Environmental Noise Assessment

Dollar General Store - Alta Sierra

Nevada County California

Job # 2015-128

Prepared For:

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INTRODUCTION

This report describes the existing noise environment in the area of the proposed Dollar General Store project in the Alta Sierra portion of Nevada County, California. This analysis will evaluate the potential of the proposed project to generate noise levels exceeding the applicable Nevada County exterior noise level standards at existing noise-sensitive receptors.

The proposed project is located at 10166 Alta Sierra Drive, and proposes the construction of a 9,100 square-foot Dollar General Store. Adjacent land uses include commercial buildings to the north and south, a vacant property to west and across Alta Sierra Drive, and residential to the east and across Little Valley Road.

Parking lot, truck deliveries and rooftop HVAC unit operations will be evaluated to determine if noise levels will exceed the Nevada County exterior noise level standards for non-transportation noise sources. Therefore, this analysis will assess the potential noise generation from non-transportation fixed noise sources on the project site. Predicted noise levels will be compared to the noise level standards of the Nevada County General Plan Noise Element and Zoning Ordinance. If necessary, noise control measures will be recommended for the proposed project.

Figure 1 shows the project site plan.

ENVIRONMENTAL SETTING

BACKGROUND INFORMATION ON NOISE

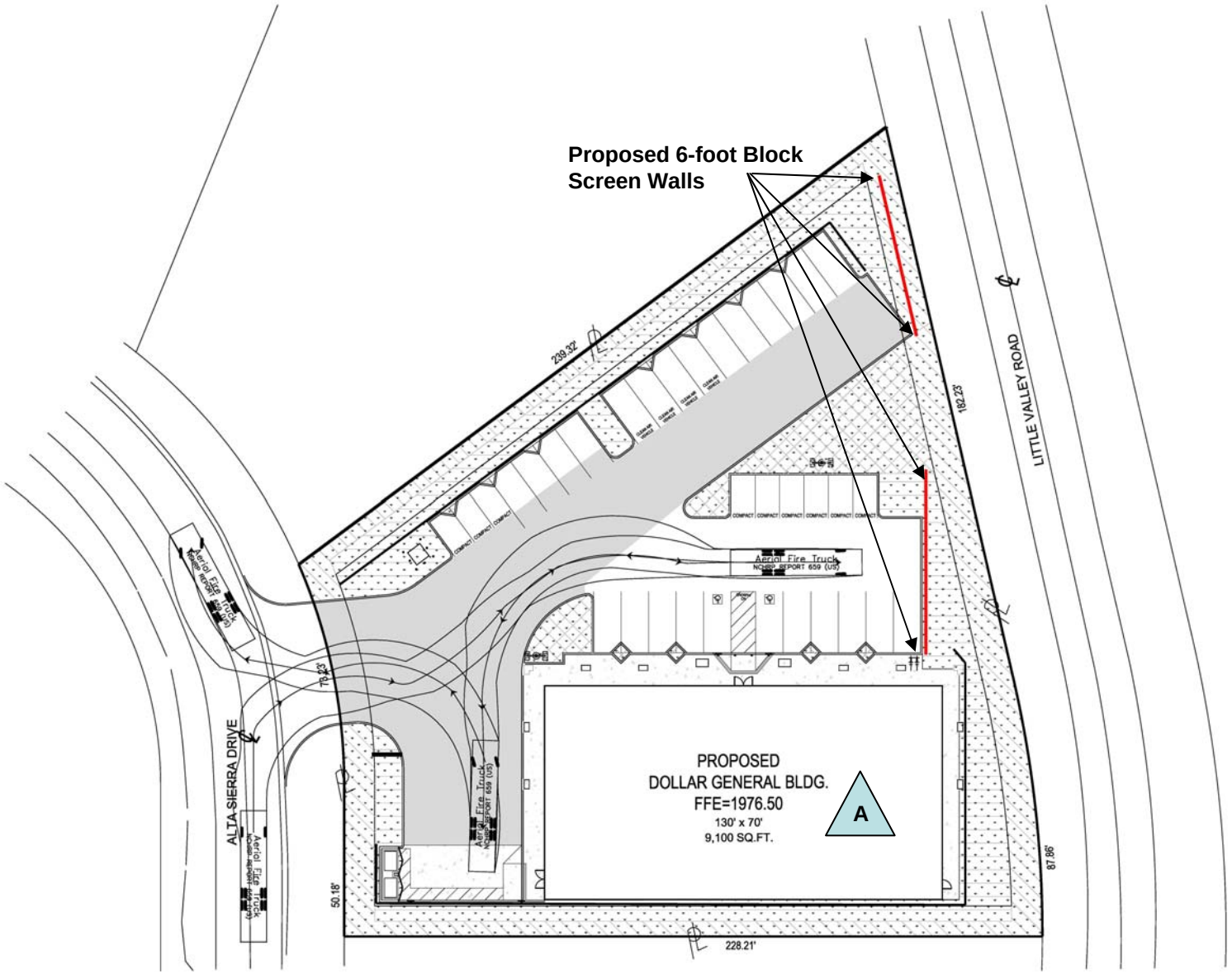
Fundamentals of Acoustics

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.

Figure 1
Dollar General – Alta Sierra



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Continuous 24-hour Noise Monitoring Site

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

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.

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.

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. November 2009		

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 Conditions

The existing noise environment in the project area is defined primarily by traffic on Alta Sierra Drive and Little Valley Road. In addition, some activities associated with the commercial development adjacent to the site also contributes to the noise environment.

Existing Ambient Noise Levels

To quantify the existing ambient noise environment in the project vicinity, a short term noise level measurement was conducted on March 18-19, 2015. The noise measurement location is shown on Figure 1. The noise level measurement survey results are provided in Table 2.

The sound level meter was programmed to record the maximum 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.

A Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meter was used for the ambient noise level measurement survey. The meter was calibrated before and after 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).

Table 2
Summary of Measured Ambient Noise Levels
Alta Sierra Dollar General Store Site
March 18-19, 2015

Site	Measured Ldn	Average Hourly Daytime (7:00am - 10:00pm)			Average Hourly Nighttime (10:00pm – 7:00am)		
		Leq	L50	Lmax	Leq	L50	Lmax
A	57.1 dB	555.2	50	72.5	49.1	45	64.5
Source: j.c. brennan & associates, Inc. - 2014							

Nevada County Zoning Ordinance

Table L-II 4.1.7 (Table 3) of the Nevada County Zoning Regulations establishes the following noise standards which would apply to the proposed project.

Table 3
Exterior Noise Limits
Nevada County Zoning Regulations

Land Use Category	Time Period	Noise Level, dBA	
		L_{eq}	L_{max}
Rural (AG, TPZ, AE, OS, FR, IDR Zoning Districts)	7am – 7pm	55	75
	7pm – 10pm	50	65
	10pm – 7am	40	55
Residential and Public (RA, R2, R1, R3, P Zoning Districts)	7am – 7pm	55	75
	7pm – 10pm	50	65
	10pm – 7am	45	60
Commercial and Recreation (C1, CH, CS, C2, C3, OP, REC Zoning Districts)	7am – 7pm	70	90
	7pm – 7 am	65	75
Business Park (BP Zoning Districts)	7am – 7pm	65	85
	7pm – 7 am	60	70
Industrial (M1, M2 Zoning Districts)	Anytime	80	90
Source: Nevada County Zoning Regulations			

Nevada County General Plan

The Nevada County General Plan Noise Element has standards which are identical to the Zoning Code shown above. However, the Noise Element also has policies for determining a significant impacts. The following policies from the General Plan Noise Element apply to this project:

> Policy 9.1d If the measured ambient level exceeds that permitted, then the allowable noise exposure standard shall be set at 5 dBA above the ambient.
>
> Policy 9.1e Because of the unique nature of sound, the County reserves the right to provide for a more restrictive standard than shown in the Exterior Noise Limits table contained in this policy. The maximum adjustment shall be limited to be not less than the current ambient noise levels and shall not exceed the standards of this policy or as they may be further adjusted by Policy 9.1b. Imposition of a noise level adjustment shall only be considered if one or more of the following conditions are found to exist.
>
> Unique characteristics of the noise source:
>
> (a). The noise contains a very high or low frequency, is of a pure tone (a steady, audible tone such as a whine, screech, or hum), or contains a wide divergence in frequency spectra between the noise source and ambient level.
>
> (b). The noise is impulsive in nature (such as hammering, riveting, or explosion), contains music or speech.
>
> (c). The noise source is of a long duration.

Unique characteristics of the noise receptor when the ambient noise level is determined to be 5 dBA or more below the Policy 9.1 standard for those projects requiring a General Plan amendment, rezoning, and/or conditional use permit. In such instances, the new standard shall not exceed 10 dBA above the ambient or the Policy 9.1 standard, whichever is more restrictive.

The project operates during the daytime hours between 7:00 a.m. and 7:00 p.m. The County would apply noise standards of 55 dB L_{eq} and 75 dB L_{max} to the proposed project for activities occurring during daytime (7:00 a.m. to 7:00 pm.). This analysis will determine the ability of the project to comply with these noise level standards.

ANALYSIS

Project Generated Noise at Sensitive Receptors

Truck Delivery Noise

Based upon discussions with the project architects, the Dollar General store will generally have 8 small truck / van deliveries per week, and 1 to 2 semi-truck deliveries per week. Typical truck activity for the store will consist of no more than (1) semi-truck delivery, and (1) step-side vans per hour during the daytime hours. Based on noise level data collected at a Trader Joes, for these types of truck passages and unloading activities, the sound exposure level (SEL) for a semi-truck at a reference distance of 50 feet, is approximately 88 dB, and a maximum noise level of 80 dB. Typical medium truck arrivals and departures and unloading are approximately 84 dB SEL and 75 dB Lmax at 50 feet. Based upon the data described above, the following formula can be utilized to determine the hourly noise level due to the truck traffic passbys.

$$L_{eq} = 88 + 10 * (\log N_{eq}) - 35.6, \text{ dB where:}$$

88 is the mean sound exposure level (SEL) for a heavy truck arrival and departure (84 for medium trucks), and 10 * (log N_{eq}) is 10 times the logarithm of the number of truck arrivals and departures during an hour, and 35.6 is 10 times the logarithm of the number seconds in an hour.

Based upon the above formula, the hourly Leq generated during the hour of truck activity is 54 dB L_{eq} and 80 dB L_{max} at a distance of 50 feet.

The proposed configuration for the Dollar General loading area is located approximately 100 feet from the closest residential uses to the east across Little Valley Road.

The predicted delivery truck hourly noise levels are 48 dB L_{eq}, and 74 dB L_{max} at the nearest residences. The project proposes to construct concrete block screen walls at a height of 6-feet as shown on Figure 1. The intent is to provide shielding of the truck and parking lot operations. Based upon existing topography on the site, there is an approximate 10-foot difference in elevation between the truck circulation area and the nearest residence across Little Valley Road. A barrier analysis was conducted to determine the shielding effects of the screen wall, and is shown in Appendix C. The results of the barrier analysis indicates that the screen wall will provide an approximate 5 dB reduction in truck loading noise levels. Therefore, overall hourly truck noise levels are expected to be no more than 45 dB Leq and less than 70 dB Lmax.

Truck deliveries will comply with the Nevada County daytime (7 a.m. to 7 p.m.) noise level standards of 55 dB Leq and 75 dB Lmax. However, truck deliveries are predicted to exceed the County's evening noise level standard (7 p.m. to 10 p.m.) of 65 dB Lmax and the County's nighttime noise level standards of 45 dB Leq and 60 dB Lmax.
Truck deliveries will need to be restricted between the hours of 7:00 a.m. and 7:00 p.m.

Mechanical Equipment Noise

The heating, ventilation, and air-conditioning (HVAC) systems for the store will consist of packaged rooftop air conditioning systems. A building of 10,000 square feet would require HVAC units totaling approximately (5-ton).

j.c. brennan and associates, Inc., used data collected from a similar project using two Bryant Model 574-DNWA 36060 (3-ton), roof mounted HVAC units. Each of the units have a sound power level of 75 dBA, per the manufacturer's cut-sheets (Appendix B).

Based upon the site plan, the nearest residential property lines are located approximately 125 feet from the location of the nearest HVAC unit. The two HVAC units are located at the following distances from the nearest property line to the northwest:

Hemispherical stationary noise sources will attenuate at a rate of 6 dB per doubling of distance. This is a 20 log attenuation rate.

Based upon the attenuation over distance, the noise levels associated with each unit and the cumulative noise from 2 HVAC units can be calculated at the nearest property line. Table 4 shows the calculated noise level from the HVAC units. This does not account for shielding from the roof parapets and the roof lines.

Table 4
Calculated Roof-top HVAC Noise Levels
At the Nearest West Property Line

Unit	Distance to Residential Property Line to the North West	Calculated Individual HVAC Unit Noise Level	**Calculated Cumulative Noise Levels**
1	125 feet	233 dBA	
2	125 feet	33 dBA	
			36 dBA

Therefore predicted HVAC noise generations would comply with the Nevada County Zoning Ordinance hourly nighttime 45 dB Leq and 560 dB Lmax noise level standards.

Parking Lot Noise

Parking lot noise typically includes periods of conversation, doors slamming, engines starting and stopping and vehicle passage. j.c. brennan & associates, Inc. file data for parking lot activities was used to model the parking lot noise environment for the project site. An average sound exposure level (SEL) of 71 dB at a distance of 50 feet was used to represent parking lot arrivals and departures.

The proposed project will create a 34 space parking lot. Dollar General predicts 10 parking lot arrivals and departures in a busy hour of use. Therefore, a total of 20 vehicle movements could occur in a busy hour.

The peak hour L_{eq} value can be calculated as follows:

$$L_{eq} = SEL + 10 \log N_{eq} - 35.6, dB \text{ where:}$$

SEL is the mean SEL of the event, N_{eq} is the sum of the number of hourly events, and 35.6 is 10 times the logarithm of the number of seconds in an hour. Based upon the calculation above, the predicted noise level due to parking lot activities is 48 dB L_{eq} at a reference distance of 50 feet.

Parking lot circulation is predicted to occur within an average distance of 130 feet from the residential uses to the east. The parking lot noise level at the nearest property line to the east is predicted to be 40 dB L_{eq}

Therefore predicted parking lot noise generations would comply with the Nevada County General Plan Noise Element hourly nighttime 45 dB L_{eq} and 60 dB L_{max} noise level standards.

CONCLUSIONS

The project will comply with the noise level standards of Nevada County noise level criteria provided that the truck deliveries are restricted between the hours of 7:00 a.m. and 7:00 p.m.

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.
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.
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.
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 B
Dollar General - Alta Sierra
24hr Continuous Noise Monitoring - Site A
March 18-19, 2015

Hour	Leq	Lmax	L50	L90
11:00	55.0	71.7	54	50
12:00	54.9	72.3	53	49
13:00	54.7	69.8	53	50
14:00	55.0	71.8	53	50
15:00	54.8	71.5	54	50
16:00	55.6	75.8	54	50
17:00	55.9	79.1	54	51
18:00	55.1	73.2	53	50
19:00	53.9	73.4	52	48
20:00	52.1	69.1	50	47
21:00	52.0	67.9	50	46
22:00	49.9	64.8	46	42
23:00	48.7	72.4	45	41
0:00	44.0	63.4	42	38
1:00	42.4	56.6	41	37
2:00	43.6	62.2	42	37
3:00	43.0	58.9	41	37
4:00	46.9	60.9	46	41
5:00	51.5	71.6	50	45
6:00	54.5	70.0	53	50
7:00	57.2	70.5	56	54
8:00	57.1	73.1	56	53
9:00	55.7	72.1	54	51
10:00	56.1	75.5	53	50

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	57.2	52.0	55.2	54.5	42.4	49.1
Lmax (Maximum)	79.1	67.9	72.5	72.4	56.6	64.5
L50 (Median)	56.3	49.9	53.2	53.5	40.8	45.1
L90 (Background)	53.8	46.1	49.9	49.7	36.5	40.9

Computed Ldn, dB	57.1
% Daytime Energy	87%
% Nighttime Energy	13%

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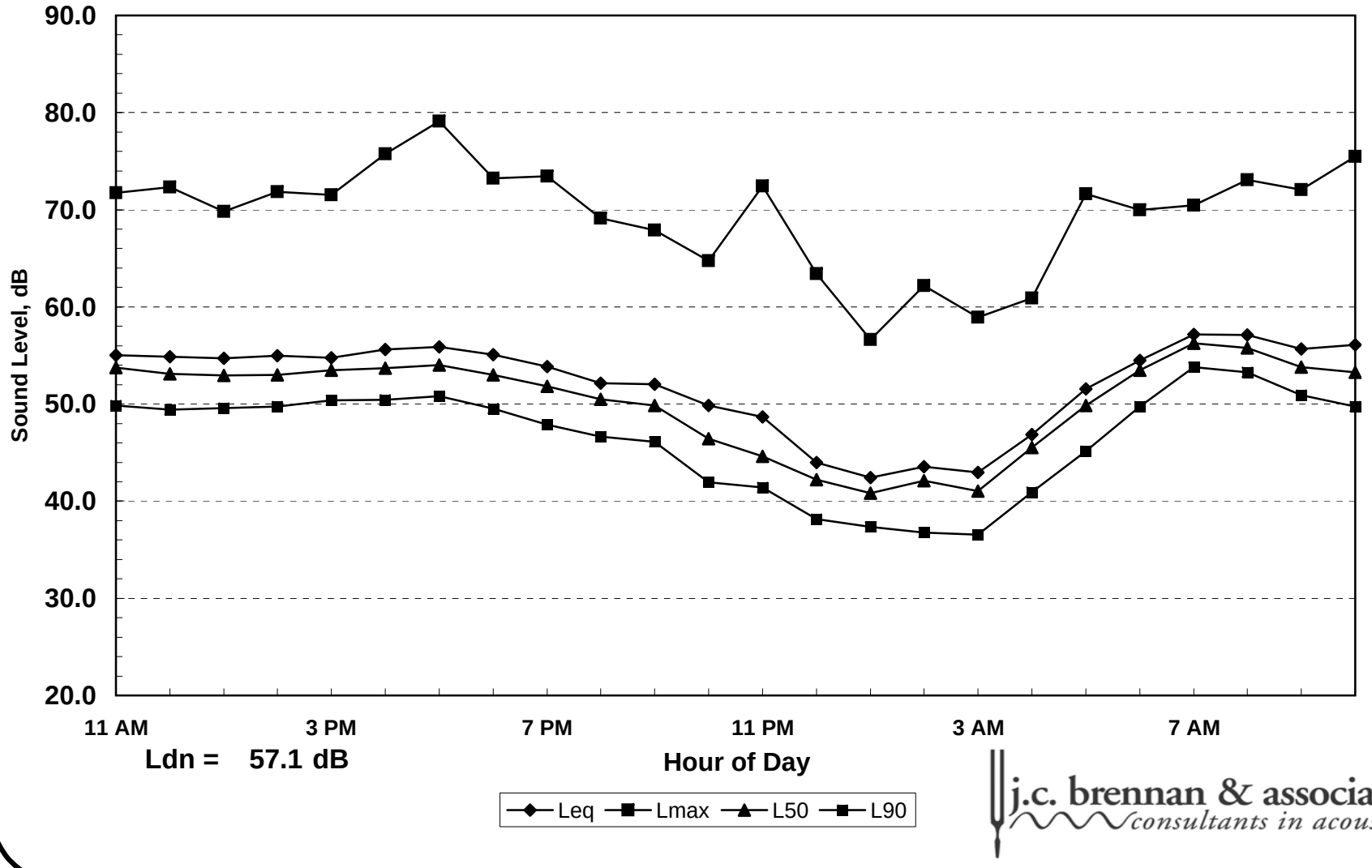
Appendix B

Dollar General - Alta Sierra

24hr Continuous Noise Monitoring - Site A

March 18-19, 2015



Ldn = 57.1 dB

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Appendix C

Barrier Insertion Loss Calculation

Project Information:

Job Number: 2015-128
Project Name: Dollar General
Location(s): 1

Noise Level Data:

Source Description: Truck Loading Maximum
Source Noise Level, dBA: 74
Source Frequency (Hz): 1000
Source Height (ft): 8

Site Geometry:

Receiver Description: Res Across Little Valley Rd
Source to Barrier Distance (C_1): 20
Barrier to Receiver Distance (C_2): 80

Pad/Ground Elevation at Receiver: -10
Receiver Elevation[1]: -5
Base of Barrier Elevation: 0
Starting Barrier Height 6

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height (ft)	Insertion Loss, dB	Noise Level, dB	Barrier Breaks Line of Site to Source?
6	6	-5	69	Yes
7	7	-6	68	Yes
8	8	-8	66	Yes
9	9	-9	65	Yes
10	10	-11	64	Yes
11	11	-12	62	Yes
12	12	-13	61	Yes
13	13	-14	60	Yes
14	14	-15	59	Yes
15	15	-15	59	Yes
16	16	-16	58	Yes

Notes: 1.Standard receiver elevation is five feet above grade/pad elevations at the receiver location(s)

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