

27 December 2017

Anne Beierle  
City of Golden  
1445 10<sup>th</sup> Street  
Golden, CO 80401

Subject: Post Construction Noise Measurement Results  
Project: US 6/19<sup>th</sup> Street Interchange

Dear Anne:

This letter presents the results of the noise measurements we made in the project study area between 18 October 2017 and 20 October 2017. The purpose of the measurements was to document the existing noise levels with the newly constructed interchange and compare them with the predicted traffic noise levels from the project's 2015 Environmental Noise Study as well as the 2014 measurements that were made for the study.

#### **I. 2017 Noise Measurements**

One long-term (39 hour duration) and six short-term (15-30 minute duration) noise measurements were made at receptor locations throughout the project study area. The measurements were made with a Larson Davis Model 820 precision integrating sound level meter conforming to American National Standards Institute (ANSI S1.4) Type 1. Figure 1 shows the 2017 measurement locations as well as the 2015 Study's noise model receiver.

The long-term measurement (Location 10) was made on a tree near the US Highway 6 right of way fence just east of Parfet Estates Drive. The monitor was positioned approximately 12 feet above ground with a partial view of the highway. This is the same location used in the 2015 Study.

For each short-term measurement, the sound level meter was mounted on a tripod with the microphone positioned approximately 5 feet above ground at the following locations which are the same as the ones from the 2015 Study. The location ID from the 2015 Study is in parenthesis:

- 1858 Parfet Estates Drive, backyard and upper deck (NW 12)
- School of Mines outside fraternity house (NE 7)
- Front yard of 1819 Parfet Estates Drive (NW 2)
- On top of overpass at the picnic area (LID 1)
- 1831 Parfet Estates Drive front yard (NW 6)

Figure 1: Noise Measurement and Modeling Locations

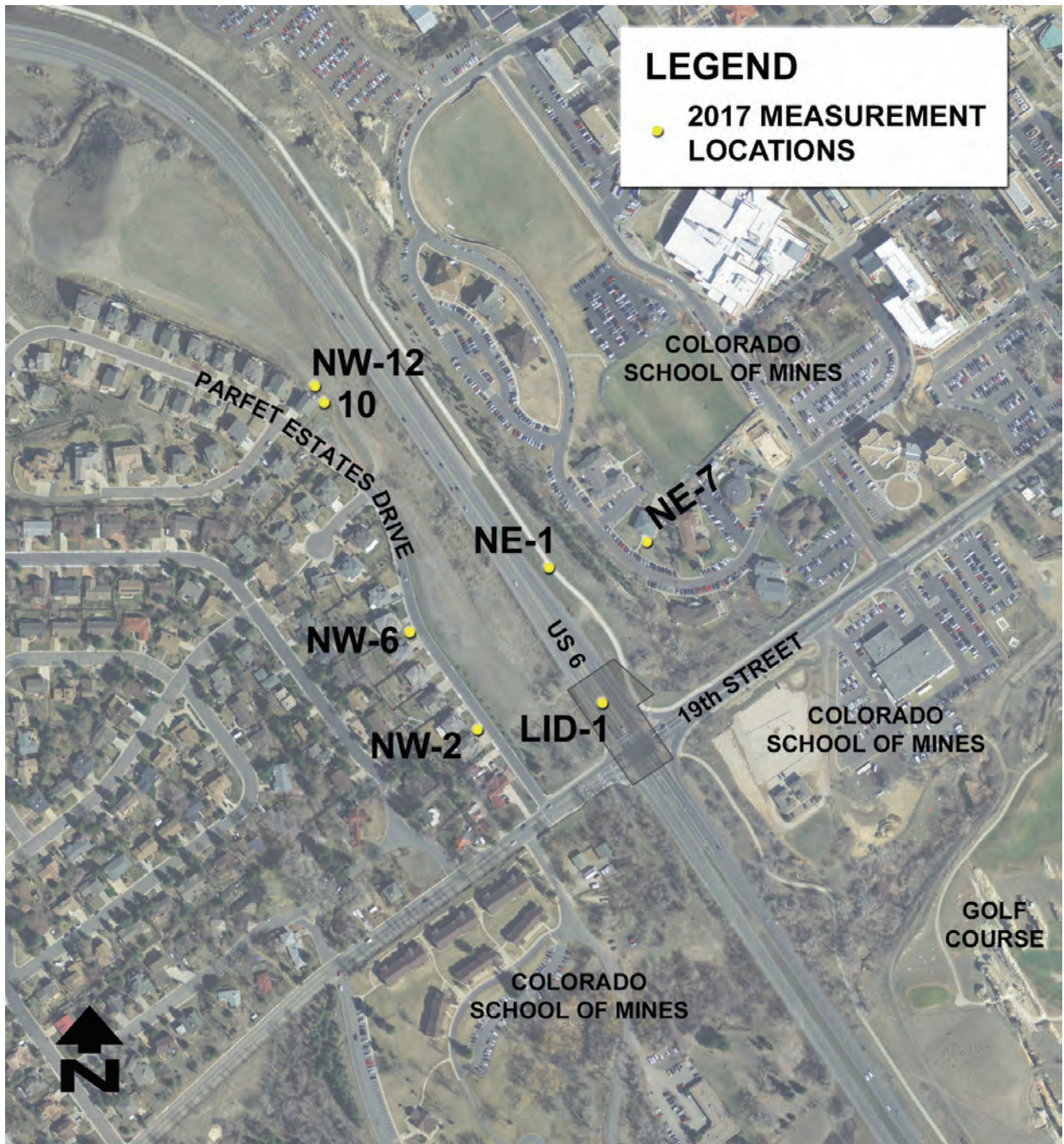
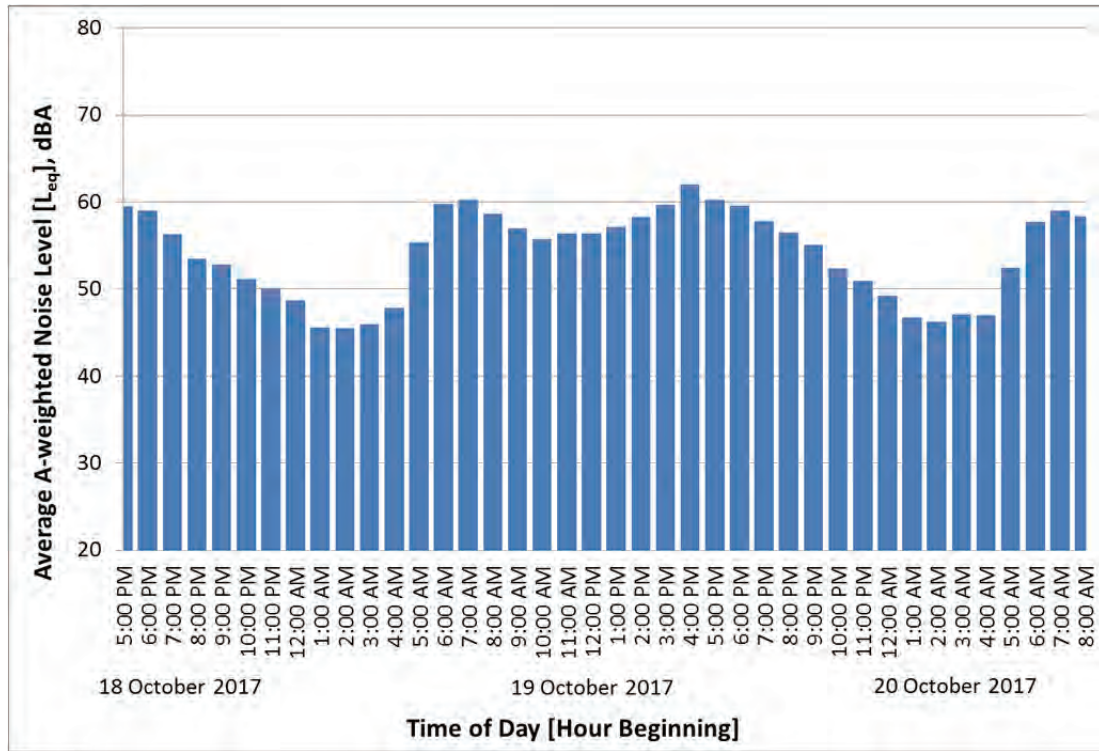




Figure 2 shows the long-term measurement results at long term monitoring location 10. Each bar represents the hourly  $L_{eq}$  during the stated time. Table 1 presents the short term measurements results. The peak-hour  $L_{eq}$  in Table 1 is based on a correlation of the short term measurement result with the simultaneous noise measurement at the long-term monitor location.

**Figure 2: 2017 Average Hourly Noise Levels – Long Term Monitor (Location 10)**



**Table 1: Short-term Noise Measurement Results – 19 October 2017**

Location		Time	Sound Level in dBA	
			$L_{eq}$	Leq (peak-hr.)
NW12	upper deck	11:30 – 11:45 AM	65.5	69.0
	backyard	11:30 – 11:45 AM	55.0	58.5
NE7		2:23 – 2:38 PM	50.0	51.6
NW2		3:30 – 3:45 PM	53.1	53.3
LID1		4:00 – 4:15 PM	56.6	56.6
NW6		4:30 – 5:00 PM	51.7	51.7

## II. Comparison of Noise Measurements and Noise Modeling

In order to understand the effect of the new interchange on noise levels in the vicinity of the project, we compare the noise levels measured in 2017 with the measurements that were made for the 2015 noise study. We also compare the 2017 measurements and those predicted in the 2015 report using FHWA’s Traffic Noise Model (TNM) and noise modeling program, SoundPLAN.

### a. Long-term Noise Monitoring Location

Figure 3 shows a comparison of the hourly  $L_{eq}$  between 2014 and 2017 at the long-term monitor location. In general, the hourly noise levels in 2017 (blue) are slightly less than the levels measured in 2014. There are some instances, around 5 am and 4 pm where the 2017 noise level was slightly higher than what was measured in 2014. As there are a number of variables that affected both measurements, it is difficult to ascertain whether the difference is solely due to the effect of the interchange or whether traffic patterns may also have had some effect (e.g. construction on roadway, traffic volumes).

**Figure 3: Comparison of Long-term Measurements at Monitor Location**

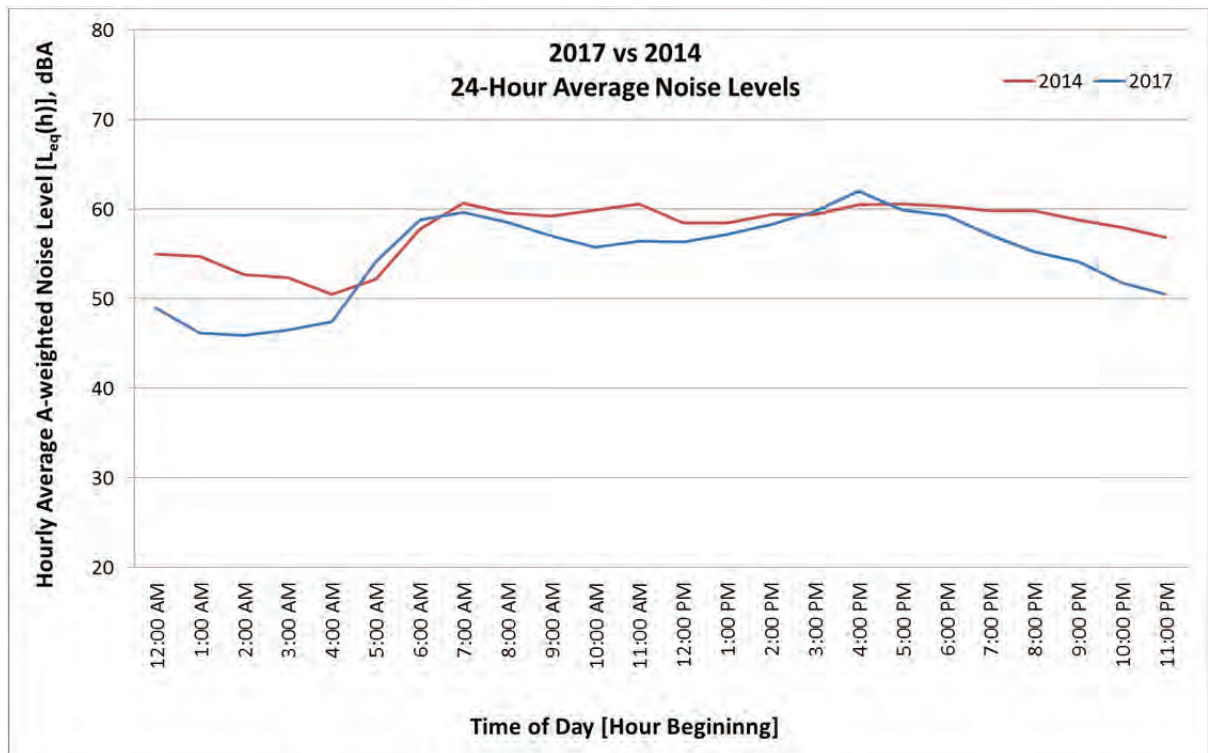


Table 2 uses the long term data from 2017 and 2014 to compute the day/night average sound level ( $L_{dn}$ ) and the hourly average sound level ( $L_{eq}$ ) during the noisiest hour of the day. A comparison shows that the average daily noise level ( $L_{dn}$ ) was 2.3 dBA less yet the  $L_{eq}$  during the peak hour was 1.4 dBA greater than in 2014.

**Table 2: Comparison of Long-term Measurements ( $L_{dn}$  and  $L_{eq}$ )**

Descriptor	Sound Level in dBA		
	2014	2017	Difference
$L_{dn}$	62.6	60.3	-2.3
$L_{eq}$ (peak-hr.)	60.6	62.0 (60.7*)	+1.4 (+0.1*)

\*excludes engine braking

The peak hour  $L_{eq}$  in the 2017, which occurred at 4 p.m. on October 19<sup>th</sup>, includes noise from a single loud truck using engine braking (Jake brake). The noise from the Jake brake significantly influenced the measured noise levels. The peak hour  $L_{eq}$  without the noise from the Jake brake is 60.7 dBA and when compared with the 2014 measurements results in a difference of only 0.1 dBA in the peak hour  $L_{eq}$  between 2014 and 2017.

**b. Receiver locations: 2017 measurements vs. 2014 Measurements**

Two locations measured in 2017 were also measured in 2014 as part of the 2015 Study. Table 3 shows that the noise levels at both locations have decreased after the construction of the new interchange. In particular, the noise level at the fraternity (NE7) decreased by 2.5 dB whereas the noise level in front of 1831 Parfet Estates Drive (NW6) decreased by 6.5 dBA.

**Table 3: Comparison of 2017 and 2014 Measurements**

Location		$L_{eq}$ (peak-hour) in dBA		
		Measured 2014	Measured 2017	Difference
NE7	Fraternity on W. Campus Rd., Front Yard	54.1	51.6	-2.5
NW6	1831 Parfet Estates Dr., Front Yard	58.2	51.7	-6.5

**c. Receiver locations: 2017 measurements vs. 2015 Study model**

Table 4 compares the 2017 measurement results with the 2015 Study model. In order to do the comparison we needed to make a couple adjustments to account for differences in the model inputs. In particular, we needed to adjust for existing traffic conditions since the model was done for year 2035 and does not account for noise from traffic on Parfet Estate Drive.

The adjustments were as follows: First, in order to compare the 2017 measurements with the modeling results from the 2015 study, we reduced the modeled sound levels for year 2035 by 0.7 dBA to reflect the existing (2017) condition with the interchange. Second, the 2015 model did not include noise from traffic on Parfet Estates Drive so we mathematically removed noise from traffic on Parfet Estates Drive from our 2017 measurement.

**Table 4: Comparison of 2017 Measurements and 2015 Model**

Location		L <sub>eq</sub> (peak-hour) in dBA			
		Modeled 2015*	Measured 2017	Difference	
NE7	Fraternity on W. Campus Rd, Front Yard		55.5	51.6	-3.9
NW6	1831 Parfet Estates Dr., Front Yard		51.5	50.8**	-0.7
NW12	1858 Parfet Estates Dr.	Backyard	58.9	58.5	-0.4
		Upper deck	66.0	69.0	+3.0
LID1	Near picnic bench on overpass		64.4	56.6	-7.8
NW2	1819 Parfet Estates Dr. Front Yard		54.3	52.0**	-2.3

\*2035 model adjusted to reflect existing traffic conditions

\*\*excludes noise from traffic on Parfet Estates Drive

Table 4 shows that all but one of the locations had measured noise levels that were less than what was predicted by the 2015 model when adjusted for existing traffic. At all locations on Parfet Estates Drive, the measured noise levels were within 3 dBA of the noise model and in some cases, within 1 dBA.

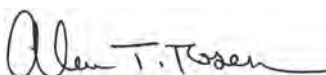
The noise level on the overpass (LID1) was 7.8 dBA less than the model but we suspect that this is due to the final design of the overpass which includes an elevated earthen berm adjacent to the north side of the overpass. The berm may be providing additional noise reduction that was not included in the original noise model.

The only location showing a measured noise level that is higher than what was modeled is the upper deck of NW12. We suspect that the computer model for this location is very sensitive to terrain (shielding of roadway) and therefore, any slight change in topography that was not accounted for in the model could have a significant effect on the results. In addition, the proximity of the existing residence to the measurement location includes acoustical reflections from the building walls that may not be fully accounted for in the noise model.

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This concludes the summary of our measurement results. Please do not hesitate to call if you have any questions.

Sincerely,



Alan Rosen  
 Principal  
 RGD Acoustics, Inc.

