



appendix d: community noise fundamentals

D

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BACKGROUND

Three aspects of community noise are important in determining subjective response:

- **Level** (i.e., magnitude or loudness) of the sound;
- The **frequency** composition or spectrum of the sound; and
- The **variation** in sound level with time.

Airborne sound is a rapid fluctuation of air pressure and local air velocity. Sound levels are measured and expressed in decibels (dB) with 0 dB roughly equal to the threshold of hearing.

The frequency of a sound is a measure of the pressure fluctuations per second measured in units of hertz (Hz). Most sounds do not consist of a single frequency, but are comprised of a broad band of frequencies differing in level. The characterization of sound level magnitude with respect to frequency is the sound spectrum. A sound spectrum is often described in octave bands that divide the audible human frequency range (i.e., from 20 to 20,000 Hz) into ten segments.

FREQUENCY WEIGHTING

Many rating methods exist to analyze sound of different spectra. The simplest method is generally used so that measurements may be made and noise impacts readily assessed using basic acoustical instrumentation. This method evaluates all frequencies by using a single weighting filter that progressively de-emphasizes frequency components below 1000 Hz and above 5000 Hz. This frequency weighting reflects the relative decreased human sensitivity to low frequencies and to extreme high frequencies. This weighting is called A-weighting and is applied by an electrical filter in all U.S. and international standard sound level meters.

NOISE EXPOSURE

Noise exposure is a measure of noise over a period of time, whereas noise level is a single value at an instant in time. Although a single sound level may adequately describe community noise at any instant in time, community noise levels vary continuously. Most community noise is produced by many distant noise sources that produce a relatively steady background noise having no identifiable source. These distant sources change gradually throughout the day and include traffic, wind in trees, and distant industrial activities. Superimposed on this slowly varying background is a succession of identifiable noise events of brief duration. These include nearby activities such as single vehicle passbys or aircraft flyovers, which cause the community noise level to vary from instant to instant.

A single number called the equivalent sound level or Leq is used to describe noise varying over a period of time. The Leq is the average noise exposure level over a period of time (i.e., the total sound energy divided by the duration). It is the constant sound level, which would contain the same acoustic energy as the varying sound level, during the same time period. The Leq is useful in describing noise over a period of time with a single numerical value.

In determining the daily measure of community noise, it is important to account for the difference in human response to daytime and nighttime noise. During the nighttime, exterior background noise levels are generally lower than in the daytime. Most household noise also decreases at night, and exterior noise intrusions become more noticeable. People are more sensitive to noise at night than during other periods of the day.

To account for human sensitivity to nighttime noise, the Community Noise Equivalent Level (CNEL) is the adopted standard in California. CNEL values are typically computed by energy summation of hourly noise level values, with the proper adjustment applied for the period of evening or night. The CNEL is computed by assessing a 5-dB penalty for evening (i.e., 7:00 pm to 10:00 pm) noise and a 10-dB penalty for nighttime (i.e., 10:00 pm to 7:00 am) noise. Noise exposure measures such as Leq and CNEL are A-weighted, with units expressed in decibels (i.e., dB).

SUBJECTIVE RESPONSE TO NOISE

The effects of noise on people can be classified into three general categories:

1. Subjective effects of annoyance, nuisance, dissatisfaction.
2. Interference with activities such as speech, sleep, and learning.
3. Physiological effects such as anxiety or hearing loss.

The sound levels associated with community noise usually produce effects only in the first two categories. No universal measure for the subjective effects of noise has been developed, nor does a measure exist for the corresponding human reactions from noise annoyance. This is primarily due to the wide variation in individual attitude regarding the noise source(s).

An important factor in assessing a person's subjective reaction is to compare the new noise environment to the existing noise environment. In general, the more a new noise exceeds the existing, the less acceptable it is. Therefore, a new noise source will be judged more annoying in a quiet area than it would be in a noisier location.

Knowledge of the following relationships is helpful in understanding how changes in noise and noise exposure are perceived.

- Except under special conditions, a change in sound level of 1 dB cannot be perceived.
- Outside of the laboratory, a 3-dB change is considered a just-noticeable difference.
- A change in level of at least 5 dB is required before any noticeable change in community response would be expected.
- A 10-dB change is subjectively heard as an approximate doubling in loudness and almost always causes an adverse community response.

NOISE MEASUREMENTS

Existing ambient noise levels were measured at 15 sites around Cupertino to document representative noise levels at a variety of locations. These locations are shown on **Figure D-1**. Short-term noise level measurements were taken at 13 locations for a minimum period of 15 minutes during the daytime on Tuesday, April 22 and Wednesday, April 23, 2014, between the hours of 8:00 a.m. and 7:00 p.m. Short-term noise measurements serve as a snapshot of noise levels at a particular time and location, offering a sense of how other, similar locations might experience noise during comparable times of day. Long-term noise level measurements were taken at two locations for a period of 24 hours between April 22 and 23, 2014.

Long-term noise level measurements serve to provide a broader picture of how noise levels vary over the course of a full day, helping to put the short-term measurements in a broader temporal context. Both long- and short-term measurements serve to indicate where excessive noise may be an existing or future issue for existing or new land uses.

As shown in **Table D-1**, noise levels at the short-term measurement locations ranged from a minimum of 58.4 dBA Leq at Location 4 to a maximum of 71.4 dBA Leq at Location 3, with an average Leq of 66.2 dBA, and the majority locations falling between 65 and 70 dBA Leq. Noise levels tended to be higher adjacent to major roadways and freeway, where high volumes of traffic were the dominant source of noise.

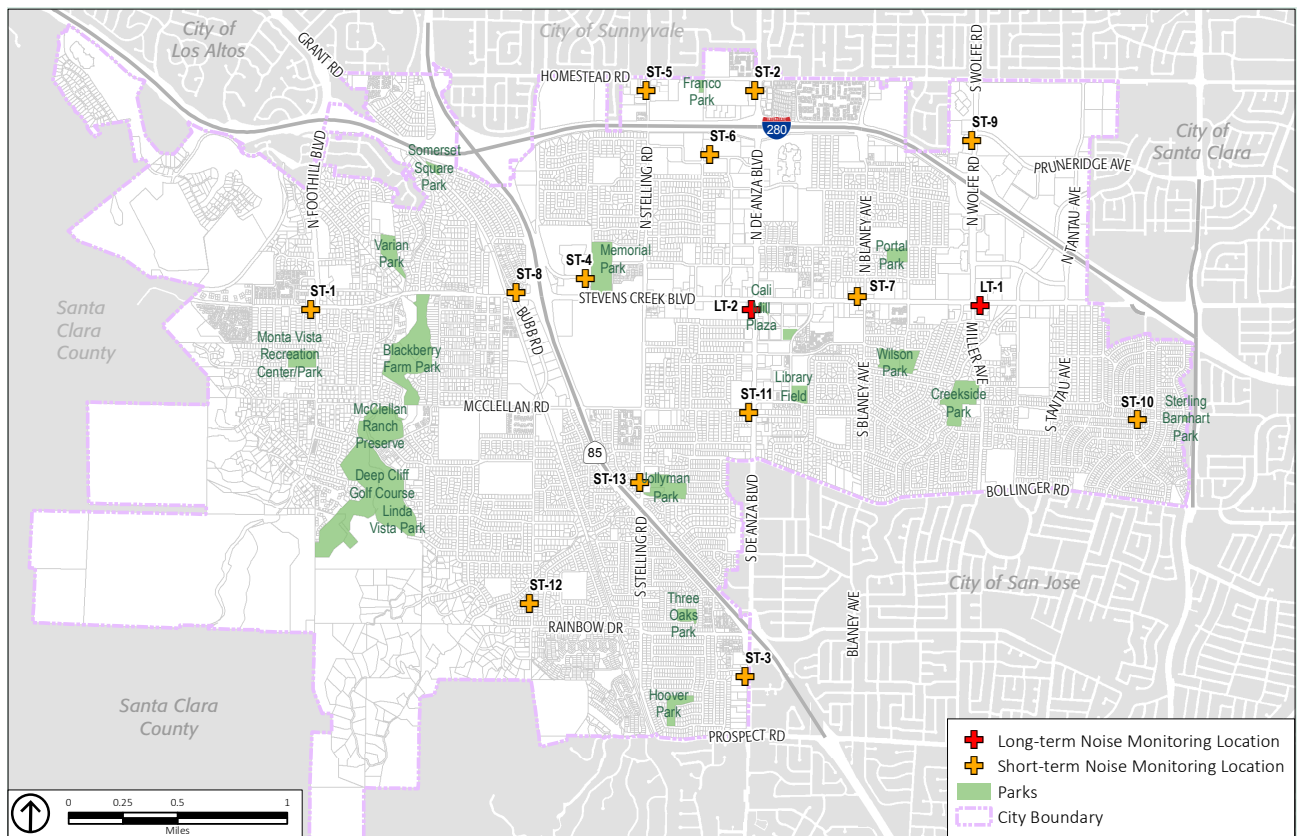
Noise levels were measured using a Larson-Davis Model 820 sound level meter, which satisfies the American National Standards Institute for Type 1 general environmental noise measurement instrumentation. The sound level meter and microphone were mounted on a tripod 5 feet above the ground and equipped with a windscreen during all short-term measurements. For long-term measurements, the microphone and windscreen were attached to available objects, at a height between four and six feet, as dictated by conditions in the field.

The sound level meters were programmed to record noise levels with the “slow” time constant and using the “A” weighting filter network. Meteorological conditions during the measurement periods were favorable and were noted

to be representative of typical conditions for the season. Generally, conditions included clear to partly cloudy skies, daytime temperatures of approximately 57 to 78 degrees Fahrenheit, and less than 5 to 10 mile-per-hour winds, with occasional higher gusts noted at certain sites. The short- and long-term noise measurement locations are described below. **Table D-1** summarizes the results of both the short- and long-term noise monitoring.

Table D-1 Noise Monitoring Summary		
Location	Duration	Noise Level
ST-1	15 minutes	68.9 dBA Leq
ST-2	15 minutes	68.8 dBA Leq
ST-3	15 minutes	71.4 dBA Leq
ST-4	15 minutes	58.4 dBA Leq
ST-5	15 minutes	67.4 dBA Leq
ST-6	15 minutes	61.6 dBA Leq
ST-7	15 minutes	67.9 dBA Leq
ST-8	15 minutes	68.0 dBA Leq
ST-9	15 minutes	67.6 dBA Leq
ST-10	15 minutes	58.5 dBA Leq
ST-11	15 minutes	70.9 dBA Leq
ST-12	15 minutes	64.2 dBA Leq
ST-13	15 minutes	67.3 dBA Leq
LT-1	24 hours	69.1 dBA Ldn
LT-2	24 hours	72.3 dBA Ldn

**FIGURE D-1
NOISE MONITORING LOCATIONS**



The sound level meters were programmed to record noise levels with the “slow” time constant and using the “A” weighting filter network. Meteorological conditions during the measurement periods were favorable and were noted to be representative of typical conditions for the season. Generally, conditions included clear to partly cloudy skies, daytime temperatures of approximately 57 to 78 degrees Fahrenheit, and less than 5 to 10 mile-per-hour winds, with occasional higher gusts noted at certain sites. The short- and longterm noise measurement locations are described below.

PRINCIPAL NOISE SOURCES IN CUPERTINO

ON-ROAD VEHICLES

Freeways that traverse Cupertino include I-280, which runs along and near the City’s northern boundary, and SR 85, which roughly bisects the geographic area of Cupertino, running from northwest to southeast. In addition to these highways, major roadways running north to south through or adjacent to Cupertino include Foothill Boulevard, Bubba Road, Stelling Road, De Anza Boulevard, Blaney Avenue, Wolfe Road/Miller Avenue, and the Lawrence Expressway, just beyond the eastern edge of the City. Major east-west roadways include Stevens Creek Boulevard, McClellan Road, Bollinger Road, Rainbow Drive, and lastly, Homestead Road and Prospect Road, which run along the northern and southern boundaries of the city, respectively. Together, these highways and streets comprise the major roads in the City of Cupertino.

TRAIN NOISE

Cupertino does not host any passenger rail lines and has only one, seldom-used freight railway. This freight right-of-way is a Union Pacific rail line, which now exclusively serves the Hanson Permanente quarry and cement plant. As described in the General Plan for the City of Cupertino, this railway presently operates at very low frequencies, with approximately three train trips in each direction per week, usually during the daytime or early evening. Therefore, this railway contributes only very minimally to the noise environment of Cupertino.

HELIPORTS

There are no heliports located within the City of Cupertino listed by the Federal Aviation Administration (FAA). The nearest heliport is located approximately 3.4 miles to the east of Cupertino at the County Medical Center in San Jose. Another nearby heliport is located at McCandless Towers in Sunnyvale, 3.6 miles to the northeast of Cupertino. There are no additional heliports within five miles of Cupertino.

AIRCRAFT NOISE

There are no public or private airports or airstrips in Cupertino. At the nearest points within city boundaries, Cupertino is located approximately 4.0 miles to the southwest of the San Jose International Airport. The Santa Clara County Airport Land Use Commission (ALUC) has adopted a Comprehensive Land Use Plan (CLUP) for areas surrounding San Jose International Airport.

The city is not located within any protected airspace zones defined by the ALUC. Cupertino is located approximately 4.4 miles to the south of Moffett Federal Airfield, 8.4 miles to the southeast of the Palo Alto Airport, 24 miles to the southeast of San Francisco International Airport, and 27 miles to the southeast of Oakland International Airport. Additional small airports in the vicinity include the San Carlos Airport, 17 miles to the northwest, Hayward Executive Airport, 23 miles to the north-northwest, and the Half Moon Bay airport, 26 miles to the northwest.

Although Cupertino does receive some noise from aircraft using these facilities, the Cupertino City Boundary does not fall within the airport land use planning areas/airport influence areas, runway protection zones, or the identified noise contours of any airport.

STATIONARY SOURCE NOISE

Stationary sources of noise may occur from all types of land uses. Cupertino is mostly developed with residential, commercial, mixed-use, institutional, and some light industrial/research and development uses. Commercial uses can generate noise from HVAC systems, loading docks, trash compactors, and other sources. Industrial uses may generate noise from HVAC systems, loading docks, and machinery required for manufacturing or other industrial processes. Noise

generated by commercial uses is generally short and intermittent. Industrial uses may generate noise on a more continual basis, or intermittently, depending on the processes and types of machinery involved. In addition to on-site mechanical equipment, which generates stationary noise, warehousing and industrial land uses generate substantial truck traffic that results in additional sources of noise on local roadways in the vicinity of industrial operations.

For Cupertino, the city's limited industrial areas are primarily located in four areas of the city, the Monta Vista Special Center, the Bubb Road Special Center, the North De Anza Special Center, and the North Vallco Park Special Center (as referenced in the existing General Plan). These industrial areas are characterized by a mix of light industrial, office, and research and development uses; with the exception of the Monta Vista Special Center and the North De Anza Special Center, these areas are usually separated from sensitive uses, such as residences, by either major roads or some degree of buffering. These uses have the potential to generate noise impacts upon nearby sensitive receptors located at the edges of these areas. Such impacts would vary depending on the specific uses, with truck deliveries, HVAC, and other mechanical equipment being the primary sources of noise. The separation of residences by streets or other buffering serves to decrease the noise perceived by these receptors and, in the case of major roads, the noise from the roads was generally observed to exceed that from the industrial uses. Residential neighborhoods in Cupertino with a notable potential to receive substantial industrial noise include portions of the Monta Vista Village Neighborhood (primarily in the vicinity of the area surrounding Bubb Road between Stevens Creek Boulevard and McClellan Road), as well as residential areas bordering the North De Anza Special Center. It should be noted, however, that although these areas allow for light industrial uses, offices and research and development comprise the majority of existing land uses in these areas.

HANSON PERMANENTE QUARRY

The Hanson Permanente Quarry and cement plant are located to the west of Cupertino, outside of the city boundary. The quarry and cement plant are owned and operated by Lehigh Hanson and are under the jurisdiction of the County of Santa Clara. The nearest sensitive receptors to the quarry and cement plant

(within the city boundary) are residences located one-third mile to the east of the closest portion of quarry and plant operations; however, the bulk of quarry/ plant equipment and structures are located approximately two-thirds mile from the nearest residence. Given this distance and the presence of intervening hills that rise 100–200 feet above the elevation of the nearest residences, even the nearest residences would not be anticipated to experience excessive noise from quarry and plant operations.

CONSTRUCTION NOISE

Construction activity also contributes to the noise environment of Cupertino; however, such activities are typically temporary, occurring in any one location for only a limited period of time. Larger or multi-phase construction projects may contribute to the noise environment of a particular location for a more extended period of time. Public infrastructure that requires ongoing maintenance may also result in ongoing noise impacts, though usually not at a constant location. For example, different sections of road may be repaved at different times, meaning that noise impacts from associated construction activities would, at any given time, only occur along and near the section of roadway undergoing such maintenance.

PUBLIC FACILITY NOISE

Outdoor activities that occur on school campuses and in parks throughout the city generate noticeable levels of noise. Noise generated on both the weekdays (from physical education classes and sports programs) and weekends (from use of the fields and stadiums) can elevate community noise levels.

FUTURE NOISE CONTOURS

Ensuring that future land use and infrastructure decisions consider the potential adverse impacts of noise is a key concern for the City of Cupertino. **Figure D-2** identifies future noise contours within the city, and in combination with the policies included in the Health and Safety Element, will be used to help reduce future noise impacts.

**FIGURE D-2
FUTURE NOISE CONTOURS**

