Environmental Noise Assessment

West Oaks Townhomes

Rocklin, California

BAC Job # 2017-224

Prepared For:

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Introduction

The West Oaks Townhomes is a proposed single-family residential development located along West Oaks Boulevard in the City of Rocklin (APN 365-020-030). The project consists of 20-single-family rowhouse style units of approximately 2,100 square feet. Figures 1 and 2 show the project area the site plan, respectively.

The project developer (Brentwood Development), has retained Bollard Acoustical Consultants, Inc. (BAC) to prepare a noise assessment for this project. This analysis focuses on future exterior and interior traffic noise levels at the proposed residences, off-site traffic noise generation, athletic field noise generation at the proposed residences, and construction activity noise generation. Where the City of Rocklin noise level standards are predicted to be exceeded by any of these noise sources, this analysis recommends appropriate noise mitigation measures.

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. If the pressure variations occur frequently enough (at least 20 times per second), they can be heard, and thus are called sound. 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. Figure 3 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

1 Long-Term Noise Level Measurement Location

Project Border (Approximate)

N

Scale (feet)

0 50 100

West Oaks Townhomes

Rocklin, California

Project Area

Figure 1

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Legend

N

Scale (feet)

0 25 50

West Oaks Townhomes

Rocklin, California

Project Site Plan

Figure 2

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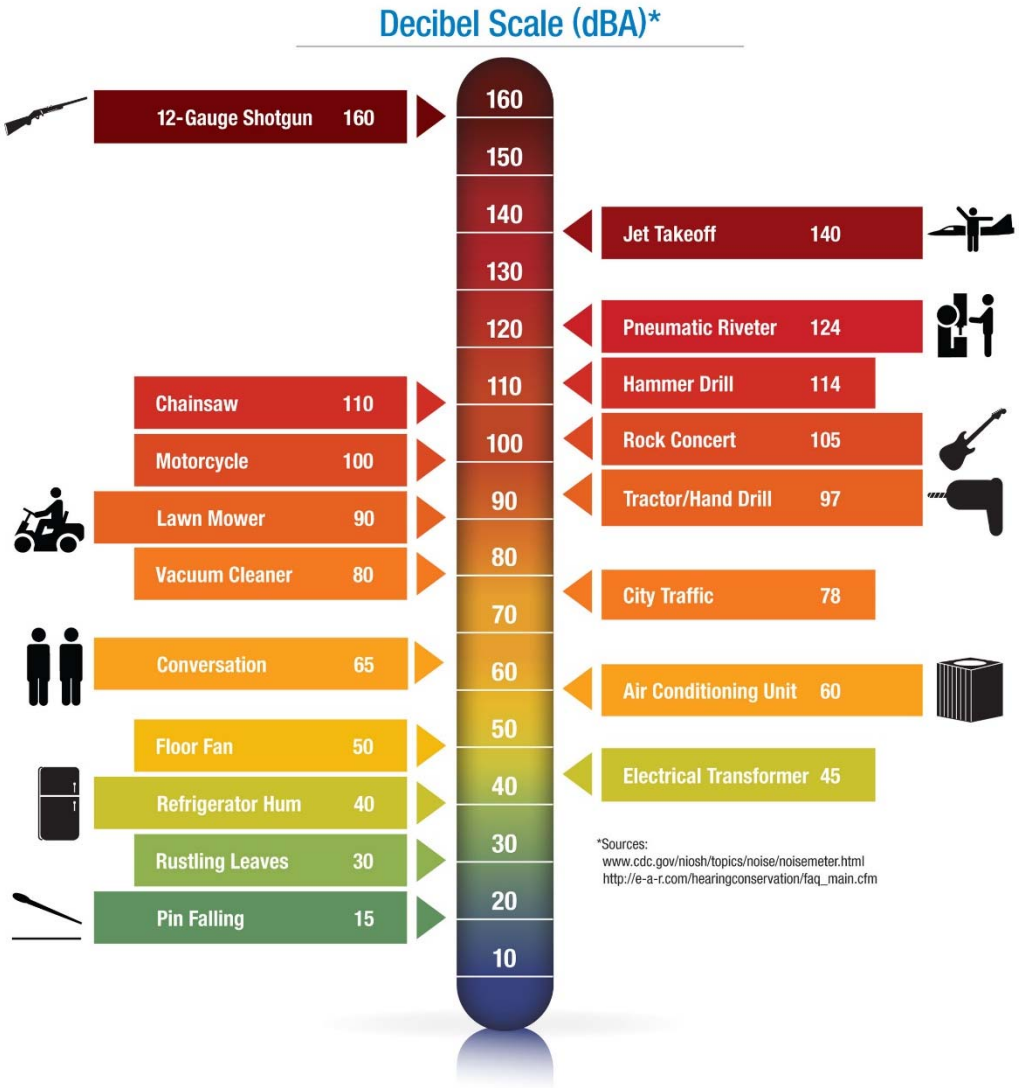
The Day-Night Average Level (L_{dn}) is based upon the average noise level over a 24-hour day, with a +10 decibel weighing applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as 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.

Figure 3
Noise Levels Associated with Common Noise Sources



Criteria for Acceptable Noise Exposure

Transportation Noise Sources

The City of Rocklin General Plan Noise Element applies an exterior noise level standard of 60 dB L_{dn} at outdoor activity areas of residential land uses exposed to transportation noise sources (i.e., traffic). The intent of this standard is to provide an acceptable exterior noise environment for outdoor activities. Where it is not possible to reduce noise in outdoor activity areas to 60 dB L_{dn} through a practical application of the best available noise-reduction means, an exterior noise environment of up to 65 dB L_{dn} may be allowed. For single-family residential uses, these limits are normally applied at backyard areas. However, for this project, the exterior noise level standard was applied at the proposed rooftop deck spaces.

The City of Rocklin utilizes an interior noise level standard of 45 dB L_{dn} or less within noise-sensitive project dwellings. The intent of this interior noise limit is to provide a suitable environment for indoor communication and sleep.

Non-Transportation Noise

The City of Rocklin General Plan Noise Element establishes acceptable noise level criteria for non-transportation noise sources (i.e., athletic field activity). Table 1 provides the City's noise level performance criteria which would be applicable to this project. These criteria are applied at the property line of the proposed project.

Table 1
Applicable Noise Level Performance Standards
Residential Areas Affected By Non-Transportation Noise Sources
Rocklin Noise Element of the General Plan

Noise Level Descriptor	Daytime (7 a.m. – 10 p.m.)	Nighttime (10 p.m. – 7 a.m.)
Hourly L_{eq}	55	45

Source: City of Rocklin General Plan Noise Element, Table 2-1

Existing Ambient Noise Environment at the Project Site

The existing ambient noise environment at the project site is primarily defined by traffic on West Oaks Boulevard, and to a lesser extent by activities at the adjacent athletic fields to the west. To generally quantify existing noise levels at the project site, BAC conducted long-term (24-hour) noise level measurements just west of the project site from December 21 to December 22, 2017. The ambient noise level measurement location, identified as Site 1 on Figure 1, was selected to quantify existing traffic noise exposure from West Oaks Boulevard. The monitoring location maintained a setback of approximately 60 feet from the centerline of West Oaks Boulevard, similar to the setback being proposed for the project residences.

A Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meter was used to conduct the noise level survey. The meter was 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 sound level meters (ANSI S1.4). The results of the measurements are shown numerically and graphically in Appendices B and C, and are summarized in Table 2.

Table 2
Summary of Long-Term Ambient Noise Monitoring Results[1]
West Oaks Townhomes – Rocklin, California

Date	L_{dn}, dB	Average Measured Hourly Noise Levels (dB)					
		Daytime (7 a.m. to 10 p.m.)			Nighttime (10 p.m. to 7 a.m.)		
		L_{eq}	L_{50}	L_{max}	L_{eq}	L_{50}	L_{max}
Site 1 – Approximately 60 feet from centerline of West Oaks Boulevard							
December 21-22, 2017	63	62	55	76	55	49	74

Notes:
[1] Long-term ambient noise monitoring location is identified on Figure 1.
Source: Bollard Acoustical Consultants, Inc. (2018)

As shown in Table 2, measured ambient day-night average noise levels at Site 1 exceeded the City of Rocklin 60 dB L_{dn} exterior traffic noise level standard for residential land uses. As a result, a detailed analysis of future traffic noise levels was conducted and that analysis is presented in the following section.

Evaluation of Future Traffic Noise Levels at the Project Site

Traffic Noise Prediction Methodology

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

Traffic Noise Prediction Model Calibration

According to traffic volume data obtained from the City of Rocklin General Plan Update Draft Environmental Impact Report (August 2011), the segment of West Oaks Boulevard adjacent to the project site experiences an average daily traffic (ADT) volume of 3,000 vehicles. Assuming vehicle speeds of 45 MPH, medium- and heavy-truck mix of 2%/2%, and an existing volume of 3,000, the FHWA Model predicts a roadway noise level of 61 dB L_{dn} at a distance of 60 feet from the centerline of West Oaks Boulevard. However, the traffic noise level measurement results

presented in Table 2, conducted 60 feet from the centerline of West Oaks Boulevard, indicate existing traffic noise levels were 63 dB L_{dn}. The difference in noise levels represents an under-prediction by the FHWA Model of 2 dB. As a result, a calibration offset of +2 dB was applied to the FHWA Model in order to provide a conservative assessment of future traffic noise levels at the project site.

Predicted Future Exterior Traffic Noise Levels

The FHWA Model was used with future traffic data to predict future traffic noise levels at the proposed outdoor activity areas of the development. Future average daily traffic was obtained from the City of Rocklin General Plan Update Draft Environmental Impact Report (August 2011). The FHWA Model inputs and predicted future traffic noise levels at the project site are shown in Appendix D. The predicted future traffic noise levels at the project lots are summarized below in Table 3. The predicted future traffic noise levels at the elevated rooftop decks take into consideration the shielding provided by the proposed rooftop parapets. Barrier insertion loss calculations for the rooftop parapets are provided in Appendix E. An illustration of the proposed rooftop decks is provided in Appendix F.

Table 3
Predicted Future Exterior Traffic Noise Levels[1]
West Oaks Townhomes – Rocklin, California

Location	Distance to Roadway Centerline (feet)[2]	Predicted Exterior Noise Level, L_{dn} (dB)[3,4,5]
Lots 1-6: 1st floor facades	60	65
Lots 1-6: 2nd and 3rd floor facades	60	68
Lots 1-6: Rooftop decks	70	57

Notes:

1 Detailed FHWA Model inputs and results are provided in Appendix D.

2 Distances were scaled from the centerline of West Oaks Boulevard to the nearest outdoor activity areas and building facades.

3 A +2 dB model calibration offset was applied to predicted noise levels.

4 A +3 dB offset was applied to the upper floor facades due to reduced ground absorption of sound at elevated floor levels.

5 Predicted future traffic noise levels at the rooftop decks take into consideration the proposed rooftop parapet, providing screening of traffic noise. Barrier insertion calculations for the rooftop parapet are provided in Appendix E.

Source: Bollard Acoustical Consultants, Inc. (2018)

The Table 3 data indicate that future traffic noise levels at the proposed outdoor activity areas of the development are predicted to be 57 dB L_{dn} and would satisfy the City of Rocklin 60 dB L_{dn} exterior noise level standard. Therefore, no further consideration of noise mitigation measures would be warranted for this aspect of the project.

At the nearest proposed building facades (Lots 1-6) the Table 3 data indicate that predicted future traffic noise exposure would be approximately 65-68 dB L_{dn}. This information is used in the following section of this report to assess compliance with the City's interior traffic noise level standard.

Predicted Future Interior Traffic Noise Levels

The worst-case exposure of any residence in the West Oaks Townhome development to future traffic noise would occur at the residences directly adjacent to West Oaks Boulevard. The predicted future L_{dn} at the first-floor facades of these residences would be approximately 65 dB. Due to reduced ground absorption of sound at elevated locations, traffic noise levels are expected to be approximately 3 dB higher at upper-floor facades (68 dB L_{dn}). Given a future worst-case exterior noise level of 68 dB L_{dn}, a building facade noise reduction of 23 dB would be required to achieve an interior noise level of 45 dB L_{dn}.

Standard residential construction (wood siding, STC-27 windows, door weather-stripping, exterior wall insulation, composition plywood roof), results in an exterior to interior noise reduction of at least 25 dB with windows closed and approximately 15 dB with windows open. Therefore, standard construction would be acceptable for both first-floor and upper-floor building facades without the requirement for acoustic upgrades to either windows or exterior wall construction. Air conditioning should be provided, however, to allow the occupants to close doors and windows as desired for additional acoustical isolation.

Evaluation of Off-Site Traffic Noise Level Increases

To assess noise impacts due to project-related traffic increases on the local roadway network, BAC utilized Institute of Transportation Engineers (ITE) trip generation rates in conjunction with the measured existing traffic noise exposure on West Oaks Boulevard. According to ITE, a single-family residential unit generates approximately 10 trips per day. Assuming the 20 proposed residential units generate 10 trips per day, the project would result in an additional 200 vehicle trips on West Oaks Boulevard during an annual average day. Assuming a vehicle speed of 45 mph, 200 vehicle trips, and a distance of 60 feet from the centerline of West Oaks Boulevard, the predicted traffic noise level from the project alone would be 48 dB L_{dn}. As mentioned previously, existing West Oaks Boulevard traffic noise levels were measured to be 63 dB L_{dn}. As a result, the additional trips would result in a traffic noise level of increase of 0.1 dB L_{dn}. Therefore, no significant noise impacts due to project-generated traffic are identified for this project.

Evaluation of Athletic Field Noise Generation at Proposed Residences

The Kathy Lund Community Park is located immediately adjacent and west of the project site. As indicated on Figure 1, the nearest park use to the project is a softball field. Noise sources associated with softball games consists of occasional shouting and cheering of the participants and observers during the contests and practices. BAC file data collected at various softball venues indicate that average noise levels generated during games are approximately 60 dB L_{eq} a distance of 100 feet from the focal point or effective noise center of the playing fields. The focal point tends to be in the vicinity of the pitcher's mound, with the participants and spectators all centrally located around and generally facing that position. To provide a simplified but realistic representation of the noise generation of a typical game, this analysis assumed that the cumulative noise generation of the softball field is centered near the pitcher's mound.

The pitcher's mound is located approximately 220 feet from the project property line. At this distance noise levels associated with activities at the softball field are predicted to be approximately 53 dB L_{eq}. In addition, at the rooftop decks, where the sensitivity to noise exists, predicted softball field noise would be further reduced by the proposed rooftop parapets. Because park activity would be limited to daytime hours, the noise level standard applicable to softball field noise would be 55 dB L_{eq} (Table 1). Predicted softball field noise levels of 53 dB L_{eq} would satisfy the city's daytime noise level standard of 55 dB L_{eq}. As a result, no further consideration of noise mitigation measures would be warranted for this aspect of the project.

Evaluation of Construction Noise at Nearest Existing Residences

During project construction, heavy equipment would be used for grading excavation, paving, and building construction, which would increase ambient noise levels when in use. Noise levels would vary depending on the type of equipment used, how it is operated, and how well it is maintained. Noise exposure at any single point outside the project site would also vary depending on the proximity of construction activities to that point. Standard construction equipment, such as graders, backhoes, loaders, and trucks, would likely be used for this work.

The range of maximum noise levels for various types of construction equipment at a distance of 50 feet is depicted in Table 4. The noise values represent maximum noise generation, or full-power operation of the equipment. As one increases the distance between equipment, or increases separation of areas with simultaneous construction activity, dispersion and distance attenuation reduce the effects of combining separate noise sources.

Table 4
Construction Equipment Noise Emission Levels

Equipment	Typical Sound Level (dBA) 50 Feet from Source
Air compressor	81
Backhoe	80
Compactor	82
Concrete mixer	85
Concrete pump	82
Concrete vibrator	76
Crane, mobile	83
Dozer	85
Generator	81
Grader	85
Impact wrench	85
Jackhammer	88
Loader	85
Paver	89
Pneumatic tool	85
Pump	76
Roller	74
Saw	76

Source: Transit Noise and Vibration Impact Assessment, Federal Transit Administration, Table 12-1. (May 2006)

The nearest sensitive receptors to the proposed project are single-family residences located immediately south of the project site. The nearest sensitive land uses are located at least 400 feet from construction activities which would occur on the project site. As shown in Table 4, construction activities typically generate noise levels ranging from approximately 75 to 90 dB L_{max} at a reference distance of 50 feet from the construction activities. The noise levels from construction operations decrease at a rate of approximately 6 dB per doubling of distance from the source. As a result, maximum construction noise levels would range from 57 to 72 dB L_{max} at the nearest existing residences. In addition, typical residential construction provides a noise level reduction of approximately 25 dBA with the windows closed, which would reduce the maximum noise levels within residences to approximately 32 to 47 dB L_{max}.

Noise generated by project construction could exceed the City's standards for short duration events near residential areas, but such noise would be short-term in duration and would not likely substantially exceed existing ambient noise levels cause by local traffic. Nonetheless, the following construction noise mitigation measures should be utilized to the extent practical to minimize the potential for adverse public reaction to project construction noise:

- Project construction activities should be limited to daytime hours unless conditions warrant that certain construction activities occur during evening or early morning hours (i.e. extreme heat).
- All noise-producing project equipment and vehicles using internal-combustion engines shall be equipped with manufacturers-recommended mufflers and be maintained in good working condition.
- All mobile or fixed noise-producing equipment used on the project site that are regulated for noise output by a federal, state, or local agency shall comply with such regulations while in the course of project activity.
- Electrically powered equipment shall be used instead of pneumatic or internal-combustion-powered equipment, where feasible.
- Material stockpiles and mobile equipment staging, parking, and maintenance areas shall be located as far as practicable from noise-sensitive receptors.
- Construction site and access road speed limits shall be established and enforced during the construction period.

Conclusions and Recommendations

The preceding analysis focused on exterior and interior traffic noise levels at the proposed residences, off-site traffic noise generation, athletic field noise generation, and construction activity noise generation. In order to ensure compliance with the City of Rocklin General Plan noise level standards, the following activity-specific mitigation measures are recommended:

Residential Lots:

1) Mechanical ventilation (air conditioning) should be provided for all residences in this development to allow the occupants to close doors and windows as desired to achieve compliance with the applicable interior noise level criteria.

Project Construction:

1) All construction activities must adhere to the City's requirements with respect to hours of construction.

2) Construction equipment must have appropriate sound muffling devices, which shall be properly maintained and used at all times such equipment is in operation.

3) The construction contractor shall locate on-site equipment staging areas so as to maximize the distance between construction-related noise sources and noise-sensitive receptors nearest the project construction areas.

These conclusions are based on the collected noise level data at the project site, the site plan shown on Figure 2, and on noise reduction data for standard residential dwellings and for typical STC rated window data. Deviations from the project site plan shown on Figure 2, could cause future traffic noise levels to differ from those predicted in this analysis. In addition, Bollard Acoustical Consultants, Inc. is not responsible for degradation in acoustic performance of the building construction due to poor construction practices, failure to comply with applicable building code requirements, or for failure to adhere to the minimum building practices cited in this report.

This concludes BAC's noise assessment for the proposed West Oaks Townhomes in Rocklin, California. Please contact BAC at (916) 663-0500 or paulb@bacnoise.com with any questions regarding this assessment.

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
West Oaks Townhomes - Rocklin, California
Ambient Noise Monitoring Results
December 21-22, 2017

Hour	Leq	Lmax	L50	L90
15:00	66	80	59	48
16:00	63	84	58	48
17:00	63	76	59	50
18:00	61	73	56	51
19:00	60	75	53	50
20:00	59	75	52	49
21:00	59	76	52	49
22:00	58	74	51	49
23:00	56	72	50	47
0:00	54	72	48	46
1:00	52	75	47	45
2:00	51	71	46	44
3:00	52	74	47	44
4:00	53	76	47	45
5:00	55	73	49	47
6:00	58	75	52	49
7:00	62	75	58	53
8:00	62	74	56	51
9:00	60	73	52	44
10:00	61	76	52	44
11:00	61	77	53	45
12:00	62	76	56	47
13:00	62	74	57	47
14:00	62	75	57	49

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	66	59	62	58	51	55
Lmax (Maximum)	84	73	76	76	71	74
L50 (Median)	59	52	55	52	46	49
L90 (Background)	53	44	48	49	44	46

Computed Ldn, dB	63
% Daytime Energy	89%
% Nighttime Energy	11%

Notes: Measurement site maintained a setback of approximately 60 feet from the centerline of West Oaks Boulevard.

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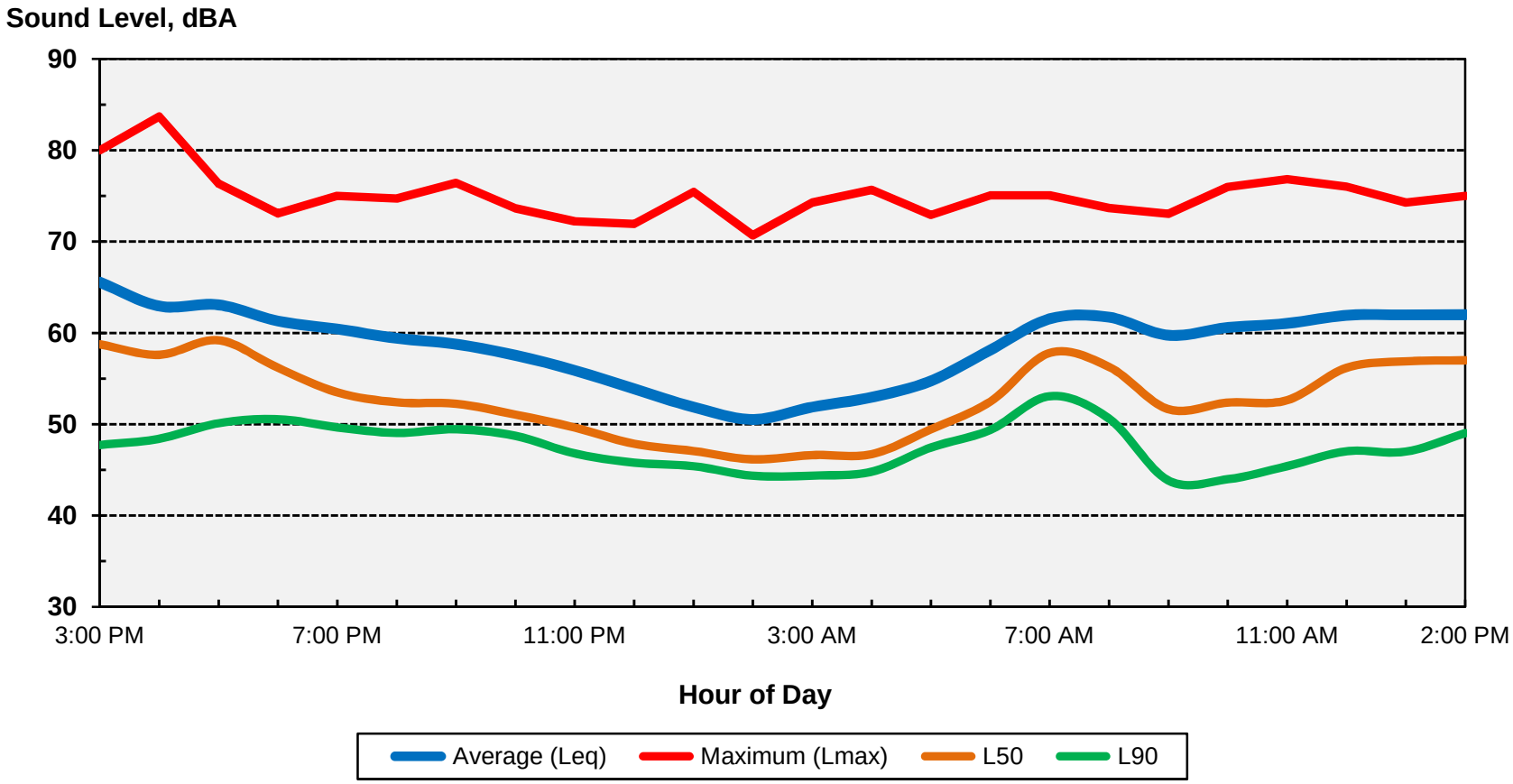
Appendix C
West Oaks Townhomes - Rocklin, California
Ambient Noise Monitoring Results
December 21-22, 2017



Ldn: 63 dB

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Appendix D

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

Project Information:

Job Number: 2017-224
Project Name: West Oaks Townhomes
Roadway Name: West Oaks Boulevard

Traffic Data:

Year:	Future
Average Daily Traffic Volume[1]:	5,000
Percent Daytime Traffic:	89
Percent Nighttime Traffic:	11
Percent Medium Trucks (2 axle):	2
Percent Heavy Trucks (3+ axle):	2
Assumed Vehicle Speed (mph):	45
Intervening Ground Type (hard/soft):	**Soft**

Traffic Noise Levels:

				----------L_{dn}, dB----------			
Lot	Description	Distance	Offset (dB)[2]	Autos	Medium Trucks	Heavy Trucks	Total
1	Lots 1-6: 1st floor facades	60	2	63	54	59	65
2	Lots 1-6: upper floor facades	60	5	66	57	62	68
3	Lots 1-6 rooftop decks	70	5	65	56	61	67

Traffic Noise Contours (No Calibration Offset):

L_{dn} Contour, dB	Distance from Centerline, (ft)
75	9
70	20
65	43
60	93

Notes: 1. Future Average Daily Traffic Volume obtained from the City of Rocklin General Plan Update DEIR (August 2011).
2. FHWA model calibration offset of +2 dB was applied to account for measured existing noise levels relative to predicted traffic noise levels (with ADT of 3,000). A +3 dB offset was applied to the elevated floor facades due to reduced ground absorption of sound at elevated positions.