Environmental Noise Assessment

The Residence Inn Hotel at 2nd and Mace

Davis, California

BAC Job # 2016-095

Prepared For:

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Introduction

The proposed Residence Inn Hotel project is located at the southwestern quadrant of 2nd Street and Mace Boulevard, approximately 1,200 feet north of Interstate 80 and approximately 900 feet north of the Union Pacific Railroad (UPRR) line, in the City of Davis, California. The project consists of a 4-story, 120-room hotel and outdoor pool. The project area and site plan are shown in Figures 1 and 2, respectively.

Due to the project's exposure to potentially significant traffic noise from local roadway traffic and UPRR train activity, Bollard Acoustical Consultants, Inc. (BAC) was retained by the project applicant to prepare this noise study. Specifically, the purpose of this study is to quantify existing and future noise levels affecting the project site, and to compare those levels against the applicable City of Davis noise standards.

Noise Fundamentals and Terminology

Noise is often described as unwanted sound. Sound is defined as any pressure variation in air that the human ear can detect. 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 allows a million-fold increase in pressure to be expressed as 120 dB. Another useful aspect of the decibel scale is that changes in levels (dB) correspond closely to human perception of relative loudness. Appendix A contains definitions of Acoustical Terminology. Table 1 shows common noise levels associated with various sources.

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 weighing the frequency response of a sound level meter by means of the standardized A-weighing 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 in decibels.

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}) over a given time period (usually one hour). The L_{eq} is the foundation of the Day-Night Average Level noise descriptor, L_{dn}, and shows very good correlation with community response to noise.

Legend

Project Area

A — Location of Noise Measurements

N

Scale (feet)

0 300 600

Figure 1
Vicinity Map and Project Area
Residence Inn - Davis, California

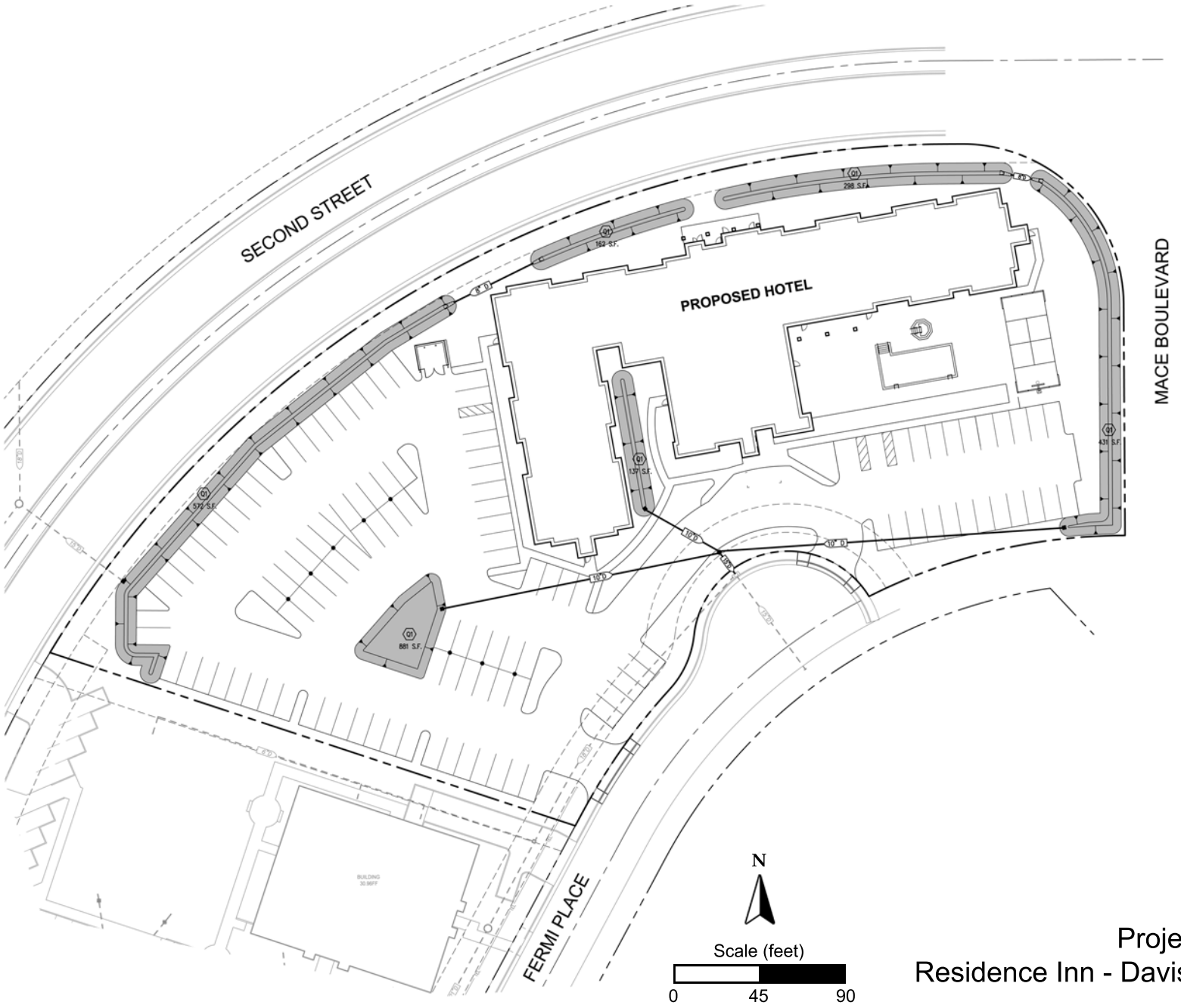
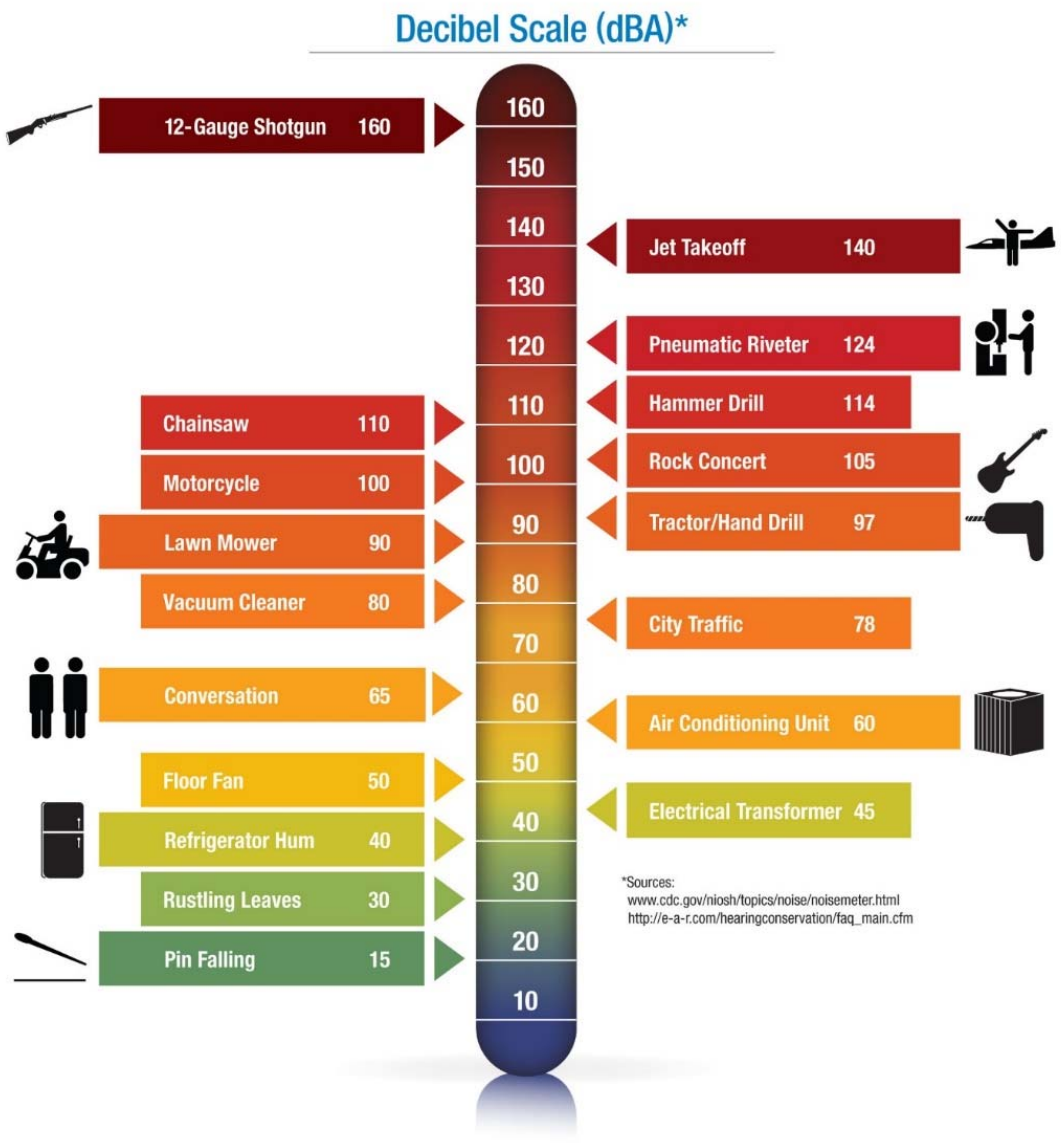


Figure 2
Project Site Plan
Residence Inn - Davis, California

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. L_{dn}-based noise standards are commonly used to assess noise impacts associated with traffic, railroad and aircraft noise sources.

Table 1
Typical A-Weighted Sound Levels of Common Noise Sources



Criteria for Acceptable Noise Exposure

The Noise Element of the City of Davis General Plan establishes a 60 dB L_{dn} exterior noise level criterion as normally acceptable for outdoor activity areas of new transient lodging uses affected by transportation noise sources. This standard is typically applied at common recreation areas (e.g., pool, spa).

The City also establishes an interior noise level criterion of 45 dB L_{dn} for new transient lodging construction. The intent of this interior noise level limit is to provide a suitable environment for indoor communication and sleep.

Existing Ambient Noise Environment

General Ambient Noise Levels at Project Site

To generally quantify the exiting ambient noise environment in the project vicinity, BAC conducted short-term and long-term noise level measurements at the project site. Figure 1 shows the noise measurement locations.

Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meters equipped with LDL ½" microphones were used for the noise level measurements. The meters were calibrated before use with an LDL Model 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 (precision) sound level meters (ANSI S1.4).

Detailed long-term measurement results are presented numerically and graphically in Appendices B and C, respectively. The Appendix C graph indicates that typical daytime noise levels averaged 55 dB L_{eq} and that the computed L_{dn} was 59 dB. Measured maximum noise levels at the project site ranged from 62 to 75 dB L_{max}. The long term measurement results indicate that the existing noise exposure at the project site is acceptable relative to the City's 60 dB Ldn noise standard for new transient lodging facilities, and that the ambient noise levels did not vary dramatically between the hours of 6 am and 9 pm.

The purpose of the short-term noise level measurement was to determine the differences in noise levels at upper floor locations relative to ground floor locations. Typically, elevated locations experience higher noise levels due to reduced ground absorption and shielding by intervening structures or topography. The results of the short-term measurements conducted at various heights above ground are shown below in Table 2.

Table 2
Short-Term Noise Measurement Results
Residence Inn – Davis, California

Site	Microphone Height	Distance to I-80 Centerline	Measured Average Noise Level (L_{eq}, dB)
A	5 feet – 1st Floor	1,200 feet	53
	15 feet – 2nd Floor		56
	25 feet – 3rd Floor		59

Note: See Figure 1 for noise measurement location.

As shown in Table 2, noise level measured 25 feet above ground were found to be 6 dB higher than measured ground floor noise measurements. This information is used later in this report to evaluate interior noise exposure within upper floor guest rooms of the proposed hotel.

Existing Railroad Noise Environment at Project Site

As noted previously, the project site is located approximately 900 feet north of the Union Pacific Railroad (UPRR) tracks adjacent to Interstate 80. Because of the grade-separated crossing of Mace Boulevard above the railroad tracks, trains are not required to sound their horns as they pass Mace Boulevard. As a result, the peak noise level commonly encountered during railroad passbys are not present at the project site.

As shown in Appendices B and C, measured maximum noise levels were fairly consistently between 65 and 75 dB Lmax, with little variation from hour to hour. This indicates that the measured maximum noise levels at the project site were caused by local traffic on Mace Boulevard and 2nd street, and that railroad operations do not contribute significantly to the ambient noise environment at the project site.

Evaluation of Future Noise Environment

Future Exterior Noise Environment

Increased future traffic volumes on the local roadway network resulting from growth in the region will cause future traffic noise levels to increase over time. Based on the conservative assumption that future traffic in the local area would increase by approximately 60% over existing levels, future ambient noise levels at the project site would increase by an estimated 2 dB.

Future Noise Exposure at Outdoor Pool Area

Given the measured existing level of 59 dB L_{dn} (as shown in Appendices B and C), the future noise level at the project site would be 61 dB L_{dn}. However, construction of the hotel would provide shielding from 2nd Street traffic and noise generated by commercial uses to the north and west. As a result, the future noise level at the proposed outdoor activity area (pool) is expected to be satisfactory relative to the City of Davis 60 dB L_{dn} exterior standard.

Future Noise Exposure within Hotel Guest Rooms

To predict future noise levels at upper-floor building facades of the proposed hotel, an offset of +3 dB per floor was applied to the predicted ground-floor level of 61 dB L_{dn}. The predicted future exterior noise levels at the building facades of the proposed hotel are shown below in Table 3.

Table 3
Existing and Predicted Future Noise Levels
Residence Inn – Davis, California

Location	Existing Noise, L_{dn}	Future Noise, L_{dn}
1st-Floor Building Facade	59	61
2nd-Floor Building Facade	62	64
3rd-Floor Building Facade	65	67
4th-Floor Building Facade	(68)	70

As indicated in Table 3, the future traffic noise exposure is predicted to range from 61-70 dB L_{dn} at the proposed building facades of the hotel. Given this range of exterior noise levels, building-façade noise reductions ranging from 16-25 dB would be required to ensure compliance with the City of Davis 45 dB L_{dn} interior noise standard.

Standard hotel construction (exterior stucco siding, insulated walls, dual-pane thermal windows STC 27-28) typically provides a minimum 25 dB of exterior to interior noise reduction. As a result, interior noise levels within the proposed hotel are not predicted to exceed the City of Davis standard. Nonetheless, BAC recommends upgrading all 3rd and 4th-floor windows with a view of Interstate 80 to a Sound Transmission Class (STC) rating of 32 to provide a wider margin of safety. It should be noted that hotel brand standards typically apply more restrictive interior noise standards than those applied by the City of Davis. While the recommendations provided above would ensure compliance with the City's 45 dB Ldn interior noise level standard, they are not intended to ensure compliance with any brand standards which may be applicable to this hotel use.

Conclusions and Recommendations

This noise study for the proposed Residence Inn Hotel project in Davis, California concludes that future exterior noise levels at the proposed outdoor activity area (pool) are predicted to be satisfactory relative to the City of Davis exterior transportation noise standard. Additionally, interior noise levels are predicted to comply with the City of Davis interior standard with standard construction practices. Nonetheless, the following mitigation measure is recommended to provide an additional margin of safety relative to the City's 45 dB L_{dn} interior noise level standard:

1. All 3rd and 4th-floor guestroom windows with a view of Interstate 80 be upgraded to an STC rating of 32.

This concludes BAC's assessment of noise levels at the proposed Residence Inn Hotel project in Davis, California. Please contact BAC at (916) 663-0500 or paulb@bacnoise.com with any questions or requests for additional information.

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.

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.

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.

Sabin The unit of sound absorption. One square foot of material absorbing 100% of incident sound has an absorption of 1 sabin.

SEL A rating, in decibels, of a discrete event, such as an aircraft flyover or train passby, that compresses the total sound energy of the event into a 1-s time period.

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.

Appendix B
Ambient Noise Monitoring Results - Site A
Residence Inn Hotel - Davis, California
May 19-20, 2016

Hour	Leq	Lmax	L50	L90
12:00	56	65	55	53
13:00	55	75	54	51
14:00	56	69	55	52
15:00	56	71	54	52
16:00	55	73	54	52
17:00	56	68	55	53
18:00	56	65	55	53
19:00	56	73	55	53
20:00	55	68	54	51
21:00	54	63	53	51
22:00	54	69	52	49
23:00	54	70	51	48
0:00	52	68	48	46
1:00	49	69	46	44
2:00	49	65	46	43
3:00	49	66	44	42
4:00	49	62	47	44
5:00	51	68	49	46
6:00	54	70	53	50
7:00	54	65	54	51
8:00	56	71	55	52
9:00	54	70	53	49
10:00	57	69	56	53
11:00	56	72	55	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)	57	54	55	54	49	52
Lmax (Maximum)	75	63	69	70	62	67
L50 (Median)	56	53	54	53	44	48
L90 (Background)	53	49	52	50	42	46

Computed Ldn, dB	59
% Daytime Energy	80%
% Nighttime Energy	20%

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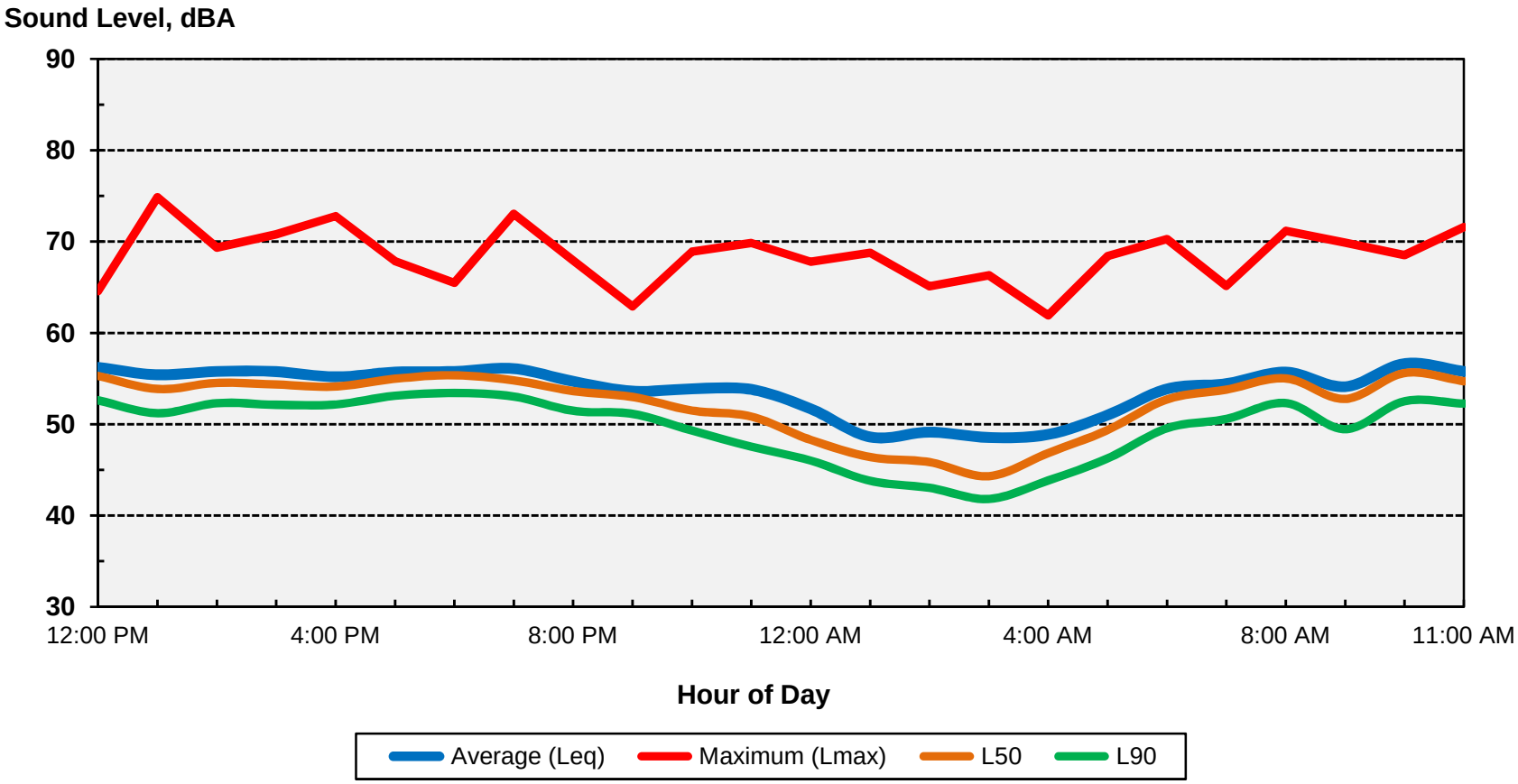
Appendix C
Ambient Noise Monitoring Results - Site A
Residence Inn Hotel - Davis, California
May 19-20, 2016



Ldn: 59 dB

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