Appendix I – Noise Impact Analysis

TERRACINA AT REDLANDS (TTM 20320) NOISE IMPACT ANALYSIS

City of Redlands

August 31, 2021

ganddini

Traffic Engineering ● Transportation Planning ● Parking ● Noise & Vibration
Air Quality ● Global Climate Change ● Health Risk Assessment

TERRACINA AT REDLANDS (TTM 20320)
NOISE IMPACT ANALYSIS

City of Redlands

August 31, 2021

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Project No. 19-0208

TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

The approximately 64.56-acre project site is located north of Reservoir Road adjacent to Wabash Avenue in the City of Redlands. The project site is currently vacant.

The proposed project involves construction of 67 single-family detached residential dwelling units.

Construction Impacts

Modeled unmitigated construction noise levels are expected to range between 44.7 dBA L_{eq} and 72.3 dBA L_{eq} at the nearest existing residential property lines surrounding the project site.

The City's Municipal Code Section 8.06.120 (G) and 8.06090 limit the hours of construction to between the hours of 7:00 AM and 6:00 PM, including Saturdays, with no activities taking place at any time on Sundays or federal holidays. Per the EIR prepared for the City of Redlands General Plan (2019), a substantial temporary increase in ambient noise levels from construction noise would be considered less than significant if construction activities comply with the City's Noise Control Ordinance in the Municipal Code, Section 8.06.090.

Project construction activities are expected to comply with the above allowed hours. Impacts related to construction noise will be minimized further with implementation of the recommended measures presented in Section 7 of this report. Impacts would be less than significant.

Noise Impacts to Off-Site Receptors Due to Project Generated Trips

The City's General Plan 2035 identifies a potentially substantial increase as either an increase of four or more dB, if the resulting noise level would exceed the clearly compatible standards, or any increase of 6 dB. To determine if project traffic would result in a substantial increase in ambient noise levels, noise associated with project generated vehicle trips were modeled for the existing and existing plus project conditions utilizing FHWA Traffic Noise Prediction Model FHWA-RD-77-108 methodology. Project generated vehicle trips are anticipated to increase roadway noise between approximately 0.05 to 3.52 dBA CNEL. Therefore, a change in noise level would not be audible and would be considered less than significant.

Transportation Noise Impacts to the Proposed Project

Future traffic noise levels from the Interstate 10 and Wabash Avenue on the project site will range between 55 and 74 dBA CNEL at first floor levels and between 60 and 75 at second story levels without mitigation and will exceed the City's "clearly compatible" standard of 60 dBA CNEL and would fall into the City's "normally incompatible" criteria.

With construction of six to fifteen-foot barriers along the southern boundaries of the southernmost lots and those lot lines that lie adjacent to Wabash Avenu, future noise levels are expected to range between 54 and 60 dBA CNEL at first floor levels and between 57 and 68 dBA CNEL at second story levels. Therefore, mitigation in the form of barriers ranging between six to fifteen-feet along southern lot lines and lot lines adjacent to Wabash Avenue (see Figure 8) will reduce exterior noise levels at first-story levels to below the 60 dBA CNEL compatibility criteria.

With construction of only six-foot barriers along the southern boundaries of the southernmost lots, future noise levels are expected to range between 55 and 64 dBA CNEL at first floor levels and between 60 and 71 dBA CNEL at second story levels. With six-foot barriers, future traffic generated exterior noise levels would still exceed the City's "clearly compatible" standard but would not exceed 65 dBA CNEL which is the level at which, if exceeded, upgraded windows are necessary to achieve acceptable interior noise levels.

Future noise levels at second floor levels would exceed the City's "clearly compatible" criteria of 60 dBA CNEL and 65 dBA CNEL. It will be necessary to install upgraded second story windows and sliding glass doors in homes along the southern boundary of the site and that lie adjacent to Wabash Avenue to ensure that interior noise levels of 45 dBA CNEL are achieved. It is recommended that the noise study is updated at which time final grading plans are available to make sure that the necessary STC levels are required. Normal conversation is typically 65 dBA CNEL.

Groundborne Vibration Impacts

Existing surrounding residential structures are located as close as approximately 10 feet from the project site boundaries. Perceptibility of construction vibration would be temporary and would only occur while vibratory equipment is utilized within 150 feet of the existing structures. Further, use of a vibratory roller within 20 feet or a large bulldozer within 12 feet of existing structures could cause architectural damage. A mitigation measure prohibiting the use of a vibratory rollers within 20 feet or a large bulldozer within 12 feet of existing structures has been added to Section 7 of this report. With incorporation of mitigation, temporary vibration levels associated with project construction would be less than significant.

Construction Noise Recommended Reduction Measures

In addition to adherence to the City of Redlands Municipal Code, which limits the construction hours of operation and requires all motorized equipment to be equipped with functioning mufflers, the following measures are recommended to reduce construction noise and vibrations, emanating from the proposed project:

1. During all project site excavation and grading on-site, construction contractors shall equip all construction equipment, fixed or mobile, with properly operating and maintained mufflers, consistent with manufacturer standards.

2. The contractor shall place all stationary construction equipment so that emitted noise is directed away from the noise sensitive receptors nearest the project site.

3. Equipment shall be shut off and not left to idle when not in use.

4. The contractor shall locate equipment staging in areas that will create the greatest distance between construction-related noise/vibration sources and sensitive receptors nearest the project site during all project construction.

5. Jackhammers, pneumatic equipment and all other portable stationary noise sources shall be shielded and noise shall be directed away from sensitive receptors.

Vibration Mitigation Measures

1. The use of vibratory rollers, or other similar vibratory equipment, within 20 feet or a large bulldozer within 12 feet of existing structures at 1760 Camelot Drive (to the north of the project site) and 731 Buckingham Drive (located to the west of the project site) is prohibited.

Operational Mitigation Measures

1. Barriers ranging between six and fifteen-feet along southern lot lines and lot lines adjacent to Wabash Avenue shall be constructed as shown on Figure 10. The barriers shall reach the ground surface and be solid with no holes or cracks.

2. At the time final grading is completed, prepare a final noise study to verify barrier mitigation and determine needed STC rating.

1. INTRODUCTION

This section describes the purpose of this noise impact analysis, project location, proposed development, and study area. Figure 1 shows the project location map and Figure 2 illustrates the project site plan.

PURPOSE AND OBJECTIVES

The purpose of this report is to provide an assessment of the noise impacts resulting from development of the proposed Terracina at Redlands (TTM 20320) project and to identify mitigation measures that may be necessary to reduce those impacts. The noise issues related to the proposed land use and development have been evaluated in light of applicable federal, state and local policies, including those of the City of Redlands.

Although this is a technical report, every effort has been made to write the report clearly and concisely. To assist the reader with those terms unique to noise analysis, a list of acronyms and a glossary of terms have been provided in Appendix A and Appendix B of this report, respectively.

PROJECT LOCATION

The approximately 64.56-acre project site is located north of Reservoir Road adjacent to Wabash Avenue in the City of Redlands. The project site is currently vacant. A vicinity map showing the project location is provided on Figure 1.

PROJECT DESCRIPTION

The proposed project involves construction of 67 single-family detached residential dwelling units. Figure 2 illustrates the project site plan.

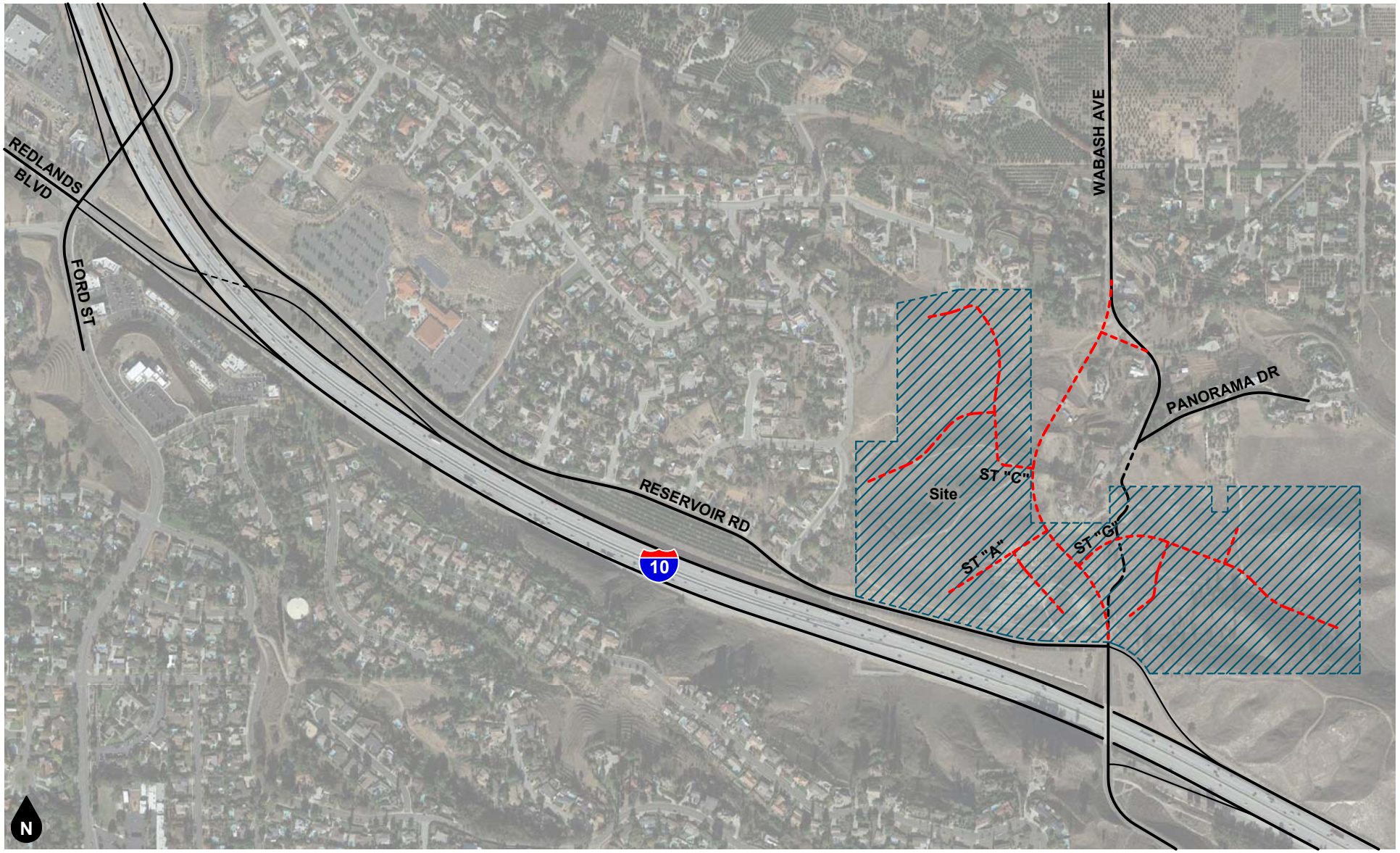


Figure 1
Project Location Map

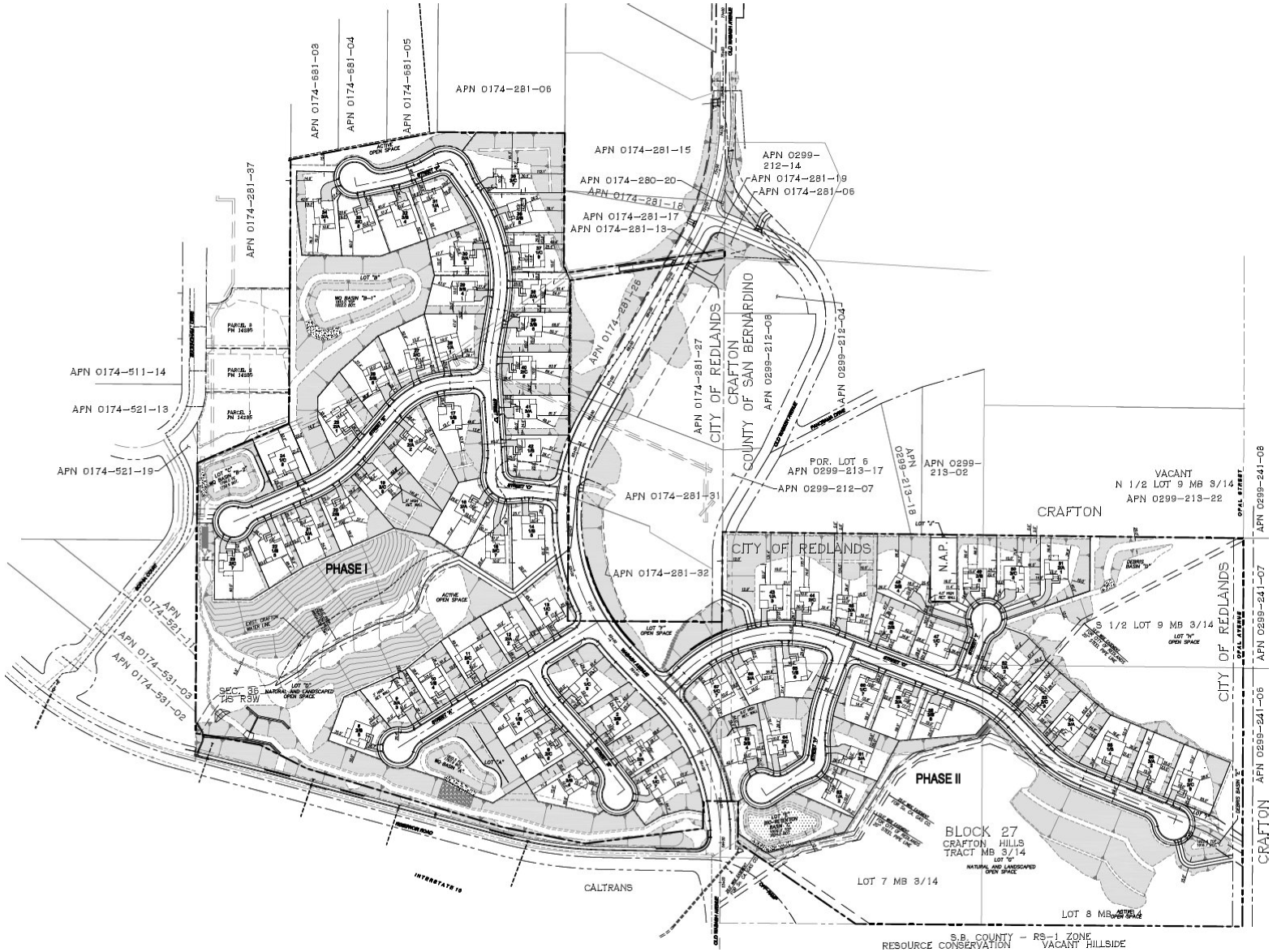


Figure 2
Site Plan

2. NOISE AND VIBRATION FUNDAMENTALS

NOISE FUNDAMENTALS

Sound is a pressure wave created by a moving or vibrating source that travels through an elastic medium such as air. Noise is defined as unwanted or objectionable sound. The effects of noise on people can include general annoyance, interference with speech communication, sleep disturbance, and in extreme circumstances, hearing impairment.

Commonly used noise terms are presented in Appendix B. The unit of measurement used to describe a noise level is the decibel (dB). The human ear is not equally sensitive to all frequencies within the sound spectrum. Therefore, the "A-weighted" noise scale, which weights the frequencies to which humans are sensitive, is used for measurements. Noise levels using A-weighted measurements are written dB(A) or dBA.

From the noise source to the receiver, noise changes both in level and frequency spectrum. The most obvious is the decrease in noise as the distance from the source increases. The manner in which noise reduces with distance depends on whether the source is a point or line source as well as ground absorption, atmospheric effects and refraction, and shielding by natural and manmade features. Sound from point sources, such as air conditioning condensers, radiates uniformly outward as it travels away from the source in a spherical pattern. The noise drop-off rate associated with this geometric spreading is 6 dBA per each doubling of the distance (dBA/DD). Transportation noise sources such as roadways are typically analyzed as line sources, since at any given moment the receiver may be impacted by noise from multiple vehicles at various locations along the roadway. Because of the geometry of a line source, the noise drop-off rate associated with the geometric spreading of a line source is 3 dBA/DD.

Decibels are measured on a logarithmic scale, which quantifies sound intensity in a manner similar to the Richter scale used for earthquake magnitudes. Thus, a doubling of the energy of a noise source, such as a doubled traffic volume, would increase the noise levels by 3 dBA; halving of the energy would result in a 3 dBA decrease. Figure 3 shows the relationship of various noise levels to commonly experienced noise events.

Average noise levels over a period of minutes or hours are usually expressed as dBA L_{eq}, or the equivalent noise level for that period of time. For example, $L_{eq(3\text{-}hr)}$ would represent a 3-hour average. When no period is specified, a one-hour average is assumed.

Noise standards for land use compatibility are stated in terms of the Community Noise Equivalent Level (CNEL) and the Day-Night Average Noise Level (DNL). CNEL is a 24-hour weighted average measure of community noise. CNEL is obtained by adding five decibels to sound levels in the evening (7:00 PM to 10:00 PM), and by adding ten decibels to sound levels at night (10:00 PM to 7:00 AM). This weighting accounts for the increased human sensitivity to noise during the evening and nighttime hours. DNL is a very similar 24-hour average measure that weights only the nighttime hours.

It is widely accepted that the average healthy ear can barely perceive changes of 3 dBA; that a change of 5 dBA is readily perceptible, and that an increase (decrease) of 10 dBA sounds twice (half) as loud. This definition is recommended by the California Department of Transportation's Technical Noise Supplement to the Traffic Noise Analysis Protocol (2013).

VIBRATION FUNDAMENTALS

The way in which vibration is transmitted through the earth is called propagation. Propagation of earthborn vibrations is complicated and difficult to predict because of the endless variations in the soil through which waves travel. There are three main types of vibration propagation: surface, compression and shear waves. Surface waves, or Rayleigh waves, travel along the ground's surface. These waves carry most of their energy along an expanding circular wave front, similar to ripples produced by throwing a rock into a pool of water.

Compression waves, or P-waves, are body waves that carry their energy along an expanding spherical wave front. The particle motion in these waves is longitudinal (i.e., in a "push-pull" fashion). P-waves are analogous to airborne sound waves. Shear waves, or S-waves, are also body waves that carry energy along an expanding spherical wave front. However, unlike P-waves, the particle motion is transverse or "side-to-side and perpendicular to the direction of propagation".

As vibration waves propagate from a source, the energy is spread over an ever-increasing area such that the energy level striking a given point is reduced with the distance from the energy source. This geometric spreading loss is inversely proportional to the square of the distance. Wave energy is also reduced with distance as a result of material damping in the form of internal friction, soil layering, and void spaces. The amount of attenuation provided by material damping varies with soil type and condition as well as the frequency of the wave.

Vibration amplitudes are usually expressed as either peak particle velocity (PPV) or the root mean square (RMS) velocity. The PPV is defined as the maximum instantaneous peak of the vibration signal in inches per second. The RMS of a signal is the average of the squared amplitude of the signal in vibration decibels (VdB), ref one micro-inch per second. The Federal Railroad Administration uses the abbreviation "VdB" for vibration decibels to reduce the potential for confusion with sound decibel.

PPV is appropriate for evaluating the potential of building damage and VdB is commonly used to evaluate human response. Decibel notation acts to compress the range of numbers required in measuring vibration. Similar to the noise descriptors, L_{eq} and L_{max} can be used to describe the average vibration and the maximum vibration level observed during a single vibration measurement interval. Figure 4 illustrates common vibration sources and the human and structural responses to ground-borne vibration. As shown in the figure, the threshold of perception for human response is approximately 65 VdB; however, human response to vibration is not usually substantial unless the vibration exceeds 70 VdB. Vibration tolerance limits for sensitive instruments such as magnetic resonance imaging (MRI) or electron microscopes could be much lower than the human vibration perception threshold.

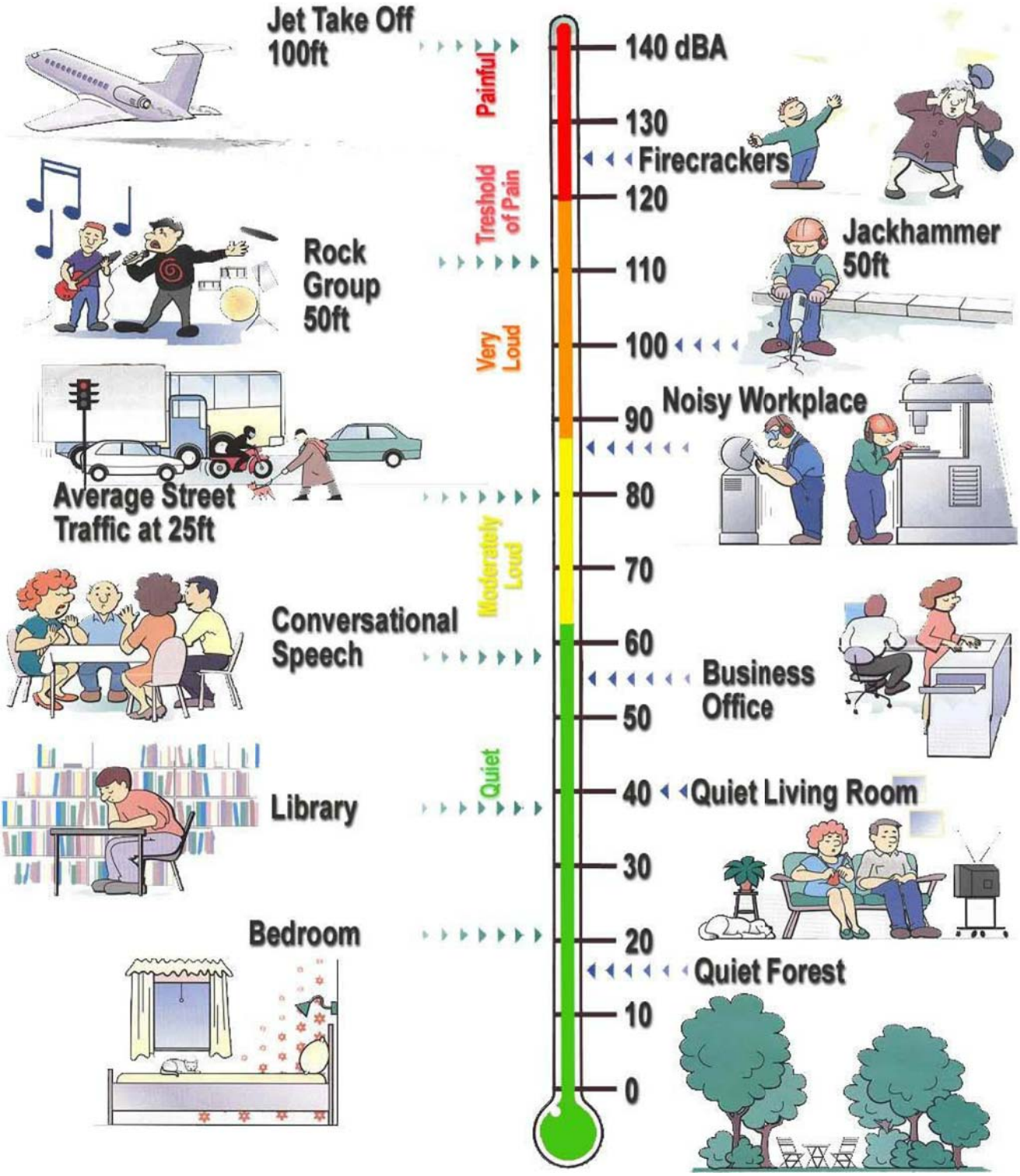
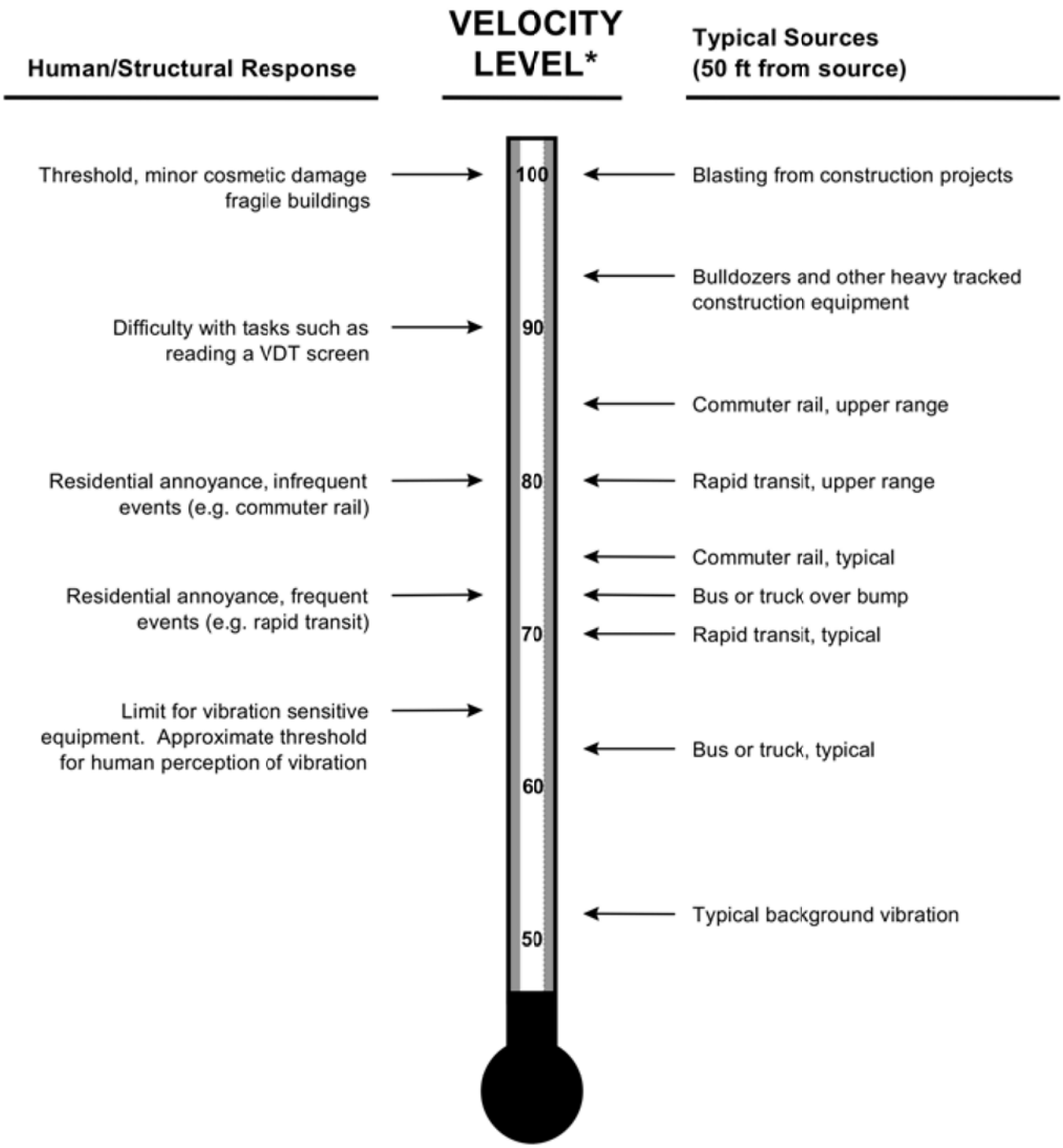


Figure 3
Weighted Sound Levels of Common Activities

Source: Bruel & Kjaer 2001



** RMS Vibration Velocity Level in dB relative to 10 $^{-6}$ inches/second*

Source: FRA, 2012. Federal Railroad Administration High-Speed Ground Transportation Noise and Vibration Impact Assessment. Office of Railroad Policy Development, Washington, D.C. DOT/FRA/ORD-12/15. September.

Figure 4
Typical Levels of Groundborne Vibration

3. EXISTING NOISE ENVIRONMENT

EXISTING LAND USES AND SENSITIVE RECEPTORS

The project site is bordered by single-family residential uses, Sophia Court, and Buckingham Drive to the west; single-family residential uses to the north; Reservoir Road and vacant land to the south; and vacant land to the east.

The State of California defines sensitive receptors as those land uses that require serenity or are otherwise adversely affected by noise events or conditions. Schools, libraries, churches, hospitals, single and multiple-family residential, including transient lodging, motels and hotel uses make up the majority of these areas.

Sensitive land uses that may be affected by project noise include the single-family detached residential dwelling surrounding the project site.

AMBIENT NOISE MEASUREMENTS

An American National Standards Institute (ANSI Section SI4 2013 Class 1) Larson Davis model LxT sound level meter was used to document existing ambient noise levels. In order to document existing ambient noise levels in the project area, five (5) 15-minute daytime noise measurements were taken between 12:10 PM and 3:09 PM on November 22, 2019. Field worksheets and noise measurement output data are included in Appendix C.

As shown on Figure 5, the noise measurements were taken near the residential uses located along Sophia Court (NM1), to the west of the project site near the residential uses located along Buckingham Drive (NM2), to the northwest of the project site near the residential uses located along Daisy Avenue (NM3), to the northeast of the project site near the residential uses located along Panorama Drive (NM4), and west of Wabash Road near residential uses (NM5). Interstate 10 freeway, Reservoir Road, and Buckingham Drive, barking dog, residential activities (i.e., gardeners, leaf blowers, and lawn mowers), and bird song.

Table 1 provides a summary of the short-term ambient noise data. Short-term ambient noise levels were measured between 45.2 and 65.7 dBA L_{eq}. The dominant noise sources were from vehicles traveling along Interstate 10 freeway, Reservoir Road, and Buckingham Drive, barking dog, residential activities (i.e., gardeners, leaf blowers, and lawn mowers), and bird song.

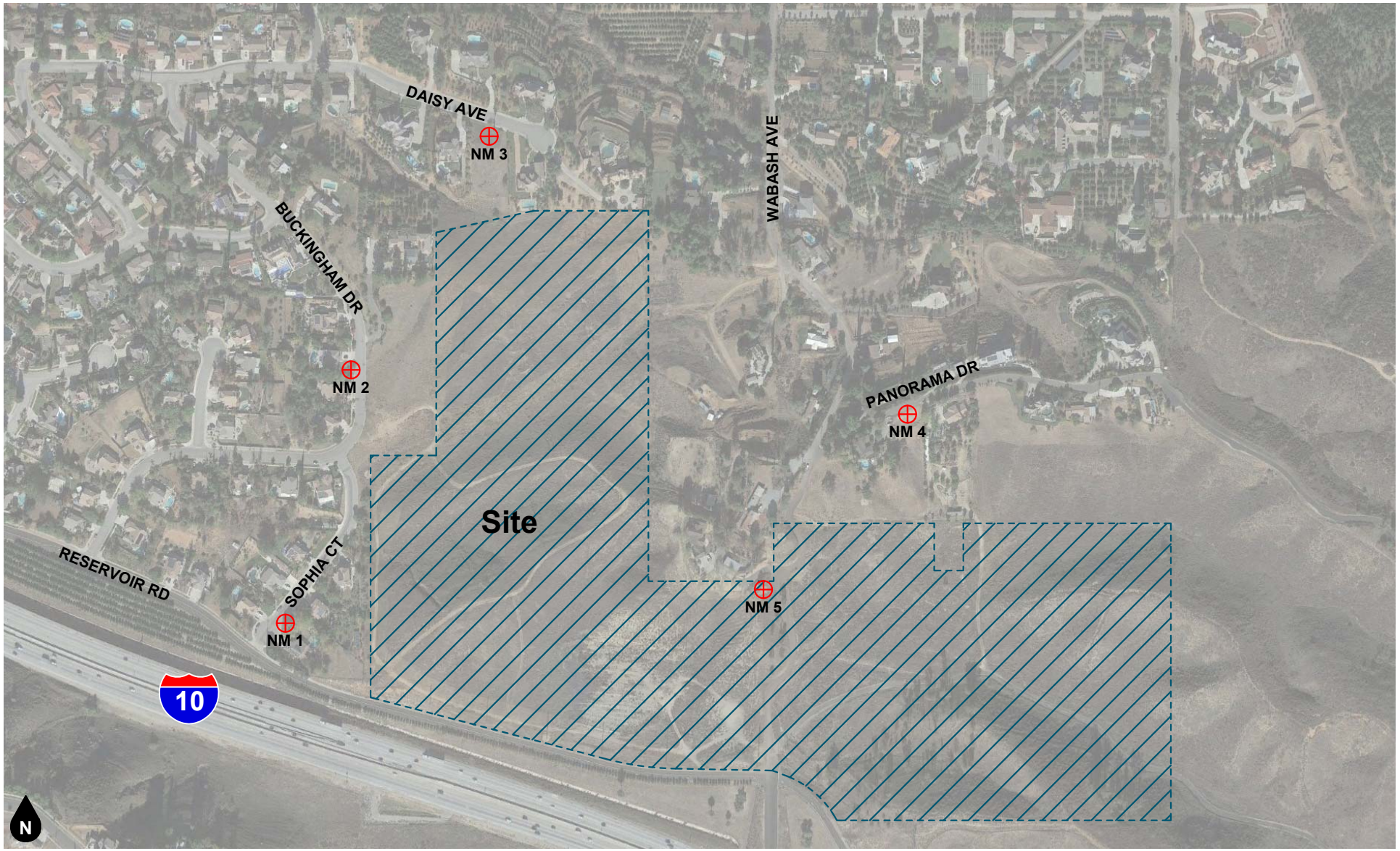
Table 1
Short-Term Noise Measurement Summary (dBA)

Daytime Measurements[1,2]								
Site Location	Time Started	Leq	Lmax	Lmin	L(2)	L(8)	L(25)	L(50)
NM1	12:10 PM	60.3	66.8	54.8	63.3	62.4	61.0	60.0
NM2	2:54 PM	60.2	83.7	39.0	66.2	55.5	48.6	43.1
NM3	12:56 PM	45.2	56.7	42.2	50.2	47.4	45.1	44.2
NM4	1:40 PM	49.0	63.7	42.2	59.5	51.3	46.0	44.7
NM5	2:20 PM	65.7	77.7	60.9	67.7	67.1	66.2	65.4

Notes:

(1) See Figure 5 for noise measurement locations. Each noise measurement was performed over a 15-minute duration.

(2) Noise measurements performed on November 22, 2019.



Legend

NM 1 Noise Measurement Location

Figure 5
Noise Measurement Location Map

4. REGULATORY SETTING

FEDERAL REGULATION

Federal Noise Control Act of 1972

The U.S. Environmental Protection Agency (EPA) Office of Noise Abatement and Control was originally established to coordinate federal noise control activities. After its inception, EPA's Office of Noise Abatement and Control issued the Federal Noise Control Act of 1972, establishing programs and guidelines to identify and address the effects of noise on public health, welfare, and the environment. In response, the EPA published Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety (Levels of Environmental Noise). The Levels of Environmental Noise recommended that the Ldn should not exceed 55 dBA outdoors or 45 dBA indoors to prevent significant activity interference and annoyance in noise-sensitive areas.

In addition, the Levels of Environmental Noise identified five (5) dBA as an "adequate margin of safety" for a noise level increase relative to a baseline noise exposure level of 55 dBA Ldn (i.e., there would not be a noticeable increase in adverse community reaction with an increase of five dBA or less from this baseline level). The EPA did not promote these findings as universal standards or regulatory goals with mandatory applicability to all communities, but rather as advisory exposure levels below which there would be no risk to a community from any health or welfare effect of noise.

In 1981, EPA administrators determined that subjective issues such as noise would be better addressed at lower levels of government. Consequently, in 1982 responsibilities for regulating noise control policies were transferred to State and local governments. However, noise control guidelines and regulations contained in EPA rulings in prior years remain in place by designated Federal agencies, allowing more individualized control for specific issues by designated Federal, State, and local government agencies.

STATE REGULATIONS

State of California General Plan Guidelines 2017

Though not adopted by law, the State of California General Plan Guidelines 2017, published by the California Governor's Office of Planning and Research (OPR) (OPR Guidelines), provides guidance for the compatibility of projects within areas of specific noise exposure. The OPR Guidelines identify the suitability of various types of construction relative to a range of outdoor noise levels and provide each local community some flexibility in setting local noise standards that allow for the variability in community preferences. Findings presented in the Levels of Environmental Noise Document (EPA 1974) influenced the recommendations of the OPR Guidelines, most importantly in the choice of noise exposure metrics (i.e., Ldn or CNEL) and in the upper limits for the normally acceptable outdoor exposure of noise-sensitive uses.

The OPR Guidelines include a Noise and Land Use Compatibility Matrix which identifies acceptable and unacceptable community noise exposure limits for various land use categories. Where the "normally acceptable" range is used, it is defined as the highest noise level that should be considered for the construction of the buildings which do not incorporate any special acoustical treatment or noise mitigation. The "conditionally acceptable" or "normally unacceptable" ranges include conditions calling for detailed acoustical study prior to the construction or operation of the proposed project. The City of Redlands has adopted their own version of the State Land Use Compatibility Guidelines for land use planning and to assess potential transportation noise impacts to proposed land uses (see Table 2).

California Environmental Quality Act

The California Environmental Quality Act Guidelines (Appendix G) establishes thresholds for noise impact analysis. This noise study includes analysis of noise and vibration impacts necessary to assess the project in light of the following Appendix G Checklist Thresholds.

Would the project result in:

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

Substantial increases in ambient noise levels are usually associated with project construction noise (temporary) and project operational noise (permanent).

Project Construction Noise: Construction noise sources are regulated within the City of Redlands Municipal Code Section 8.06.120 (G) and 8.06.090 which limit the hours of construction to between the hours of 7:00 AM and 6:00 PM, including Saturdays, with no activities taking place at any time on Sundays or federal holidays. Per the EIR prepared for the City of Redlands General Plan (2019), a substantial temporary increase in ambient noise levels from construction noise would be considered less than significant if construction activities comply with the City's Noise Control Ordinance in the Municipal Code, Section 8.06.090.

Project Operational Noise (permanent): On-site operational noise is usually only evaluated for commercial and industrial projects. Quantitative analysis of on-site operational noise is typically not conducted for residential projects as they usually do not include stationary noise sources that could result in substantial increases in ambient noise levels resulting in violation of established standards. Therefore, the evaluation of project operational noise in this study is limited to the potential impacts associated with project generated vehicle traffic (off-site noise). Depending upon how many units are proposed and the existing noise environment, project generated vehicle trips could result in substantial increases in noise levels.

Per the City's General Plan 2035 and for purposes of this analysis, increases in noise levels associated with project generated vehicle traffic will be considered substantial if they either cause an increase of four or more dB if the resulting noise level would exceed the clearly compatible standards, as identified in Tables 2 and 3, or any increase of 6 dB.

b) Generate excessive groundborne vibration or groundborne noise levels?

As shown in Table 4, the threshold at which there is a risk to "architectural" damage to historic and some older buildings is a peak particle velocity (PPV) of 0.25, at older residential structures a PPV of 0.3, and at new residential structures a PPV of 0.5. Table 5 shows that a PPV of 0.04 is the threshold at which groundborne vibration becomes distinctly perceptible in regards to annoyance. Impacts would be significant if construction activities result in groundborne vibration of 0.25 PPV or higher at a sensitive receptor.

City of Redlands

Per Section 8.05.090(F) of the City's Municipal Code, operating or permitting the operation of any device that creates a vibration, which is above the vibration perception threshold of an individual at or beyond the property boundary of the source if on private property or at one hundred fifty feet (150') from the source if on a public space or public right of way. The City of Redlands Municipal Code, Section 8.06.020, defines the vibration perception threshold as 0.01 inches per second (in/sec) RMS. As such, this noise study uses the City of Redlands Municipal Code vibration perception threshold of 0.01 in/sec RMS to assess the potential vibration impacts due to Project construction. Structural damage would not occur at this level.

California Department of Transportation (Caltrans)

The California Department of Transportation has published one of the seminal works for the analysis of ground-borne noise and vibration relating to transportation- and construction-induced vibrations and although the project is not subject to these regulations, it serves as useful tools to evaluate vibration impacts. These guidelines recommend that a standard of 0.3 inches per second (in/sec) PPV not be exceeded for the protection of older residential structures (California Department of Transportation, 2020).

LOCAL REGULATIONS

City of Redlands General Plan 2035

The City of Redlands has adopted a modified version of the State of California Noise Land Use Compatibility Matrix (see Table 2). This Matrix establishes standards for outdoor noise levels that are clearly compatible, normally compatible, and normally incompatible for a variety of land uses. For example, for single-family residential uses, noise levels of up to 60 dBA CNEL are "clearly compatible". Additional City of Redlands General Plan goals and policies which apply to the proposed project are presented below.

Policies

Principles

7-P.41 Ensure that new development is compatible with the noise environment by continuing to use potential noise exposure as a criterion in land use planning.

Actions

7-A.135 Use the noise and land use compatibility matrix (see Table 2) and Future Noise Contours map (General Plan Figure 7-9) as criteria to determine the acceptability of a given land use, including the improvement/construction of streets, railroads, freeways, and highways. Do not permit new noise-sensitive uses—including schools, hospitals, places of worship, and homes—where noise levels are "normally unacceptable" or higher, if alternative locations are available for the uses in the City.

7-A.136 Require a noise analysis be conducted for all development proposals located where projected noise exposure would be other than "clearly" or "normally compatible" as specified in Table 2.

7-A.137 For all projects that have noise exposure levels that exceed the standards in Table 2, require site planning and architecture to incorporate noise-attenuating features. With mitigation, development should meet the allowable outdoor and indoor noise exposure standards in Table 3. When a building's openings to the exterior are required to be closed to meet the interior noise standard, mechanical ventilation shall be provided.

Measure U Policies

9.0e Use the criteria specified in Table 2 to assess the compatibility of proposed land uses with the projected noise environment, and apply the noise standards in Table 3, which prescribe interior and exterior noise standards in relation to specific land uses. Do not approve projects that would not comply with the standards in Tables 2 and 3.

9.0i Require construction of barriers to mitigate sound emissions where necessary or where feasible, and encourage use of walls and berms to protect residential or other noise sensitive land uses that are adjacent to major roads, commercial, or industrial areas.

9.0s Require mitigation to ensure that indoor noise levels for residential living spaces do not exceed 45 dB LDN/CNEL due to combined effect of all exterior noise sources.

9.0v Consider the following impacts as possibly "significant":

- An increase in exposure of 4 or more dB if the resulting noise level would exceed that described as clearly compatible for the affected land use, as established in Tables 2 and 3;
- Any increase of 6 dB or more, due to potential for adverse community response.

9.0w Limit hours of construction or demolition work where site-related noise is audible beyond the site boundary.

City of Redlands Municipal Code

Chapter 8.06 of the City's Municipal Code establishes the City's noise standards and regulations.

Section 8.06.070 Exterior Noise Limits.

A. The noise standards for categories of land uses identified below, unless otherwise specifically indicated, apply to all such property within a designated zone.

Maximum Permissible Sound Levels By Receiving Land Use		
Receiving Land Use Category	Time Period	Noise Level - dBA
Single-family residential districts	10:00 PM - 7:00 AM	50
	7:00 AM – 10:00 PM	60
Multi-family residential districts; public space; institutional	10:00 PM - 7:00 AM	50
	7:00 AM - 10:00 PM	60
Commercial	10:00 PM - 7:00 AM	60
	7:00 AM - 10:00 PM	65
Industrial	Anytime	75

B. No person shall operate, or cause to be operated, any source of sound at any location within the City or allow the creation of any noise on property owned, leased, occupied or otherwise controlled by such person which causes the noise level when measured on any other property to exceed:

1. The noise standard for that land use specified in the table above of this section for a cumulative period of more than thirty (30) minutes in any hour; or
2. The noise standard specified in the table above of this section plus five (5) dB for a cumulative period of more than fifteen (15) minutes in any hour; or
3. The noise standard specified in the table above of this section plus ten (10) dB for a cumulative period of more than five (5) minutes in any hour; or
4. The noise standard specified in the table above of this section plus fifteen (15) dB for a cumulative period of more than one minute in any hour; or
5. The noise standard specified in the table above of this section plus twenty (20) dB or the maximum measured ambient level, for any period of time.

C. If the measured ambient level exceeds the allowable noise exposure standard within any of the first four (4) noise limit categories above, the allowable noise exposure standard shall be adjusted in five (5) dB increments in each category as appropriate to encompass or reflect said ambient noise level. In the event the ambient noise level exceeds the fifth noise limit category, the maximum allowable noise level under this category shall be increased to reflect the maximum ambient noise level.

Section 8.06.080 Interior Noise Standards.

A. No person shall operate or cause to be operated any source of sound, or allow the creation of any noise, which causes the noise level when measured inside a neighboring receiving occupied building to exceed the following standards:

1. The noise standard for that land use specified in the table below for a cumulative period of more than five (5) minutes in any hour.
2. The noise standard for that land use specified in the table below plus five (5) dB for a cumulative period of more than one minute in any hour.
3. The noise standard for that land use specified in the table below plus ten (10) dB for the maximum measured ambient noise level for any period of time.

B. If the measured ambient level exceeds the allowable exterior noise exposure standard in 8.06.070 of this chapter, the allowable interior noise exposure level shall be adjusted in five (5) dB increments as appropriate to reflect the ambient noise level.

Maximum Permissible Interior Sound Levels by Receiving Land Use		
Receiving Land Use Category	Time Period	Noise Level - dBA
Single-family residential districts	Any time	45
Multi-family residential districts; institutional; hotels	Any time	45
Commercial	Any time	50
Industrial	Any time	60

Section 8.06.090 Noise Disturbances Prohibited.

The following acts, and the causing or permitting thereof, are declared to be in violation of the Noise Ordinance:

F. Construction and/or Demolition: Operating or causing the operation of any tools or equipment used in construction, drilling, repair, alteration or demolition work between weekday hours of six o'clock (6:00) PM and seven o'clock (7:00) AM, including Saturdays or at any time on Sundays or holidays, such that the sound therefrom creates a noise disturbance across a residential or commercial real property line, except for emergency work by public service utilities, the City or another governmental entity. All mobile or stationary internal combustion engine powered equipment or machinery shall be equipped with exhaust and air intake silencers in proper working order, or suitable to meet the standards set forth herein.

G. Vibration: Operating or permitting the operation of any device that creates a vibration, which is above the vibration perception threshold of an individual at or beyond the property boundary of the source if on private property or at one hundred fifty feet (150') from the source if on a public space or public right of way. The City of Redlands Municipal Code, Section 8.06.020, defines the vibration perception threshold as 0.01 inches per second (in/sec) RMS. As such, this noise study uses the City of Redlands Municipal Code vibration perception threshold of 0.01 in/sec RMS to assess the potential vibration impacts due to Project construction. Structural damage would not occur at this level.

K. Noise Sensitive Zones: Creating or causing the creation of any sound within any noise sensitive zone, so as to exceed the specified land use noise standards set forth in 8.06.070A of this chapter and subsection 8.06.070B of this chapter, or so as to interfere with the functions of such activity or annoy the occupants in the activity, provided that conspicuous signs are displayed indicating the presence of the zone.

Section 8.06.120 Exemptions.

Construction Activity: This chapter shall not apply to noise sources associated with new construction, remodeling, rehabilitation or grading of any property provided such activities take place between the hours of seven o'clock (7:00) AM and six o'clock (6:00) PM on weekdays, including Saturdays, with no activities taking place at any time on Sundays or federal holidays. All motorized equipment used in such activity shall be equipped with functioning mufflers.

Further, all mobile or stationary internal combustion engine powered equipment or machinery shall be equipped with exhaust and air intake silencers in proper working order, or suitable to meet the standards set forth herein.

The Ordinance also prohibits the operation of any device that creates a vibration, which is above the vibration perception threshold of an individual at or beyond the property boundary of the source if on private property or at one hundred fifty feet (150') from the source if on a public space or public right-of-way.

Table 2
City of Redlands Noise/Land Use Compatibility Matrix[1]

Land Use Categories		Community Noise Equivalent Level (CNEL)						
Categories	Uses	< 60	65	70	75	80	85 >	
RESIDENTIAL	Single Family, Duplex, Multi-Family	A	C	C	C	D	D	D
RESIDENTIAL	Mobile Homes	A	C	C	C	D	D	D
COMMERCIAL- Regional, District	Hotels, Motels, Transient Lodging	A	A	B	B	C	C	D
COMMERCIAL- Regional, Village District, Special	Commercial Retail, Bank, Restaurant, Movie Theater	A	A	A	A	B	B	C
COMMERCIAL INDUSTRIAL INSTITUTIONAL	Office Buildings, Research and Development, Professional Offices, City Office Building	A	A	A	B	B	C	D
COMMERCIAL- Recreation INSTITUTIONAL- Civic Center	Amphitheater, Concert Hall, Auditorium, Meeting Hall	B	B	C	C	D	D	D
COMMERCIAL- Recreation	Children's Amusement Park, Miniature Golf Course, Go-cart Track, Equestrian Center, Sports Club	A	A	A	A	B	B	B
COMMERCIAL- General, Special INDUSTRIAL INSTITUTIONAL	Automobile Service Station, Auto Dealership, Manufacturing, Warehousing, Wholesale, Utilities	A	A	A	A	B	B	B
INSTITUTIONAL- General	Hospital, Church, Library, School Classroom	A	A	B	C	C	D	D
OPEN SPACE	Parks	A	A	A	B	C	D	D
OPEN SPACE	Golf Course, Cemeteries, Nature Centers, Wildlife Reserves, Wildlife Habitat	A	A	A	A	B	C	C
AGRICULTURE	Agriculture	A	A	A	A	A	A	A

Zone A:	Clearly Compatible	Specified land use is satisfactory, based up the assumption that any buildings involved are of normal conventional construction without any special noise insulation requirements.
Zone B:	Normally Compatible	New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements are made and needed noise insulation features in the design are determined. Conventional constuction, with closed windows and fresh air supply systems or air conditioning, will normally suffice.
Zone C:	Normally Incompatible	New construction or development should generally be discouraged. If new construction or development does proceed, a detailed analysis of noise reduction requirements must be made and needed noise reduction features
Zone D:	Clearly Incompatible	New construction or development should generally not be undertaken.

Notes:

(1) Source: City of Redlands General Plan Noise Element (GP Table 9.1), 2010.

Table 3
City of Redlands Interior and Exterior Noise Standards

Land Use Categories	Community Noise Equivalent Level (CNEL)	
	Interior[1]	Exterior[2]
Residential		
Single Family, Duplex, Multiple Family	45 [3]	60
Mobile Home	-	60 [4]
Commercial. Industrial, Institutional		
Hotel, Motel, Transient Lodging	45	65 [5]
Commercial Retail, Bank, Restaurant	55	-
Office Building, Research & Development, Professional Offices, City Office Building	50	-
Amphitheater, Concert Hall, Auditorium, Meeting Hall	45	-
Gymnasium (Multipurpose)	50	-
Sports Club	55	-
Manufacturing, Warehousing, Wholesale, Utilities	60	-
Movie Theaters	45	-
Institutional		
Hospitals, Schools, Classrooms	45	60
Open Space		
Parks	-	60

Notes:

* CNEL (Community Noise Equivalent Level) - The average equivalent A-Weighted sound level during a 24 hour day, obtained after addition of approximately five decibels to sound levels in the evening from 7:00 PM to 10:00 PM and ten decibels to sound levels at night after 10:00 PM and before 7:00 AM.

(1) Indoor environment excluding bathrooms, toilets, closest, corridors.

(2) Outdoor environment limited to private yard of single-family as measured at the property line; multi-family private patio or balcony which is served by a means of exit from inside; mobile home park; hospital patio; park picnic area; school playground; hotel and recreational area.

(3) Noise level requirement with open windows, if they are used to meet natural ventilation requirement.

(4) Exterior noise level should be such that interior level will not exceed 45 CNEL.

(5) Except those areas affected by aircraft noise.

Table 4
Guideline Vibration Damage Potential Threshold Criteria

Structure Condition	Maximum PPV (in/sec)	
	Transient Sources	Continuous/Frequent Intermittent Sources
Extremely fragile historic buildings, ruins, anceint monuments	0.12	0.08
Fragile buildings	0.2	0.1
Historic and some old buildings	0.5	0.25
Older residential structures	0.5	0.3
New residential structures	1.0	0.5
Modern industrial/commercial buildings	2.0	0.5

Notes:

Source: California Department of Transportation. Transportation and Construction Vibration Guidance Manual, Chapter 7 Table 19, April 2020.

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

Table 5
Guideline Vibration Annoyance Potential Criteria

Human Response	Maximum PPV (in/sec)	
	Transient Sources	Continuous/Frequent Intermittent Sources
Barely perceptible	0.04	0.01
Distinctly perceptible	0.25	0.04
Strongly perceptible	0.9	0.10
Severe	2.0	0.4

Notes:

Source: California Department of Transportation. Transportation and Construction Vibration Guidance Manual, Chapter 7 Table 20, April 2020.

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

5. ANALYTICAL METHODOLOGY AND MODEL PARAMETERS

This section discusses the analysis methodologies used to assess noise impacts.

CONSTRUCTION NOISE MODELING

Construction noise associated with the proposed project was calculated at the sensitive receptor locations, utilizing methodology presented in the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (2018) together with several key construction parameters including: distance to each sensitive receiver, equipment usage, percent usage factor, and baseline parameters for the project site. Construction noise levels were calculated for each phase based on the equipment assumptions provided in the Air Quality, Global Climate Change, and Energy Impact Analysis report prepared for the project (Ganddini 2021). For construction noise purposes, the distance measured from the project site to sensitive receptors was assumed to be the acoustical center of the project site to the property line of residential properties with existing residential buildings. Although the Air Quality, Global Climate Change, and Energy Impact Analysis prepared for the proposed project modeled project construction as occurring in one phase in order to evaluate worst-case conditions, the proposed project is anticipated to be completed in two construction phases. Therefore, in order to represent worst-case distances from the acoustical center of the project site, the construction noise levels were calculated at the surrounding sensitive receptors based on the boundaries of the two construction phases (Phase 1 and Phase 2). Construction noise worksheets are provided in Appendix D.

FEDERAL HIGHWAY ADMINISTRATON (FHWA) TRAFFIC NOISE PREDICTION MODEL

Increases in ambient noise levels due to project generated vehicle traffic were modeled utilizing a computer program that replicates the FHWA Traffic Noise Prediction Model FHWA-RD-77-108.

The FHWA Traffic Noise Prediction Model arrives at a predicted noise level through a series of adjustments to the Reference Energy Mean Emission Level (REMEL). In California the national REMELs are substituted with the California Vehicle Noise (Calveno) Emissions Levels.[1] Adjustments are then made to the REMEL to account for: total average daily traffic volumes, roadway classification (i.e., collector, secondary, major or arterial), the roadway active width (i.e., distance between the center of the outermost travel lanes on each side of the roadway), travel speed, truck mix (i.e., percentage of automobiles, medium trucks, and heavy trucks in the traffic volume), roadway grade and site conditions (hard or soft ground surface relating to the absorption of the ground, pavement, or landscaping). Research conducted by Caltrans identifies that the use of soft site conditions is appropriate for the application of the FHWA traffic noise prediction model.[2] Therefore, surfaces adjacent to all modeled roadways were assumed to have a "soft site". Possible reductions in noise levels due to intervening topography and buildings were not accounted for in this analysis.

Existing and Existing Plus Project average daily traffic volumes were obtained from the project's traffic study (Ganddini Group 2021). The City of Redlands and the County of San Bernardino do not have published vehicle/truck mixes and D/E/N splits for use in acoustical studies; therefore, the vehicle/truck mixes and D/E/N splits for use in acoustical studies published by the Riverside County Department of Industrial Hygiene were utilized for noise modeling. Existing Plus Project vehicle mixes were calculated by adding the proposed project trips to existing conditions. FHWA spreadsheets are included in Appendix E.

[1] California Department of Transportation Environmental Program, Office of Environmental Engineering. Use of California Vehicle Noise Reference Energy Mean Emission Levels (Calveno REMELs) in FHWA Highway Traffic Noise Prediction. September 1995. TAN 95-03.

[2] California Department of Transportation. Traffic Noise Attenuation as a Function of Ground and Vegetation Final Report. June 1995. FHWA/CA/TL-95/23.

SOUNDPLAN NOISE MODEL

The SoundPLAN acoustical modeling software was utilized to model future roadway noise levels at the proposed sensitive receptors (e.g., residences). SoundPLAN is capable of evaluating stationary noise sources (e.g., parking lots, drive-thru menus, car wash equipment, vacuums, etc.) and much more. The SoundPLAN software utilizes algorithms (based on the inverse square law) to calculate noise level projections. The software allows the user to input specific noise sources, spectral content, sound barriers, building placement, topography, and sensitive receptor locations. In addition to the information provided below, noise modeling data is provided in Appendix F.

Roadway segments that are located adjacent to the proposed project site include Wabash Avenue, Reservoir Road, Sophia Court, and Buckingham Drive. Per the City of Redlands General Plan 2035 Roadway Classification Map, Wabash Avenue is classified as a Minor Arterial roadway, Reservoir Road is classified as a Collector roadway, and Sophia Court and Buckingham Drive are both classified as Local roadways. In addition, at the closest point, the Interstate 10 Freeway is located approximately 150 feet south of the project site's southern boundary.

Roadways that may generate enough traffic noise under buildout conditions to affect the proposed project include Wabash Avenue and the Interstate 10 Freeway. The City of Redlands General Plan 2035 Roadway Classification Map, Wabash Avenue is classified as a Minor Arterial roadway. A volume of 5,000 ADTs, a speed pf 45 miles per hour, and a vehicle-mix of 74.6% automobiles, 1.11 % medium trucks, and 1.93% heavy trucks were used to model traffic noise associated with Wabash Avenue.[3] Traffic noise associated with Interstate 10 was modeled using an ADT of 160,000 a speed of 65 miles per hour, and a vehicle mix of 94% automobiles, 1% medium trucks, and 5% heavy trucks[4].

[3] Environmental Impact Report Appendices for the City of El Segundo General Plan Update and Climate Action Plan, Appendix F. July 21, 2017.

[4] Caltrans Traffic Census Program. 2019. https://dot.ca.gov/programs/traffic-operations/census. Accessed August 16, 2021.

6. IMPACT ANALYSIS

This impact discussion analyzes the potential for noise and/or groundborne vibration impacts to cause the exposure of a person to, or generation of, noise levels in excess of established City of Redlands standards related to: construction, operation, and transportation noise related impacts to, or from, the proposed project.

IMPACTS RELATED TO CONSTRUCTION NOISE

The existing surrounding single-family detached residential dwelling units may be affected by short-term noise impacts associated with construction noise. Construction noise will vary depending on the construction process, type of equipment involved, location of the construction site with respect to sensitive receptors, the schedule proposed to carry out each task (e.g., hours and days of the week) and the duration of the construction work.

The construction phases for the proposed project are anticipated to include: grading, building construction, paving and architectural coating. A summary of noise level data for a variety of construction equipment compiled by the Federal Transit Administration (FTA) is presented in Table 6. Typical operating cycles for these types of construction equipment may involve one or two minutes of full power operation followed by three to four minutes at lower power settings.

As discussed previously, construction noise associated with the proposed project was calculated utilizing methodology presented in the FTA Transit Noise and Vibration Impact Assessment Manual (2018) together with several key construction parameters including: distance to each sensitive receiver, equipment usage, percent usage factor, and baseline parameters for the project site. Distances to receptors were based on the acoustical center of each phase of the project site, Phase 1 and Phase 2. Construction noise levels were calculated for each construction sub-phase for both Phase 1 and Phase 2. Worksheets are included as Appendix D.

Construction noise levels are compared to existing noise levels in Table 1 of this report as follows:

- NM1 was chosen to represent the residential property line southwest of the boundaries of Phase 1,
- NM2 was chosen to represent residential property lines west of the boundaries of Phase 1,
- NM3 was chosen to represent the residential property lines north and northeast of the boundaries of Phase 1,
- NM4 was chosen to represent the residential property lines north, northeast, and southeast of the boundaries of Phase 2, and
- NM5 was chosen to represent the residential property lines southeast and east of the boundaries of Phase 1 and northeast of the boundaries of Phase 2.

As shown in Table 7, modeled unmitigated construction noise levels are expected to range between 44.7 dBA L_{eq} and 72.3 dBA L_{eq} at the nearest existing residential property lines surrounding the project site.

Per the EIR prepared for the City of Redlands General Plan (2019), a substantial temporary increase in ambient noise levels from construction noise would be considered less than significant if construction activities comply with the City's Noise Control Ordinance in the Municipal Code, Section 8.06.090 which limits the hours of construction to between the hours of 7:00 AM and 6:00 PM, including Saturdays, with no activities taking place at any time on Sundays or federal holidays. The proposed project is required to comply with the Municipal Code. Project construction activities are expected to comply with these hours. Impacts related to

construction noise would be less than significant. Although mitigation is not required, measures to further minimize construction noise are provided in Section 7 of this report.

Noise Impacts to Off-Site Receptors Due to Project Generated Trips

During operation, the proposed project is expected to generate approximately 632 average daily trips with 49 trips occurring during the AM peak-hour and 67 trips occurring during the PM peak-hour. Project generated traffic noise levels along affected road segments was estimated utilizing the FHWA Traffic Noise Prediction Model - FHWA-RD-77-108. The modeling is theoretical and did not take into account any existing barriers, structures, and/or topographical features that may further reduce noise levels. Existing and Existing Plus Project modeled noise levels are provided for comparative purposes to show the difference in noise levels with and without project conditions. Roadway input parameters including average daily traffic volumes (ADTs), speeds, and vehicle distribution data is shown in Table 8.

As shown in Table 9, modeled Existing traffic noise levels range between 52.7-73.4 dBA CNEL at the right-of-way of each modeled roadway segment; and the modeled Existing Plus Project traffic noise levels range between 53.7-73.4 dBA CNEL at the right-of-way of each modeled roadway segment.

The City's General Plan 2035 identifies a potentially substantial increase as either an increase of four or more dB, if the resulting noise level would exceed the clearly compatible standards as identified in Tables 2 or 3, or any increase of 6 dB.

Table 9 shows that all modeled roadway segments are anticipated to change the noise a nominal amount (approximately 0.05 to 3.52 dBA CNEL). Therefore, a change in noise level would not be readily noticeable and would be less than significant. No mitigation is required.

Transportation Noise Impacts to the Proposed Project

Per the City of Redlands General Plan, noise levels of up to 60 dBA CNEL are considered "clearly compatible"; and noise levels between 60 and 75 dBA CNEL are considered "normally incompatible" for single-family residential uses.

As stated previously, roadways expected to generate enough traffic noise under buildout conditions to affect the noise levels on the project site include Wabash Avenue and the Interstate 10 Freeway. The City of Redlands General Plan 2035 Roadway Classification Map, Wabash Avenue is classified as a Minor Arterial roadway. A volume of 5,000 ADTs, a speed pf 45 miles per hour, and a vehicle-mix of 74.6% automobiles, 1.11 % medium trucks, and 1.93% heavy trucks were used to model traffic noise associated with Wabash Avenue[5]. Traffic noise associated with Interstate 10 was modeled using an ADT of 160,000 a speed of 65 miles per hour, and a vehicle mix of 94% automobiles, 1% medium trucks, and 5% heavy trucks[6].

Future traffic noise levels from the Interstate 10 and Wabash Avenue on the project site will range between 55 and 74 dBA CNEL at first floor levels and between 60 and 75 at second story levels without mitigation (see Figures 6). Therefore, without mitigation, several areas will exceed the City's "clearly compatible" standard of 60 dBA CNEL and would fall into the City's "normally incompatible" criteria.

Barriers ranging between six to fifteen-feet would be necessary to reduce future traffic noise levels at first-story levels to 60 dB or below. With construction of six to fifteen-foot barriers along the southern boundaries of the southernmost lots and those lot lines that lie adjacent to Wabash Avenue (see Figure 7), future noise levels are expected to range between 54 and 60 dBA CNEL at first floor levels and between 57 and 68 dBA CNEL at second story levels. Therefore, mitigation in the form of barriers ranging between six to fifteen-feet

[5] Environmental Impact Report Appendices for the City of El Segundo General Plan Update and Climate Action Plan, Appendix F. July 21, 2017.

[6] Caltrans Traffic Census Program. 2019. https://dot.ca.gov/programs/traffic-operations/census. Accessed August 16, 2021.

along southern lot lines and lot lines adjacent to Wabash Avenue (see Figure 8) will reduce exterior noise levels at first-story levels to below 60 dBA CNEL.

With construction of only six-foot barriers along the southern boundaries of the southernmost lots, future noise levels are expected to range between 55 and 64 dBA CNEL at first floor levels and between 60 and 71 dBA CNEL at second story levels. With six-foot barriers, future traffic generated exterior noise levels would still exceed the City's "clearly compatible" standard but would not exceed 65 dBA CNEL which is the level at which, if exceeded, upgraded windows are necessary to achieve acceptable interior noise levels.

Future noise levels at second floor levels would exceed the City's "clearly compatible" criteria of 60 dBA CNEL and 65 dBA CNEL. It will be necessary to install upgraded second story windows and sliding glass doors in homes along the southern boundary of the site and that lie adjacent to Wabash Avenue to ensure that interior noise levels of 45 dBA CNEL are achieved. It is recommended that the noise study is updated at which time final grading plans are available to make sure that the necessary STC levels are required. Normal conversation is typically 65 dBA CNEL.

GROUNDBORNE VIBRATION IMPACTS

There are several types of construction equipment that can cause vibration levels high enough to annoy persons in the vicinity and/or result in architectural or structural damage to nearby structures and improvements. For example, as shown in Table 10, a vibratory roller could generate up to 0.21 PPV at a distance of 25 feet; and operation of a large bulldozer could generate up to 0.089 PPV at a distance of 25 feet (two of the most vibratory pieces of construction equipment). Groundborne vibration at sensitive receptors associated with this equipment would drop off as the equipment moves away. For example, as the vibratory roller moves further than 100 feet from the sensitive receptors, the vibration associated with it would drop below 0.0026 PPV. It should be noted that these vibration levels are reference levels and may vary slightly depending upon soil type and specific usage of each piece of equipment.

Architectural Damage
Vibration generated by construction activity generally has the potential to damage structures. This damage could be structural damage, such as cracking of floor slabs, foundations, columns, beams, or wells, or cosmetic architectural damage, such as cracked plaster, stucco, or tile. (California Department of Transportation, 2020)

Table 4 identifies a PPV level of 0.3 as the threshold at which there is a risk to "architectural" damage to older residential structures. Estimated groundborne vibration levels at the nearest sensitive receptors are presented in Table 11. In summary, if a vibratory roller is used within 20 feet of an existing structure or if a large bulldozer is used within 12 feet of an existing structure there will be some potential for this equipment to result in architectural damage and significant impacts. Therefore, a mitigation measure prohibiting the use of a vibratory roller within 20 feet or a large bulldozer within 12 feet of existing structures at 1760 Camelot Drive (to the north of the project site) and 731 Buckingham Drive (located to the west of the project site) has been added to Section 7 of this report. Vibration worksheets are provided in Appendix G.

With incorporation of mitigation provided in Section 7 of this report, potential impacts related to architectural damage would be reduced to less than significant.

Annoyance to Persons
The primary effect of perceptible vibration is often a concern. However, secondary effects, such as the rattling of a china cabinet, can also occur, even when vibration levels are well below perception. Any effect (primary perceptible vibration, secondary effects, or a combination of the two) can lead to annoyance. The degree to which a person is annoyed depends on the activity in which they are participating at the time of the disturbance. For example, someone sleeping or reading will be more sensitive than someone who is running on a treadmill. Reoccurring primary and secondary vibration effects often lead people to believe that the

vibration is damaging their home, although vibration levels are well below minimum thresholds for damage potential (California Department of Transportation, 2020).

As shown in Table 5, vibration becomes distinctly perceptible to people in buildings at a PPV of 0.04. The City of Redlands has prohibited the operation of any device that creates a vibration, which is above the vibration perception threshold of an individual at or beyond the property boundary of the source if on private property; or at one hundred fifty feet (150') from the source if on a public space or public right-of-way. The City of Redlands Municipal Code, Section 8.06.020, defines the vibration perception threshold as 0.01 inches per second (in/sec) RMS.

To assess the impact in terms of the City's vibration perception, the threshold of 0.01 inches per second (in/sec) RMS was converted to a PPV (0.014 in/sec) using the conversion factor of 0.71 which is provided in the Caltrans Transportation and Construction Vibration Guidance Manual (April 2020). Therefore, if a vibratory roller is used within 150 feet of an existing structure or if a large bulldozer is used within 85 feet of an existing structure, there will be some potential for vibration related annoyance.

Perceptibility of construction vibration would be temporary and would only occur while vibratory equipment is utilized within 150 feet of the existing structures. Furthermore, implementation of mitigation intended to avoid structural damage would reduce impacts related to annoyance at the residential uses located at 1760 Camelot Drive and 731 Buckingham Drive. This impact would be less than significant. No mitigation is required.

Table 6 (1 of 2)
CA/T Equipment Noise Emissions and Acoustical Usage Factor Database

Equipment Description	Impact Device?	Acoustical Use Factor (%)	Spec. Lmax @ 50ft (dBA, slow)	Actual Measured Lmax @ 50ft (dBA, slow)	No. of Actual Data Samples (Count)
All Other Equipment > 5 HP	No	50	85	-N/A-	0
Auger Drill Rig	No	20	85	84	36
Backhoe	No	40	80	78	372
Bar Bender	No	20	80	-N/A-	0
Blasting	Yes	-N/A-	94	-N/A-	0
Boring Jack Power Unit	No	50	80	83	1
Chain Saw	No	20	85	84	46
Clam Shovel (dropping)	Yes	20	93	87	4
Compactor (ground)	No	20	80	83	57
Compressor (air)	No	40	80	78	18
Concrete Batch Plant	No	15	83	-N/A-	0
Concrete Mixer Truck	No	40	85	79	40
Concrete Pump Truck	No	20	82	81	30
Concrete Saw	No	20	90	90	55
Crane	No	16	85	81	405
Dozer	No	40	85	82	55
Drill Rig Truck	No	20	84	79	22
Drum Mixer	No	50	80	80	1
Dump Truck	No	40	84	76	31
Excavator	No	40	85	81	170
Flat Bed Truck	No	40	84	74	4
Forklift[2,3]	No	50	n/a	61	n/a
Front End Loader	No	40	80	79	96
Generator	No	50	82	81	19
Generator (<25KVA, VMS signs)	No	50	70	73	74
Gradall	No	40	85	83	70
Grader	No	40	85	-N/A-	0
Grapple (on backhoe)	No	40	85	87	1
Horizontal Boring Hydr. Jack	No	25	80	82	6
Hydra Break Ram	Yes	10	90	-N/A-	0
Impact Pile Driver	Yes	20	95	101	11
Jackhammer	Yes	20	85	89	133
Man Lift	No	20	85	75	23
Mounted Impact hammer (hoe ram)	Yes	20	90	90	212
Pavement Scarafier	No	20	85	90	2
Paver	No	50	85	77	9
Pickup Truck	No	50	85	77	9
Paving Equipment	No	50	85	77	9
Pneumatic Tools	No	50	85	85	90

Table 6 (2 of 2)
CA/T Equipment Noise Emissions and Acoustical Usage Factor Database

Equipment Description	Impact Device?	Acoustical Use Factor (%)	Spec. Lmax @ 50ft (dBA, slow)	Actual Measured Lmax @ 50ft (dBA, slow)	No. of Actual Data Samples (Count)
Pumps	No	50	77	81	17
Refrigerator Unit	No	100	82	73	3
Rivit Buster/chipping gun	Yes	20	85	79	19
Rock Drill	No	20	85	81	3
Roller	No	20	85	80	16
Sand Blasting (Single Nozzle)	No	20	85	96	9
Scraper	No	40	85	84	12
Shears (on backhoe)	No	40	85	96	5
Slurry Plant	No	100	78	78	1
Slurry Trenching Machine	No	50	82	80	75
Soil Mix Drill Rig	No	50	80	-N/A-	0
Tractor	No	40	84	-N/A-	0
Vacuum Excavator (Vac-truck)	No	40	85	85	149
Vacuum Street Sweeper	No	10	80	82	19
Ventilation Fan	No	100	85	79	13
Vibrating Hopper	No	50	85	87	1
Vibratory Concrete Mixer	No	20	80	80	1
Vibratory Pile Driver	No	20	95	101	44
Warning Horn	No	5	85	83	12
Welder/Torch	No	40	73	74	5

Notes:

(1) Source: FHWA Roadway Construction Noise Model User's Guide January 2006.

(2) Warehouse & Forklift Noise Exposure - NoiseTesting.info Carl Stautins, November 4, 2014 http://www.noisetesting.info/blog/carl-strautins/page-3/

(3) Data provided Leq as measured at the operator. Sound Level at 50 feet is calculated using Inverse Square Law.

Table 7 (1 of 2)
Construction Noise Levels (dBA Leq)

Phase	Receptor Location[1]	Existing Ambient Noise Levels (dBA Leq)[2]	Unmitigated Noise Levels (dBA Leq)[3]
Grading	Southwest (Phase 1)	60.3	70.4
	West (Phase 1)	60.2	69.9
	Northwest (Phase 1)	60.2	68.1
	North (Phase 1)	45.2	66.7
	Northeast (Phase 1)	45.2	66.9
	East (Phase 1)	65.7	72.3
	Northwest (Phase 2)	65.7	68.3
	North (Phase 2)	49.0	71.5
	Northeast (Phase 2)	49.0	62.3
	Southeast (Phase 2)	49.0	60.0
Building Construction	Southwest (Phase 1)	60.3	67.0
	West (Phase 1)	60.2	66.5
	Northwest (Phase 1)	60.2	64.7
	North (Phase 1)	45.2	63.3
	Northeast (Phase 1)	45.2	63.5
	East (Phase 1)	65.7	68.9
	Northwest (Phase 2)	65.7	64.9
	North (Phase 2)	49.0	68.1
	Northeast (Phase 2)	49.0	58.9
	Southeast (Phase 2)	49.0	56.6
Paving	Southwest (Phase 1)	60.3	62.5
	West (Phase 1)	60.2	62.0
	Northwest (Phase 1)	60.2	60.2
	North (Phase 1)	45.2	58.8
	Northeast (Phase 1)	45.2	59.0
	East (Phase 1)	65.7	64.4
	Northwest (Phase 2)	65.7	60.4
	North (Phase 2)	49.0	63.6
	Northeast (Phase 2)	49.0	54.4
	Southeast (Phase 2)	49.0	52.1

Table 7 (2 of 2)
Construction Noise Levels (dBA Leq)

Phase	Receptor Location[1]	Existing Ambient Noise Levels (dBA Leq)[2]	Unmitigated Noise Levels (dBA Leq)[3]
Architectural Coating	Southwest (Phase 1)	60.3	55.2
	West (Phase 1)	60.2	54.7
	Northwest (Phase 1)	60.2	52.9
	North (Phase 1)	45.2	51.5
	Northeast (Phase 1)	45.2	51.6
	East (Phase 1)	65.7	57.1
	Northwest (Phase 2)	65.7	53.1
	North (Phase 2)	49.0	56.2
	Northeast (Phase 2)	49.0	47.1
	Southeast (Phase 2)	49.0	44.7

Notes:

(1) The proposed project is anticipated to be constructed in two phases per the site plan and phasing description. Therefore, in order to more accurately calculate construction noise levels, the acoustical center of the construction site was based on the boundaries for each phase. Construction noise levels were calculated at the residential receptors surrouding each phase. The construction equipment assumed for each phase was based on the Air Quality, Global Climate Change,a nd Energy Impact Analysis prepared by Ganddini Group (2021), which modeled the project's construction as occuring in only one phase.

(2) See Table 1 for measured ambient noise. NM1 was used for residential receptors to the southwest of Phase 1 of the project, NM2 was used for residential receptors to the west of Phase 1 of the project, NM3 was used for residential receptors to the north and northeast of Phase 1 of the project, NM4 was used for residental receptors to the north, northeast, and southeast of Phase 2 of the project, and NM5 was used for residential receptors to the southeast and east of Phase 1 and the northwest of Phase 2 of the project.

(3) Construction noise worksheets are provided in Appendix D.

Table 8
Project Average Daily Traffic Volumes and Roadway Parameters

Roadway	Segment	Average Daily Traffic Volume[1]		Posted Travel Speeds (MPH)	Site Conditions
		Existing	Existing Plus Project		
Ford Street	North of Reservoir Road	9,500	9,600	40	Soft
Reservoir Road	Ford Street to Wabash Avenue	3,500	3,800	45	Soft
Wabash Avenue	North of Panorama Drive	400	500	10	Soft
	Panorama Drive to Reservoir Road	400	900	10	Soft
	Reservoir Road to Interstate 10 Freeway	3,400	3,600	25	Soft

Vehicle Distribution (Light Mix)[2]			
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)
Automobiles	75.56	13.96	10.49
Medium Trucks	48.91	2.17	48.91
Heavy Trucks	47.30	5.41	47.30

Vehicle Distribution (Heavy Mix)[2]			
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)
Automobiles	75.54	14.02	10.43
Medium Trucks	48.00	2.00	50.00
Heavy Trucks	48.00	2.00	50.00

Notes:

(1) Existing and project average daily traffic volumes obtained from the Terracina at Redlands (TTM 20320) Traffic Impact Analysis, Ganddini Group, Inc. (February 27, 2020).

(2) Existing vehicle percentages are based on the Riverside County Industrial Hygiene Letter for Traffic Noise.

Table 9
Change in Existing Noise Levels Along Roadways as a Result of Project (dBA CNEL)

Roadway	Segment	Distance from roadway centerline to right-of-way (feet)[2]	Modeled Noise Levels (dBA CNEL)[1]				
			Existing Without Project at right-of-way	Existing Plus Project at right-of-way	Change in Noise Level	Exceeds Standards[3]	Increase of 4 dB or More
Ford Street	North of Reservoir Road	36	73.37	73.42	0.05	Yes	No
Reservoir Road	Ford Street to Wabash Avenue	32	66.60	66.96	0.36	Yes	No
Wabash Avenue	North of Panorama Drive	36	52.72	53.69	0.97	No	No
	Panorama Drive to Reservoir Road	36	52.72	56.24	3.52	No	No
	Reservoir Road to Interstate 10 Freeway	32	61.35	61.60	0.25	No	No

Notes:

(1) Exterior noise levels calculated 5 feet above pad elevation, perpendicular to subject roadway.

(2) Distance from the roadway centerline to the roadway right-of-way (ROW) ROW distances were estimated based on the Illustrative Street Sections provided in the City of Redlands General Plan 2035 (December 2017).

(3) Per the City of Redlands clearly compatible standard for single-family detached residential dwelling units (see Table 2).

Table 10
Construction Equipment Vibration Source Levels

Equipment		PPV at 25 ft, in/sec	Approximate Lv* at 25 ft
Pile Driver (impact)	upper range	1.518	112
	typical	0.644	104
Pile Driver (sonic)	upper range	0.734	105
	typical	0.170	93
clam shovel drop (slurry wall)		0.202	94
Hydromill (slurry wall)	in soil	0.008	66
	in rock	0.017	75
Vibratory Roller		0.210	94
Hoe Ram		0.089	87
Large Bulldozer		0.089	87
Caisson Drilling		0.089	87
Loaded Trucks		0.076	86
Jackhammer		0.035	79
Small Bulldozer		0.003	58

Source: Federal Transit Administration: Transit Noise and Vibration Impact Assessment Manual, 2018.
*RMS velocity in decibels, VdB re 1 micro-in/sec

Table 11
Construction Vibration Levels at the Nearest Receptors

Receptor Location	Distance from Property Line to Nearest Structure (feet)	Equipment	Vibration Level (PPV in/sec)	Threshold Exceeded?[1]	Vibration Level with Mitigation[2]	Threshold Exceeded With Mitigation?[1,2]
Residential to North (1760 Camelot Drive)	10	Vibratory Roller	0.830	Yes	0.268	No
	10	Large Bulldozer	0.352	Yes	0.191	No
Residential to West (731 Buckingham Drive)	12	Vibratory Roller	0.631	Yes	0.293	-
	12	Large Bulldozer	0.268	No	-	-
Residential to North (850 Wabash Avenue)	45	Vibratory Roller	0.087	No	-	-
	45	Large Bulldozer	0.037	No	-	-
Residential to North & West (854 Wabash Aveneu & 811 Sophia Court)	50	Vibratory Roller	0.074	No	-	-
	50	Large Bulldozer	0.031	No	-	-

Notes:

(1) Caltrans identifies the threshold at which there is a risk to "architectural" damage to non-engineered timber and masonry buildings as a PPV of 0.3 in/sec (see Table 4).

(2) Needed mitigation for architectural damage would include prohibiting the use of vibratory rollers, or other similar vibratory equipment, within 20 feet and large bulldozers within 12 feet of residential structures to the north and west (1760 Camelo t Drive & 731 Buckingham Drive).

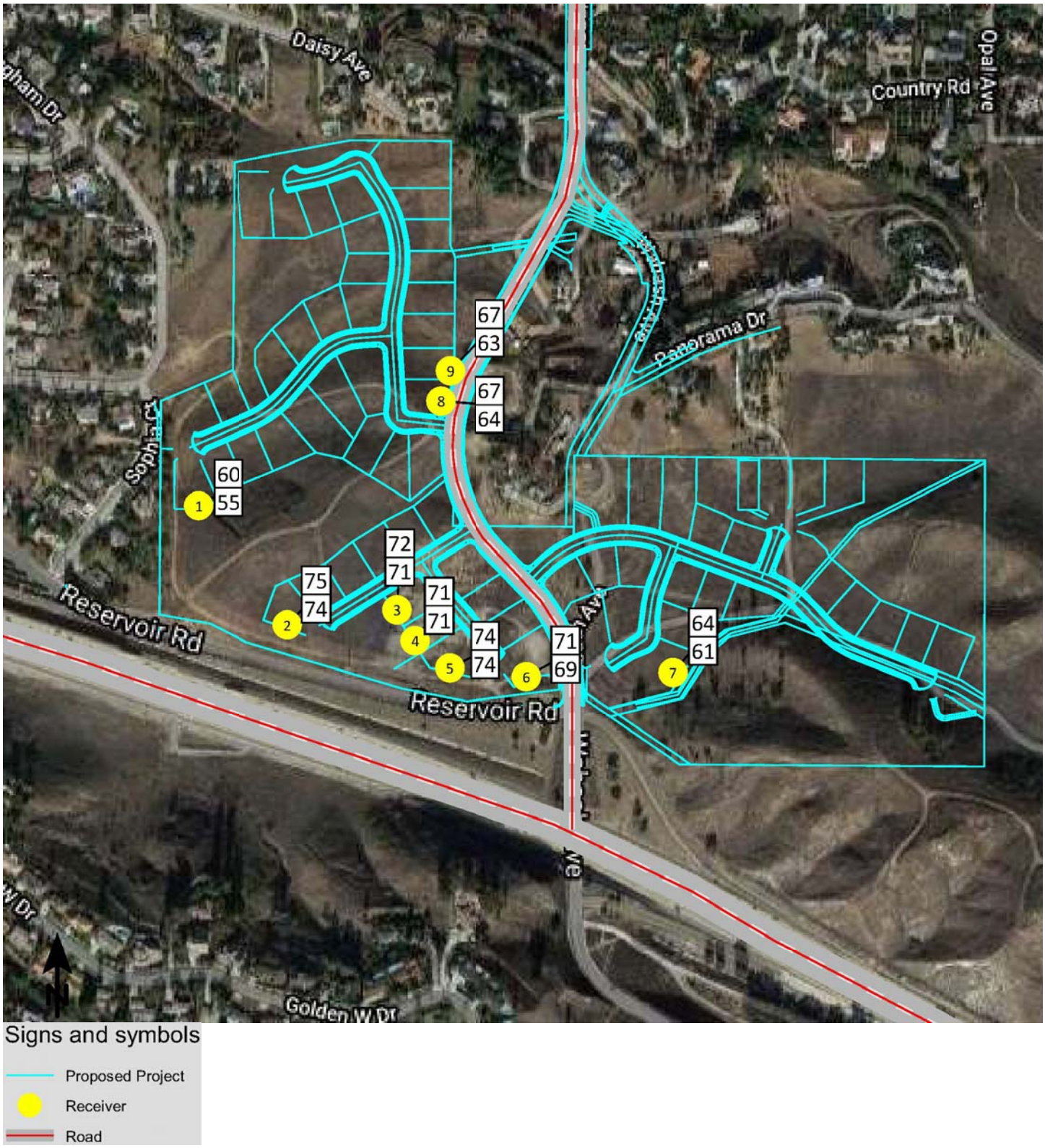


Figure 6
Future Traffic Noise Levels Without Mitigation

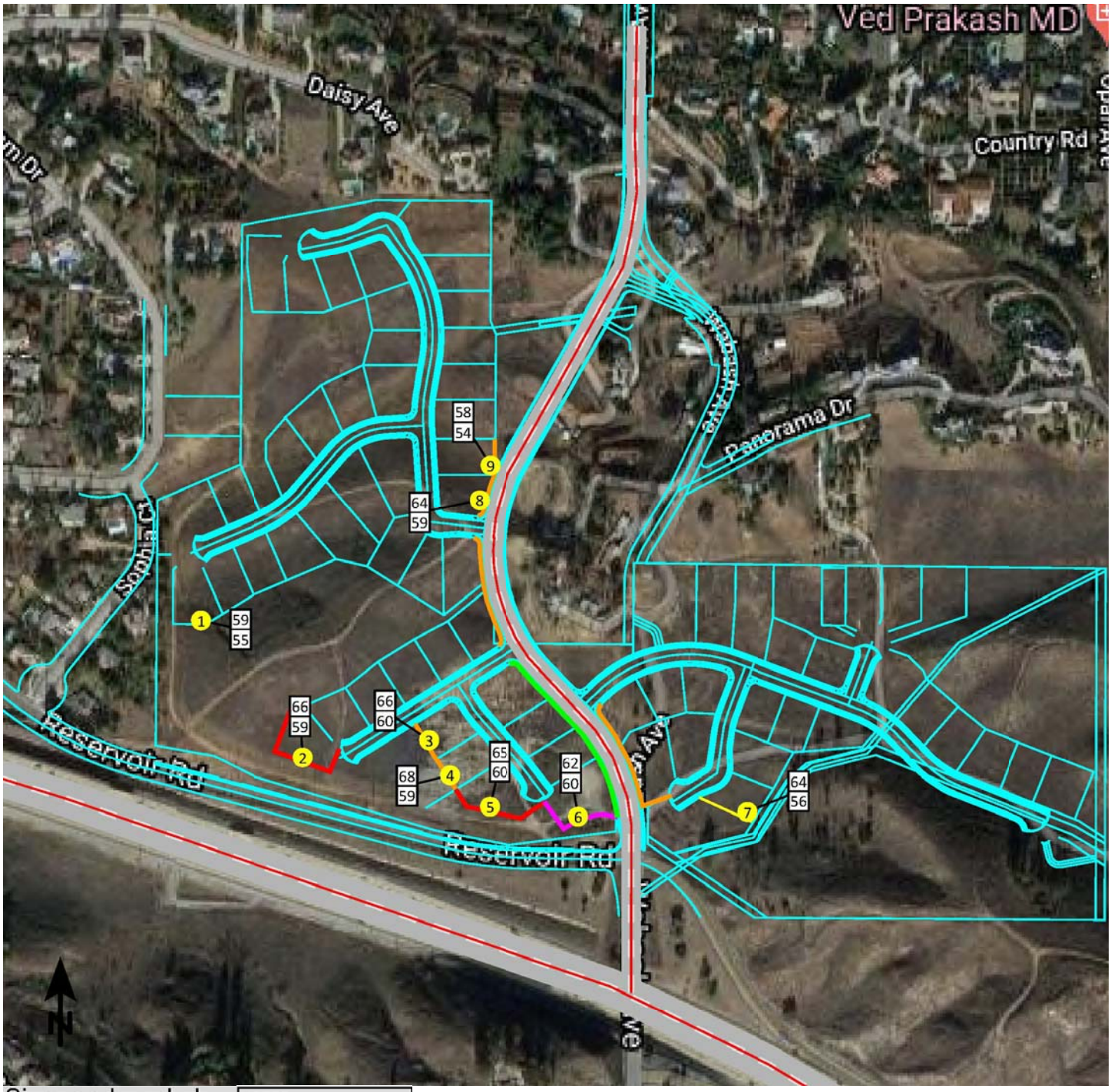


Figure 7
Future Traffic Noise Levels With Mitigation (60 dBA CNEL)

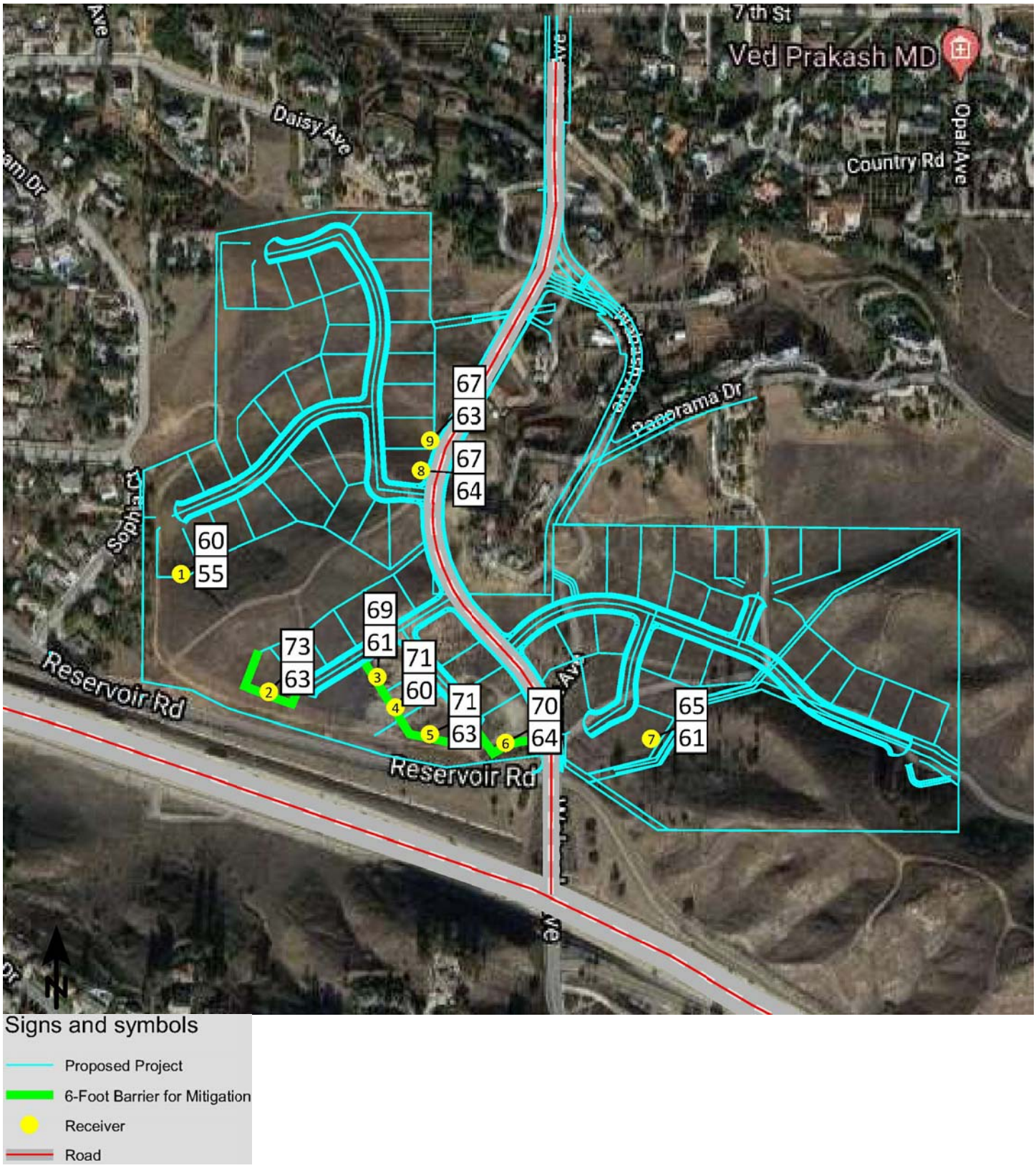


Figure 8
Future Traffic Noise Levels With Mitigation (65 dBA CNEL)

7. MEASURES TO REDUCE IMPACTS

CONSTRUCTION - RECOMMENDED NOISE REDUCTION MEASURES

In addition to adherence to the City of Redlands Municipal Code, which limits construction hours and requires all motorized equipment to be equipped with functioning mufflers, the following measures are recommended to reduce construction noise and vibrations, emanating from the proposed project:

1. During all project site excavation and grading on-site, construction contractors shall equip all construction equipment, fixed or mobile, with properly operating and maintained mufflers, consistent with manufacturer standards.

2. The contractor shall place all stationary construction equipment so that emitted noise is directed away from the noise sensitive receptors nearest the project site.

3. Equipment shall be shut off and not left to idle when not in use.

4. The contractor shall locate equipment staging in areas that will create the greatest distance between construction-related noise/vibration sources and sensitive receptors nearest the project site during all project construction.

5. Jackhammers, pneumatic equipment and all other portable stationary noise sources shall be shielded and noise shall be directed away from sensitive receptors.

VIBRATION - MITIGATION MEASURES

1. The use of vibratory rollers, or other similar vibratory equipment, within 20 feet or a large bulldozer within 12 feet of existing structures at 1760 Camelot Drive (to the north of the project site) and 731 Buckingham Drive (located to the west of the project site) is prohibited.

OPERATIONAL - MITIGATION MEASURES

1. Barriers ranging between six and fifteen-feet along southern lot lines and lot lines adjacent to Wabash Avenue shall be constructed as shown on Figure 10. The barriers shall reach the ground surface and be solid with no holes or cracks.

2. At the time final grading is completed, prepare a final noise study to verify barrier mitigation and determine needed STC rating.

8. REFERENCES

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APPENDICES

Appendix A List of Acronyms
Appendix B Glossary
Appendix C Noise Measurement Field Worksheets
Appendix D Construction Noise Calculations
Appendix E FHWA Worksheets
Appendix F SoundPLAN Worksheets
Appendix G Vibration Worksheets

APPENDIX A

LIST OF ACRONYMS

Term	Definition
ADT	Average Daily Traffic
ANSI	American National Standard Institute
CEQA	California Environmental Quality Act
CNEL	Community Noise Equivalent Level
D/E/N	Day / Evening / Night
dB	Decibel
dBA or dB(A)	Decibel "A-Weighted"
dBA/DD	Decibel per Double Distance
dBA L_{eq}	Average Noise Level over a Period of Time
EPA	Environmental Protection Agency
FHWA	Federal Highway Administration
L_{02},L_{08},L_{50},L_{90}	A-weighted Noise Levels at 2 percent, 8 percent, 50 percent, and 90 percent, respectively, of the time period
DNL	Day-Night Average Noise Level
$L_{eq(x)}$	Equivalent Noise Level for '"x" period of time
L_{eq}	Equivalent Noise Level
L_{max}	Maximum Level of Noise (measured using a sound level meter)
L_{min}	Minimum Level of Noise (measured using a sound level meter)
LOS C	Level of Service C
OPR	California Governor's Office of Planning and Research
PPV	Peak Particle Velocities
RCNM	Road Construction Noise Model
REMEL	Reference Energy Mean Emission Level
RMS	Root Mean Square

APPENDIX B

GLOSSARY

Term	Definition
Ambient Noise Level	The all-encompassing noise environment associated with a given environment, at a specified time, usually a composite of sound from many sources, at many directions, near and far, in which usually no particular sound is dominant.
A-Weighted Sound Level, dBA	The sound level obtained by use of A-weighting. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear.
CNEL	Community Noise Equivalent Level. CNEL is a weighted 24-hour noise level that is obtained by adding five decibels to sound levels in the evening (7:00 PM to 10:00 PM), and by adding ten decibels to sound levels at night (10:00 PM to 7:00 AM). This weighting accounts for the increased human sensitivity to noise during the evening and nighttime hours.
Decibel, dB	A logarithmic unit of noise level measurement that relates the energy of a noise source to that of a constant reference level; the number of decibels is 10 times the logarithm (to the base 10) of this ratio.
DNL, Ldn	Day Night Level. The DNL, or Ldn is a weighted 24-hour noise level that is obtained by adding ten decibels to sound levels at night (10:00 PM to 7:00 AM). This weighting accounts for the increased human sensitivity to noise during the nighttime hours.
Equivalent Continuous Noise Level, L_{eq}	A level of steady state sound that in a stated time period, and a stated location, has the same A-weighted sound energy as the time-varying sound.
Fast/Slow Meter Response	The fast and slow meter responses are different settings on a sound level meter. The fast response setting takes a measurement every 100 milliseconds, while a slow setting takes one every second.
Frequency, Hertz	In a function periodic in time, the number of times that the quantity repeats itself in one second (i.e., the number of cycles per second).
L_{02}, L_{08}, L_{50}, L_{90}	The A-weighted noise levels that are equaled or exceeded by a fluctuating sound level, 2 percent, 8 percent, 50 percent, and 90 percent of a stated time period, respectively.
L_{max}, L_{min}	Lmax is the RMS (root mean squared) maximum level of a noise source or environment measured on a sound level meter, during a designated time interval, using fast meter response. Lmin is the minimum level.
Offensive/ Offending/Intrusive Noise	The noise that intrudes over and above the existing ambient noise at a given location. The relative intrusiveness of sound depends on its amplitude, duration, frequency, and time of occurrence, and tonal information content as well as the prevailing ambient noise level.
Root Mean Square (RMS)	A measure of the magnitude of a varying noise source quantity. The name derives from the calculation of the square root of the mean of the squares of the values. It can be calculated from either a series of lone values or a continuous varying function.

APPENDIX C

NOISE MEASUREMENT FIELD WORKSHEETS

Noise Measurement
Field Data

Project Name: Terracina Redlands **Date:** November 22, 2019

Project #: JN 19-0208

Noise Measurement #: NM1 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Gallagher

Nearest Address or Cross Street: 819 Sophia Ct, Redlands, California

Site Description (Type of Existing Land Use and any other notable features): Project site: Empty land, vegetation, rocks & dirt, hilly mostly sloping down.
Adjacent to Project Site: 10 Freeway running East-West immediately S of site, residential N, S and W of Site, mostly open, empty, hilly land E of site.
Noise Measurement Site: Sophia Ct to west/south and residential uses surrouding, Reservoir Rd and I-10 further south.

Weather: Sunny, cloud near horizon. **Settings:** SLOW FAST

Temperature: 60 deg F **Wind:** 0-3 mph **Humidity:** 39% **Terrain:** Hilly

Start Time: 12:10 PM **End Time:** 12:25 PM **Run Time:**

Leq: 60.3 dB **Primary Noise Source:** Traffic noise associated with vehicles traveling on 10 Freeway 80 yards S of NM1.

Lmax 66.8 dB 4 vehicles passed along Reservoir Road during measurement.

L2 63.3 dB **Secondary Noise Sources:** Residential ambiance, bird song, overhead propeller and jet aircraft.

L8 62.4 dB Delivery van passes microphone on Sophia Ct at 12:22 PM.

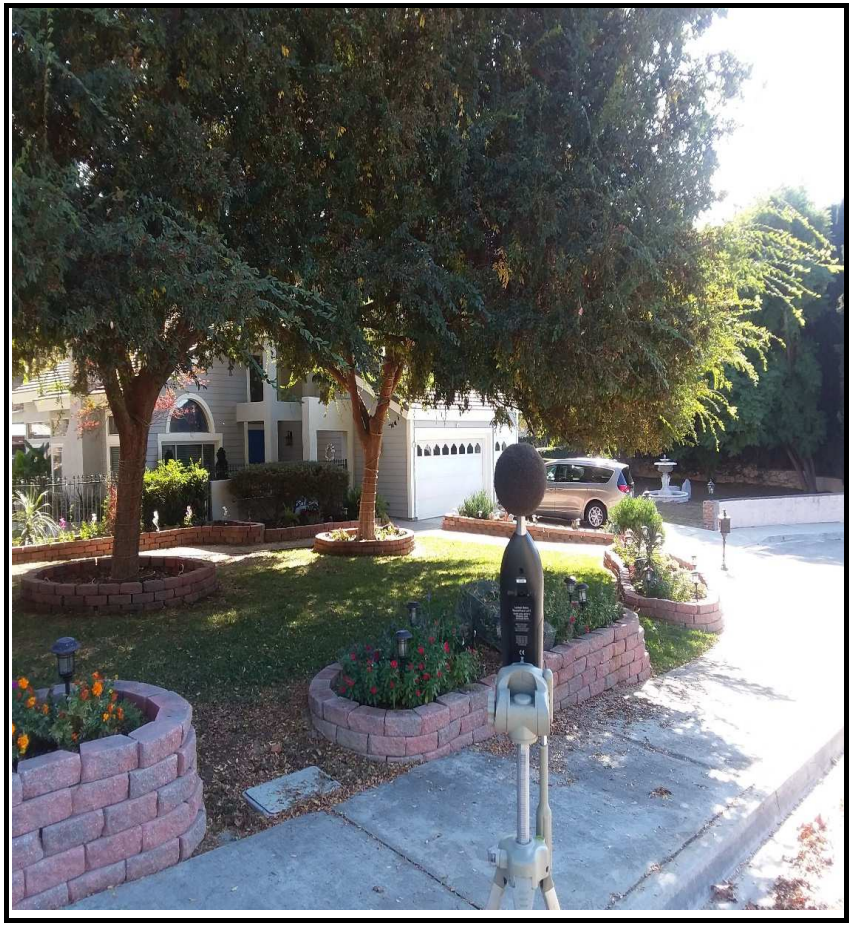
L25 61.0 dB

L50 60.0 dB

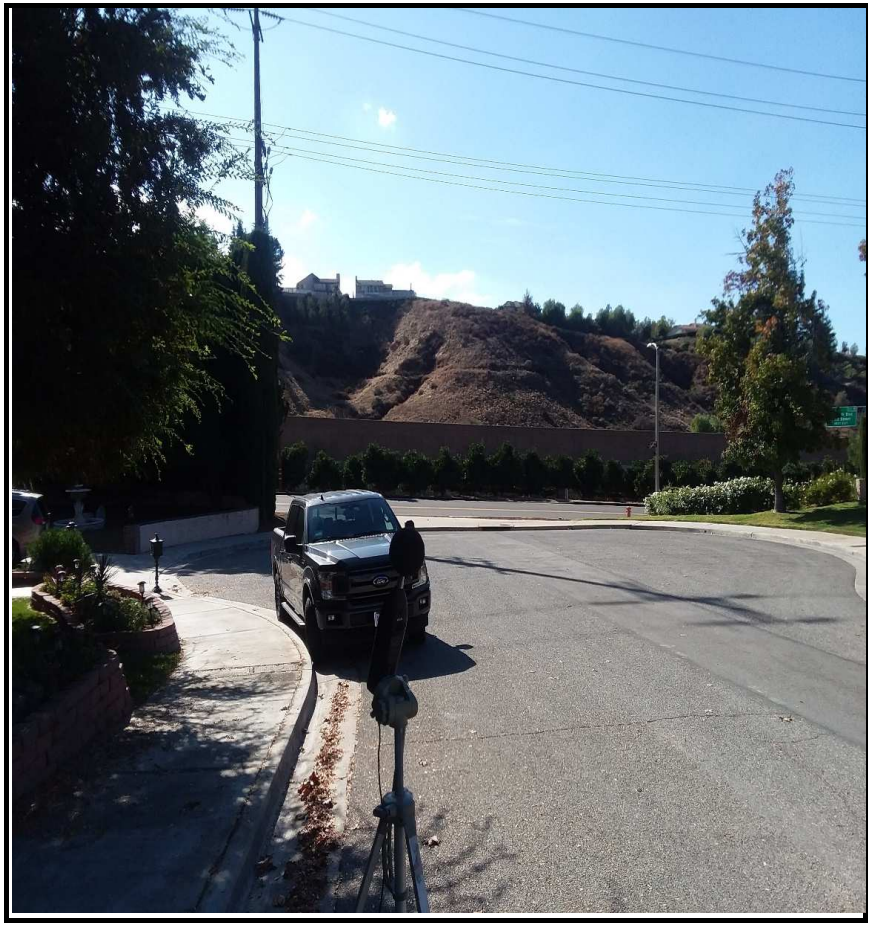
NOISE METER:	SoundTrack LXT Class 1	**CALIBRATOR:**	Larson Davis CAL250
MAKE:	Larson Davis	**MAKE:**	Larson Davis
MODEL:	LXT1	**MODEL:**	Cal 250
SERIAL NUMBER:	3099	**SERIAL NUMBER:**	2733
FACTORY CALIBRATION DATE:	6/23/2017	**FACTORY CALIBRATION DATE:**	8/9/2017
FIELD CALIBRATION DATE:	11/22/2019		

Noise Measurement
Field Data

PHOTOS:



NM1 looking SE towards residence 89 Sophia Ct, Redlands, California.



NM1 looking S down Sophia Ct towards Reservoir Road and 10 Freeway (behind wall).

Summary	
File Name on Meter	LxT_Data.288
File Name on PC	SLM_0003099_LxT_Data_288.00.ldbin
Serial Number	0003099
Model	SoundTrack LxT®
Firmware Version	2.301
User	Ian Edward Gallagher
Location	NM1 JN 19-0208 Redlands 34° 2'8.69"N 117° 8'38.30"W
Job Description	15 minute noise measurement (1 x 15 minutes)

Measurement	
Start	2019-11-22 12:10:26
Stop	2019-11-22 12:25:26
Duration	00:15:00.0
Run Time	00:15:00.0
Pause	00:00:00.0
Pre Calibration	2019-11-22 12:10:07
Post Calibration	None

Overall Settings	
RMS Weight	A Weighting
Peak Weight	Z Weighting
Detector	Slow
Preamp	PRMLxT1L
Microphone Correction	Off
Integration Method	Linear
OBA Range	Low
OBA Bandwidth	1/1 and 1/3
OBA Freq. Weighting	Z Weighting
OBA Max Spectrum	Bin Max
Overload	122.7 dB

Results				
LA_{eq}	60.3			
LAE	89.8			
EA	107.167	µPa²h		
EA8	3.429	mPa²h		
EA40	17.147	mPa²h		
$LZ_{peak\ (max)}$	2019-11-22 12:22:10	96.7 dB		
LAS_{max}	2019-11-22 12:22:10	66.8 dB		
LAS_{min}	2019-11-22 12:25:19	54.8 dB		
SEA	-99.9 dB			

		Statistics	
LC_{eq}	68.5 dB	**LAI2.00**	63.3 dB
LA_{eq}	60.3 dB	**LAI8.00**	62.4 dB
LC_{eq} - LA_{eq}	8.2 dB	**LAI25.00**	61.0 dB
LAI_{eq}	61.3 dB	**LAI50.00**	60.0 dB
LA_{eq}	60.3 dB	**LAI66.60**	59.3 dB
LAI_{eq} - LA_{eq}	1.0 dB	**LAI90.00**	58.0 dB
# Overloads	0		

Noise Measurement
Field Data

Project Name: Terracina Redlands **Date:** November 22, 2019

Project #: JN 19-0208

Noise Measurement #: NM2 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Gallagher

Nearest Address or Cross Street: 736 Buckingham Drive, Redlands, California.

Site Description (Type of Existing Land Use and any other notable features): Project site: Empty land, vegetation, rocks & dirt, hilly mostly sloping down. Adjacent to Project Site: 10 Freeway running East-West immediately S of site, residential N, S and W of Site, mostly open, empty, hilly land E of site. Noise Measurement Site: Residential uses to west and surrounding, Buckingham Dr and project site/vacant land to east.

Weather: Sunny, about 10% cloud. **Settings:** SLOW FAST

Temperature: 62 deg F **Wind:** 3-5 mph **Humidity:** 37% **Terrain:** Hilly

Start Time: 2:54 PM **End Time:** 3:09 PM **Run Time:**

Leq: 60.2 dB **Primary Noise Source:** 6 vehicles passed along Buckingham Drive during 15 minute noise measurement.

Lmax 83.7 dB Car with barking dog as passenger drove by at 3:04 PM. Noisy car passes at 3:07 PM.

L2 66.2 dB **Secondary Noise Sources:** Residential ambiance, bird song, overhead propeller and jet aircraft.

L8 55.5 dB Distant traffic ambiance from the 10 Freeway.

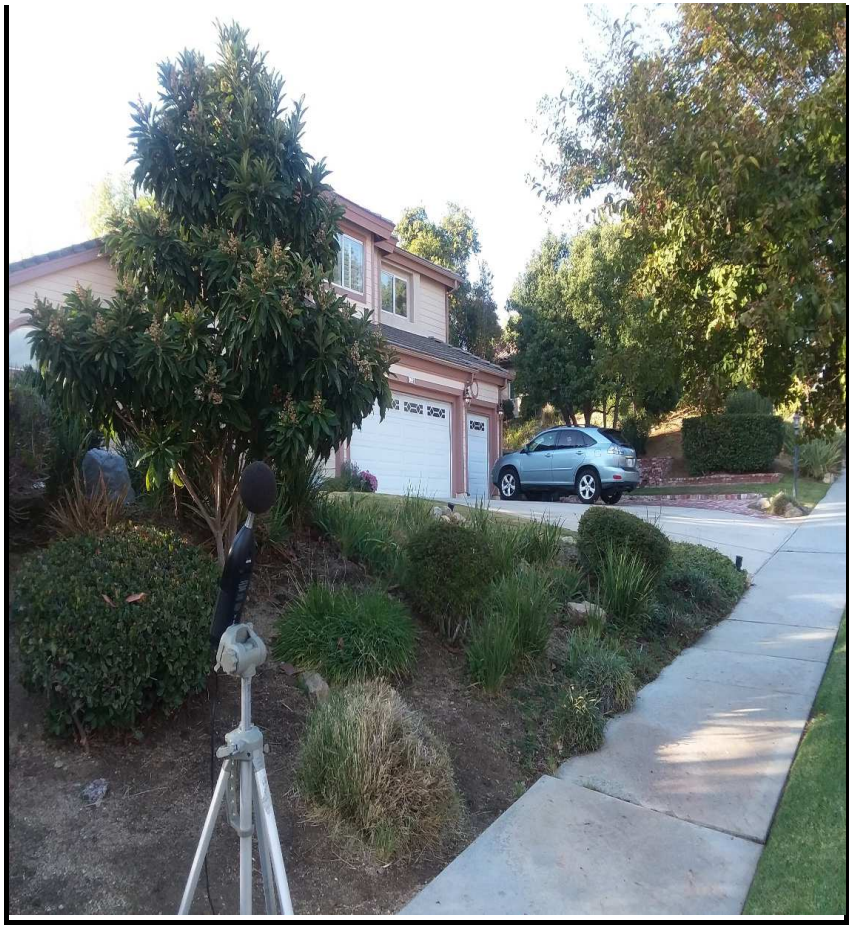
L25 48.6 dB

L50 43.1 dB

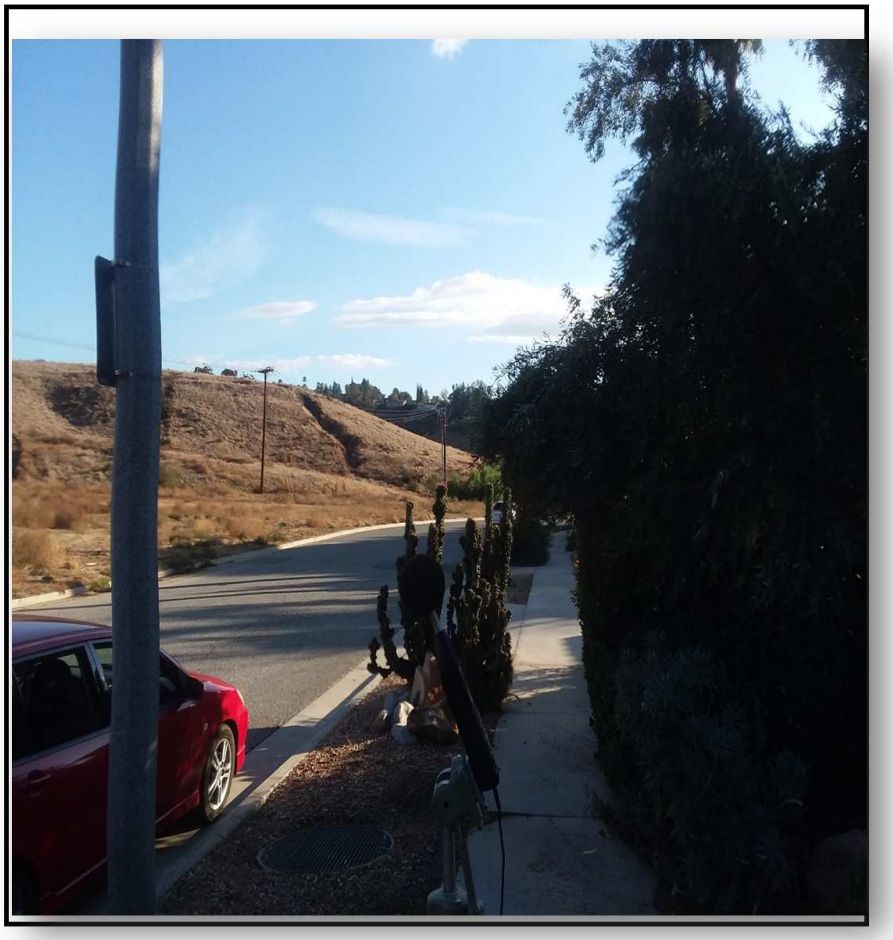
NOISE METER:	SoundTrack LXT Class 1	**CALIBRATOR:**	Larson Davis CAL250
MAKE:	Larson Davis	**MAKE:**	Larson Davis
MODEL:	LXT1	**MODEL:**	Cal 250
SERIAL NUMBER:	3099	**SERIAL NUMBER:**	2733
FACTORY CALIBRATION DATE:	6/23/2017	**FACTORY CALIBRATION DATE:**	8/9/2017
FIELD CALIBRATION DATE:	11/22/2019		

Noise Measurement
Field Data

PHOTOS:



NM2 looking NW towards residence 736 Buckingham Drive, Redlands, California.



NM2 looking south down Buckingham Drive.

Summary		
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File Name on PC	SLM_0003099_LxT_Data_292.00.ldbin	
Serial Number	0003099	
Model	SoundTrack LxT®	
Firmware Version	2.301	
User	Ian Edward Gallagher	
Location	NM2 JN 19-0208 Redlands 34° 2'16.52"N 117° 8'35.94"W	
Job Description	15 minute noise measurement (1 x 15 minutes)	
Measurement		
Start	2019-11-22 14:54:21	
Stop	2019-11-22 15:09:21	
Duration	00:15:00.0	
Run Time	00:15:00.0	
Pause	00:00:00.0	
Pre Calibration	2019-11-22 14:54:06	
Post Calibration	None	
Overall Settings		
RMS Weight	A Weighting	
Peak Weight	Z Weighting	
Detector	Slow	
Preamp	PRMLxT1L	
Microphone Correction	Off	
Integration Method	Linear	
OBA Range	Low	
OBA Bandwidth	1/1 and 1/3	
OBA Freq. Weighting	Z Weighting	
OBA Max Spectrum	Bin Max	
Overload	122.7 dB	
Results		
LA_{eq}	60.2	
LAE	89.7	
EA	104.387 µPa²h	
EA8	3.340 mPa²h	
EA40	16.702 mPa²h	
$LZ_{peak\ (max)}$	2019-11-22 15:07:56	107.5 dB
LAS_{max}	2019-11-22 15:07:56	83.7 dB
LAS_{min}	2019-11-22 15:09:03	39.0 dB
SEA	-99.9 dB	

		Statistics	
LC_{eq}	72.9 dB	**LAI2.00**	66.2 dB
LA_{eq}	60.2 dB	**LAI8.00**	55.5 dB
LC_{eq} - LA_{eq}	12.8 dB	**LAI25.00**	48.6 dB
LAI_{eq}	62.9 dB	**LAI50.00**	43.1 dB
LA_{eq}	60.2 dB	**LAI66.60**	41.9 dB
LAI_{eq} - LA_{eq}	2.7 dB	**LAI90.00**	40.8 dB
# Overloads	0		

Noise Measurement
Field Data

Project Name: Terracina Redlands **Date:** November 22, 2019

Project #: JN 19-0208

Noise Measurement #: NM3 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Gallagher

Nearest Address or Cross Street: 1752 Daisy Avenue, Redlands, California.

Site Description (Type of Existing Land Use and any other notable features): Project site: Empty land, vegetation, rocks & dirt, hilly mostly sloping down.
Adjacent to Project Site: 10 Freeway running East-West immediately S of site, residential N, S and W of Site, mostly open, empty, hilly land E of site.
Noise Measurement Site: Vacant lot, Daisy Ave to north, project site/vacant land to south, residential to east, west, and further north.

Weather: Sunny, about 20% cloud. **Settings:** SLOW FAST

Temperature: 62 deg F **Wind:** 3-5 mph **Humidity:** 39% **Terrain:** Hilly

Start Time: 12:56 PM **End Time:** 1:11 PM **Run Time:**

Leq: 45.2 dB
Lmax 56.7 dB
L2 50.2 dB
L8 47.4 dB
L25 45.1 dB
L50 44.2 dB

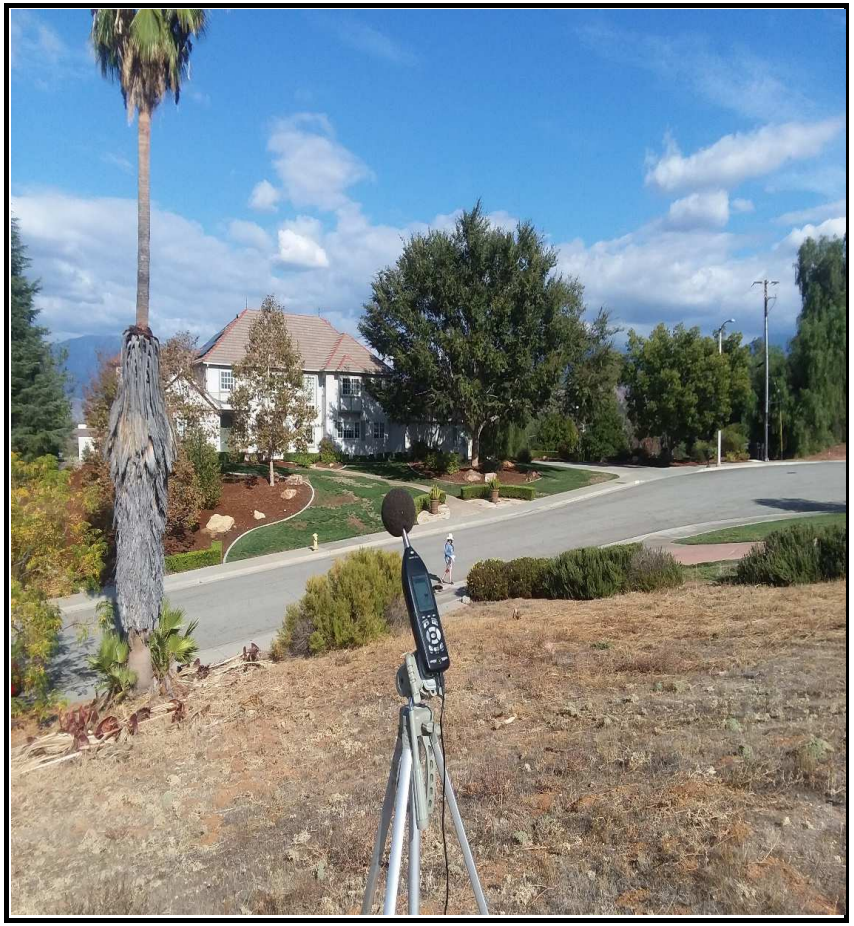
Primary Noise Source: Residential ambiance, gardeners at work all over neighborhood. Distant leaf blowers and lawn mowers in operation.

Secondary Noise Sources: Bird song, overhead propeller and jet aircraft. Very distant traffic ambiance from the 10 Freeway.

NOISE METER:	SoundTrack LXT Class 1	**CALIBRATOR:**	Larson Davis CAL250
MAKE:	Larson Davis	**MAKE:**	Larson Davis
MODEL:	LXT1	**MODEL:**	Cal 250
SERIAL NUMBER:	3099	**SERIAL NUMBER:**	2733
FACTORY CALIBRATION DATE:	6/23/2017	**FACTORY CALIBRATION DATE:**	8/9/2017
FIELD CALIBRATION DATE:	11/22/2019		

Noise Measurement
Field Data

PHOTOS:



NM3 looking N across Daisy Ave towards residence 1751 Daisy Ave, Redlands.

NM3 looking SE towards residence 1752 Daisy Ave, Redlands.

Summary		
File Name on Meter	LxT_Data.289	
File Name on PC	SLM_0003099_LxT_Data_289.00.ldbin	
Serial Number	0003099	
Model	SoundTrack LxT®	
Firmware Version	2.301	
User	Iasn Edward Gallagher	
Location	NM3 JN 19-0208 Redlands 34° 2'23.80"N 117° 8'30.72"W	
Job Description	15 minute noise measurement (1 x 15 minutes)	
Measurement		
Start	2019-11-22 12:56:06	
Stop	2019-11-22 13:11:06	
Duration	00:15:00.0	
Run Time	00:15:00.0	
Pause	00:00:00.0	
Pre Calibration	2019-11-22 12:55:05	
Post Calibration	None	
Overall Settings		
RMS Weight	A Weighting	
Peak Weight	Z Weighting	
Detector	Slow	
Preamp	PRMLxT1L	
Microphone Correction	Off	
Integration Method	Linear	
OBA Range	Low	
OBA Bandwidth	1/1 and 1/3	
OBA Freq. Weighting	Z Weighting	
OBA Max Spectrum	Bin Max	
Overload	122.6 dB	
Results		
LAeq	45.2	
LAE	74.7	
EA	3.299 µPa²h	
EA8	105.553 µPa²h	
EA40	527.766 µPa²h	
LZpeak (max)	2019-11-22 13:06:52	88.7 dB
LASmax	2019-11-22 12:58:20	56.7 dB
LASmin	2019-11-22 12:56:49	42.2 dB
SEA	-99.9 dB	

		Statistics	
LCeq	55.8 dB	**LAI2.00**	50.2 dB
LAeq	45.2 dB	**LAI8.00**	47.4 dB
LCeq - LAeq	10.6 dB	**LAI25.00**	45.1 dB
LAIeq	46.9 dB	**LAI50.00**	44.2 dB
LAeq	45.2 dB	**LAI66.60**	43.8 dB
LAIeq - LAeq	1.7 dB	**LAI90.00**	43.1 dB
# Overloads	0		

Noise Measurement
Field Data

Project Name: Terracina Redlands **Date:** November 22, 2019

Project #: JN 19-0208

Noise Measurement #: NM4 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Gallagher

Nearest Address or Cross Street: 10 Panorama drive, Redlands, California.

Site Description (Type of Existing Land Use and any other notable features): Project site: Empty land, vegetation, rocks & dirt, hilly mostly sloping down.
Adjacent to Project Site: 10 Freeway running East-West immediately S of site, residential N, S and W of Site, mostly open, empty, hilly land E of site.
Noise Measurement Site: Vacant lot south, Panorama Drive north, residential uses surrouding.

Weather: Sunny, about 20% cloud. **Settings:** SLOW FAST

Temperature: 62 deg F **Wind:** 3-5 mph **Humidity:** 39% **Terrain:** Hilly

Start Time: 1:40 PM **End Time:** 1:55 PM **Run Time:**

Leq: 49 dB **Primary Noise Source:** Bird song, overhead propeller and jet aircraft, distant lawn mower.

Lmax 63.7 dB

L2 59.5 dB **Secondary Noise Sources:** Very distant traffic ambiance from the 10 Freeway.

L8 51.3 dB

L25 46.0 dB

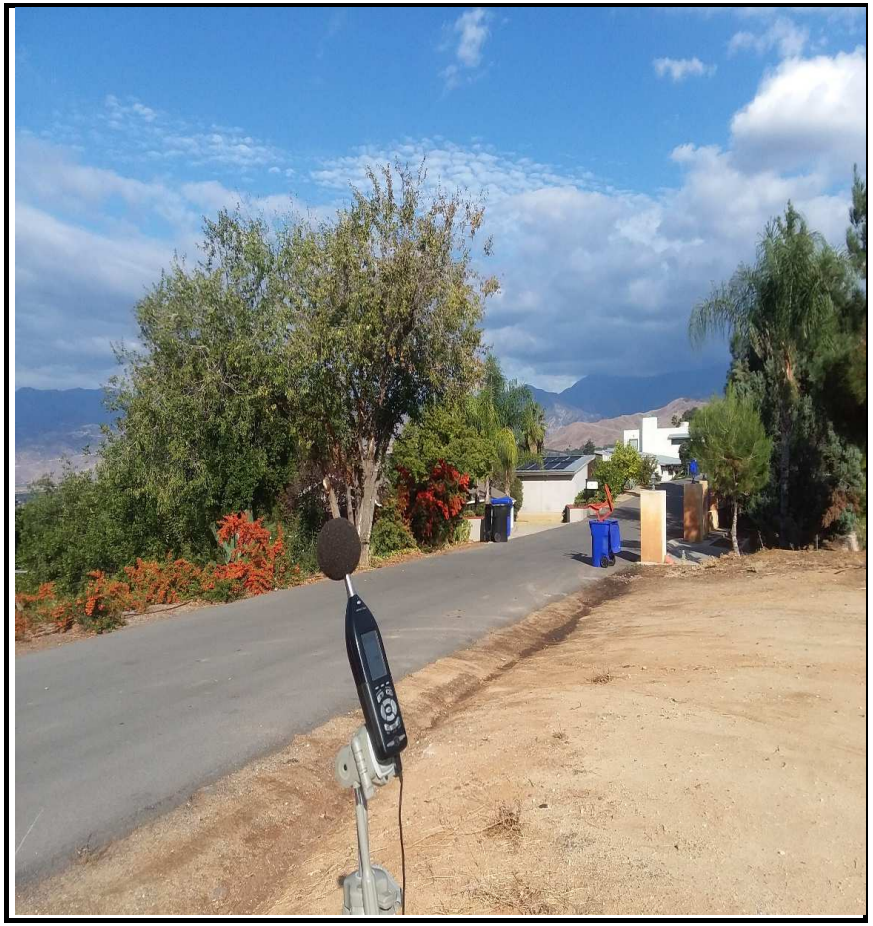
L50 44.7 dB

NOISE METER:	SoundTrack LXT Class 1	**CALIBRATOR:**	Larson Davis CAL250
MAKE:	Larson Davis	**MAKE:**	Larson Davis
MODEL:	LXT1	**MODEL:**	Cal 250
SERIAL NUMBER:	3099	**SERIAL NUMBER:**	2733
FACTORY CALIBRATION DATE:	6/23/2017	**FACTORY CALIBRATION DATE:**	8/9/2017
FIELD CALIBRATION DATE:	11/22/2019		

Noise Measurement
Field Data

PHOTOS:

NM4 looking SW towards residence 10 Panorama Drive, Redlands.



NM4 looking E along Panorama Drive towards 11 Panorama Drive, Redlands.

Summary			
File Name on Meter	LxT_Data.290		
File Name on PC	SLM_0003099_LxT_Data_290.00.ldbin		
Serial Number	0003099		
Model	SoundTrack LxT®		
Firmware Version	2.301		
User	Ian Edward Gallagher		
Location	NM4 JN 19-0208 Redlands 34° 2'15.29"N 117° 8'14.51"W		
Job Description	15 minute noise measurement (1 x 15 minutes)		
Measurement			
Start	2019-11-22 13:40:29		
Stop	2019-11-22 13:55:29		
Duration	00:15:00.0		
Run Time	00:15:00.0		
Pause	00:00:00.0		
Pre Calibration	2019-11-22 13:40:04		
Post Calibration	None		
Overall Settings			
RMS Weight	A Weighting		
Peak Weight	Z Weighting		
Detector	Slow		
Preamp	PRMLxT1L		
Microphone Correction	Off		
Integration Method	Linear		
OBA Range	Low		
OBA Bandwidth	1/1 and 1/3		
OBA Freq. Weighting	Z Weighting		
OBA Max Spectrum	Bin Max		
Overload	122.6 dB		
Results			
LAeq	49.0		
LAE	78.6		
EA	8.003 µPa²h		
EA8	256.086 µPa²h		
EA40	1.280 mPa²h		
LZpeak (max)	2019-11-22 13:43:01	89.3 dB	
LASmax	2019-11-22 13:43:06	63.7 dB	
LASmin	2019-11-22 13:50:32	42.2 dB	
SEA	-99.9 dB		
		Statistics	
LCeq	60.8 dB	**LAI2.00**	59.5 dB
LAeq	49.0 dB	**LAI8.00**	51.3 dB
LCeq - LAeq	11.8 dB	**LAI25.00**	46.0 dB
LAIeq	51.2 dB	**LAI50.00**	44.7 dB
LAeq	49.0 dB	**LAI66.60**	44.2 dB
LAIeq - LAeq	2.2 dB	**LAI90.00**	43.4 dB
# Overloads	0		

Noise Measurement
Field Data

Project Name: Terracina Redlands **Date:** November 22, 2019

Project #: JN 19-0208

Noise Measurement #: NM5 Run Time: 15 minutes (1 x 15 minutes) **Technician:** Ian Gallagher

Nearest Address or Cross Street: 854 Wabash Avenue, Redlands, California

Site Description (Type of Existing Land Use and any other notable features): Project site: Empty land, vegetation, rocks & dirt, hilly mostly sloping down.
Adjacent to Project Site: 10 Freeway running East-West immediately S of site, residential N, S and W of Site, mostly open, empty, hilly land E of site.
Noise Measurement Site: Wabash Ave to east, vacant land to south, west, and further east, and residential to north.

Weather: Sunny, about 20% cloud. **Settings:** SLOW FAST

Temperature: 62 deg F **Wind:** 3-5 mph **Humidity:** 39% **Terrain:** Hilly

Start Time: 2:20 PM **End Time:** 2:35 PM **Run Time:**

Leq: 65.7 dB **Primary Noise Source:** Bird song, overhead propeller and jet aircraft, distant lawn mower.

Lmax 77.7 dB

L2 67.7 dB **Secondary Noise Sources:** Very distant traffic ambiance from the 10 Freeway.

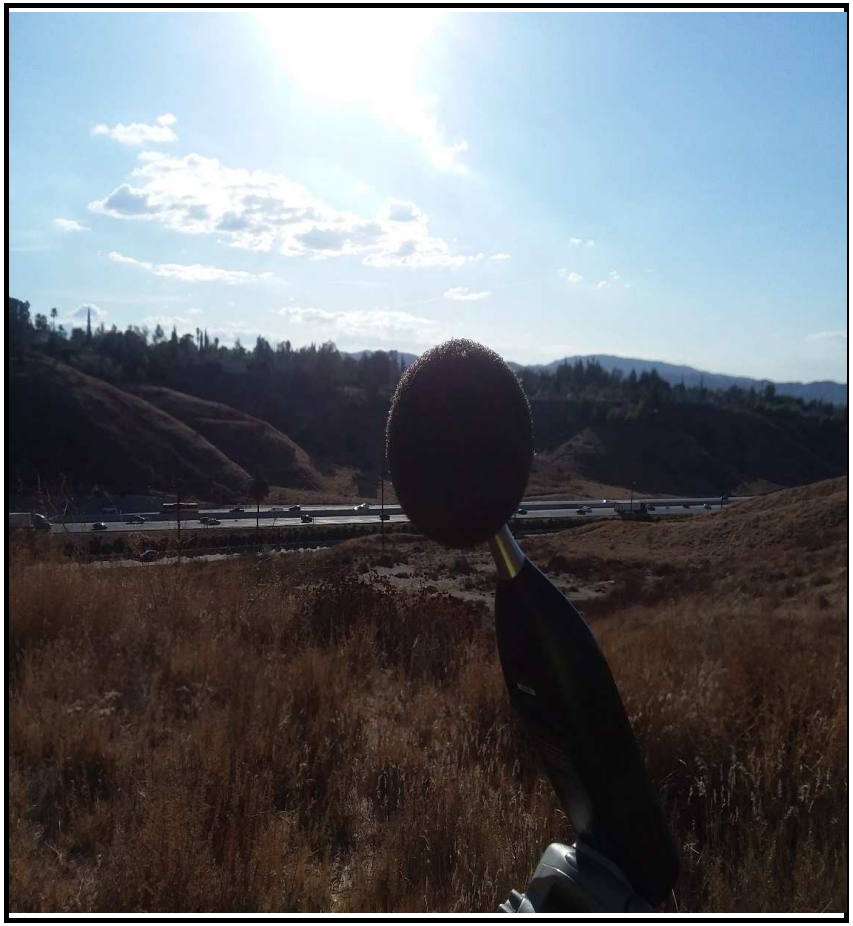
L8 67.1 dB

L25 66.2 dB

L50 65.4 dB

NOISE METER:	SoundTrack LXT Class 1	**CALIBRATOR:**	Larson Davis CAL250
MAKE:	Larson Davis	**MAKE:**	Larson Davis
MODEL:	LXT1	**MODEL:**	Cal 250
SERIAL NUMBER:	3099	**SERIAL NUMBER:**	2733
FACTORY CALIBRATION DATE:	6/23/2017	**FACTORY CALIBRATION DATE:**	8/9/2017
FIELD CALIBRATION DATE:	11/22/2019		

PHOTOS:



NM5 looking south down slope towards 10 Freeway.

NM5 looking NW towards residence 854 Wabash Avenue, Redlands.

Summary		
File Name on Meter	LxT_Data.291	
File Name on PC	SLM_0003099_LxT_Data_291.00.ldbin	
Serial Number	0003099	
Model	SoundTrack LxT®	
Firmware Version	2.301	
User	Ian Edward Gallagher	
Location	NM5 JN 19-0208 Redlands 34° 2'9.43"N 117° 8'20.00"W	
Job Description	15 minute noise measurement (1 x 15 minutes)	
Measurement		
Start	2019-11-22 14:20:32	
Stop	2019-11-22 14:35:32	
Duration	00:15:00.0	
Run Time	00:15:00.0	
Pause	00:00:00.0	
Pre Calibration	2019-11-22 14:20:07	
Post Calibration	None	
Overall Settings		
RMS Weight	A Weighting	
Peak Weight	Z Weighting	
Detector	Slow	
Preamp	PRMLxT1L	
Microphone Correction	Off	
Integration Method	Linear	
OBA Range	Low	
OBA Bandwidth	1/1 and 1/3	
OBA Freq. Weighting	Z Weighting	
OBA Max Spectrum	Bin Max	
Overload	122.7 dB	
Results		
LA_{eq}	65.7	
LAE	95.2	
EA	368.078 µPa²h	
EA8	11.779 mPa²h	
EA40	58.892 mPa²h	
$LZ_{peak\ (max)}$	2019-11-22 14:30:38	98.7 dB
LAS_{max}	2019-11-22 14:29:08	77.7 dB
LAS_{min}	2019-11-22 14:35:26	60.9 dB
SEA	-99.9 dB	

		Statistics	
LC_{eq}	69.7 dB	**LAI2.00**	67.7 dB
LA_{eq}	65.7 dB	**LAI8.00**	67.1 dB
LC_{eq} - LA_{eq}	4.0 dB	**LAI25.00**	66.2 dB
LAI_{eq}	66.7 dB	**LAI50.00**	65.4 dB
LA_{eq}	65.7 dB	**LAI66.60**	64.8 dB
LAI_{eq} - LA_{eq}	1.0 dB	**LAI90.00**	63.5 dB
# Overloads	0		

APPENDIX D

CONSTRUCTION NOISE CALCULATIONS

Receptor - Residential to Southwest (Phase 1) (along Sophia Court)

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading									
Excavator	3	85	550	40	1.2	-20.8	0.8	64.2	65.0
Grader	2	85	550	40	0.80	-20.8	-1.0	64.2	63.2
Rubber Tired Dozers	2	85	550	40	0.80	-20.8	-1.0	64.2	63.2
Scrapers	2	85	550	40	0.80	-20.8	-1.0	64.2	63.2
Tractors/Loaders/Backhoes	2	84	550	40	0.80	-20.8	-1.0	63.2	62.2
							Log Sum		70.4
Building Construction									
Cranes	2	83	550	16	0.32	-20.8	-4.9	62.2	57.2
Forklifts [2]	4	48	550	40	1.60	-20.8	2.0	27.2	29.2
Generator Set	2	81	550	50	1.00	-20.8	0.0	60.2	60.2
Welders	2	74	550	40	0.80	-20.8	-1.0	53.2	52.2
Tractors/Loaders/Backhoes	4	84	550	40	1.60	-20.8	2.0	63.2	65.2
							Log Sum		67.0
Paving									
Pavers	2	77	550	50	1.00	-20.8	0.0	56.2	56.2
Paving Equipment	2	85	550	20	0.40	-20.8	-4.0	64.2	60.2
Rollers	2	80	550	20	0.40	-20.8	-4.0	59.2	55.2
							Log Sum		62.5
Architectural Coating									
Air Compressors	1	80	550	40	0.40	-20.8	-4.0	59.2	55.2
							Log Sum		55.2

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of project site (Phase 1 or Phase 2). Construction noise projected from the center of the project site to nearest residential property line.

Receptor - Residential to West (Phase 1) (along Sophia Court & Buckingham Drive)

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading									
Excavator	3	85	585	40	1.2	-21.4	0.8	63.6	64.4
Grader	2	85	585	40	0.80	-21.4	-1.0	63.6	62.7
Rubber Tired Dozers	2	85	585	40	0.80	-21.4	-1.0	63.6	62.7
Scrapers	2	85	585	40	0.80	-21.4	-1.0	63.6	62.7
Tractors/Loaders/Backhoes	2	84	585	40	0.80	-21.4	-1.0	62.6	61.7
							Log Sum		69.9
Building Construction									
Cranes	2	83	585	16	0.32	-21.4	-4.9	61.6	56.7
Forklifts [2]	4	48	585	40	1.60	-21.4	2.0	26.6	28.7
Generator Set	2	81	585	50	1.00	-21.4	0.0	59.6	59.6
Welders	2	74	585	40	0.80	-21.4	-1.0	52.6	51.7
Tractors/Loaders/Backhoes	4	84	585	40	1.60	-21.4	2.0	62.6	64.7
							Log Sum		66.5
Paving									
Pavers	2	77	585	50	1.00	-21.4	0.0	55.6	55.6
Paving Equipment	2	85	585	20	0.40	-21.4	-4.0	63.6	59.7
Rollers	2	80	585	20	0.40	-21.4	-4.0	58.6	54.7
							Log Sum		62.0
Architectural Coating									
Air Compressors	1	80	585	40	0.40	-21.4	-4.0	58.6	54.7
							Log Sum		54.7

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of project site (Phase 1 or Phase 2). Construction noise projected from the center of the project site to nearest residential property line.

Receptor - Residential to Northwest (Phase 1) (Buckingham Drive)

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading									
Excavator	3	85	719	40	1.2	-23.2	0.8	61.8	62.6
Grader	2	85	719	40	0.80	-23.2	-1.0	61.8	60.9
Rubber Tired Dozers	2	85	719	40	0.80	-23.2	-1.0	61.8	60.9
Scrapers	2	85	719	40	0.80	-23.2	-1.0	61.8	60.9
Tractors/Loaders/Backhoes	2	84	719	40	0.80	-23.2	-1.0	60.8	59.9
							Log Sum		68.1
Building Construction									
Cranes	2	83	719	16	0.32	-23.2	-4.9	59.8	54.9
Forklifts [2]	4	48	719	40	1.60	-23.2	2.0	24.8	26.9
Generator Set	2	81	719	50	1.00	-23.2	0.0	57.8	57.8
Welders	2	74	719	40	0.80	-23.2	-1.0	50.8	49.9
Tractors/Loaders/Backhoes	4	84	719	40	1.60	-23.2	2.0	60.8	62.9
							Log Sum		64.7
Paving									
Pavers	2	77	719	50	1.00	-23.2	0.0	53.8	53.8
Paving Equipment	2	85	719	20	0.40	-23.2	-4.0	61.8	57.9
Rollers	2	80	719	20	0.40	-23.2	-4.0	56.8	52.9
							Log Sum		60.2
Architectural Coating									
Air Compressors	1	80	719	40	0.40	-23.2	-4.0	56.8	52.9
							Log Sum		52.9

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of project site (Phase 1 or Phase 2). Construction noise projected from the center of the project site to nearest residential property line.

Receptor - Residential to North (Phase 1) (Camelot Drive/Daisy Avenue)

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading									
Excavator	3	85	844	40	1.2	-24.5	0.8	60.5	61.2
Grader	2	85	844	40	0.80	-24.5	-1.0	60.5	59.5
Rubber Tired Dozers	2	85	844	40	0.80	-24.5	-1.0	60.5	59.5
Scrapers	2	85	844	40	0.80	-24.5	-1.0	60.5	59.5
Tractors/Loaders/Backhoes	2	84	844	40	0.80	-24.5	-1.0	59.5	58.5
							Log Sum		66.7
Building Construction									
Cranes	2	83	844	16	0.32	-24.5	-4.9	58.5	53.5
Forklifts [2]	4	48	844	40	1.60	-24.5	2.0	23.5	25.5
Generator Set	2	81	844	50	1.00	-24.5	0.0	56.5	56.5
Welders	2	74	844	40	0.80	-24.5	-1.0	49.5	48.5
Tractors/Loaders/Backhoes	4	84	844	40	1.60	-24.5	2.0	59.5	61.5
							Log Sum		63.3
Paving									
Pavers	2	77	844	50	1.00	-24.5	0.0	52.5	52.5
Paving Equipment	2	85	844	20	0.40	-24.5	-4.0	60.5	56.5
Rollers	2	80	844	20	0.40	-24.5	-4.0	55.5	51.5
							Log Sum		58.8
Architectural Coating									
Air Compressors	1	80	844	40	0.40	-24.5	-4.0	55.5	51.5
							Log Sum		51.5

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of project site (Phase 1 or Phase 2). Construction noise projected from the center of the project site to nearest residential property line.

Receptor - Residential to Northeast (Phase 1) (Wabash Avenue)

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading									
Excavator	3	85	830	40	1.2	-24.4	0.8	60.6	61.4
Grader	2	85	830	40	0.80	-24.4	-1.0	60.6	59.6
Rubber Tired Dozers	2	85	830	40	0.80	-24.4	-1.0	60.6	59.6
Scrapers	2	85	830	40	0.80	-24.4	-1.0	60.6	59.6
Tractors/Loaders/Backhoes	2	84	830	40	0.80	-24.4	-1.0	59.6	58.6
							Log Sum		66.9
Building Construction									
Cranes	2	83	830	16	0.32	-24.4	-4.9	58.6	53.6
Forklifts [2]	4	48	830	40	1.60	-24.4	2.0	23.6	25.6
Generator Set	2	81	830	50	1.00	-24.4	0.0	56.6	56.6
Welders	2	74	830	40	0.80	-24.4	-1.0	49.6	48.6
Tractors/Loaders/Backhoes	4	84	830	40	1.60	-24.4	2.0	59.6	61.6
							Log Sum		63.5
Paving									
Pavers	2	77	830	50	1.00	-24.4	0.0	52.6	52.6
Paving Equipment	2	85	830	20	0.40	-24.4	-4.0	60.6	56.6
Rollers	2	80	830	20	0.40	-24.4	-4.0	55.6	51.6
							Log Sum		59.0
Architectural Coating									
Air Compressors	1	80	830	40	0.40	-24.4	-4.0	55.6	51.6
							Log Sum		51.6

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of project site (Phase 1 or Phase 2). Construction noise projected from the center of the project site to nearest residential property line.

Receptor - Residential to East (Phase 1) (Wabash Avenue)

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading									
Excavator	3	85	442	40	1.2	-18.9	0.8	66.1	66.9
Grader	2	85	442	40	0.80	-18.9	-1.0	66.1	65.1
Rubber Tired Dozers	2	85	442	40	0.80	-18.9	-1.0	66.1	65.1
Scrapers	2	85	442	40	0.80	-18.9	-1.0	66.1	65.1
Tractors/Loaders/Backhoes	2	84	442	40	0.80	-18.9	-1.0	65.1	64.1
							Log Sum		72.3
Building Construction									
Cranes	2	83	442	16	0.32	-18.9	-4.9	64.1	59.1
Forklifts [2]	4	48	442	40	1.60	-18.9	2.0	29.1	31.1
Generator Set	2	81	442	50	1.00	-18.9	0.0	62.1	62.1
Welders	2	74	442	40	0.80	-18.9	-1.0	55.1	54.1
Tractors/Loaders/Backhoes	4	84	442	40	1.60	-18.9	2.0	65.1	67.1
							Log Sum		68.9
Paving									
Pavers	2	77	442	50	1.00	-18.9	0.0	58.1	58.1
Paving Equipment	2	85	442	20	0.40	-18.9	-4.0	66.1	62.1
Rollers	2	80	442	20	0.40	-18.9	-4.0	61.1	57.1
							Log Sum		64.4
Architectural Coating									
Air Compressors	1	80	442	40	0.40	-18.9	-4.0	61.1	57.1
							Log Sum		57.1

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of project site (Phase 1 or Phase 2). Construction noise projected from the center of the project site to nearest residential property line.

Receptor - Residential to Northwest (Phase 2) (Wabash Avenue)

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading									
Excavator	3	85	702	40	1.2	-22.9	0.8	62.1	62.8
Grader	2	85	702	40	0.80	-22.9	-1.0	62.1	61.1
Rubber Tired Dozers	2	85	702	40	0.80	-22.9	-1.0	62.1	61.1
Scrapers	2	85	702	40	0.80	-22.9	-1.0	62.1	61.1
Tractors/Loaders/Backhoes	2	84	702	40	0.80	-22.9	-1.0	61.1	60.1
							Log Sum		68.3
Building Construction									
Cranes	2	83	702	16	0.32	-22.9	-4.9	60.1	55.1
Forklifts [2]	4	48	702	40	1.60	-22.9	2.0	25.1	27.1
Generator Set	2	81	702	50	1.00	-22.9	0.0	58.1	58.1
Welders	2	74	702	40	0.80	-22.9	-1.0	51.1	50.1
Tractors/Loaders/Backhoes	4	84	702	40	1.60	-22.9	2.0	61.1	63.1
							Log Sum		64.9
Paving									
Pavers	2	77	702	50	1.00	-22.9	0.0	54.1	54.1
Paving Equipment	2	85	702	20	0.40	-22.9	-4.0	62.1	58.1
Rollers	2	80	702	20	0.40	-22.9	-4.0	57.1	53.1
							Log Sum		60.4
Architectural Coating									
Air Compressors	1	80	702	40	0.40	-22.9	-4.0	57.1	53.1
							Log Sum		53.1

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of project site (Phase 1 or Phase 2). Construction noise projected from the center of the project site to nearest residential property line.

Receptor - Residential to North (Phase 2) (Panorama Drive)

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading									
Excavator	3	85	488	40	1.2	-19.8	0.8	65.2	66.0
Grader	2	85	488	40	0.80	-19.8	-1.0	65.2	64.2
Rubber Tired Dozers	2	85	488	40	0.80	-19.8	-1.0	65.2	64.2
Scrapers	2	85	488	40	0.80	-19.8	-1.0	65.2	64.2
Tractors/Loaders/Backhoes	2	84	488	40	0.80	-19.8	-1.0	64.2	63.2
							Log Sum		71.5
Building Construction									
Cranes	2	83	488	16	0.32	-19.8	-4.9	63.2	58.3
Forklifts [2]	4	48	488	40	1.60	-19.8	2.0	28.2	30.3
Generator Set	2	81	488	50	1.00	-19.8	0.0	61.2	61.2
Welders	2	74	488	40	0.80	-19.8	-1.0	54.2	53.2
Tractors/Loaders/Backhoes	4	84	488	40	1.60	-19.8	2.0	64.2	66.3
							Log Sum		68.1
Paving									
Pavers	2	77	488	50	1.00	-19.8	0.0	57.2	57.2
Paving Equipment	2	85	488	20	0.40	-19.8	-4.0	65.2	61.2
Rollers	2	80	488	20	0.40	-19.8	-4.0	60.2	56.2
							Log Sum		63.6
Architectural Coating									
Air Compressors	1	80	488	40	0.40	-19.8	-4.0	60.2	56.2
							Log Sum		56.2

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of project site (Phase 1 or Phase 2). Construction noise projected from the center of the project site to nearest residential property line.

Receptor - Residential to Northeast (Phase 2) (Panorama Drive)

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading									
Excavator	3	85	1397	40	1.2	-28.9	0.8	56.1	56.9
Grader	2	85	1397	40	0.80	-28.9	-1.0	56.1	55.1
Rubber Tired Dozers	2	85	1397	40	0.80	-28.9	-1.0	56.1	55.1
Scrapers	2	85	1397	40	0.80	-28.9	-1.0	56.1	55.1
Tractors/Loaders/Backhoes	2	84	1397	40	0.80	-28.9	-1.0	55.1	54.1
							Log Sum		62.3
Building Construction									
Cranes	2	83	1397	16	0.32	-28.9	-4.9	54.1	49.1
Forklifts [2]	4	48	1397	40	1.60	-28.9	2.0	19.1	21.1
Generator Set	2	81	1397	50	1.00	-28.9	0.0	52.1	52.1
Welders	2	74	1397	40	0.80	-28.9	-1.0	45.1	44.1
Tractors/Loaders/Backhoes	4	84	1397	40	1.60	-28.9	2.0	55.1	57.1
							Log Sum		58.9
Paving									
Pavers	2	77	1397	50	1.00	-28.9	0.0	48.1	48.1
Paving Equipment	2	85	1397	20	0.40	-28.9	-4.0	56.1	52.1
Rollers	2	80	1397	20	0.40	-28.9	-4.0	51.1	47.1
							Log Sum		54.4
Architectural Coating									
Air Compressors	1	80	1397	40	0.40	-28.9	-4.0	51.1	47.1
							Log Sum		47.1

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of project site (Phase 1 or Phase 2). Construction noise projected from the center of the project site to nearest residential property line.

Receptor - Residential Dwelling Unit to Southeast (Phase 2)

Construction Phase Equipment Item	# of Items	Item Lmax at 50 feet, dBA[1]	Distance to Receptor[3]	Item Usage Percent	Usage Factor	Dist. Correction dB	Usage Adj. dB	Receptor Item Lmax, dBA	Receptor Item Leq, dBA
Grading									
Excavator	3	85	1833	40	1.2	-31.3	0.8	53.7	54.5
Grader	2	85	1833	40	0.80	-31.3	-1.0	53.7	52.7
Rubber Tired Dozers	2	85	1833	40	0.80	-31.3	-1.0	53.7	52.7
Scrapers	2	85	1833	40	0.80	-31.3	-1.0	53.7	52.7
Tractors/Loaders/Backhoes	2	84	1833	40	0.80	-31.3	-1.0	52.7	51.7
							Log Sum		60.0
Building Construction									
Cranes	2	83	1833	16	0.32	-31.3	-4.9	51.7	46.8
Forklifts [2]	4	48	1833	40	1.60	-31.3	2.0	16.7	18.8
Generator Set	2	81	1833	50	1.00	-31.3	0.0	49.7	49.7
Welders	2	74	1833	40	0.80	-31.3	-1.0	42.7	41.7
Tractors/Loaders/Backhoes	4	84	1833	40	1.60	-31.3	2.0	52.7	54.8
							Log Sum		56.6
Paving									
Pavers	2	77	1833	50	1.00	-31.3	0.0	45.7	45.7
Paving Equipment	2	85	1833	20	0.40	-31.3	-4.0	53.7	49.7
Rollers	2	80	1833	20	0.40	-31.3	-4.0	48.7	44.7
							Log Sum		52.1
Architectural Coating									
Air Compressors	1	80	1833	40	0.40	-31.3	-4.0	48.7	44.7
							Log Sum		44.7

Notes:

(1) Source: Referenced noise levels from the Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment Manual (September 2018) and the FHWA Roadway Construction Noise Model User's Guide (January 2006)

(2) Source: SoundPLAN reference list.

(3) Distance to receptor calculated from center of project site (Phase 1 or Phase 2). Construction noise projected from the center of the project site to nearest residential property line.

APPENDIX E

FHWA WORKSHEETS

Existing Traffic Noise

1	:Id	Vehicle Distribution (Heavy Truck Mix)				ADT	9500		
Ford Street	:Road	Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow	Speed	40	
North of Reservoir Road	:Segment	Automobiles	75.54	14.02	10.43	92.00	Distance	36	
		Medium Trucks	48.00	2.00	50.00	3.00	Left Angle	-90	
		Heavy Trucks	48.00	2.00	50.00	5.00	Right Angle	90	

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	550.18	11.40	19.00	408.45	1.90	3.17	101.29	15.83	26.39
Speed in MPH	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	67.36	76.31	81.16	67.36	76.31	81.16	67.36	76.31	81.16
ADJUSTMENTS									
Flow	21.08	4.24	6.46	19.78	-3.54	-1.32	13.73	5.67	7.89
Distance	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	64.80	56.91	63.98	63.50	49.13	56.20	57.45	58.34	65.40
	DAY LEQ	67.79		EVENING LEQ	64.37		NIGHT LEQ	66.73	

F		CNEL	73.37	Day hour	89.00
		DAY LEQ	67.79	Absorptive?	no
				Use hour?	no
				GRADE dB	0.00

Notes:

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

(2) Vehicle percentages based on County of Riverside heavy truck mix.

Existing Plus Project Traffic Noise

1	:Id
Ford Street	:Road
North of Reservoir Road	:Segment

Vehicle Distribution (Heavy Truck Mix)				
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow
Automobiles	75.54	14.02	10.43	92.00
Medium Trucks	48.00	2.00	50.00	3.00
Heavy Trucks	48.00	2.00	50.00	5.00

ADT	9600
Speed	40
Distance	36
Left Angle	-90
Right Angle	90

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	555.97	11.52	19.20	412.75	1.92	3.20	102.35	16.00	26.67
Speed in MPH	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	67.36	76.31	81.16	67.36	76.31	81.16	67.36	76.31	81.16
ADJUSTMENTS									
Flow	21.12	4.29	6.51	19.83	-3.49	-1.27	13.77	5.71	7.93
Distance	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	64.84	56.96	64.02	63.55	49.18	56.24	57.49	58.38	65.45
	DAY LEQ	67.83		EVENING LEQ	64.42		NIGHT LEQ	66.77	

CNEL	73.42
DAY LEQ	67.83

Day hour	89.00
Absorptive?	no
Use hour?	no
GRADE dB	0.00

Notes:

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

(2) Vehicle percentages based on County of Riverside heavy truck mix.

Existing Traffic Noise

2	:Id
Reservoir Road	:Road
Ford Street to Wabash Avenue	:Segment

Vehicle Distribution (Light Truck Mix)				
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow
Automobiles	75.56	13.96	10.49	97.40
Medium Trucks	48.91	2.17	48.91	1.84
Heavy Trucks	47.30	5.41	47.30	0.74

ADT	3500
Speed	45
Distance	32
Left Angle	-90
Right Angle	90

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	214.65	2.62	1.02	158.63	0.47	0.47	39.73	3.50	1.36
Speed in MPH	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	69.34	77.62	82.14	69.34	77.62	82.14	69.34	77.62	82.14
ADJUSTMENTS									
Flow	16.48	-2.65	-6.75	15.17	-10.16	-10.14	9.15	-1.40	-5.50
Distance	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	62.69	51.84	52.26	61.38	44.33	48.87	55.37	53.09	53.51
	DAY LEQ	63.38		EVENING LEQ	61.70		NIGHT LEQ	58.88	

CNEL	66.60
DAY LEQ	63.38

Day hour	90.00
Absorptive?	no
Use hour?	no
GRADE dB	1.00

Notes:

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

(2) Vehicle percentages based on County of Riverside light truck mix.

Existing Plus Project Traffic Noise

2	:Id
Reservoir Road	:Road
Ford Street to Wabash Avenue	:Segment

Vehicle Distribution (Light Truck Mix)				
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow
Automobiles	75.56	13.96	10.49	97.40
Medium Trucks	48.91	2.17	48.91	1.84
Heavy Trucks	47.30	5.41	47.30	0.74

ADT	3800
Speed	45
Distance	32
Left Angle	-90
Right Angle	90

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	233.05	2.85	1.11	172.23	0.51	0.51	43.14	3.80	1.48
Speed in MPH	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00	45.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	69.34	77.62	82.14	69.34	77.62	82.14	69.34	77.62	82.14
ADJUSTMENTS									
Flow	16.84	-2.29	-6.39	15.52	-9.80	-9.79	9.51	-1.04	-5.14
Distance	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	63.05	52.20	52.62	61.74	44.69	49.22	55.72	53.45	53.87
	DAY LEQ	63.74		EVENING LEQ	62.05		NIGHT LEQ	59.24	

CNEL	**66.96**
DAY LEQ	63.74

Day hour	90.00
Absorptive?	no
Use hour?	no
GRADE dB	1.00

Notes:

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

(2) Vehicle percentages based on County of Riverside light truck mix.

Existing Traffic Noise

3	:Id	Vehicle Distribution (Heavy Truck Mix)				ADT	400		
Wabash Avenue	:Road	Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow	Speed	10	
North of Panorama Drive	:Segment	Automobiles	75.54	14.02	10.43	92.00	Distance	36	
		Medium Trucks	48.00	2.00	50.00	3.00	Left Angle	-90	
		Heavy Trucks	48.00	2.00	50.00	5.00	Right Angle	90	

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	23.17	0.48	0.80	17.20	0.08	0.13	4.26	0.67	1.11
Speed in MPH	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	44.00	60.90	69.60	44.00	60.90	69.60	44.00	60.90	69.60
ADJUSTMENTS									
Flow	13.34	-3.49	-1.27	12.05	-11.27	-9.06	5.99	-2.07	0.15
Distance	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	33.70	33.76	44.68	32.41	25.98	36.90	26.35	35.19	46.11
	DAY LEQ	45.33		EVENING LEQ	38.47		NIGHT LEQ	46.49	

CNEL	52.72	Day hour	91.00
DAY LEQ	45.33	Absorptive?	no
		Use hour?	no
		GRADE dB	2.00

Notes:

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

(2) Vehicle percentages based on County of Riversideheavy truck mix.

Existing Plus Project Traffic Noise

3	:Id	Vehicle Distribution (Heavy Truck Mix)				ADT	500
Wabash Avenue	:Road	Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow	Speed	10
North of Panorama Drive	:Segment	Automobiles	75.54	14.02	10.43	92.00	Distance	36
		Medium Trucks	48.00	2.00	50.00	3.00	Left Angle	-90
		Heavy Trucks	48.00	2.00	50.00	5.00	Right Angle	90

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	28.96	0.60	1.00	21.50	0.10	0.17	5.33	0.83	1.39
Speed in MPH	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	44.00	60.90	69.60	44.00	60.90	69.60	44.00	60.90	69.60
ADJUSTMENTS									
Flow	14.31	-2.52	-0.31	13.02	-10.31	-8.09	6.96	-1.10	1.12
Distance	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	34.67	34.73	45.65	33.37	26.95	37.87	27.32	36.16	47.08
	DAY LEQ	46.30		EVENING LEQ	39.44		NIGHT LEQ	47.46	

CNEL	53.69	Day hour	91.00
DAY LEQ	46.30	Absorptive?	no
		Use hour?	no
		GRADE dB	2.00

Notes:

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

(2) Vehicle percentages based on County of Riverside heavy truck mix.

Existing Traffic Noise

4	:Id
0.00	:Road
Panorama Drive to Reservoir Road	:Segment

Vehicle Distribution (Heavy Truck Mix)				
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow
Automobiles	75.54	14.02	10.43	92.00
Medium Trucks	48.00	2.00	50.00	3.00
Heavy Trucks	48.00	2.00	50.00	5.00

ADT	400
Speed	10
Distance	36
Left Angle	-90
Right Angle	90

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	23.17	0.48	0.80	17.20	0.08	0.13	4.26	0.67	1.11
Speed in MPH	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	44.00	60.90	69.60	44.00	60.90	69.60	44.00	60.90	69.60
ADJUSTMENTS									
Flow	13.34	-3.49	-1.27	12.05	-11.27	-9.06	5.99	-2.07	0.15
Distance	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	33.70	33.76	44.68	32.41	25.98	36.90	26.35	35.19	46.11
	DAY LEQ	45.33		EVENING LEQ	38.47		NIGHT LEQ	46.49	

CNEL	52.72
DAY LEQ	45.33

Day hour	92.00
Absorptive?	no
Use hour?	no
GRADE dB	3.00

Notes:

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

(2) Vehicle percentages based on County of Riverside heavy truck mix.

Existing Plus Project Traffic Noise

4	:Id
0.00	:Road
Panorama Drive to Reservoir Road	:Segment

Vehicle Distribution (Heavy Truck Mix)				
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow
Automobiles	75.54	14.02	10.43	92.00
Medium Trucks	48.00	2.00	50.00	3.00
Heavy Trucks	48.00	2.00	50.00	5.00

ADT	900
Speed	10
Distance	36
Left Angle	-90
Right Angle	90

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	52.12	1.08	1.80	38.70	0.18	0.30	9.60	1.50	2.50
Speed in MPH	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	44.00	60.90	69.60	44.00	60.90	69.60	44.00	60.90	69.60
ADJUSTMENTS									
Flow	16.86	0.03	2.25	15.57	-7.75	-5.53	9.51	1.46	3.67
Distance	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36	1.36
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	37.22	37.29	48.20	35.93	29.50	40.42	29.87	38.71	49.63
	DAY LEQ	48.85		EVENING LEQ	41.99		NIGHT LEQ	50.01	

CNEL	56.24
DAY LEQ	48.85

Day hour	92.00
Absorptive?	no
Use hour?	no
GRADE dB	3.00

Notes:

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

(2) Vehicle percentages based on County of Riverside heavy truck mix.

Existing Traffic Noise

5	:Id
0.00	:Road
Reservoir Road to Interstate 10 Freeway	:Segment

Vehicle Distribution (Light Truck Mix)				
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow
Automobiles	75.56	13.96	10.49	97.40
Medium Trucks	48.91	2.17	48.91	1.84
Heavy Trucks	47.30	5.41	47.30	0.74

ADT	3400
Speed	25
Distance	32
Left Angle	-90
Right Angle	90

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	208.52	2.55	0.99	154.10	0.45	0.45	38.60	3.40	1.32
Speed in MPH	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	59.44	71.09	77.24	59.44	71.09	77.24	59.44	71.09	77.24
ADJUSTMENTS									
Flow	18.91	-0.22	-4.32	17.59	-7.73	-7.72	11.58	1.03	-3.07
Distance	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	55.21	47.74	49.79	53.90	40.23	46.39	47.89	48.98	51.04
	DAY LEQ	56.87		EVENING LEQ	54.77		NIGHT LEQ	54.28	

CNEL	61.35
DAY LEQ	56.87

Day hour	93.00
Absorptive?	no
Use hour?	no
GRADE dB	4.00

Notes:

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

(2) Vehicle percentages based on County of Riverside light truck mix.

Existing Plus Project Traffic Noise

5	:Id
0.00	:Road
Reservoir Road to Interstate 10 Freeway	:Segment

Vehicle Distribution (Light Truck Mix)				
Motor-Vehicle Type	Daytime % (7 AM - 7 PM)	Evening % (7 PM - 10 PM)	Night % (10 PM - 7 AM)	Total % of Traffic Flow
Automobiles	75.56	13.96	10.49	97.40
Medium Trucks	48.91	2.17	48.91	1.84
Heavy Trucks	47.30	5.41	47.30	0.74

ADT	3600
Speed	25
Distance	32
Left Angle	-90
Right Angle	90

	Daytime			Evening			Night		
Noise Parameters	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks	Autos	Medium Trucks	Heavy Trucks
INPUT PARAMETERS									
Vehicles per hour	220.79	2.70	1.05	163.16	0.48	0.48	40.87	3.60	1.40
Speed in MPH	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
Left angle	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00	-90.00
Right angle	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00	90.00
NOISE CALCULATIONS									
Reference levels	59.44	71.09	77.24	59.44	71.09	77.24	59.44	71.09	77.24
ADJUSTMENTS									
Flow	19.15	0.03	-4.07	17.84	-7.48	-7.47	11.83	1.28	-2.82
Distance	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87	1.87
Finite Roadway	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Barrier	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00	-25.00
LEQ	55.46	47.98	50.04	54.15	40.47	46.64	48.14	49.23	51.28
	DAY LEQ	57.12		EVENING LEQ	55.01		NIGHT LEQ	54.52	

CNEL	61.60
DAY LEQ	57.12

Day hour	93.00
Absorptive?	no
Use hour?	no
GRADE dB	4.00

Notes:

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

(2) Vehicle percentages based on County of Riverside light truck mix.

APPENDIX F

SOUNDPLAN WORKSHEETS

Noise emissions of road traffic

Statio km	ADT Veh/24	Vehicles type	Vehicle name	Traffic values day Veh/h	evening Veh/h	night Veh/h	Speed km/h	Contr devic	Cons Spee km/h	Affec veh. %	Road surface	Gradien Min / M %
Interstate 10			Traffic direction: In entry direction									
0+00	16000	Total	-	9779	6965	2418	-	none	-	-	Average (of DGAC a	-5.0 / -1
		Automobiles	-	9267	6880	1707	105					
		Medium trucks	-	192	32	267	105					
		Heavy trucks	-	320	53	444	105					
		Buses	-	-	-	-	-					
		Motorcycles	-	-	-	-	-					
		Auxiliary vehicle	-	-	-	-	-					
Wabash Avenue			Traffic direction: In entry direction									
0+00	5000	Total	-	306	218	76	-	none	-	-	Average (of DGAC a	-15.7 / 1
		Automobiles	-	290	215	53	72					
		Medium trucks	-	6	1	8	72					
		Heavy trucks	-	10	2	14	72					
		Buses	-	-	-	-	-					
		Motorcycles	-	-	-	-	-					
		Auxiliary vehicle	-	-	-	-	-					

Receiver list

No.	Receiver name	Building side	Floor	Limit Lden dB(A)	Level w/o NP Lden dB(A)	Level w NP Lden dB(A)	Difference Lden dB	Conflict Lden dB
1	1	-	GF	-	54.6	54.9	0.3	-
			1.Fl	-	59.7	59.7	0.0	-
2	2	-	GF	-	74.1	63.3	-10.8	-
			1.Fl	-	74.7	73.1	-1.6	-
3	3	-	GF	-	70.9	61.0	-9.9	-
			1.Fl	-	71.6	68.9	-2.8	-
4	4	-	GF	-	70.5	60.4	-10.1	-
			1.Fl	-	71.2	70.5	-0.7	-
5	5	-	GF	-	73.7	62.7	-11.0	-
			1.Fl	-	74.3	71.0	-3.3	-
6	6	-	GF	-	69.3	63.6	-5.7	-
			1.Fl	-	71.0	70.3	-0.6	-
7	7	-	GF	-	61.3	61.4	0.1	-
			1.Fl	-	64.5	64.6	0.1	-
8	8	-	GF	-	63.5	63.6	0.1	-
			1.Fl	-	67.2	67.2	0.1	-
9	9	-	GF	-	62.9	62.9	0.0	-
			1.Fl	-	66.7	66.6	0.0	-

Contribution levels of the receivers

Source name		Traffic lane	Level w/o NP Lden dB(A)	Level w NP Lden dB(A)
1	GF		54.6	54.9
Interstate 10		-	54.6	54.9
Wabash Avenue		-	26.2	31.1
1	1.Fl		59.7	59.7
Interstate 10		-	59.7	59.7
Wabash Avenue		-	29.2	33.3
2	GF		74.1	63.3
Interstate 10		-	74.1	63.2
Wabash Avenue		-	45.4	45.9
2	1.Fl		74.7	73.1
Interstate 10		-	74.7	73.1
Wabash Avenue		-	45.7	45.2
3	GF		70.9	61.0
Interstate 10		-	70.8	59.9
Wabash Avenue		-	52.1	54.4
3	1.Fl		71.6	68.9
Interstate 10		-	71.6	68.8
Wabash Avenue		-	52.3	52.7
4	GF		70.5	60.4
Interstate 10		-	70.5	59.6
Wabash Avenue		-	50.6	52.9
4	1.Fl		71.2	70.5
Interstate 10		-	71.2	70.5
Wabash Avenue		-	51.0	50.7
5	GF		73.7	62.7
Interstate 10		-	73.6	61.9
Wabash Avenue		-	53.9	54.9
5	1.Fl		74.3	71.0
Interstate 10		-	74.3	70.9
Wabash Avenue		-	54.6	53.7
6	GF		69.3	63.6
Interstate 10		-	69.0	61.3
Wabash Avenue		-	58.2	59.8
6	1.Fl		71.0	70.3
Interstate 10		-	70.7	69.9
Wabash Avenue		-	59.5	59.8
7	GF		61.3	61.4
Interstate 10		-	60.8	61.0
Wabash Avenue		-	51.3	51.3
7	1.Fl		64.5	64.6
Interstate 10		-	64.2	64.3
Wabash Avenue		-	52.6	52.6
8	GF		63.5	63.6
Interstate 10		-	48.0	47.7
Wabash Avenue		-	63.4	63.5
8	1.Fl		67.2	67.2
Interstate 10		-	53.4	53.3
Wabash Avenue		-	67.0	67.0
9	GF		62.9	62.9
Interstate 10		-	44.5	44.6
Wabash Avenue		-	62.8	62.8
9	1.Fl		66.7	66.6
Interstate 10		-	48.2	48.6
Wabash Avenue		-	66.6	66.6

Noise emissions of road traffic

Statio km	ADT Veh/24	Vehicles type	Vehicle name	Traffic values day Veh/h	evening Veh/h	night Veh/h	Speed km/h	Contr devic	Cons Spee km/h	Affec veh. %	Road surface	Gradier Min / M: %
Interstate 10			Traffic direction: In entry direction									
0+00	16000	Total	-	9779	6965	2418	-	none	-	-	Average (of DGAC a	-5.0 / -1
		Automobiles	-	9267	6880	1707	105					
		Medium trucks	-	192	32	267	105					
		Heavy trucks	-	320	53	444	105					
		Buses	-	-	-	-	-					
		Motorcycles	-	-	-	-	-					
		Auxiliary vehicle	-	-	-	-	-					
Wabash Avenue			Traffic direction: In entry direction									
0+00	5000	Total	-	306	218	76	-	none	-	-	Average (of DGAC a	-15.7 / 1
		Automobiles	-	290	215	53	72					
		Medium trucks	-	6	1	8	72					
		Heavy trucks	-	10	2	14	72					
		Buses	-	-	-	-	-					
		Motorcycles	-	-	-	-	-					
		Auxiliary vehicle	-	-	-	-	-					

Receiver list

No.	Receiver name	Building side	Floor	Limit Lden dB(A)	Level w/o NP Lden dB(A)	Level w NP Lden dB(A)	Difference Lden dB	Conflict Lden dB
1	1	-	GF	-	54.6	54.6	0.0	-
			1.Fl	-	59.7	59.2	-0.5	-
2	2	-	GF	-	74.1	59.3	-14.7	-
			1.Fl	-	74.7	66.2	-8.5	-
3	3	-	GF	-	70.9	59.7	-11.2	-
			1.Fl	-	71.6	65.9	-5.7	-
4	4	-	GF	-	70.5	58.8	-11.8	-
			1.Fl	-	71.2	67.6	-3.6	-
5	5	-	GF	-	73.7	59.9	-13.8	-
			1.Fl	-	74.3	65.0	-9.3	-
6	6	-	GF	-	69.3	60.1	-9.2	-
			1.Fl	-	71.0	61.7	-9.3	-
7	7	-	GF	-	61.3	54.3	-7.0	-
			1.Fl	-	64.5	59.8	-4.7	-
8	8	-	GF	-	63.5	59.4	-4.1	-
			1.Fl	-	67.2	64.1	-3.0	-
9	9	-	GF	-	62.9	54.2	-8.7	-
			1.Fl	-	66.7	57.2	-9.4	-

Contribution levels of the receivers

Source name	Traffic lane	Level w/o NP Lden dB(A)	Level w NP Lden dB(A)
1 GF		54.6	54.6
Interstate 10	-	54.6	54.6
Wabash Avenue	-	26.2	27.3
1 1.Fl		59.7	59.2
Interstate 10	-	59.7	59.2
Wabash Avenue	-	29.2	30.3
2 GF		74.1	59.3
Interstate 10	-	74.1	59.2
Wabash Avenue	-	45.4	43.8
2 1.Fl		74.7	66.2
Interstate 10	-	74.7	66.2
Wabash Avenue	-	45.7	42.7
3 GF		70.9	59.7
Interstate 10	-	70.8	58.3
Wabash Avenue	-	52.1	54.1
3 1.Fl		71.6	65.9
Interstate 10	-	71.6	65.7
Wabash Avenue	-	52.3	52.9
4 GF		70.5	58.8
Interstate 10	-	70.5	57.5
Wabash Avenue	-	50.6	52.9
4 1.Fl		71.2	67.6
Interstate 10	-	71.2	67.5
Wabash Avenue	-	51.0	51.7
5 GF		73.7	59.9
Interstate 10	-	73.6	58.1
Wabash Avenue	-	53.9	55.2
5 1.Fl		74.3	65.0
Interstate 10	-	74.3	64.6
Wabash Avenue	-	54.6	54.9
6 GF		69.3	60.1
Interstate 10	-	69.0	54.3
Wabash Avenue	-	58.2	58.8
6 1.Fl		71.0	61.7
Interstate 10	-	70.7	57.4
Wabash Avenue	-	59.5	59.7
7 GF		61.3	54.3
Interstate 10	-	60.8	52.6
Wabash Avenue	-	51.3	49.4
7 1.Fl		64.5	59.8
Interstate 10	-	64.2	59.3
Wabash Avenue	-	52.6	50.3
8 GF		63.5	59.4
Interstate 10	-	48.0	50.1
Wabash Avenue	-	63.4	58.9
8 1.Fl		67.2	64.1
Interstate 10	-	53.4	55.2
Wabash Avenue	-	67.0	63.5
9 GF		62.9	54.2
Interstate 10	-	44.5	49.0
Wabash Avenue	-	62.8	52.7
9 1.Fl		66.7	57.2
Interstate 10	-	48.2	50.6
Wabash Avenue	-	66.6	56.2

APPENDIX G

VIBRATION WORKSHEETS

GROUNDBORNE VIBRATION ANALYSIS

Project:	19-0208 Terracina at Redlands	Date:	2/5/20
Source:	Large Bulldozer		
Scenario:	Unmitigated		
Location:	Residential (garage/shed) to North (1760 Camelot Drive)		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment Type	2	Large Bulldozer	INPUT SECTION IN GREEN
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	10.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.352	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS			
Project:	19-0208 Terracina at Redlands	Date:	2/5/20
Source:	Large Bulldozer		
Scenario:	Unmitigated		
Location:	Residential to west (731 Buckingham Drive)		
Address:			
PPV = PPVref(25/D)^n (in/sec)			
INPUT			
Equipment Type =	2	Large Bulldozer	INPUT SECTION IN GREEN
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	12.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	
Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.			
RESULTS			
PPV =	0.268	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19-0208 Terracina at Redlands	Date:	2/5/20
Source:	Large Bulldozer		
Scenario:	Unmitigated		
Location:	Residential to North (residence at 850 Wabash Avenue)		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment Type =	2	Large Bulldozer	INPUT SECTION IN GREEN
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	45.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.037	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19-0208 Terracina at Redlands	Date:	2/5/20
Source:	Large Bulldozer		
Scenario:	Unmitigated		
Location:	Residential to North (garage/shed at 854 Wabash Ave) & to West (residence at 811 Sophia Court)		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment Type =	2	Large Bulldozer	INPUT SECTION IN GREEN
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	50.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.031	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19-0208 Terracina at Redlands	Date:	8/21/20
Source:	Large Bulldozer		
Scenario:	Unmitigated		
Location:			
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment Type	2	Large Bulldozer	INPUT SECTION IN GREEN
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	12.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.268	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19-0208 Terracina at Redlands	Date:	2/10/20
Source:	Large Bulldozer		
Scenario:	Unmitigated		
Location:	Vibratory Perception Distance		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment Type	2	Large Bulldozer	INPUT SECTION IN GREEN
PPVref =	0.089	Reference PPV (in/sec) at 25 ft.	
D =	85.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.014	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19-0208 Terracina at Redlands	Date:	2/5/20
Source:	Vibratory Roller		
Scenario:	Unmitigated		
Location:	Residential (garage/shed) to North (1760 Camelot Drive)		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment Type =	1	Vibratory Roller	INPUT SECTION IN GREEN
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	10.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.830	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19-0208 Terracina at Redlands	Date:	2/5/20
Source:	Vibratory Roller		
Scenario:	Unmitigated		
Location:	Residential to west (731 Buckingham Drive)		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment Type =	1	Vibratory Roller	INPUT SECTION IN GREEN
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	12.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.631	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19-0208 Terracina at Redlands	Date:	2/5/20
Source:	Vibratory Roller		
Scenario:	Unmitigated		
Location:	Residential to North (residence at 850 Wabash Avenue)		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment Type =	1	Vibratory Roller	INPUT SECTION IN GREEN
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	45.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.087	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19-0208 Terracina at Redlands	Date:	2/5/20
Source:	Vibratory Roller		
Scenario:	Unmitigated		
Location:	Residential to North (garage/shed at 854 Wabash Ave) & to West (residence at 811 Sophia Court)		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment Type =	1	Vibratory Roller	INPUT SECTION IN GREEN
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	50.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.074	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19-0208 Terracina at Redlands	Date:	8/21/20
Source:	Vibratory Roller		
Scenario:	Unmitigated		
Location:			
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment Type =	1	Vibratory Roller	INPUT SECTION IN GREEN
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	20.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.293	IN/SEC	OUTPUT IN BLUE

GROUNDBORNE VIBRATION ANALYSIS

Project:	19-0208 Terracina at Redlands	Date:	2/10/20
Source:	Vibratory Roller		
Scenario:	Unmitigated		
Location:	Vibration Perception Threshold		
Address:			

PPV = PPVref(25/D)^n (in/sec)

INPUT

Equipment Type =	1	Vibratory Roller	INPUT SECTION IN GREEN
PPVref =	0.21	Reference PPV (in/sec) at 25 ft.	
D =	150.00	Distance from Equipment to Receiver (ft)	
n =	1.50	Vibration attenuation rate through the ground	

Note: Based on reference equations from Vibration Guidance Manual, California Department of Transportation, 2006, pgs 38-43.

RESULTS

PPV =	0.014	IN/SEC	OUTPUT IN BLUE

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