Appendix J

OUSD Central Administrative Center at Cole Campus Project Noise Study

Illingworth & Rodkin, April 7, 2022

COLE CENTRAL ADMINISTRATIVE / EDUCATION CENTER PROJECT

Oakland, California

April 7, 2022

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INTRODUCTION

This report assesses potential noise and vibration impacts resulting from the construction and operation of the Oakland Unified School District (OUSD) Central Administrative Center at Cole Campus Project proposed at 1011 Union Street in Oakland, California. The project proposes to demolish the existing Cole Middle School and cafeteria buildings in order to build a two-story, 56,176 square foot administrative office/education building. The new building would include 13 to 14 classrooms, multiple office rooms and meeting rooms, and space for IT Department work including a separate server room.

This report evaluates the project's potential to result in significant impacts with respect to applicable California Environmental Quality Act (CEQA) guidelines. The report is divided into three sections: 1) the Setting Section provides a brief description of the fundamentals of environmental noise, summarizes applicable regulatory criteria, and discusses the results of the ambient noise monitoring survey completed to document existing noise conditions; 2) the General Plan Consistency – Noise and Land use Compatibility section discusses noise and land use compatibility utilizing policies in the City's General Plan; and, 3) the Impacts and Mitigation Measures Section describes the significance criteria used to evaluate project impacts and provides a discussion of each project impact with respect to the significance criteria.

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 Leq. The most common averaging period is hourly, but Leq can describe any series of noise events of arbitrary duration.

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

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

Effects of Noise

Sleep and Speech Interference

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

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The DNL as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 50 dBA DNL. At a DNL of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the DNL increases to 70 dBA, the percentage of the population highly annoyed increases to about 25-30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a DNL of 60-70 dBA. Between a DNL of 70-80 dBA, each decibel increase increases by about 3 percent the percentage of the population highly annoyed. People appear to respond more adversely to aircraft noise. When the DNL is 60 dBA, approximately 30-35 percent of the population is believed to be highly annoyed. Each decibel increase to 70 dBA adds about 3 percentage points to the number of people highly annoyed. Above 70 dBA, each decibel increase results in about a 4 percent increase in the percentage of the population highly annoyed.

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 – Noise

Noise-related regulations, plans, and policies established by the State of California and the City of Oakland are applicable in this assessment of the proposed project. These planning documents are implemented during the environmental review process to limit noise exposure at existing and proposed noise-sensitive land uses.

State of California

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

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

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

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

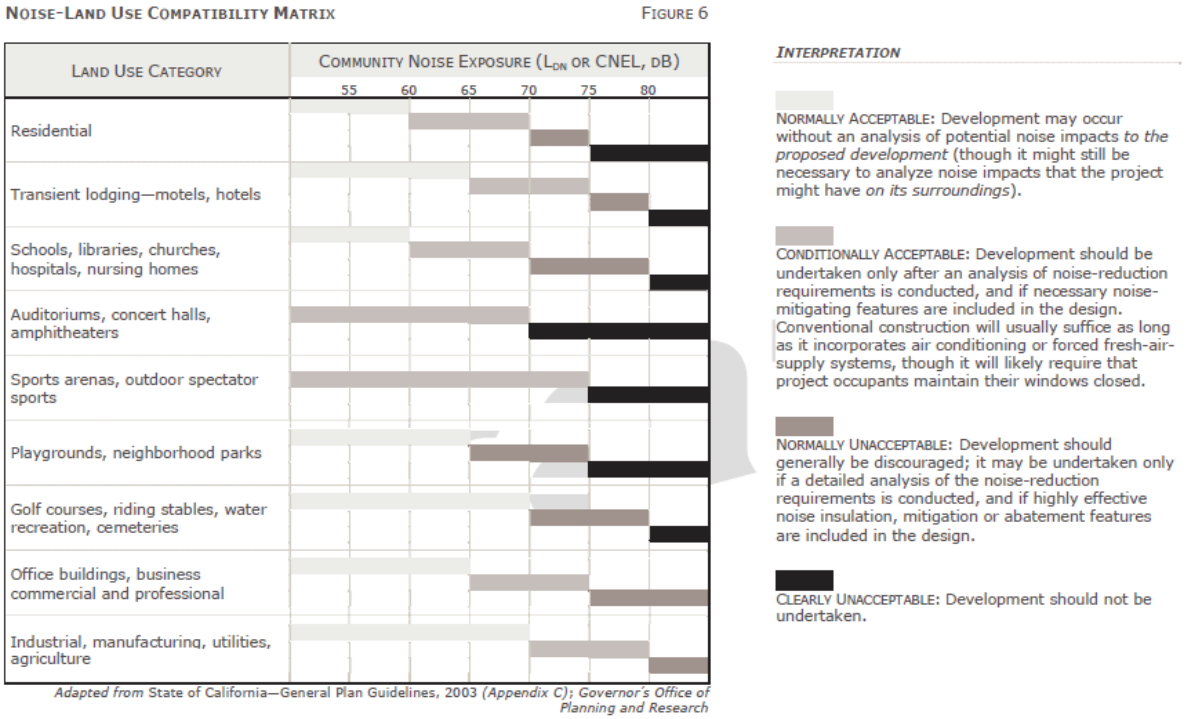
Checklist items (a) and (b) are applicable to the proposed project. The project is not located within the vicinity of a private airstrip or a public airport and would not expose people residing or working in the project area to excessive aircraft noise levels; therefore, item (c) is not carried further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

2019 California Green Building Standards Code (Cal Green Code). The State of California established exterior sound transmission control standards for new non-residential buildings as set forth in the 2019 California Green Building Standards Code (Section 5.507.4.1 and 5.507.4.2). Section 5.507 states that either the prescriptive (Section 5.507.4.1) or the performance method (Section 5.507.4.2) shall be used to determine environmental control at indoor areas. The prescriptive method is very conservative and not practical in most cases; however, the performance method can be quantitatively verified using exterior-to-interior calculations. For the purposes of this report, the performance method is utilized to determine consistency with the Cal Green Code. Both of the sections that pertain to this project are as follows:

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

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

City of Oakland General Plan Noise Element. The Noise-Land Use Compatibility Matrix (Figure 6 of the Noise Element) categorizes noise levels at office buildings of up to 65 dBA L_{dn}/CNEL as "acceptable", from 65 to 75 dBA L_{dn}/CNEL as "conditionally acceptable", and from 75 to 85 dBA L_{dn}/CNEL as "normally unacceptable".



City of Oakland Planning Code. The noise performance standards of the Oakland Planning Code set out to control operational and construction noise levels. These policies were further clarified in the City of Oakland CEQA Thresholds of Significance Guidelines, dated October 17, 2016. The following policies are applicable to the project.

Section 17.120.050 G, Temporary Construction and Demolition Noise: Table Oakland-1, below, specifies the maximum noise level allowable at receiving uses during short and long term construction or demolition projects. The City allows for an exemption if an acoustical analysis is performed that identifies recommend measures to reduce potential impacts.[1]

[1] The acoustical analysis must identify, at a minimum, (a) the types of construction equipment expected to be used and the noise levels typically associated with the construction equipment and (b) the surrounding land uses including any sensitive land uses (e.g., schools and childcare facilities, health care and nursing homes, public open space). If sensitive land uses are present, the acoustical analysis must recommend measures to reduce potential impacts.

TABLE Oakland-1 City of Oakland Construction Noise Standards at Receiving Property Line, dBA[1]		
Receiving Land Use	**Maximum Allowable Noise Level (dBA)**	
	Weekdays 7 a.m.-7 p.m.	**Weekends 9 a.m.-8 p.m.**
Less than 10 days		
Residential	80	65
Commercial, Industrial	85	70
More than 10 Days		
Residential	65	55
Commercial, Industrial	70	60
Notes: 1) If the ambient noise level exceeds these standards, the standard shall be adjusted to equal the ambient noise level.		

Section 8.18.020, Persistent Noises a Nuisance: The persistent maintenance or emission of any noise or sound produced by human, animal or mechanical means, between the hours of nine p.m. and seven a.m., which, by reason of its raucous or nerve-racking nature, shall disturb the peace or comfort, or be injurious to the health of any person shall constitute a nuisance.

Failure to comply with the following provisions shall constitute a nuisance.

A. All construction equipment powered by internal combustion engines shall be properly muffled and maintained.

B. Unnecessary idling of internal combustion engines is prohibited.

C. All stationary noise-generating construction equipment such as tree grinders and air compressors are to be located as far as is practical from existing residences.

D. Quiet construction equipment, particularly air compressors, are to be selected whenever possible.

E. Use of pile drivers and jack hammers shall be prohibited on Sundays and holidays, except for emergencies and as approved in advance by the Building Official.

Section 17.120.050 A-F, Operational Noise: Table Oakland-2, below, specifies the maximum noise level allowable at receiving uses during new project operations.

TABLE Oakland-2 City of Oakland Operational Noise Standards at Receiving Property Line, dBA[1]			
Receiving Land Use	**Cumulative No. of Minutes in 1-Hr Period[2]**	**Maximum Allowable Noise Level (dBA)**	
		Daytime 7 a.m.-10 p.m.	**Nighttime 10 p.m.-7 a.m.**
Residential and Civic[3]	20 (L_{33})	60	45
	10 ($L_{16.7}$)	65	50
	5 ($L_{8.3}$)	70	55
	1 ($L_{1.7}$)	75	60
	0 (L_{max})	80	65
		Anytime	
Commercial	20 (L_{33})	65	
	10 ($L_{16.7}$)	70	
	5 ($L_{8.3}$)	75	
	1 ($L_{1.7}$)	80	
	0 (L_{max})	85	
Manufacturing, Mining, and Quarrying	20 (L_{33})	70	
	10 ($L_{16.7}$)	75	
	5 ($L_{8.3}$)	80	
	1 ($L_{1.7}$)	85	
	0 (L_{max})	90	

Notes: 1) These standards are reduced 5 dBA for simple tone noise, noise consisting primarily of speech or music, or recurring impact noise. If the ambient noise level exceeds these standards, the standard shall be adjusted to equal the ambient noise level.

2) L_x represents the noise level that is exceeded X percent of a given period. L_{max} is the maximum instantaneous noise level.

3) Legal residences, schools and childcare facilities, health care or nursing home, public open space, or similarly sensitive land uses.

Existing Noise Environment

The project site is located west of Union Street, north of 10th Street, east of Poplar Street, and south of Wade Johnson Park. The project site consists of approximately 2.8 acres of land currently occupied by the former Cole Middle School and cafeteria buildings. The surrounding area is predominately residential with multifamily residences to the west and south, an Oakland Housing Authority office to the south, and single-family residences to the east and northeast. The California Cereal Products industrial site to the north serves as the primary source of noise in the site vicinity.

A noise monitoring survey was performed between Wednesday, July 15, 2020 and Friday, July 17, 2020 to quantify and characterize ambient noise levels at the site and in the project vicinity. The monitoring survey included one long-term measurement (LT-1) and one short-term measurement (ST-1). The noise environment results primarily from operations at the California

Cereal Products industrial site located approximately 150 feet north of the nearest project property line. Other secondary sources of noise such as traffic along local roadways and distant highways are insubstantial and dominated by noise from operations at the industrial site. Figure 1 shows the location of noise measurements relative to the project site.

Long-term measurement LT-1 was made at the southwest corner of the site near the intersection of Poplar Street and 10th Street. This location was chosen in order to characterize noise resulting from local traffic and industrial sources in the general site vicinity including at residences to the west. Hourly average noise levels at this location ranged from 54 to 65 dBA L_{eq} during the day and from 50 to 56 dBA L_{eq} at night. The day-night average noise level on Thursday, July 16, 2020 was 62 dBA L_{dn}. The daily trend in noise levels at LT-1 is shown in Figures 2 through 4.

Short-term noise measurement ST-1 was made over a 10-minute period on Wednesday, July 15, 2020 between 8:30 a.m. and 8:40 a.m. ST-1 quantified noise levels near the northwestern corner of the site, across from Wade Johnson Park and approximately 275 feet southwest of the California Cereal Products industrial site. As with the rest of the site vicinity, noise at this location was dominated by industrial activities. Table 4 summarizes the results of measurement ST-1.

TABLE 4 Summary of Short-Term Noise Measurement Data (dBA)

Noise Measurement Location (Date, Time)	L_{max}	$L_{(1)}$	$L_{(10)}$	$L_{(50)}$	$L_{(90)}$	$L_{eq(10\text{-}min)}$	L_{dn}[1]
ST-1: Across Poplar Street Near Northwest Corner of Site, ~275 feet Southwest of California Cereal Products Site (Wednesday, 7/15/2020, 8:30 a.m. – 8:40 a.m.)	67	67	67	66	65	66	71

[1] L_{dn} for short-term measurement ST-1 was calculated through comparison with corresponding long-term measurement LT-1.

FIGURE 1 Noise Measurement Locations

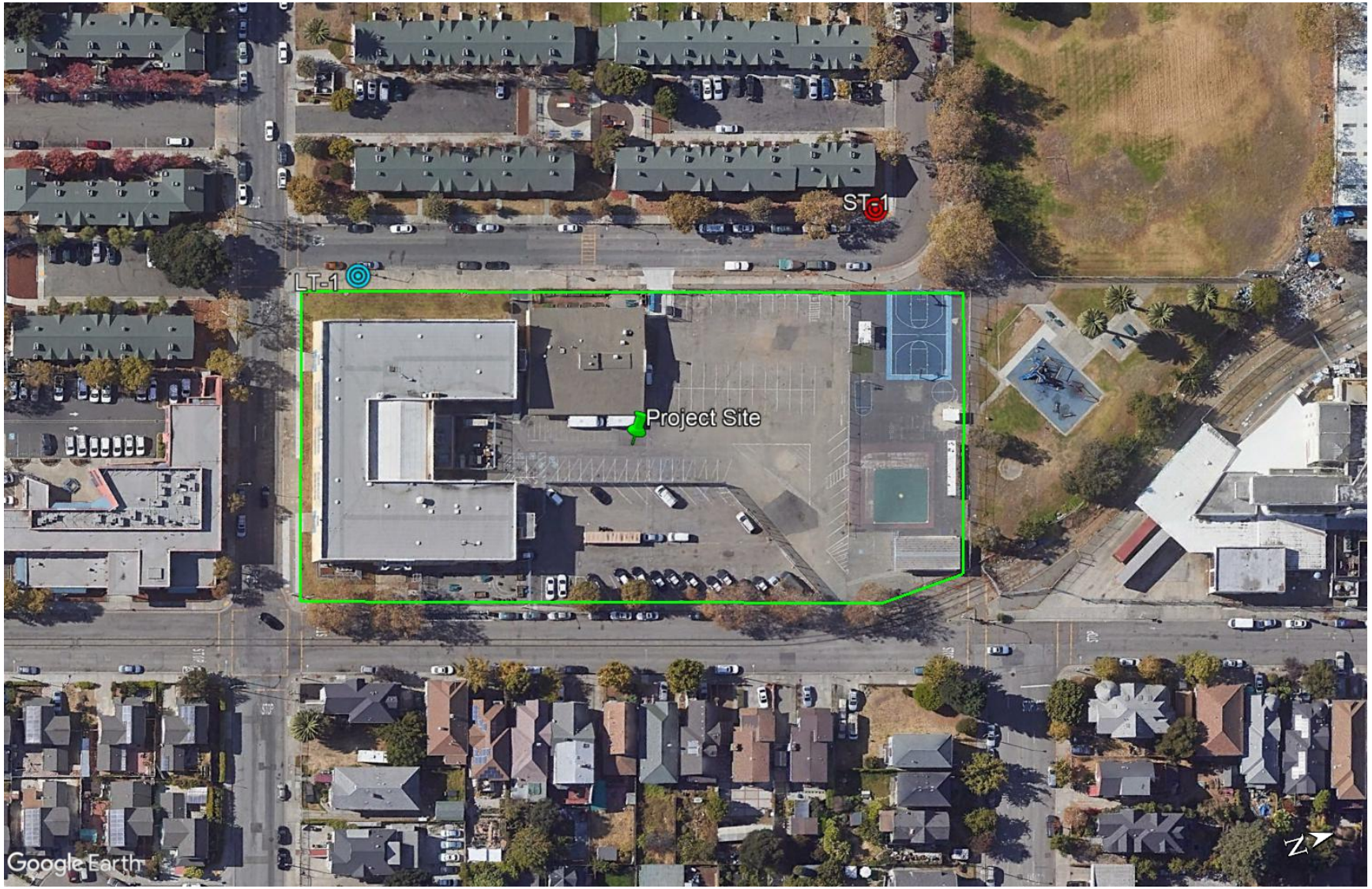


FIGURE 2 Noise Levels at Measurement Site LT-1 on Wednesday, July 15, 2020

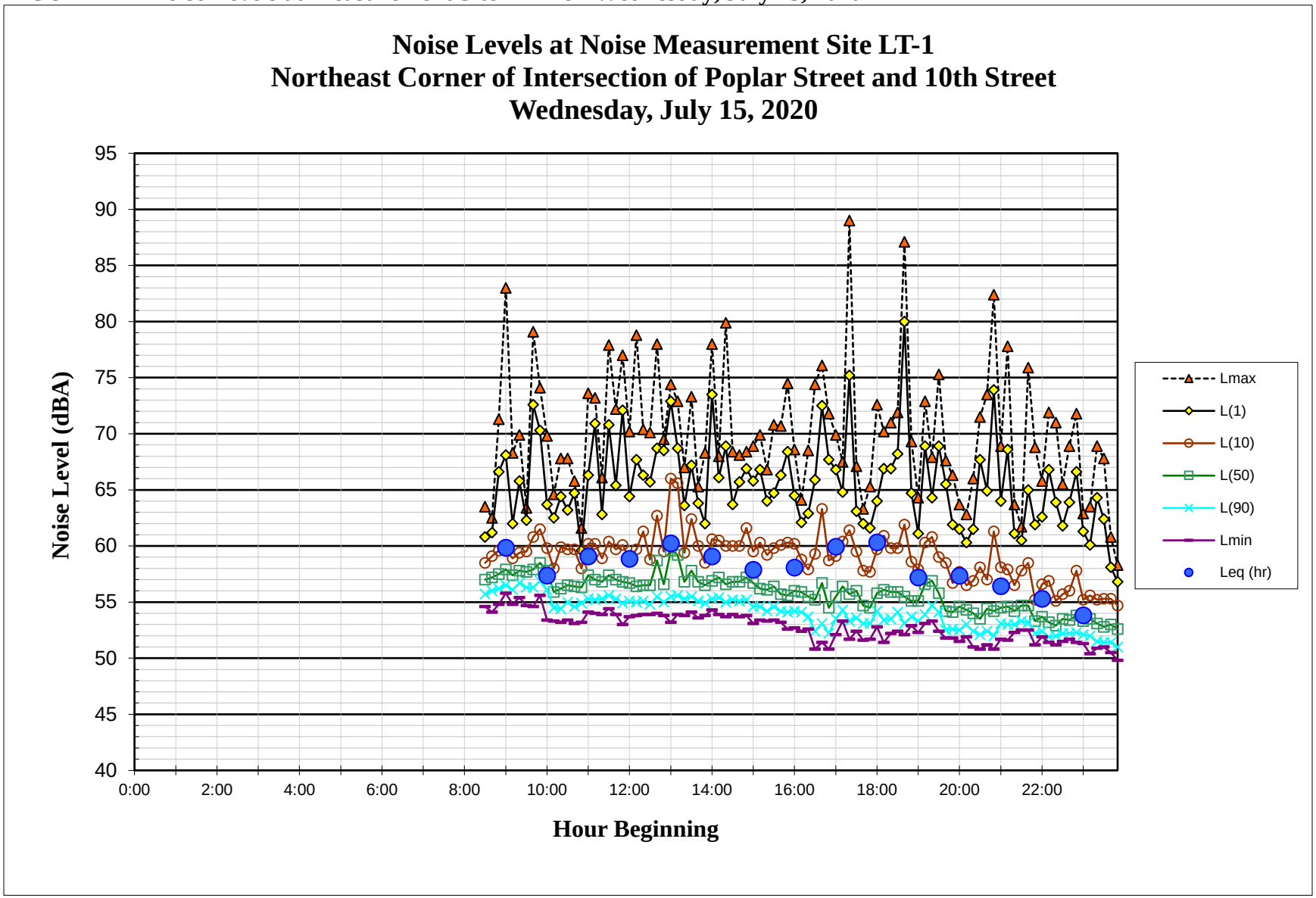


FIGURE 3 Noise Levels at Measurement Site LT-1 on Thursday, July 16, 2020

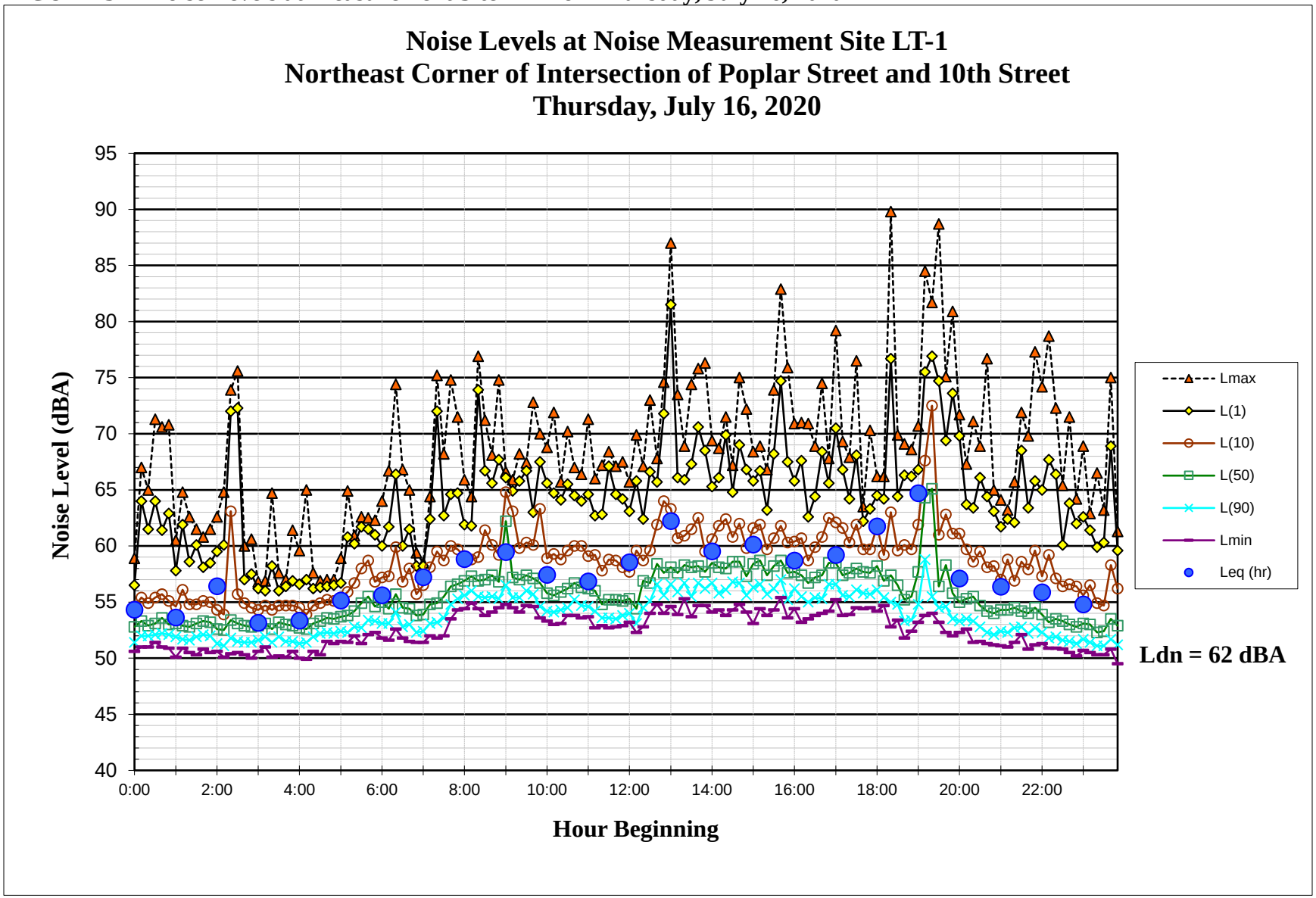
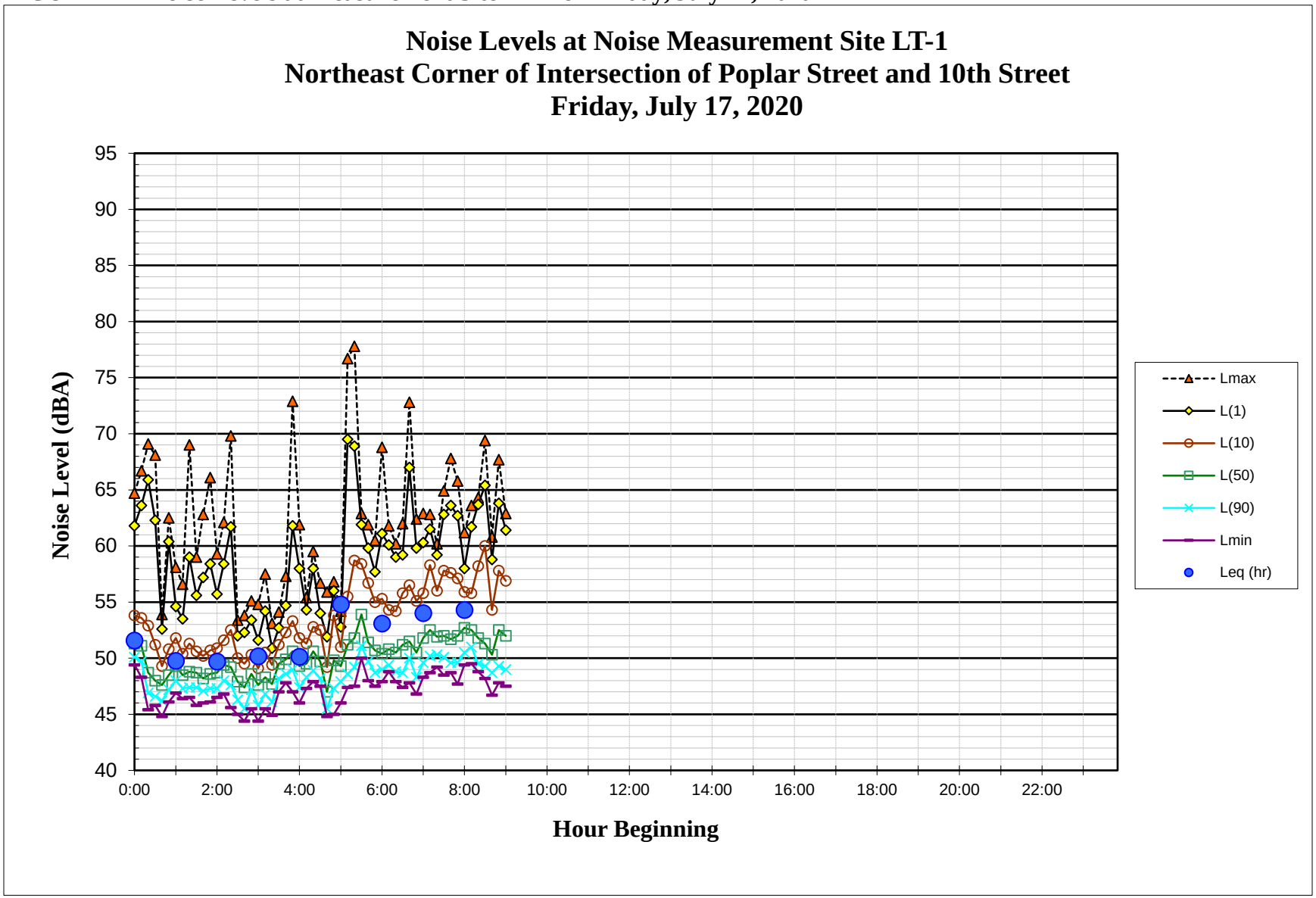


FIGURE 4 Noise Levels at Measurement Site LT-1 on Friday, July 17, 2020



GENERAL PLAN CONSISTENCY ANALYSIS

The impacts of site constraints such as exposure to excessive levels of noise and vibration are not considered under CEQA. This section addresses Noise and Land Use Compatibility for consistency with the policies set forth in the Oakland General Plan and California Green Building Standards Code.

Noise and Land Use Compatibility

The applicable State of California and City of Oakland General Plan policies were presented in detail in the Regulatory Background section and are summarized below:

- The City of Oakland General Plan specifies exterior noise level standards for office uses. An exterior noise level of 65 dBA L_{dn} is considered 'normally acceptable' and an exterior noise level of 75 dBA L_{dn} is considered 'conditionally acceptable.'

- The Cal Green Code establishes a maximum interior noise limit of 50 dBA $L_{eq\ (1\text{-}hr)}$ for occupied areas of non-residential buildings during any hour of operation.

Future Exterior Noise Environment

The future exterior noise environment at the project site would continue to result primarily from operations at the California Cereal Products industrial site. This analysis assumes that noise resulting from activity at the industrial site will continue in the future and not substantially change from existing, measured levels.

Based on measurement data, noise levels throughout the site would be dependent on distance from the industrial site to the north. Noise levels would range from 62 dBA L_{dn} along the southern property line and increase to about 74 dBA L_{dn} along the northern property line. This falls within the 'conditionally acceptable' range of noise levels specified for office land uses in the City of Oakland General Plan.

Project plans indicate a small playground space would be constructed at the northeastern corner of the site. This space would be located next to the southern end of the existing Wade Johnson Playground. Given the proximity of the California Cereal Products industrial site and its size, mitigating noise at the project site, in particular at the northern end where the playground would be located, is not practical. To adequately shield the playground space from industrial noise such that the day-night noise level would not exceed the 'normally acceptable' criterion of 65 dBA L_{dn}, the playground would have to be substantially if not fully enclosed. Revising the site plan to relocate the playground to the southern end of the site along 10th Street would have the potential to reduce the noise level to below the 65 dBA L_{dn} criterion. However, this would potentially diminish the function of the playground by no longer being adjacent to the Wade Johnson Playground and may therefore also be considered impractical. No exterior noise mitigation is recommended.

Future Interior Noise Environment

The Cal Green Code requires that interior noise levels attributable to exterior sources not exceed 50 dBA $L_{eq\ (1\text{-}hr)}$ in occupied areas of non-residential uses during any hour of operation. Based on the results of the noise monitoring survey, peak-hour noise levels would be about 3 dBA higher than day-night average levels and would range between 65 dBA $L_{eq\ (1\text{-}hr)}$ at the southern end of the site to 77 dBA $L_{eq\ (1\text{-}hr)}$ at the northern end of the site. The greatest noise exposure would occur along the northern façades of the administration building and multi-purpose room.

Floorplans for the first and second floors dated June 8, 2020 and February 19, 2021, respectively, indicate that rooms along the northern façades of the proposed building would include noise-sensitive uses such as offices, conferences rooms, and classrooms. As peak-hour noise levels along the northern façades are expected to reach up to 77 dBA $L_{eq\ (1\text{-}hr)}$, a minimum exterior-to-interior noise reduction of 27 dBA would be required to ensure compatibility with the Cal Green Code standard of 50 dBA $L_{eq\ (1\text{-}hr)}$.

Standard office construction with windows in the closed position typically provides for a noise reduction of about 25 dBA, with noise-rated construction materials being required to achieve a greater reduction. Preliminary calculations were made based on building elevations dated January 24, 2020. Rooms near the center of the northern façade would feature large windows resulting in a window-to-wall ratio of up to 48%. Considering this, and metal panel exterior wall construction, windows with a minimum Sound Transmission Class (STC) rating of 30 would be required along the northern façade of the administrative building in order to provide the noise reduction necessary to meet the Cal Green Code standard of 50 dBA $L_{eq\ (1\text{-}hr)}$. Due to shielding provided by the proposed building and attenuation resulting from an increased distance from the California Cereal Products industrial site, noise levels along eastern, western, and southern façades of project buildings are not expected to exceed 75 dBA $L_{eq\ (1\text{-}hr)}$, and therefore standard construction with windows in the closed position would be sufficient. Forced-air mechanical ventilation would be required to allow occupants to keep windows closed to control noise.

Recommended Conditions of Approval:

- Provide all occupied areas of the proposed building with a forced-air mechanical ventilation system to allow for windows to be closed to control noise at the occupant's discretion.

- Special building techniques (e.g., sound-rated windows and building façade treatments) are required to maintain interior noise levels at or below acceptable levels. These treatments would include, but are not limited to, sound-rated windows and doors, sound-rated wall construction, acoustical caulking, and protected ventilation openings. Preliminary calculations indicate that rooms located along the northern façade of the proposed building would require windows with a minimum STC rating of 30 to ensure that the 50 dBA $L_{eq\ (1\text{-}hr)}$ Cal Green Code standard is met.

IMPACTS AND MITIGATION MEASURES

Significance Criteria

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

1. **Temporary or Permanent Noise Increases in Excess of Established Standards:** A significant impact would be identified in the following cases:

    a. Operational Noise in Excess of Standards. A significant impact would be identified if project operations were to exceed the noise level standards specified in Table Oakland-2.

    b. Permanent Noise Increase. A significant permanent noise increase would occur if a) the noise level increase is 5 dBA L_{dn} or greater, with a future noise level of less than 60 dBA L_{dn}, or b) the noise level increase is 3 dBA L_{dn} or greater, with a future noise level of 60 dBA L_{dn} or greater.

    c. Temporary Noise Increase. Construction noise impacts would be considered significant if project construction were to exceed the City of Oakland's Construction (or Demolition) Noise Performance Standards for activities that occur for more than 10 days (70 dBA at commercial uses and 65 dBA at residential uses during weekday daytime hours).

2. **Generation of Excessive Groundborne Vibration:** A significant impact would be identified if the construction of the project would expose persons to excessive vibration levels. Groundborne vibration levels exceeding 0.3 in/sec PPV would have the potential to result in cosmetic damage to buildings.

Impact 1: **Temporary or Permanent Noise Increases in Excess of Established Standards.** The proposed project would not generate operational noise levels in excess of the standards established in the City's General Plan or Municipal Code at nearby sensitive receptors. With the implementation of Oakland's standard controls and recognizing that noise generated by construction activities would occur over a temporary period, the temporary increase in ambient noise levels occurring during construction would also be in compliance with the City's Code. **This is a less-than-significant impact**.

a. Permanent Noise from On-Site Operations

Operational noise sources proposed with the Project include mechanical equipment, parking, and testing of an emergency backup generator. Table Oakland-2 of the City of Oakland Planning Code establishes maximum allowable noise levels for daytime and nighttime hours at residential, civic, and commercial receiving land uses.

Mechanical Equipment

Heating, ventilation, and air conditioning (HVAC) equipment for the project would include a variable refrigerant flow (VRF) system of outdoor heat pumps and interior fan coil units. Information regarding the number, size, model, and location of HVAC equipment was not available at the time of this study. Typical VRF heat pumps for office buildings of this size would generate noise levels around 58 to 68 dBA at a distance of 3 feet. Noise from mechanical equipment would typically drop off at a rate of about 6 dBA per doubling of distance. Outdoor heat pumps are usually located on building rooftops. For rooftop equipment, shielding from the rooftop and screens would be anticipated to provide 10 to 15 dBA of additional reduction, assuming the screen/rooftop would be constructed without any gaps or cracks. Any barriers should have a minimum surface weight of 3 pounds per square foot (such as 1-inch-thick wood, ½-inch laminated glass, masonry block, concrete, or one-inch metal).

Property lines of residential and civic land uses nearest to potential locations for HVAC equipment are located at residences approximately 65 feet to the west, residences approximately 70 feet to the east, and the Wade Johnson Playground approximately 20 feet to the north. One commercial use, the Oakland Housing Authority office building, is located approximately 250 feet to the south. The most restrictive standard for operational noise set in Table Oakland-2 of the City of Oakland Planning Code limits operational noise sources at receiving residential and civic land uses to 60 dBA L_{33} during daytime hours and 45 dBA L_{33} during nighttime hours. The L_{33} metric represents a noise level that is exceeded for one third (20 minutes) of any given hour. As noise from HVAC equipment is fairly stable when operating, the average noise levels for VRF heat pumps described above can be applied to the Table Oakland-2 standards.

Without considering shielding and attenuation from rooftops and parapet walls, noise from VRF heat pumps would not be expected to exceed 45 dBA beyond a distance of 46 feet from the equipment, or to exceed 60 dBA beyond a distance of 11 feet from the equipment. VRF equipment would not exceed daytime noise limits at any surrounding land uses. Under worst-case placement conditions, nighttime operation of VRF equipment could potentially exceed the 45 dBA L_{33} limit at the Wade Johnson Playground. However, the City of Oakland Parks and Recreation Advisory Commission has established park hours at the Wade Johnson Playground to be from dawn to dusk, and therefore the park would not be used during nighttime hours. This is a **less-than-significant** impact.

Generator Testing

A data center used by OUSD would be relocated from the existing Cole Middle School building to the new administration building. Continuous operation of data centers is ensured through use of emergency backup generators. The project proposes to include a 150 kW Cummins QSB7-G5 diesel backup generator at the southwestern corner of the site. The generator would be housed in a level 2 sound enclosure and surrounded by a 12-inch thick, 15-foot high CMU wall. Generator operations during emergency situations would be exempt from City regulations. However, testing of generators is typically considered an operational noise source and Table Oakland-2 limits would apply.

Sound data for the generator was made available and analyzed. When equipped with the level 2 sound enclosure, testing of the generator at full capacity would result in a noise level of 73 dBA at a distance of 23 feet. Noise resulting from generator testing was modeled in SoundPLAN, a three-dimensional noise modeling software that considers site geometry, the characteristics of the noise sources, and shielding from structures and barriers. Based on noise modeling results, the 15-foot CMU wall surrounding the generator is anticipated to provide a noise reduction of about 17 dBA, resulting in a noise level during testing at full capacity of 56 dBA at a distance of 23 feet. The nearest noise-sensitive land uses to the generator are residences to the west and south, with property lines located approximately 75 feet from the center of the generator enclosure. At this distance, noise from generator testing is anticipated to reach approximately 47 dBA. Generator testing is typically only conducted during daytime hours and for a period of 15 minutes to two hours. With the level 2 sound enclosure and 15-foot CMU wall surrounding the generator, noise from generator testing would not exceed any daytime noise limits set in Table Oakland-2 of the City of Oakland Planning Code. This is a **less-than-significant** impact.

Parking Lot

Parking for the project would be provided in two separate parking lots; a 63-space lot at the southern portion of the site and a 30-space lot on the westerly portion of the site. The parking lots would be located approximately 70 feet from the property lines of the nearest noise-sensitive land uses including residences to the east and west and the Oakland Housing Authority office building to the south.

Noise sources associated with the use of the parking lots include vehicular circulation, engines, car alarms, squealing tires, door slams, and human voices. The sound of engines starting, doors slam closing, and people talking in the parking lot typically reach maximum levels of 50 to 60 dBA L_{max} at a distance of 50 feet. Parking lot noise would generate maximum noise levels in the range of 47 to 57 dBA L_{max} at a distance of 70 feet, not taking shielding from terrain into account. The hourly average noise level resulting from all these noise-generating activities in a small parking lot would be anticipated to reach 40 dBA L_{eq} at a distance of 50 feet from the parking area.

Maximum noise levels generated in the parking lot would be lower in level than existing maximum noise levels generated by the California Cereal Products industrial site and would be below the daytime threshold established by the City of Oakland. This is a **less-than-significant** impact.

Mitigation Measure 1a: None required.

b. Permanent Noise Increases from Project Traffic

Trip generation numbers for an earlier iteration of project design which occupied the same footprint were provided by Fehr & Peers. Daily operations at the site for this version would result in a peak hour generation of 73 trips. District board meetings would bring in greater traffic, resulting in 190 trips entering and leaving the site for maximum attendance meetings. For the current version of the project, it is anticipated that there will be approximately 70 total OUSD staff employees working on a typical day. Adult and Career Education programs to be held at within

the Education Center floor of the building are assumed to offer classes on its current schedule, with certain classes offered between 9:00 to 12:00 a.m., certain classes offered between 1:00 and 4:00 p.m., and other classes offered between 6:00 and 8:30 p.m. It is also assumed that a total of approximately 100 students and faculty would attend the morning class schedule, approximately 100 students and faculty would attend the afternoon class schedule, and as many as 175 students and faculty would attend the evening class schedule.

Traffic noise increases resulting from daily operations and board meetings were modeled in the Federal Highway Administration's Traffic Noise Model 2.5. Based on traffic noise modeling using peak hour trip generation numbers provided for the previous iteration of the project design, the project would generate a traffic noise level of 48 dBA L_{eq} at 50 feet during peak-hour daily operations and a traffic noise level of 52 dBA L_{eq} at 50 feet during maximum attendance board meetings. An additional worst-case scenario was considered wherein a trip would be generated for each of the 70 employees working on a typical day and for each of the 175 students attending an evening class session. In this scenario, the project would generate a traffic noise level of 53 dBA L_{eq} at 50 feet.

Traffic resulting from daily operations would not measurably increase noise levels in the site vicinity. Noise resulting from traffic generated by maximum attendance board meetings would have the potential to increase noise by about 2 dBA when occurring during the quietest measured existing ambient hour. The imagined worst-case scenario of 245 total trips occurring resulting from departure of all evening students and employees would have the potential to increase noise by about 3 dBA when occurring during the quietest measured existing ambient hour. Hourly trip generation resulting from typical daily project operations would not significantly increase noise levels above that of the existing ambient noise environment, which ranged from 54 to 65 dBA L_{eq} during the measurement survey. As board meetings would happen occasionally and with different levels of attendance, board meetings would not contribute significantly to the existing ambient noise environment in the site vicinity. Additionally, noise levels in the vicinity of the site are dominated by California Cereal Products industrial noise and small increases in roadway traffic would not be noticeable above the dominant industrial noise source. Typical project traffic would result in noise increases below 3 dBA and noise from the California Cereal Products would continue to dominate the noise environment in the vicinity of the site. This is a **less-than-significant** impact.

Mitigation Measure 1b: None required.

c. Temporary Noise Increases from Project Construction

Table Oakland-1 of the City of Oakland Planning Code regulates hours of construction and noise from construction activity. Construction activities are limited to the hours of 7:00 a.m. to 7:00 p.m., Monday through Friday, and 9:00 a.m. to 8:00 p.m. on weekends. Daytime construction noise levels for project lasting more than 10 days are limited to a maximum of 65 dBA at receiving property lines of residences and 70 dBA at receiving property lines of commercial and industrial uses, except for areas where the existing ambient noise level exceeds these limits and the limit is then set to the ambient level. Based on noise measurement data, existing ambient noise levels

exceed 65 dBA at some residences to the west, east, and northeast of the site. Section 8.18.020 of the Planning Code includes provisions to mitigate noise from construction activities.

The first phase of construction would include demolition of the existing cafeteria building, removal of the existing single-story freestanding modular building, and removal of all existing building foundations on the northerly portion of the site. All existing concrete, pavement and asphalt, existing on-site utility infrastructure and fencing on the northerly portion of the site would be removed and disposed of, and this portion of the site would be graded to accommodate a new building. After this preparatory phase is complete, construction of the new, two-story Cole Administrative Center/Education building would begin. After construction of the building shell is complete, the existing Cole Middle School building on the southerly portion of the site would be demolished, and the remaining area of the site would be graded to accommodate new parking. The final phase of construction would include landscaping and hardscape improvements.

During each stage of construction, there would be a different mix of equipment operating, and noise levels would vary by stage and vary within stages, based on the amount of equipment in operation and the location at which the equipment is operating. Typical construction noise levels at a distance of 50 feet are shown in Tables 5 and 6. Table 5 shows the average noise level ranges by construction phase, and Table 6 shows the maximum noise level ranges for different construction equipment.

Project construction is expected to last for a period exceeding one year. Construction would take place Monday through Friday during the hours of 7:00 a.m. to 7:00 p.m., consistent with the Planning Code. Specific information on numbers of and types of construction equipment to be used per phase was not available. Pile driving is not proposed as a method of construction.

Using typical construction noise levels for office buildings as shown in Table 5, noise from construction may reach 75 to 89 dBA L_{eq} at a distance of 50 feet. Residential property lines nearest the site are located about 170 feet east and west of the approximate center of construction. At this distance, construction noise levels may reach 64 to 78 dBA L_{eq} during busy periods of construction when multiple pieces of equipment are in operation. This would result in an increase of 6 to 20 dBA over the existing daytime ambient noise level of 58 to 69 dBA L_{eq} at these residences. The nearest nonresidential property lines are located at the Wade Johnson Playground, about 250 feet north of the approximate center of construction, and at the Oakland Housing Authority building, about 300 feet south of the approximate center of construction. Noise levels during busy periods of construction with multiple pieces of equipment in operation may reach 61 to 75 dBA L_{eq} at the Wade Johnson Playground and 59 to 73 dBA L_{eq} at the Oakland Housing Authority building. This would result in an increase of up to 10 dBA over the existing daytime ambient noise level of 64 to 75 dBA L_{eq} at Wade Johnson Park, and an increase of 6 to 20 dBA L_{eq} over the existing daytime ambient noise level of 53 to 64 at the Oakland Housing Authority Building. The use of noise control would be anticipated to reduce construction noise levels by 5 to 10 dBA.

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.

TABLE 6 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

Equipment Category	L_{max} Level (dBA)[1,2]	Impact/Continuous
Horizontal Boring Hydro Jack	80	Continuous
Hydra Break Ram	90	Impact
Impact Pile Driver	105	Impact
Insitu Soil Sampling Rig	84	Continuous
Jackhammer	85	Impact
Mounted Impact Hammer (hoe ram)	90	Impact
Paver	85	Continuous
Pneumatic Tools	85	Continuous
Pumps	77	Continuous
Rock Drill	85	Continuous
Scraper	85	Continuous
Slurry Trenching Machine	82	Continuous
Soil Mix Drill Rig	80	Continuous
Street Sweeper	80	Continuous
Tractor	84	Continuous
Truck (dump, delivery)	84	Continuous
Vacuum Excavator Truck (vac-truck)	85	Continuous
Vibratory Compactor	80	Continuous
Vibratory Pile Driver	95	Continuous
All other equipment with engines larger than 5 HP	85	Continuous

Notes:

[1] Measured at 50 feet from the construction equipment, with a "slow" (1 sec.) time constant.

[2] Noise limits apply to total noise emitted from equipment and associated components operating at full power while engaged in its intended operation.

[3] Portable Air Compressor rated at 75 cfm or greater and that operates at greater than 50 psi.

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

The City of Oakland allows for an exemption if an acoustical analysis is performed that identifies measures to reduce potential impacts. The following standard controls, consistent with the Oakland Municipal Code, are assumed to be included in the project:

- Limit all exterior construction activities to within the hours of 7:00 am and 7:00 pm on Weekdays, with no construction occurring on Sundays or federal holidays. Use of the concrete saw shall be limited to the hours between 8:00 am and 4:00 pm on weekdays. Interior construction would also be allowed from 9:00 am and 5:00 pm on Saturdays.

- Work with adjoining properties to determine the best days and times to conduct heavy construction located within 50 feet of shared property lines.

- Equipment and trucks used for project construction shall utilize the best available noise control techniques (e.g., improved mufflers, equipment redesign, use of intake silencers, ducts, engine enclosures and acoustically attenuating shields or shrouds), wherever feasible.

- Impact tools (e.g., jackhammers, pavement breakers, and rock drills) used for project construction shall be hydraulically or electrically powered to avoid noise associated with

compressed air exhaust from pneumatically powered tools. However, where use of pneumatic tools is unavoidable, an exhaust muffler on the compressed air exhaust shall be used; this muffler can lower noise levels from the exhaust by up to about 10 dBA. External jackets on the tools themselves shall be used, if such jackets are commercially available and this could achieve a reduction of 5 dBA. Quieter procedures shall be used, such as drills rather than impact equipment, whenever such procedures are available and consistent with construction procedures.

- Use temporary power poles instead of generators where feasible.

- Locate stationary noise sources as far from adjacent receptors as possible, and they shall be muffled and enclosed within temporary sheds, incorporate insulation barriers, or use other measures as determined by the City to provide equivalent noise reduction.

- Stage large equipment, compressors, or generators at least 25 feet from the site perimeters when work is not being done near these uses.

- The noisiest phases of construction shall be limited to less than 10 days at a time. Exceptions may be allowed if the City determines an extension is necessary and all available noise reduction controls are implemented.

- Construction activities should be conducted in a manner that minimizes the noise impact at the adjacent property boundaries wherever possible. Construction equipment shall be positioned as far from noise sensitive receptors as possible.

- Prohibit unnecessary idling of internal combustion engines.

- Erect temporary plywood noise barriers around the construction site when construction is located adjacent to property lines shared with residential uses.

- Utilize noise control blankets on the building structures as the buildings are erected.

- Conduct a preconstruction meeting with the City of Oakland and Contractor to identify potential sources of noise and how to mitigate them.

- Notify property owners and occupants located within 300 feet of construction activities at least 14 calendar days prior to commencement of construction.

- Designate an on-site construction complaint and enforcement manager for the project.

- Post a large on-site sign near the public right-of-way containing permitted construction days/hours, complaint procedures and phone numbers for the complaint manager and City Code Enforcement unit.

- Maintain a complaint log that records received complaints and how complaints were addressed, which shall be submitted to the City for review upon the City's request.

- Construction noise monitoring should be undertaken if reliable noise complaints are received during demolition, excavation, and/or construction activities. Noise levels should be monitored representative of ground level outdoor use areas and/or the worst-case ground level façade window exposure at the location from which the noise complaints originated by a qualified acoustical professional. Integrated average (L_{eq}) noise level measurements on an hourly basis should be made of activities representative of those that generated the complaint. If the measured noise levels during this test are found to exceed the City's construction noise performance standards, an acoustical professional should be retained to specify additional noise attenuation measures to reduce noise levels to City Standards. These measures may include operational considerations, the use of additional ground level noise barriers or noise control blanketing of the building structure.

Implementation of the above standard controls would reduce construction noise levels emanating from the site, limit construction hours, and minimize disruption and annoyance. With the implementation of these controls and recognizing that noise generated by construction activities would occur over a temporary period, the temporary increase in ambient noise levels would be **less-than-significant**.

Mitigation Measure 1c: **None required**.

Impact 2: **Exposure to Excessive Groundborne Vibration.** Construction-related vibration would not be excessive at nearby residential land uses or existing school buildings. **This is a less-than-significant impact.**

The construction of the project may generate perceptible vibration when heavy equipment or impact tools (e.g., jackhammers, hoe rams, etc.) are used in areas adjacent to developed properties. Construction activities would include demolition of existing structures, parking lot renovation, and construction of the office building and multi-purpose building.

The City of Oakland does not establish a vibration limit for construction. The California Department of Transportation recommends a vibration limit of 0.3 in/sec PPV for buildings that are found to be structurally sound and designed to modern engineering standards and a vibration limit of 0.25 in/sec PPV for historic and some old buildings (see Table 3). The nearest historic building to the site is the Herbert Hoover House located approximately 1,000 feet to the east at 1079 12th Street. Groundborne vibration levels exceeding 0.3 in/sec PPV at surrounding structures of modern construction and/or vibration levels exceeding 0.25 in/sec PPV at the Herbert Hoover House would have the potential to result in a significant vibration impact.

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 work area. Table 7 presents typical vibration levels that could be expected from construction equipment at a distance of 25 feet and calculated vibration levels at distances representative of nearby structures. Pile driving would not be used as a method of construction for the project.

TABLE 7 Vibration Source Levels for Construction Equipment

Equipment		PPV at 25 ft. (in/sec)	PPV at 55 ft. (in/sec)	PPV at 75 ft. (in/sec)	PPV at 1,000 ft. (in/sec)
Clam shovel drop		0.202	0.085	0.060	0.003
Hydromill (slurry wall)	in soil	0.008	0.003	0.002	0.000
	in rock	0.017	0.007	0.005	0.000
Vibratory Roller		0.210	0.088	0.063	0.004
Hoe Ram		0.089	0.037	0.027	0.002
Large bulldozer		0.089	0.037	0.027	0.002
Caisson drilling		0.089	0.037	0.027	0.002
Loaded trucks		0.076	0.032	0.023	0.001
Jackhammer		0.035	0.015	0.010	0.001
Small bulldozer		0.003	0.001	0.001	0.000

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

Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Residences are located as close as about 55 feet from the eastern property line of the site and 75 feet from the western and southern property lines of the site. At these distances, vibration levels resulting from heavy equipment use (e.g., vibratory rollers, clam shovel drops) would be expected to be about 0.060 to 0.088 in/sec PPV, which would be well below the 0.3 in/sec PPV limit recommended by the California Department of Transportation. Vibration levels at the Herbert Hoover House are not expected to exceed 0.004 in/sec PPV and would also not exceed any recommended limits. This is a **less-than-significant impact**.

Mitigation Measure 2: None Required