CITY PARKING GARAGE
NOISE AND VIBRATION ASSESSMENT

San José, California

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INTRODUCTION

The project proposes the construction of a 1,200 space multi-level parking garage on an approximately 2.3-acre site north of St. John Street between North Montgomery Street on the west and North Autumn Street (Barack Obama Boulevard) on the east in the City of San José, California. This project site falls within the Diridon Station Area Plan. This project would replace existing parking that either has been or will soon be removed as a result of new development in the project area. The project site includes 10 parcels and would require the demolition of four main structures, approximately two garages and sheds, and associated pavement. The design of the proposed garage would include one level of below-grade parking and five stories of above grade parking.

This report is divided into four sections: 1) the Setting Section provides a brief description of the fundamentals of environmental noise and groundborne vibration, summarizes applicable construction noise and vibration regulatory criteria, and discusses the ambient noise environment at the project site and the surrounding area; 2) the Construction Noise Section estimates construction noise levels expected at the surrounding noise-sensitive receptors, provides a discussion of the construction noise impact, and presents mitigation measures to reduce construction noise to a less-than-significant level; 3) the Construction Vibration Section estimates worst-case vibration levels at sensitive structures surrounding the site, provides a discussion of the construction vibration impact, and presents mitigation measures to reduce construction vibration to a less-than-significant level; and 4) the Operational Noise Section discusses noise sources generated by the proposed project, assesses the project's potential noise impact on the existing noise-sensitive receptors in the project vicinity, and where necessary, presents mitigation measures to reduce operational noise to a less-than-significant level.

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 p.m. to 10:00 p.m.) and a 10 dB addition to nocturnal (10:00 p.m. to 7:00 a.m.) 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 to 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 to 62 dBA DNL with open windows and 65 to 70 dBA DNL if the windows are closed. Levels of 55 to 60 dBA are common along collector streets and secondary arterials, while 65 to 70 dBA is a typical value for a primary/major arterial. Levels of 75 to 80 dBA are normal noise levels at the first row of development outside a freeway right-of-way. In order to achieve an acceptable interior noise environment, bedrooms facing secondary roadways need to be able to have their windows closed, those facing major roadways and freeways typically need special glass windows.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The 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 to 30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a DNL of 60 to 70 dBA. Between a DNL of 70 to 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 to 35 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 3 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 4 percent increase in the percentage of the population highly annoyed.

TABLE 1 Definition of Acoustical Terms Used in this Report

Term	Definition
Decibel, dB	A unit describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20 micro Pascals.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e. g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn} or DNL	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 pm and 7:00 am.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels measured in the night between 10:00 pm and 7:00 am.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Source: Handbook of Acoustical Measurements and Noise Control, Harris, 1998.

TABLE 2 Typical Noise Levels in the Environment

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

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

Fundamentals of Groundborne Vibration

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

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

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

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

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

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

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

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

Regulatory Background

This section describes the relevant guidelines, policies, and standards for construction noise and vibration activities and noise generated by new nonresidential land use activities in the City of San José.

City of San José General Plan policies relevant to the proposed project include the following:

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.

EC-2.3 Require new development to minimize continuous vibration impacts to adjacent uses during demolition and construction. For sensitive historic structures, including ruins and ancient monuments or building that are documented to be structurally weakened, a continuous vibration limit of 0.08 in/sec PPV (peak particle velocity) will be used to minimize the potential for cosmetic damage to a building. A continuous vibration limit of 0.20 in/sec PPV will be used to minimize the potential for cosmetic damage at buildings of normal conventional construction. Equipment or activities typical of generating continuous vibration include but are not limited to: excavation equipment; static compaction equipment; vibratory pile drivers; pile-extraction equipment; and vibratory compaction equipment. Avoid use of impact pile drivers within 125 feet of any buildings, and within 300 feet of historical buildings, or buildings in poor condition. On a project-specific basis, this distance of 300 feet may be reduced where warranted by a technical study by a qualified professional that verifies that there will be virtually no risk of cosmetic damage to sensitive buildings from the new development during demolition and construction. Transient vibration impacts may exceed a vibration limit of 0.08 in/sec PPV only when and where warranted by a technical study by a qualified professional that verifies that there will be virtually no risk of cosmetic damage to sensitive buildings from the new development during demolition and construction.

To reduce and avoid construction-related vibration impacts, *Downtown San José Strategy Plan 2040 EIR* and the *Diridon Station Area Plan Draft EIR* requires additional vibration- control measures to be implemented. For all projects that could generate vibration levels exceeding the thresholds for Categories 3, 4, and 5, which include historic and fragile buildings, implement all of the applicable controls outlined below. For projects impacting receptors in Categories 6 and 7 that do not involve impact or vibratory pile driving, the following best available controls shall be implemented:

- A list of all heavy construction equipment to be used for this project known to produce high vibration levels (e.g., tracked vehicles, vibratory compaction, jackhammers, hoe rams, clam shovel drop, and vibratory roller, etc.) shall be submitted to the City by the contractor. This list shall be used to identify equipment and activities that would potentially generate substantial vibration and to define the level of effort for reducing vibration levels below the thresholds;

- Place operating equipment on the construction site as far as possible from vibration-sensitive receptors;

- Use smaller equipment to minimize vibration levels below the limits;

- Avoid using vibratory rollers and clam shovel drops near sensitive areas;

- Select demolition methods not involving impact tools;

- Modify/design or identify alternative construction methods to reduce vibration levels below the limits;
- Avoid dropping heavy objects or materials.

For projects impacting receptors in Categories 6 and 7 where pile driving will occur, in addition to the controls above, implement the following best available controls:

- Notify neighbors within 500 feet of the construction site of the construction schedule and that there could be noticeable vibration levels resulting from pile driving;

- Foundation pile holes shall be pre-drilled to minimize the number of impacts required to seat the pile;

- Jet or partially jet piles into place to minimize the number of impacts required to seat the pile;

- A construction vibration monitoring plan shall be implemented to document conditions prior to, during, and after pile driving. All plan tasks shall be undertaken under the direction of a licensed Professional Structural Engineer in the State of California (and a Historic Architect if the affected structures are historic resources) and be in accordance with industry-accepted standard methods. The construction vibration monitoring plan should be implemented to include the following tasks:

    - Identification of sensitivity to groundborne vibration of nearby structures. A vibration survey (generally described below) would need to be performed;

- Performance of a pre-construction photo survey, elevation survey, and crack monitoring survey for each of these structures. Surveys shall be performed prior to any pile driving activity, in regular interval during pile driving, and after 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 pile driving. Alternative construction methods would be identified for when vibration levels approach the limits that are stated in the 2040 General Plan such as Policy EC-2.3;

- If vibration levels approach limits, suspend construction and implement alternative construction methods to either lower vibration levels or secure the affected structures;

- Conduct post-construction 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 to the City's Supervising Environmental Planner assigned by the City to the project review, 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;

- 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.

CONSTRUCTION NOISE ASSESSMENT

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.

Policy EC-1.7 of the City's General Plan requires that all construction operations within the City to use best available noise suppression devices and techniques and to limit construction hours near residential uses per the Municipal Code allowable hours, which are between the hours of 7:00 a.m. and 7:00 p.m. Monday through Friday when construction occurs within 500 feet of a residential land use. Further, the City considers significant construction noise impacts to occur if a project that is 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.

Project Construction

Project construction would require the excavation of approximately 51,000 cubic yards of soil. A truck haul route for the removal of the soil would be determined during final design; however, it is anticipated that haul routes would be restricted to major streets and highways in the project area, to the extent possible, to reduce the potential that residential streets and neighborhoods would be adversely affected.

Project construction will occur from 7:00 a.m. to 4:00 p.m. While no construction is expected to occur during nighttime hours, a permit from the City would be required to operate outside the allowable hours since the project site is located within 500 feet of residences and within 200 feet of commercial or office uses.

Construction Noise

Existing residences adjoin the site to the north of the site, as well as northwest of the site, opposite North Autumn Street. Commercial and light industrial uses are located to the east, opposite North Autumn Street. To the west, across the existing surface parking lot of the SAP Center and railroad tracks, is a multi-family residential building and other commercial and light industrial uses. Based on the existing noise contours from the *Downtown San José Strategy Plan 2040 EIR*, which are shown in Figure 1, ambient noise levels would range from 60 to 65 dBA DNL. Assuming peak hourly average noise levels would be within 1 to 2 dBA of the day-night average noise level, this range in noise levels would represent the existing ambient environment during daytime hours.

Construction activities generate considerable amounts of noise, especially during earth-moving activities when heavy equipment is used. The construction of the proposed project would involve demolition of the existing structures located at the site, excavation, trenching, and building construction. The hauling of excavated materials and construction materials would generate truck trips on local roadways, as well. For the proposed project, pile driving, which generates excessive noise levels, is not expected.

Construction activities for individual projects are typically carried out in phases. During each phase of construction, there would be a different mix of equipment operating, and noise levels would vary by phase and vary within phases, based on the amount of equipment in operation and the location at which the equipment is operating. The typical range of maximum instantaneous noise levels for the proposed project would be 70 to 90 dBA L_{max} at a distance of 50 feet (see Table 4) from the equipment. Table 5 shows the hourly average noise level ranges, by construction phase, typical for various types of projects. Hourly average noise levels generated by construction are about 71 to 89 dBA L_{eq} for a parking garage, measured at a distance of 50 feet from the center of a busy construction site. Construction-generated noise levels drop off at a rate of about 6 dBA per doubling of the distance between the source and receptor. Shielding by buildings or terrain often result in lower construction noise levels at distant receptors.

FIGURE 1 Existing Traffic Noise Contours from the San Jose Downtown Strategy Plan Area with the Project Site Identified

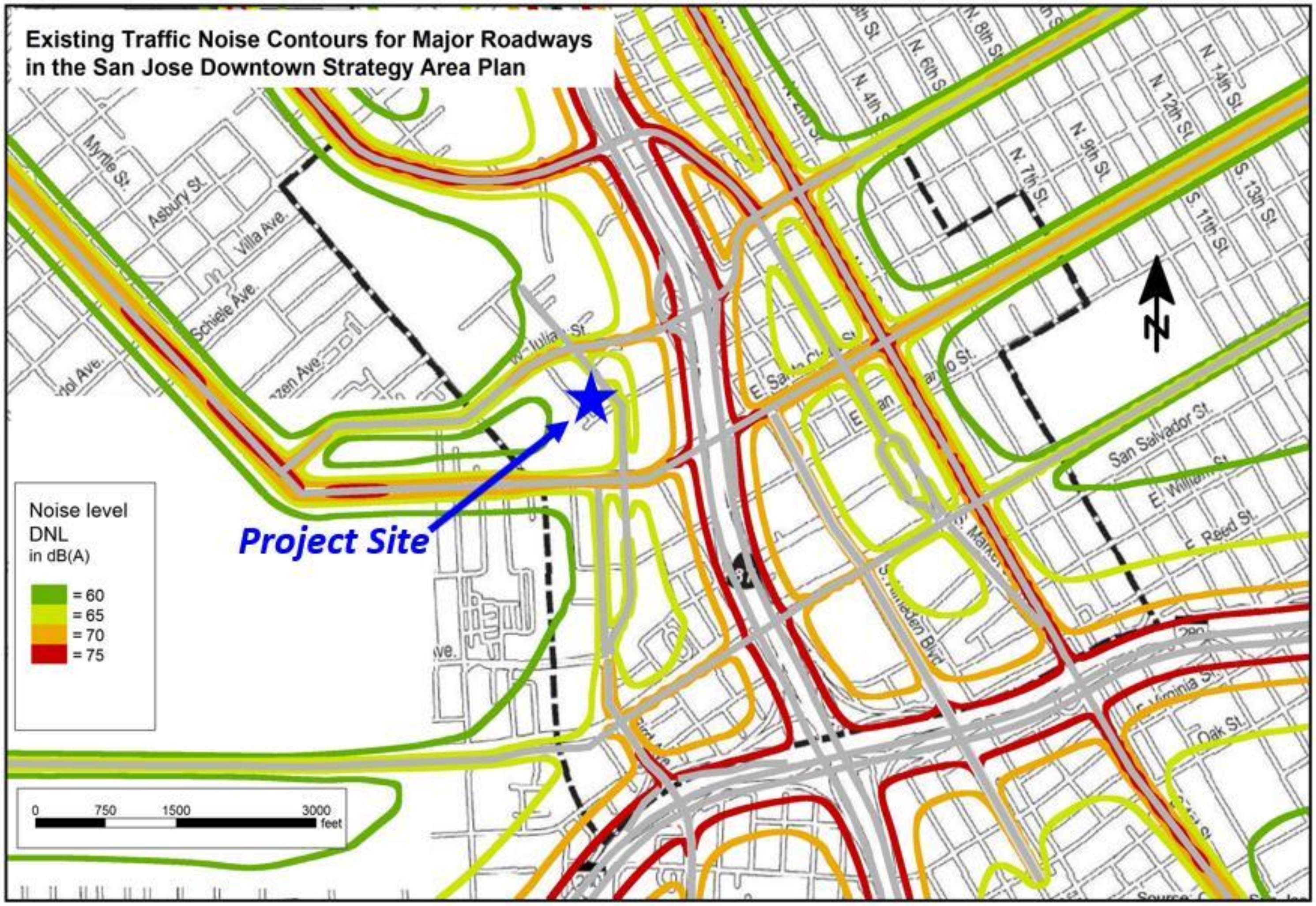

TABLE 4 Construction Equipment 50-Foot Noise Emission Limits

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.

TABLE 5 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.

A detailed list of equipment expected to be used during each phase of construction was provided for this analysis and is summarized in Table 6. Federal Highway Administration's (FHWA's) Roadway Construction Noise Model (RCNM) was used to calculate the hourly average noise levels for each phase of construction, assuming every piece of equipment would operate simultaneously, which would represent the worst-case scenario. This construction noise model includes representative sound levels for the most common types of construction equipment and the approximate usage factors of such equipment that were developed based on an extensive database of information gathered during the construction of the Central Artery/Tunnel Project in Boston, Massachusetts (CA/T Project or "Big Dig"). The usage factors represent the percentage of time that the equipment would be operating at full power.

For each phase, the worst-case hourly average noise levels were estimated at the property line of each surrounding land use. Multiple pieces of equipment used simultaneously would add together creating a collective noise source. While every piece of equipment per phase would likely be scattered throughout the site, the noise-sensitive receptors surrounding the site would be subject to the collective noise source generated by all equipment operating at once. Therefore, to assess construction noise impacts at the receiving property lines of existing noise-sensitive receptors, the collective worst-case hourly average noise level for each phase was positioned at the geometrical center of the site and propagated to the nearest property line of the surrounding land uses. These noise level estimates are also shown in Table 6. Noise levels in Table 6 do not assume reductions due to intervening buildings or existing barriers.

TABLE 6 Estimated Construction Noise Levels at Nearby Land Uses

Phase of Construction	Time Duration	Construction Equipment (Quantity)	Calculated Hourly Average Noise Levels, L_{eq} (dBA) Ambient Noise Levels = 60-65 dBA L_{eq}							
			North Res. (225ft)		NW Res. (240ft)		East Comm. & Ind. (200ft)		West Res., Comm. & Ind. (740ft)	
			L_{eq}, dBA	Exceeds Amb. by 5+ dBA?	L_{eq}, dBA	Exceeds Amb. by 5+ dBA?	L_{eq}, dBA	Exceeds Amb. by 5+ dBA?	L_{eq}, dBA	Exceeds Amb. by 5+ dBA?
Demolition	15 days	Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (1)	69	No	68	No	70	Yes	59	No
Site Preparation	7 days	Grader (1) Rubber-Tired Dozer (1) Tractor/Loader/Backhoe (2) Off-Highway Truck (1)	73	Yes	73	Yes	74	Yes	63	No
Grading/ Excavation	60 days	Excavator (2) Grader (1) Tractor/Loader/Backhoe (2) Off-Highway Truck (13)	75	Yes	75	Yes	76	Yes	65	No
Trenching/ Foundation	100 days	Tractor/Loader/Backhoe (2)	70	Yes	69	No	71	Yes	60	No
Building – Exterior	180 days	Crawler Tractor (2) Forklift (4) Generator Set (1) Tractor/Loader/Backhoe (1) Welder (1) Air Compressor (1)	73	Yes	73	Yes	74	Yes	63	No
Building – Interior/ Architectural Coating	120 days	Air Compressor (1) Aerial Lift (2)	61	No	60	No	62	No	50	No
Paving	30 days	Paver (1) Paving Equipment (1) Roller (1) Tractor/Loader/Backhoe (1)	72	Yes	72	Yes	73	Yes	62	No

As shown in Table 6, ambient levels at the surrounding uses would potentially be exceeded by 5 dBA L_{eq} or more at various times throughout construction. Project construction is expected to last for a period of approximately 16 months. Since project construction would last for a period of more than one year and considering that the project site is within 500 feet of existing residential uses and within 200 feet of existing commercial uses, this temporary construction impact would be considered significant in accordance with Policy EC-1.7 of the City's General Plan.

The proposed project falls within the *Downtown San José Strategy Plan 2040 EIR* and the *Diridon Station Area Plan Draft EIR* plan areas, which included mitigation measures to reduce temporary construction noise levels at noise-sensitive receptors. The *Downtown San José Strategy Plan 2040 EIR* and the *Diridon Station Area Plan Draft EIR* would enforce Policy EC-1.7 of the City's General Plan, which states the following:

> Construction operations within the City will be required to use available noise suppression devices and techniques and continue to 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.

Additionally, the City requires that reasonable noise reduction measures be incorporated into the construction plan and implemented during all phases of construction activity. Accordingly, the *Downtown San José Strategy Plan 2040 EIR* and the *Diridon Station Area Plan Draft EIR* requires that all projects shall implement the following standard noise control measures:

- Construction will be limited to the hours of 7:00 a.m. to 7:00 p.m. Monday through Friday for any on-site or off-site work within 500 feet of any residential unit. Construction outside of these hours may be approved through a development permit based on a site-specific "construction noise mitigation plan" and a finding by the Director of Planning, Building and Code Enforcement that the construction noise mitigation plan is adequate to prevent noise disturbance of affected residential uses.

- The contractor shall use "new technology" power construction equipment with state-of-the-art noise shielding and muffling devices. All internal combustion engines used on the project site shall be equipped with adequate mufflers and shall be in good mechanical condition to minimize noise created by faulty or poorly maintained engines or other components.

- The unnecessary idling of internal combustion engines shall be prohibited. Staging areas and stationary noise-generating equipment shall be located as far as possible from noise-sensitive receptors such as residential uses (a minimum of 200 feet, where feasible).

- Staging areas and stationary noise-generating equipment shall be located as far as possible from noise-sensitive receptors such as residential uses (a minimum of 200 feet, where feasible).

- The surrounding neighborhood within 500 feet shall be notified early and frequently of the construction activities.

- A "noise disturbance coordinator" shall be designated to respond to any local complaints about construction noise. The disturbance coordinator would determine the cause of the noise complaints (e.g., beginning work too early, bad muffler, etc.) and institute reasonable measures warranted to correct the problem. A telephone number for the disturbance coordinator would be conspicuously posted at the construction site.

Adherence to the Municipal Code requirements would minimize impacts to neighboring properties from temporary increases in ambient noise levels resulting from future construction activities. Larger projects within the *Downtown San José Strategy Plan 2040 EIR* and the *Diridon Station Area Plan Draft EIR* plan areas that are expected to last over one year in duration, such as the proposed project, may result in a substantial temporary noise increase at adjacent land uses and would require a "construction noise logistics plan," in accordance with GP Policy EC-1.7. As stated in the *Downtown San José Strategy Plan 2040 EIR* and the *Diridon Station Area Plan Draft EIR*, typical construction noise logistics plan would include, but not be limited to, the following measures to reduce construction noise levels as low as practical:

- Utilize 'quiet' models of air compressors and other stationary noise sources where technology exists;

- Equip all internal combustion engine-driven equipment with mufflers, which are in good condition and appropriate for the equipment;

- Locate all stationary noise-generating equipment, such as air compressors and portable power generators, as far away as possible from adjacent land uses;

- Locate staging areas and construction material areas as far away as possible from adjacent land uses;

- Prohibit all unnecessary idling of internal combustion engines;

- If impact driving is proposed, multiple-pile drivers shall be considered to expedite construction. Although noise levels generated by multiple pile drivers would be higher than the noise generated by a single pile driver, the total duration of pile driving activities would be reduced; *(not applicable)*

- If impact pile driving is proposed, temporary noise control blanket barriers shall shroud pile drivers or be erected in a manner to shield the adjacent land uses. Such noise control blanket barriers can be rented and quickly erected; *(not applicable)*

- If impact pile driving is proposed, foundation pile holes shall be pre-drilled to minimize the number of impacts required to seat the pile   Pre-drilling foundation pile holes is a standard construction noise control technique. Pre-drilling reduces the number of blows required to seat the pile. Notify all adjacent land uses of the construction schedule in writing; *(not applicable)*

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

With the implementation of GP Policy EC-1.7, Municipal Code requirements, and the above measures included in the *Downtown San José Strategy Plan 2040 EIR* and the *Diridon Station Area Plan Draft EIR*, the temporary construction noise impact would be reduced to a less-than-significant level.

CONSTRUCTION VIBRATION ASSESSMENT

The construction of the project may generate perceptible vibration when heavy equipment or impact tools (e.g., jackhammers, hoe rams) are used. Construction activities would include demolition, site preparation work, foundation work, and new building framing and finishing. Pile driving equipment, which can cause excessive vibration, is not expected to be required for the proposed project.

According to the City's Historic Resource Inventory,[1] several residential buildings to the north, as well as the industrial building to the east, opposite North Autumn Street, would be considered historical structures, as shown in Figure 2. Note, the Queen Anne and Vernicular structures located along North Autumn Street in Figure 2 have been removed from the site. Additionally, one building listed on the historic inventory would be relocated as part of the project, and is not considered to be a sensitive receptor in this analysis. The nearest historical buildings would be the

[1] www.sanjoseca.gov/your-government/departments/planning-building-code-enforcement/planning-division/historic-preservation/historic-resources-inventory

Queen Anne buildings adjacent to the northern boundary of the project site (approximately 10 feet north of the boundary) and the industrial building located approximately 55 feet east of the site.

FIGURE 2 Nearby Historical Buildings Surrounding the Project Site

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 0.20 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. As discussed in detail below, vibration levels exceeding these thresholds would be capable of cosmetically damaging adjacent buildings. 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.

Table 7 presents typical vibration levels that could be expected from construction equipment at a distance of 25 feet. Project construction activities, such as drilling, the use of jackhammers, rock drills and other high-power or vibratory tools, and rolling stock equipment (tracked vehicles, compactors, etc.), may generate substantial vibration in the immediate vicinity. Jackhammers typically generate vibration levels of 0.035 in/sec PPV, and drilling typically generates vibration levels of 0.09 in/sec PPV at a distance of 25 feet.

Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Table 7 also summarizes the distances to the 0.08 in/sec PPV threshold for historical buildings and to the 0.2 in/sec PPV threshold for all other buildings.

TABLE 7 Vibration Source Levels for Construction Equipment

<table>
<tr><th colspan="2">Equipment</th><th>PPV at 25 ft. (in/sec)</th><th>Minimum Distance to Meet 0.08 in/sec PPV (feet)</th><th>Minimum Distance to Meet 0.2 in/sec PPV (feet)</th></tr>
<tr><td colspan="2">Clam shovel drop</td><td>0.202</td><td>59</td><td>26</td></tr>
<tr><td rowspan="2">Hydromill (slurry wall)</td><td>in soil</td><td>0.008</td><td>4</td><td>2</td></tr>
<tr><td>in rock</td><td>0.017</td><td>7</td><td>3</td></tr>
<tr><td colspan="2">Vibratory Roller</td><td>0.210</td><td>61</td><td>27</td></tr>
<tr><td colspan="2">Hoe Ram</td><td>0.089</td><td>28</td><td>13</td></tr>
<tr><td colspan="2">Large bulldozer</td><td>0.089</td><td>28</td><td>13</td></tr>
<tr><td colspan="2">Caisson drilling</td><td>0.089</td><td>28</td><td>13</td></tr>
<tr><td colspan="2">Loaded trucks</td><td>0.076</td><td>24</td><td>11</td></tr>
<tr><td colspan="2">Jackhammer</td><td>0.035</td><td>12</td><td>6</td></tr>
<tr><td colspan="2">Small bulldozer</td><td>0.003</td><td>2</td><td><1</td></tr>
</table>

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, as modified by Illingworth & Rodkin, Inc., November 2021.

Table 8 summarizes the vibration levels at each of the surrounding buildings in the project vicinity. Vibration levels are highest close to the source and then attenuate with increasing distance at the rate $\left({D_{ref}}/{D}\right)^{1.1}$, where *D* is the distance from the source in feet and D_{ref} is the reference distance of 25 feet. While construction noise levels increase based on the cumulative equipment in use simultaneously, construction vibration levels would be dependent on the location of individual pieces of equipment. That is, equipment scattered throughout the site would not generate a collective vibration level, but a vibratory roller, for instance, operating near the project site boundary would generate the worst-case vibration levels for the receptor sharing that property line. Further, construction vibration impacts are assessed based on damage to buildings on receiving land uses, not receptors at the nearest property lines. Therefore, the distances used to propagate construction vibration levels (as shown in Table 8), which are different than the distances used to propagate construction noise levels (as shown in Table 6), were estimated under the assumption that each piece of equipment from Table 7 was operating along the nearest boundary of the project site, which would represent the worst-case scenario.

Project construction activities, such as drilling, the use of jackhammers, rock drills and other high-power or vibratory tools, and rolling stock equipment (tracked vehicles, compactors, etc.) may generate substantial vibration in the immediate vicinity of the historical buildings adjoining the project site to the north. As shown in Table 7, the 0.08 in/sec PPV threshold would potentially be exceeded within about 60 feet of the surrounding buildings, and due to the close proximity of the historical buildings to the north of the project site (about 10 feet), the use of most construction equipment along the shared property line would potentially exceed the City's 0.2 in/sec PPV threshold, as shown in Table 8. All historical buildings located more than 60 feet from the project site would not be subject to vibration levels exceeding 0.08 in/sec PPV. Likewise, all non-historical buildings in the project vicinity located more than 25 feet from the project site and would not be subject to vibration levels of 0.2 in/sec PPV or more.

A study completed by the US Bureau of Mines analyzed the effects of blast-induced vibration on buildings in USBM RI 8507.[2] The findings of this study have been applied to buildings affected by construction-generated vibrations.[3] As reported in USBM RI 8507[2] and reproduced by Dowding,[3] Figure 3 presents the damage probability, in terms of "threshold damage," "minor damage," and "major damage," at varying vibration levels. Threshold damage, which is described as cosmetic damage in this report, would entail hairline cracking in plaster, the opening of old cracks, the loosening of paint or the dislodging of loose objects. Minor damage would include hairline cracking in masonry or the loosening of plaster, and major structural damage would include wide cracking or shifting of foundation or bearing walls.

As shown in Figure 3, maximum vibration levels of 0.6 in/sec PPV would result in about 8% chance of threshold or cosmetic damage. No minor or major damage would be expected at the historical buildings immediately adjoining the project site.

Heavy vibration-generating construction equipment would have the potential to produce vibration levels of 0.08 in/sec PPV or more at historic buildings within 60 feet of the project site or 0.2 in/sec PPV or more at non-historical buildings within 25 feet of the project site.

Neither cosmetic, minor, or major damage would occur at historical or conventional buildings located 60 feet or more from the project site. At these locations, and in other surrounding areas where vibration would not be expected to cause cosmetic 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.

In summary, the construction of the project would generate vibration levels exceeding the General Plan threshold of 0.08 in/sec PPV at historic properties within 60 feet of the site or 0.2 in/sec PPV at non-historical properties within 25 feet of the site. This would be considered a significant impact.

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[2] 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.

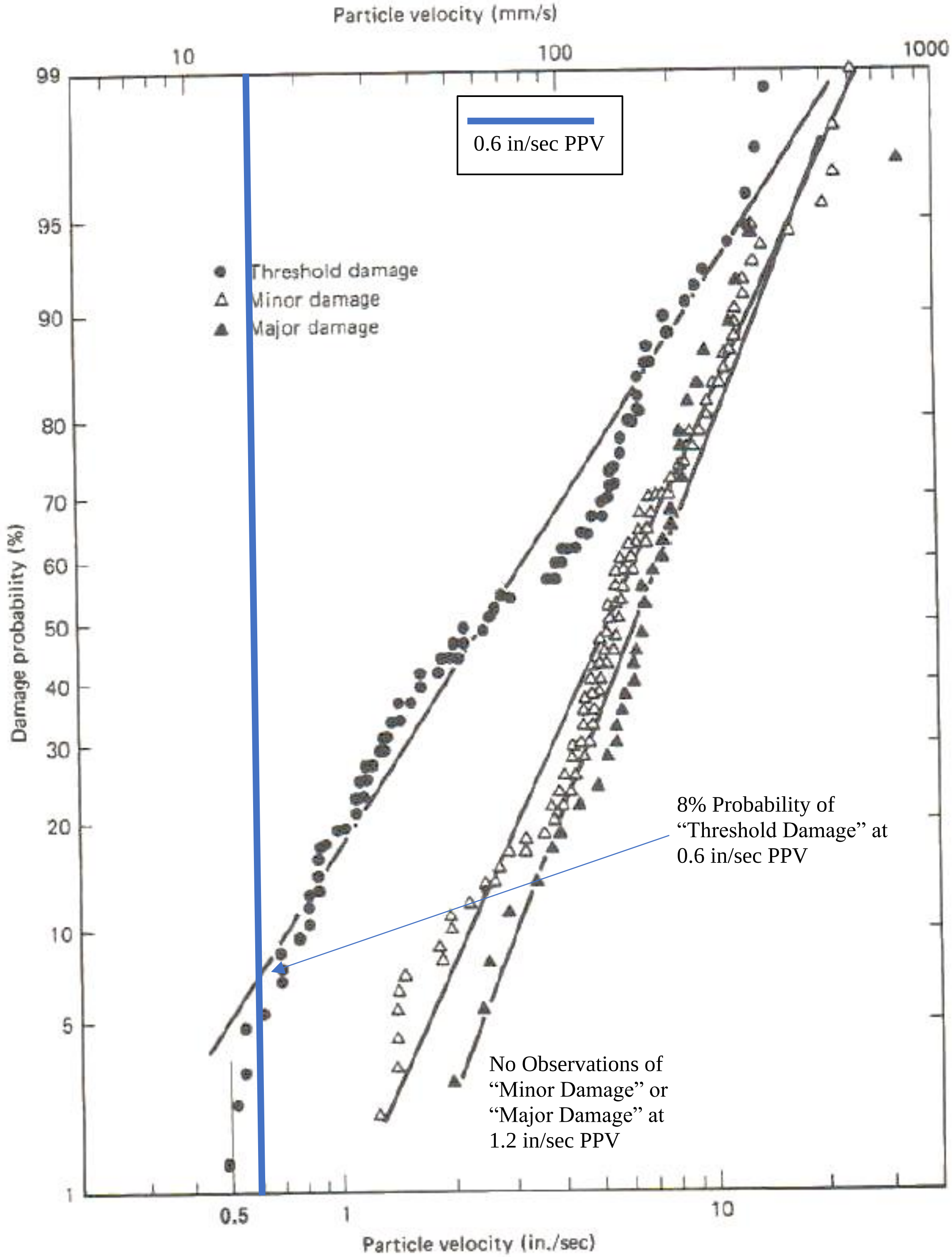
[3] Dowding, C.H., Construction Vibrations, Prentice Hall, Upper Saddle River, 1996.

TABLE 8 Vibration Source Levels for Construction Equipment

Equipment		PPV (in/sec)			
		North Historical & Non-Historical Residences (10ft)	East Historical Industrial Building (55ft)	East Non-Historical Industrial Building (80ft)	Non-Historical SAP Center (125ft)
Clam shovel drop		**0.553**	**0.085**	0.056	0.034
Hydromill (slurry wall)	in soil	0.022	0.003	0.002	0.001
	in rock	0.047	0.007	0.005	0.004
Vibratory Roller		**0.575**	**0.088**	0.058	0.036
Hoe Ram		**0.244**	0.037	0.025	0.015
Large bulldozer		**0.244**	0.037	0.025	0.015
Caisson drilling		**0.244**	0.037	0.025	0.015
Loaded trucks		**0.208**	0.032	0.021	0.013
Jackhammer		**0.096**	0.015	0.010	0.006
Small bulldozer		0.008	0.001	0.001	0.001

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, as modified by Illingworth & Rodkin, Inc., November 2021.

FIGURE 3 Probability of Cracking and Fatigue from Repetitive Loading



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

The project shall implement the following measures, in addition to the best practices specified in Construction Noise Assessment Section of this report, to minimize the impacts of groundborne vibration.

Construction Vibration Monitoring, Treatment, and Reporting Plan: The project proponent shall implement a construction vibration monitoring plan to document conditions 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 shall include, but not be limited to, the following measures:

- The report shall include a description of measurement methods, equipment used, calibration certificates, and graphics as required to clearly identify vibration-monitoring locations.

- 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 to the Director of Planning or Director's designee of the Department of Planning, Building and Code Enforcement 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. Phase demolition, earth-moving, and ground impacting operations so as not to occur during the same time period.

- Where possible, use of the heavy vibration-generating construction equipment shall be prohibited within 60 feet of any adjacent building.

- Document conditions at all historic structures located within 60 feet of construction and at all other buildings located within 25 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. Specifically:

    - Vibration limits shall be applied to vibration-sensitive structures located within 60 feet of any construction activities identified as sources of high vibration levels.

    - Performance of a photo survey, elevation survey, and crack monitoring survey for each historic structure within 60 feet of construction activities and all other buildings within 25 feet of construction activities. Surveys shall be performed prior to any construction activity, in regular intervals 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.

- Develop 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 shall be identified for when vibration levels approached the limits.

- At a minimum, vibration monitoring shall be conducted during demolition and excavation activities.

- If vibration levels approach limits, suspend construction and implement contingency measures 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 a post-construction survey on structures where either monitoring has indicated high vibration levels or complaints of damage has been made. Make appropriate repairs or compensation where damage has occurred as a result of construction activities. The survey will be submitted to the City of San José Department of Parks, Recreation, and Neighborhood Services.

Implementation of this mitigation measure would reduce the impact to a less-than-significant level.

OPERATIONAL NOISE ASSESSMENT

Mechanical Equipment

Under the City's Noise Element, noise levels generated by new nonresidential land uses shall not exceed a noise level of 55 dBA DNL at receiving noise-sensitive land uses. Noise-sensitive receptors surrounding the site would include existing residences to the north and to the east, as well as an existing multi-family building to the west, opposite the existing surface parking lot and train tracks. Policies EC-1.3 and EC-1.6 of the City's General Plan shall be enforced for the proposed project at these nearby residential land uses.

Additionally, the City's Municipal Code also has noise limits of 60 dBA for receiving commercial uses and 70 dBA for industrial uses, which are located east of the project site. While these thresholds are discussed here, exceeding these limits would not be considered a significant impact under CEQA.

While the site plan does not show the specific location of the emergency generator, a 200 kW generator would be located at the proposed parking structure. The applicant has indicated that the generator would be located away from the northern boundary on the interior of the garage. Assuming worst-case conditions, the most likely location would be on the ground-level in the southeastern corner of the garage.

A 200 kW emergency generator would typically produce noise levels of 89 dBA at 23 feet if a weather enclosure is included or noise levels that would range from 75 to 81 dBA at 23 feet if a Level 1 or Level 2 sound enclosure is included. During emergency situations, the noise produced by the operation of generators would be exempt from City noise restrictions; however, generators are typically tested for a period of one hour every month. During these testing periods, ambient noise levels would temporarily increase and would be required to meet the 55 dBA DNL threshold at nearby residential land uses. Assuming the emergency generator would run continuously during a one-hour period, the day-night average noise level at 23 feet would be 75 dBA DNL, assuming a weather enclosure, or would range from 61 to 67 dBA DNL with a Level 1 or Level 2 sound enclosure. With the location of the generator room being located on the interior of the building, the proposed parking structure would provide at least 10 dBA of shielding.

The nearest residential property line would be at least 320 feet north of the emergency generator, assuming the generator to be located along the southern façade of the structure. At this distance and assuming a conservative 10 dBA reduction, the day-night average noise level would be 42 dBA DNL with a weather enclosure or would range from 28 to 34 dBA DNL with a Level 1 or Level 2 sound enclosure. Therefore, testing the 200 kW emergency generator would not be expected to exceed the City's 55 dBA DNL threshold at the nearest residential property line.

The nearest industrial property line would be at least 75 feet from the emergency generator. At this distance and assuming a conservative 10 dBA reduction, the day-night average noise level would be 55 dBA DNL with a weather enclosure or would range from 41 to 47 dBA DNL with a Level 1 or Level 2 sound enclosure. Testing the 200 kW emergency generator would not be expected to exceed the City's 70 dBA DNL Municipal Code threshold at the nearest industrial property line.

Other mechanical equipment noise due to parking structures would include elevator noise, which would not be audible at off-site receptors, and ventilation noise, which would be caused by fan and exhaust noise. Details regarding specific equipment, location of equipment, and noise level information were not available at the time of this study. When operating at full speed, typical noise levels from fans could be up to 76 dBA at a distance of 5 feet and up to 65 dBA at 5 feet when operating at 35% speed. While it is not expected for the fans to be operating at full speed, these noise levels would represent the worst-case scenario. Assuming the fans cycle on and off continuously during a 24-hour period, the ventilation noise generated at the parking garage would be up to 82 dBA DNL at 5 feet under full speed and up to 71 dBA DNL at feet under 35% speed.

Assuming potential ventilation outlets would be located on the upper level of the garage each corner of the structure, the nearest residential property line would be at least 50 feet north of the nearest ventilation outlet. At this distance and assuming a conservative 10 dBA reduction due to the parking structure and elevation, the day-night average noise level would be 52 dBA DNL, which would be below the City's 55 dBA DNL threshold.

The nearest industrial property line would be at least 75 feet from the nearest ventilation outlet. At this distance and assuming a conservative 10 dBA reduction, the day-night average noise level would be 49 dBA DNL, which would not exceed the City's Municipal Code thresholds.

Based on the estimated noise levels for mechanical equipment noise generated by the proposed parking garage, neither the City's General Plan threshold of 55 dBA DNL at the existing residential land uses nor the City's Municipal Code threshold of 70 dBA DNL at existing industrial uses surrounding the project site is expected to be exceeded. This is a less-than-significant impact.

Parking Garage Noise

The proposed parking garage would be replacing an existing surface parking lot. While more parking spaces would be added to the site, the parking spaces would be distributed on multiple levels with the parking structure. While individual vehicles operating near the northern edge of the parking structure may be audible at times at the nearby receptors, the collective noise source would be distributed throughout each parking level and would be mostly shielded by the parking structure and the elevation of each level. Therefore, the overall noise generated within the parking garage would be included in the existing ambient noise environment and would not be expected to exceed the City's thresholds.

The number of vehicles accessing the parking structure from North Montgomery Street and North Autumn Street, however, would increase substantially with direct line-of-sight to the surrounding land uses. While a traffic study was not completed for this project, it is assumed that all 1,200 spaces of the parking structure would be used for a special event at the SAP Center. Assuming half the vehicles would access the parking structure from each roadway, any individual receptor surrounding the project site would be exposed to a maximum of 600 vehicles entering and exiting the parking structure within the same 24-hour period. Assuming the vehicles arrive over a two-hour period during daytime hours before the event and exit within the same hour after the event during nighttime hours, the nearest adjacent receptors, which would be located approximately 35 feet from the centerline of the driveway, would be exposed to day-night average noise levels of 51 dBA DNL. This would meet the City's threshold for residential land uses. All other receptors would be farther from the driveways and would be exposed to lower noise levels. The City's General Plan and Municipal Code thresholds would be met. This would be a less-than-significant impact.