HOUSING ELEMENT UPDATE
NOISE AND VIBRATION ASSESSMENT

Danville, California

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INTRODUCTION

The purpose of this report is to assess potential noise and vibration impacts associated with the Town of Danville 2023-2031 Housing Element Update (HEU). The update would allow for increased residential development, including new residences in areas currently zoned for non-residential development. The Noise and Vibration Assessment includes a Setting section providing a brief description of the fundamentals of environmental noise and vibration, summarizes the applicable regulatory criteria, and discusses the results of ambient noise monitoring surveys completed to document existing conditions. The General Plan Consistency section evaluates the noise environment at each of the 8 development subareas. The Impacts and Mitigation Measures section describes the significance criteria used to evaluate potential impacts, provides a description of each impact, and presents mitigation measures where necessary to provide a guideline for the implementation of the HEU for the Town of Danville.

SETTING

Fundamentals of Environmental Noise

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its *loudness*. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (*frequency*) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales which are used to describe noise in a particular location. A *decibel (dB)* is a unit of measurement which indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10 decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Technical terms are defined in Table 1.

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level (dBA).* This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table 2. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This *energy-equivalent sound/noise descriptor* is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

The scientific instrument used to measure noise is the sound level meter. Sound level meters can accurately measure environmental noise levels to within about plus or minus 1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways and airports. The accuracy of the predicted models depends upon the distance the receptor is from the noise source. Close to the noise source, the models are accurate to within about plus or minus 1 to 2 dBA.

Since the sensitivity to noise increases during the evening and at night -- because excessive noise interferes with the ability to sleep -- 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level* (*CNEL*) is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 pm - 10:00 pm) and a 10 dB addition to nocturnal (10:00 pm - 7:00 am) noise levels. The *Day/Night Average Sound Level* (*DNL*) is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this three-hour period are grouped into the daytime period.

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA L_{dn}/CNEL. Typically, the highest steady traffic noise level during the daytime is about equal to the L_{dn}/CNEL and nighttime levels are 10 dBA lower. The standard is designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12-17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer dwelling. Sleep and speech interference is therefore possible when exterior noise levels are about 57-62 dBA L_{dn}/CNEL with open windows and 65-70 dBA L_{dn}/CNEL if the windows are closed. Levels of 55-60 dBA are common along collector streets and secondary arterials, while 65-70 dBA is a typical value for a primary/major arterial. Levels of 75-80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed, those facing major roadways and freeways typically need special glass windows.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The L_{dn}/CNEL as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to

be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 50 dBA L_{dn}/CNEL. At a L_{dn}/CNEL of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the L_{dn}/CNEL increases to 70 dBA, the percentage of the population highly annoyed increases to about 25-30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a L_{dn}/CNEL of 60-70 dBA. Between a L_{dn}/CNEL of 70-80 dBA, each decibel increase increases by about 3 percent the percentage of the population highly annoyed. People appear to respond more adversely to aircraft noise. When the L_{dn}/CNEL is 60 dBA, approximately 30-35 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 3 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 4 percent increase in the percentage of the population highly annoyed.

TABLE 1 Definition of Acoustical Terms Used in this Report

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. The reference pressure for air is 20 micro Pascals.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e. g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting 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.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn} or DNL	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.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels measured in the night between 10:00 pm and 7:00 am.
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: Handbook of Acoustical Measurements and Noise Control, Harris, 1998.

TABLE 2 Typical Noise Levels in the Environment

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	110 dBA	Rock band
Jet fly-over at 1,000 feet		
	100 dBA	
Gas lawn mower at 3 feet		
	90 dBA	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	80 dBA	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawn mower, 100 feet	70 dBA	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	60 dBA	
		Large business office
Quiet urban daytime	50 dBA	Dishwasher in next room
Quiet urban nighttime	40 dBA	Theater, large conference room
Quiet suburban nighttime		
	30 dBA	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	20 dBA	
		Broadcast/recording studio
	10 dBA	
	0 dBA	

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

Fundamentals of Groundborne Vibration

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One method is the Peak Particle Velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. In this report, a PPV descriptor with units of mm/sec or in/sec is used to evaluate construction generated vibration for building damage and human complaints. Table 3 displays the reactions of people and the effects on buildings that continuous or frequent intermittent vibration levels produce. The guidelines in Table 3 represent syntheses of vibration criteria for human response and potential damage to buildings resulting from construction vibration.

Construction activities can cause vibration that varies in intensity depending on several factors. The use of pile driving and vibratory compaction equipment typically generates the highest construction related groundborne vibration levels. Because of the impulsive nature of such activities, the use of the PPV descriptor has been routinely used to measure and assess groundborne vibration and almost exclusively to assess the potential of vibration to cause damage and the degree of annoyance for humans.

The two primary concerns with construction-induced vibration, the potential to damage a structure and the potential to interfere with the enjoyment of life, are evaluated against different vibration limits. Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels, such as people in an urban environment, may tolerate a higher vibration level.

Structural damage can be classified as cosmetic only, such as paint flaking or minimal extension of cracks in building surfaces; minor, including limited surface cracking; or major, that may threaten the structural integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher. The damage criteria presented in Table 3 include several categories for ancient, fragile, and historic structures, the types of structures most at risk to damage. Most buildings are included within the categories ranging from “Historic and some old buildings” to “Modern industrial/commercial buildings.” Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at lower levels than those shown, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying. Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors, or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage.

TABLE 3 Reaction of People and Damage to Buildings from Continuous or Frequent Intermittent Vibration Levels

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.01	Barely perceptible	No effect
0.04	Distinctly perceptible	Vibration unlikely to cause damage of any type to any structure
0.08	Distinctly perceptible to strongly perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.1	Strongly perceptible	Threshold at which there is a risk of damage to fragile buildings with no risk of damage to most buildings
0.25	Strongly perceptible to severe	Threshold at which there is a risk of damage to historic and some old buildings.
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential structures
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to new residential and modern commercial/industrial structures

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, April 2020.

REGULATORY BACKGROUND

Regulatory Background - Noise & Vibration

This section describes the relevant guidelines, policies, and standards established by State Agencies and the Town of Danville. The California Environmental Quality Act (CEQA) Guidelines, Appendix G, are used to assess the potential significance of impacts pursuant to local General Plan policies, Municipal Code standards, or the applicable standards of other agencies. A summary of the applicable regulatory criteria is provided below.

State CEQA Guidelines. CEQA contains guidelines to evaluate the significance of effects of environmental noise attributable to a proposed project. Under CEQA, noise impacts would be considered significant if the project would result in:

(a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;

(b) Generation of excessive groundborne vibration or groundborne noise levels;

(c) For a project located within the vicinity of a private airstrip or an airport land use plan or where such a plan has not been adopted within two miles of a public airport or public use airport, if the project would expose people residing or working in the project area to excessive noise levels.

Checklist items (a) and (b) are applicable to the proposed project. The project is not located within two miles of a public airport or in the vicinity of a private airstrip and would not expose people residing or working in the project area to excessive aircraft noise levels; therefore, item (c) is not carried further in this analysis.

2019 California Building Code, Title 24, Part 2. The current version of the California Building Code (CBC) requires interior noise levels in multi-family residential units attributable to exterior environmental noise sources to be limited to a level not exceeding 45 dBA L_{dn}/CNEL in any habitable room.

Town of Danville General Plan: The stated goal of the 2030 General Plan Noise Element is to protect existing and future residents of Danville from hazards and nuisance associated with excessive levels of noise.

Goal 27: *Protect existing and future residents of Danville from hazards and nuisance associated with excessive levels of noise by maintaining or reducing noise intrusion levels in all areas of the Town to acceptable levels.*

Supporting policies from the General Plan that are applicable in this assessment are listed below:

Policy 27.01 Ensure that new residential development projects meet acceptable noise level guidelines as shown in Figure 26 (Table 4).

If an area currently meets desired noise standards, an increase up to the maximum acceptable noise level should not necessarily be allowed. The potential for a proposed project to have adverse noise impacts should be evaluated based on the potential for adverse community response, regardless of the compatibility guidelines.

Policy 27.02 Require acoustical studies for major residential and other development projects, as appropriate, and impose noise mitigation measures accordingly.

Policy 27.03 Protect the noise environment in existing residential areas. Where acceptable noise levels in residential areas would be exceeded or further impacted as a result of new development or transportation improvements, require the use of noise mitigation measures, such as wall barriers, berms, mufflers, sound traps, and baffles to reduce noise intrusion.

Policy 27.04 Encourage the location of noise-sensitive land uses away from noise sources or require appropriate noise screening.

Policy 27.06 Review and update the existing Noise Ordinance to specify and regulate the noise levels for various equipment, activities, and land uses and to clarify enforcement procedures.

Policy 27.08 Require noise monitoring as needed to determine changes in noise levels over time, measure the effectiveness of project conditions of approval, and to ensure that appropriate mitigation programs are developed.

Policy 27.09 Generally maintain exterior noise levels below 60 L_{dn} in areas where outdoor use is a major consideration, such as in residential backyards. Where the Town determines that this level cannot be achieved after reasonable mitigation has been applied, higher standards may be permitted at the discretion of the Town Council. In such cases, indoor noise levels should not exceed an L_{dn} of 45 dB.

Development sites exposed to noise levels exceeding 60 Ldn shall be analyzed following protocols in Appendix Chapter 12, Section 1207 Sound Transmission of the 2010 California Building Code (or the latest revision).

Note: L_{dn} used in this Policy and CNEL used in Table 4 are closely equivalent and are used interchangeably in this report.

Policy 27.11 Ensure that the design of new development near major noise sources (such as Interstate 680) reduces the potential for future occupants to be exposed to high levels of noise. Development on such properties should incorporate appropriate noise mitigation measures.

Policy 27.12 Require the preparation of groundborne vibration studies by qualified professionals in accordance with industry-accepted methodology where heavy construction activities involving significant site grading, underground, or foundation work will occur within 50 feet of residential or other vibration sensitive uses.

Vibration studies may also be required for projects involving significant increases in the operation of heavy vehicles such as trucks and buses. Applicable and feasible vibration reduction measures shall be incorporated into project plans.

Policy 27.13 Utilize noise reduction measures during all phases of construction activity to minimize the exposure of neighboring properties to excessive noise levels.

Construction activities are required to comply with the Town's noise ordinance limitations on hours and days of operations.

Town of Danville Municipal Code: The Town of Danville's Municipal Code includes various provisions intended to reduce nuisance noise impacts to noise-sensitive receptors associated with existing noise sources and events. Section 4-2.4 of the Town's Municipal Code includes allowable construction activity times to be between 7:30 a.m. and 7:00 p.m. Monday through Friday and to be between 9:00 a.m. and 7:00 p.m. Saturday, Sundays, and Holidays. The code also restricts noise from operating machinery, equipment, or a pump, fan, air-conditioner, or engine in a manner which causes excessive noise to nearby residents between the hours of 10:00 p.m. and 8:00 a.m.

TABLE 4 Figure 26 - Land use Compatibility Guidelines For Exterior Noise Levels

LAND USE CATEGORY	COMMUNITY NOISE EXPOSURE (CNEL)			
	Normally Acceptable	**Conditionally Acceptable**	**Normally Unacceptable**	**Clearly Unacceptable**
Residential-Low Density, Single-Family, Duplex, Mobile Homes	50-60	55-70	70-75	75-85
Residential – Multifamily	50-65	60-70	70-75	75-85
Transient Lodging – Motel, Hotels	50-65	60-70	70-80	80-85
Schools, Libraries, Churches, Hospitals, Nursing Homes	50-70	60-70	70-80	80-85
Auditoriums, Concert Halls, Amphitheaters	Not Applicable	50-70	Not Applicable	65-85
Sports Arenas, Outdoor Spectator Sports	Not Applicable	50-70	Not Applicable	65-85
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50-70	Not Applicable	70-80	80-85
Office Buildings, Business Commercial and Professional	50-70	67.5-77.5	75-85	Not Applicable
Industrial, Manufacturing, Utilities, Agricultural	50-75	70-80	75-85	Not Applicable
CNEL = Community Noise Equivalent Level in A-weighted decibels (dBA)				
Normally Acceptable: Specified land use is satisfactory, based upon assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements.				
Conditionally Acceptable: New construction of development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features have been included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning, will normally suffice.				
Normally Unacceptable: New construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise-insulation features must be included in the design.				
Clearly Unacceptable: New construction or development should generally not be undertaken.				

Source: California Office of Planning and Research, *General Plan Guidelines*, October 2003. Town of Danville, 2012.

NOISE MEASUREMENT SURVEY

A noise monitoring survey was performed from Monday, January 24, 2022, through Friday, January 28, 2022. The survey included ten (10) long-term (LT) noise measurements and nineteen (19) short-term (ST) noise measurements to quantify existing ambient noise levels in and around the eight identified opportunity subareas. Long-term noise measurement data is provided in Appendix A. Noise measurement locations are shown in Figures 1 and 2.

Long-Term Noise Measurements

Noise measurements LT-1a and LT-1b were in Subarea 1. LT-1a was located about 200 feet southwest of the I-680 centerline. Traffic along I-680 and some local traffic on La Gonda Way were the primary sources of noise in the area. Hourly average noise levels ranged from 68 to 73 dBA L_{eq} during the day and from 61 to 72 dBA L_{eq} at night. The Community Noise Exposure Level (CNEL) at this location on Thursday, January 27, 2022 was 75 dBA. Figure A1 in Appendix A shows the trend in noise levels throughout the measurement period from January 26 to 28, 2022. LT-1b was located about 22 feet south of the centerline of El Cerro Boulevard with local traffic being the primary noise source in the area. Hourly average noise levels ranged from 63 to 73 dBA L_{eq} during the day and from 50 to 65 dBA L_{eq} at night. The CNEL at this location on Thursday, January 27, 2022 was 69 dBA. Figure A2 in Appendix A shows the trend in noise levels throughout the measurement period from January 26 to 28, 2022.

Noise measurements LT-2a and LT-2b were in Subarea 2 in the downtown area. LT-2a was about 25 feet east of the Hartz Avenue centerline. Noise from local traffic along Hartz Avenue is the primary noise source in the vicinity of the measurement location. Hourly average noise levels ranged from 61 to 69 dBA L_{eq} during the day and from 51 to 64 dBA L_{eq} at night. The CNEL at this location on Thursday, January 27, 2022 was 67 dBA. Figure A3 in Appendix A shows the trend in noise levels throughout the measurement period from January 26 to 28, 2022. LT-2b was at the Danville Bowl parking lot about 280 feet west of the I-680 centerline. The primary noise source at this location is traffic noise from I-680. Hourly average noise levels ranged from 60 to 67 dBA L_{eq} during the day and from 56 to 66 dBA L_{eq} at night. The CNEL at this location on Thursday, January 27, 2022 was 68 dBA. Figure A4 in Appendix A shows the trend in noise levels throughout the measurement period from January 26 to 28, 2022.

Noise measurement LT-3 was in Subarea 3 about 47 feet west from the centerline of San Ramon Valley Boulevard. The primary noise source at this location was traffic along I-680 and traffic on San Ramon Valley Boulevard. Hourly average noise levels ranged from 65 to 71 dBA L_{eq} during the day and from 59 to 68 dBA L_{eq} at night. The CNEL at this location on January 25, 2022 was 72 dBA. Figure A5 in Appendix A shows the trend in noise levels throughout the measurement period from January 24 to 26, 2022.

Noise measurement LT-4 was in Subarea 4 near the intersection of El Cerro Boulevard and Diablo Road, about 48 feet south of the El Cerro Boulevard centerline. Traffic along the roads were the primary sources of noise in the area. Hourly average noise levels ranged from 61 to 69 dBA L_{eq} during the day and from 51 to 65 dBA L_{eq} at night. The CNEL at this location on Thursday, January

27, 2022 was 67 dBA. Figure A6 in Appendix A shows the trend in noise levels throughout the measurement period from January 26 to 28, 2022.

Noise measurement LT-5 was in Subarea 5 about 145 feet north of the Sycamore Valley Road centerline. Traffic along Sycamore Valley Road was the primary noise source at this location. Hourly average noise levels ranged from 59 to 67 dBA L_{eq} during the day and from 45 to 63 dBA L_{eq} at night. The CNEL at this location on January 25, 2022 was 65 dBA. Figure A7 in Appendix A shows the trend in noise levels throughout the measurement period from January 24 to 26, 2022.

Noise measurement LT-6 was in Subarea 6 about 111 feet south of the Camino Tassajara centerline. Traffic along Camino Tassajara was the primary noise source at this location. Hourly average noise levels ranged from 58 to 64 dBA L_{eq} during the day and from 44 to 59 dBA L_{eq} at night. The CNEL at this location on January 25, 2022 was 63 dBA. Figure A8 in Appendix A shows the trend in noise levels throughout the measurement period from January 24 to 26, 2022.

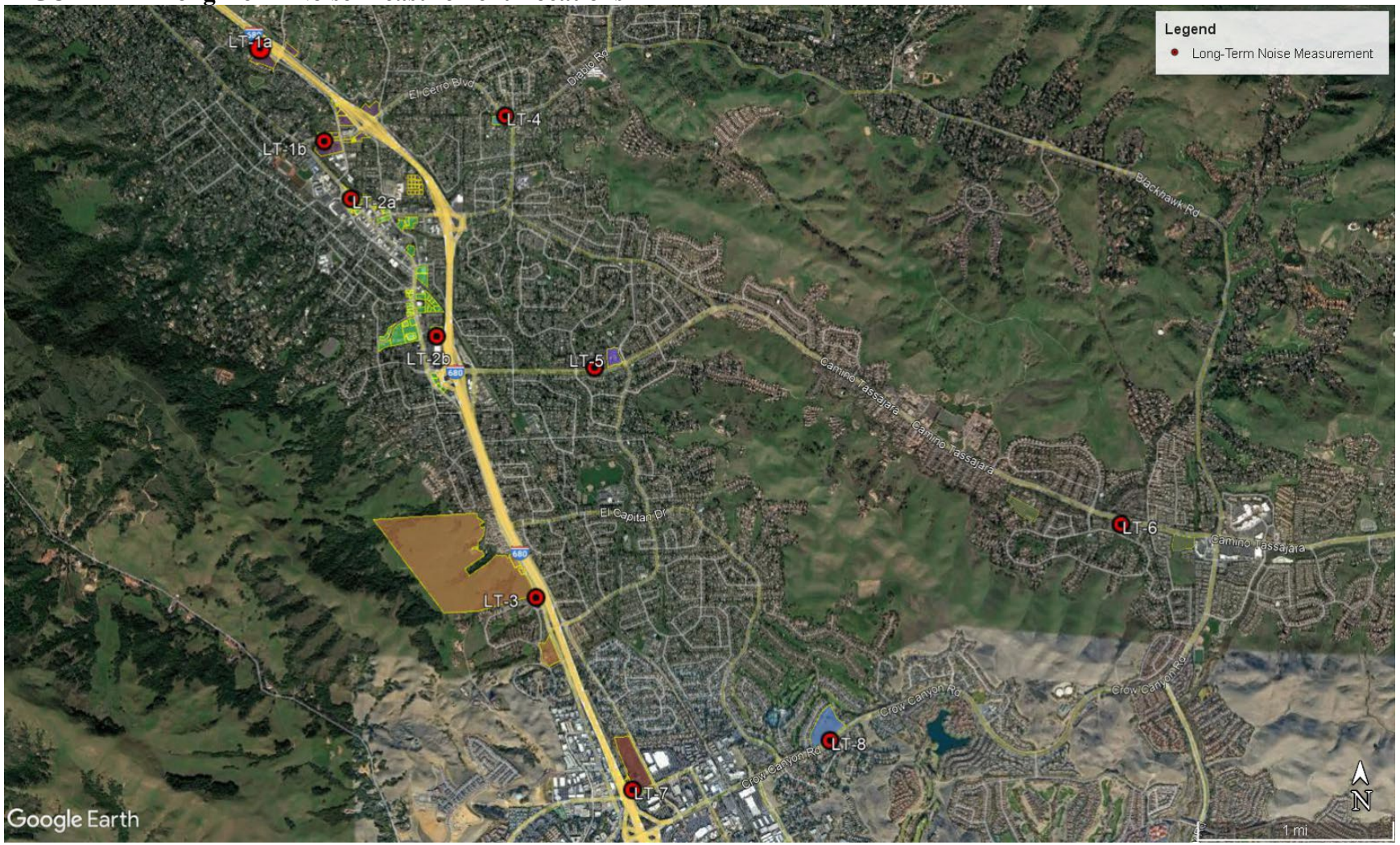
Noise measurement LT-7 was in Subarea 7 about 275 feet east of the centerline of I-680, and about 175 feet from the center of Fostoria Way. The primary noise source at this location was I-680 traffic. Hourly average noise levels ranged from 61 to 69 dBA L_{eq} during the day and from 56 to 67 dBA L_{eq} at night. The CNEL at this location on January 25, 2022 was 69 dBA. Figure A9 in Appendix A shows the trend in noise levels throughout the measurement period from January 24 to 26, 2022.

Noise measurement LT-8 was in Subarea 8 about 45 feet north of the centerline of Crow Canyon Road. Traffic along Crow Canyon Road was the primary noise source in the area. Hourly average noise levels ranged from 68 to 76 dBA L_{eq} during the day and from 54 to 72 dBA L_{eq} at night. The CNEL at this location on January 25, 2022 was 76 dBA. Figure A10 in Appendix A shows the trend in noise levels throughout the measurement period from January 24 to 26, 2022.

Short-Term Noise Measurements

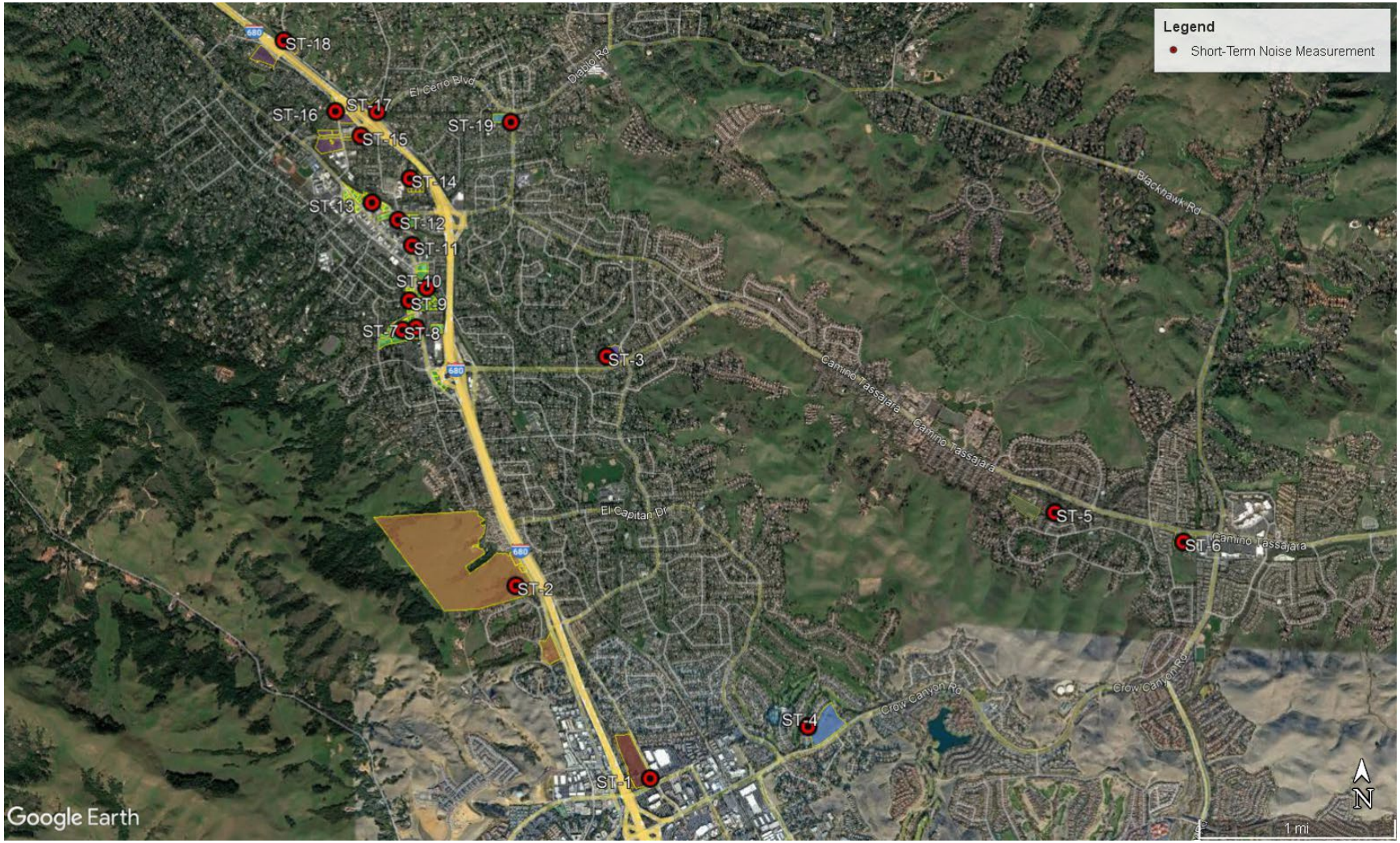
A series of nineteen attended short-term (ST) 10 – minute duration measurements were also made to identify the noise sources that occurred during the measurement and to note the level of noise associated with these identifiable events. The attended measurements assist in quantitatively and qualitatively characterizing the noise environments along the major roadways and in the quieter areas of the city. Data collected at each of the short-term sites are summarized in Table 5.

FIGURE 1 Long-Term Noise Measurement Locations



Source: Google Earth 2022

FIGURE 2 Short-Term Noise Measurement Locations



Source: Google Earth 2022

TABLE 5 Summary of Short-Term Noise Measurement Data

Noise Measurement Location (Date, Time)	Measured Noise Level, dBA						
	L_{max}	L_{min}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	L_{eq}
ST-1: ~35 feet from Camino Ramon centerline, ~215 feet from Fostoria Way centerline (1/24/22, 10:30 – 10:40 am)	76	51	73	67	61	54	64
ST-2: ~470 feet from I-680 centerline (1/24/22, 11:10 – 11:20 am)	70	60	69	68	66	64	66
ST-3: ~370 feet from Sycamore Valley Rd (1/24/22, 11:50 am – 12:00 pm)	62	42	57	54	51	46	52
ST-4: ~645 feet from Crow Canyon Rd (1/24/22, 10:50 – 11:00 am)	67	35	61	51	42	38	48
ST-5: ~450 feet from Camino Tassajara (1/24/22, 11:50 am – 12:00 pm)	60	35	56	46	42	39	45
ST-6: ~235 feet from Camino Tassajara (1/24/22, 12:30 – 12:40 pm)	55	39	53	51	47	43	48
ST-7: ~55 feet from San Ramon Valley Blvd (1/28/22, 9:50 – 10:00 am)	79	53	75	73	67	60	69
ST-8: ~425 feet from San Ramon Valley Blvd (1/28/22, 10:10 – 10:20 am)	72	48	68	57	52	49	56
ST-9: On Estates Dr, ~110 feet from San Ramon Valley Blvd (1/28/22, 10:40 – 10:50 am)	75	48	72	63	58	54	60
ST-10: ~585 feet from I-680 on Iron Horse Regional Trail (1/28/22, 10:30 – 10:40 am)	59	49	56	54	52	51	53
ST-11: ~265 feet from Hartz Ave (1/28/22, 10:10 – 10:20 am)	57	47	54	53	50	48	51
ST-12: ~170 feet from Diablo Rd (1/28/22, 9:50 – 10:00 am)	67	48	63	58	55	52	56
ST-13: ~15 feet from E. Linda Mesa Ave (1/26/22, 12:10 – 12:20 pm)	69	44	66	61	50	45	55
ST-14: Charles Lane, ~400 feet from I-680 (1/26/22, 11:50 am – 12:00 pm)	56	48	55	54	52	51	52
ST-15: ~170 feet from El Cerro Blvd, ~400 feet from I-680 (1/26/22, 11:40 – 11:50 am)	67	56	66	64	61	59	62
ST-16: 520 La Gonda Way, ~310 feet from I-680 (1/26/22, 12:30 – 12:40 pm)	75	57	72	67	61	59	64
ST-17: ~50 feet from El Cerro Blvd, ~400 feet from I-680 (1/26/22, 12:10 – 12:20 pm)	75	58	72	69	66	63	66
ST-18: 939 El Pintado Rd., ~280 feet from I-680 (1/28/22, 9:30 – 9:40 am)	78	58	74	72	70	67	70
ST-19: 828 Diablo Rd,~35 feet from Diablo Rd (1/26/22, 11:20 – 11:30 am)	79	47	75	70	63	52	66

EXISTING AND FUTURE NOISE CONDITIONS

Traffic continues to be the most significant source of noise within the Danville planning area, with Interstate 680 being the most significant source of traffic noise. There are no stationary sources that make a significant contribution to the noise environment in the HEU subareas.

Noise measurements and traffic noise modeling are used to establish noise levels along major roadways in the Town at a distance of 75 feet, as summarized in Table 6. Average Daily Traffic volumes[1] for the existing environment are compared with the future build scenario for 2031 to calculate noise levels anticipated along major roadways assuming the implementation of the project.

TABLE 6 Traffic Noise Levels along Roadways by Subarea

Subarea	Roadway	Segment	CNEL at 75 feet, dBA*	
			Existing	2031 With HEU
1	I-680	North of Diablo Rd	81	81
1	La Gonda Wy	South of El Pintado Road	63	64
1	El Cerro Blvd	West of I-680 SB Ramps	68	69
1	Danville Blvd	North of La Gonda Way	67	67
2	I-680	South of Diablo Rd	77	77
2	Hartz Ave	North of Church St	65	65
2	Railroad Ave	North of Church St	60	60
2	San Ramon Valley Blvd	North of Boone Ct	66	67
2	Diablo Rd	East of West El Pintado	58	58
3	I-680	South of Sycamore Valley Rd	69	81
3	San Ramon Valley Blvd	South of Sycamore Valley Rd	65	65
4	Diablo Rd	South of El Cerro Blvd	64	64
4	El Cerro Blvd	East of Constitution Dr	66	66
5	Sycamore Valley Rd	East of Brookside Dr	68	69
6	Camino Tassajara	West of Crow Canyon Road	68	68
7	I-680	South of Sycamore Valley Rd	77	77
7	Camino Ramon	South of Greenbrook Drive	59	59
8	Crow Canyon Road	South of Camino Tassajara	70	70

[1] Hexagon Transportation Consultants, Inc., May 2022.

GENERAL PLAN CONSISTENCY ANALYSIS

The noise exposures of housing projects facilitated by the HEU are not considered under CEQA. This section addresses Noise and Land Use Compatibility for consistency with the policies set forth in the City's General Plan.

Noise and Land Use Compatibility

The applicable Danville General Plan policies were presented in detail in the Regulatory Background section and are summarized below for the proposed project:

Policy 27.09 Generally maintain exterior noise levels below 60 L_{dn} in areas where outdoor use is a major consideration, such as in residential backyards. Where the Town determines that this level cannot be achieved after reasonable mitigation has been applied, higher standards may be permitted at the discretion of the Town Council. In such cases, indoor noise levels should not exceed an L_{dn} of 45 dB.

Development sites exposed to noise levels exceeding 60 Ldn shall be analyzed following protocols in Appendix Chapter 12, Section 1207 Sound Transmission of the 2010 California Building Code (or the latest revision).

Policy 27.11 Ensure that the design of new development near major noise sources (such as Interstate 680) reduces the potential for future occupants to be exposed to high levels of noise. Development on such properties should incorporate appropriate noise mitigation measures.

Noise and Land Use Compatibility guidelines for new development were shown in Table 4. Low density residential is considered "Normally Acceptable" up to 60 dBA L_{dn}/CNEL and multi-family residential is considered "Normally Acceptable" up to 65 dBA L_{dn}/CNEL. In the following discussion, the noise and land use compatibility is evaluated for each subarea. Noise control measures are discussed including site planning, sound walls, and detailed analysis per the requirements of the State Building Code leading to building sound insulation treatments.

Subarea 1. Housing opportunity sites are proposed along the I-680/La Gonda Way corridor and along El Cerro Boulevard southwest of I-680. The noise exposure at sites along the I-680/ La Gonda Way corridor is 70 – 75 dBA L_{dn}/CNEL. The noise and land use compatibility designation is "Normally Unacceptable" where "new construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise-insulation features must be included in the design." The noise exposure at sites within Subarea 1, not bordering I-680, is 65 – 70 dBA L_{dn}/CNEL. The noise and land use compatibility designation is "Conditionally Acceptable" where "new construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features have been included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning, will normally suffice."

Subarea 2. Subarea 2 is in the Downtown area. Sites located along local roadways including Railroad Avenue, Front Street, Diablo Road, Hartz Avenue, San Ramon Valley Boulevard, and Boone Court, where it adjoins the I-680 corridor, have noise exposures ranging from 65 – 70 dBA L_{dn}/CNEL. The noise and land use compatibility designation is "Conditionally Acceptable" at these sites where "new construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features have been included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning, will normally suffice." Sites located along Town and Country Drive have noise exposures less than 60 dBA L_{dn}/CNEL. The noise and land use compatibility designation is "Normally Acceptable" at these sites where the "specified land use is satisfactory, based upon assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements."

Subarea 3. Subarea 3 is in the San Ramon Valley Boulevard/I-680 corridor south of El Capitan Drive. The noise exposure at these sites along the I-680/San Ramon Valley Boulevard corridor is 70 – 75 dBA L_{dn}/CNEL. The noise and land use compatibility designation is "Normally Unacceptable" where "new construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise-insulation features must be included in the design."

Subareas 4 and 5. Subarea 4 is at the intersection of El Cerro Boulevard and Diablo Road. Subarea 5 is located at the intersection of Sycamore Valley Road and Old Orchard Drive. The noise exposure at these sites is 65 – 70 dBA L_{dn}/CNEL. The noise and land use compatibility designation is "Conditionally Acceptable" where "new construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features have been included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning, will normally suffice."

Subarea 6. Subarea 6 is located along the southbound side of Camino Tassajara south of Woodside Drive. The noise exposure about 500 feet from Camino Tassajara is less than 60 dBA L_{dn}/CNEL. The noise and land use compatibility designation is "Normally Acceptable" at these sites where the "specified land use is satisfactory, based upon assumption that any buildings involved are of normal conventional construction, without any special noise insulation requirements." The noise exposure adjoining the roadway is 60 – 65 dBA L_{dn}/CNEL. The noise and land use compatibility designation is "Conditionally Acceptable" where "new construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features have been included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning, will normally suffice."

Subarea 7. Subarea 7 is located at the intersection of Camino Ramon and Fostoria Way. The noise exposure along the I-680 corridor is 70 – 75 dBA L_{dn}/CNEL. The noise and land use compatibility designation is "Normally Unacceptable" where "new construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise-insulation features must be included in the design." The noise exposure about 250 feet from I-680 is 65 – 70 dBA L_{dn}/CNEL. The noise and land use compatibility designation is "Conditionally Acceptable" where "new construction or

development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features have been included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning, will normally suffice." The noise exposure at the east terminus of Fostoria Way is 60 – 65 dBA L_{dn}/CNEL. The noise and land use compatibility designation is "Conditionally Acceptable" where "new construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features have been included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning, will normally suffice."

Subarea 8. Subarea 8 is on Crow Canyon Road at Crow Canyon Country Club. The noise exposure is 70 -75 dBA L_{dn}/CNEL. The noise and land use compatibility designation is "Normally Unacceptable" where "new construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be made and needed noise-insulation features must be included in the design."

General Plan policies 27.01, 27.02, 27.04, 27.09, and 27.11 establish a framework that will result in new housing included in the HEU to be compatible with the noise environments where they would be located. The following measures, applied individually or in combination, are recommended to implement the policies:

1) Utilize site planning to minimize noise impacts to outdoor activity areas. Consider locating non-noise sensitive uses, such as parking (e.g., carports), adjacent to roadways, and using the residential buildings to provide shielding for common outdoor use areas. Site planning is critical for sites in Subareas 1, 3, 7, and 8 proposed in "Normally Unacceptable" noise environments.

2) Construct noise barriers where necessary to shield outdoor activity areas from local street traffic noise. Most of the sites are proposed in "Conditionally Acceptable" noise exposures. Barriers 6 - 10 feet high can provide the 5 – 10 dBA of the noise reduction necessary to make the "Conditionally Acceptable" noise environment compatible. The final location, heights, and designs of barriers will be determined during development of the site plan.

3) General Plan policy 27.09 stipulates than indoor noise shall not exceed an L_{dn} (or CNEL) of 45 dBA in new residences. In addition, multi-family housing proposed on a project site is subject to the requirements of Title 24, Part 2, of the State Building Code. Where exterior noise levels would exceed 60 dBA L_{dn}/CNEL, an analysis detailing the treatments incorporated into the building plans shall be prepared and submitted to the City Building Department prior to issuance of a building permit. The report shall demonstrate that the design would achieve an interior level of 45 dBA L_{dn}/CNEL or less in all habitable residential areas.

NOISE IMPACTS AND MITIGATION MEASURES

This section describes the significance criteria used to evaluate project impacts under CEQA, provides a discussion of each project impact, and presents mitigation measures, where necessary, to provide a compatible project in relation to adjacent noise sources and land uses.

Significance Criteria

The following criteria were used to evaluate the significance of environmental noise and vibration resulting from the project:

1. **Temporary or Permanent Noise Increases in Excess of Established Standards.** A significant impact would be identified if project construction or operations would result in a substantial temporary or permanent increase in ambient noise levels at sensitive receivers in excess of the local noise standards contained in the Danville General Plan or Municipal Code, as follows:

    - Temporary Noise Increase. A significant temporary noise impact would be identified if construction would occur outside of the hours specified in the Municipal Code or if construction noise levels would increase ambient noise levels resulting in measurable annoyance. The noise increase threshold adjusts based on the ambient noise level with the expectation that communities already exposed to high levels of noise can only tolerate a small increase. In contrast, if the existing noise levels are low, it is reasonable to allow a greater change in the community noise.

    - Permanent Noise Increase. A significant impact would be identified if traffic or school activity noise generated by the project would substantially increase noise levels at sensitive receivers in the vicinity. A substantial increase would occur if: a) the noise level increase is 5 dBA L_{dn}/CNEL or greater, with a future noise level of less than 60 dBA L_{dn}/CNEL, or b) the noise level increase is 3 dBA L_{dn}/CNEL or greater, with a future noise level of 60 dBA L_{dn}/CNEL or greater.

2. **Generation of Excessive Groundborne Vibration.** A significant impact would be identified if the construction of the project would generate excessive vibration levels. Groundborne vibration levels exceeding 0.25 in/sec PPV would be considered excessive as such levels would have the potential to result in cosmetic damage to historic and some old buildings. Groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in cosmetic damage to buildings that are found to be structurally sound but where structural damage is a major concern, and groundborne vibration levels exceeding 0.5 in/sec PPV would have the potential to result in cosmetic damage to buildings that are structurally sound and designed to modern engineering standards.

Impact 1: **Permanent or Temporary Noise Increases in Excess of Established Standards.** Increased vehicle traffic due to the HEU would not result in a substantial permanent increase traffic noise levels along area roadways. Construction activities facilitated by the HEU would result in substantial temporary noise increases at nearby sensitive receptors. **This is a significant impact.**

Permanent Noise Increases from Project Traffic

Increases in traffic noise gradually degrade the environment in areas sensitive to noise. According to CEQA, "a substantial increase" is necessary to cause a significant environmental impact. An increase of 3 dBA L_{dn}/CNEL is considered substantial as it would represent a just-noticeable difference. Vehicular traffic on roadways in the Town would increase as development occurs and the Town's population increases. These projected increases in traffic would, over time, increase noise levels throughout the community.

The results presented in Table 7 indicate that traffic noise levels would generally increase by 0 to 2 dBA L_{dn}/CNEL between existing and future (2031) conditions with the project due to anticipated traffic volume increases along major roadways in Danville. The HEU would contribute 1 dBA L_{dn}/CNEL or less to the overall expected traffic noise increases. The lone exception is the segment of Tassajara Ranch Drive south of Mountain Ridge Drive, where traffic noise increases of up to 4 dBA L_{dn}/CNEL are expected under the General Plan Buildout and General Plan Buildout plus HEU conditions. However, the HEU does not measurably contribute to the 4 dBA L_{dn}/CNEL noise increase expected along this roadway segment that is due solely to the General Plan Buildout. Therefore, the traffic noise increases attributable to the implementation of the HEU would not result in a substantial permanent increase noise levels in the community.

TABLE 7 ADT Traffic Volumes and Expected Traffic Noise Increases

#	Roadway	Location	ADT			Noise Increase over Existing Conditions, dBA		Project Noise Increase over General Plan Buildout, dBA
			Existing 2020	2031 General Plan Buildout	2031 + HEU	2031 General Plan Buildout	2031 + HEU	
1	Blackhawk Rd	b/w Still Creek and	10,071	11,754	12,100	0.7	0.8	0.1
2	Blackhawk Rd	N. of Camino Tassajara	19,038	22,008	22,210	0.6	0.7	0.0
3	Camino Ramon	S. of Sycamore valley Rd	11,272	14,040	14,651	1.0	1.1	0.2
4	Camino Tassajara	E. of Crow Canyon Rd	27,967	32,515	33,561	0.7	0.8	0.1
5	Camino Tassajara	W. of Crow Canyon Rd	28,431	30,726	30,541	0.3	0.3	0.0
6	Camino Tassajara	W. of Glasgow Dr	28,963	31,910	33,179	0.4	0.6	0.2
7	Camino Tassajara	E. of Lomitas Dr	8,281	9,898	10,376	0.8	1.0	0.2
8	Crow Canyon Rd	N. of Center Way	26,462	31,772	32,103	0.8	0.8	0.0
9	Danville Blvd	S. of Hartford Rd	11,705	14,786	15,638	1.0	1.3	0.2
10	Diablo Rd	W. of Fairway Dr	14,180	14,358	14,517	0.1	0.1	0.0
11	Diablo Rd	E. of Matadera Way	18,304	18,262	18,036	0.0	-0.1	-0.1
12	Diablo Rd	W. of Alamatos Dr West	22,856	23,096	23,370	0.0	0.1	0.1
13	Diablo Rd	E. of West El Pintado	21,249	19,934	21,957	-0.3	0.1	0.4
14	El Cerro Blvd	E. of Constitution Dr	10,903	10,318	10,487	-0.2	-0.2	0.1
15	Green Valley Rd	N. of Diablo Rd	13,798	16,409	16,626	0.8	0.8	0.1
16	Hartz Ave	N. of Church St	11,173	13,704	15,191	0.9	1.3	0.4
17	Railroad Ave	N. of Church St	12,468	13,857	14,422	0.5	0.6	0.2
18	San Ramon Valley Blvd	N. of Boone Ct	22,609	27,909	32,356	0.9	1.6	0.6
19	San Ramon Valley Blvd	S. of Sycamore Valley Rd	12,902	14,233	15,573	0.4	0.8	0.4
20	San Ramon Valley Blvd	S. of Greenbrook Dr	12,274	18,156	19,789	1.7	2.1	0.4
21	Sycamore Valley Rd	E. of Brookside Dr	27,286	27,779	29,671	0.1	0.4	0.3
22	Sycamore Valley Rd	W. of I-680 SB Ramps	28,456	29,602	33,164	0.2	0.7	0.5
23	Tassajara Ranch Dr	S. of Mountain Ridge Dr	2,869	7,461	7,751	4.2	4.3	0.2
24	El Cerro Blvd	W. of I-680 SB Ramps	11,586	13,650	16,436	0.7	1.5	0.8
25	Danville Blvd	N. of La Gonda Way	14,212	16,264	16,990	0.6	0.8	0.2

#	Roadway	Location	ADT			Noise Increase over Existing Conditions, dBA		Project Noise Increase over General Plan Buildout, dBA
			Existing 2020	2031 General Plan Buildout	2031 + HEU	2031 General Plan Buildout	2031 + HEU	
26	Camino Ramon	S. of Greenbrook Dr	6,729	9,279	10,210	1.4	1.8	0.4
27	Stone Valley Rd	W. of Green Valley Rd	10,323	12,654	12,670	0.9	0.9	0.0
28	Camino Tassajara	W. of Hansen Lane	21,536	26,510	26,317	0.9	0.9	0.0
29	Greenbrook Dr	S. of Sycamore Valley Rd	5,027	6,195	7,569	0.9	1.8	0.9
30	El Capitan Dr	S. of Silver Lake Dr	3,802	4,686	6,036	0.9	2.0	1.1
33	Greenbrook Dr	E. of Camion Ramon	8,518	9,987	10,544	0.7	0.9	0.2
34	El Capitan Dr	E. of Camino Ramon	3,770	3,889	3,975	0.1	0.2	0.1
35	Diablo Rd	S. of El Cerro Blvd	16,064	16,883	16,974	0.2	0.2	0.0
36	La Gonda Way	N. of El Cerro Blvd	4,758	5,896	7,791	0.9	2.1	1.2

Temporary Noise Increases from Project Construction

Background Information on Construction Noise

Noise impacts resulting from construction depend upon the noise generated by various pieces of construction equipment, the timing and duration of noise-generating activities, and the distance between construction noise sources and noise-sensitive areas. Construction noise impacts primarily result when construction activities occur during noise-sensitive times of the day (e.g., early morning, evening, or nighttime hours), the construction occurs in areas near noise-sensitive land uses, or when construction lasts over extended periods of time.

Typically, construction activities would be carried out in stages. During each stage of construction, there would be a different mix of equipment operating, and noise levels would vary by stage and vary within stages, based on the amount of equipment in operation and the location at which the equipment is operating. Typical construction noise levels at a distance of 50 feet are shown in Tables 8 and 9. Table 8 shows the average noise level ranges, by construction phase, and Table 9 shows the maximum noise level ranges for different construction equipment. Most demolition and construction noise falls in the range of 80 to 90 dBA at 50 feet from the source. Construction-generated noise levels drop off/increase at a rate of about 6 dBA per doubling/halving of the distance between the source and receptor. Shielding by buildings or terrain can provide an additional 5 to 10 dBA noise reduction at distant receptors.

TABLE 8 Typical Ranges of Construction Noise Levels at 50 Feet, L_{eq} (dBA)

	Domestic Housing		Office Building, Hotel, Hospital, School, Public Works		Industrial Parking Garage, Religious Amusement & Recreations, Store, Service Station		Public Works Roads & Highways, Sewers, and Trenches	
	I	**II**	**I**	**II**	**I**	**II**	**I**	**II**
Ground Clearing	83	83	84	84	84	83	84	84
Excavation	88	75	89	79	89	71	88	78
Foundations	81	81	78	78	77	77	88	88
Erection	81	65	87	75	84	72	79	78
Finishing	88	72	89	75	89	74	84	84

I – All pertinent equipment present at site.
II – Minimum required equipment present at site.

Source: U.S.E.P.A., Legal Compilation on Noise, Vol. 1, p. 2-104, 1973.

TABLE 9 Construction Equipment 50-foot Noise Emission Limits

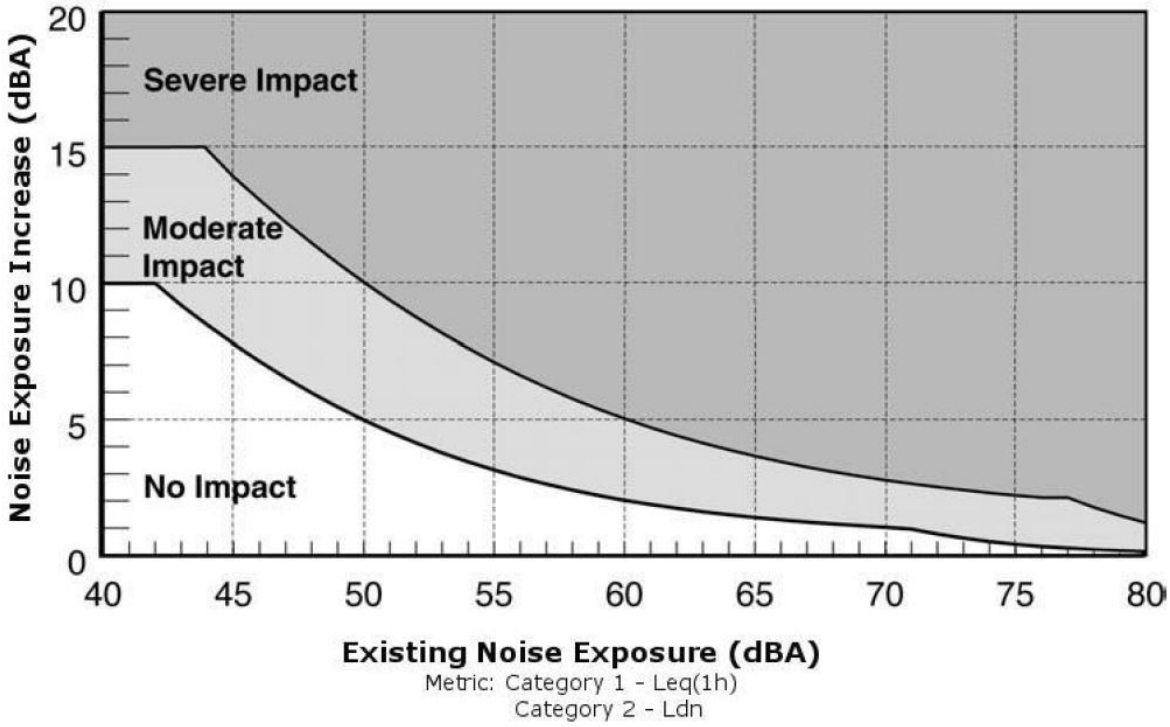
Equipment Category	L_{max} Level (dBA)1,2	Impact/Continuous
Arc Welder	73	Continuous
Auger Drill Rig	85	Continuous
Backhoe	80	Continuous
Ballast Equalizer[3]	82	Continuous
Ballast Tamper[3]	83	Continuous
Bar Bender	80	Continuous
Chain Saw	85	Continuous
Compressor (air)	80	Continuous
Concrete Mixer	85	Continuous
Concrete Pump	82	Continuous
Concrete Saw	90	Continuous
Concrete Vibrator	80	Continuous
Crane	85	Continuous
Dozer	85	Continuous
Excavator	85	Continuous
Front End Loader	80	Continuous
Generator	82	Continuous
Generator (25 KVA or less)	70	Continuous
Gradall	85	Continuous
Grader	85	Continuous
Grinder Saw	85	Continuous
Horizontal Boring Hydro Jack	80	Continuous
Hydra Break Ram	90	Impact
Impact Pile Driver	105	Impact
Jackhammer	85	Impact
Mounted Impact Hammer (hoe ram)	90	Impact
Paver	85	Continuous
Pneumatic Tools	85	Continuous
Pumps	77	Continuous
Rail Saw[3]	90	Continuous
Rock Drill	85	Continuous
Scraper	85	Continuous
Slurry Trenching Machine	82	Continuous
Soil Mix Drill Rig	80	Continuous
Street Sweeper	80	Continuous
Tie Cutter[3]	84	Continuous
Tie Handler[3]	80	Continuous
Tie Inserter[3]	85	Continuous
Tractor	84	Continuous
Truck	84	Continuous
Vibratory Compactor	80	Continuous
Vibratory Pile Driver	95	Continuous
All other equipment with engines larger than 5 HP	85	Continuous

Notes: [1] Measured at 50 feet from the construction equipment, with a "slow" (1 sec.) time constant. [2]Noise limits apply to total noise emitted from equipment and associated components operating at full power while engaged in its intended operation.[3] Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, FTA Report No. 0123, September 2018., [4] Mitigation of Nighttime Construction Noise, Vibrations and Other Nuisances, National Cooperative Highway Research Program, 1999.

Construction Noise Criteria

A significant noise impact would be identified if construction required for the development of housing in the Town would generate a substantial temporary noise level increase over ambient noise levels at noise sensitive receivers. Criteria established by the Federal Transit Administration (FTA) specify a comparison of the total noise levels resulting from a project plus the ambient noise levels to the ambient noise levels existing without the project, as shown below in Figure 3. Category 1 receivers are daytime only uses and Category 2 receivers are 24-hour uses such as residences. The "Moderate Impact" zone represents the threshold of measurable annoyance. For temporary construction noise, the upper boundary of the "Moderate Impact" zone is used to define a substantial temporary noise increase above ambient conditions. For example, if the existing noise were measured to be 60 dBA L_{dn}/CNEL, and the combined noise including the construction of the project would exceed 65 dBA L_{dn}/CNEL, the increase in the ambient would be considered substantial, resulting in significant impact. A significant noise impact would also be identified if construction occurred outside of allowable hours. The Danville Municipal Code limits construction to 7:30 a.m. and 7:00 p.m. Monday through Friday and between 9:00 a.m. and 7:00 p.m. Saturday, Sundays, and Holidays.

FIGURE 3 Increase in Cumulative Noise Levels Allowed by Criteria



Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018.

Construction Noise Impact Assessment

Federal Highway Administration's (FHWA's) Roadway Construction Noise Model (RCNM) was used to calculate the hourly average noise levels for each phase of construction, assuming the two loudest pieces of equipment would operate simultaneously, as recommend by the FTA for construction noise evaluations. This construction noise model includes representative sound levels for the most common types of construction equipment and the approximate usage factors of such equipment that were developed based on an extensive database of information gathered during the construction of the Central Artery/Tunnel Project in Boston, Massachusetts (CA/T Project or "Big Dig"). The usage factors represent the percentage of time that the equipment would be operating at full power.

For the purposes of analyzing a credible worst-case scenario, the construction equipment and phasing information of an example 90-unit multi-family project was used to calculate construction noise levels on an hourly basis (Hourly L_{eq}) and on an average basis throughout the approximate 20-month construction period (Average L_{dn}/CNEL). The construction noise levels would represent the majority of residential construction projects anticipated under the HEU, although the duration of the project would vary depending on the size of the project. Equipment expected to be used in each construction phase are summarized in Table 10, along with the quantity of each type of equipment, the reference noise level at 50 feet assuming the operation of the two loudest pieces of construction equipment, and the estimated noise levels at the nearest property lines projected from the center of the construction activity by phase. Construction noise levels were also calculated at distances of 100, 200, 400, and 500 feet.

Table 11 summarizes the minimum distances between construction sites and receptors in various ambient noise environments. In relatively quiet noise environments (i.e., 55 dBA L_{dn}/CNEL), construction noise can increase ambient noise levels by up to 7 dBA CNEL before a substantial temporary noise increase would occur. Construction activities occurring within 315 feet of sensitive receptors (as measured from the acoustic center of the construction site) would result in a substantial temporary noise increase above ambient conditions. Conversely, in relatively noisy environments (i.e., 75 dBA L_{dn}/CNEL), construction noise can increase ambient noise levels by up to 2 dBA CNEL before a substantial temporary noise increase would occur. Construction activities occurring within 80 feet of sensitive receptors (as measured from the acoustic center of the construction site) would result in a substantial temporary noise increase above ambient conditions.

TABLE 10 Construction Noise Levels

Phase	Construction Equipment (Quantity)	Calculated Hourly Average L_{eq} and CNEL (dBA) From Operation of Two Loudest Pieces of Construction Equipment				
		Noise Level at 50 feet	Noise Level at 100 feet	Noise Level at 200 feet	Noise Level at 400 feet	Noise Level at 500 feet
Demolition	Concrete/Industrial Saw (1)* Excavator (2) Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (2)*	85	79	73	67	65
Site Preparation	Grader (2)* Rubber-Tired Dozer (2) Tractor/Loader/Backhoe (2)	84	78	72	66	64
Grading/ Excavation	Excavator (4) Grader (2) Rubber Tired Dozer (1) Concrete/Industrial Saw (2)* Tractor/Loader/Backhoe (2)	86	80	74	68	66
Trenching/ Foundation	Excavator (2)* Tractor/Loader/Backhoe (2)*	82	76	70	64	62
Building Exterior	Crane (3) Forklift (2) Generator Set (1)* Tractor/Loader/Backhoe (2)* Welders (2)	82	76	70	64	62
Building Interior/ Architectural Coating	Aerial Lift (2) Air Compressor (10)*	77	71	65	59	57
Paving	Cement and Mortar Mixer (4) Paver (4) Paving Equipment (4) Roller (4) Tractor/Loader/Backhoe (4)*	83	77	71	65	63
Average Construction Noise CNEL		**77**	**71**	**65**	**59**	**57**

*Denotes two loudest pieces of construction equipment per phase

TABLE 11 Noise Levels and Distances Defining Noise Impacts Due to Construction

Existing Ambient Noise Level (L_{dn}/CNEL)	Maximum Allowable Construction Noise Level (L_{dn}/CNEL)	Overall Noise Level (L_{dn}/CNEL)	Increase Above Ambient (L_{dn}/CNEL)	Minimum Distance to Avoid Substantial Temporary Noise Increase (feet)
55	61	62	7	315
60	63	65	5	250
65	66	69	4	175
70	69	73	3	125
75	73	77	2	80

Mitigation Measure 1:

Implement General Plan Policy 27.13 which requires noise reduction measures during all phases of construction activity to minimize the exposure of neighboring properties to excessive noise levels. Construction activities are required to comply with the Town's noise ordinance limitations on hours and days of operations.

In addition, a Construction Noise Management Plan will be prepared by the construction contractor and implemented prior to the start of and throughout construction to reduce noise impacts on the nearby existing land uses. The plan will rely on project-level calculations of construction noise and achievable noise level reduction. The plan will establish the procedures the contractor will take to reasonably minimize construction noise at the nearby existing land uses. The plan would include, but not be limited to, the following measures to reduce construction noise levels as low as practical:

- Muffle and maintain all equipment used on site. All internal combustion engine driven equipment shall be fitted with mufflers, which are in good condition. Good mufflers shall result in non-impact tools generating a maximum noise level of 80 dB when measured at a distance of 50 feet.
- Utilize "quiet" models of air compressors and other stationary noise sources where technology exists.
- Locate stationary noise-generating equipment as far as possible from sensitive receptors when sensitive receptors adjoin or are near a construction project area.
- Locate staging areas and construction material areas away from noise-sensitive receptors.
- Prohibit unnecessary idling of internal combustion engines.
- Prohibit audible construction workers' radios on adjoining properties.
- Restrict noise-generating activities at the construction site or in areas adjacent to the construction site to the hours between 8:00 a.m. and 5:00 p.m., Monday through Friday.
- Do not allow machinery to be cleaned or serviced past 6:00 p.m. or prior to 7:00 a.m. Monday through Friday.

- Limit the allowable hours for the delivery of materials or equipment to the site and truck traffic coming to and from the site for any purpose to Monday through Friday between 7:00 a.m. and 6:00 p.m.
- The allowable hours for delivery of materials and equipment to the site and truck traffic coming to and from the site for any purpose shall be further limited to avoid the area's peak morning and afternoon weekday school commute hours of 7:00 a.m. to 9:00 a.m. and 2:00 p.m. to 4:00 p.m.
- Do not allow any outdoor construction or construction-related activities at the project site on weekends and holidays. Indoor construction activities may be allowed based on review/approval of the Town.
- Allowable construction hours shall be posted clearly on a sign at each construction site.
- Consider temporary noise barriers during construction phases involving earth moving equipment (e.g., grading operations) where they would be effective in reducing the construction noise impact, when directly adjoining sensitive receptors. An eight-foot plywood noise barrier could reduce noise levels by at least 5 dBA.
- Designate a "disturbance coordinator" who would be responsible for responding to any local complaints about construction noise. The disturbance coordinator will determine the cause of the noise complaint (e.g., starting too early, bad muffler, etc.) and will require that reasonable measures warranted to correct the problem be implemented. Conspicuously post a telephone number for the disturbance coordinator at the construction site and include it in the notice sent to neighbors regarding the construction schedule.

Implementation of the above mitigation measures would limit construction hours and reduce construction noise levels at noise sensitive locations. The highest noise levels would occur during site grading and during periods where construction is located directly adjacent to noise sensitive locations. With the implementation of Mitigation Measure 1, construction noise levels will be reduced to the extent feasible, resulting in a less-than-significant impact.

Impact 2: **Exposure to Excessive Groundborne Vibration during Construction.** Construction activities occurring as part of the project could expose sensitive land uses within the Town to excessive groundborne vibration. The implementation of General Plan Policy 27.12 would reduce the impact to a **less-than-significant** level.

The California Department of Transportation recommends a vibration limit of 0.5 in/sec PPV to avoid damage to buildings that are structurally sound and designed to modern engineering standards, a vibration limit of 0.3 in/sec PPV for buildings that are found to be structurally sound but where structural damage is a major concern, and a vibration limit of 0.25 in/sec PPV for historic and some old buildings.

Construction equipment such as pile drivers are known to generate substantial vibration levels that if used in the vicinity of sensitive land uses may expose persons to excessive vibration levels as well as have the potential to damage buildings. Other construction equipment such as bulldozers and vibratory rollers do not create the vibration levels of pile drivers; however, these types of equipment are more likely to operate continuously and closer to sensitive receptors, and they may

expose persons to excessive vibration levels. Foundation construction techniques involving impact or vibratory pile driving equipment, which can cause excessive vibration, are not expected with the proposed HEU.

Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Table 12 presents typical vibration levels that could be expected from construction equipment at a distances of 25 feet to 100 feet. Vibration levels would be higher at distances less than 25 feet and lower at distances greater than 100 feet. Vibration levels would also vary depending on soil conditions, construction methods, and equipment used. Vibration levels are highest close to the source, and then attenuate with increasing distance at the rate $(D_{ref}/D)^{1.1}$, where D is the distance from the source in feet and D_{ref} is the reference distance of 25 feet.

TABLE 12 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	PPV at 50 ft. (in/sec)	PPV at 100 ft. (in/sec)
Clam shovel drop		0.202	0.094	0.044
Hydromill (slurry wall)	in soil	0.008	0.004	0.002
	in rock	0.017	0.008	0.004
Vibratory Roller		0.210	0.098	0.046
Hoe Ram		0.089	0.042	0.019
Large bulldozer		0.089	0.042	0.019
Caisson drilling		0.089	0.042	0.019
Loaded trucks		0.076	0.035	0.017
Jackhammer		0.035	0.016	0.008
Small bulldozer		0.003	0.001	0.001

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, as modified by Illingworth & Rodkin, Inc., May 2022.

Table 13 summarizes the minimum safe setback distances to maintain in order to achieve the 0.25 in/sec PPV threshold for historical buildings and the 0.3 in/sec and 0.5 in/sec PPV thresholds for modern buildings.

TABLE 13 Vibration Source Levels for Construction Equipment and Minimum Safe Setbacks

Equipment		Minimum Safe Setback (feet) 0.25 in/sec PPV	Minimum Safe Setback (feet) 0.30 in/sec PPV	Minimum Safe Setback (feet) 0.50 in/sec PPV
Clam shovel drop		21	18	11
Hydromill (slurry wall)	in soil	<1	<1	<1
	in rock	3	2	2
Vibratory Roller		22	19	12
Hoe Ram		10	9	6
Large bulldozer		10	9	6
Caisson drilling		10	9	6
Loaded trucks		9	8	5
Jackhammer		5	4	3
Small bulldozer		<1	<1	<1

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, as modified by Illingworth & Rodkin, Inc., May 2022.

A review of the Town of Danville Inventory of Historic Sites[2] identified 3 historically designated sites (154 E. Prospect Avenue, 90 Railroad Avenue, and 120 W. Linda Mesa Avenue), 11 potential resource sites (340 Hartz Avenue, 1435 San Ramon Valley Boulevard, 2900 Camino Tassajara, 178 E. Prospect Avenue, 166 E. Prospect Avenue, 282 Front Street, 212 Front Street, 256 Front Street, 254 Rose Avenue, 268 Rose Avenue, and 244 Front Street), and 2 properties to be considered (Rose Street - Parks Home, and 180 Hartz Avenue) that would be immediately adjacent to or part of potential development areas within Subareas 2, 3, and 6. Since specific future projects within the Town are unknown at this time, it is conservatively assumed that the construction areas associated with these future projects could be located within the minimum safe setback distances identified in Table 13. For projects that produce vibration levels exceeding the thresholds, construction vibration would be expected to cause both human annoyance and the possibility of cosmetic damage.

General Plan Policy 27.12 requires the preparation of groundborne vibration studies by qualified professionals in accordance with industry-accepted methodology where heavy construction activities involving significant site grading, underground, or foundation work will occur within 50 feet of residential or other vibration sensitive uses. The industry-accepted methodologies include the recommended vibration assessment procedure and thresholds provided by public agencies such as Caltrans or the Federal Highway Administration. The studies should identify necessary construction vibration controls to reduce both human annoyance and the possibility of cosmetic damage. Controls shall include, but not be limited to, the following measures:

- A list of all heavy construction equipment to be used for this project known to produce high vibration levels (tracked vehicles, vibratory compaction, jackhammers, hoe rams, etc.)

[2] Town of Danville Inventory of Historic Sites - June 11, 2018.
Accessed May 16, 2022 at https://www.danville.ca.gov/DocumentCenter/View/1025/Survey-of-Historic-Sites-PDF?bidId=

shall be submitted to the City by the contractor. This list shall be used to identify equipment and activities that would potentially generate substantial vibration and to define the level of effort for reducing vibration levels below the thresholds.

- Place operating equipment on the construction site as far as possible from vibration-sensitive receptors.
- Use smaller equipment to minimize vibration levels below the limits.
- Avoid using vibratory rollers and tampers near sensitive areas.
- Select demolition methods not involving impact tools.
- Modify/design or identify alternative construction methods to reduce vibration levels below the limits.
- Avoid dropping heavy objects or materials.

With the implementation of Policy 27.12, short-term construction activities would not expose persons to excessive vibration levels.

Mitigation Measure 2: No additional measures are required.

Appendix A – Long-Term Noise Data

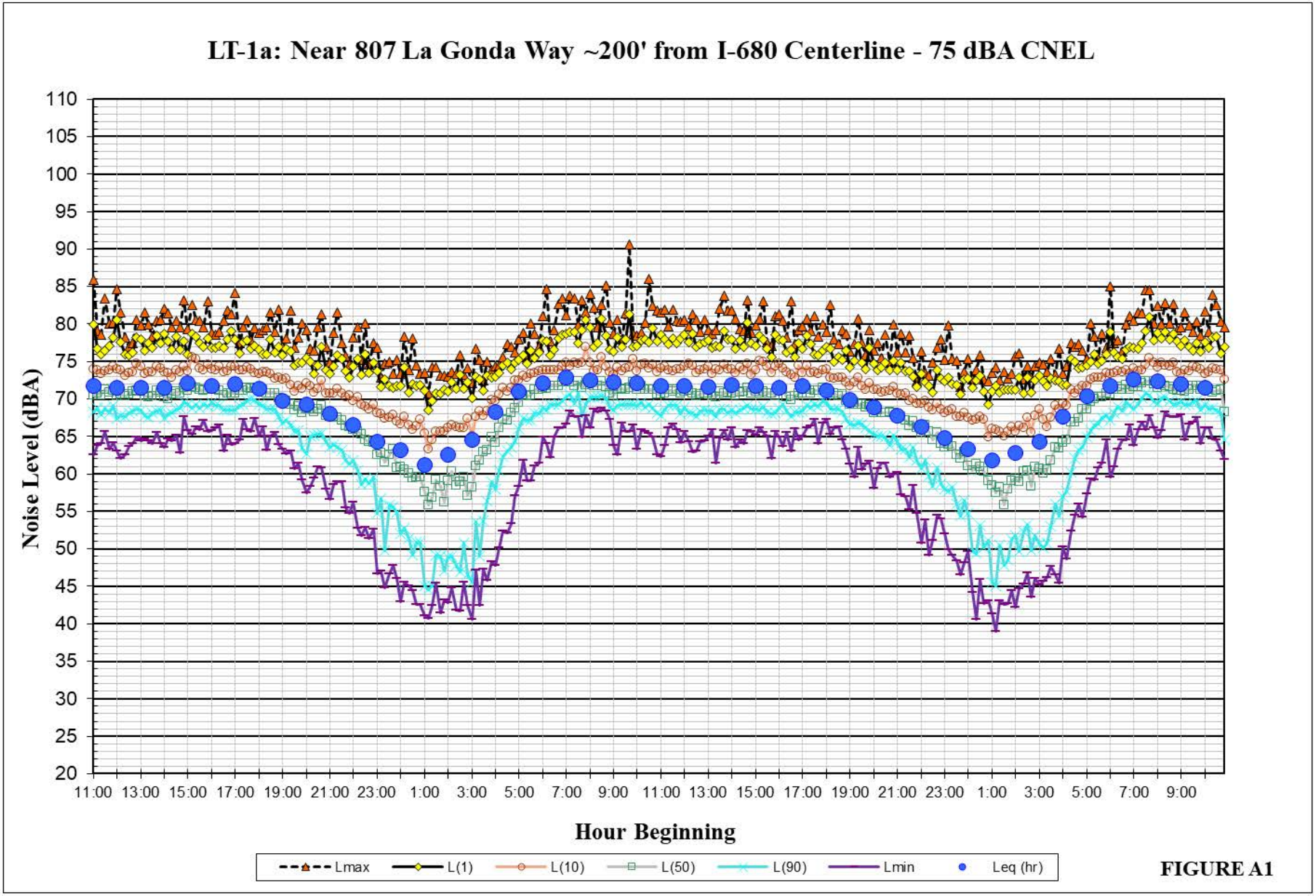

LT-1a: Near 807 La Gonda Way ~200' from I-680 Centerline - 75 dBA CNEL
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
11:00 13:00 15:00 17:00 19:00 21:00 23:00 1:00 3:00 5:00 7:00 9:00 11:00 13:00 15:00 17:00 19:00 21:00 23:00 1:00 3:00 5:00 7:00 9:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

FIGURE A1

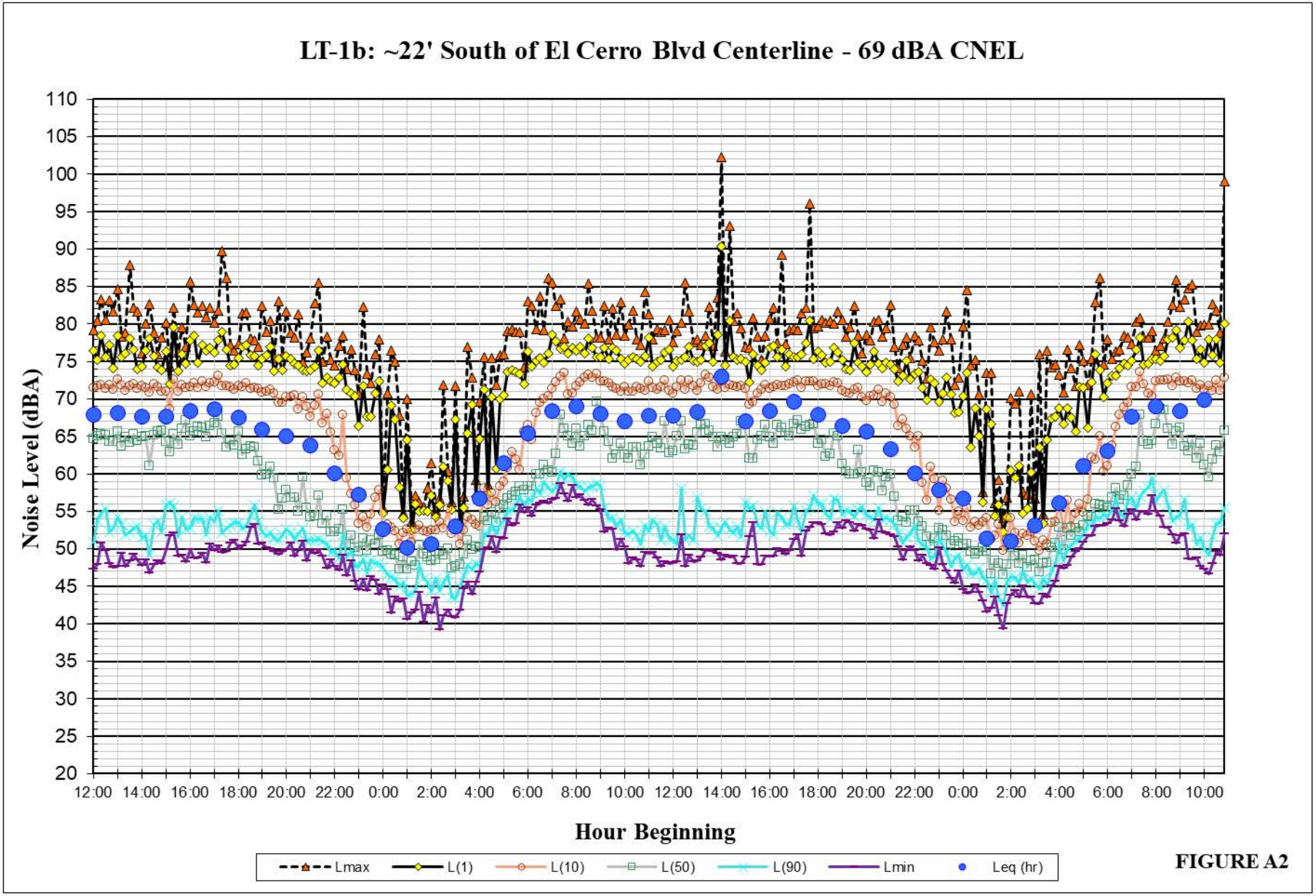

LT-1b: ~22' South of El Cerro Blvd Centerline - 69 dBA CNEL
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
12:00 14:00 16:00 18:00 20:00 22:00 0:00 2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00 2:00 4:00 6:00 8:00 10:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

FIGURE A2

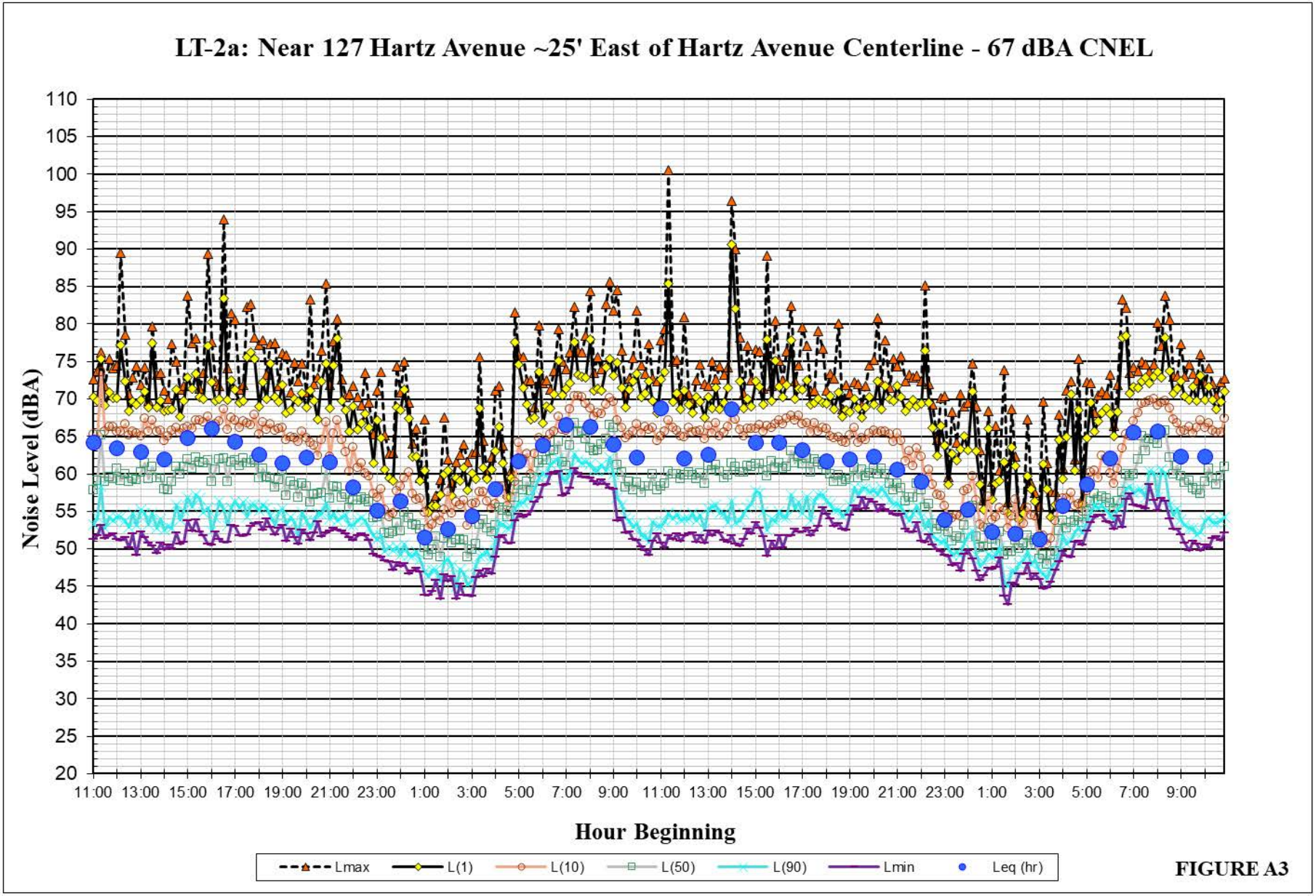

LT-2a: Near 127 Hartz Avenue ~25' East of Hartz Avenue Centerline - 67 dBA CNEL
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
11:00 13:00 15:00 17:00 19:00 21:00 23:00 1:00 3:00 5:00 7:00 9:00 11:00 13:00 15:00 17:00 19:00 21:00 23:00 1:00 3:00 5:00 7:00 9:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

FIGURE A3

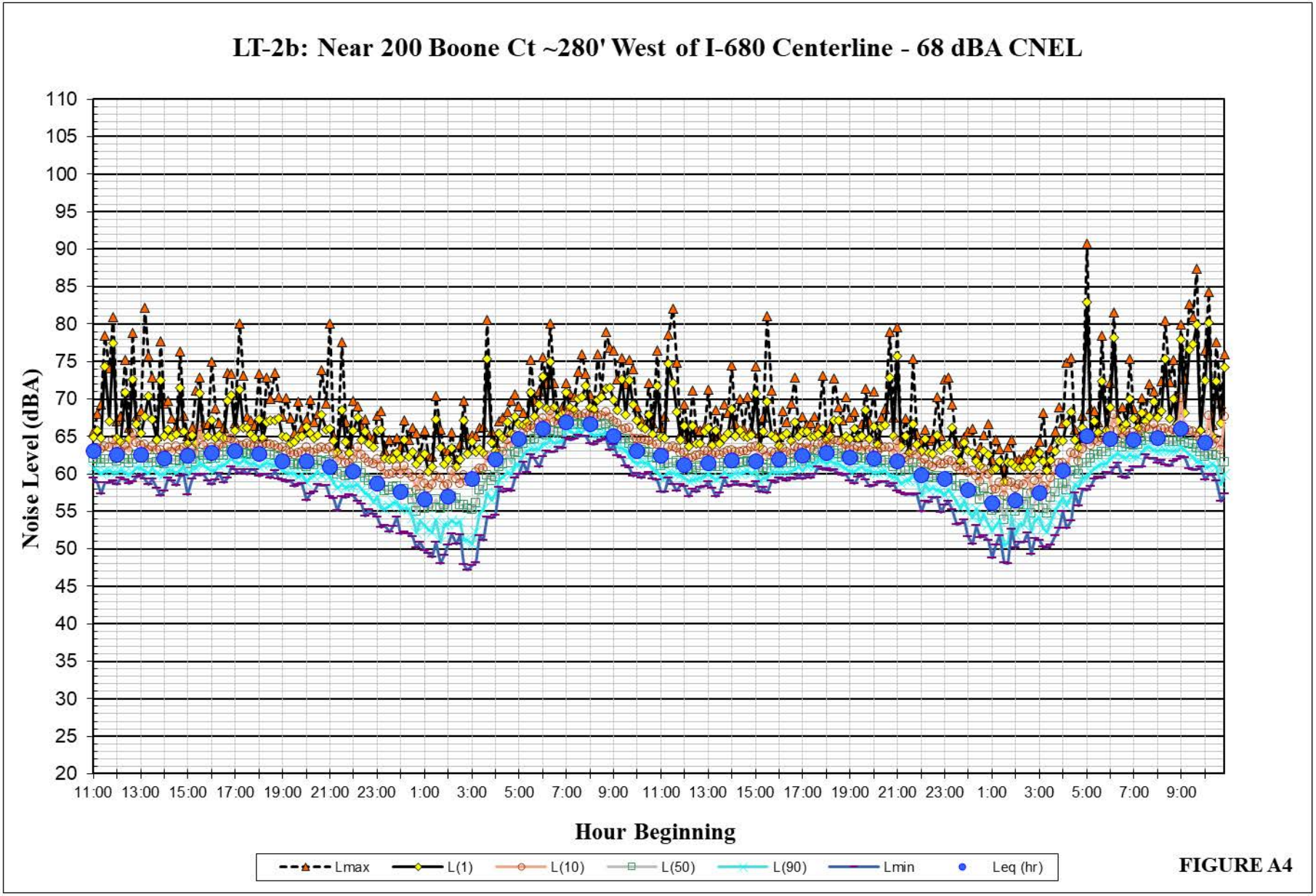

LT-2b: Near 200 Boone Ct ~280' West of I-680 Centerline - 68 dBA CNEL
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
11:00 13:00 15:00 17:00 19:00 21:00 23:00 1:00 3:00 5:00 7:00 9:00 11:00 13:00 15:00 17:00 19:00 21:00 23:00 1:00 3:00 5:00 7:00 9:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

FIGURE A4

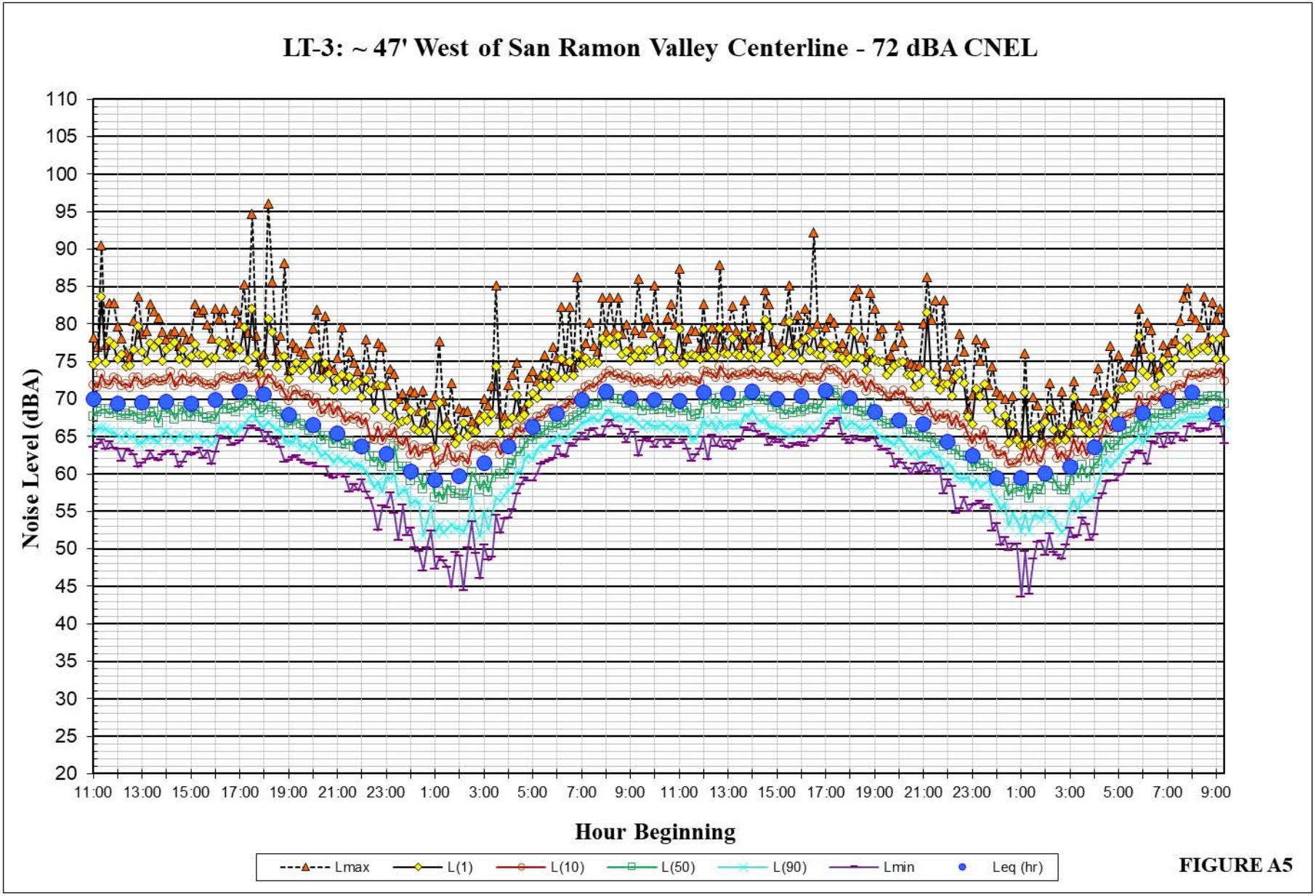
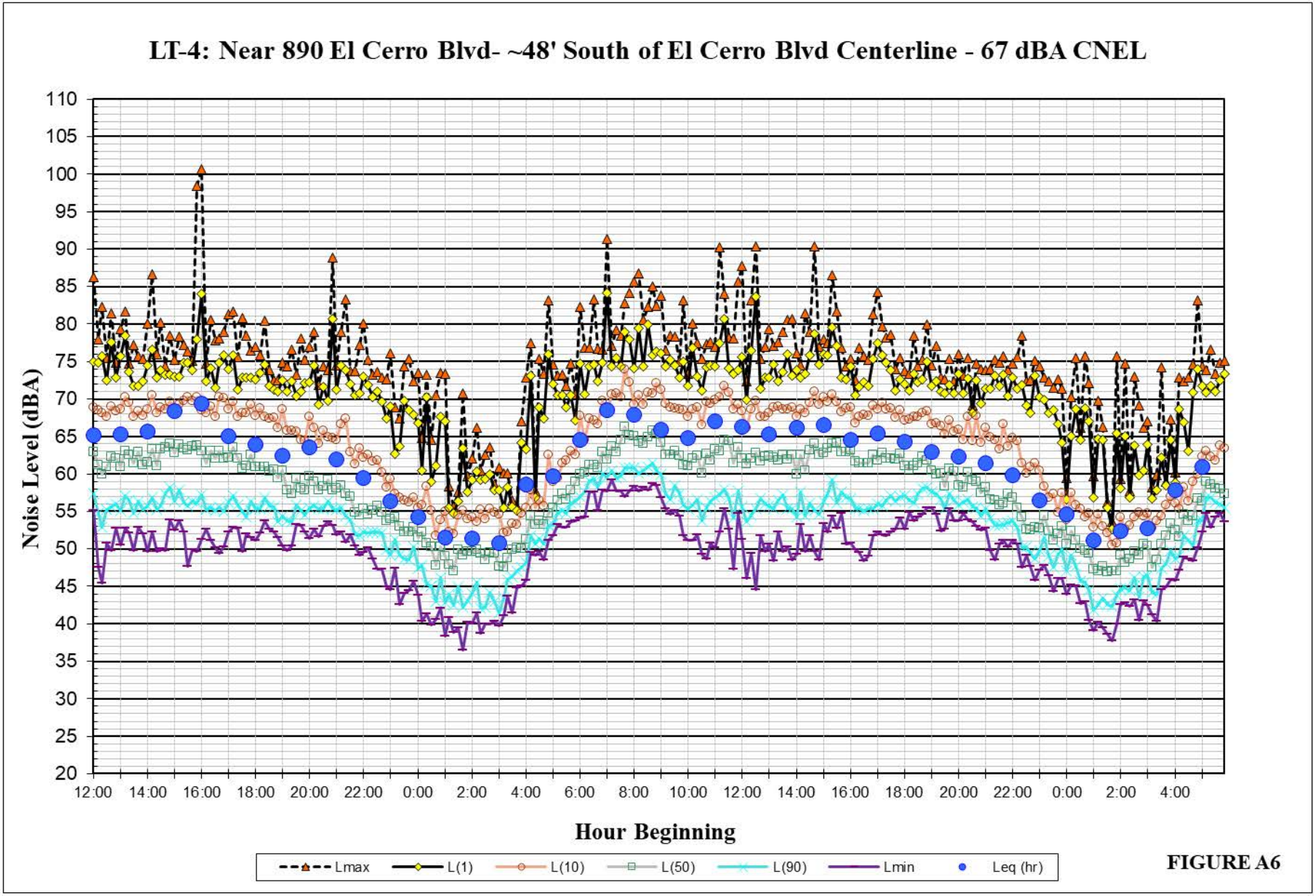

LT-3: ~ 47' West of San Ramon Valley Centerline - 72 dBA CNEL
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
11:00 13:00 15:00 17:00 19:00 21:00 23:00 1:00 3:00 5:00 7:00 9:00 11:00 13:00 15:00 17:00 19:00 21:00 23:00 1:00 3:00 5:00 7:00 9:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

FIGURE A5


LT-4: Near 890 El Cerro Blvd- ~48' South of El Cerro Blvd Centerline - 67 dBA CNEL
Noise Level (dBA)
110
105
100
95
90
85
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75
70
65
60
55
50
45
40
35
30
25
20
12:00
14:00
16:00
18:00
20:00
22:00
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
2:00
4:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

FIGURE A6

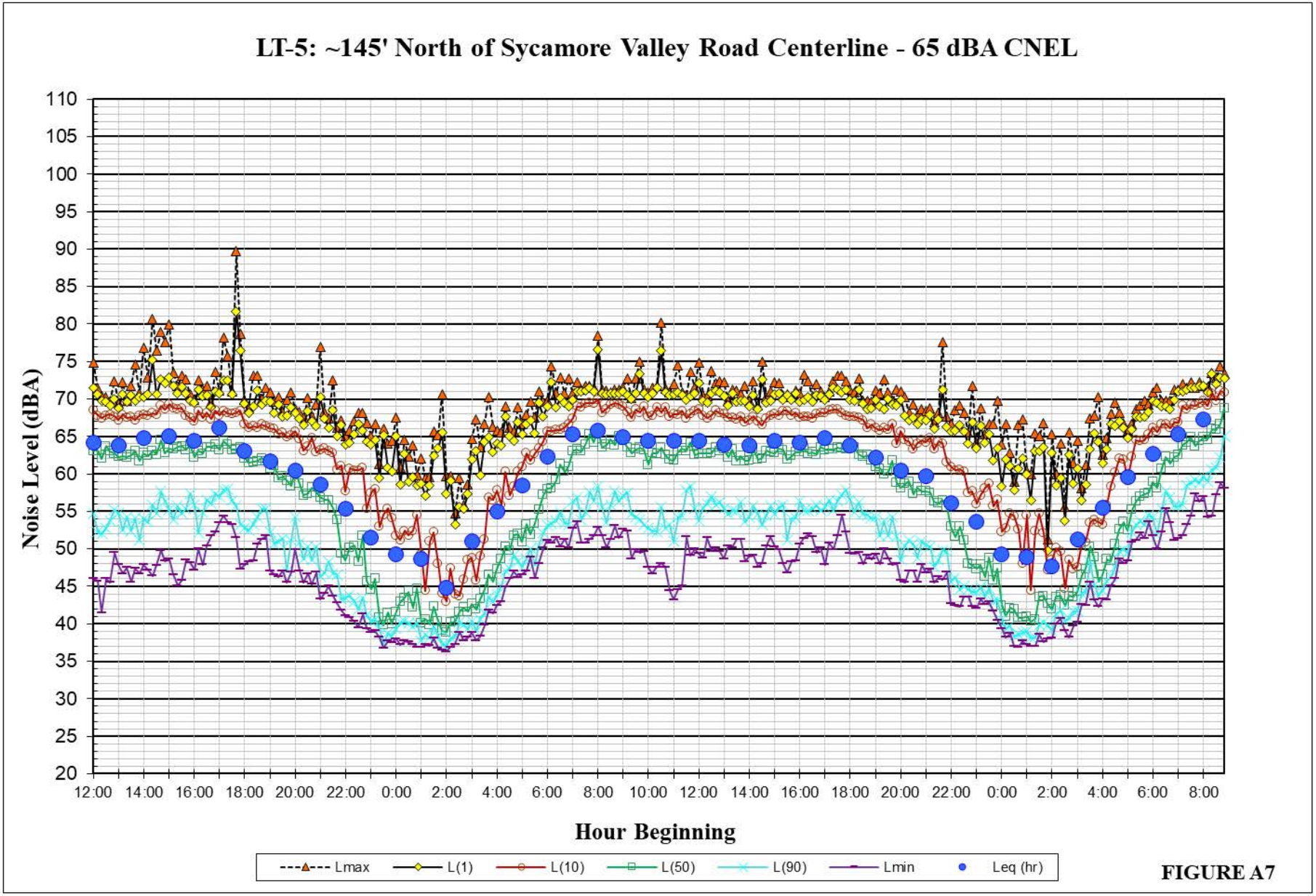
LT-5: ~145' North of Sycamore Valley Road Centerline - 65 dBA CNEL
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
12:00 14:00 16:00 18:00 20:00 22:00 0:00 2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00 2:00 4:00 6:00 8:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

FIGURE A7

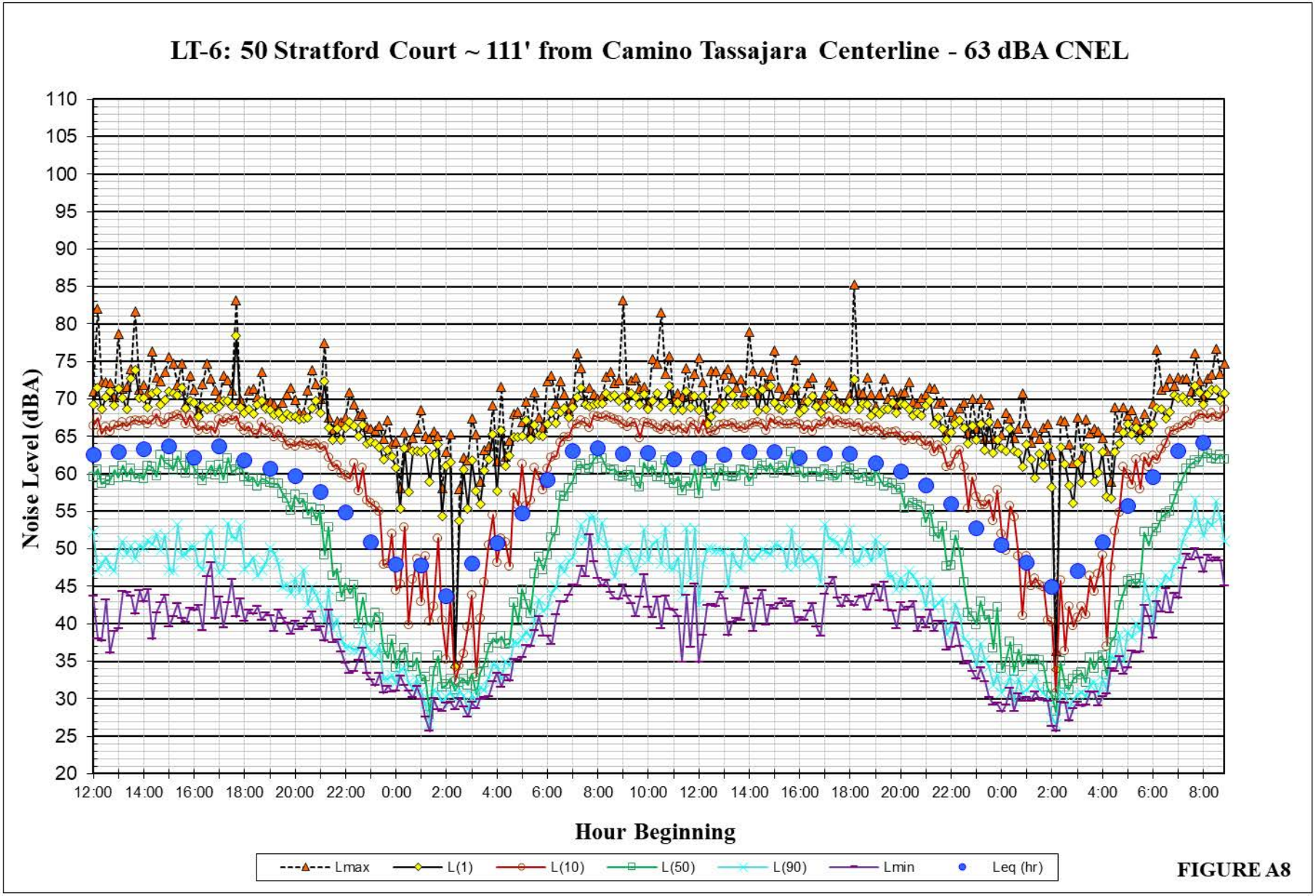
LT-6: 50 Stratford Court ~ 111' from Camino Tassajara Centerline - 63 dBA CNEL
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
12:00 14:00 16:00 18:00 20:00 22:00 0:00 2:00 4:00 6:00 8:00 10:00 12:00 14:00 16:00 18:00 20:00 22:00 0:00 2:00 4:00 6:00 8:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

FIGURE A8

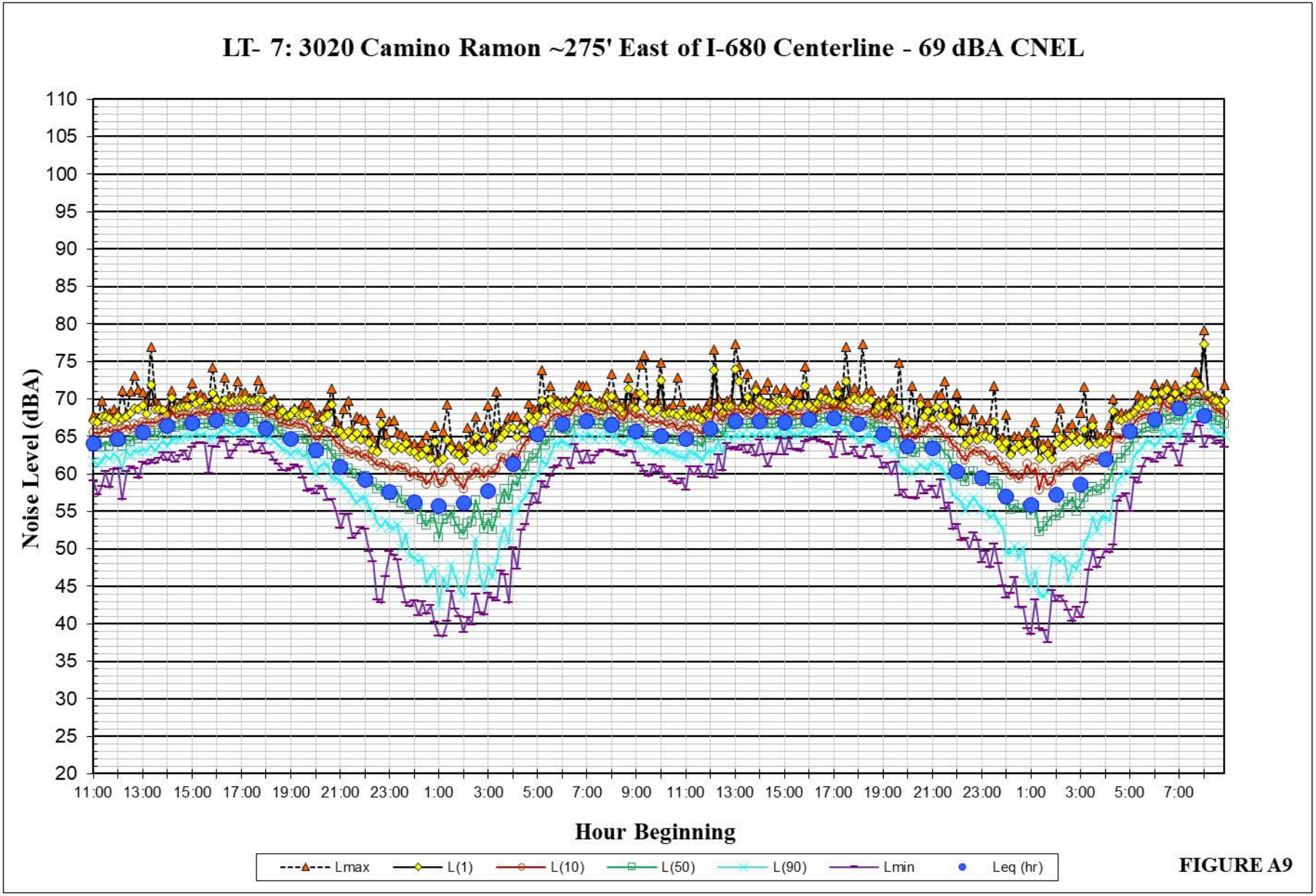
LT- 7: 3020 Camino Ramon ~275' East of I-680 Centerline - 69 dBA CNEL
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
11:00 13:00 15:00 17:00 19:00 21:00 23:00 1:00 3:00 5:00 7:00 9:00 11:00 13:00 15:00 17:00 19:00 21:00 23:00 1:00 3:00 5:00 7:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

FIGURE A9

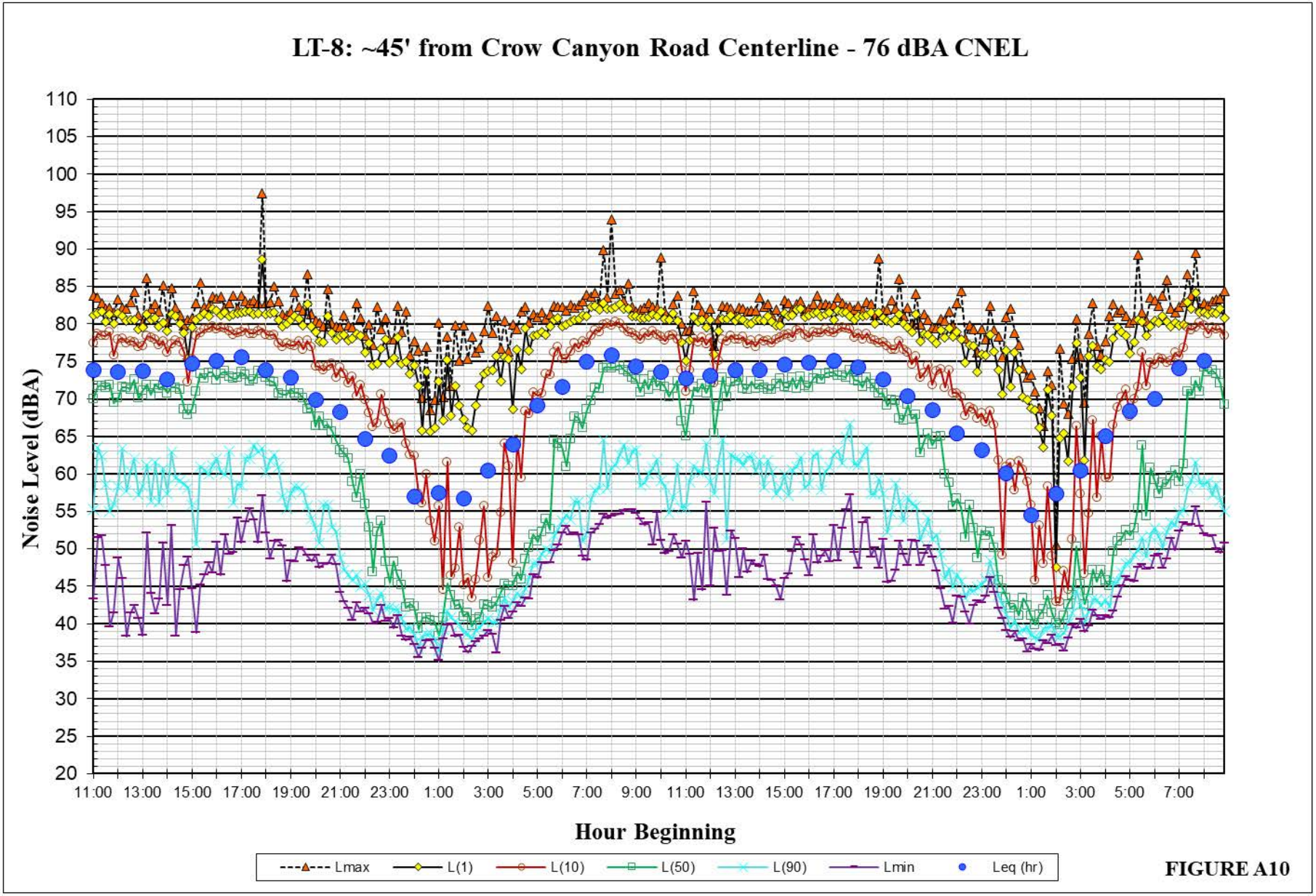
LT-8: ~45' from Crow Canyon Road Centerline - 76 dBA CNEL
Noise Level (dBA)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
11:00 13:00 15:00 17:00 19:00 21:00 23:00 1:00 3:00 5:00 7:00 9:00 11:00 13:00 15:00 17:00 19:00 21:00 23:00 1:00 3:00 5:00 7:00
Hour Beginning
Lmax
L(1)
L(10)
L(50)
L(90)
Lmin
Leq (hr)

FIGURE A10