

April 10, 2025
45dB Project 24081

Project & Address: Amplified Events at Wandermont Farms 3580 Toro Canyon Park Road Santa Barbara, CA 93108	Architect/Planner: Brian Banks brian@banksplanning.com	Owner, Client to be Invoiced: Margo Redfern margoredfern@gmail.com (415) 845-9090
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Summary

45dB Acoustics, LLC (“**45dB**”) has described and acoustically modeled the anticipated amplified music and speech sound levels for the proposed outdoor events and background music at the above address in unincorporated Santa Barbara, California. We have evaluated the proposed amplified sound levels against the Santa Barbara County Environmental Thresholds & Guidelines.

Utilizing the 3D noise modeling software SoundPLAN® to model sound level contours due to amplified music at the Pool Deck and background music at the Barn patio, we have concluded that the resulting sound levels **will comply** with the County’s CNEL 65 dBA threshold at the property lines of the nearby noise-sensitive land uses.

Based on the above analysis, for outdoor events with continual amplified music or speech throughout the winery’s operating hours (between 10:00am and 8:00pm), amplified music having the following sound limits and configurations will comply with the County guidelines:

- Barn Patio Music (background music for wine tastings) – with loudspeakers mounted to the underside of the soffit above the patio adjacent to the south exterior wall:
 - We recommend maintaining levels at or below 65 dBA (as measured at a location 10 feet directly in front of the loudspeakers) for amplified background music played during operating hours, between 10:00am and 8:00pm.
 - If louder music is desired from the existing loudspeakers in this area, source levels must be no greater than 90 dBA (at 10 feet in front of the loudspeakers), only during operating hours.
- Residence Pool Deck (wedding receptions, private parties, and charitable events):
 - With loudspeakers located at the north, east, or west edges of the deck area (i.e., at a minimum of 150 feet from the nearest property lines), source levels must be no greater than 95 dBA (as measured at a location 10 feet directly in front of the stage).

Because the CNEL calculation incorporates the total sound level measured over a 24-hour period, our recommendations assume amplified music will only be played during operating hours and no later than 8:00pm. If events having later hours, longer durations, or different loudspeaker configurations are desired, please contact **45dB** so that we can help determine the appropriate event sound limits to maintain compliance with the County guidelines.

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If the above recommendations are followed, the sound levels at the nearest noise-sensitive locations are predicted to be in compliance with the County's Noise Thresholds.

Please contact us with any questions.

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1 Introduction

This sound level assessment is intended to determine the potential noise impacts associated with amplified music and speech for outdoor events at Wanderment Farms, a winery in rural, unincorporated Santa Barbara, California. The following topics are presented in this report in response to the County's requirements for exterior noise levels, as identified by the Santa Barbara County Environmental Thresholds and Guidelines Manual. The following factors are considered:

- The topographical relationship of amplified noise sources and the nearby potential sensitive receptors
- Identification of noise sources and their characteristics, and evaluation of predicted sound levels at the site's property lines
- Factors affecting sound level prediction at the property line, noise attenuation measures to be applied (if any), and analysis of the noise propagation considering the physical layout of the built environment
- Noise attenuation measures (mitigation) to be applied, if needed
- Information on fundamentals of noise and vibration to aid in interpreting the report (see Appendix, Section 9)

The proposed outdoor events are to be located at the site shown in Figure 1, outlined in yellow. Surrounding land uses¹ are Agricultural (Figure 2), although since many residences are located in the surrounding properties, we have conservatively considered all property lines to be noise-sensitive for this analysis.

The site plan provided by the Client is shown in Figure 3, with the proposed outdoor event space at the pool deck highlighted in green. The proposed space for outdoor amplified background music, the barn patio, is highlighted in blue.

We understand that all outdoor events at the winery will occur during operating hours, between 10:00am and 8:00pm. Events are expected to include wedding receptions and charity events and will be held in the Pool Deck area, south of the residence. Amplified background music is expected to be played from loudspeakers mounted on the covered patio on the south side of the barn.

2 Regulatory Setting – Local Regulations

The Santa Barbara County Environmental Thresholds and Guidelines Manual² states that for neighboring sensitive receptors with existing ambient levels below 65 dBA CNEL, levels due to the proposed project noise may not exceed 65 dBA CNEL (see Figure 4). If existing ambient levels are above 65 dBA CNEL, an increase in the CNEL of 3 dB or more above the existing

¹ Santa Barbara County, Land Use Designation and Zoning Map. <https://www.countyofsb.org/3182/16603/LAND-USE-DESIGNATION-AND-ZONING-MAP>

² Santa Barbara County, Environmental Thresholds and Guidelines Manual, August 2024. <https://www.countyofsb.org/1432/Environmental-Review>

ambient levels will be noticeable and is presumed to have a significant impact. However, due to the remote location, we assume the existing ambient level is well below 65 dBA (and assumed to be CNEL 45 dBA for this analysis).

All adjacent/surrounding land uses are Agricultural. Because many non-agricultural residences are located in the surrounding properties, we have conservatively considered all property lines to be noise-sensitive for this analysis. Levels were evaluated at the property lines at a height of 5 feet.

3 Existing Ambient Noise Level

As discussed previously, because traffic levels are expected to be low in this rural area, we assume that the existing ambient noise level throughout the day is well below CNEL 65 dBA and estimated to be CNEL 45 dBA for the area around the winery when calculating the overall CNEL levels with the proposed amplified events.

4 Noise Propagation Model

SoundPLAN® is a 3-dimensional sound propagation modeling software package that calculates sound levels while taking into account the air and ground attenuation, terrain variation and built environment, road pavement types, and other relevant factors. Terrain/elevation data is imported from Google Maps.

The software incorporates the relevant noise propagation standards—for road traffic, the Federal Highway Administration’s Traffic Noise Model (TNM), and for other sources, such as the amplified music for events, ISO 9613-2—in order to accurately calculate noise propagation.

See the Appendix for more information on this software and its calculation methods. All sound levels in this report are presented in units of A-weighted decibels, dBA, for direct comparison to the applicable regulations.

4.1 Proposed Outdoor Events

4.1.1 Sound Levels

In our model, an initial setting was used for each of the event sources (i.e., loudspeakers) to represent typical amplified music for events in the proposed event areas, which is based upon our experience and knowledge of sound levels for these types of events. Please see the Appendix, Section 9.1.

A particular change—either increase or decrease—of a noise source will result in the same decibel change at a receiver location for a given geometrical setup, including terrain, buildings, etc., assuming other noises can be neglected. Once the resulting levels at the property line are determined, conclusions may be drawn about the compliance of the levels occurring *at the event* and adjusted upward or downward in order to determine levels that should not be exceeded *at the event* in order to remain compliant with the County’s thresholds *at the specified property lines*.

For each outdoor event area, a source with average sound pressure level (L_{eq}) of 95 dBA, as measured at a distance of 10 feet (3 meters), was initially included in the model to represent a very high-energy, amplified music group performance/concert, where having a conversation

nearby is very difficult or impossible, and a significantly raised voice or even yelling may be required to converse. **Table 6 in the Appendix has a general description of sound levels in different scenarios to help with understanding the levels discussed in this report.**

Loudspeakers are conservatively placed at a height of 6 feet (1.8 meters) and 20 feet apart in our model; each represents the center of the loudspeaker/PA system at each side of the stage. $L_{\max}$ levels (generally an “instantaneous” 1-second L_{eq}) can be approximately 15 to 20 dB higher than the average sound levels.

4.1.2 Event Duration

For this project, because the overall CNEL is dependent upon the time and duration of the event, the timing of the event having amplified music is critical. For this analysis we conservatively model the amplified music for the duration of the winery’s operating hours and adjust the hours and/or sound level, if needed, to provide a suitable recommendation based on the type of event desired.

4.2 Ground Effects

Ground cover influences sound propagation, especially near the source and receiver. Harder surfaces such as concrete, pavement, hard soil, and water provide little attenuation while softer, porous surfaces such as grass, vegetation, or snow will attenuate more sound over long distances. Attenuation is also frequency-dependent. In general, softer ground types will attenuate more sound in the 250 Hz frequency band than at other frequencies. Taller vegetation can also provide some sound attenuation; however, it must be a larger, dense forest before any significant effects can be measured.

In our analysis we assumed the ground effects based on conditions observed from the satellite views in Google Maps; pavement and concrete surfaces were modeled as harder, reflective ground and the open field areas were conservatively modeled as partially hard ground to represent the absorption provided by some vegetation (i.e., grasses and brush) and dry soil. We also conservatively assume that there are no dense forests in the immediate area to provide volume attenuation.

4.3 Wind and Temperature Effects

For noise that travels long distances, such as from any high-volume amplified music, wind and temperature variations can affect the bending of sound waves in the atmosphere, which can influence the transmitted noise levels. Wind speed and temperature change with altitude and these gradients can cause sound waves to travel faster or slower.

Outdoor sound transmission is not only affected by wind speed, but also its direction, especially over distances greater than 150 feet. Sounds measured downwind may increase by a few dB while sounds measured upwind or side-wind can drop by 20 dB or more, depending on the distance and wind speeds. Turbulent or gusty wind can also reduce the measured sound levels. Air temperatures at ground level tend to be warmer than the air at higher altitudes. When there is a “temperature inversion,” such as on a clear night, the temperature at the ground surface may be lower than at altitude and sound waves will be reflected back to the earth’s surface and can increase noise levels at large distances (1/2 mile or more) by several dB.

Our model of outdoor events at the winery assumes stable weather conditions, with low winds and no influence from temperature inversions.

5 Modeled Noise Environment with Events

5.1 Noise Model

Once terrain/elevation data, ground effects, and any other structures, buildings, and residences in the vicinity are input into the SoundPLAN model, we add the outdoor event configurations within the designated areas. Event areas are evaluated individually to determine the ideal configurations, event durations, and source/loudspeaker levels for the planned events to ensure compliance with the County's Thresholds and Guidelines.

As described below, loudspeakers were positioned according to our best estimate of the stage locations and orientations.

- Barn Music (background music for wine tastings) – loudspeakers are mounted to the underside of the soffit above the patio adjacent to the south exterior wall.
- Residence Pool Deck (for wedding receptions) – the event stage was evaluated at three locations around the pool deck:
 - A stage located on the veranda on the south side of the residence with loudspeakers facing south
 - A stage located at the east end of the pool deck with loudspeakers facing west
 - A stage located at the west end of the pool deck with loudspeakers facing east

A view of the 3D model showing the proposed event areas and loudspeaker configurations is shown in Figure 5.

5.2 Evaluation of Compliance

5.2.1 Background Music at the Barn Patio

With source/loudspeaker levels having an L_{eq} of 65 dBA (as measured at 10 feet from the loudspeaker), which is a typical level for outdoor amplified background music, music (only during operating hours) at this location **will comply** with the County's noise threshold at the nearest property lines.

In addition, we evaluated higher levels from the existing loudspeakers and determined that source levels can be increased up to 90 dBA (at 10 feet in front of the loudspeakers) if much livelier amplified music is desired for this location in the future. For reference, a sound level of 90 dBA is typical for a wedding dinner/dance band.

Modeled CNEL levels along the property lines for both sound levels discussed above can be found below in Table 1. The resulting noise contours are shown in Figure 6 and Figure 7. As shown in the table and noise contours, levels along the property lines do not exceed CNEL 65 dBA and levels at the north, west, and south property lines will remain at or below the existing ambient noise level.

Table 1: Expected Noise Levels (CNEL) at Selected Receiver Locations for Music at the Barn Patio During Operating Hours (10am – 8pm)

Noise Level at the Barn Patio*	65 dBA	90 dBA
Receiver Location	CNEL (dBA)	CNEL (dBA)
E1	46	63
E2	45	59
N	45	45
S	45	45
W	45	45

* As measured at 10 feet from the loudspeakers

5.2.2 Events on the Residence Pool Deck

With source/loudspeaker levels having an L_{eq} of 95 dBA (as measured at 10 feet from the stage or loudspeakers), events held throughout the winery's operating hours at all three stage configurations **will comply** with the County's noise threshold at the nearest property lines. For reference, 95 dBA is representative of sound levels from DJ'd dance parties where one must raise their voice or yell to be heard in close proximity.

Modeled CNEL levels along the property lines for each event configuration discussed above can be found below in Table 3. The resulting noise contours for the three pool deck stage locations are shown in Figure 8, Figure 9, and Figure 10. As shown in the table and noise contours, levels along the property lines do not exceed CNEL 65 dBA and levels at the north, west, and south property lines will remain at or below the existing ambient noise level.

Table 2: Expected Noise Levels (CNEL) at Selected Receiver Locations for Outdoor Events at the Pool Deck with Typical "Loud" Amplified Music/Speech (95 dBA at 10-ft) During Operating Hours (10am – 8pm)

Pool Deck Stage Location	North Side (loudspeakers facing south)	East Side (loudspeakers facing west)	West Side (loudspeakers facing east)
Receiver Location	CNEL (dBA)	CNEL (dBA)	CNEL (dBA)
E1	46	53	53
E2	60	53	58
N	45	45	45
S	45	45	45
W	45	45	45

To demonstrate that levels at the full extent of the property's boundaries as well as at the nearest neighboring residential property do not exceed the County's threshold, an additional view of the noise contours in and around the property is provided in Figure 11. Note that the figure is rotated so that north is to the right and we have included both sources of amplified music at the barn patio and residence pool deck.

6 Conclusion and Recommendations

Utilizing the 3D noise modeling software SoundPLAN® to model sound level contours due to amplified music at the Pool Deck and background music at the Barn patio, we have concluded that the resulting sound levels will comply with the County's CNEL 65 dBA threshold at the property lines of the nearby noise-sensitive land uses.

Based on the above analysis, for outdoor events with continual amplified music or speech throughout the winery's operating hours (between 10:00am and 8:00pm), amplified music having the following sound limits and configurations will comply with the County guidelines:

- Barn Patio Music (background music for wine tastings) – with loudspeakers mounted to the underside of the soffit above the patio adjacent to the south exterior wall:
 - We recommend maintaining levels at or below 65 dBA (as measured at a location 10 feet directly in front of the loudspeakers) for amplified background music played during operating hours, between 10:00am and 8:00pm.
 - If louder music is desired from the existing loudspeakers in this area, source levels must be no greater than 90 dBA (at 10 feet in front of the loudspeakers), only during operating hours.
- Residence Pool Deck (wedding receptions, private parties, and charitable events):
 - With loudspeakers located at the north, east, or west edges of the deck area (i.e., at a minimum of 150 feet from the nearest property lines), source levels must be no greater than 95 dBA (as measured at a location 10 feet directly in front of the stage).

Note that our mitigation recommendations assume the background music and/or events will be operational during business hours, between 10:00am and 8:00pm. Since the CNEL calculation incorporates the total sound level measured over a 24-hour period, other event durations will change the resulting CNEL. If events having later hours, longer durations, or different loudspeaker configurations are desired, please contact **45dB** so that we can help determine the appropriate event sound limits to maintain compliance with the County guidelines.

Because it is difficult for anyone to identify source levels such as 95 dBA at 10 feet, as described in this report for compliant evening outdoor events, the event sound levels may be monitored to ensure compliance with the County's Noise Thresholds. In Section 9.6 of the Appendix, we describe some commercially available tools that laypeople and owners, DJ's, and others may use to self-manage and accurately measure and control sound levels created at these events.

The conclusions and recommendations of this acoustic analysis are based upon the information known to 45dB Acoustics, LLC ("**45dB**") at the time the analysis was prepared concerning the proposed site plans, traffic volumes, proposed project-related sound source and hours of operation, and reference noise level data. Any significant changes to these factors will require a

reevaluation of the findings of this report. Additionally, any significant future changes in site layout, noise regulations, or other factors beyond **45dB**'s control may result in recommendations different from those described within this analysis.

7 Figures

Figure 1: Site View (Google Maps)



Figure 2: Project Site (outlined in blue) and Surrounding Land Uses

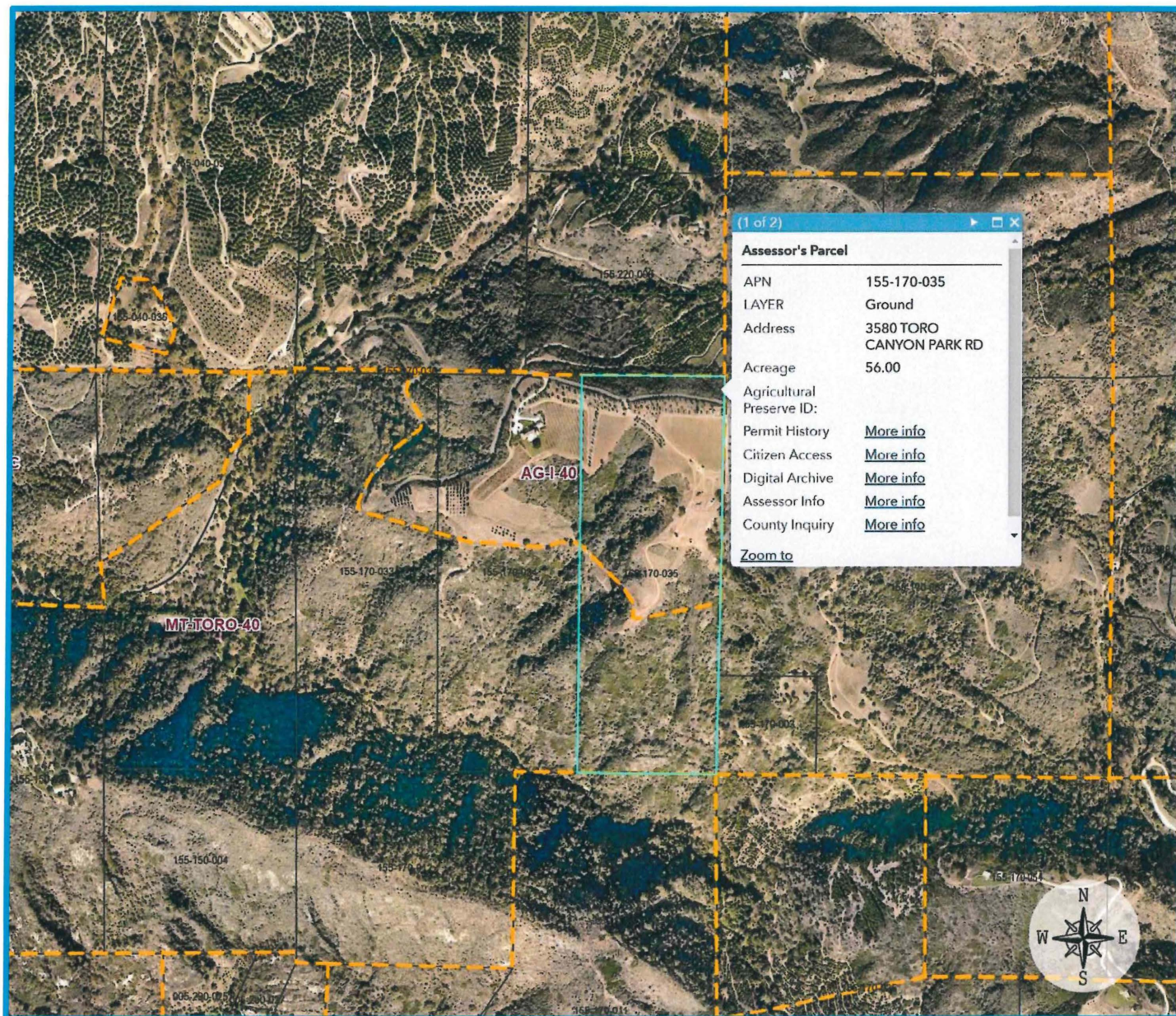


Figure 3: Property Site Plan and Event Location (reprinted from client drawings)

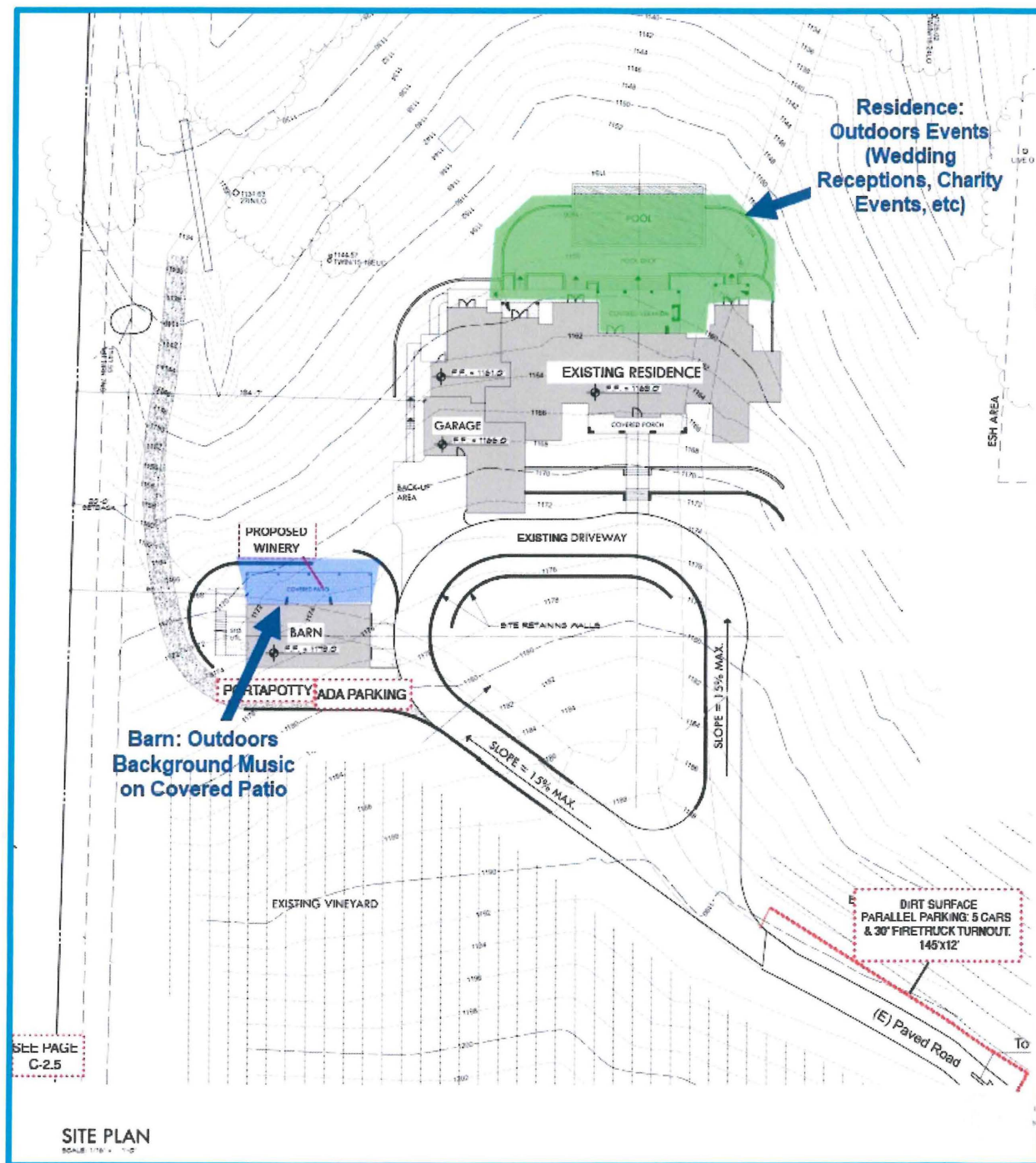


Figure 4: Santa Barbara County Noise Thresholds

3. **Noise thresholds.** The following are thresholds of significance for assisting in the determination of significant noise impacts.
- If existing exterior noise levels, including at outdoor living areas, experienced by sensitive receptors is below 65 dB(A) CNEL, and if the proposed project will generate noise that will cause the existing noise levels experienced by the sensitive receptors to exceed 65 dB(A) CNEL – either individually or cumulatively when combined with other noise-generating sources – then the proposed project is presumed to have a significant impact.
 - If existing exterior noise levels, including at outdoor living areas, experienced by sensitive receptors exceeds 65 dB(A) CNEL, and if the proposed project will generate noise that will cause the existing noise levels experienced by the sensitive receptors to increase by 3 dB(A) CNEL – either individually or cumulatively when combined with other noise-generating sources – then the proposed project is presumed to have a significant impact.

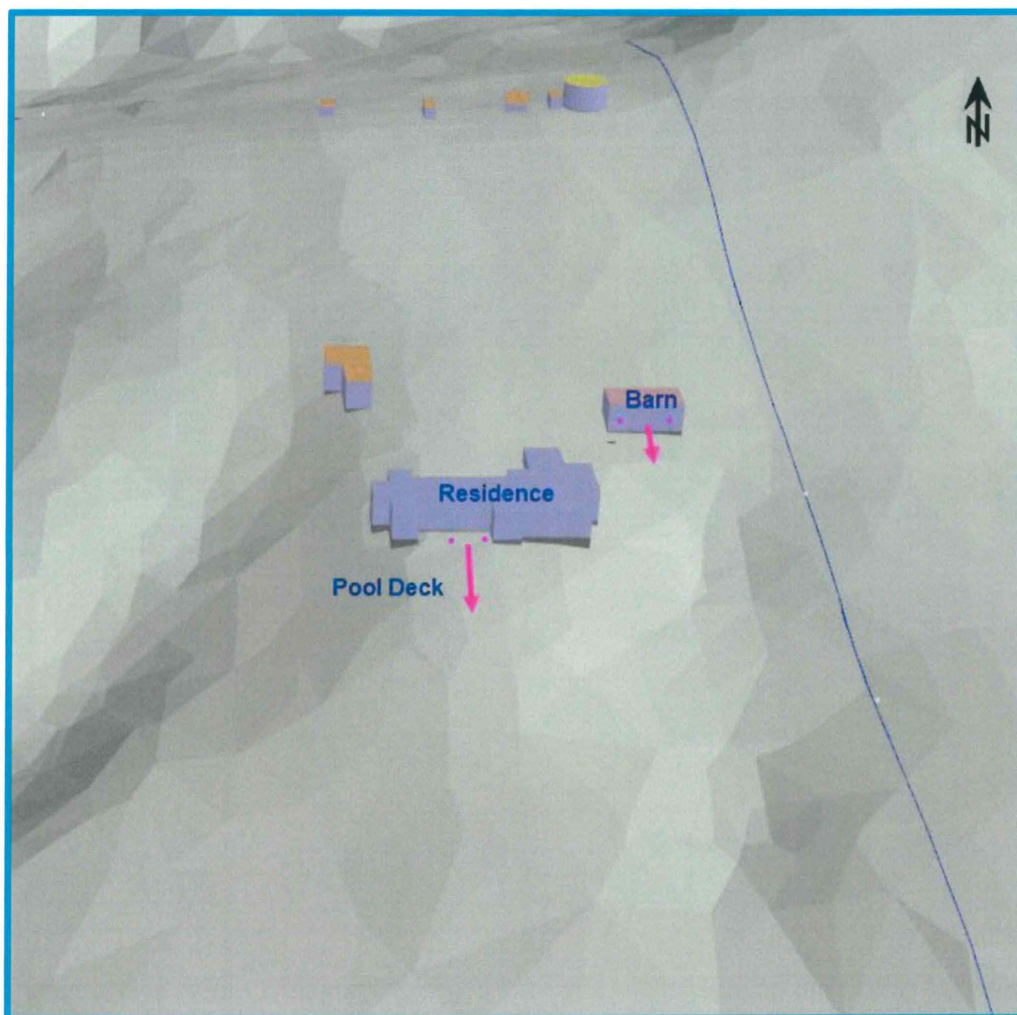
Figure 5: 3D Perspective of Acoustic Model Geometry with Proposed Outdoor Event Spaces

Figure 6: CNEL Contours for Typical Background Music at Barn Patio, 10am-8pm (65 dF



Figure 7: CNEL Contours for Lively Amplified Music at Barn Patio, 10am-8pm (90 dBA

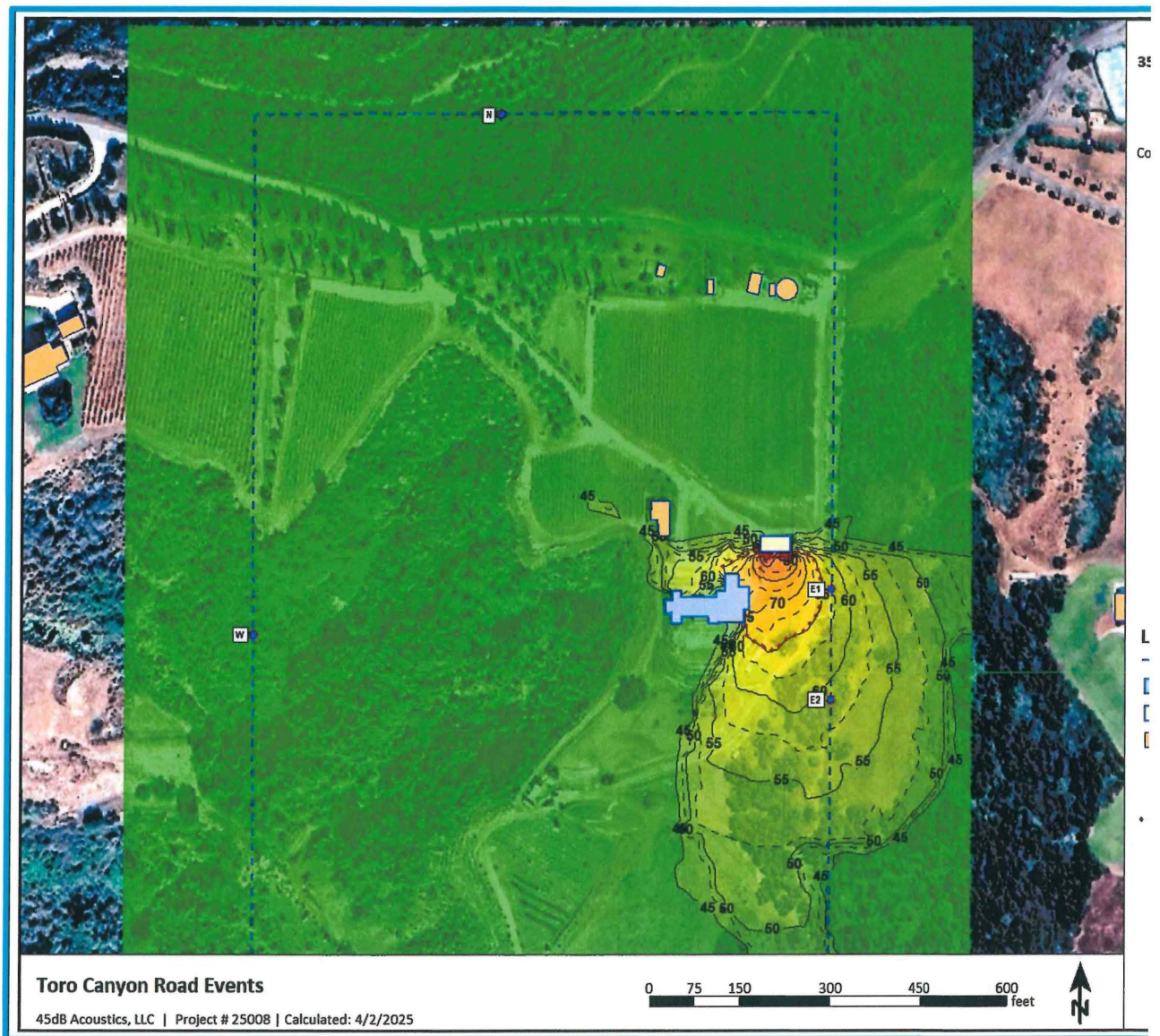


Figure 8: CNEL Contours for Amplified Music with Stage at North Side of Pool Deck, 10am-8pm

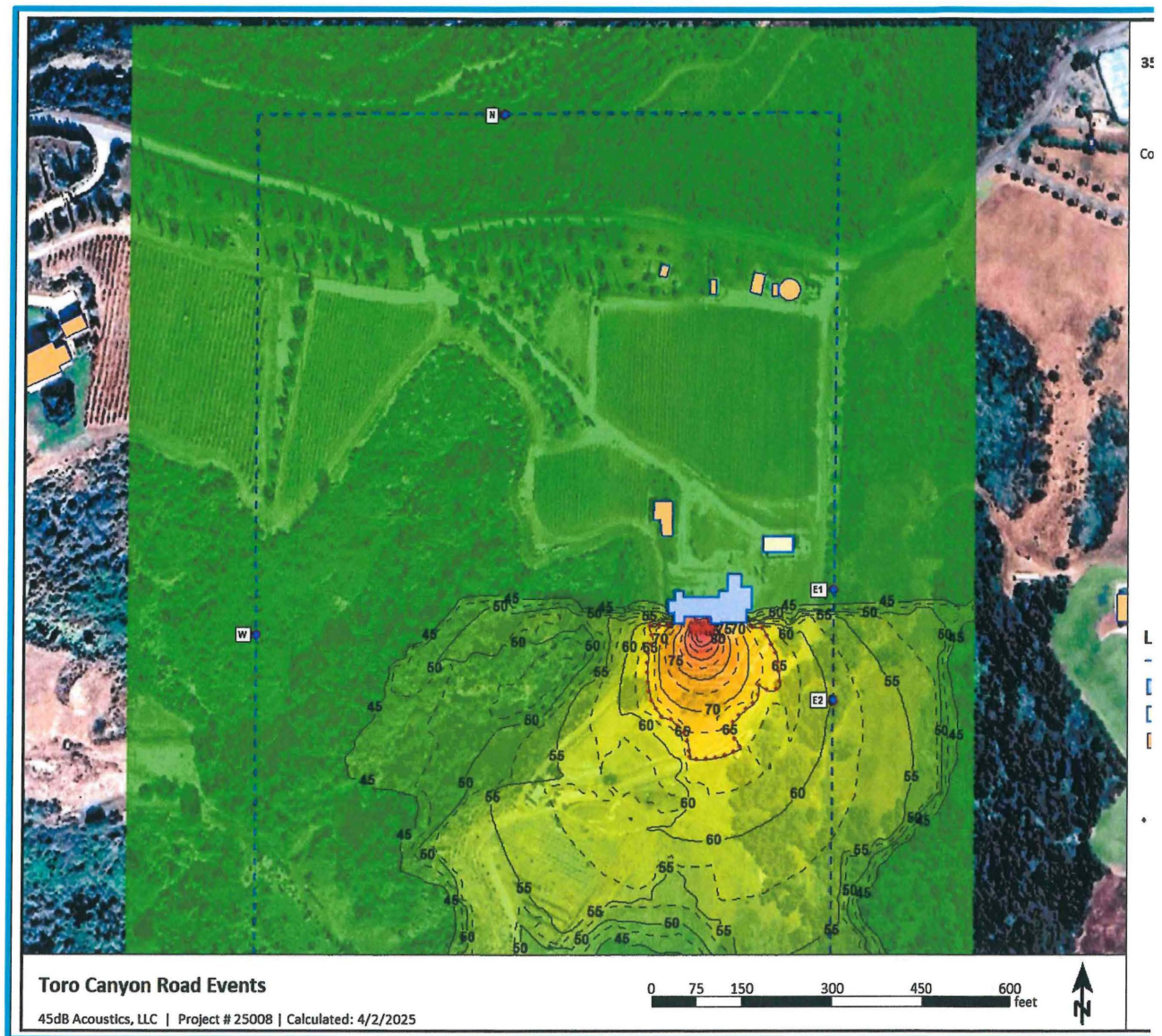


Figure 9: CNEL Contours for Amplified Music with Stage at East Side of Pool Deck, 10am-8pm

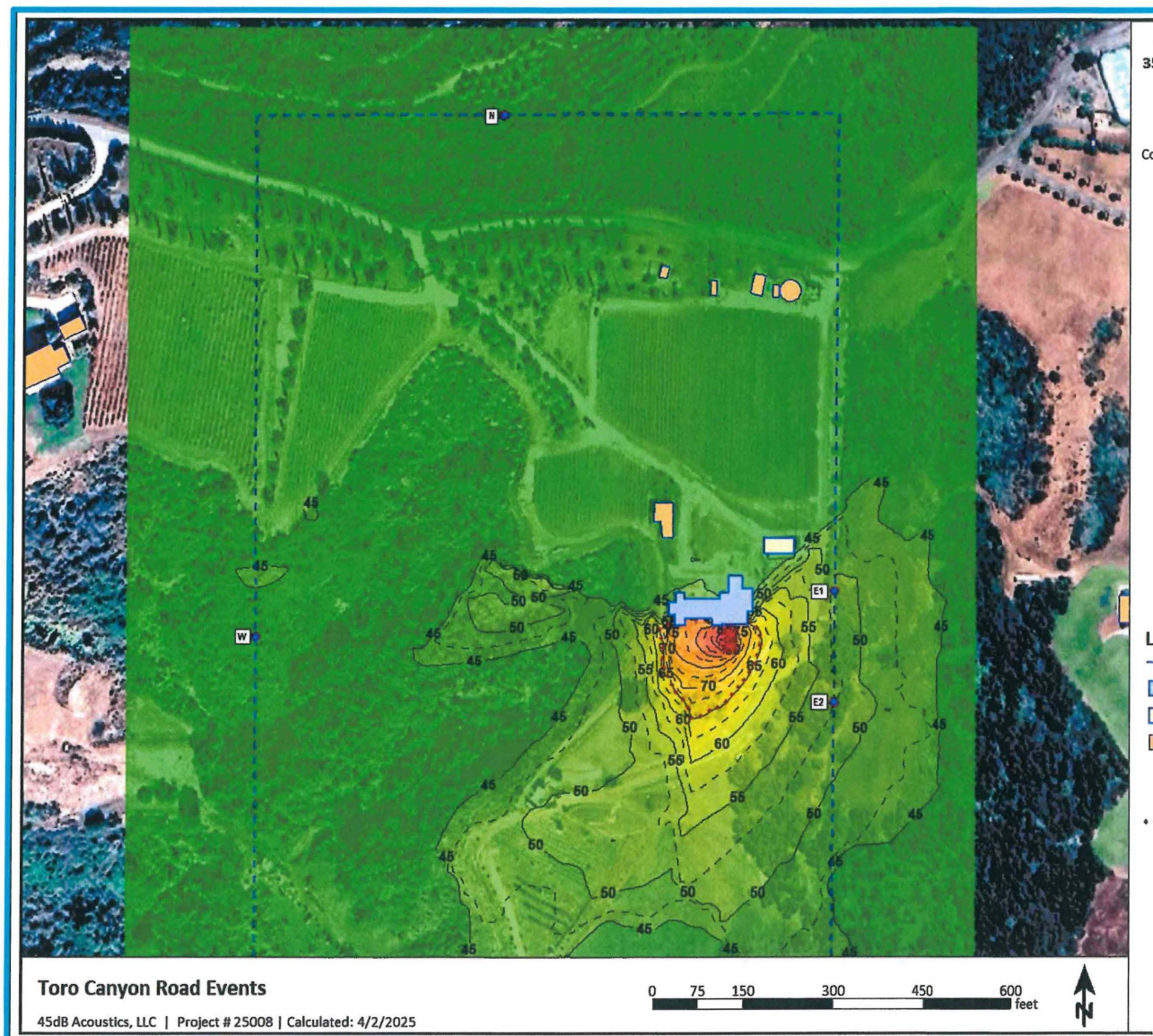


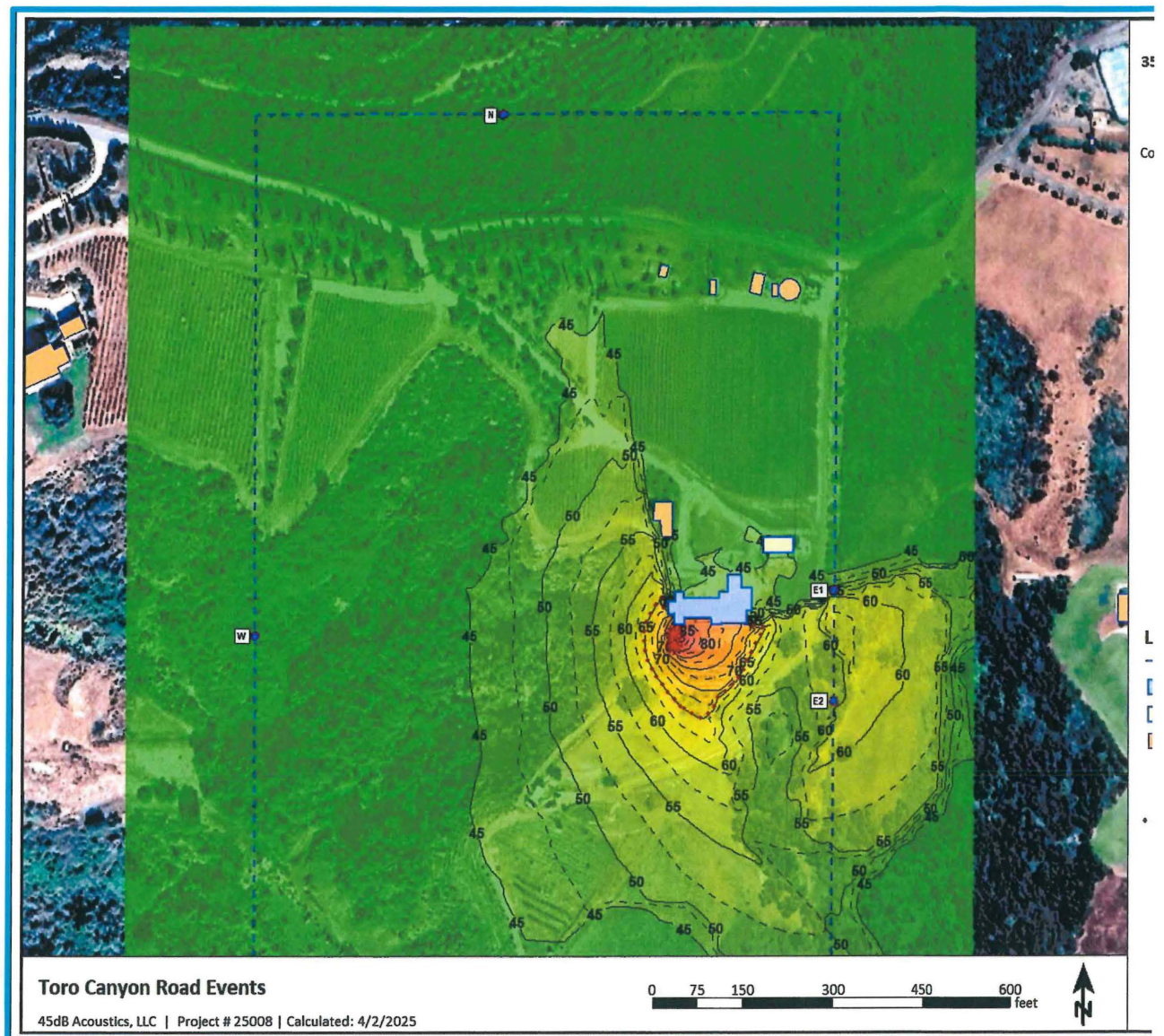
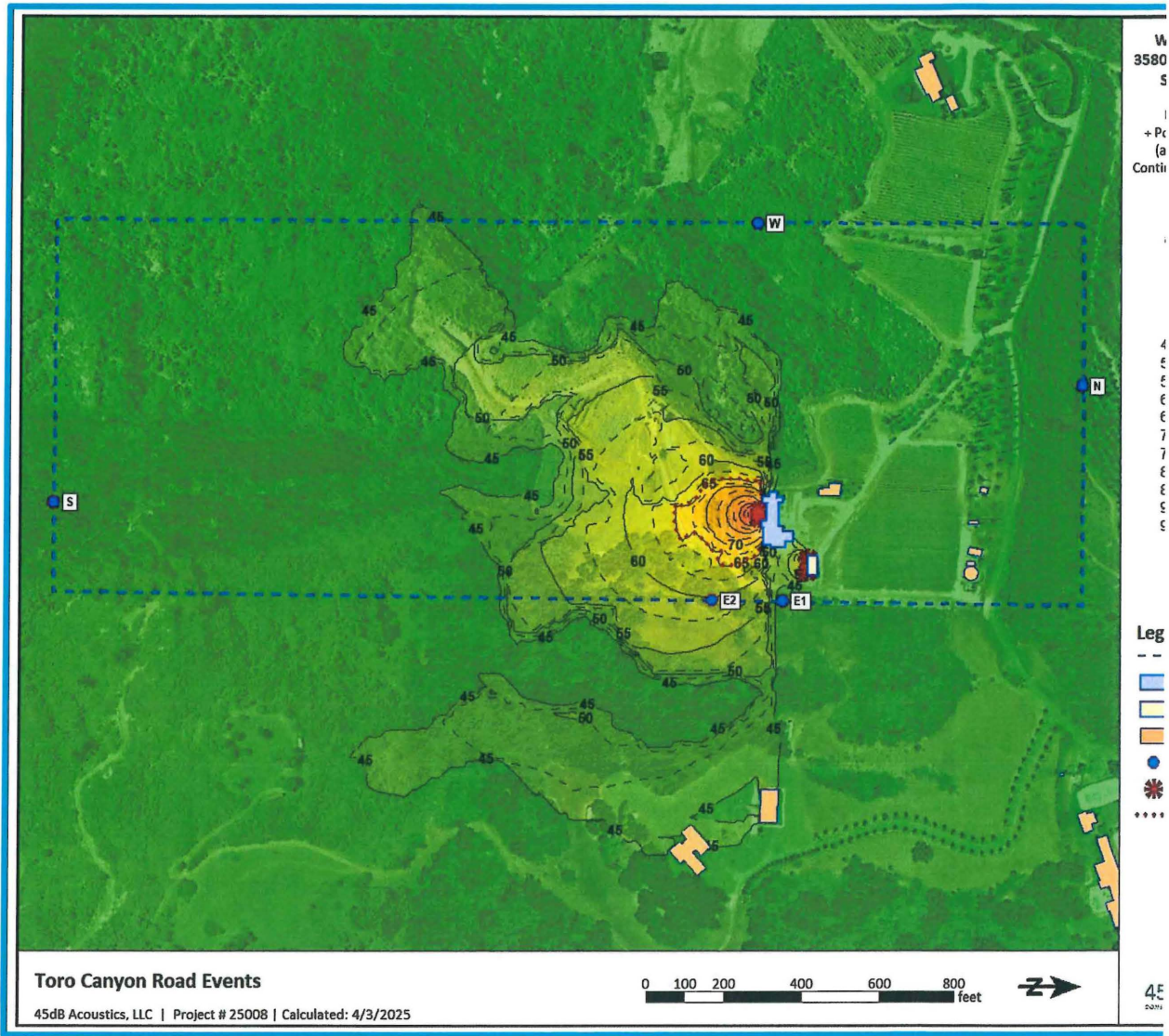
Figure 10: CNEL Contours for Amplified Music with Stage at West Side of Pool Deck, 10am-8pm

**Figure 11: Full Site View of CNEL Contours with Background Music at Barn Patio (65 dBA at 10ft) :
with Stage at North Side of Pool Deck, 10am-8pm (95 dBA at 10ft)**



8 Appendix

8.1 Characteristics of Sound

When an object vibrates, it radiates part of its energy as acoustic pressure in the form of a sound wave. Sound can be described in terms of amplitude (loudness), frequency (pitch), or duration (time). The human hearing system is not equally sensitive to sound at all frequencies. Therefore, to approximate this human, frequency-dependent response, the A-weighted filter system is used to adjust measured sound levels. The normal range of human hearing extends from approximately 0 to 140 dBA.

Table 3: Examples of Typical Sound Pressure Levels

SPL (dBA)	Description
0	<i>The threshold of hearing.</i> This is the quietest sound that a child or young adult with good hearing can detect at 1kHz. (It is not silence.)
10 - 20	Very faint. A gentle breeze through the trees.
20 - 30	A soft whisper (at 1 meter).
30 - 40	A quiet auditorium.
40 - 60	Background music in a cafe, bar, or restaurant.
60 - 70	Typical conversation levels (from the listener's position).
70 - 80	The cabin of an aircraft during normal cruise conditions.
80 - 90	Typical wedding or dinner-dance band (typical audience position).
90 - 100	Loud orchestra (playing <i>fff</i> , as it would sound in the front row of the audience).
100 - 110	Typical disco.
110 - 115	A loud rock band (front rows of audience).
115 - 130	<i>Threshold of pain.</i> Often given as 120 dB SPL, this varies with frequency and from person to person.
140	Jet engine from 3 meters.

Examples of sound levels are listed on websites such as:

- [“Time to Listen: Most Regular Patrons of Music Venues Prefer Lower Volumes”](#)
- [The Center for Hearing and Communication](#)
- [University of Michigan Health - Harmful Noise Levels](#)
- [Expected Sound Levels at Concert Venues for Amplified Music](#)

Unlike linear units such as inches or pounds, decibels are measured on a logarithmic scale, representing points on a sharply rising curve. Because of the physical characteristics of noise transmission and of noise perception, the relative loudness of sound does not closely match the actual amounts of sound energy. Table 7, below, presents the subjective effect of changes in sound pressure levels.

Table 4: Sound Level Change Relative Loudness/Acoustic Energy Loss³

Change in Level	Relative Loudness	Acoustic Energy Loss
0 dB	Reference	0%
- 3 dB	Just Perceptible Change	50%
- 5 dB	Readily Perceptible Change	67%
- 10 dB	Half as Loud	90%
- 20 dB	1/4 as Loud	99%
- 30 dB	1/8 as Loud	99.9%

Sound levels are generated from a source and their decibel level decreases as the distance from that source increases. Sound dissipates exponentially with distance from the noise source. This phenomenon is known as spreading loss. Generally, sound levels from a point source will decrease by 6 dBA for each doubling of distance. Sound levels for a highway line source vary differently with distance because sound pressure waves propagate along the line and overlap at the point of measurement. A closely spaced, continuous line of vehicles along a roadway becomes a line source and produces a 3 dBA decrease in sound level for each doubling of distance. However, experimental evidence has shown that where sound from a highway propagates close to “soft” ground (e.g., plowed farmland, grass, crops, etc.), a more suitable drop-off rate to use is not 3.0 dBA but rather 4.5 dBA per distance doubling (FHWA 2010).

When sound is measured for distinct time intervals, the statistical distribution of the overall sound level during that period can be obtained. The L_{eq} is the most common parameter associated with such measurements. The L_{eq} metric is a single-number noise descriptor that represents the average sound level over a given period of time. For example, the L50 noise level is the level that is exceeded 50 percent of the time. This level is also the level that is exceeded 30 minutes in an hour. Similarly, the L02, L08 and L25 values are the noise levels that are exceeded 2, 8, and 25 percent of the time or 1, 5, and 15 minutes per hour. Other values typically noted during a noise survey are the L_{min} and L_{max} . These values represent the minimum and maximum root-mean-square noise levels obtained over the measurement period.

Because community receptors are more sensitive to unwanted noise intrusion during the evening and at night, State law requires that, for planning purposes, an artificial dB increment be added to quiet-time noise levels in a 24-hour noise descriptor called the CNEL or L_{dn} . This increment is incorporated in the calculation of CNEL or L_{dn} , described earlier.

³ Highway Traffic Noise Analysis and Abatement Policy and Guidance, U.S. Department of Transportation, Federal Highway Administration, Office of Environment and Planning, Noise and Air Quality Branch, June 1995.

8.2 Terminology/Glossary

A-Weighted Sound Level (dBA)

The sound pressure level in decibels, as measured on a sound level meter using the internationally standardized A-weighting filter or as computed from sound spectral data to which A-weighting adjustments have been made. A-weighting de-emphasizes the low and very high frequency components of the sound in a manner similar to the response of the average human ear. A-weighted sound levels correlate well with subjective reactions of people to noise and are universally used for community noise evaluations.

Air-borne Sound

Sound that travels through the air, differentiated from structure-borne sound.

Ambient Sound Level

The prevailing general sound level that exists at a location or in a space, which usually consists of a composite of sounds from many sources near and far. The ambient level is typically defined by the L_{eq} level.

Background Sound Level

The underlying, ever-present lower-level noise that remains in the absence of intrusive or intermittent sounds. Distant sources, such as Traffic, typically make up the background. The background level is generally defined by the L_{90} percentile noise level.

Community Noise Equivalent Level (CNEL)

The L_{eq} of the A-weighted noise level over a 24-hour period with a 5-dB penalty applied to noise levels between 7 p.m. and 10 p.m. and a 10-dB penalty applied to noise levels between 10 p.m. and 7 a.m. CNEL is similar to L_{dn} .

Day-Night Sound Level (DNL or L_{dn})

The L_{eq} of the A-weighted noise level over a 24-hour period with a 10-dB penalty applied to noise levels between 10 p.m. and 7 a.m. L_{dn} is similar to CNEL.

Decibel (dB)

The decibel is a measure on a logarithmic scale of the magnitude of a particular quantity (such as sound pressure, sound power, sound intensity) with respect to a reference quantity.

DBA or dB(A)

A-weighted sound level. The ear does not respond equally to all frequencies and is less sensitive at low and high frequencies than it is at medium or speech range frequencies. Thus, to obtain a single number representing the sound level of a noise containing a wide range of frequencies in a manner representative of the ear's response, it is necessary to reduce the effects of the low and high frequencies with respect to the medium frequencies. The resultant sound level is said to be A-weighted, and the units are dBA. The A-weighted sound level is also called the noise level.

Energy Equivalent Level (L_{eq})

Because sound levels can vary markedly in intensity over a short period of time, some method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, one describes ambient sounds in terms of an average level that has the same acoustic energy as the summation of all the time-varying events.

This energy-equivalent sound/noise descriptor is called L_{eq} . In this report, unless otherwise stated, an hourly period is used.

Field Sound Transmission Class (FSTC)

A single number rating similar to STC, except that the transmission loss values used to derive the FSTC are measured in the field. All sound transmitted from the source room to the receiving room is assumed to be through the separating wall or floor-ceiling assembly.

Noise Reduction (NR)

Noise reduction is the difference between outdoor sound level and indoor sound level. It is not identical to Sound Transmission Class.

Outdoor-Indoor Transmission Class (OITC)

A single number classification, specified by the American Society for Testing and Materials (ASTM E 1332 issued 1994), that establishes the A-weighted sound level reduction provided by building facade components (walls, doors, windows, and combinations thereof), based upon a reference sound spectrum that is an average of typical air, road, and rail transportation sources. The OITC is the preferred rating when exterior façade components are exposed to a noise environment dominated by transportation sources. Once built, as much as a 5-point reduction in Apparent Outside-Inside Transmission Class (OITC) from the original, as-designed OITC may be expected.

Percentile Sound Level, L_n

The noise level exceeded during n percent of the measurement period, where n is a number between 0 and 100 (e.g., L_{10} or L_{90})

Sound Transmission Class (STC)

STC is a single number rating, specified by the American Society for Testing and Materials, which can be used to measure the sound insulation properties for comparing the sound transmission capability, in decibels, of interior building partitions for noise sources such as speech, radio, and television. It is used extensively for rating sound insulation characteristics of building materials and products.

Structure-Borne Sound

Sound propagating through building structure. Rapidly fluctuating elastic waves in gypsum board, joists, studs, etc.

Sound Exposure Level (SEL)

SEL is the sound exposure level, defined as a single number rating indicating the total energy of a discrete noise-generating event (e.g., an aircraft flyover) compressed into a 1-second time duration. This level is handy as a consistent rating method that may be combined with other SEL and L_{eq} readings to provide a complete noise scenario for measurements and predictions.

However, care must be taken in the use of these values since they may be misleading because their numeric value is higher than any sound level which existed during the measurement period.

Subjective Loudness Level

In addition to precision measurement of sound level changes, there is a subjective characteristic which describes how most people respond to sound:

- A change in sound level of 3 dBA is *barely perceptible* by most listeners.
- A change in level of 6 dBA is *clearly perceptible*.

- A change of 10 dBA is perceived by most people as being *twice* (or *half*) as loud.

8.3 SoundPLAN® Acoustics Software

SoundPLAN®, the software used for this acoustic analysis, is an acoustic ray-tracing program dedicated to the prediction of noise in the environment. Noise emitted by various sources propagates and disperses over a given terrain in accordance with the laws of physics. The software calculates sound attenuation of environmental noise, even over complex terrain, uneven ground conditions, and with complex obstacles. Up to three reflections for each noise source are taken into account to closely and accurately predict real-world acoustics. Worldwide, governments and engineering associations have created algorithms to calculate acoustical phenomena to standardize the assessment of physical scenarios. Accuracy has been validated in published studies to be ± 2.7 dBA with an 85% confidence level, for a wide variety of large-scale models and situations.

8.4 ISO 9613-2

For industrial and other noise sources besides road traffic, SoundPLAN calculates the sound field in accordance with ISO 9613-2 “Acoustics - Attenuation of sound during propagation outdoors, Part 2: General Method of Calculation.” The standard states that “this part of ISO 9613 specifies an engineering method for calculating the attenuation of sound during propagation outdoors, in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level under meteorological conditions favorable to propagation from sources of known sound emissions. These conditions are for downwind propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs at night.” The uncertainty of calculations with this method are ± 1 dB for sources less than 10m in height and within 1000m of the receiver.

8.5 Traffic Noise Model (TNM)

The Federal Highway Administration Traffic Noise Model (TNM), implemented into the SoundPLAN® software, was used for the road traffic sound level modeling in this study. TNM contains the following components:

1. Modeling of five standard vehicle types, including automobiles, medium trucks, heavy trucks, buses, and motorcycles, as well as user-defined vehicles.
2. Modeling both constant- and interrupted-flow traffic using a field-measured database.
3. Modeling effects of different pavement types, as well as the effects of graded roadways.
4. Sound level computations based on a one-third octave-band data base and algorithms.
5. Graphically-interactive noise barrier design and optimization.
6. Attenuation over/through rows of buildings and dense vegetation.
7. Multiple diffraction analysis.
8. Parallel barrier analysis.
9. Contour analysis, including sound level contours, barrier insertion loss contours, and sound-level difference contours.

These components are supported by a scientifically founded and experimentally calibrated acoustic computation methodology, as well as a flexible database, made up of over 6000 individual pass-by events measured at forty sites across the country.

8.6 Self-Management of Sound Levels

Because it is difficult for anyone to discern differences in source levels, there are some commercially available tools that laypeople, DJ's, and others may use to self-manage and accurately measure and control sound levels created at these events.

Smartphone apps are inaccurate since they rely on an uncalibrated internal microphone; studies have shown that they can be off by 10 dB or more from the accurate/actual sound level.

There are many commercial solutions for monitoring sound levels at a given location that may be of assistance in maintaining good neighbor relationships. Below are two such solutions we suggest if the Client wishes to monitor their own sound levels:

- [Studio Six Digital](#) offers a suite of affordable smartphone apps called “Audio Tools” for Apple-brand devices (e.g., iPhone or iPod). When a Class 2 (survey grade) or Class 1 (precision grade) external microphone is plugged into such a device, and calibrated using a microphone calibrator, accurate sound levels may be acquired. Their website lists several compliant microphone options.
- Class 1 high-precision meters and calibrators are “engineering grade”, while Class 2 are mid-grade accuracy, lower cost, and suitable for use by laypeople in the field while still allowing for accurate measurements. For an extremely affordable standalone Class 2 sound level meter, SoftdB's Piccolo and Piccolo II are sold in the USA through [Scantek, Inc.](#) This would allow for a permanent sound level monitoring “station” at any desired location without the need for an Apple product.
- Any sound measurement device should be calibrated using a calibrator in order to continually ensure that the device/meter is calibrated to report accurate sound levels. A Class 2 calibrator can be purchased from many suppliers for a few hundred dollars.
- **45dB** is available to consult with business owners wishing to monitor their own sound emission. Be wary of cheap products sold on Amazon or other marketplaces—if it is not IEC/ANSI certified as a Class/Type 1 or 2 device, and unable to be calibrated with an ANSI Type 1 or 2 calibrator, it is not credible, official, or to be relied upon.