Draft Noise and Vibration Technical Memorandum

Laserfiche Office Project

City of Long Beach, California

December 2018

This page is intentionally blank.

Contents

1 Introduction ... 1
1.1 Purpose of the Report ... 1
2 Project Location and Description ... 1
2.1 Project Location ... 1
2.2 Project Description ... 1
3 Acoustic and Vibration Terminology ... 5
3.1 Acoustic Terminology ... 5
3.2 Vibration Terminology ... 6
4 Existing Conditions ... 7
4.1 Sensitive land uses ... 7
4.2 Overview of the Existing Noise Environment ... 7
4.3 Existing Traffic Noise Levels ... 7
5 Regulatory Setting ... 8
5.1 State ... 8
5.1.1 California Department of Health Services ... 8
5.1.2 California Environmental Quality Act ... 9
5.2 City of Long Beach Noise Standards ... 10
5.2.1 Noise Element of the General Plan ... 10
5.2.2 Municipal Code ... 10
5.3 Vibration ... 13
5.3.1 Vibration Annoyance ... 13
5.3.2 Vibration-Related Structural Damage ... 13
6 Noise and Vibration Impact Analysis ... 14
6.1 Construction ... 14
6.1.1 Noise ... 14
6.1.2 Vibration ... 17
6.2 Operation ... 18
6.2.1 Long Term Traffic Noise Impacts ... 18
6.2.2 Stationary Noise Impacts ... 21
6.2.3 Airport Noise Impacts ... 21
7 Mitigation Measures ... 22
7.1 Construction Noise ... 22
8 Conclusion ... 22
9 References ... 23

Tables

Table 1. Laserfiche Office Project - Building and Site Characteristics ... 3
Table 2. Existing Traffic Volumes ... 8
Table 3. California Department of Health Services Noise Guidelines ... 9

Table 4. Recommended Criteria for Maximum Acceptable Noise Levels (dBA) 10
Table 5. Exterior Noise Limits 11
Table 6. Interior Noise Limits 12
Table 7. Groundborne Vibration and Noise Impact Criteria – Human Annoyance 13
Table 8. Groundborne Vibration and Noise Impact Criteria – Structural Damage 13
Table 9. Project Construction Noise Levels by Phase 15
Table 10. Vibration Source Amplitudes for Construction Equipment 17
Table 11. Existing With Project Traffic Volumes 19
Table 12. 2020 Without Project Traffic Volumes 20
Table 13. 2020 With Project Traffic Volumes 21

Figures

Figure 1. Regional Vicinity and Project Location 1
Figure 2. Project Site Plan 2
Figure 3. Relative Loudness 6

Appendices

Appendix A. Traffic and Construction Noise Calculations

1 Introduction

1.1 Purpose of the Report

This Noise and Vibration Technical Memorandum was completed for the Laserfiche Office Project (project) to identify potential impacts to on-site and nearby sensitive land uses. Project construction and operational noise and vibration were calculated and compared to applicable laws, guidelines, and/or regulations.

2 Project Location and Description

2.1 Project Location

The project site is approximately 2.1 acres and consists of ten parcels located between Locust Avenue and Long Beach Boulevard, south of East 35th Street, and north of Interstate (I-) 405 in the central portion of the City of Long Beach (Figure 1). A description of the project site and current uses is provided below:

- The five parcels along Locust Avenue comprise the western portion of the project site. These five parcels are currently vacant.
- The five parcels along Long Beach Boulevard comprise the eastern portion of the project site. These five parcels are currently vacant.

2.2 Project Description

The Laserfiche Office Project (project) consists of a new four-story office building and separate three-story parking garage. Table 1 summarizes the key elements associated with the office building and parking garage and Figure 2 depicts the project site plan. The project includes the following primary components:

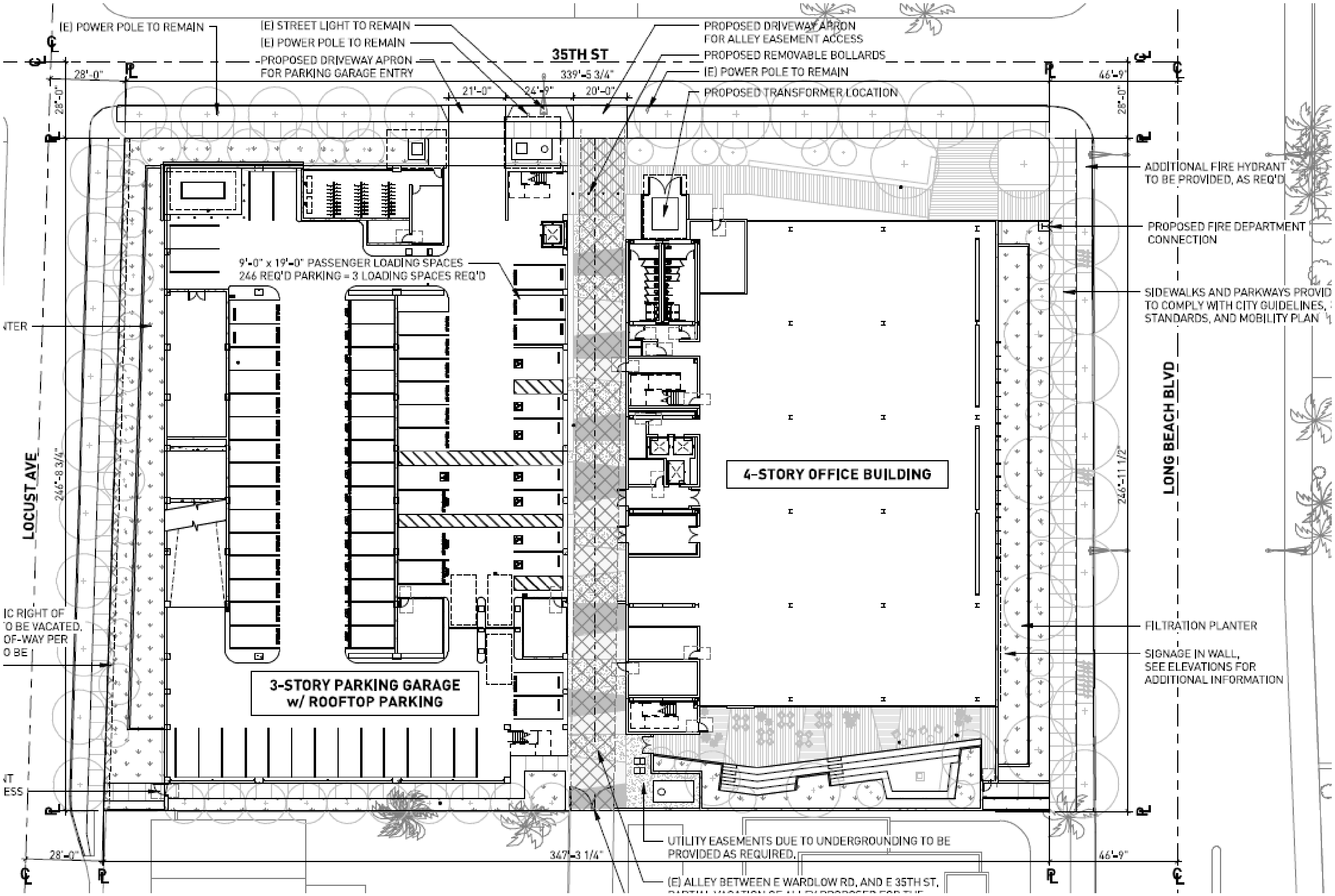
- Office building – The project includes a new 102,848-square-foot office building that is up to 74 feet in height (maximum fourstories) above ground level. The building includes offset terraces and mezzanine design features.
- Parking garage – The project includes a separate three-story parking garage with one rooftop level of parking with a total of 343 parking spaces. Access to the parking garage would occur from 35th Street west of the existing alley entrance in the center of the project site.
- Offsite improvements – The project includes modification of the 35th Street intersection from a two-way stop-controlled intersection to a signalized intersection.
- Entitlements and project approvals – The project requires the following entitlements and discretionary actions:
    - o Zone Change of five existing lots (assessor parcel numbers [APN]: 7141-004-033, 034, 019, and 020) fronting on Long Beach Boulevard from

Community Commercial Automobile-Oriented (CCA) District to Community R-4-N Commercial (CCN) District

- Zone Change of five existing lots (APNs: 7141-004-027, 028, 029, 030, and 031) fronting on Locust Street from Single-Family Residential District (R-1-N) to CCN District in conjunction with a General Plan Amendment from LUD 1 to LUD 8
- Zoning Code Amendment to permit the averaging of setbacks for the proposed office building within the High-Rise Overlay (HR-4) District.
- Site plan review of a four-story office building up to 74 feet in height and containing 102,848 square feet of floor area and a three-story parking garage with one rooftop level of parking
- Tentative Tract Map to create a single lot for development, including vacation of a portion of the alley that runs north-to-south (between Long Beach Boulevard and Locust Street)
  - The alley easement will be maintained
- General Plan Conformity Finding for the vacation of the northern 250 feet of the unnamed alley, which runs north to south between East 35th Street and Wardlow Road

Figure 1. Regional Vicinity and Project Location

Figure 2. Project Site Plan



Source: 888-5 Partners, LLC 2018

Table 1. Laserfiche Office Project - Building and Site Characteristics

Project Element	Office Building			Parking Garage		
Project Site Summary						
Project Address	3443 Long Beach Boulevard			210 E. 35th Street		
Lot Area	84,761 SF (for both office and parking)			84,761 SF (for both office and parking)		
APN #	7141-004-019, 020, 033, 034			7141-004-027, 028, 029, 030, 031		
Zone	Existing: CCA with HR-4 Overlay / Proposed: CCN with HR-4			Existing: R-1-N / Proposed: CCN		
General Plan	Existing: LUD 8 (Major Commercial Corridor) / Proposed: LUD 8			Existing: LUD 1 (Single Family District) / Proposed: LUD 8		
Project Summary						
Proposed Stories	4 Stories			3 Stories with Rooftop Parking		
Proposed Building Height	74-0” to top of parapet			38’-0” to top of parapet		
Setbacks	**Location**	**Required (per HR overlay)**	**Proposed***	**Location**	**Required (per CCN)**	**Proposed***
	Long Beach Avenue (front)	20’-0”	18’-6” minimum (Level 1) / 21’-3” average setback**	Locust Avenue (front)	15’-0”	15’-0” minimum
	E. 35th Street	20’-0”	30’-0” (Level 1) / 20’-2” average setback**	E. 35th Street (side)	10’-0”	10’-0” minimum
	Adjacent property	Underlying (5’-0” per CCN)	37’-0” (to stair) / 25’-0” (to building face)	Adjacent property (residential rear yard)	20’-0”	20’-0” minimum
	Locust Avenue	N/A	See parking	Adjacent property (residential side yard)	10’-0”	10’-0” minimum
				Long Beach Boulevard	N/A	See Office

Table 1. Laserfiche Office Project - Building and Site Characteristics

Project Element	Office Building			Parking Garage		
Proposed Building Area	**Level**	**Building Area (SF)**	**Notes**	**Level**	**Building Area (SF)**	**Notes**
	1	24,072	6,300 SF Outdoor Patio	1	33,108	
	2	25,609		2	33,108	
	3	27,261	410 SF Balcony	3	33,108	
	4	25,906	1,500 SF Balcony	Roof	N/A	33,108 SF Rooftop Parking
	Total	102,848		Total	99,324	
Lot Coverage (Allowed / Proposed)	35.4% 30,018 SF / 84,761 SF)			39.1% (33,108 SF / 84,761 SF)		
Parking Summary						
Proposed Vehicular Spaces	See Parking Garage			343		
Proposed Bicycle Spaces	See Parking Garage			54		

* See plans and elevations for addition information
** Zoning code amendment to high rise overlay district allowing the averaging of setbacks

3 Acoustic and Vibration Terminology

3.1 Acoustic Terminology

Noise levels are presented on a logarithmic scale to account for the large pressure response range of the human ear, and are expressed in units of decibels (dB). A decibel is defined as the ratio between a measured value and a reference value usually corresponding to the lower threshold of human hearing defined as 20 micropascals (µPa). Because the human ear does not perceive every frequency with equal loudness, sounds are often adjusted with a weighting filter. The A-weighted filter is applied to compensate for the frequency response of the human auditory system, known as dBA. An inherent property of the logarithmic decibel scale is that the sound pressure levels of two separate sources are not directly additive. For example, if a sound of 50 dBA is added to another sound of 50 dBA in the proximity, the result is a 3-decibel increase (or 53 dBA), not an arithmetic doubling to 100 dBA. With respect to how the human ear perceives changes in sound pressure level relative to changes in “loudness,” scientific research demonstrates the following general relationships between sound level and human perception for two sound levels with the same or very similar frequency characteristics:

- One dBA is the practical limit of accuracy for sound measurement systems and corresponds to an approximate 10 percent variation in the sound pressure level. A 1 dBA increase or decrease is a non-perceptible change in sound.
- Three dBA increase or decrease is a doubling (or halving) of acoustic pressure level and it corresponds to the threshold of change in loudness perceptible in a laboratory environment. In practice, the average person is not able to distinguish a 3 dBA difference in environmental sound outdoors.
- Five dBA increase or decrease is described as a perceptible change in sound level and is a discernible change in an outdoor environment.
- Ten dBA increase or decrease is a tenfold increase or decrease in acoustic pressure level but is perceived as a doubling or halving in loudness (i.e., the average person will judge a 10 dBA change in sound level to be twice or half as loud).

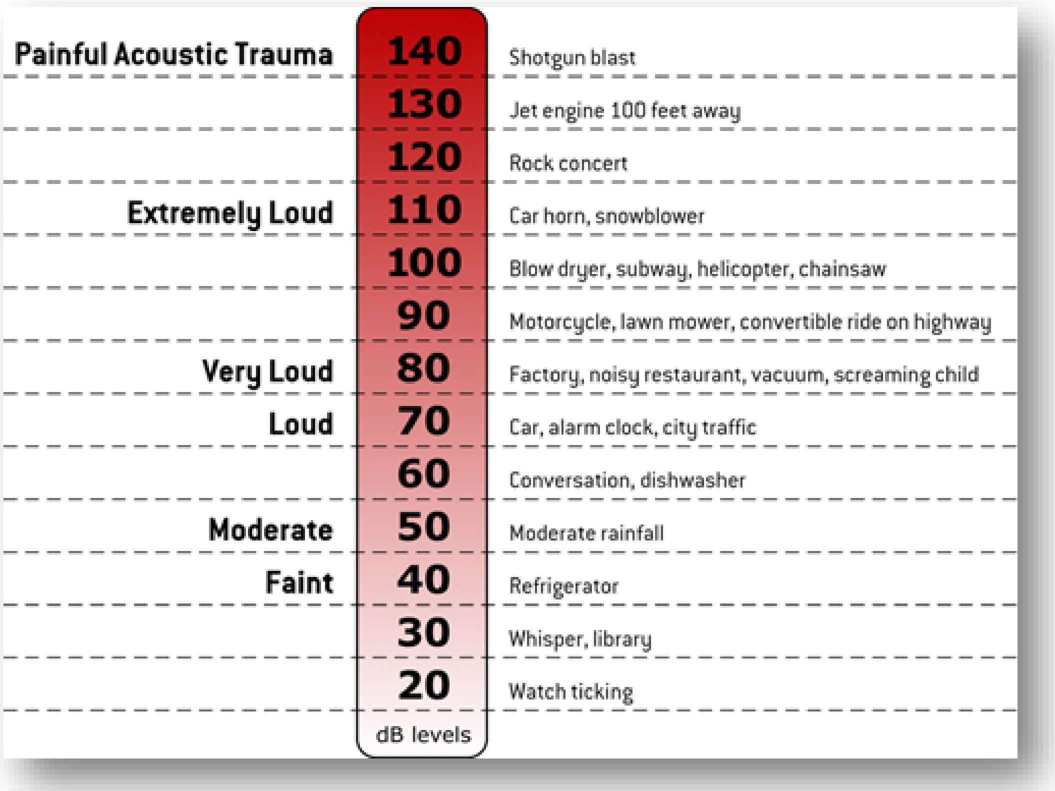
Estimations of common noise sources and outdoor acoustic environments, and the comparison of relative loudness are presented in Figure 3.

Noise levels can be measured, modeled and presented in various formats. The noise metrics that were employed in this analysis have the following definitions:

- ***L_{eq}:*** Conventionally expressed in dBA, the L_{eq} is the energy-averaged, A-weighted sound level over a specified time period. It is defined as the steady, continuous sound level over a specified time, which has the same acoustic energy as the actual varying sound levels over the specified period. It is a mean average sound level.
- ***L_{max}:*** The maximum A-weighted sound level as determined during a specified measurement period. It can also be described as the maximum instantaneous sound pressure level generated by a piece of equipment or during a construction activity.

- ***L_{dn}:*** The L_{dn} is the averaged hourly A-weighted L_{eq} for a 24-hour period with a 10 dB penalty added to sound levels occurring during the evening hours (7:00 p.m. to 10:00 p.m.) to account for individuals' increased sensitivity to noise levels during nighttime hours.
- ***CNEL:*** Community noise equivalent level is another average A-weighted L_{eq} sound level measured over a 24-hour period; however, this noise scale is adjusted to account for some individuals' increased sensitivity to noise levels during the evening and nighttime hours. A CNEL noise measurement is obtained after adding 5 dB to sound levels occurring during evening hours (7:00 p.m. to 10:00 p.m.) and 10 dB to noise levels occurring during nighttime hours (10:00 p.m. to 7:00 a.m.).

Figure 3. Relative Loudness



3.2 Vibration Terminology

According to the Federal Transit Administration Transit Noise and Vibration Impact Assessment (FTA 2006), construction activities can be a source of ground-borne vibration. Activities such as pile driving and operation of heavy equipment may cause ground-borne vibration while constructing the project. Vibration is an oscillatory motion that can be described in terms of the displacement, velocity, or acceleration (FTA 2006). Velocity or acceleration is typically used to describe vibration. Two descriptors are frequently used when discussing quantification of vibration, the peak particle velocity (PPV) and the root mean square (rms):

- ***Peak particle velocity (PPV):*** The maximum instantaneous positive or negative peak of the vibration signal (FTA 2006). The potential for damage to buildings due to construction-related vibration is evaluated using PPV.
- ***Root mean square (rms):*** The square root of the average of the squared amplitude of the vibration signal, typically calculated over a 1-second period (FTA 2006). The potential to annoy humans due to construction-related vibration is evaluated using rms.

4 Existing Conditions

4.1 Sensitive land uses

Certain land uses are considered more sensitive to noise than others. Examples of these types of land uses include residential areas, educational facilities, hospitals, childcare facilities, and senior housing. The project site is located in an urban area. The closest off-site sensitive land uses to the project site are the existing residences located adjacent to the southern perimeter of the project site and to the west across Locust Avenue at a distance of approximately 50 feet.

4.2 Overview of the Existing Noise Environment

The primary existing noise sources in the project area are transportation facilities. Traffic on Long Beach Boulevard, East Wardlow Road, and I-405 is the dominant source contributing to area ambient noise levels. Noise from motor vehicles is generated by engine vibrations, the interaction between the tires and the road, and the exhaust system.

4.3 Existing Traffic Noise Levels

The primary existing noise source in the project area is traffic on the local roadways. The Federal Highway Administration (FHWA) highway traffic noise prediction model (FHWA RD-77-108) was used to evaluate highway traffic-related noise conditions along the roadway segments in the project vicinity. Existing traffic volumes included in the traffic study prepared for the project (Iteris 2018) were used to assess the existing traffic noise levels. A typical vehicle mix for Southern California was used. Table 2 provides the traffic noise levels along the roadways adjacent to the project site under the existing conditions. These noise levels represent the worst-case scenario, which assumes that no shielding is provided between the traffic and the location where the noise contours are drawn. The specific assumptions used in developing these noise levels and model printouts are provided in Appendix A.

Table 2. Existing Traffic Volumes

Roadway Segment	ADT	Centerline to 70 CNEL (ft)	Centerline to 65 CNEL (ft)	Centerline to 60 CNEL (ft)	CNEL (dBA) 50 ft from Centerline of Outermost Lane
Long Beach Boulevard between NB 405 off-ramp and Wardlow Road	23,330	52.1	164.8	521.2	68.5
Long Beach Boulevard between Wardlow Road and 35th	24,790	55.4	175.1	553.9	68.7
Long Beach Boulevard between 35th and 36th	23,810	53.2	168.2	532.0	68.5
Long Beach Boulevard between 36th and Bixby	23,940	53.5	169.1	534.9	68.6
Wardlow Road between NB 405 on-ramp and Long Beach Boulevard	25,630	57.3	181.1	572.6	69.2
Wardlow Road east of Long Beach Boulevard	19,170	<50	135.4	428.3	68.0
35th west of Long Beach Boulevard	780	<50	<50	<50	50.0

5 Regulatory Setting

This section provides an overview of state and local regulations related to noise issues applicable to the project.

5.1 State

5.1.1 California Department of Health Services

Noise Guidelines

In 1987, the California Department of Health Services published guidelines for the noise element of local general plans (Office of Planning and Research, 2003). These guidelines include a noise level/land use compatibility chart that categorizes various outdoor L_{dn} ranges up to four compatibility categories (normally acceptable, conditionally acceptable, normally unacceptable, and clearly unacceptable), depending on land use. For many land uses, the chart shows exterior L_{dn} ranges for two or more compatibility categories. The noise element guidelines chart identifies the normally acceptable range for low-density residential uses as less than 60 dBA, while the conditionally acceptable range is 60-70 dBA. The normally acceptable range for high-density residential uses is identified as Ldn values below 65 dBA, while the conditionally acceptable range is identified as 65-70 dBA. For educational and medical facilities, L_{dn} values below 60 dB are considered normally acceptable, while Ldn values of 60-70 dBA are considered conditionally acceptable. For office and commercial land uses, L_{dn} values below

67.5 dBA are considered normally acceptable, while L_{dn} values of 67.5-77.5 dBA are categorized as conditionally acceptable.

These normally and conditionally acceptable Ldn ranges are intended to indicate that local conditions (existing noise levels and community attitudes toward dominant noise sources) should be considered in evaluating land use compatibility at specific locations. These guidelines are used by many agencies, environmental planners, and acoustical specialists as a starting point to evaluate the potential for noise impact on and by a project. The guidelines are also employed to evaluate methods for achieving noise compatibility with respect to nearby existing uses. Table 3 summarizes these guidelines for the normally and conditionally acceptable Ldn exposures.

Table 3. California Department of Health Services Noise Guidelines

Land Use Category	Community Noise Exposure (Ldn or CNEL, dBA)	
	Normally Acceptable	Conditionally Acceptable
Residential – Low Density	50 - 60	60 - 70
Residential – High Density	50 - 65	65 - 70
Transient Lodging – Motels, Hotels	50 - 65	65 – 70
Schools, Libraries, Churches, Hospitals, Nursing Homes	50 – 60	60 - 65
Auditoriums, Concert Halls, Amphitheaters	NA	50 - 70
Sports Arenas, Outdoor Spectator Sports	NA	50 - 75
Playgrounds, Neighborhood Parks	50 – 67.5	NA
Golf Courses, Riding Stables, Water Recreation, Cemeteries	50 - 70	NA
Office Buildings, Business Commercial and Professional	50 – 67.5	67.5 – 77.5
Industrial, Manufacturing, Utilities, Agriculture	50 - 70	70 - 80

5.1.2 California Environmental Quality Act

The California Environmental Quality Act (CEQA) requires that significant environmental impacts be identified and that such impacts be eliminated or mitigated to the extent feasible. Appendix G of the CEQA Statutes and Guidelines (State Clearing House, Office of Planning and Research and the Natural Resources Agency, 2018) sets forth a series of suggested thresholds for determining a potentially significant impact. Under the thresholds suggested in Appendix G, a project could be considered to have significant noise and vibration impacts if it results in one or more of the following:

- Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies

- Exposure of persons to or generation of excessive ground-borne vibration or ground-borne noise levels
- A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project
- For a project located within an airport land use plan or, where such a plan has not been adopted, within 2 miles of a public airport or public use airport, exposure of people residing or working in the project area to excessive noise levels
- For a project within the vicinity of a private airstrip, exposure of people residing or working in the project area to excessive noise levels

5.2 City of Long Beach Noise Standards

5.2.1 Noise Element of the General Plan

The goals and policies contained in the Noise Element address noise in relation to land use planning, the noise environment, transportation noise, construction and industrial noise, population and housing noise, and public health and safety. Table 4 summarizes the criteria for sensitive receivers.

Table 4. Recommended Criteria for Maximum Acceptable Noise Levels (dBA)

	Outdoor			Indoor
Major Land Use Type	Maximum Single Hourly Peak	L10	L50	Ldn
Residential (7 a.m. to 10 p.m.)	70	55	45	45
Residential (10 p.m. to 7 a.m.)	60	45	35	35
Commercial (anytime)	75	65	55	NA
Industrial (anytime)	85	70	60	NA

5.2.2 Municipal Code

Chapter 8.80, Noise, of the municipal code establishes exterior and interior noise limits for the generation of sound within the City. The maximum noise levels vary based on the receiving land use type and the cumulative duration of noise.

Exterior Noise Limits

Section 8.80.150 of the City’s municipal code establishes the exterior noise limits by receiving land use. Table 5 summarizes the exterior noise limits.

Table 5. Exterior Noise Limits

Receiving Land Use District	Time Period	Noise Level (dBA)	L_{max} (dBA)
District One	Night (10 p.m. to 7 a.m.)	45	65
	Day (7 a.m. to 10 p.m.)	50	70
District Two	Night (10 p.m. to 7 a.m.)	55	75
	Day (7 a.m. to 10 p.m.)	60	80
District Three	Any time	65	85
District Four	Any time	70	90
District Five	Regulated by other agencies and laws		

Notes:
District One: Predominantly residential with other land use types also present
District Two: Predominantly commercial with other land use types also present
District Three and Four: Predominantly industrial with other land use types also present
District Five: Airports, freeways, and waterways regulated by other agencies
District Three and Four limits are intended primarily for use at their boundaries rather than for noise control within those districts

No person shall operate or cause to be operated any source of sound at any location within the incorporated limits of 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 from any other property, either incorporated or unincorporated, to exceed:

1. The noise standard for that land use district as specified in Table 5 for a cumulative period of more than 30 minutes in any hour; or
2. The noise standard plus 5 decibels for a cumulative period of more than 15 minutes in any hour; or
3. The noise standard plus 10 decibels for a cumulative period of more than 5 minutes in any hour; or
4. The noise standard plus 15 decibels for a cumulative period of more than 1 minute in any hour; or
5. The noise standard plus 20 decibels or the maximum measured ambient, for any period of time.

Interior Noise Limits

Section 8.80.170 of the City's municipal code establishes the interior noise limits by receiving land use. Table 6 summarizes the interior noise limits.

Table 6. Interior Noise Limits

Receiving Land Use District	Type of Land Use	Time Interval	Allowable Interior Noise Level (dBA)
All	Residential	10 p.m. to 7 a.m. 7 a.m. to 10 p.m.	35 45
All	School	7 a.m. to 10 p.m. (while school is in session	45
Hospital, designated quiet zones, and noise sensitive zones		Any time	40

No person shall operate, or cause to be operated, any source of sound indoors at any location within the incorporated limits of the City or allow the creation of any indoor noise which causes the noise level when measured inside the receiving dwelling unit to exceed:

1. The noise standard for that land use district as specified in Table 6 for a cumulative period of more than 5 minutes in any hour; or
2. The noise standard plus 5 dB for a cumulative period of more than 1 minute in any hour; or
3. The noise standard plus 10 dB or the maximum measured ambient, for any period of time.

Construction Noise Limits

Section 8.80.202 of the municipal code restricts construction activities to weekdays between the hours of 7:00 a.m. and 7:00 p.m. and Saturdays, between 9:00 a.m. and 6:00 p.m., except for emergency work. Construction work on Sundays is prohibited unless the City's Noise Control Officer issues a permit. The permit may allow work on Sundays between 9:00 a.m. and 6:00 p.m.

Loading and Unloading Noise Limits

Section 8.80.200(E) of the municipal code states that loading, unloading, opening, closing, or other handling of boxes, crates, containers, building materials, garbage cans, or similar objects between the hours of 10:00 p.m. and 7:00 a.m. is restricted to the noise level provisions of Exterior Noise Limits shown in Table 5 and the Interior Noise Limits shown in Table 6.

5.3 Vibration

5.3.1 Vibration Annoyance

Ground-borne noise is the vibration of floors and walls that may cause rattling of items such as windows or dishes on shelves, or a rumbling noise. The rumbling is created by the motion of the room surfaces, which act like a giant loudspeaker. The FTA provides criteria for acceptable levels of ground-borne vibration based on the relative perception of a vibration event for vibration-sensitive land uses (Table 7).

Table 7. Groundborne Vibration and Noise Impact Criteria – Human Annoyance

Land Use Category	Max Lv (VdB)[1]	Description
Workshop	90	Distinctly felt vibration. Appropriate to workshops and non-sensitive areas.
Office	84	Felt vibration. Appropriate to offices and non-sensitive areas.
Residential – Daytime	78	Barely felt vibration. Adequate for computer equipment.
Residential – Nighttime	72	Vibration not felt, but ground-borne noise may be audible inside quiet rooms.

[1] As measured in 1/3-octave bands of frequency over the frequency ranges of 8 to 80 Hz

5.3.2 Vibration-Related Structural Damage

The level at which ground-borne vibration is strong enough to cause structural damage has not been determined conclusively. The most conservative estimates are reflected in the FTA standards, shown in Table 8. Vibration-related problems generally occur due to resonances in the structural components of a building. The maximum vibration amplitudes of the floors and walls of a building will often be at the resonance frequencies of various components of the building. That is, structures amplify ground-borne vibration. Wood-frame buildings, such as typical residential structures, are more easily excited by ground vibration than heavier buildings. According to the Caltrans' "Transportation Related Earthborne Vibration" (2002), extreme care must be taken when sustained pile driving occurs within 25 feet of any building; the threshold at which there is a risk of architectural damage to normal houses with plastered walls and ceilings is 0.2 in/sec.

Table 8. Groundborne Vibration and Noise Impact Criteria – Structural Damage

Building Category	PPV (in/sec)[1]	VdB
I. Reinforced concrete, steel, or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Nonengineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

[1] RMS velocity calculated from vibration level (VdB) using the reference of one microinch/second

6 Noise and Vibration Impact Analysis

Noise generated by the project will consist of: (1) short duration noise resulting from construction activities and (2) long-term noise from on-site stationary sources and off-site traffic noise from vehicles operated by employees using the proposed office building. Vibration from the project would only result during construction. Construction activities would take place only during daytime hours. An evaluation was performed of anticipated noise and vibration levels compared to regulatory requirements.

Airborne noise dissipates with increasing distance from the noise source. The distances involved depend primarily on the intensity of the noise generated by the source, terrain and ground cover between source and receiver, and partly on weather conditions such as wind speed and direction, the height and strength of temperature inversions, and the height of cloud cover. Temperature inversions and cloud cover can reflect or refract sound that is radiated upwards; this effect can increase noise levels at locations that receive the reflected or refracted sound. Such reflection and refraction effects are important primarily for high intensity sounds and for the calculation of sound propagation over large distances. For noise sources such as construction activity and vehicle traffic, the region of influence is typically less than 0.5 mile from the noise source. Temperature inversions and cloud cover are not accounted for in this analysis.

The region of interest for noise and vibration issues is typically localized. Ground-borne vibrations generally attenuate rapidly with increasing distance from the vibration source. The distances involved depend primarily on the intensity of the vibrations generated by the source, and partly on soil and geologic conditions. Detectable vibrations will travel the greatest distance through solid rock and the least distance through loose, unconsolidated soils or saturated soils. For vibration sources such as construction activity and vehicle traffic, the region of influence is typically less than 1,000 feet from the vibration source.

6.1 Construction

6.1.1 Noise

Construction noise, although temporary, can potentially affect nearby sensitive receptors, such as residences closest to the project site. Construction of the project will require the use of heavy equipment that may be periodically audible at off-site locations. Received noise levels will fluctuate, depending on the construction activity, equipment type, and distance between noise source and receiver. Additionally, noise from construction equipment will vary dependent on the construction phase and the number and type of equipment at a location at any given time. For the purposes of the air quality/GHG evaluation, the project is divided into five main phases of construction consistent with the CalEEMod:

1. Site preparation
2. Grading
3. Building construction
4. Paving

5. Architectural coating

The variation in power and usage of the various construction equipment types creates complexity in characterizing construction noise levels. Expected equipment types for each phase of construction are presented in Table 9 and were used to screen for potential construction noise impacts. Each phase identified will require different types of construction equipment. The estimated composite site noise level is based on the assumption that all equipment would operate at a given usage load factor, for a given hour (i.e., front end loaders are assumed to be used for up to 40 percent of 1 hour, or 24 minutes), to calculate the composite average daytime hourly L_{eq}. The load factor accounts for the fraction of time that the equipment is in use over the specified time period. The composite noise level from several pieces of equipment operating during the same phase is obtained from decibel addition of the L_{eq} of each individual unit. Although it is not possible for all the construction equipment to operate at one point simultaneously, the screening level analysis represented in Table 9 conservatively assumes concurrent operation of equipment in the same location.

The nearest sensitive receptors to the project site are the existing homes to the south of the project site. At its closest point, the construction activity would be located within 25 feet of these land uses. The average distance from the construction activities on the project site to these sensitive land uses on a daily basis is approximately 100 feet. Construction noise will attenuate with increased distance from the noise sources.

Maximum noise levels at 25 feet and composite L_{eq} noise levels at 100 feet given in Table 9 were evaluated assuming spherical free-field spreading. As a general construction practice, functional mufflers are anticipated to be maintained on all equipment to attenuate noise levels as low as reasonably achievable. As shown in Table 9, during the loudest construction phase the maximum noise level is projected to be 95.6 dBA L_{max} and the average level is projected to be 79.8 dBA L_{eq}.

Compliance with the City's Noise Ordinance would ensure that construction noise impacts are reduced to the greatest extent feasible. Although construction noise would be higher than the ambient noise in the project vicinity, construction noise would cease to occur once the project construction is completed.

Traffic noise associated with construction of the project is not anticipated to be a significant source of noise. Traffic noise is not greatly influenced by lower levels of traffic, such as those associated with the project's construction effort. For example, traffic levels would have to double in order for traffic noise on adjacent roadways to increase by 3 dBA. The project's construction traffic on adjacent roadways would increase hourly traffic volumes by much less than a factor of two; therefore, the increase in construction related traffic noise would be less than 3 dBA; and is not significant.

Table 9. Project Construction Noise Levels by Phase

Phase	Equipment[1]			Composite Sound Level[3]	
	Type	Quantity	L_{max} at 50 feet	L_{max} at 25 feet	L_{eq} at 100 feet
Site Preparation	Grader	1	85.0	91.0	78.0

Table 9. Project Construction Noise Levels by Phase

Phase	Equipment[1]			Composite Sound Level[3]	
	Scraper	1	83.6		
	Loader	1	79.1		
Grading	Grader	2	85.0	91.0	79.8
	Loader	1	79.1		
	Tractor	1	84.0		
Building Construction	Crane	1	80.6	91.0	78.9
	Forklift	2	74.7		
	Generator	1	80.6		
	Loader	1	79.1		
	Welder	3	74.0		
Paving	Mixer	1	78.8	90.0	77.5
	Paver	1	77.2		
	Paving Equipment	1	77.2		
	Roller	2	80.0		
	Tractor	1	84.0		
Architectural Coating	Compressor	1	77.7	83.7	67.7

[1] Equipment mix obtained from the CalEEMod emission calculations prepared for the Air Quality Assessment, July 2018.

[2] Measured L_{max} at given reference distance obtained from the FHWA Roadway Construction Noise Model, FHWA 2006.

[3] Distance factor determined by the inverse square law defined as 6 dBA per doubling of distance as sound travels away from an idealized point.

6.1.2 Vibration

Construction activities generate ground-borne vibration when heavy equipment travels over unpaved surfaces or when it is engaged in soil movement. The effects of ground-borne vibration include discernable movement of building floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. Vibration-related problems generally occur due to resonances in the structural components of a building because structures amplify ground-borne vibration.

Table 10 lists the vibration source amplitudes for construction equipment. As pile driving is not required, the highest reference PPV for the proposed project would be 0.210 inches per second (in/sec) associated with on-site vibration rollers.

Table 10. Vibration Source Amplitudes for Construction Equipment

Equipment	PPV at 25 feet (in/sec)	Approximate Lv1 at 25 feet (VdB)
Pile Driver (impact) – upper range	1.518	112
Pile Driver (impact) – typical	0.644	104
Pile Drive (sonic) – upper range	0.734	105
Pile Drive (sonic) – typical	0.170	93
Clam shovel drop (slurry wall)	0.202	94
Hydromill (slurry wall) – in soil	0.008	66
Hydromill (slurry wall) – 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 Guidelines, May 2006. Table 12-2

[1] RMS velocity in decibels (VdB) re 1 micro-inch/second

The residential structures to the south of the project site will be located approximately 50 feet from project construction areas that would require the use of rollers. The FTA vibration guidance provides the following equation to calculate PPV at sensitive receptors:

$PPV_{equipment} = PPV_{Ref} (25/D)^n$ (in/sec)

Where:

PPVRef = reference PPV at 25 feet

D = distance from equipment to the receiver in feet

n = 1.5 is a value related to the vibration attenuation rate through ground

Distance attenuation would reduce the construction vibration levels from the proposed project to 0.074 in/sec. This level is much lower than the 0.12 in/sec threshold listed in Table 8 for buildings extremely susceptible to vibration damage.

For consideration of annoyance or interference with vibration-sensitive activities, the vibration level at any distance is calculated using the following formula:

$L_v(D) = L_v(25 \text{ ft}) – 30\log(D/25)$

Where:

Lv(D) = Vibration level at distance D

D = distance from equipment to the receiver in feet

Lv(25 ft) = reference vibration level at 25 feet from source

At 50 feet the roller vibration level would be reduced from 94 to 85 VdB. This level would exceed FTA's daytime annoyance threshold of 78 VdB listed in Table 7. Compliance with the City's Noise Ordinance would ensure that construction vibration impacts are reduced to the greatest extent feasible and limited to daytime hours.

6.2 Operation

6.2.1 Long Term Traffic Noise Impacts

Project-related long-term vehicular trip increases are anticipated to be small when distributed to adjacent street segments. The FHWA highway traffic noise prediction model (FHWA RD-77-108) was used to evaluate highway traffic-related noise conditions along the roadway segments in the project vicinity. The typical vehicle mix for Southern California was used.

As discussed in Section 3, a 3 dBA increase or decrease is a doubling (or halving) of sound pressure level and it corresponds to the threshold of change in loudness perceptible in a laboratory environment. In practice, the average person is not able to distinguish a 3 dBA difference in environmental sound outdoors. An increase of 3 dBA is considered to be a significant off-site traffic noise impact requiring mitigation. The City has not established an exterior CNEL noise standard for office uses. Therefore, for the purposes of this analysis, a significant on-site traffic noise impact would occur if the interior noise exceeds 45 dBA CNEL.

Locust Street, a residential cul-de-sac, is located immediately to the west of the proposed project site. However, as the main entrance to the parking garage is off of 35th Street, the proposed project is not expected to change the traffic volumes on Locust Street. Therefore, Locust Street was not evaluated in either the traffic impact analysis or the traffic noise modeling.

Existing Year Conditions

Table 2 provides the existing year traffic noise levels in the area around the project site. Table 11 provides the existing traffic noise level with project conditions on the roadways in the project area.

As shown in Table 11, with the exception of the roadway segment along East 35th Street, the project-related traffic noise level increase would be 0.2 dBA or less for all analyzed roadway segments. Along East 35th Street the project-related traffic noise level increase would be 3.9 dBA. Although this increase is greater than 3 dBA the total traffic noise level would remain very low with the 60 dBA CNEL traffic noise contour contained within the roadway right-of-way. Therefore, no significant off-site traffic noise impacts would occur under existing year conditions. No mitigation measures would be required for off-site land uses.

Table 11. Existing With Project Traffic Noise Levels

Roadway Segment	ADT	Centerline to 70 CNEL (ft)	Centerline to 65 CNEL (ft)	Centerline to 60 CNEL (ft)	CNEL (dBA) 50 ft from Centerline of Outermost Lane	Project Related Increase CNEL (dBA)
Long Beach Boulevard between NB 405 off-ramp and Wardlow Road	23,910	53.4	168.9	534.2	68.6	0.1
Long Beach Boulevard between Wardlow Road and 35th	25,780	57.6	182.1	576.0	68.9	0.2
Long Beach Boulevard between 35th and 36th	23,990	53.6	169.5	536.0	68.6	0.0
Long Beach Boulevard between 36th and Bixby	24,060	53.8	170.0	537.5	68.6	0.0
Wardlow Road between NB 405 on-ramp and Long Beach Boulevard	25,920	57.9	183.1	579.1	69.3	0.0
Wardlow Road east of Long Beach Boulevard	19,290	<50	136.3	431.0	68.0	0.0
35th west of Long Beach Boulevard	1,930	<50	<50	<50	54.0	3.9

Opening Year (2020) Conditions

Table 12 provides the traffic noise levels along the roadways adjacent to the project site under the opening year (2020) without project traffic conditions.

Table 13 provides the opening year (2020) traffic noise level with project conditions on the roadways adjacent to the project site.

As shown in Table 12, with the exception of along East 35th Street, the project-related traffic noise level increase would be 0.2 dBA or less for all analyzed roadway segments. Along East 35th Street the project-related traffic noise level increase would be 3.9 dBA. Although this increase is greater than 3 dBA the total traffic noise level would remain very low with the 60 dBA CNEL traffic noise contour contained within the roadway right-of-way. In addition, once the proposed project is built there would no longer be any sensitive receptors located along East 35th Street between Long Beach Boulevard and Locust Avenue. Therefore, no significant off-site traffic noise impacts would occur under opening year conditions. No mitigation measures would be required for off-site land uses.The on-site office building would be located at a distance of approximately 65 feet from the roadway centerline of Long Beach Boulevard. At this distance, based on the noise levels listed in Table 13 the office building would be exposed to an exterior noise level of 70 dBA CNEL. Standard building construction provides 25 dBA of exterior to interior noise attenuation when windows are closed and 15 dBA of exterior to interior noise attenuation when windows are open (U.S. Environmental Protection Agency [EPA] 1978). All new construction requires some form of mechanical ventilation to ensure that proper indoor air quality is maintained even with all windows and doors closed. Therefore, with windows and doors closed, interior noise levels would be meet the 45 dBA CNEL standard (i.e., 70 dBA - 25 dBA = 45 dBA). In addition, modern commercial building construction would likely provide more than the standard 25 dBA of noise attenuation. Therefore, no exterior mitigation measures are required.

Table 12. 2020 Without Project Traffic Volumes

Roadway Segment	ADT	Centerline to 70 CNEL (ft)	Centerline to 65 CNEL (ft)	Centerline to 60 CNEL (ft)	CNEL (dBA) 50 ft from Centerline of Outermost Lane
Long Beach Boulevard between NB 405 off-ramp and Wardlow Road	24,200	54.1	171.0	540.7	68.6
Long Beach Boulevard between Wardlow Road and 35th	25,470	56.9	179.9	569.0	68.8
Long Beach Boulevard between 35th and 36th	24,470	54.7	172.9	546.7	68.7
Long Beach Boulevard between 36th and Bixby	24,620	55.0	173.9	550.1	68.7
Wardlow Road between NB 405 on-ramp and Long Beach Boulevard	26,170	58.5	184.9	584.7	69.3
Wardlow Road east of Long Beach Boulevard	19,560	<50	138.2	437.0	68.1

Table 12. 2020 Without Project Traffic Volumes

Roadway Segment	ADT	Centerline to 70 CNEL (ft)	Centerline to 65 CNEL (ft)	Centerline to 60 CNEL (ft)	CNEL (dBA) 50 ft from Centerline of Outermost Lane
35th west of Long Beach Boulevard	800	<50	<50	<50	50.1

Table 13. 2020 With Project Traffic Volumes

Roadway Segment	ADT	Centerline to 70 CNEL (ft)	Centerline to 65 CNEL (ft)	Centerline to 60 CNEL (ft)	CNEL (dBA) 50 ft from Centerline of Outermost Lane	Project Related Increase CNEL (dBA)
Long Beach Boulevard between NB 405 off-ramp and Wardlow Road	24,780	55.4	175.1	553.6	68.7	0.1
Long Beach Boulevard between Wardlow Road and 35th	26,460	59.1	186.9	591.2	69.0	0.2
Long Beach Boulevard between 35th and 36th	24,650	55.1	174.2	550.7	68.7	0.0
Long Beach Boulevard between 36th and Bixby	24,740	55.3	174.8	552.7	68.7	0.0
Wardlow Road between NB 405 on-ramp and Long Beach Boulevard	26,460	59.1	186.9	591.2	69.4	0.0
Wardlow Road east of Long Beach Boulevard	19,680	<50	139.0	439.7	68.1	0.0
35th west of Long Beach Boulevard	1,950	<50	<50	<50	54.0	3.9

6.2.2 Stationary Noise Impacts

Operation of the project would result in some acoustic emissions but would not result in vibration emissions. On-site stationary noise would include building heating, ventilation, and air conditioning (HVAC) systems and parking lot usage, including door closing/slamming, horn honking, and car alarms. HVAC systems typically result in noise levels that average between 50 and 60 dBA L_{max} at 50 feet from the equipment. Parking lots typically generate noise levels of up to 70 dBA L_{max} at 50 feet. The closest sensitive receptors to the project site, the residential uses to the south, are located within 50 feet of the on-site stationary sources. In addition, there are existing residences located to the west at a distance of approximately 80 feet. The safety barriers and proposed landscaping along the edge of the parking structure would reduce the parking lot noise by 5-8 dB to 62 to 65 dBA L_{max}. Therefore, the proposed project's stationary source noise impacts would be lower than the City's District One nighttime threshold of 65 dBA L_{max} (Table 5).

6.2.3 Airport Noise Impacts

The project site is located approximately 1.5 miles west of the Long Beach Airport. Although located within 2 miles of the airport, based on the airport's influence area map, the project site would be located outside of the 65 dBA CNEL noise contour. Therefore, aircraft noise levels will be below a level of significance.

7 Mitigation Measures

7.1 Construction Noise

Construction shall be limited to the hours of 7:00 a.m. and 7:00 p.m. Monday through Friday and Saturdays, between 9:00 a.m. and 6:00 p.m., in accordance with City standards. No construction activities shall occur outside of these hours or on Sundays and federal holidays.

The following measures shall be implemented to reduce potential construction noise impacts on nearby sensitive receptors.

1. During all site excavation and grading, the project contractors shall equip all construction equipment, fixed or mobile, with properly operating and maintained mufflers consistent with manufacturers' standards.
2. The project contractor shall place all stationary construction equipment so that emitted noise is directed away from sensitive receptors nearest the project site.
3. The construction contractor shall locate equipment staging in areas that will create the greatest distance between construction-related noise sources and noise-sensitive receptors nearest the project site during all project construction.

8 Conclusion

Project construction and operational noise and vibration were calculated and compared to applicable laws, guidelines, and/or regulations. Restricting construction activity to daytime hours (7:00 a.m. to 7:00 p.m. Monday through Friday and 9:00 a.m. and 6:00 p.m. on Saturdays) would reduce the noise and vibration impacts to below a level of significance.

Operational noise is not predicted to result in an increase in received noise levels at nearby noise sensitive receptors. On-site office uses would not be exposed to significant traffic noise levels.

9 References

888-5 Partners, LLC. 2018. City Application: Site Plan.

Bolt, Beranek & Newman. 1987. Noise Control for Buildings and Manufacturing Plants.

City of Long Beach. 1975. Noise Element of the General Plan.

Federal Highway Administration. 1977. Highway Traffic Noise Prediction Model, FHWA RD-77-108.

Iteris. 2018. Laserfiche Office Project Traffic Impact Analysis.

United States Environmental Protection Agency. 1978. Protective Noise Levels: Condensed Version of EPA Levels Document.

.

Appendix A. Traffic and Construction Noise Calculations

This page is intentionally blank.

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Saw	No	20		89.6	25.0	0.0
Excavator	No	40		80.7	25.0	0.0
Tractor	No	40	84.0		25.0	0.0
Front End Loader	No	40		79.1	25.0	0.0
Backhoe	No	40		77.6	25.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Noise Limits (dBA) Evening		Noise Limits (dBA) Night		Noise Limit Exceedance (dBA) Day		Noise Limit Exceedance (dBA) Evening		Noise Limit Exceedance (dBA) Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Saw	95.6	88.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator	86.7	82.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	90.0	86.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	85.1	81.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe	83.6	79.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	95.6	91.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #3 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
		0.0	0.0	0.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Saw	No	20		89.6	0.0	0.0
Excavator	No	40		80.7	0.0	0.0
Tractor	No	40	84.0		0.0	0.0
Front End Loader	No	40		79.1	0.0	0.0
Backhoe	No	40		77.6	0.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Saw		-7.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Excavator		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Backhoe		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	0.0	2.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 07/30/2018
Case Description: Site Preparation

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
residence	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Front End Loader	No	40		79.1	100.0	0.0
Scraper	No	40		83.6	100.0	0.0
Grader	No	40	85.0		100.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Front End Loader	73.1	69.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	77.6	73.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	79.0	75.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	79.0	78.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #2 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
residence 2	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)

Front End Loader	No	40		79.1	25.0	0.0
Scraper	No	40		83.6	25.0	0.0
Grader	No	40	85.0		25.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Calculated (dBA) Leq	Noise Limits (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Front End Loader	85.1	81.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper	89.6	85.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	91.0	87.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	91.0	90.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #3 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
		0.0	0.0	0.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Front End Loader	No	40		79.1	0.0	0.0
Scraper	No	40		83.6	0.0	0.0
Grader	No	40	85.0		0.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Calculated (dBA) Leq	Noise Limits (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Front End Loader		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Scraper		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Total	0.0	0.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 07/30/2018
Case Description: Grading

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
residence	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85.0		100.0	0.0
Tractor	No	40	84.0		100.0	0.0
Front End Loader	No	40		79.1	100.0	0.0
Grader	No	40	85.0		100.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Leq	Noise Limits (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Grader	79.0	75.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	78.0	74.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	73.1	69.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	79.0	75.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	79.0	79.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #2 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
residence 2	Residential	60.0	50.0	55.0

Equipment

Spec Actual Receptor Estimated

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85.0		25.0	0.0
Tractor	No	40	84.0		25.0	0.0
Front End Loader	No	40		79.1	25.0	0.0
Grader	No	40	85.0		25.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Grader	91.0	87.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	90.0	86.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	85.1	81.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	91.0	87.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	91.0	91.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #3 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
		0.0	0.0	0.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Grader	No	40	85.0		0.0	0.0
Tractor	No	40	84.0		0.0	0.0
Front End Loader	No	40		79.1	0.0	0.0
Grader	No	40	85.0		0.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq

Grader		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	0.0	2.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 07/30/2018
Case Description: Building Construction

**** Receptor #1 ****

		Baselines (dBA)		
Description	Land Use	Daytime	Evening	Night
residence	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Crane	No	16		80.6	100.0	0.0
Man Lift	No	20		74.7	100.0	0.0
Generator	No	50		80.6	100.0	0.0
Front End Loader	No	40		79.1	100.0	0.0
Welder / Torch	No	40		74.0	100.0	0.0
Welder / Torch	No	40		74.0	100.0	0.0
Front End Loader	No	40		79.1	100.0	0.0
Welder / Torch	No	40		74.0	100.0	0.0
Man Lift	No	20		74.7	100.0	0.0
Grader	No	40	85.0		100.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Crane	74.5	66.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift	68.7	61.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	74.6	71.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	73.1	69.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	68.0	64.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	68.0	64.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	73.1	69.1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	68.0	64.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	

N/A

Man Lift	68.7	61.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	79.0	75.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	79.0	78.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #2 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
residence 2	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Crane	No	16		80.6	25.0	0.0
Man Lift	No	20		74.7	25.0	0.0
Generator	No	50		80.6	25.0	0.0
Front End Loader	No	40		79.1	25.0	0.0
Welder / Torch	No	40		74.0	25.0	0.0
Welder / Torch	No	40		74.0	25.0	0.0
Front End Loader	No	40		79.1	25.0	0.0
Welder / Torch	No	40		74.0	25.0	0.0
Man Lift	No	20		74.7	25.0	0.0
Grader	No	40	85.0		25.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Crane	86.6	78.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift	80.7	73.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Generator	86.7	83.6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	85.1	81.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	80.0	76.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Welder / Torch	80.0	76.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Front End Loader	85.1	81.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		

N/A N/A

Welder / Torch	80.0	76.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Man Lift	80.7	73.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Grader	91.0	87.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	91.0	90.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #3 ****

Baselines (dBA)

Description	Land Use	Daytime	Evening	Night
		0.0	0.0	0.0

Equipment

Description	Impact Device	Spec Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Crane	No	16		80.6	0.0	0.0
Man Lift	No	20		74.7	0.0	0.0
Generator	No	50		80.6	0.0	0.0
Front End Loader	No	40		79.1	0.0	0.0
Welder / Torch	No	40		74.0	0.0	0.0
Welder / Torch	No	40		74.0	0.0	0.0
Front End Loader	No	40		79.1	0.0	0.0
Welder / Torch	No	40		74.0	0.0	0.0
Man Lift	No	20		74.7	0.0	0.0
Grader	No	40	85.0		0.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Crane	-8.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Man Lift	-7.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Generator	-3.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Front End Loader	-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Welder / Torch	-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
Welder / Torch	-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		

N/A
Front End Loader -4.0 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A
N/A
Welder / Torch -4.0 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A
N/A
Man Lift -7.0 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A
N/A
Grader -4.0 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A
N/A
Total 0.0 5.4 N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A N/A
N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 07/30/2018
Case Description: Paving

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
residence	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	100.0	0.0
Paver	No	50		77.2	100.0	0.0
Paver	No	50		77.2	100.0	0.0
Roller	No	20		80.0	100.0	0.0
Roller	No	20		80.0	100.0	0.0
Tractor	No	40	84.0		100.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	72.8	68.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	71.2	68.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	71.2	68.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	74.0	67.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	74.0	67.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	78.0	74.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	78.0	77.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #2 ****

Baselines (dBA)
Description Land Use Daytime Evening Night

Description	Land Use	Daytime	Evening	Night
residence 2	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Spec Usage (%)	Actual Lmax (dBA)	Receptor Lmax (dBA)	Estimated Distance (feet)	Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	25.0	0.0
Paver	No	50		77.2	25.0	0.0
Paver	No	50		77.2	25.0	0.0
Roller	No	20		80.0	25.0	0.0
Roller	No	20		80.0	25.0	0.0
Tractor	No	40	84.0		25.0	0.0

Results

Equipment	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck	84.8	80.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	83.2	80.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver	83.2	80.2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	86.0	79.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller	86.0	79.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor	90.0	86.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	90.0	89.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #3 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
		0.0	0.0	0.0

Equipment

Description	Impact Device	Spec Usage (%)	Actual Lmax (dBA)	Receptor Lmax (dBA)	Estimated Distance (feet)	Shielding (dBA)
Concrete Mixer Truck	No	40		78.8	0.0	0.0

Paver	No	50		77.2	0.0	0.0
Paver	No	50		77.2	0.0	0.0
Roller	No	20		80.0	0.0	0.0
Roller	No	20		80.0	0.0	0.0
Tractor	No	40	84.0		0.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Noise Limits (dBA) Evening		Noise Limits (dBA) Night		Noise Limit Exceedance (dBA) Day		Noise Limit Exceedance (dBA) Evening		Noise Limit Exceedance (dBA) Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Concrete Mixer Truck		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver		-3.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Paver		-3.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller		-7.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Roller		-7.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Tractor		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	0.0	3.4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Roadway Construction Noise Model (RCNM),Version 1.1

Report date: 07/30/2018
Case Description: Archetectural Coating

**** Receptor #1 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
residence	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Compressor (air)	No	40		77.7	100.0	0.0

Results

Equipment	Calculated (dBA) Lmax	Calculated (dBA) Leq	Noise Limits (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq	Noise Limit Exceedance (dBA) Day Lmax	Day Leq	Evening Lmax	Evening Leq	Night Lmax	Night Leq
Compressor (air)	71.6	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	71.6	67.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #2 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
residence 2	Residential	60.0	50.0	55.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Compressor (air)	No	40		77.7	25.0	0.0

Results

Noise Limits (dBA) Noise Limit Exceedance (dBA)

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Compressor (air)	83.7	79.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	83.7	79.7	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

**** Receptor #3 ****

Description	Land Use	Baselines (dBA) Daytime	Evening	Night
		0.0	0.0	0.0

Equipment

Description	Impact Device	Usage (%)	Spec Lmax (dBA)	Actual Lmax (dBA)	Receptor Distance (feet)	Estimated Shielding (dBA)
Compressor (air)	No	40		77.7	0.0	0.0

Results

	Calculated (dBA)		Noise Limits (dBA) Day		Evening		Night		Noise Limit Exceedance (dBA) Day		Evening		Night	
Equipment	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq	Lmax	Leq
Compressor (air)		-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	0.0	-4.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

This page is intentionally blank.