Environmental Noise & Vibration Assessment

Lincoln Square Mixed-Use Development

Dixon, California

BAC Job # 2021-107

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CEQA Checklist

NOISE AND VIBRATION – **Would the Project Result in:**	**NA – Not Applicable**	**Potentially Significant Impact**	**Less than Significant with Mitigation Incorporated**	**Less Than Significant Impact**	**No Impact**
a) Generation of substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?			**X**		
b) Generation of excessive groundborne vibration or groundborne noise levels?				**X**	
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?					**X**

Introduction

The proposed Lincoln Square Mixed-Use Development (project) is located south of Vaughn Road and west of Lincoln Highway (SR-113) in the City of Dixon, California. Existing land uses in the immediate project vicinity include retail / commercial, industrial, and residential. The project area and surrounding uses are shown on Figure 1. The project site plans are shown on 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 uses in the project vicinity, or if traffic or project-generated noise or vibration levels would exceed applicable federal, state, or local (City of Dixon) 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 upon the average noise level over a 24-hour day, with a +10-decibel weighting applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures. Because DNL represents a 24-hour average, it tends to disguise short-term variations in the noise environment. DNL-based noise standards are commonly used to assess noise impacts associated with traffic, railroad, and aircraft noise sources.

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. The maximum rate, or velocity of particle movement, is the commonly accepted descriptor of the vibration "strength".

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 Caltrans Transportation and Construction-Induced Vibration Guidance Manual (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 Border (Approximate)

Long-Term Noise Survey Locations

Vibration Measurement Locations

N

Scale (feet)

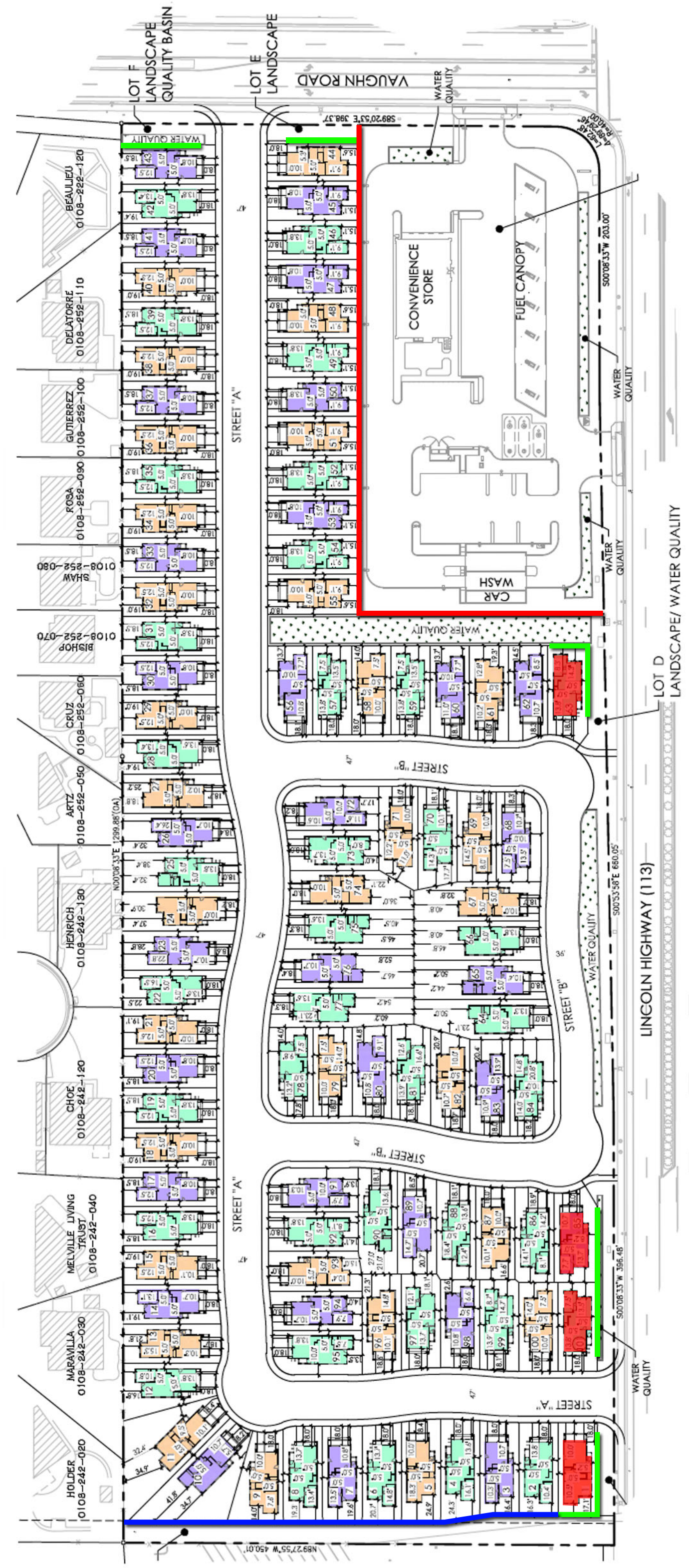
0 750 1,500

Lincoln Square Mixed-Use Development
Dixon, California

Project Area

Figure 1

BOLLARD Acoustical



Legend

- Proposed 8' Sound Wall
- 6' Traffic Noise Barriers (MM-11)
- Recommended 6' Industrial Noise Barrier
- Window Construction Upgrades (STC-32: Upper-Floors Only) (MM-12)

N

Scale (feet)

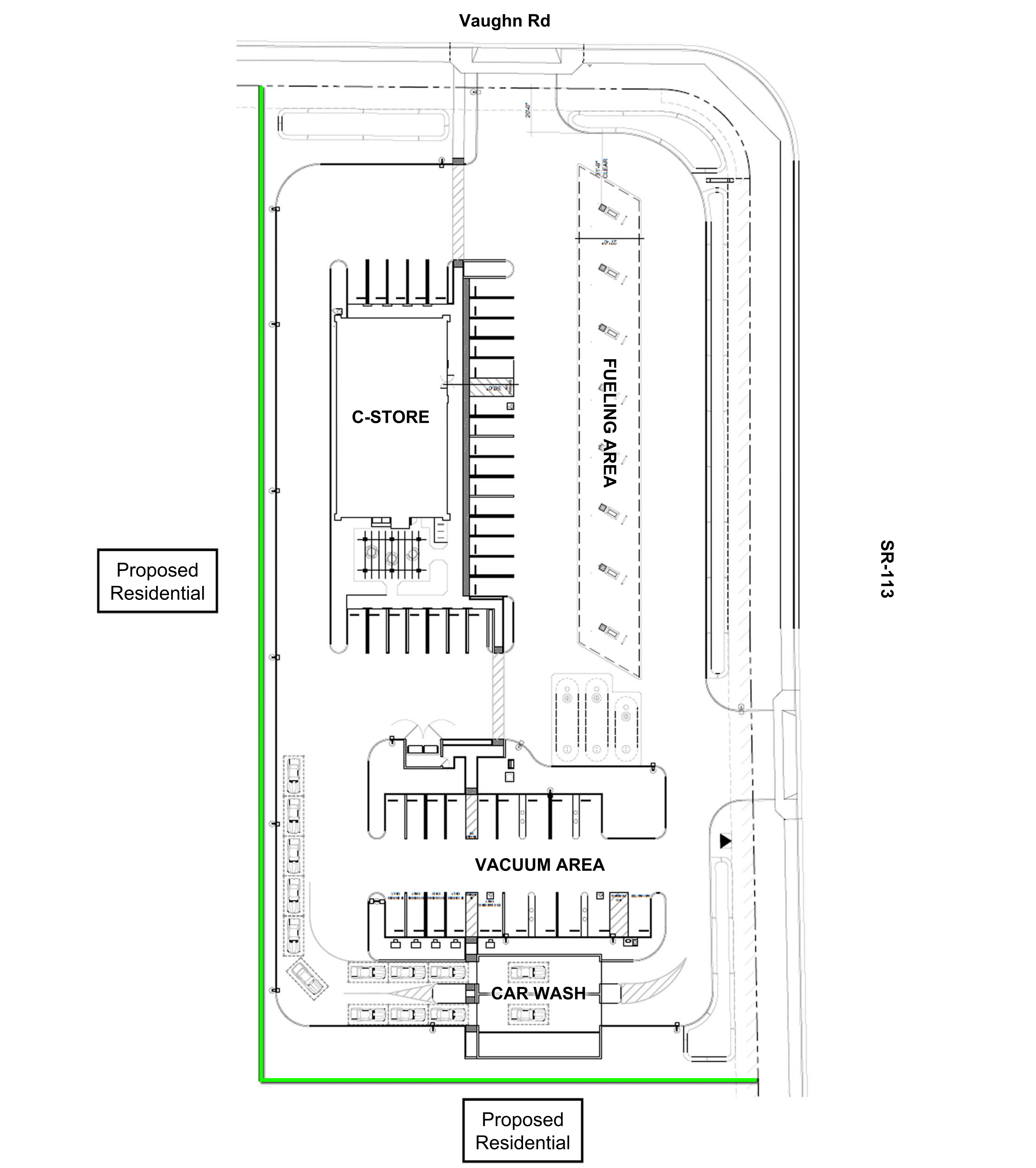
0 50 100

Lincoln Square Mixed-Use Development
Dixon, California

Site Plan

Figure 2

BOLLARD Acoustical



Legend

Proposed 8' Sound Wall

N

Scale (feet)

0 30 60

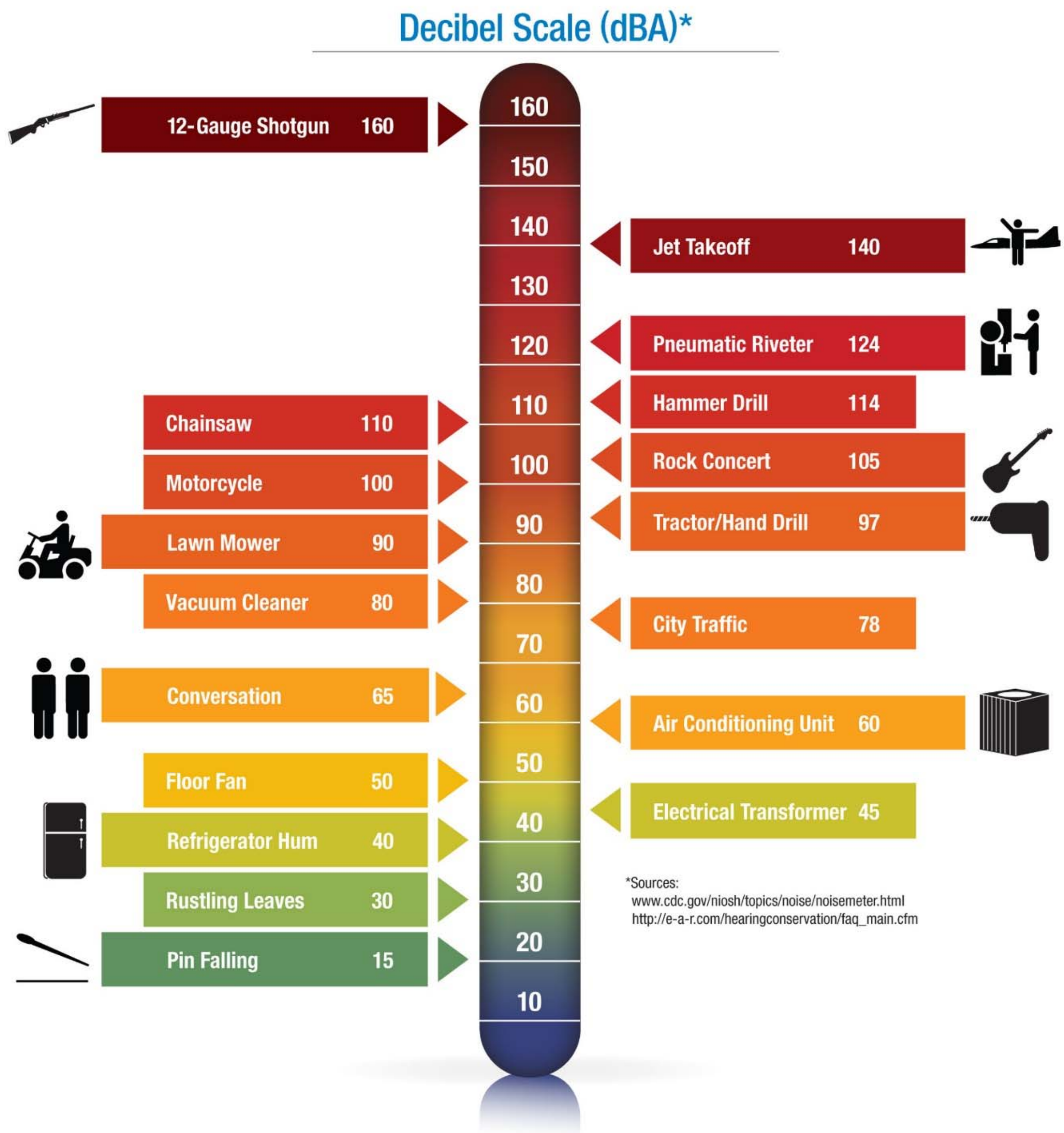
Lincoln Square Mixed-Use Development
Dixon, California

Retail Component Site Plan

Figure 3

BOLLARD Acoustical

Figure 4
Noise Levels Associated with Common Noise Sources



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, the City of Dixon does not currently have established criteria for assessing noise impacts associated with increases in ambient noise levels from project-generated noise sources. In addition, the City of Dixon does not have established performance standards for the assessment of vibration impacts. As a result, the following federal noise criteria was applied to the project.

<u>Federal Interagency Commission on Noise</u>

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 1 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 1
Significance of Changes in Cumulative Noise Exposure

Ambient Noise Level Without Project (DNL or CNEL)	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 1, 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

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; or

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

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)

The City of Dixon 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 criteria applicable to damage and annoyance from transient and continuous vibration typically associated with construction activities are presented in Tables 2 and 3. Equipment or activities typical of continuous vibration include: excavation equipment, static compaction equipment, tracked vehicles, traffic on a highway, vibratory pile drivers, pile-extraction equipment, and vibratory compaction equipment. Equipment or activities typical of single-impact (transient) or low-rate repeated impact vibration include impact pile drivers, blasting, drop balls, “pogo stick” compactors, and crack-and-seat equipment (California Department of Transportation 2020).

Table 2
Guideline Vibration Damage Potential Threshold Criteria

Structure and Condition	Maximum PPV (inches/second) Transient Sources	Maximum PPV (inches/second) Continuous/Frequent Intermittent Sources
Extremely fragile historic buildings, ruins, ancient monuments	0.12	0.08
Fragile buildings	0.20	0.10
Historic and some old buildings	0.50	0.25
Older residential structures	0.50	0.30
New residential structures	1.00	0.50
Modern industrial/commercial buildings	2.00	0.50

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

PPV = Peak Particle Velocity

Source: Caltrans Transportation and Construction Vibration Guidance Manual (2020)

Table 3
Guideline Vibration Annoyance Potential Criteria

Human Response	Maximum PPV (inches/second) Transient Sources	Maximum PPV (inches/second) Continuous/Frequent Intermittent Sources
Barely perceptible	0.40	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.90	0.10
Severe	2.00	0.40

Note: Transient sources create a single isolated vibration event, such as blasting or drop balls. Continuous/frequent intermittent sources include pile drivers, pogo-stick compactors, crack-and-seat equipment, vibratory pile drivers, and vibratory compaction equipment.

PPV = Peak Particle Velocity

Source: Caltrans Transportation and Construction Vibration Guidance Manual (2020)

Local

Dixon General Plan 2040

The Natural Environment Element of the Dixon General Plan 2040 contains policies to ensure that city residents are not subjected to noise beyond acceptable levels. Those General Plan policies are provided below.

Policies

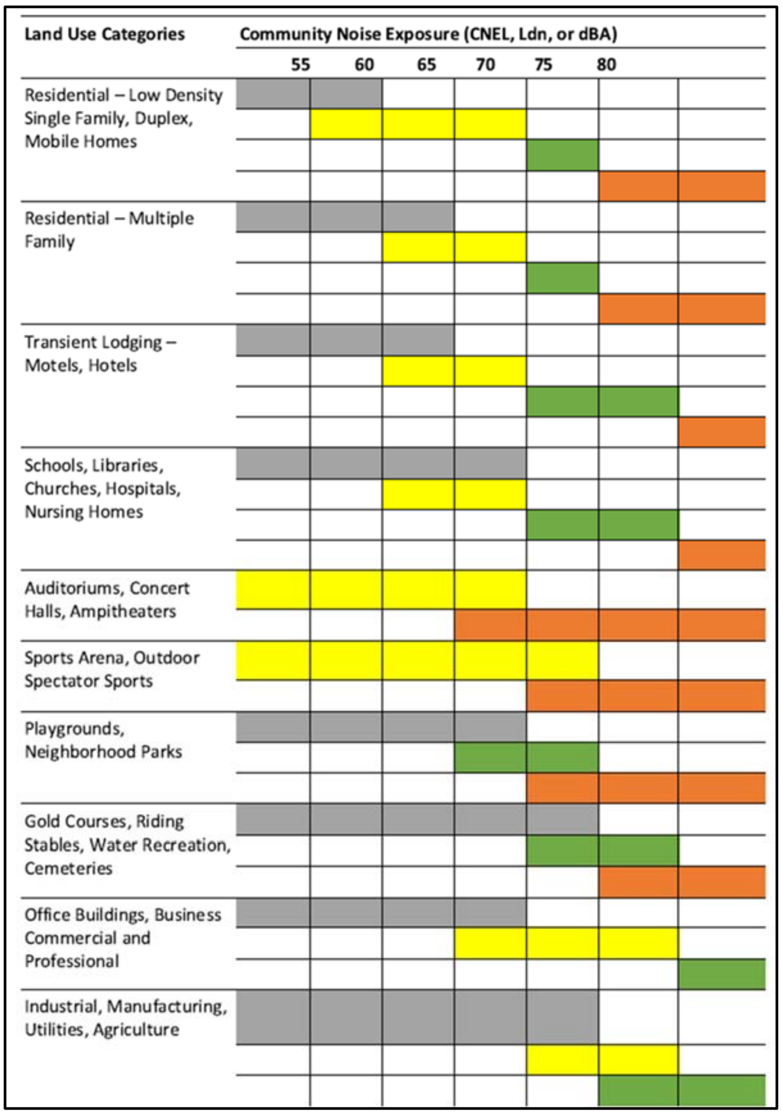
NE-5.16 Ensure that noise does not have a substantial, adverse effect on the quality of life in the community.

NE-5.17 Apply the General Plan noise and land use compatibility standards to all new residential, commercial, and mixed-use development and redevelopment, as shown in Table 4 (General Plan Table NE-2).

NE-5.18 Require acoustical studies with appropriate mitigation measures for projects that are likely to be exposed to noise levels that exceed the “normally acceptable” standard and for any other projects that are likely to generate noise in excess of these standards.

NE-5.19 Require that new noise-producing uses are located sufficiently far away from noise-sensitive receptors and/or include adequate noise mitigation, such as screening, barriers, sound enclosures, noise insulation, and/or restrictions on hours of operation.

Table 4
Community Noise Compatibility Matrix



Dixon Municipal Code

The provisions of the Dixon Municipal Code which would be generally applicable to this project are reproduced below.

18.28.030 Noise performance standards.

No land use shall generate sound exceeding the maximum levels permitted in the following table when such are measured in any zoning districts listed in this table.

Zoning District	Maximum Sound Pressure Level in Decibels
Residential and Medical	55
Multi-Family Residential	60
“C”	70
“M”	75

18.28.040 Noise performance standards – Correction factors.

The following correction factors, when applicable, shall be applied to the maximum sound pressure levels given in DMC 18.28.030.

Time and Operation of Type of Noise	Correction in Maximum Permitted Decibels
Emission only between 7:00 a.m. and 10:00 p.m.	+5
Noise of unusual impulsive character (e.g., hammering)	-5
Noise of unusual periodic character (e.g., screeching)	-5

18.28.050 Noise performance standards – Exceptions.

The following sounds, upon compliance with stated conditions, may exceed the maximum sound pressure levels given in DMC 18.28.030.

A. Time signals produced by places of employment or worship and school recess signals providing no one sound exceeds five seconds in duration and no one series of sounds exceeds 24 seconds in duration.

B. Devotional and patriotic music of worship, provided such music is emitted only between the hours of 7:00 a.m. and 10:00 p.m.

C. Sounds from transportation equipment used exclusively in the movement of goods and people to and from a given premises, temporary construction, or demolition work.

D. Sounds made in the interests of public safety.

18.28.080 Vibration performance standards.

No use shall be operated in a manner which produces vibrations discernible without instruments at any point on the property line of the lot on which the use is located.

Environmental Setting – Existing Ambient Noise and Vibration Environment

Noise-Sensitive 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, worship, and study are generally considered to be sensitive to noise because intrusive noise can be disruptive to these activities.

The noise-sensitive land uses which would potentially be affected by the project consist of residential uses. Specifically, single-family residential land uses are located to the west of the project area. Existing industrial, commercial, and retail uses are also located within the project vicinity, however these uses are typically not considered to be noise-sensitive, as they are often noise-generating. The project area and surrounding land uses are shown on Figure 1.

Existing Overall Ambient Noise Environment within the Project Vicinity

The existing ambient noise environment within the project area is defined primarily by noise from traffic on SR-113 and Vaughn Road, and to a lesser extent by nearby industrial, commercial, and retail operations. To generally quantify existing ambient noise environment within the project vicinity, BAC conducted long-term (96-hour) ambient noise level measurements from Thursday, June 10th through Sunday, June 13th, 2021. The noise survey locations are shown on Figure 1, identified as sites LT-1 though LT-3. Noise measurement sites LT-1 and LT-2 were selected to be representative of the ambient noise level environment at the nearest residential uses to the west of the project. Noise measurement site LT-3 was selected to be representative of the ambient noise level environment at the southern project property boundary, adjacent to existing industrial operations (Dependable Heating and Air Conditioning). Photographs of the noise survey locations are provided in Appendix B.

Larson Davis Laboratories (LDL) Model 820 and LxT precision integrating sound level meters were used to complete the long-term noise level measurements. 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 ambient noise level survey results are summarized below in Table 5. The detailed results of the ambient noise survey are contained in tabular and graphic format in Appendices C and D, respectively.

Table 5
Summary of Long-Term Noise Survey Measurement Results – June 10-13, 2021[1]

Site Description[2]	Date	DNL	Average Measured Hourly Noise Levels (dBA)[3]			
			Daytime[3]		Nighttime[4]	
			L_{eq}	L_{max}	L_{eq}	L_{max}
LT-1: Northwestern project property boundary adjacent to residences	6/10/21	57	52	68	50	67
	6/11/21	56	49	67	49	65
	6/12/21	55	50	67	48	62
	6/13/21	55	49	67	48	65
LT-2: Western project boundary adjacent to residences	6/10/21	56	50	67	50	68
	6/11/21	56	48	65	50	66
	6/12/21	56	49	64	50	63
	6/13/21	53	49	65	46	64
LT-3: Southern project property boundary adjacent to industrial operations	6/10/21	56	51	67	50	64
	6/11/21	56	51	68	49	63
	6/12/21	55	48	63	49	63
	6/13/21	52	47	63	46	62

[1] Detailed summaries of the noise monitoring results are provided in Appendices C and D.
[2] Long-term noise survey locations are shown on Figure 1.
[3] Daytime hours: 7:00 a.m. to 10:00 p.m.
[4] Nighttime hours: 10:00 p.m. to 7:00 a.m.
Source: Bollard Acoustical Consultants, Inc. (2021)

As indicated in Table 5, measured day-night average (DNL) and average measured hourly noise levels were consistent at sites LT-1 through LT-3 throughout the entire monitoring period. In addition, measured ambient noise levels were generally highest at site LT-1. This is believed to be due to the proximity of the measurement location relative to Vaughn Road.

Existing Ambient Vibration Environment

During BAC site visits on June 9th and 14th, 2021, vibration levels were below the threshold of perception at the project site. Nonetheless, to quantify existing vibration levels at the project site, BAC conducted short-term (15-minute) vibration measurements at the locations identified on Figure 1 (sites V-1 and V-2) on June 14th, 2021. Photographs of the vibration survey equipment are provided in Appendix B.

A Larson-Davis Laboratories Model LxT precision integrating sound level meter equipped with a PCB Electronics vibration transducer was used to complete the vibration measurements. The results are summarized below in Table 6.

Table 6
Summary of Ambient Vibration Monitoring Results – June 14, 2021

Site Description[1]	Time	Average Measured Vibration Level, PPV (in. sec)[2]
V-1: Approximately 60' from centerline of Vaughn Rd	11:22 a.m.	0.012
V-2: Approximately 60' from centerline of SR-113	9:08 a.m.	0.014

[1] Vibration survey locations are shown on Figure 1.
[2] PPV = Peak Particle Velocity (inches/second)
Source: Bollard Acoustical Consultants, Inc. (2021)

The Table 6 data indicate that measured average vibration levels at the project site ranged from 0.012 to 0.014 in/sec PPV.

Impacts and Mitigation Measures

Thresholds of Significance

For the purposes of this report, 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?
- Generation of excessive groundborne vibration or groundborne noise levels?
- 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.

The following criteria based on standards established by the Federal Interagency Commission on Noise (FICON), Caltrans, City of Dixon General Plan and Dixon Municipal Code were used to evaluate the significance of environmental noise and vibration resulting from the project:

- 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 Dixon General Plan or Municipal Code.
- A significant impact would be identified if off-site traffic noise exposure or on-site activities generated by the project would substantially increase noise levels at existing sensitive receptors in the vicinity. A substantial increase would be identified relative to the FICON standards provided in Table 1.

- A significant impact would be identified if project construction activities or proposed on-site operations would expose 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

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

The project site is accessed via SR-113 and Vaughn Road on the east and north ends of the project site, respectively. As a result, the greatest impact from project-generated off-site traffic is expected to be on SR-113 and Vaughn Road.

To assess noise impacts due to project-related traffic increases on SR-113 and Vaughn Road, BAC utilized the trip generation information obtained from the project applicant with the Federal Highway Administration Highway Traffic Noise Prediction Model (FHWA-RD-77-108). The FHWA Model was used in conjunction with the CALVENO reference noise emission curves, and accounts for vehicle volume and speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the project vicinity, and is generally considered to be accurate within 1.5 dB if the input variables are properly accounted for. The FHWA Model was developed to predict hourly L_{eq} values for free-flowing traffic conditions. To calculate a day-night average (DNL), average daily traffic (ADT) volume data is manipulated based on the assumed day/night distribution of traffic.

According to the most recently published Caltrans traffic data (2019), the segment of SR-113 adjacent to the project site currently experiences approximately 11,700 vehicles per day. Based on an existing ADT of 11,700, medium- / heavy-truck percentages of 2% / 4% (respectively), and vehicles speeds of 45 mph, existing day-night average noise level exposure computes to approximately 70 dB DNL at a distance of 50 feet from the centerline of SR-113. The FHWA Model inputs and calculated existing traffic noise levels for SR-113 are provided in Appendix E-1.

Traffic data for Vaughn Road was obtained from data published by the City of Dixon Traffic Engineering Department. The most recent traffic data available for Vaughn Road is from 2007 and indicates an ADT of 4,350. An existing (2021) traffic volume for Vaughn Road was conservatively estimated by assuming an increase in traffic by a factor of 50% relative to the reported 2007 traffic data, which computes to a daily ADT of approximately 6,530. Based on an estimated existing ADT of 6,530, medium- / heavy-truck percentages of 2% / 2% (respectively), and vehicles speeds of 35 mph, existing day-night average noise level exposure computes to approximately 64 dB DNL at a distance of 50 feet from the centerline of Vaughn Road. The FHWA Model inputs and calculated existing traffic noise levels for Vaughn Road are provided in Appendix E-2.

According to trip generation information provided to BAC, the project is estimated to generate approximately 1,818 vehicle trips per day (524 residential, 1,294 retail). Based on the project trip generation estimations above, and conservatively assuming that all project-generated daily vehicle trips could occur along either SR-113 or Vaughn Road (worst-case), combined project-generated traffic noise level exposure from residential and retail uses is predicted to be approximately 61 dB DNL and 58 dB DNL at a distance of 50 feet from the centerlines of SR-113 and Vaughn Road, respectively. The FHWA Model inputs and predicted traffic noise levels for the roadways are provided in Appendices E-3 through E-6.

According to the FICON criteria provided in Table 1, a 5 dB DNL 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.

Given a predicted worst-case project-generated SR-113 traffic noise level of approximately 61 dB DNL at 50 feet, and a computed existing traffic noise level of approximately 70 dB DNL at that same distance, the project-related increase in traffic noise levels on SR-113 is calculated to be 0.4 dB DNL. It should be noted that noise-sensitive uses were not identified within 50 feet of the centerline of SR-113 within the project vicinity. Nonetheless, the project-related increase in SR-113 traffic noise levels of 0.4 dB DNL would be below the applicable 1.5 dB increase significance criterion established by FICON.

Given a predicted worst-case project-generated Vaughn Road traffic noise level of approximately 58 dB DNL at 50 feet, and a computed existing traffic noise level of approximately 64 dB DNL at that same distance, the project-related increase in traffic noise levels along Vaughn Road is calculated to be 0.9 dB DNL. The project-related increase in Vaughn Road traffic noise levels of 0.9 dB DNL would be below the applicable 1.5 dB increase significance criterion established by FICON.

Because project-related traffic is not predicted to result in increases in ambient noise levels that would exceed the applicable FICON increase significance criteria at existing sensitive uses within the project vicinity, this impact is identified as being ***less than significant***.

Off-Site Noise Impacts Associated with On-Site Noise Sources

The project proposes a retail component to be located on the corner of SR-113 and Vaughn Road. Specifically, the retail component would consist of a Rotten Robbie's convenience store, gas station, and a car wash. The location of the proposed retail component is shown in Figure 2.

The primary noise sources associated with the convenience store component of the project have been identified as on-site vehicle circulation, on-site delivery truck circulation (i.e., medium and heavy truck passbys), truck delivery activities (i.e., unloading of product at convenience storefront), and rooftop mechanical equipment (HVAC). The most significant noise sources associated with the car wash component of the project include vacuum system operation and car wash drying assembly equipment (used for drying vehicles at the end of the wash cycle). An assessment of each identified noise source above at the nearest existing noise-sensitive uses (residential to the west) follows.

Based on information obtained from the project applicant, it is assumed for the purposes of this analysis that the project convenience store / gas station will have 24-hour operations. It is further assumed that the project car wash tunnel / vacuum components will be in operation during the hours of 6:00 a.m. to 11:00 p.m.

Finally, the Dixon Municipal Code provides noise level limits that would be applicable to non-transportation noise sources, such as those occurring on the project site. Specifically, Section 18.28.030 of the Municipal Code establishes "maximum sound pressure levels" for various receiving zoning districts. For the purposes of this analysis, the Municipal Code's "maximum sound pressure levels" have been interpreted as the highest (maximum) allowable hourly average (L_{eq}) sound level. The application of the L_{eq} sound level descriptor for project-generated non-transportation noise sources would be consistent with application of the General Plan's day-night-average (DNL) noise level to transportation noise sources.

Impact 2: Retail On-Site Vehicle Circulation Noise at Existing Sensitive Uses

The FHWA Model was utilized with daily trip generation data obtained from the project applicant to quantify noise associated with retail on-site traffic circulation at the nearest existing sensitive uses to the west. According to the provided trip generation data, the retail component of the project is expected to generate 1,294 trips per day, including 171 a.m. peak hour trips and 128 p.m. peak hour trips. Based on this trip generation data, worst-case on-site traffic circulation noise exposure would be associated the a.m. peak hour. Based on 171 vehicle trips during a given worst-case hour, and assuming an on-site vehicle speed of less than 25 mph, project retail on-site traffic circulation noise exposure at the nearest existing residential uses was calculated. The results of those calculations are presented in Table 7.

Table 7
Predicted Worst-Case On-Site Traffic Circulation Noise Levels at Existing Sensitive Uses

Receiver[1]	Distance from On-Site Vehicle Circulation (ft)[2]	Predicted Noise Level, L_{eq} (dB)[3,4]
Existing Residential – West	300	<20

[1] Residential uses are shown in Figure 1.
[2] Distance scaled from on-site circulation route to property line of residential use using provided site plans.
[3] Predicted noise level includes offsets to account for shielding provided by a proposed 8' sound wall (-7 dB) and proposed intervening buildings (-7 dB).
[4] Predicted noise levels based on a worst-case hour of on-site traffic circulation of 171 total trips during a.m. peak hour.
Source: Bollard Acoustical Consultants, Inc. (2021)

As indicated in Table 7, worst-case on-site retail traffic circulation noise level exposure is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest existing residential uses to the west.

Noise measurement site LT-1 on Figure 1 was selected to be representative of the ambient noise level environment at the nearest existing residential uses to the west of the proposed retail use. The Table 5 data indicate that measured daytime hourly average noise levels at site LT-1 ranged from 49 to 52 (arithmetic mean of 50 dB L_{eq}). The Table 5 data also indicate that measured nighttime hourly average noise levels ranged from 48 to 50 dB L_{eq} (arithmetic mean of 49 dB L_{eq}). According to the FICON increase significance criteria (Table 1), a 5 dB increase in noise levels due to project on-site activities would be required for a finding of a significant impact.

Given the arithmetic means of measured daytime and nighttime hourly average noise levels cited above, and based on the FICON criteria, a significant noise impact would be identified if predicted project-generated hourly average noise levels would exceed either 55 dB L_{eq} (during daytime hours) or 54 dB L_{eq} (during nighttime hours) at the existing residential uses to the west (i.e., 5 dB above ambient). Based on the data presented in Table 7, the increases in ambient daytime and nighttime noise levels resulting from project on-site retail vehicle circulation are calculated to be less than 0.1 dB L_{eq} at the nearest existing residential use to the west.

Because noise exposure from proposed retail use on-site vehicle circulation is predicted to satisfy applicable Dixon Municipal Code noise level standard at the nearest existing sensitive land uses, and because noise level exposure from on-site vehicle circulation is not expected to significantly increase ambient noise levels at those uses relative to the FICON criteria, this impact is identified as being ***less than significant.***

Impact 3: Retail On-Site Delivery Truck Circulation Noise at Existing Sensitive Uses

It is the experience of BAC that deliveries of product to convenience stores such as the one proposed by the project occur at the front of the store with medium-duty vendor trucks/vans. The location of the convenience store is shown on Figure 3.

On-site truck passbys are expected to be relatively brief and will occur at low speeds. To predict noise levels generated by on-site truck circulation, BAC utilized file data obtained from measurements conducted by BAC of heavy and medium duty truck passbys. According to BAC file data, single-event heavy truck passby noise levels are approximately 74 dB L_{max} and 83 dB SEL at a reference distance of 50 feet. BAC file data also indicate that single-event medium truck passby noise levels are approximately 66 dB L_{max} and 76 SEL at a reference distance of 50 feet. For the purposes of predicting hourly average noise levels for comparison against the hourly average (L_{eq}) noise level descriptor/standard, it was assumed that 1 heavy fueling truck and 2 medium duty trucks could have store deliveries during the same worst-case hour.

Based on a conservative 1 heavy fueling truck and 2 medium truck trips per hour, and SEL's of 83 and 76 dB SEL per passby, the hourly average noise level generated by project delivery truck circulation computes to 49 dB L_{eq} at a reference distance of 50 feet from the passby route during the worst-case hour of deliveries. Assuming standard spherical spreading loss (-6 dB per doubling of distance), retail-related on-site delivery truck circulation noise exposure at the nearest existing residential uses was calculated. The results of those calculations are presented in Table 8.

Table 8
Predicted On-Site Delivery Truck Circulation Noise Levels at Existing Sensitive Uses

Receiver[1]	Distance from On-Site Truck Circulation (ft)[2]	Predicted Noise Level, L_{eq} (dB)[3]
Existing Residential – West	340	<20

[1] Residential uses are shown in Figure 1.
[2] Distance scaled from on-site truck circulation route to property line of residential use using provided site plans.
[3] Predicted noise level includes offsets to account for shielding provided by a proposed 8' sound wall (-7 dB) and proposed intervening buildings (-7 dB).
Source: Bollard Acoustical Consultants, Inc. (2021)

The Table 8 data indicate that retail-related on-site delivery truck circulation noise level exposure is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest existing residential uses to the west.

Noise measurement site LT-1 on Figure 1 was selected to be representative of the ambient noise level environment at the nearest existing residential uses to the west of the proposed retail use. The Table 5 data indicate that measured daytime hourly average noise levels at site LT-1 ranged from 49 to 52 (arithmetic mean of 50 dB L_{eq}). The Table 5 data also indicate that measured nighttime hourly average noise levels ranged from 48 to 50 dB L_{eq} (arithmetic mean of 49 dB L_{eq}). According to the FICON increase significance criteria (Table 1), a 5 dB increase in noise levels due to project on-site activities would be required for a finding of a significant impact.

Given the arithmetic means of measured daytime and nighttime hourly average noise levels cited above, and based on the FICON criteria, a significant noise impact would be identified if predicted project-generated hourly average noise levels would exceed either 55 dB L_{eq} (during daytime hours) or 54 dB L_{eq} (during nighttime hours) at the existing residential uses to the west (i.e., 5 dB above ambient). Based on the data presented in Table 8, the increases in ambient daytime and nighttime noise levels resulting from project on-site delivery truck circulation are calculated to be less than 0.1 dB L_{eq} at the nearest existing residential use to the west.

Because noise exposure from proposed retail use on-site delivery truck circulation is predicted to satisfy applicable Dixon Municipal Code noise level standard at the nearest existing sensitive land uses, and because noise level exposure from on-site delivery truck circulation is not expected to significantly increase ambient noise levels at those uses relative to the FICON criteria, this impact is identified as being ***less than significant.***

Impact 4: Retail Truck Delivery Activity Noise at Existing Sensitive Uses

As mentioned previously, it is the experience of BAC that deliveries of product to convenience stores such as the one proposed by the project occur at the front of the store with medium-duty vendor trucks/vans. The primary noise sources associated with delivery activities are trucks stopping (air brakes), trucks backing into position (back-up alarms), and pulling away from the loading/unloading area (revving engines). The location of the convenience store is shown on Figure 3.

For a conservative assessment of daily truck delivery noise levels at the proposed convenience store, it was assumed that 4 medium duty trucks/vans would deliver products to the store on a typical busy day. For the purposes of predicting hourly average noise levels for comparison against the hourly average (L_{eq}) noise level descriptor/standard, it was assumed that 2 medium duty trucks could have store deliveries during the same worst-case hour.

BAC file data indicate that noise levels associated with medium-duty truck deliveries (including side-step vans) are approximately 76 dB SEL at a distance of 100 feet. Based on 2 medium duty truck deliveries during any given hour and an SEL of 76 dB, the hourly average noise level computes to 43 dB L_{eq} at a reference distance of 100 feet during the worst-case hour of deliveries. Assuming standard spherical spreading loss (-6 dB per doubling of distance), and a reference noise level of 43 dB L_{eq} at 100 feet, on-site truck delivery operations noise exposure at the nearest existing residential uses was calculated and the results of those calculations are presented in Table 9.

Table 9
Predicted Truck Delivery Activity Noise Levels at Existing Sensitive Uses

Receiver[1]	Distance from Truck Delivery Area (ft)[2]	Predicted Noise Level, L_{eq} (dB)[3]
Existing Residential – West	340	<20

[1] Residential uses are shown in Figure 1.
[2] Distance scaled from truck delivery area to property line of residential use using provided site plans.
[3] Predicted noise level includes offsets to account for shielding provided by a proposed 8' sound wall (-7 dB) and proposed intervening buildings (-7 dB).
Source: Bollard Acoustical Consultants, Inc. (2021)

As indicated in Table 9, retail-related delivery truck activity noise level exposure is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest existing residential uses to the west.

Noise measurement site LT-1 on Figure 1 was selected to be representative of the ambient noise level environment at the nearest existing residential uses to the west of the proposed retail use. The Table 5 data indicate that measured daytime hourly average noise levels at site LT-1 ranged from 49 to 52 (arithmetic mean of 50 dB L_{eq}). The Table 5 data also indicate that measured nighttime hourly average noise levels ranged from 48 to 50 dB L_{eq} (arithmetic mean of 49 dB L_{eq}). According to the FICON increase significance criteria (Table 1), a 5 dB increase in noise levels due to project on-site activities would be required for a finding of a significant impact.

Given the arithmetic means of measured daytime and nighttime hourly average noise levels cited above, and based on the FICON criteria, a significant noise impact would be identified if predicted project-generated hourly average noise levels would exceed either 55 dB L_{eq} (during daytime hours) or 54 dB L_{eq} (during nighttime hours) at the existing residential uses to the west (i.e., 5 dB above ambient). Based on the data presented in Table 9, the increases in ambient daytime and nighttime noise levels resulting from retail delivery truck activity are calculated to be less than 0.1 dB L_{eq} at the nearest existing residential use to the west.

Because noise exposure from proposed retail use delivery truck activities is predicted to satisfy applicable Dixon Municipal Code noise level standard at the nearest existing sensitive land uses, and because noise level exposure from delivery truck activities is not expected to significantly increase ambient noise levels at those uses relative to the FICON criteria, this impact is identified as being ***less than significant.***

Impact 5: Retail Rooftop Mechanical Equipment Noise at Existing Sensitive Uses

Heating, ventilating, and air conditioning (HVAC) requirements for the proposed convenience store will most likely be met using packaged roof-mounted systems. As a means of determining potential noise exposure due to rooftop mechanical equipment, BAC utilized reference file data collected for previous studies. BAC reference file data for HVAC systems indicate that a 12.5-ton packaged unit can be expected to generate an A-weighted sound power level of 85 dB. Using this sound power data, and assuming standard spherical spreading loss (-6 dB per doubling of distance), convenience store HVAC equipment noise exposure at the nearest existing residential uses was calculated and the results of those calculations are presented in Table 10.

Table 10
Predicted HVAC Equipment Noise Levels at Existing Sensitive Uses

Receiver[1]	Distance from Building (ft)[2]	Predicted Noise Level, L_{eq} (dB)[3]
Existing Residential – West	260	37

[1] Residential uses are shown in Figure 1.
[2] Distance scaled from convenience store building to property line of residential use using provided site plans.
[3] No barrier offsets were applied to predicted noise level due to elevated position of equipment.
Source: Bollard Acoustical Consultants, Inc. (2021)

The Table 10 data indicate that retail-related HVAC equipment noise level exposure is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest existing residential uses to the west.

Noise measurement site LT-1 on Figure 1 was selected to be representative of the ambient noise level environment at the nearest existing residential uses to the west of the proposed retail use. The Table 5 data indicate that measured daytime hourly average noise levels at site LT-1 ranged from 49 to 52 (arithmetic mean of 50 dB L_{eq}). The Table 5 data also indicate that measured nighttime hourly average noise levels ranged from 48 to 50 dB L_{eq} (arithmetic mean of 49 dB L_{eq}). According to the FICON increase significance criteria (Table 1), a 5 dB increase in noise levels due to project on-site activities would be required for a finding of a significant impact.

Given the arithmetic means of measured daytime and nighttime hourly average noise levels cited above, and based on the FICON criteria, a significant noise impact would be identified if predicted project-generated hourly average noise levels would exceed either 55 dB L_{eq} (during daytime hours) or 54 dB L_{eq} (during nighttime hours) at the existing residential uses to the west (i.e., 5 dB above ambient). Based on the data presented in Table 10, the increases in ambient daytime and nighttime noise levels resulting from convenience store HVAC equipment are calculated to be 0.2 dB L_{eq} and 0.3 dB L_{eq} (respectively) at the nearest existing residential use to the west.

Because noise exposure from proposed retail HVAC equipment is predicted to satisfy applicable Dixon Municipal Code noise level standard at the nearest existing sensitive land uses, and because HVAC equipment noise level exposure is not expected to significantly increase ambient noise levels at those uses relative to the FICON criteria, this impact is identified as being ***less than significant.***

Impact 6: Retail Vacuum System Noise at Existing Sensitive Uses

A vehicle vacuum area is proposed to be located adjacent to a car wash tunnel within the retail component. The location of the proposed vacuum area is shown on Figure 3. According to information provided to BAC, the project proposes the installation of four (4) vacuum units manufactured by Industrial Vacuum Systems VacLovers, Inc. 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. Specifically, the two configurations shown in the Appendix F data are the Combination and Power Vacuum systems.

For the purposes of this analysis, it was assumed that the four proposed vacuum units would be in operation concurrently and continuously for the duration of an hour (worst-case hour). Based upon the manufacturer's data, assuming the continuous and concurrent use of the vacuums for a given hour, and assuming standard spherical spreading loss (-6 dB per doubling of distance), project vacuum equipment noise exposure at the nearest existing residential uses was calculated and the results of those calculations are presented in Table 11.

Table 11
Predicted Vacuum Equipment Noise Levels at Existing Sensitive Uses

Receiver[1]	Distance from Vehicle Vacuum Area (ft)[2]	Predicted Noise Level, L_{eq} (dB)[3]	
		Combination Configuration	Power Vacuum Configuration
Existing Residential – West	355	36	52

[1] Residential uses are shown in Figure 1.
[2] Distance scaled from center of vacuum area to property line of residential use using provided site plans.
[3] Predicted noise level includes offsets to account for shielding provided by a proposed 8' sound wall (-7 dB) and proposed intervening buildings (-7 dB).
Source: Bollard Acoustical Consultants, Inc. (2021)

As indicated in Table 11, noise level exposure associated with both the Combination and Power Vacuum equipment configurations is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest existing residential uses to the west.

Noise measurement site LT-1 on Figure 1 was selected to be representative of the ambient noise level environment at the nearest existing residential uses to the west of the proposed retail use. The Table 5 data indicate that measured daytime hourly average noise levels at site LT-1 ranged from 49 to 52 (arithmetic mean of 50 dB L_{eq}). The Table 5 data also indicate that measured nighttime hourly average noise levels ranged from 48 to 50 dB L_{eq} (arithmetic mean of 49 dB L_{eq}). According to the FICON increase significance criteria (Table 1), a 5 dB increase in noise levels due to project on-site activities would be required for a finding of a significant impact.

Given the arithmetic means of measured daytime and nighttime hourly average noise levels cited above, and based on the FICON criteria, a significant noise impact would be identified if predicted project-generated hourly average noise levels would exceed either 55 dB L_{eq} (during daytime hours) or 54 dB L_{eq} (during nighttime hours) at the existing residential uses to the west (i.e., 5 dB above ambient). Based on the data presented in Table 11, the increases in ambient daytime and nighttime noise levels resulting from vacuum equipment operations in the Combination configuration are calculated to be 0.2 dB L_{eq} at the nearest existing residential use to the west. In addition, the increases in ambient daytime and nighttime noise levels resulting from vacuum equipment operations in the Power Vacuum configuration are calculated to be 4.1 dB L_{eq} and 4.9 dB L_{eq} at the nearest existing residential use to the west.

Although the analysis provided above indicate that noise level exposure associated with the Power Vacuum equipment configuration would not result in an impact at the nearest existing residences, it is recommended that the project utilize the quieter Combination vacuum unit configuration. Nonetheless, because noise exposure from proposed retail vacuum equipment operation is predicted to satisfy applicable Dixon Municipal Code noise level standard at the nearest existing sensitive land uses, and because noise level exposure from the vacuum equipment is not expected to significantly increase ambient noise levels at those uses relative to the FICON criteria, this impact is identified as being ***less than significant.***

Impact 7: Retail Car Wash Drying Assembly Noise at Existing Sensitive Uses

The project proposes the construction and operation of a two-lane car wash tunnel within the retail component at the location shown on Figure 3. According to the project applicant, the equipment selected for the project is a 3-Motor Whisper Package drying assembly manufactured by International Drying Corporation. The manufacturer's sound level data for the proposed drying system is provided as Appendix G and are summarized below in Table 12.

Table 12
3-Motor Whisper Package Drying Assembly Sound Level Data

Exit End					Entrance End				
dBA at distance (ft)					dBA at distance (ft)				
5	10	20	30	65	5	10	20	30	65
84	80	75	71	65	76	72	68	65	61
Source: International Drying Corporation, Sound Level Readings for 3 Motor Whisper Package									

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. However, 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.

The equipment noise level data provided in Table 12 are in terms of maximum (L_{max}) sound levels. It is the experience of BAC that average car wash cycles are approximately 5 minutes in duration, with the dryers operating during the last 1 minute of the cycle. Therefore, during a worst-case hour, it is calculated that 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 operations assumptions, the resulting hourly average (L_{eq}) drying assembly noise levels would be approximately 7 dB less than the maximum levels provided in Table 12.

The following predicted car wash drying assembly noise levels presented below are based on the manufacturer's reference noise level data provided in Table 12 and include offsets associated with the orientation to tunnel entrance/exit, as discussed above. Noise attenuation due to distance was calculated based on standard spherical spreading loss from a point source (-6 dB per doubling of distance from a stationary noise source). Car wash drying assembly noise exposure at the nearest existing residential uses was calculated and the results of those calculations are presented in Table 13. For the purposes of this analysis, it was assumed that two car wash drying assemblies (dual tunnel configuration) would be in operation concurrently for the duration of an hour (worst-case hour).

Table 13
Predicted Car Wash Drying Assembly Noise Levels at Existing Sensitive Uses

Receiver[1]	Distance from Car Wash Tunnel (ft)[2]	Predicted Noise Level, L_{eq} (dB)[3]
Existing Residential – West	320	29

[1] Residential uses are shown in Figure 1.
[2] Distance scaled from tunnel entrance to property line of residential use using provided site plans.
[3] Predicted noise level includes offsets to account for shielding provided by a proposed 8' sound wall (-7 dB) and proposed intervening buildings (-7 dB).
Source: Bollard Acoustical Consultants, Inc. (2021)

The Table 13 data indicate that car wash drying assembly noise level exposure is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest existing residential uses to the west.

Noise measurement site LT-1 on Figure 1 was selected to be representative of the ambient noise level environment at the nearest existing residential uses to the west of the proposed retail use. The Table 5 data indicate that measured daytime hourly average noise levels at site LT-1 ranged from 49 to 52 (arithmetic mean of 50 dB L_{eq}). The Table 5 data also indicate that measured nighttime hourly average noise levels ranged from 48 to 50 dB L_{eq} (arithmetic mean of 49 dB L_{eq}). According to the FICON increase significance criteria (Table 1), a 5 dB increase in noise levels due to project on-site activities would be required for a finding of a significant impact.

Given the arithmetic means of measured daytime and nighttime hourly average noise levels cited above, and based on the FICON criteria, a significant noise impact would be identified if predicted project-generated hourly average noise levels would exceed either 55 dB L_{eq} (during daytime hours) or 54 dB L_{eq} (during nighttime hours) at the existing residential uses to the west (i.e., 5 dB above ambient). Based on the data presented in Table 13, the increase in ambient daytime and nighttime noise levels resulting from car wash drying system operations is calculated to be less than 0.1 dB L_{eq} at the nearest existing residential use to the west.

Because noise exposure from the proposed retail car wash drying assembly is predicted to satisfy applicable Dixon Municipal Code noise level standard at the nearest existing sensitive land uses, and because car wash drying assembly noise level exposure is not expected to significantly increase ambient noise levels at those uses relative to the FICON criteria, this impact is identified as being ***less than significant.***

Impact 8: Cumulative Retail Operations Noise at Existing Sensitive Uses

The calculated cumulative (combined) noise level exposure from analyzed on-site noise sources at the nearest existing residential uses is presented in Table 14. 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 14
Predicted Cumulative Retail Operations Noise Levels at Existing Sensitive Uses

Receiver	Predicted Noise Levels, L_{eq} (dB)						Calculated Cumulative L_{eq} (dB)[2]
	On-Site Vehicle Circ.	On-Site Truck Circ.	Delivery Truck	HVAC	Vacuums[1]	Car Wash Dryers	
Existing Residential – West	20	18	19	37	36	29	40

[1] Vacuum noise levels reflect the quieter Combination equipment configuration.
[2] Calculated cumulative noise levels based on predicted noise levels presented in Impacts 2-7.
Source: Bollard Acoustical Consultants, Inc. (2021)

As indicated in Table 14, the calculated cumulative (combined) noise level exposure from retail-related on-site noise sources would satisfy the Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest existing residential uses to the west.

Noise measurement site LT-1 on Figure 1 was selected to be representative of the ambient noise level environment at the nearest existing residential uses to the west of the proposed retail use. The Table 5 data indicate that measured daytime hourly average noise levels at site LT-1 ranged from 49 to 52 (arithmetic mean of 50 dB L_{eq}). The Table 5 data also indicate that measured nighttime hourly average noise levels ranged from 48 to 50 dB L_{eq} (arithmetic mean of 49 dB L_{eq}). According to the FICON increase significance criteria (Table 1), a 5 dB increase in noise levels due to project on-site activities would be required for a finding of a significant impact.

Given the arithmetic means of measured daytime and nighttime hourly average noise levels cited above, and based on the FICON criteria, a significant noise impact would be identified if predicted project-generated hourly average noise levels would exceed either 55 dB L_{eq} (during daytime hours) or 54 dB L_{eq} (during nighttime hours) at the existing residential uses to the west (i.e., 5 dB above ambient). Based on the data presented in Table 14, the increase in ambient daytime and nighttime noise levels resulting from combined on-site noise sources is calculated to be 0.4 dB L_{eq} and 0.5 dB L_{eq} (respectively) at the nearest existing residential use to the west.

Because cumulative (combined) noise level exposure from retail on-site noise sources is calculated to satisfy applicable Dixon Municipal Code noise level standard at the nearest existing sensitive land uses, and because cumulative noise level exposure is not expected to significantly increase ambient noise levels at those uses relative to the FICON criteria, this impact is identified as being ***less than significant.***

Noise Impacts Associated with Project Construction Activities

Impact 9: Project Construction Noise Levels at Existing Sensitive Uses

During project construction, heavy equipment would be used for grading excavation, paving, and building construction, which would increase ambient noise levels when in use. Noise levels would vary depending on the type of equipment used, how it is operated, and how well it is maintained. Noise exposure at any single point outside the project work area would also vary depending upon the proximity of equipment activities to that point. The property lines of the nearest existing sensitive uses (west of the project) are located approximately 20 feet away from where construction activities could occur within the project area.

Table 15 includes the range of maximum noise levels for equipment commonly used in general 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 15 data also include predicted maximum equipment noise levels at the property lines of the nearest existing uses located 20 feet away, which assumes a standard spherical spreading loss of 6 dB per doubling of distance.

Table 15
Construction Equipment Reference and Projected Noise Levels Noise Levels

Equipment Description	Maximum Noise Level at 50 Feet (dB)	Predicted Maximum Noise Level at 20 Feet (dB)
Air compressor	80	88
Backhoe	80	88
Ballast equalizer	82	90
Ballast tamper	83	91
Compactor	82	90
Concrete mixer	85	93
Concrete pump	82	90
Concrete vibrator	76	84
Crane, mobile	83	91
Dozer	85	93
Generator	82	93
Grader	85	90
Impact wrench	85	93
Loader	80	93
Paver	85	88
Pneumatic tool	85	93
Pump	77	93
Saw	76	85
Scarifier	83	84
Scraper	85	91
Shovel	82	93
Spike driver	77	90
Tie cutter	84	85
Tie handler	80	92
Tie inserter	85	88
Truck	84	93
Source: Federal Transit Administration Noise and Vibration Impact Assessment Manual, Table 7-1 (2020)		

Based on the equipment noise levels in Table 15, noise levels from project construction are calculated to range from 84 to 93 dB at the property lines of the nearest existing off-site uses. As mentioned previously, not all of these construction activities would be required of this project.

As noted in the Regulatory Setting Section of this report, Section 18.28.050(C) of the Dixon Municipal Code exempts sound from temporary construction activities. It is the experience of BAC that construction activities associated with the development of residential and retail uses are typically considered to be short-term and/or temporary in nature. Provided that the City of Dixon considers construction activities associated with the project to be temporary, project construction activities would be exempt, and this impact would be considered less than significant. However, if the City of Dixon does not consider project construction activities to be temporary as defined in Municipal Code Section 18.28.050(C), noise levels generated by some construction activities could exceed the applicable Municipal Code exterior maximum noise level standard at the nearest residential uses to the west. As a result, noise impacts associated with construction activities are identified as being **potentially significant**.

Mitigation Impact 9: Construction Noise Control Measures

MM-9: To the maximum extent practical, the following measures should be incorporated into the project construction operations:

- The project shall utilize temporary construction noise control measures including the use of temporary noise barriers, or other appropriate measures as mitigation for noise generated during construction of projects.
- All noise-producing project equipment and vehicles using internal-combustion engines shall be equipped with manufacturers-recommended mufflers and be maintained in good working condition.
- All mobile or fixed noise-producing equipment used on the project site that are regulated for noise output by a federal, state, or local agency shall comply with such regulations while in the course of project activity.
- Electrically powered equipment shall be used instead of pneumatic or internal-combustion-powered equipment, where feasible.
- Material stockpiles and mobile equipment staging, parking, and maintenance areas shall be located as far as practicable from noise-sensitive receptors.
- Project area and site access road 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.

Significance of Impact 9 after Mitigation: ***Less than Significant***

Vibration Impacts Associated with Project Activities

Impact 10: Project Construction and Operations Vibration at Existing Sensitive 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 receptors have been identified as residential structures (west of the project) located approximately 40 feet from construction activities which would occur within the project area. Table 16 includes the range of vibration levels for equipment commonly used in general construction projects at a distance of 25 feet. The Table 16 data also include predicted equipment vibration levels at the nearest existing residences to the project area located approximately 40 feet away.

Table 16
Vibration Source Levels for Construction Equipment and Predicted Levels at 40 Feet

Equipment	Maximum Vibration Level at 25 Feet (PPV)[1]	Predicted Maximum Vibration Level at 40 Feet (PPV)
Large bulldozer	0.089	0.044
Hoe ram	0.089	0.044
Caisson drilling	0.089	0.044
Loaded trucks	0.076	0.038
Backhoe	0.051	0.025
Excavator	0.051	0.025
Grader	0.051	0.025
Loader	0.051	0.025
Jackhammer	0.035	0.017
Small bulldozer	0.003	0.001

[1] PPV = Peak Particle Velocity

Source: 2020 FTA Transit Noise and Vibration Impact Assessment Manual and BAC calculations

As shown in Table 16, vibration levels generated from on-site construction activities at the nearest existing sensitive structures located approximately 40 feet away (residences) are predicted to be well below the strictest Caltrans thresholds for damage to residential structures of 0.30 in/sec PPV shown in Table 2. Further, construction activities are not expected to result in adverse human response relative to the vibration annoyance criteria as defined by Caltrans in Table 3. Therefore, on-site construction within the project area is not expected to result in excessive groundborne vibration levels at nearby existing sensitive uses.

Results from the BAC vibration survey on June 14th, 2021, indicate that that measured average vibration levels were well 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 proposes the development of residential and retail uses. It is the experience of BAC that residential and retail 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 project will 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 City of Dixon has policies that address existing/future conditions affecting the proposed project, which are discussed in the following section.

Impact 11: Future Exterior Traffic Noise Levels at Proposed Residential Uses

The FHWA Model was used with future traffic data to predict future SR-113 and Vaughn Road traffic noise levels at the proposed residential uses of the development. The future average daily traffic (ADT) volume for SR-113 was conservatively estimated by increasing the existing ADT volume by a factor of 50%. The existing ADT volume for SR-113 was obtained from published 2019 Caltrans traffic data. The day/night distribution, truck percentages, and estimated future traffic speed assumptions for SR-113 were derived from Caltrans and BAC file data for similar roadways.

Traffic data for Vaughn Road was obtained from data published by the City of Dixon Traffic Engineering Department. However, the most recent traffic data available for Vaughn Road is from 2007. As a result, a future traffic volume for Vaughn Road was conservatively estimated by assuming an increase in traffic by a factor of 3 relative to the reported 2007 traffic data. The day/night distribution, truck percentages, and estimated future traffic speed assumptions for Vaughn Road were derived from BAC file data for similar roadways.

A complete listing of FHWA Model inputs and results for SR-113 and Vaughn Road are provided in Appendix H. The predicted future traffic noise levels at the development are summarized in Table 17.

Table 17
Predicted Future Exterior Traffic Noise Levels at Proposed Residential Uses[1]

Roadway	Location Description	Offset (dB)[2,3]	Future Exterior DNL (dB)
SR-113	Nearest backyards	-3	65
	Nearest first-floor building facades		70
	Nearest upper-floor building facades	+2	72
Vaughn Rd	Nearest backyards	-3	61
	Nearest first-floor building facades		64
	Nearest upper-floor building facades	+2	66

[1] Complete listings of FHWA Model inputs are provided as Appendix H.
[2] A -3 dB offset was applied at backyards for reduced view of roadway resulting from proposed buildings.
[3] A +2 dB offset was applied at upper-floors for reduced ground absorption at elevated locations.
Source: Bollard Acoustical Consultants, Inc. (2021)

As indicated in Table 17, future Vaughn Road and SR-113 traffic noise level exposure at the nearest residential outdoor activity areas (backyards) would exceed the Dixon General Plan 60 dB DNL exterior noise level standard for residential uses. As a result, this impact is identified as being **potentially significant**.

<u>Mitigation Impact 11:</u>

To reduce future traffic noise level exposure to a state of compliance with the applicable Dixon General Plan exterior noise level limit for residential uses, implementation of the following noise mitigation measure would be required:

MM-11: The construction of 6-foot-tall traffic noise barriers at the locations shown on Figure 2. Appendix I contains the inputs and results from the barrier analysis. As indicated in Appendix I, the construction of 6-foot-tall noise barriers at the locations on Figure 2 is calculated to reduce future SR-113 and Vaughn Road traffic noise level exposure to 60 dB DNL or less at the nearest proposed backyards and would satisfy the applicable General Plan 60 dB DNL exterior noise level standard.

The traffic noise barriers 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.

Significance of Impact 11 after Mitigation: ***Less than Significant***

Impact 12: Future Interior Traffic Noise Levels within Proposed Residential Uses

After implementation of Mitigation Measure 11 (6-foot-tall traffic noise barriers), future exterior SR-113 and Vaughn Road traffic noise levels are predicted to be 60 dB DNL or less at the first-floor facades of the residences constructed nearest to the roadways. Due to reduced ground absorption at elevated positions and lack of shielding by the noise barriers, future traffic noise levels are predicted to range from 66 dB DNL to 72 dB DNL at the upper-floor facades of those residences. To satisfy the Dixon General Plan 45 dB DNL interior noise level standard, minimum noise reductions of 15 dB and 27 dB would be required of the first- and upper-floor building facades (respectively) of the residences constructed adjacent to the roadways.

Standard building construction (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, standard construction practices would be adequate for first-floor facades nearest to the roadways but would fail to provide adequate noise level reduction within the upper-floor rooms of residences closest to SR-113. As a result, this impact is identified as being **potentially significant**.

<u>Mitigation Impact 12:</u>

To reduce future traffic noise level exposure to a state of compliance with the applicable Dixon General Plan interior noise level limit for residential uses, implementation of the following noise mitigation measure would be required:

MM-12: All upper-floor windows of the residences identified on Figure 2 with a view of SR-113 (i.e., north-, south- and east-facing windows) should be upgraded to a minimum Sound Transmission Class (STC) rating of 32. In addition, mechanical ventilation (air conditioning) should be provided to all residences of the development allow the occupants to close doors and windows as desired for additional acoustical isolation.

Significance of Impact 12 after Mitigation: ***Less than Significant***

Impact 13: Retail On-Site Vehicle Circulation Noise at Proposed Residential Uses

An analysis of on-site vehicle circulation noise exposure at existing sensitive uses was presented in **Impact 2**. Using the same methodology identified in **Impact 2**, on-site vehicle circulation noise levels were predicted at the nearest proposed residential uses of the development. The results of that analysis are provided below in Table 18.

Table 18
Predicted Worst-Case On-Site Traffic Circulation Noise Levels at Proposed Residential Uses

Receiver[1]	Distance from On-Site Vehicle Circulation (ft)[2]	Predicted Noise Level, L_{eq} (dB)[3]
Proposed Residential – West	75	36
Proposed Residential – South	170	30

[1] Locations of residential uses are shown in Figure 3.
[2] Distance scaled from on-site vehicle circulation route to property line of residential use using provided site plans.
[3] Predicted noise level includes offsets to account for shielding provided by a proposed 8' sound wall (-7 dB).
Source: Bollard Acoustical Consultants, Inc. (2021)

As indicated in Table 18, worst-case retail-related on-site traffic circulation noise level exposure is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest proposed residential uses. As a result, this impact is identified as being ***less than significant.***

Impact 14: Retail On-Site Delivery Truck Circulation Noise at Proposed Residential Uses

An analysis of on-site delivery truck circulation noise exposure at existing sensitive uses was presented in **Impact 3**. Using the same methodology identified in **Impact 3**, on-site delivery truck circulation noise levels were predicted at the nearest proposed residential uses of the development. The results of that analysis are provided below in Table 19.

Table 19
Predicted On-Site Delivery Truck Noise Levels at Proposed Residential Uses

Receiver[1]	Distance from On-Site Truck Circulation (ft)[2]	Predicted Noise Level, L_{eq} (dB)[3]
Proposed Residential – West	115	35
Proposed Residential – South	170	31

[1] Locations of residential uses are shown in Figure 3.
[2] Distance scaled from on-site truck circulation route to property lines of residential uses using provided site plans.
[3] Predicted noise level includes offsets to account for shielding provided by a proposed 8' sound wall (-7 dB).
Source: Bollard Acoustical Consultants, Inc. (2021)

The Table 19 data indicate that retail-related on-site delivery truck circulation noise level exposure is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest proposed residential uses. As a result, this impact is identified as being ***less than significant.***

Impact 15: Retail Truck Delivery Activity Noise at Proposed Residential Uses

An analysis of on-site truck delivery activity noise exposure at existing sensitive uses was presented in **Impact 4**. Using the same methodology identified in **Impact 4**, on-site truck delivery activity noise levels were predicted at the nearest proposed residential uses of the development. The results of that analysis are provided below in Table 20.

Table 20
Predicted Truck Delivery Activity Noise Levels at Proposed Residential Uses

Receiver[1]	Distance from Truck Delivery Area (ft)[2]	Predicted Noise Level, L_{eq} (dB)[3]
Proposed Residential – West	120	35
Proposed Residential – South	300	27

[1] Locations of residential uses are shown in Figure 3.
[2] Distance scaled from delivery area to property lines of residential uses using provided site plans.
[3] Predicted noise level includes offsets to account for shielding provided by a proposed 8' sound wall (-7 dB).
Source: Bollard Acoustical Consultants, Inc. (2021)

As indicated in Table 20, retail-related truck delivery activity noise level exposure is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest proposed residential uses. As a result, this impact is identified as being ***less than significant.***

Impact 16: Retail Rooftop Mechanical Equipment Noise at Proposed Residential Uses

An analysis of retail rooftop mechanical equipment (HVAC) noise exposure at existing sensitive uses was presented in **Impact 5**. Using the same methodology identified in **Impact 5**, HVAC equipment noise levels were predicted at the nearest proposed residential uses of the development. The results of that analysis are provided below in Table 21.

Table 21
Predicted HVAC Equipment Noise Levels at Proposed Residential Uses

Receiver[1]	Distance from Building (ft)[2]	Predicted Noise Level, L_{eq} (dB)[3]
Proposed Residential – West	50	51
Proposed Residential – South	290	36

[1] Locations of residential uses are shown in Figure 3.
[2] Distance scaled from convenience store building to property lines of residential uses using provided site plans.
[3] No barrier offset was applied to predicted noise levels due to elevated position of equipment.
Source: Bollard Acoustical Consultants, Inc. (2021)

The Table 21 data indicate that retail-related HVAC equipment noise level exposure is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest proposed residential uses. As a result, this impact is identified as being ***less than significant.***

Impact 17: Retail Vacuum System Noise at Proposed Residential Uses

An analysis of retail vacuum system noise exposure at existing sensitive uses was presented in **Impact 6**. Using the same methodology identified in **Impact 6**, vehicle vacuum equipment noise levels were predicted at the nearest proposed residential uses of the development. The results of that analysis are provided below in Table 22.

Table 22
Predicted Vacuum Equipment Noise Levels at Proposed Residential Uses

Receiver[1]	Distance from Vacuum Area (ft)[2]	Predicted Noise Level, L_{eq} (dB)[3]	
		Combination Configuration	Power Vacuum Configuration
Proposed Residential – West	150	50	66
Proposed Residential – South	120	52	68

[1] Locations of residential uses are shown in Figure 3.
[2] Distance scaled from center of vacuum area to property lines of residential uses using provided site plans.
[3] Predicted noise level includes offsets to account for shielding provided by a proposed 8' sound wall (-7 dB).
Source: Bollard Acoustical Consultants, Inc. (2021)

As indicated in Table 22, noise level exposure associated with the Combination vacuum system configuration is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest proposed residential uses but would exceed the criterion with the Power Vacuum system configuration. As a result, it is recommended that the project utilize the Combination vacuum system configuration to comply with the General Plan's exterior noise level standard. Provided that the project design includes the installation of the Combination vacuum system configuration, this impact is identified as being ***less than significant.***

Impact 18: Retail Car Wash Drying Assembly Noise at Proposed Residential Uses

An analysis of retail car wash drying assembly noise exposure at existing sensitive uses was presented in **Impact 7**. Using the same methodology identified in **Impact 7**, car wash drying assembly noise levels were predicted at the nearest proposed residential uses of the development. The results of that analysis are provided below in Table 23.

Table 23
Predicted Car Wash Drying Assembly Noise Levels at Proposed Residential Uses

Receiver[1]	Distance from Car Wash Tunnel (ft)[2]	Predicted Noise Level, L_{eq} (dB)[3]
Proposed Residential – West	110	52
Proposed Residential – South	70	50

[1] Locations of residential uses are shown in Figure 3.
[2] Distance scaled from tunnel entrance/exit to property lines of residential uses using provided site plans.
[3] No barrier offset was applied to predicted noise levels due to elevated position of equipment.
Source: Bollard Acoustical Consultants, Inc. (2021)

The Table 23 data indicate that retail-related car wash drying assembly noise level exposure is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest proposed residential uses. As a result, this impact is identified as being ***less than significant.***

Impact 19: Cumulative Retail Operations Noise at Proposed Residential Uses

The calculated cumulative (combined) noise level exposure from analyzed on-site noise sources at the nearest proposed residential uses is presented in Table 24. 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
Predicted Cumulative Retail Operations Noise Levels at Proposed Residential Uses

Receiver	Predicted Noise Levels, L_{eq} (dB)						Calculated Cumulative L_{eq} (dB)[2]
	On-Site Vehicle Circ.	On-Site Truck Circ.	Delivery Truck	HVAC	Vacuums[1]	Car Wash Dryers	
Proposed Residential – West	36	35	35	51	50	52	55
Proposed Residential – South	30	31	27	36	52	50	55

[1] Vacuum noise levels reflect the quieter Combination equipment configuration.
[2] Calculated cumulative noise levels based on predicted noise levels presented in Impacts 13-18.
Source: Bollard Acoustical Consultants, Inc. (2021)

As indicated in Table 24, the calculated combined noise level exposure from retail operations is predicted to satisfy the applicable Dixon Municipal Code 55 dB L_{eq} exterior noise level standard at the nearest proposed residential uses. As a result, this impact is identified as being ***less than significant.***

Impact 20: Industrial Operations Noise at Proposed Residential Uses

An existing industrial use is located to the south of the proposed development (Dependable Heating and Air Conditioning). The location of the existing industrial use is shown on Figure 1. According to BAC field observations, the industrial use consists of a storage yard, warehouse and loading dock.

Noise measurement site LT-3 was specifically selected to capture noise levels associated with the adjacent industrial operations at the project property line. According to information obtained online, the hours of operation for the industrial business (Dependable Heating and Air Conditioning) are Monday through Friday from 8:00 a.m. to 5:00 p.m. In the analysis of the ambient data contained in Appendices C & D, it was revealed measured hourly average noise levels at site LT-3 ranged from 43 dB L_{eq} to 55 dB L_{eq} during the hours of 8:00 a.m. to 5:00 p.m. throughout the 96-hour monitoring effort. The BAC ambient noise monitoring survey included days in which the industrial business conducted normal operations (Thursday and Friday).

Although measured hourly average noise levels at site LT-3 did not exceed the Dixon Municipal Code 55 dB L_{eq} exterior noise level standard, measured noise levels at this location did meet the limit. In addition, it is possible that noise levels associated with future operations at Dependable Heating and Air Conditioning could potentially exceed the Municipal Code noise level limit at the project site. Finally, there is no guarantee that noise levels associated with other potential future industrial businesses at this location would not result in an exceedance of the noise standard at the nearest proposed residential uses. Based on the information above, and to reduce the potential for an exceedance of the applicable Dixon Municipal Code noise level standard at the nearest proposed residential uses, it is recommended that the project include the construction of a 6-foot-tall solid masonry wall at the location shown on Figure 2. Nonetheless, based on the measured ambient noise level data at the project site, this impact is identified as being ***less than significant.***

This concludes BAC's noise and vibration assessment of the Lincoln Square Mixed-Use Development in Dixon, California. Please contact BAC at (530) 537-2328 or dariog@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.

A

B

C

D

Legend

A Site TC-2: Traffic calibration of SR-113, located approximately 60' from roadway centerline

B Site V-2: Vibration measurement site

C Site LT-2: Long-term noise measurement site along western project property line adjacent to residences

D Site LT-1: Long-term noise measurement site along northwestern project property line adjacent to residences

Lincoln Square Mixed-Use Development
Dixon, California

Photographs of Survey Locations

Appendix B

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Appendix C-1
Ambient Noise Monitoring Results - Site LT-1
Lincoln Square Mixed-Use Development - Dixon, California
Thursday, June 10, 2021

Hour	Leq	Lmax	L50	L90
12:00 AM	50	78	42	39
1:00 AM	44	61	41	38
2:00 AM	47	62	43	39
3:00 AM	46	63	44	41
4:00 AM	49	61	47	43
5:00 AM	55	75	52	48
6:00 AM	53	63	51	47
7:00 AM	50	63	49	45
8:00 AM	50	69	49	46
9:00 AM	50	62	49	46
10:00 AM	53	67	51	49
11:00 AM	55	70	52	50
12:00 PM	53	61	52	49
1:00 PM	53	75	51	48
2:00 PM	53	69	50	46
3:00 PM	51	65	49	46
4:00 PM	50	64	48	45
5:00 PM	50	64	49	46
6:00 PM	52	72	49	46
7:00 PM	50	75	47	45
8:00 PM	50	69	48	45
9:00 PM	55	81	49	46
10:00 PM	49	69	47	44
11:00 PM	48	72	44	42

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	55	50	52	55	44	50
Lmax (Maximum)	81	61	68	78	61	67
L50 (Median)	52	47	49	52	41	46
L90 (Background)	50	45	46	48	38	42

Computed DNL (dB)	57
% Daytime Energy	71%
% Nighttime Energy	29%

GPS Coordinates	38°28'0.82" N 121°49'26.70" W

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Appendix C-2
Ambient Noise Monitoring Results - Site LT-1
Lincoln Square Mixed-Use Development - Dixon, California
Friday, June 11, 2021

Hour	Leq	Lmax	L50	L90
12:00 AM	45	59	43	41
1:00 AM	47	64	45	41
2:00 AM	46	61	44	41
3:00 AM	47	68	45	41
4:00 AM	48	64	46	43
5:00 AM	53	74	51	48
6:00 AM	52	68	51	48
7:00 AM	50	71	47	44
8:00 AM	49	65	47	44
9:00 AM	48	64	47	43
10:00 AM	49	72	47	43
11:00 AM	49	60	47	44
12:00 PM	49	62	48	44
1:00 PM	50	65	48	44
2:00 PM	49	65	47	44
3:00 PM	50	71	47	44
4:00 PM	50	73	48	45
5:00 PM	49	65	48	45
6:00 PM	50	67	48	45
7:00 PM	50	71	47	45
8:00 PM	49	64	47	45
9:00 PM	50	71	49	47
10:00 PM	48	60	47	45
11:00 PM	47	65	46	43

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	50	48	49	53	45	49
Lmax (Maximum)	73	60	67	74	59	65
L50 (Median)	49	47	47	51	43	46
L90 (Background)	47	43	44	48	41	43

Computed DNL (dB)	56
% Daytime Energy	63%
% Nighttime Energy	37%

GPS Coordinates	38°28'0.82" N 121°49'26.70" W

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Appendix C-3
Ambient Noise Monitoring Results - Site LT-1
Lincoln Square Mixed-Use Development - Dixon, California
Saturday, June 12, 2021

Hour	Leq	Lmax	L50	L90
12:00 AM	46	66	44	42
1:00 AM	45	59	44	42
2:00 AM	44	57	43	40
3:00 AM	47	67	43	41
4:00 AM	46	58	44	40
5:00 AM	48	64	47	43
6:00 AM	51	63	50	46
7:00 AM	50	65	48	45
8:00 AM	52	72	51	49
9:00 AM	52	63	52	50
10:00 AM	51	68	50	46
11:00 AM	51	68	48	45
12:00 PM	50	66	47	43
1:00 PM	50	67	47	43
2:00 PM	50	70	46	43
3:00 PM	50	76	47	44
4:00 PM	50	62	48	45
5:00 PM	49	66	48	45
6:00 PM	49	65	47	45
7:00 PM	49	66	47	45
8:00 PM	49	69	47	45
9:00 PM	50	65	49	47
10:00 PM	50	65	49	48
11:00 PM	49	63	49	46

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	52	49	50	51	44	48
Lmax (Maximum)	76	62	67	67	57	62
L50 (Median)	52	46	48	50	43	46
L90 (Background)	50	43	45	48	40	43

Computed DNL (dB)	55
% Daytime Energy	74%
% Nighttime Energy	26%

GPS Coordinates	38°28'0.82" N 121°49'26.70" W

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Appendix C-4
Ambient Noise Monitoring Results - Site LT-1
Lincoln Square Mixed-Use Development - Dixon, California
Sunday, June 13, 2021

Hour	Leq	Lmax	L50	L90
12:00 AM	48	55	48	46
1:00 AM	47	58	47	43
2:00 AM	49	69	48	46
3:00 AM	48	66	48	46
4:00 AM	48	66	48	44
5:00 AM	49	66	46	43
6:00 AM	47	72	44	41
7:00 AM	46	63	44	42
8:00 AM	46	64	44	41
9:00 AM	46	66	44	41
10:00 AM	48	68	45	42
11:00 AM	49	65	46	43
12:00 PM	50	70	47	44
1:00 PM	49	73	47	44
2:00 PM	49	69	47	44
3:00 PM	49	62	47	44
4:00 PM	50	70	49	46
5:00 PM	50	60	48	45
6:00 PM	50	67	48	46
7:00 PM	52	77	48	45
8:00 PM	48	64	46	44
9:00 PM	50	66	49	47
10:00 PM	50	71	48	47
11:00 PM	49	61	48	47

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	52	46	49	50	47	48
Lmax (Maximum)	77	60	67	72	55	65
L50 (Median)	49	44	47	48	44	47
L90 (Background)	47	41	44	47	41	45

Computed DNL (dB)	55
% Daytime Energy	66%
% Nighttime Energy	34%

GPS Coordinates	38°28'0.82" N 121°49'26.70" W

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Appendix C-5
Ambient Noise Monitoring Results - Site LT-2
Lincoln Square Mixed-Use Development - Dixon, California
Thursday, June 10, 2021

Hour	Leq	Lmax	L50	L90
12:00 AM	48	77	43	41
1:00 AM	44	58	42	40
2:00 AM	45	57	43	41
3:00 AM	48	70	46	43
4:00 AM	50	64	49	46
5:00 AM	54	70	52	48
6:00 AM	53	75	52	47
7:00 AM	46	66	45	42
8:00 AM	45	63	44	42
9:00 AM	47	65	45	43
10:00 AM	53	71	49	46
11:00 AM	51	71	50	47
12:00 PM	51	68	50	46
1:00 PM	49	63	48	45
2:00 PM	50	69	47	43
3:00 PM	47	65	45	42
4:00 PM	46	67	44	41
5:00 PM	50	64	48	46
6:00 PM	51	76	48	46
7:00 PM	49	58	48	45
8:00 PM	48	60	47	45
9:00 PM	52	76	48	46
10:00 PM	48	66	47	45
11:00 PM	49	71	46	44

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	53	45	50	54	44	50
Lmax (Maximum)	76	58	67	77	57	68
L50 (Median)	50	44	47	52	42	47
L90 (Background)	47	41	44	48	40	44

Computed DNL (dB)	56
% Daytime Energy	60%
% Nighttime Energy	40%

GPS Coordinates	38°27'54.83" N 121°49'26.76" W

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Appendix C-6
Ambient Noise Monitoring Results - Site LT-2
Lincoln Square Mixed-Use Development - Dixon, California
Friday, June 11, 2021

Hour	Leq	Lmax	L50	L90
12:00 AM	46	55	45	43
1:00 AM	47	67	45	43
2:00 AM	46	56	45	43
3:00 AM	48	70	46	43
4:00 AM	49	71	47	44
5:00 AM	54	75	52	50
6:00 AM	53	69	52	49
7:00 AM	48	65	46	42
8:00 AM	51	70	46	43
9:00 AM	46	60	44	41
10:00 AM	46	65	44	41
11:00 AM	50	76	44	41
12:00 PM	46	61	44	40
1:00 PM	48	64	46	43
2:00 PM	46	63	45	43
3:00 PM	46	61	45	42
4:00 PM	48	63	47	44
5:00 PM	48	62	46	44
6:00 PM	47	66	47	44
7:00 PM	48	69	47	45
8:00 PM	47	66	46	44
9:00 PM	46	66	45	44
10:00 PM	46	61	45	44
11:00 PM	46	69	43	42

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	51	46	48	54	46	50
Lmax (Maximum)	76	60	65	75	55	66
L50 (Median)	47	44	45	52	43	47
L90 (Background)	45	40	43	50	42	44

Computed DNL (dB)	56
% Daytime Energy	53%
% Nighttime Energy	47%

GPS Coordinates	38°27'54.83" N 121°49'26.76" W

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Appendix C-7
Ambient Noise Monitoring Results - Site LT-2
Lincoln Square Mixed-Use Development - Dixon, California
Saturday, June 12, 2021

Hour	Leq	Lmax	L50	L90
12:00 AM	46	70	42	40
1:00 AM	44	53	43	41
2:00 AM	43	52	42	40
3:00 AM	48	73	43	41
4:00 AM	45	56	43	41
5:00 AM	49	66	48	45
6:00 AM	51	61	51	48
7:00 AM	48	63	46	44
8:00 AM	50	72	49	47
9:00 AM	50	64	50	48
10:00 AM	49	68	47	44
11:00 AM	46	67	43	40
12:00 PM	46	68	41	39
1:00 PM	47	65	43	39
2:00 PM	43	60	41	38
3:00 PM	46	63	43	40
4:00 PM	48	60	46	42
5:00 PM	48	65	47	44
6:00 PM	48	61	46	44
7:00 PM	47	63	46	44
8:00 PM	48	63	47	45
9:00 PM	54	65	54	47
10:00 PM	57	65	56	55
11:00 PM	49	70	47	46

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	54	43	49	57	43	50
Lmax (Maximum)	72	60	64	73	52	63
L50 (Median)	54	41	46	56	42	46
L90 (Background)	48	38	43	55	40	44

Computed DNL (dB)	56
% Daytime Energy	55%
% Nighttime Energy	45%

GPS Coordinates	38°27'54.83" N
	121°49'26.76" W

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Appendix C-8
Ambient Noise Monitoring Results - Site LT-2
Lincoln Square Mixed-Use Development - Dixon, California
Sunday, June 13, 2021

Hour	Leq	Lmax	L50	L90
12:00 AM	46	67	45	43
1:00 AM	44	53	44	42
2:00 AM	45	59	44	42
3:00 AM	46	70	43	41
4:00 AM	47	67	44	42
5:00 AM	50	70	46	44
6:00 AM	46	65	45	43
7:00 AM	48	78	44	42
8:00 AM	45	55	44	41
9:00 AM	43	58	41	39
10:00 AM	48	66	45	40
11:00 AM	50	67	46	42
12:00 PM	49	67	46	43
1:00 PM	51	68	47	44
2:00 PM	50	77	45	42
3:00 PM	49	63	47	44
4:00 PM	50	67	49	45
5:00 PM	50	60	48	45
6:00 PM	50	61	48	46
7:00 PM	50	69	48	45
8:00 PM	47	58	46	43
9:00 PM	47	62	46	44
10:00 PM	45	63	44	41
11:00 PM	45	64	43	41

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	51	43	49	50	44	46
Lmax (Maximum)	78	55	65	70	53	64
L50 (Median)	49	41	46	46	43	44
L90 (Background)	46	39	43	44	41	42

Computed DNL (dB)	53
% Daytime Energy	75%
% Nighttime Energy	25%

GPS Coordinates	38°27'48.93" N 121°49'24.87" W

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Appendix C-9
Ambient Noise Monitoring Results - Site LT-3
Lincoln Square Mixed-Use Development - Dixon, California
Thursday, June 10, 2021

Hour	Leq	Lmax	L50	L90
12:00 AM	45	71	42	40
1:00 AM	42	56	41	38
2:00 AM	43	58	41	39
3:00 AM	50	64	49	45
4:00 AM	51	63	50	47
5:00 AM	52	66	50	47
6:00 AM	54	63	54	49
7:00 AM	51	70	48	46
8:00 AM	51	73	48	45
9:00 AM	51	66	49	46
10:00 AM	53	73	52	50
11:00 AM	53	65	51	49
12:00 PM	52	62	51	48
1:00 PM	51	66	49	47
2:00 PM	52	71	49	45
3:00 PM	51	73	47	44
4:00 PM	47	66	45	42
5:00 PM	48	62	46	44
6:00 PM	50	71	46	44
7:00 PM	47	63	47	45
8:00 PM	48	60	48	46
9:00 PM	48	69	47	45
10:00 PM	49	68	47	45
11:00 PM	48	70	46	44

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	53	47	51	54	42	50
Lmax (Maximum)	73	60	67	71	56	64
L50 (Median)	52	45	48	54	41	47
L90 (Background)	50	42	46	49	38	44

Computed DNL (dB)	56
% Daytime Energy	66%
% Nighttime Energy	34%

GPS Coordinates	38°27'48.93" N 121°49'24.87" W

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Appendix C-10
Ambient Noise Monitoring Results - Site LT-3
Lincoln Square Mixed-Use Development - Dixon, California
Friday, June 11, 2021

Hour	Leq	Lmax	L50	L90
12:00 AM	46	60	45	43
1:00 AM	46	61	44	42
2:00 AM	46	57	45	42
3:00 AM	47	66	45	43
4:00 AM	48	62	47	44
5:00 AM	54	68	53	51
6:00 AM	53	70	52	49
7:00 AM	55	71	50	45
8:00 AM	51	67	48	44
9:00 AM	51	69	48	44
10:00 AM	51	73	48	44
11:00 AM	50	69	47	43
12:00 PM	48	63	45	42
1:00 PM	51	72	47	44
2:00 PM	55	78	48	45
3:00 PM	50	73	46	43
4:00 PM	48	63	46	44
5:00 PM	50	72	46	43
6:00 PM	48	61	47	45
7:00 PM	49	63	48	46
8:00 PM	48	60	47	46
9:00 PM	47	65	46	44
10:00 PM	46	59	45	44
11:00 PM	45	66	44	42

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	55	47	51	54	45	49
Lmax (Maximum)	78	60	68	70	57	63
L50 (Median)	50	45	47	53	44	47
L90 (Background)	46	42	44	51	42	44

Computed DNL (dB)	56
% Daytime Energy	71%
% Nighttime Energy	29%

GPS Coordinates	38°27'48.93" N 121°49'24.87" W

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Appendix C-11
Ambient Noise Monitoring Results - Site LT-3
Lincoln Square Mixed-Use Development - Dixon, California
Saturday, June 12, 2021

Hour	Leq	Lmax	L50	L90
12:00 AM	45	62	45	43
1:00 AM	48	56	47	45
2:00 AM	46	61	44	41
3:00 AM	47	67	43	41
4:00 AM	45	59	44	42
5:00 AM	51	62	50	47
6:00 AM	54	62	54	51
7:00 AM	50	65	49	47
8:00 AM	52	62	51	49
9:00 AM	52	64	51	49
10:00 AM	48	59	48	44
11:00 AM	47	64	45	42
12:00 PM	49	71	44	41
1:00 PM	48	66	45	42
2:00 PM	43	65	42	39
3:00 PM	47	66	43	40
4:00 PM	46	58	44	41
5:00 PM	46	60	45	42
6:00 PM	46	62	46	44
7:00 PM	46	61	45	43
8:00 PM	47	61	45	43
9:00 PM	47	59	46	45
10:00 PM	50	73	47	46
11:00 PM	48	65	47	46

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	52	43	48	54	45	49
Lmax (Maximum)	71	58	63	73	56	63
L50 (Median)	51	42	46	54	43	47
L90 (Background)	49	39	43	51	41	45

Computed DNL (dB)	55
% Daytime Energy	57%
% Nighttime Energy	43%

GPS Coordinates	38°27'48.93" N 121°49'24.87" W

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Appendix C-12
Ambient Noise Monitoring Results - Site LT-3
Lincoln Square Mixed-Use Development - Dixon, California
Sunday, June 13, 2021

Hour	Leq	Lmax	L50	L90
12:00 AM	46	59	45	43
1:00 AM	45	55	44	43
2:00 AM	46	60	45	43
3:00 AM	45	67	44	42
4:00 AM	45	63	44	42
5:00 AM	48	69	45	43
6:00 AM	44	61	43	41
7:00 AM	44	58	43	41
8:00 AM	45	62	43	40
9:00 AM	46	63	42	39
10:00 AM	45	68	43	40
11:00 AM	48	68	43	40
12:00 PM	45	60	44	42
1:00 PM	50	60	48	43
2:00 PM	50	58	50	43
3:00 PM	47	73	45	43
4:00 PM	48	61	47	45
5:00 PM	48	63	47	45
6:00 PM	48	59	47	45
7:00 PM	49	66	47	45
8:00 PM	47	58	46	44
9:00 PM	45	66	44	42
10:00 PM	45	57	44	43
11:00 PM	45	64	44	42

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	50	44	47	48	44	46
Lmax (Maximum)	73	58	63	69	55	62
L50 (Median)	50	42	45	45	43	44
L90 (Background)	45	39	42	43	41	42

Computed DNL (dB)	52
% Daytime Energy	71%
% Nighttime Energy	29%

GPS Coordinates	38°27'48.93" N 121°49'24.87" W

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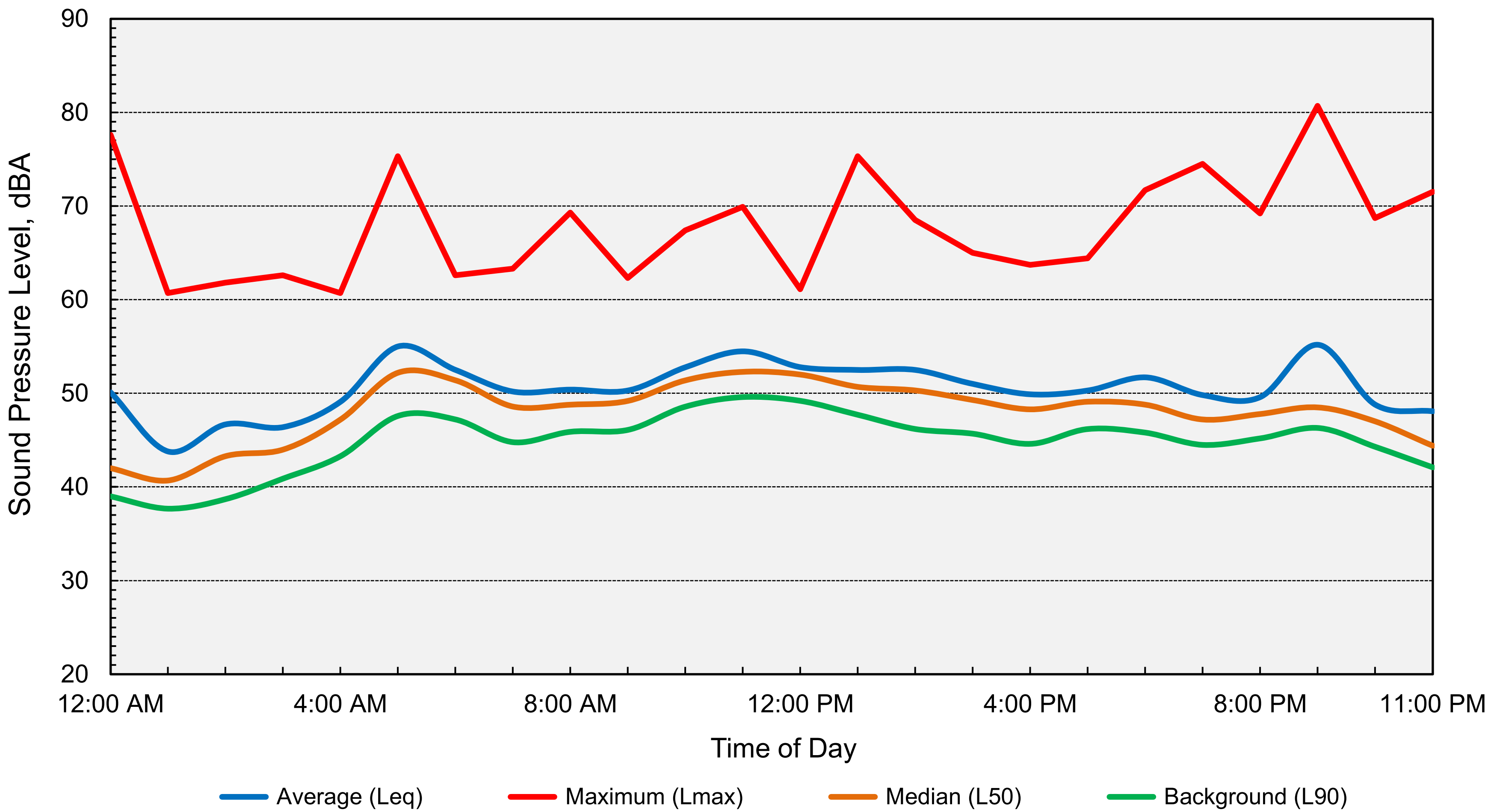
Appendix D-1
Ambient Noise Monitoring Results - Site LT-1
Lincoln Square Mixed-Use Development - Dixon, California
Thursday, June 10, 2021



Computed DNL = 57 dB

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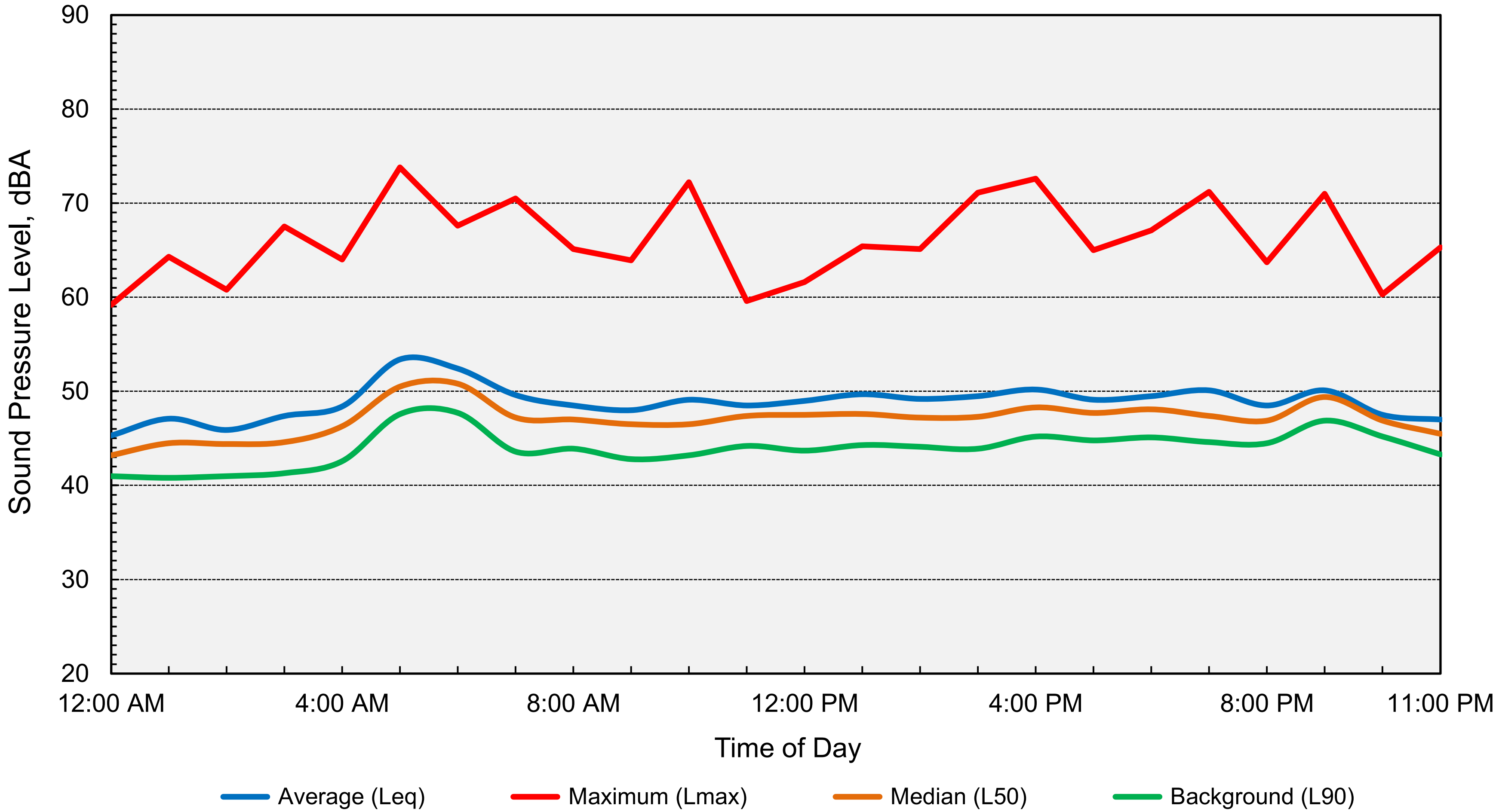
Appendix D-2
Ambient Noise Monitoring Results - Site LT-1
Lincoln Square Mixed-Use Development - Dixon, California
Friday, June 11, 2021



Computed DNL = 56 dB

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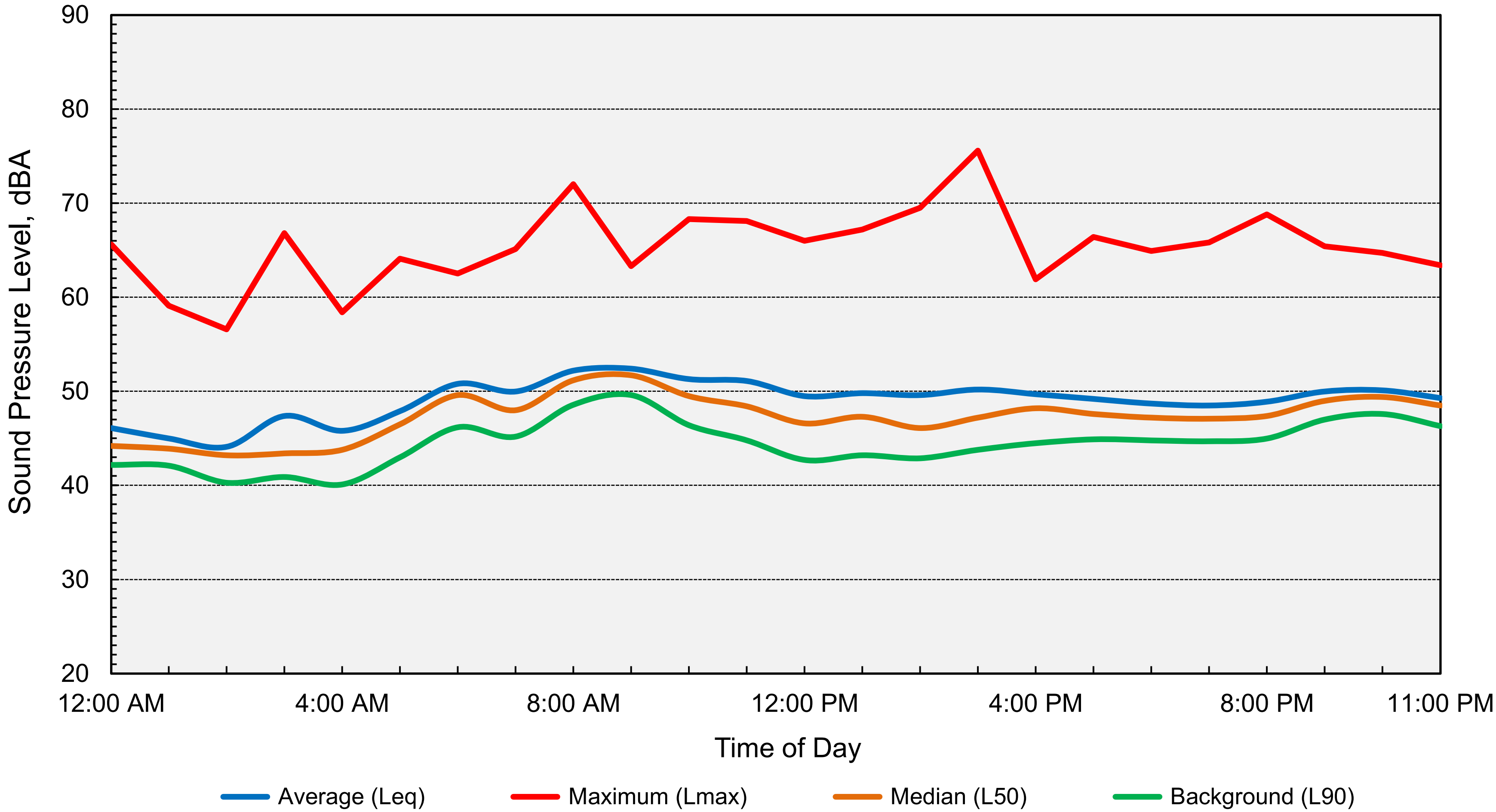
Appendix D-3
Ambient Noise Monitoring Results - Site LT-1
Lincoln Square Mixed-Use Development - Dixon, California
Saturday, June 12, 2021



Computed DNL = 55 dB

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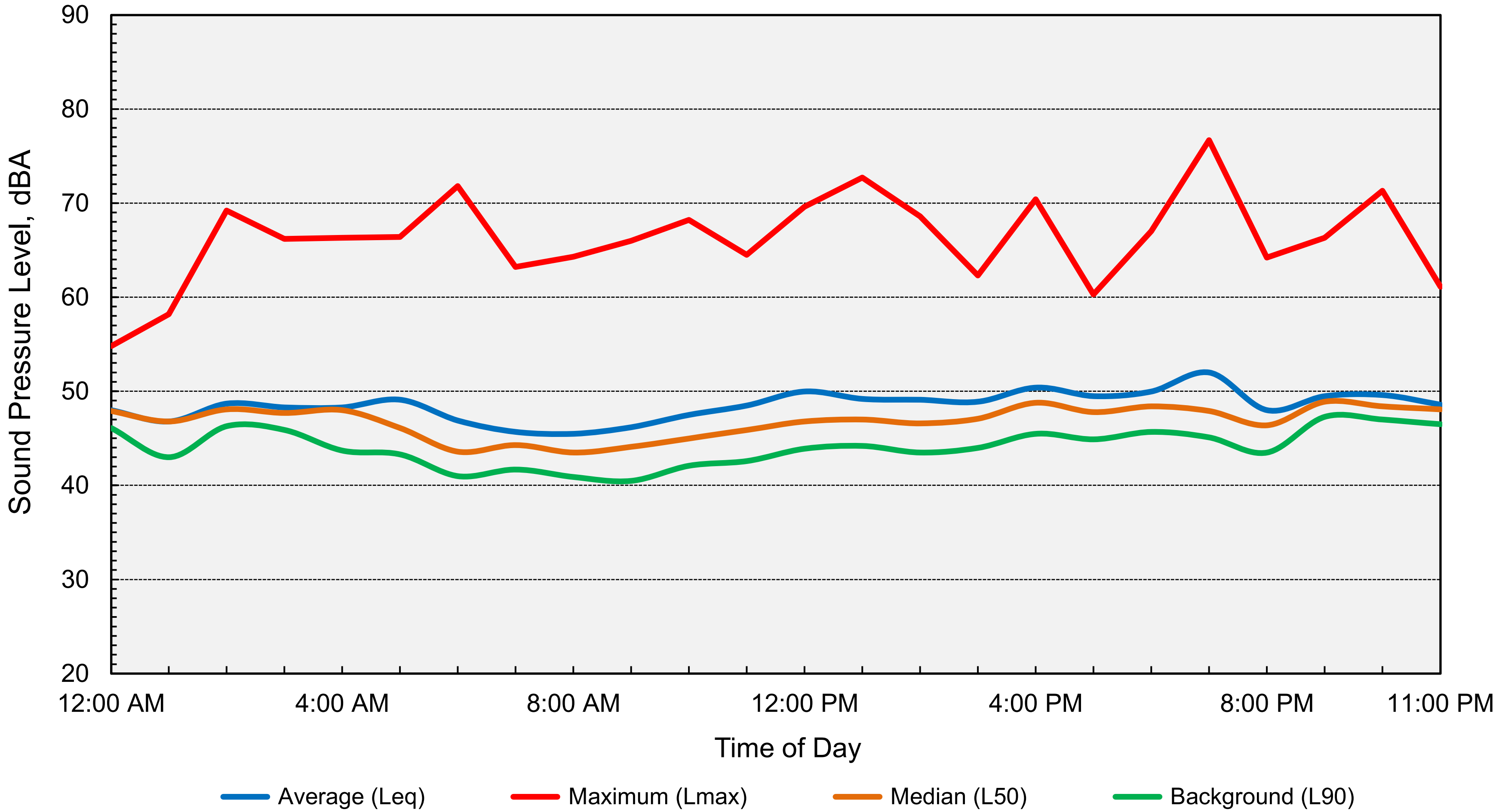
Appendix D-4
Ambient Noise Monitoring Results - Site LT-1
Lincoln Square Mixed-Use Development - Dixon, California
Sunday, June 13, 2021



Computed DNL = 55 dB

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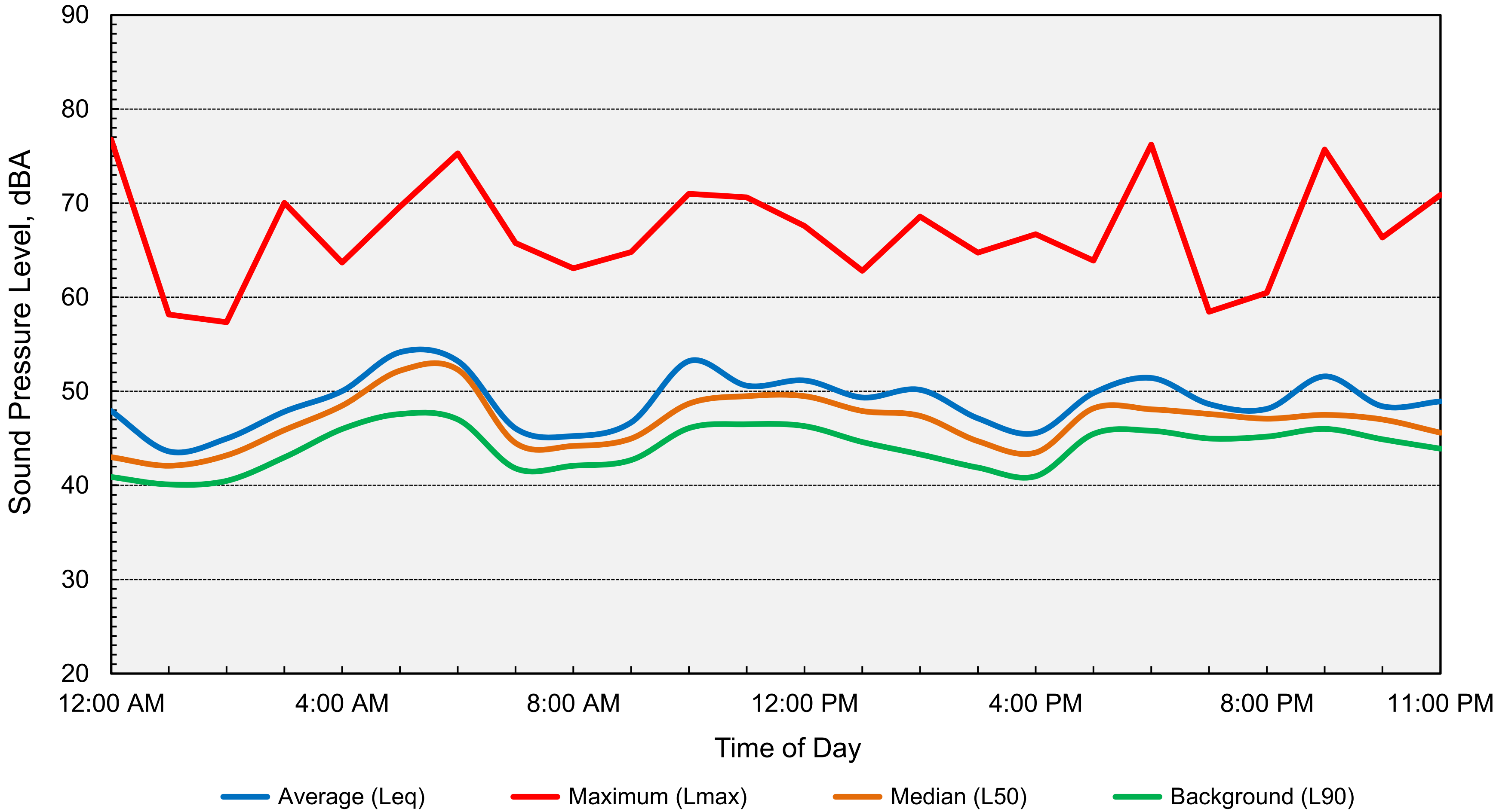
Appendix D-5
Ambient Noise Monitoring Results - Site LT-2
Lincoln Square Mixed-Use Development - Dixon, California
Thursday, June 10, 2021



Computed DNL = 56 dB

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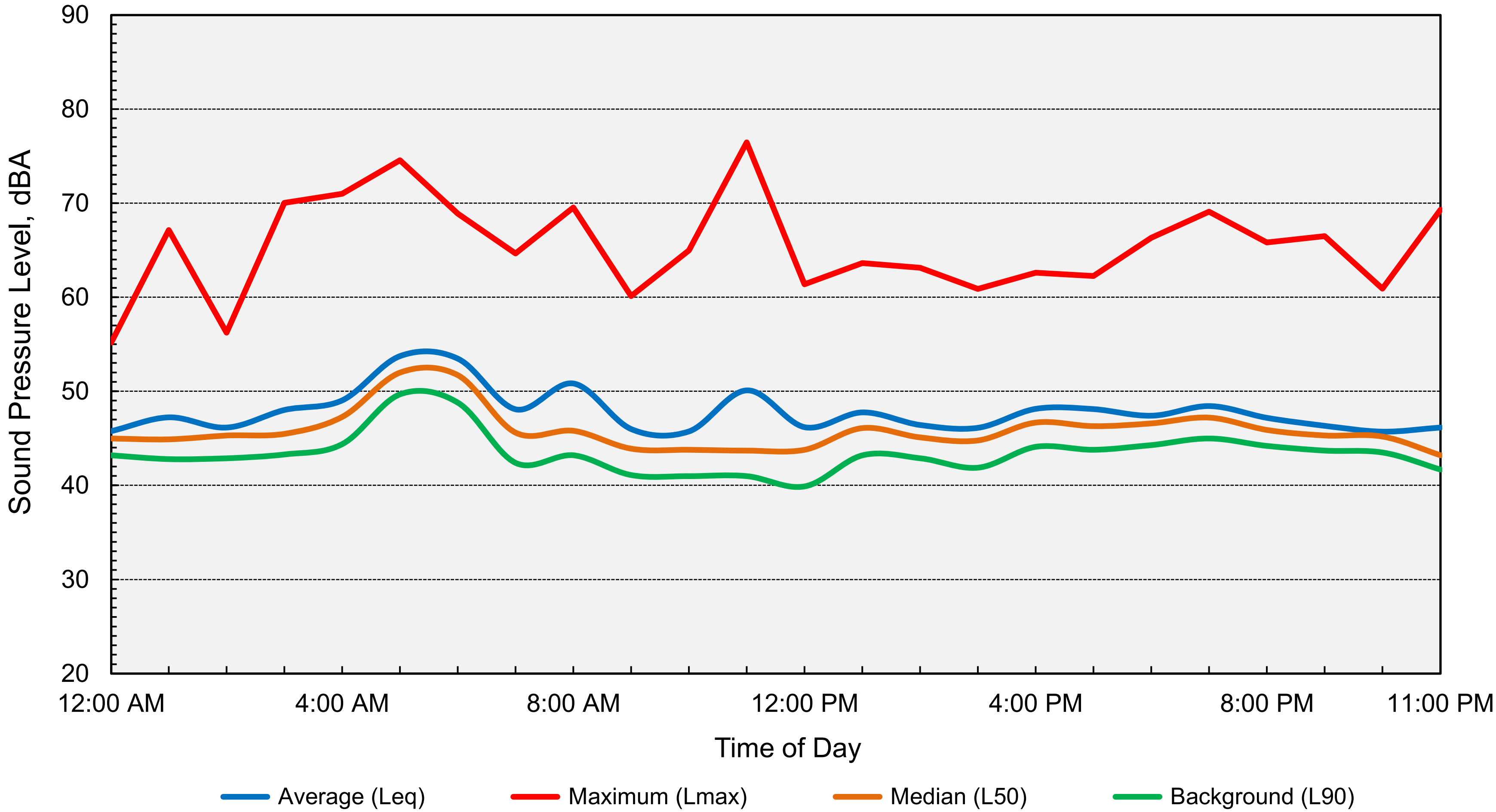
Appendix D-6
Ambient Noise Monitoring Results - Site LT-2
Lincoln Square Mixed-Use Development - Dixon, California
Friday, June 11, 2021



Computed DNL = 56 dB

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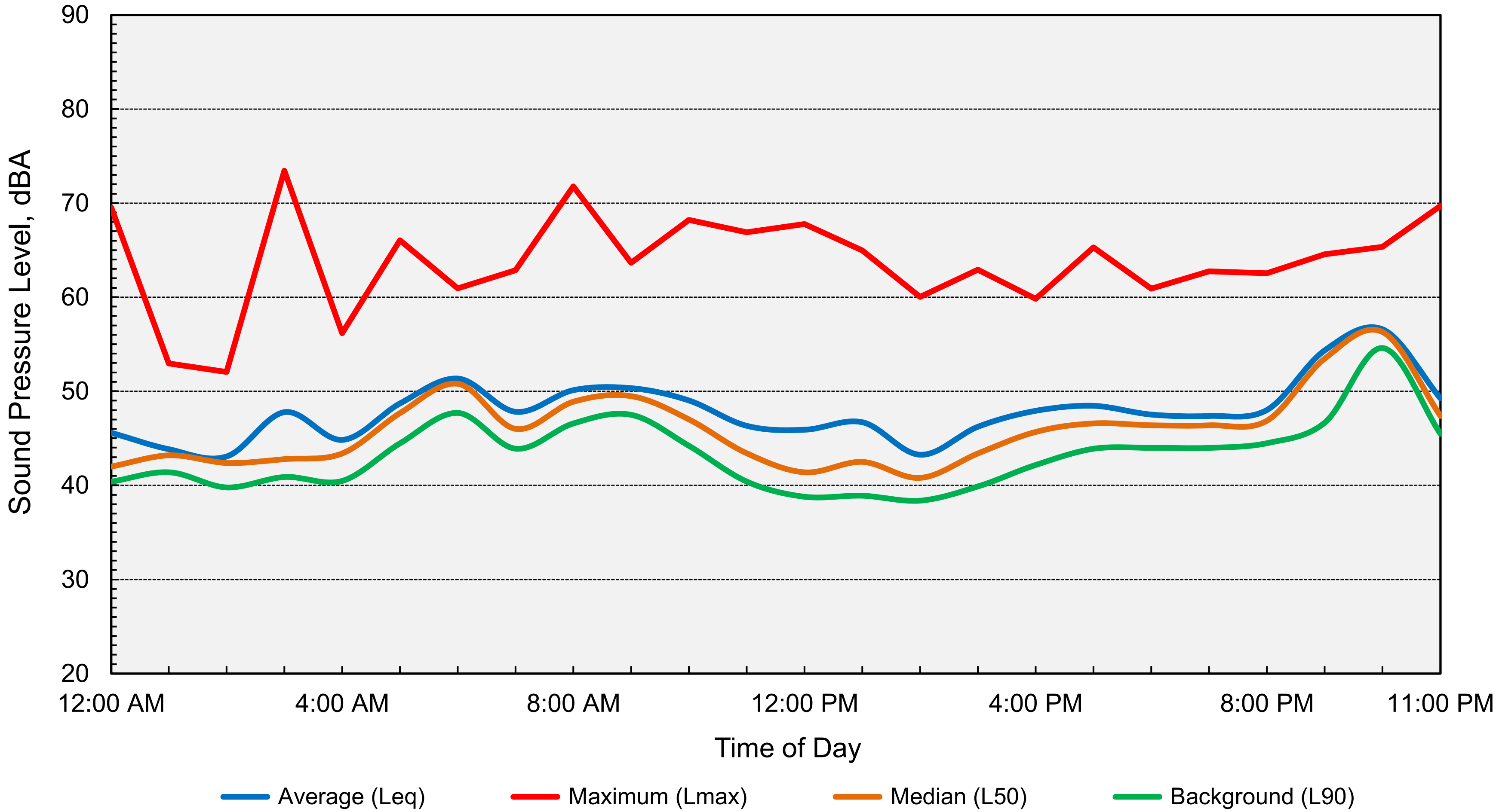
Appendix D-7
Ambient Noise Monitoring Results - Site LT-2
Lincoln Square Mixed-Use Development - Dixon, California
Saturday, June 12, 2021



Computed DNL = 56 dB

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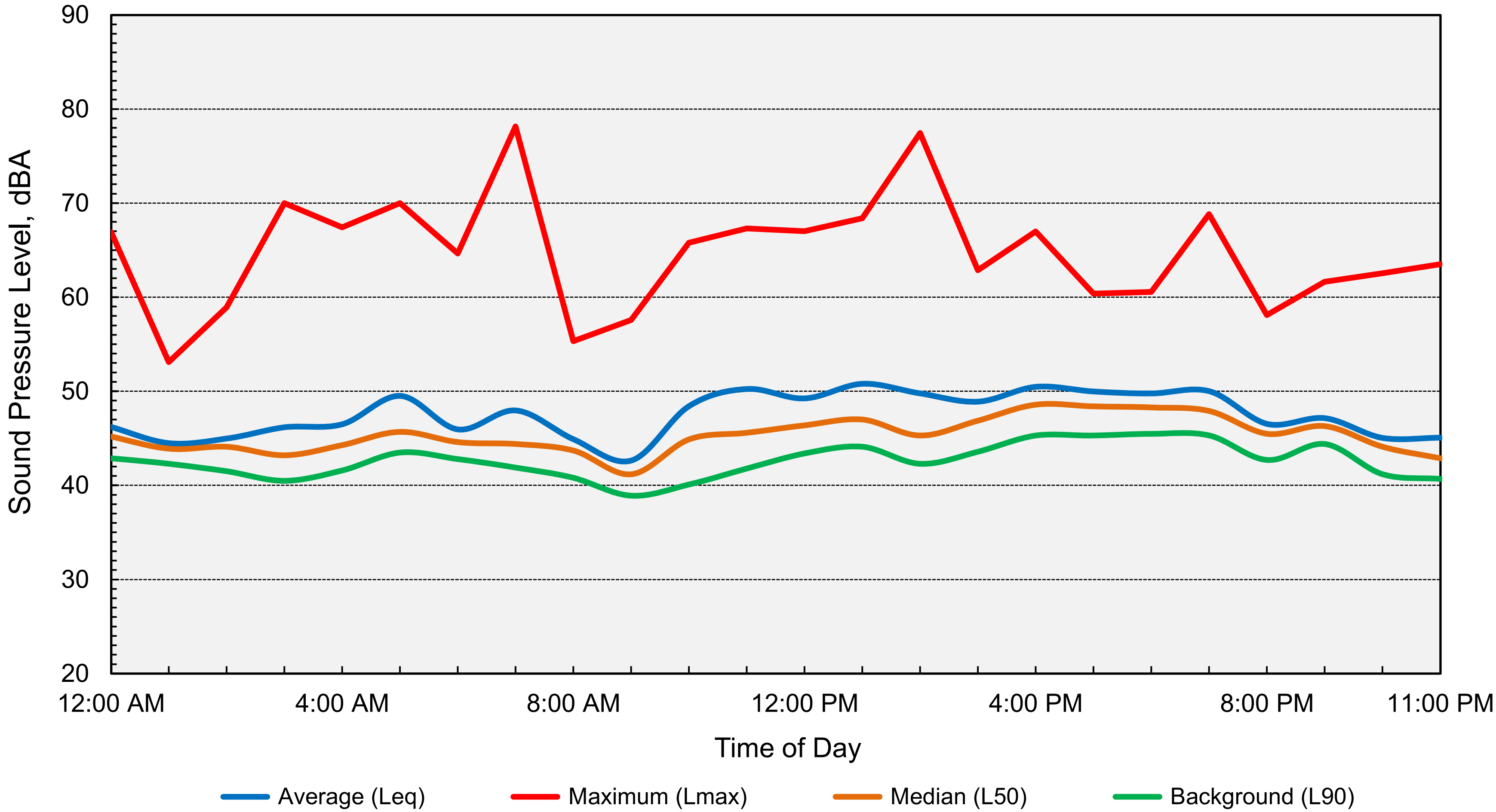
Appendix D-8
Ambient Noise Monitoring Results - Site LT-2
Lincoln Square Mixed-Use Development - Dixon, California
Sunday, June 13, 2021



Computed DNL = 53 dB

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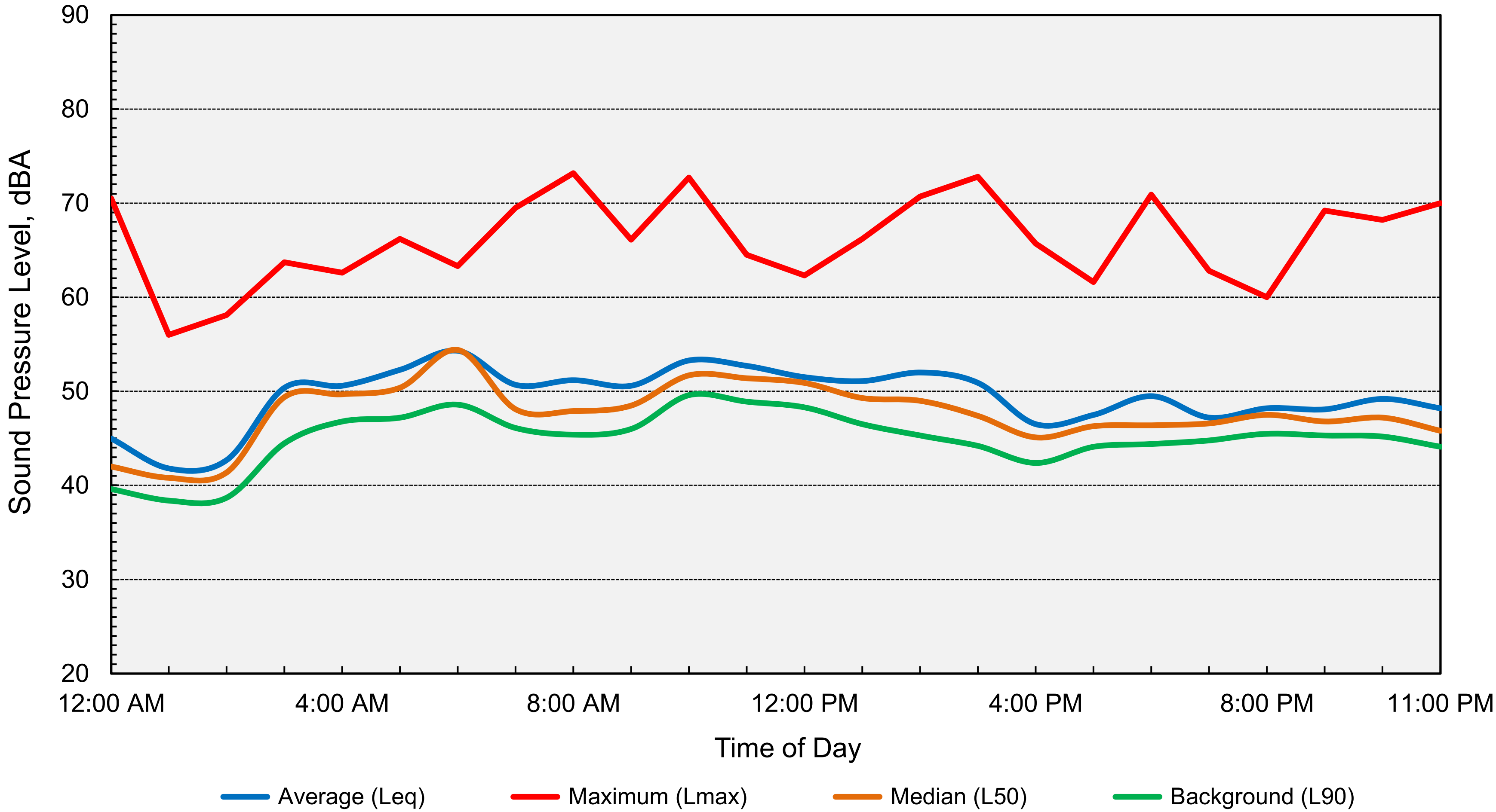
Appendix D-9
Ambient Noise Monitoring Results - Site LT-3
Lincoln Square Mixed-Use Development - Dixon, California
Thursday, June 10, 2021



Computed DNL = 56 dB

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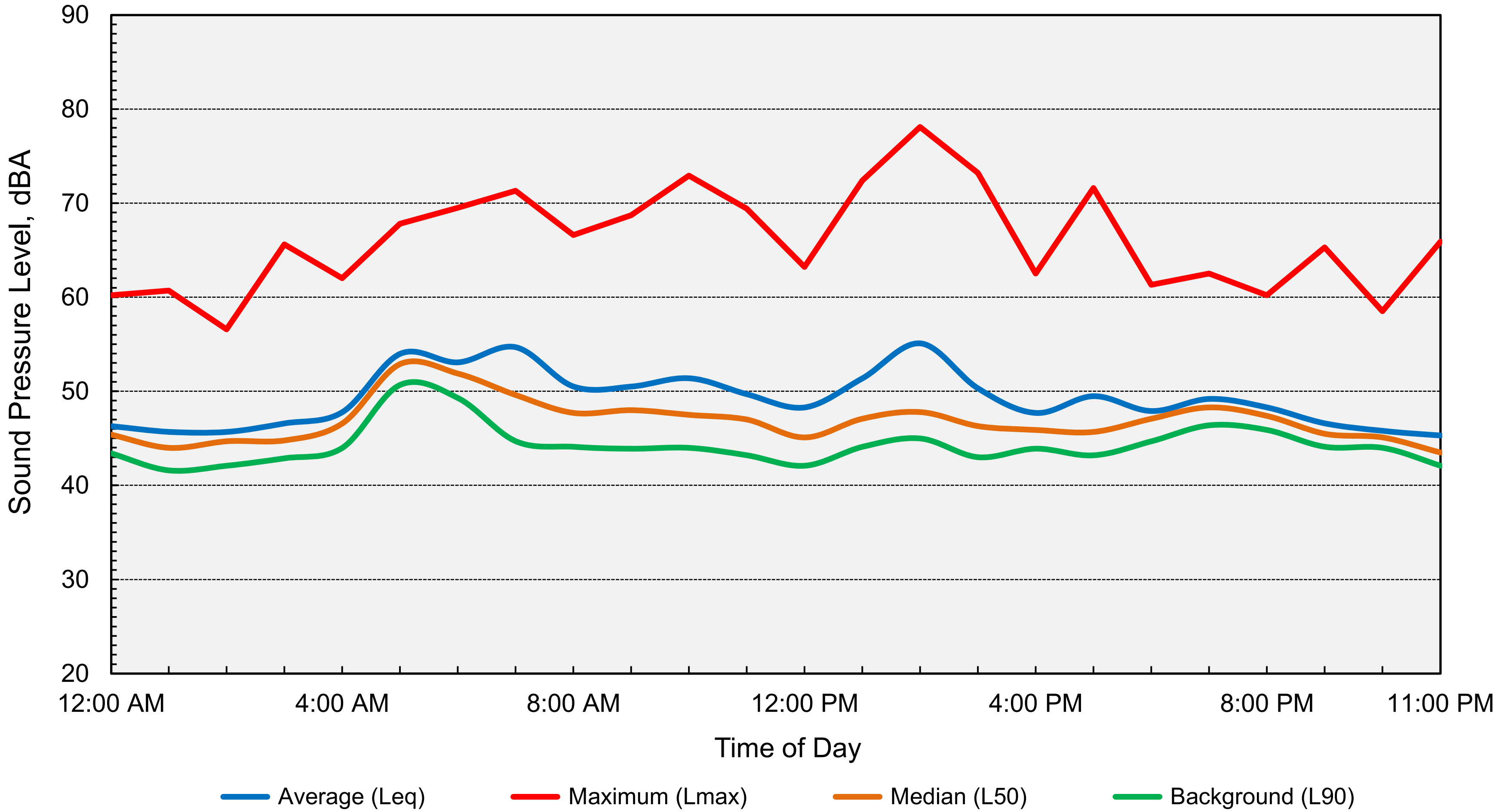
Appendix D-10
Ambient Noise Monitoring Results - Site LT-3
Lincoln Square Mixed-Use Development - Dixon, California
Friday, June 11, 2021



Computed DNL = 56 dB

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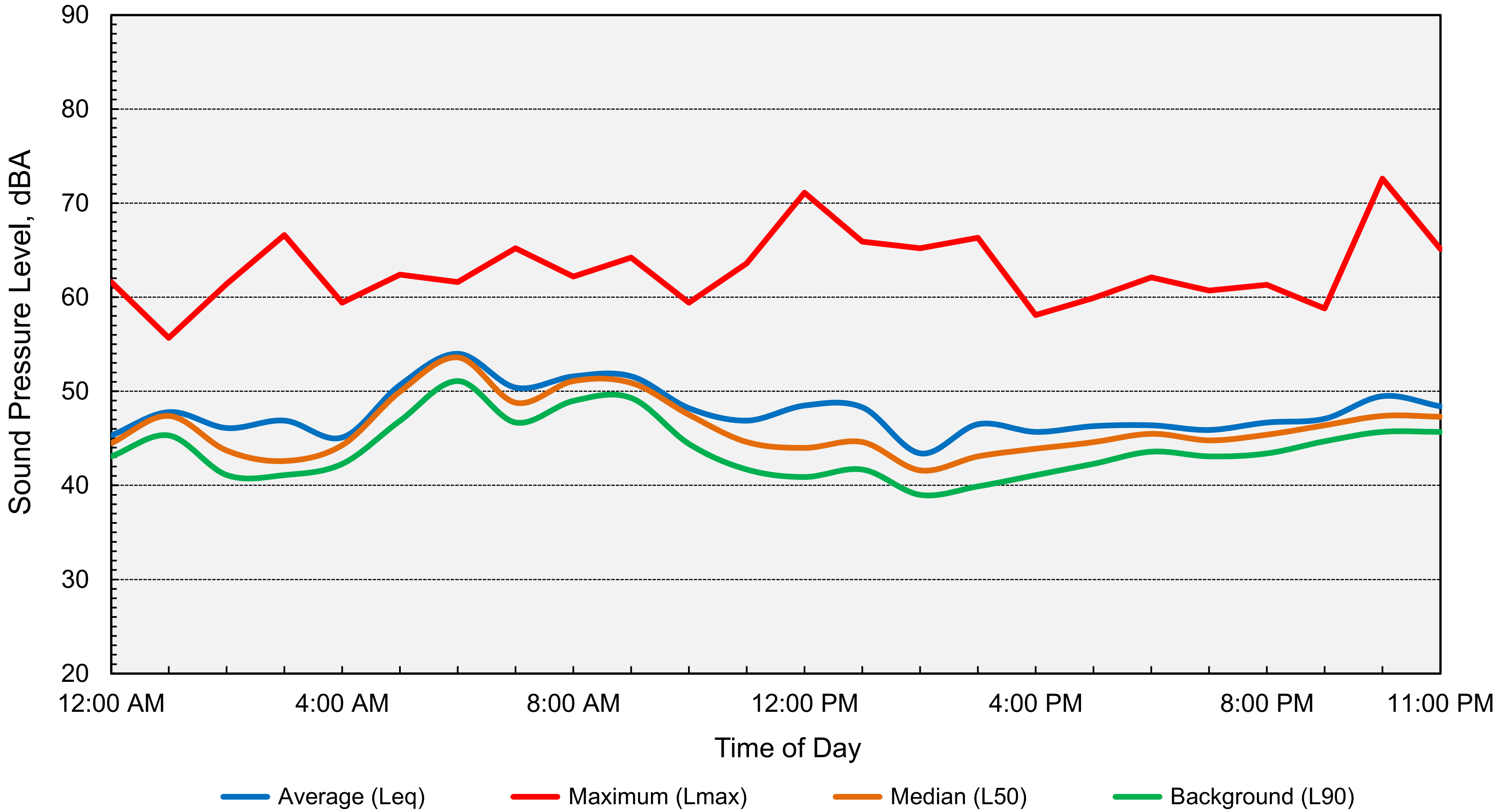
Appendix D-11
Ambient Noise Monitoring Results - Site LT-3
Lincoln Square Mixed-Use Development - Dixon, California
Saturday, June 12, 2021



Computed DNL = 55 dB

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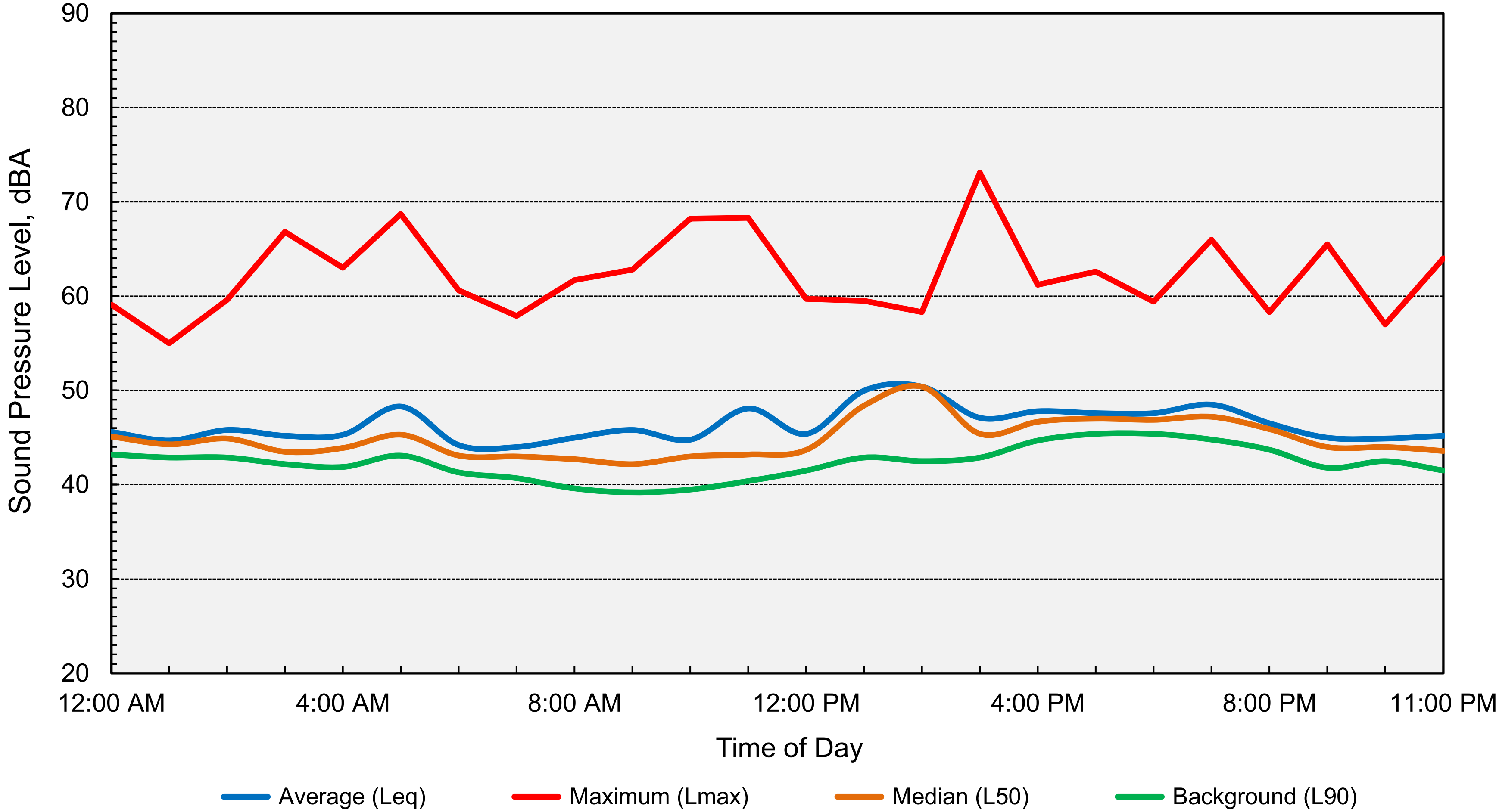
Appendix D-12
Ambient Noise Monitoring Results - Site LT-3
Lincoln Square Mixed-Use Development - Dixon, California
Sunday, June 13, 2021



Computed DNL = 52 dB

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

Project Information:

Job Number: 2021-107
Project Name: Lincoln Square Mixed-Use Development
Roadway Name: SR-113

Traffic Data:

Description: Existing
Average Daily Traffic Volume: 11,700
Percent Daytime Traffic: 83
Percent Nighttime Traffic: 17
Percent Medium Trucks (2 axle): 4
Percent Heavy Trucks (3+ axle): 4
Assumed Vehicle Speed (mph): 45
Intervening Ground Type (hard/soft): **Soft**

Traffic Noise Levels:

				DNL (dB)			
Location	**Description**	**Distance**	**Offset (dB)**	**Autos**	**Medium Trucks**	**Heavy Trucks**	**Total**
1	Existing traffic on SR-113	50	0	67	61	66	70

Traffic Noise Contours (No Calibration Offset):

DNL Contour (dB)	Distance from Centerline (ft)
75	23
70	50
65	108
60	232

Notes: 1. Existing (2019) ADT for SR-113 obtained from published Caltrans traffic counts (SR-113 from North Adams Street to I-80).

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

Project Information:

Job Number: 2021-107
Project Name: Lincoln Square Mixed-Use Development
Roadway Name: SR-113

Traffic Data:

Description: Existing
Average Daily Traffic Volume: 6,531
Percent Daytime Traffic: 83
Percent Nighttime Traffic: 17
Percent Medium Trucks (2 axle): 2
Percent Heavy Trucks (3+ axle): 2
Assumed Vehicle Speed (mph): 35
Intervening Ground Type (hard/soft): **Soft**

Traffic Noise Levels:

				----------------- DNL (dB) ------------------			
Location	**Description**	**Distance**	**Offset (dB)**	**Autos**	**Medium Trucks**	**Heavy Trucks**	**Total**
1	Existing traffic on Vaughn Rd	50	0	61	54	59	64

Traffic Noise Contours (No Calibration Offset):

DNL Contour (dB)	Distance from Centerline (ft)
75	9
70	20
65	42
60	91

Notes: 1. Existing (2021) ADT for Vaughn Road estimated from 2007 City of Dixon traffic counts (Vaughn Road from SR-113 to Regency Parkway). Specifically, existing (2021) ADT for the roadway was estimated by applying a factor of 50% to 2007 traffic count data to account for regional growth.

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Appendix E-3
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Prediction Worksheet

Project Information:

Job Number: 2021-107
Project Name: Lincoln Square Mixed-Use Development
Roadway Name: SR-113

Traffic Data:

Description: Project - Residential Component
Average Daily Traffic Volume: 524
Percent Daytime Traffic: 83
Percent Nighttime Traffic: 17
Percent Medium Trucks (2 axle): 1
Percent Heavy Trucks (3+ axle): 1
Assumed Vehicle Speed (mph): 45
Intervening Ground Type (hard/soft): **Soft**

Traffic Noise Levels:

				---------------- DNL (dB) ----------------			
Location	**Description**	**Distance**	**Offset (dB)**	**Autos**	**Medium Trucks**	**Heavy Trucks**	**Total**
1	Project residential traffic on SR-113	50	0	54	42	46	55

Traffic Noise Contours (No Calibration Offset):

DNL Contour (dB)	Distance from Centerline (ft)
75	2
70	5
65	10
60	22

Notes: 1. Project-generated off-site average daily traffic volume (vehicle trips per day) was obtained from the project applicant.

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Appendix E-4
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Prediction Worksheet

Project Information:

Job Number:	2021-107
Project Name:	Lincoln Square Mixed-Use Development
Roadway Name:	SR-113

Traffic Data:

Description:	Project - Retail Component
Average Daily Traffic Volume:	1,294
Percent Daytime Traffic:	83
Percent Nighttime Traffic:	17
Percent Medium Trucks (2 axle):	2
Percent Heavy Trucks (3+ axle):	1
Assumed Vehicle Speed (mph):	45
Intervening Ground Type (hard/soft):	**Soft**

Traffic Noise Levels:

				----------------- DNL (dB) ------------------			
Location	**Description**	**Distance**	**Offset (dB)**	**Autos**	**Medium Trucks**	**Heavy Trucks**	**Total**
1	Project retail traffic on SR-113	50	0	57	49	50	59

Traffic Noise Contours (No Calibration Offset):

DNL Contour (dB)	Distance from Centerline (ft)
75	4
70	9
65	19
60	41

Notes: 1. Project-generated off-site average daily traffic volume (vehicle trips per day) was obtained from the project applicant.

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Appendix E-5
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Prediction Worksheet

Project Information:

Job Number:	2021-107
Project Name:	Lincoln Square Mixed-Use Development
Roadway Name:	Vaughn Road

Traffic Data:

Description:	Project - Residential Component
Average Daily Traffic Volume:	524
Percent Daytime Traffic:	83
Percent Nighttime Traffic:	17
Percent Medium Trucks (2 axle):	1
Percent Heavy Trucks (3+ axle):	1
Assumed Vehicle Speed (mph):	35
Intervening Ground Type (hard/soft):	**Soft**

Traffic Noise Levels:

				----------------- DNL (dB) ------------------			
Location	**Description**	**Distance**	**Offset (dB)**	**Autos**	**Medium Trucks**	**Heavy Trucks**	**Total**
1	Project residential traffic on Vaughn	50	0	50	40	45	52

Traffic Noise Contours (No Calibration Offset):

DNL Contour (dB)	Distance from Centerline (ft)
75	1
70	3
65	7
60	14

Notes: 1. Project-generated off-site average daily traffic volume (vehicle trips per day) was obtained from the project applicant.

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Appendix E-6
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Prediction Worksheet

Project Information:

Job Number:	2021-107
Project Name:	Lincoln Square Mixed-Use Development
Roadway Name:	Vaughn Road

Traffic Data:

Description:	Project - Retail Component
Average Daily Traffic Volume:	1,294
Percent Daytime Traffic:	83
Percent Nighttime Traffic:	17
Percent Medium Trucks (2 axle):	2
Percent Heavy Trucks (3+ axle):	1
Assumed Vehicle Speed (mph):	35
Intervening Ground Type (hard/soft):	**Soft**

Traffic Noise Levels:

				----------------- DNL (dB) ------------------			
Location	**Description**	**Distance**	**Offset (dB)**	**Autos**	**Medium Trucks**	**Heavy Trucks**	**Total**
1	Project retail traffic on Vaughn	50	0	54	47	49	56

Traffic Noise Contours (No Calibration Offset):

DNL Contour (dB)	Distance from Centerline (ft)
75	3
70	6
65	13
60	27

Notes: 1. Project-generated off-site average daily traffic volume (vehicle trips per day) was obtained from the project applicant.

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Appendix F

Industrial Vacuum Systems
VacLovers, Inc.

3975 Linden Ave SE
Grand Rapids MI 49548
1-800-968-8227 or 1-616-246-1700

Sound Level Ratings for IVS Power Vacuums and Combination Units

Distance from Unit	dBA	Ametek Lamb Motor model	IVS Unit model	Dome Type

Before the below units were tested the ambient noise levels from street traffic were taken without the machine running which measured 65dBA

Acustek® Technology

the science of sound

Combination units with Poly Domes and Amtek Acustek motors part number 116757

10 feet	75 dBA	Acustek	Combination	Poly Dome
20 feet	68.97 dBA	Acustek	Combination	Poly Dome
30 feet	65.45 dBA	Acustek	Combination	Poly Dome
40 feet	62.95 dBA	Acustek	Combination	Poly Dome
50 feet	61.02 dBA	Acustek	Combination	Poly Dome
100 feet	55.01 dBA	Acustek	Combination	Poly Dome
125 feet	53.06 dBA	Acustek	Combination	Poly Dome
150 feet	51.47 dBA	Acustek	Combination	Poly Dome

Power Vac with Lamb motor 116336-01 and Stainless Steel dome

10 feet	84.9	116336-01	Power Vacuum	S.S. Dome
20 feet	81.4	116336-01	Power Vacuum	S.S. Dome
30 feet	78.9	116336-01	Power Vacuum	S.S. Dome
40 feet	77	116336-01	Power Vacuum	S.S. Dome
50 feet	75.4	116336-01	Power Vacuum	S.S. Dome
100 feet	70	116336-01	Power Vacuum	S.S. Dome
125 feet	69	116336-01	Power Vacuum	S.S. Dome
150 feet	66.9	116336-01	Power Vacuum	S.S. Dome

The following are sound comparisons found in routine dBA tests:

Jet Airplane 160 dBA
Helicopter 150 dBA
Fire Siren 140 dBA
School Dance 120 dBA
Airport 110 dBA
Heavy Traffic 90 dBA
Normal Conversation 60 dBA
Quiet Neighborhood 55 dBA
Humming 30 dBA
Whisper Voice 20 dBA

Acustek Technology is available from Amtek Lamb Inc.®

ph#216-673-3451

Appendix G

INTERNATIONAL DRYING
CORPORATION

SOUND LEVEL READINGS FOR 3 MOTOR WHISPER PACKAGE

The following readings were taken from a masonry car wash building using A-weighted decibels. The car wash building measures 70'5" end to end. Measurements were taken with overhead doors fully opened. Sound levels may vary with conditions.

Distance	Sound Level A-weighted slow response (dBA)
Exit	87
5'	84
10'	80
20'	75
30'	71
65'	65

Distance	Sound Level A-weighted slow response (dBA)
Entrance	80
5'	76
10'	72
20'	68
30'	65
47'	61

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

Project Information:

Job Number: 2021-107
Project Name: Lincoln Square Mixed-Use Development
Roadway Name: SR-113

Traffic Data:

Description: Future
Average Daily Traffic Volume: 17,550
Percent Daytime Traffic: 83
Percent Nighttime Traffic: 17
Percent Medium Trucks (2 axle): 4
Percent Heavy Trucks (3+ axle): 4
Assumed Vehicle Speed (mph): 45
Intervening Ground Type (hard/soft): **Soft**

Traffic Noise Levels:

				---------------- DNL (dB) -----------------			
Location	**Description**	**Distance**	**Offset (dB)**	**Autos**	**Medium Trucks**	**Heavy Trucks**	**Total**
1	Nearest outdoor activity areas	85	-3	62	57	61	65
2	Nearest first-floor building facades	70		66	61	65	70
3	Nearest upper-floor building facades	70	2	68	63	67	72

Traffic Noise Contours (No Calibration Offset):

DNL Contour (dB)	Distance from Centerline (ft)
75	30
70	66
65	141
60	305

Notes: 1. Future ADT was conservatively estimated by increasing the existing ADT volume for SR-113 adjacent to the site by 50%. Existing (2019) ADT volume obtained from Caltrans traffic counts (11,700 ADT).
2. A -3 dB offset was applied at backyards to account for a reduced view of the roadway resulting from proposed intervening structures (residences). An offset of +2 dB offset was applied at upper-floors to account for reduced ground absorption of sound at elevated locations.

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

Project Information:

Job Number: 2021-107
Project Name: Lincoln Square Mixed-Use Development
Roadway Name: Vaughn Road

Traffic Data:

Description: Future
Average Daily Traffic Volume: 13,062
Percent Daytime Traffic: 83
Percent Nighttime Traffic: 17
Percent Medium Trucks (2 axle): 2
Percent Heavy Trucks (3+ axle): 2
Assumed Vehicle Speed (mph): 35
Intervening Ground Type (hard/soft): **Soft**

Traffic Noise Levels:

				----------------- DNL (dB) ------------------			
Location	**Description**	**Distance**	**Offset (dB)**	**Autos**	**Medium Trucks**	**Heavy Trucks**	**Total**
1	Nearest outdoor activity areas	85	-3	58	51	56	61
2	Nearest first-floor building facades	75		62	55	60	64
3	Nearest upper-floor building facades	75	2	64	57	62	66

Traffic Noise Contours (No Calibration Offset):

DNL Contour (dB)	**Distance from Centerline (ft)**
75	15
70	32
65	68
60	147

Notes:
1. Future ADT for Vaughn Road was conservatively estimated by assuming an increase in traffic by a factor of 3 relative to 2007 traffic data reported by the City of Dixon (2007 - 4,354 ADT).
2. A -3 dB offset was applied at backyards to account for a reduced view of the roadway resulting from roposed intervening structures (residences). An offset of +2 dB offset was applied at upper-floors to account for reduced ground absorption of sound at elevated locations.

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Appendix I-1
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2021-107
Project Name: Lincoln Square Mixed-Use Development
Roadway Name: SR-113

Noise Level Data:

Year: Future
Auto DNL (dB): 62
Medium Truck DNL (dB): 57
Heavy Truck DNL (dB): 61

Site Geometry:

Receiver Description: Nearest outdoor activity areas
Centerline to Barrier Distance (C_1): 65
Barrier to Receiver Distance (C_2): 15
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?	Barrier Breaks Line of Sight to… Medium Trucks?	Barrier Breaks Line of Sight to… Heavy Trucks?
6	6	56	51	56	**60**	Yes	Yes	Yes
7	7	54	49	55	**58**	Yes	Yes	Yes
8	8	53	48	54	**57**	Yes	Yes	Yes
9	9	52	47	53	**56**	Yes	Yes	Yes
10	10	51	46	52	**55**	Yes	Yes	Yes
11	11	50	45	51	**54**	Yes	Yes	Yes
12	12	49	44	50	**53**	Yes	Yes	Yes
13	13	48	43	49	**52**	Yes	Yes	Yes
14	14	48	43	48	**52**	Yes	Yes	Yes

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

Appendix I-2
FHWA Traffic Noise Prediction Model (FHWA-RD-77-108)
Noise Barrier Effectiveness Prediction Worksheet

Project Information:

Job Number: 2021-107
Project Name: Lincoln Square Mixed-Use Development
Roadway Name: Vaughn Road

Noise Level Data:

Year: Future
Auto DNL (dB): 58
Medium Truck DNL (dB): 51
Heavy Truck DNL (dB): 56

Site Geometry:

Receiver Description: Nearest outdoor activity areas
Centerline to Barrier Distance (C_1): 75
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:

		-------------------- DNL (dB) --------------------				Barrier Breaks Line of Sight to…		
Top of Barrier Elevation (ft)	**Barrier Height (ft)**	**Autos**	**Medium Trucks**	**Heavy Trucks**	**Total**	**Autos?**	**Medium Trucks?**	**Heavy Trucks?**
6	6	52	45	51	**55**	Yes	Yes	Yes
7	7	50	43	50	**53**	Yes	Yes	Yes
8	8	49	42	48	**52**	Yes	Yes	Yes
9	9	48	40	47	**51**	Yes	Yes	Yes
10	10	47	39	45	**49**	Yes	Yes	Yes
11	11	45	38	44	**48**	Yes	Yes	Yes
12	12	45	37	43	**47**	Yes	Yes	Yes
13	13	44	37	43	**47**	Yes	Yes	Yes
14	14	43	36	42	**46**	Yes	Yes	Yes

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