

APPENDIX I:
NOISE DATA



Noise Background and Modeling Data

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.”

Construction Equipment Noise Levels

Construction Equipment

Each stage of construction involves the use of different kinds of construction equipment and therefore has its own distinct noise characteristics. Noise levels from construction activities are dominated by the loudest piece of equipment and generally occur during the site preparation and grading phase, when bulldozers, backhoes, and graders are used. Table 1 shows the average noise levels from individual pieces of construction equipment. Table 2 shows the maximum operational noise levels of heavy construction equipment.

Table 1 Average Construction Equipment Noise Levels

Type of Equipment	Average Measured Sound Levels (dBA at 50 feet)
Pile Driver, Impact	101
Pile Driver, Sonic	96
Ballast Tamper	83
Compactor	82
Concrete Mixer	85
Crane, Mobile	83
Crane, Derrick	88
Loader, Large	85
Loader, Front-End	79
Paver	89
Scraper	89
Jack Hammers	88
Pneumatic Tools	85
Pumps	76
Dozer, Small	80
Dozer, Large	86
Hydraulic Backhoe	85
Hydraulic Excavators	82
Graders	85
Air Compressors	81
Trucks	91

Source: Bolt, Beranek and Newman, 1971; FTA, 2006.¹

¹ Bolt, Beranek & Newman (BBN); Noise Control for Buildings and Manufacturing Plants, 1987; Federal Transit Administration (FTA). 2006, May. Transit Noise and Vibration Impact Assessment. U.S. Department of Transportation (DoT). FTA-VA-90-1003

Table 2 Maximum Heavy Construction Equipment Noise Levels

Type of Equipment	Range of Maximum Sound Levels Measured (dBA at 50 ft.)	Suggested Maximum Sound Levels for Analysis (dBA at 50 ft.)
Jack Hammers	75-88	82
Pneumatic Tools	78-88	85
Pumps	74-84	80
Dozers	77-90	85
Pile Driver, Impact	95-110	105
Pile Driver, Sonic	90-105	100
Scrapers	83-91	87
Haul Trucks	83-94	88
Cranes	79-86	82
Portable Generators	71-87	80
Rollers	75-82	80
Tractors	77-82	80
Front-End Loaders	77-90	86
Hydraulic Backhoe	81-90	86
Hydraulic Excavators	81-90	86
Graders	79-89	86
Air Compressors	76-89	86
Trucks	81-87	86

Source: Bolt, Beranek & Newman: Noise Control for Buildings and Manufacturing Plants, 1987.

Construction equipment typically moves around on the project site and under variable power levels. Noise from construction equipment decreases by 6 to 7.5 dB with each doubling of distance between the source and receptor.² For example, the noise levels from a bulldozer that generates 85 dBA at 50 feet would measure 79 dBA at 100 feet, 73 dBA at 200 feet, 67 dBA at 400 feet, and 61 dBA at 800 feet (conservatively using a 6 dB per doubling of distance attenuation factor). Also, noise levels are typically reduced from this value due to usage factors³ as well as the barrier effects provided by the physical structures once erected.

² As sound energy travels outward from the source, spreading loss accounts for a 6 dB decrease in noise level. Soft ground and atmospheric absorption effects can add another decrement of 1.5 dB (for a total of 7.5 dB per distance doubling).

³ Usage factor is the percentage of time during the workday that the equipment is operating at full power (on which the reference noise ratings for typical average and typical maximum noise emissions are based).

City of Cupertino Municipal Code

10.48.010 Definitions.

For purposes of this chapter:

“Commercial area” means commercially-zoned property as defined in the community zoning ordinance.

“Commercial establishment” means any store, factory, manufacturing or industrial plant used for the sale, manufacturing, fabrication, assembly or storage of goods, wares and merchandise.

“Construction” means any site preparation, assembly, erection, repair, substantial alteration, or similar action, of public or private property, rights-of-way, structures, utilities or similar property, including vehicle pick-up or delivery of construction materials or demolition debris but excluding demolition and grading.

“Daytime” means the period from seven a.m. to eight p.m. on weekdays, and the period from nine a.m. to six p.m. on weekends.

“Decibel (dB)” means a unit for measuring relative sound pressure, logarithmically referenced to a pressure of twenty micronewtons per square meter.

“Demolition” means any dismantling, intentional destruction or removal of structures, utilities, public or private right-of-way surfaces, or similar property.

“Emergency” means any occurrence or set of circumstances involving actual or imminent physical danger, crisis, trauma, or property damage which demands immediate action.

“Emergency work” means any work performed for the purpose of preventing or alleviating the physical danger, trauma, or property damage threatened or caused by an emergency, or restoration of conditions and property to their status prior to the emergency.

“Holidays” means the following days: New Year’s Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Christmas Day.

“Industrial area” means industrially-zoned property as defined in the community zoning ordinance.

“Muffler” means a device for reducing or dissipating the sound of escaping gases, or other types of noise, from a mechanical device or engine.

“Multiple-family dwelling unit” means a residential structure containing separate living quarters for two or more families, each unit with similar and common access to the outside.

“NCO” means noise control officer.

“Nighttime” means periods of weekdays from eight p.m. to twelve midnight, and from midnight to seven a.m., and periods on weekends from six p.m. to midnight and from midnight to nine a.m.

“Noise” means any sound which annoys or disturbs humans or which causes or tends to cause an adverse psychological or physiological effect on humans.

“Noise Control Officer (NCO)” means the municipal agency, department or individual having lead responsibility for implementation and enforcement of this chapter, as designated by the City Manager and approved by the City Council.

“Noise disturbance” means any sound which:

1. Endangers or injures the safety or health of humans or animals; or

2. Annoys or disturbs a reasonable person of normal sensitivities; or
3. Endangers or damages personal or real property.

“Noise level” means the same as sound level.

“Nonresidential area” means land zoned for other than residential uses, such as commercial, professional office, industrial or public, as defined in the zoning ordinance, but not including public rights-of-way.

“Person” means any individual, association, partnership, corporation, or public agency, and includes any associated officer, employee or department.

“Property boundary” means an imaginary line along the ground surface, and its vertical extension, which separates the real property owned by one person from that owned by another person.

“Public area” means any property or structures thereon which are owned, utilized, or controlled by a governmental entity.

“Public right-of-way” means any street, avenue, boulevard, highway, parkway, alley or similar place which is owned or controlled by a governmental entity.

“Residential area” means residentially zoned land as defined in the community zoning ordinance.

“Sound” means a rapid variation in air pressure, which, because of its magnitude and frequency, can be heard by a human with average hearing ability.

“Sound level” means the maximum continuous or repeated peak value measured by the use of a sound level meter and the “A” weighting network, as specified in American National Standards Institute specifications for sound level meters (ANSI S 1A - 1971, or the latest revision). The reading obtained in decibels is designated dBA. If the meter response characteristic is not indicated, “SLOW” response shall be used.

“Sound level meter” means an instrument which includes a microphone, amplifier, RMS detector, integrator or time averager, output meter, and weighting networks used to measure sound levels, and meets American National Standards Institute specification S 1.4 - 1971, or latest revision, for Type 1, Type 2 or Type 2A operation.

“Weekday” means any day, Monday through Friday, that is not one of the holidays.

“Weekend” means Saturdays and Sundays that are not holidays.

“Vehicular deliveries or pickups” means the delivery or pickup or the arrival for the delivery or pickup of goods, wares, merchandise and waste material by the use of motor vehicles, including, but not limited to, the operation of motorized commercial ground-sweeping or waste-removal machinery, whether portable or self-propelled.

(Ord. 1871, (part), 2001)

10.48.011 Notice of Violation.

Except in the case where there is clear evidence that a person is acting in good faith and with all deliberate speed to comply with provisions of this chapter after a verbal or written warning of a violation, the continuing violation shall be cause for either a citation, complaint, or an abatement order to be issued by the Noise Control Officer, or other responsible official.

(Ord. 1871, (part), 2001)

10.48.013 Multiple Section Application.

In the event that more than one section of this chapter apply generally and simultaneously to a given noise source or incident, the least restrictive regulation shall be in effect, and the most restrictive limit shall not be invoked, except as sources and incidents are specifically identified in the most restrictive limit which is applicable.

(Ord. 1871, (part), 2001)

10.48.014 Other Remedies.

No provision of this chapter shall be construed to impair any common law or statutory cause of action, or legal remedy therefrom, of any person for injury or damage arising from any violation of this chapter or from other law. The provisions of this chapter are not intended to affect in any manner, violations or arrests of persons for a violation of Section 415 of the California Penal Code or any other provision of State law. The unavailability of a sound level meter to enforce the provisions of this chapter does not preclude the enforcement of any provision of State law.

(Ord. 1871, (part), 2001)

10.48.020 Lead Agency/Official.

The noise control program established by this chapter shall be administered by and the responsibility of, the Noise Control Officer (NCO).

(Ord. 1871, (part), 2001)

10.48.021 Powers of the Noise Control Officer.

In order to implement and enforce this chapter and for the general purpose of noise abatement and control, the NCO shall have, in addition to any other vested authority, the power to:

A. Review of Public and Private Projects. Review of public and private projects, subject to mandatory review or approval by other departments, for compliance with this ordinance, if such projects are likely to cause noise in violation of this chapter;

B. Inspections. Upon presentation of proper credentials and with permission of the property owner or occupant, enter and investigate a potential ordinance violation on any property or place, and inspect any report or records at any reasonable time. If permission is refused or cannot be obtained, a search warrant may be obtained from a court of competent jurisdiction upon showing of probable cause to believe that a violation of this chapter may exist. Such inspection may include administration of any necessary tests.

(Ord. 1871, (part), 2001)

10.48.022 Duties of the Noise Control Officer.

In order to implement and enforce this chapter effectively, the NCO shall within a reasonable time after the effective date of the ordinance codified in this chapter:

A. Guidelines, Testing Methods and Procedures. Develop and promulgate guidelines, testing methods and procedures as required. Any noise measurement procedure used in enforcement of this chapter which tends to underestimate the actual noise level of the source being measured shall not invalidate the enforcement action;

B. Investigate and Pursue Violations. In consonance with provisions of this chapter, investigate and pursue possible violations;

C. Delegation of Authority. Delegate functions, where appropriate under this chapter, to other personnel and to other departments, subject to approval of the City Manager.

(Ord. 1871, (part), 2001)

10.48.023 Duties and Responsibilities of Other Departments.

A. Departmental Actions. All City departments shall, to the fullest extent consistent with other law, carry out their programs in such a manner as to further the policy and intent of this chapter.

B. Project Approval. All departments whose duty it is to review and approve new projects, or changes to existing projects, that may result in the production of disturbing noise, shall consult with the NCO prior to any such approval.

C. Contracts. Any written contract, agreement, purchase order, or other instrument whereby the City is committed to the expenditure of five thousand dollars or more in return for goods or services, and which involves noise-producing activities, shall contain provisions requiring compliance with this chapter.

(Ord. 1871, (part), 2001)

10.48.029 Homeowner or Resident-Conducted Construction Work Exception.

Construction conducted by the homeowner or resident of a single dwelling, using domestic construction tools is allowed on holidays between the hours of nine a.m. and six p.m.

(Ord. 1871, (part), 2001)

10.48.030 Emergency Exception.

The provisions of this chapter shall not apply to the emission of sound for the purpose of alerting persons to the existence of an emergency, or the emission of sound in the performance of emergency work.

(Ord. 1871, (part), 2001)

10.48.031 Special Exceptions.

A. The NCO shall have the authority, consistent with this section, to grant special exceptions which may be requested.

B. Any person seeking a special exception pursuant to this section shall file an application with the NCO. The application shall contain information which demonstrates that bringing the source of sound, or activity for which the special exception is sought, into compliance with this chapter would constitute an unreasonable hardship on the applicant, on the community, or on other persons. Prior to issuance of an exception, the NCO shall notify owners and/or occupants of nearby properties which may be affected by such exceptions. Any individual who claims to be adversely affected by allowance of the special exceptions may file a statement with the NCO containing any information to support his claim. If the NCO finds that a sufficient controversy exists regarding an application, a public hearing may be held.

C. In determining whether to grant or deny the application, the NCO shall balance the hardship to the applicant, the community, and other persons of not granting the special exception against the adverse impact on the health, safety, and welfare of persons affected, the adverse impact on property affected, and any other adverse impacts of granting the special exception. Applicants for special exceptions and persons contesting special exceptions may be required to submit any information the NCO may

reasonably require. In granting or denying an application, the NCO shall place on public file a copy of the decision and the reasons for denying or granting the special exception.

D. Special exceptions shall be granted by notice to the applicant containing all necessary conditions, including a time limit on the permitted activity. The special exception shall not become effective until all conditions are agreed to by the applicant. Noncompliance with any condition of the special exception shall terminate it and subject the person holding it to those provisions of this chapter regulating the source of sound or activity for which the special exception was granted.

E. Application for extension of time limits specified in special exceptions or for modification of other substantial conditions shall be treated like applications for initial special exceptions under subsection B of this section.

(Ord. 1871, (part), 2001)

10.48.032 Appeals.

Appeals of any decision of the NCO shall be made to the City Council.

(Ord. 1871, (part), 2001)

10.48.040 Daytime and Nighttime Maximum Noise Levels.

Individual noise sources, or the combination of a group of noise sources located on the same property, shall not produce a noise level exceeding those specified on property zoned as follows, unless specifically provided in another section of this chapter:

Land Use at Point of Origin	Maximum Noise Level at Complaint Site of Receiving Property	
	Nighttime	Daytime
Residential	50 dBA	60 dBA
Nonresidential	55 dBA	65 dBA

(Ord. 1921, (part), 2003; Ord. 1871, (part), 2001)

10.48.050 Brief Daytime Incidents.

A. During the daytime period only, brief noise incidents exceeding limits in other sections of this chapter are allowed; providing, that the sum of the noise duration in minutes plus the excess noise level does not exceed twenty in a two-hour period. For example, the following combinations would be allowable:

Noise Increment Above Normal Standard	Noise Duration in 2-Hour Period
5 DBA	15 minutes
10 dBA	10 minutes
15 dBA	5 minutes

19 dBA	1 minute
--------	----------

B. For multifamily dwelling interior noise, Section [10.48.054](#), the sum of excess noise level and duration in minutes of a brief daytime incident shall not exceed ten in any two-hour period, measured at the receiving location.

C. Section [10.48.050A](#) does not apply to Section [10.48.055](#) (Motor Vehicle Idling).
(Ord. 1871, (part), 2001)

 **10.48.051 Landscape Maintenance Activities.**

The use of motorized equipment for landscape maintenance activities shall be limited to the hours of 8:00 a.m. to 8:00 p.m. on weekdays, and 9:00 a.m. to 6:00 p.m. on weekends and holidays, with the exception of landscape maintenance activities for public schools, public and private golf courses, and public facilities, which are allowed to begin at 7:00 a.m. The use of motorized equipment for landscape maintenance activities during these hours is exempted from the limits of Section [10.48.040](#); provided, that reasonable efforts are made by the user to minimize the disturbances to nearby residents by, for example, installation of appropriate mufflers or noise baffles, running equipment only the minimal period necessary, and locating equipment so as to generate minimum noise levels on adjoining properties.

(Ord. 1921, (part), 2003; Ord. 1871, (part), 2001)

 **10.48.052 Outdoor Public Events.**

A. Outdoor events open to the general public on nonresidential property, such as parades, rallies, fairs, concerts and special sales and promotional events, involving generation of noise levels higher than would normally occur, by use of the human voice, public address systems, musical instruments, electronic amplification systems, and similar soundproducing activities, are allowed upon obtaining an appropriate permit from the city, and subject to the following general limitations:

1. The event shall not produce noise levels above seventy dBA on any residential property for a period longer than three hours during daytime.
2. The event shall not produce noise levels above sixty dBA on any residential property during the period from eight p.m. to eleven p.m., and above fifty-five dBA for any other nighttime period.
3. Continuous or repeated peak noise levels above ninety-five dBA shall not be produced at any location where persons may be continuously exposed.

B. The conditions imposed upon the event or activity in the permit issued by the City, regarding maximum noise level, location of noise sources, or duration of activity, for example, may be more limiting than this section, to protect certain individuals, areas or nearby activities which would otherwise be disturbed, and these permit conditions, when in conflict with this section, are overriding.

(Ord. 1871, (part), 2001)

 **10.48.053 Grading, Construction and Demolition.**

A. Grading, construction and demolition activities shall be allowed to exceed the noise limits of Section [10.48.040](#) during daytime hours; provided, that the equipment utilized has high-quality noise muffler and abatement devices installed and in good condition, and the activity meets one of the following two criteria:

1. No individual device produces a noise level more than eighty-seven dBA at a distance of twenty-five feet (7.5 meters); or

2. The noise level on any nearby property does not exceed eighty dBA.

B. Notwithstanding Section [10.48.053A](#), it is a violation of this chapter to engage in any grading, street construction, demolition or underground utility work within seven hundred fifty feet of a residential area on Saturdays, Sundays and holidays, and during the nighttime period, except as provided in Section [10.48.030](#).

C. Construction, other than street construction, is prohibited on holidays, except as provided in Sections [10.48.029](#) and [10.48.030](#).

D. Construction, other than street construction, is prohibited during nighttime periods unless it meets the nighttime standards of Section [10.48.040](#).

E. The use of helicopters as a part of a construction and/or demolition activity shall be restricted to between the hours of nine a.m. and six thirty p.m. Monday through Friday only, and prohibited on the weekends and holidays. The notice shall be given at least twenty-four hours in advance of said usage. In cases of emergency, the twenty-four hour period may be waived.

(Ord. 1871, (part), 2001)

10.48.054 Interior Noise in Multiple-Family Dwellings.

Noise produced in any multiple-family dwelling unit shall not produce a noise level exceeding 45 dBA five feet from any wall in any adjoining unit during the period between seven a.m. and ten p.m., or exceeding 40 dBA during hours from ten p.m. to seven a.m. the following day.

(Ord. 1871, (part), 2001)

10.48.055 Motor Vehicle Idling.

Motor vehicles, including automobiles, trucks, motorcycles, motor scooters and trailers or other equipment towed by a motor vehicle, shall not be allowed to remain in one location with the engine or auxiliary motors running for more than three minutes in any hour, in an area other than on a public right-of-way, unless:

A. The regular noise limits of Section [10.48.040](#) are met while the engine and/or auxiliary motors are running; or

B. The vehicle is in use for provision of police, fire, medical, or other emergency services.

(Ord. 1871, (part), 2001)

10.48.056 Noise from Registered Motor Vehicles.

A. It is a violation of this chapter to own or operate a motor vehicle, including automobiles, trucks, motorcycles and other similar devices of a type subject to registration, as defined in California Vehicle Code, which has a faulty, defective, deteriorated, modified, replaced, or no exhaust and/or muffler system, and which produces an excessive and disturbing noise level, as defined in California Vehicle Code Sections 27150 and 27151.

B. The Stationary Vehicle Test Procedure, as adopted by the California Highway Patrol, may be utilized as prima facie evidence of violation of this section.

(Ord. 1871, (part), 2001)

10.48.057 Noise from Off-Road Recreational Vehicles.

It is a violation of this chapter to own or operate:

A. Any off-road recreational vehicle, including all-terrain vehicles, dirt bikes, dune buggies and other similar devices, as defined in Division 16.5 of the California Vehicle Code, which has a faulty, defective, deteriorated, modified, replaced, or no exhaust and/or muffler system, and which produces an excessive and disturbing noise level, as specified in California Vehicle Code Section 38365;

B. Any off-road recreational vehicle producing a noise level:

1. Exceeding ninety-eight dBA within twenty inches of any component at an intermediate engine speed of two thousand to four thousand revolutions per minute in a stationary position; or

2. Exceeding eighty dBA under any condition of acceleration, speed, grade, and load at a distance of fifty feet. At greater or lesser measurement distances, the maximum noise level changes by four dB for each doubling or halving of distance. The sound level meter shall be set for FAST response for this measurement.

(Ord. 1871, (part), 2001)

10.48.060 Noise Disturbances.

No person shall unreasonably make, continue, or cause to be made or continued, any noise disturbance as defined in Section [10.48.010](#).

(Ord. 1871, (part), 2001)

10.48.061 Animals and Birds.

It is unlawful and a nuisance for any person to keep, maintain or permit upon any lot or parcel of land within the City under his control any animal, including any fowl, which by any sound or cry shall habitually disturb the peace and comfort of any person in the reasonable and comfortable enjoyment of life or property.

(Ord. 1871, (part), 2001)

10.48.062 Nighttime Deliveries and Pickups.

It is unlawful and a nuisance for any person to make or allow vehicular deliveries or pickups to or from commercial establishments (defined as any store, factory, manufacturing, or industrial plant used for the sale, manufacturing, fabrication, assembly or storage of goods, wares and merchandise) by the use of private roads, alleys or other ways located on either side or the back of any building housing the commercial establishment where such private road, alley or other way lies between the building and any adjacent parcel of land zoned for residential purposes, between the hours of eight p.m. and eight a.m. weekdays (Monday through Friday) and six p.m. and nine a.m. on weekends (Saturday and Sunday) and holidays except as may be permitted under Section [10.48.029](#).

(Ord. 1871, (part), 2001)

10.48.070 Violation–Penalty.

Any person who violates the provisions of this chapter shall be guilty of a misdemeanor and upon conviction thereof shall be punished as provided in [Chapter 1.12](#).

(Ord. 1886, (part), 2001; Ord. 1871, (part), 2001)



Cupertino General Plan: Community Vision 2015-2040 Health & Safety Element; Applicable Noise Portions

Introduction

Community health and public safety responsibilities have to evolve to address the community's growth and changing needs. The City is committed to maintaining a high level of preparedness to protect the community from risks to life, property and the environment associated with both natural and human-caused disasters and hazards. In the future, more emphasis will be placed on sustainable approaches to community health and safety, including crime and fire prevention through design, improved use of technology, management of hazardous materials and improved disaster planning.

This Element includes goals, policies and strategies that address the potential risks associated with these hazards, actions the City can take to reduce these risks, and ways the City and community can take more sustainable approaches for preventing or minimizing injuries to life and damages to property.

CONTENTS:

HS-2 Introduction

HS-3 Context

- Emergency Preparedness
- Fire Safety
- Public Safety
- Hazardous Materials
- Electromagnetic Fields
- Geologic and Seismic Hazards
- Flood Hazards
- Noise

HS-24 Looking Forward

HS-25 Goals and Policies

- Regional Coordination
- Emergency Preparedness
- Fire Safety
- Public Safety
- Geologic Seismic Hazards
- Hazardous Materials
- Flooding
- Noise

NOISE

The noise environment is an accumulation of many different sources, ranging from human voices to major sources such as freeway traffic. The degree to which noise becomes an annoyance depends on a variety of factors including noise level, time of day, background sounds, and surrounding land use.

COMMUNITY NOISE FUNDAMENTALS

The three elements of community noise are noise level, noise spectrum, and variation in noise level with time. Noise level is measured in decibels (dB). Noise is composed of various frequencies within a noise spectrum that define the character of the noise. Since human hearing is more sensitive to the higher speech frequencies, the A-weighted frequency network is applied, in accordance with national and international standards, to adjust the measured noise level to more closely relate to human perception of loudness.

Noise environments have different characteristics that vary with duration and time of day; for instance a freeway may emit a fairly constant noise level for long periods while an airport may emit many short-term high level noise events punctuated by extended periods of quiet. To provide a standard measure for community noise exposure that takes into account the time-varying characteristics, the State of California adopted the Community Noise Equivalent Level (CNEL) as the standard metric. The CNEL is a 24-hour energy average metric that penalizes evening and nighttime noise, and provides a uniform measure for time-varying noise environments.

NOISE ENVIRONMENT

The noise environment can generally be divided into two categories: transportation-related and non-transportation related noise. Traffic noise is the greatest contributor to noise pollution in Cupertino and one of the most difficult to control through local effort. Two major freeways (Interstate 280 and Highway 85) and four major corridors (Stevens Creek Boulevard, De Anza Boulevard, Homestead Road, and Foothill Boulevard) cross Cupertino. These roadways are utilized not only by local residents and employees, but also by commuters to destinations beyond Cupertino. Heavy-duty trucking operations to and from the Hanson Permanente Cement Plant and Stevens Creek Quarry located in the western foothills near Stevens Creek Boulevard and Foothill Boulevard are also a significant transportation-related noise contributor.

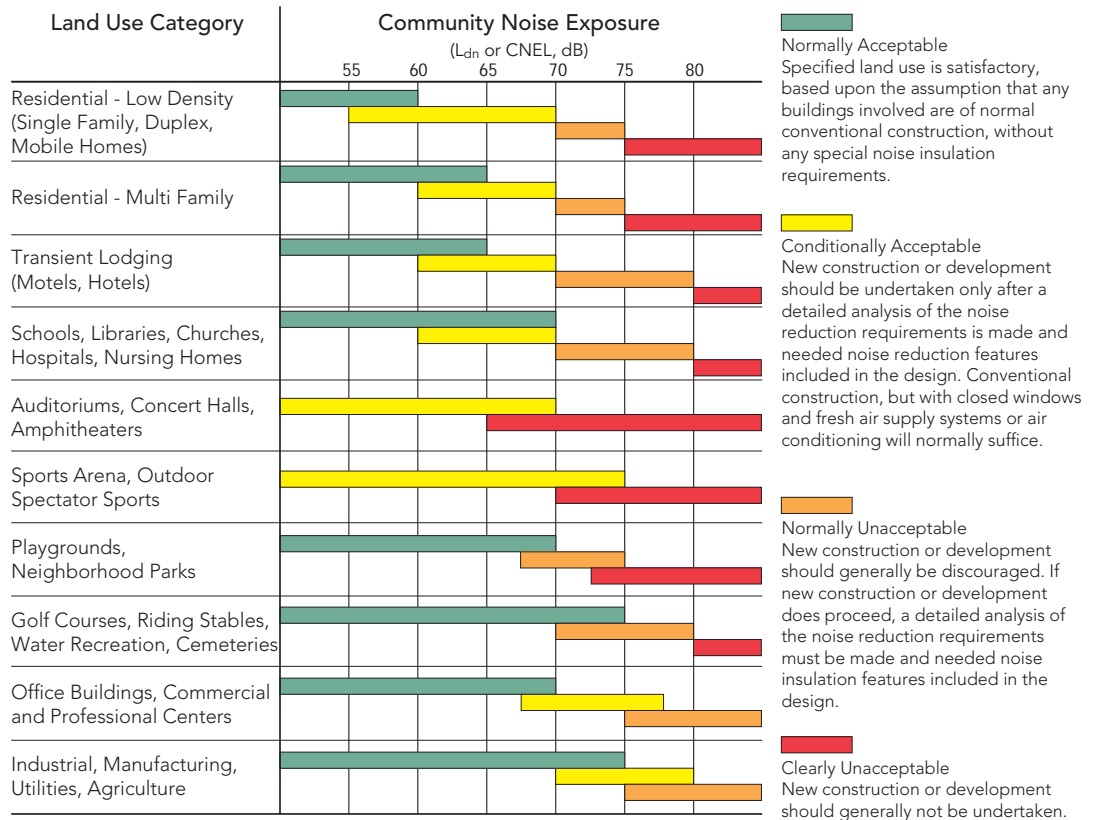
Cupertino receives some aircraft noise from facilities within the region including San Jose International Airport, Moffett Federal Airfield and Palo Alto Airport; however, the Cupertino city limit does not fall within the identified noise contours of any airport. One railroad line passes through the Monta Vista neighborhood and connects with the Hanson Permanente Cement Plant. This freight railway operates at very low frequencies, with approximately three train trips in each direction per week, usually during the daytime or early evening.

Non-transportation noise varies from stationary equipment (e.g., air conditioning units) to construction activity. Regulation to minimize excessive noise from non-transportation sources includes compliance with the City's noise standards that limit certain noise-generating activity during evening and early morning, when ambient noise levels tend to be lower. Advancements in technology to muffle sound also reduce noise from construction equipment and stationary equipment such as compressors and generators.

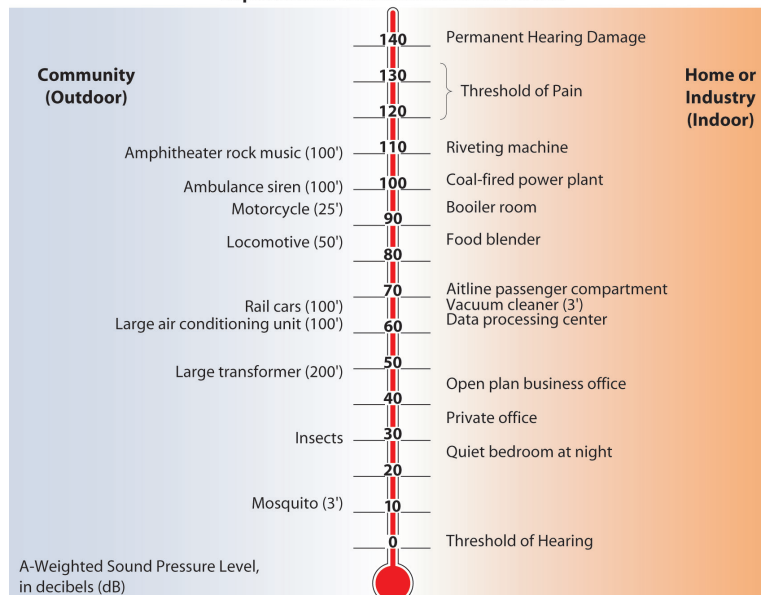
LAND USE COMPATIBILITY

The Cupertino Municipal Code, Title 10, outlines the maximum noise levels on receiving properties based upon land use types (**Figure HS-8**). Land use decisions and the development review process play a large role in minimizing noise impacts on sensitive land uses. Noise compatibility may be achieved by avoiding the location of conflicting land uses adjacent to one another and incorporating buffers and noise control techniques including setbacks, landscaping, building transitions, site design, and building construction techniques. Selection of the appropriate noise control technique will vary depending on the level of noise that needs to be reduced as well as the location and intended land use.

**FIGURE HS-8
LAND USE COMPATIBILITY FOR
COMMUNITY NOISE ENVIRONMENTS**



Representative Sounds and Sound Levels



LOOKING FORWARD

As Cupertino's resident and employee population grows, the City must identify ways to ensure public safety and support the community's high quality of life. Innovative site design and construction techniques are needed to reduce noise in developments near major corridors and where uses are mixed to ensure compatibility. Fire protection and public safety should be enhanced in a manner that provides a high quality of service while continuing to be fiscally responsible. The following are ways the City will address key challenges and opportunities facing Cupertino:

1

NOISE.

As State, regional and local policies encourage mixed-use development near corridors, the City should look to ways to reduce noise impacts on residences near and in such developments through site design, landscaping and construction techniques. Additionally, the City should review locations and site design for sensitive uses including schools, childcare facilities and hospitals to ensure that they are not negatively impacted by noise.

2

PROJECT DESIGN AND OPERATIONS.

Measures such as project and building design, emergency access, operations and maintenance of property, can help developments promote public and fire safety. Such measures will also allow the providers to maintain a high service level, while accommodating future growth.

3

COMMUNITY PARTICIPATION.

The City and service providers should enhance community participation through new and existing programs such as neighborhood watch, emergency preparedness and school programs.

4

SHARED RESOURCES.

The City can enhance emergency, fire safety and public safety services by coordinating programs with service providers and neighboring cities through shared services, mutual aid and agreements.



GOAL HS-8

Minimize noise impacts on the community and maintain a compatible noise environment for existing and future land use

NOISE

The City seeks to ensure that the community continues to enjoy a high quality of life through reduce noise pollution, effective project design and noise management operations.

POLICY HS-8.1: LAND USE DECISION EVALUATION

Use the Land Use Compatibility for Community Noise Environments chart, the Future Noise Contour Map (see Figure D-1 in Appendix D) and the City Municipal Code to evaluate land use decisions.

POLICY HS-8.2: BUILDING AND SITE DESIGN

Minimize noise impacts through appropriate building and site design.

STRATEGIES:

HS-8.2.1: Commercial Delivery Areas.

Locate delivery areas for new commercial and industrial developments away from existing or planned homes.

HS-8.2.2: Noise Control Techniques.

Require analysis and implementation of techniques to control the effects of noise from industrial equipment and processes for projects near low-intensity residential uses.

HS-8.2.3: Sound Wall Requirements.

Exercise discretion in requiring sound walls to be sure that all other measures of noise control have been explored and that the sound wall blends with the neighborhood. Sound walls should be designed and landscaped to fit into the environment.

POLICY HS-8.3: CONSTRUCTION AND MAINTENANCE ACTIVITIES

Regulate construction and maintenance activities. Establish and enforce reasonable allowable periods of the day, during weekdays, weekends and holidays for construction activities. Require construction contractors to use the best available technology to minimize excessive noise and vibration from construction equipment such as pile drivers, jack hammers, and vibratory rollers.

POLICY HS-8.4: FREEWAY DESIGN AND NEIGHBORHOOD NOISE

Ensure that roads and development along Highway 85 and Interstate 280 are designed and improved in a way that minimizes neighborhood noise.

POLICY HS-8.5: NEIGHBORHOODS

Review residents’ needs for convenience and safety and prioritize them over the convenient movement of commute or through traffic where practical.

POLICY HS-8.6: TRAFFIC CALMING SOLUTIONS TO STREET NOISE

Evaluate solutions to discourage through traffic in neighborhoods through enhanced paving and modified street design.

STRATEGY:

HS-8.6.1: Local Improvement.

Modify street design to minimize noise impact to neighbors.

POLICY HS-8.7: REDUCTION OF NOISE FROM TRUCKING OPERATIONS

Work to carry out noise mitigation measures to diminish noise along Foothill and Stevens Creek Boulevards from the quarry and cement plant trucking operations. These measures include regulation of truck speed, the volume of truck activity, and trucking activity hours to avoid late evening and early morning. Alternatives to truck transport, specifically rail, are strongly encouraged when feasible.

STRATEGIES:

HS-8.7.1: Restrictions in the County’s Use Permit.

Coordinate with the County to restrict the number of trucks, their speed and noise levels along Foothill and Stevens Creek Boulevards, to the extent allowed in the Use Permit. Ensure that restrictions are monitored and enforced by the County.

HS-8.7.2: Road Improvements to Reduce Truck Impacts.

Consider road improvements such as medians, landscaping, noise attenuating asphalt, and other methods to reduce quarry truck impacts.



appendix d: community noise fundamentals

D

CONTENTS:

- D-2 Background**
- D-2 Frequency Weighing**
- D-3 Noise Exposure**
- D-4 Subjective Response to Noise**
- D-5 Noise Measurements**
- D-8 Principle Noise Sources In Cupertino**
 - On-Road Vehicles
 - Train Noise
 - Heliports
 - Aircraft Noise
 - Stationary Source Noise
 - Hanson Permanente Quarry
 - Constructions Noise
 - Public Facility Noise
- D-12 Future Noise Contours**



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.

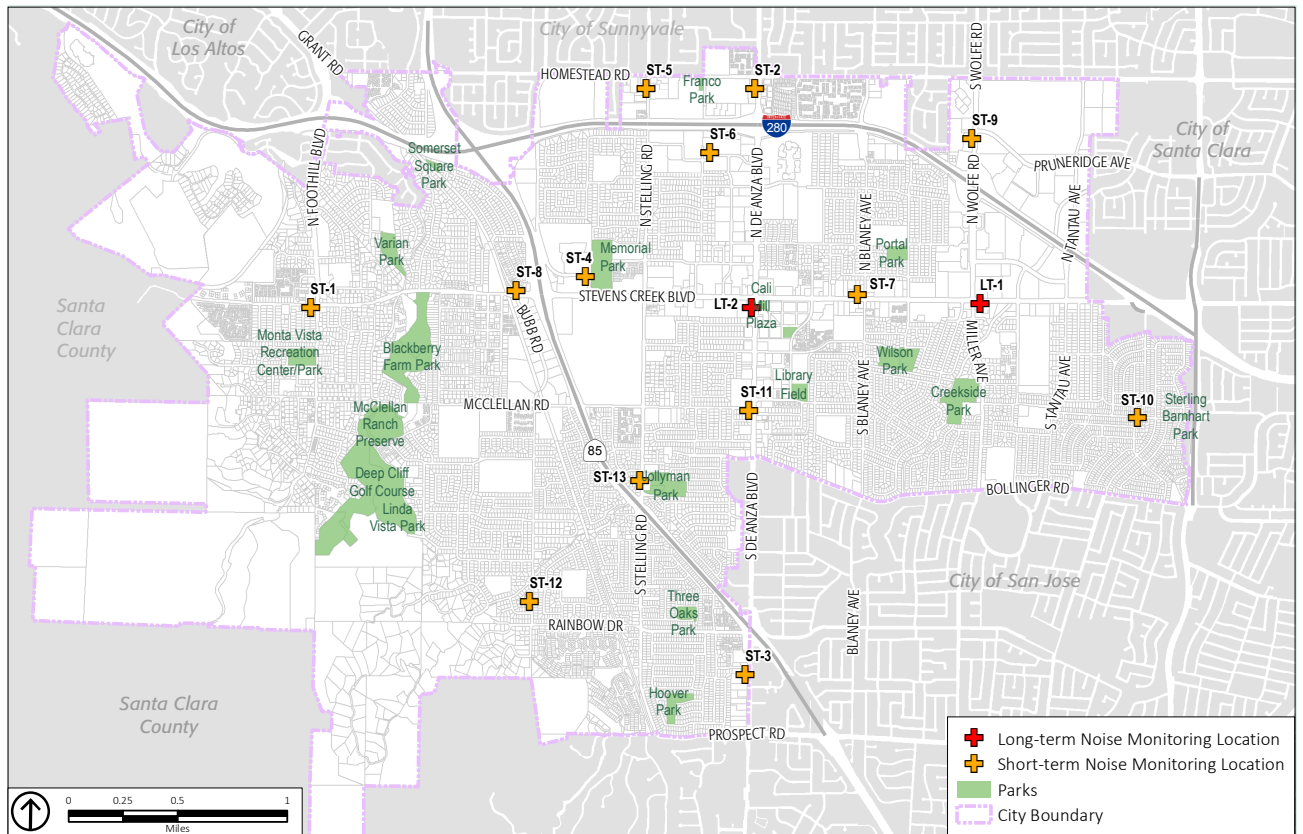
Noise levels were measured using a Larson-Davis Model 820 sound level meter, which satisfies the American National Standards Institute for Type 1 general environmental noise measurement instrumentation. The sound level meter and microphone were mounted on a tripod 5 feet above the ground and equipped 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.

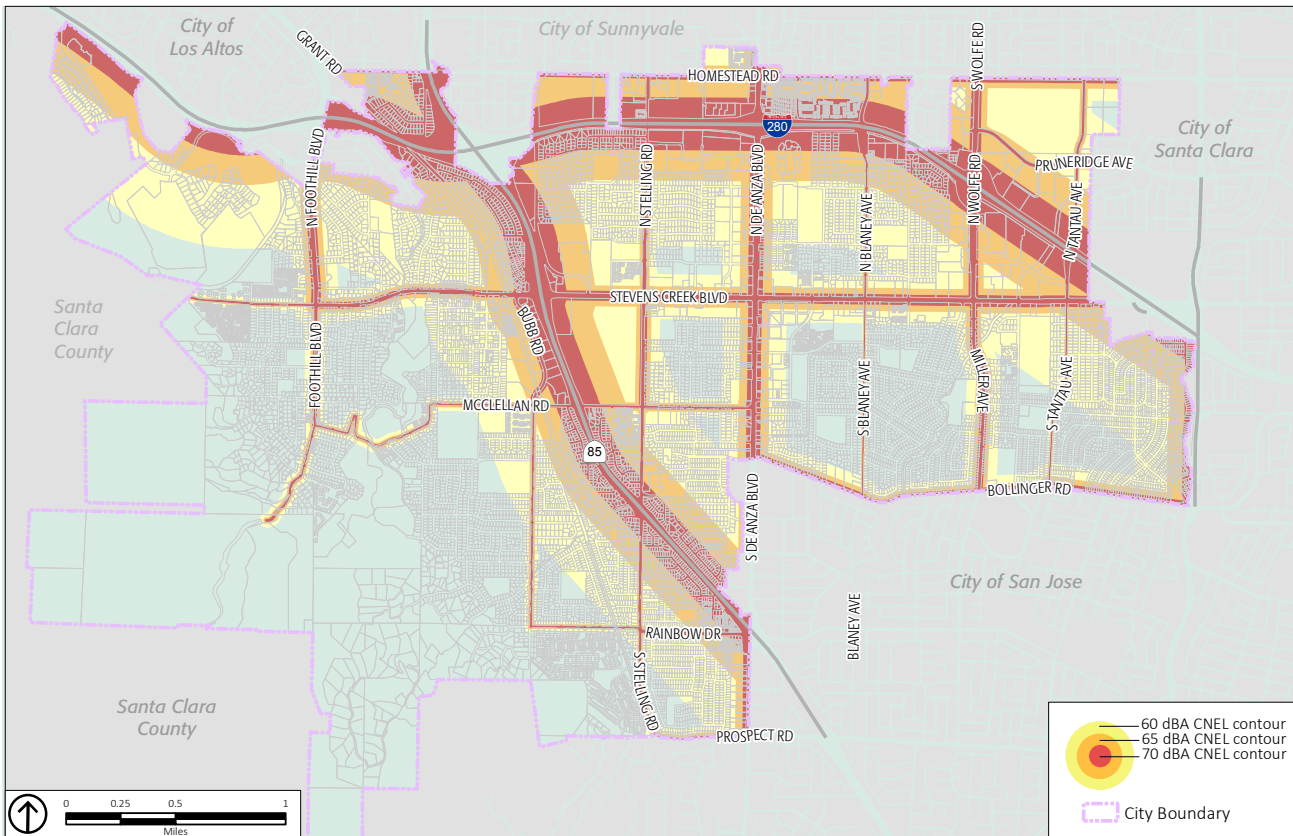
PUBLIC FACILITY NOISE

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**



Noise Calculations

Phase 1 Construction Noise

TYPE PHASE NAME >>>			Demolition (per 8 hour day)		Site Prep		Mass Grading		Construction 1a		Construction 1b		Paving	
Equipment Item (Dropdown Menu)	Leq @ 50 ft	Lmax @ 50 ft	Quantity	Hours of Usage	Quantity	Hours of Usage	Quantity	Hours of Usage	Quantity	Hours of Usage	Quantity	Hours of Usage	Quantity	Hours of Usage
(RCNM) Concrete Saw	82.6	89.6	1	8		8		8		8		8		8
(RCNM) Excavator	76.7	80.7	1	8		8	1	8		8		8		8
(RCNM) Dozer	77.7	81.7	1	8	1	8	1	8		8		8		8
(RCNM) Backhoe	73.6	77.6		8	3	8	2	8	1	7		8		8
(RCNM) Flat Bed Truck	70.3	74.3	1	4	1	4	1	4		8		8		8
(RCNM) Grader	81	85		8		8	2	8		8		8		8
(RCNM) Backhoe	73.6	77.6		8		8		8		8		8	1	8
(RCNM) Crane	72.6	80.6		8		8		8		8		8		8
(RCNM) Pickup Truck	71	75		8		8		8	2	2	3	2		8
(RCNM) Welder/Torch	70	74		8		8		8	2	8	1	8		8
(RCNM) Generator	77.6	80.6		8		8		8		8		8		8
(RCNM) Concrete Mixer Truck	74.8	78.8		8		8		8		8		8	2	6
(RCNM) Paver	74.2	77.2		8		8		8		8		8	1	8
(RCNM) Paver	74.2	77.2		8		8		8		8		8	2	6
(RCNM) Roller	73	80		8		8		8		8		8	2	6
None	0	0		8		8		8		8		8		8
None	0	0		8		8		8		8		8		8
None	0	0		8		8		8		8		8		8
None	0	0		8		8		8		8		8		8
None	0	0		8		8		8		8		8		8
None	0	0		8		8		8		8		8		8
	Totals at 50 feet	Demolition		Site Prep		Mass Grading		Construction 1a		Construction 1b		Paving		
		Total Leq	Lmax	Total Leq	Lmax	Total Leq	Lmax	Total Leq	Lmax	Total Leq	Lmax	Total Leq	Lmax	
		84.7	90.8	81.2	85.2	86.1	90.1	76.7	80.7	72.9	76.9	82.1	86.6	

Phase 1 Aggregate of all Construction Components

		Demolition	Site Prep	Grading	Construction 1a	Construction 1b	Paving
Receptors	1	73.2	69.8	74.6	65.2	61.4	70.7
	2	73.4	69.9	74.8	65.4	61.6	70.9
	3	78.9	75.4	80.3	70.9	67.1	76.3
	Maryknoll	70.3	66.8	71.7	62.2	58.5	67.7

Distances from Construction Component to Receptors

Components		N Villas	S Villas	Skilled Nursing	Memory Care	Community Space/Café	Fitness
Receptors	1		320	1300	300	580	720
	2		840	675	750	700	450
	3		1500	100	1350	1250	900
	Maryknoll		2600	275	2400	2100	1730

N Villas

		Demolition	Site Prep	Grading	Construction 1a	Construction 1b	Paving
Receptors	Leq @ 50 ft	84.7	81.2	86.1	76.7	72.9	82.1
	1	68.5	65.1	70.0	60.5	56.8	66.0
	2	60.2	56.7	61.6	52.2	48.4	57.6
	3	55.1	51.7	56.6	47.1	43.3	52.6
	Maryknoll	50.3	46.9	51.8	42.3	38.6	47.8

S Villas

		Demolition	Site Prep	Grading	Construction 1a	Construction 1b	Paving
Receptors	Leq @ 50 ft	84.7	81.2	86.1	76.7	72.9	82.1
	1	56.4	52.9	57.8	48.4	44.6	53.8
	2	62.1	58.6	63.5	54.1	50.3	59.5
	3	78.6	75.2	80.1	70.6	66.9	76.1
	Maryknoll	69.9	66.4	71.3	61.9	58.1	67.3

Skilled Nursing

		Demolition	Site Prep	Grading	Construction 1a	Construction 1b	Paving
Receptors	Leq @ 50 ft	84.7	81.2	86.1	76.7	72.9	82.1
	1	69.1	65.7	70.6	61.1	57.3	66.6
	2	61.1	57.7	62.6	53.1	49.4	58.6
	3	56.0	52.6	57.5	48.0	44.3	53.5
	Maryknoll	51.0	47.6	52.5	43.0	39.3	48.5

Memory Care

		Demolition	Site Prep	Grading	Construction 1a	Construction 1b	Paving
Receptors	Leq @ 50 ft	84.7	81.2	86.1	76.7	72.9	82.1
	1	63.4	59.9	64.8	55.4	51.6	60.9
	2	61.7	58.3	63.2	53.7	50.0	59.2
	3	56.7	53.3	58.2	48.7	44.9	54.2
	Maryknoll	52.2	48.8	53.6	44.2	40.4	49.7


Community Space/Café

		Demolition	Site Prep	Grading	Construction 1a	Construction 1b	Paving
Receptors	Leq @ 50 ft	84.7	81.2	86.1	76.7	72.9	82.1
	1	61.5	58.1	62.9	53.5	49.7	59.0
	2	65.6	62.2	67.0	57.6	53.8	63.1
	3	59.6	56.1	61.0	51.6	47.8	57.0
	Maryknoll	53.9	50.5	55.3	45.9	42.1	51.4

Fitness

		Demolition	Site Prep	Grading	Construction 1a	Construction 1b	Paving
Receptors	Leq @ 50 ft	84.7	81.2	86.1	76.7	72.9	82.1
	1	61.7	58.3	63.2	53.7	50.0	59.2
	2	71.0	67.6	72.5	63.0	59.3	68.5
	3	62.2	58.8	63.6	54.2	50.4	59.7
	Maryknoll	54.4	51.0	55.8	46.4	42.6	51.9

The Forum, Cupertino; COCU-10 PHASE 2 : Construction Noise Calculations				
Receptor	Spatially AVG Distance(ft)	Worst-case Distance (ft)	Land Use Type	
1 Receptor 1	515	450	Residential	
2 Receptor 2	200	180	Residential	
3 Receptor 3	825	775	Residential	
4 Maryknoll	1750	1625	Residential	
5 Receptor 5	0	0	Residential	
6 Receptor 6	0	0	Residential	
7 Receptor 7	0	0	Residential	
8 Receptor 8	0	0	Residential	

TYPE PHASE NAME >>>			Demolition (per 8 hour day)		Site Prep		Mass Grading		Construction		Paving		Painting	
Equipment Item (Dropdown Menu)	Leq @ 50 ft	Lmax @ 50 ft	Quantity	Hours of Usage	Quantity	Hours of Usage	Quantity	Hours of Usage	Quantity	Hours of Usage	Quantity	Hours of Usage	Quantity	Hours of Usage
(RCNM) Concrete Saw	82.6	89.6	1	8	1	8	1	8		8		8		8
(RCNM) Backhoe	73.6	77.6	1	6	2	8	2	6	2	8	1	7		8
(RCNM) Dozer	77.7	81.7	1	1		8	1	1		8		8		8
(RCNM) Flat Bed Truck	70.3	74.3	1	4	1	4	1	4		8		8		8
(RCNM) Crane	72.6	80.6		8		8		8	1	4		8		8
(RCNM) Pickup Truck	71	75		8		8		8	2	6		8		8
(RCNM) Concrete Mixer Truck	74.8	78.8		8		8		8		8	4	6		8
(RCNM) Paver	74.2	77.2		8		8		8		8	1	7		8
(RCNM) Roller	73	80		8		8		8		8	1	7		8
(RCNM) Compressor (air)	73.7	77.7		8		8		8		8		8	1	6
None	0	0		8		8		8		8		8		8
None	0	0		8		8		8		8		8		8
 Totals at 50 feet			Demolition Total Leq Lmax 83.3 89.9		Site Prep Total Leq Lmax 83.7 90.2		Mass Grading Total Leq Lmax 83.6 90.1		Construction Total Leq Lmax 78.7 83.4		Paving Total Leq Lmax 81.8 86.1		Painting Total Leq Lmax 72.5 76.5	

Total Leq/Lmax (dBA)												
Sensitive Receptor [READ ONLY]	Demolition		Site Prep		Mass Grading		Construction		Paving		Painting	
	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax
1 Receptor 1	63.0	70.9	63.4	71.1	63.3	71.0	58.4	64.3	61.5	67.1	52.2	57.4
2 Receptor 2	71.2	78.8	71.6	79.0	71.6	79.0	66.6	72.3	69.8	75.0	60.4	65.3
3 Receptor 3	58.9	66.1	59.3	66.4	59.2	66.3	54.3	59.6	57.4	62.3	48.1	52.6
4 Maryknoll	52.4	59.7	52.8	59.9	52.7	59.9	47.8	53.2	50.9	55.9	41.6	46.2
5 Receptor 5	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
6 Receptor 6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
7 Receptor 7	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
8 Receptor 8	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

References

- (RCNM) Roadway Construction Noise Model User's Guide. Federal Highway Administration. FHWA-HEP-05-054 January 2006
 - Construction Noise Control Specification 721.560, Central Artery/Tunnel Project, Massachusetts Turnpike Authority, Boston, MA, 2002.
 - Thalheimer, Erich. "Construction Noise Control Program and Mitigation Strategy at the Central Artery/Tunnel Project". Noise Control Engineering Journal, Vol. 48, No. 5, pp 157-165, September - October 2000.
 - "Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety", Environmental Protection Agency, ONAC 550/9-74-004. Washington, DC, March 1974.
 - "Power Plant Construction Noise Guide". Bolt, Beranek, and Newman Inc. and Empire State Electric Energy Research Corp., Report No. 3321. New York, NY May 1977.
- References (FTA Reference Lvl's)
Federal Transit Administration (FTA). 2006, May. Transit Noise and Vibration Impact Assessment. U.S. Department of Transportation (DoT). FTA-VA-90-1003-06.

Construction Vibration Calculations

The Forum Cupertino; COCU-10		: Construction Calculations		
VIBRATION	Spatially AVG Distance(ft)	Worst-case Distance (ft)	Land Use Type	
1	Receptor 1	300	185	Residential
2	Receptor 2	300	200	Residential
3	Receptor 3	100	70	Residential
4	Maryknoll	400	325	Residential
5	Receptor 5	0	0	Residential
6	Receptor 6	0	0	Residential
7	Receptor 7	0	0	Residential
8	Receptor 8	0	0	Residential

Vibration Annoyance Red Cell indicates level exceeds FTA criteria											
Equipment Item	VdB at 25 ft	Distance to 78 VdB	to 84 VdB	Receptor 1	Receptor 2	Receptor 3	Maryknoll	Receptor 5	Receptor 6	Receptor 7	Receptor 8
Pile Driver (impact)(typ)	104	183.9	116.0	64.6	76.9	58.4	48.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Pile Driver (sonic)(typ)	93	79.1	49.9	53.6	65.9	47.4	37.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Clam Shovel drop (slurry wall)	94	85.4	53.9	54.6	66.9	48.4	38.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Hydromill (slurry wall)(soil)	66	10.0	6.3	26.6	38.9	20.4	10.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Vibratory Roller	94	85.4	53.9	54.6	66.9	48.4	38.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Hoe Ram	87	49.9	31.5	47.6	59.9	41.4	31.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Large Bulldozer	87	49.9	31.5	47.6	59.9	41.4	31.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Caisson Drilling	87	49.9	31.5	47.6	59.9	41.4	31.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Loaded Trucks	86	46.2	29.1	46.6	58.9	40.4	30.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Jackhammer	79	27.0	17.0	39.6	51.9	33.4	23.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Small Bulldozer	58	5.4	3.4	18.6	30.9	12.4	2.6	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Vibration Damage											
Equipment Item	PPV at 25 ft	Distance to .2 PPV	to .3 PPV	Receptor 1	Receptor 2	Receptor 3	Maryknoll	Receptor 5	Receptor 6	Receptor 7	Receptor 8
Pile Driver (impact)(typ)	0.664	55.6	42.5	0.009	0.034	0.004	0.001	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Pile Driver (sonic)(typ)	0.17	22.4	17.1	0.002	0.009	0.001	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Clam Shovel drop (slurry wall)	0.202	25.2	19.2	0.003	0.010	0.001	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Hydromill (slurry wall)(soil)	0.008	2.9	2.2	0.000	0.000	0.000	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Vibratory Roller	0.21	25.8	19.7	0.003	0.011	0.001	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Hoe Ram	0.089	14.6	11.1	0.001	0.005	0.001	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Large Bulldozer	0.089	14.6	11.1	0.001	0.005	0.001	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Caisson Drilling	0.089	14.6	11.1	0.001	0.005	0.001	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Loaded Trucks	0.076	13.1	10.0	0.001	0.004	0.000	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Jackhammer	0.035	7.8	6.0	0.000	0.002	0.000	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Small Bulldozer	0.003	1.5	1.2	0.000	0.000	0.000	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Bibliography

- Cupertino, California, Municipal Code Chapter 10.48, Community Noise Control (2001).
- Cupertino, California, General Plan: Community Vision 2015-2040. Chapter 7, Health & Safety Element (2015)
- Beranek, Leo. *Noise and Vibration Control*. Revised Edition. Institute of Noise Control Engineering. Washington, D.C. 1988.
- California Department of Transportation (Caltrans). 2006, August. *Traffic Noise Analysis Protocol*.
- California Department of Transportation (Caltrans). 2009, November. *Technical Noise Supplement ("TeNS")*. Prepared by ICF International.
- California Department of Transportation (Caltrans), Department of Transportation, Noise, Vibration, and Hazardous Waste Management Office. 2004, June. *Transportation- and Construction-Induced Vibration Guidance Manual*. Prepared by ICF International.
- California Department of Transportation (Caltrans), Division of Environmental Analysis. 2002, February. *Transportation Related Earthborne Vibration (Caltrans Experiences)*. Technical Advisory, Vibration. TAV-02-01-R9601. Prepared by Rudy Hendricks.
- California Supreme Court. *California Building Industry Association v. Bay Area Air Quality Management District* (2015) [Case No. S213478]
- Federal Highway Administration (FHWA). 1978, December. *Federal Highway Traffic Noise Prediction Model*. U.S. Department of Transportation (DoT) Report No. FHWA-RD77-108.
- Federal Transit Administration (FTA). 2006, May. *Transit Noise and Vibration Impact Assessment*. U.S. Department of Transportation (DoT). FTA-VA-90-1003-06.
- Governor's Office of Planning and Research. 2003, October. *State of California General Plan Guidelines*.
- Harris, Cyril M. *Handbook of Acoustical Measurements and Noise Control*, Third Edition. Acoustical Society of America. Woodbury, NY. 1998.
- U.S. Environmental Protection Agency (EPA). 1978, November. *Protective Noise Levels*. EPA 550/9-79-100. (Condensed version of 1971 and 1974 documents.)
- Barry, T.M., and J. Regan. FHWA Traffic Noise Prediction Model. Report No. FHWA-RD-77-108. Washington, DC: Federal Highway Administration, December 1978.