OMB No. 2506-0177
(exp.2/28/2025)

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
WASHINGTON, DC 20410-1000

This Worksheet was designed to be used by those "Partners" (including Public Housing Authorities, consultants, contractors, and nonprofits) who assist Responsible Entities and HUD in preparing environmental reviews, but legally cannot take full responsibilities for these reviews themselves. Responsible Entities and HUD should use the RE/HUD version of the Worksheet.

Noise (EA Level Reviews) – PARTNER

https://www.hudexchange.info/programs/environmental-review/noise-abatement-and-control

1. **What activities does your project involve? Check all that apply:**

   ☒ New construction for residential use

   NOTE: HUD assistance to new construction projects is generally prohibited if they are located in an Unacceptable zone, and HUD discourages assistance for new construction projects in Normally Unacceptable zones. See 24 CFR 51.101(a)(3) for further details.

   → *Continue to Question 2.*

   ☐ Rehabilitation of an existing residential property

   NOTE: For major or substantial rehabilitation in Normally Unacceptable zones, HUD encourages mitigation to reduce levels to acceptable compliance standards. For major rehabilitation in Unacceptable zones, HUD strongly encourages mitigation to reduce levels to acceptable compliance standards. See 24 CFR 51 Subpart B for further details.

   → *Continue to Question 2.*

   ☐ None of the above

   → *If the RE/HUD agrees with this recommendation, the review is in compliance with this section. Continue to the Worksheet Summary below.*

2. **Complete the Preliminary Screening to identify potential noise generators in the vicinity (1000' from a major road, 3000' from a railroad, or 15 miles from an airport). Indicate the findings of the Preliminary Screening below:**

   ☐ There are no noise generators found within the threshold distances above.

   → *If the RE/HUD agrees with this recommendation, the review is in compliance with this section. Continue to the Worksheet Summary below. Provide a map showing the location of the project relative to any noise generators.*

   ☒ Noise generators were found within the threshold distances.

   → *Continue to Question 3.*

3. **Complete the Noise Assessment Guidelines to quantify the noise exposure. Indicate the findings of the Noise Assessment below:**

☐ Acceptable (65 decibels or less; the ceiling may be shifted to 70 decibels in circumstances described in §24 CFR 51.105(a))

Indicate noise level here:

→ *If the RE/HUD agrees with this recommendation, the review is in compliance with this section. Continue to the Worksheet Summary below. Provide noise analysis, including noise level and data used to complete the analysis.*

☒ Normally Unacceptable: (Above 65 decibels but not exceeding 75 decibels; the floor may be shifted to 70 decibels in circumstances described in 24 CFR 51.105(a))

Indicate noise level here:

<u>If project is rehabilitation:</u>

→ *Continue to Question 4. Provide noise analysis, including noise level and data used to complete the analysis.*

<u>If project is new construction:</u>

Is the project in a largely undeveloped area[1]?

☒ No

☐ Yes → ***The project requires completion of an Environmental Impact Statement (EIS) pursuant to 51.104(b)(1)(i).***

→ *Continue to Question 4. Provide noise analysis, including noise level and data used to complete the analysis.*

☐ Unacceptable: (Above 75 decibels)

Indicate noise level here:

<u>If project is rehabilitation:</u>

HUD strongly encourages conversion of noise-exposed sites to land uses compatible with high noise levels. Consider converting this property to a non-residential use compatible with high noise levels.

→ *Continue to Question 4. Provide noise analysis, including noise level and data used to complete the analysis, and any other relevant information.*

<u>If project is new construction:</u>

The project requires completion of an Environmental Impact Statement (EIS) pursuant to 51.104(b)(1)(i). *Work with HUD or the RE to either complete an EIS or obtain a waiver signed by the appropriate authority.*

→ *Continue to Question 4.*

4. **HUD strongly encourages mitigation be used to eliminate adverse noise impacts. Work with the RE/HUD on the development of the mitigation measures that must be implemented to mitigate for the impact or effect, including the timeline for implementation.**

   ☒ Mitigation as follows will be implemented:

---

[1] A largely undeveloped area means the area within 2 miles of the project site is less than 50 percent developed with urban uses and does not have water and sewer capacity to serve the project.

→ *Provide drawings, specifications, and other materials as needed to describe the project's noise mitigation measures.*
Continue to the Worksheet Summary.

☐ No mitigation is necessary.
Explain why mitigation will not be made here:
→ *Continue to the Worksheet Summary.*

Worksheet Summary

Provide a full description of your determination and a synopsis of the information that it was based on, such as:

- Map panel numbers and dates
- Names of all consulted parties and relevant consultation dates
- Names of plans or reports and relevant page numbers
- Any additional requirements specific to your program or region

Include all documentation supporting your findings in your submission to HUD.

A noise study was performed by a qualified acoustical engineering firm, Saxelby Acoustics. Please see attached report for details. A summary of the report's findings including recommended mitigations is provided here. Because the site is about 18 acres and contains a variety of buildings, this summary is broken out into the proposed uses.

Safe Camp Area

The safe camp is predicted to be exposed to noise levels up to 70 dbA Ldn. The Safe Camp uses ModPod structures that provide about 20 dbA noise reduction. This means interior noise levels could be 50 dbA, which is above the HUD recommended 45 dbA level. A description of the ModPod structures is provided below. The 70 dbA Ldn exterior expected noise level exceeds the HUD normally acceptable level of 65 dBA L_{dn}. To reduce noise levels at the safe camp area to 68-69 L_{dn}, two options are proposed:

1, extend the existing highway barrier along I-80 north of the project on the NDOT right-of-way, or

2. construct a 12-foot-high noise barrier inside the camp property.

Sprung Structure

The noise study determined that the existing Sprung structure itself provided a 33.5 dBA reduction in noise levels. Highway noise levels up to 68 dBA are predicted outside the Sprung structure. HUD requires at least 25 dBA sound mitigation in buildings exposed to noise levels between 65-70 dBA L_{dn}. The Sprung Structure currently exceeds this requirement as constructed and no additional mitigation is required.

Overflow Building

Under future conditions, the Overflow building will be exposed to exterior noise levels of up to 63 dBA L_{dn}. This complies with the HUD noise level standard of less than 65 dBA L_{dn} exterior exposure. The HUD interior noise goal of 45 dBA L_{dn} would be met assuming a noise level reduction of 20 dBA from the building itself. No additional noise control measures are required for this building.

Bridge Housing

The Bridge Housing building is predicted to be exposed to noise levels of up to 71 dBA L_{dn} at second floor receivers. These noise levels exceed the HUD exterior noise level standard of 65 dBA L_{dn}. Therefore, additional interior noise control measures of 30 dbA would be required, as detailed below (from the Acoustical Engineering report).

Incorporate the following into the design for the new residential building portions of the Bridge Housing:

1. Building facades shall use stucco with sheathing or cement fiber board with sheathing.
2. STC 33 minimum-rated glazing shall be used.
3. Interior gypsum wallboards shall be 5/8" hung on resilient channels.
4. Interior gypsum ceiling shall be 5/8".
5. Wherever possible, mechanical ventilation penetrations for exhaust fans should not face toward I-80 or I-580. Where feasible, these vents should be routed towards the opposite side of the building to minimize sound intrusion to sensitive areas of the buildings. Where vents must face toward I-80 or I-580, the duct work should be increased in length and make as many "S" turns as feasible prior to exiting the dwelling. This separates the openings between the noise source and the living space with a long circuitous route. Each time the sound turns a corner, it is reduced slightly. Flexible duct work is preferred ducting for this noise mitigation. Where the vent exits the building, a spring-loaded flap with a gasket should be installed to reduce sound entering the duct work when the vent is not in use.
6. Mechanical ventilation shall be provided to allow occupants to keep doors and windows closed for acoustic isolation.
7. No packaged terminal air conditioners shall be used.

In lieu of these measures, an interior noise control report may be prepared by a qualified acoustic engineer demonstrating that the proposed building construction would achieve the HUD interior noise reduction requirement of 30 dBA.

ModPod™ by LIT | SOLUTIONS

DURABLE AND SAFE MODULAR PODS FOR LIVING IN TRANSITION

Meeting people's most basic needs, our ModPod™ solutions are designed to maximize the usability and living area in small spaces. Our unique and durable ModPods are designed for maximum comfort with specific consideration to providing a secure personal space.

Engineered for Durability

Considerations Include exterior ACM (aluminum composite material) panels, interior Azdel Onboard® panels, powder coated metal frame systems, proprietary panel and corner connections that include weather tight seals, securing resistance to the outside elements.

Thoughtfully Designed

Using efficient manufacturing processes, we reduce our environmental impact producing little to no waste.

Carefully Selected Materials

Promoting a healthy, safe and comfortable living environment, our U.S.A. sourced raw materials use no formaldehydes, have low VOCs, are mold-resistant and are significantly insulated reducing ambient noise.

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With flexibility in mind our ModPods are uniquely designed to be easily assembled, with the ability to be disassembled, moved, and re-assembled while maintaining structural integrity.

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LIT Solutions | Tracy Hook O: 503.224.1399 Ext.206 M: 503.819.9506 Tracy.Hook@litws.com LITSolutionsUSA.com

ModPod: 8'x8'x8' Modular Shelter
ModPod2: 8'x8'x16' Modular Shelter
ModPod3: 8'x8'x24' Modular Shelter

Tracy Hook
O: 503.224.1399 Ext.206
M: 503.819.9506
Tracy.Hook@litws.com
LITSolutionsUSA.com

FRAME STRUCTURE	Modular, powder coated aluminum frame.
BASE	2.00" x 4.00" x 0.125" (wall thickness) T-6000 series aluminum tube frame with polyurea floor coating.
FLOOR	Laminated composite over 2.00" thick 2lb. EPS foam, core sealed with polyurea coating.
WALLS	3.00" thick 2lb rigid EPS foam insulation wall panels with Exterior ACM(aluminum composite material) and Interior Azdel Onboard® Composite panels. Interior wall panel material is impervious to mold, rot resistant, light weight, with the added benefit of being a noise canceling substrate. No formaldehydes, no VOC's and no off gassing. R-13 Insulation.
ROOFING	Laminated composite over 5.00" thick 2lb. EPS foam, core sealed with polyurea coating.
FRONT AND REAR WINDOWS	Flush trimmed tinted double hung operating windows with screens. 4 total.
EGRESS	Easy access crawl out safety exit
LIGHTING	Switched low voltage LED interior and exterior lighting.
FRONT DOOR	ADA compliant metal clad entry door with 10 key 4 digit lock with master key. Insulated weather-tight metal door
FIRE/LIFE/SAFETY	Includes fire extinguisher and smoke/carbon monoxide detector.
POWER	115V duplex coutlets. (1 GFCI and 1 USB combination plug set). Typical 30 amp RV hook up.
HEATING & COOLING	115V forced air heating system and 5,000 BTU A/C unit built in.
FURNITURE & STORAGE	• 2 each metal/powder coated twin bed frame with 3.00" Memory Foam mattress and cover. • Under bed plastic storage bins neatly concealed under the bed frame maximizing space • Cleverly designed shelf system with integrated hang bar for clothing including folding table and chair. • Intelligently designed exterior bike hook system is incorporated into corner frame structure
INSTALLATION	• All panels mechanically connect using Internal locking galvanized hardware. • Panels assemble with a standard Allen key. • Proprietary mechanical connecting corner system uses custom milled insert so it cannot be mis-threaded bringing weather resistance and overall strength to the entire structure. • Includes proprietary leveling / anchoring system.

Environmental Noise Assessment

Cares Campus HUD

Reno, Nevada

November 8, 2022

Project #221004

Prepared for:

NCE
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Pt. Richmond, CA 94804

Prepared by:

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INTRODUCTION

The Nevada Cares Campus HUD residential project will expand an existing shelter to accommodate more individuals. The project currently consists of a Sprung Structure with housing units, an overflow building, and the Safe Camp. The proposed project will remove old buildings and add the "Bridge Housing" building west of the sprung structure and a welcome center. The Safe Camp and Sprung Structure will be expanded to add more units and amenities. This analysis will determine future noise exposure at the Sprung Structure, Safe Camp, Bridge Housing, and Overflow area and evaluate the ability of the project to comply with HUD noise level standards.

Figure 1 shows the proposed project site plan. **Figure 2** shows an aerial of the proposed locations and project site boundaries.

ACOUSTIC FUNDAMENTALS AND TERMINOLOGY

BACKGROUND INFORMATION ON NOISE

Fundamentals of Acoustics

Acoustics is the science of sound. Sound may be thought of as mechanical energy of a vibrating object transmitted by pressure waves through a medium to human (or animal) ears. If the pressure variations occur frequently enough (at least 20 times per second), then they can be heard and are called sound. The number of pressure variations per second is called the frequency of sound and is expressed as cycles per second or Hertz (Hz).

Noise is a subjective reaction to different types of sounds. Noise is typically defined as (airborne) sound that is loud, unpleasant, unexpected or undesired, and may therefore be classified as a more specific group of sounds. Perceptions of sound and noise are highly subjective from person to person.

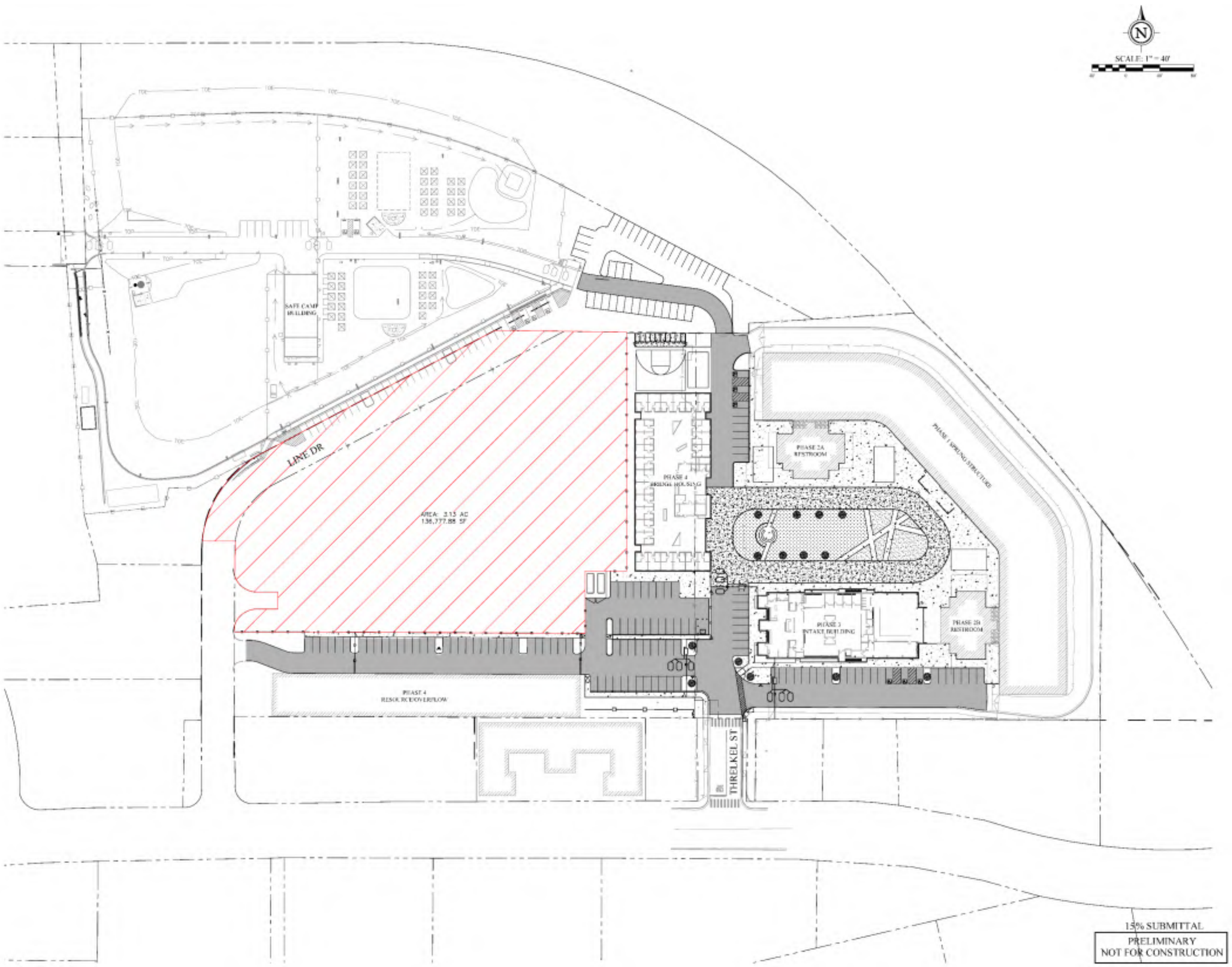
Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale uses the hearing threshold (20 micropascals), as a point of reference, defined as 0 dB. Other sound pressures are then compared to this 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, and changes in levels (dB) correspond closely to human perception of relative loudness.

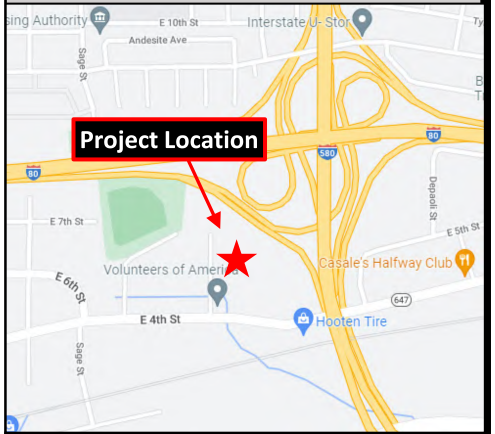
Cares Campus HUD

Reno, Nevada

Figure 1

Project Site Plan





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Cares Campus HUD

City of Reno, Nevada

Figure 2

Noise Measurement Sites

Legend

- Project Site
- Noise Measurement - Long Term

100 ft 250 ft 400 ft

Projection: UTM Zone 11 / WGS84 / meters
Rev. Date: 11/01/2022

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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 A-weighted sound levels. There is a strong correlation between A-weighted sound levels (expressed as dBA) and the way the human ear perceives sound. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. C-weighted (dBC) noise levels are also commonly used for monitoring noise from music as the C-weighting is more sensitive to low-frequency noise (a.k.a. bass).

The decibel scale is logarithmic, not linear. In other words, two sound levels 10-dB apart differ in acoustic energy by a factor of 10. When the standard logarithmic decibel is A-weighted, an increase of 10-dBA is generally perceived as a doubling in loudness. For example, a 70-dBA sound is half as loud as an 80-dBA sound, and twice as loud as a 60 dBA sound.

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 environment. A common statistical tool is the average, or equivalent, sound level (L_{eq}), which corresponds to a steady-state A weighted sound level containing the same total energy as a time varying signal over a given time period (usually one hour). The L_{eq} is the foundation of the composite noise descriptor, L_{dn}, and shows very good correlation with community response to noise.

The day/night average level (DNL or L_{dn}) is based upon the average noise level over a 24-hour day, with a +10-decibel weighing applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because L_{dn} represents a 24-hour average, it tends to disguise short-term variations in the noise environment.

Table 1 lists several examples of the noise levels associated with common situations. **Appendix A** provides a summary of acoustical terms used in this report.

TABLE 1: TYPICAL NOISE LEVELS

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	--110--	Rock Band
Jet Fly-over at 300 m (1,000 ft.)	--100--	
Gas Lawn Mower at 1 m (3 ft.)	--90--	
Diesel Truck at 15 m (50 ft.), at 80 km/hr. (50 mph)	--80--	Food Blender at 1 m (3 ft.) Garbage Disposal at 1 m (3 ft.)
Noisy Urban Area, Daytime Gas Lawn Mower, 30 m (100 ft.)	--70--	Vacuum Cleaner at 3 m (10 ft.)
Commercial Area Heavy Traffic at 90 m (300 ft.)	--60--	Normal Speech at 1 m (3 ft.)
Quiet Urban Daytime	--50--	Large Business Office Dishwasher in Next Room
Quiet Urban Nighttime	--40--	Theater, Large Conference Room (Background)
Quiet Suburban Nighttime	--30--	Library
Quiet Rural Nighttime	--20--	Bedroom at Night, Concert Hall (Background)
	--10--	Broadcast/Recording Studio
Lowest Threshold of Human Hearing	--0--	Lowest Threshold of Human Hearing

Source: Caltrans, Technical Noise Supplement, Traffic Noise Analysis Protocol. September, 2013.

Effects of Noise on People

The effects of noise on people can be placed in three categories:

- Subjective effects of annoyance, nuisance, and dissatisfaction
- Interference with activities such as speech, sleep, and learning
- Physiological effects such as hearing loss or sudden startling

Environmental noise typically produces effects in the first two categories. Workers in industrial plants can experience noise in the last category. There is no completely satisfactory way to measure the subjective effects of noise or the corresponding reactions of annoyance and dissatisfaction. A wide variation in individual thresholds of annoyance exists and different tolerances to noise tend to develop based on an individual's past experiences with noise.

Thus, an important way of predicting a human reaction to a new noise environment is the way it compares to the existing environment to which one has adapted: the so-called ambient noise level. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by those hearing it.

With regard to increases in A-weighted noise level, the following relationships occur:

- Except in carefully controlled laboratory experiments, a change of 1-dBA cannot be perceived;
- Outside of the laboratory, a 3-dBA change is considered a just-perceivable difference;
- A change in level of at least 5-dBA is required before any noticeable change in human response would be expected; and
- A 10-dBA change is subjectively heard as approximately a doubling in loudness and can cause an adverse response.

Stationary point sources of noise – including stationary mobile sources such as idling vehicles – attenuate (lessen) at a rate of approximately 6-dB per doubling of distance from the source, depending on environmental conditions (i.e. atmospheric conditions and either vegetative or manufactured noise barriers, etc.). Widely distributed noises, such as a large industrial facility spread over many acres, or a street with moving vehicles, would typically attenuate at a lower rate.

EXISTING AMBIENT NOISE LEVELS

The existing noise environment in the project area is defined primarily by traffic on Interstate 80 (I-80), Highway 395 (US395), Interstate 580 (I-580), and the connecting ramp from I-80 eastbound to I-580 southbound.

Saxelby Acoustics conducted a continuous noise measurement survey to quantify the existing ambient noise environment at the project site. The noise measurement locations are shown on **Figure 2**. A summary of the noise level measurement survey results is provided in **Table 2**. **Appendix B** contains the complete results of the noise monitoring.

The sound level meters were programmed to record the maximum, median, and average noise levels at each site during the survey. The maximum value, denoted L_{max}, represents the highest noise level measured. The average value, denoted L_{eq}, represents the energy average of all of the noise received by the sound level meter microphone during the monitoring period. The median value, denoted L_{50}, represents the sound level exceeded 50 percent of the time during the monitoring period.

Larson Davis Laboratories (LDL) model 820 precision integrating sound level meters were used for the ambient noise level measurement survey. The meters were calibrated before and after use with a CAL200 acoustical calibrator to ensure the accuracy of the measurements. The equipment used meets all pertinent specifications of the American National Standards Institute for Type 1 sound level meters (ANSI S1.4).

TABLE 2: SUMMARY OF EXISTING BACKGROUND NOISE MEASUREMENT DATA

Site	Date	L_{dn}	Daytime L_{eq}	Daytime L_{50}	Daytime L_{max}	Nighttime L_{eq}	Nighttime L_{50}	Nighttime L_{max}
LT-1	10/20/22	76	72	71	88	70	67	84
	10/21/22	76	72	71	89	70	68	85
LT-2	10/20/22	66	61	60	75	60	58	72
	10/21/22	66	63	60	77	59	58	72
LT-3	10/20/22	65	61	59	81	58	57	73
	10/21/22	66	63	59	83	59	56	75

Notes:

- *All values shown in dBA*
- *Daytime hours: 7:00 a.m. to 10:00 p.m.*
- *Nighttime Hours: 10:00 p.m. to 7:00 a.m.*
- *Source: Saxelby Acoustics 2022*

REGULATORY CONTEXT

HUD CRITERIA

The U.S. Department of Housing and Urban Development (HUD) establishes an acceptable exterior noise environment of 65 dBA L_{dn} (also expressed as "DNL" or Day/Night Level) at exterior areas of residential uses. Noise levels in the 65-75 dBA DNL range are considered Normally Unacceptable. However, 65-75 dBA DNL may be allowed, but require special approvals and additional sound attenuation measures. Such measures include a 5 dBA improvement to the building facade noise level reduction (NLR) for exterior noise levels in the 65-70 dBA range, and an improvement of 10 dBA for exterior noise levels in the 70-75 dBA range. The improvement is required in addition to "attenuation provided by buildings as commonly constructed in the area and requiring open windows for ventilation."

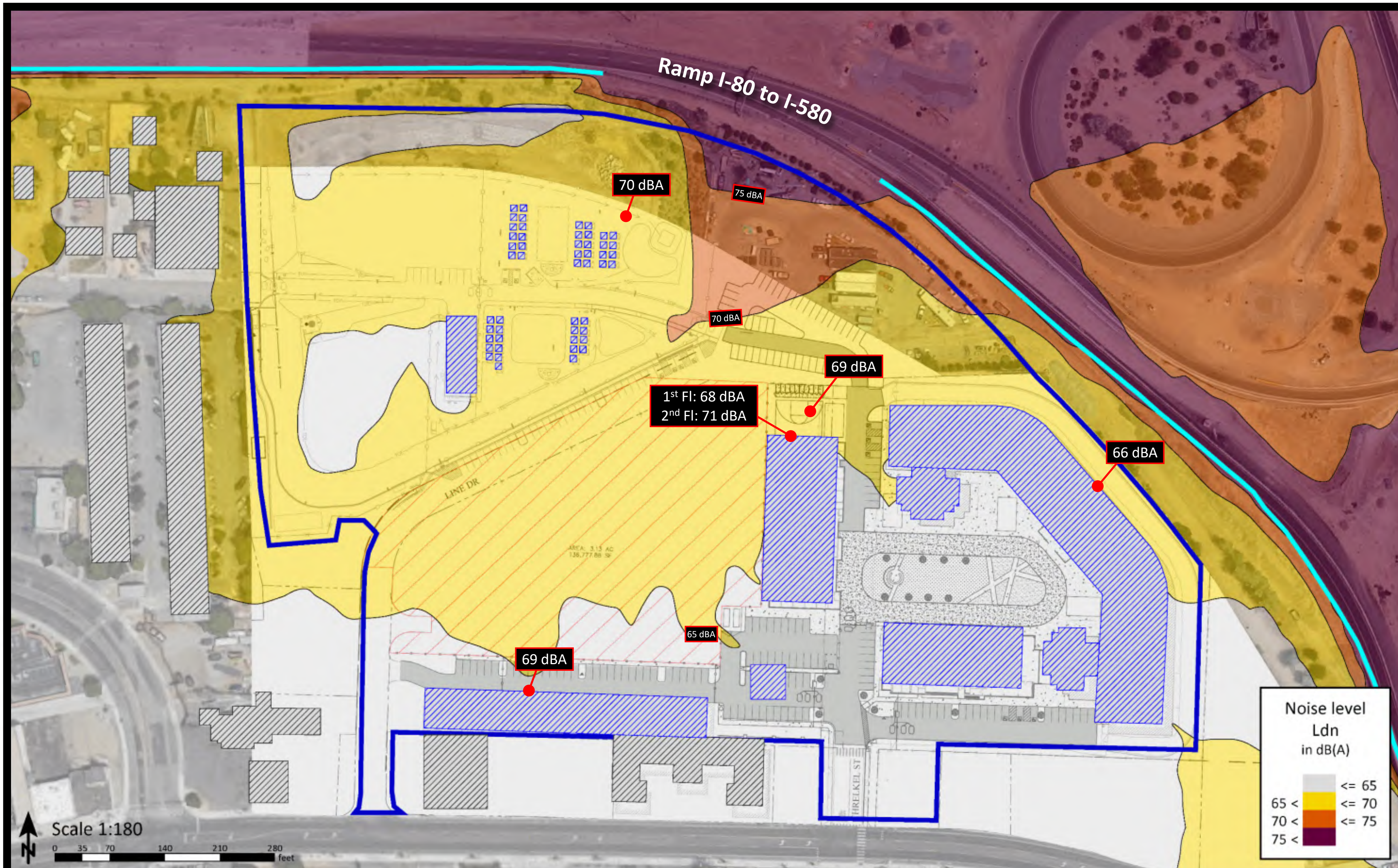
Noise levels exceeding 75 dBA DNL are considered unacceptable and may only be allowed under special circumstances.

In addition, HUD established an interior noise level goal of 45 dBA DNL, while assuming a typical exterior-to-interior NLR of 20 dBA.

EVALUATION OF TRANSPORTATION NOISE SOURCES ON THE PROJECT SITE

ON-SITE TRANSPORTATION NOISE PREDICTION METHODOLOGY

Saxelby Acoustics measured an exterior transportation noise levels emanating from the local highways at three locations on the project site (see **Figure 2** for measurement locations and **Table 2** for noise survey results). These levels were used to calibrate the SoundPLAN noise prediction model. The proposed project buildings and surrounding structures were input into the calibrated SoundPLAN model to determine the transportation noise exposure on the project site. Future (2043) transportation noise levels were calculated by assuming a 1% per year increase in transportation volumes on all highways. The results of this analysis are shown on **Figure 3**.



Cares Campus HUD

Reno, Nevada

Figure 3

Future Transportation Noise Levels (dBA L_{dn})

Legend

- Project Site
- Proposed Building
- Existing Building
- Existing Walls

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RESULTS AND ANALYSIS

Safe Camp

As shown on **Figure 3**, the safe camp is predicted to be exposed to noise levels of up to 70 dBA L_{dn}. This exceeds the HUD normally acceptable level of 65 dBA L_{dn}. To reduce noise levels at the same camp area, Saxelby Acoustics modeled two noise control scenarios. **Figure 4** shows the effects of extending of the existing highway barrier along I-80 north of the project. **Figure 5** shows the effects of constructing a 12-foot-tall barrier at the northern and eastern boundaries of the Safe Camp area. As shown in the figures, either of these noise control measures is predicted to reduce noise levels to 68-69 dBA L_{dn} at the Camp. These noise levels still exceed the HUD noise level standards, but are reduced by approximately 2 dBA, and below 70 dBA L_{dn} for the entire site.

Sprung Structure

Saxelby Acoustics conducted noise level measurements inside and outside of the sprung structure to determine noise level reduction provided by walls of the structure. An amplified speaker system was used to generate sound loud enough outside of the structure to be audible within the structure. It was determined that the Sprung Structure provided a 33.5 dBA reduction in noise levels.

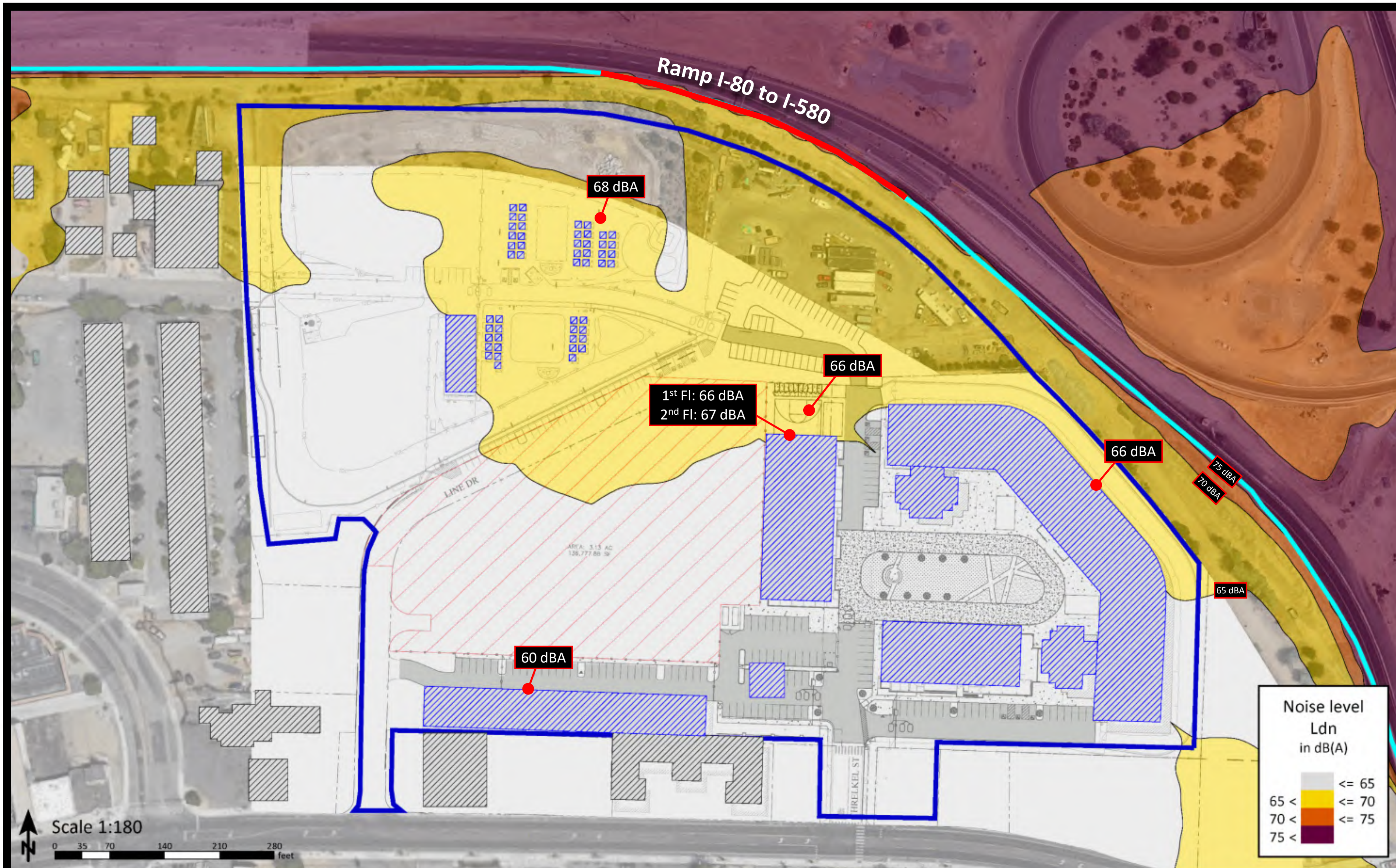
Figure 3 shows that noise levels up to 68 dBA are predicted at the sprung structure due to transportation noise. HUD noise level standards require a noise level reduction of at least 25 dBA in buildings exposed to noise levels between 65-70 dBA L_{dn}. The Sprung Structure currently exceeds this requirement as constructed.

Overflow

The Overflow building to the south of the project site will be exposed to exterior noise levels of up to 63 dBA L_{dn} under future conditions. This complies with the HUD noise level standard of 65 dBA L_{dn} exterior exposure and 45 dBA L_{dn} interior exposure (assuming a noise level reduction of 20 dBA). No additional noise control measures are required for this building.

Bridge Housing

As shown on **Figure 3**, the Bridge Housing building is predicted to be exposed to noise levels of up to 71 dBA L_{dn} at second floor receivers. These noise levels fall exceed the HUD exterior noise level standard of 65 dBA L_{dn}. Therefore, additional interior noise control measures would be required.



Cares Campus HUD

Reno, Nevada

Figure 4

Future Transportation Noise Levels (dBA L_{dn}) – Extended Freeway Sound Wall

Legend

- Project Site
- Proposed Building
- Existing Building
- Existing Walls
- Sound Wall Extension

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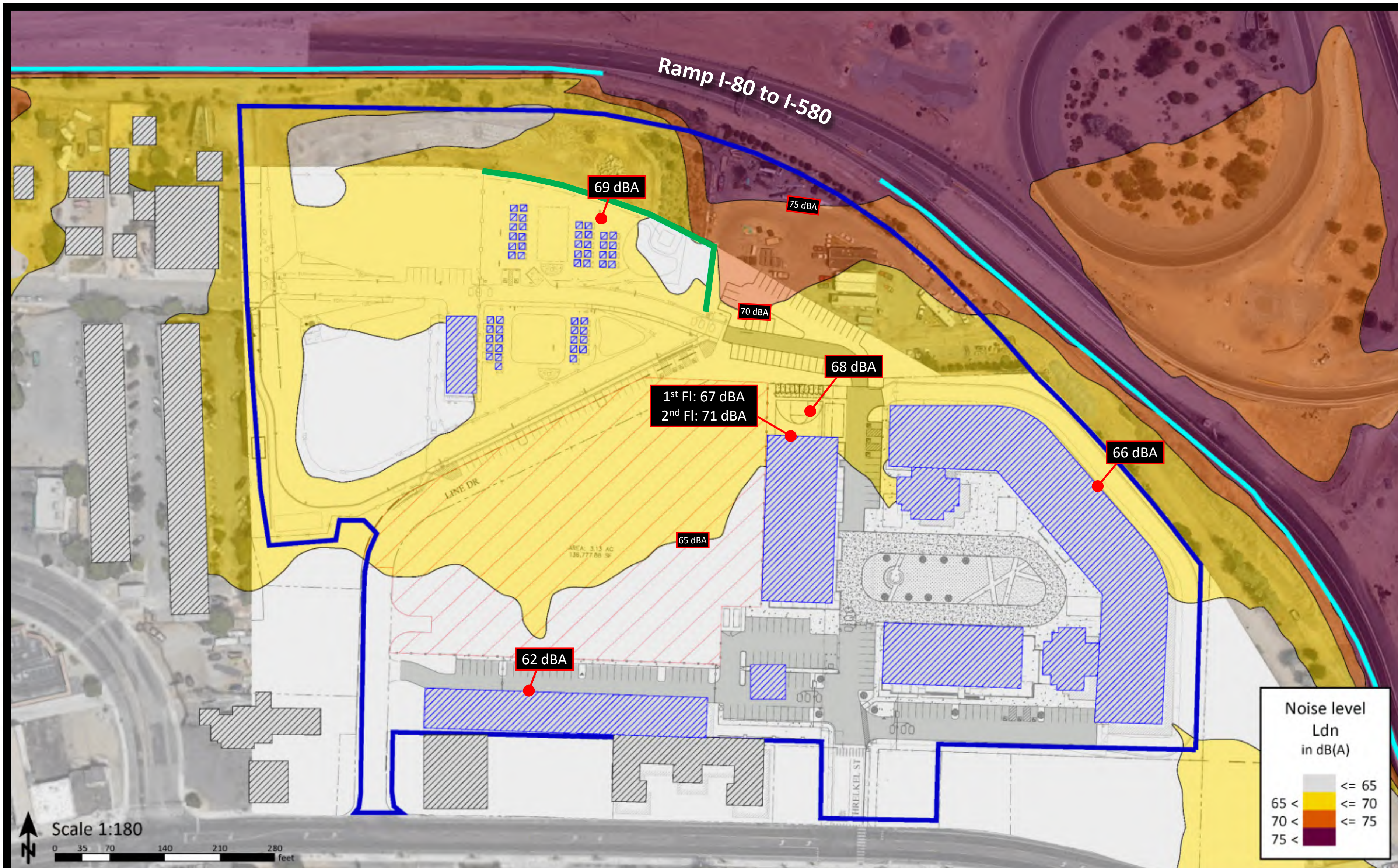

Cares Campus HUD

Reno, Nevada

Figure 5

Future Transportation Noise Levels (dBA L_{dn}) – Extended Freeway Sound Wall

Legend

- Project Site
- Proposed Building
- Existing Building
- Existing Walls
- Camp Area Sound Wall

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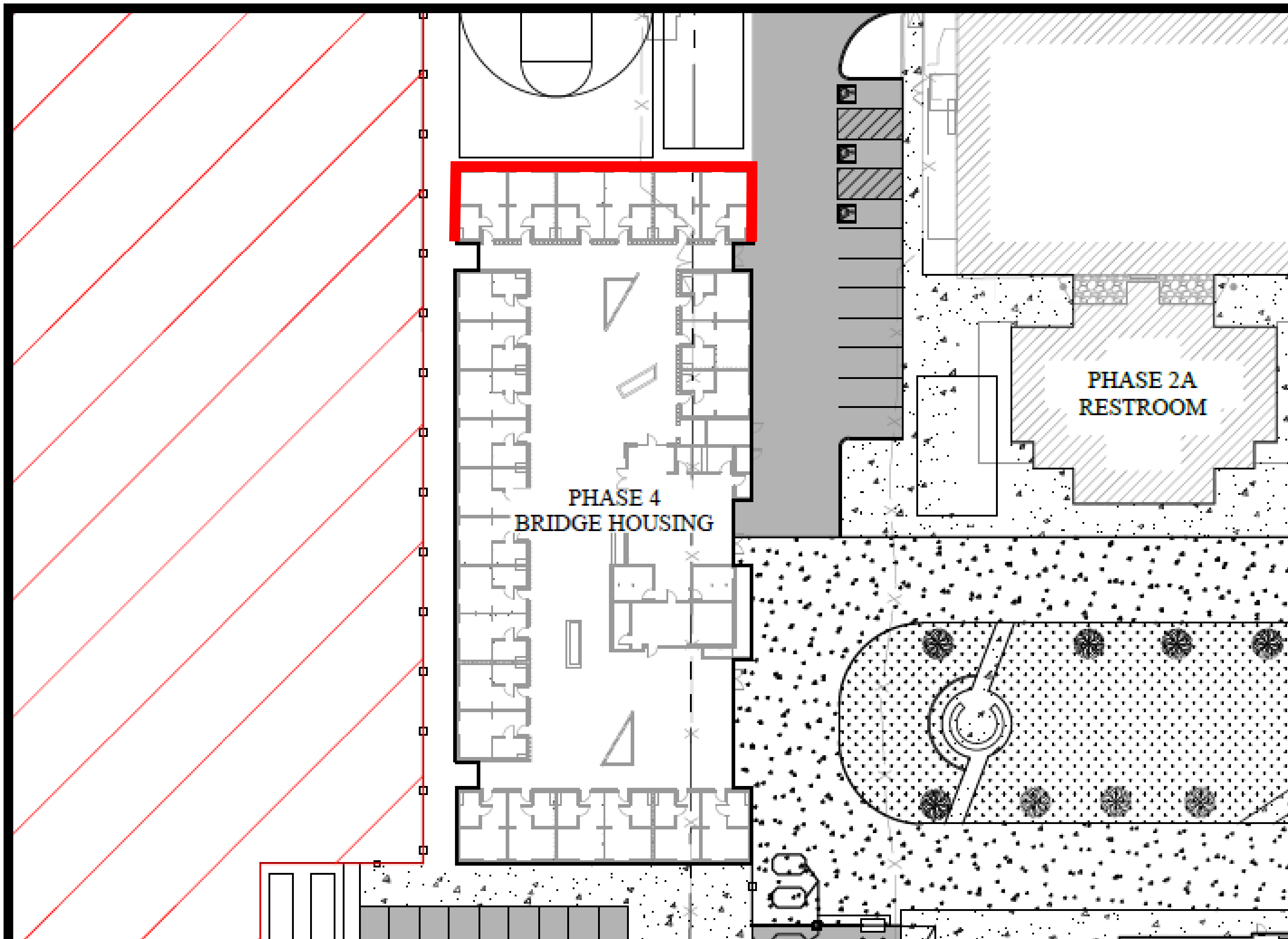
ANALYSIS OF INTERIOR NOISE CONTROL MEASURES:

In order to calculate interior noise levels for the actual project construction, it is necessary to determine the noise reduction provided by the residential building facades. This may be calculated by using a measured A-weighted noise frequency spectrum for arterial road traffic. The composite transmission loss and resulting noise level in the receiving room is first determined. After correcting for room absorption, the overall noise level in the room is calculated.

Based upon the exterior transportation noise levels at the Bridge Housing building of 71 dBA L_{dn}, an exterior-to-interior noise level reduction of 30 dBA would be required to meet HUD standards. **Figure 6** shows the required interior noise control measures. **Appendix C** shows the complete exterior-to-interior noise calculations.



Interior Noise Control Measures
(Required for Indicated Facades of Proposed Building)

- *Glazing shall have a sound transmission class (STC) rating of 33 minimum;*
- *Exterior finish shall be stucco with sheathing;*
- *Interior gypsum at exterior walls shall be 5/8" on resilient channel or 5/8" on staggered stud wall assembly;*
- *Ceiling gypsum shall be 5/8";*
- *Mechanical ventilation shall be installed in all residential uses to allow residents to keep doors and windows closed, as desired for acoustical isolation;*
- *No PTAC's shall be used.*

Cares Campus HUD

City of Reno, Nevada

Figure 6

Interior Noise Control Measures

Legend

Facades Needing Acoustic Upgrades

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CONCLUSIONS

The Safe Camp area, which is currently under construction, is predicted to be exposed to exterior noise levels of up to 70 dBA L_{dn}. No feasible option was found to reduce exterior noise levels in this area to below 65 dBA L_{dn}. However, extension of the existing freeway sound wall as shown on **Figure 4,** would reduce the entire site to below 70 dBA L_{dn}, and to approximately 68 dBA L_{dn}, or less, at the Safe Camp site. Therefore, it is recommended that the existing freeway sound wall be extended at the same height for a distance of approximately 330 feet towards the east along the EB I-80 to SB I-580 ramp.

The proposed Phase 4 Bridge Housing site is predicted to meet HUD exterior and interior noise level standards assuming the following requirements are incorporated into design for the new residential building portions of the project:

- The affected building facades of the project shall include the following noise control measures, as outlined on **Figure 6:**
  - Building facades shall include use of stucco with sheathing or cement fiber board with sheathing;
  - STC 33 minimum rated glazing shall be used;
  - Interior gypsum wallboards shall be 5/8" hung on resilient channels;
  - Interior gypsum ceiling shall be 5/8";
  - Saxelby Acoustics recommends that mechanical ventilation penetrations for exhaust fans not face toward I-80 or I-580. Where feasible, these vents should be routed towards the opposite side of the building to minimize sound intrusion to sensitive areas of the buildings. Where vents must face toward I-80 or I-580, it is recommended that the duct work be increased in length and make as many "S" turns as feasible prior to exiting the dwelling. This separates the openings between the noise source and the living space with a long circuitous route. Each time the sound turns a corner, it is reduced slightly. Flexible duct work is preferred ducting for this noise mitigation. Where the vent exits the building, a spring-loaded flap with a gasket should be installed to reduce sound entering the duct work when the vent is not in use.
  - Mechanical ventilation shall be provided to allow occupants to keep doors and windows closed for acoustic isolation;
  - No PTAC's shall be used;
  - In lieu of these measures, an interior noise control report may be prepared by a qualified acoustic engineer demonstrating that the proposed building construction would achieve the HUD interior noise reduction requirement of 30 dBA.

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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.
ASTC	Apparent Sound Transmission Class. Similar to STC but includes sound from flanking paths and correct for room reverberation. A larger number means more attenuation. The scale, like the decibel scale for sound, is logarithmic.
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 +5 dBA and nighttime hours weighted by +10 dBA.
DNL	See definition of Ldn.
IIC	Impact Insulation Class. An integer-number rating of how well a building floor attenuates impact sounds, such as footsteps. A larger number means more attenuation. The scale, like the decibel scale for sound, is logarithmic.
Frequency	The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz (Hz).
Ldn	Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.
Leq	Equivalent or energy-averaged sound level.
Lmax	The highest root-mean-square (RMS) sound level measured over a given period of time.
L(n)	The sound level exceeded a described percentile over a measurement period. For instance, an hourly L50 is the sound level exceeded 50% of the time during the one-hour period.
Loudness	A subjective term for the sensation of the magnitude of sound.
NIC	Noise Isolation Class. A rating of the noise reduction between two spaces. Similar to STC but includes sound from flanking paths and no correction for room reverberation.
NNIC	Normalized Noise Isolation Class. Similar to NIC but includes a correction for room reverberation.
Noise	Unwanted sound.
NRC	Noise Reduction Coefficient. NRC is a single-number rating of the sound-absorption of a material equal to the arithmetic mean of the sound-absorption coefficients in the 250, 500, 1000, and 2,000 Hz octave frequency bands rounded to the nearest multiple of 0.05. It is a representation of the amount of sound energy absorbed upon striking a particular surface. An NRC of 0 indicates perfect reflection; an NRC of 1 indicates perfect absorption.
RT60	The time it takes reverberant sound to decay by 60 dB once the source has been removed.
Sabin	The unit of sound absorption. One square foot of material absorbing 100% of incident sound has an absorption of 1 Sabin.
SEL	Sound Exposure Level. SEL is a rating, in decibels, of a discrete event, such as an aircraft flyover or train pass by, that compresses the total sound energy into a one-second event.
SPC	Speech Privacy Class. SPC is a method of rating speech privacy in buildings. It is designed to measure the degree of speech privacy provided by a closed room, indicating the degree to which conversations occurring within are kept private from listeners outside the room.
STC	Sound Transmission Class. STC is an integer rating of how well a building partition attenuates airborne sound. It is widely used to rate interior partitions, ceilings/floors, doors, windows and exterior wall configurations. The STC rating is typically used to rate the sound transmission of a specific building element when tested in laboratory conditions where flanking paths around the assembly don't exist. A larger number means more attenuation. The scale, like the decibel scale for sound, is logarithmic.
Threshold of Hearing	The lowest sound that can be perceived by the human auditory system, generally considered to be 0 dB for persons with perfect hearing.
Threshold of Pain	Approximately 120 dB above the threshold of hearing.
Impulsive	Sound of short duration, usually less than one second, with an abrupt onset and rapid decay.
Simple Tone	Any sound which can be judged as audible as a single pitch or set of single pitches.

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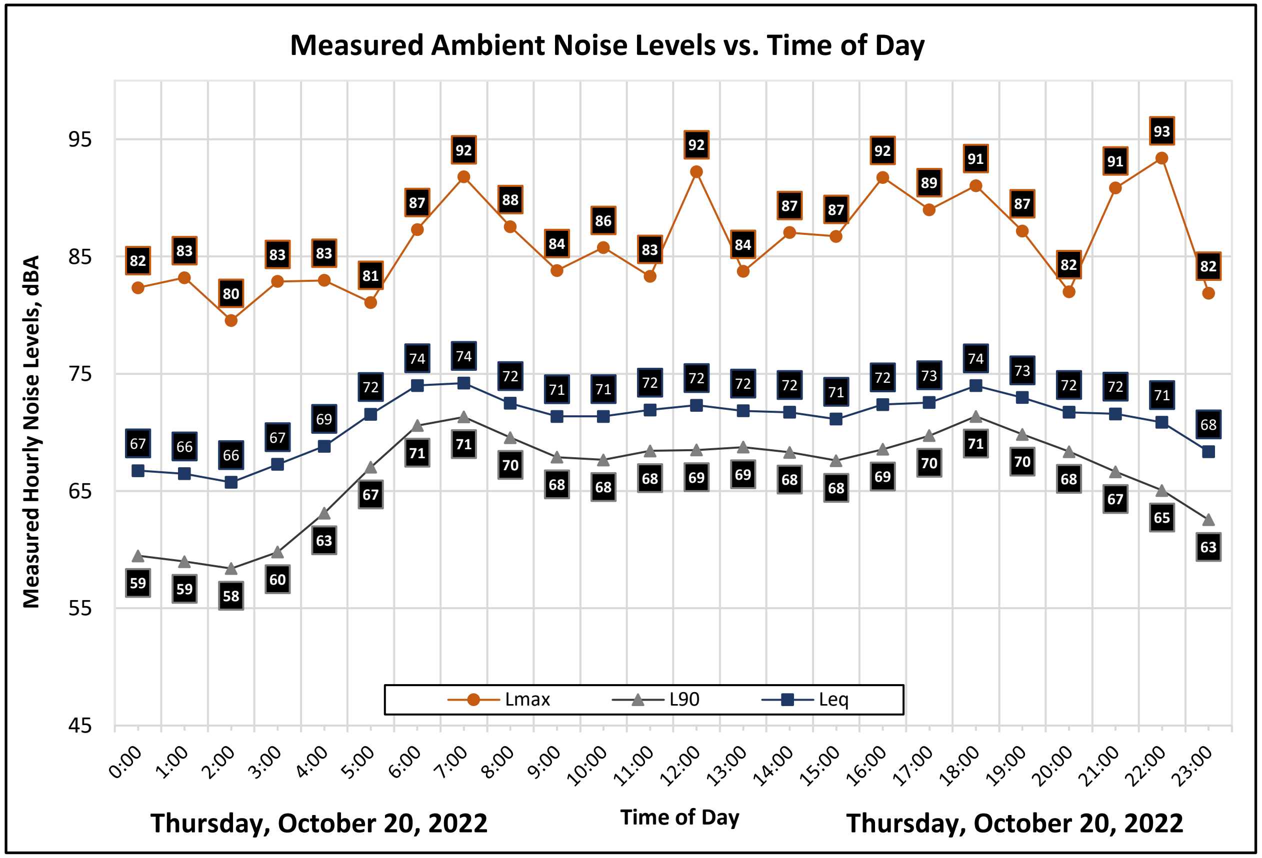
Appendix B: Continuous Ambient Noise Measurement Results

Appendix B1a: Continuous Noise Monitoring Results

Site: LT-1
Project: Cares Campus HUD
Location: Northern Project Boundary
Coordinates: (39.53611, -119.79111)
Meter: LDL 820-2
Calibrator: CAL200

Date	Time	Measured Level, dBA			
		L_{eq}	L_{max}	L_{50}	L_{90}
Thursday, October 20, 2022	0:00	67	82	65	59
Thursday, October 20, 2022	1:00	66	83	64	59
Thursday, October 20, 2022	2:00	66	80	64	58
Thursday, October 20, 2022	3:00	67	83	66	60
Thursday, October 20, 2022	4:00	69	83	67	63
Thursday, October 20, 2022	5:00	72	81	70	67
Thursday, October 20, 2022	6:00	74	87	73	71
Thursday, October 20, 2022	7:00	74	92	73	71
Thursday, October 20, 2022	8:00	72	88	72	70
Thursday, October 20, 2022	9:00	71	84	71	68
Thursday, October 20, 2022	10:00	71	86	70	68
Thursday, October 20, 2022	11:00	72	83	71	68
Thursday, October 20, 2022	12:00	72	92	71	69
Thursday, October 20, 2022	13:00	72	84	71	69
Thursday, October 20, 2022	14:00	72	87	71	68
Thursday, October 20, 2022	15:00	71	87	70	68
Thursday, October 20, 2022	16:00	72	92	71	69
Thursday, October 20, 2022	17:00	73	89	72	70
Thursday, October 20, 2022	18:00	74	91	73	71
Thursday, October 20, 2022	19:00	73	87	72	70
Thursday, October 20, 2022	20:00	72	82	71	68
Thursday, October 20, 2022	21:00	72	91	70	67
Thursday, October 20, 2022	22:00	71	93	69	65
Thursday, October 20, 2022	23:00	68	82	67	63

Statistics	Leq	Lmax	L50	L90
Day Average	72	88	71	69
Night Average	70	84	67	63
Day Low	71	82	70	67
Day High	74	92	73	71
Night Low	66	80	64	58
Night High	74	93	73	71
Ldn	76	Day %		78
CNEL	77	Night %		22

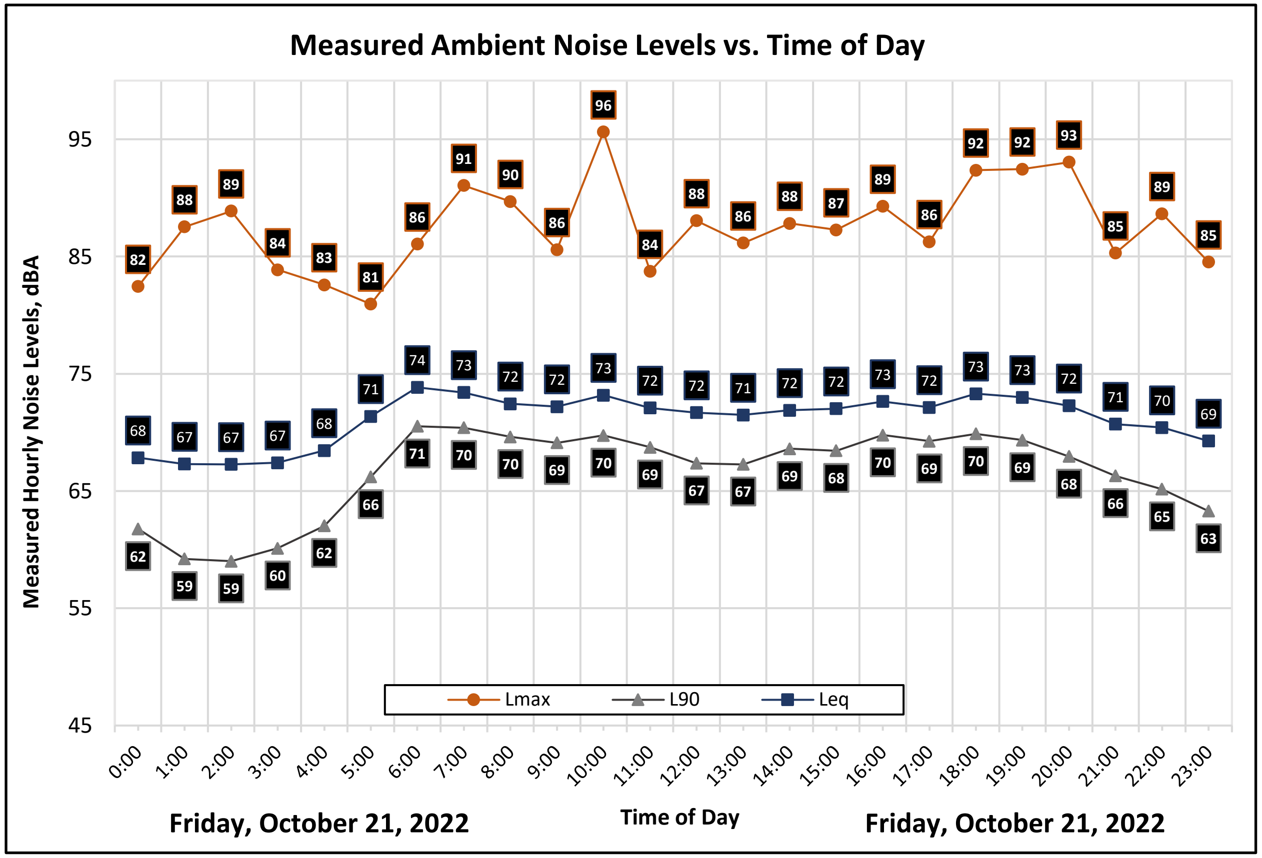


Appendix B1b: Continuous Noise Monitoring Results

Site: LT-1
Project: Cares Campus HUD
Meter: LDL 820-2
Location: Northern Project Boundary
Calibrator: CAL200
Coordinates: (39.53611, -119.79111)

Date	Time	Measured Level, dBA			
		L_{eq}	L_{max}	L_{50}	L_{90}
Friday, October 21, 2022	0:00	68	82	66	62
Friday, October 21, 2022	1:00	67	88	64	59
Friday, October 21, 2022	2:00	67	89	65	59
Friday, October 21, 2022	3:00	67	84	65	60
Friday, October 21, 2022	4:00	68	83	67	62
Friday, October 21, 2022	5:00	71	81	70	66
Friday, October 21, 2022	6:00	74	86	73	71
Friday, October 21, 2022	7:00	73	91	73	70
Friday, October 21, 2022	8:00	72	90	72	70
Friday, October 21, 2022	9:00	72	86	71	69
Friday, October 21, 2022	10:00	73	96	72	70
Friday, October 21, 2022	11:00	72	84	71	69
Friday, October 21, 2022	12:00	72	88	71	67
Friday, October 21, 2022	13:00	71	86	70	67
Friday, October 21, 2022	14:00	72	88	71	69
Friday, October 21, 2022	15:00	72	87	71	68
Friday, October 21, 2022	16:00	73	89	72	70
Friday, October 21, 2022	17:00	72	86	71	69
Friday, October 21, 2022	18:00	73	92	72	70
Friday, October 21, 2022	19:00	73	92	72	69
Friday, October 21, 2022	20:00	72	93	71	68
Friday, October 21, 2022	21:00	71	85	70	66
Friday, October 21, 2022	22:00	70	89	69	65
Friday, October 21, 2022	23:00	69	85	68	63

Statistics	Leq	Lmax	L50	L90
Day Average	72	89	71	69
Night Average	70	85	68	63
Day Low	71	84	70	66
Day High	73	96	73	70
Night Low	67	81	64	59
Night High	74	89	73	71
Ldn	76	Day %		77
CNEL	77	Night %		23

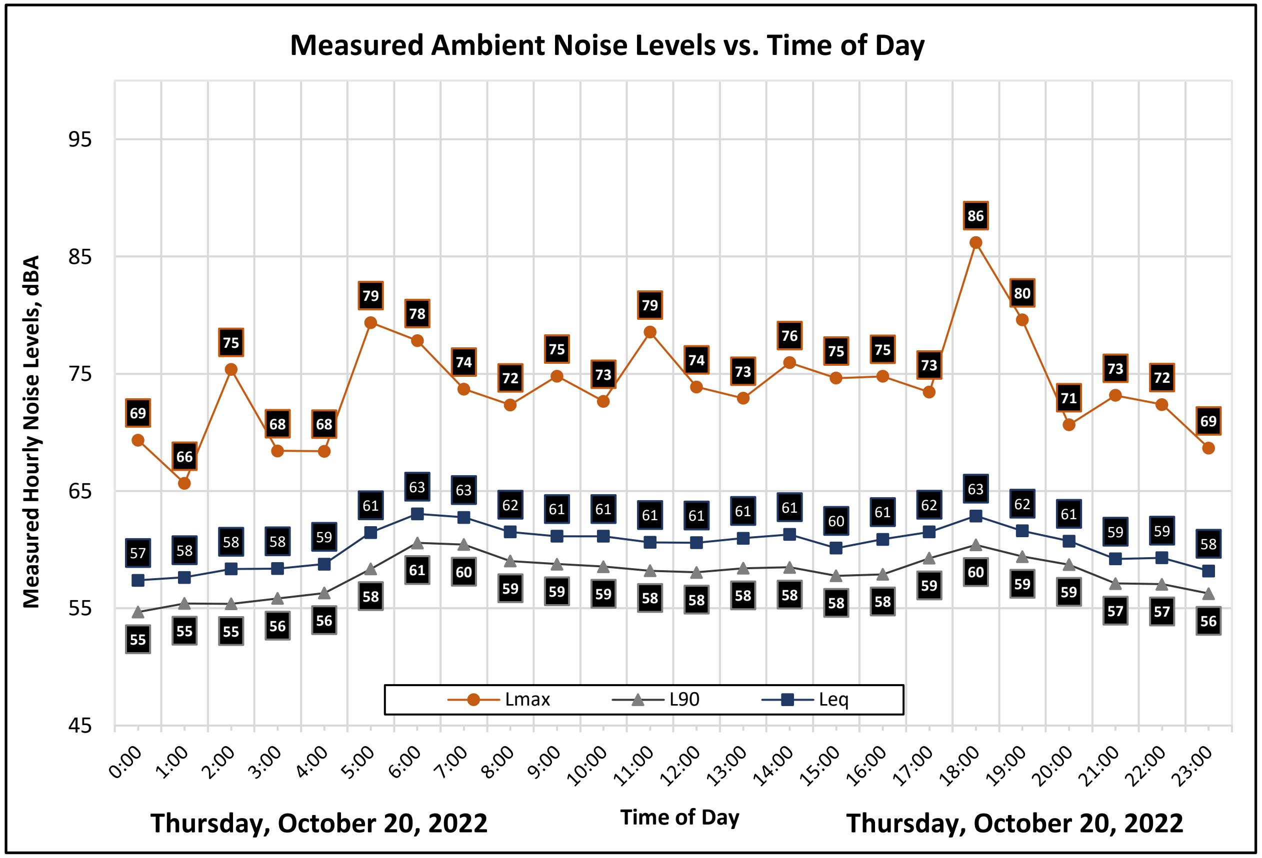


Appendix B2a: Continuous Noise Monitoring Results

Date	Time	Measured Level, dBA			
		L_{eq}	L_{max}	L_{50}	L_{90}
Thursday, October 20, 2022	0:00	57	69	57	55
Thursday, October 20, 2022	1:00	58	66	57	55
Thursday, October 20, 2022	2:00	58	75	57	55
Thursday, October 20, 2022	3:00	58	68	58	56
Thursday, October 20, 2022	4:00	59	68	58	56
Thursday, October 20, 2022	5:00	61	79	60	58
Thursday, October 20, 2022	6:00	63	78	62	61
Thursday, October 20, 2022	7:00	63	74	62	60
Thursday, October 20, 2022	8:00	62	72	61	59
Thursday, October 20, 2022	9:00	61	75	60	59
Thursday, October 20, 2022	10:00	61	73	60	59
Thursday, October 20, 2022	11:00	61	79	60	58
Thursday, October 20, 2022	12:00	61	74	59	58
Thursday, October 20, 2022	13:00	61	73	60	58
Thursday, October 20, 2022	14:00	61	76	60	58
Thursday, October 20, 2022	15:00	60	75	59	58
Thursday, October 20, 2022	16:00	61	75	59	58
Thursday, October 20, 2022	17:00	62	73	61	59
Thursday, October 20, 2022	18:00	63	86	62	60
Thursday, October 20, 2022	19:00	62	80	61	59
Thursday, October 20, 2022	20:00	61	71	60	59
Thursday, October 20, 2022	21:00	59	73	59	57
Thursday, October 20, 2022	22:00	59	72	59	57
Thursday, October 20, 2022	23:00	58	69	58	56

Statistics	Leq	Lmax	L50	L90
Day Average	61	75	60	59
Night Average	60	72	58	57
Day Low	59	71	59	57
Day High	63	86	62	60
Night Low	57	66	57	55
Night High	63	79	62	61
Ldn	66	Day %		73
CNEL	66	Night %		27

Site: LT-2
Project: Cares Campus HUD
Location: North East Project Boundary
Coordinates: (39.53532, -119.78977)
Meter: LDL 820-5
Calibrator: CAL200

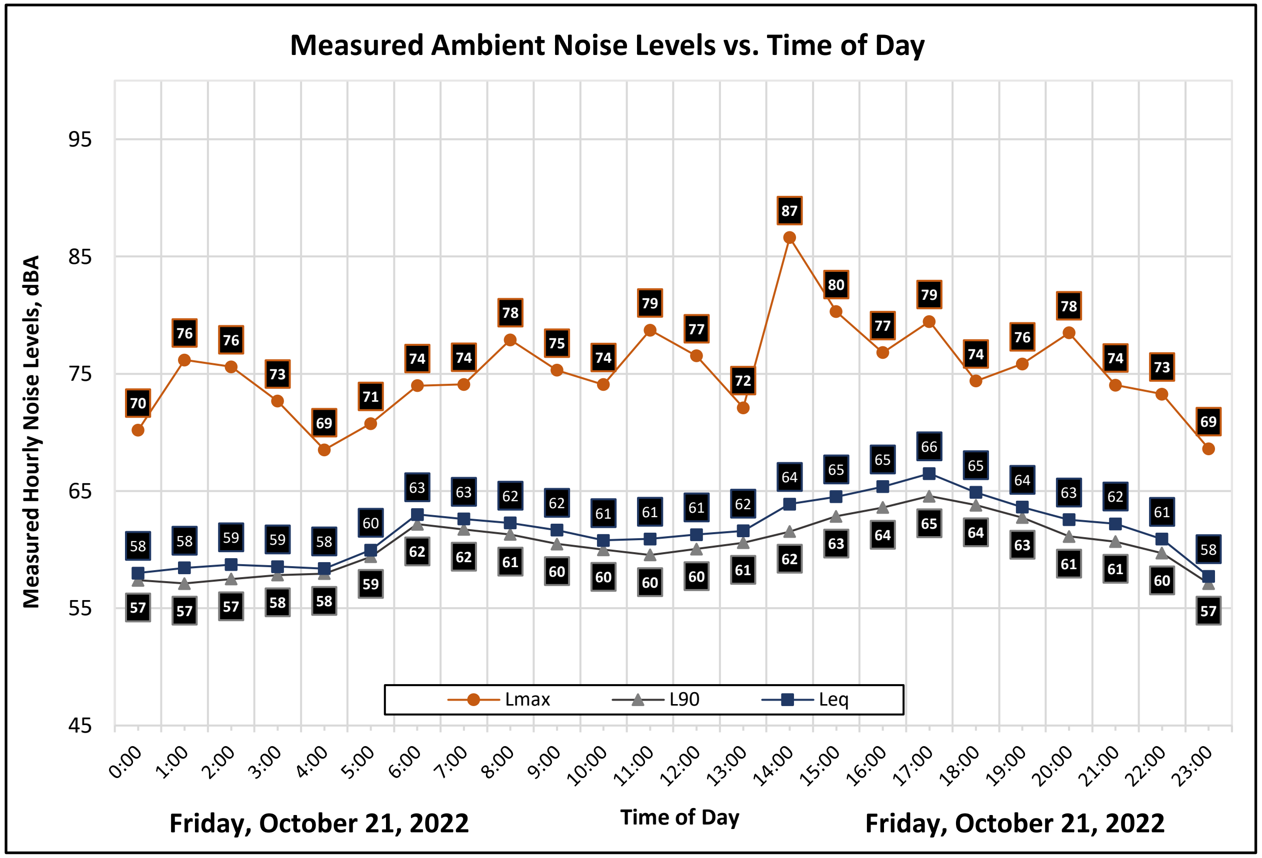


Appendix B2b: Continuous Noise Monitoring Results

Site: LT-2
Project: Cares Campus HUD
Location: North East Project Boundary
Coordinates: (39.53532, -119.78977)
Meter: LDL 820-5
Calibrator: CAL200

Date	Time	Measured Level, dBA			
		L_{eq}	L_{max}	L_{50}	L_{90}
Friday, October 21, 2022	0:00	58	70	57	57
Friday, October 21, 2022	1:00	58	76	57	57
Friday, October 21, 2022	2:00	59	76	57	57
Friday, October 21, 2022	3:00	59	73	58	58
Friday, October 21, 2022	4:00	58	69	58	58
Friday, October 21, 2022	5:00	60	71	60	59
Friday, October 21, 2022	6:00	63	74	62	62
Friday, October 21, 2022	7:00	63	74	62	62
Friday, October 21, 2022	8:00	62	78	61	61
Friday, October 21, 2022	9:00	62	75	60	60
Friday, October 21, 2022	10:00	61	74	60	60
Friday, October 21, 2022	11:00	61	79	60	60
Friday, October 21, 2022	12:00	61	77	59	60
Friday, October 21, 2022	13:00	62	72	60	61
Friday, October 21, 2022	14:00	64	87	60	62
Friday, October 21, 2022	15:00	65	80	59	63
Friday, October 21, 2022	16:00	65	77	59	64
Friday, October 21, 2022	17:00	66	79	61	65
Friday, October 21, 2022	18:00	65	74	62	64
Friday, October 21, 2022	19:00	64	76	61	63
Friday, October 21, 2022	20:00	63	78	60	61
Friday, October 21, 2022	21:00	62	74	59	61
Friday, October 21, 2022	22:00	61	73	59	60
Friday, October 21, 2022	23:00	58	69	58	57

Statistics	Leq	Lmax	L50	L90
Day Average	63	77	60	62
Night Average	59	72	58	58
Day Low	61	72	59	60
Day High	66	87	62	65
Night Low	58	69	57	57
Night High	63	76	62	62
Ldn	66	Day %		82
CNEL	67	Night %		18

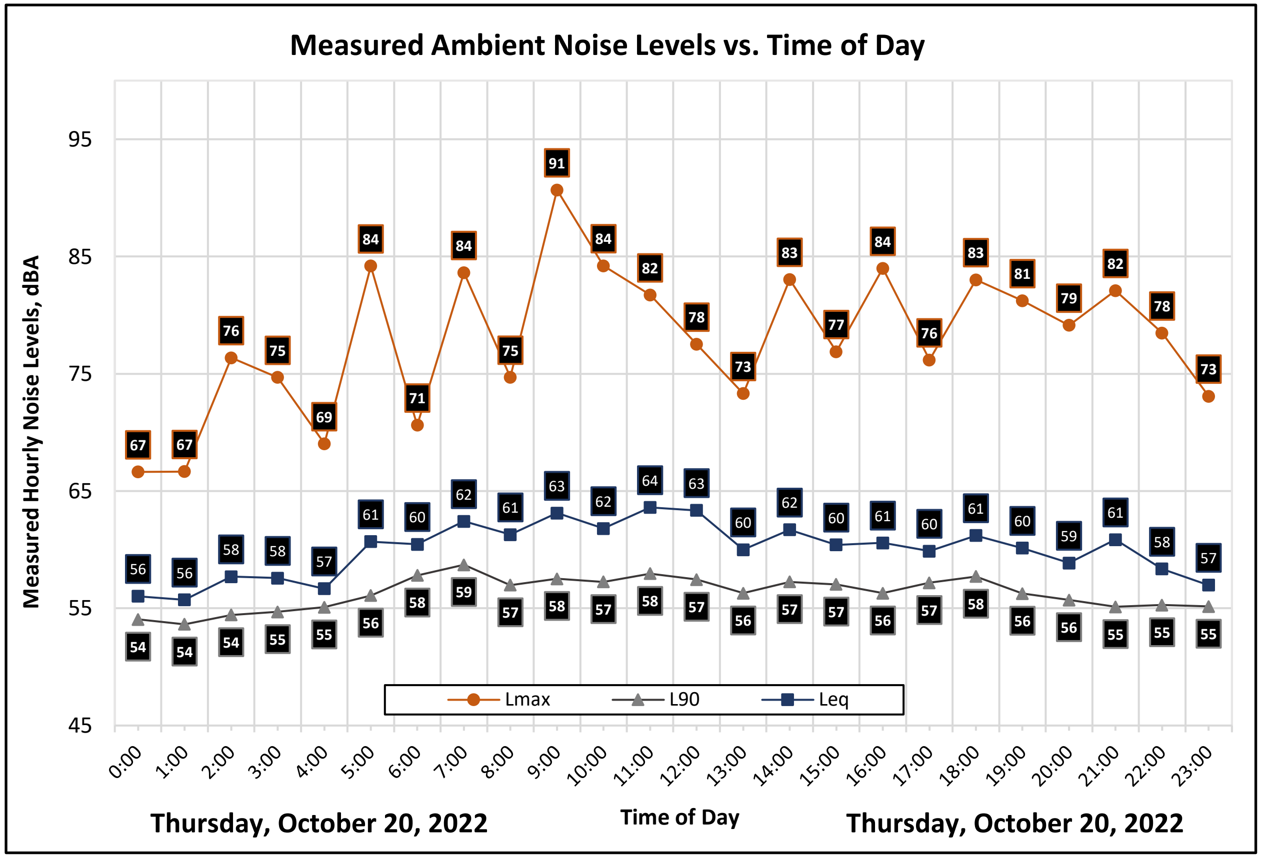


Appendix B3a: Continuous Noise Monitoring Results

Site: LT-3
Project: Cares Campus HUD
Location: Eastern Project Boundary
Coordinates: (39.53423, -119.78923)
Meter: LDL 820-4
Calibrator: CAL200

Date	Time	Measured Level, dBA			
		L_{eq}	L_{max}	L_{50}	L_{90}
Thursday, October 20, 2022	0:00	56	67	56	54
Thursday, October 20, 2022	1:00	56	67	55	54
Thursday, October 20, 2022	2:00	58	76	56	54
Thursday, October 20, 2022	3:00	58	75	56	55
Thursday, October 20, 2022	4:00	57	69	56	55
Thursday, October 20, 2022	5:00	61	84	58	56
Thursday, October 20, 2022	6:00	60	71	60	58
Thursday, October 20, 2022	7:00	62	84	60	59
Thursday, October 20, 2022	8:00	61	75	59	57
Thursday, October 20, 2022	9:00	63	91	60	58
Thursday, October 20, 2022	10:00	62	84	59	57
Thursday, October 20, 2022	11:00	64	82	61	58
Thursday, October 20, 2022	12:00	63	78	63	57
Thursday, October 20, 2022	13:00	60	73	58	56
Thursday, October 20, 2022	14:00	62	83	59	57
Thursday, October 20, 2022	15:00	60	77	59	57
Thursday, October 20, 2022	16:00	61	84	58	56
Thursday, October 20, 2022	17:00	60	76	59	57
Thursday, October 20, 2022	18:00	61	83	59	58
Thursday, October 20, 2022	19:00	60	81	58	56
Thursday, October 20, 2022	20:00	59	79	57	56
Thursday, October 20, 2022	21:00	61	82	57	55
Thursday, October 20, 2022	22:00	58	78	56	55
Thursday, October 20, 2022	23:00	57	73	56	55

Statistics	Leq	Lmax	L50	L90
Day Average	61	81	59	57
Night Average	58	73	57	55
Day Low	59	73	57	55
Day High	64	91	63	59
Night Low	56	67	55	54
Night High	61	84	60	58
Ldn	65	Day %		80
CNEL	65	Night %		20

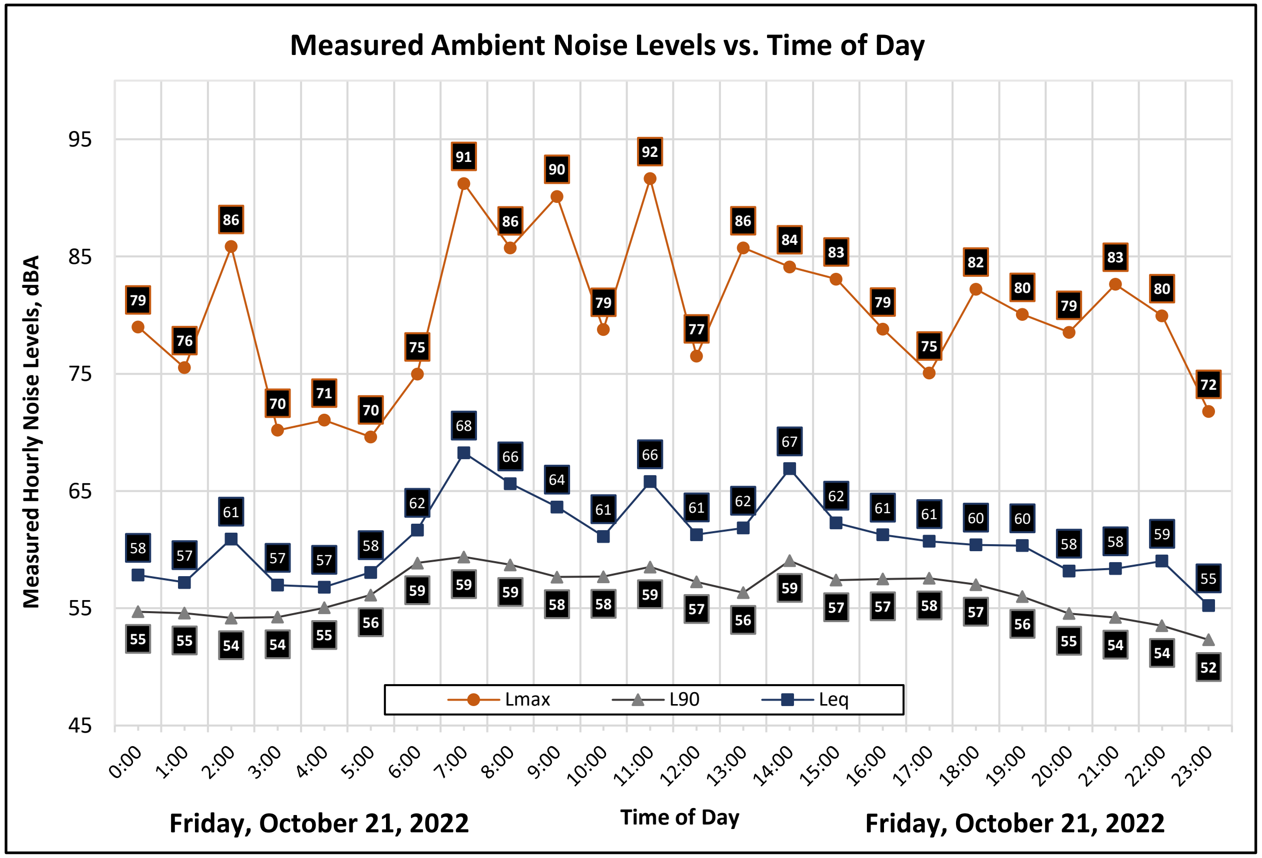


Appendix B3b: Continuous Noise Monitoring Results

Site: LT-3
Project: Cares Campus HUD
Location: Eastern Project Boundary
Coordinates: (39.53423, -119.78923)
Meter: LDL 820-4
Calibrator: CAL200

Date	Time	Measured Level, dBA			
		L_{eq}	L_{max}	L_{50}	L_{90}
Friday, October 21, 2022	0:00	58	79	56	55
Friday, October 21, 2022	1:00	57	76	56	55
Friday, October 21, 2022	2:00	61	86	56	54
Friday, October 21, 2022	3:00	57	70	56	54
Friday, October 21, 2022	4:00	57	71	56	55
Friday, October 21, 2022	5:00	58	70	57	56
Friday, October 21, 2022	6:00	62	75	60	59
Friday, October 21, 2022	7:00	68	91	61	59
Friday, October 21, 2022	8:00	66	86	61	59
Friday, October 21, 2022	9:00	64	90	60	58
Friday, October 21, 2022	10:00	61	79	60	58
Friday, October 21, 2022	11:00	66	92	61	59
Friday, October 21, 2022	12:00	61	77	59	57
Friday, October 21, 2022	13:00	62	86	59	56
Friday, October 21, 2022	14:00	67	84	64	59
Friday, October 21, 2022	15:00	62	83	59	57
Friday, October 21, 2022	16:00	61	79	59	57
Friday, October 21, 2022	17:00	61	75	59	58
Friday, October 21, 2022	18:00	60	82	59	57
Friday, October 21, 2022	19:00	60	80	58	56
Friday, October 21, 2022	20:00	58	79	56	55
Friday, October 21, 2022	21:00	58	83	56	54
Friday, October 21, 2022	22:00	59	80	56	54
Friday, October 21, 2022	23:00	55	72	54	52

Statistics	Leq	Lmax	L50	L90
Day Average	63	83	59	57
Night Average	59	75	56	55
Day Low	58	75	56	54
Day High	68	92	64	59
Night Low	55	70	54	52
Night High	62	86	60	59
Ldn	66	Day %		85
CNEL	66	Night %		15



Appendix C: Exterior to Interior Noise Reduction Calculations

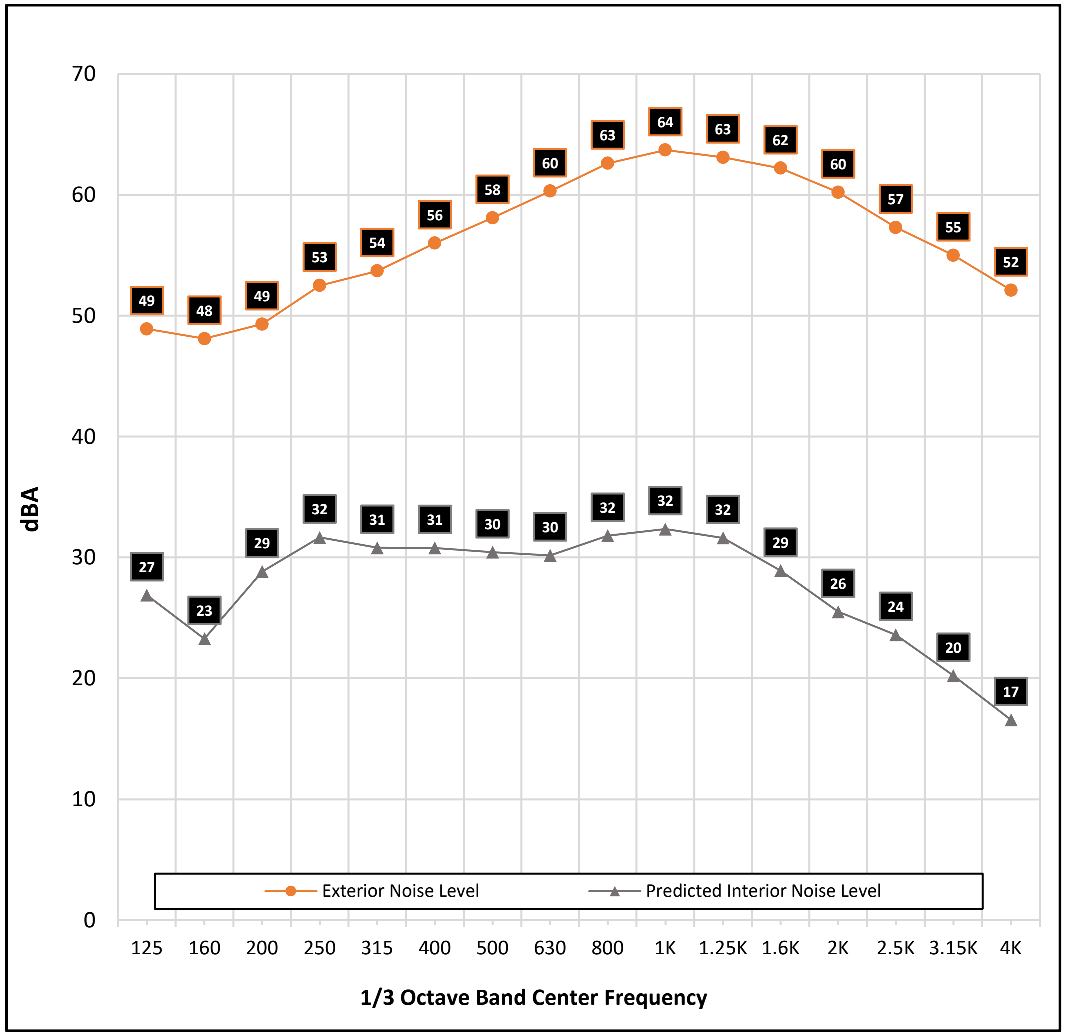
Appendix C1: Interior Noise Calculation Sheet

Project: Victory Avenue Apartments
Room Description: Bedroom

Inputs

Parallel Exterior level, dBA:	71.0	**Ldn**
Correction Factor, dBA:	5.0	
Noise Source:	Freeway Traffic	
Room Perimeter, ft:	40.0	
Room Area, ft:	100.0	
Room Height, ft:	9.0	
Transmitting Panel Length, ft:	20.0	
Glazing Area, ft:	24.0	
Ceiling Finish:	**Gyp Board**	
Ceiling, sf:	100	
Wall Finish 1:	**Gyp Board**	
Wall Finish 1, sf:	336	
Wall Finish 2:	**Glass**	
Wall Finish 2, sf:	24	
Floor:	**Vinyl Plank**	
Floor, sf:	100	
Misc. Finish:	**Soft Furnishings**	
Misc. Finish, sf:	25	
Transmitting Element 1:	**Wall - 1-Coat Stucco, RC 5/8" gyp INSUL**	
Element 1, sf:	156	
Transmitting Element 2:	**Glazing - STC 33**	
Element 2, sf:	24	
Transmitting Element 3:		
Element 3, sf:		
Transmitting Element 4:		
Element 4, sf:		

Predicted Interior Noise Level, dBA: 41
Noise Reduction, dBA: -30



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Appendix C2: Interior Noise Calculation Sheet

Project: Victory Avenue Apartments
Room Description: Living Room

Inputs		
Parallel Exterior level, dBA:	71.0	**Ldn**
Correction Factor, dBA:	5.0	
Noise Source:	Freeway Traffic	
Room Perimeter, ft:	64.0	
Room Area, ft:	240.0	
Room Height, ft:	9.0	
Transmitting Panel Length, ft:	20.0	
Glazing Area, ft:	24.0	
Ceiling Finish:	**Gyp Board**	
Ceiling, sf:	240	
Wall Finish 1:	**Gyp Board**	
Wall Finish 1, sf:	552	
Wall Finish 2:	**Glass**	
Wall Finish 2, sf:	24	
Floor:	**Vinyl Plank**	
Floor, sf:	240	
Misc. Finish:	**Soft Furnishings**	
Misc. Finish, sf:	25	
Transmitting Element 1:	**Wall - 1-Coat Stucco, RC 5/8" gyp INSUL**	
Element 1, sf:	156	
Transmitting Element 2:	**Glazing - STC 33**	
Element 2, sf:	24	
Transmitting Element 3:		
Element 3, sf:		
Transmitting Element 4:		
Element 4, sf:		

Predicted Interior Noise Level, dBA: 39
Noise Reduction, dBA: -32