Environmental Noise & Vibration Assessment

Yeshi Arden Apartments

Sacramento County, California

BAC Job # 2022-168

Prepared For:

CWE

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March 29, 2023

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CEQA Checklist

NOISE AND VIBRATION **– Would the Project Result in:**	**NA – Not Applicable**	**Potentially Significant Impact**	**Less than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
a) Generation of substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?			**X**		
b) Generation of excessive groundborne vibration or groundborne noise levels?				**X**	
c) For a project located within the vicinity of a private airstrip or an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?					**X**

Introduction

The Yeshi Arden Apartments (project) is located north of Red Robin Lane between Aurora Avenue and Capital City Freeway/Interstate 80 Business (Business 80) in Sacramento County, California. The project proposes the development of multi-story apartment buildings with associated parking areas. The project area with aerial imagery is shown in Figure 1. The project site plan is provided in Figure 2.

The purposes of this assessment are to quantify the existing noise and vibration environments, identify potential noise and vibration impacts resulting from the project, identify appropriate mitigation measures, and provide a quantitative and qualitative analysis of impacts associated with the project. Specifically, impacts are identified if project-related activities would cause a substantial increase in ambient noise or vibration levels at existing sensitive land uses in the project vicinity, or if traffic or project-generated noise or vibration levels would exceed applicable federal, state, or Sacramento County standards at existing or proposed sensitive uses.

Noise and Vibration Fundamentals

Noise

Noise is often described as unwanted sound. Sound is defined as any pressure variation in air that the human ear can detect. If the pressure variations occur frequently enough (at least 20 times per second), they can be heard and are designated as sound. The number of pressure variations per second is called the frequency of sound and is expressed as cycles per second, or Hertz (Hz). Definitions of acoustical terminology are provided in Appendix A.

Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale uses the hearing threshold (20 micropascals of pressure) as a point of reference, defined as 0 dB. Other sound pressures are then compared to the reference pressure, and the logarithm is taken to keep the numbers in a practical range. The decibel scale allows a million-fold increase in pressure to be expressed as 120 dB. Another useful aspect of the decibel scale is that changes in decibel levels correspond closely to human perception of relative loudness. Noise levels associated with common noise sources are provided in Figure 3.

The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable and can be approximated by filtering the frequency response of a sound level meter by means of the standardized A-weighting network. There is a strong correlation between A-weighted sound levels (expressed as dBA) and community response to noise. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. All noise levels reported in this section are in terms of A-weighted levels.

Community noise is commonly described in terms of the ambient noise level, which is defined as the all-encompassing noise level associated with a given noise environment. A common

statistical tool to measure the ambient noise level is the average, or equivalent, sound level (L_{eq}). The L_{eq} is the foundation of the day-night average and day-evening-night average noise descriptors, DNL and CNEL, and show very good correlation with community response to noise. DNL and CNEL are based on the average noise level over a 24-hour day, with a +5-decibel weighting applied to noise occurring during evening hours (CNEL only), and a 10-decibel weighting applied to noise occurring during nighttime hours (both DNL and CNEL). Because DNL and CNEL represent a 24-hour average, it tends to disguise short-term variations in the noise environment.

Vibration

Vibration is like noise in that it involves a source, a transmission path, and a receiver. While vibration is related to noise, it differs in that noise is generally considered to be pressure waves transmitted through air, while vibration is usually associated with transmission through the ground or structures. As with noise, vibration consists of an amplitude and frequency. A person's response to vibration will depend on their individual sensitivity as well as the amplitude and frequency of the source.

Vibration can be described in terms of acceleration, velocity, or displacement. A common practice is to monitor vibration in terms of velocity in inches per second peak particle velocity (IPS, PPV) or root-mean-square (VdB, RMS). Standards pertaining to perception as well as damage to structures have been developed for vibration in terms of peak particle velocity as well as RMS velocities.

As vibrations travel outward from the source, they excite the particles of rock and soil through which they pass and cause them to oscillate. Differences in subsurface geologic conditions and distance from the source of vibration will result in different vibration levels characterized by different frequencies and intensities. In all cases, vibration amplitudes will decrease with increasing distance.

Human response to vibration is difficult to quantify. Vibration can be felt or heard well below the levels that produce any damage to structures. The duration of the event has an effect on human response, as does frequency. Generally, as the duration and vibration frequency increase, the potential for adverse human response increases.

According to the Transportation and Construction-Induced Vibration Guidance Manual (Caltrans, April 2020), operation of construction equipment and construction techniques generate ground vibration. Traffic traveling on roadways can also be a source of such vibration. At high enough amplitudes, ground vibration has the potential to damage structures and/or cause cosmetic damage. Ground vibration can also be a source of annoyance to individuals who live or work close to vibration-generating activities. However, traffic rarely generates vibration amplitudes high enough to cause structural or cosmetic damage.



Legend

- Project Boundary (Approximate)
- Existing Traffic Sound Wall
- Long-Term Ambient Noise Survey Site
- Short-Term Ambient Noise and Vibration Survey Sites

N

Scale (Feet)

0 50 100

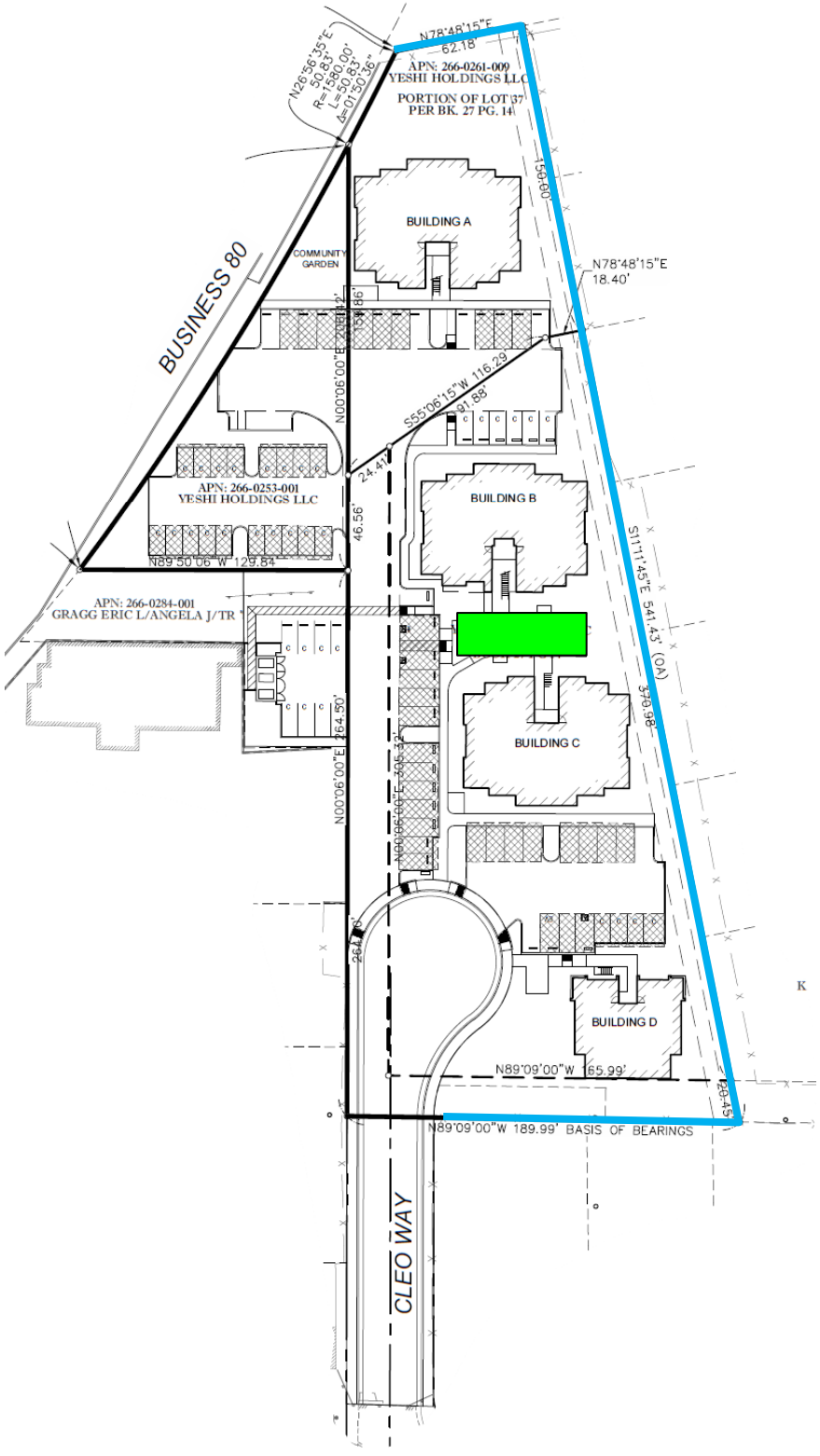
Yeshi Arden Apartments

Sacramento County, California

Project Area

Figure 1

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Legend

Proposed 6' Masonry Wall

Primary Common Outdoor Area – Playground/Tot-Lot

N

Scale (Feet)

0 40 80

Yeshi Arden Apartments

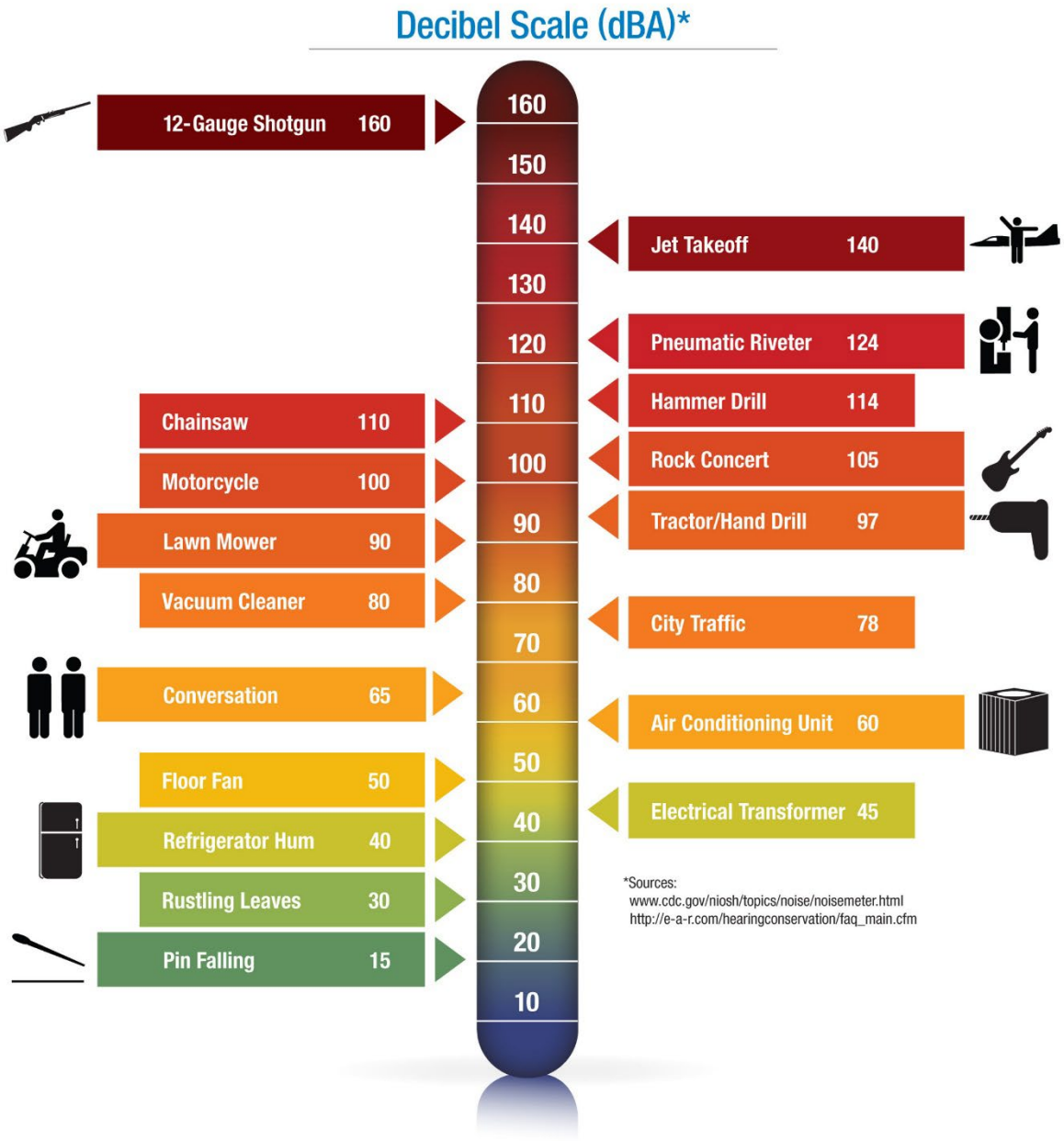
Sacramento County, California

Site Plan

Figure 2

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Figure 3
Noise Levels Associated with Common Noise Sources



Environmental Setting – Existing Ambient Noise and Vibration Environment

Existing Land Uses in the Project Vicinity

Noise-sensitive land uses are generally defined as locations where people reside or where the presence of unwanted sound could adversely affect the primary intended use of the land. Places where people live, sleep, recreate, worship and study are generally considered to be sensitive to noise because intrusive noise can be disruptive to these activities. Existing noise-sensitive uses which would potentially be affected by the project consist of residential to the south, east and west, as identified in Figure 1.

Existing Overall Ambient Noise Environment in the Project Vicinity

The existing ambient noise environment in the immediate project vicinity is defined primarily by traffic on Business 80. To generally quantify existing ambient noise environment within the immediate project vicinity, BAC conducted long-term (72-hour) ambient noise level measurements on the project site January 29-31, 2023. The long-term ambient noise survey location is identified as site A in Figure 1. Photographs of the noise survey location are provided in Appendix B.

A Larson Davis Laboratories (LDL) Models 820 precision integrating sound level meter was used to complete the long-term ambient noise level survey. The meter was calibrated immediately before with an LDL Model CA200 acoustical calibrator to ensure the accuracy of the measurements. The equipment used meets all specifications of the American National Standards Institute requirements for Type 1 sound level meters (ANSI S1.4). The complete results of the ambient noise survey are presented in Appendices C and D and summarized in Table 1.

Table 1
Summary of Long-Term Ambient Noise Survey Results – January 29-31, 2023[1]

			Average Measured Hourly Noise Levels (dB)[3]			
			Daytime		Nighttime	
Survey Location[2]	Date	DNL (dB)	L_{eq}	L_{max}	L_{eq}	L_{max}
Site A: Along eastern end of project area adjacent to residences	1/29/23	59	54	67	52	65
	1/30/23	63	60	74	55	68
	1/31/23	60	53	67	53	65

[1] Detailed summaries of the noise monitoring results are provided in Appendices C and D.
[2] Long-term ambient noise monitoring location identified in Figure 1.
[3] Daytime: 7:00 a.m. to 10:00 p.m. | Nighttime: 10:00 p.m. to 7:00 a.m.

Source: Bollard Acoustical Consultants, Inc. 2023.

BAC measurement site A was specifically selected to be representative of the existing ambient noise level environment at the residential uses to the east of the project site. As shown in Table 1, measured day-night average levels (DNL) and average measured hourly noise levels (L_{eq} and L_{max}) were highest on Monday, January 30, 2023.

Existing Ambient Vibration Environment in the Project Vicinity

During BAC visits to the project site, vibration levels were below the threshold of perception within the project area. Nonetheless, to quantify existing vibration levels in the project vicinity, BAC conducted short-term (15-minute) vibration measurements at three (3) locations within the project area on February 1, 2023. The short-term vibration survey locations are shown in Figure 1, identified as sites 1-3. Photographs of the vibration survey equipment are provided in Appendix B.

A Larson-Davis Laboratories Model LxT precision integrating sound level meter equipped with a vibration transducer was used to complete the measurements. The results are summarized in Table 2.

Table 2
Summary of Short-Term Ambient Vibration Survey Results – February 1, 2023

Survey Location	Time	Measured Maximum Vibration Level, PPV (in/sec)
Site 1: North end of project site near proposed Building A	12:57 p.m.	0.011
Site 2: Central in project site near proposed Building B	12:39 p.m.	<0.001
Site 3: Southcentral in project site near proposed Building C	12:15 p.m.	<0.001

Source: Bollard Acoustical Consultants, Inc. 2023.

Table 2 data indicate that measured vibration levels within the project area ranged from below the threshold of perception (less than 0.001 PPV in/sec) to 0.011 PPV in/sec.

Regulatory Setting: Criteria for Acceptable Noise and Vibration Exposure

Federal

There are no federal noise or vibration criteria which would be directly applicable to this project. However, Sacramento County does not currently have criteria for assessing noise impacts associated with increases in ambient noise levels due to the proposed residential project. As a result, the following federal criteria were applied to the project.

Federal Interagency Commission on Noise (FICON)

The Federal Interagency Commission on Noise (FICON) has developed a graduated scale for use in the assessment of project-related noise level increases. The criteria shown in Table 3 was developed by FICON as a means of developing thresholds for impact identification for project-related noise level increases. The FICON standards have been used extensively in recent years in the preparation of the noise sections of Environmental Impact Reports that have been certified in many California cities and counties.

The use of the FICON standards is considered conservative relative to thresholds used by other agencies in the State of California. For example, the California Department of Transportation (Caltrans) requires a project-related traffic noise level increase of 12 dB for a finding of

significance, and the California Energy Commission (CEC) considers project-related noise level increases between 5 to 10 dB significant, depending on local factors. Therefore, the use of the FICON standards, which set the threshold for finding of significant noise impacts as low as 1.5 dB, provides a very conservative approach to impact assessment for this project.

Table 3
Significance of Changes in Cumulative Noise Exposure

Ambient Noise Level Without Project (DNL)	Change in Ambient Noise Level Due to Project
<60 dB	+5.0 dB or more
60 to 65 dB	+3.0 dB or more
>65 dB[1]	+1.5 dB or more

[1] It should be noted that FICONs Federal Agency Review of Selected Airport Noise Analysis Issues (1992) report does not identify a 1.5 dBA increase as a threshold of significance for noise environments exceeding 65 DNL, but an increase that warrants further analysis. However, for purposes of this analysis, a 1.5 dB threshold is utilized to assess the significance of project-related noise increases at sensitive locations currently exposed to ambient noise environments exceeding 65 dB DNL.

Source: Federal Interagency Committee on Noise (FICON).

Based on the FICON research, as shown in Table 3, a 5 dB increase in noise levels due to a project is required for a finding of significant noise impact where ambient noise levels without the project are less than 60 dB DNL. Where pre-project ambient conditions are between 60 and 65 dB DNL, a 3 dB increase is applied as the standard of significance. Finally, in areas already exposed to higher noise levels, specifically pre-project noise levels in excess of 65 dB DNL, a 1.5 dB increase is considered by FICON as an increase warranting further analysis.

State of California

California Environmental Quality Act (CEQA)

The State of California has established regulatory criteria that are applicable to this assessment. Specifically, Appendix G of the State of California Environmental Quality Act (CEQA) Guidelines are used to assess the potential significance of impacts pursuant to local General Plan policies, Municipal Code standards, or the applicable standards of other agencies. According to Appendix G of the CEQA guidelines, the project would result in a significant noise or vibration impact if the following occur:

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

B. Generation of excessive groundborne vibration or groundborne noise levels.

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

It should be noted that audibility is not a test of significance according to CEQA. If this were the case, any project which added any audible amount of noise to the environment would be

considered significant according to CEQA. Because every physical process creates noise, the use of audibility alone as significance criteria would be unworkable. CEQA requires a substantial increase in noise levels before noise impacts are identified, not simply an audible change.

California Department of Transportation (Caltrans)

Butte County does not currently have adopted standards for groundborne vibration that would be applicable to this specific project. As a result, the vibration impact criteria developed by the California Department of Transportation (Caltrans) was applied to the project. The Caltrans guidance criteria for building structure and vibration annoyance are presented in Tables 4 and 5, respectively.

Table 4
Caltrans Guidance for Building Structure Vibration Criteria

Structure and Condition	Limiting PPV (in/sec)
Historic and some old buildings	0.5
Residential structures	0.5
New residential structures	1.0
Industrial buildings	2.0
Bridges	2.0
PPV = Peak Particle Velocity	

Source: 2020 Caltrans Transportation and Construction Vibration Guidance Manual, Table 14.

Table 5
Caltrans Guidance for Vibration Annoyance Potential Criteria

	Maximum PPV (in/sec)	
Human Response	Transient Sources	Continuous/Frequent Intermittent Sources
Severe/very disturbing	2.0	0.4 to 3.6
Strongly perceptible	0.9	0.1
Distinctly perceptible	0.24	0.035
Barely/slightly perceptible	0.035	0.012
Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent sources include pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers and vibratory compaction equipment.		
PPV = Peak Particle Velocity		

Source: 2020 Caltrans Transportation and Construction Vibration Guidance Manual, Tables 4 & 6.

Local

Sacramento County General Plan

The Noise Element of the Sacramento County General Plan contains the County's noise-related policies. The specific policies which are generally applicable to this project are reproduced below:

NO-1 The noise level standards for noise-sensitive areas of new uses affected by traffic or railroad noise sources in Sacramento County are shown in Table 6 (General Plan Noise Element Table 1). Where the noise level standards of Table 6 are predicted to be exceeded at new uses proposed within Sacramento County which are affected by traffic or railroad noise, appropriate noise mitigation measures shall be included in the project design to reduce projected noise levels to a state of compliance with the Table 6 standards.

NO-8 Noise associated with construction activities shall adhere to the County Code requirements. Specifically, Section 6.68.090(e) addresses construction noise within the County.

NO-13 Where noise mitigation measures are required to satisfy the noise level standards of this Noise Element, emphasis shall be placed on the use of setbacks and site design to the extent feasible, prior to consideration of the use of noise barriers.

NO-14 Noise analyses prepared for multi-family residential projects, town homes, mixed-use, condominiums, or other residential projects where floor ceiling assemblies or party-walls shall be common to different owners/occupants, shall be consistent with the State of California Noise Insulation standards.

Table 6
Noise Standards for New Uses Affected by Traffic and Railroad Noise

New Land Use	Sensitive Outdoor Area, DNL (dB)[1]	Sensitive Interior Area, DNL (dB)[2]	Notes
All Residential	65	45	5
Transient Lodging	65	45	3,5
Hospitals & Nursing Homes	65	45	3,4,5
Theaters & Auditoriums	--	35	3
Churches, Meeting Halls	65	40	3
Schools, Libraries	65	40	3
Office Buildings	65	45	3
Commercial Buildings	--	50	3
Playgrounds, Parks	70	--	--
Industry	65	50	3

[1] Sensitive areas are defined in acoustic terminology section.
[2] Interior noise level standards are applied within noise-sensitive areas of the various land uses, with windows and doors in the closed positions.
[3] Where there are no sensitive exterior spaces proposed for these uses, only the interior noise level standard shall apply.
[4] Hospitals are often noise-generating uses. The exterior noise level standards for hospitals are applicable only at clearly identified areas designated for outdoor relaxation by either hospital staff or patients.
[5] If this use is affected by railroad noise, a maximum (Lmax) noise level standard of 70 dB shall be applied to all sleeping rooms to reduce the potential for sleep disturbance during nighttime train passages.

Source: Sacramento County General Plan, Noise Element, Table 1.

Sacramento County Code

The provisions of the Sacramento County Code which would be most applicable to this project are reproduced below.

Section 6.68.090 Exemptions.

The following activities shall be exempted from the provisions of this chapter:

e. Noise sources associated with construction, repair, remodeling, demolition, paving, or grading of any real property, provided said activities do not take place between the hours of 8:00 p.m. and 6:00 a.m. on weekdays and Friday commencing at 8:00 p.m. through and including 7:00 a.m. on Saturday; Saturdays commencing at 8:00 p.m. through and including 7:00 a.m. on the next following Sunday and on each Sunday after the hour of 8:00 p.m. Provided, however, when an unforeseen or unavoidable condition occurs during a construction project and the nature of the project necessitates that work in process be continued until a specific phase is completed, the contractor or owner shall be allowed to continue work after 8:00 p.m. and to operate machinery and equipment necessary until completion of the specific work in progress can be brought to conclusion under conditions which will not jeopardize inspection acceptance or create undue financial hardships for the contractor or owner.

Impacts and Mitigation Measures

Thresholds of Significance

For the purposes of this assessment, a noise and vibration impact is considered significant if the project would result in:

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

- Generation of excessive groundborne vibration or groundborne noise levels; or

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

The nearest identified airport is Sacramento McClellan Airport, located approximately 2.5 miles from the project site. Because the project site is not located within the vicinity of a private airstrip, an airport land use plan, or within two miles of a public airport, the last threshold listed above is not discussed further.

The following criteria based on standards established by the Federal Interagency Commission on Noise (FICON), the California Department of Transportation (Caltrans), and the County of Sacramento were used to evaluate the significance of environmental noise and vibration resulting from the project:

- A significant noise impact would be identified if the project would expose persons to or generate noise levels that would exceed applicable noise standards presented in the Sacramento County General Plan or County Code.

- A significant impact would be identified if project-generated off-site traffic would substantially increase noise levels at existing sensitive receptors in the vicinity. A substantial increase in off-site traffic noise level exposure would be identified relative to the FICON noise level increase significance criteria presented in this report.

  In terms of determining the temporary noise increase due to project on-site construction activities, an impact would occur if those activities would noticeably increase ambient noise levels above background levels. The threshold of perception of the human ear is approximately 3 to 5 dB – a 5 dB change is considered to be clearly noticeable. For the analysis of project construction activity noise level increases, a noticeable increase in ambient noise levels is assumed to occur where those activities would result in an increase by 5 dB or more over existing ambient noise levels.

- A significant impact would be identified if project-generated on-site activities would expose nearby sensitive receptors to excessive groundborne vibration levels. Specifically, an impact would be identified if groundborne vibration levels due to those activities would exceed the Caltrans vibration impact criteria presented in this report.

Noise Impacts Associated with Project-Generated Increases in Off-Site Traffic

Impact 1: Increases in Traffic Noise Levels due to the Project

Construction of this project would result in increased traffic on the local roadway network. BAC utilized the FHWA Model (FHWA-RD-77-108) with Institution of Engineers (ITE) Trip Generation Manual rates (10th Edition) to determine whether traffic noise impacts (relative to the FICON criteria provided in Table 3) would occur as a result of this project.

The FHWA Model was used in conjunction with the CALVENO reference noise emission curves, and accounts for vehicle volume and speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the project vicinity, and is generally considered to be accurate within 1.5 dB if the input variables are properly accounted for. The FHWA Model was developed to predict hourly L_{eq} values for free-flowing traffic conditions. To calculate a day-night average (DNL), average daily traffic (ADT) volume data is manipulated based on the assumed day/night distribution of traffic.

According to the provided site plans, the proposed development will be accessed from Cleo Way via Red Robin Lane. As a result, the greatest impact from project-generated off-site traffic will be along Cleo Way and Red Robin Lane. Based on the results from the BAC ambient noise level survey, measured day-night average noise levels within the vicinity of those roadways ranged from 59 to 63 dB DNL. For the purpose of this analysis, it was conservatively assumed that the existing ambient noise level environment at the existing noise-sensitive uses along Cleo Way and Red Robin Lane (residences) is 55 dB DNL. The nearest existing residences along Cleo Way and Rd Robin Lane maintain a separation of approximately 50 feet from the roadway centerlines.

It is the understanding of BAC that the project proposes the development of approximately 39 residential apartment units. According to ITE, multi-family housing (ITE code 22) generate approximately 7.3 daily trips per unit. Assuming all 39 proposed apartment units would generate 7.3 trips per day, project-generated traffic noise level exposure is predicted to be 47 dB DNL at the nearest existing residences along Cleo Way and Red Robin Lane (50 feet from roadway centerlines).

Pursuant to FICON increase significance criteria (Table 3), where existing ambient noise levels are less than 60 dB DNL, a +5 dB DNL increase in noise levels shall be considered significant. Based on the analysis and results provided above, the project-related increase in traffic noise level exposure along roadways located within the immediate project vicinity is calculated to be 0.6 dB DNL. Because project-related traffic is not predicted to result in increases in ambient noise levels that would exceed the applicable FICON increase significance criteria at existing sensitive uses within the project vicinity, this impact is identified as being ***less than significant***.

Noise Impacts Associated with On-Site Project Construction Activities

Impact 2: On-Site Project Construction Noise Levels at Existing Residential Uses

During project construction, heavy equipment would be used for grading excavation, paving, and building construction, which would increase ambient noise levels when in use. Noise levels would vary depending on the type of equipment used, how it is operated, and how well it is maintained. Noise exposure at any single point outside the project work area would also vary depending upon the proximity of equipment activities to that point. The outdoor activity areas of the nearest existing residences are located approximately 50 feet away from where construction activities could potentially occur on the project site.

The range of maximum noise levels for various types of construction equipment at a distance of 50 feet is presented in Table 7. It should be noted that not all of these construction activities would be required for this project. The noise values in Table 7 represent maximum noise generation, or full-power operation of the equipment. As one increases the distance between equipment, or increases separation of areas with simultaneous construction activity, dispersion and distance attenuation reduce the effects of combining separate noise sources.

Table 7
Construction Equipment Reference Noise Levels

Equipment	Reference Noise Level at 50 Feet (dB)
Air compressor	80
Backhoe	80
Ballast equalizer	82
Ballast tamper	83
Compactor	82
Concrete mixer	85
Concrete pump	82
Concrete vibrator	76
Crane, mobile	83
Dozer	85
Excavator	85
Generator	82
Grader	85
Impact wrench	85
Loader	80
Paver	85
Pneumatic tool	85
Pump	77
Saw	76
Scarifier	83
Scraper	85
Shovel	82
Spike driver	77
Tie cutter	84
Tie handler	80
Tie inserter	85
Truck	84
Low	76
High	85
Average	82

Source: 2018 FTA Noise and Vibration Impact Assessment Manual, Table 7-1.

Policy NO-8 of the Sacramento County General Plan states that noise associated with construction activities shall adhere to requirements contained in County Code Section 6.68.090(e). Pursuant to Section 6.68.090(e), noise associated with construction activities is exempt *provided* that said activities do not occur during specific hours and days identified in the code section. It is reasonably assumed for the purposes of this analysis that all noise-generating on-site project construction equipment and activities would occur pursuant to County Code Section 6.68.090(e) and would thereby be exempt from County noise level criteria.

In terms of determining the temporary noise increase due to project-related construction activities, an impact would occur if construction activity would noticeably increase ambient noise levels above background levels. The threshold of perception of the human ear is approximately 3 to 5 dB – a 5 dB change is considered to be clearly noticeable. For this analysis, a noticeable increase

in ambient noise levels is assumed to occur where noise levels increase by 5 dB or more over existing ambient noise levels.

As mentioned previously, BAC ambient noise survey site A was specifically selected to be representative of the existing ambient noise level environment at the residential uses to the east of the project site. According to the ambient noise level data contained in Appendices C and D, average measured hourly maximum noise levels during the hours/days in which construction activity noise is exempted by County Code Section 6.68.090(e) ranged from 73 to 82 dB L_{max} (arithmetic mean of 82 dB L_{max}). Given the calculated means of average measured daytime maximum noise levels at BAC site A (82 dB L_{max}) and construction equipment maximum noise levels shown in Table 7 (82 dB L_{max}, Table 13), ambient plus project construction noise level exposure is calculated to be approximately 85 dB L_{max} at the nearest existing residential uses located 50 feet away. A calculated ambient plus project construction noise level of 85 dB L_{max} represents an increase of 3.1 dB L_{max} at the nearest existing residential uses, which is below the applied increase significance criterion of 5 dB.

Based on the analysis and results provided above, this impact is identified as being ***less than significant***. Nonetheless, to the reduce the potential for annoyance at nearby existing noise-sensitive uses, the following measures should be incorporated into project on-site construction operations to the maximum extent feasible:

- **Construction Hours:** All on-site noise-generating construction activities should occur pursuant to the hours and days specified in Sacramento County Code Section 6.68.090(e).
- **Construction Equipment Mufflers and Maintenance:** All construction equipment powered by internal combustion engines should be properly muffled and maintained.
- **Idling Prohibitions:** All equipment and vehicles should be turned off when not in use. Unnecessary idling of internal combustion engines should be prohibited.
- **Equipment Location and Shielding:** All stationary noise-generating construction equipment, such as air compressors, should be located as far as practical from the adjacent residences. Such equipment should be acoustically shielded when it must be located within close proximity to adjacent residences.
- **Quiet Equipment Selection:** Select quiet equipment, particularly air compressors, whenever possible. All noise-producing project equipment and vehicles using internal-combustion engines should be equipped with manufacturer-recommended mufflers and be maintained in good working condition. Electrically powered equipment should be used instead of pneumatic or internal-combustion-powered equipment, where feasible.
- **Staging and Equipment Storage:** Material stockpiles and mobile equipment staging, parking, and maintenance areas should be located as far as practicable from noise-sensitive receptors.
- **Equipment and Vehicle Movements:** Project area and site access road speed limits should be established and enforced during the construction period.

- **Schedule Notification:** Nearby residences shall be notified of construction schedules so that arrangements can be made, if desired, to limit their exposure to short-term increases in ambient noise levels.

Vibration Impacts Associated with On-Site Project Activities

Impact 3: Vibration Generated by On-Site Project Construction and Proposed Uses

During on-site construction, heavy equipment would be used for grading, excavation, paving, and building construction, which would generate localized vibration in the immediate vicinity of the construction. The nearest existing sensitive structures, newer engineered residential structures, (not highly susceptible to damage by vibration) have been identified as residences located approximately 30 feet from where construction activities could potentially occur within the project area.

Table 8 includes the range of vibration levels for equipment commonly used in general construction projects at a distance of 25 feet. Table 8 data also include projected equipment vibration levels at the aforementioned existing nearby residential structures located approximately 30 feet away.

Table 8
Reference and Projected Vibration Source Amplitudes for Construction Equipment

Equipment	Reference PPV at 25 Feet (in/sec)[1]	Projected PPV at 30 Feet (in/sec)
Hoe ram	0.089	0.068
Large bulldozer	0.089	0.068
Caisson drilling	0.089	0.068
Loaded trucks	0.076	0.058
Jackhammer	0.035	0.027
Small bulldozer	0.003	0.002

[1] PPV = Peak Particle Velocity

Source: 2018 FTA Transit Noise and Vibration Impact Assessment Manual (Table 7-4) and BAC calculations.

Table 8 data indicate that vibration levels generated from construction activities within the project area at the nearest existing residence located approximately 30 feet away are predicted to be well below the Caltrans thresholds for damage to residential structures of 0.5 in/sec PPV shown in Table 4 (building structure vibration criteria). In addition, the projected equipment vibration levels in Table 8 would range from well below perceptible to distinctly perceptible human response as defined by Caltrans in Table 5 (vibration annoyance potential threshold criteria). Based on the analysis provided above, on-site construction within the project area is not expected to result in excessive groundborne vibration levels at the nearest existing residential uses.

Results from the ambient vibration level monitoring within the project area (Table 2) indicate that measured average vibration levels below the strictest Caltrans thresholds for damage to residential structures and thresholds for annoyance. Therefore, it is expected that the project would not result in the exposure of persons to excessive groundborne vibration levels at proposed uses of the project. Finally, the project proposes the development of residential uses. It is the

experience of BAC these uses do not typically have equipment that generates appreciable vibration.

Because vibration levels due to and upon the proposed project are expected to satisfy the applicable Caltrans groundborne impact vibration criteria, this impact is identified as being ***less than significant***.

Noise Impacts Upon the Development

The California Supreme Court issued an opinion in *California Building Industry Association v. Bay Area Air Quality Management District (2015)* holding that CEQA is primarily concerned with the impacts of a project on the environment and generally does not require agencies to analyze the impact of existing conditions on a project's future users or residents. Nevertheless, the County of Sacramento has policies that address existing/future conditions affecting the proposed project, which are discussed in the following section.

Future Traffic Noise Levels at the Project Site

Issue 1: Future Exterior Traffic Noise Levels at Proposed Residential Uses

Traffic Noise Prediction Methodology

The Federal Highway Administration Highway Traffic Noise Prediction Model (FHWA-RD-77-108) was used with future traffic data to predict future Business 80 traffic noise levels at the proposed residential uses of the development. The model is based upon the CALVENO noise emission factors for automobiles, medium trucks, and heavy trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site. The FHWA Model was developed to predict hourly L_{eq} values for free flowing traffic conditions and is considered to be accurate within 1.5 dB in most situations.

Predicted Future Traffic Noise Levels at Proposed Residential Uses

The FHWA Model was used with future traffic data to predict future Business 80 traffic noise levels at the proposed residential uses of the development. According to published Caltrans traffic counts (2019), the segment of Business 80 adjacent to the project site currently experiences an average daily traffic (ADT) of approximately 159,000 vehicles. Future Business 80 average daily traffic volumes were conservatively assumed to increase by a factor of 1.5 in the future relative to existing volumes. Based on the information above, future Business 80 traffic noise levels were predicted at the project site at the results of those predictions are summarized in Table 9. A complete listing of the FHWA model inputs and results are provided in Appendix E.

The results presented in Table 9 include offsets based on the results from long-term ambient noise level survey (Table 1 of this report), which account for shielding of Business 80 traffic provided by the existing traffic noise barrier constructed adjacent to the project site. Table 9 data also include offsets based on the results from short-term noise measurements conducted at the project site on February 1, 2023. Specifically, the short-term noise surveys were conducted at three locations on the project site, representative of the locations of the nearest proposed

residential buildings to Business 80. Microphones were placed at heights of 5-feet , 15-feet, and 25-feet to establish the differences in traffic noise levels between ground level areas, which would be shielded from view of Business 80 by the existing traffic noise barrier and highway median, and elevated unshielded locations of the development. Photographs from the short-term noise level survey are provided in Appendix B.

Table 9
Predicted Future Exterior Business 80 Traffic Noise Levels at Project Site[1]

Location	Receiver Description[2]	Future Exterior DNL (dB)[3]
Playground / Tot Lot	Primary common outdoor area	62
Building A	1st floor building facade	68
	2nd floor building facade	70
	3rd floor building facade	80
Building B	1st floor building facade	64
	2nd floor building facade	66
	3rd floor building facade	68
Building C	1st floor building facade	62
	2nd floor building facade	64
	3rd floor building facade	66
Building D	1st floor building facade	59
	2nd floor building facade	61

[1] A complete listing of FHWA Model inputs and results are provided as Appendix E.
[2] Receiver locations are shown in Figure 2.
[3] Predicted future exterior traffic noise levels include offsets based on results from both short- and long-term ambient noise level surveys at the project site, which include consideration of the existing traffic noise barrier and highway median adjacent to the project site, as discussed.

Source: Bollard Acoustical Consultants, Inc. 2023.

As indicated in Table 9, future Business 80 traffic noise level exposure at the primary common outdoor area of the development (playground / tot lot) is predicted to comply with the Sacramento County General Plan 65 dB DNL exterior noise level standard for residential uses. As a result, additional consideration of traffic noise mitigation measures relative to the General Plan 65 dB DNL exterior noise level standard would not be warranted for the project.

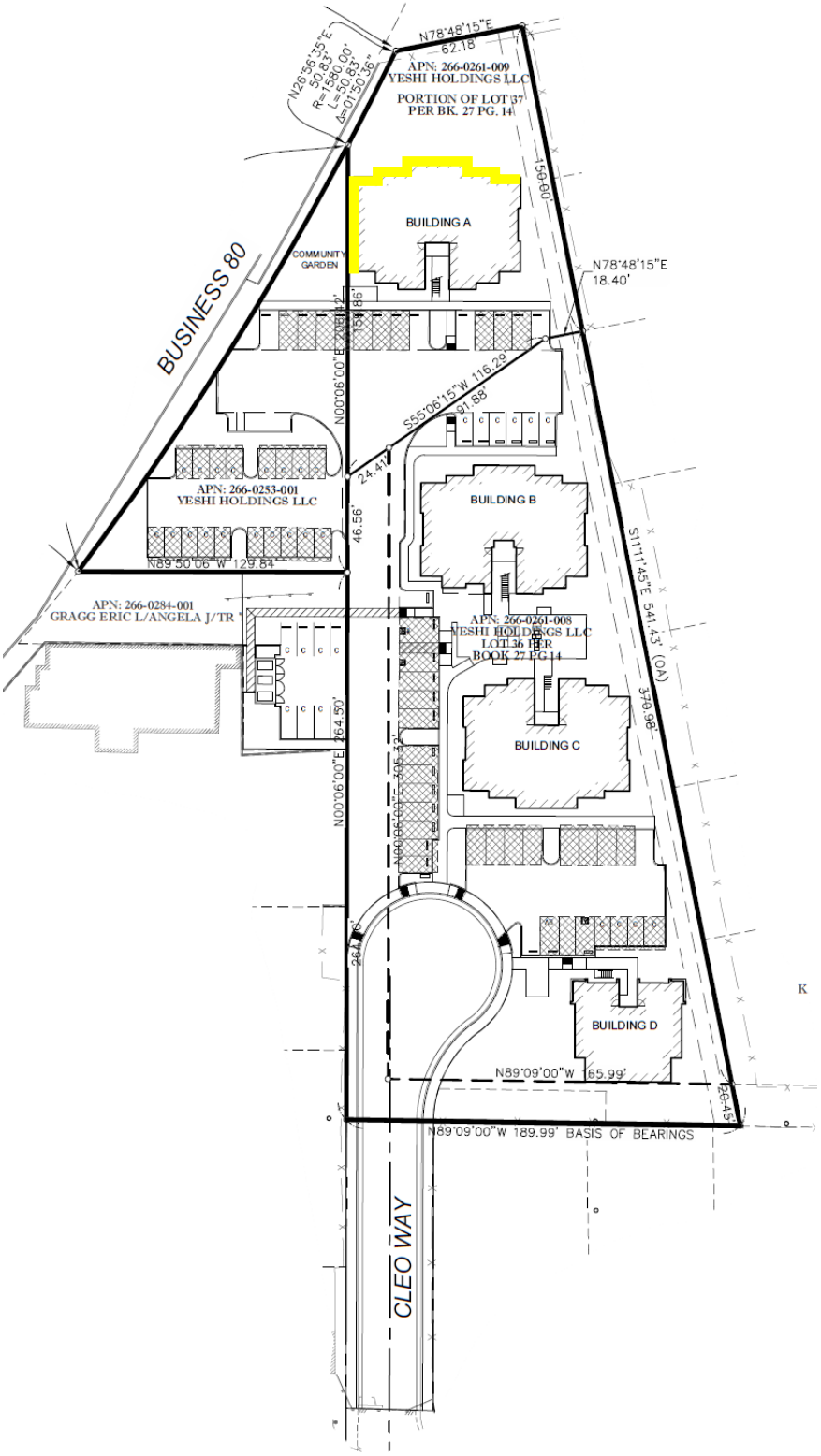
Issue 2: Future Interior Traffic Noise Levels at Proposed Residential Uses

Standard residential construction (stucco siding, STC-27 windows, door weather-stripping, exterior wall insulation, composition plywood roof), *typically* results in an exterior to interior noise reduction of approximately 25 dB with windows closed and approximately 15 dB with windows open. Therefore, provided future Business 80 traffic noise levels do not exceed 70 dB DNL at exterior building facades, standard residential construction practices as identified above should be adequate to ensure compliance with the Sacramento County General Plan 45 dB DNL interior noise level standard.

An analysis of future Business 80 exterior traffic noise level exposure at the residential building facades proposed nearest to the highway was presented in Table 9 of **Issue 1**. Given the aforementioned exterior to interior noise reduction typically provided by standard residential

construction, and based on the results shown in Table 9, upgraded window/door construction would be warranted for portions of the development.

To ensure for satisfaction of the General Plan 45 dB DNL interior noise level standard with a factor of safety, it is recommended that the bedroom windows (and bedroom balcony/patio doors where applicable) of building facades identified in Figures 4 & 5 have the minimum Sound Transmission Rating (STC) rating indicated. In addition, mechanical ventilation (air conditioning) should be provided for all residences within this development to allow the occupants to close doors and windows as desired for additional acoustical isolation.



Legend

1st & 2nd Floors

STC 32

N

Scale (Feet)

0 40 80

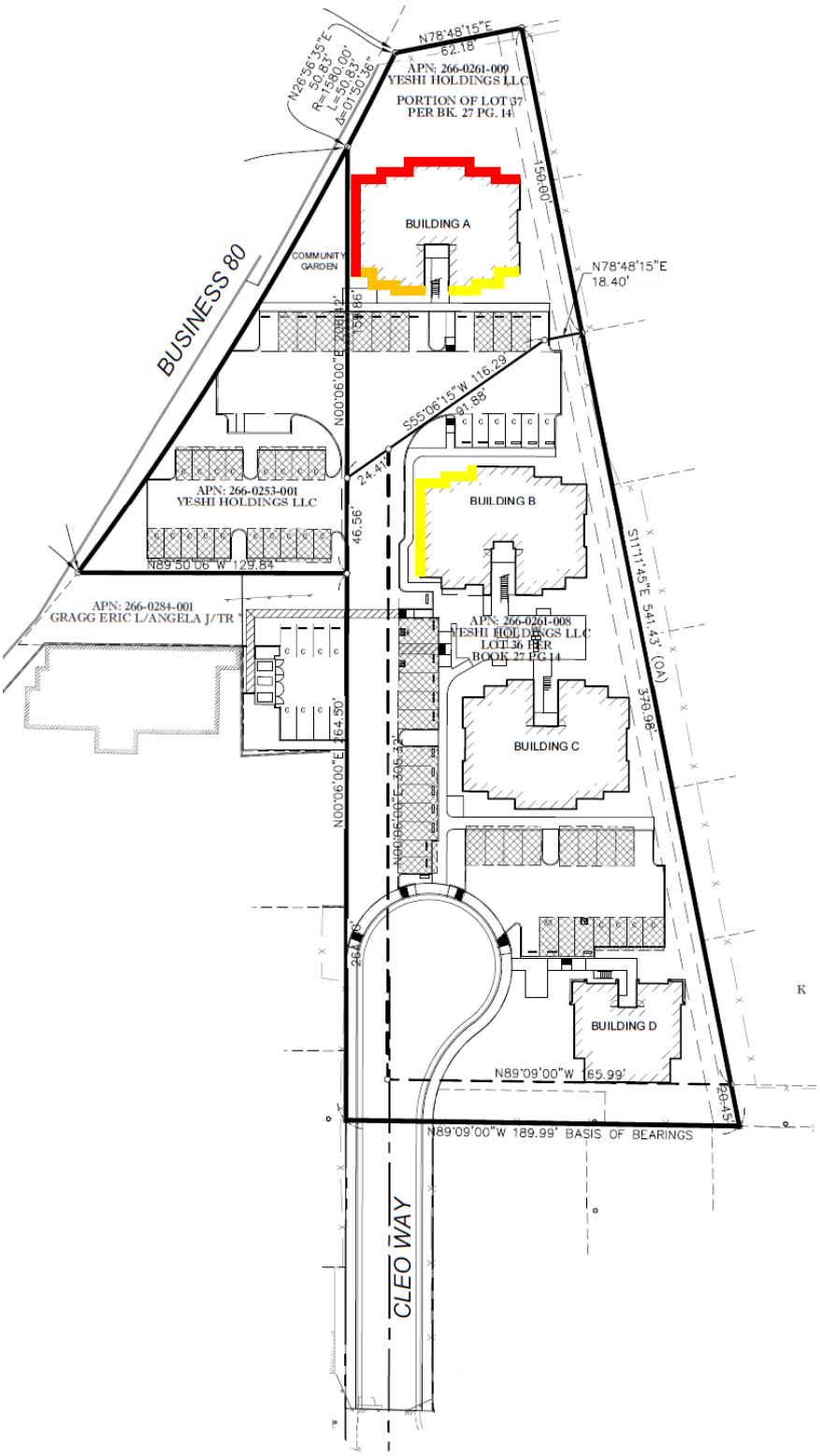
Yeshi Arden Apartments

Sacramento County, California

Recommended Window/Door Upgrades
1st & 2nd Floors

Figure 4

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Legend

3rd Floors

- STC 40
- STC 34
- STC 32

N

Scale (Feet)

0 40 80

Yeshi Arden Apartments

Sacramento County, California

Recommended Window/Door Upgrades
3rd Floors

Figure 5

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This concludes BAC's noise and vibration assessment for the Yeshi Arden Apartments in Sacramento County, California. Please contact BAC at (530) 537-2328 or info@bacnoise.com if you have any comments or questions regarding this report.

Appendix A
Acoustical Terminology

Acoustics The science of sound.

Ambient Noise The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.

Attenuation The reduction of an acoustic signal.

A-Weighting A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.

Decibel or dB Fundamental unit of sound. A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.

CNEL Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.

Frequency The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz.

IIC Impact Insulation Class (IIC): A single-number representation of a floor/ceiling partition's impact generated noise insulation performance. The field-measured version of this number is the FIIC.

L_{dn} Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.

L_{eq} Equivalent or energy-averaged sound level.

L_{max} The highest root-mean-square (RMS) sound level measured over a given period of time.

Loudness A subjective term for the sensation of the magnitude of sound.

Masking The amount (or the process) by which the threshold of audibility is for one sound is raised by the presence of another (masking) sound.

Noise Unwanted sound.

Peak Noise The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level.

RT_{60} The time it takes reverberant sound to decay by 60 dB once the source has been removed.

STC Sound Transmission Class (STC): A single-number representation of a partition's noise insulation performance. This number is based on laboratory-measured, 16-band (1/3-octave) transmission loss (TL) data of the subject partition. The field-measured version of this number is the FSTC.









Legend

A Site A: Long-term ambient noise survey location, facing east towards residences

B Site 2: Vibration survey equipment, facing west towards Business 80

C Site 1: Traffic calibration setup, facing west towards Business 80

D Site 3: Traffic calibration setup, facing west towards Business 80

Microphone

Yeshi Arden Apartments
Sacramento County, California

Survey Locations

Appendix B

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Appendix C-1
Long-Term Ambient Noise Monitoring Results - Site A
Yeshi Arden Apartments - Sacramento County, California
Sunday, January 29, 2023

Hour	Leq	Lmax	L50	L90
12:00 AM	52	62	51	49
1:00 AM	50	63	49	47
2:00 AM	49	61	48	45
3:00 AM	47	62	46	44
4:00 AM	47	64	46	44
5:00 AM	48	62	47	45
6:00 AM	51	64	49	46
7:00 AM	51	63	50	47
8:00 AM	52	73	51	48
9:00 AM	54	66	52	50
10:00 AM	53	73	51	49
11:00 AM	55	67	55	51
12:00 PM	53	66	53	50
1:00 PM	52	62	51	49
2:00 PM	52	64	51	49
3:00 PM	53	64	52	50
4:00 PM	54	65	53	51
5:00 PM	58	73	57	55
6:00 PM	54	69	54	52
7:00 PM	56	65	55	53
8:00 PM	56	70	55	53
9:00 PM	56	64	55	53
10:00 PM	56	70	55	53
11:00 PM	57	77	54	51

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	58	51	54	57	47	52
Lmax (Maximum)	73	62	67	77	61	65
L50 (Median)	57	50	53	55	46	49
L90 (Background)	55	47	51	53	44	47

Computed DNL, dB	59
% Daytime Energy	73%
% Nighttime Energy	27%

GPS Coordinates	38°36'59.87" N
	121°25'10.25" W

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Appendix C-2
Long-Term Ambient Noise Monitoring Results - Site A
Yeshi Arden Apartments - Sacramento County, California
Monday, January 30, 2023

Hour	Leq	Lmax	L50	L90
12:00 AM	53	65	52	48
1:00 AM	53	64	52	48
2:00 AM	53	68	52	48
3:00 AM	53	69	51	47
4:00 AM	53	63	53	49
5:00 AM	56	69	55	53
6:00 AM	59	70	58	57
7:00 AM	58	72	58	57
8:00 AM	59	73	59	58
9:00 AM	60	76	60	58
10:00 AM	60	79	59	58
11:00 AM	60	74	60	58
12:00 PM	60	73	60	58
1:00 PM	61	82	60	58
2:00 PM	62	75	61	59
3:00 PM	61	76	61	59
4:00 PM	60	75	60	58
5:00 PM	58	68	58	56
6:00 PM	59	73	58	57
7:00 PM	57	71	56	55
8:00 PM	57	70	57	55
9:00 PM	57	71	56	54
10:00 PM	56	72	55	53
11:00 PM	55	71	54	52

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	62	57	60	59	53	55
Lmax (Maximum)	82	68	74	72	63	68
L50 (Median)	61	56	59	58	51	54
L90 (Background)	59	54	57	57	47	50

Computed DNL, dB	63
% Daytime Energy	83%
% Nighttime Energy	17%

GPS Coordinates	38°36'59.87" N
	121°25'10.25" W

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Appendix C-3
Long-Term Ambient Noise Monitoring Results - Site A
Yeshi Arden Apartments - Sacramento County, California
Tuesday, January 31, 2023

Hour	Leq	Lmax	L50	L90
12:00 AM	53	63	52	48
1:00 AM	52	65	50	46
2:00 AM	52	66	48	45
3:00 AM	50	59	49	46
4:00 AM	52	59	52	49
5:00 AM	55	71	55	53
6:00 AM	56	69	56	55
7:00 AM	55	69	55	54
8:00 AM	53	66	53	51
9:00 AM	53	66	53	51
10:00 AM	54	68	53	52
11:00 AM	55	82	52	50
12:00 PM	52	61	51	49
1:00 PM	53	74	52	50
2:00 PM	54	66	53	51
3:00 PM	54	72	53	51
4:00 PM	51	65	50	48
5:00 PM	51	61	49	47
6:00 PM	54	66	53	52
7:00 PM	54	64	53	52
8:00 PM	54	67	53	52
9:00 PM	53	65	52	51
10:00 PM	53	66	52	50
11:00 PM	52	66	51	49

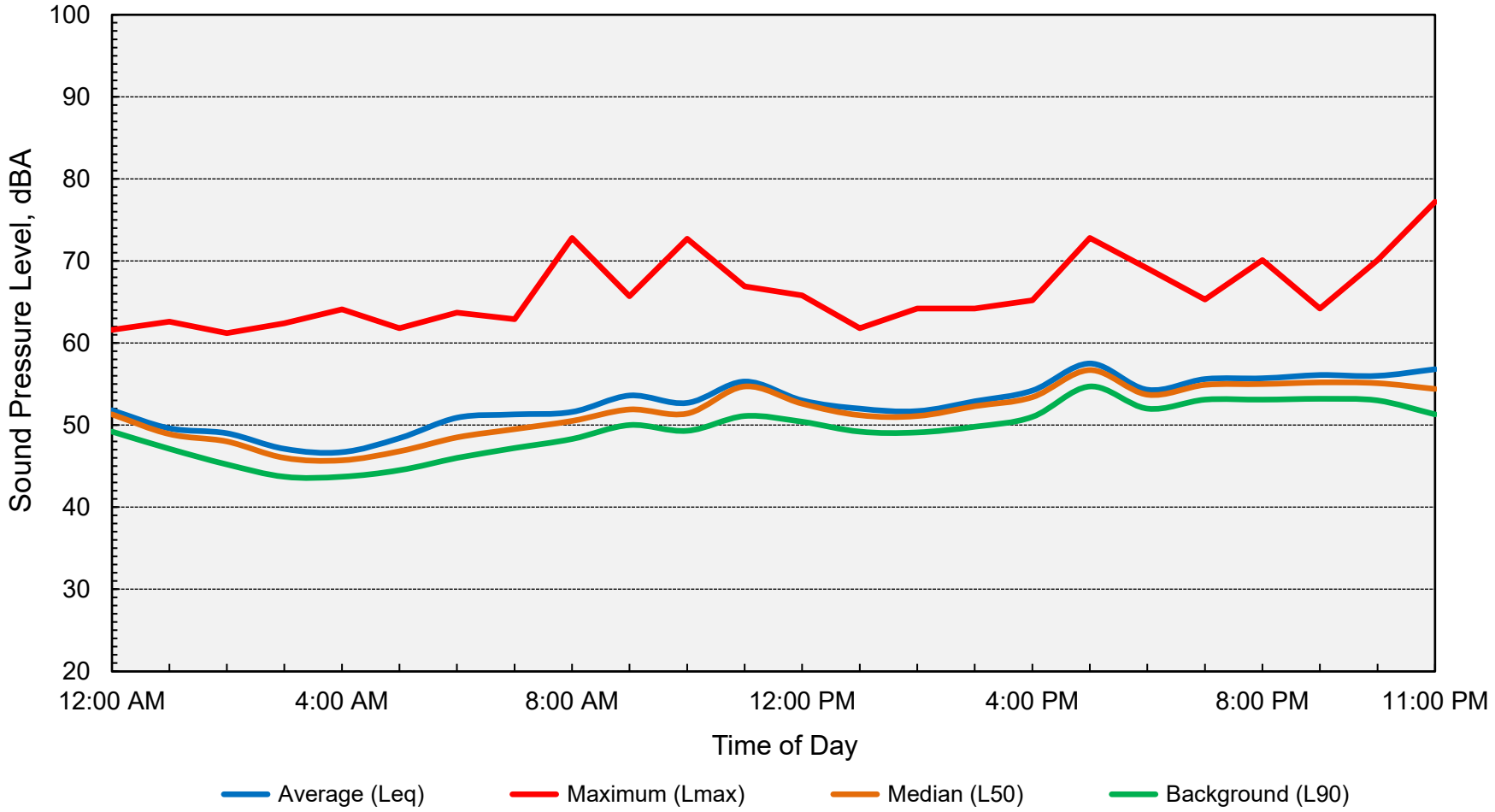
	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	55	51	53	56	50	53
Lmax (Maximum)	82	61	67	71	59	65
L50 (Median)	55	49	52	56	48	51
L90 (Background)	54	47	51	55	45	49

Computed DNL, dB	60
% Daytime Energy	64%
% Nighttime Energy	36%

GPS Coordinates	38°36'59.87" N
	121°25'10.25" W

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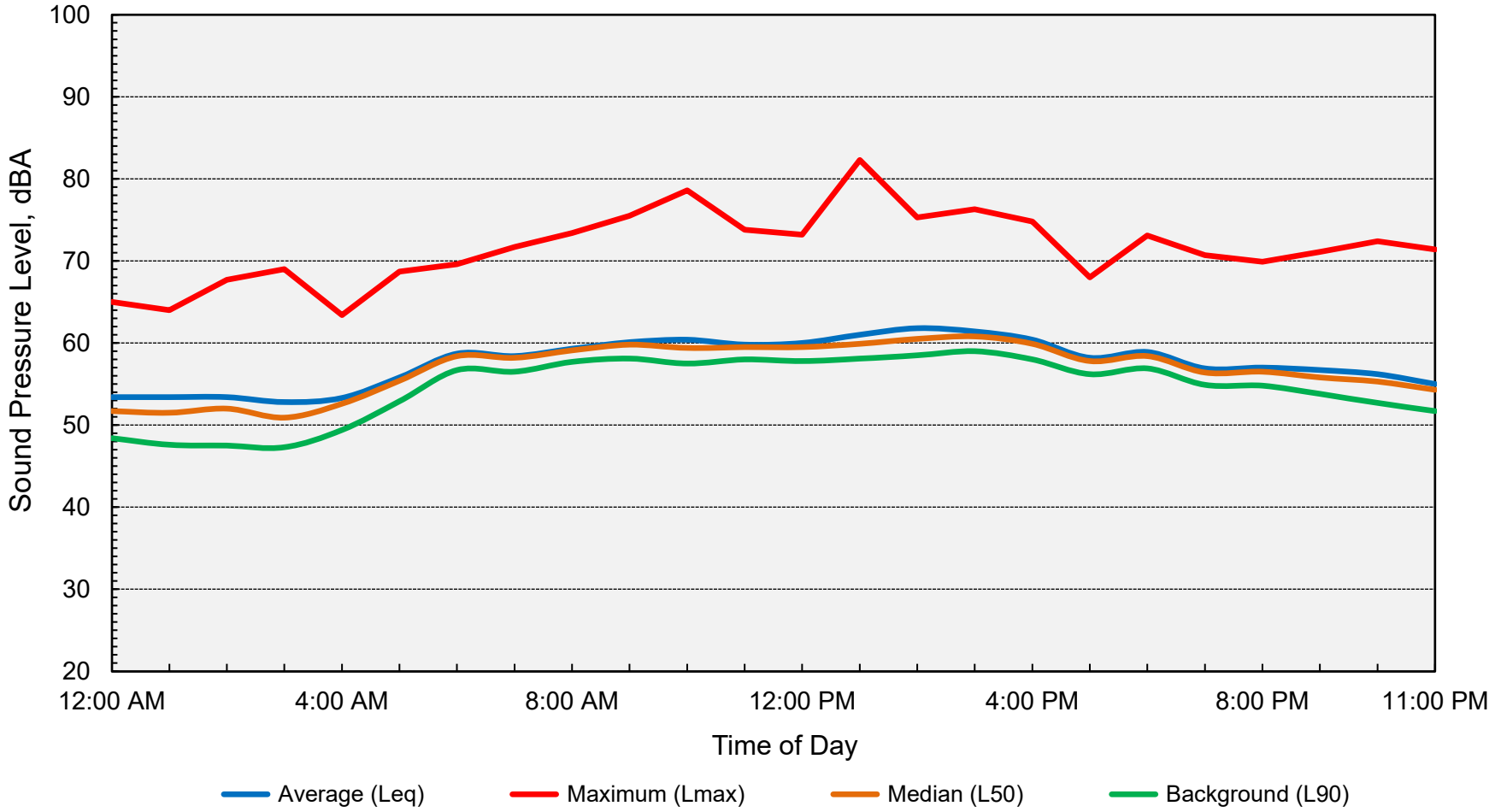
Appendix D-1
Long-Term Ambient Noise Monitoring Results - Site A
Yeshi Arden Apartments - Sacramento County, California
Sunday, January 29, 2023



Computed DNL = 59 dB

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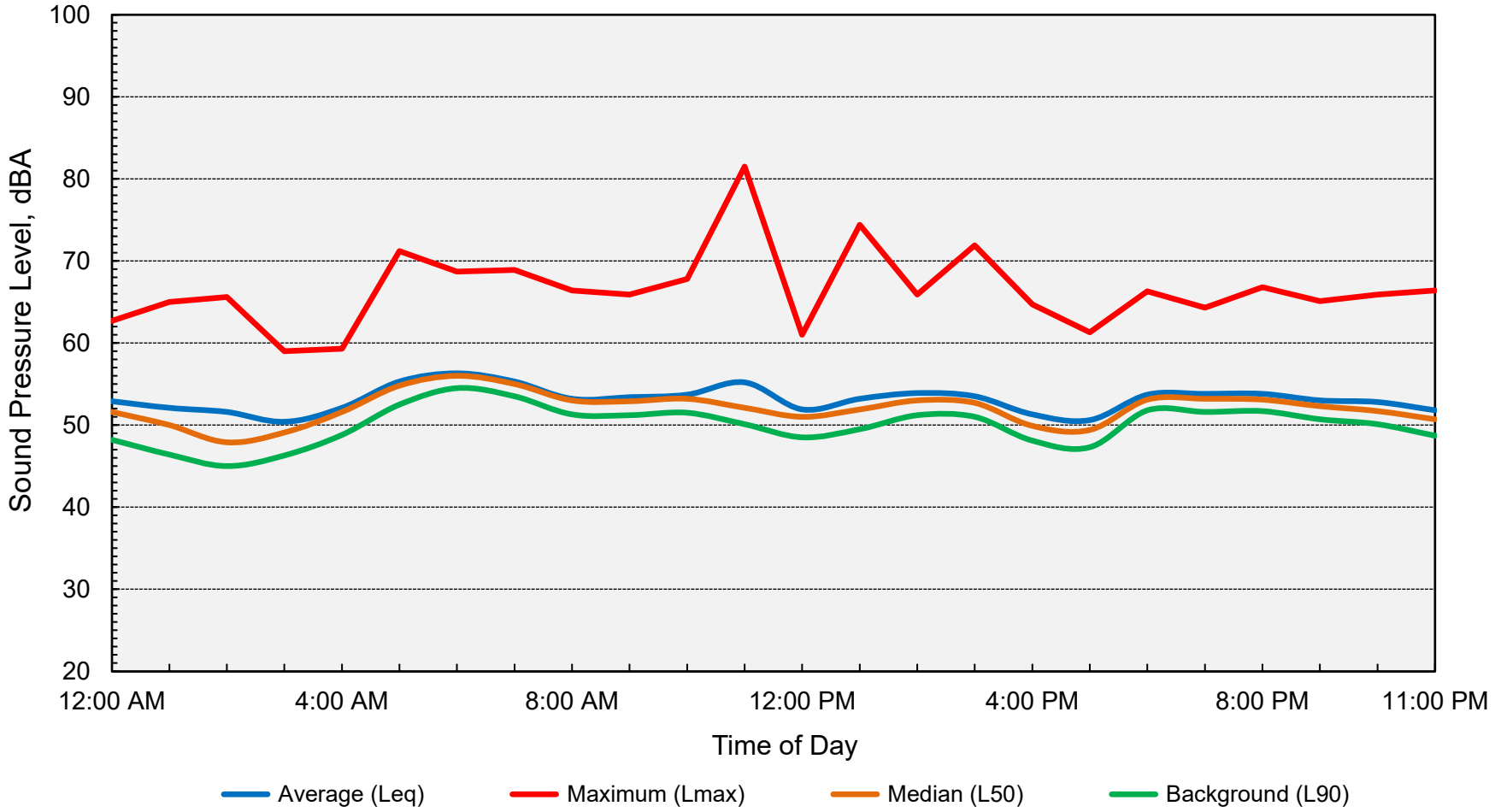
Appendix D-2
Long-Term Ambient Noise Monitoring Results - Site A
Yeshi Arden Apartments - Sacramento County, California
Monday, January 30, 2023



Computed DNL = 63 dB

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Appendix D-3
Long-Term Ambient Noise Monitoring Results - Site A
Yeshi Arden Apartments - Sacramento County, California
Tuesday, January 31, 2023



Computed DNL = 60 dB

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Appendix E
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Prediction Worksheet

Project Information:

Job Number: 2023-168
Project Name: Yeshi Arden Apartments
Roadway Name: Business 80

Traffic Data:

Year: Future
Average Daily Traffic Volume: 238,500
Percent Daytime Traffic: 75
Percent Nighttime Traffic: 25
Percent Medium Trucks (2 axle): 2
Percent Heavy Trucks (3+ axle): 2
Assumed Vehicle Speed (mph): 65
Intervening Ground Type (hard/soft): **Soft**

Traffic Noise Levels:

				DNL (dB)			
Location	**Receiver Description**	**Distance**	**Offset (dB)**	**Autos**	**Medium Trucks**	**Heavy Trucks**	**Total**
Tot Lot	Primary common outdoor area	270	-14	61	50	54	62
Building A	1st floor building facade	100	-14	67	57	60	68
	2nd floor building facade	100	-12	69	59	62	70
	3rd floor building facade	100	-2	79	69	72	80
Building B	1st floor building facade	200	-14	63	52	56	64
	2nd floor building facade	200	-12	65	54	58	66
	3rd floor building facade	200	-10	67	56	60	68
Building C	1st floor building facade	270	-14	61	50	54	62
	2nd floor building facade	270	-12	63	52	56	64
	3rd floor building facade	270	-10	65	54	58	66
Building D	1st floor building facade	400	-14	58	48	51	59
	2nd floor building facade	400	-12	60	50	53	61

Traffic Noise Contours (No Calibration Offset):

DNL Contour (dB)	Distance from Centerline (ft)
75	306
70	658
65	1419
60	3056

Notes:

1. Future ADT was conservatively estimated by applyig a factor of 1.5 to the existing ADT for Business 80 adjacent to the project site. Existing ADT (2019) obtained from published Caltrans traffic counts (159,000 ADT).
2. Offsets based results from short-term elevated measurements on the project site. Offsets also include consideration of the existing traffic noise barrier and highway median adjacent to the project site.