.4	4.3	4.4
Sassafras St to Palm St	63.3	0.3	0.6	0.7	0.8	0.4	0.8	0.7	0.8	0.5	1.2	1.0	1.2	0.6	1.5	1.3	1.5	1.0	1.9	1.7	1.9
Palm St to Laurel St	63.6	0.3	0.5	0.5	0.8	0.3	0.8	0.5	0.8	0.4	1.2	0.9	1.2	0.8	1.7	1.5	1.7	1.7	2.6	2.4	2.6
Laurel Dr to Juniper St	60.7	1.0	1.3	0.6	0.8	1.0	1.5	1.4	1.5	1.1	1.9	1.7	1.9	1.6	2.5	2.3	2.5	2.4	3.3	3.1	3.3
Kettner Blvd																					
Vine St to Sassafras St	65.8	0.9	1.0	0.6	0.9	1.0	1.3	1.0	1.3	1.3	1.9	1.5	1.9	1.6	2.3	2.0	2.3	0.8	1.8	1.4	1.8
Sassafras St to Palm St	64.2	2.0	2.1	0.5	0.8	2.1	2.4	2.2	2.4	2.4	3.1	2.8	3.1	3.0	3.7	3.5	3.7	3.0	3.8	3.5	3.8
Palm St to Laurel St	64.2	1.2	1.2	0.2	0.4	1.4	1.5	1.3	1.5	1.8	2.1	1.9	2.1	2.0	2.5	2.3	2.5	2.2	2.7	2.5	2.7
India St																					
Sassafras St to Laurel St	63.1	1.7	1.9	1.6	1.9	1.8	2.3	1.9	2.3	2.3	3.1	2.7	3.1	2.4	3.4	3.0	3.4	2.7	3.8	3.4	3.8
Laurel St to Juniper St	57.4	0.2	0.2	0.0	0.0	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.7	0.7	0.7	0.7
Washington St																					
West of Pacific Hwy	54.5	-0.1	1.2	1.3	1.5	0.0	1.5	1.2	1.5	0.3	1.9	1.7	1.9	0.5	2.3	2.1	2.3	1.5	3.1	2.9	3.1
Hancock St to San Diego Ave	64.7	0.4	0.5	0.1	0.2	0.5	0.6	0.5	0.6	0.7	0.8	0.7	0.8	0.8	1.0	0.9	1.0	1.1	1.3	1.2	1.3
East of India St	65.1	0.8	0.8	0.1	0.2	0.9	1.0	0.9	1.0	1.1	1.2	1.1	1.2	1.2	1.3	1.3	1.3	1.5	1.7	1.6	1.7
Admiral Boland Wy																					
Washington St to Terminal Link Rd	64.2	0.3	2.2	2.4	2.8	0.3	2.5	2.2	2.5	0.4	3.0	2.7	3.0	0.5	3.4	3.1	3.4	0.8	3.7	3.4	3.7
Terminal Link Rd to Pacific Hwy	64.2	0.3	2.2	2.4	2.8	0.4	2.5	2.2	2.5	0.5	3.0	2.7	3.0	0.6	3.5	3.1	3.5	0.9	3.8	3.5	3.8
Sassafras St																					
Pacific Hwy to Kettner Blvd	58.9	0.1	1.5	1.6	1.8	0.2	1.8	1.5	1.8	0.3	2.3	2.0	2.3	1.2	3.2	2.9	3.2	1.5	3.5	3.2	3.5
Palm St																					
Pacific Hwy to Kettner Blvd	50.5	6.1	6.1	6.0	6.1	6.2	6.3	6.1	6.3	6.3	7.9	6.3	6.5	7.9	8.1	8.0	8.1	1.0	8.4	8.2	8.2
Laurel St																					
Harbor Dr to Pacific Hwy	66.6	1.7	1.5	1.2	1.5	1.8	1.9	1.6	1.9	2.1	2.7	2.3	2.7	2.2	3.1	2.7	3.1	2.5	3.5	3.1	3.5
Pacific Hwy to India St	61.3	0.8	0.8	0.4	0.7	1.0	1.1	0.9	1.1	1.3	1.8	1.5	1.8	1.4	2.2	1.9	2.2	1.7	2.5	2.2	2.5
India St to State St/ Reynard Wy	58.3	0.1	0.1	0.2	0.4	0.1	0.3	0.1	0.3	0.2	0.5	0.3	0.5	0.3	0.7	0.5	0.7	0.6	1.0	0.9	1.0
Hawthorn St																					
Harbor Dr to Pacific Hwy	62.7	0.4	0.3	0.3	0.6	0.4	0.5	0.2	0.5	0.5	0.9	0.6	0.9	1.0	1.6	1.3	1.6	1.3	2.0	1.6	2.0
Pacific Hwy to India St	63.4	0.4	0.3	0.2	0.4	0.5	0.6	0.4	0.6	0.9	1.3	1.0	1.3	2.2	2.6	2.3	2.6	2.5	2.9	2.7	2.9
India St to State St	63.4	0.5	0.4	0.2	0.4	0.6	0.7	0.4	0.7	1.0	1.3	1.0	1.3	2.2	2.6	2.4	2.6	2.5	2.9	2.7	2.9
State St to Albatross St	58.7	0.2	0.2	0.0	0.0	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.7	0.7	0.7	0.7
Grape St																					
Harbor Dr to Pacific Hwy	65.3	0.9	0.8	0.2	0.5	1.0	1.1	0.8	1.1	1.4	1.9	1.5	1.9	3.0	3.5	3.2	3.5	3.3	3.8	3.6	3.8
Pacific Hwy to India St	66.0	1.5	1.4	0.2	0.4	1.6	1.7	1.4	1.7	1.9	2.3	2.0	2.3	3.0	3.5	3.2	3.5	3.3	3.8	3.6	3.8
India St to State St	66.6	1.8	1.7	0.1	0.3	2.0	2.1	1.9	2.1	2.4	2.7	2.4	2.7	3.4	3.8	3.6	3.8	3.7	4.1	3.9	4.1
Albatross St to Front St	54.9	1.6	1.6	0.0	0.0	2.0	2.0	2.0	2.0	3.1	3.1	3.1	3.1	4.1	4.1	4.1	4.1	4.4	4.4	4.4	4.4
Harbor Dr																					
Scott Rd to Nimitz Blvd	61.2	1.5	1.5	0.1	0.2	1.5	1.6	1.5	1.6	1.6	1.8	1.7	1.8	1.7	2.0	1.8	2.0	2.1	2.3	2.2	2.3
Nimitz Blvd to Laning Rd	63.4	1.3	1.2	0.2	0.4	1.3	1.4	1.2	1.4	1.4	1.7	1.4	1.7	1.5	1.9	1.7	1.9	1.8	2.3	2.0	2.3
Laning Rd to McCain Rd	65.1	0.3	0.2	0.2	0.4	0.4	0.5	0.3	0.5	0.7	1.0	0.8	1.0	0.8	1.3	1.0	1.3	1.1	1.6	1.4	1.6
McCain Rd to Spanish Landing	65.1	-0.4	0.1	0.6	0.9	-0.2	0.4	0.2	0.4	0.2	0.9	0.7	0.9	0.3	1.2	0.9	1.2	0.6	1.5	1.3	1.5
Spanish Landing to Harbor Island Dr	65.3	-0.7	1.7	0.8	0.9	-0.6	2.0	0.1	0.1	-0.4	2.4	0.4	0.5	-0.3	2.7	0.6	0.7	0.0	3.1	0.9	1.0
Harbor Island Dr to Winship Ln	69.4	-2.9	-1.9	-1.5	-1.6	-2.4	-1.3	-5.1	-5.3	-1.2	-0.1	-3.0	-3.1	-1.1	0.2	-2.9	-3.0	-0.6	0.7	-2.1	-2.2
Winship Ln to Liberator Blvd	70.0	0.6	0.6	-1.0	-0.7	0.8	1.0	-1.0	-0.7	1.4	1.9	0.1	0.4	1.5	2.3	0.5	0.7	1.8	2.9	0.9	1.1
Liberator Blvd to Cell Phone Lot	70.2	0.4	0.5	-0.9	-0.7	0.6	0.9	-1.1	-0.9	1.2	1.8	0.0	0.2	1.3	2.2	0.3	0.5	1.6	2.7	0.7	0.9
Cell Phone Lot to Laurel St/ Solar Turbines	70.2	0.9	0.6	-1.3	-1.0	1.0	1.1	-1.1	-0.8	1.6	1.9	0.0	0.3	1.7	2.3	0.3	0.6	2.0	2.9	0.8	1.0
Laurel St/ Solar Turbines to W Laurel St	69.3	1.4	-0.7	-1.1	-0.9	1.6	-0.2	-0.4	-0.2	2.2	1.0	0.7	1.0	2.3	1.3	1.0	1.3	2.5	1.7	1.5	1.7
Laurel St to Hawthorn St	68.2	0.6	0.5	0.2	0.5	0.8	0.9	0.6	0.9	1.3	1.7	1.4	1.7	2.4	2.9	2.6	2.9	2.7	3.3	3.0	3.3
Hawthorn St to Grape St	66.3	0.7	0.6	0.2	0.4	0.9	1.0	0.7	1.0	1.6	2.0	1.7	2.0	2.9	3.4	3.1	3.4	3.2	3.7	3.4	3.7
Grape St to Ash St	63.6	0.4	0.3	0.2	0.3	0.6	0.6	0.5	0.6	1.1	1.3	1.2	1.3	1.2	1.6	1.4	1.6	1.5	1.9	1.7	1.9
Harbor Island Dr																					
Harbor Dr to Old Rent A Car Access	57.9	0.2	0.3	0.0	0.1	1.3	1.4	1.3	1.4	4.0	4.1	4.0	4.1	4.1	4.1	4.1	4.1	4.2	4.3	4.2	4.3
West of Harbor Island Dr	55.7	2.5	2.5	0.1	0.1	2.5	2.6	2.5	2.6	2.6	2.7	2.6	2.7	2.7	2.8	2.8	2.8	3.0	3.2	3.1	3.2
Harbor Island Dr to Parking Lot	53.6	1.6	1.6	0.0	0.0	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	2.2	2.2	2.2	2.2	4.4	4.4	4.4	4.4
East of Parking Lot	52.8	2.4	2.4	0.0	0.0	2.5	2.5	2.5	2.5	2.6	2.6	2.6	2.6	3.1	3.1	3.1	3.1	5.3	5.3	5.3	5.3

Source: HMMH, 2019.

Table 6. Change in Future Peak Hour Traffic L_{eq} with the Project Compared to Baseline

ROADWAY SEGMENT	2024 Peak Hour Leq re: Baseline (dB)			2026 Peak Hour Leq re: Baseline (dB)			2030 Peak Hour Leq re: Baseline (dB)			2035 Peak Hour Leq re: Baseline (dB)			2050 Peak Hour Leq re: Baseline (dB)		
	No Project	Alt 4 Project	Preferred Alt Project	No Project	Alt 4 Project	Preferred Alt Project	No Project	Alt 4 Project	Preferred Alt Project	No Project	Alt 4 Project	Preferred Alt Project	No Project	Alt 4 Project	Preferred Alt Project
Pacific Highway															
Kurtz St to Barnett Ave	0.1	0.0	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Barnett Ave to Washington St	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Washington St to Sassafras St	-0.1	-0.1	-0.1	0.1	-0.1	0.1	0.2	0.1	0.2	0.3	0.2	0.3	0.2	0.1	0.2
Sassafras St to Palm St	0.3	0.1	0.3	0.4	0.3	0.4	0.7	0.5	0.7	0.9	0.7	0.9	0.9	0.7	0.9
Palm St to Laurel St	0.2	0.1	0.2	0.4	0.2	0.4	0.8	0.5	0.8	0.9	0.7	0.9	0.8	0.6	0.8
Laurel Dr to Juniper St	0.3	0.2	0.3	0.5	0.3	0.5	0.8	0.6	0.8	1.0	0.8	1.0	0.9	0.7	0.9
Kettner Blvd															
Vine St to Sassafras St	0.1	-0.1	0.1	0.3	0.0	0.3	0.6	0.3	0.6	0.8	0.5	0.8	1.0	0.7	1.0
Sassafras St to Palm St	0.2	0.0	0.2	0.3	0.1	0.3	0.6	0.4	0.6	0.8	0.5	0.8	0.8	0.6	0.8
Palm St to Laurel St	-0.1	-0.2	-0.1	0.1	-0.1	0.1	0.3	0.1	0.3	0.5	0.3	0.5	0.5	0.3	0.5
India St															
Sassafras St to Laurel St	0.2	-0.1	0.2	0.5	0.1	0.5	0.8	0.4	0.8	1.1	0.7	1.1	1.1	0.7	1.1
Laurel St to Juniper St	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Washington St															
West of Pacific Hwy	1.3	1.0	1.3	1.4	1.2	1.4	1.7	1.4	1.7	1.9	1.6	1.9	1.6	1.4	1.6
Hancock St to San Diego Ave	0.0	0.0	0.0	0.1	0.0	0.1	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.2
East of India St	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.2
Admiral Boland Wy															
Washington St to Terminal Link Rd	1.9	1.6	1.9	2.2	1.9	2.2	2.6	2.3	2.6	2.9	2.6	2.9	2.9	2.6	2.9
Terminal Link Rd to Pacific Hwy	1.9	1.6	1.9	2.2	1.9	2.2	2.6	2.3	2.6	2.9	2.6	2.9	2.9	2.6	2.9
Sassafras St															
Pacific Hwy to Kettner Blvd	1.4	1.1	1.4	1.6	1.3	1.6	2.0	1.7	2.0	2.0	1.7	2.0	2.0	1.7	2.0
Palm St															
Pacific Hwy to Kettner Blvd	-0.1	-0.2	-0.1	0.1	-0.1	0.1	0.2	0.0	0.2	0.3	0.1	0.3	7.4	7.2	7.2
Laurel St															
Harbor Dr to Pacific Hwy	-0.1	-0.4	-0.1	0.2	-0.2	0.2	0.6	0.1	0.6	0.9	0.4	0.9	0.9	0.5	0.9
Pacific Hwy to India St	-0.1	-0.3	-0.1	0.2	-0.1	0.2	0.5	0.2	0.5	0.7	0.4	0.7	0.8	0.5	0.8
India St to State St/ Reynard Wy	0.1	0.0	0.1	0.1	0.0	0.1	0.3	0.1	0.3	0.4	0.2	0.4	0.4	0.2	0.4
Hawthorn St															
Harbor Dr to Pacific Hwy	-0.1	-0.3	-0.1	0.1	-0.2	0.1	0.4	0.1	0.4	0.6	0.3	0.6	0.7	0.3	0.7
Pacific Hwy to India St	-0.1	-0.3	-0.1	0.1	-0.2	0.1	0.3	0.1	0.3	0.4	0.2	0.4	0.4	0.2	0.4
India St to State St	-0.1	-0.3	-0.1	0.1	-0.2	0.1	0.3	0.1	0.3	0.4	0.2	0.4	0.4	0.2	0.4
State St to Albatross St	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grape St															
Harbor Dr to Pacific Hwy	-0.1	-0.4	-0.1	0.1	-0.2	0.1	0.5	0.1	0.5	0.5	0.2	0.5	0.5	0.3	0.5
Pacific Hwy to India St	-0.1	-0.3	-0.1	0.1	-0.2	0.1	0.3	0.1	0.3	0.4	0.2	0.4	0.5	0.2	0.5
India St to State St	-0.1	-0.2	-0.1	0.1	-0.1	0.1	0.3	0.0	0.3	0.3	0.2	0.3	0.4	0.2	0.4
Albatross St to Front St	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harbor Dr															
Scott Rd to Nimitz Blvd	0.0	-0.1	0.0	0.0	-0.1	0.0	0.1	0.0	0.1	0.2	0.1	0.2	0.2	0.1	0.2
Nimitz Blvd to Laning Rd	-0.1	-0.2	-0.1	0.1	-0.1	0.1	0.3	0.0	0.3	0.4	0.2	0.4	0.4	0.2	0.4
Laning Rd to McCain Rd	-0.1	-0.2	-0.1	0.1	-0.1	0.1	0.3	0.0	0.3	0.4	0.2	0.4	0.5	0.2	0.5
McCain Rd to Spanish Landing	0.5	0.3	0.5	0.6	0.4	0.6	0.8	0.5	0.8	0.9	0.7	0.9	0.9	0.7	0.9
Spanish Landing to Harbor Island Dr	2.3	0.5	0.5	2.6	0.6	0.7	2.7	0.8	0.8	2.9	0.9	1.0	3.0	0.9	0.9
Harbor Island Dr to Winship Ln	1.0	-3.0	-3.3	1.1	-2.7	-2.8	1.1	-1.8	-1.9	1.3	-1.8	-1.9	1.2	-1.5	-1.6
Winship Ln to Liberator Blvd	0.0	-2.0	-1.8	0.2	-1.8	-1.5	0.5	-1.3	-1.0	0.8	-1.0	-0.7	1.1	-0.9	-0.6
Liberator Blvd to Cell Phone Lot	0.1	-1.9	-1.8	0.3	-1.7	-1.5	0.6	-1.2	-1.0	0.9	-1.0	-0.7	1.2	-0.9	-0.6
Cell Phone Lot to Laurel St/ Solar Turbines	-0.3	-2.4	-2.2	0.0	-2.1	-1.9	0.3	-1.6	-1.3	0.6	-1.4	-1.1	0.9	-1.2	-1.0
Laurel St/ Solar Turbines to W Laurel St	-2.1	-2.2	-2.1	-1.7	-2.0	-1.7	-1.2	-1.4	-1.2	-0.9	-1.2	-0.9	-0.8	-1.1	-0.8
Laurel St to Hawthorn St	-0.1	-0.4	-0.1	0.1	-0.2	0.1	0.4	0.1	0.4	0.5	0.2	0.5	0.6	0.3	0.6
Hawthorn St to Grape St	-0.1	-0.3	-0.1	0.1	-0.2	0.1	0.4	0.1	0.4	0.5	0.2	0.5	0.5	0.3	0.5
Grape St to Ash St	-0.1	-0.1	-0.1	0.1	-0.1	0.1	0.2	0.1	0.2	0.4	0.2	0.4	0.4	0.2	0.4
Harbor Island Dr															
Harbor Dr to Old Rent A Car Access	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.1
West of Harbor Island Dr	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Harbor Island Dr to Parking Lot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East of Parking Lot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: HMMH, 2019.

Table 7. Change in Average Daily Traffic CNEL by Alternative Compared to Existing Condition

ROADWAY SEGMENT	Existing CNEL at 50 ft from Edge of Road	2024 CNEL re: Existing (dB)				2026 CNEL re: Existing (dB)				2030 CNEL re: Existing (dB)				2035 CNEL re: Existing (dB)				2050 CNEL re: Existing (dB)			
		Baseline	No Project	Alt 4 Project	Preferred Alt Project	Baseline	No Project	Alt 4 Project	Preferred Alt Project	Baseline	No Project	Alt 4 Project	Preferred Alt Project	Baseline	No Project	Alt 4 Project	Preferred Alt Project	Baseline	No Project	Alt 4 Project	Preferred Alt Project
Pacific Highway																					
Kurtz St to Barnett Ave	69.7	0.2	0.3	0.3	0.3	0.3	0.4	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.7	0.6	0.7	1.0	1.2	1.1	1.2
Barnett Ave to Washington St	73.4	0.7	0.8	0.8	0.8	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.0	1.0	1.2	1.1	1.2	1.2	1.4	1.4	1.4
Washington St to Sassafras St	66.3	0.4	0.3	0.2	0.3	0.4	0.5	0.3	0.5	0.5	0.8	0.6	0.8	1.3	1.6	1.5	1.6	4.2	4.4	4.3	4.4
Sassafras St to Palm St	66.2	0.3	0.6	0.5	0.6	0.4	0.8	0.7	0.8	0.5	1.2	1.0	1.2	0.6	1.5	1.3	1.5	1.0	1.9	1.7	1.9
Palm St to Laurel St	66.5	0.3	0.5	0.3	0.5	0.3	0.8	0.5	0.8	0.4	1.2	0.9	1.2	0.8	1.7	1.5	1.7	1.7	2.6	2.4	2.6
Laurel Dr to Juniper St	63.6	1.0	1.3	1.2	1.3	1.0	1.5	1.4	1.5	1.1	1.9	1.7	1.9	1.6	2.5	2.3	2.5	2.4	3.3	3.1	3.3
Kettner Blvd																					
Vine St to Sassafras St	68.7	0.9	1.0	0.7	1.0	1.0	1.3	1.0	1.3	1.3	1.9	1.5	1.9	1.6	2.3	2.0	2.3	0.8	1.8	1.4	1.8
Sassafras St to Palm St	67.1	2.0	2.1	1.9	2.1	2.1	2.4	2.2	2.4	2.4	3.1	2.8	3.1	3.0	3.7	3.5	3.7	3.0	3.8	3.5	3.8
Palm St to Laurel St	67.1	1.2	1.2	1.0	1.2	1.4	1.5	1.3	1.5	1.8	2.1	1.9	2.1	2.0	2.5	2.3	2.5	2.2	2.7	2.5	2.7
India St																					
Sassafras St to Laurel St	66.1	1.7	1.9	1.6	1.9	1.8	2.3	1.9	2.3	2.3	3.1	2.7	3.1	2.4	3.4	3.0	3.4	2.7	3.8	3.4	3.8
Laurel St to Juniper St	60.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.7	0.7	0.7	0.7
Washington St																					
West of Pacific Hwy	57.5	-0.1	1.2	0.9	1.2	0.0	1.5	1.2	1.5	0.3	1.9	1.7	1.9	0.5	2.3	2.1	2.3	1.5	3.1	2.9	3.1
Hancock St to San Diego Ave	67.7	0.4	0.5	0.4	0.5	0.5	0.6	0.5	0.6	0.7	0.8	0.7	0.8	0.8	1.0	0.9	1.0	1.1	1.3	1.2	1.3
East of India St	68.0	0.8	0.8	0.8	0.8	0.9	1.0	0.9	1.0	1.1	1.2	1.1	1.2	1.2	1.3	1.3	1.3	1.5	1.7	1.6	1.7
Admiral Boland Wy																					
Washington St to Terminal Link Rd	64.5	0.3	2.2	1.8	2.2	0.3	2.5	2.2	2.5	0.4	3.0	2.7	3.0	0.5	3.4	3.1	3.4	0.8	3.7	3.4	3.7
Terminal Link Rd to Pacific Hwy	64.5	0.3	2.2	1.9	2.2	0.4	2.5	2.2	2.5	0.5	3.0	2.7	3.0	0.6	3.5	3.1	3.5	0.9	3.8	3.5	3.8
Sassafras St																					
Pacific Hwy to Kettner Blvd	61.9	0.1	1.5	1.3	1.5	0.2	1.8	1.5	1.8	0.3	2.3	2.0	2.3	1.2	3.2	2.9	3.2	1.5	3.5	3.2	3.5
Palm St																					
Pacific Hwy to Kettner Blvd	53.5	6.1	6.1	6.0	6.1	6.2	6.3	6.1	6.3	6.3	6.5	6.3	6.5	7.9	8.1	8.0	8.1	1.0	8.4	8.2	8.2
Laurel St																					
Harbor Dr to Pacific Hwy	69.5	1.7	1.5	1.2	1.5	1.8	1.9	1.6	1.9	2.1	2.7	2.3	2.7	2.2	3.1	2.7	3.1	2.5	3.5	3.1	3.5
Pacific Hwy to India St	64.3	0.8	0.8	0.6	0.8	1.0	1.1	0.9	1.1	1.3	1.8	1.5	1.8	1.4	2.2	1.9	2.2	1.7	2.5	2.2	2.5
India St to State St/ Reynard Wy	61.3	0.1	0.1	0.0	0.1	0.1	0.3	0.1	0.3	0.2	0.5	0.3	0.5	0.3	0.7	0.5	0.7	0.6	1.0	0.9	1.0
Hawthorn St																					
Harbor Dr to Pacific Hwy	65.6	0.4	0.3	0.0	0.3	0.4	0.5	0.2	0.5	0.5	0.9	0.6	0.9	1.0	1.6	1.3	1.6	1.3	2.0	1.6	2.0
Pacific Hwy to India St	66.3	0.4	0.3	0.1	0.3	0.5	0.6	0.4	0.6	0.9	1.3	1.0	1.3	2.2	2.6	2.3	2.6	2.5	2.9	2.7	2.9
India St to State St	66.3	0.5	0.4	0.2	0.4	0.6	0.7	0.4	0.7	1.0	1.3	1.0	1.3	2.2	2.6	2.4	2.6	2.5	2.9	2.7	2.9
State St to Albatross St	61.6	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.7	0.7	0.7	0.7
Grape St																					
Harbor Dr to Pacific Hwy	68.2	0.9	0.8	0.5	0.8	1.0	1.1	0.8	1.1	1.4	1.9	1.5	1.9	3.0	3.5	3.2	3.5	3.3	3.8	3.6	3.8
Pacific Hwy to India St	68.9	1.5	1.4	1.2	1.4	1.6	1.7	1.4	1.7	1.9	2.3	2.0	2.3	3.0	3.5	3.2	3.5	3.3	3.8	3.6	3.8
India St to State St	69.6	1.8	1.7	1.6	1.7	2.0	2.1	1.9	2.1	2.4	2.7	2.4	2.7	3.4	3.8	3.6	3.8	3.7	4.1	3.9	4.1
Albatross St to Front St	54.8	1.6	1.6	1.6	1.6	2.0	2.0	2.0	2.0	3.1	3.1	3.1	3.1	4.1	4.1	4.1	4.1	4.4	4.4	4.4	4.4
Harbor Dr																					
Scott Rd to Nimitz Blvd	64.8	1.5	1.5	1.4	1.5	1.5	1.6	1.5	1.6	1.6	1.8	1.7	1.8	1.7	2.0	1.8	2.0	2.1	2.3	2.2	2.3
Nimitz Blvd to Laning Rd	66.3	1.3	1.2	1.1	1.2	1.3	1.4	1.2	1.4	1.4	1.7	1.4	1.7	1.5	1.9	1.7	1.9	1.8	2.3	2.0	2.3
Laning Rd to McCain Rd	68.0	0.3	0.2	0.1	0.2	0.4	0.5	0.3	0.5	0.7	1.0	0.8	1.0	0.8	1.3	1.0	1.3	1.1	1.6	1.4	1.6
McCain Rd to Spanish Landing	68.1	-0.4	0.1	0.0	0.1	-0.2	0.4	0.2	0.4	0.2	0.9	0.7	0.9	0.3	1.2	0.9	1.2	0.6	1.5	1.3	1.5
Spanish Landing to Harbor Island Dr	68.2	-0.7	1.7	-0.1	-0.2	-0.6	2.0	0.1	0.1	-0.4	2.4	0.4	0.5	-0.3	2.7	0.6	0.7	0.0	3.1	0.9	1.0
Harbor Island Dr to Winship Ln	72.3	-2.9	-1.9	-5.9	-6.1	-2.4	-1.3	-5.1	-5.3	-1.2	-0.1	-3.0	-3.1	-1.1	0.2	-2.9	-3.0	-0.6	0.7	-2.1	-2.2
Winship Ln to Liberator Blvd	72.9	0.6	0.6	-1.4	-1.2	0.8	1.0	-1.0	-0.7	1.4	1.9	0.1	0.4	1.5	2.3	0.5	0.7	1.8	2.9	0.9	1.1
Liberator Blvd to Cell Phone Lot	73.2	0.4	0.5	-1.5	-1.3	0.6	0.9	-1.1	-0.9	1.2	1.8	0.0	0.2	1.3	2.2	0.3	0.5	1.6	2.7	0.7	0.9
Cell Phone Lot to Laurel St/ Solar Turbines	73.2	0.9	0.6	-1.5	-1.3	1.0	1.1	-1.1	-0.8	1.6	1.9	0.0	0.3	1.7	2.3	0.3	0.6	2.0	2.9	0.8	1.0
Laurel St/ Solar Turbines to W Laurel St	72.2	1.4	-0.7	-0.8	-0.7	1.6	-0.2	-0.4	-0.2	2.2	1.0	0.7	1.0	2.3	1.3	1.0	1.3	2.5	1.7	1.5	1.7
Laurel St to Hawthorn St	71.1	0.6	0.5	0.3	0.5	0.8	0.9	0.6	0.9	1.3	1.7	1.4	1.7	2.4	2.9	2.6	2.9	2.7	3.3	3.0	3.3
Hawthorn St to Grape St	69.2	0.7	0.6	0.4	0.6	0.9	1.0	0.7	1.0	1.6	2.0	1.7	2.0	2.9	3.4	3.1	3.4	3.2	3.7	3.4	3.7
Grape St to Ash St	70.1	0.4	0.3	0.3	0.3	0.6	0.6	0.5	0.6	1.1	1.3	1.2	1.3	1.2	1.6	1.4	1.6	1.5	1.9	1.7	1.9
Harbor Island Dr																					
Harbor Dr to Old Rent A Car Access	60.9	0.2	0.3	0.2	0.3	1.3	1.4	1.3	1.4	4.0	4.1	4.0	4.1	4.1	4.1	4.1	4.1	4.2	4.3	4.2	4.3
West of Harbor Island Dr	58.6	2.5	2.5	2.4	2.5	2.5	2.6	2.5	2.6	2.6	2.7	2.6	2.7	2.7	2.8	2.8	2.8	3.0	3.2	3.1	3.2
Harbor Island Dr to Parking Lot	56.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.7	1.7	1.7	1.7	2.2	2.2	2.2	2.2	4.4	4.4	4.4	4.4
East of Parking Lot	55.7	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.6	2.6	2.6	2.6	3.1	3.1	3.1	3.1	5.3	5.3	5.3	5.3

Source: HMMH, 2019.

hmmh

Table 8. Change in Future Average Daily Traffic CNEL with the Project Compared to Baseline

ROADWAY SEGMENT	2024 CNEL re: Baseline (dB)			2026 CNEL re: Baseline (dB)			2030 CNEL re: Baseline (dB)			2035 CNEL re: Baseline (dB)			2050 CNEL re: Baseline (dB)		
	No Project	Alt 4 Project	Preferred Alt Project	No Project	Alt 4 Project	Preferred Alt Project	No Project	Alt 4 Project	Preferred Alt Project	No Project	Alt 4 Project	Preferred Alt Project	No Project	Alt 4 Project	Preferred Alt Project
Pacific Highway															
Kurtz St to Barnett Ave	0.1	0.0	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Barnett Ave to Washington St	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Washington St to Sassafras St	-0.1	-0.1	-0.1	0.1	-0.1	0.1	0.2	0.1	0.2	0.3	0.2	0.3	0.2	0.1	0.2
Sassafras St to Palm St	0.3	0.1	0.3	0.4	0.3	0.4	0.7	0.5	0.7	0.9	0.7	0.9	0.9	0.7	0.9
Palm St to Laurel St	0.2	0.1	0.2	0.4	0.2	0.4	0.8	0.5	0.8	0.9	0.7	0.9	0.8	0.6	0.8
Laurel Dr to Juniper St	0.3	0.2	0.3	0.5	0.3	0.5	0.8	0.6	0.8	1.0	0.8	1.0	0.9	0.7	0.9
Kettner Blvd															
Vine St to Sassafras St	0.1	-0.1	0.1	0.3	0.0	0.3	0.6	0.3	0.6	0.8	0.5	0.8	1.0	0.7	1.0
Sassafras St to Palm St	0.2	0.0	0.2	0.3	0.1	0.3	0.6	0.4	0.6	0.8	0.5	0.8	0.8	0.6	0.8
Palm St to Laurel St	-0.1	-0.2	-0.1	0.1	-0.1	0.1	0.3	0.1	0.3	0.5	0.3	0.5	0.5	0.3	0.5
India St															
Sassafras St to Laurel St	0.2	-0.1	0.2	0.5	0.1	0.5	0.8	0.4	0.8	1.1	0.7	1.1	1.1	0.7	1.1
Laurel St to Juniper St	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Washington St															
West of Pacific Hwy	1.3	1.0	1.3	1.4	1.2	1.4	1.7	1.4	1.7	1.9	1.6	1.9	1.6	1.4	1.6
Hancock St to San Diego Ave	0.0	0.0	0.0	0.1	0.0	0.1	0.2	0.1	0.2	0.2	0.1	0.2	0.2	0.1	0.2
East of India St	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.2
Admiral Boland Wy															
Washington St to Terminal Link Rd	1.9	1.6	1.9	2.2	1.9	2.2	2.6	2.3	2.6	2.9	2.6	2.9	2.9	2.6	2.9
Terminal Link Rd to Pacific Hwy	1.9	1.6	1.9	2.2	1.9	2.2	2.6	2.3	2.6	2.9	2.6	2.9	2.9	2.6	2.9
Sassafras St															
Pacific Hwy to Kettner Blvd	1.4	1.1	1.4	1.6	1.3	1.6	2.0	1.7	2.0	2.0	1.7	2.0	2.0	1.7	2.0
Palm St															
Pacific Hwy to Kettner Blvd	-0.1	-0.2	-0.1	0.1	-0.1	0.1	0.2	0.0	0.2	0.3	0.1	0.3	7.4	7.2	7.2
Laurel St															
Harbor Dr to Pacific Hwy	-0.1	-0.4	-0.1	0.2	-0.2	0.2	0.6	0.1	0.6	0.9	0.4	0.9	0.9	0.5	0.9
Pacific Hwy to India St	-0.1	-0.3	-0.1	0.2	-0.1	0.2	0.5	0.2	0.5	0.7	0.4	0.7	0.8	0.5	0.8
India St to State St/ Reynard Wy	0.1	0.0	0.1	0.1	0.0	0.1	0.3	0.1	0.3	0.4	0.2	0.4	0.4	0.2	0.4
Hawthorn St															
Harbor Dr to Pacific Hwy	-0.1	-0.3	-0.1	0.1	-0.2	0.1	0.4	0.1	0.4	0.6	0.3	0.6	0.7	0.3	0.7
Pacific Hwy to India St	-0.1	-0.3	-0.1	0.1	-0.2	0.1	0.3	0.1	0.3	0.4	0.2	0.4	0.4	0.2	0.4
India St to State St	-0.1	-0.3	-0.1	0.1	-0.2	0.1	0.3	0.1	0.3	0.4	0.2	0.4	0.4	0.2	0.4
State St to Albatross St	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grape St															
Harbor Dr to Pacific Hwy	-0.1	-0.4	-0.1	0.1	-0.2	0.1	0.5	0.1	0.5	0.5	0.2	0.5	0.5	0.3	0.5
Pacific Hwy to India St	-0.1	-0.3	-0.1	0.1	-0.2	0.1	0.3	0.1	0.3	0.4	0.2	0.4	0.5	0.2	0.5
India St to State St	-0.1	-0.2	-0.1	0.1	-0.1	0.1	0.3	0.0	0.3	0.3	0.2	0.3	0.4	0.2	0.4
Albatross St to Front St	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Harbor Dr															
Scott Rd to Nimitz Blvd	0.0	-0.1	0.0	0.0	-0.1	0.0	0.1	0.0	0.1	0.2	0.1	0.2	0.2	0.1	0.2
Nimitz Blvd to Laning Rd	-0.1	-0.2	-0.1	0.1	-0.1	0.1	0.3	0.0	0.3	0.4	0.2	0.4	0.4	0.2	0.4
Laning Rd to McCain Rd	-0.1	-0.2	-0.1	0.1	-0.1	0.1	0.3	0.0	0.3	0.4	0.2	0.4	0.5	0.2	0.5
McCain Rd to Spanish Landing	0.5	0.3	0.5	0.6	0.4	0.6	0.8	0.5	0.8	0.9	0.7	0.9	0.9	0.7	0.9
Spanish Landing to Harbor Island Dr	2.3	0.5	0.5	2.6	0.6	0.7	2.7	0.8	0.8	2.9	0.9	1.0	3.0	0.9	0.9
Harbor Island Dr to Winship Ln	1.0	-3.0	-3.3	1.1	-2.7	-2.8	1.1	-1.8	-1.9	1.3	-1.8	-1.9	1.2	-1.5	-1.6
Winship Ln to Liberator Blvd	0.0	-2.0	-1.8	0.2	-1.8	-1.5	0.5	-1.3	-1.0	0.8	-1.0	-0.7	1.1	-0.9	-0.6
Liberator Blvd to Cell Phone Lot	0.1	-1.9	-1.8	0.3	-1.7	-1.5	0.6	-1.2	-1.0	0.9	-1.0	-0.7	1.2	-0.9	-0.6
Cell Phone Lot to Laurel St/ Solar Turbines	-0.3	-2.4	-2.2	0.0	-2.1	-1.9	0.3	-1.6	-1.3	0.6	-1.4	-1.1	0.9	-1.2	-1.0
Laurel St/ Solar Turbines to W Laurel St	-2.1	-2.2	-2.1	-1.7	-2.0	-1.7	-1.2	-1.4	-1.2	-0.9	-1.2	-0.9	-0.8	-1.1	-0.8
Laurel St to Hawthorn St	-0.1	-0.4	-0.1	0.1	-0.2	0.1	0.4	0.1	0.4	0.5	0.2	0.5	0.6	0.3	0.6
Hawthorn St to Grape St	-0.1	-0.3	-0.1	0.1	-0.2	0.1	0.4	0.1	0.4	0.5	0.2	0.5	0.5	0.3	0.5
Grape St to Ash St	-0.1	-0.1	-0.1	0.1	-0.1	0.1	0.2	0.1	0.2	0.4	0.2	0.4	0.4	0.2	0.4
Harbor Island Dr															
Harbor Dr to Old Rent A Car Access	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.0	0.1
West of Harbor Island Dr	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Harbor Island Dr to Parking Lot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
East of Parking Lot	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: HMMH, 2019.

2. Construction Noise

The primary components of the proposed project are the replacement of the existing Terminal 1, modifications to Terminal 2, and a new airport access roadway. As part of the Terminal 1 replacement, a new Terminal 1 access road and parking structure would be constructed. Other improvements include infrastructure upgrades and the relocation of other airport support facilities to accommodate the terminal improvements. Overall, the number of gates at SDIA would increase from 51 to 61. Implementation of the proposed improvements would occur over two phases (Phase 1 and Phase 2), each with two sub-phases (Phase 1a and Phase 1b, and Phase 2a and Phase 2b).

The primary components of Phase 1 are the replacement of Terminal 1, a new Terminal 1 parking structure, a Terminal 1 loop road, and the on-airport entry roadway. The primary components of Phase 2 are the Terminal 2-West and Terminal 2-East modifications. The total amount of demolition would be over 1 million square feet of building area and over 6 million square feet of surface elements, while the amount of new construction would entail over 5 million square feet of buildings and just under 5 million square feet of surface elements.

2.1 General Approach and Methodology

Construction noise differs from that generated by roadway traffic and aircraft due to differences in the spectral and temporal characteristics of the noise. The degree of noise impact during construction will be a function of the number and types of equipment used, and the distances between the construction equipment and noise-sensitive land use. A quantitative assessment of construction noise requires detailed information about the activities taking place, including:

- The proximity of noise-sensitive receptors;
- Noise emission levels for construction equipment;
- The phasing and duration of specific activities;
- The types and numbers of equipment used for each activity; and
- A detailed schedule that identifies the days and hours at which the activities would occur.

With some relatively minor exceptions (i.e. demolition of a parking lot and subsequent construction of an administrative building along SDIA's west property line), most of the construction activity during Phase 1 occurs to the south and east of Terminal 1. The closest residential land use to these Phase 1 activities are located to the east within approximately 2,800 to 3,000 feet of the easternmost activity. During Phase 2a, several surface elements along the west property line of SDIA would be demolished and then replaced with a new Terminal 2W, as well as new surface elements. The closest residential land use to these Phase 2 activities are approximately 2,400 feet to west of the airport boundary.

Table 9 provides the source noise emission levels for construction equipment that is contained within the FHWA Roadway Construction Noise Model (RCNM). The noise levels in Table 9 are based on the noise calculations and measurement data compiled for the Central Artery/Tunnel (CA/T) Project in Boston, Massachusetts. One component of the CA/T Project was the development of Construction Noise Control Specification 721.560. Table 9 provides two values of the A-weighted maximum sound pressure levels (L_{max}) at a reference distance of 50 feet – one based on the Specification 721.560 and one based on a sample of measurement data.[16]

At this stage of project development, the phasing of construction activities is limited to the generalized descriptions in the preceding section; detailed information about the specific types and numbers of equipment will not be known until later in the project development process.

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[16] Federal Highway Administration, US Department of Transportation. *FHWA Roadway Construction Noise Model Version 1.0 User's Guide,* DOT-VNTSC-FHWA-05-01/FHWA-HEP-05-054, January 2006. https://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/

A generalized model for construction noise was used to estimate average noise levels at various distances from piece of equipment.[17] The model takes into account the effects of spherical spreading from a point source and atmospheric absorption,[18] and ignores the excess attenuation provided by intervening structures and buildings, and is given by the following equation:

$$L_{eq} \text{ (at distance "D")} = L_{max\ at\ 50\ feet} - 20 \log (D / 50) - 10 \log (UF) - \alpha (D / 1000)$$

Where,

$L_{max\ at\ 50\ feet}$ is the maximum of the two values for a particular piece of equipment in Table 9;
D is the distance of interest as measured in feet;
UF is the acoustical usage factor from Table 9; and
α is the atmospheric absorption in decibels per 1,000 feet.[19]

2.2 Regulatory Framework

At the federal level, there are no standardized criteria for assessing potential construction noise impact. In certain cases, project-specific criteria may be developed, but in other cases, the locality may have a noise ordinance that address construction noise. The Noise Element of the General Plan recognizes that construction activities are necessary and states that the City limits excessive construction noise through the enforcement of its Noise Abatement and Control Ordinance.

2.2.1 City of San Diego, Municipal Code Article 9.5 Noise Abatement and Control

Section 59.5.0404(a) of the City of San Diego Municipal Code[20] states that it is unlawful to create disturbing, excessive or offensive noise during construction between the hours of 7:00 p.m. of any day and 7:00 a.m. of the following day. A project proponent can apply for a permit that conditionally allows nighttime construction noise. However, the City's Noise Abatement and Control Administrator must grant approval before work can commence. In the approval, the Administrator will prescribe conditions, working times, types of construction equipment to be used, and permissible noise levels deemed appropriate.

Section 59.5.0404(b) of the City of San Diego Municipal Code established a construction noise limit of 75 dBA L_{eq}, between the hours of 7:00 a.m. and 7:00 p.m., at or beyond the property lines of any property zoned residential.

2.2.2 Significance Thresholds

The City has established the following thresholds of significance.[21] If a proposed project would have a significant construction noise impact wherever:

- Construction noise levels exceed 75 dBA L_{eq} between the hours of 7:00 a.m. and 7:00 p.m. at or beyond the property line of a residential property;
- Construction noise would substantially interfere with normal business communication, or affect sensitive receptors, such as day care facilities.

[17] California Department of Transportation. *Technical Noise Supplement to the Caltrans Traffic Noise Analysis Protocol,* September 2013. http://www.dot.ca.gov/env/noise/docs/tens-sep2013.pdf
[18] Based on International Organization for Standardization. *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation,* ISO 9613-2:1996(E).
[19] Based on ISO 9613, predicted equipment noise levels at distances of 500 feet and beyond include atmospheric absorption at a rate of 1.5 dB per 1,000 feet for impact devices (re: 1,000 Hz) and 0.9 dB per 1,000 feet for non-impact devices (re: 500 Hz). These attenuation rates are based on a temperature of 68°F and 70% relative humidity.
[20] City of San Diego. *Municipal Code, Chapter 5, Article 9.5: Noise Abatement and Control.*
[21] City of San Diego, Development Services Department, *California Environmental Quality Act, Significance Determination Thresholds,* January 2011.

Construction activity between the hours of 7:00 p.m. of any day and 7:00 a.m. of the following day shall be prohibited unless a permit has been applied for and granted by the Noise Abatement and Control Administrator.

2.3 Evaluation of Construction Noise

Table 10 provides calculated construction noise levels expressed in terms of the A-weighted L_{eq} for each piece of equipment listed in Table 9 using the generalized model for construction noise described in Section 2.1. Levels of construction noise in a community are primarily a function of the number and types of equipment used, and the distances between the construction equipment and noise-sensitive land use. While detailed information about the specific types and numbers of equipment are unknown at this stage of project development, it is possible to draw some broad conclusions about the likelihood of potential construction noise impact in the community.

Based on an assumption that all of the pieces of equipment in Table 10 were operating on the same site at the same time, the total L_{eq} at a distance of 50 feet from the activity would be 96.9 dBA. At a distance of 1,000 feet from the activity, the construction noise level would be 69.5 dBA L_{eq}. At distances of 2,000 feet, or more from the construction activity, the total noise level would be 62.2 dBA L_{eq}. These projected noise levels are somewhat conservative and do not include the effects of excess attenuation provided by intervening buildings and/or terrain.

In addition, it is assumed that all work would occur between the hours of 7:00 a.m. and 7:00 p.m., unless a permit application for nighttime construction was submitted to and consequently approved by the Noise Abatement and Control Administrator.

Based on these assumptions, construction noise levels would be less than 75 dBA L_{eq}, which is one of the thresholds of significance. Consequently, noise impact due to project-related construction is not considered significant.

Table 9. Source Noise Emission Levels for Construction Equipment

Equipment Description	Impact Device?	Acoustical Use Factor (%)	Spec 721.560 Lmax @ 50 ft (dBA, slow)	Measured Lmax @ 50 ft (dBA, slow)	No. of Data Samples
All Other Equipment > 5 HP	No	50	85	-- N/A --	0
Auger Drill Rig	No	20	85	84	36
Backhoe	No	40	80	78	372
Bar Bender	No	20	80	-- N/A --	0
Blasting	Yes	-- N/A --	94	-- N/A --	0
Boring Jack Power Unit	No	50	80	83	1
Chain Saw	No	20	85	84	46
Clam Shovel (dropping)	Yes	20	93	87	4
Compactor (ground)	No	20	80	83	57
Compressor (air)	No	40	80	78	18
Concrete Batch Plant	No	15	83	-- N/A --	0
Concrete Mixer Truck	No	40	85	79	40
Concrete Pump Truck	No	20	82	81	30
Concrete Saw	No	20	90	90	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Drill Rig Truck	No	20	84	79	22
Drum Mixer	No	50	80	80	1
Dump Truck	No	40	84	76	31
Excavator	No	40	85	81	170
Flat Bed Truck	No	40	84	74	4
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Generator (<25KVA, VMS signs)	No	50	70	73	74
Gradall	No	40	85	83	70
Grader	No	40	85	-- N/A --	0
Grapple (on backhoe)	No	40	85	87	1
Horizontal Boring Hydr. Jack	No	25	80	82	6
Hydra Break Ram	Yes	10	90	-- N/A --	0
Impact Pile Driver	Yes	20	95	101	11
Jackhammer	Yes	20	85	89	133
Man Lift	No	20	85	75	23
Mounted Impact Hammer (hoe ram)	Yes	20	90	90	212
Pavement Scarafier	No	20	85	90	2
Paver	No	50	85	77	9
Pickup Truck	No	40	55	75	1
Pneumatic Tools	No	50	85	85	90
Pumps	No	50	77	81	17
Refrigerator Unit	No	100	82	73	3
Rivit Buster/chipping gun	Yes	20	85	79	19
Rock Drill	No	20	85	81	3
Roller	No	20	85	80	16
Sand Blasting (Single Nozzle)	No	20	85	96	9
Scraper	No	40	85	84	12
Shears (on backhoe)	No	40	85	96	5
Slurry Plant	No	100	78	78	1
Slurry Trenching Machine	No	50	82	80	75
Soil Mix Drill Rig	No	50	80	-- N/A --	0
Tractor	No	40	84	-- N/A --	0
Vacuum Excavator (Vac-truck)	No	40	85	85	149
Vacuum Street Sweeper	No	10	80	82	19
Ventilation Fan	No	100	85	79	13
Vibrating Hopper	No	50	85	87	1
Vibratory Concrete Mixer	No	20	80	80	1
Vibratory Pile Driver	No	20	95	101	44
Warning Horn	No	5	85	83	12
Welder / Torch	No	40	73	74	5

Source: Based on Table 1 in *FHWA Roadway Construction Noise Model, Version 1.0 User's Guide.*

Table 10. Average A-weighted Noise Levels (L_{eq} in dBA) for Construction Equipment at Various Distances

Equipment Description	50 ft	500 ft**	1,000 ft**	1,500 ft**	2,000 ft**	2,500 ft**	3,000 ft**	3,500 ft**	4,000 ft**	4,500 ft**
Other Equipment > 5 hp	68.0	47.6	41.1	37.1	34.2	31.8	29.7	28.0	26.3	24.9
Auger Drill Rig	72.0	51.5	45.1	41.1	38.1	35.8	33.7	31.9	30.3	28.9
Backhoe	64.0	43.5	37.1	33.1	30.1	27.8	25.7	23.9	22.3	20.8
Bar Bender	67.0	46.5	40.1	36.1	33.1	30.8	28.7	26.9	25.3	23.9
Blasting*	94.0	73.3	66.5	62.2	59.0	56.3	53.9	51.8	49.9	48.2
Boring Jack Power Unit	66.0	45.6	39.1	35.1	32.2	29.8	27.7	26.0	24.3	22.9
Chain Saw	72.0	51.5	45.1	41.1	38.1	35.8	33.7	31.9	30.3	28.9
Clam Shovel (dropping)	80.0	59.2	52.5	48.2	44.9	42.3	39.9	37.8	35.9	34.2
Compactor (ground)	70.0	49.5	43.1	39.1	36.1	33.8	31.7	29.9	28.3	26.9
Compressor (air)	64.0	43.5	37.1	33.1	30.1	27.8	25.7	23.9	22.3	20.8
Concrete Batch Plant	71.2	50.8	44.3	40.3	37.4	35.0	33.0	31.2	29.6	28.1
Concrete Mixer Truck	69.0	48.5	42.1	38.1	35.1	32.8	30.7	28.9	27.3	25.8
Concrete Pump Truck	69.0	48.5	42.1	38.1	35.1	32.8	30.7	28.9	27.3	25.9
Concrete Saw	77.0	56.5	50.1	46.1	43.1	40.8	38.7	36.9	35.3	33.9
Crane	73.0	52.5	46.0	42.1	39.1	36.7	34.7	32.9	31.3	29.8
Dozer	69.0	48.5	42.1	38.1	35.1	32.8	30.7	28.9	27.3	25.8
Drill Rig Truck	71.0	50.5	44.1	40.1	37.1	34.8	32.7	30.9	29.3	27.9
Drum Mixer	63.0	42.6	36.1	32.1	29.2	26.8	24.7	23.0	21.3	19.9
Dump Truck	68.0	47.5	41.1	37.1	34.1	31.8	29.7	27.9	26.3	24.8
Excavator	69.0	48.5	42.1	38.1	35.1	32.8	30.7	28.9	27.3	25.8
Flat Bed Truck	68.0	47.5	41.1	37.1	34.1	31.8	29.7	27.9	26.3	24.8
Front End Loader	64.0	43.5	37.1	33.1	30.1	27.8	25.7	23.9	22.3	20.8
Generator	65.0	44.6	38.1	34.1	31.2	28.8	26.7	25.0	23.3	21.9
Generator (<25KVA)	56.0	35.6	29.1	25.1	22.2	19.8	17.7	16.0	14.3	12.9
Gradall	69.0	48.5	42.1	38.1	35.1	32.8	30.7	28.9	27.3	25.8
Grader	69.0	48.5	42.1	38.1	35.1	32.8	30.7	28.9	27.3	25.8
Grapple (on backhoe)	71.0	50.5	44.1	40.1	37.1	34.8	32.7	30.9	29.3	27.8
Horizontal Boring	68.0	47.6	41.1	37.1	34.2	31.8	29.8	28.0	26.4	24.9
Hydra Break Ram	80.0	59.3	52.5	48.2	45.0	42.3	39.9	37.8	35.9	34.2
Impact Pile Driver	88.0	67.2	60.5	56.2	52.9	50.3	47.9	45.8	43.9	42.2
Jackhammer	76.0	55.2	48.5	44.2	40.9	38.3	35.9	33.8	31.9	30.2
Man Lift	72.0	51.5	45.1	41.1	38.1	35.8	33.7	31.9	30.3	28.9
Mounted Impact Hammer	77.0	56.2	49.5	45.2	41.9	39.3	36.9	34.8	32.9	31.2
Pavement Scarafier	77.0	56.5	50.1	46.1	43.1	40.8	38.7	36.9	35.3	33.9
Paver	68.0	47.6	41.1	37.1	34.2	31.8	29.7	28.0	26.3	24.9
Pickup Truck	59.0	38.5	32.1	28.1	25.1	22.8	20.7	18.9	17.3	15.8
Pneumatic Tools	68.0	47.6	41.1	37.1	34.2	31.8	29.7	28.0	26.3	24.9
Pumps	64.0	43.6	37.1	33.1	30.2	27.8	25.7	24.0	22.3	20.9
Refrigerator Unit	62.0	41.6	35.1	31.1	28.2	25.8	23.7	21.9	20.3	18.9
Rivit Buster/chipping gun	72.0	51.2	44.5	40.2	36.9	34.3	31.9	29.8	27.9	26.2
Rock Drill	72.0	51.5	45.1	41.1	38.1	35.8	33.7	31.9	30.3	28.9
Roller	72.0	51.5	45.1	41.1	38.1	35.8	33.7	31.9	30.3	28.9
Sand Blasting (one nozzle)	83.0	62.5	56.1	52.1	49.1	46.8	44.7	42.9	41.3	39.9
Scraper	69.0	48.5	42.1	38.1	35.1	32.8	30.7	28.9	27.3	25.8
Shears (on backhoe)	80.0	59.5	53.1	49.1	46.1	43.8	41.7	39.9	38.3	36.8
Slurry Plant	58.0	37.6	31.1	27.1	24.2	21.8	19.7	17.9	16.3	14.9
Slurry Trenching Machine	65.0	44.6	38.1	34.1	31.2	28.8	26.7	25.0	23.3	21.9
Soil Mix Drill Rig	63.0	42.6	36.1	32.1	29.2	26.8	24.7	23.0	21.3	19.9
Tractor	68.0	47.5	41.1	37.1	34.1	31.8	29.7	27.9	26.3	24.8
Vacuum Excavator	69.0	48.5	42.1	38.1	35.1	32.8	30.7	28.9	27.3	25.8
Vacuum Street Sweeper	72.0	51.6	45.1	41.1	38.2	35.8	33.7	31.9	30.3	28.9
Ventilation Fan	65.0	44.6	38.1	34.1	31.2	28.8	26.7	24.9	23.3	21.9
Vibrating Hopper	70.0	49.6	43.1	39.1	36.2	33.8	31.7	30.0	28.3	26.9
Vibratory Concrete Mixer	67.0	46.5	40.1	36.1	33.1	30.8	28.7	26.9	25.3	23.9
Vibratory Pile Driver	88.0	67.5	61.1	57.1	54.1	51.8	49.7	47.9	46.3	44.9
Warning Horn	78.0	57.6	51.1	47.1	44.2	41.8	39.7	38.0	36.3	34.9
Welder / Torch	58.0	37.5	31.1	27.1	24.1	21.8	19.7	17.9	16.3	14.8

Source: HMMH, 2018.

Notes:

* An acoustical usage factor is not available for blasting, so the L_{max} is provided in this table.

** Predicted equipment noise levels at distances of 500 feet and beyond include atmospheric absorption at a rate of 1.5