16. Noise and Vibration

This chapter describes the environmental setting, regulatory framework, and existing noise and vibration conditions in Livermore. This chapter uses the term "Livermore" to cover the City of Livermore together with the immediately surrounding area within the Urban Growth Boundary (UGB) and Sphere of Influence (SOI). See the Introduction for more information on these boundaries. It includes a glossary of terms related to noise and vibration to assist the reader.

16.1 ENVIRONMENTAL SETTING

16.1.1 SOUND FUNDAMENTALS

Sound is a pressure wave transmitted through the air. It is described in terms of loudness or amplitude (measured in decibels), frequency or pitch (measured in Hertz [Hz] or cycles per second), and duration (measured in seconds or minutes). The standard unit of measurement of the loudness of sound is the decibel (dB). Changes of 1 to 3 A-weighted decibels (dBA) are detectable under quiet, controlled conditions and changes of less than 1 dBA are usually indiscernible. A 3-dBA change in noise levels is considered the minimum change that is detectable with human hearing in outside environments. A change of 5 dBA is readily discernable to most people in an exterior environment whereas a 10-dBA change is perceived as a doubling (or halving) of the sound.

The human ear is not equally sensitive to all frequencies. Sound waves below 16 Hz are not heard at all and are "felt" more as a vibration. Similarly, while 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. Since the human ear is not equally sensitive to sound at all frequencies, a special frequency dependent rating scale is usually used to relate noise to human sensitivity. The A-weighted decibel scale (dBA) performs this compensation by weighting frequencies in a manner approximating the sensitivity of the human ear.

Noise is defined as unwanted sound and is known to have several adverse effects on people, including hearing loss, speech and sleep interference, physiological responses, and annoyance. Based on these known adverse effects, the federal government, the State of California, and many local governments have established criteria to protect public health and safety and to prevent disruption of certain human activities.

16.1.1.1 SOUND MEASUREMENT

Sound pressure is measured through the sdBA scale to correct for the relative frequency response of the human ear. That is, an A-weighted noise level de-emphasizes low and very high frequencies of sound similar to the human ear's de-emphasis of these frequencies.

Unlike linear units such as inches or pounds, decibels are measured on a logarithmic scale, representing points on a sharply rising curve. On a logarithmic scale, an increase of 10 dBA is 10 times more intense than 1 dBA, while 20 dBA is 100 times more intense, and 30 dBA is 1,000 times more intense. The decibel system of measuring sound gives a rough connection between the physical intensity of sound and its perceived loudness to the human ear. Ambient sounds generally range from 30 dBA (very quiet) to 100 dBA (very loud).

Sound levels are generated from a source and their decibel level decreases as the distance from that source increases. 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 dBA for each doubling of distance from the source. 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 dBA for each doubling of distance in a hard site environment.[1] Line source noise in a relatively flat environment with absorptive vegetation, such as trees and shrubs, decreases by 4.5 dBA for each doubling of distance.[2][3]

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 Leq), 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. These "L_n" values are typically used to demonstrate compliance for stationary noise sources with a city's noise ordinance, as discussed below.

16.1.1.2 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 our entire system, with prolonged noise exposure in excess of 75 dBA increasing body tensions, and thereby affecting blood pressure, functions of the heart, and the nervous system. Extended periods of noise exposure above 90 dBA could result in permanent hearing damage. When the noise level reaches 120 dBA, a tickling sensation occurs in the human ear even with short-term exposure. This level of noise is called the threshold of feeling. As the sound reaches 140 dBA, the tickling sensation is replaced by the feeling of pain in the ear. This is called the threshold of pain. Table 16-1 shows typical noise levels from familiar noise sources.

[1] A hard site as defined by FHWA Traffic Noise Prediction Manual, is where the absorption of a site, or roadway surface, is effectively zero or in other words, fully reflective.

[2] A soft site as defined by FHWA Traffic Noise Prediction Manual, is where the absorption of a site, or roadway surface, is half, or in other words, fifty percent.

[3] U.S. Department of Transportation Federal Highway Administration. October, 1979. FHWA-RD-77-108 Highway Traffic Noise Prediction Model Manual.

TABLE 16-1 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 3 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: Caltrans, 2013. *Technical Noise Supplement ("TeNS")*.

16.1.2 VIBRATION FUNDAMENTALS

Vibration is an oscillating motion. Like noise, vibration is transmitted in waves, but in this case through earth or solid objects. Unlike noise, vibration is typically felt rather than heard.

Vibration can be either natural as in the form of earthquakes, volcanic eruptions, landslides, or human-made as from explosions, heavy machinery, or trains. Both natural and human-made vibration may be continuous such as from operating machinery, or impulsive as from an explosion.

As with noise, vibration can be described by both its amplitude and frequency. Amplitude may be characterized in three ways: displacement, velocity, and acceleration. Particle displacement is a measure of the distance that a vibrated particle travels from its original position. Soil displacement is typically measured in inches or millimeters. Particle velocity is the rate of speed at which soil particles move in inches per second or millimeters per second. Particle acceleration is the rate of change in velocity with respect to time and is measured in inches per second or millimeters per second. Typically, particle velocity

(measured in inches or millimeters per second) and/or acceleration (measured in gravities) are used to describe vibration. Table 16-2 presents the human reaction to various levels of peak particle velocity.

TABLE 16-2 HUMAN REACTION TO TYPICAL VIBRATION LEVELS

Vibration Level Peak Particle Velocity (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: Caltrans, 2013. *Transportation and Construction Vibration Guidance Manual*.

Vibrations also vary in frequency and this affects perception. Typical construction vibrations fall in the 10 to 30 Hz range and usually occur around 15 Hz. Traffic vibrations exhibit a similar range of frequencies; however, because of their suspension systems, buses often generate frequencies around 3 Hz at high vehicle speeds. It is less common, but possible, to measure traffic vibration frequencies above 30 Hz.

The way in which vibration is transmitted through the earth is called propagation. As vibration waves propagate from a source, the energy is spread over an ever-increasing area such that the energy level striking a given point is reduced with the distance from the energy source. This geometric spreading loss is inversely proportional to the square of the distance. Wave energy is also reduced with distance as a result of material damping in the form of internal friction, soil layering, and void spaces. The amount of attenuation provided by material damping varies with soil type and condition as well as the frequency of the wave.

16.2 REGULATORY FRAMEWORK

16.2.1 FEDERAL REGULATIONS

The following are federal regulations and standards pertaining to noise in Livermore.

16.2.1.1 FEDERAL HIGHWAY ADMINISTRATION

Proposed federal or federal-aid highway construction projects at a new location, or the physical alteration of an existing highway that significantly changes either the horizontal or vertical alignment, or increases the number of through-traffic lanes, requires an assessment of noise and consideration of noise abatement pursuant to 23 Code of Federal Regulations (CFR) Part 772, "Procedures for Abatement of Highway Traffic Noise and Construction Noise." The Federal Highway Administration (FHWA) has adopted noise abatement criteria (NAC) for sensitive receivers such as picnic areas, recreation areas, playgrounds, active sport areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals when "worst-hour" noise levels approach or exceed 67 dBA L_{eq}. The California Department of Transportation (Caltrans) has further defined approaching the NAC to be 1 dBA below the NAC for noise-sensitive receivers identified as Category B activity areas (e.g., 66 dBA L_{eq} is considered approaching the NAC).[4]

16.2.1.2 FEDERAL RAILROAD ADMINISTRATION

Train Horn Rule

Under the Train Horn Rule (49 CFR Part 222), locomotive engineers must begin to sound train horns at least 15 seconds, and no more than 20 seconds, in advance of all public grade crossings. If a train is traveling faster than 60 miles per hour (mph), engineers will not sound the horn until it is within a quarter-mile of the crossing, even if the advance warning is less than 15 seconds. There is a "good faith" exception for locations where engineers can't precisely estimate their arrival at a crossing and begin to sound the horn no more than 25 seconds before arriving at the crossing.

Train horns must be sounded in a standardized pattern of two long, one short, and one long blast. The pattern must be repeated or prolonged until the lead locomotive or lead cab car occupies the grade crossing. The rule does not stipulate the durations of long and short blasts. The maximum volume level for the train horn is 110 dB, which is a new requirement. The minimum sound level remains 96 dB.

For "Quiet Zones," the rule also provides an opportunity for localities nationwide to mitigate the effects of train horn noise by establishing "new quiet zones." "No horn" restriction, which may have existed prior to the establishment of the rule, may be qualified to be "pre-rule quiet zones." In a quiet zone, railroads have been directed to cease the routine sounding their horns when approaching public highway-rail grade crossings. Train horns may still be used in emergency situations or to comply with other federal regulations or railroad operating rules. Localities desiring to establish a quiet zone are first required to mitigate the increased risk caused by the absence of a horn.

[4] Caltrans Division of Environmental Analysis, 2020, *Traffic Noise Analysis Protocol.*

16.2.1.3 UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

In addition to FHWA standards, the United States Environmental Protection Agency (USEPA) has identified the relationship between noise levels and human response. The USEPA has determined that over a 24-hour period, a L_{eq} of 70 dBA will result in some hearing loss. Interference with activity and annoyance will not occur if exterior levels are maintained at a L_{eq} of 55 dBA and interior levels at or below 45 dBA. While these levels are relevant for planning and design and useful for informational purposes, they are not land use planning criteria because they do not consider economic cost, technical feasibility, or the needs of the community.

The USEPA has set 55 dBA L_{dn} as the basic goal for exterior residential noise intrusion. However, other federal agencies, in consideration of their own program requirements and goals, as well as difficulty of actually achieving a goal of 55 dBA L_{dn}, have settled on the 65 dBA L_{dn} level as their standard. At 65 dBA L_{dn}, activity interference is kept to a minimum, and annoyance levels are still low. It is also a level that can realistically be achieved.

16.2.1.4 OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

The federal government regulates occupational noise exposure common in the workplace through the Occupational Safety and Health Administration (OSHA) under the USEPA. Such limitations would apply to the operation of construction equipment and could also apply to any proposed industrial land uses. Noise exposure of this type is dependent on work conditions and is addressed through a facility's Health and Safety Plan, as required under OSHA, and is therefore not addressed further in this analysis.

16.2.1.5 UNITED STATES DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT

The US Department of Housing and Urban Development (HUD) has set a goal of 65 dBA L_{dn} as a desirable maximum exterior standard for residential units developed under HUD funding. (This level is also generally accepted within the State of California.) While HUD does not specify acceptable interior noise levels, standard construction of residential dwellings typically provides in excess of 20 dBA of attenuation with the windows closed. Based on this premise, the interior L_{dn} should not exceed 45 dBA.

16.2.2 STATE REGULATIONS

The following are State of California regulations and standards pertaining to noise in Livermore.

16.2.2.1 CALIFORNIA BUILDING CODE

The California Building Code (CBC), Title 24, Part 2, Volume 1, Chapter 12, Interior Environment, Section 1207.11.2, Allowable Interior Noise Levels, requires that interior noise levels attributable to exterior sources shall not exceed 45 dB in any habitable room. The noise metric is evaluated as either the L_{dn} or the community noise equivalent level (CNEL), consistent with the noise element of the local general plan.

16.2.2.2 CALIFORNIA BUILDING CODE: CALGREEN

The State of California's noise insulation standards for nonresidential uses are codified in the California Code of Regulations, Title 24, Building Standards Administrative Code, Part 11, California Green Building Standards Code (CALGreen). CALGreen noise standards are applied to new or renovation construction projects in California to control interior noise levels resulting from exterior noise sources. Proposed projects may use either the prescriptive method (Section 5.507.4.1) or the performance method (Section 5.507.4.2) to show compliance. Under the prescriptive method, a project must demonstrate transmission loss ratings for the wall and roof-ceiling assemblies and exterior windows when located within a noise environment of 65 dBA CNEL or higher. Under the performance method, a project must demonstrate that interior noise levels do not exceed 50 dBA $L_{eq(1hr)}$.

16.2.2.3 AIRPORT NOISE STANDARDS

California Code of Regulations Title 21, Subchapter 6, Airport Noise Standards, establishes 65 dBA CNEL as the acceptable level of aircraft noise for persons living in the vicinity of airports. Noise-sensitive land uses in locations where the aircraft exterior noise level exceeds 65 dBA CNEL are generally incompatible, unless an aviation easement for aircraft noise has been acquired by the airport proprietor, or the residence is a high-rise apartment or condominium that has an interior CNEL of 45 dBA or less in all habitable rooms despite aircraft noise and an air circulation or air conditioning system, as appropriate. Assembly Bill (AB) 2776 requires any person who intends to sell or lease residential properties within an airport influence area to disclose that fact to the person buying the property.

16.2.3 LOCAL REGULATIONS

The following are local regulations and standards pertaining to noise in Livermore.

16.2.3.1 LIVERMORE 2003-2025 GENERAL PLAN

The State of California, through its General Plan Guidelines, discusses how ambient noise should influence land use and development decisions and includes a table of normally acceptable, conditionally acceptable, normally unacceptable, and clearly unacceptable uses at different noise levels, expressed in CNEL. These guidelines are known as land use and noise compatibility guidelines. When a city has not adopted their own, the State's guidelines are defaulted to. The City of Livermore has adopted its own noise and land use compatibility guidelines and are found in the Livermore General Plan Noise Element.

Land use and noise compatibility guidelines are a tool used by urban planners to gauge the compatibility of future projects considering existing and projected future noise levels in the area where the project is proposed, such as the noise compatibility between proposed noise-sensitive uses (e.g., schools, residential, and health care facilities) and existing non-noise-sensitive uses (e.g., industrial, commercial, and entertainment venues). Livermore's guidelines are summarized in Table 16-3.

The City of Livermore General Plan goals, objectives, and policies that are relevant to noise are primarily in the Noise Element. As part of the General Plan update, some existing goals, objectives, and policies would be amended, substantially changed, or newly added.

TABLE 16-3 LIVERMORE LAND USE COMPATIBILITY GUIDELINES FOR EXTERIOR NOISE

Land Use	Normally Acceptable[a]	Conditionally Acceptable[a]	Normally Unacceptable[a]	Clearly Unacceptable[a]
Residential-Low Density, Single-Family, Duplex, Mobile Home	≤ 60	55-70	70-75	> 75
Residential Multifamily	≤ 65	60-70	70-75	> 75
Transient Lodging, Hotels, Motels	≤ 65	60-70	70-80	> 80
School, Library, Church, Hospital, Nursing Home	≤ 70	60-70	70-80	> 80
Auditorium, Concert Hall, Amphitheater	X	≤ 70	X	> 65
Sports Arena, Outdoor Spectator Sports	X	≤ 75	X	> 70
Playground, Neighborhood Park	≤ 70	X	70-75	> 75
Golf Course, Water Recreation, Cemetery	≤ 75	X	70-80	> 80
Office Building, Business Commercial, Professional, Retail	≤ 70	70-75	>	X
Industrial, Manufacturing, Utilities, Agricultural	≤ 75	70-80	>	X

Source: City of Livermore General Plan, Noise Element.
Note: [a] Where dBA levels overlap between these categories, determination of noise level acceptability will be made on a project-by-project basis. dBA is measured in CNEL or Ldn and Normally Acceptable, Conditionally Acceptable, Normally Unacceptable, and Clearly Unacceptable are defined in Policy P5 of the Livermore General Plan as:
Normally Acceptable: If the noise level is within the "normally acceptable "level, noise exposure would be acceptable for the intended land use. Development may occur without requiring an evaluation of the noise environment unless the use could generate noise impacts on adjacent uses.
Conditionally Acceptable: If the noise level is within the "conditionally acceptable" level, noise exposure would be conditionally acceptable; a specified land use may be permitted only after detailed analysis of the noise environment and the project characteristics to determine whether noise insulation or protection features are required. Such noise insulation features may include measures to protect noise-sensitive outdoor activity areas (e.g., at residences, schools, or parks) or may include building sound insulation treatments such as sound-rated windows to protect interior spaces in sensitive receptors.
Normally Unacceptable: If the noise level is within the "normally unacceptable" level, analysis and mitigation are required. Development should generally not be undertaken unless adequate noise mitigation options have been analyzed and appropriate mitigations incorporated into the project to reduce the exposure of people to unacceptable noise levels.
Clearly Unacceptable: If the noise level is within the "clearly unacceptable" level, new construction or development should not be undertaken unless all feasible noise mitigation options have been analyzed and appropriate mitigations incorporated into the project to adequately reduce exposure of people to unacceptable noise levels.

The existing General Plan policies under Objective N-1.5 regulate various noise sources at sensitive receptors. As such, these policies are seen as the noise standards. The policies include:

- **Policy P1.** The City shall require that industrial and commercial uses be designed and operated so as to avoid the generation of noise effects on surrounding sensitive land uses (e.g., residential, churches, schools, hospitals) from exceeding the following noise levels for exterior environments:
  - 55 dBA L_{50} during daytime hours of 7:00 a.m. to 10:00 p.m.
  - 45 dBA L_{50} during nighttime hours of 10:00 p.m. to 7:00 a.m.
- **Policy P2.** In order to allow for temporary construction, demolition or maintenance noise and other necessary short-term noise events, the stationary source noise standards in Policy N-1.5. P1, above, may be exceeded within the receiving land use by:
  - 5 dBA for a cumulative period of no more than fifteen minutes in any hour(L_{25}).
  - 10 dBA for a cumulative period of no more than five minutes in any hour(L_8).
  - 15 dBA for a cumulative period of no more than one minute in any hour(L_2).

- Policy P3. In order to allow for temporary construction, demolition or maintenance noise and other necessary short-term noise events, the stationary noise standards in Policy N-1.5.P1, above, shall not be exceeded within the receiving land use by more than 15 dBA for any period of time (L_{max}).
- Policy P4. The following sources of noise are exempt from the standard in N-1.5.P1: motor vehicles on public streets; trains; emergency equipment, vehicles, devices, and activities; temporary construction, maintenance, or demolition activities conducted between the hours of 7:00 a.m. and 8:00 p.m.

16.2.3.2 CITY OF LIVERMORE MUNICIPAL CODE

As summarized previously, specific exterior noise standards are summarized in the City's General Plan Noise Element under the policies in Objective N-1.5. The City of Livermore Municipal Code includes various directives pertaining to noise. Specific interior and exterior standards are not provided but exemptions to the standards are identified in Chapter 9.36, *Noise*. Additionally, Chapter 9.36 generally prohibits loud, disturbing, unusual, and unnecessary noises from any person that annoys, disturbs, injures, or endangers the comfort, health, repose, peace, or safety of other persons within the city. Section 9.36.030 of the Municipal Code declares the following noise sources to be loud, disturbing, unnecessary, unusual, or habitual noises.

- Section 9.36.040 Blowers, fans, and combustion engines. The operation of any noise-creating blower, power fan or internal combustion engine, the operation of which causes noise due to the explosion of operating gases or fluids, is prohibited, unless the noise from such blower or fan is muffled and such engine is equipped with a muffler device to deaden such noise in such a manner so as not to be plainly audible at a distance of either 75 feet from the source of the noise, or between the hours of 6:00 p.m. Saturday to 7:00 a.m. Monday; 8:00 p.m. to 7:00 a.m. on Monday, Tuesday, Wednesday, and Thursdays; 8:00 p.m. Friday to 9:00 a.m. on Saturday or at all on city-observed holidays.
- Section 9.36.050 Exhausts from engines, boats, or vehicles. The discharge into the open air of the exhaust of any steam engine, stationary internal-combustion engine, motorboat or motor vehicle, except through a muffler or other device which will effectively prevent loud or explosive noises therefrom in such a manner so as not to be plainly audible at the distance of either 75 feet from the source of the noise, or the property line, whichever is greater, is prohibited.
- Section 9.36.060 Loading and unloading vehicles and opening crates and containers. The creation of loud and excessive noise in connection with loading or unloading any vehicle or the opening and destruction of bales, boxes, crates, and containers is prohibited.
- Section 9.36.070 Noises adjacent to schools, courts, churches, and hospitals. The creation of any excessive noise on any street adjacent to any school, institution of learning, church or court 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 is prohibited, provided conspicuous signs are displayed in such streets, indicating that the streets are adjacent to a school, hospital or court.
- Section 9.36.080 Hammers, pile drivers, pneumatic tools, and similar equipment. The operation between the hours of 6:00 p.m. Saturday to 7:00 a.m. Monday; 8:00 p.m. to 7:00 a.m. on Monday, Tuesday, Wednesday, and Thursdays; 8:00 p.m. Friday to 9:00 a.m. on Saturday or at all

on city-observed holidays of any pile driver, pneumatic tools, derrick, electric hoist, sandblaster, or other equipment used in construction, demolition or other repair work, the use of which is attended by loud or unusual noise, is prohibited.

- Section 9.36.090 Radios, phonographs, musical instruments, and similar devices. The using or operating, or permitting to be played, used or operated, of any radio receiving set, musical instrument, phonograph or other machine or device for the producing or reproducing of sound in such a manner as to disturb the peace, quiet and comfort of the neighboring inhabitants, or at any time with louder volume than is necessary for convenient hearing for the persons who are in the room, vehicle or chamber in which such machine or device is operated, and who are voluntary listeners.

  The operation of such set, instrument, phonograph, machine or device between the hours of 11:00 p.m. and 7:00 a.m. in such manner as to be plainly audible at a distance of either 75 feet from the source of the noise, or the property line, whichever is greater, which shall be prima facie evidence of a violation of the provisions of LMC 9.36.040 through 9.36.100.

- Section 9.36.0100 Yelling, shouting, and similar noise. Yelling, shouting, hooting, whistling, or singing on the public streets between the hours of 11:00 p.m. and 7:00 a.m., or at any time or place so as to annoy or disturb the quiet, comfort or repose of persons in any office or in any dwelling, hotel, or other type of residence, or of any persons in the vicinity, is prohibited.

Exceptions

- Section 9.36.110. A. Any homeowner/resident constructing home improvements to their residence and doing the work themselves (without a contractor present) with a valid building permit (if required) shall be allowed to utilize noise generating construction tools and equipment between the hours of 7:00 a.m. through 11:00 p.m. seven days a week
- Section 9.36.110. B. Outdoor noise levels associated with a short-term rental, operating with a valid permit, are prohibited between the hours of 10:00 p.m. and 8:00 a.m., or at any time or place so as to annoy or disturb the quiet, comfort, or repose of persons in any office or dwelling, hotel, or other type of residence, or of any persons in the vicinity.
- Section 9.36.110. C. Industrial areas located more than 500 feet from a residential development are exempt from the noise hour restrictions.
- Section 9.36.110. D. The city engineer and/or building official shall have the authority to authorize construction activities during the hours restricted by this chapter for the following reasons:
  - A public agency, other than the City, requires as a condition of a permit that the construction be done during the restricted hours.
  - Public health, safety or welfare requires the work to be done during the restricted hours.
  - Specific construction activities (such as large concrete foundation pours) can be identified and approved to occur as an exemption to this ordinance in the conditions of approval for a project at the time of the public hearing.

- Section 9.36.110. E. If the city engineer and/or building official approves the exception or it is an exception allowed by the conditions of approval for the project, the following shall be done by the contractor or city staff:
  - Notify the Livermore police department, watch commander, at least 24 hours in advance.
  - Notify residents and business owners that are adjacent to the work area at least 24 hours in advance. The limits of this notification shall be determined by the city engineer and/or building official.

16.3 EXISTING CONDITIONS

Primary noise sources in Livermore include traffic from surrounding highways, major roadways, residential streets, the Livermore Municipal Airport, local railroad activity, and outdoor recreational uses. In commercial and retail areas, truck-loading docks can be a source of localized noise.

Sensitive Receptors

Certain land uses, such as residences, schools, and hospitals are particularly sensitive to noise and vibration. Sensitive receptors within Livermore include residences, senior housing, schools, libraries, places of worship, and recreational areas. These uses are regarded as sensitive because they are where citizens most frequently engage in activities that are likely to be disturbed by noise, such as reading, studying, sleeping, resting, or otherwise engaging in quiet or passive recreation. Commercial and industrial uses are not particularly sensitive to noise or vibration.

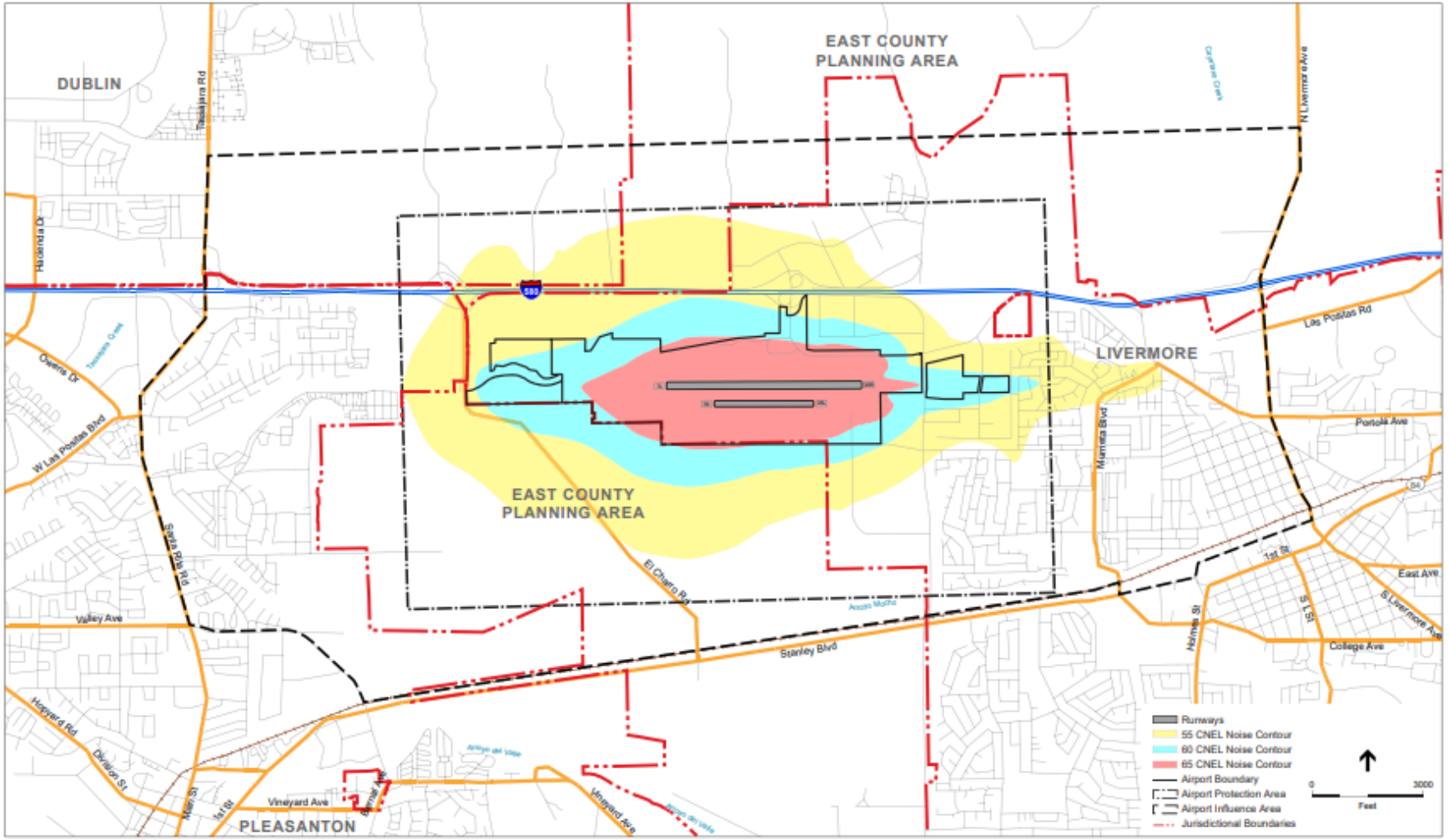
Aircraft Noise

The Livermore Municipal Airport is the only airport in the City of Livermore and is near the northwest portion of the city limits. Aircraft noise in Livermore is characterized as rare but can be intrusive to sensitive receptors east of the airport runway. The Livermore Municipal Airport is a public airstrip with supporting general aviation activities. Airport noise contours (see Figure 16-1) from the 2012 Livermore Municipal Airport Land Use Compatibility Plan extend east into a residential neighborhood. The 60 CNEL noise contour extends slightly beyond Stealth Street, and the 55 CNEL contour extends approximately 0.6 miles east of the 60 CNEL noise contour. This City of Livermore could experience some noise from occasional aircraft overflights in destination to or departing from San Francisco International Airport, Oakland International Airport, and San Jose International Airport.[5]

[5] SFO Flight Patterns and Operations Plans. https://www.flysfo.com/community/noise/sfo-flight-patterns-and-operations

NOISE AND VIBRATION

Figure 16-1 Livermore Municipal Airport Existing Noise Contours



Alameda County ALUC, Livermore Executive Airport Land Use Compatibility Plan, August 2012.

Traffic Noise

Traffic noise is a major source of noise in the City of Livermore. Major freeways that run though the city include Interstate 580 and State Route 84. Some major arterial roadways include North and South Valco Road, East Stanley Boulevard, Holmes Street, South Livermore Avenue, and East Avenue. Figure 16-2 shows the 2025 traffic noise contours from the existing General Plan. The existing traffic noise contour map will be updated and included in the Noise section of the Draft Environmental Impact Report (EIR). Present-day traffic noise contours are anticipated to be comparable to the 2025 map shown in Figure 16-2.

Railroad Noise

There is one railroad corridor that runs through the City of Livermore. The Union Pacific (UP) Railroad owns and operates freight traffic on the Oakland Subdivision. The UP Oakland Subdivision extends from Stockton in the east to Oakland, crossing Altamont Pass and traversing Niles Canyon. There is one main track and one siding track throughout most of the city. The single track diverges into two tracks at Arroyo Seco and is aligned through the city as two tracks until reaching Trader Joe's (between North P Street and Murietta Boulevard) where it again converges into one track. The Altamont Corridor Express (ACE) also operates commuter trains along this line. There are two ACE stations within the city; one is at 2418 Railroad Avenue (Livermore Station) and one is at 575 South Vasco Road (Vasco Road Station).

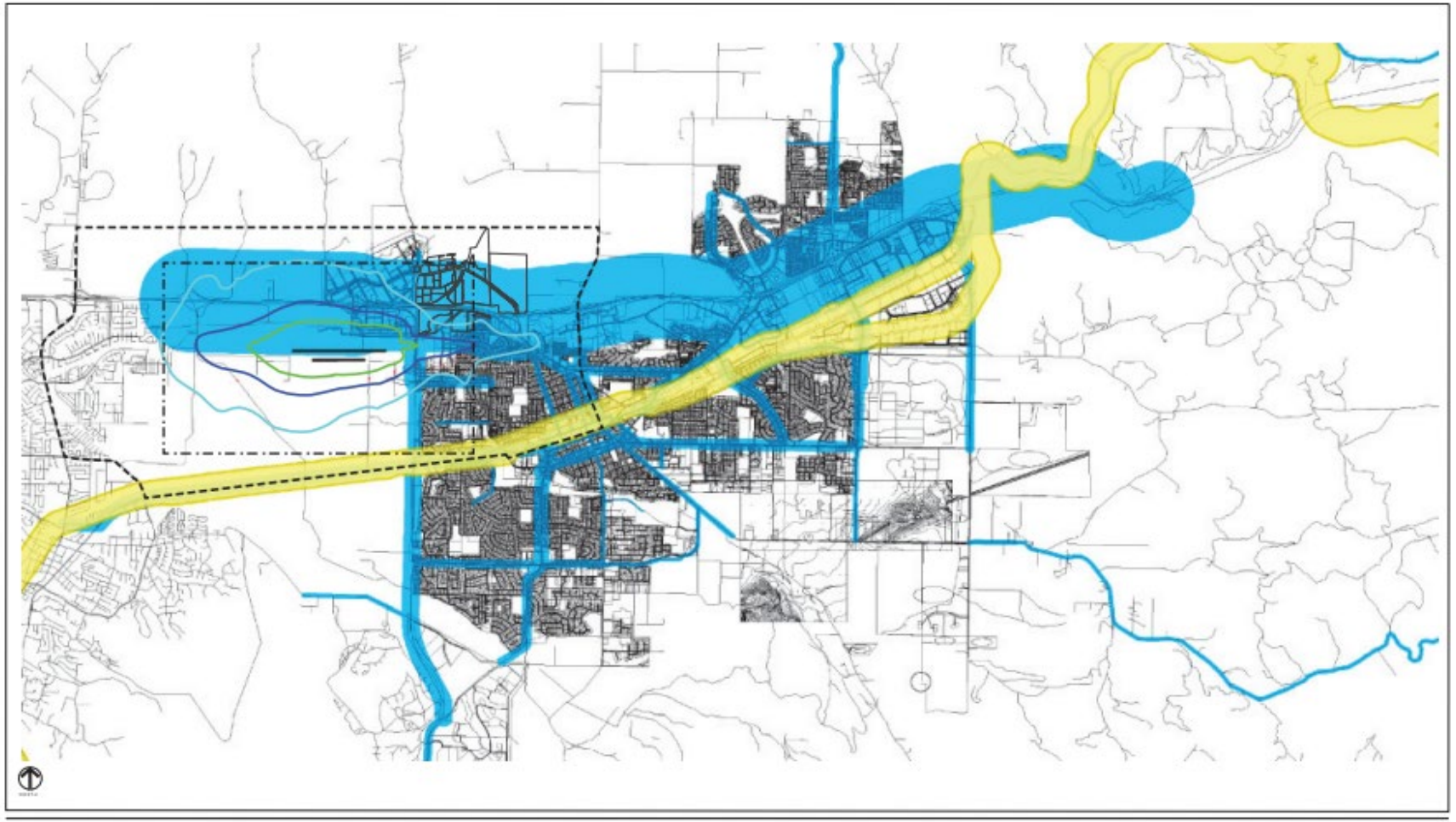
There are two at-grade crossings within the city at L Steet and Junction Avenue. All the other rail crossings are grade separated by overpasses or underpasses. According to federal regulations, trains are required to blow their horns as they approach at-grade crossings as a safety measure to alert motorists and pedestrians. However, this can be a significant noise impact for nearby residents and commercial/industrial land uses.

According to Federal Rail Administration (FRA) crossing data, there are a total of 12 trains that travel through Livermore each day. There are eight ACE passenger trains and four UP freight trains. Although the speed limits for freight and passenger trains along the sections of track within the city are 50 and 60 mph, respectively, most of the trains are traveling at speeds of approximately 40 to 45 mph because of starts and stops at the ACE passenger stations. The typical ACE train consists of one locomotive and seven cars.

The San Joaquin Regional Rail Commission (SJRRC) manages the ACE commuter rail service that connects Stockton and San Jose during morning and evening commuting hours. ACE operates eight passenger trains that travel through the city – four westbound and four eastbound trains every weekday. The morning westbound trains arrive in Livermore between the hours of 5:10 a.m. and 8:37 a.m. and the evening eastbound trains depart Livermore between 4:37 p.m. and 7:45 p.m. The trains run approximately every hour during commuting hours. As indicated by the ACE vision plan, future service is expected to increase to two additional round trips in the near term and four additional round trips in the long term.

NOISE AND VIBRATION

Figure 16-2 2025-2030 Contours



City of Livermore, 2003-2025 General Plan, July 2021

Approximately four freight trains per day pass through the City of Livermore. The Lathrop Shuttle (ILTLT) typically runs from Oakland to Lathrop and back every day, which is a total of two Lathrop Shuttle trains through Livermore per day. The average Lathrop Shuttle consists of two locomotives and about 65 cars.

There is one long intermodal train (INPOA) traveling from the Midwest to Oakland every day and occasionally a second long intermodal train (ZG2OAB). For this analysis, it is assumed that there are two long-distance intermodal trains per day through Livermore with an average of six locomotives and 100 cars. The large number of locomotives is needed to climb over Altamont Pass. Most of these trains are traveling at approximately 45 mph as they pass through Livermore.

Existing Noise Contour Distances

Day-night average noise levels from train traffic vary depending on the number of trains operating along a given line per day, the timing and duration of train pass-by events, and whether the receptor is near an at-grade crossing. When trains approach an at-grade crossing or passenger station, they are required to sound their locomotive horns for 15 to 20 seconds but not more than 0.25 mile in advance of the crossing. The required pattern is two long, one short, and one long sounding horn. The required volume for train horns is between 96 and 110 dBA.

Existing railroad noise levels were estimated based on the train traffic along the UP Oakland Subdivision and using the Federal Transit Administration's (FTA's) CREATE rail noise model and the FRA's Grade Crossing Horn Model. The number of locomotives and rail cars was determined from the ACE website, UP Oakland Subdivision videos, and FRA accident data.

There currently are 12 trains per weekday along the UP Oakland Subdivision, with 9 trains passing through Livermore during the day and 3 during the night. As shown in Table 16-4, the distance from the track to the 65 dBA contour from rail noise is 85 feet, and the 65 dBA contour within a quarter-mile of the two at-grade crossings from the trains blowing their horns extends to 212 feet.

TABLE 16-4 EXISTING RAILROAD NOSIE LEVELS

Operator	Subdivision	Distance (feet) to 65 dBA CNEL Contour (Mainline)	Distance (feet) to 65 dBA CNEL Contour (within 0.25 mile of grade crossing)
Union Pacific	Oakland Subdivision (Freight)	85	212

Source: Calculated using the FTA CREATE Model and FRA Grade Crossing Horn Model.

FRA Quiet Zones

The FRA has established a process that enables cities to implementing Quiet Zones to mitigate noise impacts from train horn soundings. To qualify for a Quiet Zone, a city must comply with the regulations established by the FRA related to upgrading crossing safety devices and periodic reporting and obtain approval by the California Public Utilities Commission (CPUC) and UP. Additional safety measures typically include four-quadrant gates, gates with raised medians or other channelization devices, or wayside horns. The required Supplemental Safety Measures (SSMs) are determined based on the existing infrastructure, the number of trains per day, the speed of the trains, the size of the roadway crossing, the volume of

traffic on the roadway crossing, and historical safety data. The output is a Quiet Zone Risk Index score, which can be determined using the FRA's online Quiet Zone Calculator. The results allow the City to consider a variety of options in determining which SSMs make the most sense. The estimated cost of SSMs per crossing typically ranges from $500,000 to $2 million, depending on the SSMs that need to be installed.

Stationary Noise Source

Stationary sources of noises may occur from all types of land uses. Residential uses generate noise from landscaping, maintenance activities, refuse collection, and air conditioning systems. Commercial/retail uses generate noise from heating, ventilation, air conditioning (HVAC) systems; generators; loading docks/truck deliveries; rail yards; and other sources. Mixed-uses generate a combination of residential and retail/commercial-related noise sources. Industrial uses generate noise from HVAC systems, loading docks, equipment, and machinery. Noise generated by residential or commercial uses are generally short and intermittent. Industrial uses may generate noise on a more continual basis due to the nature of the activities. In addition, equipment on agricultural and mining lands can create localized noise to existing residential uses. For example, the CEMEX Pleasanton Plant east of State Route 24 and Livermore City limits. Nightclubs, outdoor dining areas, gas stations, car washes, fire stations, drive-throughs, swimming pool and hot tub pumps, school playgrounds, athletic and music events, and public parks are other common noise sources.

16.4 IMPLICATIONS FOR THE GENERAL PLAN UPDATE

Based on the information in this chapter, the General Plan Update process should consider the following:

- Coordination with FRA to establish quiet zones at railroad crossings adjacent to sensitive receptors within the City of Livermore.
- Implementation of temporary construction noise and vibration thresholds, in addition to the limited hours of construction activity (Section 9.36.080).
- Standard conditions of approval and best management practices for construction equipment and activity.
- Limiting the development of noise-sensitive uses to the degree feasible within the 65 dBA CNEL (or greater) airport, rail, and roadway noise contours. If not feasible, require that an acoustical study be conducted to recommend any necessary building design features or other measures to reduce interior and common use exterior areas of the project site to acceptable noise levels.
- Include policies/actions for noise reduction measures (sound-rated windows and other building materials, site layout, barriers, etc) that directly address putting residential in areas that do not meet noise compatibility standards. In general, trees are not effective at substantially reducing noise unless they are dense evergreens hundreds of feet deep. New sound wall construction will be discouraged unless it is the only option for reducing noise to acceptable levels.
- Adopt exterior noise level standards in the City of Livermore Municipal Code for stationary, non-transportation noise sources (e.g., mechanical equipment, truck loading, etc).

16.5 GLOSSARY

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 the human ear or a microphone.
- **Noise.** Sound that is loud, unpleasant, unexpected, or otherwise undesirable.
- **Decibel (dB).** A measure of sound on a logarithmic scale.
- **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}).** The mean of the noise level, energy averaged over the measurement period.
- **L_{max}.** The maximum root-mean-square noise level during a measurement period.
- **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). This is also 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."
- **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 dBA added to the sound levels occurring during the period from 10:00 p.m. to 7:00 a.m.
- **Community Noise Equivalent Level (CNEL).** The energy-average of the A-weighted sound levels occurring during a 24-hour period, with 5 dBA added to the levels occurring during the period from 7:00 p.m. to 10:00 p.m. and 10 dBA added to the sound levels occurring during the period from 10:00 p.m. to 7:00 a.m. Note: For general community/environmental noise, CNEL and L_{dn} values rarely differ by more than 1 dBA. As a matter of practice, L_{dn} and CNEL values are considered to be equivalent/interchangeable.
- **Peak Particle Velocity (PPV).** The peak rate of speed at which soil particles move (e.g., inches per second) due to ground vibration.

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