Fundamentals of Noise

NOISE

Noise is most often defined as unwanted sound; whether it is loud, unpleasant, unexpected, or otherwise undesirable. Although sound can be easily measured, the perception of noise and the physical response to sound complicate the analysis of its impact on people. People judge the relative magnitude of sound sensation in subjective terms such as "noisiness" or "loudness."

Noise Descriptors

The following are brief definitions of terminology used in this chapter:

- **Sound.** A disturbance created by a vibrating object, which, when transmitted by pressure waves through a medium such as air, is capable of being detected by a receiving mechanism, such as the human ear or a microphone.

- **Noise.** Sound that is loud, unpleasant, unexpected, or otherwise undesirable.

- **Decibel (dB).** A unitless measure of sound, expressed on a logarithmic scale and with respect to a defined reference sound pressure. The standard reference pressure is 20 micropascals (20 μPa).

- **A-Weighted Decibel (dBA).** An overall frequency-weighted sound level in decibels that approximates the frequency response of the human ear.

- **Equivalent Continuous Noise Level (L_{eq}); also called the Energy-Equivalent Noise Level.** The value of an equivalent, steady sound level which, in a stated time period (often over an hour) and at a stated location, has the same A-weighted sound energy as the time-varying sound. Thus, the L_{eq} metric is a single numerical value that represents the equivalent amount of variable sound energy received by a receptor over the specified duration.

- **Statistical Sound Level (L_n).** The sound level that is exceeded "n" percent of time during a given sample period. For example, the L_{50} level is the statistical indicator of the time-varying noise signal that is exceeded 50 percent of the time (during each sampling period); that is, half of the sampling time, the changing noise levels are above this value and half of the time they are below it. This is called the "median sound level." The L_{10} level, likewise, is the value that is exceeded 10 percent of the time (i.e., near the maximum) and this is often known as the "intrusive sound level." The L_{90} is the sound level exceeded 90 percent of the time and is often considered the "effective background level" or "residual noise level."

- **Maximum Sound Level (L_{max})**. The highest RMS sound level measured during the measurement period.
- **Root Mean Square Sound Level (RMS).** The square root of the average of the square of the sound pressure over the measurement period.

- **Day-Night Sound Level (L_{dn} or DNL).** The energy-average of the A-weighted sound levels occurring during a 24-hour period, with 10 dB added to the sound levels occurring during the period from 10:00 PM to 7:00 AM.

- **Community Noise Equivalent Level (CNEL).** The energy average of the A-weighted sound levels occurring during a 24-hour period, with 5 dB added from 7:00 PM to 10:00 PM and 10 dB from 10:00 PM to 7:00 AM. NOTE: For general community/environmental noise, CNEL and L_{dn} values rarely differ by more than 1 dB (with the CNEL being only slightly more restrictive – that is, higher than the L_{dn} value). As a matter of practice, L_{dn} and CNEL values are interchangeable and are treated as equivalent in this assessment.

- **Peak Particle Velocity (PPV).** The peak rate of speed at which soil particles move (e.g., inches per second) due to ground vibration.

- **Sensitive Receptor.** Noise- and vibration-sensitive receptors include land uses where quiet environments are necessary for enjoyment and public health and safety. Residences, schools, motels and hotels, libraries, religious institutions, hospitals, and nursing homes are examples.

Characteristics of Sound

When an object vibrates, it radiates part of its energy in the form of a pressure wave. Sound is that pressure wave transmitted through the air. Technically, airborne sound is a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure that creates sound waves.

Sound can be described in terms of amplitude (loudness), frequency (pitch), or duration (time). Loudness or amplitude is measured in dB, frequency or pitch is measured in Hertz [Hz] or cycles per second, and duration or time variations is measured in seconds or minutes.

Amplitude

Unlike linear units such as inches or pounds, decibels are measured on a logarithmic scale. Because of the physical characteristics of noise transmission and perception, the relative loudness of sound does not closely match the actual amounts of sound energy. Table 1 presents the subjective effect of changes in sound pressure levels. Ambient sounds generally range from 30 dBA (very quiet) to 100 dBA (very loud). Changes of 1 to 3 dB are detectable under quiet, controlled conditions, and changes of less than 1 dB are usually not discernible (even under ideal conditions). A 3 dB change in noise levels is considered the minimum change that is detectable with human hearing in outside environments. A change of 5 dB is readily discernible to most people in an exterior environment, and a 10 dB change is perceived as a doubling (or halving) of the sound.

Table 1 Noise Perceptibility

Change in dB	Noise Level
± 3 dB	Barely perceptible increase
± 5 dB	Readily perceptible increase
± 10 dB	Twice or half as loud
± 20 dB	Four times or one-quarter as loud

Source: California Department of Transportation (Caltrans). 2013, September. Technical Noise Supplement ("TeNS").

Frequency

The human ear is not equally sensitive to all frequencies. Sound waves below 16 Hz are not heard at all, but are "felt" more as a vibration. Similarly, though people with extremely sensitive hearing can hear sounds as high as 20,000 Hz, most people cannot hear above 15,000 Hz. In all cases, hearing acuity falls off rapidly above about 10,000 Hz and below about 200 Hz.

When describing sound and its effect on a human population, A-weighted (dBA) sound levels are typically used to approximate the response of the human ear. The A-weighted noise level has been found to correlate well with people's judgments of the "noisiness" of different sounds and has been used for many years as a measure of community and industrial noise. Although the A-weighted scale and the energy-equivalent metric are commonly used to quantify the range of human response to individual events or general community sound levels, the degree of annoyance or other response also depends on several other perceptibility factors, including:

- Ambient (background) sound level
- General nature of the existing conditions (e.g., quiet rural or busy urban)
- Difference between the magnitude of the sound event level and the ambient condition
- Duration of the sound event
- Number of event occurrences and their repetitiveness
- Time of day that the event occurs

Duration

Time variation in noise exposure is typically expressed in terms of a steady-state energy level equal to the energy content of the time varying period (called L_{eq}), or alternately, as a statistical description of the sound level that is exceeded over some fraction of a given observation period. For example, the L_{50} noise level represents the noise level that is exceeded 50 percent of the time; half the time the noise level exceeds this level and half the time the noise level is less than this level. This level is also representative of the level that is exceeded 30 minutes in an hour. Similarly, the L_2, L_8 and L_{25} values represent the noise levels that are exceeded 2, 8, and 25 percent of the time or 1, 5, and 15 minutes per hour, respectively. These "n" values are typically used to demonstrate compliance for stationary noise sources with many cities' noise ordinances. Other values typically noted during a noise survey are the L_{min} and L_{max}. These values represent the minimum and maximum root-mean-square noise levels obtained over the measurement period, respectively.

Because community receptors are more sensitive to unwanted noise intrusion during the evening and at night, state law and many local jurisdictions use an adjusted 24-hour noise descriptor called the Community Noise Equivalent Level (CNEL) or Day-Night Noise Level (L_{dn}). The CNEL descriptor requires that an artificial increment (or "penalty") of 5 dBA be added to the actual noise level for the hours from 7:00 PM to 10:00 PM and 10 dBA for the hours from 10:00 PM to 7:00 AM. The L_{dn} descriptor uses the same methodology except that there is no artificial increment added to the hours between 7:00 PM and 10:00 PM. Both descriptors give roughly the same 24-hour level, with the CNEL being only slightly more restrictive (i.e., higher). The CNEL or L_{dn} metrics are commonly applied to the assessment of roadway and airport-related noise sources.

Sound Propagation

Sound dissipates exponentially with distance from the noise source. This phenomenon is known as "spreading loss." For a single-point source, sound levels decrease by approximately 6 dB for each doubling of distance from the source (conservatively neglecting ground attenuation effects, air absorption factors, and barrier shielding). For example, if a backhoe at 50 feet generates 84 dBA, at 100 feet the noise level would be 79 dBA, and at 200 feet it would be 73 dBA. This drop-off rate is appropriate for noise generated by on-site operations from stationary equipment or activity at a project site. If noise is produced by a line source, such as highway traffic, the sound decreases by 3 dB for each doubling of distance over a reflective ("hard site") surface such as concrete or asphalt. Line source noise in a relatively flat environment with ground-level absorptive vegetation decreases by an additional 1.5 dB for each doubling of distance.

Psychological and Physiological Effects of Noise

Physical damage to human hearing begins at prolonged exposure to noise levels higher than 85 dBA. Exposure to high noise levels affects the entire system, with prolonged noise exposure in excess of 75 dBA increasing body tensions, thereby affecting blood pressure and functions of the heart and the nervous system. Extended periods of noise exposure above 90 dBA results in permanent cell damage, which is the main driver for employee hearing protection regulations in the workplace. For community environments, the ambient or background noise problem is widespread, through generally worse in urban areas than in outlying, less-developed areas. Elevated ambient noise levels can result in noise interference (e.g., speech interruption/masking, sleep disturbance, disturbance of concentration) and cause annoyance. Since most people do not routinely work with decibels or A-weighted sound levels, it is often difficult to appreciate what a given sound pressure level number means. To help relate noise level values to common experience, Table 2 shows typical noise levels from familiar sources.

Table 2 Typical Noise Levels

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Onset of physical discomfort	120+	
	110	Rock Band (near amplification system)
Jet Flyover at 1,000 feet		
	100	
Gas Lawn Mower at three feet		
	90	
Diesel Truck at 50 feet, at 50 mph		Food Blender at 3 feet
	80	Garbage Disposal at 3 feet
Noisy Urban Area, Daytime		
	70	Vacuum Cleaner at 10 feet
Commercial Area		Normal speech at 3 feet
Heavy Traffic at 300 feet	60	
		Large Business Office
Quiet Urban Daytime	50	Dishwasher Next Room
Quiet Urban Nighttime	40	Theater, Large Conference Room (background)
Quiet Suburban Nighttime		
	30	Library
Quiet Rural Nighttime		Bedroom at Night, Concert Hall (background)
	20	
		Broadcast/Recording Studio
	10	
Lowest Threshold of Human Hearing	0	Lowest Threshold of Human Hearing

Source: California Department of Transportation (Caltrans). 2013, September. Technical Noise Supplement ("TeNS").

Vibration Fundamentals

Vibration is an oscillatory motion through a solid medium in which the motion's amplitude can be described in terms of displacement, velocity, or acceleration. Vibration is normally associated with activities stemming from operations of railroads or vibration-intensive stationary sources, but can also be associated with construction equipment such as jackhammers, pile drivers, and hydraulic hammers. As with noise, vibration can be described by both its amplitude and frequency. Vibration displacement is the distance that a point on a surface moves away from its original static position; velocity is the instantaneous speed that a point on a surface moves; and acceleration is the rate of change of the speed. Each of these descriptors can be used to correlate vibration to human response, building damage, and acceptable equipment vibration levels. During construction, the operation of construction equipment can cause groundborne vibration. During the operational phase of a project, receptors may be subject to levels of vibration that can cause annoyance due to noise generated from vibration of a structure or items within a structure.

Vibration amplitudes are usually described in terms of either the peak particle velocity (PPV) or the root mean square (RMS) velocity. PPV is the maximum instantaneous peak of the vibration signal and RMS is the

square root of the average of the squared amplitude of the signal. PPV is more appropriate for evaluating potential building damage and RMS is typically more suitable for evaluating human response.

As with airborne sound, annoyance with vibrational energy is a subjective measure, depending on the level of activity and the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying. Persons accustomed to elevated ambient vibration levels, such as in an urban environment, may tolerate higher vibration levels. Table 3 displays the human response and the effects on buildings resulting from continuous vibration (in terms of various levels of PPV).

Table 3 Human Reaction to Typical Vibration Levels

Vibration Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.006–0.019	Threshold of perception, possibility of intrusion	Vibrations unlikely to cause damage of any type
0.08	Vibrations readily perceptible	Recommended upper level of vibration to which ruins and ancient monuments should be subjected
0.10	Level at which continuous vibration begins to annoy people	Virtually no risk of "architectural" (i.e. not structural) damage to normal buildings
0.20	Vibrations annoying to people in buildings	Threshold at which there is a risk to "architectural" damage to normal dwelling – houses with plastered walls and ceilings
0.4–0.6	Vibrations considered unpleasant by people subjected to continuous vibrations and unacceptable to some people walking on bridges	Vibrations at a greater level than normally expected from traffic, but would cause "architectural" damage and possibly minor structural damage

Source: California Department of Transportation (Caltrans). 2020, April. *Transportation and Construction Vibration Guidance Manual*. Prepared by ICF International.

LOCAL REGULATIONS AND STANDARDS

City of Pasadena

Revised Noise Element

of the General Plan

Objectives, Policies, and Implementation

December 2002

City of Pasadena

Revised Noise Element
of the General Plan

Objectives, Policies, and Implementation

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December 2002

City of Pasadena Revised Noise Element

Objectives, Policies, and Implementation

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Objectives, Policies, and Implementation

Introduction

The City of Pasadena is affected by several different sources of noise, including automobile traffic, Rose Bowl events, commercial activity, and periodic nuisances such as construction, loud parties, and other events. The Noise Element is intended to identify these sources and provide objectives and policies that ensure that noise from these sources does not create an unacceptable noise environment. Noise is a normal part of the urban environment. However, controlling noise sources can make a substantial improvement in the quality of life for City residents.

The major noise sources in Pasadena are listed below and are discussed in detail in the *Existing and Future Conditions* report:

Transportation-Related Noise Sources

- Traffic on Interstates 210 and 710, State Routes 134 and 110
- Street Traffic
- Future Light Rail
- Aircraft Flyovers

Other Noise Sources

- Central Arroyo
- Commercial Activity
- Nuisance Noise
- Pasadena Police Department Eaton Canyon Shooting Range

The overriding objective of the Noise Element in the General Plan is to minimize exposure of residents, workers, and visitors to excessive noise levels, while maximizing the Land Use Element's objectives to encourage mixed-use development in the Central District and other Specific Plan areas as well as to promote economic vitality. Specific objectives and policies relevant to each of the specific noise issues are listed below.

Transportation-Related Noise Sources

Interstates 210 and 710, State Routes 134 and 110

Motor vehicle noise is the most common and widely dispersed continuous source in the City of Pasadena. The roadways that generate the most noise

include the Foothill Freeway (Interstate 210) and the Ventura Freeway (State Route 134). In different parts of the City, Interstate 210 is both a north-south and east-west travel corridor. State Route 134 is an east-west travel corridor in the western portions of the City. To a lesser extent, the Long Beach Freeway is used for north-south travel. The City is also minimally affected by noise associated with the one-quarter mile segment of the Pasadena Freeway (SR110), which enters the City at the southern end of Arroyo Parkway and terminates at Glenarm Street.

Objective 1 The City will work to reduce the effects of noise from freeway traffic on residential and other sensitive land uses.

Policy 1a The City will encourage noise-compatible land uses near existing freeways.

Policy 1b The City will cooperate with Caltrans and Metropolitan Transportation Authority (MTA) to landscape or install noise attenuation along freeways adjacent to residential or noise sensitive uses.

Street Traffic

The major north-south roadways in the City include Lincoln Avenue, Fair Oaks Avenue, Los Robles Avenue, Lake Avenue, Allen Avenue, Altadena Drive, San Gabriel Boulevard, and Rosemead Boulevard. The major east-west roadways include Orange Grove Boulevard, Walnut Street, Colorado Boulevard, Sierra Madre Boulevard, and Del Mar Boulevard. Noise from these major roadways may affect sensitive receptors.

Objective 2 The City will work to reduce the effects of traffic-generated noise from major roadways on residential and other sensitive land uses.

Policy 2a The City will encourage noise-compatible land uses along major roadways.

Policy 2b The City will encourage site planning and traffic control measures that minimize the effects of traffic noise in residential zones.

Policy 2c The City will encourage the use of alternative transportation modes as stipulated in the Mobility Element (walking, bicycling, transit use, electric vehicles) to minimize traffic noise in the City.

Policy 2d The City will work with local and regional transit agencies and businesses to provide transportation services that reduce traffic and associated noise as stipulated in the Mobility Element.

Policy 2e The City will work to reduce the effects of traffic-related noise in residential neighborhoods, including but not limited to neighborhoods adjacent to South Orange Grove Boulevard, Saint John Avenue, Pasadena Avenue, California Boulevard, and other busy streets passing thorough residential neighborhoods.

Future Light Rail

The Los Angeles to Pasadena Metro Construction Authority is constructing a passenger light rail service that will connect Pasadena business centers with downtown Los Angeles. Future train traffic will generate noise that may exceed acceptable levels for noise-sensitive uses along the rail corridor.

Objective 3 The City will minimize noise from the Los Angeles to Pasadena Metro Line on residential and other sensitive land uses.

Policy 3a The City will encourage noise-compatible land uses and mitigation measures near the Los Angeles to Pasadena Metro Line rail system.

Policy 3b After commencing operations and regularly thereafter, the City will work with the Los Angeles to Pasadena Metro Blue Line Construction Authority and/or the Los Angeles County Metropolitan Transportation Authority (LACMTA) to install noise attenuation features if the Gold Line (formerly known as the Blue Line) adversely affects existing adjacent residential or other noise-sensitive uses (refer to Implementation Measure 13).

Aircraft Flyovers

Activity from commercial and private aircraft, emergency and traffic-monitoring helicopters contribute to the general noise environment. In particular, low-flying helicopters are a source of noise complaints in the City.

Objective 4 Considering the City's legal authority, the City will encourage minimizing noise from aircraft flyovers on residential and other sensitive land uses.

Policy 4a The City will work with local and regional agencies, including Los Angeles County and other agencies utilizing Fire Camp #2, to reduce excessive noise associated with aircraft flyovers.

Policy 4b The City will work with federal agencies to determine appropriate standards for helicopter noise.

Policy 4c The Pasadena Police Department will work to minimize helicopter noise throughout the City to the extent feasible, taking into account operational requirements and the need to protect public health and safety.

Policy 4d The City will work with federal agencies to reduce airplane noise to the extent feasible.

Other Noise Sources

Central Arroyo

Sports, music and other events at the Rose Bowl, Brookside Park, the Rose Bowl Aquatic Center, and the future Kids Space Museum in the Fannie Morrison Center have the potential to generate noise in the Central Arroyo. The noise levels for these activities are highly variable due to the fact that both the number of events occurring and the noise levels experienced from the events can fluctuate. However, a waiver from the Noise Restrictions Ordinance (Chapter 9.36 of the Municipal Code) has been required for some events because noise from those events exceeded permitted levels.

Objective 5 The City will balance the effects of noise associated with events held in the Central Arroyo with the benefits of events occurring at Central Arroyo facilities.

Policy 5a The City will continue to seek improvements to noise-generating equipment and activities at the Rose Bowl, Aquatics Center, Jackie Robinson Field, Brookside Park, Area H, and the future Kids Space Museum in order to minimize the effects of noise on nearby residents.

Policy 5b The City will continue to coordinate events in the Central Arroyo to minimize noise to the degree feasible.

Commercial Activity

Noise generated by commercial operations, maintenance, truck deliveries and traffic can affect adjacent residential areas and other sensitive land uses. Future industrial and commercial development should generally be located away from existing and planned residential and other sensitive zones. Day and night activities and special events in the Central District and other mixed-use areas are expected to generate urban noise throughout the year.

Objective 6 The City will minimize noise spillovers from commercial and industrial operations into adjacent residential neighborhoods and other sensitive uses, while maximizing the Land Use Element's objectives to encourage mixed-use development in

the Central District and other Specific Plan areas as well as to promote economic vitality.

Policy 6a The City will encourage automobile and truck access to industrial and commercial properties abutting residential zones to be located at the maximum practical distance from residential zones.

Policy 6b The City will limit the use of motorized landscaping equipment, parking lot sweepers, and other high-noise equipment on commercial properties if their activity will result in noise that adversely affects residential zones.

Policy 6c The City will encourage limitations on the hours of truck deliveries to industrial and commercial properties abutting residential zones unless there is no feasible alternative or there are substantial transportation benefits for scheduling deliveries at another hour.

Nuisance Noise

The City occasionally receives complaints about individual sources of nuisance noise, including loud parties, events, and gardening equipment. Construction activity is also a source of occasional temporary nuisance noise throughout the City. These and other such nuisance noises are common to cities and, because of their unpredictable nature, must be addressed on a case-by-case basis.

Objective 7 The City will minimize the effects of nuisance noise on sensitive land uses as defined in Figure 1 to the degree feasible.

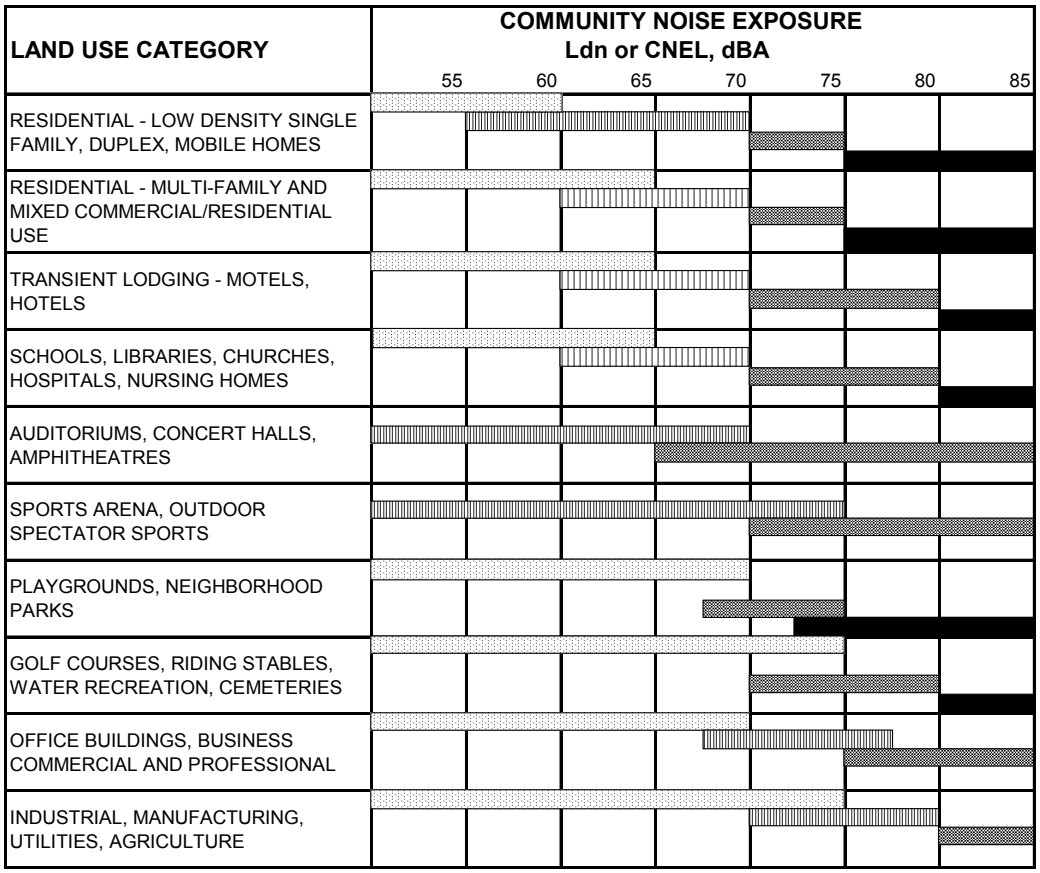
Policy 7a Whenever possible, City-sponsored events that generate noise will be scheduled during hours when effects would be minimal.

Policy 7b The City will encourage limitations on construction activities adjacent to sensitive noise receptors as defined in Figure 1.

Policy 7c The City will encourage construction and landscaping activities that employ techniques to minimize noise.

Policy 7d The City will enforce noise level restrictions contained in the City of Pasadena Noise Regulations (Chapter 9.36 of the Municipal Code), except during federal, State, or local emergencies (such as power generators required for energy emergencies).

Figure 1 Guidelines for Noise Compatible Land Use



CLEARLY ACCEPTABLE
Specified land use is satisfactory, based upon the assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.

CONDITIONALLY ACCEPTABLE
If new construction or development proceeds, an analysis of the noise reduction requirements should be made and needed noise insulation features included in the design.

NORMALLY ACCEPTABLE
New construction or development should be undertaken after an analysis of the noise reduction requirements is made and needed noise insulation features included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning will normally suffice.

NORMALLY UNACCEPTABLE
New construction or development should generally not be undertaken, unless it can be demonstrated that an interior level of 45 dBA can be achieved.

** Please note that these guidelines are general and may not apply to specific sites.*

Source: California General Plan Guidelines, 1998, as modified by the City of Pasadena, 2002.

Pasadena Police Department Eaton Canyon Firing Range

Noise generated at the Pasadena Police Department Eaton Canyon Firing Range is a source of concern for residents. Noise from this facility can be particularly irritating due to the impulsive sound emanating from gunfire.

Objective 8 The City will minimize noise emanating from the Eaton Canyon Firing Range into residential areas and other sensitive land uses.

Policy 8a The City will limit exterior activity within the Eaton Canyon Firing Range to work towards noise remaining within acceptable levels at nearby residences.

Implementation Measures

The following implementation measures are designed to carry out the objectives and policies of the Noise Element.

Measure 1 The City will consult the guidelines for noise compatible land use shown on Figure 1 to guide the appropriateness of land uses relative to roadway noise. [Policies 1a, 2a]

Measure 2 An acoustical study showing the ability to meet state noise insulation standards may be required for any development proposed in an area where the noise level, as indicated on Figures 2 and 3, exceeds the "clearly acceptable level" as determined by the City and shown on Figure 1. [Policies 1a, 2a]

Measure 3 The City will enforce the California Noise Insulation Standards (Title 25 California Administration Code for future development and redevelopment) to ensure an acceptable interior noise level of 45dBA Ldn in habitable rooms. [Policies 1a, 2a]

Measure 4 The City will consider the use of alternative paving materials that can reduce traffic noise, as feasible, depending on roadway conditions and cost efficiency. [Policies 1b, 2b]

Measure 5 The City will consider the use of "traffic calming" devices, to reduce traffic speed in residential zones. [Policies 2b, 2d]

Measure 6 The City will cooperate with Caltrans in the planning of noise attenuation along freeways. [Policy 1b]

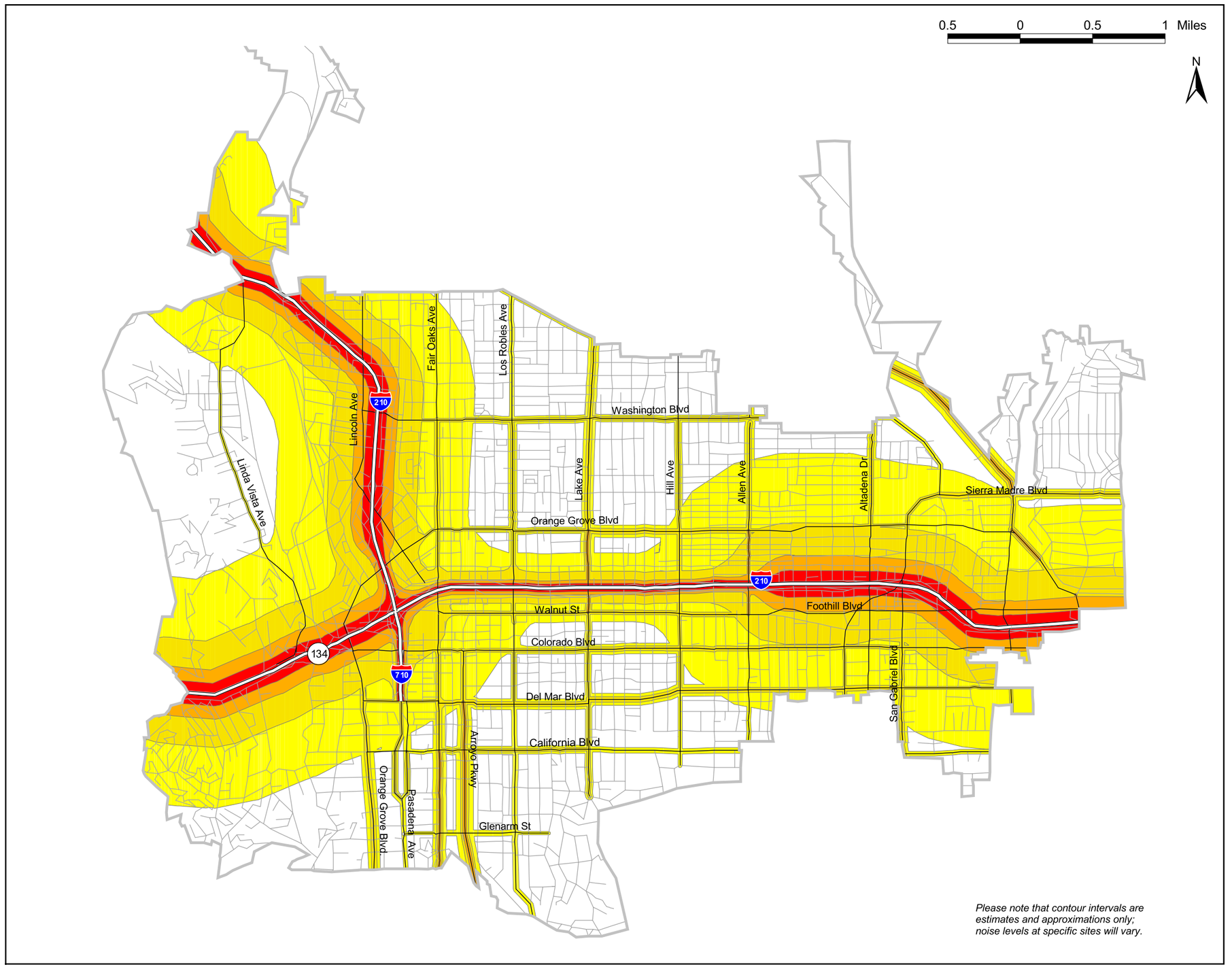
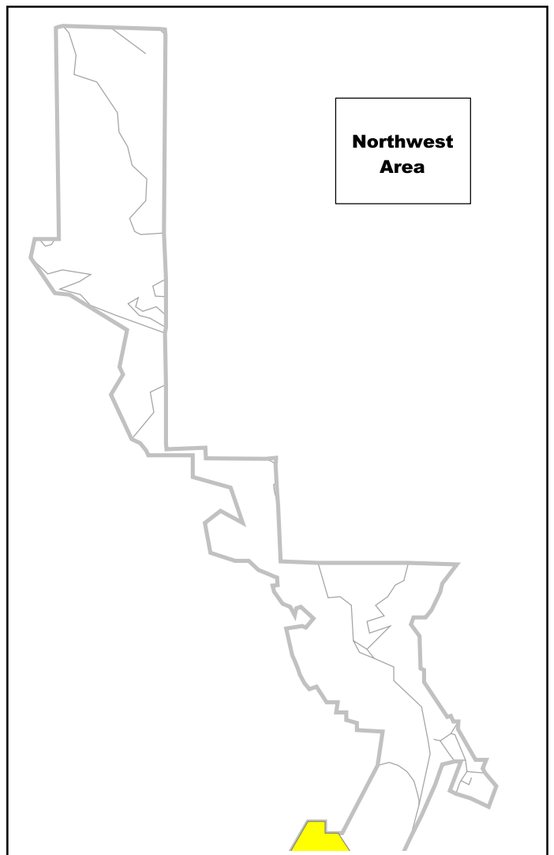
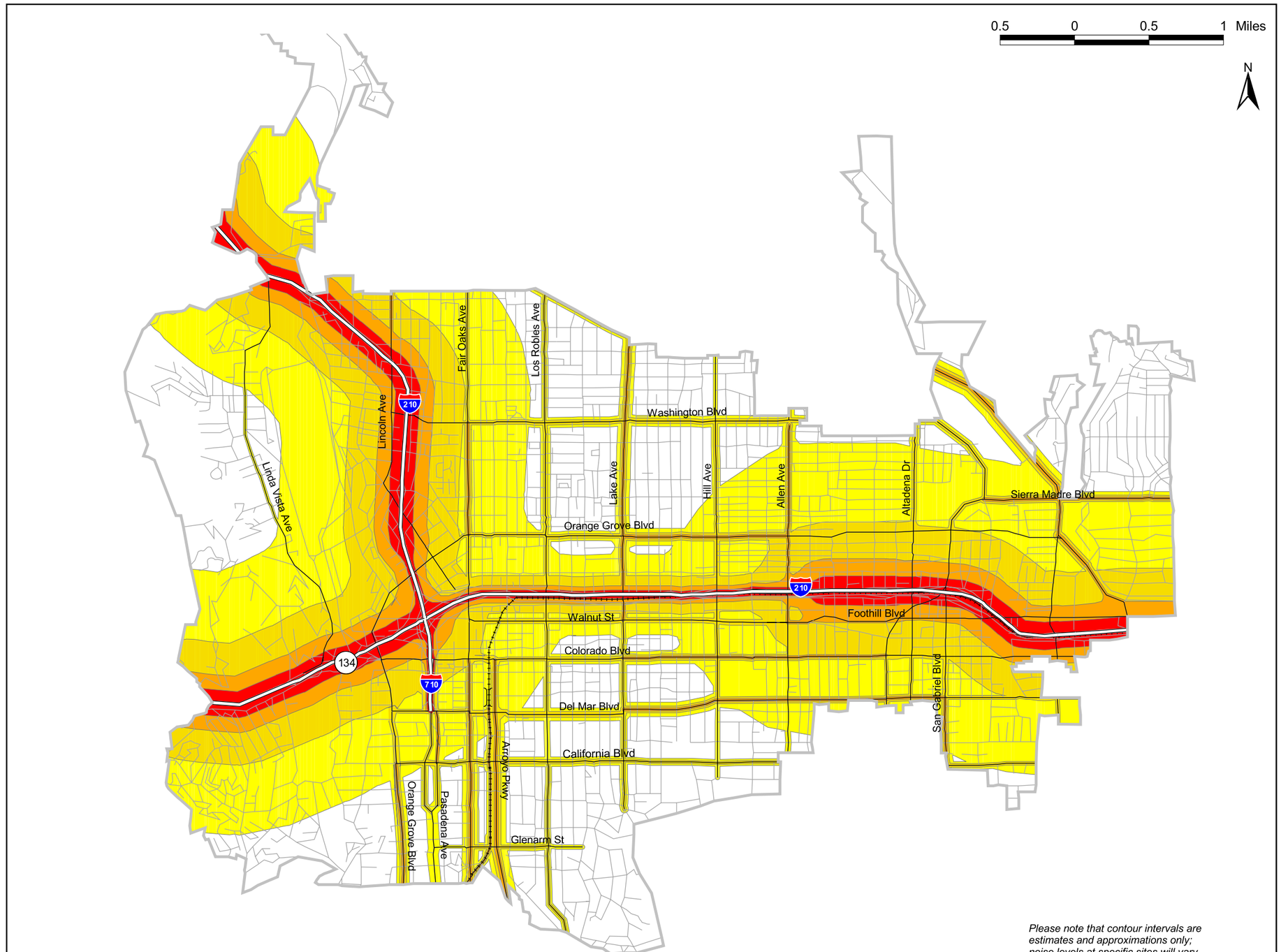


Figure 2 Existing Noise Contours (2001)





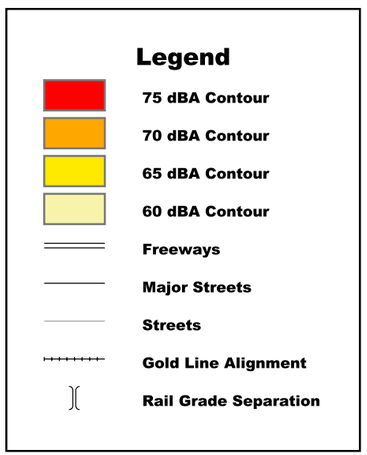


Figure 3 Future Noise Contours (2015)

Measure 7 The City will periodically review major roadways and designated truck routes to reduce traffic in residential zones. [Policy 2b]

Measure 8 As feasible and practical, new equipment purchased by the City will meet noise performance standards consistent with the best available noise reduction technology. [Policy 7c]

Measure 9 The City will review and update the Noise Restrictions Ordinance at least every five years (Chapter 9.36 of the Pasadena Municipal Code) to ensure effectiveness in controlling noise sources. [Policies 6b, 6c, 7b, 7c]

Measure 10 The City will enforce Chapter 9.37 of the Pasadena Municipal Code on the hours, use, and maintenance of leaf blowing machines. [Policy 7c]

Measure 11 The City will consider amending the Pasadena Municipal Code to restrict the use of other landscape equipment and heating, ventilation, and air conditioning (HVAC) equipment if problems arise in the future. [Policy 7d]

Measure 12 The City will monitor implementation of noise-related mitigation measures outlined in the General Plan FEIR to ensure effectiveness in minimizing noise from mobile sources. [Policies 2c, 2b, 2c]

Measure 13 The City will monitor implementation of mitigation measures outlined in the Final Supplemental Environmental Impact Report for the Los Angeles Light Rail Transit project (1993) to verify their success in minimizing noise from the Gold Line (formerly known as the Blue Line). [Policy 3b]

Measure 14 The City will work with the Federal Aviation Administration (FAA) to determine appropriate altitude standards for aircraft flying over congested areas, taking into account public health and safety.[*] [Policies 4a, 4b, 4d]

Measure 15 The City will cooperate with the County Fire Department and Metropolitan Water District to minimize noise conflicts associated with Los Angeles County Fire Department helicopter activity. [Policy 4a]

Measure 16 The City Police Department will continue to implement its standard operating procedures for helicopters to minimize noise conflicts. [Policy 4a]

[*] *Note: Several community groups around the country are lobbying for a 1,000 foot minimum altitude for helicopter flyovers.*

Measure 17 The Police Department and the Environmental Health Division will coordinate tracking of community noise complaints. [Policy 7d]

Measure 18 The City will consider adoption of financial penalties for repeated violations of Pasadena Noise Restrictions Ordinance (Chapter 9.36 of the Municipal Code). [Policy 7d]

Measure 19 The City will continue to monitor noise levels at the Pasadena Police Department Eaton Canyon Firing Range. [Policy 8a]

Measure 20 The City will pursue funding to enclose the pistol range at the Pasadena Police Department Eaton Canyon Firing Range. [Policy 8a]

Measure 21 The City will encourage new developments to site outdoor commercial areas and gathering places, loading areas, parking lots, driveways, trash enclosures, mechanical equipment, and other noisier components away from residential zones and other sensitive uses as defined in Figure 1, to the extent feasible, unless the siting of such components near to noise-sensitive uses provides transportation or other benefits. [Policies 7a, 7b, 7c]

Measure 22 The City will limit new heliports to the Central District or other appropriate areas and will condition new heliports to minimize noise at sensitive uses as defined in Figure 1. [Policy 4c]

Measure 23 The City will encourage commercial and/or industrial uses abutting residential zones to limit deliveries and trash pick-ups from 7:00 A.M. to 9:00 P.M. Monday through Saturday, unless there are substantial transportation or other benefits for different times. [Policy 6c]

Measure 24 The City will continue to enforce the Transportation Management Program Ordinance (Chapter 10.64 of the Pasadena Municipal Code) to reduce vehicle trips and associated noise. [Policies 2b, 2c, 2d]

Measure 25 The City will work with the FAA to limit aircraft operating in the vicinity of the Rose Bowl. [Policies 4c, 4d]

Measure 26 The City will warn new residents and other sensitive noise receptors (refer to Figure 1) about the potential for noise in the Central District and other mixed-use areas. [Policies 6a, 6b, 6c, 7a]

Measure 27 The City will periodically monitor noise levels at major events in the Central Arroyo to determine whether or not current restrictions are achieving acceptable noise levels. [Policy 5a]

Noise Evaluation and Mitigation

The following provides a general methodology to be followed in the evaluation of potential noise problems associated with new development in Pasadena.

When mitigation must be applied to new development to ensure an acceptable noise environment, the following approaches will be considered. First preference will be given to approach (a). Second preference will be given to approach (b). Due to possible aesthetic concerns regarding the use of sound walls, approach (c) will be used only if neither approach (a) nor (b) will achieve desired noise conditions.

a. *Site layout, including setbacks, open space separation and shielding of noise sensitive uses with non-noise-sensitive uses; then*

b. *Acoustical treatment of buildings (see Standard Mitigation Packages below for the types of treatment normally required depending upon the amount of noise reduction needed); then*

c. *Structural measures: Construction of earthen berms or wood or concrete barriers.*

Standard Mitigation Packages

Below are standard mitigation packages that can generally be used to mitigate interior building noise if the needed noise reduction is 30 dBA or less and the noise problem is from a single source.

1. If a 15-20 dBA reduction is needed, the following may suffice:
    a. Air conditioning or a mechanical ventilation system; and
    b. Windows and sliding glass doors should be double-paned glass and mounted in low air infiltration rate frames (0.5 cfm or less, per American National Standard Institute [ANSI] specifications); and
    c. Solid core exterior doors with perimeter weather stripping and threshold seals
2. If a 20-25 dBA reduction is needed, the following may suffice:
    a. Same as No. 1a-c; and
    b. Exterior walls consist of stucco or brick veneer. Wood siding with a 1/2” minimum thickness fiberboard underlayer may also be used; and

c. Glass in both windows and doors should not exceed 20% of the floor area in a room; and

d. Roof or attic vents facing the noise source should be baffled.

3. If a 25-30 dBA reduction is needed, the following may suffice:

   a. Same as No. 2a-d; and

   b. The interior sheetrock of exterior wall assemblies should be attached to studs by resilient channels. Staggered studs or double walls are acceptable alternatives; and

   c. Window assemblies should have a laboratory-tested STC rating of 30 or greater (Windows that provide superior noise reduction capability and that are laboratory-tested are sometimes called "sound-rated" windows. In general, these windows have thicker glass and/or increased air space between panes. In contrast, standard energy conservation double-pane glazing with a 1/8" or 1/4" air space may be less effective in reducing noise from some noise sources than single pane glazing).

Standard Disclosure in New or Rehabilitated Residential Developments in Mixed-Use Areas

When the City exercises discretionary review, provides financial assistance, or otherwise facilitates residential projects in the Central District, Specific Plan areas, or other mixed-use districts, written warnings to potential residents about noise should be made a condition of that approval, assistance, or facilitation. The following language is provided as an example:

> *"All potential buyers and/or renters of residential property within Pasadena's Central District, Specific Plan areas, and/or other mixed-use districts are hereby notified that they may be subject to audible noise levels attributed to business and entertainment-related activities common to such areas, including amplified sound, music, delivery vehicles, pedestrian and vehicular traffic, and other urban noise."*

Chapter 9.36 - NOISE RESTRICTIONS*

Sections:

9.36.010 - Short title.

This chapter shall be known as the "noise restrictions ordinance."

(Ord. 7150 § 2 (part), 2008)

9.36.020 - Declaration of policy.

It is declared to be the policy of the city to prohibit unnecessary, excessive and annoying noises from all sources pursuant to its police power. Noise at certain levels is detrimental to the health and welfare of the general public. Consequently, it shall be systematically proscribed in the public interest.

(Ord. 7150 § 2 (part), 2008)

9.36.030 - Definitions.

As used in this chapter, unless the context otherwise clearly indicates, the words and phrases used in the ordinance codified in this chapter are defined as follows:

A. "Ambient noise" means the all-encompassing noise associated with a given environment, being usually a composite of many sources near and far. For the purpose of this chapter, ambient noise level is the level obtained when the noise level is averaged over a period of 15 minutes without inclusion of noise from isolated identifiable sources, at the location and time of day near that at which a comparison is to be made. This value shall not include noise from occasional, or occasional and transient sources.

B. "A-weighted sound level" means the sound level in decibels as measured on sound level meter using the A weighting network. The level so read is designated "dB(A)" or "dBA."

C. "Commercial purpose" means and includes the use, operation or maintenance of any sound amplifying equipment for the purpose of advertising any business, or any goods, or any services, or for the purpose of attracting the attention of the public to, or advertising for, or soliciting patronage or customers to or for any performance, show, entertainment, exhibition or event, or for the purpose of demonstrating such sound equipment.

D. "Decibel" means a unit measure of sound (noise) level. It is a unit for expressing the relative intensity of sounds on a scale from zero for the average least perceptible sound to about 130 for the average pain level; also a unit for expressing the ratio of two amounts of electric or acoustic signal power equal to 10 times the common logarithm of this ratio.

E. "Emergency work" means work made necessary to restore property to a safe condition

following a public calamity or work required to protect persons or property from an imminent exposure to danger or work by private or public utilities when restoring utility service.

F. "General noise" means noise from any source not specifically exempted in this chapter.

G. "Noncommercial purpose" means the use, operation or maintenance of any sound equipment for other than a commercial purpose. "Noncommercial purpose" means and includes, but shall not be limited to, religious, philanthropic, political, patriotic and charitable purposes.

H. "Property line" means the line that separates private property or the event from the public right-of-way.

I. "Sound amplifying equipment" means any machine or device for the amplification of the human voice, music or any other sound. "Sound amplifying equipment" shall not include standard automobile radios when used and heard only by the occupants of the vehicle in which the automobile radio is installed. "Sound amplifying equipment," as used in this chapter, shall not include warning devices on authorized emergency vehicles or horns or other warning devices on any vehicle used only for traffic safety purposes.

J. "Sound level" (noise level), in decibels (dB), is the sound measured with the A weighting and slow response by a sound level meter.

K. "Sound level meter" means an instrument including a microphone, an amplifier, an output meter and frequency weighting networks for the measurement of sound levels which satisfies the pertinent requirements in American Standard Specifications for sound level meters S1.4-1971 or the most recent revision thereof.

L. Supplementary Definitions of Technical Terms. Definitions of technical terms not defined herein shall be obtained from the American National Standards Institute's Acoustical Terminology S1-1-1971 or any revision thereof.

(Ord. 7150 § 2 (part), 2008)

9.36.040 - Ambient noise level.

A. When "ambient noise level" is referred to in this chapter, it means the actual measured ambient noise level.

B. Any sound level measurement made pursuant to the provisions of this chapter shall be measured with a sound level meter using the A weighting.

1. Where the sound alleged to be offending is of a type or character set forth below, the following values shall be added to the sound level measurement of the offending noise:

a. Except for noise emanating from any electrical transformer or gas metering and pressure control equipment existing and installed prior to the effective date of the ordinance codified herein, any steady audible tone: + 5;

b. Repeated impulsive noise: + 5;

c. Noise occurring more than 5 but less than 15 minutes per hour: - 5;

d. Noise occurring more than 1 but less than 5 minutes per hour: - 10;

e. Noise occurring less than 1 minute per hour: -20.

2. Values of subsections (B)(1)(c), (B)(1)(d) and (B)(1)(e) of this section shall be added to the sound level measurements during daytime (6 a.m. to 11 p.m.) periods only.

(Ord. 7150 § 2 (part), 2008)

9.36.050 - General noise sources.

A. It is unlawful for any person to create, cause, make or continue to make or permit to be made or continued any noise or sound which exceeds the ambient noise level at the property line of any property by more than 5 decibels.

B. Notwithstanding any other provision of this chapter and in addition thereto it shall be unlawful for any person to willfully make or continue, or cause to be made or continued, any loud, unnecessary or unusual noise which disturbs the peace or quiet of any neighborhood or which causes discomfort or annoyance to any reasonable person of normal sensitiveness residing in the area. The standards which shall be considered in determining whether a violation of the provisions of this section exists shall include, but not be limited to, the following:

1. The level of the noise;
2. The intensity of the noise;
3. Whether the nature of the noise is usual or unusual;
4. Whether the origin of the noise is natural or unnatural;
5. The level and intensity of the background noise, if any;
6. The proximity of the noise to residential sleeping facilities;
7. The nature and zoning of the area within which the noise emanates;
8. The density of the inhabitation of the area within which the noise emanates;
9. The time of the day or night the noise occurs;
10. The duration of the noise;
11. Whether the noise is recurrent, intermittent or constant; and
12. Whether the noise is produced by a commercial or noncommercial activity.

(Ord. 7150 § 2 (part), 2008)

9.36.060 - Interior noise standard—Multifamily residential property.

It is unlawful for any person to produce, suffer or allow to be produced on any multifamily residential property, sounds at a level in excess of those enumerated in Table No. 1 when measured inside any dwelling unit on the same property or twenty (20) feet from the outside of the dwelling unit in which the noise source or sources may be located.

TABLE NO. 1—Interior Noise Standard

Time Interval	Interior Noise Standards (dBA)
7:00 a.m. to 10:00 p.m.	60
10:00 p.m. to 7:00 a.m.	50

(Ord. 7150 § 2 (part), 2008)

9.36.070 - Construction projects.

A. No person shall operate any pile driver, power shovel, pneumatic hammer, derrick power hoist, forklift, cement mixer or any other similar construction equipment within a residential district or within a radius of 500 feet therefrom at any time other than as listed below:
   1. From 7:00 a.m. to 7:00 p.m. Monday through Friday;
   2. From 8:00 a.m. to 5:00 p.m. on Saturday;
   3. Operation of any of the listed construction equipment is prohibited on Sundays and holidays.

B. No person shall perform any construction or repair work on buildings, structures or projects within a residential district or within a radius of 500 feet therefrom in such a manner that a reasonable person of normal sensitiveness residing in the area is caused discomfort or annoyance at any time other than as listed below:
   1. From 7:00 a.m. to 7:00 p.m. Monday through Friday;

2. From 8:00 a.m. to 5:00 p.m. on Saturday;
3. Performance of construction or repair work is prohibited on Sundays and holidays.

C. The prohibition against construction on Sundays and holidays as set forth in subsection B of this section shall not apply under either of the following conditions:
   1. The construction is actually performed by an individual who is the owner or lessor of the premises and who is assisted by not more than two individuals;
   2. The person performing the construction shall have provided the building official with a petition which indicates the consent of 65 percent of the households residing within 500 feet of the construction site and the unanimous consent of the households adjacent to the construction site. Said petition shall be on a form promulgated by said building official and shall be accompanied by a fee, the amount of which shall be established by resolution by the city council.

D. The prohibitions of this section shall not apply to the performance of emergency work as defined in Section 9.36.030.

E. For purposes of this section, holidays are New Year's Day, Martin Luther King Jr. Day, Lincoln's Birthday, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, Day after Thanksgiving, and Christmas.

(Ord. 7150 § 2 (part), 2008)

9.36.080 - Construction equipment.

It is unlawful for any person to operate any powered construction equipment if the operation of such equipment emits noise at a level in excess of 85 dBA when measured within a radius of 100 feet from such equipment.

(Ord. 7150 § 2 (part), 2008)

9.36.090 - Machinery, equipment, fans and air conditioning.

Except for emergency work, as defined in this chapter it is unlawful for any person to operate any machinery, equipment, pump, fan, air conditioning apparatus or similar mechanical device in any manner so as to create any noise which would cause the noise level at the property line of any property to exceed the ambient noise level by more than 5 decibels.

(Ord. 7150 § 2 (part), 2008)

9.36.100 - Motor driven vehicles and vehicle repairs.

A. It is unlawful for any person within any residential area of the city to repair, rebuild or test any motor vehicle between the hours of 10 p.m. of one day and 8 a.m. of the next day in such a

manner that a reasonable person of normal sensitiveness residing in the area is caused discomfort or annoyance.

B. It is unlawful for any person to operate any motor driven vehicle within the city in such a manner that a reasonable person of normal sensitiveness residing in the area is caused discomfort or annoyance; provided, however, any such vehicle which is operated upon any public highway, street, or right-of-way shall be excluded from the provisions of this section.

(Ord. 7150 § 2 (part), 2008)

9.36.110 - Radio, television sets and similar devices.

A. Use Restricted. It is unlawful for any person within any residential zone of the city to use or operate any radio receiving set, musical instrument, phonograph, television set or other machine or device for the producing or reproducing of sound (between the hours of 10 p.m. of one day and 7 a.m. of the following day) in such a manner as to disturb the peace, quiet and comfort of neighboring residents or any reasonable person of normal sensitiveness residing in the area.

B. Prima Facie Violation. Any noise level exceeding the ambient base level at the property line of any property by more than 5 decibels is deemed to be prima facie evidence of a violation of the provisions of this section.

(Ord. 7150 § 2 (part), 2008)

9.36.120 - Near schools, hospitals and churches.

It is unlawful for any person to create any noise on any street, sidewalk or public place adjacent to any school, institution of learning, or church while the same is in use or adjacent to any hospital, which noise unreasonably interferes with the workings of such institution or which disturbs or unduly annoys patients in the hospital, provided conspicuous signs are displayed in such streets, sidewalk or public place indicating the presence of a school, church or hospital.

(Ord. 7150 § 2 (part), 2008)

9.36.130 - Hawkers and peddlers.

It is unlawful for any person within the city to sell anything by shouting out loud within any area of the city zoned for residential uses. The provisions of this section shall not be construed to prohibit the selling by yelling of merchandise, food and beverages at licensed sporting events, parades, fairs, circuses and other similar licensed public entertainment events.

(Ord. 7150 § 2 (part), 2008)

9.36.140 - Drums.

It is unlawful for any person to use any drum or other instrument or device of any kind for the purpose of attracting attention by the creation of noise within the city. This section shall not apply to any person who is a participant in a school band or duly licensed parade or who has been otherwise duly authorized to engage in such conduct.

(Ord. 7150 § 2 (part), 2008)

9.36.150 - Animals and fowl.

No person shall keep or maintain, or permit the keeping of, upon any premises owned, occupied or controlled by such person any animal or fowl otherwise permitted to be kept which, by any sound, cry, or behavior, causes annoyance or discomfort to a reasonable person of normal sensitiveness in any residential neighborhood.

(Ord. 7150 § 2 (part), 2008)

9.36.160 - Amplified sound on public property.

A. Purpose. The city council enacts this section for the sole purpose of securing and promoting the public health, comfort, safety and welfare of its residents and visitors. While recognizing that the use of sound amplifying equipment is protected by the constitutional rights of freedom of speech and assembly, the council nevertheless feels obligated to regulate reasonably the use of sound amplifying equipment in order to protect the correlative constitutional rights of the residents and visitors of this community to privacy and freedom from the public nuisance of loud and unnecessary noise.

B. Required Registration. It is unlawful for any person, other than personnel of law enforcement or governmental agencies, to install, use or operate within the city a loudspeaker or sound amplifying equipment in a fixed or movable position or mounted upon any sound truck for the purposes of giving instructions, directions, talks, addresses, lectures or transmitting music to any persons or assemblages of persons in or upon any street, alley, sidewalk, park or public property without first filing a registration statement with the director of finance and obtaining approval thereof as set forth in this chapter.

C. Filing. Every user of sound amplifying equipment shall file a registration statement with the director of finance 10 days prior to the date on which the sound amplifying equipment is intended to be used, which statement shall contain the following information:

1. The name, address and telephone number of both the owner and user of the sound amplifying equipment;
2. The maximum sound-producing power of the sound amplifying equipment which shall include the wattage to be used, the volume in decibels of sound which will be produced, and the approximate distance for which sound will be audible from the sound amplifying

equipment;

3. The license and motor number if a sound truck is to be used;
4. A general description of the sound to be amplified (speech, music, or both) and the sound amplifying equipment which is to be used;
5. Whether the sound amplifying equipment will be used for commercial or noncommercial purposes;
6. Location of fixed sound equipment, or general route where the sound truck will be used; and
7. Such other information as the director of finance may reasonably require.

D. Appeal Process.

1. Initial Determination. The director of finance shall return to the applicant an approved certified copy of the registration statement unless it is found that:
   a. The conditions of the motor vehicle movement are such that in the opinion of the police chief, use of the equipment would constitute a detriment to traffic safety; or
   b. The conditions of pedestrian movement are such that use of the equipment would constitute a detriment to traffic safety; or
   c. The registration statement required reveals that the applicant would violate the provisions set forth in subsection E of this section or any other provisions of this chapter; or
   d. Failure to file said statement within the prescribed period.

In the event the registration statement is disapproved, the director of finance shall cause to be endorsed upon the statement the reasons for disapproval, and return it forthwith to applicant.

2. Appeal of Decision. Any person aggrieved by disapproval of a registration statement may file a written appeal with the city manager within five (5) days of receipt of the notice of disapproval, setting forth all the facts which the applicant wishes the city manager to consider. The city manager or designee shall render a written decision on the appeal within five business days of receipt.
3. Fee for Operation. Prior to the issuance of the registration statement, a fee in the amount of $25.00 per day, or any portion thereof, shall be paid to the city, if the loudspeaker or sound amplifying equipment is to be used for commercial purposes. No fee shall be required for the operation of a loudspeaker or sound amplifying equipment for noncommercial purposes.

E. Regulations. The commercial and noncommercial use of sound amplifying equipment shall be subject to the following regulations:

1. The only sounds permitted shall be either music or the human voice, or both.
2. The operation of sound amplifying equipment shall only occur between the hours of 8 a.m. and 10 p.m. each day except on Sundays and legal holidays. No operation of sound amplifying equipment for commercial purposes shall be permitted on Sundays or legal

holidays. The operation of sound amplifying equipment for noncommercial purposes on Sundays and legal holidays shall only occur between the hours of 10 a.m. and 10 p.m., except New Year's Day.

3. Sound level emanating from sound amplifying equipment shall not exceed continuously the maximum noise level of 15 decibels above the ambient noise level when measured at the outside property line where the event is being held.
4. Notwithstanding the provisions of subsection (E)(3) of this section, sound amplifying equipment shall not be operated within 200 feet of churches, schools, hospitals or city or county buildings, unless written consent thereto has been given by such church, school, hospital, city or county.
5. In any event, the volume of sound shall be so controlled that it will not be unreasonably loud, raucous, jarring, disturbing or a nuisance to reasonable persons of normal sensitiveness within the area of audibility.

F. Old Pasadena. The commercial use of sound amplifying equipment in the Old Pasadena section of the city shall be subject to the following regulations:

1. In this section "amplified sound" means amplified music or the human voice used for entertainment only.
2. The ambient noise level in the Old Pasadena section of the city shall be 60 decibels between 6:00 a.m. and 1:30 a.m. of the following day; and 50 decibels between 1:30 a.m. and 6:00 a.m.
3. Amplified music on private property shall not exceed 15 decibels above the ambient noise level.
4. Use of sound amplifying equipment shall be limited to the hours between 6:00 p.m. and 1:30 a.m. of the following day.
5. Operators of sound amplifying equipment within 500 feet of a functioning church, school or hospital site shall initially obtain the written consent of such facility prior to commencing operation of amplified sound equipment.
6. Any business owner within 300 feet of a business using amplified sound equipment may request the health officer or a designee to mediate informally any dispute related to the use of such amplified sound equipment.
7. Notwithstanding the enactment of the ordinance codified in this chapter, the city council reserves the right at a future time to amend or repeal this provision in its entirety, and does not intend the creation of any special property rights by this amendment.

(Ord. 7150 § 2 (part), 2008)

9.36.170 - Exemptions.

A. This chapter is not intended to regulate construction or maintenance and repair activities

conducted by public agencies or their contractors necessitated by emergency conditions or deemed necessary by the city to serve the best interests of the public and to protect the public health, safety and welfare. These operations may include, but are not limited to, street sweeping, debris and limb removal, removal of downed wires, restoring electrical service, repairing traffic lights, unplugging sewers, vacuuming catch basins, repairing water hydrants and mains, gas lines, oil lines, storm drains, roads, sidewalks, etc.

B. Notwithstanding the ordinance codified in this chapter, the city manager is authorized to permit special events to generate noise levels up to the limits specified in the noise element of the city's general plan.

C. Notwithstanding the ordinance codified in this chapter, the general manager of the Rose Bowl is authorized to permit events licensed by the Rose Bowl Operating Company to generate noise levels up to the limits specified in the noise element of the city's general plan.

D. Provisions in the permit or license agreement shall specify the specific hour limitations imposed, and the set decibel level delineated in the noise element which would apply.

(Ord. 7150 § 2 (part), 2008)

9.36.180 - Enforcement responsibility.

The manager of the environmental health division shall have primary responsibility for the administration and enforcement of this chapter.

(Ord. 7150 § 2 (part), 2008)

9.36.190 - Violation—Penalty.

A. It shall be unlawful and a public nuisance for any person to violate the provisions of this chapter, punishable as a misdemeanor.

B. The provisions of this chapter are nonexclusive and supplementary to existing rights and remedies. Nothing in this chapter shall prevent the city from commencing any appropriate civil action to abate a public nuisance in addition to, or alternatively to, or in conjunction with the proceedings set forth in this chapter.

(Ord. 7150 § 2 (part), 2008)

CONSTRUCTION NOISE MODELING

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 09/10/2021
Case Description: RBOC-01

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Demolition	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Spec Usage (%)	Actual Lmax (dBA)	Receptor Lmax (dBA)	Estimated Distance (feet)	Shielding (dBA)
Concrete Saw	No	20	89.6	50.0		0.0
Excavator	No	40	80.7	50.0		0.0
Dozer	No	40	81.7	50.0		0.0

Results

Equipment	Calculated (dBA) Lmax	Calculated (dBA) Leq	Noise Limits (dBA) Day Lmax	Noise Limits (dBA) Day Leq	Noise Limits (dBA) Evening Lmax	Noise Limits (dBA) Evening Leq	Noise Limits (dBA) Night Lmax	Noise Limits (dBA) Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Noise Limit Exceedance (dBA) Day Leq	Noise Limit Exceedance (dBA) Evening Lmax	Noise Limit Exceedance (dBA) Evening Leq	Noise Limit Exceedance (dBA) Night Lmax	Noise Limit Exceedance (dBA) Night Leq
Concrete Saw	89.6	82.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dozer	81.7	77.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.6	84.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 09/10/2021
Case Description: RBOC-01

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Site Prep	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dozer	No	40		81.7	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Tractor	No	40	84.0		50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)				Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Dozer	81.7	77.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	84.0	84.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 09/10/2021
Case Description: RBOC-01

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Grading	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85.0		50.0	0.0
Scraper	No	40		83.6	50.0	0.0
Tractor	No	40	84.0		50.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Calculated (dBA) Leq	Noise Limits (dBA) Day Lmax	Noise Limits (dBA) Day Leq	Noise Limits (dBA) Evening Lmax	Noise Limits (dBA) Evening Leq	Noise Limits (dBA) Night Lmax	Noise Limits (dBA) Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Noise Limit Exceedance (dBA) Day Leq	Noise Limit Exceedance (dBA) Evening Lmax	Noise Limit Exceedance (dBA) Evening Leq	Noise Limit Exceedance (dBA) Night Lmax	Noise Limit Exceedance (dBA) Night Leq
Grader	85.0	81.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	85.0	85.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 09/10/2021
Case Description: RBOC-01

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
Grading (Mini Golf Course Area)	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Dozer	No	40	81.7	50.0	0.0	
Front End Loader	No	40	79.1	50.0	0.0	
Tractor	No	40	84.0	50.0	0.0	

Results

Equipment	Calculated (dBA) Lmax	Leq	Noise Limits (dBA) Day Lmax	Leq	Evening Lmax	Leq	Night Lmax	Leq	Noise Limit Exceedance (dBA) Day Lmax	Leq	Evening Lmax	Leq	Night Lmax	Leq
Dozer	81.7	77.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	79.1	75.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	84.0	82.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 09/10/2021
Case Description: RBOC-01

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Trenching	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Tractor	No	40	84.0		50.0	0.0
Excavator	No	40		80.7	50.0	0.0

Results

	Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
	Calculated (dBA)		Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	84.0	81.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 09/10/2021
Case Description: RBOC-01

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Fencing	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Crane	No	16		80.6	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Soil Mix Drill Rig	No	50	80.0		50.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Calculated (dBA) Leq	Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Crane	80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Soil Mix Drill Rig	80.0	77.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	84.0	82.3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 09/10/2021
Case Description: RBOC-01

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Paving	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Paver	No	50		77.2	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0
Drum Mixer	No	50		80.0	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)				Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Drum Mixer	80.0	77.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.5	84.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 09/10/2021
Case Description: RBOC-01

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Fencing and Trenching Overlap	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Crane	No	16		80.6	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Welder / Torch	No	40		74.0	50.0	0.0
Tractor	No	40	84.0		50.0	0.0
Excavator	No	40		80.7	50.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA)				Noise Limit Exceedance (dBA)					
			Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Crane	80.6	72.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	74.0	70.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	84.0	84.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 09/10/2021
Case Description: RBOC-01

**** Receptor #1 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
Trenching & Paving Overlap (Mini Golf Course)	Residential	60.0	55.0	50.0

Equipment

Description	Impact Device	Spec Usage (%)	Actual Lmax (dBA)	Receptor Lmax (dBA)	Estimated Distance (feet)	Shielding (dBA)
Tractor	No	40	84.0	50.0		0.0
Excavator	No	40		80.7	50.0	0.0
Paver	No	50		77.2	50.0	0.0
Drum Mixer	No	50		80.0	50.0	0.0
Pavement Scarafier	No	20		89.5	50.0	0.0

Results

	Noise Limits (dBA)						Noise Limit Exceedance (dBA)					
	Calculated (dBA)		Day		Evening		Night		Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Tractor	84.0	80.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	80.7	76.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	77.2	74.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Drum Mixer	80.0	77.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pavement Scarafier	89.5	82.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	89.5	86.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

RBOC-01 Construction Noise Modeling Attenuation Calculations

Levels in dBA Leq

Driving Range Phases	**RCNM Reference Noise Level**	**Levels at 100 feet**	**Residences to East**	**Residences to West**
Distance in feet	*50*	*100*	*1000*	*900*
Demolition	85	79	59	59
Distance in feet	*50*	*100*	*960*	*1080*
Site Prep	84	78	58	57
Grading	85	79	59	58
Trenching	82	76	56	55
Distance in feet	*50*	*100*	*660*	*870*
Fencing	82	76	60	57
Overlapping Fencing and Trenching (Driving Range)	84	78	62	60
Distance in feet	*50*	*100*	*1050*	*1050*
Paving of Golf Cart Path	84	78	58	58

Levels in dBA Leq

Mini Golf Phases	**RCNM Reference Noise Level**	**Levels at 100 feet**	**Residences to East**	**Residences to West**
Distance in feet	*50*	*100*	*1000*	*900*
Demolition	85	79	59	59
Distance in feet	*50*	*100*	*1200*	*900*
Site Prep	84	78	56	59
Grading (Mini Golf Course Area)	83	77	55	58
Trenching	82	76	54	57

Attenuation calculated through Inverse Square Law: Lp(R2) = Lp(R1) - 20Log(R2/R1)

RBOC-01 Vibration Annoyance Attenuation Calculations

Levels in in/sec PPV

Distance in feet	**Vibration Reference Level at *25 feet***	**Residential to east** *440*	**Residential to west** *900*
Vibratory Roller	0.21	0.003	0.001
Clam shovel	0.202	0.003	0.001
Hoe Ram	0.089	0.001	0.000
Large Bulldozer	0.089	0.001	0.000
Caisson Drilling	0.089	0.001	0.000
Loaded Trucks	0.076	0.001	0.000
Jackhammer	0.035	0.000	0.000
Small Bulldozer	0.003	0.000	0.000