NOISE AND VIBRATION IMPACT ANALYSIS

BATAVIA SELF-STORAGE PROJECT

ORANGE, CALIFORNIA

LSA

June 2023

NOISE AND VIBRATION IMPACT ANALYSIS

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ORANGE, CALIFORNIA

Submitted to:

EPD Solutions, Inc.
3333 Michelson Drive, Suite 500
Irvine, California 92612

Prepared by:

LSA
3210 El Camino Real, Suite 100
Irvine, California 92602
(949) 553-0666

Project No. ESL2201.60

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LIST OF ABBREVIATIONS AND ACRONYMS

CALGreen Code	California Green Building Standards Code
CEQA	California Environmental Quality Act
City	City of Orange
CNEL	Community Noise Equivalent Level
dB	decibel(s)
dBA	A-weighted decibel(s)
EPA	United States Environmental Protection Agency
ft	foot/feet
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
HVAC	heating, ventilation, and air conditioning
in/sec	inches per second
L_{dn}	day-night average noise level
L_{eq}	equivalent continuous sound level
L_{max}	maximum instantaneous sound level
Noise Element	City of Orange General Plan Noise Element
JWA	John Wayne International Airport
PPV	peak particle velocity
project	Batavia Self-Storage Project
RMS	root-mean-square
SPL	sound pressure level
sq ft	square foot/feet
VdB	vibration velocity decibels

INTRODUCTION

This noise and vibration impact analysis has been prepared to evaluate the potential noise and vibration impacts and reduction measures associated with the Batavia Self-Storage Project (project) in the City of Orange (City), California. This report is intended to satisfy the City's 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 AND DESCRIPTION

The 3.06-acre project site is located at 630 North Batavia Street in the City of Orange, Orange County, California. The project site is currently developed with two light manufacturing buildings totaling approximately 47,932 square feet (sq ft). Local access to the project site is provided via North Batavia Street (see Figure 1, Regional and Project Location, and Figure 2, Site Plan).

The project proposes the demolition of the two existing on-site buildings and associated structures to construct three new self-storage buildings totaling 133,378 sq ft. The project would dedicate approximately 10.1 percent of the total project site area to landscaping, which is approximately 13,338 sq ft of landscape. The proposed project would also include 51 parking spaces. As described in the *Vehicles Miles Traveled (VMT) Screening Analysis* (EPD Solutions, Inc. 2023) prepared for the project, approximately 193 average daily trips would be generated by the proposed project.

Construction is anticipated to begin in the fourth quarter of 2023 and be completed in 13 months. The proposed project would require the import of approximately 9,155 cubic yards of soil. Construction activities for the project include demolition, grading and excavation, site preparation, building construction, landscape installation, paving, and architectural coatings.

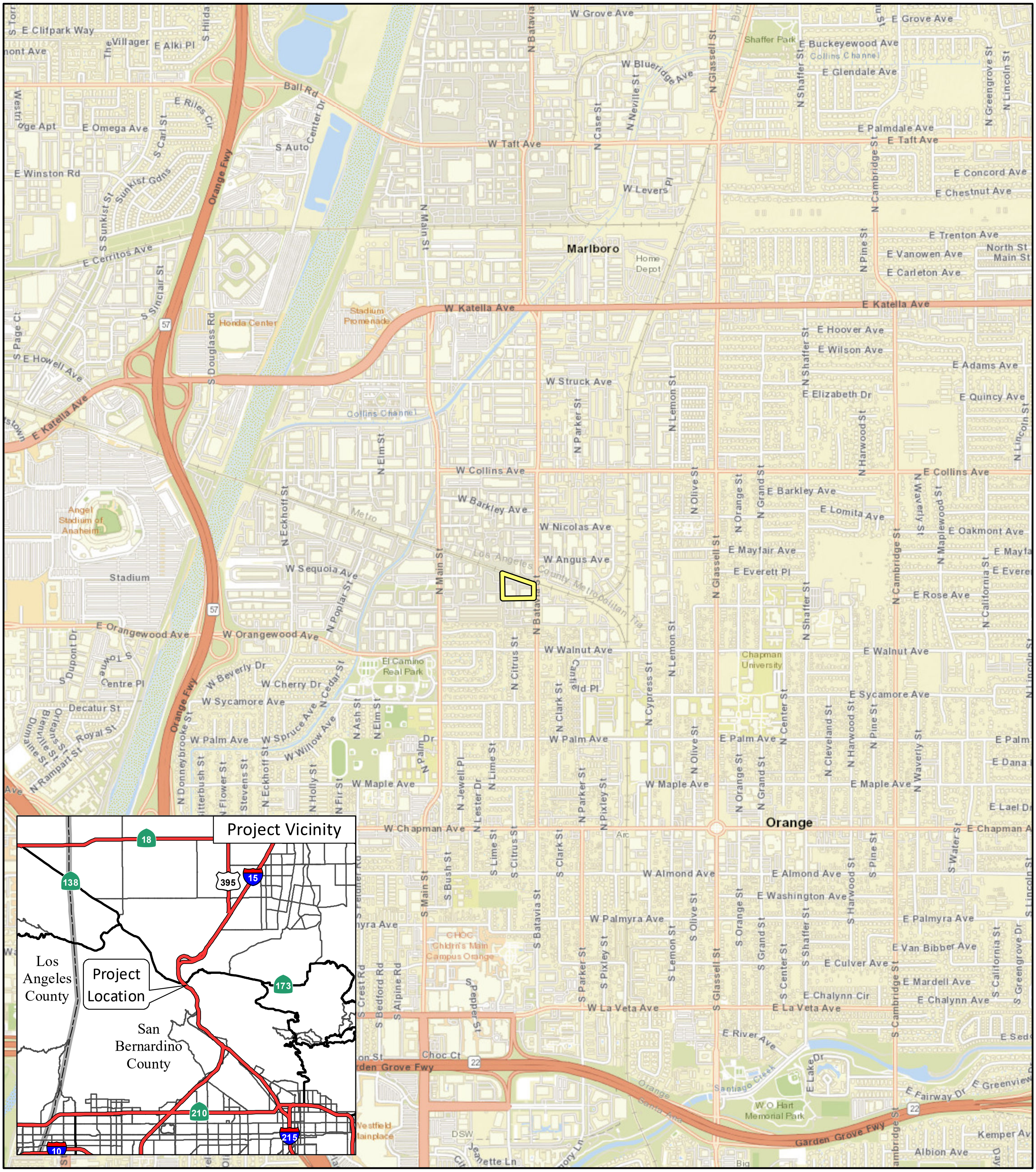
PROJECT DESIGN FEATURES

As indicated on project plans, the use of large, loaded trucks or dozers that are 80,000 pounds or more would be prohibited within 15 feet of the property line during construction.

EXISTING LAND USES IN THE PROJECT AREA

The project site is surrounded primarily by industrial uses. The areas adjacent to the project site include the following uses:

- **North:** Existing ATSF railway followed by industrial uses;
- **East:** Existing industrial uses opposite Batavia Street;
- **South:** Existing industrial uses; and
- **West:** Existing industrial uses.



LSA

LEGEND

Project Location

FIGURE 1

0 1000 2000
FEET

SOURCE: ESRI 2023

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Batavia Self-Storage Project

Regional and Project Location

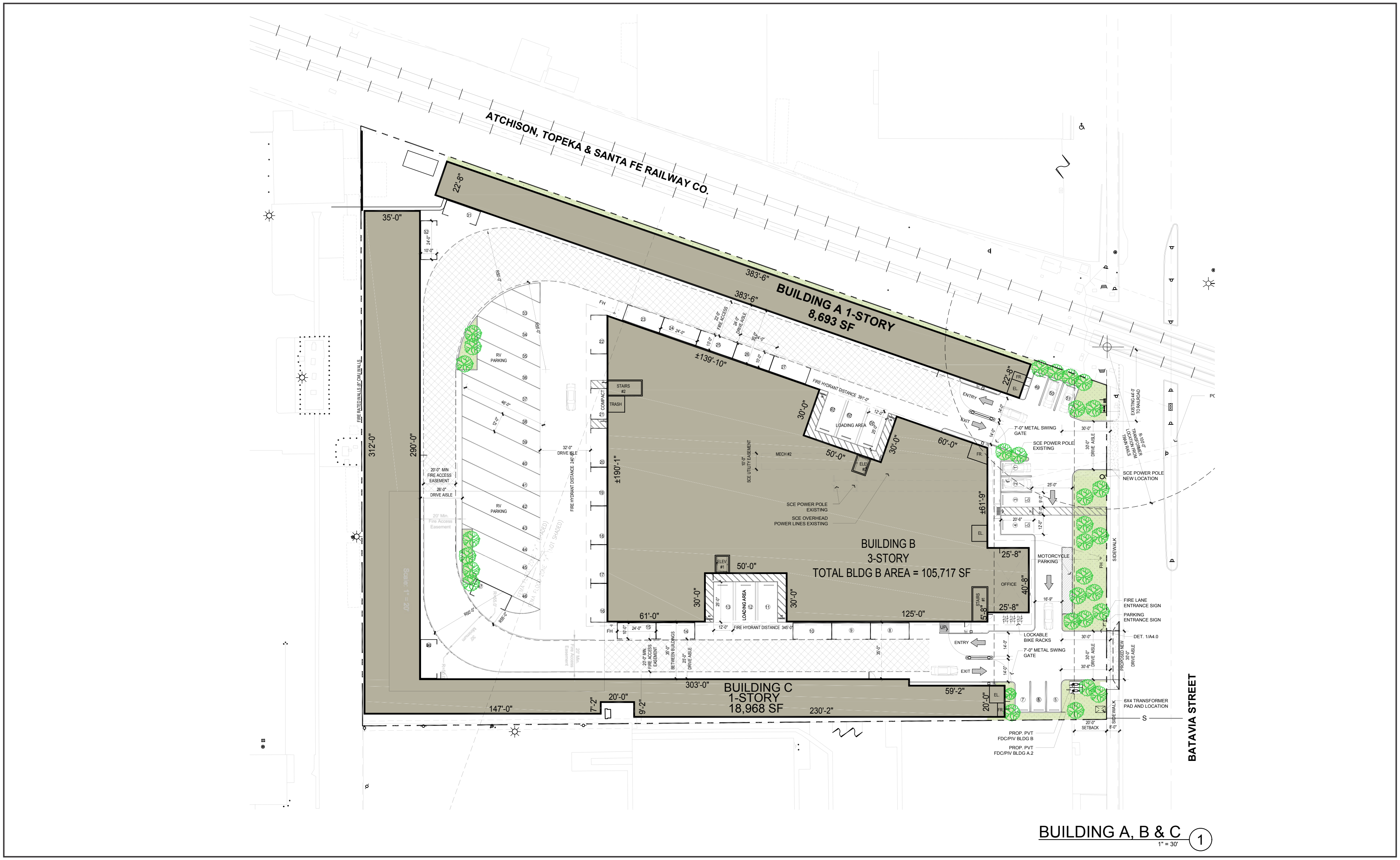

FIGURE 2

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SOURCE: Jordan Architects

Batavia Self-Storage Project

Site Plan

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The nearest sensitive receptors are:

- **South:** Existing single-family and multi-family residences approximately 330 feet (ft) away from the project boundary line.

- **Southwest:** Existing Sycamore Elementary School approximately 1,830 ft away from the project boundary line. Because this receptor is over 0.25 mile from the project site, it is not expected that project-related noise would contribute to the existing environment.

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, while 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 a 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) represents 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, Hz	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.

Source: *Handbook of Acoustical Measurements and Noise Control* (Harris, ed. 1991).

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 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. Annoyance from vibration often occurs when the vibration exceeds the threshold of perception by 10 dB or less. This is an order of magnitude below the damage threshold for normal buildings.

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 ft from the vibration source, although there are examples of ground-borne vibration causing interference out to distances greater than 200 ft 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 RMS velocity amplitude, and "V_{ref}" is the reference velocity amplitude, or 1×10^{-6} inches/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 City of Orange's General Plan Noise Element (Noise Element) and the City of Orange Municipal Code.

City of Orange

Noise Element of the General Plan

The Noise Element provides the City's goals and policies related to noise, including the land use compatibility guidelines for community exterior noise environments. The City has identified the following goals and policies in the General Plan Noise Element which are applicable to the project.

- **Goal 1.0**: Promote a pattern of land uses compatible with current and future noise levels.

  Policy 1.1: Consider potential excessive noise levels when making land use planning decisions.

  Policy 1.2: Encourage new development projects to provide sufficient spatial buffers to separate excessive noise generating land uses and noise-sensitive land uses.

  Policy 1.4: Ensure that acceptable noise levels are maintained near noise-sensitive uses.

  Policy 1.5: Reduce impacts of high-noise activity centers located near residential areas.

- **Goal 6.0**: Minimize industrial activity noise in residential areas and near noise-sensitive land uses.

  Policy 6.1: Encourage the design and construction of industrial uses to minimize excessive noise through project design features that include noise control.

  Policy 6.2: Encourage industrial uses to locate vehicular traffic and operations away from abutting residential zones as much as possible.

- **Goal 7.0**: Minimize construction, maintenance vehicle, and nuisance noise in residential areas and near noise-sensitive land uses.

  Policy 7.1: Schedule City maintenance and construction projects so that they generate noise during less sensitive hours.

  Policy 7.2: Require developers and contractors to employ noise minimizing techniques during construction and maintenance operations.

  Policy 7.3: Limit the hours of construction and maintenance operations located adjacent to noise-sensitive land uses.

Policy 7.4: Encourage limitations on the hours of operations and deliveries for commercial, mixed-use, and industrial uses abutting residential zones.

Operational Noise Standards. The City's performance standards set the limits for non-transportation or stationary noise sources as summarized in Table C. These standards are designed to protect noise-sensitive land uses adjacent to stationary sources from excessive noise and represent the acceptable exterior noise levels at the sensitive receptor.

Table C: Maximum Allowable Noise Exposure – Stationary Noise Sources

Noise Level Descriptor	Daytime (7:00 a.m. to 10:00 p.m.) L_{eq}	Nighttime (10:00 p.m. to 7:00 a.m.) L_{eq}
Hourly Equivalent Level (L_{eq}), dBA	55 dBA	45 dBA
Maximum Level (L_{max}), dBA	70 dBA	65 dBA

Source: City of Orange (2010).

Notes:

1. These standards apply to new or existing noise-sensitive land uses affected by new or existing non-transportation noise sources, as determined at the outdoor activity area of the receiving land use. However, these noise level standards do not apply to residential units established in conjunction with industrial or commercial uses (e.g., caretaker dwellings).
2. Each of the noise levels specified above should be lowered by five dB for simple tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises. Such noises are generally considered by residents to be particularly annoying and are a primary source of noise complaints. These noise level standards do not apply to residential units established in conjunction with industrial or commercial uses (e.g., caretaker dwellings).
3. No standards have been included for interior noise levels. Standard construction practices that comply with the exterior noise levels identified in this table generally result in acceptable interior noise levels.
4. The City may impose noise level standards which are more or less restrictive than those specified above based upon determination of existing low or high ambient noise levels. If the existing ambient noise level exceeds the standards listed in Table C, then the noise level standards shall be increased at 3 dB increments to encompass the ambient environment. Noise level standards incorporating adjustments for existing ambient noise levels shall not exceed a maximum of 70 dB L_{eq}.

dBA = A-weighted decibels

L_{eq} = equivalent continuous sound level

Construction Noise Standards. The City addresses construction noise in Chapter 8.24, Noise Control, of the Orange Municipal Code, which states that construction noise is exempt from the standards identified in Table D if construction activities occur during the hours of 7:00 a.m. to 8:00 p.m., Monday through Saturday, or during the hours of 9:00 a.m. to 8:00 p.m. on Sundays and federal holidays.

State of California Green Building Standards Code

The State of California's Green Building Standards Code (CALGreen Code) contains mandatory measures for non-residential building construction in Section 5.507 on Environmental Comfort. These noise standards are applied to new construction in California for controlling interior noise levels resulting from exterior noise sources. The regulations specify that acoustical studies must be prepared when non-residential structures are developed in areas where the exterior noise levels exceed 65 dBA CNEL, such as within a noise contour of an airport, freeway, railroad, and other noise source. If the development falls within an airport or freeway 65 dBA CNEL noise contour, buildings shall be constructed to provide an interior noise level environment attributable to exterior sources that does not exceed an hourly equivalent level of 50 dBA L_{eq} in occupied areas during any hour of operation.

Federal Transit Administration

Though the City does not have daytime construction noise level limits for activities that occur within the specified hours of the OMC, to determine potential California Environmental Quality Act (CEQA) noise impacts, construction noise was assessed using criteria from the FTA Manual (FTA 2018). 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: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
dBA = A-weighted decibels
FTA = Federal Transit Administration
L_{eq} = equivalent continuous sound level

APPLICABLE VIBRATION STANDARDS

Federal Transit Administration

Vibration standards included in the FTA Manual are used in this analysis for ground-borne vibration impacts on human annoyance. The criteria for environmental impact from ground-borne vibration and noise are based on the maximum levels for a single event. 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

Land Use	Max L_v (VdB)[1]	Description of Use
Workshop	90	Vibration that is distinctly felt. Appropriate for workshops and similar areas not as sensitive to vibration.
Office	84	Vibration that can be felt. Appropriate for offices and similar areas not as sensitive to vibration.
Residential Day	78	Vibration that is barely felt. Adequate for computer equipment and low-power optical microscopes (up to 20×).
Residential Night and Operating Rooms	72	Vibration is not felt, but ground-borne noise may be audible inside quiet rooms. Suitable for medium-power microscopes (100×) and other equipment of low sensitivity.

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
[1] As measured in 1/3-Octave bands of frequency over the frequency range 8 to 80 hertz.
FTA = Federal Transit Administration
L_V = velocity in decibels
Max = maximum
VdB = vibration velocity decibels

Table F lists the potential vibration building damage criteria associated with construction activities, as suggested in the FTA Manual. FTA guidelines show that a vibration level of up to 0.5 in/sec in PPV is considered safe for buildings consisting of reinforced concrete, steel, or timber (no plaster), and would not result in any construction vibration damage. For non-engineered timber and masonry buildings, the construction building vibration damage criterion is 0.2 in/sec in PPV.

Table F: Construction Vibration Damage Criteria

Building Category	PPV (in/sec)
Reinforced concrete, steel, or timber (no plaster)	0.50
Engineered concrete and masonry (no plaster)	0.30
Non-engineered timber and masonry buildings	0.20
Buildings extremely susceptible to vibration damage	0.12

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
FTA = Federal Transit Administration
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 traffic on Batavia Street, industrial uses in the vicinity of the project site, and infrequent rail activity to the south.

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 March 7 through March 8, 2023, using two Larson Davis Spark 706RC Dosimeters. Table G provides a summary of the measured hourly noise levels and calculated CNEL level from the long-term noise level measurements. As shown in Table G, the calculated CNEL levels range from 60.5 dBA CNEL to 66.3 dBA CNEL. Hourly noise levels at surrounding sensitive uses are as low as 48.0 dBA L_{eq} during nighttime hours and 53.1 dBA L_{eq} during daytime hours. Noise measurement sheets are provided in Appendix A. Figure 3 shows the long-term monitoring locations.

Table G: Long-Term 24-Hour Ambient Noise Monitoring Results

Location		Daytime Noise Levels[1] (dBA L_{eq})	Evening Noise Levels[2] (dBA L_{eq})	Nighttime Noise Levels[3] (dBA L_{eq})	Daily Noise Levels (dBA CNEL)
LT-1	Northeast corner of the project site near a gated fence adjacent to the railway line, approximately 95 ft away from Batavia Street centerline	59.6 – 66.3	54.8 – 57.6	49.5 – 65.6	66.3
LT-2	West of 533 North Citrus Street, on a utility pole, approximately 310 ft away from Batavia Street centerline.	53.1 – 57.4	51.8 – 55.6	48.0 – 58.2	60.5

Source: Compiled by LSA (2023).
Note: Noise measurements were conducted from March 7 to March 8, 2023, starting at 1:00 p.m.
[1] Daytime Noise Levels = noise levels during the hours from 7:00 a.m. to 7:00 p.m.
[2] Evening Noise Levels = noise levels during the hours from 7:00 p.m. to 10:00 p.m.
[3] Nighttime Noise Levels = noise levels during the hours from 10:00 p.m. to 7:00 a.m.
CNEL = Community Noise Equivalent Level
dBA = A-weighted decibels
ft = foot/feet
L_{eq} = equivalent continuous sound level

EXISTING AIRCRAFT NOISE

Aircraft flyovers may be audible on the project site due to aircraft activity in the vicinity. The nearest airport to the project is John Wayne Airport (JWA), a commercial airport approximately 7.8 miles to the south. The project site is well outside the JWA Airport the 60–65 dBA CNEL noise contour (John Wayne Airport 2022). Because the project site is outside the 60–65 dBA CNEL noise contour, no further analysis associated with aircraft noise impacts is necessary.

LSA

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Project Site Boundary

LT-1 Long-term Noise Monitoring Location

0 160 320
FEET

SOURCE: Google Earth 2023

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FIGURE 3

Batavia Self Storage Development

Noise Monitoring Locations

EXISTING RAIL ACTIVITY NOISE

As shown in Table G above, the exterior noise level at the LT-1 location, representing the northern section of the project site, was recorded at 66.3 dBA CNEL. Because the office use portion of the proposed buildings would be further to the south, noise impacts from the adjacent rail line would decrease below 65 dBA CNEL due to distance attenuation and shielding from the proposed Building A. Because the areas of the project containing office uses would be below 65 dBA CNEL, the project would comply with the applicable CALGreen Code standards, and no further analysis associated with on-site rail noise impacts is necessary.

PROJECT IMPACTS

SHORT-TERM CONSTRUCTION NOISE IMPACTS

Two types of short-term noise impacts could occur during the 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 ft would generate up to 84 dBA L_{max}), the effect on longer-term ambient noise levels would be small when compared to existing daily traffic volumes on Batavia Street. Because construction-related vehicle trips would not approach existing daily traffic volumes, traffic noise would not increase by 3 dBA CNEL. 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 commutes 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, which includes demolition of the existing structures and other site improvements, site preparation, grading, building construction, paving, and architectural coating on the project site. Construction is completed in discrete steps, each of which has its own mix of equipment and, consequently, its own noise characteristics. 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 ft between the equipment and a noise receptor, taken from the Federal Highway Administration's *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:

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

where: $L_{eq}(equip)$ = L_{eq} at a receiver resulting from the operation of a single piece of equipment over a specified time period.

E.L. = noise emission level of the particular piece of equipment at a reference distance of 50 ft.

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

D = distance from the receiver to the piece of equipment.

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
Impact Pile Drivers	20	95
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

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 ft would range from 74 dBA L_{eq} to 88 dBA L_{eq}, with the highest noise levels occurring during the demolition, site preparation, and paving phases.

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 while halving the distance would increase noise levels by 6 dBA.

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

Table I: Potential Construction Noise Impacts at Nearest Receptor

Receptor (Location)	Composite Noise Level (dBA L_{eq}) at 50 ft[1]	Distance (ft)	Composite Noise Level (dBA L_{eq})
Industrial Uses (South)	88	165	78
Industrial Uses (North)		200	76
Industrial Uses (West)		290	73
Industrial Uses (East)		380	70
Residence (South)		580	67

Source: Compiled by LSA (2023).

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

dBA L_{eq} = average A-weighted hourly noise level

ft = foot/feet

While construction noise will vary, it is expected that composite noise levels during construction at the nearest off-site industrial uses to the south would reach 78 dBA L_{eq} while construction noise levels would approach 67 dBA L_{eq} at the nearest sensitive residential use to the south 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. While 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 no longer occur once project construction is completed.

As stated above, the City's Noise Ordinance regulates noise impacts associated with construction activities. The proposed project would comply with the construction hours specified in the City's Noise Ordinance, which states that construction activities are allowed between the hours 7:00 a.m. to 8:00 p.m., Monday through Saturday, and during the hours of 9:00 a.m. to 8:00 p.m. on Sundays and federal holidays.

As it relates to off-site uses, construction-related noise impacts would remain below the 80 dBA L_{eq} and 90 dBA L_{eq} 1-hour construction noise level criteria for daytime construction noise level criteria as established by the FTA for residential and industrial land uses, respectively; therefore, the impact 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 (VdB) and assesses the potential for building damages using vibration levels in PPV (in/sec). This is because vibration levels calculated in RMS are best for characterizing human response to building vibration, while vibration level in PPV is best for characterizing potential for damage.

Table J shows the PPV and VdB values at 25 ft 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 PPV in/sec or 87 VdB of ground-borne vibration when measured at 25 ft, based on the FTA 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)	L_V (VdB)[1]
Pile Driver (Impact), Typical	0.644	104
Pile Driver (Sonic), Typical	0.170	93
Vibratory Roller	0.210	94
Hoe Ram	0.089	87
Large Bulldozer[2]	**0.089**	**87**
Caisson Drilling	0.089	87
Loaded Trucks[2]	**0.076**	**86**
Jackhammer	0.035	79
Small Bulldozer	0.003	58

Source: *Transit Noise and Vibration Impact Assessment Manual* (FTA 2018).
[1] RMS vibration velocity in decibels (VdB) is 1 µin/sec.
[2] Equipment shown in **bold** is expected to be used on site.
µin/sec = microinches per second
ft = foot/feet
FTA = Federal Transit Administration
in/sec = inch/inches per second
L_V = velocity in decibels
PPV = peak particle velocity
RMS = root-mean-square
VdB = vibration velocity decibels

The formulae for vibration transmission are provided below and Tables K and L below provide a summary of off-site construction vibration levels.

$$L_v dB\ (D) = L_v dB\ (25\ ft) - 30\ Log\ (D/25)$$

$$PPV_{equip} = PPV_{ref} \times (25/D)^{1.5}$$

As previously shown in Table E, the threshold at which vibration levels would result in annoyance would be 90 VdB for workshop type uses and 78 VdB for daytime residential uses. As shown in Table

F, the FTA guidelines indicate that for a non-engineered timber and masonry building, the construction vibration damage criterion is 0.2 in/sec in PPV.

Table K: Potential Construction Vibration Annoyance Impacts at Nearest Receptor

Receptor (Location)	Reference Vibration Level (VdB) at 25 ft[1]	Distance (ft)[2]	Vibration Level (VdB)
Industrial Uses (South)	87	165	62
Industrial Uses (North)		200	60
Industrial Uses (West)		290	55
Industrial Uses (East)		380	52
Residence (South)		580	46

Source: Compiled by LSA (2023).

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 assessmente distance is associated with the average condition, identified by the distance from the center of construction activities to surrounding uses.

ft = foot/feet

VdB = vibration velocity decibels

Table L: Potential Construction Vibration Damage Impacts at Nearest Receptor

Receptor (Location)	Reference Vibration Level (PPV) at 25 ft[1]	Distance (ft)[2]	Vibration Level (PPV)
Industrial Uses (South)	0.089	15	0.191
Industrial Uses (North)		65	0.021
Industrial Uses (West)		15	0.191
Industrial Uses (East)		130	0.008
Residence (South)		380	0.002

Source: Compiled by LSA (2023).

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 peak condition, identified by the distance from the perimeter of construction activities and incorporating the project design features to surrounding structures.

ft = foot/feet

PPV = peak particle velocity

Based on the information provided in Table K, vibration levels are expected to approach 62 VdB at the closest industrial uses to the south and 46 VdB at the closest residence to the south and would not exceed the annoyance thresholds.

Based on the information provided in Table L, vibration levels are expected to approach 0..191 PPV in/sec at the nearest surrounding structures and would remain below the FTA threshold of 0.2 in/sec PPV for building damage. Vibration levels associated with smaller equipment would be substantially lower than the heavy equipment analyzed. Therefore, construction would not result in any vibration annoyance or damage, and impacts would be less than significant.

Because construction activities are regulated by the City's Municipal Code, which states that construction activities are allowed between the hours of 7:00 a.m. to 8:00 p.m., Monday through Saturday, and during the hours of 9:00 a.m. to 8:00 p.m. on Sundays and federal holidays, vibration impacts would not occur during the more sensitive nighttime hours.

LONG-TERM OFF-SITE TRAFFIC NOISE IMPACTS

As a result of the implementation of the proposed project, off-site traffic volumes on surrounding roadways have the potential to increase. The proposed project would generate 193 daily trips including 12 trips during the AM peak hour and 20 trips during the PM peak hour according to the *Vehicle Miles Traveled (VMT) Screening Analysis* (EPD Solutions, Inc. 2023). It takes a doubling of traffic to increase traffic noise levels by 3 dBA per the following equation that is used to determine potential traffic noise increases:

$$\text{Change in CNEL} = 10 \log_{10} [V_{e+pt}/V_{existing}]$$

where: $V_{existing}$ = the existing daily volume
V_{e+pt} = existing daily volumes plus project trips
Change in CNEL = the increase in noise level due to project trips

Due to the low daily increase in traffic volumes associated with the proposed project, there would be a minimal increase, less than 1 dBA, in traffic noise impact from project-related traffic to off-site sensitive receptors. Because an increase of less than 1 dBA is not perceptible to the human ear, impacts would be less than significant, and 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 ft from the roadways that contain project trips 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 mitigation measures are required.

LONG-TERM OFF-SITE STATIONARY NOISE IMPACTS

Adjacent off-site land uses would be potentially exposed to stationary-source noise impacts from the proposed on-site heating, ventilation, and air conditioning (HVAC) equipment, and truck deliveries and loading and unloading activities. The potential noise impacts to off-site sensitive land uses from the proposed HVAC equipment and truck delivery activities are discussed below. To determine the future noise impacts from project operations to the noise-sensitive uses, a 3-D noise model, SoundPLAN, was used to incorporate the site topography as well as the shielding from the proposed building on-site. A graphic representation of the operational noise impacts is presented in Appendix C.

Heating, Ventilation, and Air Conditioning Equipment

The project would have various rooftop mechanical equipment including HVAC units on the proposed building. Based on the project site plan, the project is assumed to have twelve (12) rooftop HVAC units and assumed to operate 24 hours per day. The HVAC equipment could operate 24 hours per day and would generate sound pressure levels (SPL) of up to 87 dBA SPL or 72 dBA L_{eq} at 5 ft, based on manufacturer data (Trane n.d.).

Truck Deliveries and Truck Loading and Unloading Activities

Noise levels generated by delivery trucks would be similar to noise readings from truck loading and unloading activities, which generate a noise level of 75 dBA L_{eq} at 20 ft based on measurements taken by LSA (*Operational Noise Impact Analysis for Richmond Wholesale Meat Distribution Center* [LSA 2016]). Shorter term noise levels that occur during the docking process taken by LSA were measured to be 76.3 dBA L_8 at 20 ft. Delivery trucks would arrive on site and maneuver their trailers so that trailers would be parked within the loading docks. During this process, noise levels are associated with the truck engine noise, air brakes, and back-up alarms while the truck is backing into the dock. These noise levels would occur for a shorter period of time (less than 5 minutes). To present a conservative assessment, it is assumed that truck arrivals and departure activities could occur at 4 spaces for a period of less than 5 minutes.

Cumulative Operations Noise Assessment

Tables M and N below show the combined hourly noise levels generated by HVAC equipment, trash bin emptying activities, cold storage fan units, and truck delivery activities at the closest off-site land uses.

Table M: Daytime Exterior Noise Level Impacts

Receptor	Direction	Existing Quietest Daytime Noise Level (dBA L_{eq})	Project Generated Noise Levels (dBA L_{eq})	Potential Operational Noise Impact?[1]
Residential (545 N Emerald Drive)	South	53.1	41.7	No

Source: Compiled by LSA (2023).

[1] A potential operational noise impact would occur if (1) the quietest daytime ambient hour is less than 55 dBA L_{eq} and project noise impacts are greater than 55 dBA L_{eq}, OR (2) the quietest daytime ambient hour is greater than 55 dBA L_{eq} and project noise impacts are 3 dBA greater than the quietest daytime ambient hour.

dBA = A-weighted decibels

L_{eq} = equivalent noise level

Table N: Nighttime Exterior Noise Level Impacts

Receptor	Direction	Existing Quietest Nighttime Noise Level (dBA L_{eq})	Project Generated Noise Levels (dBA L_{eq})	Potential Operational Noise Impact?[1]
Residential (545 N Emerald Drive)	South	48.0	41.7	No

Source: Compiled by LSA (2023).

[1] A potential operational noise impact would occur if (1) the quietest nighttime ambient hour is less than 45 dBA L_{eq} and project noise impacts are greater than 45 dBA L_{eq}, OR (2) the quietest nighttime ambient hour is greater than 45 dBA L_{eq} and project noise impacts are 3 dBA greater than the quietest nighttime ambient hour.

dBA = A-weighted decibels

L_{eq} = equivalent noise level

The results in Tables M and N show that project-generated noise levels would remain below the residential use daytime noise standard of 55 dBA L_{eq} and would not exceed the residential nighttime noise standard of 45 dBA L_{eq}. Under both conditions, project-generated noise levels would also be more than 5 dBA below existing ambient noise levels. Therefore, because project noise levels would not generate a noise level increase of 3 dBA or more over the quietest ambient noise levels for daytime and nighttime, the impact would be less than significant, and no noise reduction measures are required. Additionally, as shown in Appendix C, the 70 dBA L_{max} and 65 dBA L_{max} noise contours generated by the proposed project during daytime and nighttime hours, respectively, would remain outside the limits of the closest sensitive receptors. Therefore, operations at the proposed project would not generate noise levels at surrounding sensitive properties that exceed the noise level standard of 70 dBA L_{max} or 65 dBA L_{max}.

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APPENDIX A

NOISE MONITORING DATA

Noise Measurement Survey – 24 HR

Project Number: ESL2201.60
Project Name: Batavia Self-Storage

Test Personnel: Kevin Nguyendo
Equipment: Spark 706RC (SN:224)

Site Number: LT-1 Date: 3/7/23

Time: From 1:00 p.m. To 1:00 p.m.

Site Location: Located on the northeast corner of the project site near a gated fence adjacent To the railway line.

Primary Noise Sources: Nearby vehicle traffic noise near Batavia Street, parking lot activity noise and nearby train traffic noise.

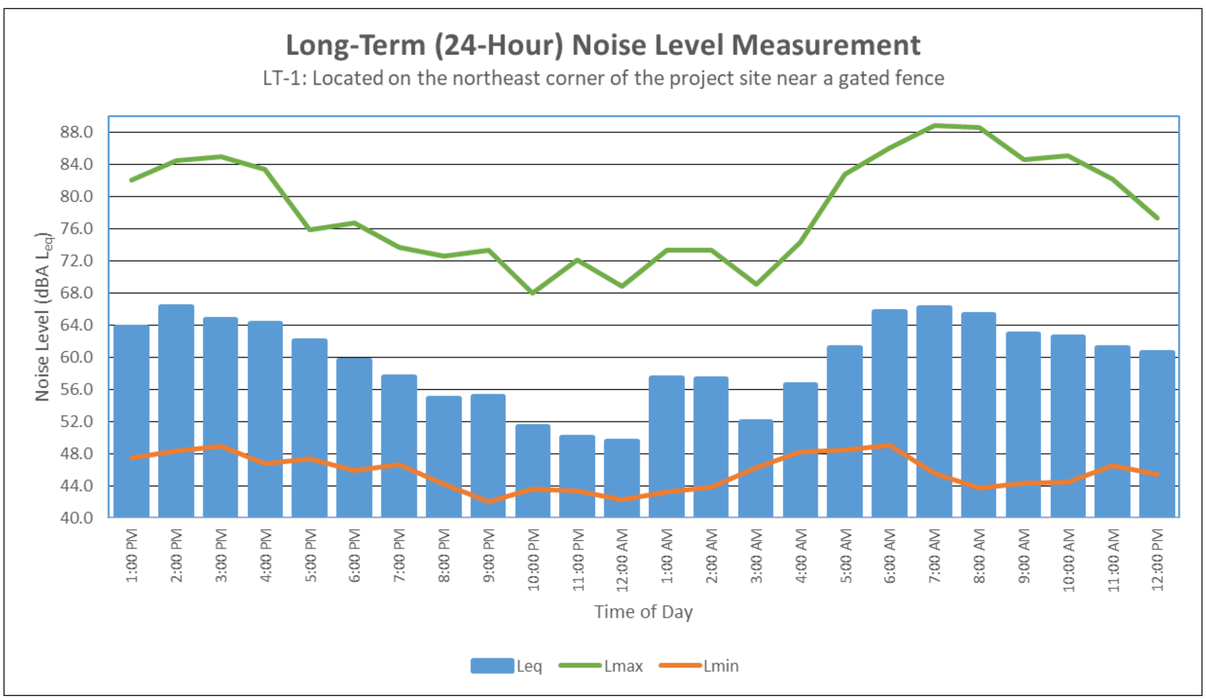
Comments:

Photo:

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

Start Time	Date	Noise Level (dBA)		
		L_{eq}	L_{max}	L_{min}
1:00 PM	3/7/23	63.7	82.0	47.5
2:00 PM	3/7/23	66.3	84.4	48.3
3:00 PM	3/7/23	64.6	84.9	48.9
4:00 PM	3/7/23	64.3	83.4	46.7
5:00 PM	3/7/23	62.1	75.8	47.3
6:00 PM	3/7/23	59.6	76.7	45.9
7:00 PM	3/7/23	57.6	73.6	46.6
8:00 PM	3/7/23	54.8	72.6	44.2
9:00 PM	3/7/23	55.1	73.3	42.0
10:00 PM	3/7/23	51.3	68.0	43.6
11:00 PM	3/7/23	50.0	72.1	43.4
12:00 AM	3/8/23	49.5	68.8	42.3
1:00 AM	3/8/23	57.4	73.3	43.2
2:00 AM	3/8/23	57.2	73.3	43.8
3:00 AM	3/8/23	52.0	69.0	46.3
4:00 AM	3/8/23	56.6	74.3	48.2
5:00 AM	3/8/23	61.2	82.8	48.4
6:00 AM	3/8/23	65.6	86.0	49.0
7:00 AM	3/8/23	66.2	88.8	45.5
8:00 AM	3/8/23	65.3	88.6	43.7
9:00 AM	3/8/23	62.8	84.6	44.3
10:00 AM	3/8/23	62.5	85.1	44.5
11:00 AM	3/8/23	61.2	82.1	46.5
12:00 PM	3/8/23	60.5	77.3	45.4

Source: Compiled by LSA Associates, Inc. (2023).
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: ESL2201.60
Project Name: Batavia Self-Storage
Test Personnel: Kevin Nguyendo
Equipment: Spark 706RC (SN:908)

Site Number: LT-2 Date: 3/7/23
Time: From 1:00 p.m. To 1:00 p.m.

Site Location: Located just west of 533 North Citrus Street on a utility pole.

Primary Noise Sources: Faint vehicle traffic noise on Batavia Street.

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}
1:00 PM	3/7/23	55.9	70.2	49.5
2:00 PM	3/7/23	56.5	71.1	50.3
3:00 PM	3/7/23	56.7	74.8	51.4
4:00 PM	3/7/23	57.2	78.8	49.6
5:00 PM	3/7/23	55.0	69.6	50.3
6:00 PM	3/7/23	54.6	69.9	50.0
7:00 PM	3/7/23	55.6	74.1	51.4
8:00 PM	3/7/23	54.5	69.1	49.6
9:00 PM	3/7/23	51.8	65.8	43.8
10:00 PM	3/7/23	49.9	65.8	45.0
11:00 PM	3/7/23	49.2	63.1	44.7
12:00 AM	3/8/23	50.8	69.9	44.1
1:00 AM	3/8/23	48.0	61.1	44.5
2:00 AM	3/8/23	51.8	65.5	46.9
3:00 AM	3/8/23	54.9	69.6	50.0
4:00 AM	3/8/23	54.4	63.7	51.4
5:00 AM	3/8/23	53.8	63.3	50.3
6:00 AM	3/8/23	58.2	78.4	50.4
7:00 AM	3/8/23	57.4	77.3	43.8
8:00 AM	3/8/23	53.1	68.8	42.2
9:00 AM	3/8/23	53.4	72.6	43.5
10:00 AM	3/8/23	54.0	68.9	46.1
11:00 AM	3/8/23	55.2	76.7	49.3
12:00 PM	3/8/23	56.2	74.6	49.4

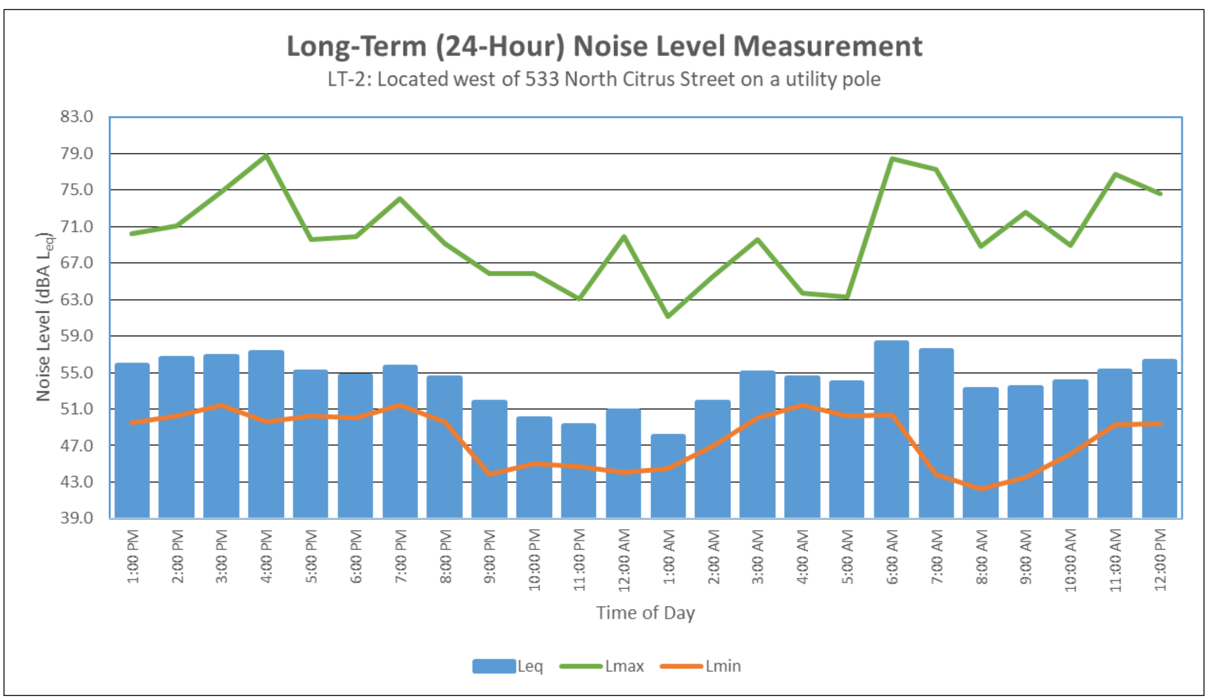
Source: Compiled by LSA Associates, Inc. (2023).

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 Calculations

Phase: Demolition

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Concrete Saw	1	90	20	50	0.5	90	83
Tractor	3	84	40	50	0.5	84	85
Dozer	2	82	40	50	0.5	82	81
					Combined at 50 feet	**91**	**88**
					Combined at Receptor 165 feet	**81**	**78**
					Combined at Receptor 200 feet	**79**	**76**
					Combined at Receptor 290 feet	**76**	**73**
					Combined at Receptor 380 feet	**74**	**70**
					Combined at Receptor 580 feet	**70**	**67**

Phase: Site Preparation

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Tractor	4	84	40	50	0.5	84	86
Dozer	3	82	40	50	0.5	82	83
					Combined at 50 feet	**86**	**88**
					Combined at Receptor 165 feet	**76**	**77**

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
Dozer	1	82	40	50	0.5	82	78
Tractor	3	84	40	50	0.5	84	85
Excavator	1	81	40	50	0.5	81	77
					Combined at 50 feet	**89**	**87**
					Combined at Receptor 165 feet	**79**	**77**

Phase:Building Construstion

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Crane	1	81	16	50	0.5	81	73
Man Lift	3	75	20	50	0.5	75	73
Generator	1	81	50	50	0.5	81	78
Tractor	3	84	40	50	0.5	84	85
Welder / Torch	1	74	40	50	0.5	74	70
					Combined at 50 feet	**87**	**86**
					Combined at Receptor 165 feet	**77**	**76**

Phase:Paving

Equipment	Quantity	Reference (dBA) 50 ft Lmax	Usage Factor[1]	Distance to Receptor (ft)	Ground Effects	Noise Level (dBA) Lmax	Leq
Drum Mixer	2	80	50	50	0.5	80	80
Paver	1	77	50	50	0.5	77	74
All Other Equipment > 5 HP	2	85	50	50	0.5	85	85
Roller	2	80	20	50	0.5	80	76
Tractor	1	84	40	50	0.5	84	80
					Combined at 50 feet	**89**	**88**
					Combined at Receptor 165 feet	**79**	**77**

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	78	40	50	0.5	78	74
					Combined at 50 feet	**78**	**74**
					Combined at Receptor 165 feet	**68**	**64**

Sources: RCNM

[1]- Percentage of time that a piece of equipment is operating at full power.
dBA – A-weighted Decibels
Lmax- Maximum Level
Leq- Equivalent Level

APPENDIX C

SOUNDPLAN NOISE MODEL PRINTOUTS

630 N Batavia Self-Storage

Project No. ESL2201.60

Project Operational Noise Levels - Leq

630 N Batavia Self-Storage

Project No. ESL2201.60

Project Operational Noise Levels - Lmax