

TECHNICAL MEMORANDUM

VAIL NOISE MEASUREMENTS 2007

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PROJECT: Town of Vail Noise Measurements 2007
DATE: June 22, 2007

Noise measurements were conducted along Interstate 70 in Vail for one week in April-May 2007. The purpose of the measurements was to a) provide a comparison to measurements conducted in 2004, and b) to see if construction work on I-70 west of Vail was having any measurable impact on I-70 traffic noise in Vail. Noise levels were measured at the same four locations in 2007 that were used in 2004. The measurement equipment used in both surveys was the same or similar, and the same measurement procedures were followed. Finally, the same data reduction procedures were followed, including the analysis of traffic conditions.

Noise Measurement Locations

Noise measurements were conducted at the four locations shown in Figure 1. A description of each measurement site is provided below. Traffic and weather conditions were monitored northeast of Donovan Park. More detailed information regarding the measurement locations can be found in Hankard Environmental's *Results of Noise and Speed Measurements and Analyses* memorandum dated November 18, 2004.

- **M1 (West Vail):** Located on the north side of I-70, west of the West Vail Interchange, and along Chamonix Lane near the Chamonix Chalets Condominiums. This site was selected to represent the West Vail area. The measurement location is 200 feet from the centerline of Westbound I-70, and the view to the highway is unobstructed.
- **M2 (Donovan Park):** Located on the south side of I-70, east of the West Vail Interchange, along Matterhorn Circle. This site was chosen to represent the residents in the area, and Donovan Park. The measurement location is 400 feet from the centerline of Eastbound I-70, and the view to the highway is obstructed somewhat by trees, residences, and the shoulder of Eastbound I-70.
- **M3 (Sandstone Park):** Located on the north side of I-70, west of the Main Vail Interchange, in Sandstone Park. This site was chosen to represent the residences in the area, and Sandstone Park. The measurement location is 300 feet from the centerline of Westbound I-70, and the view to the highway is obstructed somewhat by trees.
- **M4 (East Vail):** Located on the north side of I-70, east of East Vail Interchange, along Fall Line Drive. This site was chosen to represent the East Vail area, and to capture noise from trucks coming down off of Vail Pass. The measurement location is 200 feet from the centerline of Westbound I-70, and the view to the highway is obstructed by a berm to the east.

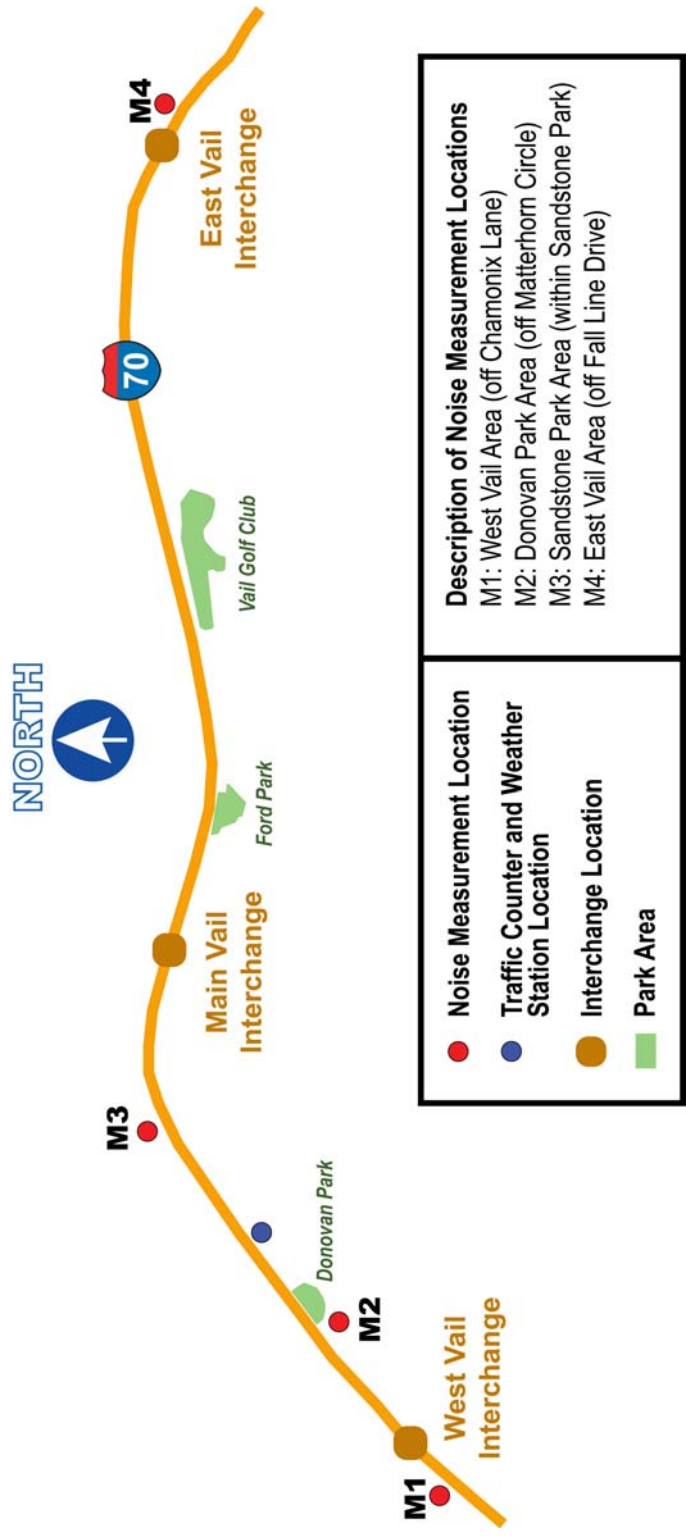


Figure 1: Vail Noise Measurement Sites

Measurement Equipment

A Norsonics Type 114 sound level meter was used at M1, and Larson Davis Model 820 sound level meters were used at M2, M3, and M4. The Larson Davis meters were calibrated by an accredited laboratory within the past one year, and the Norsonics meter was calibrated within the past two years.

Traffic counting was conducted using a Wavetronix SmartSensor Model 105 attached to an instrumentation grade 20-foot tall tripod. This sensor is radar based and monitors the speed and length of each vehicle in up to eight lanes simultaneously.

Weather conditions were monitored using a tripod-mounted system that includes a RM Young wind sensor, a Vaisala relative humidity probe, and a Campbell Scientific CR510 data logger.

Measurement Procedures

All four sound level meters were set to monitor the overall, A-weighted, five-minute, equivalent noise level (L_{eq} , dBA). All microphones were equipped with windscreens and were located five feet above the ground. All sound level meters were time-synchronized with each other. Each sound level meter was field calibrated prior to and re-checked after each measurement. All calibrations were within ± 0.2 dBA.

The traffic counter was setup to monitor traffic along I-70 and traffic along the southern frontage road. Monitoring traffic on the north frontage road was not possible due to the distance limitations of the traffic counter. The traffic counter automatically located each lane of traffic and speed and length adjustments to the program as necessary. The traffic counter was time synchronized with the sound level meters and logging was set at five-minute intervals to match the sound level meters.

The weather station was setup to monitor the wind speed, wind direction, and relative humidity. The station was time synchronized with the sound level meters and set to monitor five-minute averages. The orientation of the weather station was situated using a compass.

Noise measurements were started on April 26, 2007 (Thursday). The traffic and weather stations were setup and started on April 27, 2007 (Friday). All meters were checked on May 1, 2007 (Tuesday) and some equipment was downloaded as needed. All equipment was retrieved on May 4, 2007 (Friday). Post checks of the noise meter calibrations showed no error greater than ± 0.2 dBA (which is acceptable).

Measured Noise Levels

Figures 2 through 5 show the measured noise levels, and Figures 6 and 7 show the measured wind and relative humidity values. Table 1 lists the average noise levels measured in 2007, those measured in 2004, and the difference between the two surveys. These levels have not been adjusted for differences in traffic conditions. The results of that analysis are provided in the following section. For both 2004 and 2007, the noise levels measured when wind speeds were greater than five miles per hour or when the pavement was wet (based on humidity monitoring) were not included in the averages.

TABLE 1

Average Measured Noise Levels for 2004 and 2007 (dBA) – No traffic adjustments

2007	All Data	Loudest Hours (7:30 to 8:30am, 4:30 to 5:30pm)	Daytime (7am to 10pm)	Nighttime (10pm to 7am)
M1	63	66	65	60
M2	59	60	59	57
M3	57	59	58	54
M4	61	63	63	58
2004	All Data	Loudest Hours (7:30 to 8:30am, 4:30 to 5:30pm)	Daytime (7am to 10pm)	Nighttime (10pm to 7am)
M1	66	68	68	63
M2	60	61	61	57
M3	58	61	60	55
M4	61	64	63	58
Change	All Data	Loudest Hours (7:30 to 8:30am, 4:30 to 5:30pm)	Daytime (7am to 10pm)	Nighttime (10pm to 7am)
M1	-3	-2	-3	-3
M2	-1	-1	-2	0
M3	-1	-2	-2	-1
M4	0	-1	0	0

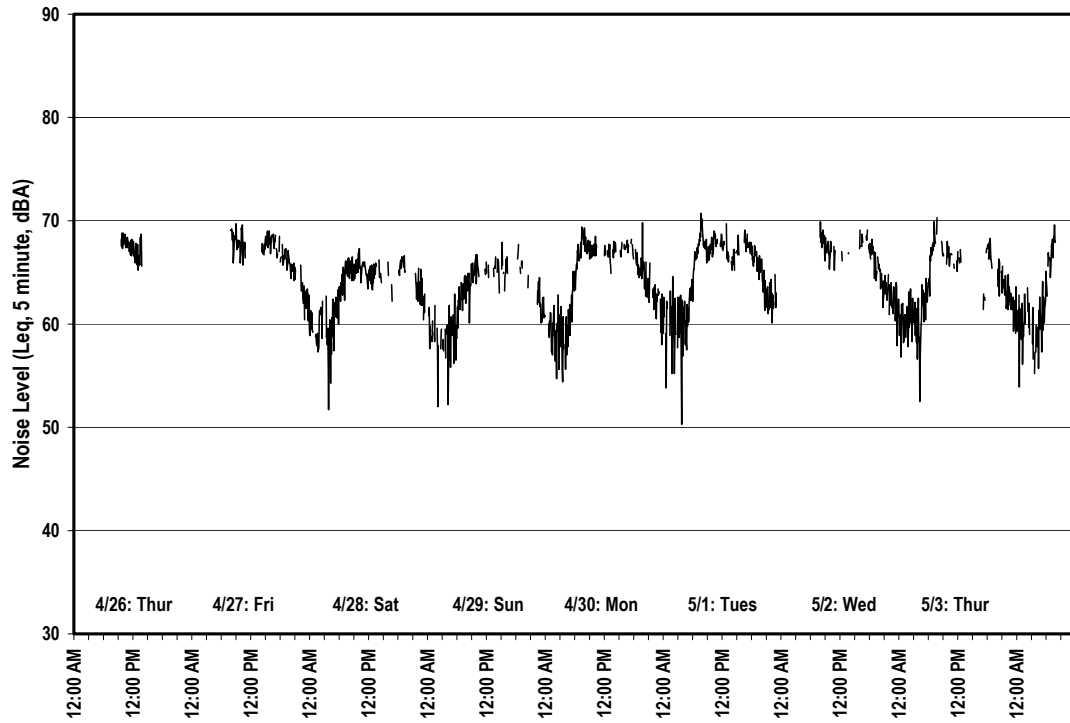


Figure 2: Valid Noise Levels for West Vail Area (M1) in 2007

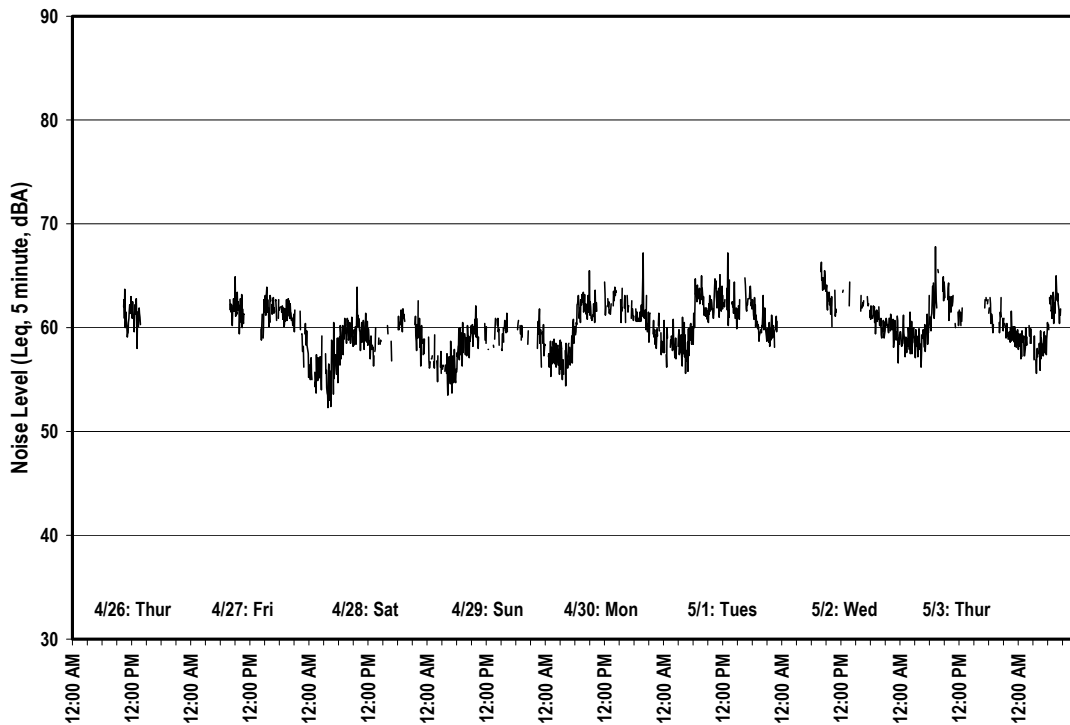


Figure 3: Valid Noise Levels for Donovan Park Area (M2) in 2007

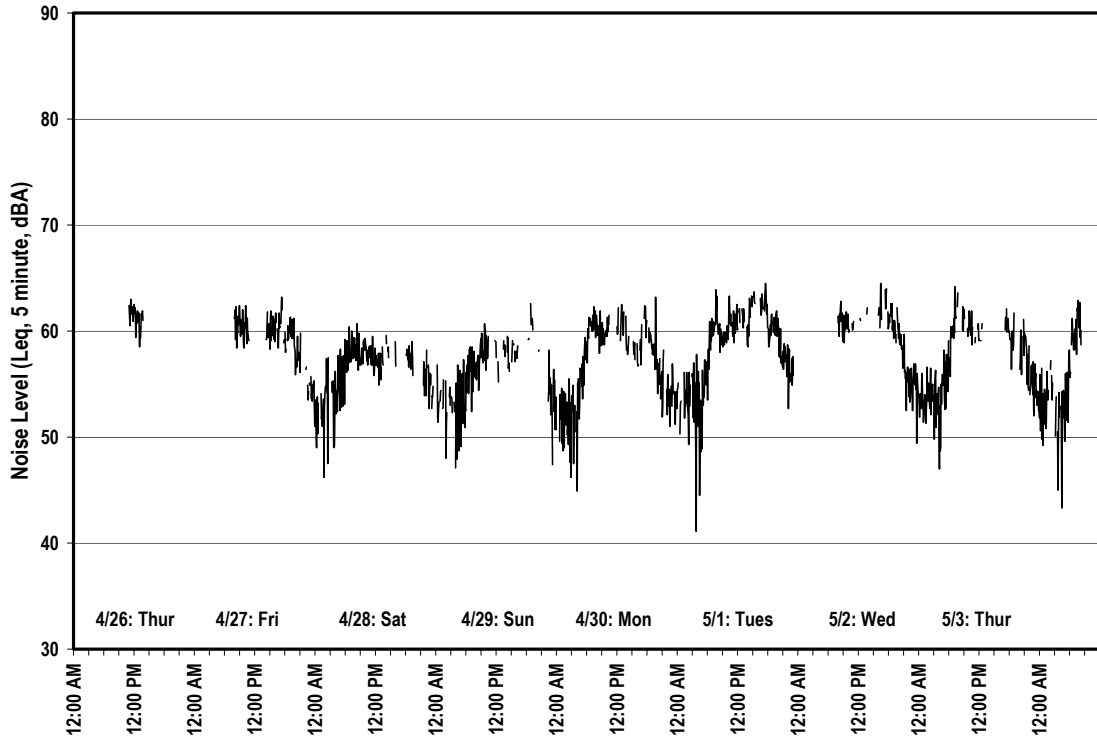


Figure 4: Valid Noise Levels for Sandstone Park Area (M3) in 2007

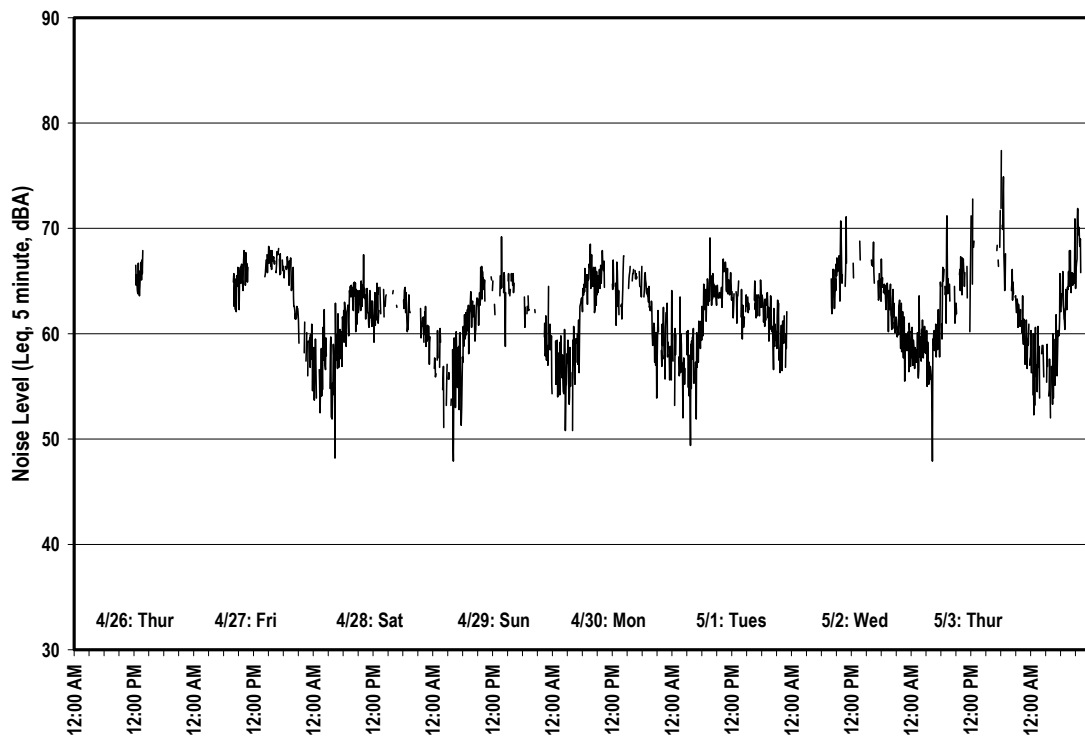


Figure 5: Valid Noise Levels for East Vail Area (M4) in 2007

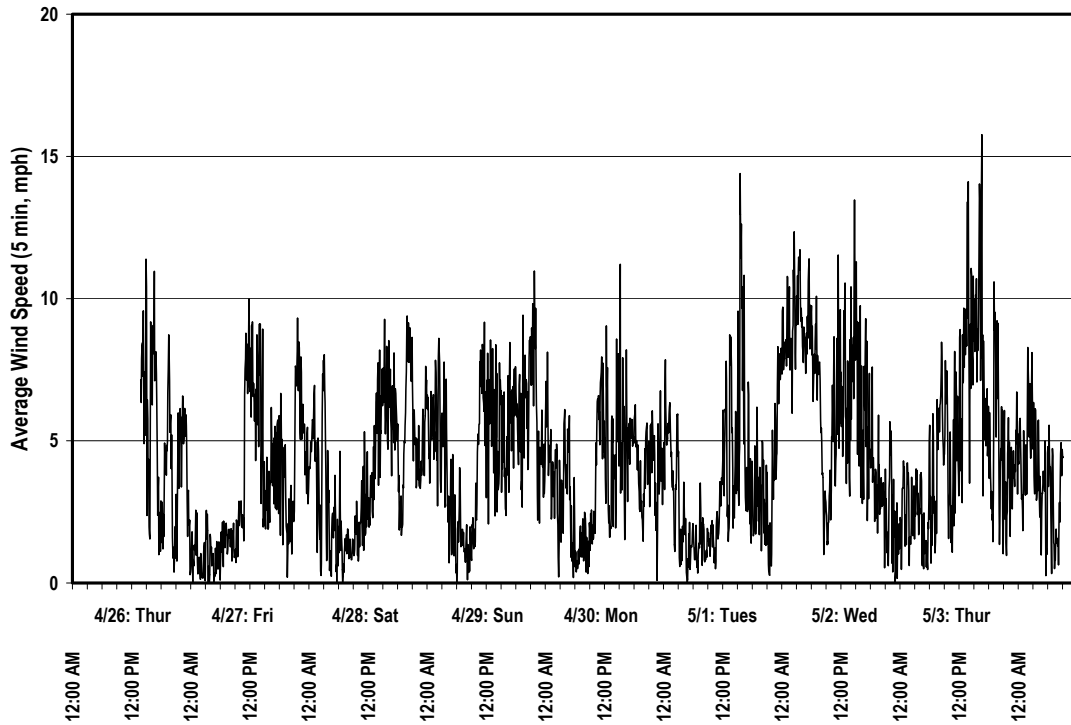


Figure 6: Average Wind Speeds for 2007 Noise Measurements

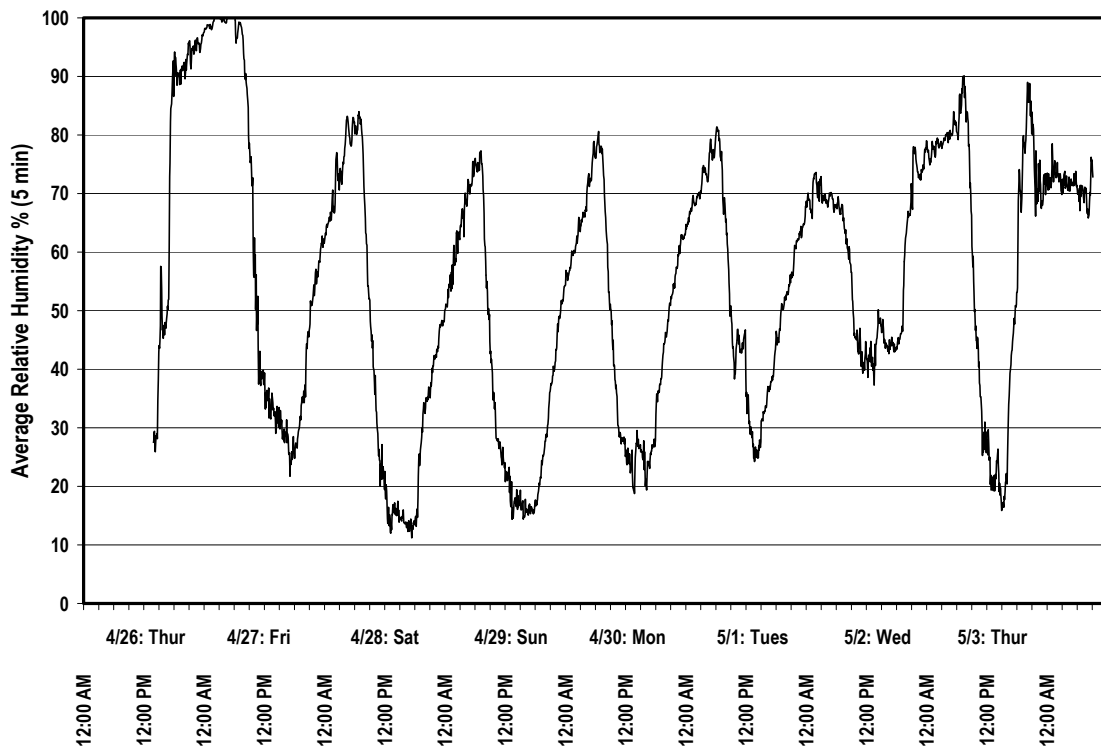


Figure 7: Average Relative Humidity for 2007 Noise Measurements

Accounting For Traffic Conditions

From Table 1, above, the noise levels measured in 2007 were 0 to 3 dBA lower than those measured in 2004. In order to try and determine the cause of this, traffic data was analyzed. The following conclusions can be drawn from the data we have:

- Based on Hankard Environmental's traffic counts, average hourly traffic volumes on I-70 were 1,014 in 2004 and 932 in 2007. This would account for about 0.5 dBA of the measured decrease in noise levels.
- Based on CDOT's permanent traffic counter near West Vail, average hourly vehicle counts during the 2004 survey were 1,296, and during the 2007 survey they were 1,016. This would account for about 1.0 dBA of the measured decrease in noise levels.
- Based on Hankard Environmental's measurements, vehicle speeds decreased from 67 mph to 66 mph for eastbound I-70 between 2004 and 2007, but increased from 65 mph to 69 mph for westbound I-70. A 0.5 dBA increase in noise levels would be expected as a result.

Overall, we feel it is appropriate to add 1 dB to the measured levels in 2007 to account for the lower traffic volumes that occurred during that survey relative to the 2004 survey. We do not recommend making changes to the noise levels based on the speed data, as the accuracy of the radar system we used does not warrant that. Table 2 shows the change in noise levels between 2004 and 2007 when 1 dB is added to the 2007 levels. As can be seen, the levels are quite similar between the two surveys, particularly given the fact that environmental noise levels are known to fluctuate by as much as 5 to 10 dBA from time to time.

TABLE 2

Change in Noise Levels Between 2004 and 2007 (dBA) – Adjusted for traffic volume

	All Data	Loudest Hours (7:30 to 8:30am, 4:30 to 5:30pm)	Daytime (7am to 10pm)	Nighttime (10pm to 7am)
M1	-2	-1	-2	-2
M2	0	0	-1	1
M3	0	-1	-1	0
M4	1	0	1	1