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CONSTRUCTION NOISE AND VIBRATION

UPDATES TO THRESHOLDS AND METHODOLOGY

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INTRODUCTION

This document updates the construction noise and vibration thresholds to be used by the Department of City Planning in assessing the environmental impacts of projects in accordance with the California Environmental Quality Act (CEQA).[1] As discussed in more detail below, the thresholds are intended to be suited to the generally urban nature of the City, while still recognizing the importance of human health, including sleep disruption. The thresholds are intended to account for reasonable expectations regarding construction noise and vibration during daytime and nighttime hours, and also include absolute maximum noise levels that are intended to protect human health. These thresholds have been established based on input from Technical Advisory Committee noise experts, as well as a review of noise thresholds used by other state and local agencies.

[1] Other City Departments may utilize these thresholds or their own thresholds as they deem appropriate.

REGULATORY BACKGROUND

Noise and vibration impacts are one of the environmental impact categories considered for development projects pursuant to CEQA. There are several plans and regulations that include policies, guidelines, and requirements regarding noise impacts at the federal, state, and local levels. As described below, these plans, guidelines, and laws include the following: the U.S. Occupational Safety and Health Administration (OSHA), the Environmental Protection Agency (EPA), the State of California's Division of Occupational Safety and Health (Cal/OSHA), the State of California's Office of Planning and Research (OPR) CEQA Guidelines (Title 14, Division 6, Chapter 3 of the California Code of Regulations), the City of Los Angeles' (City)'s General Plan Noise Element, the Los Angeles Municipal Code (LAMC), and the Federal Transportation Authority's (FTA) Transit Noise and Vibration Impact Assessment Manual. In addition, as discussed below, relevant information included in the City's 2006 CEQA Thresholds Guide also may be used for guidance in evaluating construction-related noise impacts of development projects.

GENERAL EFFECTS OF NOISE AND VIBRATION EXPOSURE ON HUMAN HEALTH

There are varying effects of noise and associated standards and metrics set forth by agencies to address such effects. For example, the U.S. Occupational Safety and Health Administration (OSHA) and the State's Division of Occupational Safety and Health (also known as Cal/OSHA) have adopted regulations designed to protect workers against the effects of occupational noise exposure. Per Cal/OSHA, the permissible noise exposure for 8 hours is 90 dBA (L_{eq}), which is the limit for potential hearing loss.[2] In addition, based on an urban noise survey conducted by the Environmental Protection Agency (EPA), the relationship between noise level and annoyance ranges from seven percent of the population annoyed at a

[2] Cal/OSHA, Title 8 Regulations, Subchapter 7. General Industry Safety Orders, Group 15. Occupational Noise, Article 105. Control of Noise Exposure, §5096. Exposure Limits for Noise, Table N-1 Permissible Noise Exposure.

noise level of 55 dBA (L_{dn}) to 23 percent annoyed at 70 dBA (L_{dn}).[3] Furthermore, per the EPA, sleep disturbance is one of the main major causes of annoyance due to noise. Two components of sleep disturbance include falling asleep and awakening. The EPA states that noise levels of 40 to 50 dBA could result in difficulty in falling asleep for some people, and noise levels of 70 dBA or higher would likely result in awakening.[4] As another example, the Federal Transit Authority (FTA) also states that there may be adverse community reaction to construction noise and sets forth its own criteria of 80 dBA $L_{eq(8\text{-}hour)}$ for FTA construction activity noise near residential uses during daytime hours.[5] Generally, quantifying noise pollution's contribution to other specific health problems (such as heart disease, high blood pressure and stroke, ulcers, and other digestive disorders), remains a challenge because of a lack of comprehensive and verified data.

There are also varying effects of construction vibration and associated standards and metrics that have been established by various agencies to address such effects. These include effects associated with building damage with criteria for specific building types set forth by Caltrans and the FTA. These agencies have also established guidelines regarding construction vibration related to human annoyance.

CEQA FRAMEWORK FOR NOISE IMPACTS

The CEQA Guidelines state that a significant noise impact would occur if a project would result in the "generation of a substantial temporary or permanent increase in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies." With regard to vibration, the CEQA Guidelines state that a significant vibration impact would occur if the project would result in a "generation of excessive groundborne vibration or groundborne noise levels."

CITY POLICIES & REGULATIONS RELATED TO NOISE

The City's General Plan Noise Element includes general objectives and policies related to reducing or eliminating intrusive noise and reducing or eliminating noise impacts associated with development of land and changes in land use. The Noise Element also includes guidelines for noise compatible land uses. However, the Noise Element does not include specific or mandatory standards, policies, or guidance

[3] EPA, Noise Effects Handbook: A Desk Reference to Health and Welfare Effects of Noise, October 1979, Revised July 1981.
[4] EPA, Noise Effects Handbook: A Desk Reference to Health and Welfare Effects of Noise, Page 6-2, October 1979, Revised July 1981.
[5] FTA, Transit Noise and Vibration Impact Assessment Manual, Chapter 7.1, p. 179, September 2018.

specifically related to thresholds or analysis of construction noise and vibration. The Noise Element defines noise-sensitive land uses as single-family and multi-unit dwellings, long-term care facilities (including convalescent and retirement facilities), dormitories, motels, hotels, transient lodging, and other residential uses; places of assembly including churches or houses of worship; hospitals; libraries; schools; auditoriums; concert halls; outdoor theaters; nature and wildlife preserves; and parks.

The LAMC is the regulatory mechanism for implementing the goals and policies of the City's General Plan, including those set forth in the Noise Element. With regard to construction noise, the City's Noise Ordinance (LAMC Section 112.05) sets forth a maximum noise level for construction equipment of 75 dBA at a distance of 50 feet when operated within 500 feet of a residential zone. Compliance with this standard does not apply where compliance therewith is technically infeasible.[6] In addition, LAMC Section 41.40 prohibits construction between the hours of 9:00 p.m. and 7:00 a.m. Monday through Friday, before 8:00 a.m. and after 6:00 p.m. on Saturday or any national holiday, and at any time on Sunday (i.e., construction is allowed Monday through Friday between 7:00 a.m. and 9:00 p.m. and Saturdays and national holidays between 8:00 a.m. and 6:00 p.m.). Construction may be permitted outside of these hours if a temporary noise variance is approved by the Los Angeles Board of Police Commissioners.

With regard to vibration, LAMC Section 91.3307.1 states, "Adjoining public and private property shall be protected from damage during construction, remodeling, and demolition work. Protection must be provided for footings, foundations, party walls, chimneys, skylights, and roofs. Provisions shall be made to control water runoff and erosion during construction or demolition activities."

In 2006, the City set forth the L.A. CEQA Thresholds Guide, which was intended to provide guidance, as a voluntary tool, for CEQA impact analysis. Today, these thresholds are only used as guidance in instances where staff finds they are beneficial to use and supported with substantial evidence.[7] In addition, the L.A. CEQA Thresholds Guide recognizes that its applicability and use may be re-evaluated after a period of use. With regard to construction noise, the L.A. CEQA Threshold Guide states that a project would normally have a significant impact on noise levels from construction if:

- Construction activities lasting more than one day would exceed existing ambient exterior sound levels by 10 dBA or more at a noise-sensitive use;

[6] In accordance with the City's Noise Regulations, "technically feasible" means that the established noise limitations can be complied with at a project site, with the use of mufflers, shields, sound barriers, and/or other noise reduction devices or techniques employed during the operation of equipment.

[7] "Substantial evidence" in this document is as defined in Public Resources Code Section 21080(e)(1) and CEQA Guidelines Section 15384, and is evidence that is of a ponderable legal significance, reasonable in nature, credible and of solid value.

- Construction activities lasting more than 10 days in a three-month period would exceed existing ambient exterior noise levels by 5 dBA or more at a noise-sensitive use; or
- Construction activities would exceed the ambient noise level by 5 dBA at a noise-sensitive use between the hours of 9:00 p.m. and 7:00 a.m. Monday through Friday, before 8:00 a.m. or after 6:00 p.m. on Saturday, or at any time on Sunday.

Note that in practice, these noise increases have been evaluated in terms of hourly L_{eq}, in lieu of the 24-hour CNEL noise metric, as construction noise typically does not occur over a 24-hour basis. Also note that the above thresholds in the L.A. CEQA Thresholds Guide were developed based on more open-ended noise questions within Appendix G of the CEQA Guidelines that have since been revised.

Use of the above thresholds in City CEQA documents for construction noise impact analysis has proven to be overly sensitive and has resulted in impact conclusions that are not supported with substantial evidence. In particular, use of a threshold of a 5 dBA increase over existing ambient conditions often results in significant impacts for routine construction activities that are expected to occur in an urban environment. For example, in a single-family neighborhood with a 48 dBA L_{eq} daytime baseline, the 5 dBA threshold suggests that a construction impact of 54 dBA L_{eq} would be significant. However, evidence supports that noise levels less than 55 dBA are acceptable to over 90 percent of the general public. The EPA has identified a 55 dBA noise level as the acceptable noise limit for outdoors uses as it would not interfere with activity or result in annoyance[8].

The existing threshold is so low that it has the potential to show significant impacts even for the construction or exterior remodeling of a single-family home in a residential area involving no unusual noise producing equipment. In addition, according to this threshold, a single daily impact in excess of 5 dBA is considered to be a significant environmental impact, even though the impact would be temporary in nature, could result in short-term impacts in terms of human annoyance, but may not necessarily result in direct health impacts unless a certain absolute noise threshold is attained. In other words, while a two- or three-year construction project could result in a 5 dBA impact for a single day, the conclusion that this should be considered a significant effect on the environment would be overly conservative, as the impact would be temporary in nature and not necessarily impactful to public health. The L.A. CEQA Thresholds Guide does not include specific thresholds for vibration related to construction activities. However, over time many City CEQA

[8] EPA, Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety, March 1974.

documents have used the FTA's criteria for addressing construction vibration related to both human annoyance and building damage.

In the future, the City proposes to require environmental protection measures (EPMs) to be implemented as part of development projects. These EPMs have been drafted and have already been incorporated into draft updates to the City's Land Use Element (in individual Community Plan updates which comprise the Land Use Element) that are underway, such as the Downtown Community Plan Update. These will be applicable to development projects within those geographic areas once those Community Plans or other policy efforts that rezone properties to the new LAMC Chapter 1A zoning are adopted. For areas not undergoing Community Plan updates, EPMs could be made standard conditions of approval until such time that the EPMs are adopted for discretionary projects requiring findings that could support imposing noise conditions. Relevant EPMs related to noise and vibration are included in Attachment 1.

OTHER REFERENCE DOCUMENTS

The following documents and studies were also considered in the evaluation and determination of updated noise and vibration thresholds:

- OSHA – OSHA Technical Manual (OTM) Section III: Chapter 5 Noise; OSHA Standard 1910 Occupational Safety and Health Standards Subpart G Occupational Health and Environmental Control
- EPA – Noise Effects Handbook: A Desk Reference to Health and Welfare Effects of Noise
- FTA – Transit Noise and Vibration Impact Assessment Manual, Chapter 7.1
- Cal/OSHA – Title 8 Regulations, Subchapter 7. General Industry Safety Orders, Group 15, Occupational Noise, Article 105. Control of Noise Exposure, §5096.
- State of California's OPR – General Plan Guidelines
- Caltrans – Traffic Noise Analysis Protocol, Chapter 3.2
- Caltrans – Technical Noise Supplement to the Traffic Noise Analysis Protocol,
- Caltrans – Transportation and Construction Vibration Guidance Manual, Chapter 7.3 Evaluating Potential Vibration Impacts
- City of Los Angeles – General Plan Noise Element
- City of Los Angeles – Municipal Code Chapter XI Noise Regulation

- City of Los Angeles – 2006 L.A. CEQA Threshold Guide
- City of Beverly Hills – Municipal Code, Chapter 1 Noise Regulations, Article 2. Specific Noise Sources and Regulations, Section 5-1-205: Restrictions on Construction Activity
- City of Fresno - General Plan Noise Element
- City of Pasadena – Municipal Code Chapter 9.36 – Noise Restrictions

CONSTRUCTION NOISE & VIBRATION ANALYSIS IN CITY CEQA DOCUMENTS

NOISE ANALYSIS

The City has used various thresholds for evaluating construction noise impacts. Prior to 2006, the City had often used the criteria in the Noise Ordinance to evaluate potential construction noise impacts. Once the L.A. CEQA Thresholds Guide was approved in 2006, the City also used the construction noise thresholds established within the Thresholds Guide. Note that the thresholds in the L.A. CEQA Thresholds Guide were based on broader questions within Appendix G of the CEQA Guidelines that have since been refined after 2006.

In practice, use of the thresholds from the L.A. CEQA Thresholds Guide has resulted in construction noise impact conclusions that are not supported by substantial evidence. This construction noise threshold does not recognize the urban nature of much of the City and the expectation that daytime construction activities are a common activity within an urban environment. As an example, construction of a typical single-family residential addition within an existing neighborhood could potentially exceed the significance thresholds within the L.A. CEQA Thresholds Guide, which are primarily based on increases above ambient noise levels, and which may not necessarily result in human health effects or impacts. Furthermore, these thresholds do not distinguish between daytime and nighttime construction activities where nighttime construction activities are the activities that may have the greater potential to create intrusive noise and impact sleep. In addition, while use of the criteria from the Noise Ordinance (described above) for a maximum 75 dBA at a distance of 50 feet when operated within 500 feet of a residential zone when technically feasible is reasonable, the wording of the criteria including the use of the terminology “technically feasible” as defined therein is somewhat open ended and the standard is limited to a residentially zoned subset of sensitive noise uses, rather than a broader range of sensitive uses which may also be impacted by construction noise.

VIBRATION ANALYSIS

With regard to vibration, City CEQA documents often use FTA's guidance related to potential building damage and human annoyance. Based on this FTA guidance, impacts relative to ground-borne vibration associated with potential building damage would be considered significant if any of the following future events were to occur:

- Project construction activities cause ground-borne vibration levels to exceed 0.5 PPV at the nearest off-site reinforced concrete, steel, or timber building.
- Project construction activities cause ground-borne vibration levels to exceed 0.3 PPV at the nearest off-site engineered concrete and masonry building.
- Project construction activities cause ground-borne vibration levels to exceed 0.2 PPV at the nearest off-site non-engineered timber and masonry building.
- Project construction activities cause ground-borne vibration levels to exceed 0.12 PPV at buildings extremely susceptible to vibration damage, such as historic buildings.

Based on FTA guidance, construction vibration impacts associated with human annoyance would be significant if the following were to occur (applicable to frequent events; 70 or more vibration events per day):

- Project construction activities cause ground-borne vibration levels to exceed 72 VdB at off-site sensitive uses, including residential, hotel and theater uses.

In practice, use of the FTA guidance regarding human annoyance from vibration has proven to be too rigid as most typical construction activities during daytime hours within an urban environment would exceed the 72 VdB threshold if a sensitive use is nearby (i.e., within 80 feet). Similar to construction noise, construction vibration is reasonably anticipated in an urban environment, like that found in the City, and such vibration levels would not be anticipated to result in health impacts or substantially affect the activities of the general public during daytime hours. The guidance regarding building damage has been more reasonable in practice.

CONSTRUCTION NOISE & VIBRATION THRESHOLDS

Recognizing the overly sensitive construction noise threshold in the L.A. CEQA Thresholds Guide and the FTA guidance for construction vibration, the following new thresholds are more suited to the generally urban nature of the City yet still recognize the importance of human health, including sleep disruption. Specifically, these thresholds account for reasonable expectations during daytime and nighttime hours and also include absolute noise levels that are intended to protect human health. These thresholds (Attachment 2 - Thresholds) and methodology (Attachment 3 – Methodology) have been determined based on input from noise experts in the Technical Advisory Committee, as well as a review of noise thresholds used by other state and local agencies and other resource documents.

The construction noise thresholds are focused on impacts to sensitive uses. The Noise Element defines noise-sensitive land uses as single-family and multi-unit dwellings, long-term care facilities (including convalescent and retirement facilities), dormitories, motels, hotels, transient lodging, and other residential uses; places of assembly including churches or houses of worship; hospitals; libraries; schools; auditoriums; concert halls; outdoor theaters; nature and wildlife preserves; and parks. For purposes of environmental analysis based on the updated thresholds, this definition of sensitive uses will be carried over from the list in the Noise Element; however, recording studios will be added as a sensitive use relative to construction vibration impacts.

Generally, there are commonly two types of noise standards, as follows:

- Relative or “increase” standards - these are quantified thresholds, expressed as an allowable increase in decibels, attributed to the construction noise contribution, over the pre-existing outdoor ambient sound level at a receptor.
- Absolute or “fixed” standards - these are quantified thresholds that represent a fixed noise limit and take into account a potential impact that is independent of the pre-existing outdoor ambient sound level at a receptor.

NOISE THRESHOLDS

Daytime Construction Noise Thresholds

Increase Over Ambient

- For construction activities that occur between 7:00 a.m. and 7:00 p.m. Monday through Friday, and between 8:00 a.m. and 6:00 p.m. on Saturdays, there is no numerical threshold above ambient noise levels.

Supporting Discussion Points:

- This approach is consistent with many jurisdictions within the State, including the cities of Beverly Hills, Fresno, and Pasadena, and Caltrans, which do not have a threshold for a numeric increase in ambient noise levels.[9]
- Daytime hours experience higher ambient levels of noise due to additional sources of noise such as traffic noise, maintenance activities, construction activities, etc.
- Construction activity hours for this threshold are within the envelope of the construction hours currently permitted by LAMC 41.40. However, rather than a 9:00 p.m. construction hour end time as permitted by the LAMC, an earlier 7:00 p.m. end time was chosen as people are more sensitive to noise during evening hours when compared to daytime hours. In addition, a 7:00 p.m. end time is supported by the CNEL metric itself wherein a 5-dB penalty is added for noise levels between 7:00 p.m. and 10:00 p.m.
- Daytime construction activities are temporary and periodic.
- This approach recognizes the urban environment of the City and that daytime construction activities are commonplace (e.g., it is not expected that daytime activities would affect most of the general public's sleeping). Potential human health impacts are addressed by the absolute thresholds below and increases in ambient noise levels are addressed in the nighttime thresholds below, including consideration of sleep disruption.
- Within the City, existing daytime ambient noise for uses along major roadways is in the range of 65 to 70 dBA and along quiet residential streets is between 55 and 60 dBA. The table below

[9] City of Beverly Hills Municipal Code Section 5-1-205; City of Fresno General Plan Noise Element Table 14.3-5; City of Pasadena Municipal Code Chapter 9.36.80; Caltrans Traffic Noise Analysis Protocol Chapter 3.2, April 2020.

provides samples of the daytime ambient noise levels, as measured along major roadways and smaller quiet residential streets. As discussed below, construction noise would be limited to a maximum absolute noise threshold of 80 dBA $L_{eq(8\text{-}hour)}$ at noise sensitive uses. With respect to ambient noise, the 80 dBA $L_{eq(8\text{-}hour)}$ absolute threshold would be similar to a noise increase of approximately 10 dBA (based on an existing 70 dBA ambient noise level, a typical noise level along major roadways) to 25 dBA (based on an existing 55 dBA ambient noise level, a typical noise level in a quieter residential neighborhood) over the ambient noise level. Table 1, below, provides the typical ambient noise levels along various roadways within the City.

Table 1

Typical Ambient Noise Levels Along Roadways

LOCATION	DAYTIME AMBIENT NOISE LEVELS,[a] dBA
Major Roadways	
Hollywood Boulevard (Hollywood)	71.7
Vine Street (Hollywood)	69.5
Sunset Boulevard (Hollywood)	71.0
Highland Boulevard (Hollywood)	71.5
Figueroa Street (downtown)	71.1
Hope Street (downtown)	66.6
7th Street (downtown)	70.5
Vermont Avenue (South LA)	68.6
Burbank Boulevard (Encino)	68.7
Minor Roadways (residential areas)	
Stanbury Avenue (Sherman Oaks)	58.8
Calhoun Avenue (Sherman Oaks)	57.6
Hudson Avenue (Hollywood)	59.9
Leland Way (Hollywood)	60.9
Browning Boulevard (South LA)	58.3
Etiwanda Avenue (Encino)	53.3
Angelo Drive (hillside)	54.7
Hillgrove Drive (hillside)	56.5

[a] *Measured ambient noise levels along noted roadways are based on analysis of previous projects within the City.*

- Although the increase in ambient noise levels of 10 to 25 dBA would be noticeable, the construction noise would be temporary and would occur during daytime hours (outside of the sensitive sleeping hours). Furthermore, residents of urban areas are used to temporary construction noise and its increase to ambient noise levels of 10 to 25 dBA and higher, from time to time during daytime hours. The City of Los Angeles encounters a large amount construction projects; specifically, there

were approximately 173,000 permits applied with the Los Angeles Department of Building and Safety for fiscal year 2022-2023[10]. As such, the City would not consider increases in ambient noise levels resulting from construction activities as constituting significant environmental effects. Instead, as discussed below, the City would utilize an absolute noise exposure level over an extended period for evaluating potential noise impacts during daytime hours, as this metric better reflects potential health impacts due to construction noise.

- Daytime construction noise levels are further reduced by existing building codes for certain types of buildings. For example, the State has established noise insulation standards for new multi-family residential units, hotels, and motels via the California Noise Insulation Standards (Title 24, California Code of Regulations). The noise insulation standards set forth an interior standard of 45 dBA CNEL in any habitable room. The standards require an acoustical analysis demonstrating that dwelling units have been designed to meet this interior standard where such units are proposed in areas subject to exterior noise levels greater than 60 dBA CNEL. Title 24 standards are typically enforced by local jurisdictions through the building permit application process.
- Sensitive uses such as hospital buildings are generally designed to limit the effects of exterior noise on the interior uses of the building, and include fixed windows, which further minimize noise from exterior sources. [11]
- Noise-related impacts to biological resources should be addressed in the biological resources analysis of the CEQA document.

<u>Absolute Thresholds</u>

- On- and off-site construction noise during daytime hours (7:00 a.m. and 7:00 p.m. Monday through Friday, and 8:00 a.m. to 6:00 p.m. on Saturdays) are limited to a maximum 80 dBA $L_{eq(8\text{-}hour)}$ absolute threshold at sensitive uses (at the property line or at the exterior of the building), including outdoor public recreational areas owned or maintained by a public agency. This standard does not apply to private residential balconies which may or may not extend past the exterior of a building, or to private residential recreational areas.

Supporting Discussion Points:

[10] LADBS, "A Few Facts About Us", https://www.ladbs.org/our-organization/messaging/a-few-facts-about-us, Accessed June 2024.

[11] As required per the California Noise Insulation Standards (Title 24, California Code of Regulations), exterior sound insulation requirements.

- The 80 dBA $L_{eq(8\text{-}hour)}$ absolute threshold is used by the FTA for construction noise near residential uses during daytime hours.
- The 80 dBA $L_{eq(8\text{-}hour)}$absolute threshold would be similar to the 75 dBA at 50 feet criteria for residential uses set forth by the LAMC when adjusting for distance and would expand its applicability by also applying to other non-residential sensitive uses.
- Regarding the identification of construction noise sensitive uses, a distinction is also made between regularly inhabited areas of residential uses (such as residential units within a building) and temporarily inhabited residential areas (such as private outdoor amenity spaces, backyards, and private balconies). These private outdoor areas are typically utilized on a more temporary and intermittent basis, often outside the hours of construction, are exposed to higher ambient noise levels from other daytime outdoor activities, such as leaf blowers, traffic noise, human voices, and children playing, and therefore exposure to continuous noise levels at which health impacts could occur or be unreasonably disruptive is not expected. Additionally, residents may opt to not utilize the spaces and avoid exposure to higher noise levels, should construction noise be audible in those spaces.
- Per OSHA/CalOSHA, the noise limit for potential hearing loss is 90 dBA $L_{eq(8\text{-}hour)}$ and the absolute threshold would be well below this limit.[12]

Nighttime Construction Noise Thresholds

Note: Nighttime construction activities require a variance approved by the City of Los Angeles Police Commission.

Increase Over Ambient

- For construction activities that occur between 7:00 P.M. and 7:00 A.M. Monday through Friday, and between 6:00 P.M. and 8:00 A.M. on Saturdays, and anytime on Sundays or national holidays, noise levels at sensitive uses would not exceed 5 dBA above the ambient noise level at the receptor.
- Mat pour activities (and other types of concrete pour, which require an extended continuous pour beyond the allowable construction hours) that are required to occur during nighttime hours for less than five days are exempt from this provision.

[12] OSHA, Standard 1910.95 – Occupation noise exposure. In addition to the permissible noise level of 90 dBA ($L_{eq(8\text{-}hour)}$), OSHA also specified an action level of 85 dBA ($L_{eq(8\text{-}hour)}$) at which a hearing conservation program is required (OSHA Standard 1910.95(c)(1)).

Supporting Discussion Points:

- The threshold is rigorous and similar to San Francisco and other jurisdictions/agencies (including the City Beverly Hills, the FTA and Caltrans).
- A 5-dB increase is generally an increase that is distinctly perceptible.
- The threshold recognizes the importance of human health, as the nighttime ambient noise levels with a 5-dB increase may indicate a potential sleep disturbance, but would be well below the noise limits for potential hearing loss.
- People generally do not use outdoor areas during nighttime activities. However, as indicated above, the threshold takes into account potential noise increase at the building interior, which may result in potential sleep disturbance.
- Mat concrete pour activities typically require a continuous concrete pour to achieve a seamless, integral slab and are necessary for certain types of construction. Therefore, depending on the size of the mat foundation, mat concrete pour activities at times extend into the nighttime hours due to the continuous pour requirements. The number of mat concrete pours is typically limited to a few days for most projects and is temporary in nature. Activities associated with mat and other types of concrete pours involve cement trucks and pumps that do not typically generate noise levels above 80 dBA at a distance of 50 feet. Therefore, mat pour activities with a limited duration are exempted from this threshold and are not expected to result in significant construction noise impacts related to human health. In addition, in accordance with the City's anticipated forthcoming EPMs, staging areas for the mat pour activities would be required to be located as far from noise-sensitive uses as reasonably possible and technically feasible in consideration of site boundaries, topography, intervening roads and uses, and operational constraints.

<u>Absolute Noise</u>

- For construction activities that occur between 7:00 p.m. and 7:00 a.m. Monday through Friday, and between 6:00 p.m. and 8:00 a.m. on Saturdays, and anytime on Sundays or national holidays, the maximum exterior noise level at sensitive uses where sleep is expected will not exceed the following:
    - 55 dBA L_{eq} for sensitive uses within older buildings that would have operable windows that may be open.
    - 65 dBA L_{eq} for sensitive uses with windows closed that are not operable and are single-glazed.

  - 70 dBA L_{eq} for sensitive uses that have newer construction (i.e., the structures have been designed to ensure that an interior 45 dBA is obtained with double-paned windows)

- Mat pour activities (and other types of concrete pour, which require an extended continuous pour beyond the allowable construction hours) that are required to occur during nighttime hours for less than five days are exempt from this provision.

Supporting Discussion Points:

- The nighttime absolute noise threshold levels are generally based on levels so as not to impact people sleeping. Two components of sleep disturbance include falling asleep and awakening. Per the EPA, noise levels of 40 to 50 dBA could result in difficulty in falling asleep for some people, and noise levels of 70 dBA or higher would likely result in awakening.[13] Therefore, the threshold is based on not exceeding an interior noise level of 45 dBA L_{eq} (averaged between 40 and 50 dBA).
- These maximums, which are tailored based on likely noise attenuation from different building types would foreseeably provide for an interior noise level of 45 dBA L_{eq}, which will address potential noise disruptions to sleep.
- These noise levels support the expectation of a quieter sound environment at residential land uses during nighttime periods, and all-day on Sundays and national holidays when traditionally most occupants would be home.

[13] EPA, Noise Effects Handbook: A Desk Reference to Health and Welfare Effects of Noise, p. 6-2, July 1981.

VIBRATION THRESHOLDS

Vibration Thresholds for Human Annoyance

- For construction activities that occur between 7:00 a.m. and 7:00 p.m. Monday through Friday, and between 8:00 a.m. and 6:00 p.m. on Saturdays, there is no numerical threshold related to human annoyance.
- During nighttime hours (between 7:00 p.m. and 7:00 a.m. Monday through Friday, and between 6:00 p.m. and 8:00 a.m. on Saturdays), and anytime on Sundays or national holidays, construction activities shall not generate groundborne vibration levels that exceed 80 VdB at the exterior of a sensitive use building.

Supporting Discussion Points:

- The City is an urban area where intermittent human annoyance from construction activity is commonplace and expected during daytime hours and such vibration levels are unlikely to result in health impacts or substantially affect the activities of the public during daytime hours.
- The Federal Transit Administration (FTA) provides ground borne vibration impact criteria ranging from 72 (for frequent vibration events) VdB to 80 VdB (infrequent vibration events) for residences and buildings where people normally sleep. The FTA vibration criteria are specified for long-term operations. However, since project construction activities are temporary, the 80 VdB criteria for infrequent vibration events would be appropriate as a vibration threshold for human annoyance. In addition, vibration due to mat concrete pour activities would be minimal (below 80 VdB), as concrete trucks and concrete pumps do not generate excessive vibration levels. Therefore, mat pour activities with a limited duration are exempted from this threshold and are not expected to result in significant construction vibration impacts.

Vibration Thresholds for Building Damage

- Architectural Building Damage—Construction activities shall not exceed the following building damage thresholds for the identified structures:
    - Fragile Buildings: 0.1 PPV
    - Historic Buildings: 0.25 PPV
    - Older[14] Residential Structures: 0.3 PPV
    - New Residential Structures: 0.5 PPV
    - Modern Industrial/Commercial Buildings: 0.5 PPV

Supporting Discussion Points:

- These thresholds are consistent with Caltrans criteria that are based on specific building types.[15]

[14] Caltrans does not specify the age of the building to be considered. For vibration impact analyses, a building over 50 years old can be considered an "older" residential structure.

[15] Caltrans, Transportation and Construction Guidance Manual, Table 19, Guideline Vibration Damage Potential Threshold Criteria, April 2020.

ATTACHMENT 1

ENVIRONMENTAL PROTECTION MEASURES RELATED TO NOISE AND VIBRATION

The following Environmental Protection Measures (EPMs) are included in new Community Plan EIRs:

Noise and Vibration Standards (NV1) – Construction Noise

NV1-1: Noise Shielding and Muffling

a. Applicability Threshold

Any Project whose earthwork or construction activities involve the use of construction equipment and require a permit from LADBS.

b. Standard

Power construction equipment (including combustion engines), fixed or mobile, shall be equipped with noise shielding and muffling devices consistent with manufacturers' standards or the Best Available Control Technology. All equipment shall be properly maintained, and the Applicant or Owner shall require any construction contractor to keep documentation on-site during any earthwork or construction activities demonstrating that the equipment has been maintained in accordance with manufacturer's specifications.

NV1-2: Use of Driven Pile Systems

a. Applicability Threshold

Any Project whose earthwork and construction activities involve the use of construction equipment and require a permit from LADBS.

b. Standard

Driven (impact) pile systems shall not be used, except in locations where the underlying geology renders drilled piles, sonic, or vibratory pile drivers infeasible, as determined by a soils or geotechnical engineer and documented in a soils report.

NV1-3: Enclosure or Screening of Outdoor Mechanical Equipment

a. Applicability Threshold

Any Project whose earthwork or construction activities involve the use of construction equipment and require a permit from LADBS.

b. Standard

All outdoor mechanical equipment (e.g., generators, compressors) shall be enclosed or visually screened. The equipment enclosure or screen shall be impermeable (i.e., solid material with minimum weight of 2 pounds per square feet) and break the line of sight between the equipment and any off-site Noise-Sensitive Uses.

NV1-4: Location of Construction Staging Areas

a. Applicability Threshold

Any Project whose earthwork or construction activities involve the use of construction equipment and require a permit from LADBS.

b. Standard

Construction staging areas shall be located as far from Noise-Sensitive Uses as reasonably possible and technically feasible in consideration of site boundaries, topography, intervening roads and uses, and operational constraints. The burden of proving what constitutes 'as far as possible' shall be upon the Applicant or Owner, in consideration of the above factors.

NV1-5: Temporary Walls

a. Applicability Threshold

Any Project whose earthwork and construction activities involve the use of construction equipment and require a permit from LADBS; and whose construction activities are located within a line of sight to and within 500 feet of Noise-Sensitive Uses, with the exception of Projects limited to the construction of 2,000 square feet or less of floor area dedicated to residential uses.

b. Standard

Noise barriers, such as temporary walls (minimum ½-inch thick plywood) or sound blankets (minimum STC 25 rating), that are a minimum of eight feet tall, shall be erected between construction activities and Noise-Sensitive Uses as reasonably possible and technically feasible in consideration of site boundaries, topography, intervening roads and uses, and operational constraints. The burden of proving that compliance is technically infeasible shall be upon the Applicant or Owner. Technical infeasibility shall mean that noise barriers cannot be located between construction activities and Noise-Sensitive Uses due to site boundaries, topography, intervening roads and uses, and/or operational constraints.

NV1-6: Noise Study

a. Applicability Threshold

Any Project whose earthwork or construction activities involve the use of construction equipment and require a permit from LADBS; are located within 500 feet of Noise-Sensitive Uses; and have one or more of the following characteristics:

- Two or more subterranean levels;
- 20,000 cubic yards or more of excavated material
- Simultaneous use of five or more pieces of construction equipment; or
- Construction duration (excluding architectural coatings) of 18 months or more.

Or any Project whose construction activities involve impact pile driving or the use of 300 horsepower equipment.

b. Standard

A Noise Study prepared by a Qualified Noise Expert shall be required and prepared prior to obtaining any permit by LADBS. The Noise Study shall characterize expected sources of earthwork and construction noise that may affect identified Noise-Sensitive Uses, quantify expected noise levels at these Noise-Sensitive Uses, and recommend measures to reduce noise exposure to the extent noise reduction measures are available and feasible, and to demonstrate compliance with any noise requirements in the LAMC. Specifically, the Noise Study shall identify noise reduction devices or techniques to reduce noise levels in accordance with accepted industry practices and in compliance with LAMC standards. Noise reduction devices or techniques shall include but not be limited to mufflers, shields, sound barriers, and time and place restrictions on equipment and activities. The Noise Study shall identify anticipated noise reductions at Noise-Sensitive Uses associated with the noise reduction measures. Applicants and Owners shall be required to implement and comply with all measures identified and recommended in the Noise Study. The Noise Study and copies of any contractor agreements shall be maintained pursuant to the proof of compliance requirements in Section I.D.6.

Noise and Vibration Standards (NV2) – Construction Vibration

NV2-1: Baseline Survey and Vibration Control Plan

a. Applicability Threshold

Any Project, with the exception of Projects limited to the construction of 2,000 square feet or less of floor area dedicated to residential uses, whose earthwork or construction activities: (1) involve the use of construction equipment, including Heavy Construction Equipment, that produces 0.12 PPV or more of vibration at a distance of 25 feet (see reference vibration levels in Appendix F); (2) require a permit from LADBS; and (3) which occur:

- Within 25 feet of any building extremely susceptible to vibration damage, including unreinforced masonry buildings, tilt-up concrete wall buildings, wood-frame multi-story buildings with soft, weak or open front walls, and non-ductile concrete buildings, or a building that is designated or determined to be a historic resource pursuant to local or state law or that is determined to be potentially eligible for historic designation in a Historic Resources Survey; or
- Within 15 feet of non-engineered timber and masonry buildings.

Or any Project whose construction activities involve the use of pile drivers within 135 feet of any building extremely susceptible to vibration damage, including existing unreinforced masonry buildings, existing tilt-up concrete wall buildings, existing wood-frame multi-story buildings with soft, weak or open front walls, and existing non-ductile concrete buildings, or a building that is designated or determined to be a historic resource pursuant to local or state law or that is determined to be potentially eligible for historic designation in a Historic Resources Survey.

b. Standard

Prior to demolition, grading/excavation, or construction, a Qualified Structural Engineer shall prepare a survey establishing baseline structural conditions of potentially affected structures and a Vibration Control Plan, which shall include methods to minimize vibration, including, but not limited to:

- A visual inspection of the potentially affected structures to document (by video and/or photography) the apparent physical condition of the building (e.g., cracks, broken panes, etc.).
- A shoring design to protect the identified structures from potential damage;
- Use of drilled piles or a sonic vibratory pile driver rather than impact pile driving, when the use of vibrating equipment is unavoidable;
- Use of rubber-tired equipment rather than metal-tracked equipment; and
- Avoiding the use of vibrating equipment when allowed by best engineering practice.

NV2-2: Repair of Damage

a. Applicability Threshold

Any Project, with the exception of Projects limited to the construction of 2,000 square feet or less of floor area dedicated to residential uses, whose earthwork or construction activities: (1) involve the use of construction equipment, including Heavy Construction Equipment, that produces 0.12 PPV or more of vibration at a distance of 25 feet (see reference vibration levels in Appendix F); (2) require a permit from LADBS; and (3) which occur:

- Within 25 feet of any building extremely susceptible to vibration damage, including unreinforced masonry buildings, tilt-up concrete wall buildings, wood-frame multi-story buildings with soft, weak or open front walls, and non-ductile concrete buildings, or a building that is designated or determined to be a historic resource pursuant to local or state law or that is determined to be potentially eligible for historic designation in a Historic Resources Survey; or
- Within 15 feet of non-engineered timber and masonry buildings.

Or any Project whose construction activities involve the use of pile drivers within 135 feet of any building extremely susceptible to vibration damage, including existing unreinforced masonry buildings, existing tilt-up concrete wall buildings, existing wood-frame multi-story buildings with soft, weak or open front walls, and existing non-ductile concrete buildings, or a building that is designated or determined to be a historic resource pursuant to local or state law or that is determined to be potentially eligible for historic designation in a Historic Resources Survey.

b. Standard

In the event of damage to any non-historic building due to construction vibration, as verified by the Qualified Structural Engineer, a letter describing the damage to the impacted building(s) and recommendations for repair shall be prepared by the Qualified Structural Engineer within 60 days of the time when damage occurred. Repairs shall be undertaken and completed, at the Owner's or Applicant's expense, in conformance with all applicable codes.

In the event of vibration damage to any building that is designated or determined to be a historic resource pursuant to local or state law or that is determined to be potentially eligible for historic designation in a Historic Resources Survey, a letter describing the damage to the impacted building(s) and recommendations for repair shall be prepared by the Qualified Historian within 60 days of the time when damage occurred. Repairs shall be undertaken and completed, at the Owner's or

Applicant's expense, in conformance with the California Historical Building Code (Title 24, Part 8) as well as the Secretary of the Interior's Standards for the Treatment of Historic Properties and associated guidelines, as applicable and as determined by the Qualified Historian.

Additional EPM

Although not included in the current new Community Plan EIRs, the following Additional EPM is included to address vibration-sensitive uses:

NV2-3: Vibration Sensitive Uses

a. Applicability Threshold

Any Project, with the exception of Projects limited to the construction of 2,000 square feet or less of floor area dedicated to residential uses, whose earthwork or construction activities occur within 150 feet of hospital and veterinary operating centers, imaging facilities, and recording studios.

b. Standard

- Prior to demolition, grading/excavation, or construction, a Qualified Vibration Consultant shall prepare a Vibration Impact Analysis at the vibration sensitive use and shall prepare a Vibration Control Plan, to minimize vibration impacts.
- The qualified vibration consultant shall take vibration monitoring measurements during site clearing, earthmoving activities, and foundation and structural activities within 150 feet of the sensitive use in order to assess the actual impact of vibration on adjacent structures and to incorporate and adjust techniques as necessary to reduce vibration. To the extent the adjacent sensitive use allows the applicant to conduct monitoring within the adjacent sensitive use, baseline monitoring prior to construction and monitoring during these construction activities shall be conducted at the sensitive use. The engineer shall insure the incorporation of measures that reduce vibration at the sensitive use.
- Noticing of the scheduling of various phases of construction will be submitted to the adjacent vibration-sensitive use 45 days in advance of activities and shall identify the dates of activity, the hours of activity, types of equipment to be used and the anticipated noise and vibration.

ATTACHMENT 2

THRESHOLDS

CONSTRUCTION NOISE THRESHOLDS

The following thresholds apply to both on- and off-site construction activities associated with a project:

Daytime Construction Activities:

Daytime Construction Activities: Construction activities occurring between 7:00 A.M. and 7:00 P.M. holidays.

Daytime Noise Sensitive Uses. These include single-family and multi-unit dwellings, long-term care facilities (including convalescent and retirement facilities), dormitories, motels, hotels, transient lodging, and other residential uses; places of assembly including churches or houses of worship; hospitals; libraries; schools; auditoriums; concert halls; outdoor theaters; nature and wildlife preserves; outdoor public recreational areas; and parks. This does not include private residential balconies which may or may not extend past the exterior of a building, or to private outdoor spaces.

Threshold:

Increase Over Ambient Threshold. No numerical threshold above ambient noise levels.

Absolute Threshold. Maximum 80 dBA Leq (8-hour) absolute threshold at daytime noise sensitive uses (at the property line with outdoor uses or at the exterior of the building).

Nighttime Construction Activities:

Nighttime Construction Activities: Construction activities occurring between 7:00 P.M. and 7:00 A.M. Monday through Friday, and between 6:00 P.M. and 8:00 A.M. on Saturdays, and anytime on Sundays or national holidays.

Nighttime Noise Sensitive Uses. These include single-family and multi-unit dwellings, long-term care facilities (including convalescent and retirement facilities), dormitories, motels, hotels, transient lodging, and other residential uses; nature and wildlife preserves; outdoor public recreational areas; and parks. This does not include private residential balconies which may or may not extend past the exterior of a building, or to private outdoor spaces.

Threshold:

Increase Over Ambient Threshold. Maximum 5 dBA increase above the ambient noise level at nighttime noise sensitive uses (at the property line with outdoor uses or at the exterior of the building). Mat pour activities (and other types of concrete pour, which require an extended continuous pour beyond the allowable construction hours) that are required to occur during nighttime hours for less than five days are exempt from this provision.

Absolute Threshold. The maximum exterior noise level at nighttime noise sensitive uses where sleep is expected will not exceed the following:

- Maximum 55 dBA Leq for sensitive uses within older buildings that would have operable windows that may be open.
- Maximum 65 dBA Leq for sensitive uses with windows closed that are not operable and are single-glazed.
- Maximum 70 dBA Leq for sensitive uses that have newer construction (e.g., the structures have been designed to ensure that an interior 45 dBA is obtained with double- paned windows). Certain mat pour activities are exempt from this provision.

Mat pour activities (and other types of concrete pour, which require an extended continuous pour beyond the allowable construction hours) that are required to occur during nighttime hours for less than five days are exempt from this provision.

CONSTRUCTION VIBRATION THRESHOLDS

The following thresholds apply to both on- and off-site construction activities associated with a project:

Human Annoyance:

Vibration Sensitive Uses for Human Annoyance. These include single-family and multi-unit dwellings, long-term care facilities (including convalescent and retirement facilities), dormitories, motels, hotels, transient lodging, and other residential uses; places of assembly including churches or houses of worship; hospitals; libraries; schools; auditoriums; concert halls; outdoor theaters; nature and wildlife preserves; outdoor public recreational areas; parks; and recording studios.

Threshold:

Daytime Construction Activities. No numerical threshold.

Nighttime Construction Activities: Maximum 80 VdB at the exterior of a vibration sensitive use building.

Building Damage:

Fragile Buildings are buildings which are extremely susceptible to vibration damage and would include, but not be limited to, existing unreinforced masonry buildings, existing wood-frame multi-story buildings with soft, weak or open front walls, and existing non-ductile concrete buildings.

Historic Buildings are buildings which are considered potential historic resources pursuant to CEQA.

Older Residential Structures are residential buildings which are 50 or more years in age.

New Residential Structures and **Modern Industrial/Commercial Buildings** are buildings which are less than 50 years in age.

Threshold:

Construction activities shall not exceed the following building damage thresholds for the identified structures:

- Fragile Buildings: 0.1 PPV
- Historic Buildings: 0.25 PPV
- Older Residential Structures: 0.3 PPV
- New Residential Structures: 0.5 PPV
- Modern Industrial/Commercial Buildings: 0.5 PPV

ATTACHMENT 3

METHODOLOGY

CONSTRUCTION NOISE AND VIBRATION ANALYSIS METHODOLOGY

Daytime Construction Noise Calculations

In calculating the absolute noise levels, Project construction-related noise levels at the receptor locations are to be calculated based on the anticipated construction equipment planned to be used and using the construction equipment noise levels published by the FHWA's "Roadway Construction Noise Model," as provided in Table 1, on page 3.[1] The construction noise calculations are to be based on the standard point source noise-distance attenuation factor of 6.0 dBA for each doubling of distance, using the following equations:

EQUAiTION 1: $L_{eq(8\text{-}hr)} = L_{max}$ at 50 feet - 20log(D/50) + 10log(UF) + 10Glog(D/50)

Where:

$L_{eq(8\text{-}hr)}$ = calculated noise level, $L_{eq(8\text{-}hr)}$, at a receptor from the operation of a single piece of equipment, dBA.

L_{max} at 50 feet = noise emission level of the construction equipment at the reference distance of 50 feet, dBA (from Table 1).

D = distance from the receptor to the construction equipment, feet

To represent the average construction noise level, as construction equipment would move around the project site, the distance (D) is to be from the approximate center of the project site to the receptor location (maximum 500 feet from the interior of the Project site).

UF = usage factor is the percentage of time during a construction noise operation that a piece of construction equipment is operating at full power.

G = a constant that accounts for topography and ground effects.

For general assessment, assumed G = 0 assuming free-field conditions and without ground effects. If ground effects are of specific importance, use the FTA procedure for calculating G.[2]

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1 FHWA Roadway Construction Noise Model User's Guide, 2006.

2 FTA, Transit Noise and Vibration Impact Assessment Manual, Table 4-26, September 2018. See attached.

Table 1

Equipment Noise Emissions and Acoustical Usage Factors

EQUIPMENT	ACOUSTICAL USAGE FACTOR (%)	NOISE LEVEL AT 50 FEET FROM EQUIPMENT, DBA (LMAX)
Auger Drill Rig	20	84
Backhoe	40	78
Compactor (ground)	20	83
Compressor (air)	40	78
Concrete Mixer Truck	40	79
Concrete Pump Truck	20	81
Concrete Saw	20	90
Crane	16	81
Dozer	40	82
Drill Rig Truck	20	84
Drum Mixer	50	80
Dump Truck	40	76
Excavator	40	81
Flat Bed Truck	40	74
Front End Loader	40	79
Generator	50	81
Generator (<25KVA, VMS Sign)	50	73
Gradall	40	83
Grader	40	85
Jackhammer	20	89
Man Lift	20	75
Mounted Impact Hammer (hoe ram)	20	90
Paver	50	77
Pneumatic Tools	50	85
Pump	50	81
Roller	20	80
Scraper	40	84
Trenching Machine	50	80
Tractor	40	84
Vacuum Street Sweeper	10	82
Welders	40	74

Source: FHWA Roadway Construction Noise Model User's Guide, 2006.

The 8-hour $L_{eq(8\text{-}hr)}$ should be calculated for all equipment anticipated to be used for each phase of construction using Equation 1 above.

In addition, the noise level for the loudest equipment operating for some period of time at the nearest distance to the receptor should be calculated using Equation 2 below.

EQUATION 2: $L_{eq(8\text{-}hr)} = L_{max}$ at 50 feet - 20log(D/50) + 10log(UF) + 10log(T/8) + 10Glog(D/50)

Where:

$L_{eq(8\text{-}hr)}$ = calculated noise level, $L_{eq(8\text{-}hr)}$, at a receptor from the operation of a single loudest piece of equipment, dBA.

L_{max} at 50 feet = noise emission level of the construction equipment at the reference distance of 50 feet, dBA (from Table 1).

D = distance from the receptor to the construction equipment, feet

To represent the noise level from the loudest equipment, the distance (D) is to be from perimeter of the project construction site (or, if known, as close to the perimeter as on-site conditions physically allow and/or based on nearest expected work/activity proximity of the loudest equipment piece) to the to the receptor location.

UF = usage factor is the percentage of time during a construction noise operation that a piece of construction equipment is operating at full power.

T = number of hours (within an 8-hour period) that the loudest equipment would be operating at the distance "D" above. For example, for one hour, T would equal one (1). If T is unknown, assume one hour for purposes of this calculation.

G = a constant that accounts for topography and ground effects.

For general assessment, assumed G = 0 assuming free-field conditions and without ground effects. If ground effects are of specific importance, use the FTA procedure for calculating G.[3]

This additional loudest-equipment calculation reflects consideration for such a potentially dominant acoustical contributor to overall construction noise for a defined phase to be closer to the studied off-site receptor than the approximate geographic center of the Project site per Equation 1.

Combine the individually calculated noise levels, using Equation 1 and Equation 2, from all construction equipment within each phase of construction, using the Equation 3, below:

EQUATION 3: $L_{eq(8\text{-}hr)\ total} = 10\log\left[\sum_{all\ sources} 10^{Leq(8\text{-}hr)/10}\right]$

[3] FTA, Transit Noise and Vibration Impact Assessment Manual, Table 4-26, September 2018

An alternative calculation to the $L_{eq(8\text{-}hr)}$ noise level can be made using an area source method, using a computer prediction model, such as, SoundPLAN, CadnaA, or comparable software tools or emulators. The area source calculation method would provide a more refined calculation of the spatial average of the construction equipment over the project site. (See, e.g., attached Sample Noise Calculations Attached for the alternative calculation.)

Nighttime Construction Noise Calculations

For the nighttime construction noise, calculate the one-hour $L_{eq(1\text{-}hr)\ total}$ using above Equations 1 and 2 for the expected operating on-site equipment during a nighttime hour of interest. Then, logarithmically combine these results with Equation 4 below:

EQUATION 4: $L_{eq(1\text{-}hr)\ total} = 10\log\left[\sum_{all\ sources} 10^{Leq(1\text{-}hr)/10}\right]$

Finally, calculate the composite construction plus ambient noise level, using Equation 5 below:

EQUATION 5: $L_{eq(composite)} = 10\log\left[10^{Leq(1\text{-}hr)\ total/10} + 10^{Leq(ambient)/10}\right]$

Determine the potential noise impact by comparing the composite construction noise level from Equation 5 with the measured nighttime ambient noise levels. Noise impact is considered significant if the composite construction noise levels (project construction noise plus nighttime ambient) is 5 dBA or higher than the nighttime ambient noise level.

Vibration Calculations

Vibration levels at the receptor locations are to be calculated based on the Caltrans published standard vibration velocities for various construction equipment operations, as provided in Table 2.

Table 2

Construction Equipment Reference Vibration Source Levels

EQUIPMENT	REFERENCE PPV AT 25 FEET (IN/SEC)
Vibratory Roller	0.210
Large Bulldozer	0.089
Caisson Drilling	0.089
Loaded Trucks	0.076
Jackhammer	0.035
Small Bulldozer	0.003

Source: Caltrans, Transportation and Construction Vibration Guidance Manual, 2020.

The vibration velocities at a receptor can be calculated based on a point source with standard distance propagation conditions, pursuant to Caltrans procedures, using Equation 6, below.

EQUATION 6: $PPV_{Equipment} = PPV_{Ref} (25/D)^n$ (in/sec)

Where:

$PPV_{Equipment}$ = calculated vibration level at a receptor from the operation of a single piece of equipment.

PPV_{Ref} = reference vibration level (PPV) of the construction equipment at the reference distance of 25 feet, dBA (from Table 2).

D = distance from the receptor to the construction equipment, feet

n = 1.1 (the value related to the attenuation rate through ground)

Caltrans suggests a value of 1.1 for "n" because vibration from construction equipment originates primarily near the ground surface. A higher value of "n" based on site-specific soil conditions could be used for a less-conservative estimation of vibration level, such as 1.5 as used by FTA or per Table 3 from the Caltrans 2020 *Transportation and Construction Vibration Guidance Manual*.

Sample Noise Calculations:

Project 1 (Large Project): 1111 Sunset Project EIR

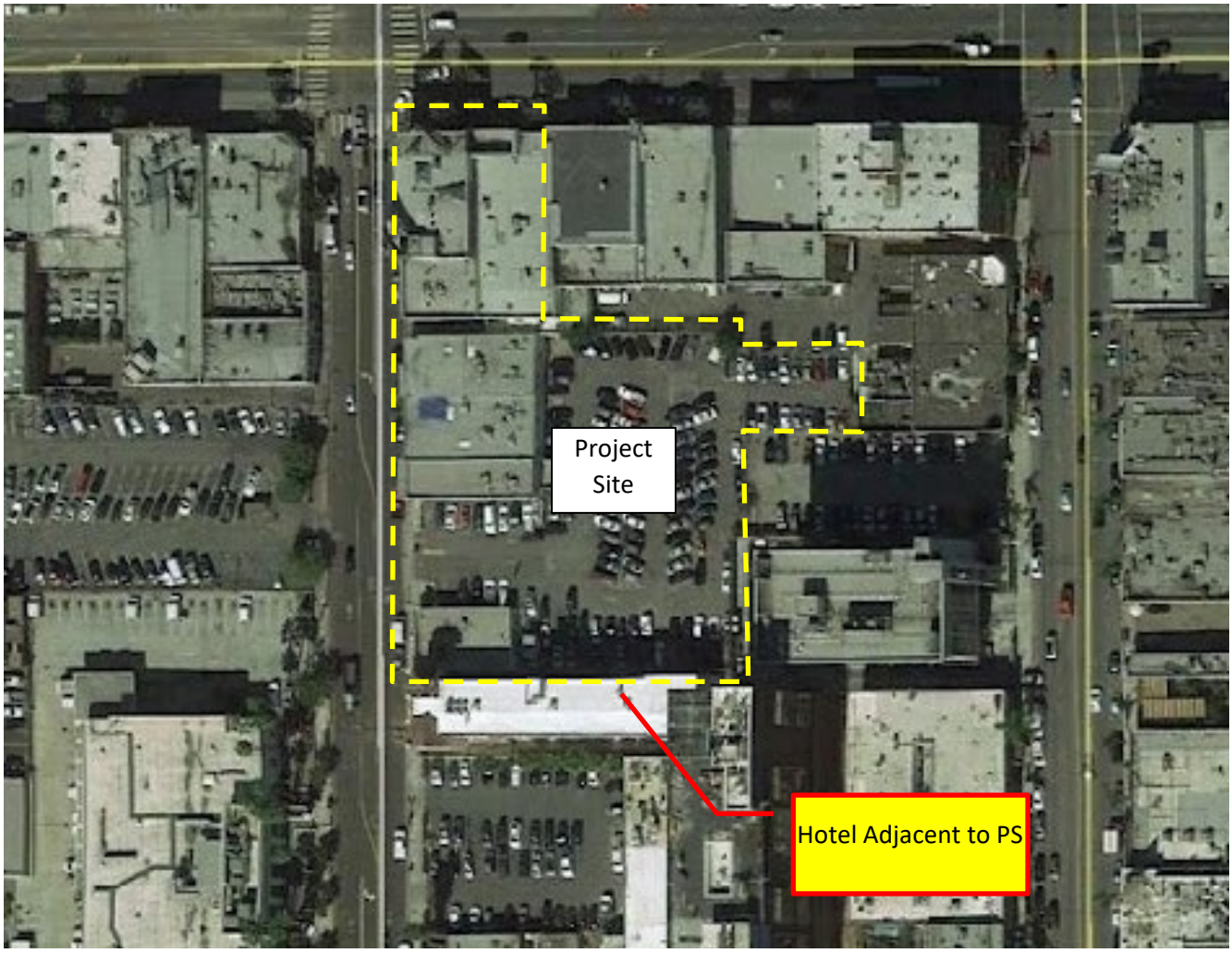
Project 2 (Medium Project): Hollywood & Wilcox Project EIR

Project 3 (Small Project): 8000 W 3rd Street Project MND

PROJECT 1: 8-Hour Leq Construction Noise Calculations - 1111 Sunset Project EIR

Calculation Method (With all equipment operating 8 hours)	Estimated Noise Levels at Nearest Receptor, dBA Leq(8-hr)	
	Demolition/Grading Phase	Grading/Excavation Phase
1. All equipment at center of Project Site (approximately 300 feet), with one noisiest piece near the receptor (70 feet) for one hour. *Calculation using Excel spreadsheet.*	77	75
2. All equipment spatially spread across entire site (modelled as an area source). *Calculation using SoundPLAN computer prediction model.*	72	71
Assumptions: – Demo/Grading Phase: (3) bore/drill rigs, (2) cement and mortar mixers, (4) excavator, (2) plate compactor, (1) generator, (1) rough terrain forklift, (4) rubber-tired loaders, (2) skid steer loaders, (2) tractor/loader/backhoes, (3) water trucks, (3) welders, (1) air compressor, (1) concrete saw. – Grading/Excavation Phase: (3) bore/drill rigs, (2) cement and mortar mixers, (4) excavator, (2) plate compactor, (1) generator, (1) rough terrain forklift, (4) rubber-tired loaders, (2) skid steer loaders, (2) tractor/loader/backhoes, (3) water trucks, (3) welders.		

PROJECT 2: 8-Hour Leq Construction Noise Calculations - Hollywood & Wilcox Project EIR



Calculation Method (With all equipment operating 8 hours)	**Estimated N oise Levels at Nearest Receptor, dBA Leq(8-hr)**	
	Demolition Phase	**Grading Phase**
1. All equipment at center of Project Site (approximately 150 feet), with one noisiest piece near the receptor (10 feet) for one hour. *Calculation using Excel spreadsheet.*	88	83
2. All equipment spatially spread across entire site (modelled as an area source). *Calculation using SoundPLAN computer prediction model.*	80	80
Assumptions: - Demo Phase: (1) concrete saw, (2) excavators, (1) front end loader, (1) bobcat, (1) water truck, (1) air compressor. – Grading Phase: (2) bore/drill rigs, (1) plate compactor, (1) excavator, (1) front end loader, (2) tieback drill rigs, (1) air compressor, (2) concrete trucks, (1) crane, (4) welders.		

PROJECT 3: 8-Hour L_{eq} Construction Noise Calculations - 8000 W 3rd Street Project MND

Calculation Method (With all equipment operating 8 hours)	Estimated Noise Levels at Nearest Receptor, dBA Leq(8-hr)	
	Demolition Phase	Grading Phase
1. All equipment at center of Project Site (approximately 75 feet), with one noisiest piece near the receptor (75 feet) for one hour. *Calculation using Excel spreadsheet.*	84	82
2. All equipment spatially spread across entire site (modelled as an area source). *Calculation using SoundPLAN computer prediction model.*	79	78
Assumptions: – Demo Phase: (1) concrete saw, (1) excavators, (2) tractor/loader/backhoe, (1) air compressor. – Grading Phase: (1) bore/drill rigs, (2) excavators, (2) tractor/loader/backhoe, (1) pump, (1) crane, (1) welder.		