APPENDIX D

Noise and Vibration Assessment

477 SOUTH MARKET STREET ENVIRONMENTAL NOISE AND VIBRATION ASSESSMENT

San José, California

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INTRODUCTION

The project proposes to demolish an existing one-story commercial use building and construct a 6-level mixed use building with 130 apartment units and approximately 9,120 sq.ft. of associated amenity spaces, approximately 6,000 sq.ft. of commercial/retail, and three levels of below grade parking. This report evaluates the project's potential to result in significant noise and vibration impacts with respect to applicable California Environmental Quality Act (CEQA) guidelines. The report is divided into three 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 conditions; 2) the General Plan Consistency Section discusses noise and land use compatibility utilizing policies in the City's General Plan; and, 3) the Impacts and Mitigation Measures Section describes the significance criteria used to evaluate project impacts, 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.

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 DNL. Typically, the highest steady traffic noise level during the daytime is about equal to the DNL 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 DNL with open windows and 65-70 dBA DNL 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 DNL 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 DNL. At a DNL of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the DNL 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 DNL of 60-70 dBA. Between a DNL 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 DNL 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 vibration levels produce.

The annoyance levels shown in Table 3 should be interpreted with care since vibration may be found to be annoying at much 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.

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 induce structural 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. Studies have shown that the threshold of perception for average persons is in the range of 0.008 to 0.012 in/sec PPV. 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 minor cracking of building elements, or may threaten the integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher and there is no general consensus as to what amount of vibration may pose a threat for structural damage to the building. 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.

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, November 2009.

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	Virtually no risk of damage to normal buildings
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential dwellings such as plastered walls or ceilings
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to newer residential structures

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, September 2013.

Regulatory Background – Noise

The State of California and the City of San José 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 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) 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, if the project would expose people residing or working in the project area to excessive noise levels; or

(f) For a project within the vicinity of a private airstrip, if the project would expose people residing or working in the project area to excessive noise levels.

Checklist items (a), (b), (c), and (d) are applicable to the proposed project. The project would not expose people residing or working in the project area to excessive aircraft noise levels; therefore, items (e) and (f) are not carried further in this analysis.

The impacts of the project on the surrounding land uses are addressed in the Noise Impacts and Mitigation Measures Section of the report. The impacts of site constraints such as exposure of the proposed project to excessive levels of noise and vibration are not considered under CEQA and are discussed in a separate section addressing Noise and Land Use Compatibility for consistency with the policies set forth in the City's General Plan.

2016 California Building Code, Title 24, Part 2. The current version of the California Building Code (CBC) requires interior noise levels attributable to exterior environmental noise sources to be limited to a level not exceeding 45 dBA DNL/CNEL in any habitable room.

2016 California Green Building Standards Code (Cal Green Code). The State of California established exterior sound transmission control standards for new non-residential buildings as set forth in the 2016 California Green Building Standards Code (Section 5.507.4.1 and 5.507.4.2). Section 5.507 states that either the prescriptive (Section 5.507.4.1) or the performance method (Section 5.507.4.2) shall be used to determine environmental control at indoor areas. The prescriptive method is very conservative and not practical in most cases; however, the performance method can be quantitatively verified using exterior-to-interior calculations. For the purposes of this report, the performance method is utilized to determine consistency with the Cal Green Code. The sections that pertain to this project are as follows:

> **5.507.4.1 Exterior noise transmission, prescriptive method.** Wall and roof-ceiling assemblies exposed to the noise source making up the building envelope shall meet a composite STC rating of at least 50 or a composite OITC rating of no less than 40, with exterior windows of a minimum STC of 40 or OITC of 30 when the building falls within the 65 dBA L_{dn} noise contour of a freeway or expressway, railroad, industrial source or fixed-guideway noise source, as determined by the local general plan noise element.
>
> **5.507.4.2 Performance method.** For buildings located, as defined by Section 5.507.4.1, wall and roof-ceiling assemblies exposed to the noise source making up the building envelope shall be constructed to provide an interior noise environment attributable to exterior sources that does not exceed an hourly equivalent noise level ($L_{eq\ (1\text{-}hr)}$) of 50 dBA in occupied areas during any hour of operation.

The performance method, which establishes the acceptable interior noise level, is the method typically used when applying these standards.

City of San José General Plan. The Environmental Leadership Chapter in the Envision San José 2040 General Plan sets forth policies with the goal of minimizing the impact of noise on people through noise reduction and suppression techniques, and through appropriate land use policies in the City of San José. The following policies are applicable to the proposed project:

EC-1.1 Locate new development in areas where noise levels are appropriate for the proposed uses. Consider federal, State, and City noise standards and guidelines as a part of new development review. Applicable standards and guidelines for land uses in San José include:

Interior Noise Levels

- The City's standard for interior noise levels in residences, hotels, motels, residential care facilities, and hospitals is 45 dBA DNL. Include appropriate site and building design, building construction and noise attenuation techniques in new development to meet this standard. For sites with exterior noise levels of 60 dBA DNL or more, an acoustical analysis following protocols in the City-adopted California Building Code is required to demonstrate that development projects can meet this standard. The acoustical analysis shall base required noise attenuation techniques on expected Envision General Plan traffic volumes to ensure land use compatibility and General Plan consistency over the life of this plan.

Exterior Noise Levels

- The City's acceptable exterior noise level objective is 60 dBA DNL or less for residential and most institutional land uses such as schools, 65 dBA DNL for playground and outdoor spaces, and 70 dBA DNL for commercial uses (Table EC-1). The acceptable exterior noise level objective is established for the City, except in the environs of the San José International Airport and the Downtown, as described below:

    - For new multi-family residential projects and for the residential component of mixed-use development, use a standard of 60 dBA DNL in usable outdoor activity areas, excluding balconies and residential stoops and porches facing existing roadways. Some common use areas that meet the 60 dBA DNL exterior standard will be available to all residents. Use noise attenuation techniques such as shielding by buildings and structures for outdoor common use areas. On sites subject to aircraft overflights or adjacent to elevated roadways, use noise attenuation techniques to achieve the 60 dBA DNL standard for noise from sources other than aircraft and elevated roadway segments.

Table EC-1: Land Use Compatibility Guidelines for Community Noise in San José

LAND USE CATEGORY	EXTERIOR NOISE EXPOSURE (DNL IN DECIBELS (DBA)) 55 60 65 70 75 80
1. Residential, Hotels and Motels, Hospitals and Residential Care[1]	
2. Outdoor Sports and Recreation, Neighborhood Parks and Playgrounds	
3. Schools, Libraries, Museums, Meeting Halls, Churches	
4. Office Buildings, Business Commercial, and Professional Offices	
5. Sports Arena, Outdoor Spectator Sports	
6. Public and Quasi-Public Auditoriums, Concert Halls, Amphitheaters	

[1]Noise mitigation to reduce interior noise levels pursuant to Policy EC-1.1 is required.

Normally Acceptable:

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

Conditionally Acceptable:

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

Unacceptable:

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

EC-1.2 Minimize the noise impacts of new development on land uses sensitive to increased noise levels (Categories 1, 2, 3 and 6) by limiting noise generation and by requiring use of noise attenuation measures such as acoustical enclosures and sound barriers, where feasible. The City considers significant noise impacts to occur if a project would:

- Cause the DNL at noise sensitive receptors to increase by five dBA DNL or more where the noise levels would remain "Normally Acceptable;" or

- Cause the DNL at noise sensitive receptors to increase by three dBA DNL or more where noise levels would equal or exceed the "Normally Acceptable" level.

EC-1.3 Mitigate noise generation of new nonresidential land uses to 55 dBA DNL at the property line when located adjacent to existing or planned noise-sensitive residential and public/quasi-public land uses.

EC-1.6 Regulate the effects of operational noise from existing and new industrial and commercial development on adjacent uses through noise standards in the City's Municipal Code.

EC-1.7 Require construction operations within San José to use best available noise suppression devices and techniques and limit construction hours near residential uses per the City's Municipal Code. The City considers significant construction noise impacts to occur if a project located within 500 feet of residential uses or 200 feet of commercial or office uses would:

- Involve substantial noise generating activities (such as building demolition, grading, excavation, pile driving, use of impact equipment, or building framing) continuing for more than 12 months.

- For such large or complex projects, a construction noise logistics plan that specifies hours of construction, noise and vibration minimization measures, posting or notification of construction schedules, and designation of a noise disturbance coordinator who would respond to neighborhood complaints will be required to be in place prior to the start of construction and implemented during construction to reduce noise impacts on neighboring residents and other uses.

City of San José Municipal Code. The City's Municipal Code contains a Zoning Ordinance that limits noise levels at adjacent properties. Chapter 20.30.700 states that sound pressure levels generated by any use or combination of uses on a property shall not exceed 55 dBA at any property line shared with land zoned for residential use and to 60 dBA at commercial property lines, except upon issuance and in compliance with a Conditional Use Permit. No specific limits are given for industrial property lines. This code is not explicit in terms of the acoustical descriptor associated with the noise level limit. Consistent with General Plan policy E.C.-1.3, a reasonable interpretation of this standard would identify the ambient base noise level criteria as the day/night noise level (DNL).

Chapter 20.100.450 of the Municipal Code establishes allowable hours of construction within 500 feet of a residential unit between 7:00 am and 7:00 pm Monday through Friday unless permission is granted with a development permit or other planning approval. No construction activities are permitted on the weekends at sites within 500 feet of a residence.

Regulatory Background – Vibration

The City of San Jos**é** has established vibration guidelines applicable to this analysis.

City of San José General Plan. The Environmental Leadership Chapter in the Envision San José 2040 General Plan sets forth policies to achieve the goal of minimizing vibration impacts on people, residences, and business operations in the City of San José. The following policies are applicable to the proposed project:

EC-2.3 Require new development to minimize vibration impacts to adjacent uses during demolition and construction. A vibration limit of 0.20 in/sec PPV will be used to minimize the potential for cosmetic damage at buildings of normal conventional construction.

Existing Noise Environment

The project site is located at the southwest corner of intersection of South Market Street and Balbach Street. Residential, commercial and recreational structures surround the project site. San Jose Convention Center's South Hall building is located 30 meters north of project site. The Convention Center host indoor events only, which do not substantially contribute to the ambient noise environment. A noise monitoring survey was performed in the vicinity of the project site beginning Tuesday, August 7, 2018 and concluding on Thursday, August 9, 2018. The monitoring survey included one long-term noise measurements and three short-term measurements, as shown in Figure 1. Table 4 summarizes the results of the short-term measurements. The results of the long-term noise measurements at LT-1 is shown in Figure 2.

Long-term noise measurement LT-1 was made at a distance of about 40 feet west from the centerline of South Market Street. The primary noise source at this location was traffic along South Market Street. Hourly average noise levels ranged from 66 to 72 dBA L_{eq} during daytime hours, and from 61 to 70 dBA L_{eq} at night. The day-night average noise level on Wednesday, August 8, 2018 was 73 dBA DNL.

TABLE 4 Summary of Short-Term Noise Measurement Data, August 7th & 9th, 2018

ID	Location (Start Time)	Measured Noise Levels, dBA				Primary noise source
		L_{10}	L_{50}	L_{90}	L_{eq}	
ST-1	On South Market Street (8/7/18, 2:00 pm to 2:10 pm)	74	65	57	70	Traffic on South Market Street
ST-2	Southwest corner of the site (8/9/18, 1:10 p.m. to 1:20 p.m.)	57	54	51	57	Construction noise, jet noise and noise from residences
ST-3	On Balbach Street (8/9/18, 1:30 p.m. to 1:40 p.m.)	67	63	56	64	Traffic on Balbach Street

FIGURE 1 Noise Measurement Locations

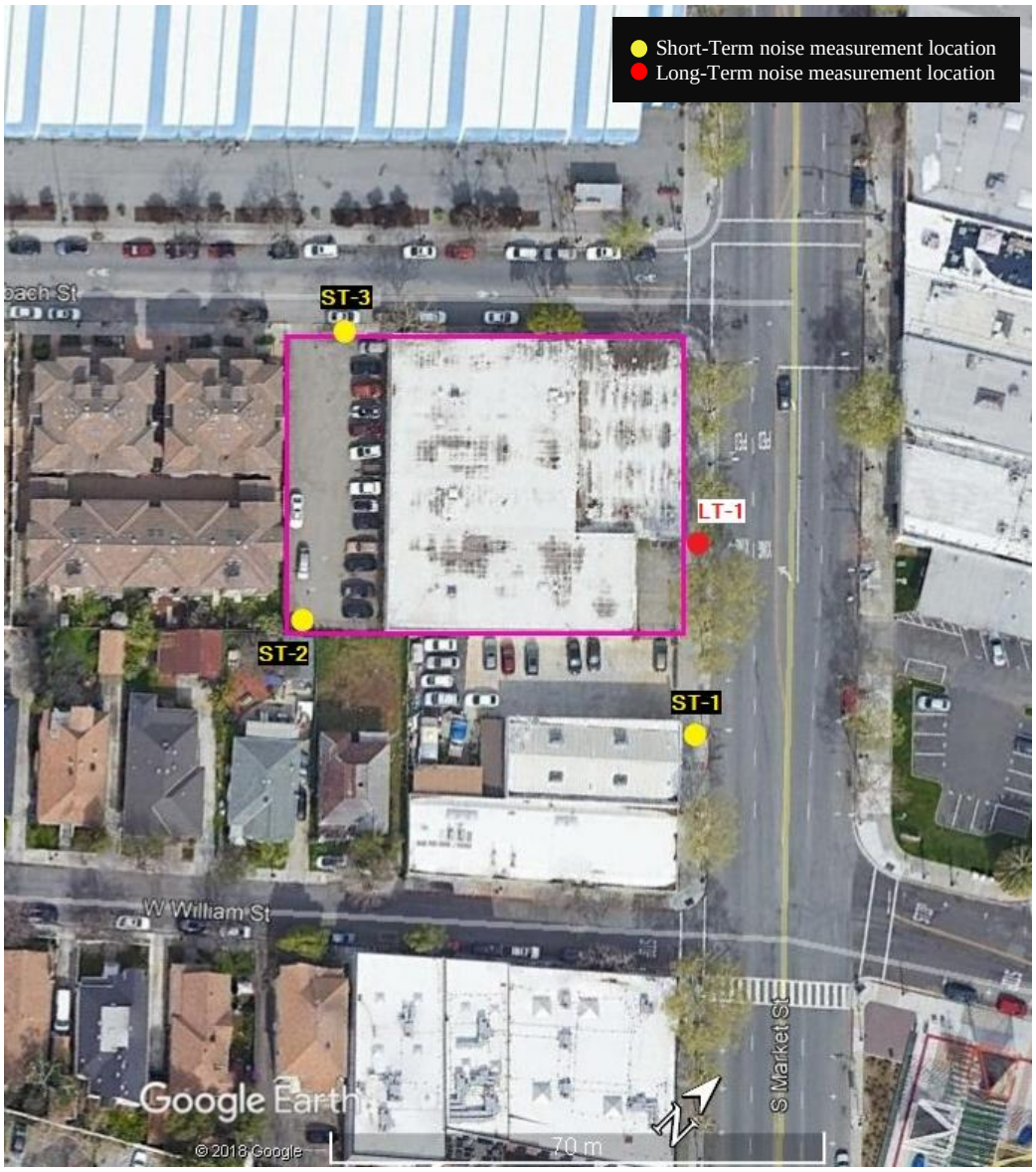
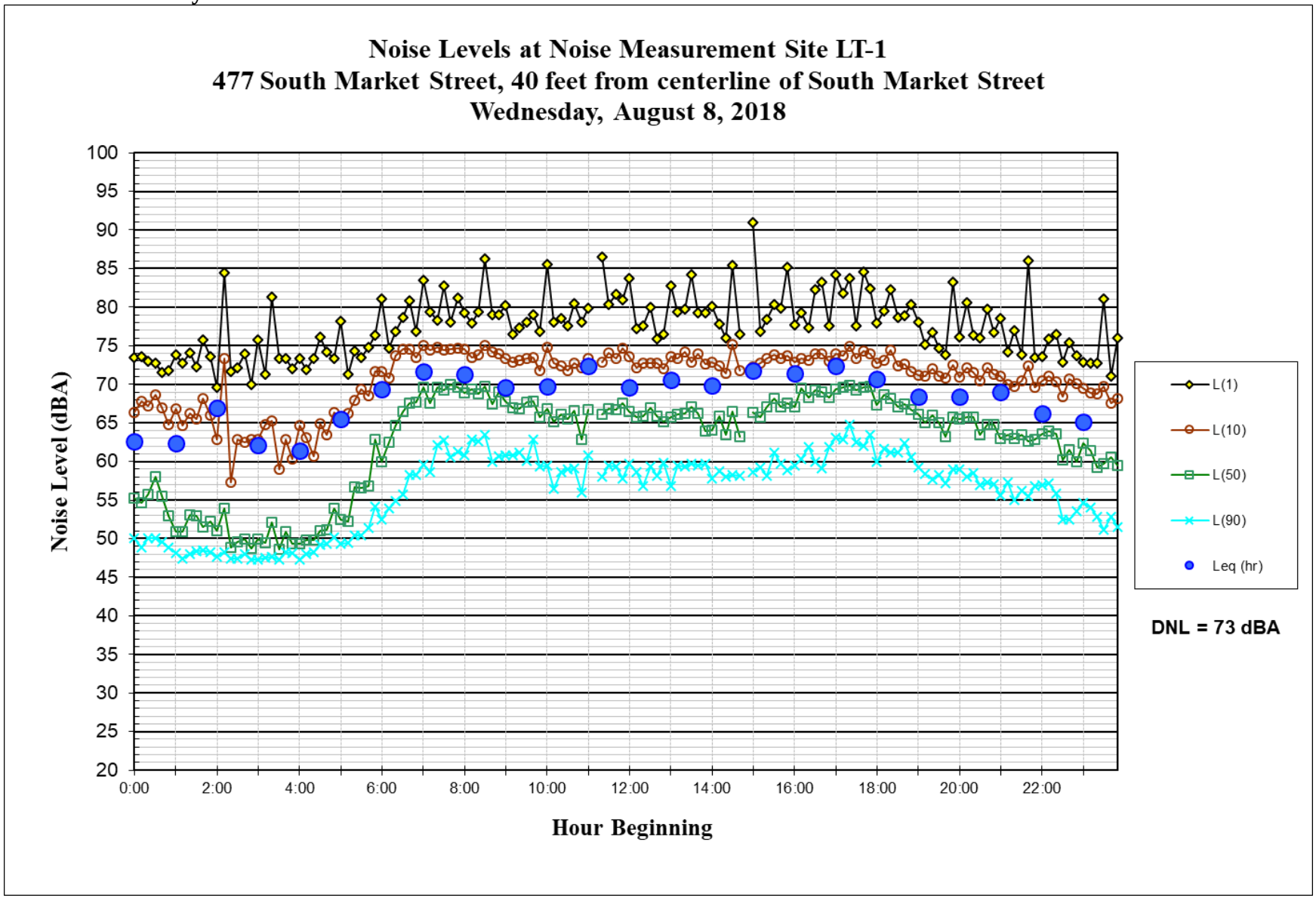


FIGURE 2 Daily Trend in Noise Levels at LT-1



GENERAL PLAN CONSISTENCY ANALYSIS

Noise and Land Use Compatibility

The Environmental Leadership Chapter in the Envision San José 2040 General Plan sets forth policies with the goal of minimizing the impact of noise on people through noise reduction and suppression techniques, and through appropriate land use policies in the City of San José. The applicable General Plan policies were presented in detail in the Regulatory Background section and are summarized below for the proposed project:

- The City's acceptable exterior noise level objective is 60 dBA DNL or less for the proposed residential uses (Table EC-1).

- The City's acceptable exterior noise level objective is 70 dBA DNL for the proposed office and commercial uses (Table EC-1).

- The City's standard for interior noise levels in residences is 45 dBA DNL.

- The Cal Green Code standards specify an interior noise environment attributable to exterior sources not to exceed an hourly equivalent noise level ($L_{eq\ (1\text{-}hr)}$) of 50 dBA in occupied areas of non-residential uses during any hour of operation.

Noise and Land Use Compatibility

The project proposes to redevelop an approximately 0.58-acre site. The project would demolish existing commercial building and construct a six-level mixed use building with 130 residential units on Levels 2 through 6, and approximately 5,000 square feet of retail space on Level 1. The building will include three levels of underground parking.

The proposed building will be located on the southwest corner of intersection of South Market Street and Balbach Street. Exterior use areas would include a courtyard on Podium/Level 2, two rooftop gardens on Level 7 facing South Market Street and Balbach Street, and patios along the northern and eastern side of the building. Indoor amenities would include a leasing office on Level 1 (ground level) on the south side. Retail/commercial uses would be located on the ground level of the north and east side. The primary noise source for proposed building would continue to be the traffic on South Market Street and Balbach Street.

Future Exterior Noise Environment

Future traffic noise levels at the site were calculated based on the results of the noise monitoring survey and future increase in traffic noise on South Market Street. Based on the existing and future traffic volumes and trip generation data provided for the project[1], future traffic noise levels on South Market Street are calculated to increase 1 dB over existing levels. Future traffic noise levels on Balbach Street are not anticipated to change substantially from existing levels (increase would be less than 1 dBA).

[1] *477 Market Street Mixed-Use Volumes and Trip Generation (Consultant)*, data received on October 29, 2018.

Proposed exterior use areas would include a courtyard on Level 2, two rooftop gardens facing Balbach Street and South Market Street, a patio outside retail space facing South Market Street on Level 1 and outdoor patios on Levels 3 through 6. The primary noise source for these outdoor areas is the traffic on Balbach Street and South Market Street. The courtyard area would be well shielded from traffic noise by the project building. The rooftop terraces are also shielded from traffic noise by the rooftop itself and by a solid parapet wall provided at the edge of the rooftop. Based on measurements made during the noise monitoring survey, the courtyard area would be exposed to a noise level of 50 dBA DNL and the rooftop gardens facing South Market Street and Balbach Street would be exposed to noise levels of 50 to 60 dBA DNL. The outdoor use areas available for the commercial spaces (patios) would be exposed to 71 dBA DNL. The outdoor residential patios on Levels 3 through 6, facing Balbach Street would be exposed to noise levels up to 68 dBA DNL and the outdoor patios on Levels 3 and 4, facing South Market Street, would be exposed to noise levels up to 71 dBA DNL.

Noise levels at residential shared outdoor use areas, including the Level 2 courtyard and rooftop gardens, would meet the City's acceptable exterior noise level criteria of 60 dBA DNL for residential use. Noise levels at the building's residential patios would exceed the City's acceptable exterior noise level criteria of 60 dBA DNL for residential use; however, all residents would have access to the common shared outdoor areas, which are exposed to acceptable levels. Noise levels at the commercial use patio on Level 1 would exceed the City's acceptable exterior noise level criteria of 70 dBA DNL for commercial uses.

Future Interior Noise Environment

The City of San José and the California Building Code require that interior noise levels be maintained at 45 dBA DNL or less for residences. The Cal Green code requires interior noise attributable to exterior sources to not exceed 50 dBA $L_{eq\text{-}1hr}$ in non-residential spaces.

The calculated exterior noise level exposures of building façades are summarized in Table 5, based on the results of the noise monitoring survey.

TABLE 5 Predicted Exterior Noise Levels at Building Façades

Building façade	**Predicted Noise Levels at Façades (dBA DNL)**		
	Commercial	Residential Level 2	Residential Level 6
North façade facing Balbach Street	61	61	59
East façade facing South Market Street	71	71	70
South façade partially facing South Market Street	-	68	66
West facade	-	40	39

Interior noise levels would vary depending upon the design of the buildings (relative window area to wall area) and the selected construction materials and methods. Standard residential construction provides approximately 15 dBA of exterior-to-interior noise reduction, assuming the windows are partially open for ventilation. Standard construction with the windows closed provides approximately 20 to 25 dBA of noise reduction in interior spaces. Where exterior noise levels range from 60 to 65 dBA DNL, the inclusion of adequate forced-air mechanical ventilation can reduce interior noise levels to acceptable levels by allowing occupants the option of closing the windows to control noise. Where noise levels exceed 65 dBA DNL, forced-air mechanical ventilation systems and sound-rated construction methods are normally required. Such methods or materials may include a combination of smaller window and door sizes as a percentage of the total building façade facing the noise source, sound-rated windows and doors, sound-rated exterior wall assemblies, and mechanical ventilation so windows may be kept closed at the occupant's discretion.

Assuming a 15 dBA noise reduction with windows open, interior noise levels would be up to 46 dBA DNL inside residential units facing Balbach Street, 55 dBA DNL inside residences facing South Market Street and up to 53 dBA DNL inside residences on the southern façade. These levels exceed the City's threshold for interior noise (45 dBA DNL). The inclusion of forced air mechanical ventilation and windows with STC[2] 28 rating or higher would be necessary to reduce the interior noise exposure in these units to 45 dBA DNL or less, assuming a window to wall ratio of 40% or less and a wall construction providing sound rating of STC 39 or better.

Commercial use spaces on Level 1 of proposed building would have standard commercial construction, with closed windows and forced air conditioning provided. Commercial-use construction with closed windows would be anticipated to provide approximately 25 dBA of noise reduction from exterior noise sources, resulting in interior noise levels 45 dBA $L_{eq\ (1\text{-}hr)}$. These levels would comply with the acceptable interior limit of 50 dBA $L_{eq\ (1\text{-}hr)}$ specified by the Cal Green Code.

Recommended Conditions of Approval

For consistency with the General Plan, the following Conditions of Approval are recommended for consideration by the City:

- Provide a suitable form of forced-air mechanical ventilation, as determined by the local building official, so that windows can be kept closed to control noise.

- Provide sound rated windows to proposed building residential façades facing South Market Street to maintain interior noise levels at acceptable levels. Preliminary calculations show that sound-rated windows with minimum STC Ratings of 28 or higher would be satisfactory for units to achieve acceptable interior noise levels, assuming a windows to wall ratio of 40% or less. The specific determination of what noise insulation treatments

[2] **Sound Transmission Class (STC)** A single figure rating designed to give an estimate of the sound insulation properties of a partition. Numerically, STC represents the number of decibels of speech sound reduction from one side of the partition to the other. The STC is intended for use when speech and office noise constitute the principal noise problem.

are necessary shall be conducted on a room-by-room basis during final design of the project.

NOISE IMPACTS AND MITIGATION MEASURES

Significance Criteria

Paraphrasing from Appendix G of the CEQA Guidelines, a project would normally result in significant noise impacts if noise levels generated by the project conflict with adopted environmental standards or plans, if the project would generate excessive groundborne vibration levels, or if ambient noise levels at sensitive receivers would be substantially increased over a permanent, temporary, or periodic basis. The following criteria were used to evaluate the significance of environmental noise resulting from the project:

- **Conflict with Established Standards:** A significant impact would be identified if project construction were to conflict with local noise standards contained in the San José General Plan or Municipal Code.

- **Groundborne Vibration from Construction:** A significant impact would be identified if the construction of the project would expose persons to excessive vibration levels. Groundborne vibration levels exceeding 0.2 in/sec PPV would have the potential to result in cosmetic damage to normal buildings. (General Plan Policy EC-2.3)

- **Permanent Noise Increases:** A significant permanent noise impact would occur if the project resulted in an increase of 3 dBA DNL or greater at noise-sensitive land uses where existing or projected noise levels would equal or exceed the noise level considered satisfactory for the affected land use (60 dBA DNL for single-family residential areas) and/or an increase of 5 dBA DNL or greater at noise-sensitive land uses where noise levels would continue to be below those considered satisfactory for the affected land use. (General Plan Policy EC-1.2)

- **Construction Noise:** A significant noise impact would be identified if construction-related noise would temporarily increase ambient noise levels at sensitive receptors. Hourly average noise levels exceeding 60 dBA L_{eq} at the property lines shared with residential land uses, and the ambient by at least 5 dBA L_{eq}, for a period of more than one year would constitute a significant temporary noise increase at adjacent residential land uses. Hourly average noise levels exceeding 70 dBA L_{eq} at the property lines shared with residential land uses, and the ambient by at least 5 dBA L_{eq}, for a period of more than one year would constitute a significant temporary noise increase at adjacent commercial land uses.

Impact 1a: Conflict with Established Standards – Project Construction. Project construction is anticipated to last more than 12 months, within 500 feet of residential land use. **This is a potentially significant impact.**

Chapter 20.100.450 of the City's Municipal Code establishes allowable hours of construction within 500 feet of a residential unit between 7:00 am and 7:00 pm Monday through Friday unless

permission is granted with a development permit or other planning approval. No construction activities are permitted on the weekends at sites within 500 feet of a residence. Policy EC-1.7 of the City's General Plan states that for large or complex projects within 500 feet of residential land uses or within 200 feet of commercial land uses or offices involving substantial noise-generating activities lasting more than 12 months, a construction noise logistics plan that specifies hours of construction, noise and vibration minimization measures, posting or notification of construction schedules, and designation of a noise disturbance coordinator who would respond to neighborhood complaints will be required to be in place prior to the start of construction and implemented during construction to reduce noise impacts on neighboring residents and other uses.

Construction activities will occur only during the allowable hours and project construction would be carried out in staggered phases. Construction of the proposed building would commence in March of 2019 and finish in February 2021. Most construction activities would occur within 500 feet of residential land use. This would be a **potentially significant** impact.

Short-term noise increases due to construction are discussed further in Impact 4.

Mitigation Measure 1a: Implementation of the following measures would reduce construction noise levels emanating from the site, limit construction hours, and minimize disruption and annoyance.

Best Construction Management Practices

- Construction activities shall be limited to the hours between 7:00 am and 7:00 pm, Monday through Friday, unless permission is granted with a development permit or other planning approval. No construction activities are permitted on the weekends at sites within 500 feet of a residence.

- Construct solid plywood fences around ground level construction sites adjacent to noise-sensitive land uses.

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

- Unnecessary idling of internal combustion engines should be strictly prohibited.

- Locate stationary noise-generating equipment such as air compressors or portable power generators as far as possible from sensitive receptors. Construct temporary noise barriers to screen stationary noise-generating equipment when located near adjoining sensitive land uses. Temporary noise barriers could reduce construction noise levels by 5 dBA.

- Utilize "quiet" air compressors and other stationary noise sources where technology exists.

- Control noise from construction workers' radios to a point where they are not audible at existing residences bordering the project site.

- A temporary noise control blanket barrier could be erected, if necessary, along building façades facing construction sites. This mitigation would only be necessary if conflicts occurred which were irresolvable by proper scheduling. Noise control blanket barriers can be rented and quickly erected.

- Pre-drill foundation pile holes to minimize the number of impacts required to seat the pile.

- Consider the use of "acoustical blankets" for receptors located within 100 feet of the site during pile driving activities.

- Notify all adjacent business, residences, and other noise-sensitive land uses of the construction schedule, in writing, and provide a written schedule of "noisy" construction activities to the adjacent land uses and nearby residences.

- Designate a "disturbance coordinator" who would be responsible for responding to any complaints about construction noise. The disturbance coordinator will determine the cause of the noise complaint (e.g., bad muffler, etc.) and will require that reasonable measures be implemented to correct the problem. Conspicuously post a telephone number for the disturbance coordinator at the construction site and include in it the notice sent to neighbors regarding the construction schedule.

With the implementation of these best management practices and recognizing that noise generated by construction activities would occur over a temporary period, this would be a **less-than-significant** impact.

Impact 1b: Conflict with Established Standards –Mechanical Equipment Noise. Mechanical equipment proposed by the project would not exceed the City's established operational noise thresholds at off-site receptors. **This is a less-than-significant impact.**

Chapter 20.30.700 of the City's Municipal Code states that sound pressure levels generated by any use or combination of uses on a property shall not exceed 55 dBA at any property line shared with land zoned for residential use, except upon issuance and in compliance with a Conditional Use Permit. The code is not explicit in terms of the acoustical descriptor associated with the noise level limit. However, a reasonable interpretation of this standard, which is based on policy EC-1.3 of the City's General Plan, would identify the ambient base noise level criteria as a day-night average noise level (DNL). For mechanical equipment, which would be assumed to be operating continuously during all daytime and nighttime hours, 55 dBA DNL would be equivalent to a continuous L_{eq} level of 49 dBA.

Mechanical equipment will be housed in the mechanical equipment room on the ground floor of the building. The noise generated by indoor mechanical equipment is not anticipated not be audible at sensitive receptors. This is a **less-than-significant** impact.

Mitigation Measure 1b: None required.

Impact 2: **Groundborne Vibration from Construction.** Construction-related vibration levels resulting from construction activities are not calculated to exceed 0.2 in/sec PPV at the nearest structures. **This is a less-than-significant impact.**

According to Policy EC-2.3 of the City of San José General Plan, a vibration limit of 0.08 in/sec PPV shall be used to minimize the potential for cosmetic damage to sensitive historical structures, and a vibration limit of 0.2 in/sec PPV shall be used to minimize damage at buildings of normal conventional construction. The vibration limits contained in this policy are conservative and designed to provide the ultimate level of protection for existing buildings in San José. Demolition and construction activities required for construction often generate perceptible vibration levels and levels that could affect nearby structures when heavy equipment or impact tools (e.g. jackhammers, pile drivers, hoe rams) are used in the vicinity of nearby sensitive land uses. Building damage generally falls into three categories. Cosmetic damage (also known as threshold damage) is defined as hairline cracking in plaster, the opening of old cracks, the loosening of paint or the dislodging of loose objects. Minor damage is defined as hairline cracking in masonry or the loosening of plaster. Major structural damage is defined as wide cracking or the shifting of foundation or bearing walls.

Construction activities would include site demolition work, preparation work, excavation of below-grade levels, foundation work, and new building framing and finishing. Impact pile driving is anticipated during the grading and the excavation of the site, has the potential for generating the highest ground vibration levels and would be the primary concern to structural damage. Table 6 presents typical vibration levels that could be expected from construction equipment at a distance of 25 feet. Construction activities, such as use of saws, excavators, scrapers and other high-power or vibratory tools, and rolling stock equipment (tracked vehicles, compactors, etc.) may generate substantial vibration in the immediate vicinity. Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Table 6 also presents construction vibration levels at various distances from the construction equipment. Calculations were made to estimate vibration levels at distances at 10, 25, 50, 100, and 150 feet from the site to represent other nearby buildings. Vibration levels are highest close to the source, and then attenuate with increasing distance at the rate of $(D_{ref}/D)^{1.1}$, where D is the distance from the source in feet and D_{ref} is the reference distance of 25 feet.

TABLE 6 Vibration Source Levels for Construction Equipment at Various Distances

Equipment		PPV at 10 ft. (in/sec)	PPV at 25 ft. (in/sec)	PPV at 50 ft. (in/sec)	PPV at 100 ft. (in/sec)	PPV at 150 ft. (in/sec)
Pile Driver (Impact)	upper range	3.173	1.158	0.540	0.252	0.161
	typical	1.764	0.644	0.300	0.140	0.090
Pile Driver (Sonic)	upper range	2.011	0.734	0.342	0.160	0.102
	typical	0.466	0.17	0.079	0.037	0.024
Clam shovel drop		0.798	0.553	0.071	0.094	0.044
Hydromill (slurry wall)	in soil	0.022	0.008	0.004	0.002	0.001
	in rock	0.047	0.017	0.008	0.004	0.002
Vibratory Roller		0.830	0.575	0.074	0.098	0.046
Hoe Ram		0.352	0.244	0.031	0.042	0.019
Large bulldozer		0.352	0.244	0.031	0.042	0.019
Caisson drilling		0.352	0.244	0.031	0.042	0.019
Loaded trucks		0.300	0.208	0.027	0.035	0.017
Jackhammer		0.138	0.096	0.012	0.016	0.008
Small bulldozer		0.012	0.008	0.001	0.001	0.001

Source: Transit Noise and Vibration Impact Assessment, United States Department of Transportation, Office of Planning and Environment, Federal Transit Administration, May 2006 as modified by Illingworth & Rodkin, Inc., June 2018.

'Upper range' impact pile driving activity would have the potential to produce vibration levels of 0.08 in/sec PPV or more at historic buildings within 300 feet and 'typical' impact pile driving activity would have the potential to produce vibration levels of 0.08 in/sec PPV or more at historic buildings within 175 feet. Impact pile driving would have the potential to produce vibration levels of 0.2 in/sec PPV or more at buildings of conventional construction located within 75 feet of project site assuming "typical" levels and within 125 feet of project site assuming "upper range" levels. Other heavy vibration generating construction equipment such as vibratory rollers, clam shovels and would be anticipated to exceed 0.08 in/sec PPV within 60 feet of construction and exceed 0.2 in/sec PPV within 25 feet of construction.

Based on the City of San José Historic Resources Inventory, there are five historic structures within 300 feet of the project site, located at 463, 499 and 501 South Market Street (40, 80 and 150 feet south of project site, respectively) and 439 and 455 South First Street (100 and 130 feet east of project site, respectively). Project construction activities, such as pile driving, and high-power vibratory tools may generate substantially high vibration in the immediate vicinity of the project site. Some activities would occur as close as 40 feet from the closest historical building, 463 South Market Street. At this distance, vibration levels due to construction are conservatively calculated to reach up to 0.69 in/sec PPV for "upper range" impact pile driving, 0.38 in/sec PPV for "typical" impact pile driving, and 0.125 in/sec PPV for vibratory roller use, which would exceed 0.08 in/sec PPV threshold for historical buildings. Vibration levels during impact pile driving activity would also be anticipated to exceed 0.08 in/sec PPV at 499 and 501 South Market Street and 439 and 455 South First Street. Other project construction would be below the 0.08 in/sec PPV threshold for historic structures at these locations.

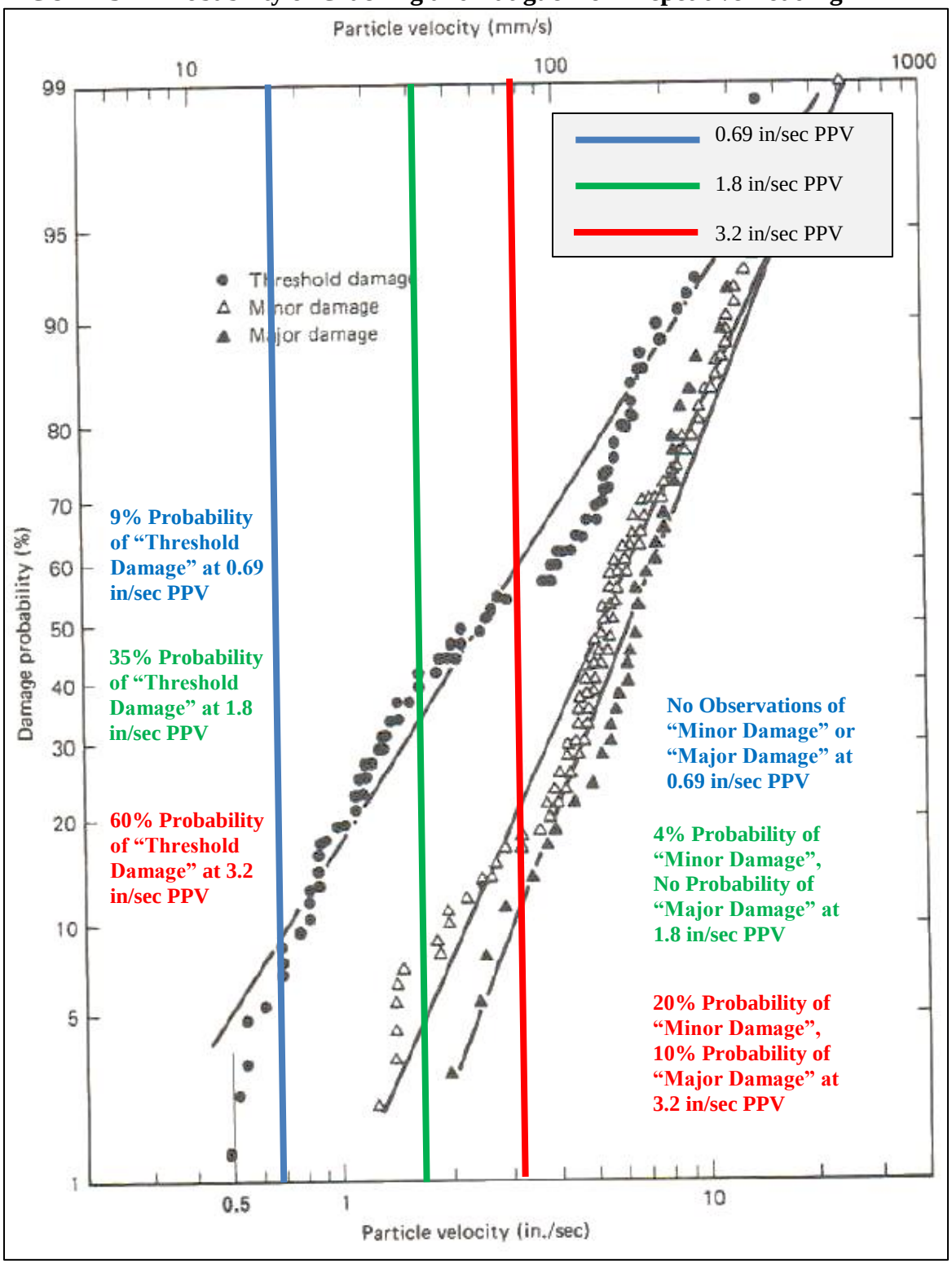
Existing structures of normal construction in the vicinity of the site include a residential building located 10 feet to the west, commercial buildings located 100 feet to the east, and the McEnry Convention Center, located 100 feet to the north. At a distance of 10 feet, impact pile driving could generate "upper range" vibration levels as high as 3.17 in/sec PPV and "typical" levels of 1.76 in/sec PPV. Vibration levels from other construction activities would be considerably lower; but could still exceed 0.2 in/sec PPV within 25 feet of construction. Impact pile driving would be anticipated to generate vibration levels as high as 0.25 in/sec PPV at a distance of 100 feet and "typical" levels of 0.14 in/sec PPV. Vibration levels from "upper range" impact pile driving may exceed the 0.2 in/sec PPV threshold at structures of normal construction located within 125 feet, with "typical" pile driving levels exceeding the 0.2 in/sec PPV threshold within 75 feet. Vibration levels during all other construction activities would be below the 0.2 in/sec PPV threshold at all structures of normal construction surrounding the project site, with the exception of the residences located within 25 feet of the western property line.

The US Bureau of Mines has analyzed the effects of blast-induced vibration on buildings in USBM RI 8507[3], and these findings have been applied to vibrations emanating from construction equipment on buildings[4]. Figure 3 presents the damage probability as reported in USBM RI 8507 and reproduced by Dowding assuming maximum vibration levels of 3.2, 1.8, and 0.69 in/sec PPV. As shown on Figure 3, these studies indicate an approximate 60% probability of "threshold damage" (referred to as cosmetic damage elsewhere in this report) and 20% probability of "minor damage", and a 10% probability of "major damage" at vibration levels of 3.2 in/sec PPV or less. At vibration levels of 1.8 in/sec PPV or less studies indicate an approximate 35% probability of "threshold damage" and 4% probability of "minor damage", with no observations of "major damage". At vibration levels of 0.69 in/sec PPV or less studies indicate an approximate 9% probability of "threshold damage" with no observations of "minor damage" or "major damage". Based on these data, cosmetic or threshold damage would be manifested in the form of hairline cracking in plaster, the opening of old cracks, the loosening of paint or the dislodging of loose objects. Minor damage (e.g., hairline cracking in masonry or the loosening of plaster) could occur assuming a maximum vibration level of 1.2 in/sec PPV or higher (within about 25 feet of "upper range" impact pile driving). Major structural damage (e.g., wide cracking or shifting of foundation or bearing walls) to adjacent structures would not be anticipated to occur for pile driving located at distance of 15 feet or more from structures.

3 Siskind, D.E., M.S. Stagg, J.W. Kopp, and C.H. Dowding, Structure Response and Damage Produced by Ground Vibration form Surface Mine Blasting, RI 8507, Bureau of Mines Report of Investigations, U.S. Department of the Interior Bureau of Mines, Washington, D.C., 1980.

4 Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996.

FIGURE 3 Probability of Cracking and Fatigue from Repetitive Loading



Source: Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996 as modified by Illingworth & Rodkin, Inc., June 2018.

The use of impact pile driving could exceed 0.08 in/sec at historic structures within 300 feet and could exceed 0.2 in/sec at conventional structures within 125 feet. Other heavy vibration generating construction equipment could exceed 0.08 in/sec PPV when located within 60 feet of historic structures and 0.2 in/sec PPV when located within 25 feet of conventional structures. Construction of the project could generate vibration levels exceeding the General Plan thresholds at historic structures, including 463, 499 and 501 South Market Street and 439 and 455 South First Street, and conventional structures, including residences to the west and south, commercial buildings to the east, and the McEnry Convention Center. Such vibration levels could be capable of cosmetically damaging these buildings. For impact pile driving located within 25 feet of structures, "minor damage" to structures is also possible. This is a **potentially significant** impact.

In surrounding areas where vibration would not be expected to cause structural damage, vibration levels may still be perceptible. However, as with any type of construction, this would be anticipated and would not be considered significant, given the intermittent and short duration of the phases that have the highest potential of producing vibration (use of jackhammers and other high-power tools). By use of administrative controls, such as notifying neighbors of scheduled construction activities and scheduling construction activities with the highest potential to produce perceptible vibration during hours with the least potential to affect nearby businesses, perceptible vibration can be kept to a minimum.

Mitigation Measure 2: The following measures, in addition to the best construction practices specified in Mitigation Measure 2, are recommended to reduce vibration impacts from construction activities:

- Avoid impact pile driving where possible. Drilled piers or rammed aggregate piers cause lower vibration levels where geological conditions permit their use.

- Where possible, use of the heavy vibration-generating construction equipment shall be prohibited within 25 feet of any adjacent building.

- Phase demolition, earth-moving, and ground impacting operations so as not to occur during the same time period.

- A list of all heavy construction equipment to be used for this project and the anticipated time duration of using the equipment that is known to produce high vibration levels (clam shovel drops, vibratory rollers, hoe rams, large bulldozers, caisson drillings, loaded trucks, jackhammers, etc.) shall be submitted 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 required for continuous vibration monitoring.

- A construction vibration monitoring plan shall be implemented to document conditions at all structures located within 125 feet of construction and at historic structures located within 300 feet of construction prior to, during, and after vibration generating construction activities. All plan tasks shall be undertaken under the direction of a licensed Professional Structural Engineer in the State of California and be in accordance with industry-accepted standard methods. The construction vibration monitoring plan should be implemented to include the following tasks:

- Identification of the sensitivity of nearby structures to groundborne vibration. Vibration limits should be applied to all historic and/or vibration-sensitive structures located within 300 feet of any pile driving activities and 75 feet of other construction activities identified as sources of high vibration levels.

- Performance of a photo survey, elevation survey, and crack monitoring survey for each structure of normal construction within 125 feet of pile driving activities and/or within 25 feet of other construction activities identified as sources of high vibration levels and each historic structure within 300 feet of pile driving activities and/or within 75 feet of other construction activities. Surveys shall be performed prior to any construction activity, in regular interval during construction, and after project completion, and shall include internal and external crack monitoring in structures, settlement, and distress, and shall document the condition of foundations, walls and other structural elements in the interior and exterior of said structures.

- Development of a vibration monitoring and construction contingency plan to identify structures where monitoring would be conducted, set up a vibration monitoring schedule, define structure-specific vibration limits, and address the need to conduct photo, elevation, and crack surveys to document before and after construction conditions. Construction contingencies would be identified for when vibration levels approached the limits.

- At a minimum, vibration monitoring should be conducted during pavement demolition, excavation, and pile driving activities. Monitoring results may indicate the need for more or less intensive measurements.

- If vibration levels approach limits, suspend construction and implement contingencies to either lower vibration levels or secure the affected structures.

- Designate a person responsible for registering and investigating claims of excessive vibration. The contact information of such person shall be clearly posted on the construction site.

- Conduct post-survey on structures where either monitoring has indicated high levels or complaints of damage has been made. Make appropriate repairs or compensation where damage has occurred as a result of construction activities.

- The results of all vibration monitoring shall be summarized and submitted in a report shortly after substantial completion of each phase identified in the project schedule. The report will include a description of measurement methods, equipment used, calibration certificates, and graphics as required to clearly identify vibration-monitoring locations. An explanation of all events that exceeded vibration limits will be included together with proper documentation supporting any such claims.

The implementation of these mitigation measures would reduce the impact to a **less-than-significant** level.

Impact 3: **Permanent Noise Increases.** The project would not result in a substantial permanent traffic noise level increase at existing noise-sensitive land uses in the project vicinity. **This is a less-than-significant impact**.

A significant permanent noise increase would be identified if traffic 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 DNL or greater, with a future noise level of less than 60 dBA DNL, or b) the noise level increase is 3 dBA DNL or greater, with a future noise level of 60 dBA DNL or greater.

To determine the effect of the project-generated traffic on the nearby residences, AM and PM peak hour traffic volumes for the Existing + Project condition were compared to Existing traffic volumes. Based on these calculations, project traffic volumes[5] would result in traffic noise increases of less than 1 dBA L_{eq} along the roadway network. Day-night average (DNL) noise level increases would be anticipated to be similar. This increase would not typically be noticeable and would be below the 3 dBA and 5 dBA DNL thresholds of significance. This is a **less-than-significant** impact.

Mitigation Measure 3: None required.

Impact 4: **Construction Noise.** Existing noise-sensitive land uses are anticipated to be exposed to construction noise levels in excess of the significance thresholds for a period of more than one year. **This is a potentially significant impact**.

As described in Impact 1, construction would be conducted in accordance with the City of San Jose's Municipal Code, which limits construction to within specified daytime hours. With the implementation of Mitigation Measure 1a, the project would also be in compliance with Policy EC-1.7 of the General Plan.

Neither the City of San Jose 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 (see Setting Section, Effects of Noise). 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 and 70 dBA L_{eq} at commercial 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 or exceeded 70 dBA L_{eq} at nearby commercial land uses and exceeded the ambient noise environment by 5 dBA L_{eq} or more for a period longer than one year.

Project construction is proposed from March 2019 through February 2021. Impact pile driving, which produces substantial noise levels, is anticipated to occur during grading and excavation of

[5] Trip generation volumes for 477 South Market Street provided on October 29, 2018.

the site. 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 immediately adjoining noise-sensitive land uses, or when construction lasts over extended periods of time.

The commercial receptors to the east and south of the project site have existing daytime ambient noise levels in the range of 66 to 72 dBA L_{eq} (see LT-1). Residences to the west have existing ambient noise levels of up to 63 dBA L_{eq} (see ST-3).

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 7 and 8. Table 7 shows the average noise level ranges, by construction phase, and Table 8 shows the maximum noise level ranges for different construction equipment. Most demolition and construction noise falls with the range of 80 to 90 dBA at a distance of 50 feet from the source.

TABLE 7 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 8 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
Bar Bender	80	Continuous
Boring Jack Power Unit	80	Continuous
Chain Saw	85	Continuous
Compressor[3]	70	Continuous
Compressor (other)	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
Insitu Soil Sampling Rig	84	Continuous
Jackhammer	85	Impact
Mounted Impact Hammer (hoe ram)	90	Impact
Paver	85	Continuous
Pneumatic Tools	85	Continuous
Pumps	77	Continuous
Rock Drill	85	Continuous
Scraper	85	Continuous
Slurry Trenching Machine	82	Continuous
Soil Mix Drill Rig	80	Continuous
Street Sweeper	80	Continuous
Tractor	84	Continuous
Truck (dump, delivery)	84	Continuous
Vacuum Excavator Truck (vac-truck)	85	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 Portable Air Compressor rated at 75 cfm or greater and that operates at greater than 50 psi.

Source: Mitigation of Nighttime Construction Noise, Vibrations and Other Nuisances, National Cooperative Highway Research Program, 1999.

Construction activities generate considerable amounts of noise, especially during pile driving and earth-moving activities when heavy equipment is used. The construction of the proposed project would involve demolition of existing structures and pavement, site preparation, grading and excavation, trenching, building erection, and paving. The hauling of excavated materials and construction materials would generate truck trips on local roadways as well.

Table 9 shows the anticipated construction noise levels during each phase of construction calculated using the Federal Highway Administration's (FHWA) Roadway Construction Noise Model (RCNM), based on the provided construction equipment list. 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 reference distance of 50 feet. Levels calculated in RCNM represent an upper bound of possible construction noise. Construction noise levels assuming best management practices would range 5 to 10 dBA below these upper bound levels.

Hourly average noise levels due to construction activities during busy construction periods would typically range from 74 to 85 dBA L_{eq} for non-pile driving activities. Pile driving noise typically generate up to 105 dBA L_{eq} at a distance of 50 feet. Maximum instantaneous noise levels generated by project construction equipment without pile driving are calculated to range from 78 to 90 dBA L_{max}. Construction-generated noise levels drop off at a rate of about 6 dBA per doubling of the distance between the source and receptor.

TABLE 9 Calculated Construction Noise Levels for Each Phase of Construction

Construction Phase	At Distance of 50 ft.	
	L_{eq}, dBA	**L_{max}, dBA**
Demolition (15 days)	85	90
Site Preparation (35 days)	85	84
Pile Driving	105	105
Grading/Excavation (20 days)	82	85
Trenching (51 days)	81	84
Building-Exterior (246 days)	76	81
Building-Interior (97 days)	74	78
Paving (25 days)	77	83

Noise sensitive uses surrounding the site include residential buildings, located 10 feet to the west, and commercial buildings, located 40 feet to the south and 100 feet to the east. The residential building to the west would be exposed to a maximum noise level of 102 dBA L_{max} during demolition phase and maximum noise levels of 90 to 97 dBA L_{max} during other phases of construction. Typical hourly average noise levels of 97 dBA L_{eq} during demolition and site preparation and 86 to 94 dBA L_{eq} during other phases of construction are anticipated. At 40 feet from the project site, hourly average noise levels due to construction would be 76 to 87 dBA L_{eq}.

Noise levels would exceed 60 dBA L_{eq} at residences and 70 dBA L_{eq} at commercial uses and ambient levels by more than 5 dBA for over one year. This is a **potentially significant** impact.

Mitigation Measure 4: Implementation of *Best construction Management Practices* discussed in Mitigation Measure 1a would reduce the temporary increase in noise due to construction to a **less-than-significant** impact.