April 27, 2017

Alexandra Shifflett
KGD Architecture
1300 Wilson Boulevard, Suite 250
Rosslyn, VA 22209

Re: Elizabeth Square
Site Exterior Sound Level Report
C&A #22667

Dear Alexandra,

This memo contains the results of a 24-hour measurement and acoustic model of the Elizabeth Square project on Fenwick Lane in Silver Spring, Maryland.

1.0 EXECUTIVE SUMMARY

Elizabeth Square is a development between Fenwick Lane and Apple Avenue in Silver Spring, Maryland currently under design. The development includes the following proposed properties within its scope:

- Elizabeth House III, senior living
- Elizabeth House IV, residential and commercial space
- Alexander House, residential and commercial to remain
- Recreation and Aquatic Center
- Central plaza

Montgomery County sets exterior ambient noise conditions to be met for residential buildings in the Noise Ordinance and County Guidelines. Guidelines for buildings in high noise environments are described in the document "Staff Guidelines for the Consideration of Transportation Noise Impacts in Land Use Planning and Development" from the Montgomery County Planning Board, dated June, 1983. Maximum exterior noise levels are dependent on the location of the building (see Figure 01).

The County requires that residential buildings located between the boundary highlighted in magenta in Figure 01 and Washington, DC have a Day-Night Average Sound Level (L_{DN}) not to exceed 65 dBA when measured outdoors at the property line. In order for a residential building to be granted a permit in a location where the L_{DN} exceeds 65 dBA, the County must issue a waiver. To earn the waiver, the County requires a certification that the building has acoustic mitigation such that the L_{DN} measured inside of a residential unit does not exceed 45 dBA. Comments on mitigation are addressed in Section 5.0 of this report.
A 24-hour measurement was conducted at the planned site for Elizabeth House III, which is the property closest to the nearby rail lines, to evaluate the $L_{DN}$ of the property. The outside ambient $L_{DN}$ level was 75 dBA, which exceeds the maximum level as described above. Therefore, in order to be granted a permit, the project requires acoustic mitigation with the goal of achieving an interior $L_{DN}$ of 45 dBA. These findings were used to construct an acoustic computer model in order to evaluate the overall noise at the site.

See Appendix A for definitions of terms and calculations used throughout this memo.
Fenwick Professional Park. **Figure 03** shows this location relative to the new construction site plan. Weather during this period was clear without heavy rain. Metro and MARC trains were operating on normal schedules.

The microphone was located about 5 feet from the side of the building and 12 to 15 feet from the fence between the rail lines and the Fenwick lot. It was about 15 feet above the ground (see **Figure 04**).
The WMATA Metro Rail lines and other rail lines were on the other side of the fence from the microphone. In total, there are 5 train tracks in this rail right-of-way. The middle 3 tracks serve the WMATA Metro, the 2 tracks on the outside serve freight trains and commuter trains. The nearest track is 30 to 40 feet from the fence and below the grade level of the site.

2.3 Method
Average sound levels were logged for each hour over the 24 hours between 11AM on December 29 to 11AM on December 30. A 10 dB penalty was applied to measurements made between 10 PM and 7 AM per the definition of the Day-Night Average sound level. The hourly $L_{eq}$’s in A-Weighted sound levels were then used to calculate the $L_{DN}$ for the property. This data was used to calibrate an acoustic model to calculate the expected $L_{DN}$ across the property.
3.0 RESULTS

3.1 Measurement Result

The $L_{A_{EQ}}$ levels measured for each hour are shown in Figure 05. Once the appropriate hours are penalized, these levels correspond to an $L_{DN}$ of 75 dBA. This exceeds the Montgomery County maximum allowable level for residential buildings without a waiver. See Appendix B for a tabulated version of these results.

![Figure 05: 24 Hour Measured Noise Levels December 29-30, 2015](image)

Sound levels were primarily generated by passing trains. Metro Rail trains were the most common, and their rate varied based on the time of day. WMATA headways are 5 minutes during peak commuting hours and 12 to 15 minutes during mid-day and evening operation. MARC commuter trains also make use of the right-of-way, though their rate is lower than that of the Metro Rail and were most active during rush hour times.

Freight trains were less common than Metro Rail trains, but are likely the controlling factor for measured levels at 11 AM on December 29 and 5 AM on December 30. The rate of passing freight trains in general cannot be determined as schedules vary and are held as propriety by the operating companies.

3.2 Acoustic Model

To construct the acoustic computer model, the railways were treated as five distinct line sources and sound levels were mapped across the proposed site plan with building heights as established in the April 7, 2017 Entitlement Backgrounds. Sound levels were calibrated to the measured levels on the site. We have plotted the resulting noise contours 5 feet above grade in Appendix C.
The contours in Appendix C show that the west façade of Elizabeth House III is most impacted by the train noise. Additionally, the model shows that "shadowing" of sound from the three buildings in Elizabeth Square will result in exterior noise levels at 65 dBA in the outdoor plaza area and parking drop offs.

A markup of the West Elevation of Elizabeth House III is provided in Figure 06. The East Elevation of Elizabeth House III and IV and the Recreation Center is shown in Figure 07. Figure 06 shows that we expect the majority of the west façade will be impacted by sound levels between 70 and 74 dB L\text{DN}.

![Figure 06: West Elevation, Noise Contour Markup](image-url)
Figure 07 shows that we expect that most of the north façade will be impacted by sound levels below 70 dBA L_{DN}.

Appendix C shows plan views of the ground level and rooftop amenities spaces at Elizabeth House III and IV with contours plotted at 5 feet above the elevations of each space.

The contours show that the Elizabeth House IV amenity spaces will be below 65 dBA L_{DN}. Elizabeth House III will be somewhat louder. The contours show that the Elizabeth House III façade and parapet facing the train tracks provide shadowing such that exterior noise will be between 60 and 65 dBA L_{DN} for approximately 75% of the amenity space area. When people are seated, they will be lower than 5 feet above the rooftop and closer to the height of the parapet. This will result in more shadowing and nearly all of the amenity space will be at or below 65 dBA at seated height.
4.0 FUTURE SOUND CONDITIONS

4.1 Purple Line

The Elizabeth Square site is located near the future site of the MTA Purple Line light rail transit system. This is likely to be the most significant addition to transit in the area in the next 20 years. Elizabeth Square is about 150 feet from the nearest proposed location for the Purple Line. The Purple Line will be further from the site than the CSX, Commuter, or WMATA Metro lines. Figure 08 shows an inset of the Elizabeth Square site relative to the Proposed Purple Line Tracks from the Purple Line Conceptual Engineering Plan, Sheet CV-19, from the State of Maryland.

The State of Maryland released the final version of an extensive Environmental Impact Study (FEIS) in August, 2013. Noise was one of the impacts studied for the FEIS (Volume III, Technical Report: Noise). One of the locations studied for noise impact was North Falkland Lane, labeled M-22 in Figure 08. North Falkland Lane is southwest of the Elizabeth Square site, on the south side of the railroad right-of-way. The study found that the addition of the Purple Line would not have an impact on the existing noise environment in terms of A-Weighted L_{DN}.

![Figure 08: Elizabeth Square Site Relative to Measurement Sites for the Purple Line Environmental Impact Study (North Falkland Lane is Marked M-22)](image)

Due to the proximity of Elizabeth Square with the site studied for the Purple Line, we conclude that the Purple Line will not increase the L_{DN} from the levels reported here at Elizabeth Square.

4.2 Automobile Traffic

Elizabeth Square is located between 650 and 700 feet from 16th Street, which is west of the railroads considered throughout this report. 16th Street is the most traveled road near the site (AADT of 39,101 in 2014), according to the Maryland Highway Administration. 2nd Avenue is about 250 feet from the northeast property line of the site and is traveled about 84% less than 16th Street (AADT of 6,272 in 2014). Data is from...
the report “Annual Average Daily Traffic (AADT) 2008-2014 by County and Route” available from the Maryland State High Administration.

We expect that automobile traffic will have the following impacts on the residential buildings at the site:

**Elizabeth House III**
- Elizabeth House III will be shielded from sound from 2nd Avenue by Alexander House and Elizabeth House IV
- 16th Street is far from the site and sound will be controlled by train activity to the west of the site
- Elizabeth House III will be shielded from sound from 16th Street by existing buildings.

**Elizabeth House IV**
- Elizabeth House IV will be shielded from noise from 16th Street by existing buildings and will be
- Elizabeth House IV is to replace the existing Elizabeth House building on 2nd Avenue. The façade of Elizabeth House IV will be designed to match or exceed the sound isolation provided at the current building. As a result, we expect that interior sound levels at Elizabeth House IV will be equal to or lower than at the existing Elizabeth House building.

In general, we do not expect automobile traffic to significantly impact the buildings at Elizabeth Square, especially in comparison to the noise due to train activity.

### 4.3 Future Sound - Acoustic Model
We conclude that the projected sound level at the site 20 years from now will not be significantly different from our measured level, based on the following:

- We cannot conclude that WMATA, Commuter Rail, or Private Rail usage of the right-of-way will increase significantly over the next 20 years.
- The FEIS for the Purple Line released by the State of Maryland concluded that the Purple Line would not increase the overall environmental sound level of the area around Elizabeth Square.
- Automobile traffic volume near Elizabeth Square is low and residential buildings are currently present on Second Avenue

With these conclusions, the contours provided in Appendix C are representative of the 20-year sound levels at the site.

### 5.0 MITIGATION

#### 5.1 Interior Mitigation
Sound intrusion from the exterior to the interior of Elizabeth House III and IV will be controlled by the exterior windows of dwelling units. For interior sound within these units to meet the 45 dBA $L_{10N}$ requirement, treatments to the building façade, such as upgraded sound-rated exterior glazing, will be necessary.

#### 5.2 Exterior Mitigation
The model shows that the expected sound levels at the plaza and rooftop amenity spaces will be at or below 65 dBA $L_{10N}$ and no mitigation is required for the exterior locations.
6.0 LIMITATIONS OF MODEL

We note that the acoustic model was assembled based on site drawings available in the project Entitlement Backgrounds provided on April 7, 2017 and the models of the site provided by KGD Architecture on April 18, 2017. Any changes to the landscape or buildings could affect the results of the acoustic model and the model would have to be reanalyzed.

This concludes our comments at this time. We welcome further involvement in the process where requested.

Very truly yours,

Cerami & Associates, Inc.

Jameson Dickman, LEED Green Associate
Associate

cc: Tom Donaghy / KGD Architecture
Robby Deem / Cerami & Associates
Geoffrey Sparks / Cerami & Associates
Appendix A: Definition of Terms

1. **Decibel (dB)**
   Humans perceive changes in sound pressure on a roughly logarithmic scale. As a result, sound pressure is often measured in decibels. A decibel is a logarithm of the ratio of two numbers. Decibels with reference to pressure are calculated using Equation 1, where $P$ is a measured pressure and $P_0$ is a reference pressure.

   $$ dB = 20 \times \log \left( \frac{P}{P_0} \right) \quad (Eq. 1) $$

   The standard unit for sound pressure level is a decibel referenced to atmospheric pressure at sea level ($P_0 = 20 \mu Pa$). Decibels with this unit are often called dB SPL or dB re 20 µPa. 0 dB re 20 µPa corresponds to the threshold of hearing at 1 kHz.

2. **Decibel Addition**
   The sound pressure of multiple sound sources near each other are summed logarithmically. For $n$ sources, where source 1 has level $X_1$, dB re 20 µPa and source $n$ has level $X_n$, dB re 20 µPa, the resulting sound level from all sources is calculated with Equation 2.

   $$ Total\ Sound\ Level\ dB\ re\ 20\mu Pa = 10 \times \log \left( \sum_{i=1}^{n} 10 \times \frac{X_i}{10} \right) \quad (Eq. 2) $$

   This has the result that two sources of the same sound level sum to produce an overall level that is 3 dB higher.

3. **A-Weighting**
   A human’s experience of loudness is dependent on the frequency of the sound being heard. This phenomenon is well studied and widely understood. To reflect the frequency dependency of human hearing on overall loudness, certain weighting curves have been developed. These weighting curves are applied to sound pressure levels in order to compute a single number representing loudness. A-Weighting is most commonly used with regards to public health. The A-Weighting curve for third octave bands is shown in Table A.

<table>
<thead>
<tr>
<th>Frequency (Hz)</th>
<th>A-Weighting Values</th>
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<tbody>
<tr>
<td>12.5Hz</td>
<td>16Hz</td>
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<tr>
<td>-63.4</td>
<td>-56.7</td>
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<tr>
<td>80Hz</td>
<td>100Hz</td>
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<tr>
<td>-8.5</td>
<td>-9.1</td>
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<td>500Hz</td>
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<td>5kHz</td>
<td>6.3kHz</td>
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<tr>
<td>0.5</td>
<td>-0.1</td>
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Table A: A-Weighting Values
To calculate an A-Weighted sound power level, or dBA, each weighting value is applied to each third octave band of a measured sound level. The resulting sound pressure levels at each third octave band are then summed using Equation 2.

4. $L_{EQ}$

$L_{EQ}$ is a metric that describes the continuous average sound level over a given time period. If sound pressure, $p(t)$, is measured continuously over a time interval (0 to $T$), the $L_{EQ}$ of the measurement is computed with Equation 3, where $p_0$ is 20 $\mu$Pa.

$$L_{EQ} = 10 \cdot \log \left( \frac{1}{T} \int_0^T \frac{p^2(t)}{p_0^2} dt \right) \quad (Eq. \ 3)$$

5. Day-Night Level ($L_{DN}$ or DNL)

The Day-Night Sound Level metric is a measurement standard defined by the Federal Aviation Administration. The Day-Night Level of a location is calculated with a modified version of Equation 2. First, the 1 hour $L_{EQ}$'s for a 24 hour period are measured. Next, a 10 dB penalty is added to each measurement between 10 PM and 7 AM. This is meant to represent people's heightened sensitivity to sound during nighttime. Finally, these weighted levels are then used in Equation 2 to calculate the $L_{DN}$ for the day.
Appendix B: Measurement Results

**Table B: Hourly Measured LA_{EQ}'s for L_{DN} Calculation**

<table>
<thead>
<tr>
<th>Start date</th>
<th>Period Start Hour</th>
<th>LA_{EQ}</th>
<th>Nighttime L_{DN} Correction</th>
<th>Corrected LA_{EQ}</th>
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<td>10:00 AM</td>
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</tbody>
</table>

L_{DN} = 75
Sound Pressure Level (DNL, dBA) 5 feet above Ground Level

- < 49 dBA
- 49 - 54 dBA
- 55 - 59 dBA
- 60 - 64 dBA
- 65 - 69 dBA
- 70 - 74 dBA
- 75 - 79 dBA
- 80 - 85 dBA
- > 85 dBA

Elizabeth Square, Appendix C

Building at Elevation of Model

Outdoor amenity area, above ground

EXISTING BUILDING 6 STORY

EXISTING BUILDING 4-5 STORY

Elizabeth House IV

Second Avenue

First Avenue

Fenwick Lane

Rec & Aquatic Center

Capital Crescent Commuter Trail