Appendix I: Noise and Vibration Assessment

DUBLIN BOULEVARD-NORTH CANYONS PARKWAY EXTENSION PROJECT

ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT

Dublin, California

November 28, 2018

Prepared for:

Brianna Ceglia Bohonok
Circlepoint
200 Webster Street, Suite 200
Oakland, CA 94607

Prepared by:

Dana M. Lodico, PE, INCE Bd. Cert.

ILLINGWORTH & RODKIN, INC.
Acoustics • Air Quality
429 E. Cotati Ave.
Cotati, CA 94931
(707) 794-0400

Project: 17-027

INTRODUCTION

This report evaluates the potential for Dublin Boulevard-North Canyons Parkway Extension Project to result in significant impacts with respect to applicable California Environmental Quality Act (CEQA) guidelines. The report is divided into two sections: 1) the Setting Section provides a brief description of the fundamentals of environmental noise, summarizes applicable regulatory criteria, and discusses the results of the ambient noise monitoring survey completed to document existing noise condition and 2) the Impacts and Mitigation Measures Section describes the significance criteria used to evaluate project impacts and provides a discussion of each project impact.

PROJECT DESCRIPTION

The Dublin Boulevard-North Canyons Parkway Extension Project would include the extension of Dublin Boulevard 1.5 miles eastward through eastern Dublin and an unincorporated portion of the County. The roadway extension would start from the current terminus of Dublin Boulevard at the Dublin Boulevard/Fallon Road intersection in Dublin and would end at the Doolan Road/North Canyons Parkway intersection along the boundary of the County and Livermore. This roadway extension would provide four to six travel lanes and bicycle and pedestrian facilities (i.e., sidewalks and bike lanes). Beginning at Fallon Road, the roadway extension would have six travel lanes (three in each direction). Continuing eastward, the roadway extension would transition to four travel lanes (two in each direction) before or at the intersection with Croak Road. From Croak Road to Doolan Road, the roadway extension would remain in the four lane configuration. The permanent area needed for the project, including the roadway, sidewalks, intersections, and land acquired for right-of-way is estimated at 29 acres.

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* or L_{dn}) 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 CNEL. Typically, the highest steady traffic noise level during the daytime is about equal to the 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 CNEL with open windows and 65-70 dBA 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, and 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} 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}. At an L_{dn} of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the L_{dn} 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 an L_{dn} of 60-70 dBA. Between an L_{dn} 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 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.

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.

Railroad and light-rail operations are potential sources of substantial ground vibration depending on distance, the type and the speed of trains, and the type of railroad track. People's response to ground vibration from rail vehicles has been correlated best with the average, root mean square (RMS) velocity of the ground. The velocity of the ground is expressed on the decibel scale. The reference velocity is 1 x 10-6 in/sec RMS, which equals 0 VdB, and 1 in/sec equals 120 VdB. Although not a universally accepted notation, the abbreviation "VdB" is used in this document for vibration decibels to reduce the potential for confusion with sound decibels.

Typical background vibration levels in residential areas are usually 50 VdB or lower, well below the threshold of perception for most humans. Perceptible vibration levels inside residences are attributed to the operation of heating and air conditioning systems, door slams and foot traffic. Construction activities, train operations, and street traffic are some of the most common external sources of vibration that can be perceptible inside residences. Table 4 illustrates some common sources of vibration and the association to human perception or the potential for structural damage.

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.

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, September 2013.

Regulatory Background – Noise

The State of California, the Cities of Dublin and Livermore, and Alameda County have established regulatory criteria that are applicable in this assessment. The State 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. The California Environmental Quality Act (CEQA) contains guidelines to evaluate the significance of environmental noise impacts attributable to a proposed project. Applicable CEQA checklist questions ask whether the project would result in:

a) Exposure of persons to or generation of noise levels in excess of standards established in the local General Plan or Noise Ordinance, or applicable standards of other agencies?

b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?

c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?

d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?

e) For a project located within 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, would the project expose people residing or working in the project area to excessive noise levels?

f) For a project located in the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?

The project is proposed within the 55 CNEL noise contour for the Livermore Municipal Airport. However, the project does not propose noise sensitive land uses and aircraft noise levels would be well below the noise produced by the construction equipment necessary to complete the project when construction workers would be working at the site; therefore, checklist items e) and f) are not applicable to the project.

City of Dublin General Plan. The City of Dublin's Noise Element of the General Plan aims to mitigate traffic noise to appropriate levels considered compatible for community noise environments. The City's normally acceptable exterior noise exposure standard is 60 dBA CNEL or less for residential and hotels and 70 dBA CNEL or less for offices and retail commercial.

City of Dublin Municipal Code. The City of Dublin's Municipal Code includes standards pertaining to noise control within the City. Municipal Code Section 5.28.020 prohibits any person within the City to make any loud, or disturbing, or unnecessary, or unusual or habitual noise or any noise which annoys or disturbs or injures or endangers the health, repose, peace or safety of any reasonable person of normal sensitivity present in the area.

City of Livermore General Plan. The City of Livermore's normally acceptable exterior noise exposure standard is 60 dBA CNEL or less for single-family residential, 65 dBA CNEL or less for multi-family and hotels, and 70 dBA CNEL or less for office buildings, commercial, and retail. The following policies are applicable to the proposed project:

Objective N-1.2: Adopt design standards and identify effective noise attenuation programs to prevent noise or reduce noise to acceptable levels.

- Policy 1. When crafting mitigation programs for adverse noise exposure from new development, the City shall encourage the use of noise attenuation programs that avoid constructing sound walls.

- Policy 5. During all phases of construction, the City shall take measures to minimize the exposure of neighboring properties to excessive noise levels from construction related activity.

- Policy 8. It shall be the responsibility of new development or new land uses to be consistent with noise standards appropriate and sensitive to adjacent land uses

Objective N-1.4: Reduce noise levels from traffic, which is the single largest continual source of unacceptable noise in the City.

- Policy 2. The City shall minimize potential transportation noise through proper design of street circulation, coordination of routing, and other traffic control measures.

- Policy 4. The City shall require exterior noise in backyards to be Normally Acceptable at a maximum of 60 dBA CNEL for single-family development and a maximum of 65 dBA CNEL for multi-family development.

- Policy 5. The City will consider sound walls as a means of noise mitigation along proposed and existing roadway segments and railroad right-of-ways only after other noise attenuation programs such as building construction, larger landscaped berms, and distances have been considered to reduce noise to appropriate levels in residential areas.

City of Livermore Municipal Code. The City of Livermore prohibits the operation, between the hours of 6:00 p.m. Saturday to 7:00 a.m. Monday; 8:00 p.m. to 7:00 a.m. on Monday, Tuesday, Wednesday and Thursdays; 8:00 p.m. Friday to 9:00 a.m. on Saturday or at all on city-observed holidays, of any pile driver, pneumatic tools, derrick, electric hoist, sandblaster or other equipment used in construction, demolition or other repair work, the use of which is attended by loud or unusual noise.

Additionally, the city engineer and/or building official shall have the authority to authorize construction activities during the hours specified above for the following reasons:

1. A public agency, other than the city, requires as a condition of a permit that the construction be done during the restricted hours.

2. Public health, safety or welfare requires the work to be done during the restricted hours.

3. Specific construction activities (such as large concrete foundation pours) can be identified and approved to occur as an exemption to this ordinance in the conditions of approval for a project at the time of the public hearing.

If the city engineer and/or building official approves the exception or it is an exception allowed by the conditions of approval for the project, the following shall be done:

1. Notify the Livermore police department, watch commander, at least 24 hours in advance.

2. Notify residents and business owners that are adjacent to the work area at least 24 hours in advance. The limits of this notification shall be determined by the city engineer and/or building official.

Alameda County Municipal Code. Construction is exempt from the noise limits specified in Alameda County's Municipal Code, provided that construction activities are limited to the hours between 7:00 am to 7:00 pm, Mondays through Fridays, and 8:00 am to 5:00 pm on Saturdays and Sundays.

Existing Noise Environment

A noise monitoring survey was conducted from December 12th to 14th, 2017, to identify land uses that could be subject to traffic and construction noise impacts from the proposed project and to measure ambient noise levels at these locations. The monitoring survey included two long-term (L1 and L2) noise measurements and six short-term (S1 through S6) noise measurements. The primary existing noise source in the area is vehicles traveling on I-580 and local roads. Local non-traffic related noise sources include aircraft, sounds of nature, and agricultural operations. Measurement locations are shown in Figure 1. The daily trends in noise levels for the long-term measurements are shown in Figures 2 and 3. Table 4 summarizes the results of the short-term measurements. Two consecutive short-term noise measurements were made at each location, as indicated in Table 4.

TABLE 4 Summary of Short-Term Noise Measurement Data

Site	Location	Start Time	Measured Noise Levels, dBA				Primary Noise Source
			L_{10}	L_{50}	L_{90}	L_{eq}	
S1	2601 Alliston Loop, Dublin	11:30 a.m.	63	60	56	60	Traffic on Fallon Road
		11:40 a.m.	63	60	56	60	
S2	3899 Camino Loop, Dublin	11:20 a.m.	49	45	43	52	Distant traffic (I-580), intermittent aircraft, occasional local traffic
		11:30 a.m.	47	45	43	46	
S3	Croak Road, north of Central Parkway, Dublin	10:50 a.m.	45	39	35	45	Distant traffic (I-580), intermittent aircraft, occasional local traffic
		11:00 a.m.	48	42	38	45	
S4[1]	Croak Road, 730 feet north of I-580, Dublin	10:10 a.m.	61	58	53	58	Traffic on I-580, police sirens
		10:20 a.m.	58	56	54	57	
S5	500 feet north of I-580, Dublin	10:00 a.m.	60	59	57	59	Traffic on I-580
		10:10 a.m.	62	59	58	61	
S6	901 Doolan Road, Livermore	10:30 a.m.	61	52	50	59	Traffic on I-580 and Doolan Road
		10:40 a.m.	61	51	49	60	

[1] Measurement location S4 was selected to be representative of the adjacent residence, but was not located at the noise sensitive land use due to access restrictions. Measurement results were used to determine the Existing loudest hour at the adjacent sensitive land use represented by R4 (see Figure 1).

FIGURE 1 Noise Measurement and Modeling Positions

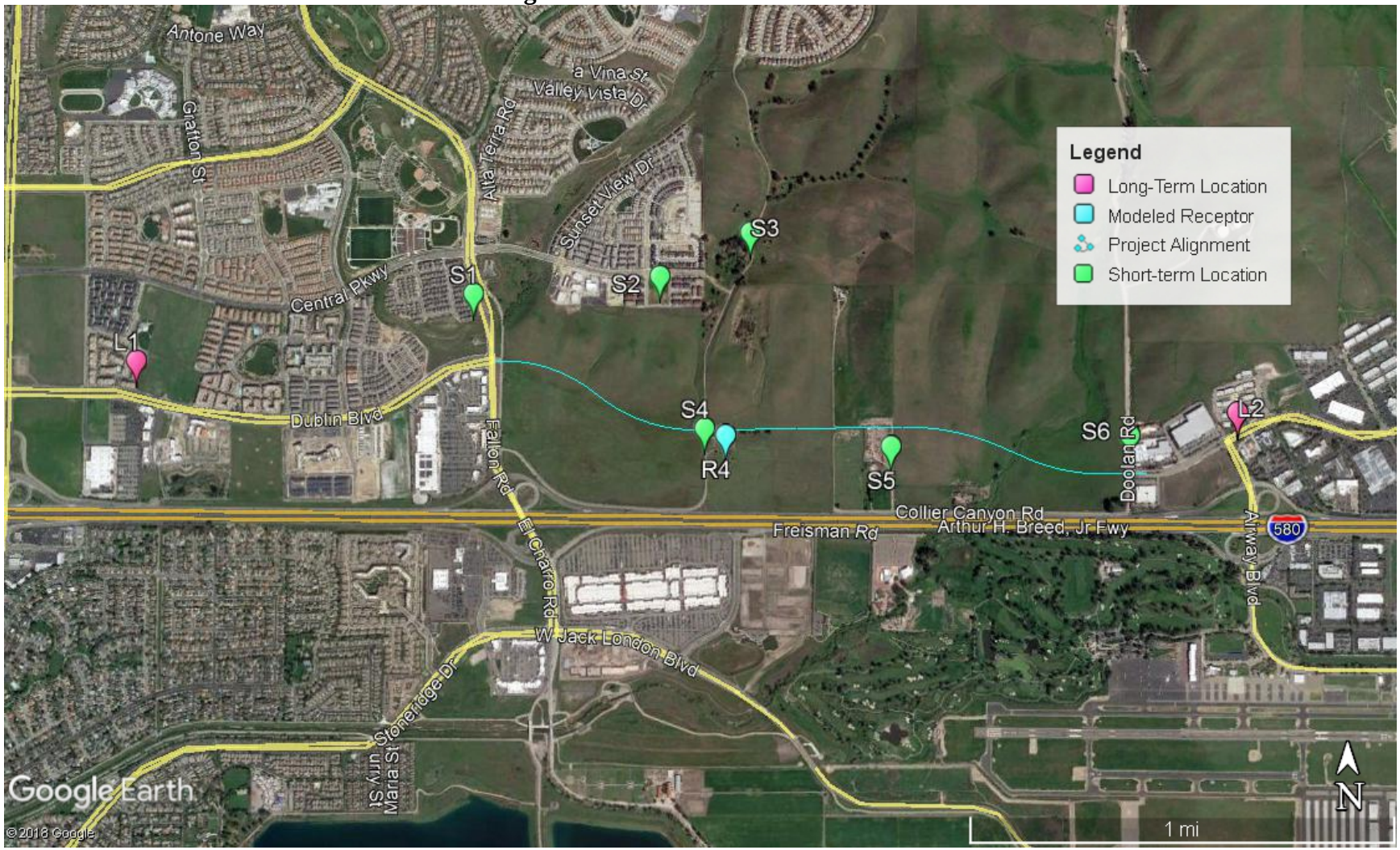


FIGURE 2 Daily Noise Trends at L1, 1051 Airway Boulevard, Livermore, Wednesday, December 13th, 2017

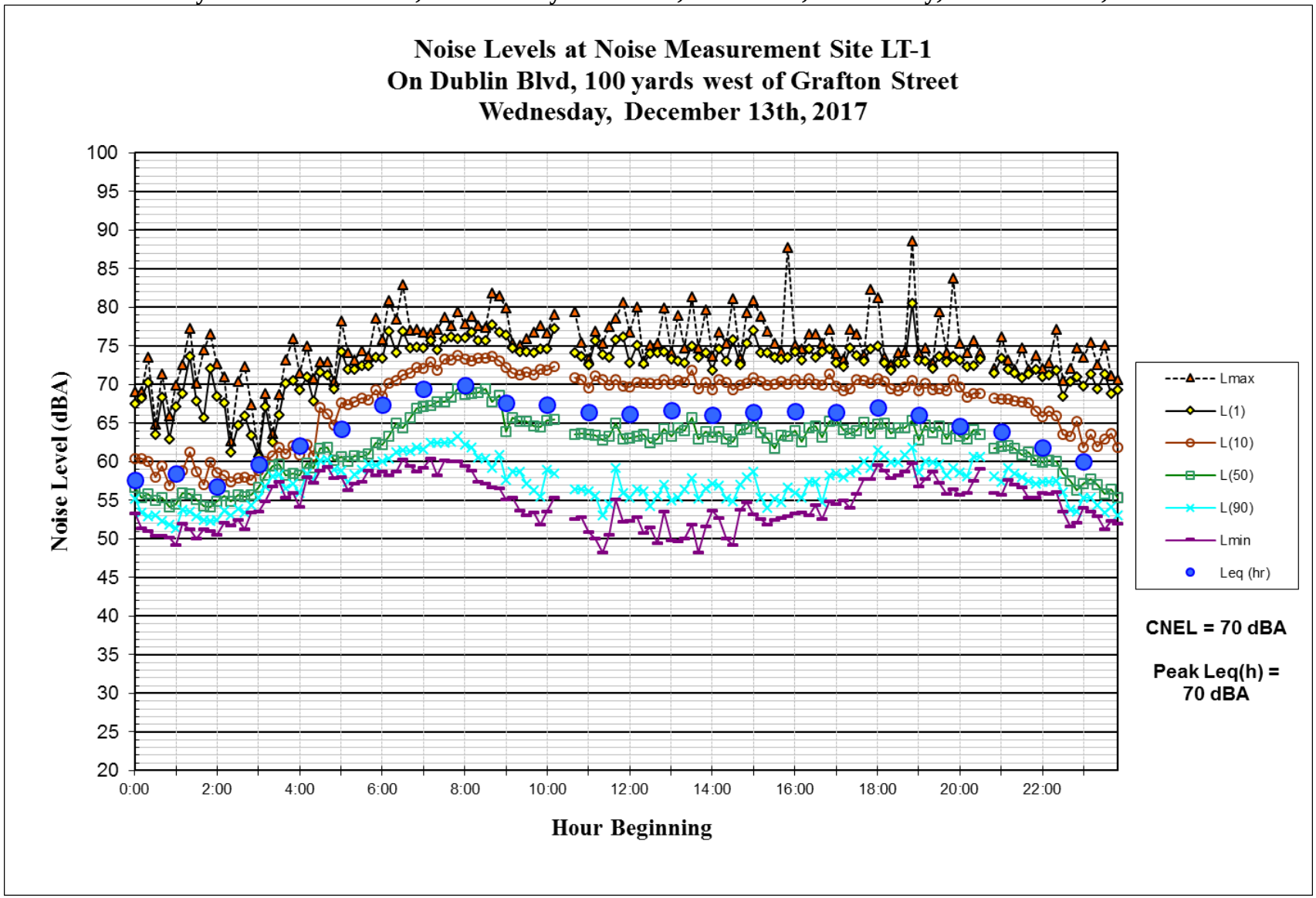
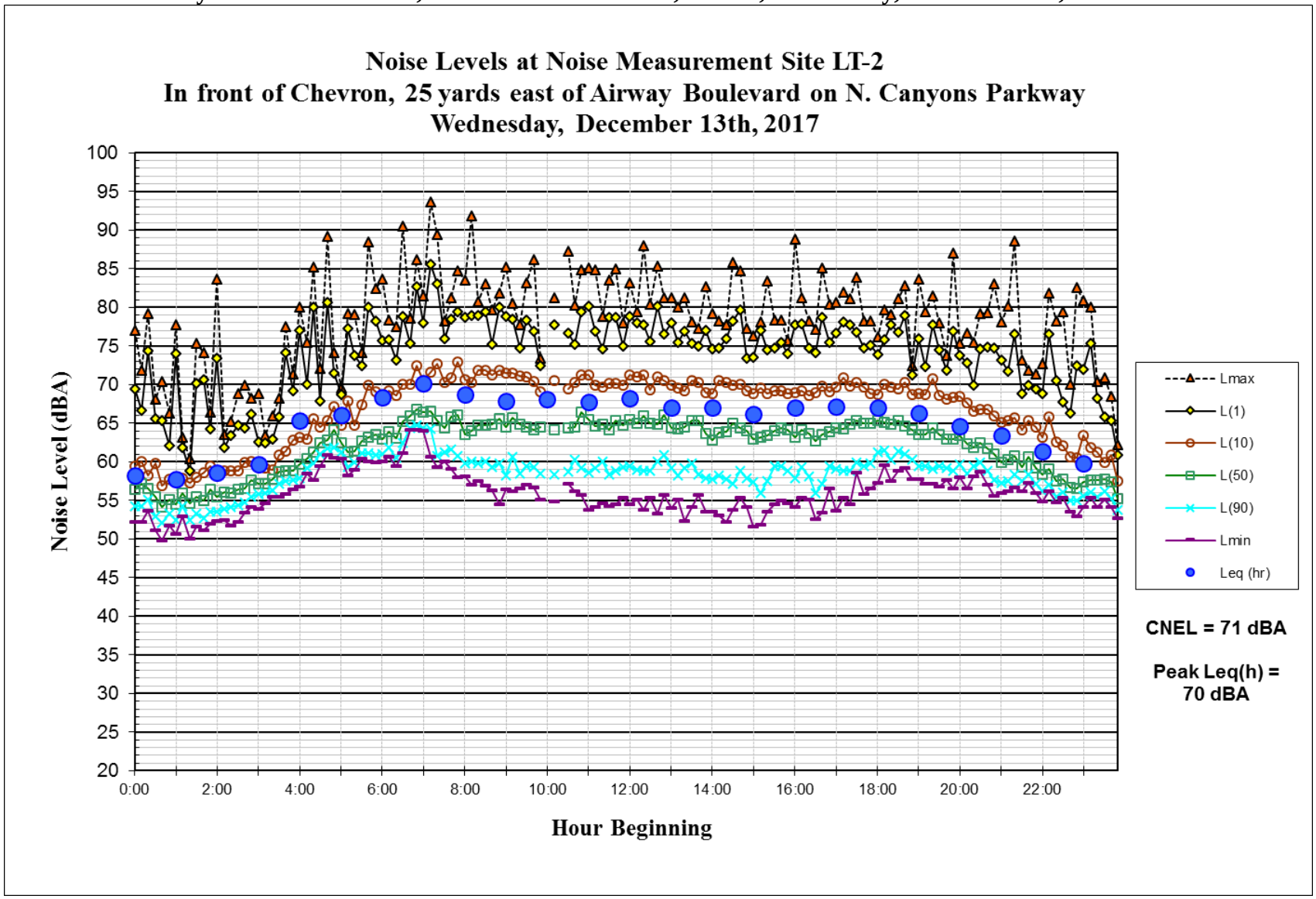


FIGURE 3 Daily Noise Trends at L2, 3637 Dublin Boulevard, Dublin, Wednesday, December 13th, 2017



NOISE IMPACTS AND MITIGATION MEASURES

Significance Criteria

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

- **Noise Levels in Excess of Standards:** A significant noise impact would be identified if the project would expose persons to or generate noise levels that would exceed applicable noise standards presented in the Dublin, Livermore, or Alameda County. Where noise standards conflict, the more conservative standard is applied.

- **Groundborne Vibration from Construction:** Neither the Cities of Dublin or Livermore, nor Alameda County define excessive groundborne vibration levels. To avoid structural damage, the California Department of Transportation recommends a vibration limit of 0.5 in/sec PPV for buildings structurally sound and designed to modern engineering standards, which typically consist of buildings constructed since the 1990s. A conservative vibration limit of 0.3 in/sec PPV has been used for buildings that are found to be structurally sound but where structural damage is a major concern (see Table 3).

- **Permanent Noise Increases:** Neither the Cities of Dublin or Livermore, nor Alameda County define the permanent noise level increase that is considered substantial. Typically, a permanent increase in the day-night average noise level of 3 dBA CNEL or greater at noise-sensitive receptors would be considered significant when projected noise levels would exceed those considered satisfactory for the affected land use. An increase of 5 dBA CNEL or greater would be considered significant when projected noise levels would continue to meet those considered satisfactory for the affected land use.

- **Construction Noise:** Neither the Cities of Dublin or Livermore, Alameda County, nor the State of California define the temporary noise level increase that is considered substantial. Based on the thresholds for speech interferences (see Setting Section), a significant temporary noise increase would be identified if hourly average construction noise levels exceed 60 dBA L_{eq} and the ambient by at least 5 dBA L_{eq} at residential land uses for a period of more than one year.

Impact 1: **Conflict with Established Standards.** The project would not conflict with local noise standards. **This is a less-than-significant impact.**

Applicable standards, goals, and policies contained in the City of Dublin's, the City of Livermore's, and Alameda County's General Plans and Municipal Codes are summarized in the Setting section of this report. These document do not contain noise standards applicable to project construction. The City of Livermore limits the operation of any pile driver, pneumatic tools, derrick, electric hoist, sandblaster or other equipment used in construction, demolition or other repair work, the use of which is attended by loud or unusual noise, to between the hours of 7:00 a.m. and 8:00 p.m. on weekdays and 9:00 a.m. and 6:00 p.m. on Saturdays, with these operations prohibited on Sundays and Holidays. Alameda County limits construction activities to the hours

between 7:00 am to 7:00 pm, Mondays through Fridays, and 8:00 am to 5:00 pm on Saturdays and Sundays.

The project would be constructed through largely undeveloped areas. Construction activities would include but are not limited to demolition, earthwork, paving, pile driving, concrete/rebar/formwork, utility trenching, and roadway striping. Pile driving is a possible construction method needed to construct the bridge over Cottonwood Creek. Construction staging would be located at the eastern end of the project site, south of the roadway extension and north of Collier Canyon Road. Project construction would occur in a single construction phase.

Construction noise would primarily result from the operation of heavy construction equipment and arrival and departure of heavy-duty trucks. The highest maximum instantaneous noise levels would result from special impact tools such as impact pile drivers. FHWA's Roadway Construction Noise Model (RCNM) was used to calculate the maximum and average noise levels anticipated during each phase of construction. 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. Vehicles and equipment anticipated during each phase of construction were input into RCNM to calculate noise levels at a distance of 100 feet. Table 5 presents the construction noise levels calculated for each major phase of the project. In some instances, maximum instantaneous noise levels are calculated to be slightly lower than hourly average noise levels. This occurs because the model reports the maximum instantaneous noise level generated by the loudest single piece of construction equipment, while alternatively, the model reports the hourly average noise levels resulting from the additive effect of multiple pieces of construction equipment operating simultaneously. Noise generated by construction equipment drops off at a rate of 6 dB per doubling of distance.

TABLE 5 Noise Levels by Construction Phase at 100 feet

Construction Phase	Maximum Noise Level (L_{max}, dBA)	Hourly Average Noise Level (L_{eq}, dBA)
Site Preparation	84	85
Grading and Excavation	79	82
Sewer Trenching and Installation	75	79
Utility Trenching and Installation	75	79
Bridge Foundations	75	77
Impact Pile Driving	95	88
Bridge Abutment and Piers	75	76
Bridge Superstructure/ Barriers	75	76
Landscaping, Irrigation, and Lighting	75	76
Paving	77	80

Although the overall construction schedule is anticipated to occur over a period exceeding 12 months, roadway construction activities typically occur for relatively short periods of time in any specific location as construction proceeds along the project's alignment. Much of construction would be located more than 500 feet from any noise sensitive receptors, resulting in noise levels that are 14 dBA or more below the levels indicated in Table 5. Residences are located 4,000 feet or greater from pile driving activities. At a distance of 4,000 feet, pile driving activities would generate hourly average noise levels of about 56 dBA L_{eq} and maximum instantaneous noise levels of about 63 dBA L_{max}.

To reduce the potential for noise impacts resulting from project construction, the following measures should be implemented during project construction.

Mitigation Measure 1:

- The project shall submit a Construction Noise Management Program that identifies measures proposed to minimize construction noise impacts on existing residents.

- Construction shall be limited to comply with local ordinances. If work is necessary outside of these hours, the contractor shall acquire appropriate permits from the local jurisdiction and implement a construction noise monitoring program, providing additional mitigation where practical and feasible.

- Pile driving activities should be limited to daytime hours only, when feasible. If pile driving outside of typical construction hours specified in this measure is required, the contractor shall acquire appropriate permits from the local jurisdiction and implement a construction noise monitoring program, providing additional mitigation where practical and feasible.

- Equip all internal combustion engine driven equipment with manufacturer recommended intake and exhaust mufflers that are in good condition and appropriate for the equipment.

- Locate stationary noise generating equipment as far as possible from sensitive receptors when sensitive receptors adjoin or are near a construction project area.

- Utilize "quiet" air compressors and other "quiet" equipment where such technology exists.

- Prohibit unnecessary idling of internal combustion engines within 100 feet of residences.

- Avoid staging of construction equipment within 200 feet of sensitive uses.

- The construction contractor shall designate a noise disturbance coordinator who would be responsible for responding to any local complaints about construction noise. When a complaint is received, the disturbance coordinator shall notify the City within 24 hours of the complaint and determine the cause of the noise complaints (starting too early, bad muffler, etc.) and institute reasonable measures warranted to correct the problem, as deemed acceptable by the City of Dublin Community Development Department. The construction contractor shall conspicuously post the contact name and telephone number for the noise disturbance coordinator at the construction site.

This impact is **less-than-significant**.

Impact 2: **Groundborne Vibration.** The proposed project will not result in excessive groundborne vibration at structures in the vicinity. **This is a less-than-significant impact.**

A significant impact would be identified if project construction activity or project-related vehicle traffic would result in vibration levels of 0.3 in/sec PPV or greater at nearby structures. Project-related vehicle traffic is not anticipated to generate perceptible levels of groundborne vibration at nearby structures (vibration levels are anticipated to be below 0.01 in/sec PPV). Project construction equipment to be used on the project is anticipated to include concrete saws, excavators, graders, dozers, backhoes, forklifts, cement mixers, bore/drill rigs, aerial lifts, cranes, welders, generators, pavers, paving equipment, rollers, and pick-up trucks. Pile driving is anticipated as part of the construction of the project bridge over Cottonwood Creek. Construction activities with the greatest potential of generating perceptible vibration levels would include pile driving, the removal of pavement and soil, the movement of heavy tracked equipment, and vibratory compacting of roadway base materials by use of a roller. Table 6 summarizes typical vibration levels associated with varying pieces of construction equipment at a distance of 25 feet.

TABLE 6 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)
Pile Driver (Impact)	upper range	1.158
	typical	0.644
Pile Driver (Sonic)	upper range	0.734
	typical	0.170
Clam shovel drop		0.202
Hydromill (slurry wall)	in soil	0.008
	in rock	0.017
Vibratory Roller		0.210
Hoe Ram		0.089
Large bulldozer		0.089
Caisson drilling		0.089
Loaded trucks		0.076
Jackhammer		0.035
Small bulldozer		0.003

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

A review of the anticipated construction equipment and the vibration level data provided in Table 6 indicates that vibration levels generated by proposed activities and equipment other than pile driving would be below the 0.3 in/sec PPV criteria when construction occurs at distances of 20 feet or greater from structures. Pile driving activities would be below the 0.3 in/sec PPV criteria when construction occurs at distances of 100 feet or greater from structures. There are no existing structures located within 100 feet of the project alignment and architectural or structural damage to normal structures would not be anticipated. This is a **less-than-significant** impact.

Mitigation Measure 2: None Required.

Impact 3: Permanent Traffic Noise Increases. Project generated traffic and changes to the roadway alignment would not substantially increase traffic noise levels at noise sensitive land uses in the vicinity of the project. **This is a less-than-significant impact.**

A permanent increase in the day-night average noise level of 3 dBA CNEL or greater at noise-sensitive receptors would be considered significant when projected noise levels would exceed those considered satisfactory for the affected land use. An increase of 5 dBA CNEL or greater would be considered significant when projected noise levels would continue to meet those considered satisfactory for the affected land use. Both the Cities of Dublin and Livermore define a noise level of 60 dBA CNEL or less to be normally acceptable for residential land uses and 70 dBA CNEL or less to be normally acceptable for commercial land uses.

Traffic noise modeling was conducted using the Federal Highway Administration's Traffic Noise Model (TNM v 2.5). Roadway/site geometries were entered into the model based on digital project plans, GIS coordinates, observations documented in the field, and a review of available mapping software such as Google Earth, etc. Traffic volumes were provided by Kittelson & Associates, Inc. The primary existing noise source at receptors located along the proposed alignment of the Dublin Boulevard – North Canyons Parkway Extension is vehicles traveling on I-580, which is located 500 feet to 2,500 feet from these receptors. Local non-traffic related noise sources include aircraft, sounds of nature, and agricultural operations. TNM has been validated by FHWA within 500 feet of a highway or roadway noise source; therefore, Existing noise levels were established based on the results of noise monitoring and modeling results.

Traffic noise modeling results and predicted traffic noise impacts for existing and design year conditions are shown in Table 7. Receptor locations are indicated in Figure 1. Based on a review of measured and modeled data, the CNEL at each location was calculated to be equal to the peak-hour traffic noise level.

TABLE 7 Modeled Traffic Noise Levels

Receiver	Land Use	Calculated CNEL, dBA			Noise Increase Over Existing, dBA		2040 Build Noise Increase Over No Build, dBA
		Existing	2040 No Build	2040 Build	2040 No Build	2040 Build	
S1	Residential	63	64	65	1	2	1
S2	Residential	50	50	51	0	1	1
S3	Residential	48	48	48	0	0	0
R4	Residential	63	63	64	0	1	1
S5	Agricultural	67	67	67	0	0	0
S6	Office	63	63	65	0	2	2

As shown in Table 7, traffic noise increases at existing land uses along the proposed project alignment are calculated to increase by 0 to 2 dBA CNEL. Existing noise levels at residential

receptors R4 and S1 currently exceed the Cities' noise and land use compatibility thresholds for residential land use and would continue to do so with the development of the project. The primary noise source at these locations is traffic on I-580 (R4) or traffic on local roadways (S1). The project's contribution to traffic noise levels at these locations would be 1 dBA or less, which would not be considered significant because the increase is below the applicable significance threshold of an increase of 3 dBA CNEL. All other existing land uses would be considered compatible with the noise environment and would experience project generated noise increases of less than the applicable significance threshold of an increase in 5 dBA CNEL.

Traffic data provided by Kittelson & Associates, Inc. was also reviewed to calculate potential traffic noise level increases attributable to the Dublin Boulevard – North Canyons Parkway Extension expected along roadways serving the site. Roadways evaluated in the analysis included Dublin Boulevard, North Canyons Parkway, Hacienda Drive, Tassajara Road, Fallon Road, the I-580 ramps, El Charro Road, Airway Boulevard, Doolan Road, Isabel Avenue, Portola Avenue, and Murrieta Boulevard. Traffic volumes under the 2025 + Project scenario were compared to the 2025 No Build scenario and traffic volumes under the 2040 + Project scenario were compared to 2040 No Build conditions to calculate the noise increase attributable to the project. The data indicate that traffic volumes in the site vicinity will increase as a result of the proposed project. Traffic noise levels due to the proposed project are calculated to increase by 0 to 1 dBA CNEL along all existing roadways in the network. These noise increases would not be considered significant because the noise increases would be less than the lowest applicable significance threshold of 3 dBA CNEL. This is a **less-than-significant** impact.

Mitigation Measure 3: None Required.

Impact 4: **Temporary Construction Noise Increases.** The project will not expose off-site noise-sensitive land uses to a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project. **This is a less-than-significant impact.**

Neither the Cities of Dublin and Livermore, Alameda County, nor the State of California specify quantitative thresholds for the impact of temporary increases in noise due to construction. The threshold for speech interference indoors is 45 dBA. Assuming a 15 dB exterior-to-interior reduction for standard residential construction with windows open and a 25 dB exterior-to-interior reduction for standard commercial construction, assuming windows closed, this would correlate to an exterior threshold of 60 dBA L_{eq} at residential land uses. Therefore, the project would be considered to generate a significant temporary construction noise impact if project construction activities exceeded 60 dBA L_{eq} at nearby residences and exceeded the ambient noise environment by 5 dBA L_{eq} or more for a period longer than one year.

As described in Impact 1, 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 activities would include demolition, earthwork, paving, pile driving, concrete/rebar/formwork, utility trenching, and roadway striping. Anticipated construction activities and resulting noise levels are described in Impact 1. As described in Impact 1, unshielded

noise levels at 100 feet from the center of construction activities would generally range from 76 to 85 dBA L_{eq} during peak periods without pile driving and would be about 88 dBA L_{eq} during periods with pile driving, with the highest maximum instantaneous noise levels typically ranging from 75 to 84 dBA L_{max} without pile driving and about 95 dBA L_{max} during pile driving. Noise produced by construction equipment typically attenuates over distance at a rate of about 6 dB per doubling of distance.

Existing peak-hour noise levels are in the range of 48 to 63 dBA L_{eq} at adjacent residences. Construction noise levels at these residences, which are located 300 to more than 2,000 feet from project construction, would range from 66 to 75 dBA L_{eq} at R4, 60 to 69 dBA L_{eq} at S1, 52 to 61 dBA L_{eq} at S2, and 50 to 59 dBA L_{eq} at S3, not taking additional noise reduction from shielding into account, during periods without pile driving when construction is located closest to residences. Residences are located 4,000 feet or greater from pile driving activities proposed to construct the bridge over Cottonwood Creek. At a distance of 4,000 feet, pile driving activities would generate hourly average noise levels of about 56 dBA L_{eq} and maximum instantaneous noise levels of about 63 dBA L_{max}.

Average noise levels could exceed ambient daytime noise levels at adjacent residential land uses by 0 to 6 dBA L_{eq} during most construction phases when construction is located closest to residences and by 6 to 15 dBA L_{eq} during site preparation. Pile driving activities would generally be below 60 dBA L_{eq} at residences due to the large distance from Cottonwood Creek bridge construction.

Hourly average construction noise levels would exceed 60 dBA L_{eq} and ambient noise levels by as much as 15 dBA L_{eq} during short periods of site preparation work located closest to residences, but would be 5 dBA L_{eq} or less above ambient levels during most phases of construction. Additionally, although construction is anticipated to occur over a total period of greater than 1-year, the duration of noise generating activities at individual locations along the project alignment would be significantly shorter as construction moves along the alignment and progress occurs. Construction noise levels at residences would not be anticipated to exceed 60 dBA L_{eq} and the ambient noise environment by 5 dBA L_{eq} or more for a period longer than one year. As discussed in Impact 1, construction would be conducted in compliance with the appropriate local regulatory criteria and would include standard noise suppression devices and techniques, as described in Mitigation Measure 1.

Mitigation Measure 4: No Additional Mitigation Required. This is a **less-than-significant** impact with implementation of Mitigation Measure 1.