Plaza 2555 Residential

City of Davis, California

July 31, 2017

Project # 170704

Prepared for:

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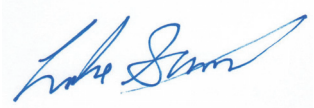

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INTRODUCTION

The Plaza 2555 residential project is located south of Interstate 80 and north of the easternmost intersection of Research Park Drive and Cowell Boulevard. The project includes the construction of a 170-unit multi-family residential project on 6.57 acres. The project is in the City of Davis, California.

Figure 1 shows the project site plan. Figure 2 shows an aerial photo of the project site.

ENVIRONMENTAL SETTING

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.

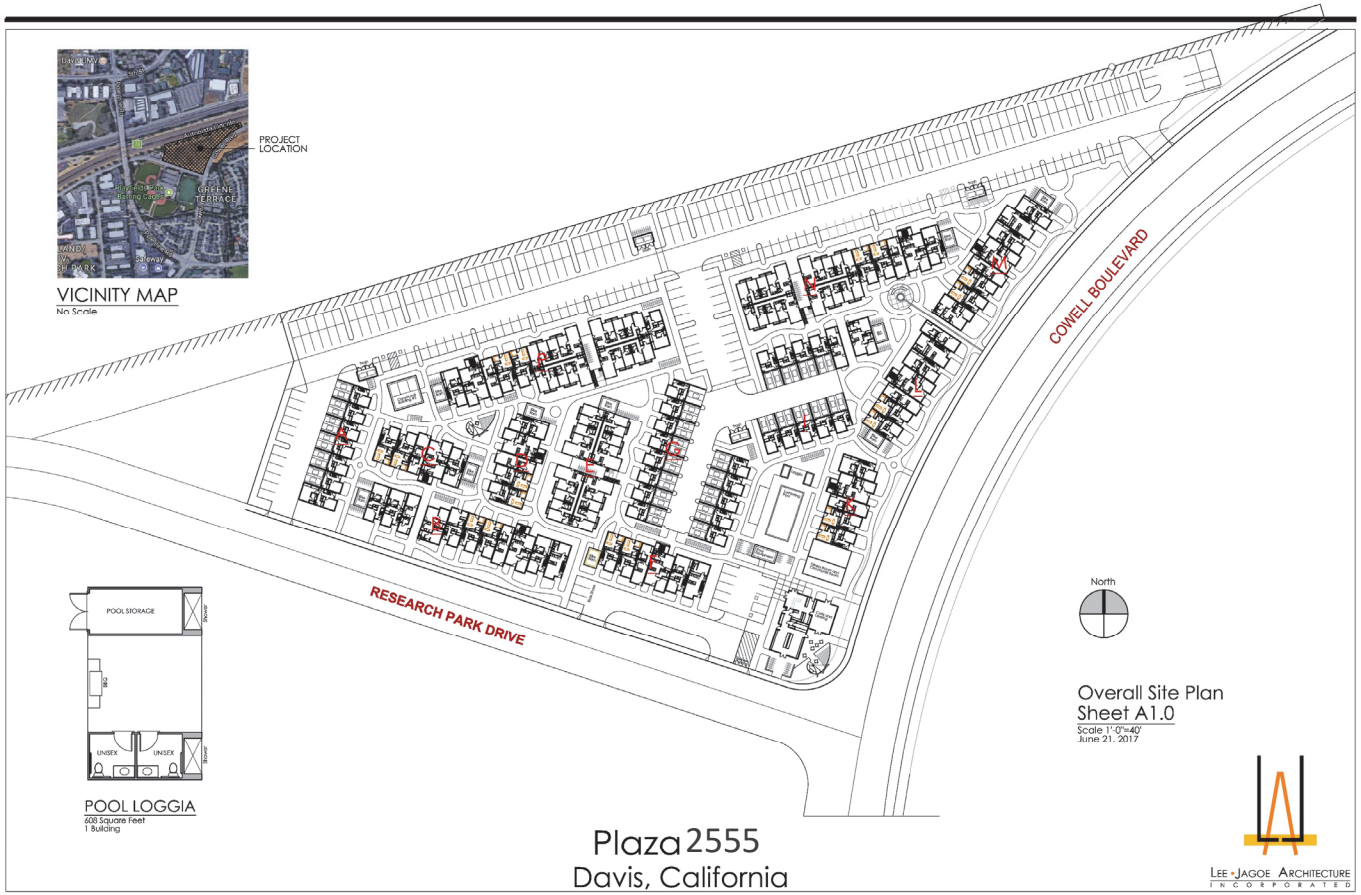
Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale uses the hearing threshold (20 micropascals), as a point of reference, defined as 0 dB. Other sound pressures are then compared to this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

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. All noise levels reported in this section are in terms of A-weighted levels, but are expressed as dB, unless otherwise noted.

Plaza 2555 Residential
City of Davis, California

Figure 1

Project Site Plan



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Plaza 2555 Noise Assessment
City of Davis, Calfornia

Figure 2: Noise Measurement Sites

Legend

- Arterial Road
- Major/US Highway
- Noise Measurement - Long Term

0 ft 250 ft 750 ft 1250 ft 1750 ft 2250 ft

Projection: State Plane (California Zone 2) / NAD83 / meters
Rev. Date: 07/31/2017

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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 (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 and to a lesser extent by traffic on Cowell Blvd.

To quantify the existing ambient noise environment on the project site, Saxelby Acoustics conducted a continuous noise measurement survey. 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 meter was 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 812 precision integrating sound level meters were used for the ambient noise level measurement survey. The meters were calibrated before and after use with a B&K Model 4230 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	Location	Date	Average Measured Hourly Noise Levels, dBA						
				Daytime (7:00 am - 10:00 pm)			Nighttime (10:00 pm – 7:00 am)		
			L_{dn}	L_{eq}	L_{50}	L_{max}	L_{eq}	L_{50}	L_{max}
Continuous 24-hour Noise Measurement Site									
LT-1	Northwest corner of site, 125' to centerline of I-80	July 20-21, 2017	75	71	69	84	69	66	82
LT-2	South of project site, 50' to centerline of Cowell	July 20-21, 2017	63	61	58	79	55	51	71
Source: Saxelby Acoustics – 2017									

REGULATORY CONTEXT

FEDERAL

There are no federal regulations related to noise that apply to the Proposed Project.

STATE

There are no state regulations related to noise that apply to the Proposed Project.

LOCAL

City of Davis General Plan

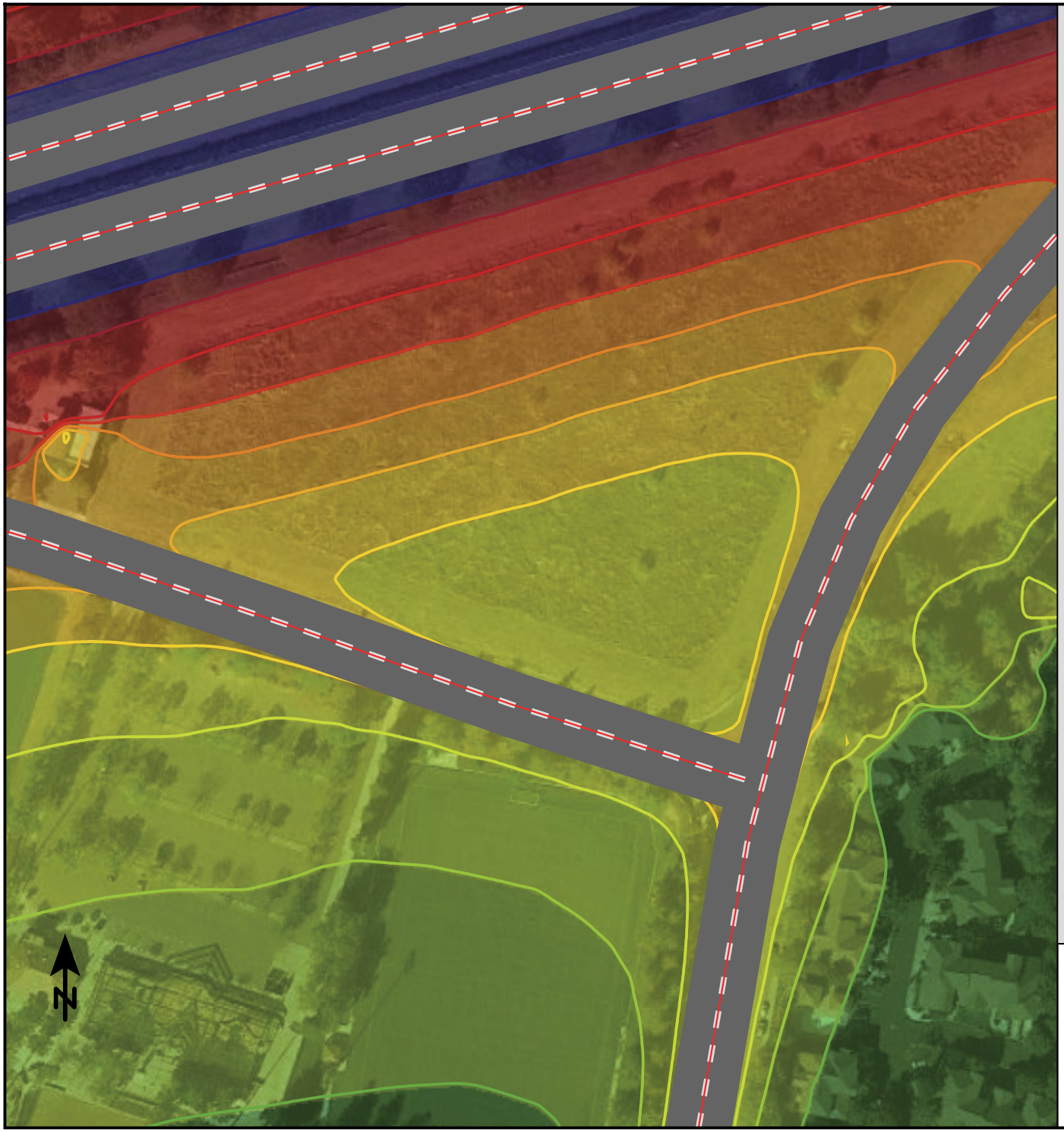
The City of Redding General Plan Noise Element Table 19 establishes an acceptable exterior noise level of 60 dBA L_{dn} at outdoor activity areas of residential uses. For interior spaces of residential uses, the allowable interior noise level standard is 45 dBA L_{dn} (General Plan Table 20).

EVALUATION OF FUTURE TRANSPORTATION NOISE SOURCES ON THE PROJECT SITE

On-Site Traffic Noise Prediction Methodology

Saxelby Acoustics measured an exterior noise level of 75 dBA L_{dn} at noise measurement site LT-1 and 63 dBA L_{dn} at site LT-2. These levels and existing traffic volumes for Interstate 80, Cowell Boulevard, and Research Park Drive, were used to calibrate the SoundPlan noise prediction model to within 1 dBA of measured levels. Existing site noise levels are shown in Figure 3.

Based upon traffic projections contained in the Mace Ranch Innovation Center DEIR, future I-80 traffic noise levels are predicted to increase by approximately 1 dBA under future conditions. Therefore, a +1 dBA adjustment was made to the SoundPlan model to account for future traffic noise levels on the project site. Additionally, the proposed project buildings and parking lots were input into the calibrated SoundPlan model to determine the future traffic noise exposure on the project site. The results of this analysis are shown on Figure 4.



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Existing Noise Levels

Figure 3

Signs and symbols

Emission line

Surface

Level tables

Levels in dB(A)

<= 60
60 - 62
62 - 64
64 - 66
66 - 68
68 - 70
70 - 72
72 - 74
74 - 76
76 - 78
> 78

1 : 1577

0 10 20 40 60 80 m

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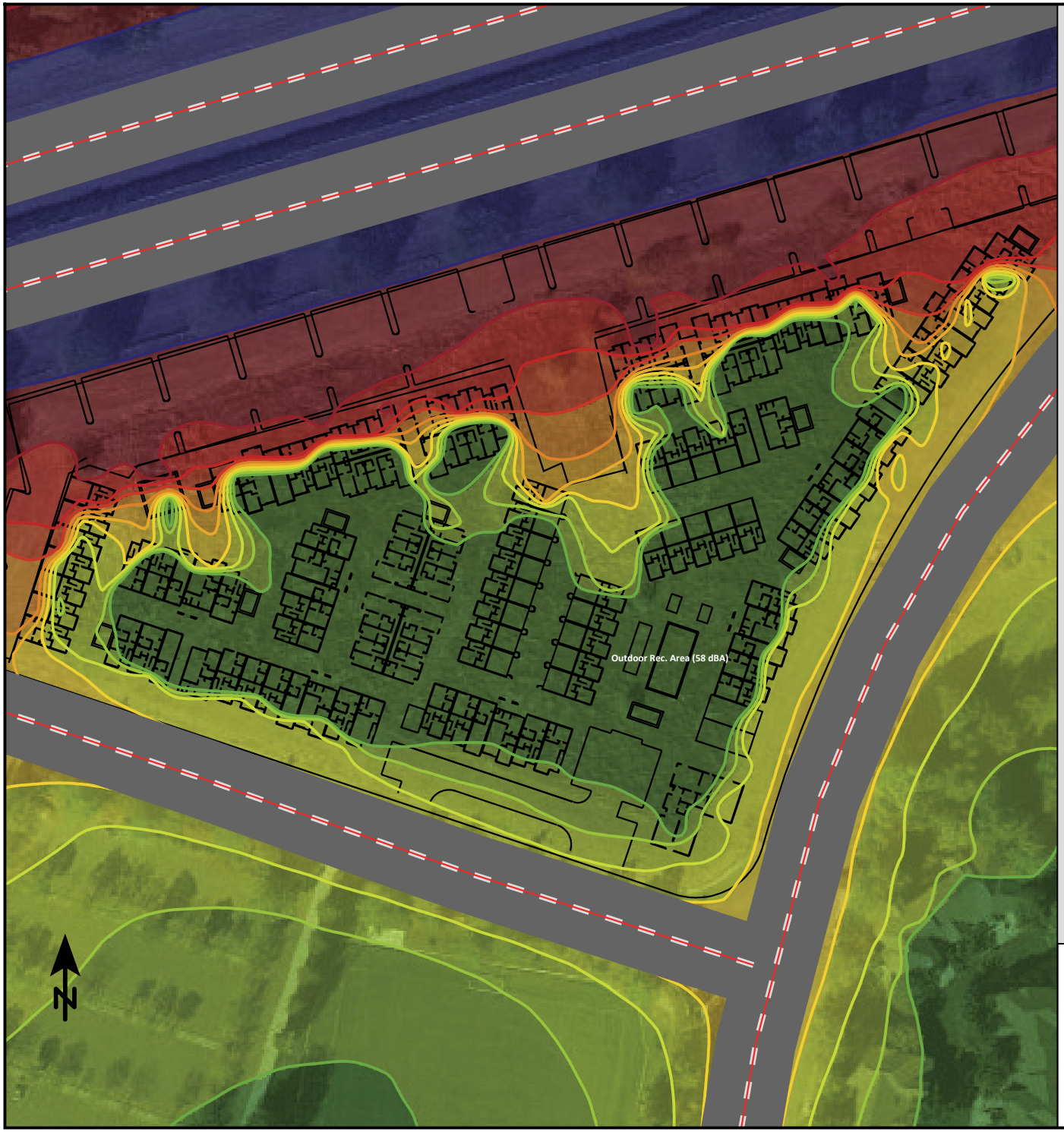

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Future Noise Levels

Figure 4

Signs and symbols

Ground absorption

Emission line

Surface

Levels in dB(A)

<= 60
60 - 62
62 - 64
64 - 66
66 - 68
68 - 70
70 - 72
72 - 74
74 - 76
76 - 78
> 78

1 : 1296

0 5 10 20 30 40 m

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Based upon the SoundPlan noise model, Table 3 shows the predicted traffic noise levels at specific locations of the project.

TABLE 3: TRAFFIC NOISE LEVELS ON PROJECT SITE

Location	Exterior Noise Level, Ldn	Estimated Interior Noise Level, Ldn[1]	Noise Standard	Complies with Standard?
Swimming Pool Area	58 dBA	N/A	60 dBA Exterior	Yes
1st Row of Buildings Along I-80	74 dBA	49 dBA	45 dBA Interior	No, additional noise control measures required
1st Row of Buildings Along Research Park Drive	65 dBA	40 dBA	45 dBA Interior	Yes
1st Row of Buildings Along Cowell Blvd.	66 dBA	41 dBA	45 dBA Interior	Yes
[1] Assumes typical 25 dBA exterior-to-interior noise level reduction.				

As shown in Table 3, traffic noise levels of 58 dBA L_{dn} are predicted at the proposed outdoor activity areas of the project. This meets the City's 60 dBA L_{dn} exterior noise level standard and no additional exterior noise control measures would be required.

As shown in Table 3, traffic is predicted to be 74 dBA L_{dn} at the building façades of the first row of buildings along I-80. Based upon a typical 25 dB exterior-to-interior noise level reduction achieved by modern building construction, an interior noise level of 49 dBA L_{dn} would be expected. This would exceed the City's 45 dB L_{dn} interior noise level standard. Therefore, interior noise control measures would be required to achieve compliance with the City's interior noise level standards for these buildings. Interior noise control measures are outlined below for these buildings. See Appendix C for the interior noise calculations.

Noise Control Measures

Noise Control Measure 1: The following interior noise reduction measures should be included for all first-row, north facing units. See Figure 5 for the specific buildings needing these upgrades:

- ***Interior Noise Control Measures:***
    - *Glazing shall have a sound transmission class (STC) rating of 36.*
    - *Exterior finish shall be three-coat stucco or system with equivalent weight per square foot;*
    - *Interior gypsum at exterior walls shall be 5/8" Type X on resilient channel or 5/8" Type X on staggered stud wall assembly;*
    - *Ceiling gypsum shall be 5/8" type X or Type C;*
    - *Mechanical ventilation shall be installed in all residential uses to allow residents to keep doors and windows closed, as desired for acoustical isolation. PTAC's shall not be used for any unit requiring these acoustical upgrades.*
- As an alternative to the above-listed interior noise control measures, the applicant may provide a detailed analysis of interior noise control measures once building plans become available. The analysis should be prepared by a qualified noise control engineer and shall outline the specific measures required to meet the City's 45 dB L_{dn}, interior noise level standards.

Interior Noise Control Measures
(Required for units facing towards I-80)

- *Glazing shall have a sound transmission class (STC) rating of 36;*
- *Exterior finish shall be three-coat stucco or system with equivalent weight per square foot;*
- *Interior gypsum at exterior walls shall be 5/8" Type X on resilient channel or 5/8" Type X on staggered stud wall assembly;*
- *Ceiling gypsum shall be 5/8" type X or Type C;*
- *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).*

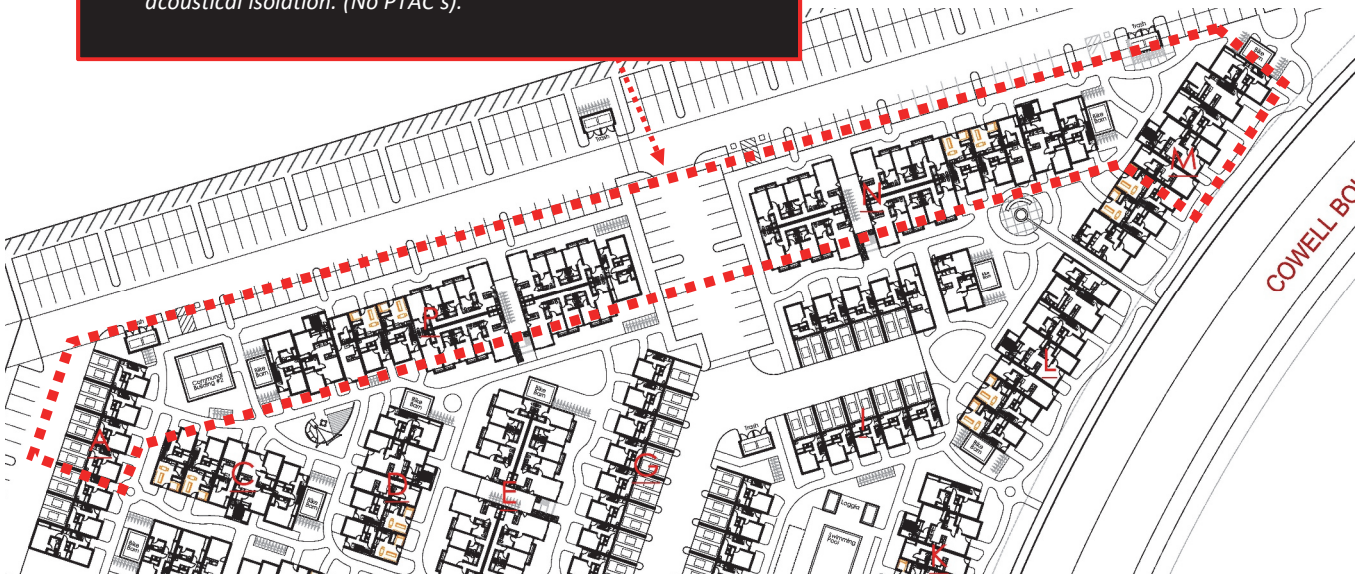

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Figure 5

Interior Noise Control Measures

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Conclusions

The proposed project is predicted to meet the exterior noise requirements of the City of Davis without any additional exterior noise control measures. However, the project is predicted to be exposed to interior noise levels which may exceed the City's 45 dB L_{dn} interior noise level standard and the following Noise Control Measure 1 should be implemented.

Noise Control Measure 1: The following interior noise reduction measures should be included for all first-row, north facing units. See Figure 5 for the specific buildings needing these upgrades:

- ***Interior Noise Control Measures:***
    - *Glazing shall have a sound transmission class (STC) rating of 36.*
    - *Exterior finish shall be three-coat stucco or system with equivalent weight per square foot;*
    - *Interior gypsum at exterior walls shall be 5/8" Type X on resilient channel or 5/8" Type X on staggered stud wall assembly;*
    - *Ceiling gypsum shall be 5/8" type X or Type C;*
    - *Mechanical ventilation shall be installed in all residential uses to allow residents to keep doors and windows closed, as desired for acoustical isolation. PTAC's shall not be used for any unit requiring these acoustical upgrades.*
- As an alternative to the above-listed interior noise control measures, the applicant may provide a detailed analysis of interior noise control measures once full building plans become available. The analysis should be prepared by a qualified noise control engineer and shall outline the specific measures required to meet the City's 45 dB L_{dn}, interior noise level standards.

Appendix A: Acoustical Terminology

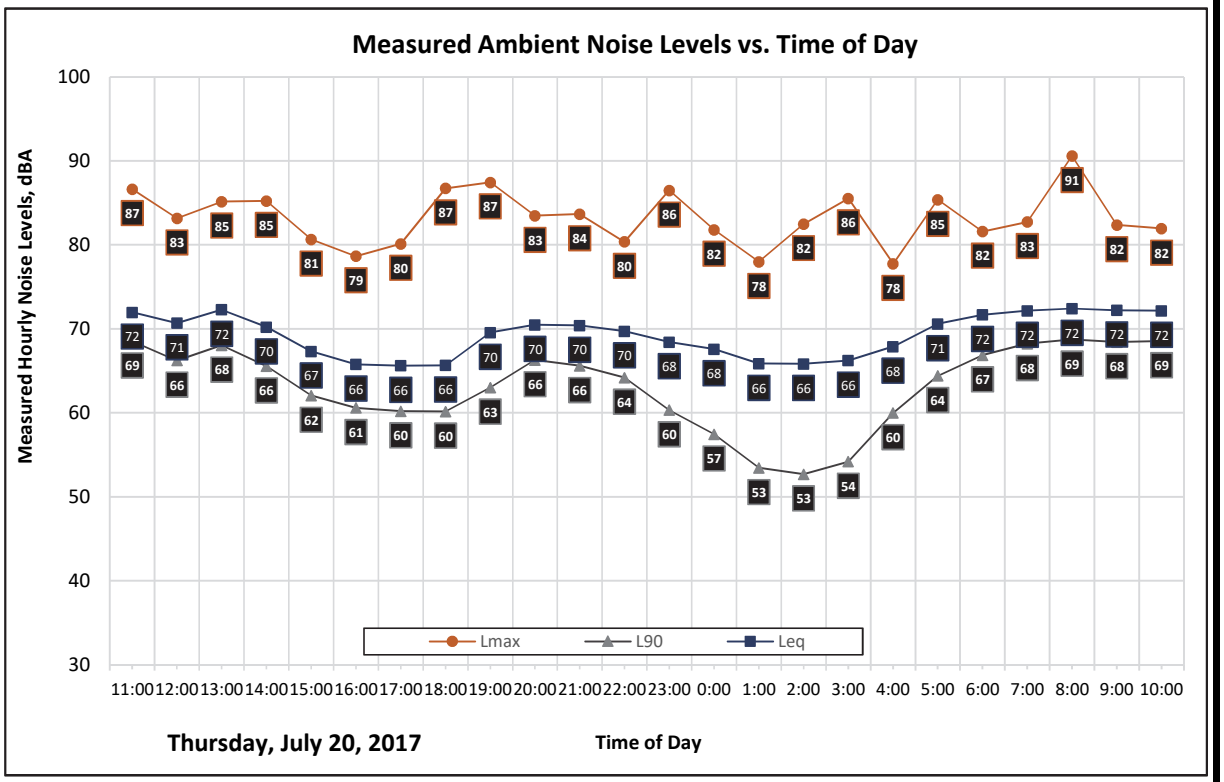
Acoustics	The science of sound.
Ambient Noise	The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.
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 +5 dBA and nighttime hours weighted by +10 dBA.
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.
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 s rating, in decibels, of a discrete event, such as an aircraft flyover or train passby, that compresses the total sound energy into a one-second event.
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.
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.

Appendix B1 : Continuous Noise Monitoring Results

Site: LT-1
Project: 170704 Plaza 2555 **Meter:** LDL 812-1
Location: 120' from I-80 centerline **Calibrator:** B&K 4230
Coordinates: 38.546° -121.724°

Date	Time	Measured Level, dBA			
		L_{eq}	L_{max}	L_{50}	L_{90}
Thursday, July 20, 2017	11:00	72	87	71	69
Thursday, July 20, 2017	12:00	71	83	70	66
Thursday, July 20, 2017	13:00	72	85	71	68
Thursday, July 20, 2017	14:00	70	85	69	66
Thursday, July 20, 2017	15:00	67	81	66	62
Thursday, July 20, 2017	16:00	66	79	64	61
Thursday, July 20, 2017	17:00	66	80	64	60
Thursday, July 20, 2017	18:00	66	87	64	60
Thursday, July 20, 2017	19:00	70	87	68	63
Thursday, July 20, 2017	20:00	70	83	70	66
Thursday, July 20, 2017	21:00	70	84	70	66
Thursday, July 20, 2017	22:00	70	80	69	64
Thursday, July 20, 2017	23:00	68	86	67	60
Friday, July 21, 2017	0:00	68	82	65	57
Friday, July 21, 2017	1:00	66	78	63	53
Friday, July 21, 2017	2:00	66	82	62	53
Friday, July 21, 2017	3:00	66	86	63	54
Friday, July 21, 2017	4:00	68	78	66	60
Friday, July 21, 2017	5:00	71	85	69	64
Friday, July 21, 2017	6:00	72	82	71	67
Friday, July 21, 2017	7:00	72	83	71	68
Friday, July 21, 2017	8:00	72	91	72	69
Friday, July 21, 2017	9:00	72	82	72	68
Friday, July 21, 2017	10:00	72	82	72	69

Statistics	Leq	Lmax	L50	L90
Day Average	71	84	69	65
Night Average	69	82	66	59
Day Low	66	79	64	60
Day High	72	91	72	69
Night Low	66	78	62	53
Night High	72	86	71	67
Ldn	75	Day %		72
CNEL	76	Night %		28

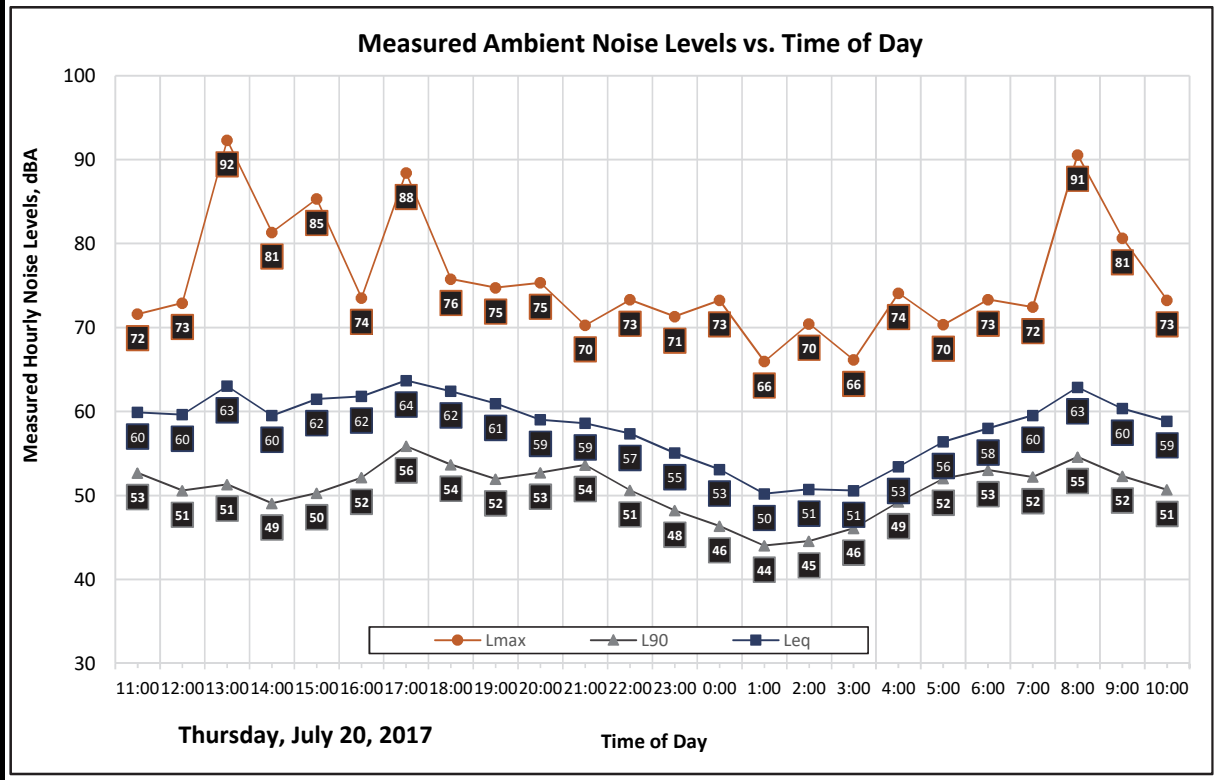


Appendix B2 : Continuous Noise Monitoring Results

Site: LT-2
Project: 170704 Plaza 2555 **Meter:** LDL 812-2
Location: 75' from Cowell Blvd. centerline **Calibrator:** B&K 4230
Coordinates: 38.545° -121.722°

Date	Time	Measured Level, dBA			
		L_{eq}	L_{max}	L_{50}	L_{90}
Thursday, July 20, 2017	11:00	60	72	58	53
Thursday, July 20, 2017	12:00	60	73	57	51
Thursday, July 20, 2017	13:00	63	92	57	51
Thursday, July 20, 2017	14:00	60	81	56	49
Thursday, July 20, 2017	15:00	62	85	59	50
Thursday, July 20, 2017	16:00	62	74	60	52
Thursday, July 20, 2017	17:00	64	88	62	56
Thursday, July 20, 2017	18:00	62	76	61	54
Thursday, July 20, 2017	19:00	61	75	58	52
Thursday, July 20, 2017	20:00	59	75	56	53
Thursday, July 20, 2017	21:00	59	70	56	54
Thursday, July 20, 2017	22:00	57	73	54	51
Thursday, July 20, 2017	23:00	55	71	51	48
Friday, July 21, 2017	0:00	53	73	49	46
Friday, July 21, 2017	1:00	50	66	46	44
Friday, July 21, 2017	2:00	51	70	47	45
Friday, July 21, 2017	3:00	51	66	49	46
Friday, July 21, 2017	4:00	53	74	52	49
Friday, July 21, 2017	5:00	56	70	54	52
Friday, July 21, 2017	6:00	58	73	55	53
Friday, July 21, 2017	7:00	60	72	56	52
Friday, July 21, 2017	8:00	63	91	59	55
Friday, July 21, 2017	9:00	60	81	57	52
Friday, July 21, 2017	10:00	59	73	56	51

Statistics	Leq	Lmax	L50	L90
Day Average	61	79	58	52
Night Average	55	71	51	48
Day Low	59	70	56	49
Day High	64	92	62	56
Night Low	50	66	46	44
Night High	58	74	55	53
Ldn	63	Day %		88
CNEL	63	Night %		12



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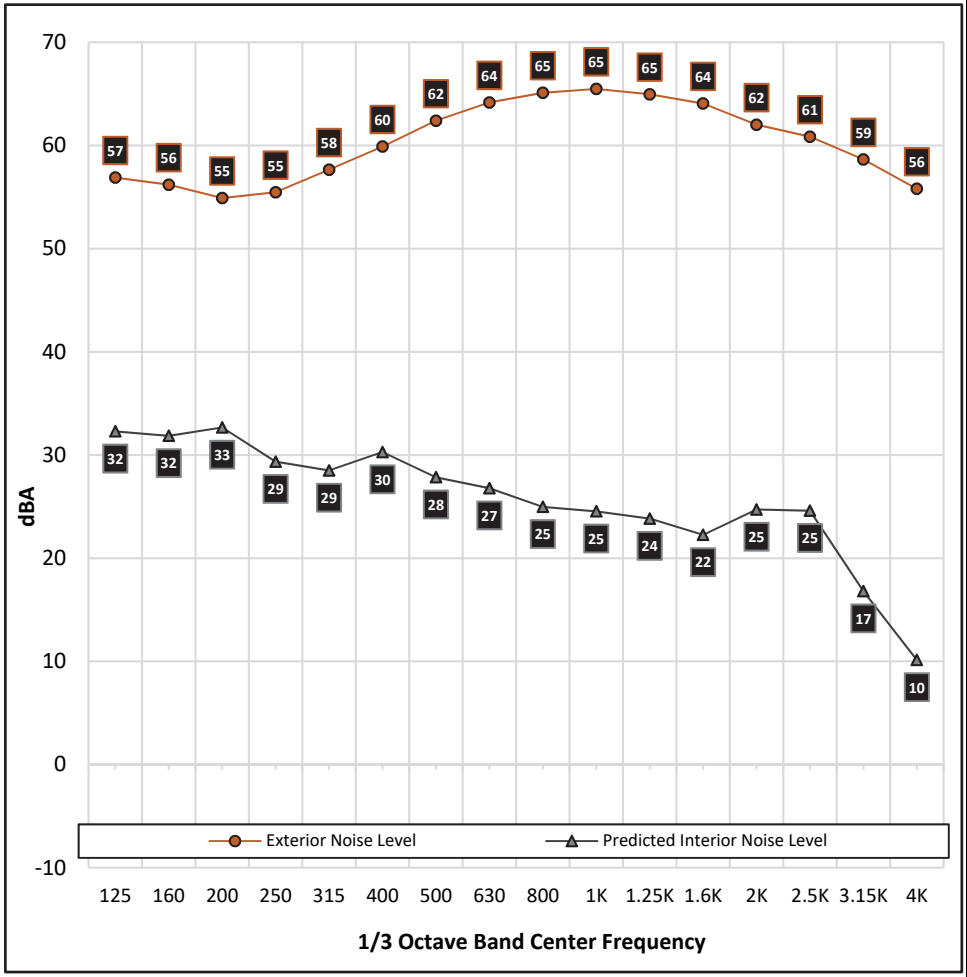
Appendix C1: Interior Noise Calculation Sheet

Project: Plaza 2555
Room Description: Typical Bedroom

Inputs	
Parallel Exterior level, dBA:	74
Correction Factor, dBA:	5
Noise Source:	Freeway Traffic - I80 Davis
Room Length, ft:	13
Room Width, ft:	11
Room Height, ft:	9
Transmitting Panel Length, ft:	25
Transmitting Panel Height, ft:	9
Ceiling Finish:	**Gyp Board**
Ceiling, sf:	143
Wall Finish 1:	**Gyp Board**
Wall Finish 1, sf:	392
Wall Finish 2:	**Glass**
Wall Finish 2, sf:	40
Floor:	**Carpet, latex backing on foam pad**
Floor, sf:	143
Misc. Finish:	**Soft Furnishings**
Misc. Finish, sf:	
Transmitting Element 1:	**Wall - 3-coat Stucco wall with RC**
Element 1, sf:	205
Transmitting Element 2:	**Window - Millgard 6340 Fixed STC 36**
Element 2, sf:	20
Transmitting Element 3:	
Element 3, sf:	
Transmitting Element 4:	
Element 4, sf:	

Predicted Interior Noise Level, dBA: 40



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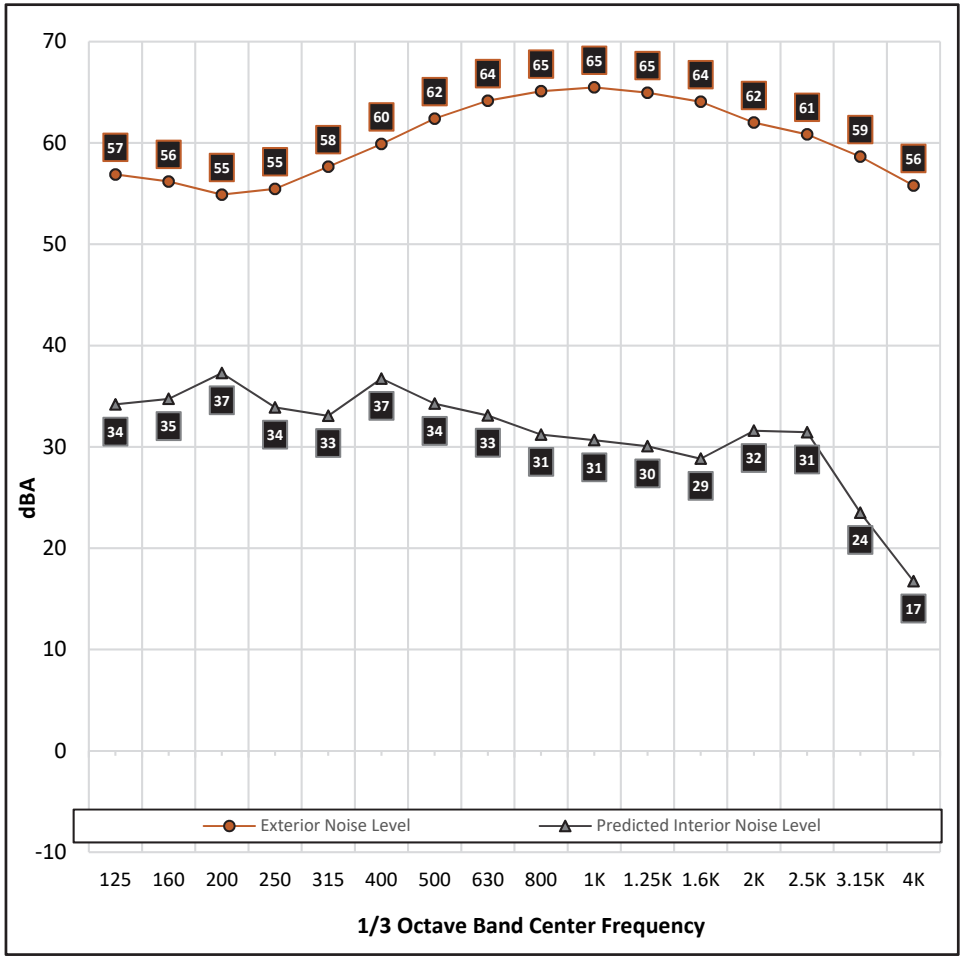
Appendix C2: Interior Noise Calculation Sheet

Project: Plaza 2555
Room Description: Typical Living Room

	Inputs
Parallel Exterior level, dBA:	74
Correction Factor, dBA:	5
Noise Source:	Freeway Traffic - I80 Davis
Room Length, ft:	17
Room Width, ft:	11
Room Height, ft:	9
Transmitting Panel Length, ft:	29
Transmitting Panel Height, ft:	9
Ceiling Finish:	**Gyp Board**
Ceiling, sf:	187
Wall Finish 1:	**Gyp Board**
Wall Finish 1, sf:	449
Wall Finish 2:	**Glass**
Wall Finish 2, sf:	55
Floor:	**Linoleum, rubber, or asphalt tile on concrete**
Floor, sf:	187
Misc. Finish:	**Soft Furnishings**
Misc. Finish, sf:	
Transmitting Element 1:	**Wall - 3-coat Stucco wall with RC**
Element 1, sf:	206
Transmitting Element 2:	**Window - Millgard 6340 Fixed STC 36**
Element 2, sf:	55
Transmitting Element 3:	
Element 3, sf:	
Transmitting Element 4:	
Element 4, sf:	



Predicted Interior Noise Level, dBA: 45

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