Lam Research

2025 Site Noise Survey

Tualatin, OR

PRESENTED TO:

Mackenzie

BEST VIEWED IN COLOR

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Table of Contents

1. Introduction

Colin Gordon Associates (CGA) conducted a noise survey along the north edge of the Lam Research campus in Tualatin, OR. The purpose of this survey was to document the current background noise levels along adjacent sensitive property lines, to help assess whether the site was currently in compliance with applicable noise ordinance requirements.

2. Measurement Conditions

The Lam site is bounded on the north by a high traffic road (SW Tualatin Rd), with residential housing on the opposite side of the road directly to the north. Colin Gordon Associates (CGA) visited the site on the evening of 4 September 2025 between 10:00 PM and 12:00 AM to conduct noise measurements along these sensitive property lines to the north.

Measurements were conducted while standing on the sidewalk on the north side of SW Tualatin Road, directly adjacent to the residential properties along this road. Our measurement Locations 1 through 6 are shown overlaid on a satellite image of the Lam property and surrounding environment in **Figure 1**. Measurement locations were selected to represent the range of background noise levels experienced by the residential properties along the road. This includes Location 4, which is on the sidewalk directly adjacent to 11045 SW Tualatin Road – where we understand that previous noise measurements were conducted earlier this year by others.[1]

Throughout our visit, the noise levels in the area were dominated by noise generated by vehicles traveling on SW Tualatin Road most of the time. Passing vehicles were audible and generated noise levels that exceeded the typical background levels at the measurement locations for around 10 to 15 seconds after they had disappeared from view to the east or west of the measurement location. Since the purpose of our study was to evaluate the noise from the Lam plant sources, we conducted measurements during time periods when vehicles on SW Tualatin Road were *not audible*. Cars passed by very frequently, which limited the time windows for documenting the background levels without local traffic present to around 2 to 3 minutes at each location.

In the absence of traffic noise from SW Tualatin Road, the dominant audible noise source was crickets – which generated continuous high frequency noise that was distinctly audible at all locations. At Locations 3 through 5, on the eastern side of the Lam site, there was also audible continuous lower frequency noise originating from the Lam plant. Noise from more distant traffic was also audible during our measurement periods.

Temperatures during our measurements ranged from around 72 to 76 degrees, with low winds, some clouds, and no precipitation.

[1] S. Lank, "Lam Research Tualatin Site – Comments on A Acoustics Noise Survey Report," dated 3 September 2025 and submitted to Mackenzie

Figure 1: Measurement Locations

3. Noise Performance Standards

The Tualatin Development Code notes the following with respect to noise:[2]

All uses and development must comply with the Oregon State Department of Environmental Quality standards relating to noise and the City of Tualatin noise ordinance in, TMC 6-14.

The applicable standards contained within both of the City of Tualatin and Department of Environmental Quality (DEQ) standards are summarized below, and are discussed in further detail in **Appendix A**.

City of Tualatin Noise Ordinance (10:00pm to 7:00am):		**50 dBA**
Oregon DEQ standards (10:00pm to 7:00am):	**L_1:**	**60 dBA**
	L_{10}:	**55 dBA**
	L_{50}:	**50 dBA**

For the purpose of this study, we consider these to apply mainly to continuously operating noise sources within the Lam Research Campus, as we understand that this has been the focus of recent complaints from nearby neighbors.

The Oregon DEQ standards are defined in the form of statistical noise levels, or centile levels, which represent the noise levels that were exceeded for a certain percentage of the time during the measurement period. For a given measurement, the various centile levels can be quite different, due to the influence of transient noise sources. The DEQ requirements specifically reference the L_1, L_{10}, and L_{50} levels – which are the noise levels exceeded for 1%, 10%, and 50% of the measurement period, which in this case was defined as "any one hour". For example, for an L_{50} level of 68 dBA, this means that for 50% of the time during the period measured, the noise level was at least 68 dBA.

In a given measurement, these various noise level metrics can be controlled by a variety of sources. The L_1 metric is usually driven by loud intermittent sources such as a passing motorcycle or a dog bark. In other words, a very loud source that only happens for a short time over the measurement duration. The L_{50}, which would be the noise level exceeded for 30 minutes of an hourlong measurement, typically represents the impact of intermittent but fairly frequent activities, such as aircraft (if near an airport) or vehicle traffic. In this case however, since we intentionally selected measurement periods where the most dominant transient noise source (local vehicle traffic on SW Tualatin Rd.) did not have a substantial impact, the difference in these various metrics is expected to be fairly small.

The City of Tualatin ordinance does not specify a noise metric, nor does it specify the measurement duration, that is to be used to assess noise levels for evidence of a noise violation. We therefore assume that the noise should be assessed using the metric and measurement duration that is most appropriate for determining the noise generated by the particular source of concern in each case.

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[2] TDC 63.051 Noise

Another commonly used metric is the L_{90}, which is the noise level exceeded for 90% of the time. This metric is often used to assess the contribution from noise sources that are present and stable throughout the measurement period – such as continuously operating mechanical equipment. It represents the continuous background noise level caused by those equipment. The L_{90} is exceeded when there are transient events such as traffic noise.

Ordinances in many other municipalities have also been defined in terms of the maximum allowable L_{eq}, or equivalent energy noise level – which is defined as the constant noise level that would result in the same total sound energy produced by the measured time-varying noise over a given period of time. It can be considered as an "energy average" of the noise levels over the measurement interval. The L_{eq} levels can be quite sensitive to the impact from loud short term transient noises due to the logarithmic nature of the decibel scale.

Since the "Octave Bands and Audible Discrete Tones" portion of the Oregon DEQ requirements are described as being applied only at the discretion of the Director, it is unclear whether they are applicable in this case. Results presented in comparison to these standards should be considered for reference only, unless the City confirms that they are applicable in this case. If applicable, for the purposes of this study we will assume that they are only relevant with respect to noise generated by continuously operating noise sources located on the Lam campus.

4. Measurement Methodologies and Instruments

Measurements were conducted using instrumentation and methodologies that are in conformance with the requirements in the City of Tualatin and DEQ standards, as we understand them.

4.1 Measurement Instrumentation

Measurements were conducted with the following set of equipment:

Table 1: Measurement Instrumentation

Equipment Description	Make	Model
Type 1 Sound Level Meter	Larson Davis	831C
Acoustic Calibrator	Larson Davis	CAL200

This equipment was used together with the associated calibration systems, cables, connectors, etc. The annual calibration of the measurement instruments uses reference standards traceable to the US National Institute of Standards and Technology (NIST). The calibration was verified in the field at the time of measurement.

4.2 Noise Measurement Methodology

Overall A-weighted and unweighted octave band and one-third octave band sound pressure levels were measured with the Larson Davis Type 1 sound level meter, using the "slow" integration time setting (1 second). Measurements in each case were conducted over the course of 1.5 to 3 minutes, at times where there was no audible traffic noise from SW Tualatin Rd. – as discussed above. For each measurement, the sound level meter logged the L_{eq} as well as various statistical noise metrics

(L_n), as discussed above. We will present the L_1, L_{10} and L_{50} values, which are the metrics referenced by the Oregon DEQ standards, as well as the L_{90} values, which best represent the background noise controlled by continuous noise sources. The L_{50} levels will be used for the octave band and one-third octave band results, since the DEQ frequency requirements (if applicable) are described as applying to the "median" levels.

Note that, due to typically expected variance in acoustical measurements and equipment, measured differences of 1 dB or less are generally not considered meaningful.

5. Noise Measurement Results

Table 2 below shows the measured L_{90}, L_{50}, L_{10}, L_1, and L_{eq} at each location.

Table 2 Summary of Measured Background Noise Levels
Night of Thursday, September 4th, 2025

Location	Time	Sound Pressure Level (dBA)				
		L_1	L_{10}	L_{50}	L_{90}	L_{eq}
1	22:50	46	45	44	44	44
2	22:39	46	46	45	45	45
3	23:05	50	49	48	47	48
4	23:15	50	49	49	48	49
5	23:31	50	50	50	49	50
6	23:34	48	47	47	47	47

The measured unweighted L_{50} levels are shown as a function of frequency in both octave bands and one-third octave bands in **Figure 2** and **Figure 3** below. We have the following comments on these results:

- The noise levels measured (without SW Tualatin Rd traffic sources) at all locations in all metrics are at or below 50 dBA maximum allowable limit in the City of Tualatin and Oregon DEQ requirements.
- There is minimal difference between the different statistical metrics at each location, and minimal difference between these metrics and the L_{eq}. This is as expected, given that our measurements intentionally avoided time periods where traffic on SW Tualatin Rd. was audible.
- The measured noise levels are highest at Locations 4 and 5 – where both Lam plant sources as well as cricket noise was audibly louder compared to the west side of the site. The influence from both of these sources is evident in **Figures 2 and 3**, with the increases at 2 kHz and above driven by cricket noise while the increases at around 500 Hz and below likely driven by plant sources.
- The levels measured in the 2 kHz octave band/2.5 kHz one-third octave band are the primary driver of the overall A-weighted levels at all locations. This indicates that the overall background noise levels would be lower in the absence of cricket noise.

- The levels around 2 kHz exceed the Oregon DEQ requirements for noise levels in octave bands at Locations 3 through 6, and the one-third octave band requirements at Locations 1 and 2. However, DEQ noise control regulations for industry and commerce would not be considered applicable to cricket noise.

This concludes our report.

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Figure 2: Measured Noise Levels, Octave Bands

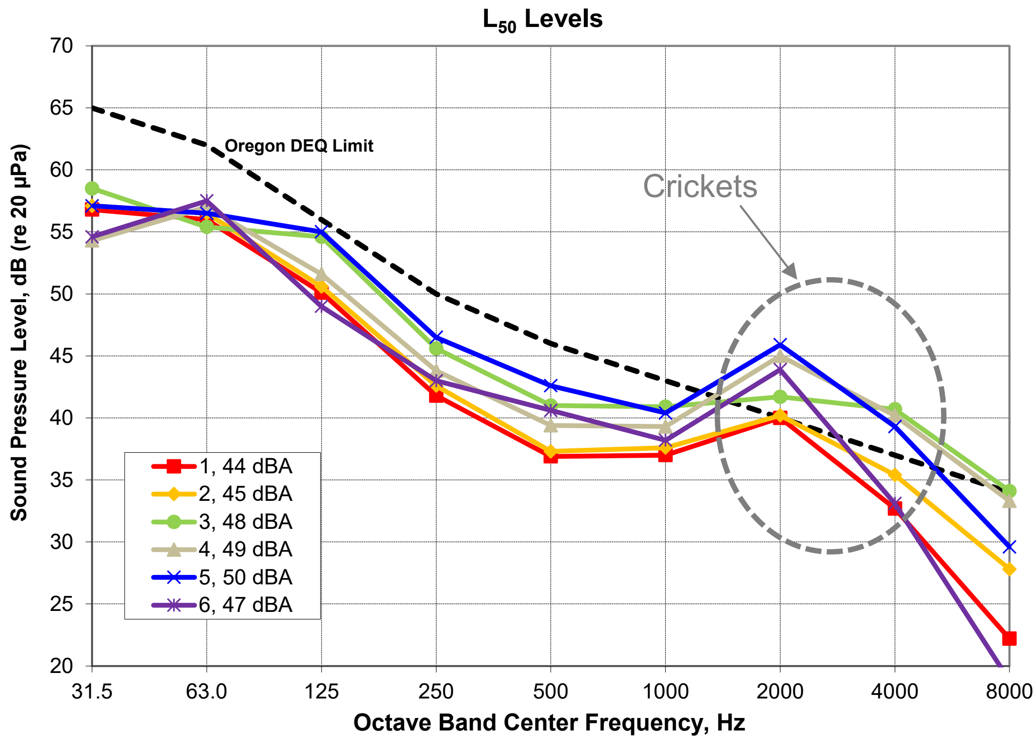
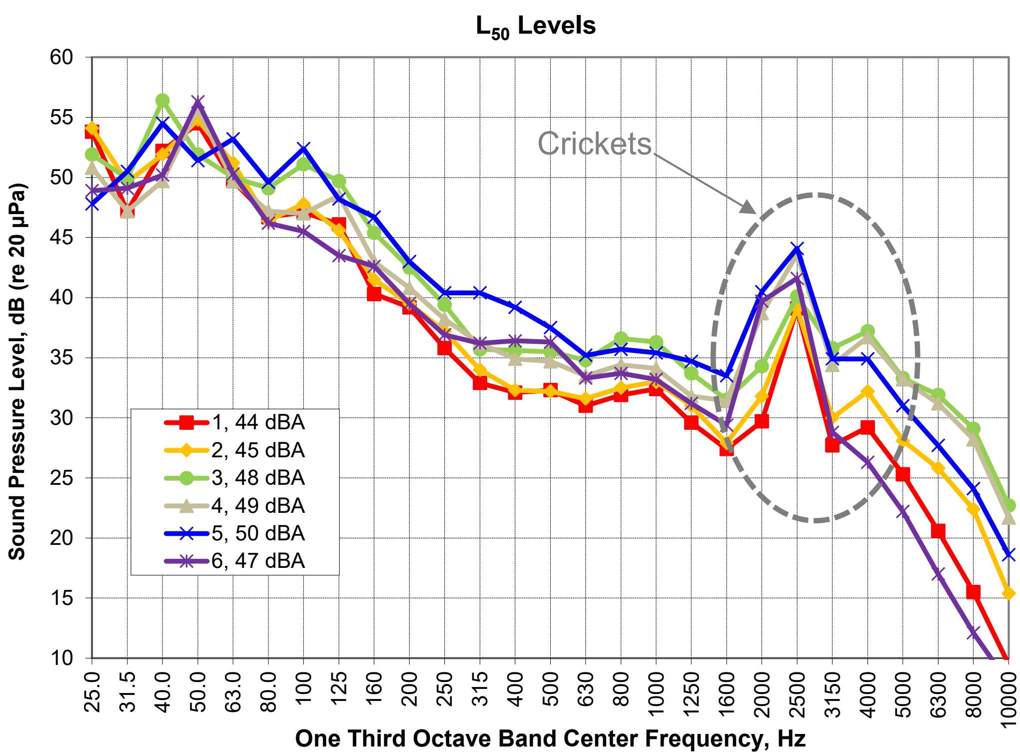


Figure 3: Measured Noise Levels, One-Third Octave Bands



Appendix A – Discussion of Applicable Noise Standards

City of Tualatin Noise Ordinance

Chapter 6-14-050 of the City of Tualatin Municipal Code notes:[3] -

No person shall knowingly create, permit, or assist in the creation or continuance of any noise from any sound source that exceeds the following decibel levels, measured from the property line of the recipient property:

1. *Where the recipient property is a noise sensitive property:*
   a. *Fifty decibels at any time between 10:00 p.m. and 7:00 a.m. the following day, or*
   b. *Seventy decibels at any time between 7:00 a.m. and 10:00 p.m.*
2. *Any other property:*
   a. *Sixty decibels between 10:00 pm. and 7:00 a.m. the following day; or*
   b. *Eighty decibels at any time between 7:00 a.m. and 10:00 p.m.*

Subsection 6-14-020 defines a Noise Sensitive Property as a

> *real property normally used for sleeping, or any real property used as a school, daycare facility, place of worship, hospital, or public library.*

Subsection 6-14-060 lists exceptions to the above noise limits, including the following exception for industrial sites in 6-14-060(4):[4]

> *Industrial, Agricultural, Construction and Demolition.* Sounds caused by industrial, agricultural, construction, or demolition activities when performed during the hours of 7:00 a.m. to 6:00 p.m., seven days a week or otherwise under a permit issued by the City or other governmental authority with jurisdiction;

The residential areas north of the campus qualify as Noise Sensitive Properties and therefore noise sources impacting these properties are understood to be held to a 50 dBA[5] limit between 10:00 PM and 7:00 AM the following morning. Due to the exception for industrial activities, we assume that the 70 dBA daytime limit applies to sources associated with the Lam plant between 6:00 PM and 10:00 PM only.

Unlike most noise ordinances, the City of Tualatin ordinance does not specify a specific noise metric (e.g., L_{eq}, L_{50}, L_{90}, etc.), nor does it specify the measurement duration, that is to be used to assess noise levels for evidence of a noise violation. The ordinance only notes that the decibel level requirements apply to "any sound source." This is critical, since measured noise levels can vary considerably (20 dBA or more) depending upon the specific metric and measurement duration utilized. We therefore assume that the noise should be assessed using the metric and

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[3]https://library.municode.com/or/tualatin/codes/city_charter_and_municipal_code_?nodeId=TUALATIN_MUNICIPAL_CODE_TIT6GEOFNU_CH6-14NOOR_TMC_6-14-050EXDELE
[4]https://library.municode.com/or/tualatin/codes/city_charter_and_municipal_code_?nodeId=TUALATIN_MUNICIPAL_CODE_TIT6GEOFNU_CH6-14NOOR_TMC_6-14-060EX
[5] Section TMC 6-14-110 requires a sound level meter with an A-weighted scale, and therefore the limits are assumed to be defined in A-weighted decibels (dBA). This is typical for environmental noise regulations, as the A weighting adjusts the frequency spectrum of the measured noise based on the typical frequency response of human hearing.

measurement duration that is most appropriate for determining the noise generated by the particular source of concern in each case.

Oregon Department of Environmental Quality (DEQ) Standards

Section 340-035-0035 Oregon DEQ Standards[6] contains Noise Control Regulations for Industry and Commerce. This Section contains the following requirements for new sources[7] located on previously used sites (340-034-0035.1.b.A):

> *New Sources Located on Previously Used Sites: No person owning or controlling a new industrial or commercial noise source located on a previously used industrial or commercial site shall cause or permit the operation of that noise source if the statistical noise levels generated by that new source and measured at an appropriate measurement point, specified in subsection (3)(b) of this rule, exceed the levels specified in Table 8, except as otherwise provided in these rules.*

Table 8 from the regulations is extracted below:

OAR 340-035-0035
Table 8
New Industrial and Commercial Noise Source Standards
Allowable Statistical Noise Levels in Any One Hour

7:00 a.m. – 10:00 p.m.	10:00 p.m. – 7:00 a.m.
L_{50} – 55 dBA	L_{50} – 50 dBA
L_{10} – 60 dBA	L_{10} – 55 dBA
L_{1} – 75 dBA	L_{1} – 60 dBA

Subsection (3)(b) states the following:

> *Unless otherwise specified, the appropriate measurement point shall be that point on the noise sensitive property, described below, which is further from the noise sources:*
>
> *(A) 25 feet (7.6 meters) toward the noise source from that point on the noise sensitive building nearest the noise sources;*
>
> *(B) That point on the noise sensitive property line nearest the noise source*

Given the distance between the residences and any fixed sources on the Lam campus are well above 25 feet, we will assume that these requirements apply at the property line of the residences.

Unlike the City of Tulatin Noise Ordiance, the aforementioned Oregon DEQ Standards clearly indicate the noise metrics: L_1, L_{10}, L_{50}; and the measurement interval: "*Allowable Statistical Noise Level in Any One Hour*".

[6] https://secure.sos.state.or.us/oard/displayDivisionRules.action?selectedDivision=1455

[7] For the purpose of this regulation, anything constructed after 1975 would appear to be considered "new." See Section 340-035-0015.17

Additionally, the DEQ Standards include the following rules with respect to the frequency content of noise in subsection (1)(e), which may be applied as the discretion of the Director (emphasis added):

> *Octave Bands and Audible Discrete Tones.* ***When the Director has reasonable cause to believe that the requirements of subsection (1)(a), (b), or (c) of this rule do not adequately protect the health, safety, or welfare of the public as provided for in ORS Chapter 467, the Department may require the noise source to meet the following rules****:*
>
> > *(A) Octave Bands. No person owning or controlling an industrial or commercial noise source shall cause or permit the operation of that noise source if such operation generates a median octave band sound pressure level which, as measured at an appropriate measurement point, specified in subsection (3)(b) of this rule, exceeds applicable levels specified in Table 10.*
> >
> > *(B) One-third Octave Band. No person owning or controlling an industrial or commercial noise source shall cause or permit the operation of that noise source if such operation generates a median one-third octave band sound pressure level which, as measured at an appropriate measurement point, specified in subsection (3)(b) of this rule, and in a one-third octave band at a preferred frequency, exceeds the arithmetic average of the median sound pressure levels of the two adjacent one-third octave bands by:*
> >
> > > *(i) 5 dB for such one-third octave band with a center frequency from 500 Hertz to 10,000 Hertz, inclusive. Provided: Such one-third octave band sound pressure level exceeds the sound pressure level of each adjacent one-third octave band; or*
> > >
> > > *(ii) 8 dB for such one-third octave band with a center frequency from 160 Hertz to 400 Hertz, inclusive. Provided: Such one-third octave band sound pressure level exceeds the sound pressure level of each adjacent one-third octave band; or*
> > >
> > > *(iii) 15 dB for such one-third octave band with a center frequency from 25 Hertz to 125 Hertz, inclusive. Provided: Such one-third octave band sound pressure level exceeds the sound pressure level of each adjacent one-third octave band;*
> > >
> > > *(iv) This rule shall not apply to audible discrete tones having a one-third octave band sound pressure level 10 dB or more below the allowable sound pressure levels specified in Table 10 for the octave band which contains such one-third octave band.*

Table 10 is extracted below:

OAR 340-035-0035
Table 10
Median Octave Band Standards
For Industrial and Commercial Noise Sources
Allowable Octave Band Sound Pressure Levels

Octave Band Frequency (Hz)	7:00 a.m. – 10:00 p.m.	10:00 p.m. – 7:00 a.m.
31.5	68	65
63	65	62
125	61	56
250	55	50
500	52	46
1000	49	43
2000	46	40
4000	43	37
8000	40	34

The Oregon DEQ requirements do not contain a similar daytime exception for industrial use, however subsection (6)(c) notes that the Department may authorize exemptions for:

> *Those industrial or commercial noise sources whose statistical noise levels at the appropriate measurement point are exceeded by any noise source external to the industrial or commercial noise sources in question*

Discussion

For the purpose of this study, we consider the limits City of Tualatin and Oregon DEQ limits discussed above to apply mainly to continuously operating noise sources within the Lam Research Campus, as we understand that this has been the focus of recent complaints from nearby neighbors. Such sources would include continuously operating rooftop fans, cooling towers, and outdoor compressors and pumps. The reality is that there are other noise sources on and off of the campus that can affect the property line noise levels. These include traffic, construction, and noise from other nearby facilities. The ideal time to measure noise impacts from continuously operating sources on the campus is very late in the evening and into early morning when other transient noise sources are typically less impactful.

The Oregon DEQ standards are defined in the form of statistical noise levels, or centile levels, which represent the noise levels that were exceeded for a certain percentage of the time during the measurement period. For a given measurement, the various centile levels can be quite different, due to the influence of transient noise sources. The DEQ requirements specifically reference the L_1, L_{10}, and L_{50} levels – which are the noise levels exceeded for 1%, 10%, and 50% of the measurement period. For example, for an L_{50} level of 68 dBA, this means that for 50% of the time during the period measured, the noise level was at least 68 dBA.

In a given measurement, these various noise level metrics will often be controlled by a variety of sources. The L_1 metric is usually driven by loud intermittent sources such as a passing motorcycle or a dog bark. In other words, a very loud source that only happens for a short time over the measurement duration. The L_{50}, which would be the noise level exceeded for 30 minutes of an hourlong measurement, typically represents the impact of intermittent but fairly frequent activities, such as air (if near an airport) or vehicle traffic. Another commonly used metric is the L_{90}, which is the noise level exceeded for 90% of the time. This metric is commonly used to assess the contribution from noise sources that are present and stable throughout the measurement period – such as continuously operating mechanical equipment. It represents the continuous background noise level caused by those equipment. The L90 is exceeded when there are transient events such as traffic noise.

Ordinances in many other municipalities have also been defined in terms of the maximum allowable L_{eq}, or equivalent energy noise level – which is defined as the constant noise level that would result in the same total sound energy produced by the measured time-varying noise over a given period of time. It can be considered as an "energy average" of the noise levels over the measurement interval. The L_{eq} levels can be quite sensitive to the impact from loud short term transient noises due to the logarithmic nature of the decibel scale.

Since the "Octave Bands and Audible Discrete Tones" portion of the Oregon DEQ requirements are described as being applied only at the discretion of the Director, it is unclear whether they are applicable in this case. Results presented in comparison to these standards should be considered for reference only, unless the City confirms that they are applicable in this case. If applicable, for the purposes of this study we will assume that they are only relevant with respect to noise generated by continuously operating noise sources located on the Lam campus.

Appendix B – CGA Firm Information

FIRM DESCRIPTION

Colin Gordon Associates, founded in 1990, provides specialized consulting services in acoustics and vibration control. The company has grown steadily from a one-person firm to an experienced organization offering services world-wide. Currently the staff numbers fourteen employees, including support personnel, offering both breadth and a desirable degree of redundancy. Staff members include technical experts in architectural acoustics and noise control, industrial and environmental noise studies, structural dynamics and building vibration, computer modeling techniques, and dynamic measurements.

The firm is recognized nationally and internationally for its work in the design of low- vibration and low-noise environments for technological buildings. CGA serves a wide variety of organizations in the tech sector, including university research laboratories, the semiconductor and optoelectronics industries, the biotech, pharma, and healthcare communities, as well as the cutting-edge areas associated with nanotechnology. CGA provides to these sectors a selection of services ranging from sophisticated vibration and noise control to solutions of more conventional problems that may arise.

The firm also works extensively in the more traditional areas of building and environmental noise and vibration studies. The control of noise and vibration in buildings poses some unique problems ranging from the selection of design criteria to the development of design details and specifications for structural and mechanical systems. On many projects, the company serves as a member of the architect/engineer design team. On others, the company acts individually and directly with the owner.

CGA is based in a single office in Northern California as well as having several employees working remotely in various locations throughout the United States. The firm routinely provides services throughout the western hemisphere, the Middle East, Europe, and Asia.

Staff members have published extensively; a list of publications is available at the firm's website (*www.colingordon.com*). Collectively and individually, the staff of Colin Gordon Associates has a proven record of success in developing cost-effective solutions for a wide variety of noise and vibration problems.

Role at Firm
Vice President, Senior Consultant

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Work Location
Portland, OR

Education
BS Mechanical Engineering, University of Virginia

Certification / Licenses
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Member
National Council of Acoustical Consultant (NCAC)
Acoustical Society of America (ASA)
Institute of Noise Control Engineering (INCE)

Work History
2010 - Present
Consultant, then Senior Consultant, then Vice President, Colin Gordon Associates

2001-2010
Timber Truss Housing Systems

1999-2000
Facilities Planning and Construction at the University of Virginia Health Sciences Center

Steven Lank

Acoustics and Vibration Consultant

Steven Lank has over 25 years of experience in the construction industry, and has been with Colin Gordon Associates since 2010. At CGA, his work has focused upon noise and vibration control for buildings of all types, including technology facilities, university laboratories, healthcare, office, and industrial facilities. His contributions involve environmental noise measurements and modeling, HVAC noise analysis, room acoustics and speech privacy, structural dynamic analysis and evaluation, mechanical vibration control, and construction noise and vibration control and monitoring. He also oversees CGA's efforts in sustainable design, including LEED certification, as well as the firm's in-house instrumentation laboratory. He is a member of CGA's team of computer modelers, addressing environmental and room acoustics and HVAC noise modeling, as well as structural and groundborne vibration. He has provide acoustics and vibration consulting support, measurements, and diagnostic evaluations on hundreds of projects, including many projects focused on environmental noise assessments, measurements, modeling, and mitigation designs.

Steven regularly engages in research activities related to acoustics, noise, and vibration control, and has published a number of technical papers. He has also served on multiple committees related to acoustic standards and guidelines, including for the International Standards Organization (ISO) and Facilities Guidelines Institute for the Design of Healthcare Facilities (FGI).

Prior to joining Colin Gordon Associates, Steven worked as a Project Engineer for Facilities Planning and Construction at the University of Virginia Health Sciences Center, where he oversaw and assisted with multiple lab and hospital renovation projects, and as a structural designer for Timber Truss Housing Systems, where he provided layout and design of support structures for roof and floor systems in residential and commercial construction projects. He obtained his B.S. in Mechanical Engineering at the University of Virginia in 2001, where he completed his undergraduate thesis on frequency analysis of guitar woods for the purpose of characterizing sound.