65th Avenue
37th Street to US34 Bypass
Greeley and Evans, Colorado

STU M570-046
Sub Acct #: 20148

Traffic Noise
Technical Report

September 2015

Submitted To:
James Eussen
Colorado Department of Transportation
Region 4
1420 2nd Street
Greeley, CO 80631

Submitted By:
Wilson & Company
1675 Broadway, Suite 200
Denver, CO 80202

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1.0 INTRODUCTION

The Cities of Greeley and Evans Colorado have identified a need for capacity and mobility improvements to 65th Avenue from U.S. (US) Highway 34 south to West 37th Street as Shown in Figure 1. The improvements consist of widening 65th Avenue from US Highway 34 in Greeley to 37th Street in Evans from one through lane in each direction (with several auxiliary lanes and some sidewalks) to two through lanes in each direction plus bike lanes, center turn lane and medians, right turn lanes, and sidewalks on both sides of the road. The approximate length of improvements along 65th Avenue is 5,200 feet. The south 880 linear feet of the project improvements will be in the City of Evans and the remaining 4,320 linear feet of improvements will be in the City of Greeley. The municipal boundary line is approximately 190 feet north of Ashcroft Draw. All of the adjacent, developed parcels have already dedicated right of way for this ultimate improvement to the road.

Figure 1. 65th Avenue Project Area

Landscaped and hardscape medians will be built throughout the project corridor. In the locations without medians, the space will be used for left-turn lanes. Right-turn lanes will be built at northbound Chardonnay Street and southbound 32nd Street Road. The outside southbound lane will terminate as a southbound to westbound right-turn lane at 37th Street. The road will be widened to the east at US 34, but the laneage of the road will remain as it is today and the signal will not be modified.

This Traffic Noise Technical Memorandum describes the results of a noise study conducted along this corridor.

2.0 APPLICABLE NOISE STANDARDS

The 65th Avenue Proposed Action would use state and federal funds and thus is subject to regulations that govern highway traffic noise for Federal-aid and Federal action projects contained in Part 772 of Title 23 of the Code of Federal Regulations (23CFR772). These regulations describe the methods that must be followed in the evaluation and mitigation of highway traffic noise in Federal-aid and Federal action highway projects. The regulations require each state highway agency to prepare and adopt written guidelines specific to that state which must demonstrate compliance with 23CFR772.

CDOT's Noise Analysis and Abatement Guidelines dated January 15, 2015, see Appendix A, describe CDOT policy and program to implement 23CFR772. These guidelines establish noise abatement criteria as well as design and cost requirements for noise mitigation. Traffic noise impacts occur when noise levels, for different categories of land uses and activities, meet or exceed the CDOT Noise Abatement Criteria (NAC) shown in **Table 1.** The noise impact threshold for residential (Category B) and recreational outdoor use areas (Category C) receptors is 66 dB(A). These are the primary receptor types in the corridor. The guidelines also state that noise mitigation must be considered for any receptors where predicted noise levels for future conditions are greater than existing noise levels by 10 dB(A) or more.

Table 1. CDOT Noise Abatement Criteria

Activity Category	Activity Leq(h)*	Evaluation Location	Activity Description
A	56	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to its intended purpose.
B[1]	66	Exterior	Residential
C[1]	66	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	51	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[1]	71	NA	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	NA	NA	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	NA	NA	Undeveloped lands that are not permitted for development.

[1] Includes undeveloped lands permitted for this activity category.

* Hourly A- weighted sound level in dB(A), reflecting a 1-dB(A) approach value below 23CFR772 values.

CDOT guidelines also outline a method for determining the "feasibility and reasonableness" of proposed mitigation measures. Feasibility issues include:

- Can a 5 dB(A) noise reduction be achieved by constructing a noise barrier or berm?
- Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
- Can a noise barrier or berm less than or equal to 20 feet tall be constructed?

Reasonableness issues include:

- Has the design goal of 7 dB(A) noise reduction for mitigation measure been met for at least one impacted receptor?
- Is the Cost Benefit Index below $6,800 per receptor per dB(A) reduced?
- Are more than 50% of benefitted resident/owners in favor of the recommended noise mitigation measure?

This noise analysis complies with regulatory requirements defined in 23CFR772 and CDOT Noise Analysis and Abatement Guidelines approved January 15, 2015 by FHWA.

3.0 NOISE PREDICTION METHODOLOGY

Noise levels were predicted using the TNM 2.5 highway noise level prediction software program developed by the Federal Highway Administration, which is approved for use on CDOT and Federal-aid projects. TNM calculates the hourly noise level at a receptor location based on the following factors:

- the noise emission level of automobiles, medium trucks, heavy trucks, buses, and motorcycles
- the volume and speed of each of these vehicle types on each key roadway
- the relative location of all roadways, receptors, and terrain features
- the type of land cover between each receptor and each roadway

Sub-section 3.1 describes the TNM input data used to predict existing and 2035 design-year conditions. Sub-section 3.2 describes the validation of the model.

The following paragraphs from the Colorado Noise Analysis and Abatement Guidelines explain the technical terminology for the units of measurement that the model uses:

> *Since sound travels in waves, there are also varying frequencies associated with each sound event. The human ear does not respond equally to all frequencies, however, and filtering of these frequencies must be done in order to obtain accurate measurements and descriptions of highway traffic noise, as this noise is comprised of many frequencies. The filtering (weighting of frequencies) of the "A" scale on sound-level meters most closely approximates the average frequency response of the human ear, and is the scale that is used for traffic noise analyses. Decibel units described in this manner are referred to as A-weighted decibels, or dB(A).*
>
> *As sound intensity tends to fluctuate with time, a method is required to describe a noise source, such as a highway, in a steady state condition. The descriptor most commonly used in environmental noise analysis is the equivalent steady state sound level, or Leq. This value is representative of the same amount of acoustic energy that is contained in a time-varying sound measurement over a specified period. For highway traffic noise analyses in Colorado that time period is one hour, and the value then reflects the hourly equivalent sound level, or Leq(h).*

3.1 TNM Model Input and Assumptions

<u>Vehicle Emission Levels</u>
Vehicle emission levels refer to the noise level of vehicles measured at a reference distance and a reference speed. TNM provides separate emission levels for automobiles, medium trucks (trucks with two axles, six tires, and a gross vehicle weight greater than 4500 kg and less than 12,000 kg), and heavy trucks (trucks with three or more axles and a gross vehicle weight greater than 12,000 kg).

<u>Traffic</u>
The loudest hour for noise occurs when the highest volume of traffic is traveling at the highest free flow speed for the particular roadway. This is often not the peak hour, when heavy traffic volumes result in lower speeds. However, for the 65th Avenue project peak hour traffic is projected to travel at the posted speed and is thus the loudest hour.

For 65th Avenue, 2035 traffic projections range from 1,600 northbound and 1,600 southbound just south of US 34 to 1,150 northbound and 1,045 southbound just north of 37th Street in the peak periods. The detailed projected traffic volumes used for this study are included in Appendix B. In addition to the peak period traffic numbers, it should be noted that the noise analysis used one percent trucks with posted speeds of 40 mph on 65th Avenue, 30 mph on the minor cross streets and 50 mpg on US 34 and 37th Street for the worst-case.

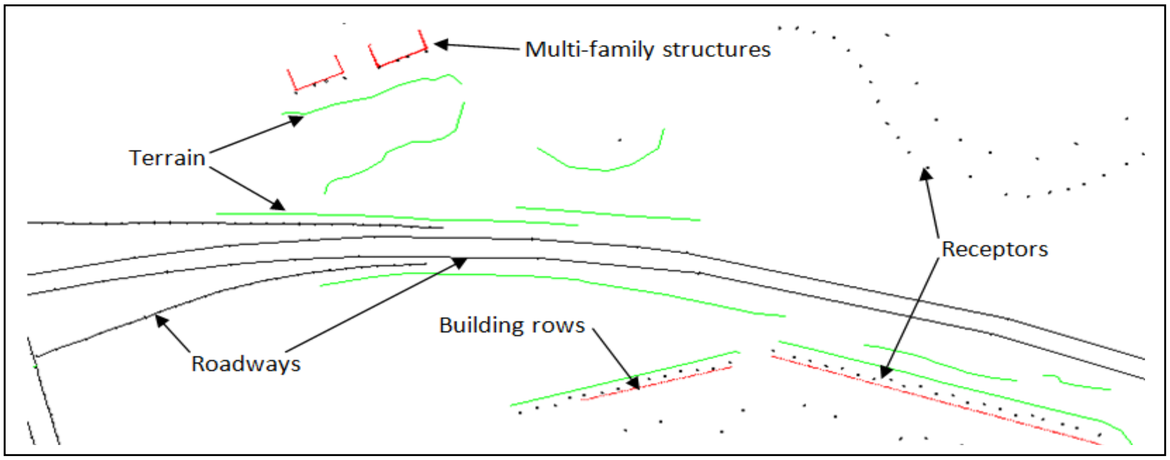
<u>Terrain</u>
The terrain surrounding 65th Avenue is very level with limited natural and man-made features that directly affect the propagation of traffic noise to the surrounding area and receptors. The locations and elevations of the features along 65th Avenue were determined using the CAD topographic files and included in the TNM model.

<u>Ground Cover</u>
Throughout the study area, ground cover adjacent to 65th Avenue consists primarily of landscaped lawns with sporadic trees.

<u>Buildings</u>
Developed areas along 65th Avenue have a mix of single-family homes with some commercial properties located primarily on the north end of the project. Closely spaced or large buildings structures impede the transmission of sound from the roadway to the receptors. In TNM, building rows are used to replicate the effect of closely spaced structures and three-sided barriers are used to replicate the effects of large structures. The locations and elevations of these features was determined using the CAD topographic files and included in the TNM model and are shown in **Figure 2**.

<u>Receptors</u>
Modeled receptors, as shown in the TNM screen shot in **Figure 2**, are located in the outdoor use areas of individual residential, commercial, and recreational properties within 500 feet of the 65th Avenue project limits. All first row homes were modeled as individual receptors. Some second row homes, depending on modeled noise levels, were modeled either as individual receptors or grouped. The locations and elevations of these features was determined using the CAD topographic files and included in the TNM model. Individual receptors locations are identified in **Figures 4** and **5.**

Figure 2. TNM Features



Receptors

Modeled receptors, as shown in the TNM screen shot in **Figure 2**, are located in the outdoor use areas of individual residential, commercial, and recreational properties within 500 feet of the 65th Avenue project limits. All first row homes were modeled as individual receptors. Some second row homes, depending on modeled noise levels, were modeled either as individual receptors or grouped. One noise activity category E commercial receptor, La Mariposa Restaurant & Margarita House, was identified with a sensitive outdoor use and was modeled. Commercial properties without a sensitive outdoor use, agricultural properties, and undeveloped and unpermitted land were not modeled and the zoning for these areas is shown in **Figures 4** and **5**. The locations and elevations of all features was determined using the CAD topographic files and included in the TNM model. Individual receptors locations are identified in **Figures 4** and **5.**

Roadways

The existing and proposed roadway alignments, including profiles and pavement width, for 65th Avenue and cross streets, were determined using the CAD roadway design files and topographical survey data and included in the TNM model and are shown in **Figure 2**. Where two through travel lanes are moving traffic in the same direction, the lanes were combined in a single TNM roadway in the center of the two lanes with the traffic combined. All single travel lanes were modeled as a single TNM roadway in the center of the lane.

3.2 Validation of Noise Model

The above-described modeling procedures were validated by measuring noise levels at five locations along the corridor, **Figure 3** shows collection at site 2, and comparing the measured readings with the TNM model predictions for these locations with the traffic counted during the measurement times. These sites are shown in **Figures 4** and **5**. Noise levels were measured on August 13th, 2015 which was a warm, dry, wind free (less than 10 mph) days, using a Quest 2900 integrating/logging level meter. The meter was field-calibrated before and re-checked after the measurements.

Figure 3. Site 2 Data Collection

Figure 4 – South of 32nd Street Receptor Locations

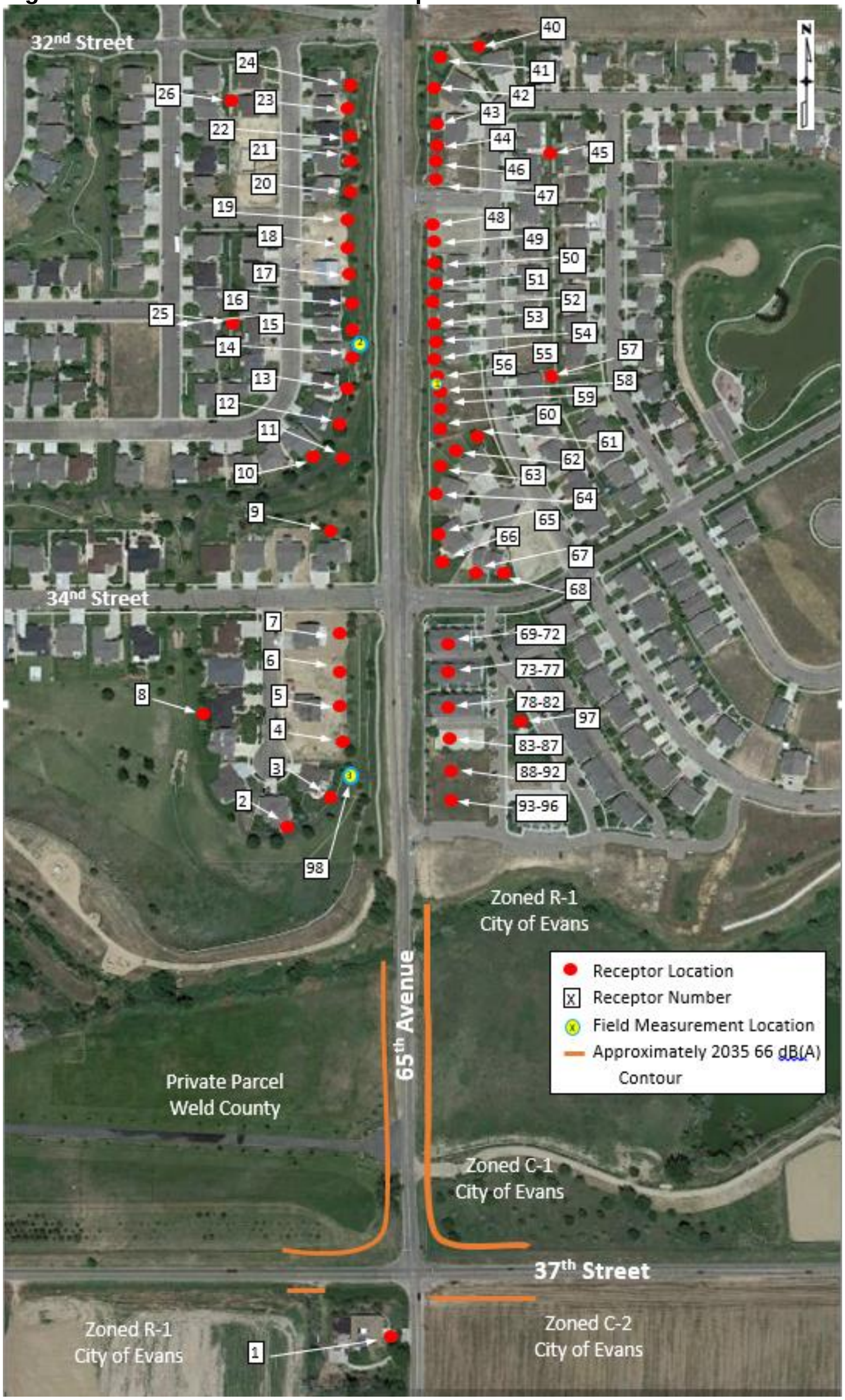


Figure 5 – North of 32nd Street Receptor Locations

At the same time that noise levels were measured, the associated traffic counts, vehicle type data, and average speeds were collected. Noise measurements were collected during off-peak hours to ensure free flow traffic. Two readings were conducted at each site. Modifications the TNM model, e.g. reduction in fence height between 32^{nd} Street and 34^{th} Street on the east side of 65^{th} Avenue, to were made to ensure the model was sufficiently replicating the site conditions and the manner in which sound propagates through the environment.

The measured and predicted noise levels are compared in **Table 2.** When the noise model predicts noise levels with an accuracy of ± 3 dB(A) when compared to the measured levels, the model is considered validated and suggests the model is accurately predicting the noise environment.

Table 2 - Noise Model Validation

Site #	Location	Field (dB(A) Leq)	Direction of Travel	Traffic (Hourly Equivalent)					Model (dB(A) Leq)	Variance (dB(A) Leq)	Notes/ Issues in Field
				Auto	MT	HT	MO	Bus			
1 - 1	Undeveloped lot east of 65^{th} Ave. between Chardonnay St. and Concord St.	**54.7**	NB	273	3	0	3	0	**53.5**	**1.2**	Dog Barking
			SB	252	3	0	3	0			
1 – 2		**53.4**	NB	237	3	0	3	0	**52.9**	**0.5**	Less Dog Barking
			SB	198	6	0	0	0			
2 - 1	Back lot line of home west of 65^{th} Ave. between 34^{th} St. and 32^{nd} St.	**57.7**	NB	237	3	0	3	0	**57.1**	**0.6**	
			SB	198	6	0	0	0			
2 - 2		**56.9**	NB	264	3	0	0	0	**56.5**	**0.4**	
			SB	225	6	0	0	0			
3 - 1	Trail west of 65^{th} Ave. and south of 34^{th} St.	**56.0**	NB	285	3	0	0	0	**55.1**	**0.9**	
			SB	246	0	0	0	0			
3 - 2		**56.1**	NB	288	3	0	0	0	**55.6**	**0.5**	
			SB	279	3	0	0	0			
4 - 1	Open field west of 65^{th} Ave and just north of 32^{nd} St	**56.2**	NB	279	3	0	3	0	**56.1**	**0.1**	
			SB	306	9	0	0	0			
4 – 2		**55.6**	NB	288	0	0	0	0	**55.3**	**0.3**	
			SB	261	3	0	0	0			
5-1	Utility easement east of 65^{th} St. between Lesser Dr. and Ashcroft Rd.	**58.5**	NB	228	6	0	0	0	**58.5**	**0.0**	
			SB	189	0	0	0	0			
5-2		**59.8**	NB	252	0	0	0	0	**59.2**	**0.6**	
			SB	204	3	0	0	0			

Note: “Auto” represents passenger vehicles, “MT” represents medium delivery trucks, “HT” presents heavy 18 wheel trucks, “MO” represents motorcycles, “Bus represents buses and motorhomes.

4.0 NOISE IMPACT ASSESSMENT AND MITIGATION ANALYSIS

The validated noise models were the basis for the development of the noise prediction models for the Existing, 2035 No Action, and 2035 Proposed Action traffic scenarios. These models were then used to predict noise levels for all receptor locations.

4.1 Noise Impact Assessment

Traffic noise impacts occur when noise levels, for different categories of land uses and activities, meet or exceed the CDOT Noise Abatement Criteria (NAC) shown in **Table 1.** The noise impact threshold for residential (Category B) and recreational outdoor use areas (Category C) receptors is 66 dB(A). The guidelines also state that noise mitigation must be considered for any receptors where predicted noise levels for future conditions are greater than existing noise levels by 10 dB(A) or more.

4.2 Mitigation Analysis

Any and all receptors which were determined to be impacted by noise must be evaluated for traffic noise mitigation. This requires that the overall social, economic, and environmental effects of the mitigation be evaluated against the benefits. When determining mitigation measures, primary consideration is to be given to exterior areas surrounding residential areas or areas of frequent human use for other uses such as parks and commercial districts where a reduced noise level would be of benefit. All feasible and reasonable mitigation measures are required to be included in the highway project.

The following are common mitigation measures that may be incorporated in roadway projects to reduce traffic noise impacts.

- Traffic management measures, such as lane-use restrictions, designated truck routes, and speed limit reductions. While lesser speeds do decrease noise levels, it generally will take a reduction in speed of approximately 20 miles per hour to achieve a readily perceptible (5 dB(A)) reduction of noise at its source
- Alteration of horizontal and vertical alignments to reduce noise impacts.
- Acquisition of undeveloped land for buffer zone creation. This is not an option as the area is a highly developed corridor with residential uses adjacent to the roadway.
- Noise insulation, but for NAC Activity Category D structures only.
- Construction of noise barriers or earthen berms within highway right of way is the most common mitigation measure employed by CDOT and will be evaluated for this project.

CDOT guidelines outline a method for determining the “feasibility and reasonableness” of constructing an acoustically effective noise barrier at a particular site. Feasibility considerations include:

- Can a 5 dB(A) noise reduction be achieved by constructing a noise barrier or berm?
- Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
- Can a noise barrier or berm less than or equal to 20 feet tall be constructed?

Reasonableness issues include:

- Is the design goal of 7 dB(A) noise reduction for mitigation measure met for at least one impacted receptor?
- Is the Cost Benefit Index below $6,800 per receptor per dB(A)?

- Are more than 50% of benefitted resident/owners in favor of the recommended noise mitigation measure?

The cost-benefit index is not intended to function as an accurate cost itemization for the design and construction of a noise barrier, but rather to provide a consistent level of consideration that will be used for CDOT noise mitigation decision-making. For purposes of the mitigation evaluation, the unit cost for a generic wall, as prescribed by CDOT, is $45 per exposed square foot, which approximates the typical costs in construction of a standard concrete/masonry barrier that does not require special site considerations. This cost is based on an average of 2005 to 2009 noise wall square footage costs collected from CDOT cost tabulations. This cost does not include engineering design, right-of-way acquisition, or utility mitigations.

Communities, recreational resources, and noise sensitive commercial properties within 500 feet of 65th Avenue were analyzed separately for noise impact and mitigation.

The analysis includes:

- Predicted Existing, No Action, and 2035 Proposed Action noise levels,
- Change in noise levels between the Existing and the Proposed Action,
- Determination of whether predicted noise levels equal or exceed CDOT's abatement criteria, as presented in Section 2.0 Applicable Noise Standards,
- Noise mitigation analysis with feasible and reasonable evaluation (as presented in Section 2.0, Applicable Noise Standards), and
- Mitigation recommendation.

4.3 Impact Assessment

Using the prediction methodology described in Section 3.0, receptors were developed for front row and select second row outdoor use areas as shown in **Figures 4 and 5.** Noise levels were predicted at each receptor, residential, recreational and sensitive commercial, for both Existing, and Proposed Action conditions, the increase between Existing and Proposed Action, and whether or not each receptor is considered impacted are shown in **Table 3.**

While the average daily traffic on 65th Avenue, as presented in Appendix B, is projected to increase as much as four to five fold and associated traffic noise levels will be audibly higher than existing conditions, no receptors equal or exceed CDOT impact criteria for residential, recreational or sensitive commercial properties. A 66 dB(A) contour line is shown in Figures 4 & 5 along the undeveloped areas for future reference.

Noise mitigation at these location does not meet CDOT/FHWA criteria for implementation and thus mitigation is not recommended and no further abatement criteria need to be evaluated. However, during final design alignment shifts or profile changes beyond project tolerances could trigger a re-evaluation and re-analysis of noise impacts and mitigation.

Because no receptors met CDOT impact criteria, no Noise Abatement Determination forms were completed for this project.

Table 3 –Noise Model Results without Mitigation

Receptors			Modeled Noise Levels (dB(A))				CDOT Noise Abatement Criteria	
ID No.	Description	NAC Activity Category	Existing	No-Action	Proposed 2035	Change in Levels (Prop – NB)	Approach or Exceed Activity Value	Increase Over Existing
1	School	C	59	62	65	5.9	No	No
2	Residential	B	50	56	57	6.9	No	No
3	Residential	B	52	58	60	7.7	No	No
4	Residential	B	53	58	61	8.2	No	No
5	Residential	B	53	58	61	8.2	No	No
6	Residential	B	53	59	61	8.3	No	No
7	Residential	B	54	59	62	8.1	No	No
8	Residential	B	45	51	53	7.9	No	No
9	Residential	B	54	59	62	8.3	No	No
10	Residential	B	52	57	59	7.1	No	No
11	Trail	C	55	60	64	8.8	No	No
12	Residential	B	53	58	61	7.9	No	No
13	Residential	B	55	60	63	8.5	No	No
14	Residential	B	54	60	63	8.5	No	No
15	Residential	B	54	60	63	8.4	No	No
16	Residential	B	54	60	63	8.4	No	No
17	Residential	B	55	60	63	8.4	No	No
18	Residential	B	55	60	63	8.3	No	No
19	Residential	B	55	60	63	8.4	No	No
20	Residential	B	55	60	63	8.2	No	No
21	Residential	B	55	60	63	8.2	No	No
22	Residential	B	55	60	63	8.1	No	No
23	Residential	B	55	60	63	8.1	No	No
24	Residential	B	56	61	64	7.9	No	No
25	Residential	B	48	53	55	7.4	No	No
26	Residential	B	48	53	55	7.2	No	No
27	Residential	B	57	62	65	8.0	No	No
28	Residential	B	55	60	63	8.0	No	No
29	Residential	B	55	60	63	8.1	No	No
30	Residential	B	55	60	63	8.2	No	No
31	Residential	B	55	60	64	8.2	No	No
32	Residential	B	55	60	63	8.3	No	No
33	Commercial	E	56	61	65	8.4	No	No
34	Residential	B	56	59	60	3.8	No	No
35	Residential	B	58	60	61	3.8	No	No
36	Residential	B	52	57	57	5.2	No	No
37	Residential	B	52	57	58	5.9	No	No
38	Residential	B	52	57	59	6.4	No	No
39	Residential	B	52	57	59	6.5	No	No
40	Residential	B	53	58	60	6.5	No	No

Note: Model values are calculated to the nearest tenth decimal; however, for impact identification, CDOT requires noise level values to be arithmetically round to the nearest whole number e.g. 65.5 is round to 66. Based on this rounding changes in noise levels from the existing to the proposed will not appear to be arithmetically correct. This table contains no impacted receptors

Table 3 –Noise Model Results without Mitigation (continued 1)

Receptors			Modeled Noise Levels (dB(A))				CDOT Noise Abatement Criteria	
ID No.	Description	NAC Activity Category	Existing	No-Action	Proposed 2035	Change in Levels (Prop – NB)	Approach or Exceed Activity Value	Increase Over Existing
41	Residential	B	56	60	62	6.5	No	No
42	Residential	B	57	62	64	6.7	No	No
43	Residential	B	56	61	62	6.3	No	No
44	Residential	B	55	60	62	6.1	No	No
45	Residential	B	48	53	54	5.9	No	No
46	Residential	B	55	60	61	6.3	No	No
47	Residential	B	57	62	63	6.5	No	No
48	Residential	B	57	62	64	6.8	No	No
49	Residential	B	58	63	65	7.4	No	No
50	Residential	B	58	63	65	7.4	No	No
51	Residential	B	56	61	62	6.4	No	No
52	Residential	B	56	61	62	6.2	No	No
53	Residential	B	55	61	62	6.3	No	No
54	Residential	B	56	61	62	6.5	No	No
55	Residential	B	56	61	62	6.4	No	No
56	Residential	B	55	61	62	6.4	No	No
57	Residential	B	46	52	52	6.0	No	No
58	Residential	B	55	60	61	6.0	No	No
59	Residential	B	56	61	62	6.4	No	No
60	Residential	B	56	61	62	6.5	No	No
61	Residential	B	51	57	57	6.1	No	No
62	Residential	B	54	59	60	6.3	No	No
63	Residential	B	54	59	60	6.3	No	No
64	Residential	B	55	61	61	5.9	No	No
65	Residential	B	56	61	62	6.6	No	No
66	Residential	B	55	60	61	6.4	No	No
67	Residential	B	53	58	59	5.6	No	No
68	Residential	B	53	57	57	4.6	No	No
69	Residential	B	54	58	59	5.4	No	No
70	Residential	B	55	59	61	5.8	No	No
71	Residential	B	56	60	62	6.6	No	No
72	Residential	B	59	64	65	6.6	No	No
73	Residential	B	43	49	50	6.9	No	No
74	Residential	B	44	50	52	7.4	No	No
75	Residential	B	47	53	55	7.9	No	No
76	Residential	B	51	57	59	8.0	No	No
77	Residential	B	57	63	64	7.1	No	No
78	Residential	B	58	63	65	7.2	No	No
79	Residential	B	51	57	59	8.0	No	No
80	Residential	B	47	53	55	7.9	No	No

Note: Model values are calculated to the nearest tenth decimal; however, for impact identification, CDOT requires noise level values to be arithmetically round to the nearest whole number e.g. 65.5 is round to 66. Based on this rounding changes in noise levels from the existing to the proposed will not appear to be arithmetically correct. This table contains no impacted receptors

Table 3 –Noise Model Results without Mitigation (continued 2)

Receptors			Modeled Noise Levels (dB(A))				CDOT Noise Abatement Criteria	
ID No.	Description	NAC Activity Category	Existing	No-Action	Proposed 2035	Change in Levels (Prop – NB)	Approach or Exceed Activity Value	Increase Over Existing
81	Residential	B	44	50	52	7.4	No	No
82	Residential	B	43	49	50	6.7	No	No
83	Residential	B	57	63	64	7.2	No	No
84	Residential	B	55	61	62	7.5	No	No
85	Residential	B	49	55	57	8.2	No	No
86	Residential	B	45	51	53	7.9	No	No
87	Residential	B	43	48	50	7.0	No	No
88	Residential	B	42	48	49	6.9	No	No
89	Residential	B	45	51	53	7.7	No	No
90	Residential	B	48	54	57	8.2	No	No
91	Residential	B	54	60	62	7.6	No	No
92	Residential	B	57	63	65	7.2	No	No
93	Residential	B	58	64	65	7.3	No	No
94	Residential	B	55	61	63	8.2	No	No
95	Residential	B	52	58	60	8.4	No	No
96	Residential	B	51	56	58	7.5	No	No
97	Residential	B	44	49	51	6.7	No	No
98	Trail	C	56	62	65	9.0	No	No

Note: Model values are calculated to the nearest tenth decimal; however, for impact identification, CDOT requires noise level values to be arithmetically round to the nearest whole number e.g. 65.5 is round to 66. Based on this rounding changes in noise levels from the existing to the proposed will not appear to be arithmetically correct. This table contains no impacted receptors

4.4 Statement of Likelihood and Summary of Recommendations

No receptors on the 65th Avenue corridor equal or exceed CDOT impact criteria for residential, recreational or sensitive commercial properties. Noise mitigation is not recommended. However, during final design alignment shifts or profile changes beyond project tolerances could trigger a re-evaluation and re-analysis of noise impacts and mitigation.

5.0 CONSTRUCTION NOISE IMPACTS

Construction of the project will generate noise from diesel-powered earth moving equipment such as dump trucks and bulldozers, back-up alarms on certain equipment, and compressors. Construction noise at off-site receptor locations will usually be dependent on the loudest one or two pieces of equipment operating at the moment. Noise levels from diesel-powered equipment range from 80 to 95 dB(A) at a distance of 50 feet. Impact equipment such as rock drills and pile drivers can generate louder noise levels. Construction noise, while temporary, can be mitigated by limiting work to daylight hours, requiring the contractor to use well-maintained equipment (particularly with respect to mufflers), and through the use of mitigation measures such as temporary noise barriers where applicable.

REFERENCES

CDOT. 2015. Colorado Department of Transportation Noise Analysis and Abatement Guidelines.