Krause Acoustics
2635 Monte Vista Ave.
El Cerrito, CA 94530
Tel (510) 685-9987
nickkrause@comcast.net

To: City of Oakland
250 Frank H. Ogawa Plaza
Oakland CA 94612

Attn: Neil Gray, Senior Planner

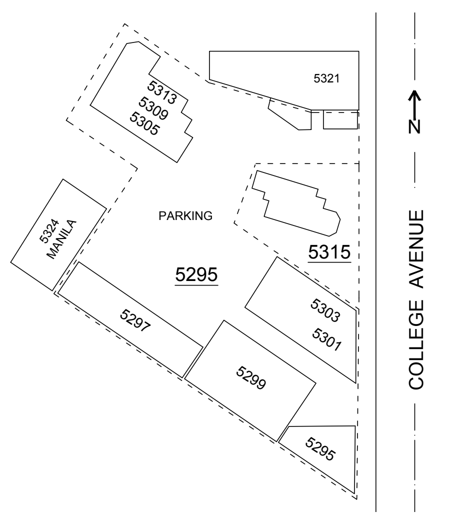
Date: January 2, 2024

Re: Case PLN22189
5315 College Ave. Oakland
Preschool Play Yard Noise Study

1. Introduction

The proposed project is a preschool in a renovated residence. Adjacent property at 5295 College has three office buildings used by health practitioners around an off street parking lot, along with a retail shop and restaurants fronting on College Avenue. Figure 1 shows the project and identifies the buildings on the adjacent lot; both properties are zoned CN-l.

Figure 1 - Project Setting



The primary study objective is to assess the potential impact of project operations with respect to performance standards defined in Chapter 17.120 of the Oakland Planning Code.

A secondary objective is to describe the effect of project noise as perceived inside the adjacent buildings, to address the issue of potential noise intrusion into consultation offices.

The study is based on a sound level survey at the project site to classify existing traffic noise and a play yard noise survey at local preschool. The study uses sound path analysis of the proposed project arrangement to predict the emissions of a similar play yard operation located at the project site.

2. Noise Regulations

Allowable noise levels are defined in City of Oakland Planning Code Section 17.120.050 - Noise, which states as follows:

"All activities shall be so operated that the noise level inherently and regularly generated by these activities across real property lines shall not exceed the applicable values indicated in Subsection A., B., or C. as modified where applicable by the adjustments indicated in Subsection D. or E.

A. Residential Noise Standards ... (N/A)

B. Commercial Noise Level Standards. The maximum allowable noise levels received by any land use activity within any Commercial Zone area ... are described in Table 17.120.02

Table 17.120.02
MAXIMUM ALLOWABLE RECEIVING NOISE LEVEL STANDARDS

Cumulative Minutes in Either the Daytime or Nighttime One Hour Time Period	Anytime
20	65
10	70
5	75
1	80
0	85

C. Industrial Noise Standards ... (N/A)

D. In the event that the measured ambient noise level exceeds the applicable noise level standard in any category above, the stated applicable noise level shall be adjusted so as to equal the ambient noise level.

E. Each of the noise level standards specified above in Subsections A., B., and C. shall be reduced by (5) five dBA for a simple tone noise such as a whine, screech, or hum, noise consisting primarily of speech or music, or for recurring impulsive noise such as hammering or riveting.

F. Noise Measurement Procedures. Utilizing the "A" weighting scale of the sound level meter and "slow" meter response (use fast meter response for impulsive type sounds), the noise level shall be measured at a position or positions at any point on the receiver's property. In general, the microphone shall be located four (4) to five (5) feet above the ground; ten (10) feet or more from the nearest reflective surface, where possible. However, in those cases where another elevation is deemed appropriate, the latter shall be utilized."

(Subsection D implies that ambient noise level measurement is a necessary element of the assessment. Subsection E is assumed to be applicable since the noise is primarily speech.)

3. Sound Level Measurement Method

Sound level data was obtained using SPL Graph acoustic analysis software by Studio Six Digital installed in smartphones. Data was sampled at one-second intervals to approximate "Slow" sound level meter response; the system used "A-weighted" frequency response. Instruments were calibrated prior to use with a source traceable to national standards.

The SPL Graph system provides a time-stamped list of the individual data values. These were sorted after acquisition to find the statistical percentile values corresponding to Ln criteria used in the Planning Code. The convention in the following analysis is to use the average noise level L20 as a single descriptor for use in discussion.

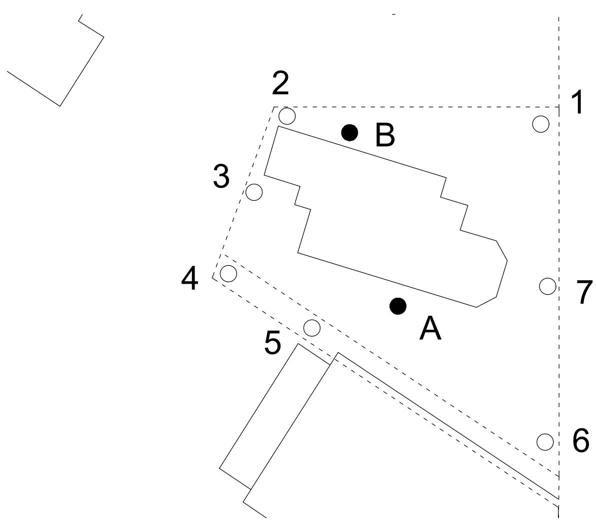
One system logged sound levels continuously at a fixed station and saved the data at the end of each one-hour record. This system used a micW type I436 measurement microphone.

Short-term measurements were made at various other locations around the site using a similar analysis system and the smartphone internal mic. This roving system logged sound levels at one-second intervals and saved the data at the end of each record of length three to five minutes.

4. Site Noise Survey

Figure 2 shows measurement stations used for the site ambient noise survey. Fixed Stations A and B recorded long-term trends of traffic noise from College Avenue on different days. Station A is the nominal location of the proposed play yard. Roving Stations 1 through 7 were used during one session for coincident short-term data to map traffic noise spatial pattern by using the correlations between roving stations and the fixed station.

Figure 2 - Site Noise Survey Stations



The dominant noise source near the project, especially at the front of the building, is vehicle traffic on College Avenue immediately to the east of the site. Noise level is slightly lower at the rear of the project lot due to distance and partial screening by adjacent buildings. Traffic noise level is significantly lower at Station 3 due to near-complete screening by the project building.

This noise is highly variable in both loudness and character, depending on vehicle mix, speed and separation. The traffic flow is intermittent, as influenced by the timing of nearby traffic lights at the intersections with Broadway and Manila.

A secondary source of ambient noise, especially at the rear of the lot, is traffic on Interstate Route 24, an elevated eight-lane freeway with median rail line about 2000 feet to the Northwest of the site. This noise is essentially steady and broadband with only occasional discrete anomalous events; it is audible during lulls in the dominant College Avenue traffic, and it constitutes the residual sound level or noise floor in the project vicinity.

5. Site Survey Results

The first survey session consisted of continuous recording at Station A from 2 p.m. November 30 through 4 p.m. December 1. The microphone was on a mast outside a window at a distance of three feet from the building and eight feet above the ground.

Figure 3 is a typical hourly survey record; Figure 4 is a 5-minute detail of the full hour. The detail shows a series of peaks as vehicles pass by, at a rate of about ten per minute; larger peaks are trucks or buses. The residual noise level is about 52 dB.

Figure 3 - Typical Hourly Survey Record

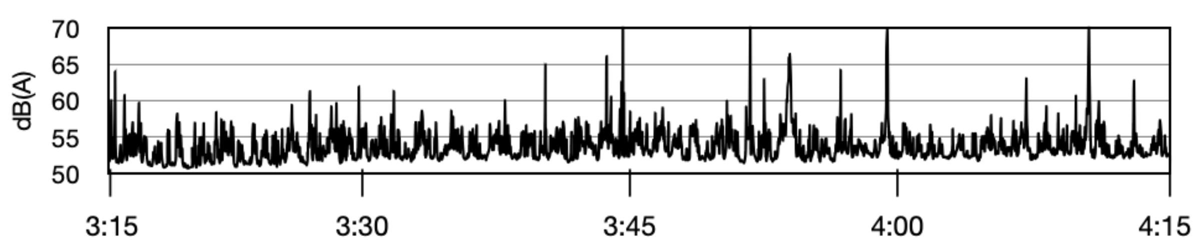


Figure 4 - Hourly Record Detail

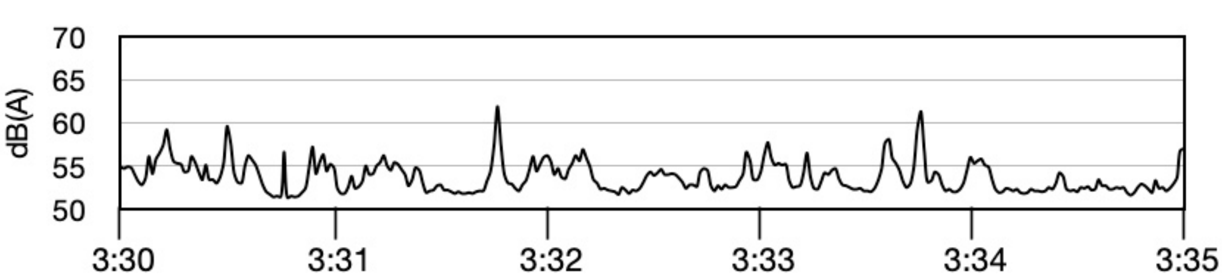


Table 1 lists values of Ln metrics found in analysis of data from five survey sessions at Stations A and B. The table also lists the overall averages of L20 - L0 values.

Table 1a - Site Noise Survey Station A

Date	Time	Station	L20	L10	L05	L01	L0
11/30	2 - 7 p.m.	A	55	56	57	60	70
12/01	7 - 11 a.m.	A	54	56	58	62	78
12/01	12 - 4 p.m.	A	53	55	56	60	71
	Average		54	56	57	61	73

A second survey session consisted of continuous recording at Station B on December 8. The microphone was positioned on a mast outside a window at a distance of two feet from the building and twelve feet above the ground. Portions of the data from 10:00 a.m. to Noon on 12/08 were omitted due to interference from another non-traffic noise source, such as nearby construction activity.

Table 1b - Site Noise Survey Station B

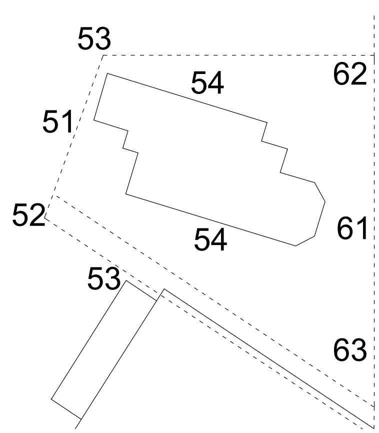
Date	Time	Station	L20	L10	L05	L01	L0
12/08	8 - 10 a.m.	B	55	58	60	68	73
12/08	12 - 5 p.m.	B	54	56	57	62	80
	Average		54	57	58	61	77

The value L20 = 54 dB is used as the basis for reference in the following discussions.

6. Traffic Noise Pattern

A short-term survey was used to assess the variance of traffic noise with respect to location around the property; results are Shown in Figure 5.

Figure 5 - Noise Pattern



A roving sound level meter took short-term records at seven locations, with coincident data taken by the continuous recorder. The roving and base data were compared to find the difference in sound levels.

Highest sound levels are along the east side of the lot near the dominant source of traffic noise, College Avenue.

Sound levels along the west side lot line are similar to the base stations except at the middle, where the house provides significant shielding from the traffic sound path.

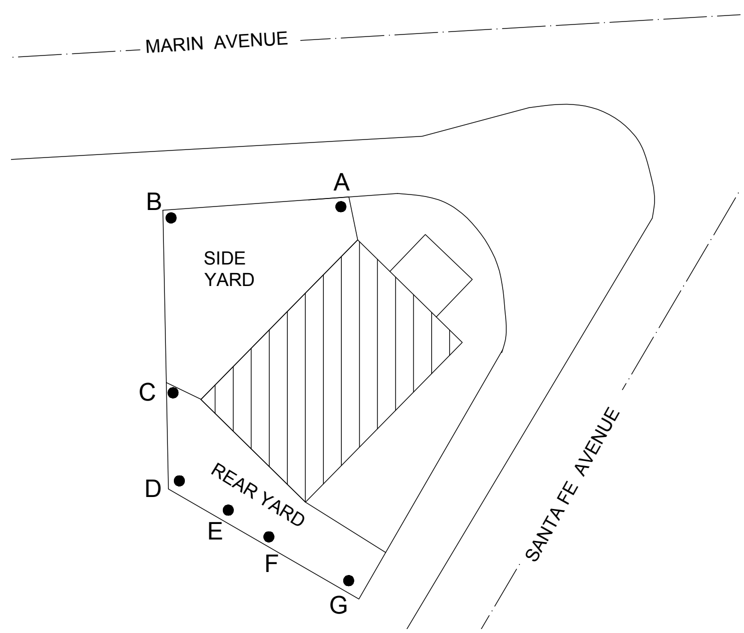
The west side of the house is slightly exposed to noise from Route 24, audible only during lulls in local traffic.

7. Play Yard Noise Survey

A series of sound level measurements was conducted from November 20 to December 5 at a facility similar to the project as shown in Figure 6. This is located at 1370 Marin Avenue in Albany, at the corner of Santa Fe Avenue. The lot has play yard areas at the side and rear of a two-story house, separated by a low fence.

Location C was used as the base station for continuous data recording and observation of yard activities; it has a direct view of both play yards, at a distance of about 30 feet from the center of each. Other stations along the yard perimeter were used for coincident short-term data to find the variance of play yard noise with location. Stations A and B were used for initial observations but were later dismissed due to excessive traffic noise. Stations D thru G were used to observe the shielding effect of the school building on sound paths from the side yard to the rear yard.

Figure 6 - Play Yard Noise Survey Stations



Maximum enrollment of the school is 36, with typically 30 - 32 in attendance. The play yards are used for two sessions each day; the younger kids (3's) use the rear yard and the older kids (4's) use the side yard.

The morning session is split into two halves, with 3's in the rear yard from 10:30 to 11:15 and 4's in the side yard from 11:15 to 12:00.

The afternoon session is from 3:15 to 5:00, with the side yard used the entire time and the rear yard used part time.

8. Play Yard Survey Results

Figure 7 shows examples of data from play yard noise surveys.

Figure 7 - Typical Play Yard Noise 11/20/23

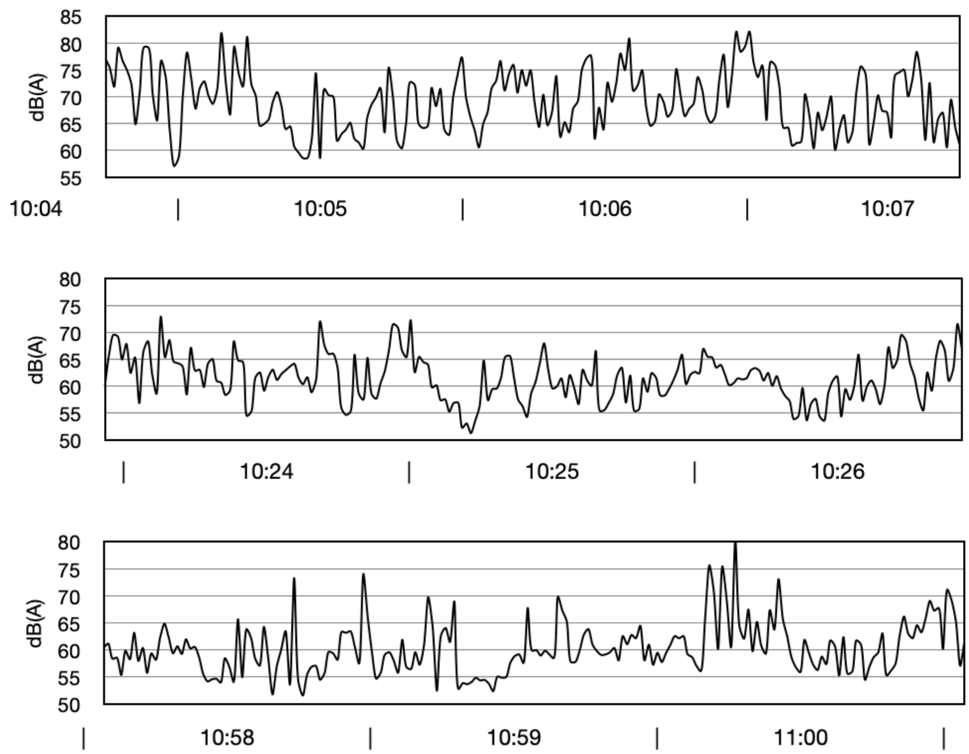


Table 2 lists values of Ln metrics found in analysis of data from four survey sessions on three days. These represent periods of maximum attendance, activity and noise. The table also lists the overall averages of values for L20 - L01 and the overall maximum value for L0.

Table 2 - Play Yard Noise Survey Summary

Date	Time	L20	L10	L05	L01	L0	Kids
11/20	10-11a.m.	68	71	74	79	83	10- 14
11/20	4 - 5 p.m.	65	68	71	74	81	17 - 28
11/28	4 - 5 p.m.	65	69	71	77	82	11 - 27
12/05	4 - 5 p.m.	68	72	75	78	83	15 - 28
	Average	67	70	73	77	83	

Overall average value of L20 = 67 dB @ 30' is taken as the basis for the following analysis.

9. Noise Prediction Method

Sound path analysis includes the effects of sound divergence with distance and diffraction around barriers. The sound level Divergence Attenuation term (Ad) between two points located at distances D1 and D2 from a source is calculated using the formula:

$$Ad = 10 \log(D2 / D1),\ \text{dB}$$

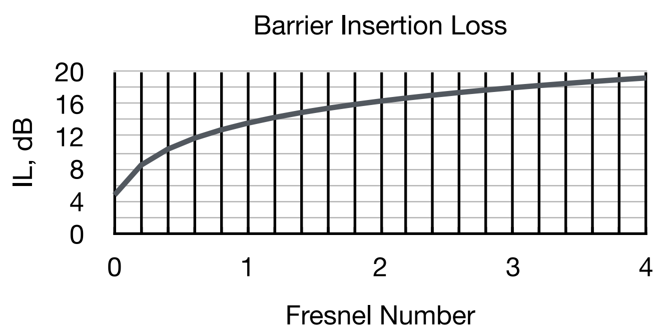
This means that the sound level decreases by about 3 dB if the distance is doubled or increases by 3 dB if the distance is halved.

The barrier attenuation or Insertion Loss (IL) between two points is a function of the Fresnel Number (N), which is the difference (Δ) between the length of the direct sound path and the length of the actual sound path around the barrier, compared to the Wavelength (W) of the sound.

$$N = 2 \times \Delta / W$$

The IL value is determined using the following formula, derived from empirical studies by Maekawa et.al. Practical barrier IL values range from 5 dB to a maximum limit of about 20 dB.

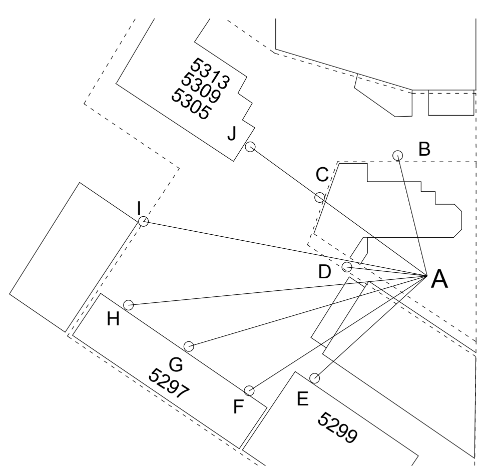
$$IL = 10 \log(3 + 20 N)$$



10. Noise Prediction Sound Paths

Figure 8 shows locations of sound paths around surrounding structures that act as sound barriers. Point A at the play yard center is 5' above the ground, as are Points B, C and D at the project lot line. Point E is at the third story of Building 5299. Points F, G and H are at the second story of Building 5297. Points I and D are along the only direct sound path from A. Point J is at the second story of Building 5305/5309/5313.

Figure 8 - Sound Path Locations



11. Noise Prediction - Base Case

Figure 9 shows the barrier geometries used to find the difference Δ between direct and indirect sound paths. Paths in the horizontal plane go around buildings; paths in the vertical plane go over buildings.

Figure 9 - Sound Path Geometries

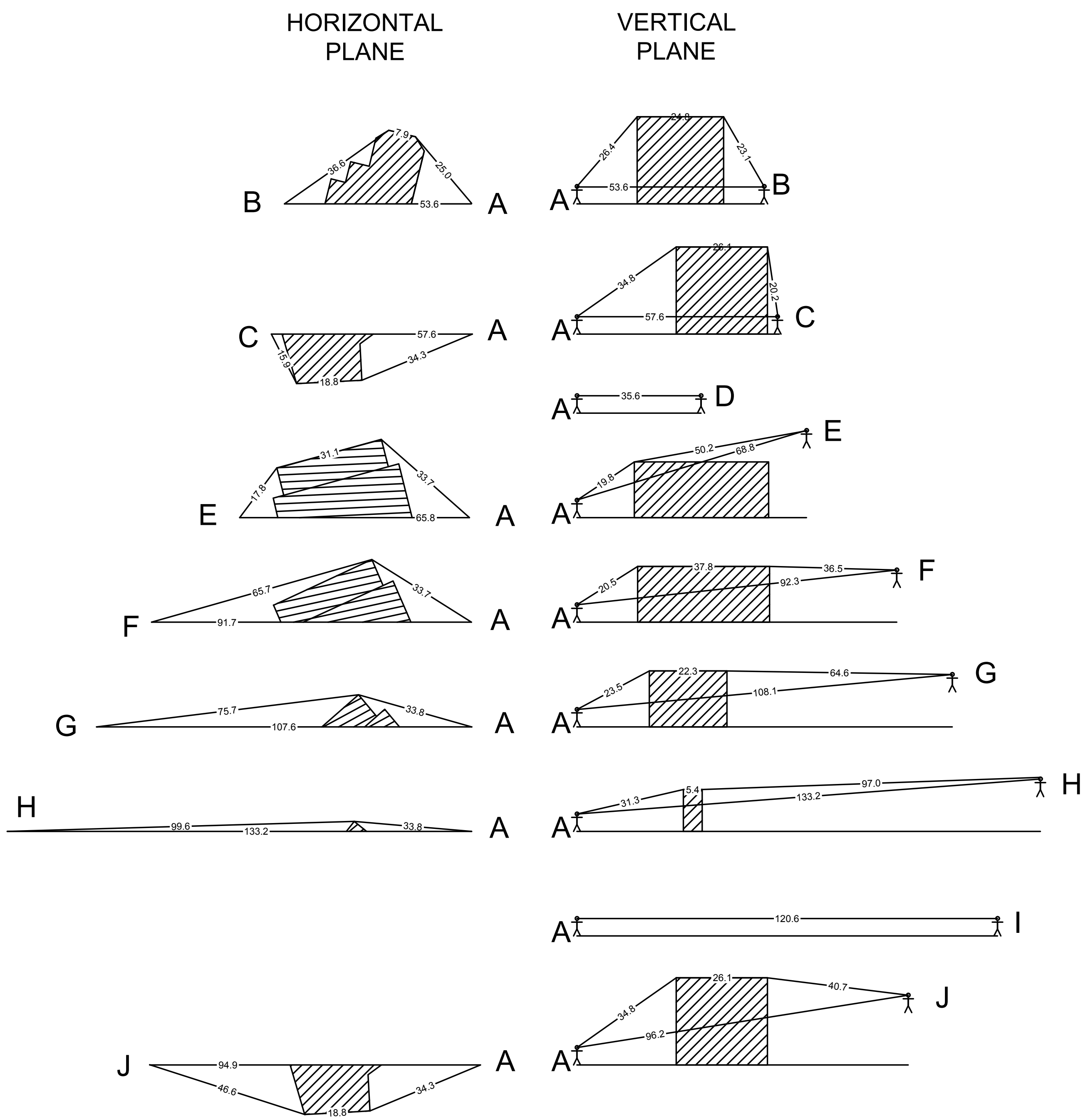


Table 3 lists the barrier calculations used to predict sound levels using the method of Section 7, based on a source of 67 dB at 30' with wavelength of one foot (i.e., 1000 Hz). Insertion Loss values are limited to a maximum of 20 dB for high Fresnel numbers.

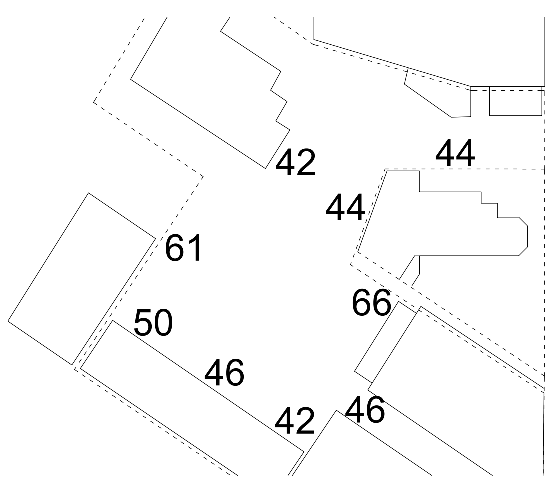
Table 3 - Barrier Calculations

VERT. PLANE	AB	AC	AD	AE	AF	AG	AH	AI	AJ
DIRECT PATH	53.6	57.6	35.6	68.8	92.3	108.1	133.2	120.6	96.2
INDIRECT PATH	74.3	81.1		70.1	94.8	110.4	133.7		101.6
PATH DIFFERENCE	20.7	23.5		1.3	2.5	2.3	0.5		5.4
FRESNEL NUMBER	41.4	47.0		2.6	5.0	4.6	1.0		10.8
INSERTION LOSS	20.0	20.0		17.4	20.0	19.8	13.6		20.0
DISTANCE ATTEN.	2.5	2.8	0.7	3.6	4.9	5.6	6.5	6.0	5.1
TOTAL ATTEN.	22.5	22.8	0.7	21.0	24.9	25.3	20.1	6.0	25.1
SPL	44	44	66	46	42	42	47	61	42

HORIZ. PLANE	AB	AC	AD	AE	AF	AG	AH	AI	AJ
DIRECT PATH	53.6	57.6	35.6	65.8	91.7	108.1	133.2	120.6	96.2
INDIRECT PATH	69.5	69.0		82.6	99.4	109.0	133.4		99.7
PATH DIFFERENCE	15.9	11.4		16.8	7.7	0.9	0.2		3.5
FRESNEL NUMBER	31.8	22.8		33.6	15.4	1.8	0.4		7.0
INSERTION LOSS	20.0	20.0		20.0	20.0	15.9	10.4		20.0
DISTANCE ATTEN.	2.5	2.8	0.7	3.4	4.9	5.6	6.5	6.0	5.1
TOTAL ATTEN.	22.5	22.8	0.7	23.4	24.9	21.5	16.9	6.0	25.1
SPL	44	44	66	44	42	46	50	61	42

Figure 10 shows the results of Base Case sound path predictions. Sound levels at most receiver locations are from 42 to 46 dB except at H, which has a sound path close to a barrier edge. Locations D and I are on direct sound paths and have sound levels in excess of the limit L20 = 60 dB allowed by the Planning Code.

Figure 10 - Predicted Play Yard Noise, Base Case



12. Noise Prediction - Alternate Case

A sound barrier wall could be used to block the direct sound path through the gap between buildings 5303 and 5315. This would be a vertical extension to the security fence between the play yard and the adjacent public access walkway.

Figure 11 - Sound Wall Location

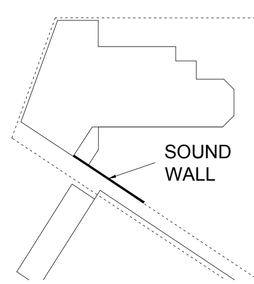


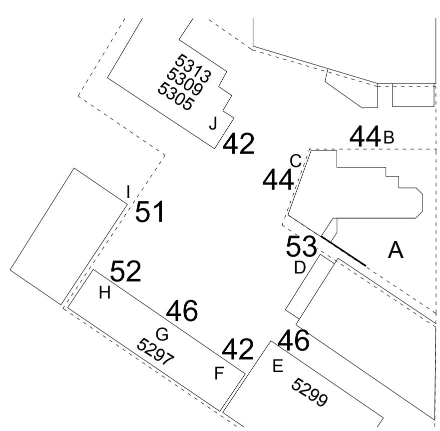
Table 4 lists the results of a study to determine the effect of sound wall height. The direct sound paths to locations D, H and I were analyzed for barrier heights of 8 to 14 feet. The study shows that a height of 8' would reduce sound levels to about 52 dB. Figure 12 shows the results of Alternate Case sound path predictions with 8' barrier hight.

Table 4 - Sound Wall Height Study

SOUND WALL CALCULATIONS: 67 dB @ 30', 1000Hz

VERT. PLANE	AD-8	AD-10	AD-12	AD-14	AH-8	AH-10	AH-12	AH-14	AI-8	AI-10	AI-12	AI-14
DIRECT PATH	35.6	35.6	35.6	35.6	133.2	133.2	133.2	133.2	120.6	120.6	120.6	120.6
INDIRECT PATH	36.1	37.1	38.5	40.1	133.3	133.6	134	134.9	120.8	121.2	121.7	122.4
PATH DIFFERENCE	0.5	1.5	2.9	4.5	0.1	0.4	0.8	1.7	0.2	0.6	1.1	1.8
FRESNEL NUMBER	1.0	3.0	5.8	9.0	0.2	0.8	1.6	3.4	0.4	1.2	2.2	3.6
INSERTION LOSS	13.6	18.0	20.0	20.0	8.5	12.8	15.4	18.5	10.4	14.3	16.7	18.8
DISTANCE ATTEN.	0.7	0.7	0.7	0.7	6.5	6.5	6.5	6.5	6.0	6.0	6.0	6.0
TOTAL ATTEN.	14.4	18.7	20.7	20.7	14.9	19.3	21.9	25.0	16.5	20.4	22.8	24.8
SPL	53	48	46	46	52	48	45	42	51	47	44	42

Figure 12 - Predicted Play Yard Noise With 8' Barrier



13. Code Compliance Assessment

Commercial Zone noise level standards of Planning Code Section 17.120.050.B, when reduced by 5 dB per the noise characteristic penalty listed in 17.120.050.D, are as follows:

L20	L10	L05	L01	L0
60	65	70	75	80

The ambient sound levels at Stations A and B as summarized in Table 1 do not exceed the values listed above, so the condition of 17.120.050.E does not apply and the above values are the defining allowable limits.

Table 5 lists the LN values at office exterior locations for the alternate case prediction, based on the statistical distribution of the overall average survey result from Table 2. The table shows that the predicted play yard noise of the alternate case is significantly less than the allowable limit in all statistical categories.

Table 5 - Code Compliance Assessment

	L20	L10	L05	L01	L0
CODE LIMIT	60	65	70	75	80
PROJECT	42	45	48	52	58
	44	47	50	54	60
	46	49	52	56	62
	52	55	58	62	68

14. Barrier Construction

Since the barrier insertion loss will be no more than 20 dB, it is not necessary for the wall to be particularly massive, i.e., concrete or masonry. The barrier must be continuous, without any gaps at the bottom or between panel elements.

Recommended barrier design is to use 4 x 4 wood fence framing with a concrete footing to prevent gaps due to damage caused by fence material in contact with damp soil. Each side should have a facing of about one inch thickness. Siding of genuine or faux wood board material should have shiplap or tongue-in-groove edges to prevent gaps between boards; genuine wood should be clear grain and free of knot holes, kiln dried to prevent shrinkage that might cause gaps. Alternate face material for one or both sides is plywood sheathing with cement stucco face.

Recommended barrier height is 8' above the ground elevation at the play yard. The fence top would be 4' above the project porch near the play yard and about 6' above the elevation of the adjacent easement walkway pavement.

15. Conclusions

The site sound level survey did not include stations in the adjacent property parking lot. The following discussion is based on cursory observations made on the initial project walk-around.

Traffic noise level in the parking lot is similar to that at the rear of the project, i.e., a steady residual sound level of about 52 dB due to Route 24 traffic with a variable sound level of 55 dB average and 70 dB maximum due to College Avenue traffic.

The loudest project noise outdoors at stations near office buildings, with the alternate case including the sound barrier, is about 52 dB average and 70 dB maximum at location H. This means that the project noise level is slightly less than the ambient noise level, so the project noise may be audible at times. The project noise will be more audible when a peak in playground activity coincides with a lull in traffic.

The sound level inside offices on the adjacent property will be a function of the sound level outdoors and the noise reduction provided by office windows facing the parking lot.

Building 5305/5309/5313 windows appear to have double-hung wood frames with single glazing; this type of assembly provides about 15 dB of noise reduction, so interior noise level due to traffic is about 40 dB average and 55 dB maximum. The project noise will be about 10 dB less than the traffic noise and therefore inaudible.

Building 5297 windows appear to be double-hung metal frames with single glazing; there are numerous through-the-window air conditioning units, apparently one for each office. This arrangement provides noise reduction of only about 10 dB due to sound passage thru the air conditioners. Interior noise level at location H due to both traffic and the project will be about 45 dB average and 60 dB maximum; the project noise will be slightly audible some of the time and more audible when a peak in playground activity coincides with a lull in traffic. Interior noise level at location F due to the project will be about 10 dB less than the traffic noise and therefore inaudible.

This Report Prepared by:
Nicholas Krause, P.E.

REGISTERED PROFESSIONAL ENGINEER
NICHOLAS D. KRAUSE
exp.
9/30/2025
No. 17831
MECHANICAL
STATE OF CALIFORNIA

Nicholas Krause, P.E.

2635 Monte Vista Ave.
El Cerrito, CA 94530
(510) 685-9987
nickkrause@comcast.net

EXPERIENCE	Four decades of design and engineering work in the construction industry, with a specialty of sound and vibration control
EDUCATION	Redwood High School, Larkspur CA - Class of 1967
1967 - 1972	U.C. Berkeley, Mechanical Engineering - BSME 1972 Emphasis on machinery dynamics and acoustics
1974 - 1975	U.C. Berkeley - Mechanical Engineering Graduate research in vibration, impact and wave propagation
REGISTRATION	Professional Engineer (Mechanical # 17831) California 1976 - 2025

WORK HISTORY:

1976 - 1977	FMC Associates, San Francisco - Mechanical Engineer Central power plants and distribution systems for government facilities
1978 - 1993	Bechtel Group, San Francisco - Sound and Vibration Engineer Noise standards and practices development for company policies Project noise prediction, planning and management Environmental noise measurements for compliance verification Noise problem assessment and correction Structure and piping system vibration assessment surveys Rotating machinery balance and bearing condition assessment Temporary instruments used to identify control dynamics faults Structural integrity test instrument fabrication and installation
1994 - 2000	Krause Engineering Services, San Luis Obispo - Noise Consultant Traffic noise surveys and building design for noise plan compliance Interior noise insulation design and testing for building code compliance Environmental noise impact studies for proposed developments Sound level surveys for community noise impact assessment Sound absorption treatments for room ambience management Mechanical equipment noise and vibration controls
2001 - 2023	Krause Acoustics, El Cerrito - Senior Consultant Noise insulation studies for residential and mixed-use projects Environmental noise surveys and impact assessment Mechanical equipment noise measurements and mitigations Facility noise surveys and noise abatement programs Construction noise monitoring for ordinance compliance assessment Sound absorption treatments for room ambience management

Engineering studies provided by Krause Acoustics:

Exterior Noise Insulation

Apartment Complexes - Oakland, Pismo Beach, San Leandro, San Luis Obispo, San Mateo
Homes - Arroyo Grande, Berkeley, Mountain View, Oakland, San Mateo, San Rafael
Hotels and motels - Avila Beach, King City, San Luis Obispo, Shell Beach
Mixed use developments - El Cerrito, El Sobrante, Oakland, San Luis Obispo, Santa Maria
Residential developments - Atascadero, Oakland, Paso Robles, Shell Beach, Templeton

Interior Noise Insulation

Business offices - Avila Beach, Berkeley, San Luis Obispo
Dental offices - Berkeley, Templeton
Manufacturing plants - Berkeley, Hayward, Nipomo, Paso Robles, San Luis Obispo
Residences and hotels - Berkeley, King City, Larkspur, Oakland, San Francisco
Senior care centers - San Luis Obispo, Santa Maria

Community Noise Assessment

Airport area hotel and casino - Las Vegas
Amphitheaters - Kensington, Paso Robles, Santa Maria
Car washes - Buellton, Cambria, El Cerrito
Commercial retail centers - Nipomo, Redding, Yuba City
Construction sites - Avila Beach, Berkeley, Las Vegas, Milpitas, Oakland
County landfill expansion - San Luis Obispo
HVAC Equipment - Alameda, Lafayette, Piedmont
Miniature golf / go-cart track - Morro Bay
Restaurants and taverns - Berkeley, Oakland
School playgrounds - Berkeley, Cambria, Oakland, Santa Ynez

Sound Absorption Treatments

Community activity rooms - Arroyo Grande, Santa Maria
Churches - Alameda. Santa Maria
Health clubs - Oakland, Piedmont, Pismo Beach, Tiburon.
Music studios - Lucas Valley, Oakland, San Francisco, San Rafael
Open plan offices - Berkeley, San Francisco, San Luis Obispo,
Restaurants - Avila Beach, Berkeley, Oakland, San Luis Obispo, Shell Beach
Schools - Nicasio, Santa Ynez, Tomales

Machinery Noise Reduction

Generator power systems - Berkeley, Nipomo
HVAC systems - Alameda, Arroyo Grande, Berkeley, San Rafael
Juice bottling production line - Berkeley
Municipal water wells and pipelines - Atascadero, Berkeley, Nipomo
Power plant lube oil system - Avila Beach