Environmental Noise Assessment
University Commons DEIR

City of Davis, California

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Prepared for:

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NOISE AND VIBRATION

INTRODUCTION

This section describes the existing noise environment in the area of the proposed University Commons Mixed Use project (Proposed Project) in the City of Davis, California, and the potential of the Proposed Project to be a source of noise which may adversely affect the noise and vibration environment, or be exposed to noise and vibration levels exceeding the City of Davis' applicable standards.

LOCATION

The Project Site is located north of Russell Boulevard, east of Sycamore Lane, and west of Anderson Road. The site is currently developed with the University Mall neighborhood shopping center.

Figure 1 shows the project location.

PROJECT DESCRIPTION

The Proposed Project is a redevelopment of the University Mall and would entail reconfiguration of buildings to create a mixed-use development which includes approximately 264 residential units and 136,800 square feet of retail uses.

Figures 2 shows the proposed project site plan.

ENVIRONMENTAL SETTING

BACKGROUND INFORMATION ON NOISE AND VIBRATION

Fundamentals of Acoustics

Acoustics is the science of sound. Sound may be thought of as mechanical energy of a vibrating object transmitted by pressure waves through a medium to human (or animal) ears. If the pressure variations occur frequently enough (at least 20 times per second), then they can be heard and are called sound. The number of pressure variations per second is called the frequency of sound, and is expressed as cycles per second or Hertz (Hz).

Noise is a subjective reaction to different types of sounds. Noise is typically defined as (airborne) sound that is loud, unpleasant, unexpected or undesired, and may therefore be classified as a more specific group of sounds. Perceptions of sound and noise are highly subjective from person to person.

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

The perceived loudness of sounds is dependent upon many factors, including sound pressure level and frequency content. However, within the usual range of environmental noise levels,

perception of loudness is relatively predictable, and can be approximated by A-weighted sound levels. There is a strong correlation between A-weighted sound levels (expressed as dBA) and the way the human ear perceives sound. For this reason, the A-weighted sound level has become the standard tool of environmental noise assessment. All noise levels reported in this section are in terms of A-weighted levels, but are expressed as dB, unless otherwise noted.

The decibel scale is logarithmic, not linear. In other words, two sound levels 10 dB apart differ in acoustic energy by a factor of 10. When the standard logarithmic decibel is A-weighted, an increase of 10 dBA is generally perceived as a doubling in loudness. For example, a 70 dBA sound is half as loud as an 80 dBA sound, and twice as loud as a 60 dBA sound.

Community noise is commonly described in terms of the ambient noise level, which is defined as the all-encompassing noise level associated with a given environment. A common statistical tool to measure the ambient noise level is the average, or equivalent, sound level (L_{eq}), which corresponds to a steady-state A weighted sound level containing the same total energy as a time varying signal over a given time period (usually one hour). The L_{eq} is the foundation of the composite noise descriptor, L_{dn}, and shows very good correlation with community response to noise.

The day/night average level (L_{dn}) is based upon the average noise level over a 24-hour day, with a +10 decibel weighing applied to noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours. The nighttime penalty is based upon the assumption that people react to nighttime noise exposures as though they were twice as loud as daytime exposures.

Table 1 lists several examples of the noise levels associated with common situations. Appendix A provides a summary of acoustical terms used in this report.

Legend

△# : 24-Hour Noise Monitoring Site

(#) : Short Term Measurement Site

Figure 1
University Mall Redevelopment
Project Site

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Rev. 1/11/17

NORTH ELEVATION LOADING AND PARKING GARAGE ACCESS- GRADE LEVEL SHOWN FOR REFERENCE

BRIXMOR Property Group

UNIVERSITY **COMMONS**

PROPOSED DESIGN CONCEPT

DAVIS, CA #180035 01-24-2019

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Figure 2
University Commons Site Plan

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Table 1

LOUDNESS COMPARISON CHART (dBA)

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Jet Fly-over at 1000 ft	110	Rock Band
	100	
Gas Lawn Mower at 3 ft		
	90	Food Blender at 3 ft
Diesel Truck at 50 ft at 50 mph	80	Garbage Disposal at 3 ft
Noisy Urban Area, Daytime		Vacuum Cleaner at 10 ft
Gas Lawn Mower at 100 ft	70	Normal Speech at 3 ft
Commercial Area		
Heavy Traffic at 300 ft	60	Large Business Office
Quiet Urban, Daytime	50	Dishwasher Next Room
Quiet Urban, Nighttime	40	Theater, Large Conference Room (Background)
Quiet Suburban, Nighttime		Library
	30	Bedroom at Night, Concert Hall (Background)
Quiet Rural, Nighttime	20	Broadcast/Recording Studio
	10	
Lowest Threshold of Human Hearing	0	Lowest Threshold of Human Hearing

An increase of 3 dBA is barely perceptible to the human ear.

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Effects of Noise on People

The effects of noise on people can be placed in three categories:

- Subjective effects of annoyance, nuisance, and dissatisfaction
- Interference with activities such as speech, sleep, and learning
- Physiological effects such as hearing loss or sudden startling

Environmental noise typically produces effects in the first two categories. Workers in industrial plants can experience noise in the last category. There is no completely satisfactory way to measure the subjective effects of noise or the corresponding reactions of annoyance and dissatisfaction. A wide variation in individual thresholds of annoyance exists and different tolerances to noise tend to develop based on an individual's past experiences with noise.

Thus, an important way of predicting a human reaction to a new noise environment is the way it compares to the existing environment to which one has adapted: the so-called ambient noise level. In general, the more a new noise exceeds the previously existing ambient noise level, the less acceptable the new noise will be judged by those hearing it.

With regard to increases in A-weighted noise level, the following relationships occur:

- Except in carefully controlled laboratory experiments, a change of 1 dBA cannot be perceived;
- Outside of the laboratory, a 3 dBA change is considered a just-perceivable difference;
- A change in level of at least 5 dBA is required before any noticeable change in human response would be expected; and
- A 10 dBA change is subjectively heard as approximately a doubling in loudness, and can cause an adverse response.

Stationary point sources of noise – including stationary mobile sources such as idling vehicles – attenuate (lessen) at a rate of approximately 6 dB per doubling of distance from the source, depending on environmental conditions (i.e. atmospheric conditions and either vegetative or manufactured noise barriers, etc.). Widely distributed noises, such as a large industrial facility spread over many acres, or a street with moving vehicles, would typically attenuate at a lower rate.

EXISTING CONDITIONS

Existing Noise Receptors

The surrounding land uses include an ARCO service station which is located at the northwest corner of Russell Boulevard and Anderson Road. A Rite Aid pharmacy is across Anderson Road to the east. The University of California, Davis campus is located south of the site. Multi-family apartment communities are located immediately north and east of the site.

In the immediate vicinity of the project site, sensitive land uses include the multi-family residential uses to the north. These land uses could potentially experience noise impacts associated with project demolition/construction, increased roadway traffic associated with the project, and delivery vehicles which occur at the north side of the project site.

Existing Ambient Noise Levels

On November 5th - 6th, 2018, j.c. brennan & associates, Inc. staff conducted short-term noise level measurements and continuous 24-hour noise level measurements on the project site to quantify the existing ambient noise environment in the project vicinity. The noise measurement locations are shown on Figure 1. The noise level measurement survey results are provided in Table 2. Appendix B provides the complete results of the continuous noise level measurement survey and the short-term noise level measurements.

Larson Davis Laboratories (LDL) Model 820 and Model 824 precision integrating sound level meters were used for the ambient noise level measurement survey. The meters were calibrated before and after use with an LDL Model CAL200 acoustical calibrator to ensure the accuracy of the measurements. The equipment used meets all pertinent specifications of the American National Standards Institute for Type 1 sound level meters (ANSI S1.4).

The sound level meters were programmed to record the maximum, median, and average noise levels at each site during the survey. The maximum value, denoted L_{max}, represents the highest noise level measured. The average value, denoted L_{eq}, represents the energy average of all of the noise received by the sound level meter microphone during the monitoring period. The median value, denoted L_{50}, represents the sound level exceeded 50 percent of the time during the monitoring period.

TABLE 2: MEASURED AMBIENT NOISE LEVELS
(NOVEMBER 5TH- 6TH, 2018)

Continuous 24-hour Noise Measurement Site								
		Average Measured Hourly Noise Levels, dBA						
			Daytime (7:00 am – 10:00 pm)			**Nighttime (10:00 pm -7:00 am)**		
Site	**Location**	**L_{dn}**	**L_{eq}**	**L_{50}**	**L_{max}**	**L_{eq}**	**L_{50}**	**L_{max}**
A	West Portion of the Project Site	60.8	57.6	53.1	79.6	53.5	47.4	69.6

Short-Term Noise Measurement Sites						
Site	**Location**	**Time**	**L_{eq}**	**L_{50}**	**L_{max}**	**Notes**
1	Southwest on-site	12:00 p.m.	63.3	58.7	77.2	Roadway Traffic / Parking Lot Activity
2	South-central on-site	12:20 p.m.	58.6	55.1	70.8	Some Roadway Traffic / Parking Lot Activity
3	Eastern on-site	12:50 p.m.	56.7	55.0	68.6	Anderson Road Traffic
4	Northeastern on-site	1:20 p.m.	50.4	49.7	60.8	Roadway Traffic
5	Northwestern on-site	2:00 p.m.	53.2	51.2	64.0	Traffic on Sycamore

Source: j.c. brennan & associates, Inc., 2018

Based upon field observations and noise measurement data described above, the existing noise environment at the project site is defined by roadway traffic and noise sources associated with the existing commercial uses. Additional discussions on traffic noise, based upon the noise measurement data, are included later in this report.

Existing Roadway Noise Levels

Traffic volumes for existing conditions were obtained from the project traffic consultant. Truck percentages and vehicle speeds on the local area roadways were estimated from field observations..

Traffic noise levels are generally predicted at 75-feet from the centerline along each project-area roadway segment. Sensitive receptors may be located at distances which vary from the assumed calculation distance and may experience shielding from intervening barriers or sound walls. However, the traffic noise analysis is believed to be representative of the majority of sensitive receptors located closest to the project-area roadway segments analyzed in this report.

Table 3 shows the existing traffic noise levels in terms of L_{dn} along each roadway segment. This table also shows the distances to existing traffic noise contours. A complete listing of the FHWA Model input data is contained in Appendix C.

The actual distances to noise level contours may vary from the distances predicted by the FHWA model due to roadway curvature, grade, shielding from local topography or structures, elevated roadways, or elevated receivers. The distances reported in Table 3 are generally considered to be conservative estimates of noise exposure along the project-area roadways.

TABLE 3: PREDICTED EXISTING TRAFFIC NOISE LEVELS

Roadway	Segment	Ldn, dBA*	Contour Noise Levels (Ldn, dBA)*			
			Distance* (feet)	Distance to Contours (feet)		
				70	65	60
Russell Road	West of Arthur St.	66	75	39	83	179
Russell Road	Arthur St. to S.R. 113	67	75	46	100	215
Russell Road	S.R. 113 to Orchard Park	67	75	51	109	236
Russell Road	Orchard Park to Sycamore Ln.	68	75	51	111	238
Russell Road	Sycamore to Project Driveways	67	75	45	97	209
Russell Road	Project Driveways to Anderson Rd.	68	75	54	117	252
Russell Road	Anderson Rd. to College Park	68	75	53	115	247
Russell Road	College Park to A Street	68	75	55	119	256
Russell Road	A Street to B Street	68	75	54	116	250
Arthur Street	North of Russell Rd.	61	75	19	42	90
Orchard Park	South of Russell Rd.	60	75	15	32	70
Sycamore Lane	Russell Rd. to S. U Mall Driveway	63	75	27	58	125
Sycamore Lane	S. U Mall Driveway to N. U Mall Driveway	62	75	23	50	107
Sycamore Lane	North of Project Site	62	75	23	50	108
La Rue Road	South of Russell Rd.	66	75	42	91	197
Anderson Road	Russell Rd. to Central U Mall Driveways	65	75	35	75	162
Anderson Road	Central U Mall Driveways to N. U Mall Drive	65	75	34	72	156
Anderson Road	North of Project Site	65	75	34	73	156
California Avenue	South of Russell Rd.	61	75	18	40	85
Oak Avenue	North of Russell Rd.	58	75	13	27	58
Howard Way	South of Russell Rd.	63	75	26	56	121
College Park	North of Russell Rd.	56	75	8	18	39
A Street	South of Russell Rd.	58	75	12	26	55
A Street	North of Russell Rd.	55	75	8	17	36
B Street	North of Russell Rd.	62	75	22	46	100
B Street	South of Russell Rd.	65	75	37	79	170

[1] Traffic noise levels do not account for shielding from existing noise barriers or intervening structures. Traffic noise levels may vary depending on actual setback distances and localized shielding.

*All calculations of traffic noise levels and distances to contours are relative to the roadway centerlines.
Source: [Fehr & Peers], j.c. brennan & associates, Inc. - 2019

REGULATORY CONTEXT

FEDERAL

There are no federal regulations related to noise that apply to the Proposed Project.

State

California Environmental Quality Act

The California Environmental Quality Act (CEQA) Guidelines, Appendix G, indicate that a significant noise impact may occur if a project exposes persons to noise levels in excess of local general plans or noise ordinance standards, or cause a substantial permanent or temporary increase in ambient noise levels.

California State Building Codes

The State Building Code, Title 24, Part 2 of the State of California Code of Regulations establishes uniform minimum noise insulation performance standards to protect persons within new buildings which house people, including hotels, motels, dormitories, apartment houses and dwellings other than single-family dwellings. Title 24 mandates that interior noise levels attributable to exterior sources shall not exceed 45 dB L_{dn} or CNEL in any habitable room.

Title 24 also mandates that for structures containing noise-sensitive uses to be located where the L_{dn} or CNEL exceeds 60 dB, an acoustical analysis must be prepared to identify mechanisms for limiting exterior noise to the prescribed allowable interior levels. If the interior allowable noise levels are met by requiring that windows be kept closed, the design for the structure must also specify a ventilation or air conditioning system to provide a habitable interior environment.

LOCAL

City of Davis General Plan

Policy NOISE 1.1 Minimize vehicular and stationary noise sources, and noise emanating from temporary activities.

Standards

a. The City shall strive to achieve the "normally acceptable" exterior noise levels shown in Table 4 (Table 19 of the General Plan) and the target interior noise levels in Table 5 (Table 20 of the General Plan) in future development areas and in currently developed areas.

b. New development shall generally be allowed only in areas where exterior and interior noise levels consistent with Table 4 (Table 19 of the General Plan) and Table 5 (Table 20 of the General Plan) can be achieved.

c. New development and changes in use shall generally be allowed only if they will not adversely impact attainment within the community of the exterior and interior noise standards shown in Table 4 (Table 19 of the General Plan) and Table 5 (Table 20 of the General Plan). Cumulative and project specific impacts by new development on existing residential land uses shall be mitigated consistent with the standards in Table 4 (Table 19 of the General Plan) and Table 5 (Table 20 of the General Plan).

d. Required noise mitigation measures for new and existing housing shall be provided with the first stage and prior to completion of new developments or the completion of capacity-enhancing roadway changes wherever noise levels currently exceed or are projected within 5 years to exceed the normally acceptable exterior noise levels in Table 4 (Table 19 of the General Plan).

TABLE 4: EXTERIOR NOISE LEVEL STANDARDS
(CITY OF DAVIS GENERAL PLAN TABLE 19)

LAND USE CATEGORY	COMMUNITY NOISE EXPOSURE LDN OR CNEL, DBA			
	NORMALLY ACCEPTABLE	CONDITIONALLY ACCEPTABLE	UNACCEPTABLE	CLEARLY UNACCEPTABLE
Residential	Under 60	60-70*	70-75	Above 75
Transient Lodging - Motels, Hotels	Under 60	65-75	75-80	Above 80
Schools, Libraries, Churches, Hospitals, Nursing Homes	Under 60	60-70	70-80	Above 80
Auditoriums, Concert Halls, Amphitheaters	Under 50	50-70	NA	Above 70
Sports Arenas, Outdoor Spectator Sports	NA	Under 75	NA	Above 75
Playgrounds, Neighborhood Parks	Under 70	NA	70-75	Above 75
Golf Courses, Riding Stables, Water Recreation, Cemeteries	Under 70	NA	70-80	Above 80
Office Buildings, Business Commercial and Professional	Under 65	65-75	Above 75	NA
Industrial, Manufacturing, Utilities, Agriculture	Under 65	70-80	Above 80	NA

Normally Acceptable: *Specified land use is satisfactory based upon the assumption that any buildings involved are of normal conventional construction, without special noise insulation requirements.*
Conditionally Acceptable: New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is conducted, and needed noise attenuation features are included in the construction or development.
Normally Unacceptable: *New construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be conducted and needed noise attenuation features shall be included in the construction or development.*
Clearly Unacceptable: *New construction or development shall not be undertaken.*
NA: *Not applicable*
** The City Council shall have discretion within the "conditionally acceptable" range for residential use to allow levels in outdoor spaces to go up to 65 dBA if cost effective or aesthetically acceptable measures are not available to reduce noise levels in outdoor spaces to the "normally acceptable" levels. Outdoor spaces which are designed for visual use only (for example, street-side landscaping in an apartment project), rather than outdoor use space may be considered acceptable up to 70 dBA.*

Source: City of Davis, 2010

TABLE 5: STANDARDS FOR INTERIOR NOISE LEVELS (CITY OF DAVIS GENERAL PLAN TABLE 20)

Use	Noise Level (dBA)
Residences, schools through grade 12, hospitals and churches	45
Offices	55

Source: City of Davis, 2010

Policy NOISE 1.2 Discourage the use of sound walls whenever alternative mitigation measures are feasible, while also facilitating the construction of sound walls where desired by the neighborhood and there is no other way to reduce noise to acceptable exterior levels shown in Table 4 (Table 19 of the General Plan).

Standards

a. Where sound walls are built, they should include dense landscaping along them to mitigate their visual impact, as illustrated in Figure 38 (of the General Plan).

b. Where sound walls are built, they should provide adequate openings and visibility from surrounding areas to increase safety and access, as illustrated in Figure 38 (Of the General Plan). Openings should be designed so as to maintain necessary noise attenuation.

c. Review sound walls and other noise mitigations through the design review process.

GOAL NOISE 2. Provide for indoor noise environments that are conducive to living and working.

Policy NOISE 2.1 Take all technically feasible steps to ensure that interior noise levels can be maintained at the levels shown in Table 5 (Table 20 of the General Plan)

Standards

a. New residential development or construction shall include noise attenuation measures necessary to achieve acceptable interior noise levels shown in Table 5 (Table 20 of the General Plan).

b. Existing areas that will be subjected to noise levels greater than the acceptable noise levels shown in Table 8 (Table 20 of the General Plan) as a result of increased traffic on existing city streets (including streets remaining in existing configurations and streets being widened) shall be mitigated to the acceptable levels in Table 8 (Table 20 of the General Plan). If traffic increases are caused by specific projects, then the City shall be the lead agency in implementing cumulative noise mitigation projects. Project applicants shall pay their fair share for any mitigation.

City of Davis Noise Ordinance

Section 24 of the City of Davis City Code establishes a maximum noise level standard of 55 dB during the hours of 7:00 a.m. to 9:00 p.m., and 50 dB during the hours of 9:00 p.m. to 7:00 a.m. The ordinance defines maximum noise level as the "maximum continuous sound level or repetitive peak level produced by a sound source or group of sources. For the purposes of this analysis, j.c. brennan & associates, Inc. interprets this definition to be equivalent to the average noise level descriptor, Leq. The City Code makes exemptions for certain typical activities which may occur within the city. These exemptions are listed in Article 24.02.040, Special Provisions, and are summarized below:

a) Normal operation of power tools for non-commercial purposes are typically exempted between the hours of 8 am and 8 pm unless the operation unreasonably disturbs the peace and quiet of any neighborhood.

b) Construction or landscape operations would be exempt during the hours of 7am to 7 pm Mondays through Fridays and between the hours of 8 am to 8 pm Saturdays and Sundays assuming that the operations are authorized by valid city permit or business license, or carried out by employees or contractors of the city and one of the following conditions apply (conditions summarized, please see section 24.02.040 of the City Code for the full text):

    1) No piece of equipment produces a noise level exceeding 83 dBA at 25-feet.

    2) The noise level at any point outside the property plane of the project shall not exceed 86 dBA.

    3) Requires that impact equipment and tools be fitted with the best available silencing equipment.

    4) Limits individual powered blowers to a noise level of 70 dBA at 50 feet.

    5) Prohibits more than one blower from simultaneously operating within 100 feet of another blower.

    6) On single-family residential property, the 70 dBA at 50 feet requirement would not apply to blowers operated on single-family residential property.

c) The City Code also exempts air conditioners, pool pumps, and similar equipment from the noise regulations, provided that they are in good working order.

d) Work related to public health and safety is exempt from the noise requirements.

e) Safety devices are exempt from the noise requirements.

f) Emergencies are exempt from the noise requirements.

The noise standards applicable to the project include the relevant portions of the City of Davis General Plan, the City of Davis Noise Ordinance described in the Regulatory Framework section above (Section 3.11.2), and the following standards. Generally, a project may have a significant effect on the environment if it will substantially increase the ambient noise levels for adjoining areas or expose people to severe noise levels. In practice, more specific professional standards have been developed. These standards state that a noise impact may be considered significant if it would generate noise that would conflict with local project criteria or ordinances, or substantially increase noise levels at noise sensitive land uses. The potential increase in traffic noise from the project is a factor in determining significance. Research into the human perception of changes in sound level indicates the following:

- A 3-dB change is barely perceptible,
- A 5-dB change is clearly perceptible, and
- A 10-dB change is perceived as being twice or half as loud.

A limitation of using a single noise level increase value to evaluate noise impacts is that it fails to account for pre-project-noise conditions. Table 6 is based upon recommendations made by the Federal Interagency Committee on Noise (FICON) to provide guidance in the assessment of changes in ambient noise levels resulting from aircraft operations. The recommendations are based upon studies that relate aircraft noise levels to the percentage of persons highly annoyed by the noise. Although the FICON recommendations were specifically developed to assess aircraft noise impacts, it has been accepted that they are applicable to all sources of noise described in terms of cumulative noise exposure metrics such as the Ldn.

Table 6: Significance of Changes in Noise Exposure

Ambient Noise Level Without Project, Ldn	Increase Required for Significant Impact
<60 dB	+5.0 dB or more
60-65 dB	+3.0 dB or more
>65 dB	+1.5 dB or more

Source: Federal Interagency Committee on Noise (FICON)

The test of significance for increases in off-site traffic noise is two-fold. First, traffic noise levels are reviewed to see if the project's contribution to traffic noise would exceed the FICON levels identified in Table 6. If the project's increase in traffic noise levels along surrounding roadways would exceed the FICON criteria shown in Table 6, the proposed project would be considered to have a significant noise impact along that roadway segment.

The second part of the significance test would be applied if the project does not result in the traffic noise level increases shown in Table 6 (i.e., the project does not exceed the FICON criteria). In this case, each roadway segment is assessed to determine:

1). whether the project's traffic noise contribution would cause any new receptors along the roadway to be exposed to exterior noise levels exceeding the Table 4 and Table 5 standards (i.e., the City's General Plan Noise Element standards); and
2) whether the project's traffic would cause any receptor locations already exceeding the values in Table 4 and Table 5 to experience a perceivable increase in noise at these locations, defined as 1.5 dB.

CRITERIA FOR ACCEPTABLE VIBRATION

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

Vibration can be measured in terms of acceleration, velocity, or displacement. A common practice is to monitor vibration measures in terms of peak particle velocities in inches per second. Standards pertaining to perception as well as damage to structures have been developed for vibration levels defined in terms of peak particle velocities.

The City of Davis does not contain specific policies pertaining to vibration levels. However, vibration levels associated with construction activities are discussed in this report.

Human and structural response to different vibration levels is influenced by a number of factors, including ground type, distance between source and receptor, duration, and the number of perceived vibration events. Table 7, which was developed by Caltrans, shows the vibration levels which would normally be required to result in damage to structures. The vibration levels are presented in terms of peak particle velocity in inches per second.

Table 7 indicates that the threshold for architectural damage to structures is 0.20 in/sec p.p.v. and continuous vibrations of 0.10 in/sec p.p.v., or greater, would likely cause annoyance to sensitive receptors.

TABLE 7: EFFECTS OF VARIOUS VIBRATION LEVELS ON PEOPLE AND BUILDINGS

Vibration Level (Peak Particle Velocity)*		Human Reaction	Effect on Buildings
mm/s	in/sec		
0.15-0.30	0.006-0.019	Threshold of perception; possibility of intrusion	Vibrations unlikely to cause damage of any type
2.0	0.08	Vibrations readily perceptible	Recommended upper level of the vibration to which ruins and ancient monuments should be subjected
2.5	0.10	Level at which continuous vibrations begin to annoy people	Virtually no risk of "architectural" damage to normal buildings
5.0	0.20	Vibrations annoying to people in buildings (this agrees with the levels established for people standing on bridges and subjected to relative short periods of vibrations)	Threshold at which there is a risk of "architectural" damage to normal dwelling - houses with plastered walls and ceilings Special types of finish such as lining of walls, flexible ceiling treatment, etc., would minimize "architectural" damage
10-15	0.4-0.6	Vibrations considered unpleasant by people subjected to continuous vibrations and unacceptable to some people walking on bridges	Vibrations at a greater level than normally expected from traffic, but would cause "architectural" damage and possibly minor structural damage.

Source: Transportation Related Earthborne Vibrations, Caltrans Experiences. Technical Advisory: TAV-02-01-R9601. February 20, 2002.

IMPACTS AND MITIGATION MEASURES

THRESHOLDS OF SIGNIFICANCE

Appendix G of the CEQA Guidelines states that a project would normally be considered to result in significant noise impacts if noise levels conflict with adopted environmental standards or plans or if noise generated by the project would substantially increase existing noise levels at sensitive receivers on a permanent or temporary basis. Significance criteria for noise impacts are drawn from CEQA Guidelines Appendix G (Items XI [a-f]).

Additional thresholds included in the General Plan EIR also are shown.

Would the project:

a. Expose persons to or generate noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies. This is used in conjunction with the substantial increase in noise levels described below under "c". For stationary noise, the limits set in Section 24.02.040 of the City's Noise Ordinance shall be considered the applicable standard;

b. Expose persons to, or generate, excessive groundborne vibration or groundborne noise levels;

c. Cause a substantial permanent increase in ambient noise levels in the project vicinity above existing levels without the project. For the purposes of this project, the FICON criteria shown in Table 6 are applied for transportation-related noise levels. For stationary noise sources, an increase in noise levels of a 5 dB hourly Leq level is used for determining a substantial permanent increase in ambient noise levels. The rationale for the 5 dB increase is based upon the fact that, as discussed earlier, it is the threshold where noise is "clearly perceptible", and for this proposed project, the stationary noise sources generally only occurs a few hours out of each day, and are not a continuous noise source such as roadway traffic;

d. Cause a substantial temporary or periodic increase in ambient noise levels in the project vicinity above existing levels without the project;

e. Expose persons residing or working in the project area to excessive noise levels if 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; or

f. Expose persons residing or working in the project area to excessive noise levels if located within the vicinity of a private airstrip.

The proposed project is not located within two miles of a public or private airport, therefore items "e" and "f" are not discussed any further in this study.

PROJECT-SPECIFIC IMPACTS AND MITIGATION MEASURES

Impact 1 Construction and Demolition Noise at Sensitive Receptors

Demolition of existing buildings, and the construction of the Proposed Project would temporarily increase noise levels during construction. This would be a ***potentially significant*** impact.

The new development, maintenance of roadways, installation of public utilities, and infrastructure improvements associated with the project will require construction activities. These activities include the use of heavy equipment and impact tools. Table 8 provides a list of the types of equipment which may be associated with construction and demolition activities and the associated noise levels.

Table 8: Construction / Demolition Equipment Noise

Type of Equipment	Predicted Noise Levels, Lmax dB				Distances to Noise Contours (feet)	
	Noise Level At 20'	Noise Level at 50'	Noise Level at 100'	Noise Level at 200'	70 dB Lmax contour	65 dB Lmax contour
Backhoe	86	78	72	66	126	223
Compactor	91	83	77	71	223	397
Compressor (air)	86	78	72	66	126	223
Concrete Saw	98	90	84	78	500	889
Dozer	90	82	76	70	199	354
Dump Truck	84	76	70	64	100	177
Excavator	89	81	75	69	177	315
Generator	89	81	75	69	177	315
Jackhammer	97	89	83	77	446	792
Pneumatic Tools	93	85	79	73	281	500

Source: Roadway Construction Noise Model User's Guide. Federal Highway Administration. FHWA-HEP-05-054. January 2006. j.c. brennan & associates, Inc. 2016.

Activities involved in project construction would typically generate maximum noise levels ranging from 76 to 90 dB at a distance of 50 feet. The nearest sensitive receptor would be located within 50-feet to the north.

Construction could result in periods of elevated ambient noise levels and the potential for annoyance. However, the City of Davis Noise Ordinance establishes allowable hours of operation and noise limits for construction activities as follows:

24.02.040 Special provisions

(b) Construction and landscape maintenance equipment. Notwithstanding any other provision of this chapter, between the hours of 7:00 a.m. and 7:00 p.m. on Mondays through Fridays, and between the hours of 8:00 a.m. and 8:00 p.m. on Saturdays and Sundays, construction, alteration, repair or maintenance activities which are authorized by valid city permit or business license, or carried out by employees of contractors of the city shall be allowed if they meet at least one of the following noise limitations:

(1) No individual piece of equipment shall produce a noise level exceeding eighty-three dBA at a distance of twenty-five feet. If the device is housed within a structure on the property, the measurement shall be made outside the structure at a distance as close to twenty feet from the equipment as possible.

(2) The noise level at any point outside of the property plane of the project shall not exceed eighty-six dBA.

(3) The provisions of subdivisions (1) and (2) of this subsection shall not be applicable to impact tools and equipment; provided, that such impact tools and equipment shall have intake and exhaust mufflers recommended by manufacturers thereof and approved by the director of public works as best accomplishing maximum noise attenuation, and that pavement breakers and jackhammers shall also be equipped with acoustically attenuating shields or shrouds recommended by the manufacturers thereof and approved by the director of public works as best accomplishing maximum noise attenuation. In the absence of manufacturer's recommendations, the director of public works may prescribe such means of accomplishing maximum noise attenuation as he/she may determine to be in the public interest.

Construction projects located more than two hundred feet from existing homes may request a special use permit to begin work at six a.m. on weekdays from June 15th until September 1st. No percussion type tools (such as ramsets or jackhammers) can be used before 7:00 a.m. The permit shall be revoked if any noise complaint is received by the police department.

(4) No individual powered blower shall produce a noise level exceeding seventy dBA measured at a distance of fifty feet.

(5) No powered blower shall be operated within one hundred feet radius of another powered blower simultaneously.

(6) On single-family residential property, the seventy dBA at fifty feet restriction shall not apply if operated for less than ten minutes per occurrence.

Based upon measured background noise levels, the existing maximum noise levels can be as high as 79 dBA. Assuming ambient maximum noise levels would occur during the same time when noise levels from construction would be 86 dBA (Compliance with the requirement of 86 dBA at the property plane as required in the Noise Ordinance), the overall combined noise level could be as high as 86.8 dBA Lmax. An increase in noise levels of 0.8 dB would not be perceptible to the human ear. However, construction activities would temporarily add to the noise environment in the project vicinity. To ensure that construction activities do not exceed the requirements of the City of Davis Municipal Code Section 24.02.040, or result in a significant increase in noise levels, mitigation measures are included. Temporary construction noise would not result in a significant noise impact, consistent with the City's Noise Ordinance with the following mitigation measures and shall reduce construction noise to a **less than significant** impact.

Mitigation Measure for Impact 1:

MM 1-1 In order to comply with the Municipal Code, the following mitigation measures are required:

1) Comply with the hours of operations between 7:00 a.m. and 7:00 p.m. on Mondays through Fridays, and between the hours of 8:00 a.m. and 8:00 p.m. on Saturdays and Sundays;

2) Impact tools and equipment shall have intake and exhaust mufflers recommended by manufacturers;

3) All equipment shall not exceed 86 dBA outside of the property line. Based upon Table 8, compactors, dozers and excavators shall maintain a distance of 50-feet from the north property line. Concrete saws and jackhammers shall maintain a distance of 100-feet from the nearest property line. If any equipment listed cannot provide either a housing or muffler, or other type of noise suppression equipment to reduce noise levels to 86 dBA or less outside of the property line, then it will require approval by the director of public works;

4) If equipment such as compactors, dozers and excavators will need to be within 50 feet of the north property line, temporary barriers such as "Noise Soaker" curtains can be applied at the construction site fence. The barriers should be 8-feet in height along the north property line. See Appendix D for the brochure on "Sound Soaker" Curtains.

Impact 2: Construction Vibration.

Construction vibration impacts include human annoyance and building structural damage. Human annoyance occurs when construction vibration rises significantly above the threshold of perception. Building damage can take the form of cosmetic or structural. Table 9 shows the typical vibration levels produced by construction equipment.

The primary vibration-generating activities associated with the project would occur when the infrastructure such as utilities, and foundations are constructed. The most significant source of ground-borne vibrations during the project construction would occur from the use of vibratory compactors which may be used for compacting fill-soil where new foundations or footings may be required. Vibratory compactors would generate typical vibration levels of 0.210 in/sec at a distance of 25 feet, and 0.070 at a distance of 50-feet. The closest residential buildings to the project site where construction activities could include vibratory compactors is at a distance of approximately 50 feet. Table 7, above, indicates that the threshold for architectural damage to buildings is 0.20 in/sec. Therefore, based upon Table 9 data, vibratory compactors would not generate vibration levels exceeding safe levels at these distances, therefore mitigation measures would not be required. This is a ***less than significant impact.***

The following mitigation measures will reduce construction vibration to a **less than significant** level.

Mitigation Measure for Impact 2:

None Required

TABLE 9: VIBRATION LEVELS FOR VARIOUS CONSTRUCTION EQUIPMENT

Type of Equipment	Peak Particle Velocity @ 25 feet (inches/second)	Peak Particle Velocity @ 50 feet (inches/second)
Large Bulldozer	0.089	0.029
Loaded Trucks	0.076	0.025
Pile Driving (Sonic)	0.734	0.50
Small Bulldozer	0.003	0.000
Auger/drill Rigs	0.089	0.029
Jackhammer	0.035	0.011
Vibratory Hammer	0.070	0.023
Vibratory Compactor/roller	0.210	0.070

Source: Federal Transit Administration, *Transit Noise and Vibration Impact Assessment Guidelines*, May 2006

Impact 3 Project Generated Traffic Noise at Existing Sensitive Receptors

Traffic generated by the Proposed Project would result in traffic noise level increases of no more than 1 dB. Where existing traffic noise levels currently exceed the City of Davis exterior noise level standards, the project still would not generate traffic noise increases exceeding the substantial increase criterion of 1.5 dB, as outlined above in Table 6. This is a **less than significant** impact.

Traffic noise levels are predicted at locations that are assumed to be typical residential outdoor use areas, where residences exist, for each project-area roadway segment. The actual distances to noise level contours may vary from the distances predicted by the FHWA model due to roadway curvature, grade, shielding from local topography or structures, elevated roadways, or elevated receivers. The distances reported in Table 10 are generally considered to be conservative estimates of noise exposure along the project-area roadways.

Table 10 shows the predicted traffic noise level increases on the local roadway network for the "Existing", "Existing Plus Project", Cumulative No Project, and the Cumulative Plus Project scenarios. Appendix C provides the complete inputs and results of the FHWA traffic noise modeling.

Based upon Table 10, the project will not result in an increase in traffic noise levels of more than 1 dBA at distances representing the nearest outdoor activity areas. In addition, the project will not result in a new exceedance of the City of Davis exterior traffic noise level standards.

This would be a ***less than significant*** impact.

Mitigation Measure for Impact 3:

None Required

TABLE 10: EXISTING - EXISTING + PROJECT - CUMULATIVE - CUMULATIVE + PROJECT TRAFFIC NOISE LEVELS

Roadway	Segment	Traffic Noise Levels (Ldn, dBA)*						
		Distance (feet)	Existing	Existing + Project	Δ Change	Cumulative	Cumulative + Project	Δ Change
Russell Road	West of Arthur St.	75	66	66	0	67	67	0
Russell Road	Arthur St. to S.R. 113	75	67	67	0	68	68	0
Russell Road	S.R. 113 to Orchard Park	75	67	68	+1	69	69	0
Russell Road	Orchard Park to Sycamore Ln.	75	68	68	0	69	69	0
Russell Road	Sycamore To Project Driveways	75	67	67	0	68	68	0
Russell Road	Project Driveways to Anderson Rd.	75	68	68	0	70	70	0
Russell Road	Anderson Rd. to College Park	75	68	68	0	70	70	0
Russell Road	College Park to A Street	75	68	68	0	70	70	0
Russell Road	A Street to B Street	75	68	68	0	70	70	0
Arthur Street	North of Russell Rd.	75	61	61	0	62	62	0
Orchard Park	South of Russell Rd.	75	60	60	0	62	62	0
Sycamore Lane	Russell Rd. to S. U Mall Drivway	75	63	64	+1	64	64	0
Sycamore Lane	S. U Mall Driveway to N. U Mall Driveway	75	62	63	+1	63	63	0
Sycamore Lane	North of Project Site	75	62	63	+1	63	63	0
La Rue Road	South of Russell Rd.	75	66	66	0	68	68	0
Anderson Road	Russell Rd. to Central U Mall Driveways	75	65	65	0	66	66	0
Anderson Road	Central U Mall Driveways to N. U Mall Drive	75	65	65	0	65	66	+1
Anderson Road	North of Project Site	75	65	65	0	65	65	0
California Avenue	South of Russell Rd.	75	61	61	0	62	62	0
Oak Avenue	North of Russell Rd.	75	58	58	0	59	59	0
Howard Way	South of Russell Rd.	75	63	63	0	63	63	0
College Park	North of Russell Rd.	75	56	56	0	57	57	0
A Street	South of Russell Rd.	75	58	58	0	60	60	0
A Street	North of Russell Rd.	75	55	55	0	56	56	0
B Street	North of Russell Rd.	75	62	62	0	64	64	0
B Street	South of Russell Rd.	75	65	65	0	66	66	0

* Distances to predicted traffic noise levels, and traffic noise contours are measured in feet from the centerlines of the Roadways.
Source: Fehr & Peers - j.c. brennan & associates, Inc. - 2019

Impact 4: Compliance with the City of Davis Noise Ordinance Criteria for Stationary Noise Sources, and would not result in a significant increase in overall noise levels at Adjacent Noise Sensitive Receivers.

The project contains a loading and receiving area at the north side of the project site. Residential uses are located to the north of the site, and the project will need to comply with the City Noise Ordinance which requires achieving an exterior noise level due to the loading area of 55 dB Leq during the daytime hours of 7:00 a.m. to 9:00 p.m., and 50 dB Leq during the nighttime hours of 9:00 p.m. to 7:00 a.m. at the residences to the north.

Loading Docks and Truck Circulation Analysis

Based upon the project applicant information, the commercial loading dock with two docks will have a maximum of 20 to 28 large truck deliveries over a seven day period. Since there are two loading docks, it is assumed that up to 2 large eighteen-wheeler truck deliveries could occur per hour. A total of 4 retail spaces are located along the rear loading dock drive aisle, only 2 of which can receive deliveries to the north (back side). All other tenants will receive deliveries to the front of the stores. Some other outdoor uses could occur such as pallet / baling equipment. However, this is expected to occur during the daytime hours.

Large 18-wheeler truck passbys and loading dock operations produce an average Sound Exposure Level (SEL) of 88 dBA at a distance of 50 feet. This includes deliveries, unloading of trucks, and departures. This is based upon j.c. brennan & associates, Inc. file data for truck deliveries at large super markets. This included the use of back-up beepers, revving of engines, and air brake use which may be used during the arrivals / departures, and the loading or unloading from the trucks. It should be noted that the north elevations for the proposed loading docks include sealed loading pads. In other words, the loading / unloading will be contained within the loading docks and the interior of the trucks. The project also includes a partial enclosure wall along the loading docks. In order to calculate the hourly average (L_{eq}) for truck passbys, the following equation can be used:

$$L_{eq} = SEL + 10*\log (\#\ of\ events) - 35.6$$

Where the number of events is 2, and 35.6 is the log of the number of seconds in an hour.

The resulting truck circulation noise levels at a distance of 50-feet is 55 dBA Leq. The project includes sealed loading docks and partial sound walls. However, no sound walls are located along the driveway.

Pallet and Baling Operations Analysis

Based upon the project description, no fork lift operations are expected to occur in the loading areas. Other activities will occur at the rear of the building in the loading areas. This analysis assumes that up to 4 medium trucks such as bread trucks, UPS or Federal Express, or similar will occur at the rear area. In addition there may be some baling operations, although that type of activity is minimal compared to the assumed truck deliveries. Medium truck deliveries generally result in an SEL of approximately 84 dBA at a distance of 50-feet. Using the same methodology shown above, the 4 medium truck deliveries will result in an hourly Leq of 54 dBA.

HVAC Equipment Operations Analysis

All HVAC equipment is located on the roof level of the residential uses, and are shielded by parapets. The HVAC equipment could produce noise levels of 50 dBA at a distance of 50-feet. However, shielding from the roof-line and parapets would result in levels of less than 45 dBA at the nearest residences.

Increases in Loading Dock Noise Levels

Based upon discussions with the project applicant and the City staff, the previous uses had truck deliveries in the rear area, similar to the proposed operations. Thus the CEQA baseline, which, for the purposes of this EIR, is the time the notice of preparation (NOP) was published by the City, pursuant to CEQA Guidelines Section 15125(a)(1), included loading dock operations similar to that which would occur under the proposed project. Therefore, this analysis assumes that the proposed project will not result in a significant increase in loading dock noise levels.

Conclusion

The cumulative hourly noise level from all sources are expected to be 58 dB Leq at the nearest residences. This will exceed the daytime hourly noise level criterion of 55 dBA Leq, and the nighttime noise level criterion of 50 dBA Leq.

This impact is **significant**.

The following mitigation measures will reduce the impact to **less than significant**.

Mitigation for Impact 4

MM 4-1 j.c. brennan & associates, Inc. conducted a barrier analysis as shown in Appendix C. The analysis indicates that a barrier of 8-feet in height would be required to reduce overall noise levels associated with loading docks, truck circulation, and other outdoor noise sources to the daytime (7AM to 9PM) standard of 55 dBA Leq. If nighttime heavy truck deliveries occur, a barrier of 10-feet in height would be required to reduce noise levels to the nighttime (9PM to 7AM) standard of 50 dB Leq. If the applicant restricts heavy truck deliveries to the daytime hours, the 8-foot barrier would be sufficient. At this time, the applicant has not decided whether or not to restrict nighttime heavy truck deliveries. The barrier should be constructed along the north property line of the project site where trucks circulate. The project can eliminate the partial loading dock walls, if desired.

The significance after mitigation is **less than significant.**

Impact 5: Compliance with the City of Davis Traffic Noise Levels at New Sensitive Receptors

> *The proposed project will need to comply with the City of Davis exterior and interior noise level standards at any residential uses. Although this is not a CEQA requirement, The project will be required to comply with the General Plan noise level criteria.*

Exterior Traffic Noise Levels:

The proposed residential uses are located at 345-feet from the Russell Boulevard centerline. Under the Cumulative + Project scenario the 60 dB Ldn/CNEL contour is located at a distance of 336-feet from the Russell Boulevard centerline. The nearest facade of the residential portion of the site will be located approximately 75-feet from the Sycamore Lane centerline. Under the Cumulative + Project scenario, the traffic noise levels from Sycamore Lane would be 63 dB Ldn/CNEL at the nearest on-site residential unit facades. In addition, the project proposes a large common outdoor activity area with a pool and areas for relaxation at the interior of the residential portion of the site. The building facades will reduce traffic noise levels by a minimum of 10 dB, and would result in overall traffic noise levels of less than 55 dB Ldn/CNEL at the common outdoor area and would comply with the City's 60 dB Ldn/CNEL exterior noise level standard.

Interior Traffic Noise Levels:

Modern construction typically provides a 25 dB exterior-to-interior noise level reduction with windows closed. Therefore, sensitive receptors exposed to exterior noise of 70 dB Ldn, or less, will typically comply with the City's 45 dB CNEL/Ldn interior noise level standard. Exterior noise levels over 70 dB Ldn will generally require specific upgrades to the building facades such as upgraded STC rated windows, or details on wall construction improvements. The predicted future traffic noise levels do not exceed 65 dB CNEL/Ldn at the lower floors of the nearest residential buildings. Upper floors are expected to be exposed to traffic noise levels of approximately 68 dB Ldn/CNEL. Therefore, the residential portion of the project will comply with the interior noise level standard of 45 dB Ldn/CNEL.

This would be a ***less than significant*** impact.

Mitigation Measure for Impact 5:

None Required

CUMULATIVE IMPACTS AND MITIGATION MEASURES

The cumulative context for noise impacts associated with the Proposed Project consists of the existing and future noise sources that could affect the project or surrounding uses. Noise generated by construction would be temporary, and would not add to the permanent noise environment or be considered as part of the cumulative context.

Impact 6 Cumulative Noise

The cumulative context for noise impacts associated with the Proposed Project consists of the existing and future noise sources that could affect the project or surrounding uses. Noise generated by construction would be temporary, and would not add to the permanent noise environment or be considered as part of the cumulative context. The total noise impact of the Proposed Project would be fairly small and would not be a substantial increase to the existing future noise environment. Thus, the Proposed Project would result in a ***less than significant cumulative impact.***

Traffic

Cumulative noise impacts would occur primarily as a result of increased traffic on local roadways due to the Proposed Project. Based upon the previous analysis, increases in traffic noise due to the Proposed Project are no more than 1 dB Ldn. The cumulative exterior noise levels will not result in a significant impact.

Non-Traffic Noise

The Proposed Project is a mixed use development. Typical noise sources would include lawn maintenance, people conversing and on-site circulation and loading dock activity. The cumulative noise levels will not result in a significant impact with the proposed mitigation.

Construction activities would comply with the requirements of the City of Davis with respect to hours of operation and muffling of noise-generating equipment.

Cumulative Conclusion

The combination of traffic and non-traffic noise from the Proposed Project would not produce noise levels that would exceed City standards or produce isolated events that could disrupt sleep. Consequently, the total noise impact of the Proposed Project would not be a substantial increase to the future noise environment. The Proposed Project would result in a **less than significant** cumulative impact.

Mitigation for Impact 6

None required

Appendix A
Acoustical Terminology

Acoustics	The science of sound.
Ambient Noise	The distinctive acoustical characteristics of a given space consisting of all noise sources audible at that location. In many cases, the term ambient is used to describe an existing or pre-project condition such as the setting in an environmental noise study.
Attenuation	The reduction of an acoustic signal.
A-Weighting	A frequency-response adjustment of a sound level meter that conditions the output signal to approximate human response.
Decibel or dB	Fundamental unit of sound, A Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell.
CNEL	Community Noise Equivalent Level. Defined as the 24-hour average noise level with noise occurring during evening hours (7 - 10 p.m.) weighted by a factor of three and nighttime hours weighted by a factor of 10 prior to averaging.
Frequency	The measure of the rapidity of alterations of a periodic signal, expressed in cycles per second or hertz (Hz).
L_{dn}	Day/Night Average Sound Level. Similar to CNEL but with no evening weighting.
L_{eq}	Equivalent or energy-averaged sound level.
L_{max}	The highest root-mean-square (RMS) sound level measured over a given period of time.
$L_{(n)}$	The sound level exceeded a described percentile over a measurement period. For instance, an hourly L_{50} is the sound level exceeded 50% of the time during the one hour period.
Loudness	A subjective term for the sensation of the magnitude of sound.
Noise	Unwanted sound.
NRC	Noise Reduction Coefficient. NRC is a single-number rating of the sound-absorption of a material equal to the arithmetic mean of the sound-absorption coefficients in the 250, 500, 1000, and 2,000 Hz octave frequency bands rounded to the nearest multiple of 0.05. It is a representation of the amount of sound energy absorbed upon striking a particular surface. An NRC of 0 indicates perfect reflection; an NRC of 1 indicates perfect absorption.
Peak Noise	The level corresponding to the highest (not RMS) sound pressure measured over a given period of time. This term is often confused with the AMaximum@ level, which is the highest RMS level.
RT_{60}	The time it takes reverberant sound to decay by 60 dB once the source has been removed.
Sabin	The unit of sound absorption. One square foot of material absorbing 100% of incident sound has an absorption of 1 Sabin.
SEL	Sound Exposure Level. SEL is s rating, in decibels, of a discrete event, such as an aircraft flyover or train passby, that compresses the total sound energy into a one-second event.
STC	Sound Transmission Class. STC is an integer rating of how well a building partition attenuates airborne sound. It is widely used to rate interior partitions, ceilings/floors, doors, windows and exterior wall configurations.
Threshold of Hearing	The lowest sound that can be perceived by the human auditory system, generally considered to be 0 dB for persons with perfect hearing.
Threshold of Pain	Approximately 120 dB above the threshold of hearing.
Impulsive	Sound of short duration, usually less than one second, with an abrupt onset and rapid decay.
Simple Tone	Any sound which can be judged as audible as a single pitch or set of single pitches.

Appendix B
2018-157 University Mall Redevelopment
24hr Continuous Noise Monitoring - Site A
11/05/2018 - 11/06/2018

Hour	Leq	Lmax	L50	L90
13:00	60	79	52	48
14:00	57	78	53	49
15:00	57	80	53	48
16:00	58	84	53	49
17:00	59	80	55	51
18:00	58	78	54	51
19:00	56	79	53	50
20:00	58	78	53	50
21:00	53	75	51	48
22:00	52	74	49	45
23:00	51	72	48	44
0:00	53	72	45	42
1:00	60	82	46	43
2:00	46	57	44	41
3:00	46	62	45	42
4:00	52	66	50	47
5:00	51	69	48	46
6:00	53	74	50	47
7:00	55	77	53	50
8:00	59	80	56	52
9:00	58	75	53	49
10:00	59	83	53	49
11:00	58	88	52	49
12:00	57	80	52	49

	Statistical Summary					
	Daytime (7 a.m. - 10 p.m.)			Nighttime (10 p.m. - 7 a.m.)		
	High	Low	Average	High	Low	Average
Leq (Average)	59.7	53.2	57.6	59.9	45.8	53.5
Lmax (Maximum)	87.8	75.1	79.6	82.1	56.9	69.6
L50 (Median)	56.3	51.2	53.1	50.3	44.3	47.4
L90 (Background)	52.5	47.5	49.4	47.4	41.5	44.1

Computed Ldn, dB	60.8
% Daytime Energy	81%
% Nighttime Energy	19%

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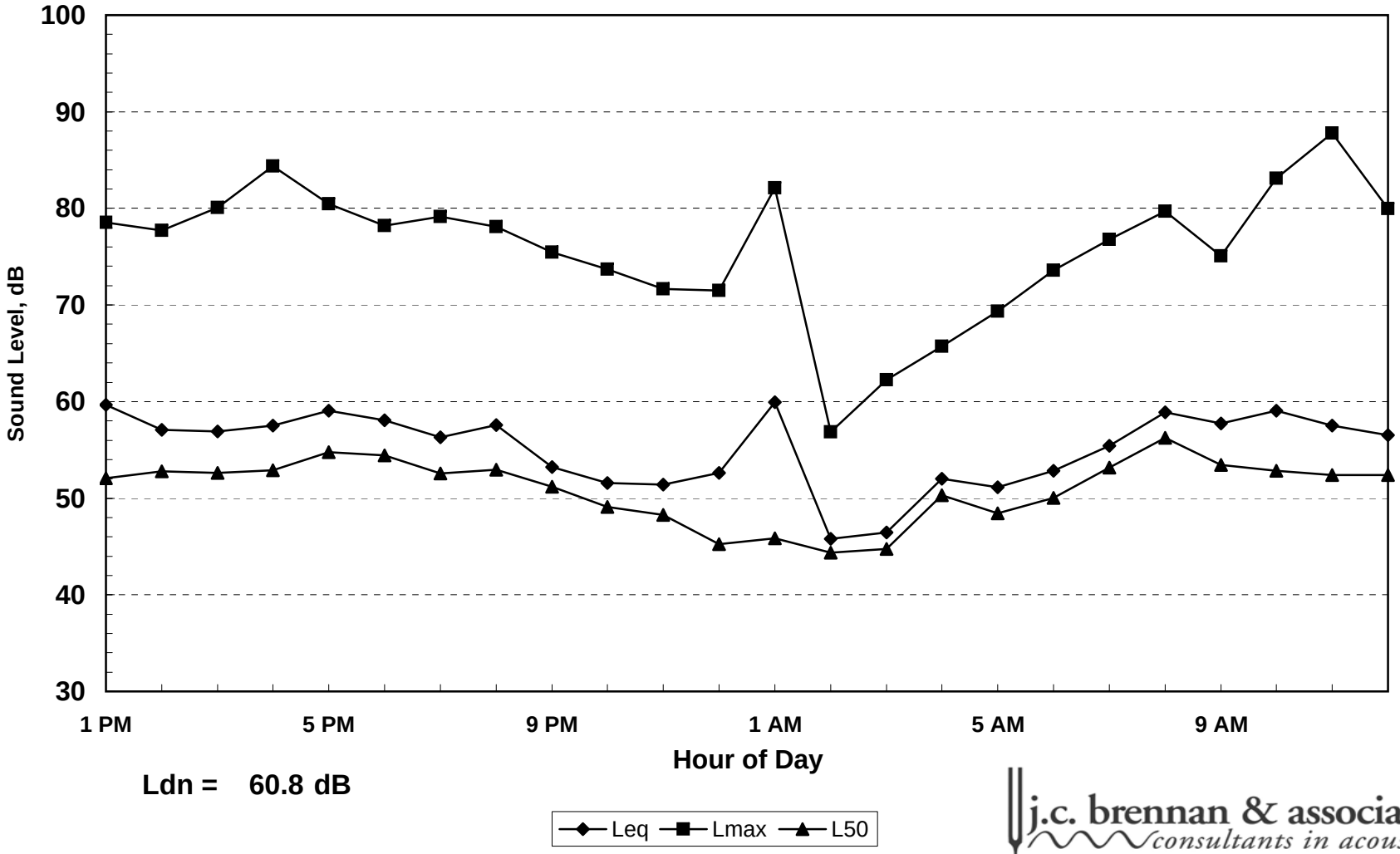
Appendix B

2018-157 University Mall Redevelopment

24hr Continuous Noise Monitoring - Site A

11/05/2018 - 11/06/2018



Ldn = 60.8 dB

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Appendix C

FHWA-RD-77-108 Highway Traffic Noise Prediction Model

Data Input Sheet

Project #: 2018-157
Description: Existing
Ldn/CNEL: Ldn
Hard/Soft: Soft

Segment	Roadway Name	Segment Description	ADT	Day %	Eve %	Night %	% Med. Trucks	% Hvy. Trucks	Speed	Distance	Offset (dB)
1	Russell Road	West of Arthur Street	10,670	85		15	21	1.5	35	75	
2	Russell Road	Arthur to S.R. 113	14,090	85		15	21	1.5	35	75	
3	Russell Road	S.R. 113 to Orchard Park	16,120	85		15	21	1.5	35	75	
4	Russell Road	Orchard Park to Sycarmore Ln	16,390	85		15	21	1.5	35	75	
5	Russell Road	Sucamore to Project Driveways	13,500	85		15	21	1.5	35	75	
6	Russell Road	Project Driveways to Anderson	17,870	85		15	21	1.5	35	75	
7	Russell Road	Anderson Rd to College Park	17,310	85		15	21	1.5	35	75	
8	Russell Road	College Park to A Street	18,210	85		15	21	1.5	35	75	
9	Russell Road	A Street to B Street	17,620	85		15	21	1.5	35	75	
10	Arthur Street	North of Russell Rd	3,780	85		15	21	1.5	35	75	
11	Orchard Park Dr	South of Russell Rd	2,610	85		15	21	1.5	35	75	
12	Sycamore Lane	Russell Rd to S. U Mall Drive	6,250	85		15	21	1.5	35	75	
13	Sycamore Lane	S. Umall Drive to N. U Mall Drive	4,910	85		15	21	1.5	35	75	
14	Sycamore Lane	North of Project Site	5,010	85		15	21	1.5	35	75	
15	La Rue Road	South of Russell Rd	12,320	85		15	21	1.5	35	75	
16	Anderson Road	Russell Rd to Central Umall Driveways	9,170	85		15	21	1.5	35	75	
17	Anderson Road	Central Umall Driveays to N Driveway	8,650	85		15	21	1.5	35	75	
18	Anderson Road	North of Project Site	8,700	85		15	21	1.5	35	75	
19	California Avenue	South of Russell Rd	3,510	85		15	21	1.5	35	75	
20	Oak Avenue	North of Russell Rd	1,970	85		15	21	1.5	35	75	
21	Howard Way	South of Russell Rd	5,960	85		15	21	1.5	35	75	
22	College Park	North of Russell Rd	1,080	85		15	21	1.5	35	75	
23	A Street	South of Russell Rd	1,830	85		15	21	1.5	35	75	
24	A Street	North of Russell Rd	970	85		15	21	1.5	35	75	
25	B Street	North of Russell Rd	4,460	85		15	21	1.5	35	75	
26	B Street	South of Russell Rd	9,910	85		15	21	1.5	35	75	

Appendix C

FHWA-RD-77-108 Highway Traffic Noise Prediction Model
Predicted Levels

Project #: 2018-157
Description: Existing
Ldn/CNEL: Ldn
Hard/Soft: Soft

Segment	Roadway Name	Segment Description	Autos	Medium Trucks	Heavy Trucks	Total
1	Russell Road	West of Arthur Street	59.5	63.5	57.3	66
2	Russell Road	Arthur to S.R. 113	60.7	64.7	58.5	67
3	Russell Road	S.R. 113 to Orchard Park	61.3	65.3	59.1	67
4	Russell Road	Orchard Park to Sycarmore Ln	61.4	65.4	59.1	68
5	Russell Road	Sucamore to Project Driveways	60.5	64.6	58.3	67
6	Russell Road	Project Driveways to Anderson	61.8	65.8	59.5	68
7	Russell Road	Anderson Rd to College Park	61.6	65.6	59.4	68
8	Russell Road	College Park to A Street	61.8	65.9	59.6	68
9	Russell Road	A Street to B Street	61.7	65.7	59.5	68
10	Arthur Street	North of Russell Rd	55.0	59.0	52.8	61
11	Orchard Park Dr	South of Russell Rd	53.4	57.4	51.2	60
12	Sycamore Lane	Russell Rd to S. U Mall Drive	57.2	61.2	54.9	63
13	Sycamore Lane	S. Umall Drive to N. U Mall Drive	56.1	60.2	53.9	62
14	Sycamore Lane	North of Project Site	56.2	60.3	54.0	62
15	La Rue Road	South of Russell Rd	60.1	64.2	57.9	66
16	Anderson Road	Russell Rd to Central Umall Driveway	58.9	62.9	56.6	65
17	Anderson Road	Central Umall Driveays to N Driveway	58.6	62.6	56.4	65
18	Anderson Road	North of Project Site	58.6	62.7	56.4	65
19	California Avenue	South of Russell Rd	54.7	58.7	52.4	61
20	Oak Avenue	North of Russell Rd	52.2	56.2	49.9	58
21	Howard Way	South of Russell Rd	57.0	61.0	54.7	63
22	College Park	North of Russell Rd	49.6	53.6	47.3	56
23	A Street	South of Russell Rd	51.9	55.9	49.6	58
24	A Street	North of Russell Rd	49.1	53.1	46.9	55
25	B Street	North of Russell Rd	55.7	59.7	53.5	62
26	B Street	South of Russell Rd	59.2	63.2	57.0	65

Appendix C

FHWA-RD-77-108 Highway Traffic Noise Prediction Model
Noise Contour Output

Project #: 2018-157
Description: Existing
Ldn/CNEL: Ldn
Hard/Soft: Soft

			-------- Distances to Traffic Noise Contours --------				
Segment	Roadway Name	Segment Description	75	70	65	60	55
1	Russell Road	West of Arthur Street	18	39	83	179	386
2	Russell Road	Arthur to S.R. 113	22	46	100	215	464
3	Russell Road	S.R. 113 to Orchard Park	24	51	109	236	508
4	Russell Road	Orchard Park to Sycarmore Ln	24	51	111	238	513
5	Russell Road	Sucamore to Project Driveways	21	45	97	209	451
6	Russell Road	Project Driveways to Anderson	25	54	117	252	544
7	Russell Road	Anderson Rd to College Park	25	53	115	247	532
8	Russell Road	College Park to A Street	26	55	119	256	551
9	Russell Road	A Street to B Street	25	54	116	250	539
10	Arthur Street	North of Russell Rd	9	19	42	90	193
11	Orchard Park Dr	South of Russell Rd	7	15	32	70	151
12	Sycamore Lane	Russell Rd to S. U Mall Drive	13	27	58	125	270
13	Sycamore Lane	S. Umall Drive to N. U Mall Drive	11	23	50	107	230
14	Sycamore Lane	North of Project Site	11	23	50	108	233
15	La Rue Road	South of Russell Rd	20	42	91	197	424
16	Anderson Road	Russell Rd to Central Umall Drivewa	16	35	75	162	349
17	Anderson Road	Central Umall Driveays to N Drivewa	16	34	72	156	335
18	Anderson Road	North of Project Site	16	34	73	156	337
19	California Avenue	South of Russell Rd	9	18	40	85	184
20	Oak Avenue	North of Russell Rd	6	13	27	58	125
21	Howard Way	South of Russell Rd	12	26	56	121	262
22	College Park	North of Russell Rd	4	8	18	39	84
23	A Street	South of Russell Rd	6	12	26	55	119
24	A Street	North of Russell Rd	4	8	17	36	78
25	B Street	North of Russell Rd	10	22	46	100	216
26	B Street	South of Russell Rd	17	37	79	170	367

Appendix C

FHWA-RD-77-108 Highway Traffic Noise Prediction Model

Data Input Sheet

Project #: 2018-157
Description: Existing + Project
Ldn/CNEL: Ldn
Hard/Soft: Soft

Segment	Roadway Name	Segment Description	ADT	Day %	Eve %	Night %	% Med. Trucks	% Hvy. Trucks	Speed	Distance	Offset (dB)
1	Russell Road	West of Arthur Street	10,950	85		15	21	1.5	35	75	
2	Russell Road	Arthur to S.R. 113	14,370	85		15	21	1.5	35	75	
3	Russell Road	S.R. 113 to Orchard Park	16,870	85		15	21	1.5	35	75	
4	Russell Road	Orchard Park to Sycarmore Ln	17,140	85		15	21	1.5	35	75	
5	Russell Road	Sucamore to Project Driveways	13,660	85		15	21	1.5	35	75	
6	Russell Road	Project Driveways to Anderson	18,640	85		15	21	1.5	35	75	
7	Russell Road	Anderson Rd to College Park	18,670	85		15	21	1.5	35	75	
8	Russell Road	College Park to A Street	18,950	85		15	21	1.5	35	75	
9	Russell Road	A Street to B Street	18,360	85		15	21	1.5	35	75	
10	Arthur Street	North of Russell Rd	3,780	85		15	21	1.5	35	75	
11	Orchard Park Dr	South of Russell Rd	2,610	85		15	21	1.5	35	75	
12	Sycamore Lane	Russell Rd to S. U Mall Drive	6,940	85		15	21	1.5	35	75	
13	Sycamore Lane	S. Umall Drive to N. U Mall Drive	5,250	85		15	21	1.5	35	75	
14	Sycamore Lane	North of Project Site	5,180	85		15	21	1.5	35	75	
15	La Rue Road	South of Russell Rd	12,430	85		15	21	1.5	35	75	
16	Anderson Road	Russell Rd to Central Umall Driveways	9,710	85		15	21	1.5	35	75	
17	Anderson Road	Central Umall Driveays to N Driveway	9,160	85		15	21	1.5	35	75	
18	Anderson Road	North of Project Site	9,020	85		15	21	1.5	35	75	
19	California Avenue	South of Russell Rd	3,510	85		15	21	1.5	35	75	
20	Oak Avenue	North of Russell Rd	1,980	85		15	21	1.5	35	75	
21	Howard Way	South of Russell Rd	5,960	85		15	21	1.5	35	75	
22	College Park	North of Russell Rd	1,100	85		15	21	1.5	35	75	
23	A Street	South of Russell Rd	1,840	85		15	21	1.5	35	75	
24	A Street	North of Russell Rd	970	85		15	21	1.5	35	75	
25	B Street	North of Russell Rd	4,500	85		15	21	1.5	35	75	
26	B Street	South of Russell Rd	10,190	85		15	21	1.5	35	75	

Appendix C

FHWA-RD-77-108 Highway Traffic Noise Prediction Model
Predicted Levels

Project #: 2018-157
Description: Existing + Project
Ldn/CNEL: Ldn
Hard/Soft: Soft

Segment	Roadway Name	Segment Description	Autos	Medium Trucks	Heavy Trucks	Total
1	Russell Road	West of Arthur Street	59.6	63.6	57.4	66
2	Russell Road	Arthur to S.R. 113	60.8	64.8	58.6	67
3	Russell Road	S.R. 113 to Orchard Park	61.5	65.5	59.3	68
4	Russell Road	Orchard Park to Sycarmore Ln	61.6	65.6	59.3	68
5	Russell Road	Sucamore to Project Driveways	60.6	64.6	58.3	67
6	Russell Road	Project Driveways to Anderson	61.9	66.0	59.7	68
7	Russell Road	Anderson Rd to College Park	61.9	66.0	59.7	68
8	Russell Road	College Park to A Street	62.0	66.0	59.8	68
9	Russell Road	A Street to B Street	61.9	65.9	59.6	68
10	Arthur Street	North of Russell Rd	55.0	59.0	52.8	61
11	Orchard Park Dr	South of Russell Rd	53.4	57.4	51.2	60
12	Sycamore Lane	Russell Rd to S. U Mall Drive	57.6	61.7	55.4	64
13	Sycamore Lane	S. Umall Drive to N. U Mall Drive	56.4	60.5	54.2	63
14	Sycamore Lane	North of Project Site	56.4	60.4	54.1	63
15	La Rue Road	South of Russell Rd	60.2	64.2	57.9	66
16	Anderson Road	Russell Rd to Central Umall Driveway	59.1	63.1	56.9	65
17	Anderson Road	Central Umall Driveays to N Driveway	58.9	62.9	56.6	65
18	Anderson Road	North of Project Site	58.8	62.8	56.5	65
19	California Avenue	South of Russell Rd	54.7	58.7	52.4	61
20	Oak Avenue	North of Russell Rd	52.2	56.2	50.0	58
21	Howard Way	South of Russell Rd	57.0	61.0	54.7	63
22	College Park	North of Russell Rd	49.7	53.7	47.4	56
23	A Street	South of Russell Rd	51.9	55.9	49.6	58
24	A Street	North of Russell Rd	49.1	53.1	46.9	55
25	B Street	North of Russell Rd	55.8	59.8	53.5	62
26	B Street	South of Russell Rd	59.3	63.3	57.1	65

Appendix C

FHWA-RD-77-108 Highway Traffic Noise Prediction Model
Noise Contour Output

Project #: 2018-157
Description: Existing + Project
Ldn/CNEL: Ldn
Hard/Soft: Soft

			-------- Distances to Traffic Noise Contours --------				
Segment	Roadway Name	Segment Description	75	70	65	60	55
1	Russell Road	West of Arthur Street	18	39	85	182	392
2	Russell Road	Arthur to S.R. 113	22	47	101	218	470
3	Russell Road	S.R. 113 to Orchard Park	24	52	113	243	523
4	Russell Road	Orchard Park to Sycarmore Ln	25	53	114	245	529
5	Russell Road	Sucamore to Project Driveways	21	45	98	211	455
6	Russell Road	Project Driveways to Anderson	26	56	121	260	559
7	Russell Road	Anderson Rd to College Park	26	56	121	260	560
8	Russell Road	College Park to A Street	26	57	122	262	566
9	Russell Road	A Street to B Street	26	55	119	257	554
10	Arthur Street	North of Russell Rd	9	19	42	90	193
11	Orchard Park Dr	South of Russell Rd	7	15	32	70	151
12	Sycamore Lane	Russell Rd to S. U Mall Drive	13	29	62	134	289
13	Sycamore Lane	S. Umall Drive to N. U Mall Drive	11	24	52	112	240
14	Sycamore Lane	North of Project Site	11	24	51	111	238
15	La Rue Road	South of Russell Rd	20	43	92	198	427
16	Anderson Road	Russell Rd to Central Umall Drivewa	17	36	78	168	362
17	Anderson Road	Central Umall Driveays to N Drivewa	16	35	75	162	348
18	Anderson Road	North of Project Site	16	34	74	160	345
19	California Avenue	South of Russell Rd	9	18	40	85	184
20	Oak Avenue	North of Russell Rd	6	13	27	58	125
21	Howard Way	South of Russell Rd	12	26	56	121	262
22	College Park	North of Russell Rd	4	8	18	39	85
23	A Street	South of Russell Rd	6	12	26	55	119
24	A Street	North of Russell Rd	4	8	17	36	78
25	B Street	North of Russell Rd	10	22	47	101	217
26	B Street	South of Russell Rd	17	37	81	174	374

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FHWA-RD-77-108 Highway Traffic Noise Prediction Model

Data Input Sheet

Project #: 2018-157
Description: Cumulative No Project
Ldn/CNEL: Ldn
Hard/Soft: Soft

Segment	Roadway Name	Segment Description	ADT	Day %	Eve %	Night %	% Med. Trucks	% Hvy. Trucks	Speed	Distance	Offset (dB)
1	Russell Road	West of Arthur Street	13,350	85		15	21	1.5	35	75	
2	Russell Road	Arthur to S.R. 113	17,000	85		15	21	1.5	35	75	
3	Russell Road	S.R. 113 to Orchard Park	21,900	85		15	21	1.5	35	75	
4	Russell Road	Orchard Park to Sycarmore Ln	20,850	85		15	21	1.5	35	75	
5	Russell Road	Sucamore to Project Driveways	17,550	85		15	21	1.5	35	75	
6	Russell Road	Project Driveways to Anderson	26,600	85		15	21	1.5	35	75	
7	Russell Road	Anderson Rd to College Park	26,650	85		15	21	1.5	35	75	
8	Russell Road	College Park to A Street	26,950	85		15	21	1.5	35	75	
9	Russell Road	A Street to B Street	26,100	85		15	21	1.5	35	75	
10	Arthur Street	North of Russell Rd	4,150	85		15	21	1.5	35	75	
11	Orchard Park Dr	South of Russell Rd	4,250	85		15	21	1.5	35	75	
12	Sycamore Lane	Russell Rd to S. U Mall Drive	7,100	85		15	21	1.5	35	75	
13	Sycamore Lane	S. Umall Drive to N. U Mall Drive	5,850	85		15	21	1.5	35	75	
14	Sycamore Lane	North of Project Site	5,800	85		15	21	1.5	35	75	
15	La Rue Road	South of Russell Rd	18,900	85		15	21	1.5	35	75	
16	Anderson Road	Russell Rd to Central Umall Driveways	10,500	85		15	21	1.5	35	75	
17	Anderson Road	Central Umall Driveays to N Driveway	9,900	85		15	21	1.5	35	75	
18	Anderson Road	North of Project Site	9,800	85		15	21	1.5	35	75	
19	California Avenue	South of Russell Rd	4,500	85		15	21	1.5	35	75	
20	Oak Avenue	North of Russell Rd	2,300	85		15	21	1.5	35	75	
21	Howard Way	South of Russell Rd	6,200	85		15	21	1.5	35	75	
22	College Park	North of Russell Rd	1,300	85		15	21	1.5	35	75	
23	A Street	South of Russell Rd	3,200	85		15	21	1.5	35	75	
24	A Street	North of Russell Rd	1,200	85		15	21	1.5	35	75	
25	B Street	North of Russell Rd	6,500	85		15	21	1.5	35	75	
26	B Street	South of Russell Rd	11,900	85		15	21	1.5	35	75	

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FHWA-RD-77-108 Highway Traffic Noise Prediction Model
Predicted Levels

Project #: 2018-157
Description: Cumulative No Project
Ldn/CNEL: Ldn
Hard/Soft: Soft

Segment	Roadway Name	Segment Description	Autos	Medium Trucks	Heavy Trucks	Total
1	Russell Road	West of Arthur Street	60.5	64.5	58.2	67
2	Russell Road	Arthur to S.R. 113	61.5	65.6	59.3	68
3	Russell Road	S.R. 113 to Orchard Park	62.6	66.7	60.4	69
4	Russell Road	Orchard Park to Sycarmore Ln	62.4	66.4	60.2	69
5	Russell Road	Sucamore to Project Driveways	61.7	65.7	59.4	68
6	Russell Road	Project Driveways to Anderson	63.5	67.5	61.2	70
7	Russell Road	Anderson Rd to College Park	63.5	67.5	61.2	70
8	Russell Road	College Park to A Street	63.5	67.6	61.3	70
9	Russell Road	A Street to B Street	63.4	67.4	61.2	70
10	Arthur Street	North of Russell Rd	55.4	59.4	53.2	62
11	Orchard Park Dr	South of Russell Rd	55.5	59.5	53.3	62
12	Sycamore Lane	Russell Rd to S. U Mall Drive	57.7	61.8	55.5	64
13	Sycamore Lane	S. Umall Drive to N. U Mall Drive	56.9	60.9	54.7	63
14	Sycamore Lane	North of Project Site	56.9	60.9	54.6	63
15	La Rue Road	South of Russell Rd	62.0	66.0	59.8	68
16	Anderson Road	Russell Rd to Central Umall Driveway	59.4	63.5	57.2	66
17	Anderson Road	Central Umall Driveays to N Driveway	59.2	63.2	56.9	65
18	Anderson Road	North of Project Site	59.1	63.2	56.9	65
19	California Avenue	South of Russell Rd	55.8	59.8	53.5	62
20	Oak Avenue	North of Russell Rd	52.9	56.9	50.6	59
21	Howard Way	South of Russell Rd	57.2	61.2	54.9	63
22	College Park	North of Russell Rd	50.4	54.4	48.1	57
23	A Street	South of Russell Rd	54.3	58.3	52.0	60
24	A Street	North of Russell Rd	50.0	54.0	47.8	56
25	B Street	North of Russell Rd	57.4	61.4	55.1	64
26	B Street	South of Russell Rd	60.0	64.0	57.7	66

Appendix C

FHWA-RD-77-108 Highway Traffic Noise Prediction Model
Noise Contour Output

Project #: 2018-157
Description: Cumulative No Project
Ldn/CNEL: Ldn
Hard/Soft: Soft

			-------- Distances to Traffic Noise Contours --------				
Segment	Roadway Name	Segment Description	75	70	65	60	55
1	Russell Road	West of Arthur Street	21	45	96	208	448
2	Russell Road	Arthur to S.R. 113	24	53	113	244	526
3	Russell Road	S.R. 113 to Orchard Park	29	62	134	289	623
4	Russell Road	Orchard Park to Sycarmore Ln	28	60	130	280	603
5	Russell Road	Sucamore to Project Driveways	25	54	116	249	537
6	Russell Road	Project Driveways to Anderson	33	71	153	329	709
7	Russell Road	Anderson Rd to College Park	33	71	153	329	710
8	Russell Road	College Park to A Street	33	72	154	332	715
9	Russell Road	A Street to B Street	32	70	151	325	700
10	Arthur Street	North of Russell Rd	10	21	44	95	205
11	Orchard Park Dr	South of Russell Rd	10	21	45	97	209
12	Sycamore Lane	Russell Rd to S. U Mall Drive	14	29	63	136	294
13	Sycamore Lane	S. Umall Drive to N. U Mall Drive	12	26	56	120	258
14	Sycamore Lane	North of Project Site	12	26	55	119	257
15	La Rue Road	South of Russell Rd	26	56	122	262	565
16	Anderson Road	Russell Rd to Central Umall Drivewa	18	38	82	177	381
17	Anderson Road	Central Umall Driveays to N Drivewa	17	37	79	170	367
18	Anderson Road	North of Project Site	17	36	78	169	364
19	California Avenue	South of Russell Rd	10	22	47	101	217
20	Oak Avenue	North of Russell Rd	6	14	30	64	139
21	Howard Way	South of Russell Rd	12	27	58	125	269
22	College Park	North of Russell Rd	4	9	20	44	95
23	A Street	South of Russell Rd	8	17	37	80	173
24	A Street	North of Russell Rd	4	9	19	42	90
25	B Street	North of Russell Rd	13	28	60	129	277
26	B Street	South of Russell Rd	19	41	89	192	415

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FHWA-RD-77-108 Highway Traffic Noise Prediction Model

Data Input Sheet

Project #: 2018-157
Description: Cumulative + Project
Ldn/CNEL: Ldn
Hard/Soft: Soft

Segment	Roadway Name	Segment Description	ADT	Day %	Eve %	Night %	% Med. Trucks	% Hvy. Trucks	Speed	Distance	Offset (dB)
1	Russell Road	West of Arthur Street	13,430	85		15	21	1.5	35	75	
2	Russell Road	Arthur to S.R. 113	17,280	85		15	21	1.5	35	75	
3	Russell Road	S.R. 113 to Orchard Park	22,650	85		15	21	1.5	35	75	
4	Russell Road	Orchard Park to Sycarmore Ln	21,600	85		15	21	1.5	35	75	
5	Russell Road	Sucamore to Project Driveways	17,710	85		15	21	1.5	35	75	
6	Russell Road	Project Driveways to Anderson	27,470	85		15	21	1.5	35	75	
7	Russell Road	Anderson Rd to College Park	27,510	85		15	21	1.5	35	75	
8	Russell Road	College Park to A Street	27,790	85		15	21	1.5	35	75	
9	Russell Road	A Street to B Street	26,940	85		15	21	1.5	35	75	
10	Arthur Street	North of Russell Rd	4,150	85		15	21	1.5	35	75	
11	Orchard Park Dr	South of Russell Rd	4,250	85		15	21	1.5	35	75	
12	Sycamore Lane	Russell Rd to S. U Mall Drive	7,790	85		15	21	1.5	35	75	
13	Sycamore Lane	S. Umall Drive to N. U Mall Drive	6,180	85		15	21	1.5	35	75	
14	Sycamore Lane	North of Project Site	5,970	85		15	21	1.5	35	75	
15	La Rue Road	South of Russell Rd	19,010	85		15	21	1.5	35	75	
16	Anderson Road	Russell Rd to Central Umall Driveways	11,140	85		15	21	1.5	35	75	
17	Anderson Road	Central Umall Driveays to N Driveway	10,580	85		15	21	1.5	35	75	
18	Anderson Road	North of Project Site	10,250	85		15	21	1.5	35	75	
19	California Avenue	South of Russell Rd	4,500	85		15	21	1.5	35	75	
20	Oak Avenue	North of Russell Rd	2,310	85		15	21	1.5	35	75	
21	Howard Way	South of Russell Rd	6,200	85		15	21	1.5	35	75	
22	College Park	North of Russell Rd	1,320	85		15	21	1.5	35	75	
23	A Street	South of Russell Rd	3,210	85		15	21	1.5	35	75	
24	A Street	North of Russell Rd	1,200	85		15	21	1.5	35	75	
25	B Street	North of Russell Rd	6,580	85		15	21	1.5	35	75	
26	B Street	South of Russell Rd	12,180	85		15	21	1.5	35	75	

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FHWA-RD-77-108 Highway Traffic Noise Prediction Model
Predicted Levels

Project #: 2018-157
Description: Cumulative + Project
Ldn/CNEL: Ldn
Hard/Soft: Soft

Segment	Roadway Name	Segment Description	Autos	Medium Trucks	Heavy Trucks	Total
1	Russell Road	West of Arthur Street	60.5	64.5	58.3	67
2	Russell Road	Arthur to S.R. 113	61.6	65.6	59.4	68
3	Russell Road	S.R. 113 to Orchard Park	62.8	66.8	60.5	69
4	Russell Road	Orchard Park to Sycarmore Ln	62.6	66.6	60.3	69
5	Russell Road	Sucamore to Project Driveways	61.7	65.7	59.5	68
6	Russell Road	Project Driveways to Anderson	63.6	67.6	61.4	70
7	Russell Road	Anderson Rd to College Park	63.6	67.7	61.4	70
8	Russell Road	College Park to A Street	63.7	67.7	61.4	70
9	Russell Road	A Street to B Street	63.5	67.6	61.3	70
10	Arthur Street	North of Russell Rd	55.4	59.4	53.2	62
11	Orchard Park Dr	South of Russell Rd	55.5	59.5	53.3	62
12	Sycamore Lane	Russell Rd to S. U Mall Drive	58.2	62.2	55.9	64
13	Sycamore Lane	S. Umall Drive to N. U Mall Drive	57.1	61.2	54.9	63
14	Sycamore Lane	North of Project Site	57.0	61.0	54.7	63
15	La Rue Road	South of Russell Rd	62.0	66.0	59.8	68
16	Anderson Road	Russell Rd to Central Umall Driveway	59.7	63.7	57.5	66
17	Anderson Road	Central Umall Driveays to N Driveway	59.5	63.5	57.2	66
18	Anderson Road	North of Project Site	59.3	63.4	57.1	65
19	California Avenue	South of Russell Rd	55.8	59.8	53.5	62
20	Oak Avenue	North of Russell Rd	52.9	56.9	50.6	59
21	Howard Way	South of Russell Rd	57.2	61.2	54.9	63
22	College Park	North of Russell Rd	50.4	54.5	48.2	57
23	A Street	South of Russell Rd	54.3	58.3	52.1	60
24	A Street	North of Russell Rd	50.0	54.0	47.8	56
25	B Street	North of Russell Rd	57.4	61.4	55.2	64
26	B Street	South of Russell Rd	60.1	64.1	57.8	66

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FHWA-RD-77-108 Highway Traffic Noise Prediction Model
Noise Contour Output

Project #: 2018-157
Description: Cumulative + Project
Ldn/CNEL: Ldn
Hard/Soft: Soft

Segment	Roadway Name	Segment Description	-------- Distances to Traffic Noise Contours -------- 75	70	65	60	55
1	Russell Road	West of Arthur Street	21	45	97	209	450
2	Russell Road	Arthur to S.R. 113	25	53	115	247	532
3	Russell Road	S.R. 113 to Orchard Park	30	64	137	296	637
4	Russell Road	Orchard Park to Sycarmore Ln	29	62	133	286	617
5	Russell Road	Sucamore to Project Driveways	25	54	116	251	541
6	Russell Road	Project Driveways to Anderson	34	72	156	336	724
7	Russell Road	Anderson Rd to College Park	34	73	156	337	725
8	Russell Road	College Park to A Street	34	73	157	339	730
9	Russell Road	A Street to B Street	33	71	154	332	715
10	Arthur Street	North of Russell Rd	10	21	44	95	205
11	Orchard Park Dr	South of Russell Rd	10	21	45	97	209
12	Sycamore Lane	Russell Rd to S. U Mall Drive	15	31	67	145	313
13	Sycamore Lane	S. Umall Drive to N. U Mall Drive	12	27	58	124	268
14	Sycamore Lane	North of Project Site	12	26	56	122	262
15	La Rue Road	South of Russell Rd	26	57	122	263	567
16	Anderson Road	Russell Rd to Central Umall Drivewa	18	40	85	184	397
17	Anderson Road	Central Umall Driveays to N Drivewa	18	38	83	178	383
18	Anderson Road	North of Project Site	17	38	81	174	375
19	California Avenue	South of Russell Rd	10	22	47	101	217
20	Oak Avenue	North of Russell Rd	6	14	30	65	139
21	Howard Way	South of Russell Rd	12	27	58	125	269
22	College Park	North of Russell Rd	4	10	21	44	96
23	A Street	South of Russell Rd	8	17	37	80	173
24	A Street	North of Russell Rd	4	9	19	42	90
25	B Street	North of Russell Rd	13	28	60	130	279
26	B Street	South of Russell Rd	20	42	91	195	421

Appendix D

Barrier Insertion Loss Calculation

Project Information:

Job Number: 2018-157
Project Name: University Commons
Location(s): Loading Dock / Circulation Route

Noise Level Data:

Source Description: Loading Dock Night Use
Source Noise Level, dBA: 58
Source Frequency (Hz): 500
Source Height (ft): 8

Site Geometry:

Receiver Description: Apartments to the North
Source to Barrier Distance (C_1): 25
Barrier to Receiver Distance (C_2): 25

Pad/Ground Elevation at Receiver: 0
Receiver Elevation[1]: 5
Base of Barrier Elevation: 0
Starting Barrier Height 8

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height (ft)	Insertion Loss, dB	Noise Level, dB	Barrier Breaks Line of Site to Source?
8	8	-6	52	Yes
9	9	-7	51	Yes
10	10	-8	50	Yes
11	11	-9	49	Yes
12	12	-10	48	Yes
13	13	-11	47	Yes
14	14	-12	46	Yes
15	15	-13	45	Yes
16	16	-14	44	Yes
17	17	-14	44	Yes
18	18	-15	43	Yes

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

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Appendix D

Barrier Insertion Loss Calculation

Project Information:

Job Number: 2018-157
Project Name: University Commons
Location(s): Loading Dock / Circulation Route

Noise Level Data:

Source Description: Loading Dock No Heavy
Source Noise Level, dBA: 55
Source Frequency (Hz): 500
Source Height (ft): 8

Site Geometry:

Receiver Description: Apartments to the North
Source to Barrier Distance (C_1): 25
Barrier to Receiver Distance (C_2): 25

Pad/Ground Elevation at Receiver: 0
Receiver Elevation[1]: 5
Base of Barrier Elevation: 0
Starting Barrier Height 8

Barrier Effectiveness:

Top of Barrier Elevation (ft)	Barrier Height (ft)	Insertion Loss, dB	Noise Level, dB	Barrier Breaks Line of Site to Source?
8	8	-6	49	Yes
9	9	-7	48	Yes
10	10	-8	47	Yes
11	11	-9	46	Yes
12	12	-10	45	Yes
13	13	-11	44	Yes
14	14	-12	43	Yes
15	15	-13	42	Yes
16	16	-14	41	Yes
17	17	-14	41	Yes
18	18	-15	40	Yes

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

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