Environmental Noise & Vibration Assessment

Winding Ranch Project

Sacramento County, California

BAC Job # 2022-121

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Introduction

The proposed Winding Ranch development (project) is located south of Winding Way and east of Manzanita Avenue in Sacramento County, California. The project consists of single-family and multi-family residential, and commercial (retail) uses. The commercial component consists of a total of six parcels – one parcel containing a gas station/convenience store (with car wash tunnel), and five parcels containing a retail/restaurant use (of which three will have drive-through lanes). Existing land uses in the immediate project vicinity include a mix of commercial and residential (single- and multi-family). The project area with aerial imagery is shown in Figure 1. The project site plans are presented in Figures 2 and 3.

The purposes of this assessment are to quantify the existing noise and vibration environments, identify potential noise and vibration impacts resulting from the project, identify appropriate mitigation measures, and provide a quantitative and qualitative analysis of impacts associated with the project. Specifically, impacts are identified if project-related activities would cause a substantial increase in ambient noise levels at existing sensitive land uses in the project vicinity, or if future traffic or project-generated noise or vibration levels would exceed applicable federal, state, or local (Sacramento County) standards at existing or proposed sensitive uses.

Noise and Vibration Fundamentals

Noise

Noise is often described as unwanted sound. Sound is defined as any pressure variation in air that the human ear can detect. If the pressure variations occur frequently enough (at least 20 times per second), they can be heard and are designated as sound. The number of pressure variations per second is called the frequency of sound and is expressed as cycles per second, or Hertz (Hz). Definitions of acoustical terminology are provided in Appendix A.

Measuring sound directly in terms of pressure would require a very large and awkward range of numbers. To avoid this, the decibel scale was devised. The decibel scale uses the hearing threshold (20 micropascals of pressure) as a point of reference, defined as 0 dB. Other sound pressures are then compared to the reference pressure, and the logarithm is taken to keep the numbers in a practical range. The decibel scale allows a million-fold increase in pressure to be expressed as 120 dB. Another useful aspect of the decibel scale is that changes in decibel levels correspond closely to human perception of relative loudness. Noise levels associated with common noise sources are provided in Figure 4.

The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels, perception of loudness is relatively predictable and can be approximated by filtering the frequency response of a sound level meter by means of the standardized A-weighting network. There is a strong correlation between A-weighted sound levels (expressed as dBA) and community response to noise. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. All noise levels reported in this section are in terms of A-weighted levels.

Community noise is commonly described in terms of the ambient noise level, which is defined as the all-encompassing noise level associated with a given noise environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (L_{eq}). The L_{eq} is the foundation of the day-night average noise descriptor, DNL (or L_{dn}), and shows very good correlation with community response to noise. DNL is based on the average noise level over a 24-hour day, with a +10-decibel weighting applied to noise occurring during nighttime (10:00 PM to 7:00 AM) hours. The nighttime penalty is based on the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because DNL represents a 24-hour average, it tends to disguise short-term variations in the noise environment.

Vibration

Vibration is like noise in that it involves a source, a transmission path, and a receiver. While vibration is related to noise, it differs in that noise is generally considered to be pressure waves transmitted through air, while vibration is usually associated with transmission through the ground or structures. As with noise, vibration consists of an amplitude and frequency. A person's response to vibration will depend on their individual sensitivity as well as the amplitude and frequency of the source.

Vibration can be described in terms of acceleration, velocity, or displacement. A common practice is to monitor vibration in terms of velocity in inches per second peak particle velocity (IPS, PPV) or root-mean-square (VdB, RMS). Standards pertaining to perception as well as damage to structures have been developed for vibration in terms of peak particle velocity as well as RMS velocities.

As vibrations travel outward from the source, they excite the particles of rock and soil through which they pass and cause them to oscillate. Differences in subsurface geologic conditions and distance from the source of vibration will result in different vibration levels characterized by different frequencies and intensities. In all cases, vibration amplitudes will decrease with increasing distance.

Human response to vibration is difficult to quantify. Vibration can be felt or heard well below the levels that produce any damage to structures. The duration of the event has an effect on human response, as does frequency. Generally, as the duration and vibration frequency increase, the potential for adverse human response increases.

According to the Transportation and Construction-Induced Vibration Guidance Manual (Caltrans, April 2020), operation of construction equipment and construction techniques generate ground vibration. Traffic traveling on roadways can also be a source of such vibration. At high enough amplitudes, ground vibration has the potential to damage structures and/or cause cosmetic damage. Ground vibration can also be a source of annoyance to individuals who live or work close to vibration-generating activities. However, traffic, rarely generates vibration amplitudes high enough to cause structural or cosmetic damage.

Legend

- Project Area Boundary (Approximate)
- Short-Term Noise & Vibration Survey Locations

N

Scale (Feet)

0 150 300

Winding Ranch Project

Sacramento County, California

Project Area

Figure 1

BOLLARD Acoustical Consultants

Drawing dated January 13, 2023

Legend

Project Area Boundary

N

Scale (Feet)

0 100 200

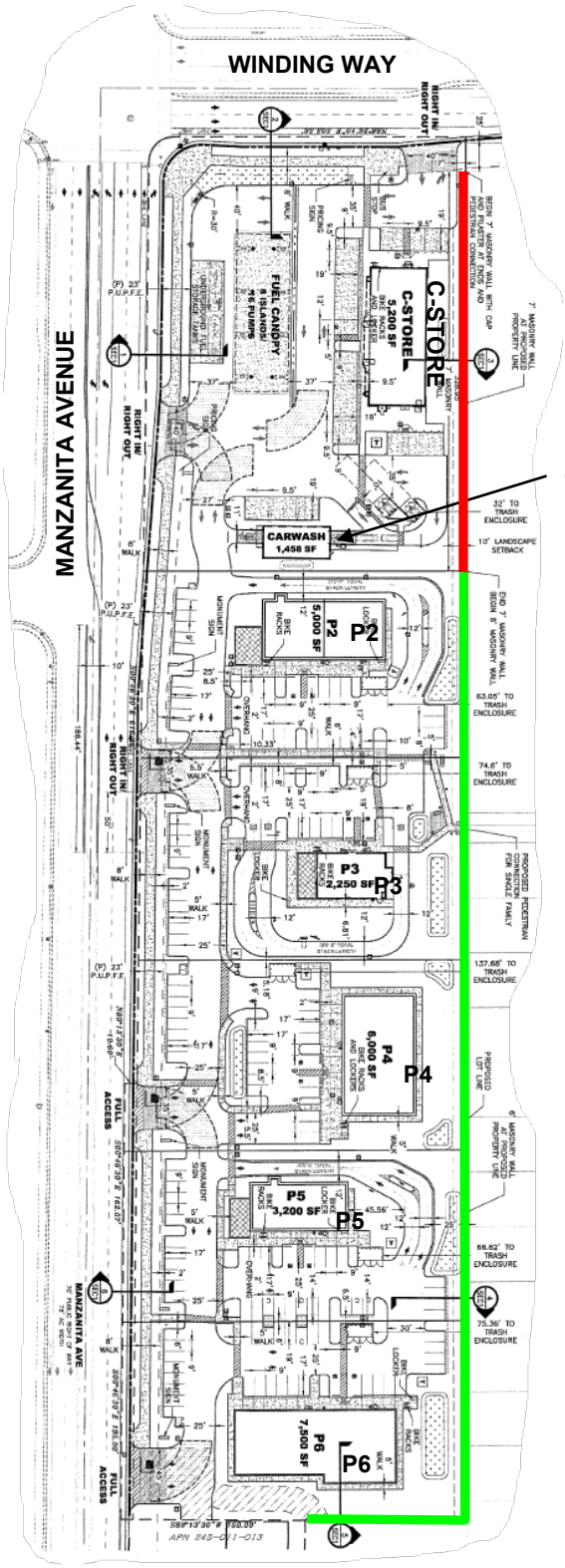
Winding Ranch Project

Sacramento County, California

Composite Site Plan

Figure 2

BOLLARD Acoustical Consultants



Drawing dated January 27, 2023

Legend

- Proposed 7' Masonry Wall
- Proposed 6' Masonry Wall

N

Scale (Feet)

0 75 150

Winding Ranch Project

Sacramento County, California

Site Plan – Commercial Component

Figure 3

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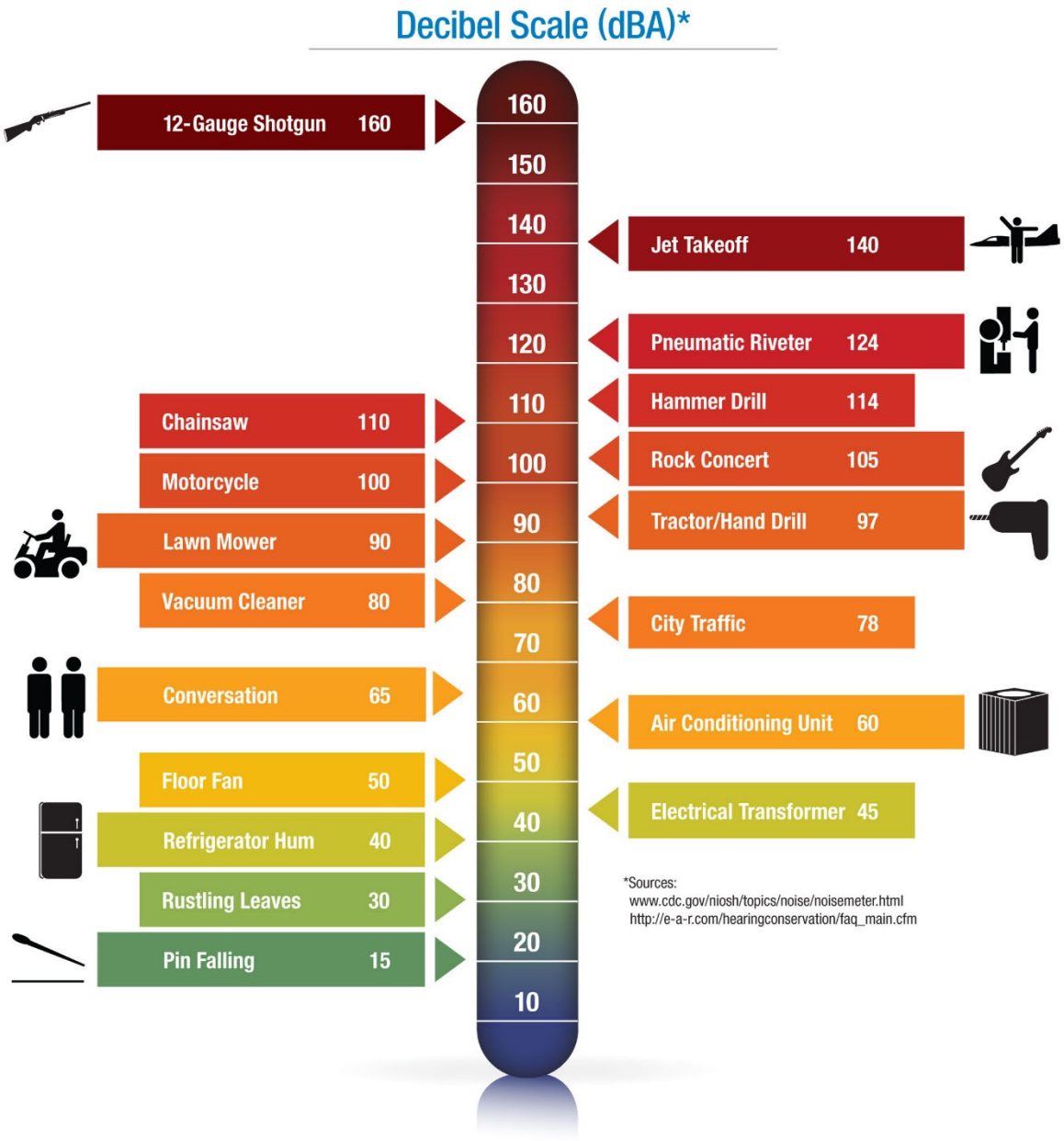
Figure 4
Noise Levels Associated with Common Noise Sources



Environmental Setting – Existing Ambient Noise and Vibration Environment

Land Uses in the Project Vicinity

Noise-sensitive land uses are generally defined as locations where people reside or where the presence of unwanted sound could adversely affect the primary intended use of the land. Places where people live, sleep, recreate, worship and study are generally considered to be sensitive to noise because intrusive noise can be disruptive to these activities. The nearest existing noise-sensitive land uses which would potentially be affected by the project consist of single- and multi-family residential uses. The project area and existing residential uses are shown in Figure 1.

Existing Traffic Noise Levels along Project Area Roadway Network

To predict traffic noise levels along existing roadway networks with multiple segments, modelling is commonly used rather than monitoring. The FHWA Traffic Noise Model (FHWA-RD-77-108) was used to quantify existing traffic noise levels at the existing sensitive land uses nearest to the project area roadway network. The Model was also used to quantify the distances to the 60, 65 and 70 dB DNL traffic noise contours for these roadways. The FHWA Model predicts hourly average (L_{eq}) values for free-flowing traffic conditions. Estimates of the hourly distribution of traffic for a typical 24-hour period were used to develop DNL values from L_{eq} values.

Existing traffic data in the form of AM and PM peak hour intersection turning movements were provided by the project transportation consultant (Wood Rodgers). Those data were converted to Average Daily Traffic (ADT) segment volumes by applying a factor of 5 to the sum of AM and PM peak hour conditions. Other inputs were obtained from BAC observations and noise measurement data. The existing traffic noise levels at the distances representing the nearest sensitive land uses (residential) to the project area roadways and distances from the centerlines of selected roadways to the 60 dB, 65 dB and 70 dB DNL contours are summarized in Table 1. The Table 1 data includes offsets where appropriate to account for the presence of existing intervening shielding (e.g., building screening). Appendix B contains the FHWA Model inputs for existing conditions.

Table 1
Existing Traffic Noise Levels at Nearest Receptors and Distances to DNL Contours

#	Roadway	Segment Description	DNL at Nearest Sensitive Receptor	Distance to Contour (ft)		
				70 dB DNL	65 dB DNL	60 dB DNL
1	College Oak Dr	North of Winding Way	60	20	43	93
2	College Oak Dr	South of Winding Way	61	12	26	56
3	Winding Way	West of College Oak Dr	48	2	3	7
4	Winding Way	College Oak to Manzanita Ave	63	18	39	84
5	Winding Way	Manzanita Ave to Rampart Dr	59	38	83	178
6	Winding Way	East of Rampart Dr	63	37	79	170
7	Manzanita Ave	North of Winding Way	64	38	83	178
8	Manzanita Ave	Winding Way to Windmill Way	53	40	85	184
9	Manzanita Ave	Winding Way to Lincoln Ave	66	43	92	199
10	Manzanita Ave	Lincoln Ave to Cypress Ave	59	43	94	202
11	Manzanita Ave	South of Cypress Ave	57	49	105	226
12	Windmill Way	West of Manzanita Ave	52	9	20	42
13	Lincoln Ave	West of Manzanita Ave	27	0	1	1
14	Lincoln Ave	East of Manzanita Ave	57	10	23	49
15	Cypress Ave	West of Manzanita Ave	58	16	35	76
16	Cypress Ave	East of Manzanita Ave	37	3	7	14
17	Rampart Ave	North of Winding Way	38	1	2	5
18	Rampart Ave	Winding Way to Mary Lynn Ln	36	1	2	5
19	Rampart Ave	South onto Mary Lynn Ln	35	0	1	2
20	Rampart Ave	East of Mary Lynn Ln	49	3	7	15

Source: FHWA-RD-77-108 and Wood Rodgers. Appendix B contains model inputs for existing conditions.

Existing Overall Ambient Noise Environment in Project Vicinity

The existing ambient noise environment within the project vicinity is defined primarily by noise from traffic on Winding Way and Manzanita Avenue, and by nearby commercial operations and residential activities. To generally quantify existing ambient noise environment within the project vicinity, BAC conducted short-term (20-minute) ambient noise level measurements at four (4) locations on August 9th, 2022. Specifically, several 20-minute measurement samples were taken at each monitoring site during daytime (7:00 a.m. to 7:00 p.m.) and nighttime (10:00 p.m. to 7:00 a.m.) hours. The locations of the noise survey sites are shown on Figure 1. Photographs of the survey locations are provided in Appendix C.

Larson Davis Laboratories (LDL) Model LxT precision integrating sound level meters were used to complete the noise level surveys. The meters were calibrated immediately before and after use with an LDL Model CA200 acoustical calibrator to ensure the accuracy of the measurements. The equipment used meets all specifications of the American National Standards Institute requirements for Type 1 sound level meters (ANSI S1.4). The results of the ambient noise surveys are summarized below in Table 2.

Table 2
Summary of Ambient Noise Survey Results – August 9th, 2022

Survey Location[1]	Time	Average Measured Noise Levels (dB)[2]	
		L_{50}	L_{max}
Site 1: Northeast end of project area	8:53 a.m.	58	73
	4:09 p.m.	59	80
	11:55 p.m.	45	71
Site 2: East end of project area	8:00 a.m.	69	81
	5:31 p.m.	68	92
	11:26 p.m.	54	63
Site 3: South of project area across Jan Drive	8:27 a.m.	60	74
	5:03 p.m.	65	84
	10:31 p.m.	50	70
Site 4: West of project area across Manzanita Avenue	7:31 a.m.	70	79
	4:39 p.m.	69	79
	10:58 p.m.	60	80

[1] Locations of ambient noise monitoring sites are shown on Figure 1.
[2] Average measured noise levels during each 20-minute measurement sample.

Source: BAC 2022.

The BAC measurement sites were specifically selected to be representative of the ambient noise level environments at the nearest existing residential uses to the northeast (site 1), east (site 2), south (site 3), southwest and west (both site 4) of the project area. The Table 2 data indicate that measured noise levels during the monitoring period were elevated. This is believed to be attributed to nearby traffic, commercial and residential activities.

Existing Ambient Vibration Environment in Project Vicinity

During a BAC site visit on August 9th, 2022, vibration levels were below the threshold of perception within the project area. Nonetheless, to quantify existing vibration levels within the project vicinity, BAC conducted short-term (10-minute) vibration measurements at the four survey locations identified on Figure 1 on August 9th, 2022. Photographs of the survey locations are provided in Appendix C.

A Larson-Davis Laboratories Model LxT precision integrating sound level meter equipped with a vibration transducer was used to complete the measurements. The results are summarized in Table 3.

Table 3
Summary of Ambient Vibration Survey Results – August 9th, 2022

Survey Location	Time	Measured Maximum Vibration Level, PPV (in/sec)
Site 1: Northeast end of project area	4:21 p.m.	0.024
Site 2: East end of project area	5:32 p.m.	<0.001
Site 3: South of project area across Jan Drive	5:05 p.m.	<0.001
Site 4: West of project area across Manzanita Avenue	4:39 p.m.	0.015
PPV = Peak Particle Velocity (inches/second)		

Source: BAC 2022.

The Table 3 data indicate that measured maximum vibration levels within the project area ranged from less than 0.001 to 0.024 PPV in/sec.

Regulatory Setting: Criteria for Acceptable Noise and Vibration Exposure

Federal

There are no federal noise or vibration criteria which would be directly applicable to this project. However, because the Sacramento County General Plan does not currently have a policy for assessing noise impacts associated with increases in ambient noise levels from project-generated noise sources, recommendations made by the Federal Interagency Commission on Noise (FICON) are provided.

Federal Interagency Commission on Noise (FICON)

The Federal Interagency Commission on Noise (FICON) has developed a graduated scale for use in the assessment of project-related noise level increases. The criteria shown in Table 4 was developed by FICON as a means of developing thresholds for impact identification for project-related noise level increases. The FICON standards have been used extensively in recent years in the preparation of the noise sections of Environmental Impact Reports that have been certified in many California cities and counties.

The use of the FICON standards is considered conservative relative to thresholds used by other agencies in the State of California. For example, the California Department of Transportation (Caltrans) requires a project-related traffic noise level increase of 12 dB for a finding of significance, and the California Energy Commission (CEC) considers project-related noise level increases between 5 to 10 dB significant, depending on local factors. Therefore, the use of the FICON standards, which set the threshold for finding of significant noise impacts as low as 1.5 dB, provides a very conservative approach to impact assessment for this project.

Table 4
Significance of Changes in Cumulative Noise Exposure

Ambient Noise Level Without Project (DNL)	Change in Ambient Noise Level Due to Project
<60 dB	+5.0 dB or more
60 to 65 dB	+3.0 dB or more
>65 dB	+1.5 dB or more

Source: Federal Interagency Committee on Noise (FICON).

Based on the FICON research, as shown in Table 4, a 5 dB increase in noise levels due to a project is required for a finding of significant noise impact where ambient noise levels without the project are less than 60 dB DNL. Where pre-project ambient conditions are between 60 and 65 dB DNL, a 3 dB increase is applied as the standard of significance. Finally, in areas already exposed to higher noise levels, specifically pre-project noise levels in excess of 65 dB DNL, a 1.5 dB increase is considered by FICON as the threshold of significance.

State of California

California Environmental Quality Act (CEQA)

The State of California has established regulatory criteria that are applicable to this assessment. Specifically, Appendix G of the State of California Environmental Quality Act (CEQA) Guidelines are used to assess the potential significance of impacts pursuant to local General Plan policies, Municipal Code standards, or the applicable standards of other agencies. According to Appendix G of the CEQA guidelines, the project would result in a significant noise or vibration impact if the following occur:

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 other applicable standards of other agencies.

B. Generation of excessive groundborne vibration or groundborne noise levels.

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, would the project expose people residing or working in the project area to excessive noise levels.

It should be noted that audibility is not a test of significance according to CEQA. If this were the case, any project which added any audible amount of noise to the environment would be considered significant according to CEQA. Because every physical process creates noise, the use of audibility alone as significance criteria would be unworkable. CEQA requires a substantial increase in noise levels before noise impacts are identified, not simply an audible change.

California Department of Transportation (Caltrans)

Sacramento County does not currently have adopted standards for groundborne vibration. As a result, the vibration impact criteria developed by the California Department of Transportation (Caltrans) was applied to the project. The Caltrans guidance criteria for building structure and vibration annoyance are presented in Tables 5 and 6, respectively.

Table 5
Caltrans Guidance for Building Structure Vibration Criteria

Structure and Condition	Limiting PPV (in/sec)
Historic and some old buildings	0.5
Residential structures	0.5
New residential structures	1.0
Industrial buildings	2.0
Bridges	2.0
PPV = Peak Particle Velocity	

Source: 2020 Caltrans Transportation and Construction Vibration Guidance Manual, Table 14.

Table 6
Caltrans Guidance for Vibration Annoyance Potential Criteria

	Maximum PPV (in/sec)	
Human Response	Transient Sources	Continuous/Frequent Intermittent Sources
Severe/very disturbing	2.0	0.4 to 3.6
Strongly perceptible	0.9	0.1
Distinctly perceptible	0.24	0.035
Barely/slightly perceptible	0.035	0.012
Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent sources include pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers and vibratory compaction equipment.		
PPV = Peak Particle Velocity		

Source: 2020 Caltrans Transportation and Construction Vibration Guidance Manual, Tables 4 & 6.

Local

Sacramento County General Plan

The Noise Element of the Sacramento County General Plan contains the County's noise-related policies. The specific policies which are generally applicable to this project are reproduced below:

Traffic Noise

Policy NO-1 The noise level standards for noise-sensitive areas of new uses affected by traffic or railroad noise sources in Sacramento County are shown in Table 7.

Where the noise level standards of Table 7 are predicted to be exceeded at new uses proposed within Sacramento County which are affected by traffic or railroad noise, appropriate noise mitigation measures shall be included in the project design to reduce projected noise levels to a state of compliance with the Table 7 standards.

Non-Transportation Noise

Policy NO-5 The interior and exterior noise level standards for noise-sensitive areas of new uses affected by existing non-transportation noise sources in Sacramento County are shown in Table 8. Where the noise level standards of Table 8 are predicted to be exceeded at a proposed noise-sensitive area due to existing non-transportation noise sources, appropriate noise mitigation measures shall be included in the project design to reduce projected noise levels to a state of compliance with the Table 8 standards within sensitive areas.

Policy NO-6 Where a project would consist of or include non-transportation noise sources, the noise generation of those sources shall be mitigated so as not exceed the interior and exterior noise level standards of Table 8 at existing noise-sensitive areas in the project vicinity.

Policy NO-7 The “last use there” shall be responsible for noise mitigation. However, if a noise generating use is proposed adjacent to lands zoned for uses which may have sensitivity to noise, then the noise generating use shall be responsible for mitigating its noise generation to a state of compliance with the Table 8 standards at the property line of the generating use in anticipation of the future neighboring development.

Construction Noise

Policy NO-8 Noise associated with construction activities shall adhere to the County Code requirements. Specifically, Section 6.68.090.E addresses construction noise within the County.

Table 7
Noise Standards for New Uses Affected by Traffic and Railroad Noise

Receiving Land Use	Outdoor Areas[1] dBA (DNL/CNEL)	Interior Areas[2] dBA (DNL/CNEL)	Notes
Residential	65	45	5
Transient lodging	65	45	3, 5
Hospitals, nursing homes	65	45	3, 4, 5
Theaters & auditoriums	--	35	3
Churches, schools, libraries	65	40	3
Office buildings	65	45	3
Commercial buildings	--	50	3
Playgrounds, parks	70	--	
Industry	65	50	3

[1] Sensitive areas are defined in acoustic terminology section.
[2] Interior noise level standards applied within noise-sensitive areas of land uses, with windows and doors in the closed positions.
[3] Where there are no sensitive exterior spaces proposed for these uses, only the interior noise level standard shall apply.
[4] Hospitals are often noise-generating uses. The exterior noise level standards for hospitals are applicable only at clearly identified areas designated for outdoor relaxation by either hospital staff or patients.
[5] If this use is affected by railroad noise, a maximum (L_{max}) noise level standard of 70 dB shall be applied to all sleeping rooms to reduce the potential for sleep disturbance during nighttime train passages.

Source: Sacramento County General Plan, Noise Element, Table 1. 2011.

Table 8
Non-Transportation Noise Standards – Median (L_{50}) / Maximum (L_{max})[1]

Receiving Land Use	Outdoor Area Daytime (7am-10pm)	Outdoor Area Nighttime (10pm to 7am)	Interior[2] Day & Night	Notes
Residential	55 / 75	50 / 70	35 / 55	--
Transient lodging	55 / 75	--	35 / 55	3
Hospitals, nursing homes	55 / 75	--	35 / 55	4,5
Theaters & auditoriums	--	--	30 / 50	5
Churches, schools, libraries	55 / 75	--	35 / 60	5
Office buildings	60 / 75	--	45 / 65	5
Commercial buildings	--	--	45 / 65	5
Playgrounds, parks	65 / 75	--	--	5
Industry	60 / 80	--	50 / 70	5

[1] The Table 8 standards shall be reduced by 5 dB for sounds consisting primarily of speech or music, and for recurring impulsive sounds. If the existing ambient noise level exceeds the standards of Table 8, then the noise level standards shall be increased at 5 dB increments to encompass the ambient.
[2] Interior noise level standards are applied within noise-sensitive areas with windows and doors in the closed positions.
[3] Outdoor activity areas of transient lodging facilities are not commonly used during nighttime hours.
[4] Hospitals are often noise-generating uses. The exterior noise level standards for hospitals are applicable only at clearly identified areas designated for outdoor relaxation by either hospital staff or patients.
[5] The outdoor activity areas of these uses (if any) are not typically utilized during nighttime hours.
-Where median (L50) noise level data is not available for a particular noise source, average (Leq) values may be substituted for the standards of this table provided the noise source in question operates for at least 30 minutes of an hour. If the source in question operates less than 30 minutes per hour, then the maximum noise level standards shown would apply.

Source: Sacramento County General Plan, Noise Element, Table 2. 2011.

Sacramento County Municipal Code

The provisions of the Sacramento County Municipal Code which would be most applicable to this project are reproduced below. For residential uses affected by non-transportation noise sources, the County Municipal Code standards, provided below in Section 6.68.070, are effectively identical to the County's General Plan Noise Element standards shown in Table 8. Because the Municipal Code standards are consistent with the General Plan standards, compliance with the General Plan standards in Table 8 would ensure satisfaction of both the Noise Element and Municipal Code standards.

6.68.070 Exterior Noise Standards.

A. The following noise standards, unless otherwise specifically indicated in this chapter, shall apply to all properties within a designated noise area.

Noise Area	County Zoning Districts	Time Period	Exterior Noise Standard
1	RE-1, RD-1, RE-2, RD-2, RE-3, RED-3, RD-4, R-1-A, RD-5, R-2, RD-10, R-2A, RD-20, R-3, RD-30, RD-40, RM-1, RM-2, A-1-B, AR-1, A-2, AR-2, A-5, AR-5	7:00 a.m. to 10:00 p.m.	55 dBA
		10:00 p.m. to 7:00 a.m.	50 dBA

B. It is unlawful for any person at any location within the County to create any noise which causes the noise levels on an affected property, when measured in the designated noise area, to exceed for the duration of time set forth following, the specified exterior noise standards in any one hour by:

Cumulative Duration of the Intrusive Sound	Allowance Decibels
1. Cumulative period of 30 minutes per hour	0
2. Cumulative period of 15 minutes per hour	+5
3. Cumulative period of 5 minutes per hour	+10
4. Cumulative period of 1 minute per hour	+15
5. Level not to be exceeded for any time per hour	+20

C. Each of the noise limits specified in subdivision (B) of this section shall be reduced by five dBA for impulsive or simple tone noises, or for noises consisting of speech or music.

D. If the ambient noise level exceeds that permitted by any of the first four noise limit categories specified in subdivision (B), the allowable noise limit shall be increased in five dBA increments in each category to encompass the ambient noise level. If the ambient noise level exceeds the fifth noise level category, the maximum ambient noise level shall be the noise limit for that category.

6.68.090 Exemptions.

The following activities shall be exempted from the provisions of this chapter:

E. Noise sources associated with construction, repair, remodeling, demolition, paving or grading of any real property, provided said activities do not take place between the hours of eight p.m. and six a.m. on weekdays and Friday commencing at eight p.m. through and including seven a.m. on Saturday; Saturdays commencing at eight p.m. through and including seven a.m. on the next following Sunday and on each Sunday after the hour of eight p.m. Provided, however, when an unforeseen or unavoidable conditions occurs during a construction project and the nature of the project necessitates that work in process be continued until a specific phase is completed, the contractor or owner shall be allowed to continue work after eight p.m. and to operate machinery and equipment necessary until completion of the specific work in progress can be brought to conclusion under conditions which will not jeopardize inspection acceptance or create undue financial hardships for the contractor or owner;

Adjustments to County Exterior Noise Level Standards Based on Measured Ambient Conditions

For the purposes of this assessment, the County's daytime and nighttime noise level standards shown in Table 8 were applied to noise sources associated with all proposed on-site commercial uses.

Pursuant to footnote 1 of Table 8, the County's exterior noise level standards shall be increased in 5 dB increments to encompass the ambient in cases where ambient noise levels already exceed the Table 8 standards. As discussed previously, BAC conducted ambient noise level measurements at four (4) locations on August 9th, 2022 (Table 2). Comparison of the ambient noise level data contained in Table 2 and the County noise level standards in Table 8 revealed that a portion of the County's criteria are being exceeded at the measurement sites, representative of the ambient noise level environment at the nearest residential uses.

Based on the results from the BAC ambient noise survey, and pursuant to the County's adjustment criteria discussed above, the following exterior noise level standards shown in Tables 9 and 10 have been applied to proposed on-site commercial operations and assessed at the nearest existing residential uses to the project.

Table 9
Sacramento County Daytime Exterior Noise Level Standards Applied to the Project

Residential Use	Representative Measurement Site	Measured Noise Levels (dB)[1]		Unadjusted Noise Standards (dB)[2]		Adjusted for Ambient?		Applied Noise Standards (dB)[3]	
		L_{50}	L_{max}	L_{50}	L_{max}	L_{50}	L_{max}	L_{50}	L_{max}
Northeast	1	59	77	55	75	Yes	Yes	60	80
East	2	69	87			Yes	Yes	70	90
South	3	63	79			Yes	Yes	65	80
Southwest & West	4	70	79			Yes	Yes	70	80

[1] Average of measured daytime noise levels at monitoring sites during BAC noise survey.
[2] Unadjusted County daytime noise level standards applicable to residential uses.
[3] Applied daytime noise standards based on BAC ambient noise survey and County ambient noise adjustment criteria.

Table 10
Sacramento County Nighttime Exterior Noise Level Standards Applied to the Project

Residential Use	Representative Measurement Site	Measured Noise Levels (dB)[1]		Unadjusted Noise Standards (dB)[2]		Adjusted for Ambient?		Applied Noise Standards (dB)[3]	
		L_{50}	L_{max}	L_{50}	L_{max}	L_{50}	L_{max}	L_{50}	L_{max}
Northeast	1	45	71	50	70	No	Yes	50	75
East	2	44	53			No	No	50	70
South	3	50	69			No	No	50	70
Southwest & West	4	60	80			Yes	Yes	60	80

[1] Measured nighttime noise levels at monitoring sites during BAC noise survey.
[2] Unadjusted County nighttime noise level standards applicable to residential uses.
[3] Applied nighttime noise standards based on BAC ambient noise survey and County ambient noise adjustment criteria.

Impacts and Mitigation Measures

Thresholds of Significance

For the purposes of this assessment, a noise and vibration impact is considered significant if the project would result in:

- 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 other applicable standards of other agencies; or
- Generation of excessive groundborne vibration or groundborne noise levels; or
- 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, would the project expose people residing or working in the project area to excessive noise levels.

The project site is not within the vicinity of a private airstrip, an airport land use plan, or within two miles of a public airport. Therefore, the last threshold listed above is not discussed further.

For the purposes of this assessment, a noise or vibration impact may be considered significant if the project would result in exceedance of the following criteria based on standards established by the Federal Interagency Commission on Noise (FICON), California Department of Transportation (Caltrans), Sacramento County General Plan and Municipal Code:

- A significant noise impact would be identified if the project would expose persons to or generate noise levels that would exceed applicable noise standards presented in the Sacramento County General Plan or Municipal Code.

- A significant impact would be identified if project-generated off-site traffic, on-site operations, or on-site construction activities would substantially increase noise levels at existing sensitive receptors in the vicinity. A substantial increase in off-site traffic noise levels would be identified relative to the FICON noise level increase significance criteria presented in Table 4.

  In terms of determining the temporary noise increase due to project on-site operations and construction activities, an impact would occur if those activities would noticeably increase ambient noise levels above background levels. The threshold of perception of the human ear is approximately 3 to 5 dB – a 5 dB change is considered to be clearly noticeable. For the analysis of project on-site operations and construction activity noise level increases, a noticeable increase in ambient noise levels is assumed to occur where those activities would result in an increase by 5 dB or more over existing ambient noise levels at nearby existing sensitive receptors.

- A significant impact would be identified if project construction activities or proposed on-site operations would expose noise-sensitive receptors to excessive groundborne vibration levels. Specifically, an impact would be identified if groundborne vibration levels due to these sources would exceed the Caltrans vibration impact criteria.

Noise Impacts Associated with Project-Generated Increases in Off-Site Traffic

With development of the project, traffic volumes on the local roadway network will increase. Those increases in daily traffic volumes will result in a corresponding increase in traffic noise levels at existing uses located along those roadways. Impact 1 evaluates increases in off-site traffic noise levels which would result from the project.

Impact 1: Increases in Existing Traffic Noise Levels due to the Project

The FHWA Traffic Noise Model (FHWA-RD-77-108) was used to quantify increases in existing traffic noise levels at the existing sensitive land uses nearest to the project area roadway network. The FHWA Model predicts hourly L_{eq} values for free-flowing traffic conditions. Estimates of the hourly distribution of traffic for a typical 24-hour period were used to develop DNL values from L_{eq} values.

Traffic data in the form of peak hour intersection turning movements were provided by the project transportation consultant (Wood Rodgers). Those data were converted to Average Daily Traffic (ADT) segment volumes by applying a factor of 5 to the sum of AM and PM peak hour conditions. Other inputs were obtained from BAC observations and noise measurement data. Appendices B and D contains the FHWA Model inputs for existing and existing plus project conditions, respectively. The existing and existing plus project traffic noise levels at the distances representing the nearest sensitive land uses to the project area roadways (residential uses) are summarized in Table 11. Table 11 also shows the thresholds for determination of a significant traffic noise increase (relative to applied FICON criteria), whether the roadway segment contains sensitive uses, and whether or not significant noise impacts are identified for each segment.

It should be noted that the FHWA Model predictions presented in Table 11 are based on inputs that include weekday peak hour traffic volumes, day/night, and truck type percentages (e.g., medium and heavy trucks), vehicle speed, and distance from roadway centerlines. Further, the FHWA Model does not account for non-traffic ambient noise sources such as nearby wildlife (e.g., birds chipping) or other anthropogenic noise sources within an area (e.g., distant traffic from other roadways, recreational activities, commercial or industrial operations, etc.).

Table 11
Predicted Traffic Noise Level Increases at Existing Sensitive Receptors – Existing vs. Existing Plus Project Conditions

#	Roadway	Segment Description	Predicted DNL (dB)			Significance Threshold (dB)[1]	Threshold Exceeded?	Sensitive Receptors Present?	Significant Impact Identified?
			E	E+ P	Increase				
1	College Oak Dr	North of Winding Way	59.5	59.8	0.3	5.0	No	**Yes**	No
2	College Oak Dr	South of Winding Way	60.8	61.2	0.5	3.0	No	**Yes**	No
3	Winding Way	West of College Oak Dr	47.6	47.6	0.0	5.0	No	**Yes**	No
4	Winding Way	College Oak to Manzanita Ave	63.4	64.0	0.6	3.0	No	**Yes**	No
5	Winding Way	Manzanita Ave to Rampart Dr	59.2	59.6	0.3	5.0	No	**Yes**	No
6	Winding Way	East of Rampart Dr	63.5	63.7	0.2	6.0	No	**Yes**	No
7	Manzanita Ave	North of Winding Way	63.8	64.1	0.3	3.0	No	**Yes**	No
8	Manzanita Ave	Winding Way to Windmill Way	53.5	54.1	0.6	5.0	No	No	No
9	Manzanita Ave	Winding Way to Lincoln Ave	66.4	66.6	0.3	1.5	No	**Yes**	No
10	Manzanita Ave	Lincoln Ave to Cypress Ave	58.6	58.9	0.3	5.0	No	**Yes**	No
11	Manzanita Ave	South of Cypress Ave	57.2	57.4	0.2	5.0	No	**Yes**	No
12	Windmill Way	West of Manzanita Ave	51.8	51.8	0.0	5.0	No	**Yes**	No
13	Lincoln Ave	West of Manzanita Ave	27.1	27.1	0.0	5.0	No	**Yes**	No
14	Lincoln Ave	East of Manzanita Ave	57.2	57.5	0.3	5.0	No	**Yes**	No
15	Cypress Ave	West of Manzanita Ave	58.2	58.3	0.1	5.0	No	**Yes**	No
16	Cypress Ave	East of Manzanita Ave	36.9	38.4	0.0	5.0	No	No	No
17	Rampart Ave	North of Winding Way	37.8	37.8	0.0	5.0	No	**Yes**	No
18	Rampart Ave	Winding Way to Mary Lynn Ln	35.6	36.6	1.0	5.0	No	**Yes**	No
19	Rampart Ave	South onto Mary Lynn Ln	35.2	35.2	0.0	5.0	No	**Yes**	No
20	Rampart Ave	East of Mary Lynn Ln	49.4	49.4	0.0	5.0	No	**Yes**	No
21	Gas Station Dwy	North of Winding Way	NA[2]	42.1	42.1	--	--	No	No
22	Project Dwy 1	South onto Project Site	NA[2]	37.8	37.8	--	--	No	No
23	Project Dwy 2	East onto Project Site	NA[2]	35.0	35.0	--	--	No	No
24	Project Dwy 3	East onto Project Site	NA[2]	37.9	37.9	--	--	**Yes**	No
25	Project Dwy 4	East onto Project Site	NA[2]	35.9	35.9	--	--	**Yes**	No
26	Project Dwy 5	East onto Project Site	NA[2]	40.9	40.9	--	--	**Yes**	No
27	Shopping Center Dwy	North of Winding Way	NA[2]	42.1	42.1	--	--	No	No
28	Project Street 1	South onto Project Site	NA[2]	22.5	22.5	--	--	**Yes**	No
29	Project Street 6	West of Rampart Ave	NA[2]	24.4	24.4	--	--	**Yes**	No

[1] FICON significance thresholds provided in Table 4 of this report.
[2] The project traffic study did not contain existing conditions data for segments 21-27.

Source: FHWA-RD-77-108 with inputs from Wood Rodgers. Appendices B & D contain FHWA Model inputs.

As indicated in Table 11, the proposed project's contribution is calculated to result in increases ranging from approximately 23 to 42 dB DNL along roadway segments 21-27. Of those roadway segments, seven (7) are access points to the proposed development and are located on-site (segments 22-26). The remaining two (2) identified roadway segments are located off-site and have been identified as access points/parking aisles associated with the existing gas station/convenience store and shopping center to the north of the project area (segments 21 and 27).

As stated previously, the FHWA Model does not account for non-traffic ambient noise sources such as nearby wildlife or other anthropogenic noise sources within an area. Consideration of such sources typically results in higher ambient noise levels (i.e., existing no project) than those predicted by the FHWA Model alone. Thus, baseline ambient conditions are considerably higher than baseline traffic noise levels alone. After consideration of the measured existing ambient environment within the project vicinity (BAC noise survey) and taking into consideration typical noise levels associated with the existing commercial uses located north of the project area (e.g., parking movements, on-site traffic circulation, truck deliveries, etc.), project-related traffic noise level increases along roadway segments 21-27 are not expected to be substantial relative to the applicable FICON criteria. Further, although existing residential uses were identified along a portion of those roadway segments, it should be noted that the predicted Existing Plus Project traffic noise levels for those segments are well below the Sacramento County General Plan exterior noise level standard of 65 dB DNL applicable to traffic noise affecting residential uses.

Based on the analysis presented above, including consideration of measured ambient noise conditions within the project area and noise associated with nearby existing commercial operations, off-site traffic noise impacts related to increases in traffic resulting from the implementation of the project are identified as being ***less than significant***.

Off-Site Noise Impacts Associated with Proposed On-Site Commercial Operations

As mentioned previously, the commercial component consists of a total of six parcels – one parcel containing a gas station/convenience store (with car wash tunnel), and five parcels containing a retail/restaurant use (of which three will have drive-through lanes). The commercial component is presented in Figure 3.

Pursuant to Comment 30(C) of a Sacramento County Planning and Environmental Review letter to the project applicant, noise analyses for project car wash operations (i.e., drying assembly), vacuum equipment and drive-through operations (i.e., amplified menu speaker boards) are required. Impact discussions for each of the identified noise sources at nearby existing single-family residential (SFR) and multi-family residential (MFR) uses are provided in the following section.

For noise generated by on-site commercial operations, the Sacramento County General Plan's non-transportation noise standards for residential uses (shown in Table 8) were applied to the project. The General Plan's noise level limits are to be assessed at the outdoor areas of residential uses, which are considered to be backyards for single-family residential uses and common outdoor spaces such as pools or parks for multi-family residential uses. In terms of determining the noise level increase due to on-site noise sources, an impact would occur if those

sources would noticeably increase ambient noise levels above background levels. The threshold of perception of the human ear is approximately 3 to 5 dB – a 5 dB change is considered to be clearly noticeable. For the following analyses of commercial operations noise sources, a noticeable increase in ambient noise levels is assumed to occur where noise levels increase by 5 dB or more over existing ambient noise levels at existing nearby residential uses.

Finally, the following analyses of project on-site operations noise at the nearest residential uses include consideration of shielding (where applicable) that would be provided by a masonry wall ranging from 6 to 7' proposed for construction along the eastern and southern boundary of the commercial component. The location of the proposed masonry noise barrier is illustrated in Figure 3.

Impact 2: Car Wash Drying Assembly Noise at Nearest Existing Residential Uses

According to the project applicant, the project proposes the installation of a 40 Horsepower (HP) AquaDri Freestanding Drying System (Model FS-40) manufactured by Mark VII / WashTec within a car wash tunnel. The location of the proposed car wash tunnel is shown in Figure 3. The manufacturer's sound level data for the proposed drying system are provided in Appendix E and are summarized in Table 12. The equipment manufacturer's sound level data presented in Table 12 and Appendix E are in terms of maximum (L_{max}) sound levels.

Table 12
AquaDri 40 HP Freestanding Drying System Reference Noise Levels

Exit End					Entrance End				
dBA (L_{max}) at distance (ft)					dBA (L_{max}) at distance (ft)				
10	20	30	40	50	10	20	30	40	50
92	87	84	81	77	89	84	81	80	78

Source: Mark VII / WashTec.

As indicated in Table 12, the noise level generation of the car wash drying assembly varies depending on the distance from the tunnel entrance/exit ends. It is the experience of BAC in previous car wash projects that drying assembly noise levels also vary depending on orientation of the measurement position relative to the tunnel openings. Worst-case drying assembly noise levels occur at a position directly facing the car wash exit, considered to be 0 degrees off-axis. At off-axis positions, the car wash building facade provides varying degrees of noise level reduction. At positions 45 degrees off-axis relative to the building facade of the car wash exit and entrance, drying assembly noise levels are approximately 5 dB lower. At 90 degrees off-axis, drying assembly noise levels are approximately 10 dB lower.

It is the experience of BAC in similarly configured car wash projects that the average car wash cycle is approximately 5 minutes in duration. The dryers would operate during the last 1 minute of the cycle. Therefore, during a worst-case hour, the car wash would go through 12 full cycles and the dryer would operate for approximately 12 minutes during a busy hour. Based on the above operation duration assumptions (i.e., less than 30 minutes of equipment operation during a given hour), and pursuant to the noise source duration criteria footnoted in Table 8, the County's

maximum (L_{max}) noise level standards would be applicable to the project car wash drying assembly.

Based on the information above, and after consideration of screening of residential outdoor areas that would be provided by existing intervening structures, the following reference noise levels and offsets shown in Table 13 were applied to project car wash drying assembly noise level exposure at the nearest residential uses.

Table 13
Equipment Reference Noise Level Data and Applied Offsets

Nearest Residential Use	Base Reference Noise Level, L_{max} (dB)[1]	Orientation Relative to Tunnel Exit/Entrance	Applied Offsets (dB)		
			Orientation[2]	Proposed Sound Wall[3]	Existing Shielding[4]
Northeast – MFR	78 dB @ 50 feet	0°	--	-6	-7
East – MFR	78 dB @ 50 feet	0°	--	-6	-10
South – SFR	78 dB @ 50 feet	90°	-10	-6	--
Southwest – SFR	77 dB @ 50 feet	90°	-10	--	--
West – MFR	77 dB @ 50 feet	45°	-5	--	--

[1] Because all of the nearest existing residential uses are located in excess of 50' from the tunnel exit/entrance, the base reference noise levels at 50' from tunnel exit/entrance shown in Table 12 were utilized in the analysis.
[2] Orientation offsets based on BAC measurements at off-axis locations from tunnel exit/entrance, as discussed in report.
[3] Sound wall offset applied where shielding would be provided by proposed 6' to 7' masonry wall, as indicated in Figure 3.
[4] Existing shielding offsets applied where screening of outdoor area would occur from existing intervening buildings.

Source: BAC 2023.

Using the information shown in Table 13, and assuming standard spherical spreading loss from a point source (-6 dB per doubling of distance from a stationary noise source), project car wash drying assembly noise exposure at the closest existing residential uses was calculated and the results of those calculations are presented in Table 14.

Table 14
Predicted Car Wash Drying Assembly Noise Levels at Nearest Existing Residential Uses

Nearest Residential Use[1]	Distance (ft)[2]	Offset (dB)[3]	Predicted Noise Level, L_{max} (dB)	Applied County Standards, L_{max} (dB)[4]	
				Daytime	Nighttime
Northeast – MFR	775	-13	41	**80**	**75**
East – MFR	750	-16	38	**90**	**70**
South – SFR	1,200	-6	34	**80**	**70**
Southwest – SFR	1,100	0	40	**80**	**80**
West – MFR	650	0	50	**80**	**80**

[1] Residential uses are shown in Figure 1.
[2] Distances scaled from either tunnel entrance or exit to outdoor spaces of residential uses using site plans.
[3] Applied offsets are shown in Table 13.
[4] Applied noise standards based on BAC ambient noise survey results and County adjustment criteria.

Source: BAC 2023.

As indicated in Table 14, project car wash drying assembly noise level exposure is predicted to satisfy the applied Sacramento County General Plan daytime and nighttime exterior noise level standards at the nearest existing residential uses by a wide margin. In addition, standard residential construction (e.g., stucco siding, STC-27 windows, door weather-stripping, exterior wall insulation, composition plywood roof), typically results in an exterior to interior noise reduction of approximately 25 dB with windows closed and approximately 15 dB with windows open. Given this exterior to interior noise reduction typically achieved from standard residential construction and based on the predicted exterior noise levels in Table 14, project car wash drying assembly noise level exposure is expected to be well below the General Plan's daytime and nighttime interior noise level standards within the nearest existing residences.

Table 2 of this report summarizes the results from the BAC short-term ambient noise survey. Using the calculated averages of measured daytime and nighttime noise levels presented in Table 2, ambient plus project car wash drying assembly noise level increases were calculated at the nearest residential uses and the results of those calculations are presented in Tables 15 and 16.

Table 15
Ambient Plus Project Car Wash Noise Increases at Nearest Residential Uses – Daytime L_{max}

Nearest Residential Use	Predicted Noise Level, L_{max} (dB)[1]	Ambient Plus Project, L_{max} (dB)[2]	Increase in Ambient, L_{max}(dB)[3]
Northeast – MFR	41	80.0	<0.1
East – MFR	38	90.0	<0.1
South – SFR	34	80.0	<0.1
Southwest – SFR	40	80.0	<0.1
West – MFR	50	80.0	<0.1

[1] Predicted noise levels from Table 14 which include offsets as indicated.
[2] Sum of predicted and measured ambient daytime noise levels.
[3] Calculated increase in ambient daytime noise levels.

Source: BAC 2023.

Table 16
Ambient Plus Project Car Wash Noise Increases at Nearest Residential Uses – Nighttime L_{max}

Nearest Residential Use	Predicted Noise Level, L_{max} (dB)[1]	Ambient Plus Project, L_{max} (dB)[2]	Increase in Ambient, L_{max}(dB)[3]
Northeast – MFR	41	75.0	<0.1
East – MFR	38	70.0	<0.1
South – SFR	34	70.0	<0.1
Southwest – SFR	40	80.0	<0.1
West – MFR	50	80.0	<0.1

[1] Predicted noise levels from Table 14 which include offsets as indicated
[2] Sum of predicted and measured ambient nighttime noise levels.
[3] Calculated increase in ambient nighttime noise levels.

Source: BAC 2023.

As shown in Tables 15 and 16, the increases in ambient noise levels from project car wash drying assembly equipment are calculated to be well below the applied significance criterion of 5 dB.

Because noise exposure from project car wash drying assembly equipment is predicted to satisfy applicable Sacramento County General Plan noise level standards at the nearest existing residential uses, and because noise exposure from those activities is not calculated to significantly increase ambient noise levels at those uses, this impact is identified as being ***less than significant***.

Impact 3: Vacuum Equipment Noise at Nearest Existing Residential Uses

A vehicle vacuum area is proposed to be located adjacent to the proposed car wash tunnel within the commercial component. According to information provided to BAC, the project proposes the installation of JE Adams Super Vac Model #9200 series vacuum units.

The manufacturer's specifications, provided as Appendix F, indicate that the sound level exposure associated with the vacuum system varies depending on motor type configuration. For the purposes of this analysis, it was conservatively assumed that that project would have the loudest vacuum assembly indicated in Appendix F (regular 2-motor plastic dome configuration, 65 dB at 40 feet). Because the number of proposed vacuum units is unclear after a review of the project plan, it was further conservatively assumed that the project would have a total of six (6) within the vacuum area.

Because operation of the project vacuum equipment could exceed 30 continuous minutes in duration during a given worst-case busy hour, and pursuant to the noise source duration criteria footnoted in Table 8, the County's median (L_{50}) noise level standards would be applicable to the vacuum equipment. Based upon the manufacturer's data (Appendix F), the operations assumptions above, and assuming standard spherical spreading loss (-6 dB per doubling of distance), worst-case (all 6 combined units) project vacuum equipment noise exposure at the nearest existing residential uses was calculated and the results of those calculations are presented in Table 17. The results presented in Table 17 include consideration of shielding that would be provided by the masonry wall proposed for construction along the eastern and southern commercial component project boundary (ranging from 6 to 7' in height). The location of the proposed noise barrier is shown in Figure 3.

Table 17
Predicted Vacuum Equipment Noise Levels at Nearest Existing Residential Uses

Nearest Residential Use[1]	Distance (ft)[2]	Offset (dB)[3]	Predicted Noise Level, L_{50} (dB)	Applied County Standards, L_{50} (dB)[4]	
				Daytime	Nighttime
Northeast – MFR	800	-13	34	**60**	**50**
East – MFR	780	-16	31	**70**	**50**
South – SFR	1,330	-16	26	**65**	**50**
Southwest – SFR	1,100	0	44	**70**	**60**
West – MFR	680	0	48	**70**	**60**

[1] Residential uses are shown in Figure 1.
[2] Distances scaled from proposed vacuum area to outdoor spaces of residential uses using site plans.
[3] Offsets account for existing and proposed building shielding (-7 to -10 dB) and proposed walls (-6 dB).
[4] Predicted combined noise level exposure from 6 vacuum units (reference noise level of 73 dB at 40 feet).
[5] Applied noise standards based on BAC ambient noise survey results and County adjustment criteria.

Source: BAC 2023.

The Table 17 data indicate that worst-case vacuum equipment noise level exposure is predicted to satisfy the applied Sacramento County General Plan daytime and nighttime exterior noise level standards at the nearest existing residential uses by a wide margin. In addition, given the exterior to interior noise reduction typically achieved from standard residential construction (approximately 25 dB with windows closed and approximately 15 dB with windows open), and based on the predicted exterior noise levels in Table 17, project vacuum equipment noise level exposure is expected to be well below the General Plan's daytime and nighttime interior noise level standards within the nearest existing residences.

Table 2 of this report summarizes the results from the BAC short-term ambient noise survey. Using the calculated averages of measured daytime and nighttime noise levels presented in Table 2, ambient plus project vacuum equipment noise level increases were calculated at the nearest residential uses and the results of those calculations are presented in Tables 18 and 19.

Table 18
Ambient Plus Project Vacuum Noise Increases at Nearest Residential Uses – Daytime L_{50}

Nearest Residential Use	Predicted Noise Level, L_{50} (dB)[1]	Ambient Plus Project, L_{50} (dB)[2]	Increase in Ambient, L_{50} (dB)[3]
Northeast – MFR	34	60.0	<0.1
East – MFR	31	70.0	<0.1
South – SFR	26	65.0	<0.1
Southwest – SFR	44	70.0	<0.1
West – MFR	48	70.0	<0.1

[1] Predicted noise levels from Table 17 which include offsets as indicated.
[2] Sum of predicted and measured ambient daytime noise levels.
[3] Calculated increase in ambient daytime noise levels.

Source: BAC 2023.

Table 19
Ambient Plus Project Vacuum Noise Increases at Nearest Residential Uses – Nighttime L_{50}

Nearest Residential Use	Predicted Noise Level, L_{50} (dB)[1]	Ambient Plus Project, L_{50} (dB)[2]	Increase in Ambient, L_{50} (dB)[3]
Northeast – MFR	34	50.1	0.1
East – MFR	31	50.1	0.1
South – SFR	26	50.0	<0.1
Southwest – SFR	44	60.1	0.1
West – MFR	48	60.3	0.3

[1] Predicted noise levels from Table 17 which include offsets as indicated.
[2] Sum of predicted and measured ambient nighttime noise levels.
[3] Calculated increase in ambient nighttime noise levels.

Source: BAC 2023.

The data in Tables 18 and 19 indicate that the increases in ambient noise levels from worst-case project vacuum equipment operations are calculated to be well below the applied significance criterion of 5 dB.

Because noise exposure from project vacuum equipment is predicted to satisfy applicable Sacramento County General Plan noise level standards at the nearest existing residential uses, and because noise exposure from those activities is not calculated to significantly increase ambient noise levels at those uses, this impact is identified as being ***less than significant***.

Impact 4: Drive-Through Operations Noise at Nearest Existing Residential Uses

According to the project site plans, the project proposes drive-through lanes at Building Pads P2 through P6. Information on the menu speaker board models for the proposed drive-through lanes was not available at the time of writing this report. To quantify the noise emissions of proposed drive-through operations (i.e., menu speaker board and vehicles passages), BAC utilized noise level measurement data collected by BAC at other similar drive-through facilities located within the Sacramento region in recent years. Table 20 contains the reference sound levels utilized in this analysis (also contained in Appendix G).

Table 20
Reference Drive-Through Noise Levels

Noise Source	Measured Noise Levels (dB)	
	Average (L_{50})	Maximum (L_{max})
Speaker[1]	63 dB at 10 feet	67 dB at 10 feet
Vehicles[2]	60 dB at 5 feet	70 dB at 5 feet

[1] Noise level data obtained from measurements conducted at a drive-through restaurant located at 2845 Bell Road in Auburn, California in 2018 (Appendix G).

Source: BAC 2018.

Because project drive-through operations could exceed 30 continuous minutes in duration during a given worst-case busy hour, and pursuant to the noise source duration criteria footnoted in Table 8, the County's median (L_{50}) noise level standards were applied. Using the BAC speaker and drive-through vehicle passby data presented in Table 20, and assuming standard spherical spreading loss (-6 dB per doubling of distance), data were projected from each of the proposed drive-through lane/speaker board areas to the nearest existing residential uses. The results of those projections are provided in Table 21. The results presented in Table 21 include consideration of shielding that would be provided by the masonry wall proposed for construction along the eastern and southern commercial component project boundary (ranging from 6 to 7' in height). The location of the proposed noise barrier is shown in Figure 3.

Table 21
Predicted Drive-Through Operations Noise Levels at Nearest Existing Residential Uses

Residential Use[1]	Nearest Building Pads	Distance from Sources (ft)[2]		Predicted Combined Level, L_{50} (dB)[3]		Applied County Standards, L_{50} (dB)[4]	
		Speaker	Vehicles	Speaker	Vehicles	Daytime	Nighttime
Northeast – MFR	P2 P3	715 740	705 620	<20	<20	**60**	**50**
East – MFR	P5	650	600	<20	<20	**70**	**50**
South – SFR	P5	775	715	24	22	**65**	**50**
Southwest – SFR	P5	600	575	28	26	**70**	**60**
West – MFR	P5	660	630	22	<20	**70**	**60**

[1] Residential uses are shown in Figure 1.
[2] Distances scaled from nearest drive-throughs components to outdoor spaces of residential uses using site plans.
[3] Predicted noise levels include offsets that account for existing and proposed building shielding (-3 to -10 dB) and proposed walls (-6 dB).
[4] Applied noise standards based on BAC ambient noise survey results and County adjustment criteria.

Source: BAC 2023.

As shown in Table 21, project drive-through operations noise level exposure is predicted to satisfy the applied Sacramento County General Plan daytime and nighttime exterior noise level standards at the nearest existing residential uses by a wide margin. In addition, given the exterior to interior noise reduction typically achieved from standard residential construction (approximately 25 dB with windows closed and approximately 15 dB with windows open), and based on the predicted exterior noise levels in Table 21, project drive-through operations noise level exposure is expected to be well below the General Plan's daytime and nighttime interior noise level standards within the nearest existing residences. It should be noted that the predicted noise levels in Table 21 would also comply with the County's 5 dB downward adjusted noise criteria, which would be applicable to noise sources consisting primarily of music or speech.

Table 2 of this report summarizes the results from the BAC short-term ambient noise survey. Using the calculated averages of measured daytime and nighttime noise levels presented in Table 2, ambient plus project drive-through operations noise level increases were calculated at the nearest residential uses and the results of those calculations are presented in Tables 22 and 23.

Table 22
Ambient Plus Project Drive-Thru Noise Increases at Nearest Residential Uses – Daytime L_{50}

Nearest Residential Use	Highest Predicted Noise Level, L_{50} (dB)[1]	Ambient Plus Project, L_{50} (dB)[2]	Increase in Ambient, L_{50} (dB)[3]
Northeast – MFR	<20	60.0	<0.1
East – MFR	<20	70.0	<0.1
South – SFR	24	65.0	<0.1
Southwest – SFR	28	70.0	<0.1
West – MFR	22	70.0	<0.1

[1] Highest predicted noise levels from Table 21 which include offsets as footnoted in table.
[2] Sum of highest predicted and measured ambient daytime noise levels.
[3] Calculated increase in ambient daytime noise levels.

Source: BAC 2023.

Table 23
Ambient Plus Project Drive-Thru Noise Increases at Nearest Residential Uses – Nighttime L_{50}

Nearest Residential Use	Highest Predicted Noise Level, L_{50} (dB)[1]	Ambient Plus Project, L_{50} (dB)[2]	Increase in Ambient, L_{50} (dB)[3]
Northeast – MFR	<20	50.1	<0.1
East – MFR	<20	50.1	<0.1
South – SFR	24	50.0	<0.1
Southwest – SFR	28	60.1	<0.1
West – MFR	22	60.3	<0.1

[1] Highest predicted noise levels from Table 21 which include offsets as footnoted in table.
[2] Sum of highest predicted and measured ambient nighttime noise levels.
[3] Calculated increase in ambient nighttime noise levels.

Source: BAC 2023.

As indicated in Tables 22 and 23, the increases in ambient noise levels from project drive-through operations are calculated to be well below the applied significance criterion of 5 dB.

Because noise exposure from project drive-through operations is predicted to satisfy applicable Sacramento County General Plan noise level standards at the nearest existing residential uses, and because noise exposure from those activities is not calculated to significantly increase ambient noise levels at those uses, this impact is identified as being ***less than significant***.

Impact 5: Cumulative (Combined) Project Noise at Existing Nearest Residential Uses

The calculated combined median (L_{50}) noise level exposure from analyzed on-site noise sources at the nearest existing residential uses is presented in Tables 24 and 25. It should be noted that due to the logarithmic nature of the decibel scale, the sum of two noise values which differ by 10 dB equates to an overall increase in noise levels of 0.4 dB. When the noise sources are equivalent, the sum would result in an overall increase in noise levels of 3 dB.

Table 24
Calculated Cumulative On-Site Operations Noise at Nearest Residential Uses – Daytime L_{50}

Residential Use	Predicted Noise Levels, L_{50} (dB)		Calculated Cumulative, L_{50} (dB)[1]	Applied County Daytime Standard, L_{50} (dB)[2]
	Vacuums	Drive-Through Operations		
Northeast – MFR	34	<20	34	**60**
East – MFR	31	<20	31	**70**
South – SFR	26	24	28	**65**
Southwest – SFR	44	28	44	**70**
West – MFR	48	22	48	**70**

[1] Calculated cumulative noise levels based on predicted noise levels presented in Impacts 2-4.
[2] Applied noise standards based on BAC noise survey results and County adjustment criteria.

Source: BAC 2023.

Table 25
Calculated Cumulative On-Site Operations Noise at Nearest Residential Uses – Nighttime L_{50}

Residential Use	Predicted Noise Levels, L_{50} (dB)		Calculated Cumulative, L_{50} (dB)[1]	Applied County Nighttime Standard, L_{50} (dB)[2]
	Vacuums	Drive-Through Operations		
Northeast – MFR	34	<20	34	**50**
East – MFR	31	<20	31	**50**
South – SFR	26	24	28	**50**
Southwest – SFR	44	28	44	**60**
West – MFR	48	22	48	**60**

[1] Calculated cumulative noise levels based on predicted noise levels presented in Impacts 2-4.
[2] Applied noise standards based on BAC noise survey results and County adjustment criteria.

Source: BAC 2023.

The data in Tables 24 and 25 indicate that calculated cumulative median (L_{50}) noise level exposure from analyzed on-site operations would comply with the applied Sacramento County General Plan daytime and nighttime exterior noise level standards at the nearest existing residential uses by a wide margin. In addition, given the exterior to interior noise reduction typically achieved from standard residential construction (approximately 25 dB with windows closed and approximately 15 dB with windows open), and based on the predicted exterior noise levels in Tables 24 and 25, combined on-site operations noise level exposure is expected to be well below the General Plan's daytime and nighttime interior noise level standards within the nearest existing residences.

Table 2 of this report summarizes the results from the BAC short-term ambient noise survey. Using the calculated averages of measured daytime and nighttime noise levels presented in Table 2, ambient plus combined project noise level increases were calculated at the nearest residential uses and the results of those calculations are presented in Tables 26 and 27.

Table 26
Ambient Plus Combined Project Noise at Nearest Residential Uses – Daytime L_{50}

Residential Use	Calculated Cumulative, L_{50} (dB)[1]	Ambient Plus Project, L_{50} (dB)[2]	Overall Increase in Ambient, L_{50} (dB)[3]
Northeast – MFR	34	60.0	<0.1
East – MFR	31	70.0	<0.1
South – SFR	28	65.0	<0.1
Southwest – SFR	44	70.0	<0.1
West – MFR	48	70.0	<0.1

[1] Calculated cumulative median noise levels from Table 24.
[2] Sum of calculated combined and measured ambient daytime median noise levels.
[3] Calculated combined increase in ambient daytime median noise levels.

Source: BAC 2023.

Table 27
Ambient Plus Combined Project Noise at Nearest Residential Uses – Nighttime L_{50}

Residential Use	Calculated Cumulative, L_{50} (dB)[1]	Ambient Plus Project, L_{50} (dB)[2]	Overall Increase in Ambient, L_{50} (dB)[3]
Northeast – MFR	34	50.1	0.1
East – MFR	31	50.1	0.1
South – SFR	28	50.0	<0.1
Southwest – SFR	44	60.1	0.1
West – MFR	48	60.3	0.3

[1] Calculated cumulative median noise levels from Table 25.
[2] Sum of calculated combined and measured ambient daytime median noise levels.
[3] Calculated combined increase in ambient daytime median noise levels.

Source: BAC 2023.

The data provided in Tables 26 and 27 indicate that the increases in ambient median (L_{50}) noise levels from combined project on-site operations are calculated to be well below the applied significance criterion of 5 dB.

Because the calculated cumulative (combined) noise exposure from project on-site operations is predicted to satisfy applicable Sacramento County General Plan noise level standards at the nearest existing residential uses, and because cumulative noise exposure is not calculated to significantly increase ambient noise levels at those uses, this impact is identified as being ***less than significant***.

Noise Impacts Associated with Project On-Site Construction Activities

Impact 6: On-Site Project Construction Noise at Existing Residential Uses

During project construction, heavy equipment would be used for grading excavation, paving, and structure construction, which would increase ambient noise levels when in use. Noise levels would vary depending on the type of equipment used, how it is operated, and how well it is maintained. Noise exposure at any single point outside the project work area would also vary depending upon the proximity of equipment activities to that point. Table 28 includes the range of maximum (L_{max}) noise levels for equipment commonly used in general residential construction projects at full-power operation at a distance of 50 feet. Not all of these construction activities would be required of this project. The Table 28 data also include predicted maximum equipment noise levels at the nearest existing residential uses, which assume a standard spherical spreading loss of 6 dB per doubling of distance.

Table 28
Reference and Projected Noise Levels for Typical Construction Equipment

Equipment Description	Reference Maximum Noise Level at 50 Feet (dBA)	Projected Maximum Noise Levels Nearest Receivers (dB)				
		NE-MFR (100 feet)	E-MFR (40 feet)	S-SFR (70 feet)	SW-SFR (100 feet)	W-MFR (100 feet)
Air compressor	80	74	82	77	74	74
Backhoe	80	74	82	77	74	74
Ballast equalizer	82	76	84	79	76	76
Ballast tamper	83	77	85	80	77	77
Compactor	82	76	84	79	76	76
Concrete mixer	85	79	87	82	79	79
Concrete pump	82	76	84	79	76	76
Concrete vibrator	76	70	78	73	70	70
Crane, mobile	83	77	85	80	77	77
Dozer	85	79	87	82	79	79
Excavator	85	79	87	82	79	79
Generator	82	76	84	79	76	76
Grader	85	79	87	82	79	79
Impact wrench	85	79	87	82	79	79
Loader	80	74	82	77	74	74
Paver	85	79	87	82	79	79
Pneumatic tool	85	79	87	82	79	79
Pump	77	71	79	74	71	71
Saw	76	70	78	73	70	70
Scarifier	83	77	85	80	77	77
Scraper	85	79	87	82	79	79
Shovel	82	76	84	79	76	76
Spike driver	77	71	79	74	71	71
Tie cutter	84	78	86	81	78	78
Tie handler	80	74	82	77	74	74
Tie inserter	85	79	87	82	79	79
Truck	84	78	86	81	78	78
Low		70	78	73	70	70
High		79	87	82	79	79
Average		76	84	79	76	76

Source: 2018 Federal Transit Administration Noise and Vibration Impact Assessment Manual, Table 7-1 and BAC.

Sacramento County Municipal Code Section 6.68.090(E) exempts noise sources associated with construction activities provided such activities do not occur between the hours of 8:00 p.m. and 6:00 a.m. on weekdays and Friday commencing at 8:00 p.m. through and including 7:00 a.m. on the next following Sunday and on each Sunday after the hour of 8:00 p.m. It is reasonably assumed for the purposes of this analysis that all on-site noise-generating project construction equipment and activities would occur pursuant to and in compliance with Municipal Code Section 6.68.090(E) and would thereby be exempt from County noise level criteria.

However, noise from project on-site construction activities would add to the noise environment in the immediate vicinity of the work area. In terms of determining the temporary noise increase due to project-related construction activities, an impact would occur if construction activity would noticeably increase ambient noise levels above background levels. The threshold of perception of the human ear is approximately 3 to 5 dB – a 5 dB change is considered to be clearly noticeable. For this analysis, a noticeable increase in ambient noise levels is assumed to occur where noise levels increase by 5 dB or more over existing ambient noise levels.

Table 2 of this report summarizes the results from the BAC short-term ambient noise survey. Using the measured daytime (calculated average) maximum (L_{max}) noise levels presented in Table 2, and the highest predicted construction equipment maximum noise levels shown in Table 28, ambient plus project construction noise level increases were calculated at the nearest residential uses and the results of those calculations are presented in Table 29.

Table 29
Ambient Plus Project Construction Noise Increases at Residential Uses – Daytime L_{max}

Residential Use	Highest Predicted Noise Level, L_{max} (dB)[1]	Measured Ambient Daytime Noise Level, L_{max} (dB)[2]	Ambient Plus Project, L_{max} (dB)[3]	Increase in Ambient, L_{max} (dB)[4]
Northeast – MFR	79	76.8	81.1	4.3
East – MFR	87	86.9	89.9	3.0
South – SFR	82	79.0	83.8	4.8
Southwest – SFR	79	79.1	82.1	3.0
West – MFR	79	79.1	82.0	3.0

[1] Highest predicted maximum equipment noise levels from Table 28.
[2] Calculated average of measured daytime noise levels from Table 2.
[3] Sum of highest predicted equipment noise levels and measured daytime maximum noise levels.
[4] Calculated increase in ambient daytime noise levels.

Source: BAC 2023.

The data provided in Table 29 indicate that the increases in ambient noise levels from on-site project construction activities are calculated to be below the applied significance criterion of 5 dB.

Based on the analysis and results provided above, this impact is identified as being ***less than significant***. Nonetheless, to the reduce the potential for annoyance at nearby noise-sensitive uses, the following measures should be incorporated into project on-site construction operations

- Pursuant to Sacramento County Municipal Code Section 6.68.090(E), noise-generating on-site construction activities should not occur between the hours of 8:00 p.m. and 6:00 a.m. on weekdays and Friday commencing at 8:00 p.m. through and including 7:00 a.m. on the next following Sunday and on each Sunday after the hour of 8:00 p.m.
- All mobile or fixed noise-producing equipment used on the project site that are regulated for noise output by a federal, state, or local agency shall comply with such regulations while in the course of project activity.
- Electrically powered equipment shall be used instead of pneumatic or internal-combustion-powered equipment, where feasible.
- Material stockpiles and mobile equipment staging, parking, and maintenance areas shall be located as far as practicable from noise-sensitive uses.
- Work area speed limits shall be established and enforced during the construction period.
- Nearby residences shall be notified of construction schedules so that arrangements can be made, if desired, to limit their exposure to short-term increases in ambient noise levels.

Vibration Impacts Associated with On-Site Project Construction & Operations

Impact 7: On-Site Project Vibration Levels at Existing Residential Uses

During project construction, heavy equipment would be used for grading, excavation, paving, and building construction, which would generate localized vibration in the immediate vicinity of the construction. The nearest existing sensitive structures have been identified as residential.

Table 30 includes the range of vibration levels for equipment commonly used in general construction projects at a distance of 25 feet. The Table 30 data also include projected equipment vibration levels at the nearest existing sensitive structures (residences) to the project area.

Table 30
Reference and Projected Vibration Source Amplitudes for Construction Equipment

Equipment	Reference PPV at 25 Feet (in/sec)[1]	Projected PPV at Nearest Receptor (in/sec)				
		NE-MFR (100 feet)	E-MFR (40 feet)	S-SFR (70 feet)	SW-SFR (100 feet)	W-MFR (100 feet)
Vibratory roller	0.210	0.026	0.104	0.045	0.026	0.026
Hoe ram	0.089	0.011	0.044	0.019	0.011	0.011
Large bulldozer	0.089	0.011	0.044	0.019	0.011	0.011
Caisson drilling	0.089	0.011	0.044	0.019	0.011	0.011
Loaded trucks	0.076	0.010	0.038	0.016	0.010	0.010
Jackhammer	0.035	0.004	0.017	0.007	0.004	0.004
Small bulldozer	0.003	<0.001	0.001	0.001	<0.001	<0.001

[1] PPV = Peak Particle Velocity

Source: 2018 FTA Transit Noise and Vibration Impact Assessment Manual (Table 7-4) and BAC.

The Table 30 data indicate that vibration levels generated from on-site project construction activities at the nearest existing residences are predicted to be well below the Caltrans thresholds

for damage to residential structures of 0.5 in/sec PPV shown in Table 5 (building structure vibration criteria). In addition, the projected equipment vibration levels in Table 29 would range from well below a "barely/slightly perceptible" human response to "perceptible" human response as defined by Caltrans in Table 6 (vibration annoyance potential threshold criteria). Based on the analysis provided above, construction activities within the project area are not expected to result in excessive groundborne vibration levels at nearby existing residences.

Results from the ambient vibration level monitoring within the project area (Table 3) indicate that measured maximum vibration levels were below the strictest Caltrans thresholds for damage to structures and thresholds for annoyance. Therefore, it is expected that the project would not result in the exposure of persons to excessive groundborne vibration levels at proposed uses of the project.

Finally, the project consists of the development of residential and commercial uses. It is the experience of BAC these uses do not typically have equipment that generates appreciable vibration. Further, it is our understanding that the project does not propose equipment that will produce appreciable vibration.

Because vibration levels due to and upon the proposed project are expected to satisfy the applicable Caltrans groundborne impact vibration criteria, this impact is identified as being ***less than significant***.

Noise Impacts Upon the Development

The California Supreme Court issued an opinion in *California Building Industry Association v. Bay Area Air Quality Management District (2015)* holding that CEQA is primarily concerned with the impacts of a project on the environment and generally does not require agencies to analyze the impact of existing conditions on a project's future users or residents. Nevertheless, the County of Sacramento has policies that address existing/future conditions affecting the proposed project, which are discussed in the following section.

Future Traffic Noise at Proposed Residential Uses

Issue 1: Future Exterior Traffic Noise at Proposed Single-Family Residential Uses

The FHWA Model (FHWA-RD-77-108) was used with future traffic data to predict future Winding Way and Manzanita Avenue traffic noise levels at the proposed single-family residential uses of the development. The future average daily traffic (ADT) volumes for the roadways were conservatively estimated by increasing the existing ADT volume by a factor of 50%. The existing (2019) ADT volumes for the roadways were obtained from published Sacramento County traffic count data. The day/night distribution, truck percentages, and estimated future traffic speed assumptions for the roadways were derived from BAC file data for similar roadways.

Complete listings of FHWA Model inputs and results for Winding Way and Manzanita Avenue provided in Appendix H. The predicted future traffic noise levels at the development are summarized in Table 31.

Table 31
Predicted Future Exterior Traffic Noise Levels at Proposed Single-Family Residential Uses[1]

Roadway	Location Description	Offset (dB)[2]	Future Exterior DNL (dB)
Winding Way	Nearest backyards		68
	Nearest first-floor building facades		67
	Nearest upper-floor building facades	+2	69
Manzanita Avenue	Nearest backyards		63
	Nearest first-floor building facades		63
	Nearest upper-floor building facades	+2	65

[1] Complete listings of FHWA Model inputs are provided as Appendix H.
[2] A +2 dB offset was applied at upper-floors for reduced ground absorption of sound at elevated locations.

Source: BAC 2022.

As indicated in Table 31, future Winding Way traffic noise level exposure is predicted to exceed the Sacramento County General Plan 65 dB DNL exterior noise level standard at the outdoor activity areas (backyards) of the nearest proposed single-family residential lots to the roadway. As a result, further consideration of exterior traffic noise reduction measures would be warranted for this aspect of the project.

To reduce future Winding Way traffic noise level exposure to a state of compliance with the applicable Sacramento County General Plan 65 dB DNL exterior noise level standard at the project site, it is recommended that the project design include the construction of a 6' traffic noise barrier at the location shown on Figure 5. A barrier insertion loss calculation worksheet is provided as Appendix I. The construction of 6' traffic noise barrier at the location illustrated on Figure 5 is calculated to reduce future Winding Way traffic noise level exposure to 62 dB DNL or less at the nearest proposed backyards to the roadway, which would satisfy the applicable General Plan 65 dB DNL exterior noise level standard. The 6' traffic noise barrier could take the form of a masonry wall, earthen berm, or combination of the two. Other materials may be acceptable but should be reviewed by an acoustical consultant prior to construction.

It should be noted that lot grading plans were not available at the time of preparing this report. As a result, the 6' barrier height assumes that the difference in elevations between Winding Way and proposed adjacent residential lots are within ± 2 feet. Should differences in elevations be greater than ± 2 feet, an additional analysis would be warranted. Nonetheless, the 6' barrier height is relative to lot or roadway elevation, whichever is greater.

Drawing dated January 13, 2023

Legend

- Project Area Boundary
- 6' Traffic Noise Barrier

N

Scale (Feet)

0 100 200

Winding Ranch Project

Sacramento County, California

Recommended Traffic Noise Barrier

Figure 5

BOLLARD Acoustical Consultants

Issue 2: Future Interior Traffic Noise at Proposed Single-Family Residential Uses

Standard residential construction (i.e., stucco siding, STC-27 windows, door weather-stripping, exterior wall insulation, composition plywood roof), *typically* results in an exterior to interior noise reduction of approximately 25 dB with windows closed and approximately 15 dB with windows open. Therefore, provided that future traffic noise levels do not exceed 70 dB DNL at proposed exterior building facades, standard construction should be adequate to ensure compliance with the Sacramento County General Plan 45 dB DNL interior noise level standard within the single-family residences of the development.

The Table 31 data indicate that future exterior Manzanita Avenue traffic noise level exposure is predicted to range from 63 to 65 dB DNL at the single-family residential building facades proposed nearest to the roadway. The Table 31 data also indicate that future exterior Winding Way traffic noise levels are predicted to range from 67 to 69 dB DNL at the single-family residential building facades proposed nearest to the roadway. Although, after implementation of Mitigation Measure 8 (6' traffic noise barrier), future exterior Winding Way traffic noise levels are expected to be reduced to 62 dB DNL or less at the first-floor facades of the residences constructed nearest to the roadway.

Based on the above-identified exterior to interior noise reduction typically achieved with standard residential construction, window and door construction upgrades would not be warranted for satisfaction of the General Plan 45 dB DNL interior noise level standard at the project site. However, if a greater margin of safety is desired, the window assembly upgrades identified on Figure 6 could be integrated into the project design. Specifically, all upper-floor windows of the residences identified on Figure 6 with a view of Winding Way (i.e., north-, east- and west-facing windows) should be upgraded to a minimum Sound Transmission Class (STC) rating of 32. Finally, mechanical ventilation (air conditioning) should be provided for all residences within this development to allow the occupants to close doors and windows as desired to achieve compliance with the interior noise level criterion.

Drawing dated January 13, 2023

Legend

- Project Area Boundary
- Window Assembly Upgrades: STC 32 (Upper-Floors Only)

N

Scale (Feet)

0 100 200

Winding Ranch Project

Sacramento County, California

Recommended Window Assembly Upgrades

Figure 6

BOLLARD Acoustical Consultants

Proposed Commercial Operations Noise at Proposed Residential Uses

Issue 3: Project Car Wash Dryer Noise at Proposed Single-Family Residential Uses

An analysis of project car wash drying assembly noise exposure at nearby existing residential uses was presented in **Impact 2**. Using the same methodology identified in **Impact 2**, project car wash drying assembly noise levels were predicted at the nearest proposed single-family residential uses of the development (east of the commercial component). The results of that analysis are provided below in Table 32. The results presented in Table 32 include consideration of shielding that would be provided by the masonry wall proposed for construction along the eastern commercial component project boundary (6' height adjacent to nearest proposed residential lot). The location of the proposed noise barrier is shown in Figure 3.

Table 32
Predicted Car Wash Dryer Noise Levels at Proposed Single-Family Residential Uses

Receiver[1]	Distance (ft)[2]	Offset (dB)[3]	Predicted Noise Level, L_{max} (dB)	County Noise Standards, L_{max} (dB)[4]	
				Daytime	Nighttime
Nearest Proposed SFR Lot	175	-6	61	**75**	**70**

[1] Proposed single-family residential uses are shown in Figure 2.
[2] Distance scaled from tunnel to property line of nearest proposed single-family residential lot using site plans.
[3] Shielding offset of -6 dB to account for the proposed 6' masonry wall.
[4] County unadjusted exterior maximum noise level standards for residential uses.

Source: BAC 2023.

As indicated in Table 32, project car wash drying assembly noise level exposure is predicted to satisfy the applicable Sacramento County General Plan's exterior daytime and nighttime maximum (L_{max}) noise level standards at the property line of the nearest proposed single-family residential lot. In addition, given the exterior to interior noise reduction typically achieved from standard residential construction (approximately 25 dB with windows closed and approximately 15 dB with windows open), and based on the predicted exterior noise level in Table 32, project car wash drying assembly noise level exposure is expected to be well below the General Plan's daytime and nighttime interior maximum (L_{max}) noise level standards within the nearest proposed single-family residences. Based on the analysis presented above, no further consideration noise mitigation measures would be warranted for this aspect of the project.

Issue 4: Project Vacuum Noise at Proposed Single-Family Residential Uses

An analysis of project vacuum equipment noise exposure at nearby existing residential uses was presented in **Impact 3**. Using the same methodology identified in **Impact 3**, project vacuum equipment noise levels were predicted at the nearest proposed single-family residential uses of the development (east of the commercial component). The results of that analysis are provided below in Table 33. The results presented in Table 33 include consideration of shielding that would be provided by the masonry wall proposed for construction along the eastern commercial component project boundary (6' height adjacent to nearest proposed residential lot). The location of the proposed noise barrier is shown in Figure 3.

Table 33
Predicted Vacuum Noise Levels at Proposed Single-Family Residential Uses

Receiver[1]	Distance (ft)[2]	Offset (dB)[3]	Predicted Noise Level, L_{50} (dB)	County Noise Standards, L_{50} (dB)[4]	
				Daytime	Nighttime
Nearest Proposed SFR Lot	220	-9	49	**55**	**50**

[1] Proposed single-family residential uses are shown in Figure 2.
[2] Distance scaled from vacuum area to nearest proposed single-family residential lot using site plans.
[3] Shielding offset of -9 dB was applied to account for the proposed 6' masonry wall (-6 dB) and proposed intervening structure (car wash tunnel, -3 dB).
[4] County unadjusted exterior median noise level standards for residential uses.

Source: BAC 2023.

The Table 33 data indicate that project vacuum equipment noise level exposure is predicted to satisfy the applicable Sacramento County General Plan's (unadjusted) exterior daytime and nighttime median (L_{50}) noise level standards at the property line of the nearest proposed single-family residential lot. In addition, given the exterior to interior noise reduction typically achieved from standard residential construction (approximately 25 dB with windows closed and approximately 15 dB with windows open), and based on the predicted exterior noise level in Table 33, project vacuum equipment noise level exposure is expected to be well below the General Plan's daytime and nighttime interior median (L_{50}) noise level standards within the nearest proposed single-family residences. Based on the analysis presented above, no further consideration noise mitigation measures would be warranted for this aspect of the project.

Issue 5: Project Drive-Through Noise at Proposed Single-Family Residential Uses

An analysis of drive-through operations noise exposure at nearby existing residential uses was presented in **Impact 4**. Using the same methodology identified in **Impact 4**, project drive-through operations noise levels were predicted at the nearest proposed single-family residential uses of the development (east of the commercial component). The results of that analysis are provided below in Table 34. The results presented in Table 34 include consideration of shielding that would be provided by the masonry wall proposed for construction along the eastern commercial component project boundary (6' in height adjacent to drive-through lanes). The location of the proposed noise barrier is shown in Figure 3.

Table 34
Predicted Drive-Through Noise Levels at Proposed Single-Family Residential Uses

Reciever[1]	Building Pad	Distance (ft)[2]		Offset (dB)[3]	Predicted Noise Level, L_{50} (dB)[4]	County Noise Standards, L_{50} (dB)[5]	
		Speaker	Vehicles			Daytime	Nighttime
Nearest Proposed SFR Lots	P2	90	50	-6	39	**50**	**45**
	P3	170	55	-6	33		
	P5	75	35	-6	41		

[1] Proposed single-family residential uses are shown in Figure 2.
[2] Distances scaled from drive-thru components to nearest proposed single-family residential lots using site plans.
[3] Shielding offset of -6 dB was applied to account for the proposed 6' masonry wall.
[4] Predicted combined noise level exposure from sources.
[5] County downward-adjusted (-5 dB) exterior median noise level standards for residential uses affected by sources consisting primarily of music or speech.

Source: BAC 2023.

As shown in Table 34, project drive-through operations noise level exposure is predicted to satisfy the applicable (downward adjusted for speech) Sacramento County General Plan's exterior daytime and nighttime median (L_{50}) noise level standards at the property lines of the nearest proposed single-family residential lots. The predicted exterior noise level in Table 34 would also satisfy the General Plan's daytime and nighttime interior median (L_{50}) noise level standards within the nearest proposed single-family residences. Based on the analysis presented above, no further consideration noise mitigation measures would be warranted for this aspect of the project.

Issue 6: Cumulative Commercial Noise at Proposed Single-Family Residential Uses

The calculated combined median (L_{50}) noise level exposure from analyzed on-site noise sources at the nearest proposed single-family residential uses is presented in Tables 35 and 36. It should be noted that due to the logarithmic nature of the decibel scale, the sum of two noise values which differ by 10 dB equates to an overall increase in noise levels of 0.4 dB. When the noise sources are equivalent, the sum would result in an overall increase in noise levels of 3 dB.

Table 35
Calculated Cumulative Commercial Noise at Proposed Residential Uses – Daytime L_{50}

Receiver	Predicted Noise Levels, L_{50} (dB)		Calculated Cumulative, L_{50} (dB)[1]	County Daytime Standard, L_{50} (dB)[2]
	Vacuums	Drive-Through Operations		
Nearest Proposed SFR Lot	49	39	49	**55**

[1] Calculated worst-case cumulative noise levels at a proposed single-family residential lot (with stated barrier offset).
[2] County unadjusted exterior median daytime noise level standard for residential uses.

Source: BAC 2023.

Table 36
Calculated Cumulative Commercial Noise at Proposed Residential Uses – Nighttime L_{50}

Receiver	Predicted Noise Levels, L_{50} (dB)		Calculated Cumulative, L_{50} (dB)[1]	County Nighttime Standard, L_{50} (dB)[2]
	Vacuums	Drive-Through Operations		
Nearest Proposed SFR Lot	49	39	49	**50**

[1] Calculated worst-case cumulative noise levels at a proposed single-family residential lot (with stated barrier offset).
[2] County unadjusted exterior median nighttime noise level standard for residential uses.

Source: BAC 2023.

Table 35 and 36 data indicate that calculated cumulative median (L_{50}) noise level exposure from analyzed on-site operations would comply with the applicable Sacramento County General Plan's (unadjusted) exterior daytime and nighttime median (L_{50}) noise level standards at the property line of the nearest proposed single-family residential lot. In addition, given the exterior to interior noise reduction typically achieved from standard residential construction (approximately 25 dB with windows closed and approximately 15 dB with windows open), and based on the predicted exterior noise level in Tables 35 and 36, cumulative median noise level exposure from analyzed on-site operations is expected to be well below the General Plan's daytime and nighttime interior median noise level standards within the nearest proposed single-family residences. Based on the analysis presented above, no further consideration noise mitigation measures would be warranted for this aspect of the project.

This concludes BAC's noise and vibration assessment of the Winding Ranch project in Sacramento County, California. Please contact BAC at (530) 537-2328 or info@bacnoise.com if you have any comments or questions regarding this report.

Appendix A
Acoustical Terminology

Acoustics The science of sound.

Ambient Noise The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.

Attenuation The reduction of an acoustic signal.

A-Weighting A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.

Decibel or dB Fundamental unit of sound. A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.

CNEL Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.

Frequency The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz.

IIC Impact Insulation Class (IIC): A single-number representation of a floor/ceiling partition's impact generated noise insulation performance. The field-measured version of this number is the FIIC.

L_{dn} Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.

L_{eq} Equivalent or energy-averaged sound level.

L_{max} The highest root-mean-square (RMS) sound level measured over a given period of time.

Loudness A subjective term for the sensation of the magnitude of sound.

Masking The amount (or the process) by which the threshold of audibility is for one sound is raised by the presence of another (masking) sound.

Noise Unwanted sound.

Peak Noise The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the "Maximum" level, which is the highest RMS level.

RT_{60} The time it takes reverberant sound to decay by 60 dB once the source has been removed.

STC Sound Transmission Class (STC): A single-number representation of a partition's noise insulation performance. This number is based on laboratory-measured, 16-band (1/3-octave) transmission loss (TL) data of the subject partition. The field-measured version of this number is the FSTC.

Appendix B-1 of 1
FHWA Highway Traffic Noise Prediction Model Inputs
Winding Way Development
File Name: Existing
Run Date: 8/17/2023

#	Roadway	Description	ADT	Day %	Night %	% Med. Trucks	% Hvy. Trucks	Speed	Distance to Receptor	Offset (dB)
1	Collge Oak Dr	North of Winding Way	8,110	83	17	2	1	35	100	0
2	Collge Oak Dr	South of Winding Way	6,970	83	17	2	1	25	50	0
3	Winding Way	West of College Oak Dr	335	83	17	2	1	25	50	0
4	Winding Way	College Oak Dr to Manzanita Ave	12,865	83	17	2	1	25	50	0
5	Winding Way	Manzanita Ave to Rampart Dr	15,665	83	17	2	1	40	200	0
6	Winding Way	East of Rampart Dr	14,650	83	17	2	1	40	100	0
7	Manzanita Ave	North of Winding Way	15,695	83	17	2	1	40	100	0
8	Manzanita Ave	Winding Way to Windmill Way	16,490	83	17	2	1	40	500	0
9	Manzanita Ave	Windmill Way to Lincoln Ave	18,525	83	17	2	1	40	75	0
10	Manzanita Ave	Lincoln Ave to Cypress Ave	18,925	83	17	2	1	40	250	0
11	Manzanita Ave	South of Cypress Ave	22,450	83	17	2	1	40	350	0
12	Windmill Way	West of Manzanita Ave	2,485	83	17	2	1	35	150	0
13	Lincoln Ave	West of Manzanita Ave	570	83	17	2	1	15	200	-10
14	Lincoln Ave	East of Manzanita Ave	3,060	83	17	2	1	35	75	0
15	Cypress Ave	West of Manzanita Ave	10,910	83	17	2	1	25	100	0
16	Cypress Ave	East of Manzanita Ave	2,175	83	17	2	1	15	500	0
17	Rampart Ave	North of Winding Way	475	83	17	1	1	15	150	0
18	Rampart Ave	Winding Way to Mary Lynn Lane	1,800	83	17	1	1	25	200	-10
19	Rampart Ave	South onto Mary Lynn Lane	585	83	17	1	1	25	100	-10
20	Rampart Ave	East of Mary Lynn Lane	1,005	83	17	1	1	25	75	0

Notes: Where a noise-sensitive receiver is not identified a distance of 500 feet is used

Legend

- A Site 1: Northeast end of project area
- B Site 2: East end of project area
- C Site 3: South of project area across Jan Drive
- D Site 4: West of project area across Manzanita Avenue

Winding Ranch

Sacramento County, California

Noise & Vibration Survey Photographs

Appendix C

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Appendix D-1 of 1
FHWA Highway Traffic Noise Prediction Model Inputs
Winding Way Development
File Name: Existing+Project (V4)
Run Date: 11/20/2023

#	Roadway	Description	ADT	Day %	Night %	% Med. Trucks	% Hvy. Trucks	Speed	Distance to Receptor	Offset (dB)
1	Collge Oak Dr	North of Winding Way	8,665	83	17	2	1	35	100	0
2	Collge Oak Dr	South of Winding Way	7,760	83	17	2	1	25	50	0
3	Winding Way	West of College Oak Dr	335	83	17	2	1	25	50	0
4	Winding Way	College Oak Dr to Manzanita Ave	14,635	83	17	2	1	25	50	0
5	Winding Way	Manzanita Ave to Rampart Dr	16,870	83	17	2	1	40	200	0
6	Winding Way	East of Rampart Dr	15,450	83	17	2	1	40	100	0
7	Manzanita Ave	North of Winding Way	16,775	83	17	2	1	40	100	0
8	Manzanita Ave	Winding Way to Windmill Way	18,920	83	17	2	1	40	500	0
9	Manzanita Ave	Windmill Way to Lincoln Ave	19,780	83	17	2	1	40	75	0
10	Manzanita Ave	Lincoln Ave to Cypress Ave	20,260	83	17	2	1	40	250	0
11	Manzanita Ave	South of Cypress Ave	23,550	83	17	2	1	40	350	0
12	Windmill Way	West of Manzanita Ave	2,485	83	17	2	1	35	150	0
13	Lincoln Ave	West of Manzanita Ave	570	83	17	2	1	15	200	-10
14	Lincoln Ave	East of Manzanita Ave	3,310	83	17	2	1	35	75	0
15	Cypress Ave	West of Manzanita Ave	11,145	83	17	2	1	25	100	0
16	Cypress Ave	East of Manzanita Ave	2,175	83	17	2	1	15	400	0
17	Rampart Ave	North of Winding Way	475	83	17	1	1	15	150	0
18	Rampart Ave	Winding Way to Mary Lynn Lane	2,265	83	17	1	1	25	200	-10
19	Rampart Ave	South onto Mary Lynn Lane	585	83	17	1	1	25	100	-10
20	Rampart Ave	East of Mary Lynn Lane	1,005	83	17	1	1	25	75	0
21	Gas Station Dwy	North of Winding Way	7,660	83	17	1	1	15	500	0
22	Project Dwy 1	South onto Project Site	2,845	83	17	1	1	15	500	0
23	Project Dwy 2	East onto Project Site	1,525	83	17	1	1	15	500	0
24	Project Dwy 3	East onto Project Site	1,705	83	17	1	1	15	350	0
25	Project Dwy 4	East onto Project Site	2,730	83	17	1	1	15	300	-5
26	Project Dwy 5	East onto Project Site	2,700	83	17	1	1	15	300	0
27	Shopping Center Dwy	North of Winding Way	7,660	83	17	1	1	15	500	0
28	Project Street 1	South onto Project Site	250	83	17	1	1	25	400	-10
29	Project Street 6	West of Rampart	465	83	17	1	1	15	250	-10

Notes: Where a noise-sensitive receiver is not present a default distance of 500 feet was used.

Appendix E
AquaDri Drying System Reference Noise Level Data

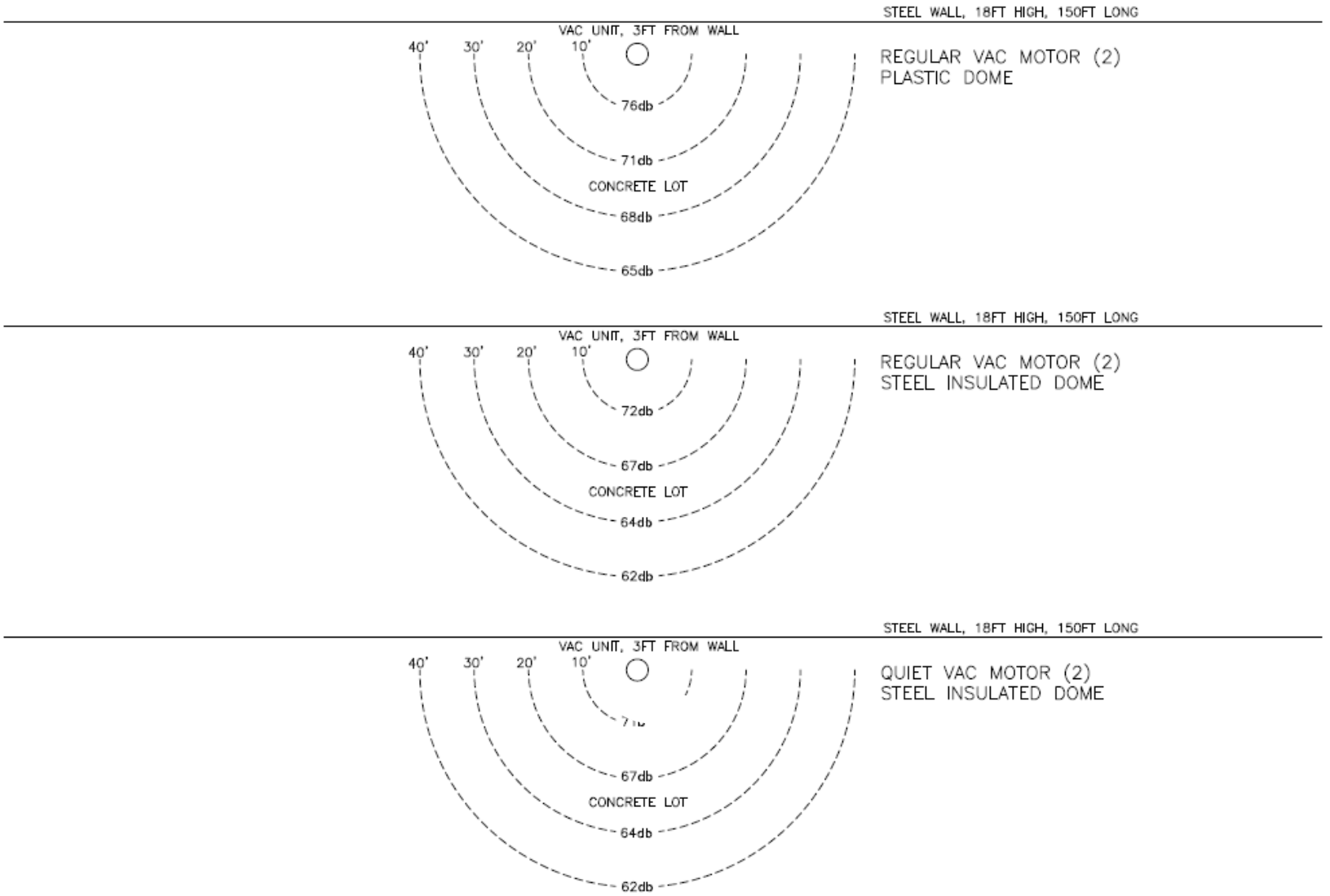
Mark VII®
A subsidiary of WashTec AG

AquaDri® Dryers

Dryer Noise Levels

	Exit End					Entrance End				
Dryer	dBA @ 10'	dBA @ 20'	dBA @ 30'	dBA @ 40'	dBA @ 50'	dBA @ 10'	dBA @ 20'	dBA @ 30'	dBA @ 40'	dBA @ 50'
AquaDri® FS-30 30hp Freestanding	91	86	83	80	75	88	85	80	79	77
AquaDri® FS-40 40hp Freestanding	92	87	84	81	77	89	84	81	80	78
AquaDri® E-20i 20hp On-Board	84	82	78	74	72	83	80	75	73	71
AquaDri® E-30i 30hp On-Board	85	83	80	76	74	84	81	78	75	72
AquaDri® C-15 15hp Contouring	92	88	84	80	77	90	86	82	80	77

Appendix F
JE Adams Vacuum Reference Noise Level Data



Appendix G
BAC File Data
Drive-Through Operations

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Test Date: 10/13/2018
Location: Panera Bread (2845 Bell Road, Auburn, CA)

			Measured Noise Levels (dB)		Distance
Site	Time	Duration	Leq/L50	Lmax	ft
1	12:00 p.m. to 1:00 p.m.	1 hr	63.4	67.2	10
2	12:00 p.m. to 1:00 p.m.	1 hr	59.8	70.3	5

Notes:
-Measurements at 10 feet of drive-through speaker with no car present.
'-Measurements at 5 feet from drive-through vehicles with no speaker.

Appendix H-1
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Prediction Worksheet

Project Information:

Job Number: 2022-121
Project Name: Winding Ranch Project
Roadway Name: Winding Way

Traffic Data:

Year: Future
Average Daily Traffic Volume: 25,671
Percent Daytime Traffic: 83
Percent Nighttime Traffic: 17
Percent Medium Trucks (2 axle): 2
Percent Heavy Trucks (3+ axle): 1
Assumed Vehicle Speed (mph): 40
Intervening Ground Type (hard/soft): **Soft**

Traffic Noise Levels:

				DNL (dB)			
Location	Description	Distance	Offset (dB)	Autos	Medium Trucks	Heavy Trucks	Total
1	SFR - Nearest Backyards	75		66	58	60	68
2	SFR - Nearest First-Floor Facades	85		65	58	59	67
3	SFR - Nearest Upper-Floor facades	85	2	67	60	61	69

Traffic Noise Contours (No Calibration Offset):

DNL Contour (dB)	Distance from Centerline (ft)
75	25
70	53
65	115
60	247

Notes: Future ADT was conservatively estimated by increasing the existing (2019) ADT volume of the section of Winding Way adjacent to the project site by 50%. Existing (2019) ADT obtained from published Sacramento County traffic counts (Winding Way - 17,114 ADT).

Appendix H-2
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Prediction Worksheet

Project Information:

Job Number: 2022-121
Project Name: Winding Ranch Project
Roadway Name: Manzanita Avenue

Traffic Data:

Year: Future
Average Daily Traffic Volume: 37,287
Percent Daytime Traffic: 83
Percent Nighttime Traffic: 17
Percent Medium Trucks (2 axle): 2
Percent Heavy Trucks (3+ axle): 1
Assumed Vehicle Speed (mph): 40
Intervening Ground Type (hard/soft): **Soft**

Traffic Noise Levels:

				DNL (dB)			
Location	Description	Distance	Offset (dB)	Autos	Medium Trucks	Heavy Trucks	Total
1	SFR - Nearest Backyards	190		62	54	56	63
2	SFR - Nearest First-Floor Facades	200		62	54	55	63
3	SFR - Nearest Upper-Floor facades	200	2	64	56	57	65

Traffic Noise Contours (No Calibration Offset):

DNL Contour (dB)	Distance from Centerline (ft)
75	32
70	68
65	147
60	317

Notes: Future ADT was conservatively estimated by increasing the existing (2019) ADT volume of the section of Manzanita Avenue adjacent to the project site by 50%. Existing (2019) ADT obtained from published Sacramento County traffic counts (Manzanita Avenue - 24,858 ADT).

Appendix I
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2022-121
Project Name: Winding Ranch Project
Roadway Name: Winding Way

Noise Level Data:

Year: Future
Auto DNL (dB): 66
Medium Truck DNL (dB): 58
Heavy Truck DNL (dB): 60

Site Geometry:

Receiver Description: SFR - Nearest Backyards
Centerline to Barrier Distance (C_1): 65
Barrier to Receiver Distance (C_2): 10
Automobile Elevation: 0
Medium Truck Elevation: 2
Heavy Truck Elevation: 8
Pad/Ground Elevation at Receiver: 0
Receiver Elevation: 5
Base of Barrier Elevation: 0
Starting Barrier Height 6

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height (ft)	DNL (dB) Autos	DNL (dB) Medium Trucks	DNL (dB) Heavy Trucks	DNL (dB) Total	Barrier Breaks Line of Sight to… Autos?	Medium Trucks?	Heavy Trucks?
6	6	60	52	55	**62**	Yes	Yes	Yes
7	7	58	51	54	**60**	Yes	Yes	Yes
8	8	57	49	52	**59**	Yes	Yes	Yes
9	9	56	48	51	**58**	Yes	Yes	Yes
10	10	55	47	50	**56**	Yes	Yes	Yes
11	11	53	46	49	**55**	Yes	Yes	Yes
12	12	53	45	48	**54**	Yes	Yes	Yes
13	13	52	44	47	**54**	Yes	Yes	Yes
14	14	52	44	46	**53**	Yes	Yes	Yes

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

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