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**Subject: Castilleja School Master Plan, Palo Alto, CA –  
DRAFT Environmental Noise Study  
Salter Project #: 16-0590**

Dear Ms. Layendecker:

This letter and the attached figures provide a summary of our on-site noise measurements and projections for future noise associated with the Master Plan for Castilleja School in Palo Alto, CA. Our analysis is focused on water polo games, events, and bus and truck operations.

### SUMMARY

Castilleja's proposed master plan includes several notable design elements intended to reduce the noise impact of on-campus activities on the surrounding neighborhood. These elements include:

- Lowering the swimming pool by 15 feet
- Surrounding the Main Circle on three sides with buildings
- Adding a wall along Emerson Street to help contain swimming pool noise
- Enclosing the bus transit path underground

Following is a summary of conclusions from our analysis.

1. For the campus events and neighborhood locations examined in this study, the implementation of the master plan results in 4 increases in noise levels, 3 instances of no change, and 7 decreases of noise levels.
2. Average noise levels from Main Circle gatherings and pool events are expected to meet the Palo Alto Municipal Code limits at neighboring properties, with the exception of residences on Emerson Street with direct visibility to the Main Circle which may exceed the noise ordinance on occasion.
3. Instantaneous noise levels from the loudest activities (e.g., group cheers, DJ speaking into microphone, whistles), may occasionally exceed the Municipal Code criteria in some locations, depending on the daily traffic and hours of the activity.
4. For Main Circle events, these maximum noise levels are estimated to be similar or quieter than the existing levels for neighbors examined in this study, with the exception of noise levels at 1300 and 1326 Emerson. At these locations, noise levels may be further decreased by increasing the height of the pool barrier near the Main Circle, incorporating a solid entry gate, or adjusting speaker location during events.
5. For pool events, these maximum noise levels will generally be quieter than the existing levels for neighbors to the east, and louder than existing maximum noise levels for neighbors to the west.

6. Sound amplification systems at the pool should be designed to limit noise exposure to adjacent residences.
7. Noise from bus activity inside the Main Circle is anticipated to meet Municipal Code limits at the adjacent residences.
8. Noise from loading activity at the designated loading dock may occasionally exceed the Municipal Code noise limits at the residences along Emerson Street with direct line-of-sight to the Main Circle.

## ACOUSTICAL CRITERIA

The Noise Ordinance of the Palo Alto Municipal Code (Chaper 9.10) limits noise generation to 6 decibels (dB) above the local ambient at adjacent residential properties. The Noise Ordinance defines the local ambient as the lowest sound level repeating itself during a six-minute period, and indicates that in no case shall it be considered less than 40 dB.

## PROJECT DESCRIPTION

The project proposes to replace the existing Classroom Building and Campus Center with a new Upper School and Middle School Building. In addition, the project proposes other changes to the campus including the following:

- Removal of the following buildings along Emerson Street: Lockey Alumnae House, Head's House, Leonard Ely Fine Arts Center, Maintenance Building (at corner of Emerson Street and Kellogg Avenue)
- Relocating the Pool along Emerson Street, recessed approximately 15' below grade.
- Creation of an underground path below the Main Circle for buses

## PROJECT GENERATED NOISE

This analysis focuses on the following sources of project-generated noise:

- Events at the pool (e.g., water polo games and swim meets)
  - The new pool will include amplified sound
  - The new pool will be recessed approximately 15' below grade and include a solid barrier that extends upward approximately 6' above grade and will include a kicker on top facing in towards the pool
- Events and gatherings in the Main Circle
  - Events are scheduled twice per year: Gator Gathering and Founder's Day
  - Gator Gathering includes amplified music and we understand is typically louder than Founder's Day
- Truck and bus operations in the Main Circle
  - Will include fire trucks, garbage trucks, passenger buses, and loading trucks
  - Operation paths as shown in the Conditional Use Permit & Master Plan Submittal dated 30 June 2016. Passenger buses will drive on an underground path below the Main Circle.

## EXISTING NOISE LEVELS

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### Noise Environment

To quantify the existing noise environment, two multi-day monitors continuously measured noise levels at the site between 23 and 27 September 2016 (Friday to Tuesday). The approximate locations of monitors are shown in Figure 1, attached. Table 1, below shows measured noise levels in terms of Day/Night Average Sound Levels (DNL)<sup>1</sup> and weekday ambient noise levels.<sup>2</sup>

Table 1: Existing Noise Environment

Site	Location	Date/Time	DNL	Weekday Hourly Ambient Noise Levels
L1	Emerson Street Monitor Approx. 30' NE of Emerson St Centerline	23 to 27 September 2016	58-60 dB	46-56 dB
L2	Kellogg Avenue Monitor Approx. 30' NW of Kellogg Ave Centerline		56-62 dB	45-51 dB

### Main Circle Events

On Friday, 23 September 2016, we measured noise levels during the Gator Gathering at Castilleja, an event centered around the main Circle, which contained amplified music. Average noise levels<sup>3</sup> were 72 dB at a distance of approximately 100 feet from the center of the Circle. The loudest noise events were due to groups of people shouting, the DJ talking into the microphone, and louder moments in songs. Typical maximum noise levels<sup>4</sup> were 80 dB from the loudest events at a distance of approximately 100 feet from the center of the Circle.

### Pool Events

On Wednesday, 5 October 2016, we measured noise levels during a varsity water polo game at Castilleja. Measurements were performed approximately 70 feet from the center of the pool. Average noise levels were approximately 69 dB during the game. The loudest individual events included team cheers, referee whistles, coaches shouting, and a buzzer signifying the end of a quarter. Typical maximum noise levels were 81 dB from the loudest events at the noise monitor.

### FUTURE NOISE SOURCES

#### Trucks, Buses, and Loading

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<sup>1</sup> DNL (Day-Night Average Sound Level) – A descriptor for a 24-hour A-weighted average noise level. DNL accounts for the increased acoustical sensitivity of people to noise during the nighttime hours. DNL penalizes sound levels by 10 dB during the hours from 10 PM to 7 AM. For practical purposes, the DNL and CNEL are usually interchangeable. DNL is sometimes written as Ldn.

<sup>2</sup> Hourly ambient levels between 7 am to 10 pm

<sup>3</sup> Leq – The equivalent steady-state sound pressure level that, in a stated period of time, contains the same acoustic energy as the time-varying sound level. It is the energy average sound level over a period of time.

<sup>4</sup> L<sub>max30</sub> (Typical Maximum Sound Level) – There is no standardized metric to quantify “typical” maximum sound levels in the noise environment (as opposed to the absolute maximum sound level for a measurement period). The metric L<sub>max30</sub> comes from a paper by Rob Greene (“Max Level Intrusive Noise Limit: 1982 National Conference on Environmental and Occupational Noise”). It is based on the logarithmic average of the noisiest 30 percent of single events.

In separate noise studies performed in the past<sup>5</sup>, noise levels were found to be approximately 82 dB at a distance of 25 feet when large trucks were passing and between 47-58 dB<sup>6</sup> at a distance of 300 feet during loading activity. We have assumed future truck, bus, and loading activity will be of similar noise levels.

**Amplified Sound**

The pool is expected to include amplified sound to signal the start of races, end of water polo periods, announcements, etc.

**ANALYSIS**

Based on the noise measurements above, the daytime Municipal Code limit, which is relative to the surrounding ambient noise levels, range between 52 and 62 dB on Emerson Street, and between 51 and 57 dB on Kellogg Avenue. Since water polo and swim meet activity will typically occur between 3 pm and 6 pm, the Municipal Code limits for these activities can be refined to these particular hours, which based on our measurement data range between 53 and 59 dB on Emerson Street, and between 52 and 55 dB on Kellogg Street.

**Pool and Main Circle Events**

Table 2, below, shows projected average and maximum noise levels at adjacent residential properties with the existing campus. Locations of adjacent residential properties are shown in Figure 1, attached. Estimates are based upon the measurements above and the site layout.<sup>7</sup>

Table 2: Estimated received noise levels at adjacent residential properties (existing)

Receiver	Location	Main Circle Gathering (average)	Main Circle Gathering (loudest sounds)	Water Polo Game (average)	Water Polo Game (loudest sounds)
A	1215 Emerson St	43 dB	51 dB	Under 40 dB	49 dB
B	1260 Emerson St	43 dB	51 dB	Under 40 dB	50 dB
C	1300 Emerson St	46 dB	54 dB	42 dB	54 dB
D	1326 Emerson St	61 dB	69 dB	59 dB	71 dB
E	1360 Emerson St	48 dB	56 dB	44 dB	54 dB
F	230 Kellogg Ave	46 dB	54 dB	46 dB	58 dB
G	256 Kellogg Ave	47 dB	55 dB	Under 40 dB	48 dB

	Expected to meet Municipal Code Criteria
	May exceed Municipal Code Criteria depending on daily traffic patterns and time of activity
	Exceeds Municipal Code Criteria at all daytime hours

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Table 3 below, shows projected future average and maximum noise levels at adjacent residential properties with the future buildings and site layout from the Master Plan.

<sup>5</sup> Noise studies by Charles M. Salter Associates Inc.  
<sup>6</sup> Typical maximums from activities including closing lift gate, rolling carts, and pallet jacks.  
<sup>7</sup> Municipal Code Criteria limited to 3 pm to 6 pm for Water Polo activity

Table 3: Estimated future received noise levels at adjacent residential properties (Master Plan)

Receiver	Location	Main Circle Gathering (average)	Main Circle Gathering (loudest sounds)	Water Polo Game (average)	Water Polo Game (loudest sounds)
A	1215 Emerson St	42 dB	50 dB	42 dB	50 dB
B	1260 Emerson St	43 dB	51 dB	46 dB	54 dB
C	1300 Emerson St	57 dB	65 dB	47 dB	59 dB
D	1326 Emerson St	58 dB	66 dB	47 dB	55 dB
E	1360 Emerson St	44 dB	52 dB	41 dB	52 dB
F	230 Kellogg Ave	46 dB	54 dB	Under 40 dB	46 dB
G	256 Kellogg Ave	47 dB	55 dB	Under 40 dB	44 dB

	Expected to meet Municipal Code Criteria
	May exceed Municipal Code Criteria depending on daily traffic patterns and time of activity
	Exceeds Municipal Code Criteria at all daytime hours

As shown in Table 3, average future noise levels meet the Palo Alto Noise Ordinance at all examined receivers, with the exception of noise from Main Circle gatherings at Receivers C and D. At Receivers C and D, depending on the daily traffic patterns and time of day of the activity, the Noise Ordinance limits may be exceeded. At Receivers C and D, noise levels may be further decreased by incorporating a combination of the following:

- A solid gate at the school entrance, blocking line of sight from the Main Circle to Receiver D.<sup>8</sup>
- Aiming speakers during events towards buildings, rather than in the direction of Receiver D.
- Increasing the height of the solid wall around the pool to a minimum height of 10 feet in the location shown below:



Figure A: Location where an increased barrier height may lower Main Circle event noise at Receiver C (Shown in Red)

At some of the nearest residences, future instantaneous maximum noise levels for the very loudest events may exceed 6 dB above the ambient (Palo Alto Noise Ordinance limit) during some hours.

- For Main Circle events, these maximum noise levels are expected to be quieter than the existing levels for all neighbors examined, with the exception of Receiver C.
- For pool activity, noise levels from the loudest events may exceed the Palo Alto Noise Ordinance depending on the daily traffic levels at Receivers B, C, and D. At Receivers B and C,

<sup>8</sup> In order to act as an effective noise barrier, the gate should have no cracks or gaps, extend fully to the ground, have a minimum surface density of 3 psf, and be at least 8 feet tall.

the noise levels are expected to be 4-5 dB louder than existing levels. At Receiver D, noise levels are expected to be quieter than existing levels.

Please note that Table 3 does not include contributions from amplified sound during pool events. Speakers should be directed towards the crowd/athletes and away from neighbors, if feasible. Noise levels should be adjusted to meet the Municipal Code limits defined above.

**Trucks, Buses, and Loading**

Table 4, below, shows estimated noise levels from trucks and buses while driving in the Main Circle and loading in the loading area.

Table 4: Estimated future noise levels from trucks at adjacent neighbors

Receiver	Location	Trucks Driving in Main Circle	Loading (gate open)
A	1215 Emerson St	Under 40 dB	Under 40 dB to 43 dB
B	1260 Emerson St		Under 40 dB to 45 dB
C	1300 Emerson St		Under 40 dB to 48 dB
D	1326 Emerson St		47 dB to 58 dB
E	1360 Emerson St		Under 40 dB to 45 dB
F	230 Kellogg Ave		Under 40 dB to 43 dB
G	256 Kellogg Ave		Under 40 dB to 41 dB

	May exceed Municipal Code Criteria depending on daily traffic patterns and time of activity
	Exceeds Municipal Code Criteria at all daytime hours

At all the examined adjacent residences, estimated noise levels from trucks and buses driving inside the Main Circle is expected to meet the Municipal Code criteria. At locations along Emerson Street with line-of-sight to the Main Circle, the Municipal Code criteria may be exceeded, depending on ambient noise levels at the particular time of day, for loading activity if the gate is open.

\* \* \*

This concludes our noise measurement summary and analysis for the Castilleja Master Plan. Should you have any questions, please give us a call.

Sincerely,

Philip N. Sanders, LEED AP  
Senior Vice President

Greg R. Enenstein  
Senior Consultant

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**CASTILLEJA MASTER PLAN  
APPROX. NOISE MEASUREMENT LOCATIONS**

**FIGURE 1**

Salter #  
16-0590

GRE  
11.23.16