NOISE AND VIBRATION IMPACT ANALYSIS

9822 RUSSELL AVENUE PROJECT

GARDEN GROVE, CALIFORNIA

LSA

March 2026

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LIST OF ABBREVIATIONS AND ACRONYMS

ALUC	Airport Land Use Commission
Caltrans	California Department of Transportation
Caltrans Manual	California Department of Transportation's *Transportation and Construction Vibration Guidance Manual*
CCR	California Code of Regulations
City	City of Garden Grove
CMU	concrete masonry unit
CNEL	Community Noise Equivalent Level
D	distance from the receiver to a piece of equipment
dB	decibel(s)
dBA	A-weighted decibel(s)
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
FTA Manual	Federal Transit Administration's 2018 *Transit Noise and Vibration Impact Assessment Manual*
HVAC	heating, ventilation, and air conditioning
in/sec	inches per second
JWA	John Wayne Airport
L_{50}	median noise level
L_{dn}	day-night average noise level
L_{eq}	equivalent continuous sound level
L_{max}	maximum instantaneous sound level
L_V	vibration velocity
Noise Element	Noise Element of the City of Garden Grove General Plan
PPV	peak particle velocity

project	9822 Russell Avenue Project
RMS	root-mean-square
SR-22	California State Route 22
V	root-mean-square velocity amplitude

INTRODUCTION

LSA prepared this Noise and Vibration Impact Analysis to evaluate the potential noise and vibration impacts and reduction measures associated with the proposed 9822 Russell Avenue Project (project) in Garden Grove, California. This report is intended to satisfy the City of Garden Grove's (City) requirement for a project-specific noise impact analysis by examining the impacts of the project site and evaluating noise reduction measures that the project may require.

PROJECT LOCATION

The project site is at 9822 Russell Avenue, in the central portion of Garden Grove. The site is approximately 0.12 mile north of State Route 22 (SR-22) and one block west of Brookhurst Street, both of which provide regional access to the site. Direct access to the site is provided by Russell Avenue to the north and Kerry Street to the west.

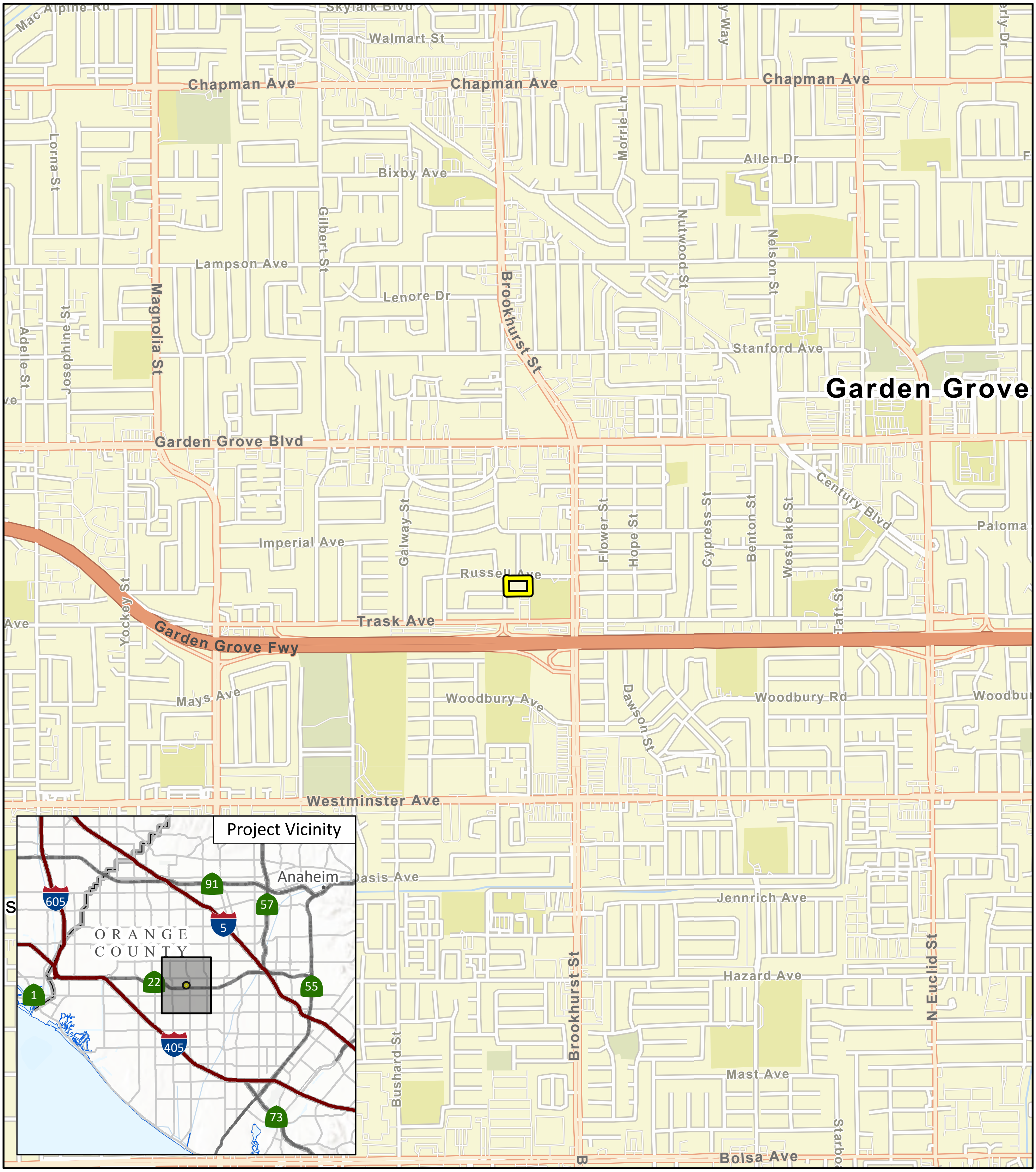
The project site is identified as Assessor Parcel Number 098-081-19 and is within the United States Geologic Survey *Anaheim* 7.5 Minute Series Topographic Quadrangle, and within Section 5, Township 5 South, Range 10. Figure 1 illustrates the regional and project locations.

EXISTING SITE CONDITIONS

The 1.81-acre project site is currently developed with a church, preschool, and daycare facility; a parking lot; and landscaping areas. The existing on-site development consists of three buildings that include a church structure located adjacent to Russel Avenue that is approximately 33 feet in height and topped with a church steeple and cross, and two buildings (a one-story and a two-story) that include a preschool/daycare and office areas. The two buildings are connected by a covered breezeway and the maximum height of the two-story preschool/office building is 28 feet.

The church sanctuary consists of 7,700 square feet, the office and meeting rooms used by the church total 7,892 square feet, and the preschool/daycare is 2,875 square feet, which totals 18,467 square feet of building space on the project site.

The project site has General Plan Land Use designation of Low Density Residential (LDR). The General Plan states that the LDR land use designation is characterized by detached, single-unit structures and accessory dwelling units, and allows up to 11 dwelling units per acre. The site is zoned Single-Family Residential (R-1). Section 9.08.020.020 of the Municipal Code states that the R-1 zone is intended to provide for the establishment and promotion of single-family detached residences on individual lots and compatible associated activities. Section 9.08.020.020 of the Municipal Code details that churches, child daycare centers, religious schools, educational institutions are permitted within the R-1 zone with a Conditional Use Permit.



Project Location

FIGURE 1

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SOURCE: Esri Street Map 2026

9822 Russell Avenue Project

Project Location

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EXISTING LAND USES IN THE PROJECT AREA

The project site is within a developed and urban area and is adjacent to roadways, residential, school, and church uses as described below:

- **North:** Russell Avenue is adjacent to the north of the site followed by multifamily residential uses that have a General Plan land use and zoning designation of R-2 (Limited Multiple Residential).

- **East:** Sunnyside Elementary School is adjacent to the east of the site on land that has a General Plan land use and zoning designation of Open Space (O-S).

- **South:** Single-family residences and a church parking lot are adjacent to the south on land that has a General Plan land use and zoning designation of Single-Family Residential (R-1).

- **West:** Kerry Street is adjacent to the west of the site followed by single-family residences on land that has a General Plan land use and zoning designation of Single-Family Residential (R-1).

The nearest sensitive receptors are the existing residential uses approximately 10 feet south of the project site boundary.

PROJECT DESCRIPTION

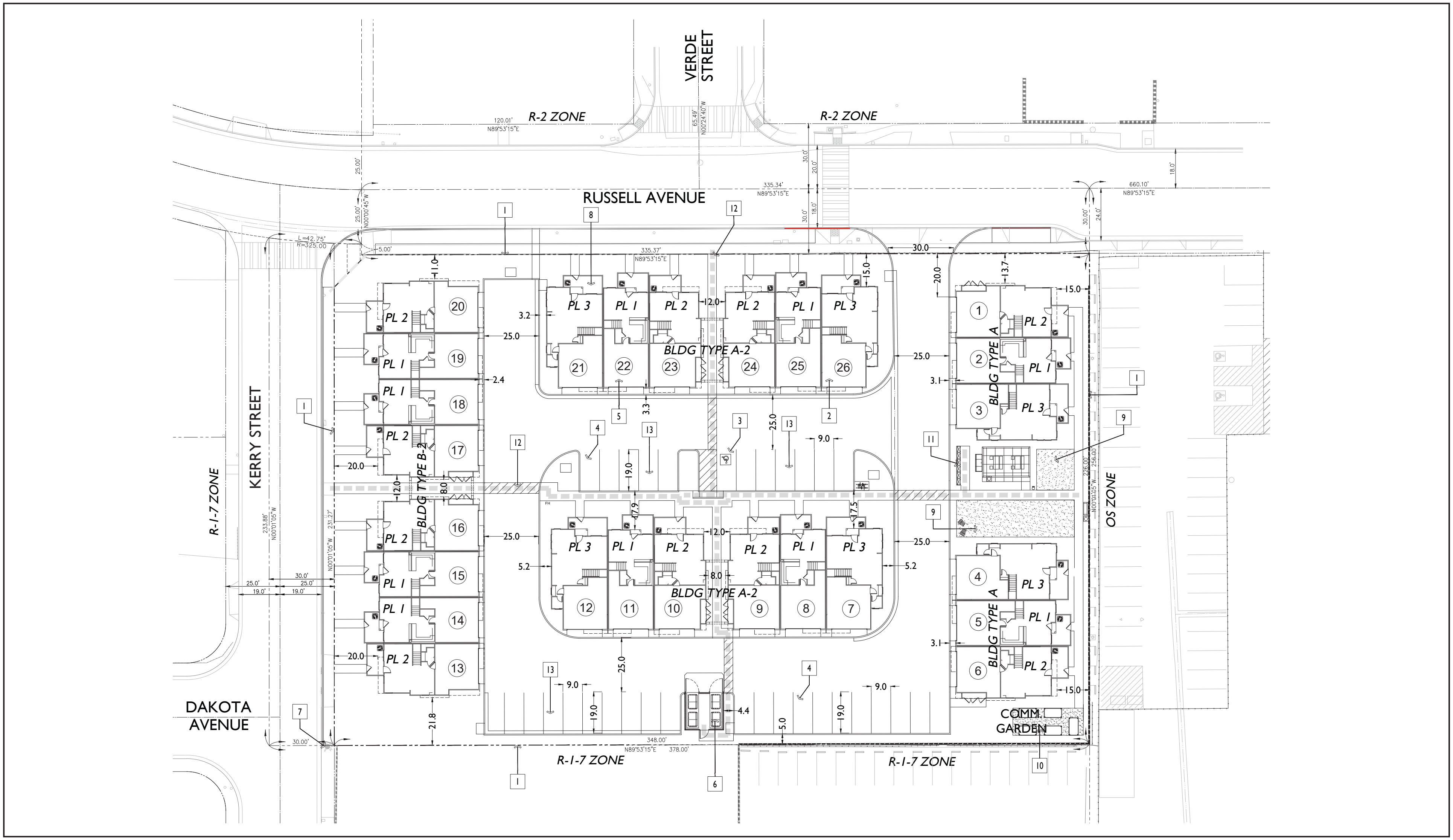
The project would demolish the existing church, preschool, and daycare facility building and improvements on the project site and construct 26 two-story townhome residences, open space/recreation, and parking. The project would include parking, open space, ornamental landscaping, and associated infrastructure. Figure 2 shows the site plan.

The two-story residential buildings would have a maximum height of 29 feet 9 inches. The project would result in a density of 14.4 dwelling units per acre. The residences would have a two-car garage and a ground-level patio that would be delineated by 3-foot, 6-inch-high vinyl fencing.

The townhome structures would be set back a minimum of 20-feet from the Kerry Street right-of-way, 11 feet from the 5-foot-wide sidewalk along Russell Avenue along the building sides, and 15 feet from building frontages facing Russell Avenue. In addition, building structures would be a minimum of 20 feet from the single-family residences to the south and a minimum of 15 feet from the eastern property line.

The project includes a 3,750 square foot central active open space recreation area with shade structures, barbecues with buffet countertops, picnic seating, a community garden with raised planter boxes, open turf, bench seating, and shade trees.

The project would install 6-foot-high concrete masonry unit (CMU) walls along the south and east site boundaries. In addition, the front patio area of each residence would be delineated by a 3-foot, 6-inch-high vinyl fencing while providing Americans with Disabilities Act path of travel through the site.



LSA

FIGURE 2

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SOURCE: Suma Architechture

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9822 Russell Avenue Project

Site Plan

The project applicant would install new, on-site water and sewer lines, which would connect to the existing 6-inch-diameter water main in Russell Avenue and the existing 8-inch sewer main within Russell Avenue to the north of the project site.

The project would install a new on-site drainage system to accommodate the proposed site plan. Stormwater runoff would be captured by catch basins that would route runoff to biofiltration treatment devices prior to infiltration into site soils.

Construction activities for the project would take place over 11 months in the following stages: (1) demolition and removal of existing structures/asphalt/pavement; (2) site preparation, which includes clearing any remaining infrastructure, utilities, and trenching for the new utilities/services; (3) grading and excavation; (4) building construction; and (5) landscape installation, paving, and application of architectural coatings.

The City's Municipal Code Chapter 8.47 limits construction activities to the hours of 7:00 a.m. to 7:00 p.m. Monday through Friday and 9:00 a.m. to 6:00 p.m. on Saturdays. No construction work would be permitted on Sundays or federal holidays.

NOISE AND VIBRATION FUNDAMENTALS

CHARACTERISTICS OF SOUND

Noise is usually defined as unwanted sound. Noise consists of any sound that may produce physiological or psychological damage and/or interfere with communication, work, rest, recreation, and sleep.

To the human ear, sound has two significant characteristics: pitch and loudness. Pitch is generally an annoyance, whereas loudness can affect the ability to hear. Pitch is the number of complete vibrations, or cycles per second, of a sound wave, which results in the tone's range from high to low. Loudness is the strength of a sound, and it describes a noisy or quiet environment; it is measured by the amplitude of the sound wave. Loudness is determined by the intensity of the sound waves combined with the reception characteristics of the human ear. Sound intensity is the average rate of sound energy transmitted through a unit area perpendicular to the direction in which the sound waves are traveling. This characteristic of sound can be precisely measured with instruments. The analysis of the project defines the noise environment of the project area in terms of sound intensity and its effect on adjacent sensitive land uses.

MEASUREMENT OF SOUND

Sound intensity is measured with the A-weighted decibel (dBA) scale to correct for the relative frequency response of the human ear. That is, an A-weighted noise level de-emphasizes low and very high frequencies of sound, similar to the human ear's de-emphasis of these frequencies. Decibels (dB), unlike the linear scale (e.g., inches or pounds), are measured on a logarithmic scale representing points on a sharply rising curve.

For example, 10 dB is 10 times more intense than 0 dB, 20 dB is 100 times more intense than 0 dB, and 30 dB is 1,000 times more intense than 0 dB. Thirty decibels (30 dB) represent 1,000 times as much acoustic energy as 0 dB. The decibel scale increases as the square of the change, representing the sound pressure energy. A sound as soft as human breathing is about 10 times greater than 0 dB. The decibel system of measuring sound gives a rough connection between the physical intensity of sound and its perceived loudness to the human ear. A 10 dB increase in sound level is perceived by the human ear as only a doubling of the sound's loudness. Ambient sounds generally range from 30 dB (very quiet) to 100 dB (very loud).

Sound levels are generated from a source, and their decibel level decreases as the distance from that source increases. Sound levels dissipate exponentially with distance from their noise sources. For a single point source, sound levels decrease approximately 6 dB for each doubling of distance from the source. This drop-off rate is appropriate for noise generated by stationary equipment. If noise is produced by a line source (e.g., highway traffic or railroad operations), the sound decreases 3 dB for each doubling of distance in a hard site environment. Line source sound levels decrease 4.5 dB for each doubling of distance in a relatively flat environment with absorptive vegetation.

There are many ways to rate noise for various time periods, but an appropriate rating of ambient noise affecting humans also accounts for the annoying effects of sound. The equivalent continuous sound level (L_{eq}) is the total sound energy of time-varying noise over a sample period. However, the predominant rating scales for human communities in the State of California are the L_{eq} and Community Noise Equivalent Level (CNEL) or the day-night average noise level (L_{dn}) based on A-weighted decibels. CNEL is the time-weighted average noise over a 24-hour period, with a 5 dBA weighting factor applied to the hourly L_{eq} for noises occurring from 7:00 p.m. to 10:00 p.m. (defined as relaxation hours) and a 10 dBA weighting factor applied to noises occurring from 10:00 p.m. to 7:00 a.m. (defined as sleeping hours). L_{dn} is similar to the CNEL scale but without the adjustment for events occurring during the relaxation. CNEL and L_{dn} are within 1 dBA of each other and are normally interchangeable. The City uses the CNEL noise scale for long-term traffic noise impact assessment.

Other noise rating scales of importance when assessing the annoyance factor include the maximum instantaneous noise level (L_{max}), which is the highest sound level that occurs during a stated time period. The noise environments discussed in this analysis for short-term noise impacts are specified in terms of maximum levels denoted by L_{max}, which reflects peak operating conditions and addresses the annoying aspects of intermittent noise. It is often used together with another noise scale, or noise standards in terms of percentile noise levels, in noise ordinances for enforcement purposes. For example, the L_{10} noise level represents the noise level exceeded 10 percent of the time during a stated period. The L_{50} noise level represents the median noise level. Half the time the noise level exceeds this level, and half the time it is less than this level. The L_{90} noise level represents the noise level exceeded 90 percent of the time and is considered the background noise level during a monitoring period. For a relatively constant noise source, the L_{eq} and L_{50} are approximately the same.

Noise impacts can be described in three categories. The first category includes audible impacts, which are increases in noise levels noticeable to humans. Audible increases in noise levels generally refer to a change of 3 dB or greater because this level has been found to be barely perceptible in exterior environments. The second category, potentially audible, refers to a change in the noise level between 1 dB and 3 dB. This range of noise levels has been found to be noticeable only in laboratory environments. The last category includes changes in noise levels of less than 1 dB, which are inaudible to the human ear. Only audible changes in existing ambient or background noise levels are considered potentially significant.

PHYSIOLOGICAL EFFECTS OF NOISE

Physical damage to human hearing begins at prolonged exposure to sound levels higher than 85 dBA. Exposure to high sound levels affects the entire system, with prolonged sound exposure in excess of 75 dBA increasing body tensions, thereby affecting blood pressure and functions of the heart and the nervous system. In comparison, extended periods of sound exposure above 90 dBA would result in permanent cell damage. When the sound level reaches 120 dBA, a tickling sensation occurs in the human ear, even with short-term exposure. This level of sound is called the threshold of feeling. As the sound reaches 140 dBA, the tickling sensation is replaced by a feeling of pain in the ear (i.e., the threshold of pain). A sound level of 160–165 dBA will result in dizziness or a loss of equilibrium. The ambient or background noise problem is widespread and generally more concentrated in urban areas than in outlying, less developed areas.

Table A lists definitions of acoustical terms, and Table B shows common sound levels and their sources.

Table A: Definitions of Acoustical Terms

Term	Definitions
Decibel, dB	A unit of sound measurement that denotes the ratio between two quantities that are proportional to power; the number of decibels is 10 times the logarithm (to the base 10) of this ratio.
Frequency, hertz	Of a function periodic in time, the number of times that the quantity repeats itself in 1 second (i.e., the number of cycles per second).
A-Weighted Sound Level, dBA	The sound level obtained by use of A-weighting. 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. (All sound levels in this report are A-weighted unless reported otherwise.)
L_{01}, L_{10}, L_{50}, L_{90}	The fast A-weighted noise levels that are equaled or exceeded by a fluctuating sound level 1%, 10%, 50%, and 90% of a stated time period, respectively.
Equivalent Continuous Noise Level, L_{eq}	The level of a steady sound that, in a stated time period and at a stated location, has the same A-weighted sound energy as the time-varying sound.
Community Noise Equivalent Level, CNEL	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 5 dBA to sound levels occurring in the evening from 7:00 p.m. to 10:00 p.m. and after the addition of 10 dBA to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m.
Day/Night Noise Level, L_{dn}	The 24-hour A-weighted average sound level from midnight to midnight, obtained after the addition of 10 dBA to sound levels occurring in the night between 10:00 p.m. and 7:00 a.m.
L_{max}, L_{min}	The maximum and minimum A-weighted sound levels measured on a sound level meter, during a designated time interval, using fast time averaging.
Ambient Noise Level	The all-encompassing noise associated with a given environment at a specified time. Usually a composite of sound from many sources from many directions, near and far; no particular sound is dominant.
Intrusive	The noise that intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, time of occurrence, and tonal or informational content, as well as the prevailing ambient noise level.

Sources: (1) *Technical Noise Supplement* (Caltrans 2013); (2) *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
Caltrans = California Department of Transportation
FTA = Federal Transit Administration

Table B: Common Sound Levels and Their Noise Sources

Noise Source	A-Weighted Sound Level in Decibels	Noise Environments	Subjective Evaluations
Near Jet Engine	140	Deafening	128 times as loud
Civil Defense Siren	130	Threshold of Pain	64 times as loud
Hard Rock Band	120	Threshold of Feeling	32 times as loud
Accelerating Motorcycle at a Few Feet Away	110	Very Loud	16 times as loud
Pile Driver; Noisy Urban Street/Heavy City Traffic	100	Very Loud	8 times as loud
Ambulance Siren; Food Blender	95	Very Loud	—
Garbage Disposal	90	Very Loud	4 times as loud
Freight Cars; Living Room Music	85	Loud	—
Pneumatic Drill; Vacuum Cleaner	80	Loud	2 times as loud
Busy Restaurant	75	Moderately Loud	—
Near Freeway Auto Traffic	70	Moderately Loud	Reference level
Average Office	60	Quiet	One-half as loud
Suburban Street	55	Quiet	—
Light Traffic; Soft Radio Music in Apartment	50	Quiet	One-quarter as loud
Large Transformer	45	Quiet	—
Average Residence without Stereo Playing	40	Faint	One-eighth as loud
Soft Whisper	30	Faint	—
Rustling Leaves	20	Very Faint	—
Human Breathing	10	Very Faint	Threshold of Hearing
—	0	Very Faint	—

Source: Compiled by LSA (2022).

FUNDAMENTALS OF VIBRATION

Vibration refers to ground-borne noise and perceptible motion. Ground-borne vibration is almost exclusively a concern inside buildings and is rarely perceived as a problem outdoors, where the motion may not be discernible, but without the effects associated with the shaking of a building there is less adverse reaction. Vibration energy propagates from a source through intervening soil and rock layers to the foundations of nearby buildings. The vibration then propagates from the foundation throughout the remainder of the structure. Building vibration may be perceived by occupants as the motion of building surfaces, the rattling of items sitting on shelves or hanging on walls, or a low-frequency rumbling noise. The rumbling noise is caused by the vibration of walls, floors, and ceilings that radiate sound waves.

Typical sources of ground-borne vibration are construction activities (e.g., blasting, pile-driving, and operating heavy-duty earthmoving equipment), steel-wheeled trains, and occasional traffic on rough roads. Problems with both ground-borne vibration and noise from these sources are usually localized to areas within approximately 100 feet of the vibration source, although there are examples of ground-borne vibration causing interference out to distances greater than 200 feet as detailed in the Federal Transit Administration's (FTA) 2018 *Transit Noise and Vibration Impact Assessment Manual* (FTA Manual). When roadways are smooth, vibration from traffic, even heavy trucks, is rarely perceptible. It is assumed for most projects that the roadway surface will be smooth enough that ground-borne vibration from street traffic will not exceed the impact criteria; however, construction of the project could result in ground-borne vibration that may be perceptible and annoying. Ground-borne noise is not likely to be a problem because noise arriving via the normal airborne path will usually be greater than ground-borne noise.

Ground-borne vibration has the potential to disturb people and damage buildings. Although it is very rare for train-induced ground-borne vibration to cause even cosmetic building damage, it is not uncommon for construction processes such as blasting and pile-driving to cause vibration of sufficient amplitudes to damage nearby buildings (FTA 2018). Ground-borne vibration is usually measured in terms of vibration velocity, either the root-mean-square (RMS) velocity or peak particle velocity (PPV). The RMS is best for characterizing human response to building vibration, and PPV is used to characterize the potential for damage. Decibel notation acts to compress the range of numbers required to describe vibration. Vibration velocity level in decibels is defined as

$$L_v = 20 \log_{10} [V/V_{ref}]$$

where "L_v" is the vibration velocity in decibels (VdB), "V" is the vibration amplitude, and "V_{ref}" is the reference velocity amplitude, or 1×10^{-6} inches per second (in/sec) used in the United States.

REGULATORY SETTING

APPLICABLE NOISE STANDARDS

The applicable noise standards governing the project site include the criteria in the California Code of Regulations, the Noise Element of the City's General Plan (Noise Element) and the City's Municipal Code.

California Code of Regulations

Interior noise levels for residential habitable rooms are regulated by Title 24 of the California Code of Regulations (CCR) California Noise Insulation Standards. Title 24, Chapter 12, Section 1206.4, of the 2019 California Building Code requires that interior noise levels attributable to exterior sources not exceed 45 dBA CNEL/L_{dn} in any habitable room. A habitable room is a room used for living, sleeping, eating, or cooking. Bathrooms, closets, hallways, utility spaces, and similar areas are not considered habitable rooms for this regulation (CCR Title 24, Chapter 12, Section 1206.4).

City of Garden Grove

Noise Element of the General Plan

The City's General Plan Noise Element (City of Garden Grove 2008) has established exterior noise standards to identify and prevent the creation of incompatible land uses due to noise. For multifamily residential land uses, a noise environment of 50 to 65 dBA CNEL is "normally acceptable" and 60 to 70 dBA CNEL is considered to be conditionally acceptable. For low density, single-family, and duplex residential land uses, a noise environment of 50 to 60 dBA CNEL is "normally acceptable" and 55 to 70 dBA CNEL is conditionally acceptable. If a land use falls into the conditionally acceptable category, then new construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is made and needed noise insulation features are included in the design. Conventional construction, but with closed windows and fresh air supply systems or air conditioning, will normally suffice.

The Noise Element includes the following policies that are applicable to the project:

- **Policy N-1.1:** Require all new residential construction in areas with an exterior noise level greater than 55 dBA to include sound attenuation measures.
- **Policy N-1.2**: Incorporate a noise assessment study into the environmental review process, when needed for a specific project for the purposes of identifying potential noise impacts and noise abatement procedures.
- **Policy N-1.3:** Require noise reduction techniques in site planning, architectural design, and construction, where noise reduction is necessary consistent with the standards in Tables 7-1 and 7-2, Title 24 of the California Code of Regulations, and Section 8.47 of the Municipal Code.
- **Policy N-1.5:** Require the design of mixed-use structures to incorporate techniques to prevent the transfer of noise and vibration from the commercial to residential use.

Municipal Code

The City's Municipal Code establishes the following applicable standards applicable to noise. Section 8.47.040 states that ambient base noise levels contained in Table C shall be used as the basis for determining noise levels in excess of those allowed by this chapter unless the actual measured ambient noise level occurring at the same time as the noise under review is being investigated exceeds the ambient base noise level contained in Table C. When the actual measured ambient noise level exceeds the ambient base noise level, the actual measured ambient noise level shall be used as the basis for determining whether or not the subject noise exceeds the level allowed by this section. In situations where two adjoining properties exist within two different use designations, the most restrictive ambient base noise level will apply. Sections 8.47.040 and 8.47.050(C) state that the noise standard for a cumulative period of more than 30 minutes in any hour is the ambient base noise level plus 5 dBA, as measured at the property line of the noise generation property.

Table C: Ambient Base Noise Levels

<table>
<tr><th>Use Categories</th><th>Use Designations</th><th>Ambient Base Noise Level</th><th>Noise Level Standard</th><th>Time of Day</th></tr>
<tr><td rowspan="2">Sensitive</td><td rowspan="2">Residential Use</td><td>55 dBA</td><td>60 dBA</td><td>7:00 a.m. - 10:00 p.m.</td></tr>
<tr><td>50 dBA</td><td>55 dBA</td><td>10:00 p.m. - 7:00 a.m.</td></tr>
<tr><td rowspan="3">Conditionally Sensitive</td><td>Institutional Use</td><td>65 dBA</td><td>70 dBA</td><td>Any Time</td></tr>
<tr><td>Office-Professional Use</td><td>65 dBA</td><td>70 dBA</td><td>Any Time</td></tr>
<tr><td>Hotels and Motels</td><td>65 dBA</td><td>70 dBA</td><td>Any Time</td></tr>
</table>

Source: City of Garden Grove (2025).
Note: The noise standard is the higher of the ambient base noise level or the measured ambient noise level, plus 5 dBA.
dBA = A-weighted decibel(s)

Construction noise is exempt from the provisions within the Municipal Code except as set forth in Section 8.47.060(D). Subsection D states that construction work within 500 feet from a residential area is prohibited outside the hours of 7:00 a.m. to 7:00 p.m. Monday through Friday and 9:00 a.m. to 6:00 p.m. on Saturdays. No construction work shall be permitted on Sundays or federal holidays.

Federal Transit Administration

The City does not have daytime construction noise level limits for activities within the specified hours of Section 8.47.060(D). Therefore, to determine potential California Environmental Quality Act noise impacts, construction noise was assessed using criteria from the FTA Manual. Table D shows the FTA's Detailed Assessment Construction Noise Criteria based on the composite noise levels per construction phase.

Table D: Detailed Assessment Daytime Construction Noise Criteria

Land Use	Daytime 1-hour L_{eq} (dBA)
Residential	80
Commercial	85
Industrial	90

Source: FTA (2018).
dBA = A-weighted decibel(s)
FTA = Federal Transit Administration
L_{eq} = equivalent continuous sound level

APPLICABLE VIBRATION STANDARDS

California Department of Transportation

Vibration standards included in the California Department of Transportation's (Caltrans) *Transportation and Construction Vibration Guidance Manual* (Caltrans Manual) (2020) are used in this analysis for ground-borne vibration impacts on human annoyance and building damage. The criteria for environmental impact from ground-borne vibration are based on the maximum levels for a single event and the RMS vibration level. Table E provides the criteria for assessing the potential for interference or annoyance from vibration levels in a building.

Table E: Interpretation of Vibration Criteria for Detailed Analysis

Human Response	Vibration Level (RMS in/sec)
Barely perceptible	0.01
Distinctly perceptible	0.04
Strongly perceptible	0.10
Severe	0.40

Source: *Transportation and Construction Vibration Guidance Manual* (Caltrans 2020).
Caltrans = California Department of Transportation
in/sec = inch/inches per second
RMS = root-mean-square

Table F lists the potential vibration building damage criteria associated with construction activities, as suggested in the Caltrans Manual. Caltrans guidelines show that a vibration level of up to 0.3 in/sec in PPV is considered safe for older residential structures and would not result in any construction vibration damage. Vibration levels of up to 0.5 in/sec in PPV are considered safe for newer residential structures and modern industrial or commercial buildings.

Table F: Construction Vibration Damage Criteria

Structure / Condition	PPV (in/sec)
Extremely fragile historic buildings, ruins, ancient monuments	0.08
Fragile buildings	0.10
Historic and some old buildings	0.25
Older residential structures	0.30
New residential structures	0.50
Modern industrial / commercial buildings	0.50

Source: *Transportation and Construction Vibration Guidance Manual,* Table 19 (Caltrans 2020).
Caltrans = California Department of Transportation
PPV = peak particle velocity
in/sec = inch/inches per second

OVERVIEW OF THE EXISTING NOISE ENVIRONMENT

The primary existing noise sources in the project area include vehicle traffic on SR-22, Russell Avenue, Kerry Street, and other local roads in the project vicinity.

AMBIENT NOISE MEASUREMENTS

Long-Term Noise Measurements

To assess existing noise levels, LSA conducted two long-term noise measurements in the vicinity of the project site. The long-term (24-hour) noise level measurements were conducted on December 9 and 10, 2025, using two Larson Davis Spark 706RC dosimeters. Table G provides a summary of the measured hourly noise levels from the long-term noise level measurements. Appendix A provides noise measurement sheets. Figure 3 shows the long-term monitoring locations.

Table G: Existing Noise Level Measurements

Location Number	Location Description	Daytime Noise Levels[1] (dBA L_{eq})	Evening Noise Levels[2] (dBA L_{eq})	Nighttime Noise Levels[3] (dBA L_{eq})	Average Daily Noise Levels (dBA CNEL)
LT-1	9822 Russell Avenue, Garden Grove. On the northwest corner of the project site, on a tree. Approximately 940 feet from the SR-22 centerline, 30 feet from the Kerry Street centerline, and 45 feet from the Russell Avenue centerline.	54.6-61.9	57.7-58.7	54.3-64.0	66.8
LT-2	9822 Russell Avenue, Garden Grove. Near the southeast corner of the project site, on a light pole. Approximately 780 feet from the SR-22 centerline.	56.8-63.8	59.7-62.7	59.4-66.8	69.8

Source: Compiled by LSA (2026).
[1] Daytime Noise Levels = noise levels during the hours of 7:00 a.m. to 7:00 p.m.
[2] Evening Noise Levels = noise levels during the hours of 7:00 p.m. to 10:00 p.m.
[3] Nighttime Noise Levels = noise levels during the hours of 10:00 p.m. to 7:00 a.m.
CNEL = Community Noise Equivalent Level
dBA = A-weighted decibels
L_{eq} = equivalent continuous sound level
SR-22 = California State Route 22

EXISTING AIRCRAFT NOISE

Aircraft flyovers may be audible on the project site due to aircraft activity in the vicinity. The nearest airports to the project are the Joint Forces Training Base Los Alamitos (60 dBA), located 5 miles to the west, Fullerton Municipal Airport (60 dBA), located 7.2 miles to the north, and John Wayne Airport (JWA), located 7.9 miles to the southeast. The project site is outside the 60 dBA CNEL noise contours of all three airports based on the Airport Land Use Commission (ALUC) Airport Environs Land Use Plan for Joint Forces Training Base Los Alamitos (ALUC 2017), the ALUC Airport Environs Land Use Plan for Fullerton Municipal Airport (ALUC 2019), and the JWA Airport 2022 Annual Community Noise Equivalent Level Contours (JWA 2024). Additionally, there are no helipads or private airstrips within 2 miles of the project area. Due to the distance of the project site from the nearest airport, this analysis does not further discuss impacts related to aircraft operations.

LSA

LEGEND

Project Site Boundary

LT-1 Long-term Noise Monitoring Location

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0 75 150
FEET

SOURCE: Google Earth (2025)

FIGURE 3

9822 Russell Avenue Project

Noise Monitoring Locations

I:\2025\20252686\G\Noise_Locs.ai (1/26/2026)

PROJECT IMPACTS

SHORT-TERM CONSTRUCTION NOISE IMPACTS

Two types of short-term noise impacts could occur during construction of the proposed project. First, construction crew commutes and the transport of construction equipment and materials to the site for the proposed project would incrementally increase noise levels on access roads leading to the site. Although there would be a relatively high single-event noise-exposure potential causing intermittent noise nuisance (passing trucks at 50 feet would generate up to 84 dBA L_{max}), the effect on longer-term ambient noise levels would be small compared to existing daily traffic volumes on Russell Avenue. The results of the California Emissions Estimator Model for the proposed project indicate that, during the demolition phase, the acoustical equivalent traffic volume would be 1,765 passenger car equivalent vehicles. Based on the Orange County Highway Design Manual (County of Orange 2005), the traffic volume on residential collector streets such as Russell Avenue, assumed to be the main construction access, is between 1,200 and 6,000 vehicles (average of 3,600 vehicles). When adding 1,765 to the existing average daily trips, the increase is 1.8 dBA. A noise level increase of less than 3 dBA would not be perceptible to the human ear in an outdoor environment. Therefore, short-term, construction-related impacts associated with worker commute and equipment transport to the project site would be less than significant.

The second type of short-term noise impact is related to noise generated during construction. Construction is completed in discrete steps, each of which has its own mix of equipment and, consequently, its own noise characteristics. Construction phases for the project would include demolition, site preparation, grading, building construction, paving, and architectural coating on the project site. These various sequential phases would change the character of the noise generated on the site and, therefore, the noise levels surrounding the site as construction progresses. Despite the variety in the type and size of construction equipment, similarities in the dominant noise sources and patterns of operation allow construction-related noise ranges to be categorized by work phase. Table H lists typical construction equipment noise levels recommended for noise impact assessments, based on a distance of 50 feet between the equipment and a noise receptor, taken from the Federal Highway Administration's (FHWA) *FHWA Roadway Construction Noise Model* (FHWA 2006).

In addition to the reference maximum noise level, the usage factor provided in Table H is used to calculate the hourly noise level impact for each piece of equipment based on the following equation:

$$L_{eq}(equip) = E.L. + 10\log(U.F.) - 20\log\left(\frac{D}{50}\right)$$

"L_{eq} (equip)" is the L_{eq} at a receiver resulting from the operation of a single piece of equipment over a specified time period,

"E.L." is the noise emission level of the particular piece of equipment at a reference distance of 50 feet,

"U.F." is the usage factor that accounts for the fraction of time that the equipment is in use over the specified period of time, and

"D" is the distance from the receiver to the piece of equipment.

Each piece of construction equipment operates as an individual point source. Using the following equation, a composite noise level can be calculated when multiple sources of noise operate simultaneously:

$$Leq\ (composite) = 10 * \log_{10}\left(\sum_{1}^{n} 10^{\frac{Ln}{10}}\right)$$

Using the equations from the methodology above, the reference information in Table H, and the construction equipment list provided, the composite noise levels of each construction phase were calculated. The project construction composite noise levels at a distance of 50 feet would range from 76 dBA L_{eq} to 87 dBA L_{eq}, with the highest noise levels during the site preparation and paving phases.

Table H: Typical Construction Equipment Noise Levels

Equipment Description	Acoustical Usage Factor (%)[1]	Maximum Noise Level (L_{max}) at 50 ft[2]
Auger Drill Rig	20	84
Backhoes	40	80
Compactor (ground)	20	80
Compressor	40	80
Cranes	16	85
Dozers	40	85
Dump Trucks	40	84
Excavators	40	85
Flat Bed Trucks	40	84
Forklift	20	85
Front-end Loaders	40	80
Graders	40	85
Jackhammers	20	85
Paver	50	77
Pickup Truck	40	55
Pneumatic Tools	50	85
Pumps	50	77
Rock Drills	20	85
Rollers	20	85
Scrapers	40	85
Tractors	40	84
Trencher	50	80
Welder	40	73

Source: *FHWA Roadway Construction Noise Model User's Guide,* Table 1 (FHWA 2006).
Note: Noise levels reported in this table are rounded to the nearest whole number.
1 Usage factor is the percentage of time during a construction noise operation that a piece of construction equipment is operating at full power.
2 Maximum noise levels were developed based on Specification 721.560 from the Central Artery/ Tunnel program to be consistent with the City of Boston's Noise Code for the "Big Dig" project.
FHWA = Federal Highway Administration
ft = foot/feet
L_{max} = maximum instantaneous sound level

Once composite noise levels are calculated, reference noise levels can then be adjusted for distance using the following equation:

$$Leq\ (at\ distance\ X) = Leq\ (at\ 50\ feet) - 20 * \log_{10}\left(\frac{X}{50}\right)$$

In general, this equation shows that doubling the distance would decrease noise levels by 6 dBA, and halving the distance would increase noise levels by 6 dBA.

Table I shows the nearest sensitive uses to the project site, their distances from the center of construction activities, and composite noise levels expected during construction. These noise level projections do not consider intervening topography or barriers. Appendix B provides construction equipment calculations.

Table I: Potential Construction Noise Impacts at Nearest Receptor

Receptor (Location)	Composite Noise Level (dBA L_{eq}) at 50 ft[1]	Distance (ft)[2]	Composite Noise Level (dBA L_{eq})
Residential Uses (North)	87	160	76
School (East)		175	76
Residential Uses/School (South)		120	79
Residential Uses (West)		220	74

Source: Compiled by LSA (2026).

[1] The composite construction noise level represents the site preparation and paving phases, which are expected to result in the greatest noise levels as compared to other phases.

[2] The assessment distance is associated with the average condition, identified by the distance from the center of construction activities to the property line of the surrounding uses.dBA = A-weighted decibels

ft = foot/feet

L_{eq} = equivalent continuous sound level

Although construction noise will vary, it is expected that composite noise levels during construction at the nearest off-site residential uses and the school to the south would approach 79 dBA L_{eq} during daytime hours. These predicted noise levels would only occur when all construction equipment is operating simultaneously and, therefore, are assumed to be rather conservative in nature. Although construction-related short-term noise levels have the potential to be higher than existing ambient noise levels in the project area under existing conditions, the noise impacts would cease once project construction is completed.

The proposed project will be required to comply with the construction hours specified in the City's Municipal Code Section 8.47.060(D), which states that construction activities are prohibited between 7:00 p.m. and 7:00 a.m. on Monday through Friday or 6:00 p.m. and 9:00 a.m. on Saturday or anytime on Sundays or federal holidays, such that the sound creates a noise disturbance across a residential or commercial property line.

As it relates to off-site uses, construction-related noise impacts would remain below the 80 dBA L_{eq} construction noise level criteria, as established by the FTA for residential land uses for the average daily condition as modeled from the center of the project site and therefore would be considered less than significant.

SHORT-TERM CONSTRUCTION VIBRATION IMPACTS

This construction vibration impact analysis discusses the level of human annoyance using vibration levels in RMS and assesses the potential for building damage using vibration levels in PPV (in/sec). This is because vibration levels calculated in RMS are best for characterizing human response to building vibration, and vibration level in PPV is best for characterizing the potential for damage.

Table J shows the PPV and RMS values at 25 feet from the construction vibration source. As shown in Table J, bulldozers and other heavy-tracked construction equipment (expected to be used for this project) generate approximately 0.089 in/sec PPV or 0.062 in/sec RMS of ground-borne vibration when measured at 25 feet, based on the Caltrans Manual. The distance to the nearest buildings for vibration impact analysis is measured between the nearest off-site buildings, and the project construction boundary (assuming the construction equipment would be used at or near the project setback line).

Table J: Vibration Source Amplitudes for Construction Equipment

Equipment	Reference PPV/L_V at 25 ft	
	PPV (in/sec)	RMS (in/sec)[1]
Pile Driver (Impact), Typical	0.644	0.451
Pile Driver (Sonic), Typical	0.170	0.119
Vibratory Roller	0.210	0.147
Hoe Ram	0.089	0.062
Large Bulldozer[2]	**0.089**	**0.062**
Caisson Drilling	0.089	0.062
Loaded Trucks (Dumpers/Tenders)[2]	**0.076**	**0.053**
Jackhammer	0.035	0.025
Small Bulldozer[2]	**0.003**	**0.002**

Source: *Transportation and Construction Vibration Guidance Manual* (Caltrans 2020).
[1] RMS vibration velocity is 70 percent of maximum PPV.
[2] Equipment shown in **bold** is expected to be representative of the equipment used on site.
Caltrans = California Department of Transportation
ft = foot/feet
in/sec = inches per second
L_V = vibration velocity in decibels
PPV = peak particle velocity
RMS = root-mean-square

The formula for vibration transmission is provided below, and Tables K and L, below, provide a summary of off-site construction vibration levels. The material dampening coefficient, “n”, ranges between 1.1 and 1.5 depending on soil type and distance from equipment.

$$PPV_{equip} = PPV_{ref} \times (25/D)^n$$

Table K: Potential Construction Vibration Annoyance Impacts at Nearest Receptor

Receptor (Location)	Reference Vibration Level (in/sec RMS) at 25 ft[1]	Distance (ft)[2]	Vibration Level (in/sec RMS)
Residential Uses (North)	0.062	180	0.007
School (East)		240	0.005
Residential Uses (South)		125	0.011
Residential Uses (West)		225	0.006

Source: Compiled by LSA (2026).

1 The reference vibration level is associated with a large bulldozer, which is expected to be representative of the heavy equipment used during construction.

2 The assessment distance is associated with the average condition, identified by the distance from the center of construction activities to the nearest buildings within the surrounding uses.

ft = foot/feet

in/sec = inches per second

RMS = root-mean-square

Table L: Potential Construction Vibration Damage Impacts at Nearest Receptor

Receptor (Location)	Reference Vibration Level (in/sec PPV) at 25 ft[1]	Distance (ft)[2]	Vibration Level (in/sec PPV)
Residential Uses (North)	0.089	75	0.017
School (East)	0.089	65	0.021
Residential Uses (South)	0.089	10	0.352
	0.089	20[3]	0.124
	0.003	10	0.012
Residential Uses (West)	0.089	50	0.027

Source: Compiled by LSA (2026).

1 This reference vibration level is associated with a large bulldozer, which is expected to be representative of the heavy equipment used during construction.

2 The assessment distance is associated with the peak condition, identified by the distance from the perimeter of construction activities to surrounding structures.

3 A distance of 20 ft from the perimeter of large equipment construction activity to the nearest structure to the south would apply with the implementation of Mitigation Measure (MM) NOI-1.

in/sec = inches per second

ft = foot/feet

PPV = peak particle velocity

As previously shown in Table E, the threshold at which vibration levels would result in annoyance would be 0.04 in/sec RMS. Based on the information provided in Table K, vibration levels are expected to approach 0.011 in/sec RMS at the closest receptors and would not exceed the annoyance thresholds.

As discussed above, the standards indicate that the construction vibration damage criterion is 0.3 in/sec PPV for older residential buildings. Based on the information provided in Table L, the closest structures to construction activities are the residential uses to south, which are approximately 10 feet from the southern property line. Using the reference data from Table J and the equation above, it is expected that vibration levels generated by large bulldozers and other large equipment would generate ground-borne vibration levels of up to 0.352 in/sec PPV at the closest structures to the south of the project site. This vibration level would exceed the 0.3 in/sec PPV threshold considered safe for older residential structures. Mitigation measure MM NOI-1, shown below, would limit the use of large construction equipment such as large bulldozers within 10 feet of the southern property line, which would result in a 20-foot setback from the closest structures and would reduce vibration levels to 0.124 in/sec PPV at the closest structures to the south of the project site. This vibration level would not exceed the 0.3 in/sec PPV threshold considered safe for older residential structures. Vibration levels at all other buildings would be lower. Therefore, with the implementation of MM NOI-1, construction would not exceed the vibration damage threshold, and impacts would be less than significant.

MM NOI-1 The Community Development Director, or designee, shall verify prior to issuance of demolition or grading permits, that the construction plans require that the construction contractor restrict the use of heavy construction equipment (i.e., greater than 80,000 pounds), vibratory rollers, large, loaded trucks, and large dozers within 10 feet of the southern property line. Instead, smaller, rubber-tired bulldozers (less than 80,000 pounds) shall be used within this area during project construction to reduce vibration levels.

LONG-TERM OFF-SITE TRAFFIC NOISE IMPACTS

Traffic noise is the major noise source in the project area. Other sources of noise in the project area would be low or intermittent and would not contribute to or reach the levels of noise generated by traffic.

The project trip generation was obtained from the *Level of Service (LOS) Screening Analysis for 9822 Russell Ave, Garden Grove Project* (EPD Solutions, Inc. 2025). Based on the trip generation, the existing church and daycare center use is estimated to generate a total of 219 daily vehicle trips, and the proposed project is estimated to generate a total of 161 daily passenger vehicle trips. Considering both the existing use and the proposed project, the project would result in a net decrease of 58 daily passenger vehicle trips. This would not generate an increase in noise on the surrounding streets. Therefore, project-related traffic would not have an impact on off-site sensitive receptors, and no noise reduction measures are required.

LONG-TERM OFF-SITE STATIONARY NOISE IMPACTS

The project would include ground-floor heating, ventilation, and air conditioning (HVAC) equipment that could operate 24 hours per day. The HVAC equipment would generate noise levels of approximately 66.5 dBA L_{eq} at 5 ft based on previous measurements conducted by LSA for similar residential units. A group of four HVAC units would generate noise levels of approximately 72.5 dBA L_{eq} at 5 ft. The nearest HVAC units to off-site sensitive uses would be approximately 68 feet from the residential property line to the west. Attenuating for distance would reduce the noise level by 22.7 dBA. Noise levels of 49.8 dBA generated from on-site HVAC units would not exceed the City's exterior daytime (7:00 a.m. to 10:00 p.m.) and nighttime (10:00 p.m. to 7:00 a.m.) 30-minute (L_{50}) noise standards of 60 dBA and 55 dBA, respectively, for residential uses. All other sensitive receptors are farther from the proposed HVAC equipment. Additionally, noise levels to the south and east would be further reduced by the proposed six-foot-high CMU walls along the south and east site boundaries. Therefore, no off-site noise impacts from on-site HVAC equipment would occur. No noise reduction measures are required.

LONG-TERM TRAFFIC-RELATED VIBRATION IMPACTS

The proposed project would not generate vibration levels related to on-site operations. In addition, vibration levels generated from project-related traffic on the adjacent roadways are unusual for on-road vehicles because the rubber tires and suspension systems of on-road vehicles provide vibration isolation. Based on a reference vibration level of 0.076 in/sec PPV, structures greater than 20 feet from the roadways would experience vibration levels below the most conservative standard of 0.12 in/sec PPV; therefore, vibration levels generated from project-related traffic on the adjacent roadways would be less than significant, and no reduction measures are required.

ON-SITE LAND USE COMPATIBILITY ANALYSIS

The proposed project is in an area where parcels surrounding the project site are currently in use. For this reason, this analysis relies on the existing measured noise levels as well as future predicted noise levels to provide the most accurate description of the noise environment related to traffic noise impacts.

As described in the Noise Element, the City a noise level of up to 65 dBA CNEL is considered normally acceptable for the exterior of multifamily noise-sensitive uses. As described in Title 24, Chapter 12, Section 1206.4 of the California Building Code, the State has a noise standard of a 45 dBA CNEL for interior habitable rooms.

ON-SITE EXTERIOR NOISE IMPACTS

Based on the monitoring results shown in Table G, existing traffic noise levels at the project site range from 66.8 dBA CNEL near the northwestern project boundary to 69.8 dBA CNEL near the southeastern project boundary. Traffic noise from SR-22 is the dominant source of noise in the vicinity of the project site.

The main amenity areas where humans would spend time include the common open space recreation area near the eastern edge of the project site as well as the ground-level patios of the proposed townhomes. The project would install 6-foot-high CMU walls along the south and east site boundaries. Based on the distance of SR-22 to the project site, a 6-foot-high wall is expected to provide an approximately 5 dBA noise reduction, which would reduce levels at the exterior habitable areas to 64.8 dBA CNEL. This noise level would be below the General Plan acceptable level of 65 dBA CNEL, and no additional reduction measures would be required.

ON-SITE INTERIOR NOISE IMPACTS

In addition to the exterior noise level standards, the project must demonstrate compliance with the interior noise standard of 45 dBA CNEL. The traffic noise levels would approach 69.8 dBA CNEL near the southern façade of the proposed building closest to SR-22.

Based on the United States Environmental Protection Agency's Protective Noise Levels (1974), with windows and doors open, interior noise levels at the units along the southern boundary would be 58 dBA (i.e., 70 dBA - 12 dBA = 58 dBA). In addition, the proposed project includes HVAC systems that would allow windows to remain closed. Based on reference information from transmission loss test reports for Greenworld Windows (2018), the necessary additional reduction of 13 dBA can be achieved with standard residential building construction and standard windows with a minimum Sound Transmission Class 28, which would yield an interior noise level below 45 dBA CNEL. No noise reduction measures would be required.

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APPENDIX A

NOISE MONITORING DATA

Noise Measurement Survey – 24 HR

Project Number: 20252686
Project Name: Russell Site Residential

Test Personnel: Corey Knips
Equipment: LD Spark 703+ (SN: 20224)

Site Number: LT-1

Date: From 12/9/2025 To 12/10/2025
Time: From 11:00 a.m. To 11:00 a.m.

Site Location: 9822 Russell Avenue, Garden Grove, CA. On the northwest corner of the project site, on a tree. Approximately 940 feet from the California State Route 22 (SR-22) centerline, 30 feet from the Kerry Street centerline, and 45 feet from the Russell Avenue centerline.

Primary Noise Sources: Traffic on SR-22 and very light traffic on Russell Avenue and Kerry Street.

Comments:

Photo:

Long-Term (24-Hour) Noise Level Measurement Results at LT-1

Start Time	Date	Noise Level (dBA)		
		L_{eq}	L_{max}	L_{min}
11:00 AM	12/9/2025	55.4	70.9	47.9
12:00 PM	12/9/2025	54.6	68.6	46.0
1:00 PM	12/9/2025	54.7	72.4	47.8
2:00 PM	12/9/2025	59.6	85.2	46.8
3:00 PM	12/9/2025	58.2	73.1	52.8
4:00 PM	12/9/2025	60.2	83.6	52.5
5:00 PM	12/9/2025	61.1	79.0	56.4
6:00 PM	12/9/2025	60.3	70.7	57.1
7:00 PM	12/9/2025	57.9	72.8	52.6
8:00 PM	12/9/2025	57.7	78.0	53.5
9:00 PM	12/9/2025	58.7	72.5	54.1
10:00 PM	12/9/2025	57.4	71.0	54.0
11:00 PM	12/9/2025	57.7	69.8	53.0
12:00 AM	12/10/2025	57.4	69.1	50.0
1:00 AM	12/10/2025	57.8	70.4	46.6
2:00 AM	12/10/2025	54.3	64.3	47.0
3:00 AM	12/10/2025	58.3	68.3	50.4
4:00 AM	12/10/2025	63.5	71.5	55.7
5:00 AM	12/10/2025	64.0	76.1	59.8
6:00 AM	12/10/2025	62.9	75.0	59.6
7:00 AM	12/10/2025	61.9	74.3	54.7
8:00 AM	12/10/2025	59.4	82.5	49.5
9:00 AM	12/10/2025	57.5	76.9	49.6
10:00 AM	12/10/2025	55.1	70.1	48.3

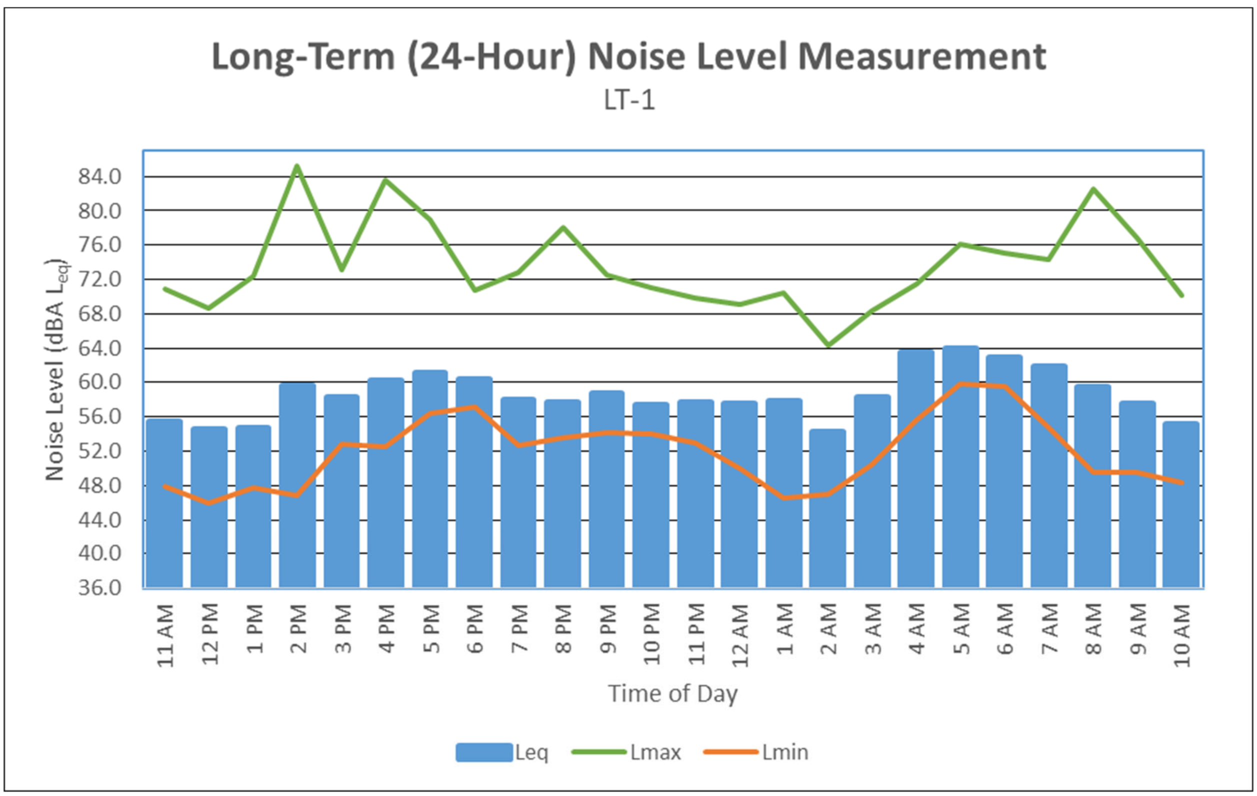
Source: Compiled by LSA Associates, Inc. (2025).

dBA = A-weighted decibel

L_{eq} = equivalent continuous sound level

L_{max} = maximum instantaneous noise level

L_{min} = minimum measured sound level



Noise Measurement Survey – 24 HR

Project Number: 20252686
Project Name: Russell Site Residential

Test Personnel: Corey Knips
Equipment: LD Spark 706RC (SN: 17637)

Site Number: LT-2

Date: From 12/9/2025 To 12/10/2025
Time: From 11:00 a.m. To 11:00 a.m.

Site Location: 9822 Russell Avenue, Garden Grove, CA. Near the southeast corner of the project site, on a light pole. Approximately 780 feet from the California State Route 22 (SR-22) centerline.

Primary Noise Sources: Traffic on SR-22, noise from school to the east, and occasional parking lot noise (on-site and from adjacent uses to the east and south).

Comments:

Photo:

Long-Term (24-Hour) Noise Level Measurement Results at LT-2

Start Time	Date	Noise Level (dBA)		
		L_{eq}	L_{max}	L_{min}
11:00 AM	12/9/2025	56.8	68.6	53.2
12:00 PM	12/9/2025	58.0	73.6	52.2
1:00 PM	12/9/2025	57.9	69.9	52.9
2:00 PM	12/9/2025	61.6	76.3	54.7
3:00 PM	12/9/2025	59.7	75.0	55.4
4:00 PM	12/9/2025	60.3	70.9	55.1
5:00 PM	12/9/2025	61.7	69.7	58.7
6:00 PM	12/9/2025	61.7	70.6	59.2
7:00 PM	12/9/2025	59.7	72.4	55.5
8:00 PM	12/9/2025	60.4	71.3	56.9
9:00 PM	12/9/2025	62.7	75.4	59.5
10:00 PM	12/9/2025	62.0	68.9	58.8
11:00 PM	12/9/2025	60.9	70.4	57.1
12:00 AM	12/10/2025	61.3	72.7	56.6
1:00 AM	12/10/2025	61.3	72.1	52.0
2:00 AM	12/10/2025	59.4	72.6	50.5
3:00 AM	12/10/2025	61.1	68.4	53.5
4:00 AM	12/10/2025	65.5	71.8	58.5
5:00 AM	12/10/2025	66.8	73.0	63.4
6:00 AM	12/10/2025	66.4	70.4	64.3
7:00 AM	12/10/2025	63.8	83.4	58.5
8:00 AM	12/10/2025	60.0	76.3	53.4
9:00 AM	12/10/2025	60.4	83.4	53.4
10:00 AM	12/10/2025	59.7	71.6	53.5

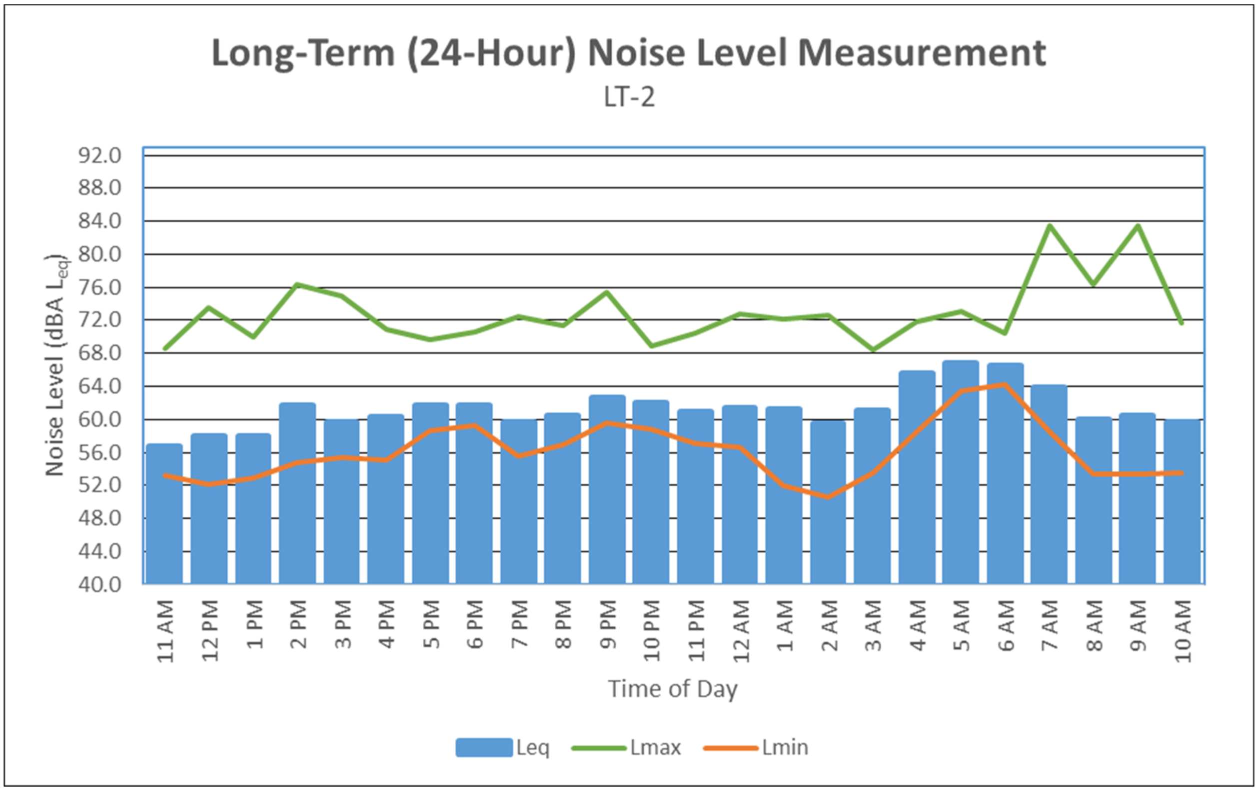
Source: Compiled by LSA Associates, Inc. (2025).

dBA = A-weighted decibel

L_{eq} = equivalent continuous sound level

L_{max} = maximum instantaneous noise level

L_{min} = minimum measured sound level



APPENDIX B

CONSTRUCTION NOISE LEVEL CALCULATIONS

Construction Traffic Noise Calculator

Construction Phase	One-Way Worker Trip/Day	One Way Vendor Trip/Day	One Way Hauling Trip/Day	Total
Demolition	13	0	44	57
Site Preparation	23	0	0	23
Grading	13	0	31	44
Building Construction	19	2.8	0	21.8
Paving	13	0	0	13
Architectural Coating	3.7	0	0	3.7
Maximum				**44**

Phase Number	Phase Name	Number of Days
1	Demolition	20
2	Site Preparation	2
3	Grading	4
4	Building Construction	200
5	Paving	10
6	Architectural Coating	15

Speed (mph)	MT Factor	HT Factor
25	12.6	39.8
30	8.9	26.3
35	7.1	19.1
40	5.8	15.1
45	5	12.9
50	4.5	11.5
55	4.1	10.4
60	3.7	9.6
65	3.5	8.9

Roadway	Speed	Existing Volume	MT Factor	HT Factor
Russell Avenue	25	3,600	12.6	39.8

	Worker Trip/Day	Vendor Trip/Day	Hauling Trip/Day	Total
Demolition	13	0	1,752	1765
Site Preparation	23	0	0	23
Grading	13	0	1,234	1247
Building Construction	19	74	0	93
Paving	13	0	0	13
Architectural Coating	4	0	0	4

Chosen Phase	Demolition
Total Equivalent Vehicles	1,765
Noise Increase (dBA)	**1.73**

Construction Calculations

Phase: Demolition

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Dozer	1	85	40	50	0.5	85	81
Concrete Saw	1	90	20	50	0.5	90	83
Front End Loader	1	80	40	50	0.5	80	76
					Combined at 50 feet	**92**	**86**
					Combined at Receptor 160 feet	**81**	**76**
					Combined at Receptor 175 feet	**81**	**75**
					Combined at Receptor 120 feet	**84**	**78**
					Combined at Receptor 220 feet	**79**	**73**

Phase: Site Preparation

Equipment[2]	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Dozer	1	85	40	50	0.5	85	81
Tractor	1	84	40	50	0.5	84	80
Grader	1	85	40	50	0.5	85	81
Dump Truck	1	84	40	50	0.5	84	80
					Combined at 50 feet	**91**	**87**
					Combined at Receptor 160 feet	**80**	**76**
					Combined at Receptor 175 feet	**80**	**76**
					Combined at Receptor 120 feet	**83**	**79**
					Combined at Receptor 220 feet	**78**	**74**

Phase: Grading

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Grader	1	85	40	50	0.5	85	81
Tractor	1	84	40	50	0.5	84	80
Dozer	1	85	40	50	0.5	85	81
					Combined at 50 feet	**89**	**85**
					Combined at Receptor 160 feet	**79**	**75**
					Combined at Receptor 175 feet	**79**	**75**
					Combined at Receptor 120 feet	**82**	**78**
					Combined at Receptor 220 feet	**77**	**73**

Phase:Building Construction

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Crane	1	85	16	50	0.5	85	77
Man Lift	1	85	20	50	0.5	85	78
Generator	1	82	50	50	0.5	82	79
Tractor	1	84	40	50	0.5	84	80
Welder / Torch	1	73	40	50	0.5	73	69
					Combined at 50 feet	**90**	**85**
					Combined at Receptor 160 feet	**80**	**75**
					Combined at Receptor 175 feet	**79**	**74**
					Combined at Receptor 120 feet	**83**	**77**
					Combined at Receptor 220 feet	**77**	**72**

Phase: Paving

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Paver	1	85	50	50	0.5	85	82
Roller	1	85	20	50	0.5	85	78
Concrete Mixer Truck	1	85	40	50	0.5	85	81
Tractor	1	84	40	50	0.5	84	80
					Combined at 50 feet	**91**	**87**
					Combined at Receptor 160 feet	**81**	**76**
					Combined at Receptor 175 feet	**80**	**76**
					Combined at Receptor 120 feet	**83**	**79**
					Combined at Receptor 220 feet	**78**	**74**

Phase:Architectural Coating

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA)	
						Lmax	Leq
Compressor (air)	1	80	40	50	0.5	80	76
					Combined at 50 feet	**80**	**76**
					Combined at Receptor 160 feet	**70**	**66**
					Combined at Receptor 175 feet	**69**	**65**
					Combined at Receptor 120 feet	**72**	**68**
					Combined at Receptor 220 feet	**67**	**63**

[1]- Percentage of time that a piece of equipment is operating at full power.

[2]- These four pieces of equipment represent a typical condition for this phase.

dBA – A-weighted Decibels

L_{max} – Maximum Level

L_{eq} – Equivalent Level