ENVIRONMENTAL NOISE ASSESSMENT
Azari Vineyards Tasting Room

1321 Spring Hill Road, Petaluma
Sonoma County, California

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INTRODUCTION

This report summarizes the assessment of noise resulting from the proposed Azari Vineyards Tasting Room at 1321 Spring Hill Road near the City of Petaluma in unincorporated Sonoma County. This assessment was completed with respect to the regulatory criteria established by the Sonoma County General Plan and the Sonoma County Guidelines for the Preparation of Noise Analysis. The report first describes the project, and then summarizes the applicable regulatory criteria used in the assessment. Existing noise levels in the project vicinity are described, followed by evaluations of project-generated noise levels. A brief discussion of the fundamentals of environmental noise and vibration is presented in Appendix A for those unfamiliar with acoustical terms or concepts.

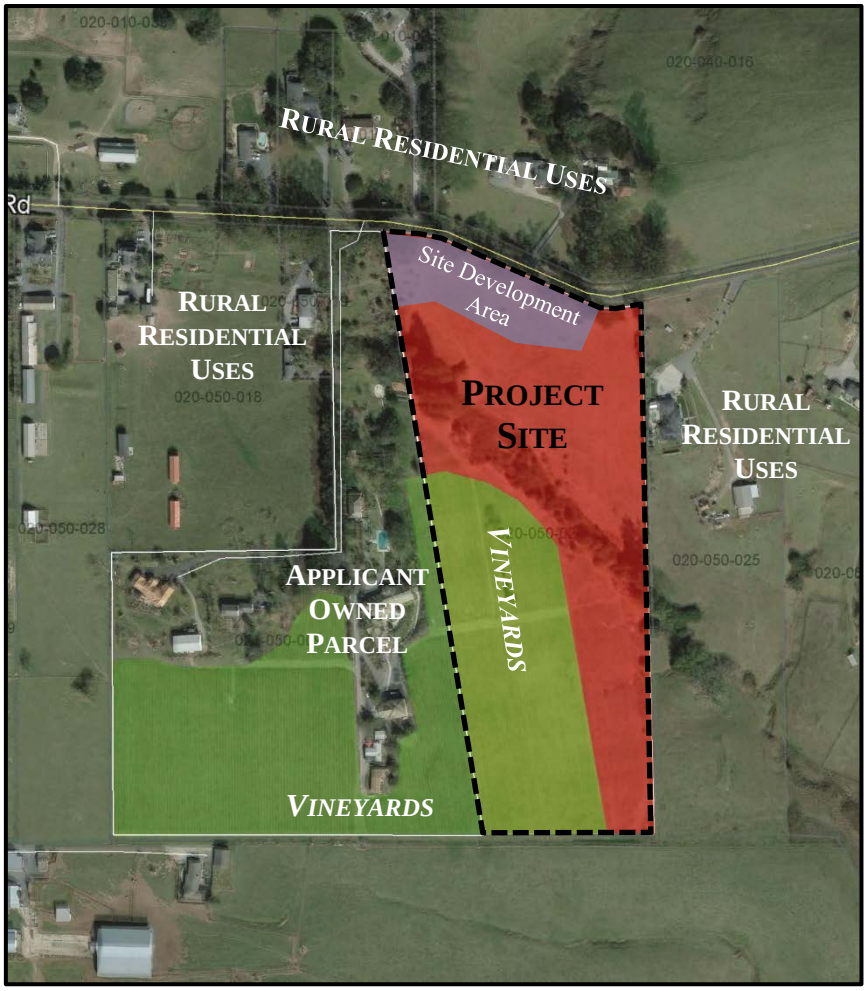


Figure 1: Project site and Surroundings

PROJECT DESCRIPTION

The Use Permit proposal for the development of the Tasting Room at 1321 Spring Hill Road west of the City of Petaluma (see Figure 1) describes the project as follows:

1. A new 2,809 square foot tasting room building with approximately 2,409 square foot tasting area and 400 square foot food preparation area. Restrooms are proposed in a separate 302 square foot building. Hours of operation for the tasting room will be Thursday-Sunday between 11am to 5pm.
2. Approximately 4,973 square feet of patio/walkways are proposed around the perimeter of the proposed tasting room building with an approximately 2,000 square foot patio/terrace for viewing west of the proposed tasting room,
3. Two new driveways to allow access to the proposed parking lot from Spring Hill Road,
4. The new tasting room will hold 10 Special Events (8 Agricultural Promotional Events, 2 Industry Wide Events) per year with 200 guests per Event. Special Events will utilize music and amplified sound and will be held between the hours of 11am-5pm, and
5. A new parking lot adjacent to the tasting room building with 28 regular parking spaces and 2 handicap parking spaces. An overflow parking area with 53 regular parking spaces will be located to the east.

NOISE ANALYSIS STUDY AREA

The project site is located in the unincorporated Sonoma County west of the City of Petaluma on the northern unplanted portion of a sloping vineyard parcel which overlooks rural residential and agricultural lands to the south and east. The project site is bordered by rural residential uses to the east, Spring Hill Road and rural residential uses beyond to the north, Azari vineyards lands and winery buildings to the west, and agricultural lands to the south.

REGULATORY BACKGROUND

Goals, objectives, and policies designed to protect noise-sensitive uses from exposure to excessive noise are set forth in the Noise Element of the Sonoma General Plan 2020. The primary goal of the Noise Element is to "Protect people from the adverse effects of exposure to excessive noise bad to achieve an environment in which people and land uses function without impairment from noise." Objectives and policies of the Noise Element that are applicable in the assessment of the proposed project are as follows:

Objective NE-1.1: Provide noise exposure information so that noise impacts may be effectively evaluated in land use planning and project review.

Objective NE-1.2: Develop and implement measures to avoid exposure of people to excessive noise levels.

Objective NE-1.3: Protect the present noise environment and prevent intrusion of new noise sources which would substantially alter the noise environment.

Objective NE-1.4: Mitigate noise from recreational and visitor serving uses.

Policy NE-1a: Designate areas within Sonoma County as noise impacted if they are exposed to existing or projected exterior noise levels exceeding 60 dB Ldn, 60 dB CNEL, or the performance standards of Table NE-2.

Policy NE-1b: Avoid noise sensitive land use development in noise impacted areas unless effective measures are included to reduce noise levels. For noise due to traffic on public roadways, railroads and airports, reduce exterior noise to 60 dBA Ldn or less in outdoor activity areas and interior noise levels to 45 dBA Ldn or less with windows and doors closed. Where it is not possible to meet this 60 dBA Ldn standard using practical application of best available noise reduction technology, a maximum level up to 65 dBA Ldn may be allowed but interior noise level shall be maintained so as not to exceed 45 dBA Ldn. For uses such as Single Room Occupancy, Work-Live, Mixed Use Projects and Caretaker Units, exterior noise levels above 65 dBA Ldn or the Table NE-2 standards may be considered if the interior standards of 45 dBA Ldn can be met. For schools, libraries, offices, and other similar uses, the interior noise standard shall be 45 dBA Leq in the worst-case hours when the building is in use.

Policy NE-1c: Control non-transportation related noise from new projects. The total noise level resulting from new sources shall not exceed the standards in Table NE-2 as measured at the exterior property line of any adjacent noise sensitive land use. Limit exceptions to the following:

(1) If the ambient noise level exceeds the standard in Table NE-2, adjust the standard to equal the ambient level, up to a maximum of 5 dBA above the standard, provided that no measurable increase (i.e. +/- 1.5 dBA) shall be allowed.

(2) Reduce the applicable standards in Table NE-2 by five dBA for simple tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises, such as pile drivers and dog barking at kennels.

(3) Reduce the applicable standards in Table NE-2 by 5 decibels if the proposed use exceeds the ambient level by 10 or more decibels

(4) For short term noise sources which are permitted to operate no more than six days per year, such as concerts or race events, the allowable noise exposures shown in Table NE-2 may be increased by 5 dB. These events shall be subject to a noise management plan including provisions for maximum noise level limits, noise monitoring, complaint response and allowable hours of operation. The plan shall address potential cumulative noise impacts from all events in the area.

(5) Noise levels may be measured at the location of the outdoor activity area of the noise sensitive land use, instead of the exterior property line of the adjacent noise sensitive land use where:

(a) the property on which the noise sensitive use is located has already been substantially developed pursuant to its existing zoning, and

(b) there is available open land on those noise sensitive lands for noise attenuation.

This exception may not be used on vacant properties which are zoned to allow noise sensitive uses.

TABLE NE-2 :
Maximum Allowable Exterior Noise Exposures for Non-transportation Noise Sources

Hourly Noise Metric[1], dBA	Daytime: 7 am to 10 pm	Nighttime: 10 pm to 7 am
L_{50} (30 minutes in any hour)	50	45
L_{25} (15 minutes in any hour)	55	50
L_{08} (5 minutes in any hour)	60	55
L_{02} (1 minute in any hour)	65	60

[1] The sound level exceeded n% of the time in any hour. For example, the L_{50} is the value exceeded 50% of the time or 30 minutes in any hour; this is the median noise level. The L_{02} is the sound level exceeded 1 minute in any hour.

It is clear for the footnote of Table NE-2 that the applicable noise standard is based on the *"sound level exceeded n% of the time in any hour"*, such that the L_{50} is the value exceeded 50% of the time or 30 minutes in any hour or more, the L_{25} is the value exceeded 25% of the time or 15 minutes in any hour or more, L_{08} is the value exceeded 8% of the time or 5 minutes in any hour or more, and the L_{02} is the value exceeded 2% of the time or 1 minute in any hour or more.

Policy NE-1d: Consider requiring an acoustical analysis prior to approval of any discretionary project involving a potentially significant new noise source or a noise sensitive land use in a noise impacted area.

Policy NE-1e: Continue to follow building permit procedures to ensure that requirements based upon the acoustical analysis are implemented.

Policy NE-1f: Require development projects that do not include or affect residential uses or other noise sensitive uses to include noise mitigation measures where necessary to maintain noise levels compatible with activities planned for the project site and vicinity.

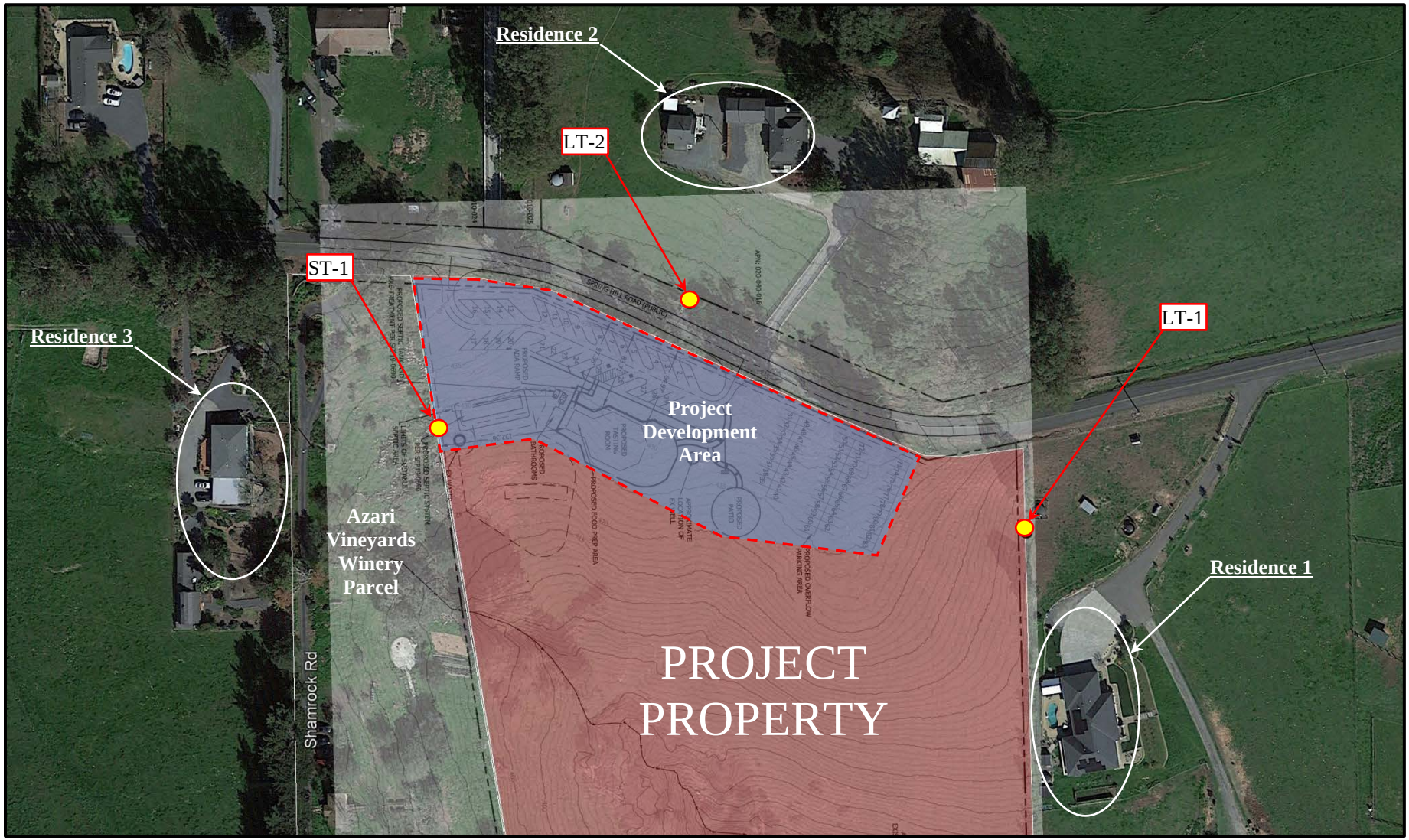


Figure 2: Project Site Development Area, Surrounding uses and Noise Measurement Locations

EXISTING NOISE ENVIRONMENT

A noise survey was conducted between Friday, June 11th and Tuesday, June 15th, 2021 to document existing noise conditions at the closest noise sensitive rural residential property lines to the proposed tasting room and event activities. The noise monitoring survey included two long-term (96-hour duration) measurement and one short term (10-minute duration) measurement. The measurement locations, the proposed project development area, and the closest adjacent non-applicant owned residential uses shown in Figure 2. The noise levels were measured with Larson-Davis LXT Type I sound level meters fitted with ½-inch pre-polarized condenser microphones and windscreens. The meters were calibrated before and after the surveys with a Larson Davis acoustical calibrator.

The first long-term sound level measurement (see LT-1 in Figure 2) was made on the eastern side of the site on the property line of the nearest residence to the east as shown in Figure 2 and identified as Residence 1. The monitoring equipment was installed in the branches of an existing redwood tree on the property line at a height of approximately 10 feet above the surrounding grade and at a distance of approximately 110 feet from the centerline of Spring Hill Road.

Noise levels measured at this site primarily resulted from afternoon and evening wind on the leaves of area Eucalyptus trees, distant sound from passing vehicles on the Spring Hill Road, with sounds from the use of the adjacent residence and the existing vineyard activities also contributing to background sound levels during low winds or periods without vehicles passing on the roadway. The noise measurement results at this location are considered representative of the noise exposure at the near project property line shared with Residence 1 as identified in Figure 2. The hourly trend in noise levels at this location, including the energy equivalent noise level (L_{eq}), maximum (L_{max}), minimum (L_{min}), and the noise levels exceeded 2, 8, 25, and 50 percent of the time (indicated as L_2, L_8, L_{25}, and L_{50}) are shown on Chart 1, following.

A review of Chart 1 shows that the average weekday noise levels at LT-1 ranged from 37 to 62 dBA L_{eq} during the day, and 27 to 57 dBA L_{eq} at night, and average weekend noise levels ranged from 39 to 62 dBA L_{eq} during the day and 29 to 52 dBA L_{eq} at night. The calculated average day/night noise level (L_{dn}) at this location was 58 dBA for weekdays and 55 dBA for weekends. The average, maximum, minimum levels measured for the daytime and nighttime periods for the entire LT-1 measurement along with the corresponding Sonoma County Table NE-2 Noise Standards are shown in Table 3, following.

The second long-term sound level measurement (see LT-2 in Figure 2) was made on the northern side of Spring Hill Road at the property of the nearest residence to the north as shown in Figure 2 and identified as Residence 2. The monitoring equipment was installed on a utility pole at a height of approximately 10 feet above grade and at a distance of approximately 25 feet from the centerline of Spring Hill Road.

Noise levels measured at this site also resulted from afternoon and evening wind on the leaves of area trees and the sound of passing vehicles on the Spring Hill Road, with sounds from the use of the adjacent residences and area agricultural activities also contributing to background sound levels. The noise measurement results at this location are considered representative of the noise exposure at the project property line shared with Residence 2. The hourly trend in noise levels at this location are shown on Chart 2, following.

A review of Chart 2 shows that the average weekday noise levels at LT-2 ranged from 50 to 64 dBA L_{eq} during the day, and 32 to 52 dBA L_{eq} at night, and average weekend noise levels ranged from 49 to 62 dBA L_{eq} during the day and 41 to 51 dBA L_{eq} at night. The calculated average day/night noise level (L_{dn}) at this location was 60 dBA for weekdays and 57 dBA for weekends.

The average, maximum, minimum levels measured for the daytime and nighttime periods for the entire measurement period at LT-2 along with the corresponding Sonoma County Table NE-2 Noise Standards are shown in Table 1, below.

Table 1: Comparison of Long-term Noise Measurements and Sonoma County Noise Standards

Type of Level		Noise Levels at LT-1, dBA				Noise Levels at LT-2, dBA			
		L_{50}	L_{25}	L_8	L_2	L_{50}	L_{25}	L_8	L_2
Daytime Levels	NE-2 Noise Standard	50	55	60	65	50	55	60	65
	Measured Ambient Level[1]	**38**	**42**	**47**	**52**	**43**	**46**	**51**	**60**
	Measured Range (Max/Min)	*59/31*	*63/34*	*66/38*	*69/44*	*57/31*	*59/34*	*63/41*	*69/53*
Nighttime Levels	NE-2 Noise Standard	45	50	55	60	45	50	55	60
	Measured Ambient Level[1]	**29**	**31**	**33**	**37**	**32**	**34**	**35**	**40**
	Measured Range (Max/Min)	*54/24*	*57/24*	*60/27*	*62/31*	*52/29*	*54/29*	*55/30*	*63/35*

[1] Calculated based on an average of the four quietest L_{eq} for daytime or nighttime hours in each 24-hour period

The short-term sound level measurement (see ST-1 in Figure 1) was made simultaneously with measurements at both long-term monitoring sites on the western property line of the site development area shared the adjacent Azari winery parcel to the west and closest to Residence 3 as identified in Figure 2. This measurement was conducted between 1:40 and 1:50 pm on June 15th, 2021 at a height of 5 feet above grade and approximately 180 feet from the centerline of Spring Hill Road. The measurement results at this location are at the same setback from Spring Hill Road as Residence 3 as shown in Figure 2, so are considered representative of ambient conditions at the near property line of this non applicant owned property.

The average day-night noise level (L_{dn}) at the short-term measurement locations was estimated by correlating the short-term measurement data to the data gathered during the corresponding period of time at the long-term site. The short-term measurement and simultaneous measurement results at the long-term locations are shown in Table 2.

Table 2: Summary of Short-Term Noise Measurement Data, dBA

Noise Measurement Location	L_{50}	L_{25}	L_{eq}	L_{08}	L_{02}	Weekday L_{dn}	Weekend L_{dn}
ST-1: Western Property line	49	51	51	55	59	**51**	**48**
LT-1: Eastern Property line	62	61	64	67	70	**58**	**55**
LT-2: Northern Property line	56	57	61	66	73	**60**	**57**

Note: L_{dn} is approximated by correlation to the corresponding measurement period at the long-term sites.

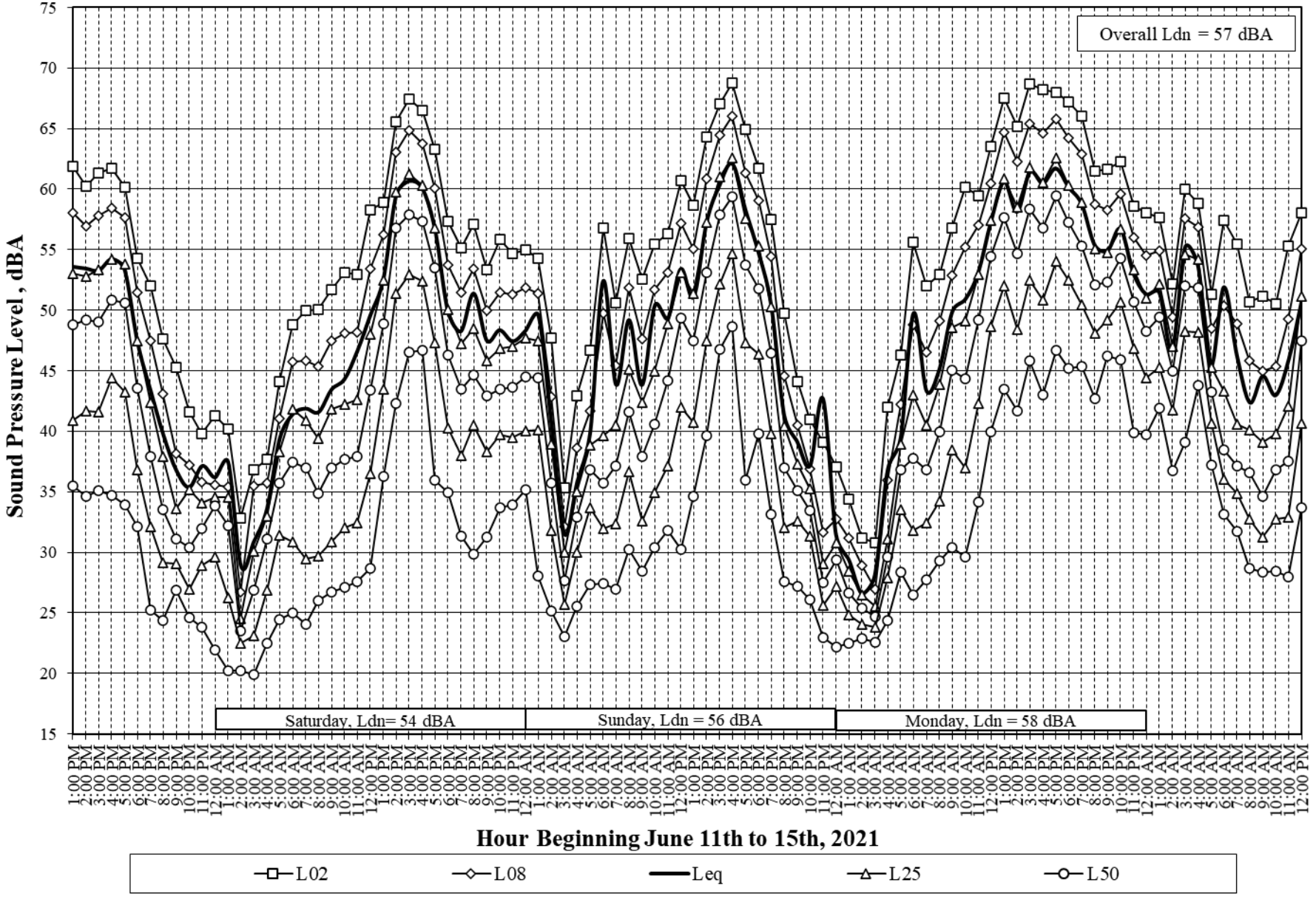
Based on the noise measurement results the daytime and nighttime noise descriptors used to interpret the County's Noise Standards at the near property lines of the closest identified noise sensitive uses (Residences 1, 2, & 3 in Figure 2) have been established using the measurement results and the differences between the long and short-term measurements. The results are shown in Table 3.

Table 3: Noise Levels at property lines of adjacent Residential Uses

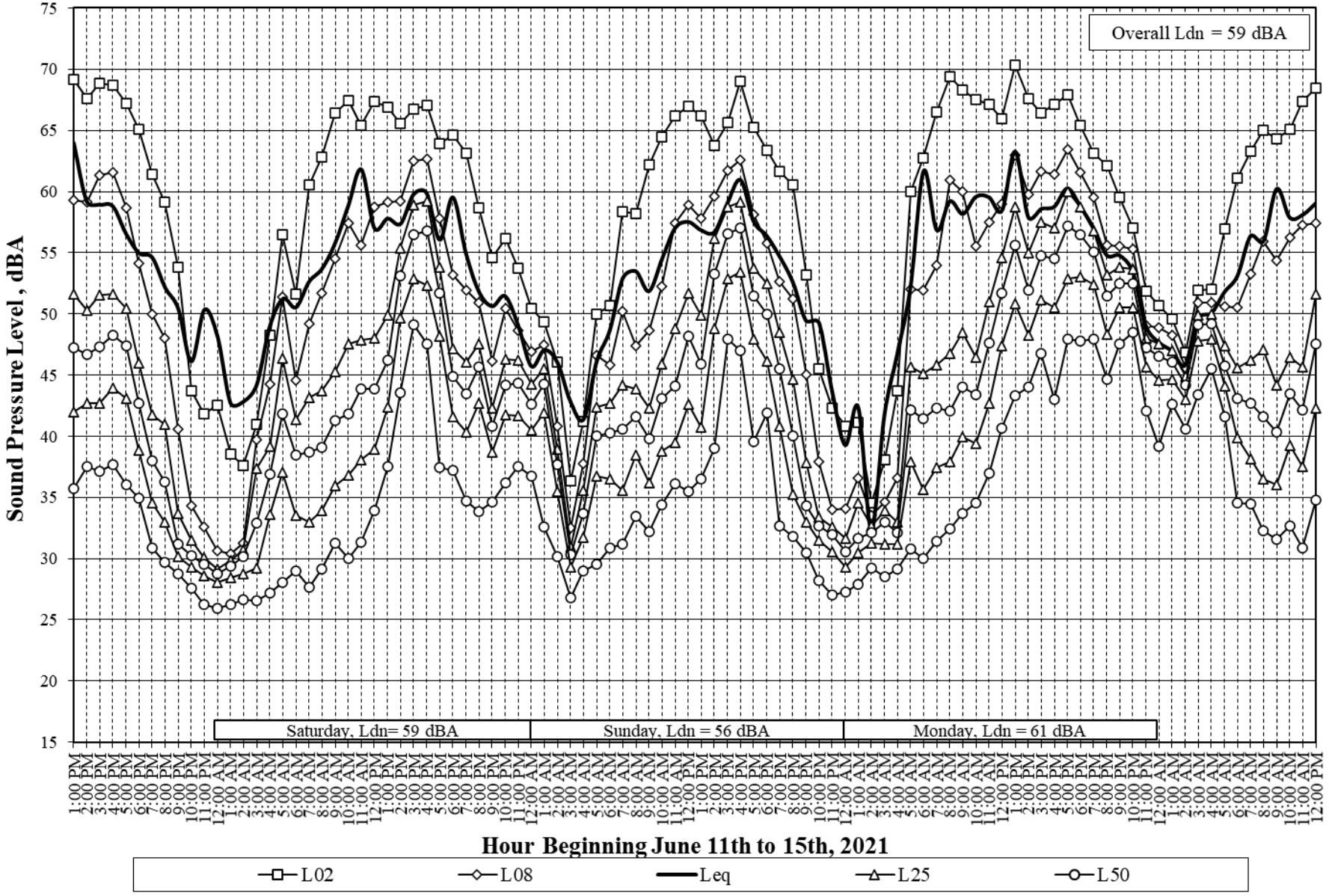
Hourly Noise Metric	Exterior Ambient Noise Levels, dBA[1]					
	Residence 1 (LT-1)		Residence 2 (LT-2)		Residence 3 (ST-1)	
	Daytime	Nighttime	Daytime	Nighttime	Daytime	Nighttime
L_{50} (30 Min.)	38	29	43	32	35	24
L_{25} (15 Min.)	42	31	46	34	38	26
L_{08} (5 Min.)	47	33	51	35	43	27
L_{02} (1 Min.)	52	37	60	40	51	33

[1] Based on an average of the four quietest L_{eq} for daytime or nighttime hours in each 24-hour period

LT-1 Hourly Measurement Data



LT-2 Hourly Measurement Data



NOISE IMPACT ANALYSIS

Estimating the expected noise produced by, and impacts from, the proposed changes to the existing use permit at adjacent noise sensitive uses requires three elements; the first is an assessment of what noise producing operations are likely to occur, the second is typical noise source levels for those operations, and the third is to determine the temporal nature of the operations.

I. Identification of Noise Producing operations/uses

There are several operations associated with tasting room use and events at the proposed facility that will produce noise. These include:

1. Parking and On-site Visitor Traffic,
2. Tasting room activities, and
3. Promotional Event and Activity Noise.

II. Typical Noise Source Levels

To estimate the noise levels associated with project operations, some attention must be given to the temporal nature of the noise produced. Below each of the major winery related noise producing operations outlined above are discussed:

Tasting Room and Event Activity Vehicle Noise

Guest and employee automobile and light vehicle traffic to and from the tasting room, activities and events would reach the facility via the existing access driveways on the site. This traffic will occur during the daytime hours and noise produced is expected to include the sounds of vehicles accessing the site from Spring Hill Road along with noise from engine starts and door slams in the parking areas. These noises typically produce maximum (L_{max}) sound levels ranging from of 53 dBA to 63 dBA at 50 feet, with average maximum sound level sound levels of 58 dBA. Automobile and light vehicle traffic traveling at constant speeds on the access driveway would be expected to produce a sound level of 56 dBA at 50 feet[1].

Wine Tasting Activities

Wine tasting activities will occur within the interior of the proposed winery building and patio/terrace during normal business hours, between 10am-5pm. These activities are expected to be comprised of small sized groups of patrons in conversation and some background music within the production building tasting room. Based on a consideration of published[2] relaxed, normal and raised conversational voice levels, the sound levels from groups of 5 to 15 patrons could range from 47 to 67 dBA at 10 feet within the tasting room and between 39 to 59 dBA at 25 feet outdoors.

Promotional Event and Activity Noise

The project requests up to a total of 10 Special Events (8 Agricultural Promotional Events, 2 Industry Wide Events) per year with up to 200 guests per event. These special events will utilize music and amplified sound and will be held between the hours of 11am-5pm. Table 4, following, summarizes typical noise levels generated by moderate to large sized events at distances of 50 feet from the source which have been developed from measurements conducted by Illingworth & Rodkin at events in the Northbay and throughout the Bay Area.

[1] Reported sound levels are calculated considering a driveway speed of 20 mph with the use of the California Vehicle Noise Reference Energy Mean Emissions Levels (REMELS) per Cal Trans Technical Advisory, Noise TAN 95-03, Page 2.

[2] Harris, Cyril M., "Effects of Noise on Speech", *Handbook of Noise Control*, 2nd Ed., McGraw Hill, 1979, Pg. 14-2

Table 4: Typical Noise Source Levels for Events (A-Weighted L_{eq} Levels)

Event or Activity	Typical Noise Level @ 50 ft.
Amplified Music Performances	72 dBA[1]
Amplified Speech	70 dBA
Non-amplified (acoustic) Music Performances	67 dBA[1]
20 Guests in Raised Conversation with Background Music	54 dBA
50 Guests in Raised Conversation with Background Music	58 dBA
100 Guests in Raised Conversation with Background Music	61 dBA
200 Guests in Raised Conversation with Background Music	66 dBA

[1] Based on the results of measurements conducted at wineries and other event venues, I&R has found that Music performances are louder than multiple (100 person) guests with background music. In general, we have found that when music is only used as a background for dinner, tasting, and similar events it is played at a lower level to encourage conversation. Conversely, where Music performances are a focal point of an event, they typically produce higher sound levels than simple background music.

Based upon a review of the project plans and experience with other wineries, events may occur inside the Tasting Room Building and outside on the Patio/Terrace Patio shown in Figure 3.

III. Propagation of sound

The final step in estimating the project noise levels is assessing the propagation of sound to the sensitive receptors. To do this, it is necessary to assume some rate of sound attenuation between the operations and receiver locations. The most dominant physical effect is due to the spreading out of sound waves with distance. Depending on ground absorption conditions noise from traffic noise sources can be considered to attenuate at 3 to 4.5 dB per doubling of distance from the source while noise from fixed project source can be considered to attenuate at a rate of 6 to 7.5 dB per doubling of distance from the source. Considering the vegetative over much of the site, distance attenuation rates of 4.5 dB per distance doubling for traffic noise sources and 7.5 dB per distance doubling for fixed noise sources are used in this analysis. Other effects can modify these fall-off rates such as partial shielding from buildings or topography, atmospheric attenuation of sound, and meteorological effects. These effects almost always reduce the noise in addition to that due to sound divergence. As most of these effects will vary with time due to changing environmental conditions, it is most conservative to assume only attenuation due to divergence for outdoor activities, minimum terrain or building shielding factors (6 dBA) where intervening terrain or structures break the line of sight from source to receiver. Where operations and events take place within a building structure a minimum building interior to exterior attenuation rate of 12 dBA is considered for non-conditioned spaces where windows and/or exterior doors may b e open when not in use and a minimum interior to exterior attenuation rate of 20 dBA is used for conditioned spaces where doors and windows are typically maintained in closed positions when not in use.

NOISE IMPACT ASSESSMENT

The project proposes to construct a new 2,809 square foot Tasting Room on the parcel at 1321 Spring Hill Road, immediately east of the parcel where the Azari Vineyards winery is located. Other site improvements will include:

1. Patios/walkways at around the perimeter of the tasting room building,
2. An approximately 2,000 square foot patio/terrace,
3. A new parking lot adjacent to the tasting room building with contain 28 regular parking spaces and 2 handicap parking spaces, and
4. Two new driveways to allow access to the Tasting Room parking lot from Spring Hill Road.

The proposed site development plan is shown in Figure 3, following.

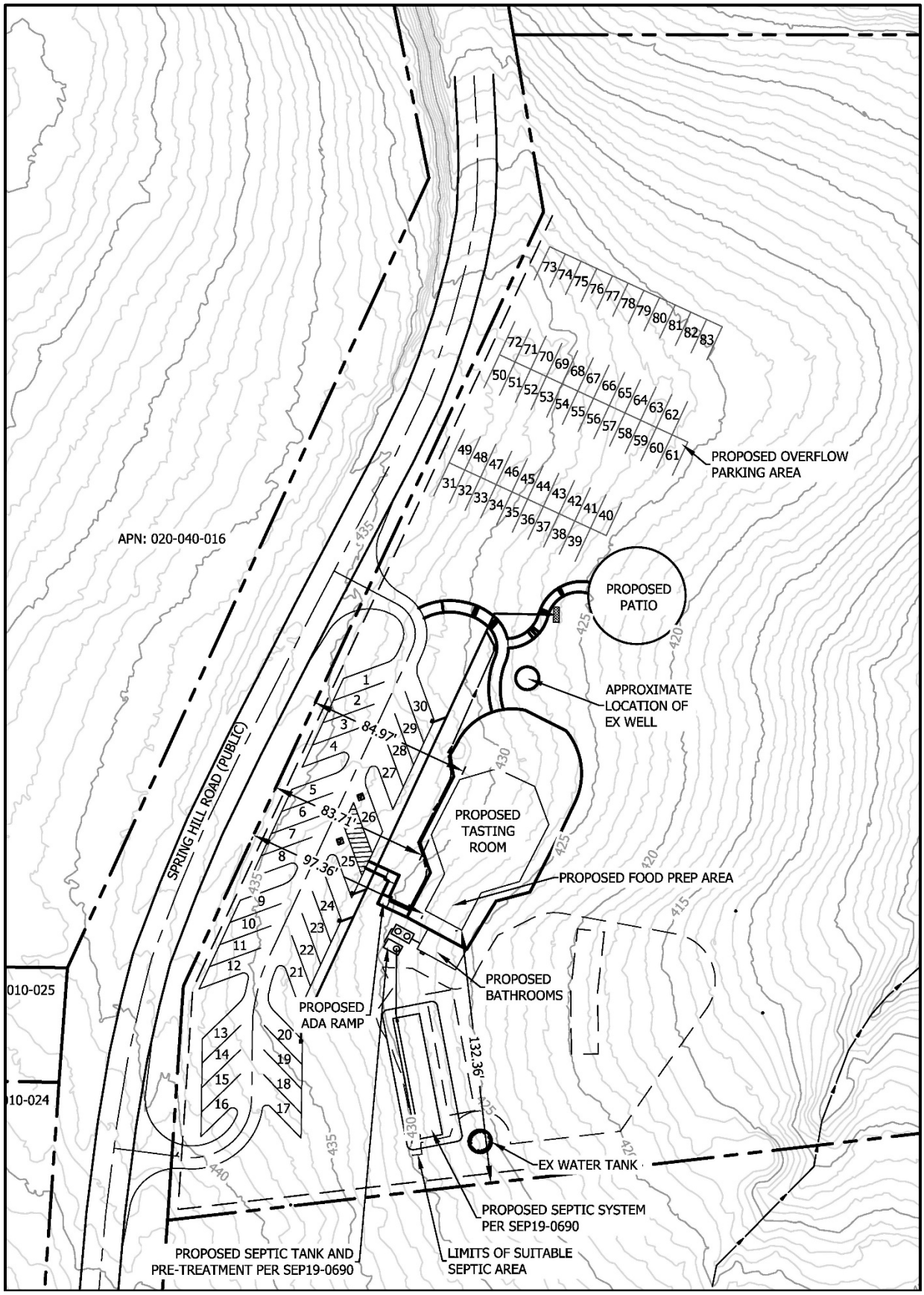


Figure 3: Site Development Plan

Impact 1: Vehicle Parking Lot Activities

The project proposes a paved parking lot on the northern side of the site adjacent to Spring Hill Road with 28 regular and 2 handicap parking spaces and an overflow parking area with 53 regular parking spaces to the east in order to accommodate attendees during events. Vehicle circulation, engine starts, and door slams on the site would be the primary sources of noise associated with the parking lots. For this analysis the center of the parking areas is assumed to credibly represent the acoustic center of parking lot noise sources. Based on a review of the project site plan and distance information obtained via Goggle Earth[3], the closest non-applicant noise sensitive use to the parking areas will be Residences 1, 2 and 3 as shown in Figure 2. The property line of these residences will, respectively, be approximately 200, 90, and 300 feet from the center of the main or overflow parking areas. Other noise sensitive non-applicant owned residential uses in the project vicinity will be at greater distances from these driveway and parking areas.

Given the small size of the f tasting room proposed, most visitor parking is expected to occur in the eastern parking areas adjacent to Spring Hill Road though if needed, overflow parking will be accommodated in the overflow parking area. Considering these distances to the near (non-applicant owned) rural residential property lines and the source levels discussed above, the average maximum noise generated by automobile and light vehicles in the parking areas would be 46 dBA, 53 dBA and 42 dBA at the respective property lines of Residences 1, 2, and 3.

Given the expected visitor and employee use, the maximum noise levels produced by engine starts and door slams would be expected to occur for less than 15 minutes out of an hour and fall in the 5 to 15 minutes per hour or the L_{08} NE-2 daytime category of 60 dBA (see Table 3). Table 5, following, presents and summarizes the assessment of passenger vehicle noise.

Table 5: Parking Lot Noise Levels

	L_{08} (Noise Level Exceeded 5 to 15 min. in an Hour), dBA		
	Residence number (see Figure 2)		
	1	**2**	**3**
Unadjusted Table NE-2 Daytime Limit	60	60	60
Daytime Ambient Noise Levels (see Table 3)	*47*	*51*	*43*
Parking lot Noise at Receiver	46	53	42
Operations Exceed Ambient by 10 dBA?	No	No	No
NE-2 Adjustment	0	0	0
Adjusted Table NE-2 Daytime Limit	60	60	60
Parking Lot Noise Exceeds NE-2?	**No**	**No**	**No**

Considering the findings shown in Table 5, noise levels associated with automobiles and light vehicles in the winery parking areas would not exceed the daytime NE-2 noise standards at the property lines of the closest adjacent residences.

Impact 2: Tasting Room Activities

Wine tasting activities will occur from Thursday through Sunday between 11am and 5pm within the interior of the new Tasting Room Building with the possibility of small groups of tasters at outdoor patios adjacent to the tasting room building or at the viewing patio to the east. Based on a review of the project site plan, the interior of the Tasting Room will be as close as 400, 140, and 280 feet from the respective property lines of Residences 1,2, and 3, while the outdoor tastings could occur as close as 300, 135, and 450 feet from these respective property lines. Other noise

[3] The distances determined from Google Earth are the line of sight distances, not the distances over intervening terrain or buildings, which may be greater.

sensitive residential uses in the project vicinity will be further from these areas. Considering this, along with the source levels discussed above, and that the tasting room is proposed to accommodate 20 wine tasters a day, the sound level produced by 10 to 15 guests[4] in raised conversation[5] within the Tasting Room would be between 21 to 23 dBA at the property line of Residence 1, between 30 to 32 dBA at the property line of Residence 2, and between 24 to 26 dBA at the property line of Residence 3. With the same number of tasting room guests outdoors in raised conversation the sound levels would be between 35 to 37 dBA at the property line of Residence 1, between 42 to 44 dBA at the property line of Residence 2, and between 35 to 37 dBA at the property line of Residence 3. Table 6 following presents and summarize the assessment of tasting room related noise versus County Noise Standards.

Table 6: Tasting Room L_{50} Noise Levels

	L_{50} (Noise Level Exceeded 30 min. or more in an Hour), dBA		
	Residence number (see Figure 2)		
	1	**2**	**3**
Unadjusted Table NE-2 Daytime Limit	50	50	50
NE-2 Adjustment for speech and/or music	-5	-5	-5
Daytime Ambient Noise Levels (see Table 3)	*38*	*43*	*35*
Interior Tasting Room sound at Receiver	21 to 23	30 to 32	24 to 26
Exterior Tasting Room sound at Receiver	35 to 37	42 to 44	35 to 37
Operations Exceed Ambient by 10 dBA?	No	No	No
NE-2 Adjustment	0	0	0
Adjusted Table NE-2 Daytime Limit	45	45	45
Tasting Room Noise Exceeds NE-2?	**No**	**No**	**No**

Considering the findings shown in Table 6, the noise associated with Wine Tasting Activities would not result in noise levels which exceed the daytime NE-2 noise standards at the property lines of the closest identified adjacent residences.

Impact 3: Special Event Noise

The project requests 10 Special Events (8 Agricultural Promotional Events, 2 Industry Wide Events) per year with 200 guests per Event which will utilize music and amplified sound and will be held between the hours of 11am-5pm. These events are expected to be held within the new Tasting Room and the adjacent outdoor patios, with the possibility of event activities at the outdoor viewing patio to the east. All events will conclude by 10 pm, are thus considered a daytime only use per County Noise Standards.

A review of the development plan and distance information obtained via Goggle Earth indicates that indoor events could be as close as 400, 140 and 280 feet from the respective near property lines of Residences 1, 2, and 3. Though the events are expected to occur within winery buildings, because it is possible that events could occur outdoors at patios adjacent to the tasting room or at the outdoor viewing terrace to the east, event activities are also analyzed in these areas. A review of Goggle Earth information indicates that event activities in these areas could be as close as 300, 135 and 450 feet from the respective near property lines of Residences 1, 2, and 3. Using these distances and considering that indoor events would receive either a minimum 12 dBA of interior to exterior attenuation when windows and doors are open when not in use or a minimum of 20

[4] Based on the total daily visitation number of 20 tasters this number of tasting guests is considered the maximum number of guests that could reasonably be expected at the facility at any one time.

[5] Tasting room guests would are more commonly be expected to converse on normal or quiet voices, however, to conduct a conservative (worst case) analysis guests conversing in raised voices has been used.

dBA when windows and doors are maintained closed when not in use, and the L_{50} sound levels for events have been calculated at the near property lines of the closest adjacent residences. Table 7 presents and summarizes the assessment of Outdoor event related noise versus County Noise Standards and Tables 8a and 8b presents and summarizes the assessment of Indoor events related noise versus County Noise Standards.

Table 7: Outdoor Event L_{50} Noise Levels

	L_{50} (Noise Level exceeded 30 min. or more in an Hour)		
	Residence number (see Figure 2)		
Outdoor Event L_{50} Levels at Receivers	**1**	**2**	**3**
Unadjusted Table NE-2 Daytime Limit	50	50	50
NE-2 Adjustment for speech and/or music	-5	-5	-5
Daytime Ambient Noise Levels (see Table 3)	*38*	*43*	*35*
1. Amplified Music Performances	**56**	**63**	**53**
2. Amplified Speech	**54**	**61**	**51**
3. Non-amplified (acoustic) Music Performances	**51**	**58**	**48**
4. 20 Guests in Raised Conversation w/Bkg. Music	38	45	35
5. 50 Guests in Raised Conversation w/Bkg. Music	42	**49**	39
6. 100 Guests in Raised Conversation w/Bkg. Music	45	**52**	42
7. 200 Guests in Normal Conversation w/Bkg. Music	**50**	**57**	**47**
Events Exceed Ambient by 10 dBA?	**Yes:** 1,2,3,7 **No:** 4,5,6	**Yes:** 1,2,3,5,6,7 **No:** 4	**Yes:** 1,2,3,7 **No:** 4,5,6
Total NE-2 Adjustments: speech/music (0 or -5) ambient (0 or -5)	**-10:** 1,2,3,7 **-5:** 4,5,6	**-10:** 1,2,3,7 **-5:** 4,5,6	**-10:** 1,2,3,7 **5:** 4,5,6
Adjusted Table NE-2 Daytime Limit	**40:** 1,2,3,7 **45:** 4,5,6	**40:** 1,2,3,7 **45:** 4,5,6	**40:** 1,2,3,7 **45:** 4,5,6
Outdoor Event Noise Exceeds NE-2?	**Yes:** 1,2,3,7 **No:** 4,5,6	**Yes:** 1,2,3,5,6,7 **No:** 4	**Yes:** 1,2,3,7 **No:** 4,5,6

Considering the findings shown in Table 7, noise associated with music performances or amplified speech at outdoor events would exceed the County NE-2 standards at the property lines of all adjacent residences. Additionally, outdoor gatherings of more than 20 guests during events have the potential to exceed the County NE-2 standards at the property lines of the adjacent residences.

Based on this we recommend that winery events should not include outdoor music performances or amplified speech, that events be planned so as to take place largely within the proposed tasting room building, and that outdoor gatherings during events be limited to 20 guests or less to meet County NE-2 standards and limit the potential for noise disturbances at the property lines of adjacent residential uses.

Table 8a: Indoor Event L_{50} Noise Levels (windows and doors OPEN when not in use)

Indoor Event L_{50} Levels at Receivers with Windows and Doors OPEN when not in use	L_{50} (Noise Level exceeded 30 min. or more in an Hour) Residence number (see Figure 2)		
	1	**2**	**3**
Unadjusted Table NE-2 Daytime Limit	50	50	50
NE-2 Adjustment for speech and/or music	-5	-5	-5
Daytime Ambient Noise Levels (see Table 3)	*38*	*43*	*35*
1. Amplified Music Performances	42	**51**	**45**
2. Amplified Speech	40	**49**	43
3. Non-amplified (acoustic) Music Performances	37	**46**	40
4. 20 Guests in Raised Conversation w/Bkg. Music	24	33	27
5. 50 Guests in Raised Conversation w/Bkg. Music	28	37	31
6. 100 Guests in Raised Conversation w/Bkg. Music	31	40	34
7. 200 Guests in Normal Conversation w/Bkg. Music	36	45	39
Events Exceed Ambient by 10 dBA?	**No:** all	**No:** all	**Yes:** 1 **No:** all others
Total NE-2 Adjustments: speech/music (0 or -5) ambient (0 or -5)	**-5:** all	**-5:** all	**-10:** 1 **-5:** all others
Adjusted Table NE-2 Daytime Limit	45: all	45: all	40:1 45: all others
Indoor Event Noise Exceeds NE-2?	**No:** all	**Yes:** 1,2,3 **No:** 4,5,6,7	**Yes:** 1 **No:** all others

Table 8b: Indoor Event L_{50} Noise Levels (windows and doors CLOSED when not in use)

Indoor Event L_{50} Levels at Receivers with Windows and Doors CLOSED when not in use	L_{50} (Noise Level exceeded 30 min. or more in an Hour) Residence number (see Figure 2)		
	1	**2**	**3**
Unadjusted Table NE-2 Daytime Limit	50	50	50
NE-2 Adjustment for speech and/or music	-5	-5	-5
Daytime Ambient Noise Levels (see Table 3)	*38*	*43*	*35*
1. Amplified Music Performances	34	43	37
2. Amplified Speech	32	41	35
3. Non-amplified (acoustic) Music Performances	29	38	32
4. 20 Guests in Raised Conversation w/Bkg. Music	16	25	19
5. 50 Guests in Raised Conversation w/Bkg. Music	20	29	23
6. 100 Guests in Raised Conversation w/Bkg. Music	23	32	26
7. 200 Guests in Normal Conversation w/Bkg. Music	28	37	31
Events Exceed Ambient by more than 10 dBA?	**No:** all	**No:** all	**No:** all
Total NE-2 Adjustments: speech/music (0 or -5) ambient (0 or -5)	**-5:** all	**-5:** all	**-5:** all
Adjusted Table NE-2 Daytime Limit	45	45	45
Indoor Event Noise Exceeds NE-2?	**No:** all	**No:** all	**No:** all

Considering the findings shown in Tables 8a and 8b, noise associated with non-music performance related event sound would meet County NE-2 standards at the property lines of all adjacent residences with or without the tasting room windows and doors open. However, the findings shown in these tables indicate that noise associated with indoor music performances would exceed County NE-2 standards at the adjacent residential property lines the tasting room windows and doors open and comply with County NE-2 standards with closed windows and doors.

Based on this we recommend that winery events which include indoor music performances or amplified speech should only occur within the tasing room building with windows and doors closed to meet County NE-2 standards and limit the potential for noise disturbances at the property lines of adjacent residential uses.

Impact 4: Construction Noise

Noise impacts resulting from construction depend on the noise generated by various pieces of construction equipment, the timing and duration of noise-generating activities, the distance between construction noise sources and noise-sensitive receptors, any shielding provided by intervening structures or terrain, and ambient noise levels. Construction noise impacts primarily result when construction activities occur during noise-sensitive times of the day (early morning, evening, or nighttime hours), when construction occurs in areas immediately adjoining noise-sensitive land uses, or when construction durations last over extended periods of time.

Each construction phase would include a different mix of equipment operating. The highest noise levels are typically generated when impact tools are used (e.g., jackhammers, hoe rams). Site grading and excavation activities would also generate high noise levels as these phases often require the simultaneous use of multiple pieces of heavy equipment, such as dozers, excavators, scrapers, and loaders. Lower noise levels result from construction activities when less heavy equipment is required to complete the tasks. Pile driving is not anticipated for project construction.

Typical construction noise levels at a distance of 50 feet are shown in Tables 8 and 9. Table 8 illustrates the average noise level range by typical construction phase type and Table 9 shows the maximum noise level range for different construction equipment.

TABLE 8: Typical Ranges of Noise Levels at 50 Feet from Construction Sites (dBA L_{eq})

	Domestic Housing		Office Building, Hotel, Hospital, School, Public Works		Parking Garage, Religious Amusement & Recreations, Store, Service Station		Public Works Roads & Highways, Sewers, and Trenches	
	I	II	I	II	I	II	I	II
Ground Clearing	83	83	84	84	84	83	84	84
Excavation	88	75	89	79	89	71	88	78
Foundations	81	81	78	78	77	77	88	88
Erection	81	65	87	75	84	72	79	78
Finishing	88	72	89	75	89	74	84	84

I - All pertinent equipment present at site.

II - Minimum required equipment present at site.

Source: United States Environmental Protection Agency, 1973, Legal Compilation on Noise, Vol. 1, p. 2-104.

TABLE 9: Construction Equipment 50-foot Noise Emission Limits

Equipment Category	L_{max} Level (dBA)[1,2]	Impact/Continuous
Arc Welder	73	Continuous
Auger Drill Rig	85	Continuous
Backhoe	80	Continuous
Bar Bender	80	Continuous
Boring Jack Power Unit	80	Continuous
Chain Saw	85	Continuous
Compressor[3]	70	Continuous

Equipment Category	L_{max} Level (dBA)[1,2]	Impact/Continuous
Compressor (other)	80	Continuous
Concrete Mixer	85	Continuous
Concrete Pump	82	Continuous
Concrete Saw	90	Continuous
Concrete Vibrator	80	Continuous
Crane	85	Continuous
Dozer	85	Continuous
Excavator	85	Continuous
Front End Loader	80	Continuous
Generator	82	Continuous
Generator (25 KVA or less)	70	Continuous
Gradall	85	Continuous
Grader	85	Continuous
Grinder Saw	85	Continuous
Horizontal Boring Hydro Jack	80	Continuous
Hydra Break Ram	90	Impact
Impact Pile Driver	105	Impact
Insitu Soil Sampling Rig	84	Continuous
Jackhammer	85	Impact
Mounted Impact Hammer (hoe ram)	90	Impact
Paver	85	Continuous
Pneumatic Tools	85	Continuous
Pumps	77	Continuous
Rock Drill	85	Continuous
Scraper	85	Continuous
Slurry Trenching Machine	82	Continuous
Soil Mix Drill Rig	80	Continuous
Street Sweeper	80	Continuous
Tractor	84	Continuous
Truck (dump, delivery)	84	Continuous
Vacuum Excavator Truck (vac-truck)	85	Continuous
Vibratory Compactor	80	Continuous
Vibratory Pile Driver	95	Continuous
All other equipment with engines larger than 5 HP	85	Continuous

Notes:

1 Measured at 50 feet from the construction equipment, with a "slow" (1 sec.) time constant.

2 Noise limits apply to total noise emitted from equipment and associated components operating at full power while engaged in its intended operation.

3 Portable Air Compressor rated at 75 cfm or greater and that operates at greater than 50 psi.

Source: Mitigation of Nighttime Construction Noise, Vibrations and Other Nuisances, National Cooperative Highway Research Program, 1999.

Construction would be conducted within the allowable hours of 8:00 am and 5:00 pm. Extreme noise generating construction methods, such as impact pile driving, are not proposed. Given the small project area, multiple pieces of heavy construction equipment are also not anticipated.

The nearest residential property line would be located over 60 feet and the nearest residential structure would be located over 200 feet from areas of the site that would undergo major construction activities. Construction noise levels may exceed 87 dBA L_{eq} at 60 feet and 77 dBA at 200 feet during busy construction periods and would drop off at a rate of about 6 dBA per doubling of distance between the noise source and the receptor. Construction noise levels would range from 63 to 74 dBA L_{eq} at 100 feet.

Standard best management practices would be implemented to limit construction hours to daytime periods only, reduce construction noise levels emanating from the site, and minimize disruption and annoyance at adjacent noise sensitive uses:

- Limit construction to between the hours of 8:00 am to 5:00 pm.
- Limit work to non-motorized equipment on Sundays and holidays.
- Locate construction staging areas as far as practical from nearby sensitive receptors.
- Locate stationary noise-generating equipment, such as air compressors or portable power generators, as far as practical from nearby sensitive receptors.
- Equip all internal combustion engine-driven equipment with intake and exhaust mufflers that are in good condition and appropriate for the equipment. Air compressors and pneumatic equipment should be equipped with mufflers, and impact tools should be equipped with shrouds or shields.
- Prohibit all unnecessary idling of internal combustion engines.

Construction Vibration

The construction of the project may generate perceptible vibration at nearby residential land uses when heavy equipment or impact tools (e.g. jackhammers, hoe rams) are used near the perimeter of the site improvement areas. Vibration-producing activities would occur when heavy equipment is used to during demolition, site preparation work, grading and excavation, trenching, and paving. Foundation construction techniques involving impact or vibratory pile driving, which can cause excessive vibration, are not anticipated as part of the project.

There are no applicable Federal, state, or local quantitatively defined regulations relating to vibration resulting from construction activities. Based on the thresholds provided by Caltrans, a vibration limit of 0.3 in/sec PPV would minimize damage at buildings of normal conventional construction. A significant impact would occur if buildings adjacent to the proposed construction site were exposed to vibration levels in excess of 0.3 in/sec PPV.

Table 10 presents typical vibration levels that could be expected from construction equipment at a distance of 200 feet which is representative of the nearest residential building to the project site. The dropping of heavy equipment (e.g., clam shovel drop) and vibratory rollers produce vibration levels 0.009 in/sec PPV at 200 feet. Jackhammers would generate vibration levels of 0.0001 in/sec PPV and drilling would generate vibration levels of 0.004 in/sec PPV at this distance. Vibration levels would vary depending on soil conditions, construction methods, and equipment used. Considering this we find that vibration levels due to construction activities would be well below the 0.3 in/sec PPV threshold for construction activities at the nearest residential building to the project site.

TABLE 10: Vibration Source Levels for Construction Equipment

Equipment	PPV at 200 ft. (in/sec)
Clam shovel drop	0.009
Vibratory Roller	0.009
Hoe Ram	0.004
Large bulldozer	0.004
Caisson drilling	0.004
Loaded trucks	0.003
Jackhammer	0.002
Small bulldozer	0.0001

Source: Transit Noise and Vibration Impact Assessment Manual, Federal Transit Administration, Office of Planning and Environment, U.S. Department of Transportation, September 2018, as modified by Illingworth & Rodkin, Inc., June 2021.

CUMULATIVE NOISE ENVIRONMENT

There are a few other wineries in the project vicinity, however the closest of these wineries are between over 3,000 feet from the project site. To determine the cumulative effect of events at these wineries on the noise environment at the identified residential receivers (1, 2 and 3, in Figure2) adjacent to the project site, a worst-case condition where all of these nearby wineries held outdoor events on the same day and time as the project winery was analyzed. The result if this analysis indicated that under this worst-case condition, cumulative noise levels at the identified residential receivers adjacent to the project site the increase would increase by less than 1 dBA. As a result, this we find that cumulative noise impacts would be identical to the project impacts described above.

MITIGATION MEASURES

Impact 3a: Outdoor Event Noise

The findings of this noise assessment show that noise associated with outdoor gatherings of greater than 20 guests, outdoor music performances or amplified speech could exceed County NE-2 standards at the property lines of Residences 1, 2, and 3. To allow the County noise standards to be met, we offer the following noise mitigation measures:

Mitigation 3a.1:

Winery events should not include outdoor amplified speech or outdoor amplified or acoustic music performances.

Mitigation 3a.2:

Large events should primarily occur within the winery tasting room building and outdoor gatherings during events be limited to 20 guests or less in the outdoor patios adjacent to the tasting room building or at the outdoor viewing patio east of the tasting room.

The implementation of these measure will reduce this impact to a less-than-significant level.

Impact 3b: Indoor Event Noise

The findings of this noise assessment show that noise associated with indoor music performances or amplified speech could exceed County NE-2 standards at the property lines of Residences 1, 2, and 3. To allow the County noise standards to be met, we offer the following noise mitigation measure:

Mitigation 3b:

Music performances during winery events should occur within the Tasting Room building with closed windows and doors closed when not in use.

The implementation of this measure will reduce this impact to a less-than-significant level.

CEQA INITIAL STUDY CHECKLIST QUESTIONS

The California Environmental Quality Act (CEQA) includes qualitative guidelines for determining the significance of environmental noise impacts. The CEQA Initial Study checklist questions are listed below:

(a) Generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;

With the incorporation of the mitigation measures outlined in this report tasting room and event noise from the project will be in compliance with the Sonoma County limits are not anticipated to result in a substantial increase in noise in the site vicinity. ***Less-than-Significant Impact.***

Construction would be conducted within allowable hours. Pile driving is not anticipated as a method of construction. With implementation of standard best management practices this would be a ***Less-than-Significant Impact.***

(b) Generation of excessive groundborne vibration or groundborne noise levels;

Project construction or operation would not generate any significant ground borne vibration at surrounding residential uses. ***No Impact.***

(c) For a project located within the vicinity of a private airstrip or an airport land use plan or where such a plan has not been adopted within two miles of a public airport or public use airport, if the project would expose people residing or working in the project area to excessive noise levels.

The project is located more than 2 miles of the Petaluma Municipal Airport. Therefore, we find that Petaluma Municipal Airport operations would not expose persons in the project area to excessive airport-related noise. ***No Impact.***

SUMMARY/CONCLUSIONS

Based on the above findings, noise associated with project operations would be reduced to levels below the Sonoma County noise standards residential properties in the site vicinity with the incorporation of recommended mitigation measures. Disruption and annoyance from temporary construction noise at adjacent noise sensitive uses would be minimized by the implementation of standard best management practices.

Appendix A – Noise and Vibration Fundamentals

Fundamentals of Environmental Noise

Noise may be defined as unwanted sound. Noise is usually objectionable because it is disturbing or annoying. The objectionable nature of sound could be caused by its *pitch* or its *loudness*. *Pitch* is the height or depth of a tone or sound, depending on the relative rapidity (*frequency*) of the vibrations by which it is produced. Higher pitched signals sound louder to humans than sounds with a lower pitch. *Loudness* is intensity of sound waves combined with the reception characteristics of the ear. Intensity may be compared with the height of an ocean wave in that it is a measure of the amplitude of the sound wave.

In addition to the concepts of pitch and loudness, there are several noise measurement scales which are used to describe noise in a particular location. A *decibel (dB)* is a unit of measurement which indicates the relative amplitude of a sound. The zero on the decibel scale is based on the lowest sound level that the healthy, unimpaired human ear can detect. Sound levels in decibels are calculated on a logarithmic basis. An increase of 10 decibels represents a ten-fold increase in acoustic energy, while 20 decibels is 100 times more intense, 30 decibels is 1,000 times more intense, etc. There is a relationship between the subjective noisiness or loudness of a sound and its intensity. Each 10 decibel increase in sound level is perceived as approximately a doubling of loudness over a fairly wide range of intensities. Technical terms are defined in Table A1.

There are several methods of characterizing sound. The most common in California is the *A-weighted sound level (dBA).* This scale gives greater weight to the frequencies of sound to which the human ear is most sensitive. Representative outdoor and indoor noise levels in units of dBA are shown in Table A2. Because sound levels can vary markedly over a short period of time, a method for describing either the average character of the sound or the statistical behavior of the variations must be utilized. Most commonly, environmental sounds are described in terms of an average level that has the same acoustical energy as the summation of all the time-varying events. This *energy-equivalent sound/noise descriptor* is called L_{eq}. The most common averaging period is hourly, but L_{eq} can describe any series of noise events of arbitrary duration.

The scientific instrument used to measure noise is the *sound level meter*. Sound level meters can accurately measure environmental noise levels to within about plus or minus 1 dBA. Various computer models are used to predict environmental noise levels from sources, such as roadways and airports. The accuracy of the predicted models depends upon the distance the receptor is from the noise source. Close to the noise source, the models are accurate to within about plus or minus 1 to 2 dBA.

Since the sensitivity to noise increases during the evening and at night -- because excessive noise interferes with the ability to sleep -- 24-hour descriptors have been developed that incorporate artificial noise penalties added to quiet-time noise events. The *Community Noise Equivalent Level (CNEL)* is a measure of the cumulative noise exposure in a community, with a 5 dB penalty added to evening (7:00 pm - 10:00 pm) and a 10 dB addition to nocturnal (10:00 pm - 7:00 am) noise levels. The *Day/Night Average Sound Level (L_{dn})* is essentially the same as CNEL, with the exception that the evening time period is dropped and all occurrences during this three-hour period are grouped into the daytime period.

Effects of Noise

Sleep and Speech Interference

The thresholds for speech interference indoors are about 45 dBA if the noise is steady and above 55 dBA if the noise is fluctuating. Outdoors the thresholds are about 15 dBA higher. Steady noises of sufficient intensity (above 35 dBA) and fluctuating noise levels above about 45 dBA have been shown to affect sleep. Interior residential standards for multi-family dwellings are set by the State of California at 45 dBA L_{dn}. Typically, the highest steady traffic noise level during the daytime is about equal to the L_{dn} and nighttime levels are 10 dBA lower. The standard is designed for sleep and speech protection and most jurisdictions apply the same criterion for all residential uses. Typical structural attenuation is 12 to 17 dBA with open windows. With closed windows in good condition, the noise attenuation factor is around 20 dBA for an older structure and 25 dBA for a newer dwelling. Sleep and speech interference are therefore possible when exterior noise levels are about 57 to 62 dBA L_{dn} with open windows and 65 to 70 dBA L_{dn} with standard construction if the windows are closed.

Annoyance

Attitude surveys are used for measuring the annoyance felt in a community for noises intruding into homes or affecting outdoor activity areas. In these surveys, it was determined that the causes for annoyance include interference with speech, radio and television, house vibrations, and interference with sleep and rest. The L_{dn} as a measure of noise has been found to provide a valid correlation of noise level and the percentage of people annoyed. People have been asked to judge the annoyance caused by aircraft noise and ground transportation noise. There continues to be disagreement about the relative annoyance of these different sources. When measuring the percentage of the population highly annoyed, the threshold for ground vehicle noise is about 50 dBA L_{dn}. At a L_{dn} of about 60 dBA, approximately 12 percent of the population is highly annoyed. When the L_{dn} increases to 70 dBA, the percentage of the population highly annoyed increases to about 25 to 30 percent of the population. There is, therefore, an increase of about 2 percent per dBA between a L_{dn} of 60 to 70 dBA. Between a L_{dn} of 70 to 80 dBA, each decibel increase, increases by about 3 percent, the percentage of the population highly annoyed. People appear to respond more adversely to aircraft noise. When the L_{dn} is 60 dBA, approximately 30 to 35 percent of the population is believed to be highly annoyed.

TABLE A1 Definition of Acoustical Terms Used in this Report

Term	Definition
Decibel, dB	A unit describing, the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure. The reference pressure for air is 20 micro Pascals.
Sound Pressure Level	Sound pressure is the sound force per unit area, usually expressed in micro Pascals (or 20 micro Newtons per square meter), where 1 Pascal is the pressure resulting from a force of 1 Newton exerted over an area of 1 square meter. The sound pressure level is expressed in decibels as 20 times the logarithm to the base 10 of the ratio between the pressures exerted by the sound to a reference sound pressure (e. g., 20 micro Pascals). Sound pressure level is the quantity that is directly measured by a sound level meter.
Frequency, Hz	The number of complete pressure fluctuations per second above and below atmospheric pressure. Normal human hearing is between 20 Hz and 20,000 Hz. Infrasonic sound are below 20 Hz and Ultrasonic sounds are above 20,000 Hz.
A-Weighted Sound Level, dBA	The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise.
Equivalent Noise Level, L_{eq}	The average A-weighted noise level during the measurement period.
L_{max}, L_{min}	The maximum and minimum A-weighted noise level during the measurement period.
L_{01}, L_{10}, L_{50}, L_{90}	The A-weighted noise levels that are exceeded 1%, 10%, 50%, and 90% of the time during the measurement period.
Day/Night Noise Level, L_{dn} or DNL	The average A-weighted noise level during a 24-hour day, obtained after addition of 10 decibels to levels measured in the night between 10:00 pm and 7:00 am.
Community Noise Equivalent Level, CNEL	The average A-weighted noise level during a 24-hour day, obtained after addition of 5 decibels in the evening from 7:00 pm to 10:00 pm and after addition of 10 decibels to sound levels measured in the night between 10:00 pm and 7:00 am.
Ambient Noise Level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Intrusive	That noise which intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of a sound depends upon its amplitude, duration, frequency, and time of occurrence and tonal or informational content as well as the prevailing ambient noise level.

Source: Handbook of Acoustical Measurements and Noise Control, Harris, 1998.

TABLE A2 Typical Noise Levels in the Environment

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
	110 dBA	Rock band
Jet fly-over at 1,000 feet		
	100 dBA	
Gas lawn mower at 3 feet		
	90 dBA	
Diesel truck at 50 feet at 50 mph		Food blender at 3 feet
	80 dBA	Garbage disposal at 3 feet
Noisy urban area, daytime		
Gas lawn mower, 100 feet	70 dBA	Vacuum cleaner at 10 feet
Commercial area		Normal speech at 3 feet
Heavy traffic at 300 feet	60 dBA	
		Large business office
Quiet urban daytime	50 dBA	Dishwasher in next room
Quiet urban nighttime	40 dBA	Theater, large conference room
Quiet suburban nighttime		
	30 dBA	Library
Quiet rural nighttime		Bedroom at night, concert hall (background)
	20 dBA	
		Broadcast/recording studio
	10 dBA	
	0 dBA	

Source: Technical Noise Supplement (TeNS), California Department of Transportation, September 2013.

Fundamentals of Groundborne Vibration

Ground vibration consists of rapidly fluctuating motions or waves with an average motion of zero. Several different methods are typically used to quantify vibration amplitude. One method is the Peak Particle Velocity (PPV). The PPV is defined as the maximum instantaneous positive or negative peak of the vibration wave. In this report, a PPV descriptor with units of mm/sec or in/sec is used to evaluate construction generated vibration for building damage and human complaints. Table A3 displays the reactions of people and the effects on buildings that continuous vibration levels produce. The guidelines in Table A3 represent syntheses of vibration criteria for human response and potential damage to buildings resulting from construction vibration.

Construction activities can cause vibration that varies in intensity depending on several factors. The use of pile driving and vibratory compaction equipment typically generates the highest construction related groundborne vibration levels. Because of the impulsive nature of such activities, the use of the PPV descriptor has been routinely used to measure and assess groundborne vibration and almost exclusively to assess the potential of vibration to induce structural damage and the degree of annoyance for humans.

The two primary concerns with construction-induced vibration, the potential to damage a structure and the potential to interfere with the enjoyment of life, are evaluated against different vibration limits. Human perception to vibration varies with the individual and is a function of physical setting and the type of vibration. Persons exposed to elevated ambient vibration levels, such as people in an urban environment, may tolerate a higher vibration level.

Structural damage can be classified as cosmetic only, such as paint flaking or minimal extension of cracks in building surfaces; minor, including limited surface cracking; or major, that may threaten the structural integrity of the building. Safe vibration limits that can be applied to assess the potential for damaging a structure vary by researcher. The damage criteria presented in Table A3 include several categories for ancient, fragile, and historic structures, the types of structures most at risk to damage. Most buildings are included within the categories ranging from “Historic and some old buildings” to “Modern industrial/commercial buildings”. Construction-induced vibration that can be detrimental to the building is very rare and has only been observed in instances where the structure is at a high state of disrepair and the construction activity occurs immediately adjacent to the structure.

The annoyance levels shown in Table A3 should be interpreted with care since vibration may be found to be annoying at lower levels than those shown, depending on the level of activity or the sensitivity of the individual. To sensitive individuals, vibrations approaching the threshold of perception can be annoying. Low-level vibrations frequently cause irritating secondary vibration, such as a slight rattling of windows, doors, or stacked dishes. The rattling sound can give rise to exaggerated vibration complaints, even though there is very little risk of actual structural damage.

TABLE A3 Reaction of People and Damage to Buildings from Continuous or Frequent Intermittent Vibration Levels

Velocity Level, PPV (in/sec)	Human Reaction	Effect on Buildings
0.01	Barely perceptible	No effect
0.04	Distinctly perceptible	Vibration unlikely to cause damage of any type to any structure
0.08	Distinctly perceptible to strongly perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
0.1	Strongly perceptible	Threshold at which there is a risk of damage to fragile buildings with no risk of damage to most buildings
0.25	Strongly perceptible to severe	Threshold at which there is a risk of damage to historic and some old buildings.
0.3	Strongly perceptible to severe	Threshold at which there is a risk of damage to older residential structures
0.5	Severe - Vibrations considered unpleasant	Threshold at which there is a risk of damage to new residential and modern commercial/industrial structures

Source: Transportation and Construction Vibration Guidance Manual, California Department of Transportation, September 2013.