CHAPTER VII

NOISE

Adopted in entirety by Resolution 2002-56 on October 28, 2002

PURPOSE

The purpose of the Noise Section is to protect the health and welfare of the community by promoting development which is compatible with established noise standards. This section has been prepared in conformance with Government Code § 65302(f) and the guidelines adopted by the State Office of Noise Control, pursuant to Health and Safety Code § 46050.1. Existing and future noise problems in Lafayette and its Sphere of Influence are identified. Policies and implementation programs are provided to reduce the community's exposure to excessive noise levels. Accomplishing this task requires an evaluation of the noise from sources such as roads, highways, BART, and from stationary sources such as schools and businesses.

The Noise Chapter contains the following sections:

- A map of projected future noise contours
- Standards for indoor and outdoor noise exposure
- Policies and implementation programs to mitigate the major noise problems where possible, both in the present and in the foreseeable future

NOISE CHARACTERISTICS

Noise is defined as unwanted sound. Airborne sound is a rapid fluctuation of air pressure above and below atmospheric pressure. Sound levels are usually measured and expressed in decibels (dB) with 0 dB corresponding roughly to the threshold of hearing. Decibels and other technical terms are defined in Table 1.

Most of the sounds, which we hear in the environment, do not consist of a single frequency, but rather a broad band of frequencies, with each frequency differing in sound level. The intensities of each frequency add together to generate a sound. The method commonly used to quantify environmental sounds consists of evaluating all of the frequencies of a sound in accordance with a weighting that reflects the fact that human hearing is less sensitive at low frequencies and extreme high frequencies than in the mid-range frequency. This method is called "A" weighting, and the decibel level so measured is called the A-weighted sound level (dBA). In practice, the level of a sound source is conveniently measured using a sound level meter that includes an electrical filter corresponding to the A-weighting curve. Typical A-levels measured in the environment and in industry are shown in Table 2 for different types of noise.

Although the A-weighted noise level may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously. Most environmental noise includes a conglomeration of noise from distant sources which create a relatively steady background noise, often called ambient noise in which no particular source is identifiable. To describe the time-varying character of environmental noise, the statistical noise descriptors, L_{10}, L_{50}, and L_{90}, are commonly used. They are the A-weighted noise levels equaled or exceeded during 10 percent, 50 percent, and 90 percent of a stated time period. A single number descriptor called the L_{eq} is now also widely used. The L_{eq} is the average A-weighted noise level during a stated period of time.

TABLE 1

DEFINITION OF ACOUSTICAL TERMS

Term	Definition
Decibel (dB)	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals (20 micronewtons per square meter).
Frequency (Hz)	The number of complete pressure fluctuations per second above and below the atmospheric pressure.
A-Weighed Sound Level (dBA)	The sound pressure level in decibels as measured on a sound level meter using the A-weighing filter network. The A-weighing filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded by 1%, 10%, 50% and 90% of the time during the measurement period.
Equivalent Noise Level (L_{eq})	The average A-weighted noise level during the measurement period.
L_{dn}	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 PM and 7:00 AM.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

SOURCE: ILLINGWORTH & RODKIN, INC. ACOUSTICAL ENGINEERS, 1995

TABLE 2

TYPICAL NOISE LEVELS

At a Given Distance From Noise Source	Sound Levels (dBA)	Noise Environments	Subjective Impression
Civil Defense Siren (100')	130		
Jet Takeoff (200')	120		Threshold of Pain
	110	-Rock Music Concert	
Pile Driver (50')	100		Very Loud
Ambulance Siren			
	90	-Boiler Room	
Freight Cars (50')		-Printing Press Plant	
Pneumatic Drill (50')	80	-25 ft. From Hwy. 24*	
Freeway (100')		-In Kitchen With Garbage Disposal Running	
	70	-50 ft. from Moraga Road at City Limits*	Moderately Loud
		-50 ft. From Happy Valley Road at Palo Alto Drive*	
Vacuum Cleaner (10')	60	-Busy Department Store	
		-Typical Lafayette residential neighborhoods*	
Light Traffic (100')	50	-Private Business Office	
Large Transformer (200')		-Low density residential well shielded from traffic noise*	
	40	-Undeveloped open space in well shielded canyon*	Quiet
Soft Whisper (5')	30	-Quiet Bedroom	
	20	-Recording Studio	
	10		
	0		Threshold of Hearing

SOURCE: ILLINGWORTH & RODKIN, INC. ACOUSTICAL ENGINEERS, 1995
* SOURCE FOR OUTDOOR LOCATIONS: WILSON, IRHIG & ASSOCIATES, LAFAYETTE NOISE ELEMENT MARCH 1976

In determining the daily level of environmental noise, it is important to account for the difference in response of people to daytime and nighttime noises. During the nighttime, exterior background noises are generally lower than the daytime levels. However, most household noise also decreases at night and exterior noise becomes very noticeable. Further, sensitivity to noise increases when people sleep at night. To account for human sensitivity to nighttime noise levels, a descriptor, the L_{dn} (day/night average sound level), was developed. The L_{dn} divides the 24-hour day into the daytime of 7:00 AM to 10:00 PM and the nighttime of 10:00 PM to 7:00 AM. The nighttime noise level is weighted 10 dB higher than the daytime noise level.

Human Response to Noise

The effects of noise on people can be categorized as follows:

- Subjective effects of annoyance, nuisance, dissatisfaction
- Interference with activities such as speech, sleep, learning
- Physiological effects such as fear response, hearing loss

The levels associated with environmental noise, in almost every case, produce effects only in the first two categories. Workers in industrial plants can experience noise in the last category. Unfortunately, there is as yet no completely satisfactory way to measure the subjective effects of noise, or of the corresponding reactions of annoyance and dissatisfaction. This is primarily because of the wide variation in individual thresholds of annoyance, and habituation to noise over differing individual past experiences with noise. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by people.

The following relationships will be helpful in understanding the significance of increases in the A-weighted noise level.

- In short-term laboratory experiments, a change of 1 dB can just be perceived. Longer-term exposure to a 1 dB change in environmental noise is perceivable.
- Outside of the laboratory, a 3 dB change is considered a noticeable difference.
- A change in level of 5 dB is very obvious, and a noticeable change in community response would be expected.
- A 10 dB change is subjectively heard as approximately a doubling in loudness, and would almost certainly cause an adverse change in community response.

In any typical noise environment about 10 percent of the population will object to any noise not of their own making and 25 percent will not react or complain at all, regardless of the level of noise being generated. Consequently, noise control measures are most beneficial to the remaining 65 percent of the population who are neither ultra sensitive nor insensitive to noise. Negative reaction to noise generally increases with the increase in difference between background (or ambient) noise and the noise generated from a particular source such as traffic or railroad operations. In most situations, noise control measures need to reduce noise by 5 to 10 dBA in order to effectively reduce complaints.

People generally have the ability to distinguish one sound from a background of sounds, such as a telephone ringing over music. However, certain noise levels can render a sound inaudible. For example, heavy trucks can interfere with a conversation. Face-to-face conversation usually can proceed where the noise level is up to 66 dBA, group conversations up to 50 to 60 dBA, and public meetings up to 45 or 55 dBA, without interruption.

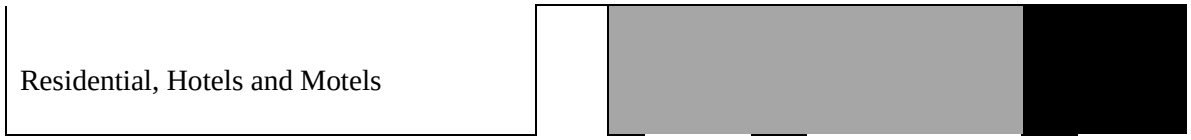
Sleep interference is more difficult to quantify, although studies have shown that progressively deeper levels of sleep require louder noise levels to cause a disturbance. The California Office of Noise Control (ONC) recommends that individual events within sleeping areas should not exceed 50 dBA in residential areas exposed to noise levels of 60 L_{dn}, or greater. Interior noise standards of 45 L_{dn} will help protect against sleep interference.

Environmental noise, in almost every case, produces effects, which are subjective in nature or involve interference with human activity. However, brief sounds at levels exceeding 70 dBA can produce temporary physiological effects such as constriction of blood vessels, changes in breathing and dilation of the pupils. Steady noises of 90 dBA have been shown to increase muscle tension and adversely affect simple decision-making. Long-term exposure to levels exceeding 70 dBA can cause hearing loss.

Noise and Land Use Compatibility Standards

The standards listed in Figure 1 should be used to evaluate the compatibility between land uses and future noise in Lafayette. Figure 1 should be used in combination with Map VII-1: *Noise Contours* to determine whether a proposed development or land use is located in an area requiring special noise mitigating measures. A proposed development or land use located in an area indicated by Map VII-1 as being within an acceptable level would not require any special noise abatement measures. An office building proposed in an area with an exterior noise level exceeding 65 dBA, however, would be required to have a combination of noise mitigating features such as additional noise insulation, building setbacks, noise walls or other measures as indicated by an acoustical study.

Figure 1



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

Conditionally Acceptable
Specified land use may be permitted only after a detailed analysis of the noise reduction requirements and needed noise insulation features included in the design.

Unacceptable
New construction or development should generally not be undertaken because mitigation is usually not feasible to comply with noise element policies.

Explanation of Figure 1: Land Use Compatibility for Community Noise

A. Noise Source Characteristics

Figure 1 shows the ranges of exterior noise exposure which are considered to be acceptable, conditionally acceptable, or unacceptable for the specified land use. Figure 1 is used to determine whether or not the noise exposure requires mitigation in order to achieve a compatible noise environment.

Where the noise exposure is acceptable for the intended land use, new development may occur without requiring an evaluation of the noise environment.

Where the noise exposure would be conditionally acceptable a specified land use may be permitted only after a detailed analysis is made of the noise reduction requirements and the needed noise insulation features are included in the design. 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 residences, schools, hospitals or other buildings which are sensitive to noise. Mitigation measures should be focused on reducing noise where it would have an adverse effect for the specified land use, outdoors and/or indoors depending upon the land use.

For areas where the existing noise environment is unacceptable, new development should generally not be undertaken because there may not be sufficient mitigations to bring the development into compliance with the noise policies of this Chapter.

B. Suitable Interior Environments

One objective of locating residential units relative to a known noise source is to maintain a suitable interior noise environment at no greater than 45 dB L_{dn} or L_{dn}. This requirement, coupled with the measured or calculated noise reduction performance of all types of structures under consideration, should govern the minimal acceptable distance to a noise source.

C. Acceptable Outdoor Environments

Another consideration, which in some communities is an overriding factor, is the desire for an acceptable outdoor noise environment. When this is the case, more restrictive standards for land use compatibility, typically below the maximum considered "normally acceptable" for that land use category may be appropriate.

The following considerations should be taken into account when using the Noise and Land Use Compatibility Standards:

1. The standard for maximum outdoor noise levels in residential areas is a L_{dn} of 60 dB. This standard is applied where outdoor use is a major consideration, such as backyards in single-family housing developments and recreation areas in multifamily developments. This standard should not be applied to outdoor areas such as small decks and balconies typically associated with multifamily residential developments, which can have a higher standard of 65 L_{dn}.

2. The maximum acceptable interior noise level in new residential development required by the State of California Noise Insulation Standards is an L_{dn} of 45. This standard continues to be applied to single family and all other residential development in Lafayette. In addition, the interior noise level for offices shall be L_{dn} 45 dB or less.

3. These standards are not intended to be applied reciprocally. In other words, if an area is currently below the desired noise standard, an increase in noise up to the maximum should not necessarily be permitted. The impact of a proposed project on an existing land use should be evaluated in terms of the potential for adverse community response, based on existing community noise levels, regardless of the compatibility standards.

4. The Noise and Land Use Compatibility Standards should be reviewed in relation to the specific source of noise. These standards are based on measurement systems, which average noise over a 24-hour period and do not take into account single-event noise sources. For example, aircraft noise normally consists of a higher single-noise event than vehicular traffic and has been linked to sleep interference and other significant problems, but occurs infrequently in Lafayette. Different noise sources yielding the same composite noise exposure do not necessarily create the same environment. Additional standards may be applied on a case-by-case basis where supported by acoustical analysis to mitigate the effects of single-event noise sources.

   Sensitive receptors are land uses, which are sensitive to noise such as hospitals, convalescent homes, schools, and libraries. Noise levels for these types of uses should not exceed those allowed in Figure 1. Map VII-1 *Noise Contours* indicates the projected environmental noise levels and the location of some noise sensitive uses in the City.

THE EXISTING NOISE ENVIRONMENT

The major source of noise in Lafayette is vehicular traffic, including automobiles, trucks, buses, and motorcycles. The level of vehicular noise generally varies with the volume of traffic, the number of trucks or buses, the speed of traffic, and the distance from the roadway. Noise generated by vehicular traffic in the City is greatest along State Route 24, which is the dominant noise source in Lafayette. Local roadways including Moraga Road, First Street, Pleasant Hill Road, and Mt. Diablo Boulevard are also significant sources of traffic noise.

Noise levels were measured at selected points throughout Lafayette in order to quantify the existing noise environment. Day/night average noise levels range from a high of about 82 dBA in rear yards of homes adjacent to State Route 24 down to about 49 dBA at locations on the shielded or far side of ridges from the highway. The residual L_{dn} of 49 dBA results from regular high altitude jet aircraft overflights.

Traffic noise levels throughout Lafayette were calculated using a noise contour program based on Federal Highway Administration research document FHWA RD77-108. The California Vehicle Noise Emission Levels (CALVENO) developed by Caltrans were used in the model. The noise contour data are tabulated in Tables 16 and 17 in the Appendix of the Lafayette General Plan Revision Environmental Impact Report. The calculated levels depend upon the number of automobiles, medium trucks and heavy trucks, and the speed of the vehicles to calculate the distance to noise contours. Implicit in this model is the assumption that the average noise level during the noisiest hour approximates the 24-hour day/night average noise level. The hourly data gathered during the long-term measurements indicate that along State Route 24 the L_{dn} is approximately 2 dB higher than the noisiest hour L_{eq}. This is due to high noise levels during the early morning hours and late evening hours. Noise levels measured along local streets indicate good correlation between the peak hour L_{eq} and the L_{dn}. The results of the computer modeling were adjusted to account for the results of the long-term measurements.

The Bay Area Rapid Transit (BART) system runs in the median of State Route 24 through Lafayette. The noise of the State Route 24 masks (obscures) the noise of BART at most locations most of the time. BART trains are audible at residences located north and south of State Route 24 in western Lafayette where freeway noise is partially shielded from these residences. Noise levels measured in western Lafayette indicate that maximum noise levels due to BART trains can reach about 80 dBA at the residences. BART noise is unique in character and therefore identifiable in comparison to traffic noise. The contribution of BART to the 24-hour average noise level is insignificant, however, due to the continuous noise levels generated by the freeway.

There are no significant sources of industrial noise or stationary noise sources in the Lafayette Planning Area.

The noise of high altitude jet aircraft is significant in Lafayette in areas where traffic noise is not significant. Aircraft are heard regularly during the daytime. Maximum noise levels resulting from jet aircraft overflights typically range from 50 to 60 dBA and can be as high as 65 to 70 dBA. The L_{dn} resulting from jet aircraft overflights is less than 50 dBA.

Goal N-1 Ensure that all new development is consistent with the standards for noise.

Policy N-1.1 General Noise Levels: The maximum allowable noise levels are established in this Chapter.

Policy N-1.2 Reduce Noise Impacts: Avoid or reduce noise impacts first through site planning and project design. Barriers and structural changes may be used as mitigation techniques only when planning and design prove insufficient.

Program N-1.2.1: Use the City's Noise Ordinance in environmental review of all development proposals and incorporate project design measures to reduce noise to allowable limits. (Formerly S-11.2.10)

Program N-1.2.2: Evaluate mitigation measures for projects that would cause a "substantial increase" in noise as defined by the following criteria or would generate unusual noise which could cause significant adverse community response:

a) cause the L_{dn} in existing residential areas to increase by 3 dB or more;

b) cause the L_{dn} in existing residential areas to increase by 2 dB or more if the L_{dn} would exceed 70 dB; or

c) cause the L_{dn} resulting exclusively from project-generated traffic to exceed an L_{dn} of 60 dBA at any existing residence.

A 3 dB increase would result if traffic increased by 100% over existing levels. It is recognized that there are locations where the outdoor criteria of an L_{dn} of 55 dB cannot be reasonably and feasibly achieved. These situations will be evaluated on a case-by-case basis to determine the appropriate level of mitigation.

Policy N-1.3 Noise and Land Use Compatibility Standards: Ensure that all new noise sensitive development proposals be reviewed with respect to *Figure 1: Noise and Land Use Compatibility Standards*. Noise exposure shall be determined through actual on-site noise measurements.

Policy N-1.4 Residential and Noise Sensitive Land Use Standards: Require a standard of 40 - 45 L_{dn} (depending on location) for indoor noise level for all new residential development including hotels and motels, and a standard of 55 L_{dn} for outdoor noise, except near the freeway. These limits shall be reduced by 5 dB for senior housing and residential care facilities.

Program N-1.4.1: Use the standards in Policy N-1.2.2 to determine the need for noise studies and require new developments to provide noise attenuation features as a condition of approving new projects.

Program N-1.4.2: Require an acoustical study for all new residential projects with a future L_{dn} noise exposure of 55 L_{dn} or greater. The study shall describe how the project will comply with the Noise and Land Use Compatibility Standards.

The studies shall also satisfy the requirements set forth in Title 24, part 2 of the California Government Code, Noise Insulation Standards, for multi-family attached dwellings, hotels, motels, etc. regulated by Title 24.

Program N-1.4.3: Require that all new single-family residential development meet the standards set forth in California Title 24, in addition to multi-family residential development, hotels, motels, etc.

Policy N-1.5 Interior Noise Standards Applied to Remodel Projects: Interior noise standards shall be applied to residential remodel projects where the remodeling is valued at 50% of the assessed value or greater.

Program N-1.5.1: Review all building permit applications for compliance with the applicable interior noise standards and require, as necessary, the appropriate noise mitigating features.

Goal N-2 Work to reduce noise to acceptable levels where it now exceeds those standards.

Policy N-2.1 Reduce Outdoor Noise in Existing Residential Areas: Reduce outdoor noise in existing residential areas where economically and aesthetically feasible.

Program N-2.1.1: Consider sound barrier walls, grading and landscaping, and change in traffic patterns as potential measures.

Policy N-2.2 Mitigate Noise Impacts: Mitigate noise impacts to the maximum feasible extent.

Program N-2.2.1: Require acoustical studies and mitigation measures for new developments and roadway improvements which affect noise sensitive uses such as schools, hospitals, libraries and convalescent homes.

Program N-2.2.2: Require acoustical studies of any project that would potentially generate non-transportation noise levels in a residential area such that noise levels would exceed the planning standards set forth in Program N-1.2.2.

Program N-2.2.3: Work with Caltrans to ensure that adequate noise studies are prepared and alternative noise mitigation measures are considered when state and federal funds are available.

Program N-2.2.4: Consider and carefully evaluate the noise impacts of all street, highway and other transportation projects.

Program N-2.2.5: Continue to seek state and federal funding to construct noise barriers where impact of noise can be significantly reduced and the project would be in keeping with all the goals & policies of the General Plan

Program N-2.2.6: Restrict truck traffic to designated routes.

Program N-2.2.7: Recommend acoustical studies for all projects that would be exposed to noise levels in excess of those deemed normally acceptable, as defined in Figure 1.

Program N-2.2.8: Consider developing an ordinance that regulates the allowable hours of construction activities.

Program N-2.2.9: Consider developing standards to regulate the use of leaf blowers and like equipment.

(Just deleted) *(Moved to S-10.2.1)*

Program N-2.2.10: Consider using "quiet" pavement such as dense graded asphalt or open graded asphalt when re-paving streets.