US 6 Bridges Design Build Project

BR 0061-083

Sub Account Number 18838 (CN)

Noise Technical Report

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Colorado Department of Transportation
Federal Highway Administration

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List of Abbreviated Terms

AM	morning
CDOT	Colorado Department of Transportation
CFR	Code of Federal Regulations
dB	Decibel
EB	eastbound
EIS	Environmental Impact Statement
EPA	US Environmental Protection Agency
FHWA	Federal Highway Administration
I-25	Interstate 25
L_{eq}	equivalent sound level
NAC	Noise Abatement Criteria
PM	afternoon/evening
ROD	Record of Decision
ROD2	Record of Decision 2
RTP	Regional Transportation Plan
SB	southbound
SEL	Sound Exposure Level
TNM®	FHWA's Traffic Noise Model
US 6	6th Avenue
USGS	United States Geological Survey
WB	westbound

Executive Summary

This Noise Technical Report documents a noise analysis and study conducted in support of a Re-evaluation under 23 CFR 771.129 for the US 6 Bridges Design Build Project (the Project). It takes into consideration the following factors relative to the I-25 Valley Highway Final Environmental Impact Statement (FEIS) and the resultant 2007 Record of Decision (ROD):

- Have there been changes in the Project or its surroundings?
- Have any new issues been identified?
- Are there new circumstances to be considered?
- Is there new information that was not considered in the original document?
- Are there changes in laws or regulations that apply to the Project?

A new analysis of the existing noise environment, predicted future noise levels, potential noise abatement, and construction noise effects was undertaken and then compared to the analysis conducted for the FEIS.

The noise levels along the current roadways were measured at 19 locations, and existing and future No Build Alternative and Build Alternative peak noise levels were modeled for 31 locations using the FHWA's Traffic Noise Model (TNM®). Modeled noise levels range from 62 dBA $L_{eq(h)}$ to 75 dBA $L_{eq(h)}$ for the existing peak noise conditions. For the No Build Alternative and Build Alternative, modeled noise levels ranged from 63 dBA $L_{eq(h)}$ to 76 dBA $L_{eq(h)}$ and 62 dBA $L_{eq)h)}$ to 77 dBA $L_{eq(h)}$, respectively. Noise levels at nearby receptors are dependent upon the proximity of the receptor to the existing and proposed roadways, the amount of physical shielding provided by buildings and topography, and the presence of non-traffic-related noise. Non-traffic-related noise can include industrial and commercial noise, aircraft noise, and railroad noise. These non-traffic-related noise sources influence the existing noise levels; however, the dominant noise source in the study area is from traffic on US 6 with traffic noise from I-25 influencing noise levels east of Federal Boulevard.

Existing traffic noise levels at 84 residences, 6 park uses, and 2 trails meet or exceed the CDOT Noise Abatement Criteria (NAC) (i.e., 66 dBA $L_{eq(h)}$ for residences and parks). The CDOT sets the NAC at 1 dBA less than the FHWA Noise Abatement Criteria of 67 dBA $L_{eq(h)}$ resulting in a 66 dBA $L_{eq(h)}$ limit for residences, parks, and similar land uses. Residences located nearest US 6 make up most of the impacted sites along with several parks that currently experience noise levels above the NAC. A system of existing noise barriers are located north of and south of US 6 from Knox Court to Sheridan Boulevard.

Future year 2035 No Build traffic noise levels are predicted to meet or exceed the CDOT NAC at 113 residences, 10 park uses, and 2 trails and 2035 Build Alternative traffic noise levels are predicted to meet or exceed the noise abatement criteria at 107 residences, 10 park uses, and 2 trails. Consequently, noise mitigation measures, including the placement of noise barriers have been evaluated to reduce traffic noise levels at noise impacted receptors. Mitigation measures were found not to be feasible and reasonable in accordance with FHWA/CDOT policies. The existing noise barriers located north and south of US 6 from Knox Court to Sheridan Boulevard were found to provide adequate noise mitigation consistent with CDOT guidelines.

During project construction, areas adjacent would be exposed to construction noise in addition to the traffic-related noise. Noise from construction equipment can be mitigated using a variety of techniques including, but not limited to, restrictions on the times during the day construction can take place, proximity of construction equipment to sensitive receptors, use of alternative quieter equipment and techniques, and use of temporary noise control barriers and enclosures.

At the time of this report, there are no undeveloped or vacant portions of the area studied along the Project area (City and County of Denver 2012). According to CDOT Noise Analysis and Abatement Guidance, if building permits have been submitted for the undeveloped properties, the proposed development needs to be included in the noise study. As of July 29, 2012, the City and County of Denver Community Planning and Development office indicated that no building permits had been submitted to develop structures such as residences, commercial uses, or other NAC B, C, D, or E properties along the corridor.

1 Project Background

The Project includes modifications to the roadway, interchanges, and bridges along 6th Avenue (US 6) between Sheridan Boulevard and the BNSF Railway in Denver, Colorado. The Colorado Department of Transportation (CDOT) is preparing a Reevaluation and Record of Decision (ROD2) to document the impacts of and mitigation for the Project.

1.1 The Valley Highway Project

The Federal Highway Administration (FHWA) and CDOT prepared a Final Environmental Impact Statement (FEIS) in 2006 and a ROD in 2007 for the Interstate 25 (I-25) Valley Highway Project, located in Denver, Colorado. The Valley Highway Project includes the reconstruction of I-25 and reconfiguration of interchanges from Logan Street to United States Highway (US) 6, US 6 from I-25 to Federal Boulevard, and the crossing of Santa Fe Drive and Kalamath Street at the Consolidated Main Line railroad. The Preferred Alternative, as described in the FEIS, includes the following elements:

- I-25 Mainline: Widening of I-25 to provide a consistent section with four through lanes plus auxiliary lanes in each direction throughout the project area
- I-25/Broadway: Tight diamond interchange
- I-25/Santa Fe Drive: Single point urban interchange with a flyover ramp for northbound Santa Fe Drive to northbound I-25
- I-25/Alameda/Santa Fe/Kalamath: Offset partial urban interchange at I-25 and Alameda Avenue; Santa Fe Drive and Kalamath Street grade separated under the railroad close to their current alignments
- US 6: Ramp improvements at the I-25/US 6 interchange; closure of the Bryant Street interchange; diamond interchange at US 6/Federal Boulevard with slip ramps to Bryant Street and a braided ramp from Federal Boulevard to eastbound US 6; reconstruction of US 6 with collector-distributor roads/auxiliary lanes throughout the project area

The Preferred Alternative of the Valley Highway Project is shown in Figure 1.

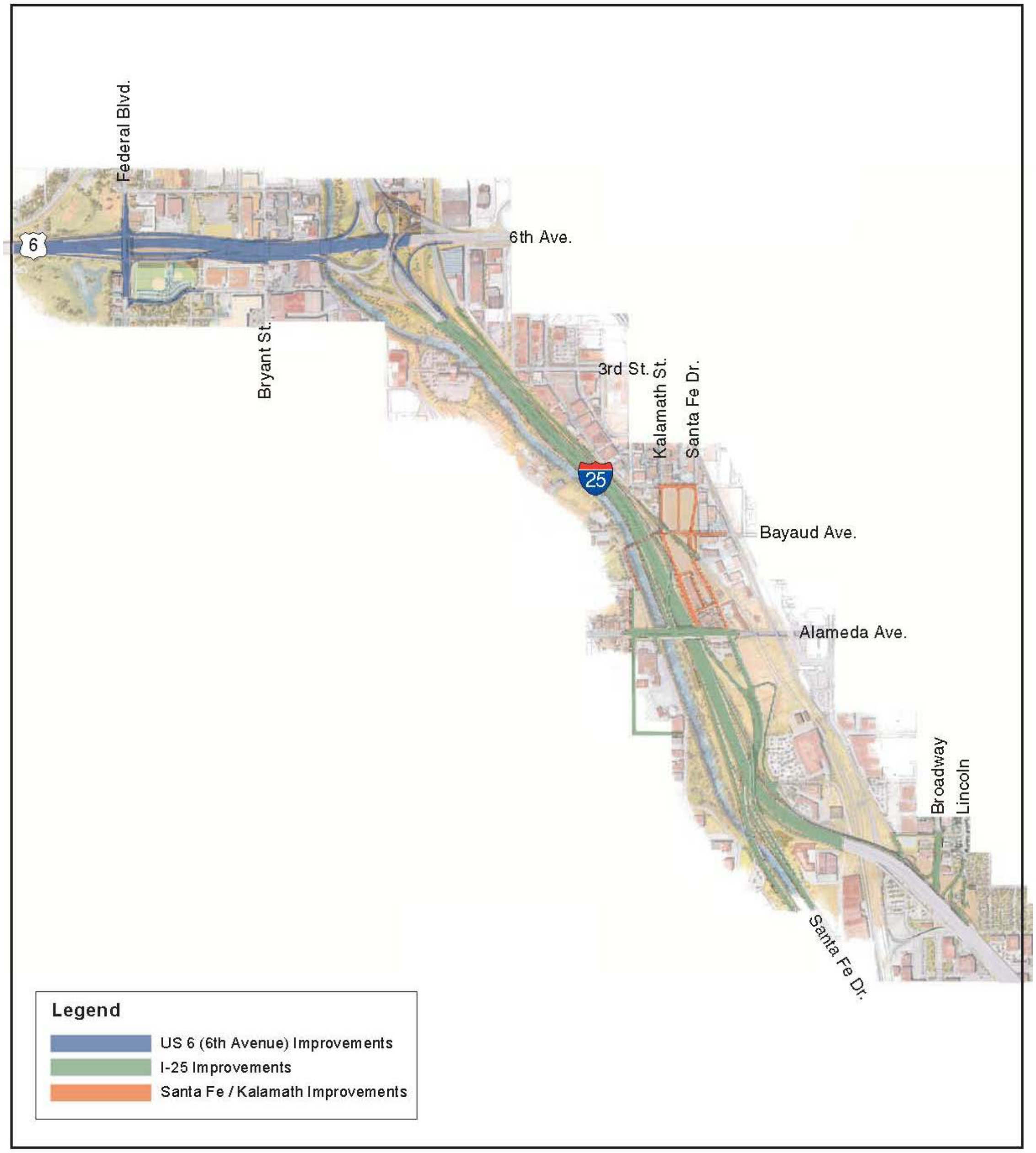

Figure 1: I-25 Valley Highway Project Preferred Alternative

1.2 US 6 Bridges Design Build Project

The Project includes the reconstruction of US 6, reconfiguration of interchanges from Federal Boulevard to I-25, and replacement of the US 6 bridges from Federal Boulevard to the bridge over the BNSF Railway. More specifically, the Project includes the following elements:

- The replacement of five bridges along US 6: Federal Boulevard, Bryant Street, South Platte River, I-25, and BNSF Railway. Three of these bridges are in poor condition and the other two are functionally obsolete. The project would also add a tunnel immediately east of I-25 under US 6 to separate traffic on northbound I-25 from traffic exiting the interstate to travel east and west on US 6.
- Ramp improvements at the I-25/US 6 interchange, closure of the westbound (WB) US 6 to Bryant Street ramp, a diamond interchange at US 6/Federal Boulevard with slip ramps to Bryant Street, and a braided ramp from Federal Boulevard to eastbound (EB) US 6.
- Reconstruction of US 6 with collector-distributor roads/auxiliary lanes from Federal Boulevard to the BNSF Railway bridge structure
- Conversion of 5th Avenue to two-way traffic from Federal Boulevard to Decatur Street
- Widening of Federal Boulevard, from five to six lanes, from 5th to 7th Avenues to accommodate current and future improvements
- Pavement resurfacing of US 6 from Knox Boulevard to Sheridan Boulevard
- In-kind replacement of impacted facilities for Barnum East Park
- A bicycle/pedestrian bridge structure over US 6, connecting Barnum North Park and Barnum Park (also known as Barnum Park South, and herein referred to as Barnum Park South)
- Upgrading portions of the South Platte River Trail to current standards

Figure 2 shows the Project.

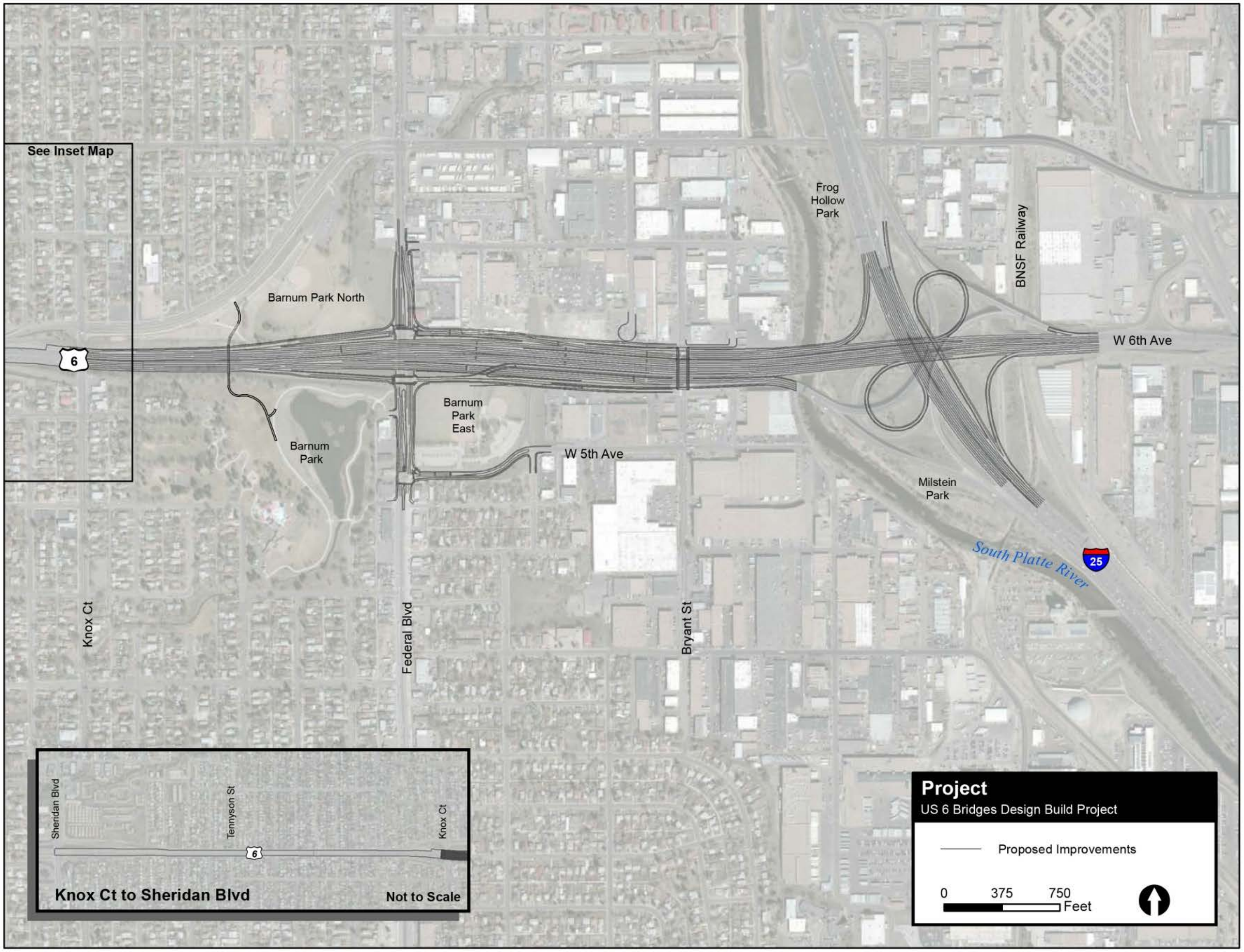

Figure 2: Project

1.3 Relationship of the Valley Highway Project and the US 6 Bridges Design Build Project

At the time of the FEIS, funding had not been identified for the entire Preferred Alternative. Although budget placeholders were included in the 2030 Regional Transportation Plan (RTP), these budgets fell short of the estimated cost of the Preferred Alternative. Therefore, FHWA and CDOT planned for a phased implementation of the Preferred Alternative. These six phases are outlined in Chapter 7 of the FEIS. The ROD2 for the Project will reevaluate part of Phase 1 (the part including the US 6/Federal Boulevard interchange) as presented in the 2007 ROD, and provide a decision for Phase 5 of the Valley Highway Project. The ROD2 for the Project will also address six new, minor project elements, which were not part of the FEIS. Due to the minor environmental significance and nature of these additional components, they are included in the ROD2 and will not affect the independent utility, logical termini, or Preferred Alternative of the Valley Highway Project.

1.3.1 *Phasing of the FEIS Preferred Alternative*

The Project includes elements of two of the six construction phases—Phase 1 and Phase 5—from the Valley Highway Project. A decision on construction Phase 1 of the Valley Highway Project, which included the US 6/Federal Boulevard bridge and ramps, excluding the braided ramp, was made in the 2007 ROD. Figure 3 shows the phases of the Valley Highway Project's Preferred Alternative and Figure 4 shows the Project Elements and how they relate to the FEIS phasing.

1.3.2 *Additional Project Elements in the Project*

At this time, the Project includes six additional elements that were not included in the FEIS or 2007 ROD:

- Reconstruction of the southbound (SB) I-25 to EB US 6 ramp;
- A bicycle/pedestrian bridge structure over US 6, connecting Barnum North and Barnum South parks;
- Replacement of the US 6 bridge over Bryant Street;
- Replacement of the US 6 bridge over I-25;
- Replacement of the US 6 bridge over the BNSF Railway; and
- Pavement resurfacing of US 6 between Sheridan Boulevard and Knox Court

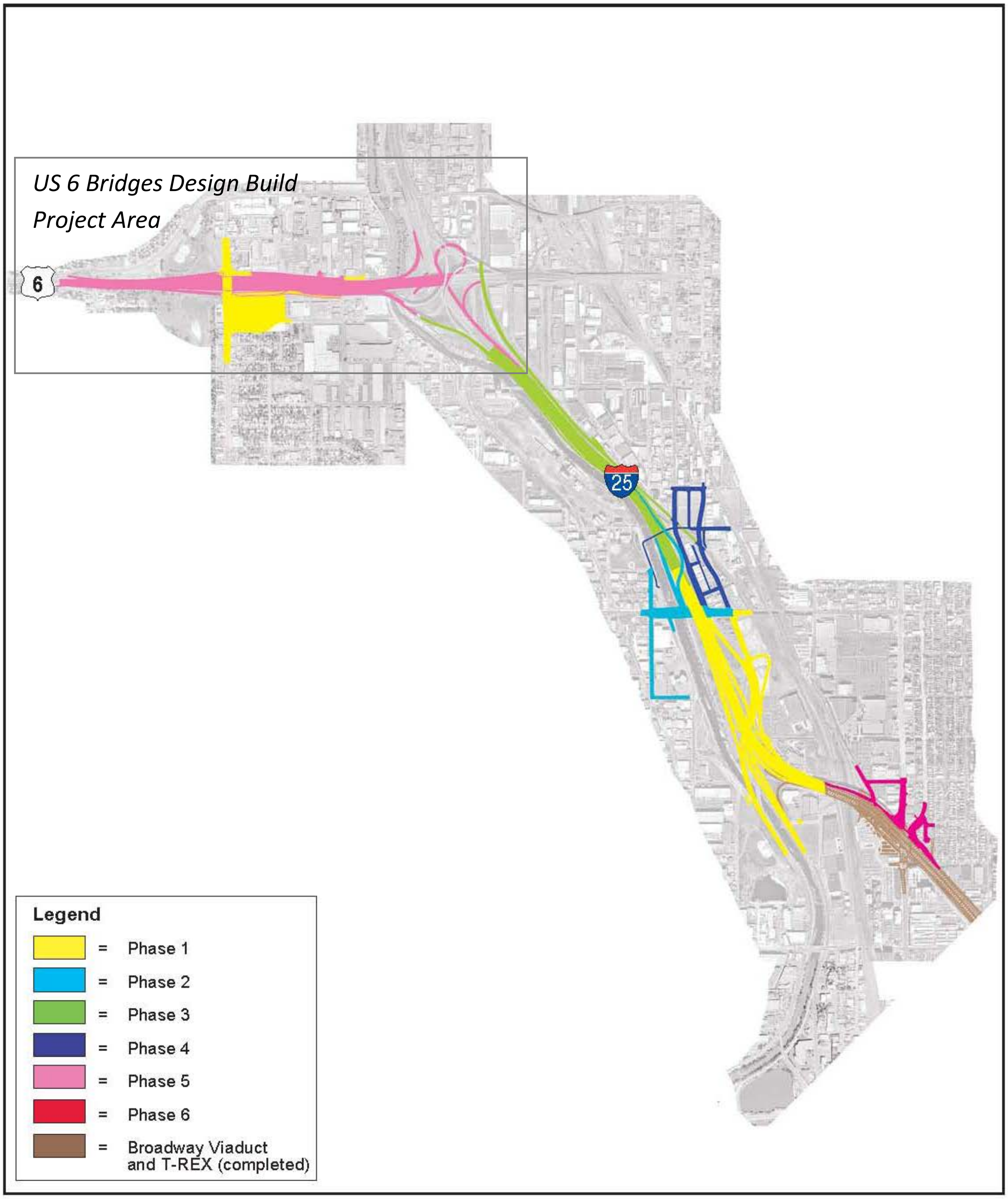

Figure 3: FEIS Phased Implementation of the Preferred Alternative

(source: I-25 Valley Highway FEIS)

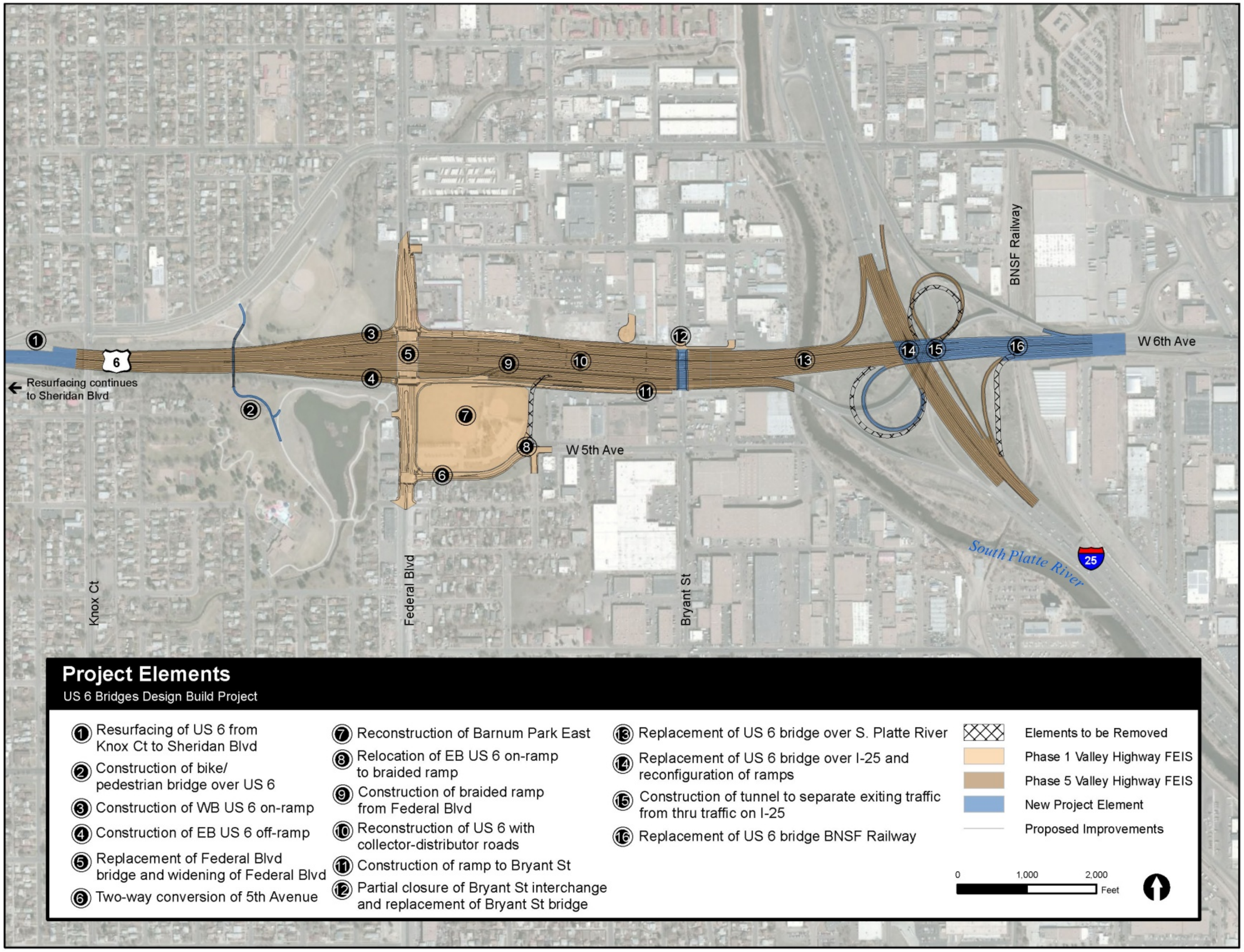

Figure 4: Project Elements

2 Noise Introduction

A traffic noise analysis is required for the Project because it includes improvements that meet the definition of a Type I Project. The purpose of this noise study is to describe the existing noise environment, predict future noise levels, evaluate potential noise abatement, if applicable, and evaluate construction noise effects. This study also provides existing and predicted future traffic noise levels to local officials to assist in future planning.

3 Comparison to Noise Impacts and Mitigation in FEIS and 2007 ROD

The noise analysis conducted in the EIS and the noise mitigation measures documented in the Record of Decision were compared to the results of this new analysis.

The Project noise study area includes the improvements from US 6 and Knox Court to the US 6/I-25 interchange which is consistent with the Valley Highway EIS; however, the Project extends further west along US 6 to Sheridan Boulevard and does not extend further to the south along I-25 as in the Valley Highway EIS.

No new issues or circumstances related to the noise environment or the noise study area have been identified during the time between the completion of the Valley Highway EIS and the noise study for the Project.

The new information included in the Project that was not included in the Valley Highway EIS is the inclusion of a new eastbound on-ramp from Federal Boulevard to US 6 designed north of Barnum Park East, which is closer to noise sensitive park uses and further from noise sensitive residential uses located on West 5th Avenue. The noise study for the Project again included US 6 repaving from Knox Court to Sheridan Boulevard. The realignment of ball fields at Barnum Park East was considered in the evaluation of noise impacts and mitigation measures at Barnum Park East. An updated traffic analysis was also performed in support of the Project and results were included in this study.

For highway transportation projects with FHWA involvement, the *Federal-Aid Highway Act of 1970* and the associated implementing regulations (23 CFR 772) govern the analysis and abatement of traffic noise impacts. In July 2010, the FHWA revised 23 CFR 772 (FHWA 2010). CDOT implements FHWA noise regulations in the State of Colorado in accordance with The CDOT Noise Analysis and Abatement Guidelines (CDOT 2011). This technical report serves to update the findings in the Valley Highway EIS and follows all requirements of the new rules.

In support of the re-evaluation of the Valley Highway EIS, changes from the noise analysis impacts disclosed in the FEIS and the mitigation included in the 2007 ROD are described below and summarized in Table 1.

Table 1: Summary of Previously and Currently Identified Noise Impacts, Mitigation Measures, and Impact Criteria

	FEIS and 2007 ROD				2012 US 6 Bridges Design Build Project		
Resource	Impacts of No-Action Alternative (presented in 2006 FEIS and 2007 ROD, based on 2002 NAC)	Impacts of Proposed Action (presented in 2006 FEIS and 2007 ROD, based on 2002 NAC)	Mitigation (presented in 2006 FEIS and 2007 ROD, based on 2002 NAC)	2012 US 6 Bridges Design Build Project: What Has Changed	Impacts of No-Action Alternative (using 2011 NAC)	Impacts of Proposed Action (using 2011 NAC)	Mitigation (using 2011 NAC)
Noise	Noise Impacts at Barnum Parks (North and East), Frog Hollow Park, and at residences located at West 5th and West Short Place.	Noise Impacts at Barnum Parks (North and East), Frog Hollow Park, and at residences located at West 5th and West Short Place.	Mitigation measures were evaluated and not recommended as they did not meet CDOT Criteria.	2011 revisions to FHWA and CDOT Noise Analysis and Abatement Guidance. The US6 Bridges Design Build Project extends further west to Sheridan Boulevard. Updated traffic analysis included in the noise study.	Noise Impacts at Barnum Parks (North and East), Frog Hollow Park, Milstein Park, South Platte River Trail, one Hotel, and at most first and second row residences located north and south of US6 between Knox Court and Sheridan Boulevard.	Noise Impacts at Barnum Parks (North and East), Frog Hollow Park, Milstein Park, South Platte River Trail, one Hotel, and at many first and second row residences located north and south of US6 between Knox Court and Sheridan Boulevard.	Mitigation measures were evaluated and not recommended as they did not meet CDOT's updated 2011 Criteria. Schedule nosiest construction activities during less noise sensitive times when possible. Schedule construction between 7am and 9pm, or in accordance with local noise regulations. Denver ordinance requirements shall be adhered to if noise sensitive receptors will be impacted at night.

For the portion of the Valley Highway EIS that included the Project, noise impacts were predicted at Barnum Parks (North and East), Frog Hollow Park, and at residences located at West 5th and West Short Place. Noise barriers were evaluated at all impact locations and not recommended as they did not meet CDOT Criteria.

The noise analysis for the Project resulted in noise impacts at Barnum Parks (North and East), Frog Hollow Park, Milstein Park, South Platte River Trail, one hotel, and at many first and second row residences located north and south of US6 between Knox Court and Sheridan Boulevard. Noise barriers were evaluated at all impact locations and not recommended as they did not meet CDOT 2011 Criteria.

4 Existing Land Use and Features

Land uses adjacent to the Project are a mix of commercial, light industrial, parks and trails along the eastern end of the project area with single-family residential and several parks located along the western half of the project area. A hotel is located at Federal Boulevard and US 6 and a City of Denver Fire Station is located at Knox Court and US 6. Noise levels at receptors vary depending on the proximity to the nearest noise source.

On July 29, 2012, City and County of Denver Planner Olga Mikhailova confirmed that no records of planned development in the noise study area for the Project were currently on file. No large vacant parcels are located along US 6 that appear to be likely candidates for future development.

In the study area noise included in the FEIS, a system of existing noise barriers are located north of and south of US 6 from Knox Court to Sheridan Boulevard. Existing noise barriers from Knox Court to Sheridan Boulevard are generally 8 feet tall and located along private property lines at locations where US 6 is at the same grade as the surrounding community. Land use located near US 6 from Knox Court to Sheridan Boulevard is primarily single-family residential with apartment buildings located north of US 6 near the western project terminus.

5 Noise Regulations and Impact Criteria

Since federal funds will be used to construct the Project, the Project must comply with state and federal noise regulations. Applicable noise regulations and guidelines provide a basis for evaluating potential noise impacts. For highway transportation projects with FHWA involvement, the *Federal-Aid Highway Act of 1970* and the associated implementing regulations (23 CFR 772) govern the analysis and abatement of traffic noise impacts. The regulations require that potential noise impacts in areas of frequent human use be identified during the planning and design of a highway project. In July 2010, the FHWA revised 23 CFR 772 (FHWA 2010). This technical report follows all requirements of the new rule.

CDOT implements FHWA noise regulations in the State of Colorado in accordance with Analysis and Abatement Guidelines (CDOT 2011). According to this manual, a noise impact occurs when the future noise level for one or more build alternative results in a substantial increase in the noise level (defined as a 10 dBA or more increase over the existing noise levels) or when the future noise level for one or more Build Alternative approaches or exceeds the Noise Abatement Criteria (NAC). CDOT noise policy defines the Noise Abatement Criteria (NAC) as 1 dBA less than the FHWA NAC. The CDOT Noise Manual was revised to comply with the June 2010 update to 23 CFR 772 (CDOT 2011). This report complies with the current CDOT manual.

Table 2 summarizes the FHWA and CDOT noise abatement criteria used in this analysis and report.

Table 2: FHWA and CDOT Noise Abatement Criteria Hourly A-Weighted Sound Level Decibels (dBA)

	Activity Criteria[a] $L_{eq(h)}$			
Activity Category	**FHWA NAC[b]**	**CDOT NAC[c]**	**Evaluation Location**	**Activity Description**
A	57	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 serve its intended purpose.
B[d]	67	66	Exterior	Residential
C[d]	67	66	Exterior	Active sports areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or non-profit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails and trails crossings.
D	52	51	Interior	Auditoriums, campgrounds, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or non-profit institutional structures, radio studios, recording studios, schools, and television studios.
E[d]	72	71	Exterior	Hotels, hotels, offices, restaurants/bars, and other develop lands, properties, or activities not included in A through D or F.
F	—	—	—	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	—	—	—	Undeveloped lands that are not permitted.

[a] The $L_{eq(h)}$ Activity Criteria values are for impact determination only and are not design standards for noise abatement measures.
[b] Federal Highway Administration noise abatement criteria
[c] Colorado Department of Transportation noise abatement approach criteria
[d] Includes undeveloped lands permitted for this activity category

6 Methodology

Ambient noise levels were measured for 15-minute periods at 19 locations near the project area to describe the existing noise environment, identify major noise sources in the project area, validate the noise prediction model, and characterize the weekday background environmental noise levels. These 19 measurement locations are shown on Figure 5. Measurements were taken on May 16, 17, 18, and 21, 2012 and July 16 and 18, 2012, using a calibrated Larson Davis Model 820 noise meter that complies with ANSI S1.4 Standard for a Type I accuracy instrument. These measurement locations represent 50 residences and 10 park uses.

The TNM® Version 2.5 computer model (FHWA 2004) was used to predict $L_{eq(h)}$ traffic noise levels. TNM® was used to predict noise levels at discrete points by considering interactions between different noise sources and the effects of topographical features on the propagation of noise. The model estimates the traffic noise level at a receptor location resulting from a series of straight-line roadway segments. Noise emissions from free-flowing traffic depend on the number of automobiles, medium trucks, and heavy trucks per hour; vehicular speed; and reference noise emission levels of specified vehicles. TNM® also considers effects of intervening barriers, topography, trees, and atmospheric absorption. By intent and design, noise from sources other than traffic is not included. Therefore, when non-traffic noise, such as aircraft, is considerable in an area, the TNM® results can be slightly less than the measured noise levels.

In addition to the 19 measured sites, 31 additional receptors representing approximately 121 residences, one park use, two trails, one fire station, and one hotel were also included in the TNM® model to provide predicted traffic noise levels for receptors that could be impacted by the Project. The modeling locations were chosen because they are representative of outdoor ground floor areas of frequent human use, such as residential front or back yards. The locations of all 50 receptors are shown in Figure 5.

The noise monitoring results were used to validate the TNM® model by comparing the predicted (modeled) and measured noise levels at all 19 monitoring locations using the traffic count data obtained during the measurement periods.

Base maps were exported as DXF files and imported into the TNM® package. In addition, ArcGIS was used to develop the TNM® model. As-built drawings were used to verify roadway widths and for additional base mapping. Major roadways, retaining walls, topographical features, building rows, and sensitive receptors were digitized into the model. The United States Geological Survey (USGS) 7.5-minute Digital Elevation Model was also used (USGS 2004).

Peak-hour traffic volumes used for existing conditions, 2035 No Build, and 2035 Build noise modeling were developed by Parsons Brinckerhoff (Parsons Brinckerhoff 2012). CDOT's suggested maximum traffic volumes for worst noise hour were used when peak-hour traffic volumes surpassed CDOT's maximum worst noise hour volumes (CDOT 2011). Generally, CDOT's suggested maximum worst hour volumes were used for US 6 volumes for the 2035 No Build and 2035 Build condition models.

Construction noise consequences were qualitatively assessed using FHWA reference levels. Suggested construction noise mitigation measures are provided for inclusion in contractor documents.

7 Existing Noise Levels and Noise Model Validation

Current 2012 noise levels in the Project are noticeably different than existing noise levels included in the 2006 Valley Highway EIS. The Project includes receptors from the large single-family area from Knox Court to Sheridan Boulevard but does not consider noise further south of the I-25/US 6 interchange.

Fifteen-minute noise measurements were taken at the 19 locations shown on Figure 5 during the morning and afternoon on May 16, 17, 18, and 21, 2012 and on July 16 and 18, 2012. Traffic conditions were also observed throughout each day. The noise measurements were performed during satisfactory weather conditions and during times when traffic on US 6 was free-flowing. The temperatures on these days ranged from 65 to 90 degrees Fahrenheit with mostly sunny skies, no precipitation, and low wind speeds during measurement periods.

The measured noise levels, traffic counts, and average vehicle speeds taken during the noise measurements were used to validate the TNM® traffic noise model (Appendix B, Tables B-4 and B-5).

Traffic noise was the dominant noise source in the project area although other non-traffic noises, such as a railroad and aircraft noise, can periodically be heard in the surrounding area. A railroad track passes under the I-25/6th Avenue interchange near the eastern project limit. Phil Milstein Park and the South Platte River Trail are the only noise-sensitive sites located near operating railroad lines. The dominant noise source in the study area however is from traffic on US 6 with traffic noise from I-25 influencing noise levels east of Federal Boulevard. The TNM® model results agree within (+/- 3 dBA) when compared against the measured noise levels.

Table 3 compares measured noise levels and levels modeled in the TNM model noise levels for these same sites. Noise levels at the 19 measurement sites ranged from 58 dBA L_{eq} to 67 dBA L_{eq}, depending on the proximity to US 6 and other existing roadways. Figure 5 shows the approximate location of all 19 measurement locations as well as the additional 31 locations analyzed in the TNM model. Table 3 includes the approximate location of each measurement, the time and day each measurement was taken, the measured noise level, and the approximate distance to the nearest roadway noise source.

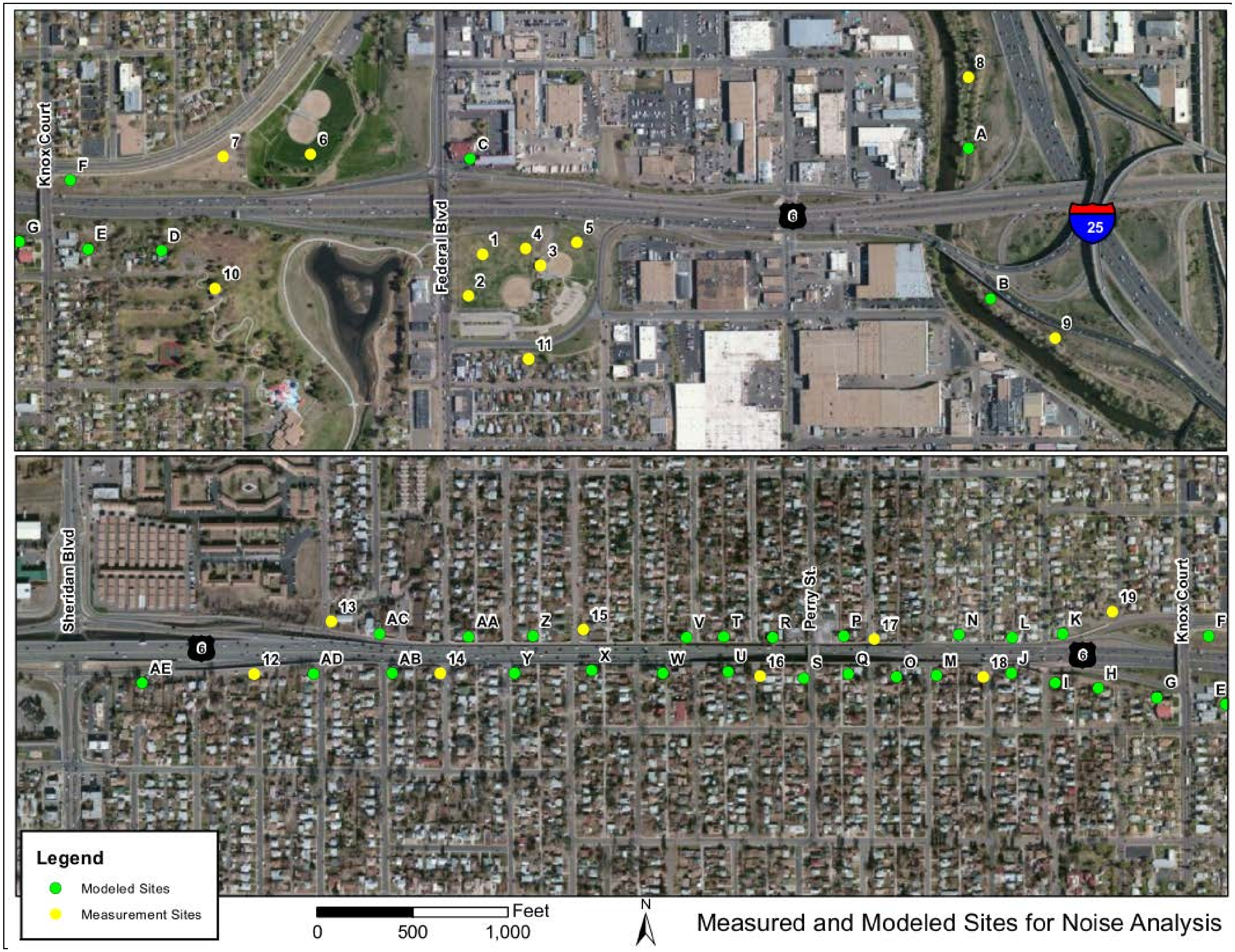

Figure 5: Measured and Modeled Noise Receptor Sites

Table 3: Noise Measurement Data and TNM Model Validation

Site Identification Number and Description	Land Use	Date/Time	Approximate Distance to Edge of Pavement at US 6 or nearest roadway (feet)	Measured Noise Level (dBA L_{eq})	Modeled Noise Level for Validation (dBA L_{eq})	Difference between Modeled and Measured Noise Level (dBA L_{eq})
1 – Barnum Park East, Upper Sports Fields	Park	5/16/2012 1:25 PM	185	60	63	3
2 – Barnum Park East, Upper Sports Fields	Park	5/16/2012 1:39 PM	90 (to Federal)	62	64	2
3 – Barnum Park East, Grand Stands	Park	5/16/2012 2:10 PM	260	63	62	-1
4 – Barnum Park East, Upper Sports Fields	Park	5/17/2012 10:45 AM	175	60	61	1
5 – Barnum Park East, Lower Sports Fields	Park	5/17/2012 10:45 AM	120	66	68	2
6 – Barnum Park North, Ball Fields	Park	5/17/2012 12:15 PM	175 (to US6 WB on-ramp)	62	62	0
7 – Barnum Park North, Trestle Bike Course	Park	5/17/2012 12:40 PM	195	61	64	3
8 – Frog Hollow Park	Park	5/18/2012 9:55 AM	210	64	66	2
9 – Phil Milstein Park	Park	5/18/2012 10:20 AM	45	62	65	3
10 – Barnum Park, Overlook	Park	5/18/2012 10:50 AM	375	63	62	-1
11 – W 5th/Barnum Park East	Residential	5/18/2012 11:23 AM	60	58	61	3
12 – W 6th Ave S Dr/Xavier St	Residential	7/16/2012 3:08 PM	10 (to W 6th Ave S Dr)	66	65	-1
13 – W 6th Ave N Dr/Wolff St	Residential	7/16/2012 2:17 AM	50 (to W 6th Ave N Dr)	64	61	-3

Site Identification Number and Description	Land Use	Date/Time	Approximate Distance to Edge of Pavement at US 6 or nearest roadway (feet)	Measured Noise Level (dBA L_{eq})	Modeled Noise Level for Validation (dBA L_{eq})	Difference between Modeled and Measured Noise Level (dBA L_{eq})
14 – W 6th Ave N Dr/Tennyson St	Residential	5/21/2012 12:50 PM	30 (to W 6th Ave S Dr)	67	65	-2
15 – W 6th Ave S Dr/Vrain St	Residential	7/18/2012 2:50 PM	75 (to W 6th Ave N Dr)	64	65	1
16 – W 6th Ave S Dr/Quitman St	Residential	5/21/2012 1:20 PM	25 (to W 6th Ave S Dr)	64	62	-2
17 – W 6th Ave N Dr/ Osceola St	Residential	7/18/2012 2:15 PM	25 (to W 6th Ave N Dr)	66	65	-1
18 – W 6th Ave S Dr/Meade St	Residential	7/16/2012 3:41 PM	35 (to W 6th Ave S Dr)	65	62	-3
19 – W 6th Ave/ King St	Residential	7/16/2012 4:03 PM	125	67	66	-1

All noise measurements performed by Parsons Brinckerhoff, 2012.

For noise model validation, measured noise levels, traffic counts, and average traffic speeds taken during the measurements were used to validate the TNM® traffic noise model. Roadway geometric details were included in the modeling. The existing conditions TNM® model was validated by ensuring that the modeled noise levels at each of the three measured sites were within +/-3 dBA of the measured levels. Because a 3- dBA change in noise levels is barely perceptible to the average human ear, an agreement of +/-3 dBA is considered acceptable for noise model validation purposes.

The verification of the modeled and measured noise levels within 3 dBA indicates that the model is accurately representing the noise levels in this area. The model can therefore be relied upon to accurately predict the noise levels for existing and future peak vehicle hour traffic conditions.

Table 4 shows the TNM® predicted noise results for the measured and modeled sites within the area studied for the existing peak hour traffic worst-case noise condition. The locations of these sites and the corresponding NAC and land use are shown on Figure 6.

The modeled noise levels along the current roadways range from 62 dBA Leq(h) to 75 dBA Leq(h). The modeled noise levels at these receptors are dependent upon the proximity of the receptor to the existing roadways, the amount of physical shielding provided by buildings, and topography. Table 4 also shows that 24 receptors representing 64 residences, 6 park uses, and 2 trails are currently exposed to traffic noise levels in excess of CDOT NAC.

Table 4: Predicted Noise Levels for the Existing Condition

Site Identification Number and Description	Dwelling Units	Activity Category[1]	CDOT NAC dBA $L_{eq(h)}$	Existing Traffic Noise Level dBA $L_{eq(h)}$	At or Above CDOT NAC (Yes/No)
1 – Barnum Park East	1	C	66	65	No
2 – Barnum Park East	1	C	66	66	Yes
3 – Barnum Park East	1	C	66	64	No
4 – Barnum Park East	1	C	66	64	No
5 – Barnum Park East	1	C	66	70	Yes
6 – Barnum Park North	1	C	66	64	No
7 – Barnum Park North	1	C	66	66	Yes
8 – Frog Hollow Park	1	C	66	69	Yes
9 – Phil Milstein Park	1	C	66	68	Yes
10 – Barnum Park	1	C	66	65	No
11 – W 5th/Barnum Park	6	B	66	64	No
12 - W 6th S/Xavier St	6	B	66	66	Yes
13 - W 6th N/Wolff St	14	B	66	62	No
14 – W 6th N/Tennyson St	4	B	66	67	Yes
15 – W 6th S/Vrain St	4	B	66	66	Yes
16 – W 6th S/Quitman St	4	B	66	63	No
17 – W 6th N/ Osceola St	4	B	66	65	No
18 – W 6th S/Meade St	4	B	66	64	No
19 – W 6th N/ King St	4	B	66	67	Yes
A – S Platte River Trail	1	B	66	70	Yes
B – S Platte River Trail	1	B	66	70	Yes
C – Days Inn	1	E	71	70	Yes
D – W 5th/Barnum Park	4	B	66	70	Yes
E – W 5th/Julian St	1	B	66	70	Yes
F – Barnum Park North	4	C	66	75	Yes
G – Fire Station	4	E	71	62	No
H – W 6th S/King St	4	B	66	64	No
I – W 6th S/Lowell St	4	B	66	64	No
J - W 6th S/Meade St	4	B	66	65	No
K – W 6th N/Lowell St	4	B	66	71	Yes
L – W 6th N/Meade St	4	B	66	74	Yes
M – W 6th S/Newton St	4	B	66	65	No
N – W 6th N/Newton St	4	B	66	71	Yes
O – W 6th S/Osceola St	4	B	66	63	No
P – W 6th N/Osceola St	4	B	66	64	No

Site Identification Number and Description	Dwelling Units	Activity Category[1]	CDOT NAC dBA $L_{eq(h)}$	Existing Traffic Noise Level dBA $L_{eq(h)}$	At or Above CDOT NAC (Yes/No)
Q - W 6th S/Osceola St	4	B	66	63	No
R – W 6th N/Quitman St	4	B	66	63	No
S – W 6th S/Perry St	4	B	66	68	Yes
T – W 6th N/Raleigh St	4	B	66	64	No
U - W 6th S/Raleigh St	4	B	66	62	No
V – W 6th N/Stuart St	4	B	66	65	No
W – W 6th S/Stuart St	4	B	66	67	Yes
X – W 6th S/Tennyson St	4	B	66	64	No
Y – W 6th S/Utica St	4	B	66	66	Yes
Z – W 6th N/Utica St	4	B	66	65	No
AA – W 6th N/Vrain St	6	B	66	68	Yes
AB – W 6th S/Winona Ct	4	B	66	66	Yes
AC – W 6th N/Winona Ct	22	B	66	65	No
AD – W 6th S/Wolff St	4	B	66	67	Yes
AE – W 6th S/Zenobia St	4	B	66	68	Yes

[1]See Table 2 for information noise abatement criteria activity categories.

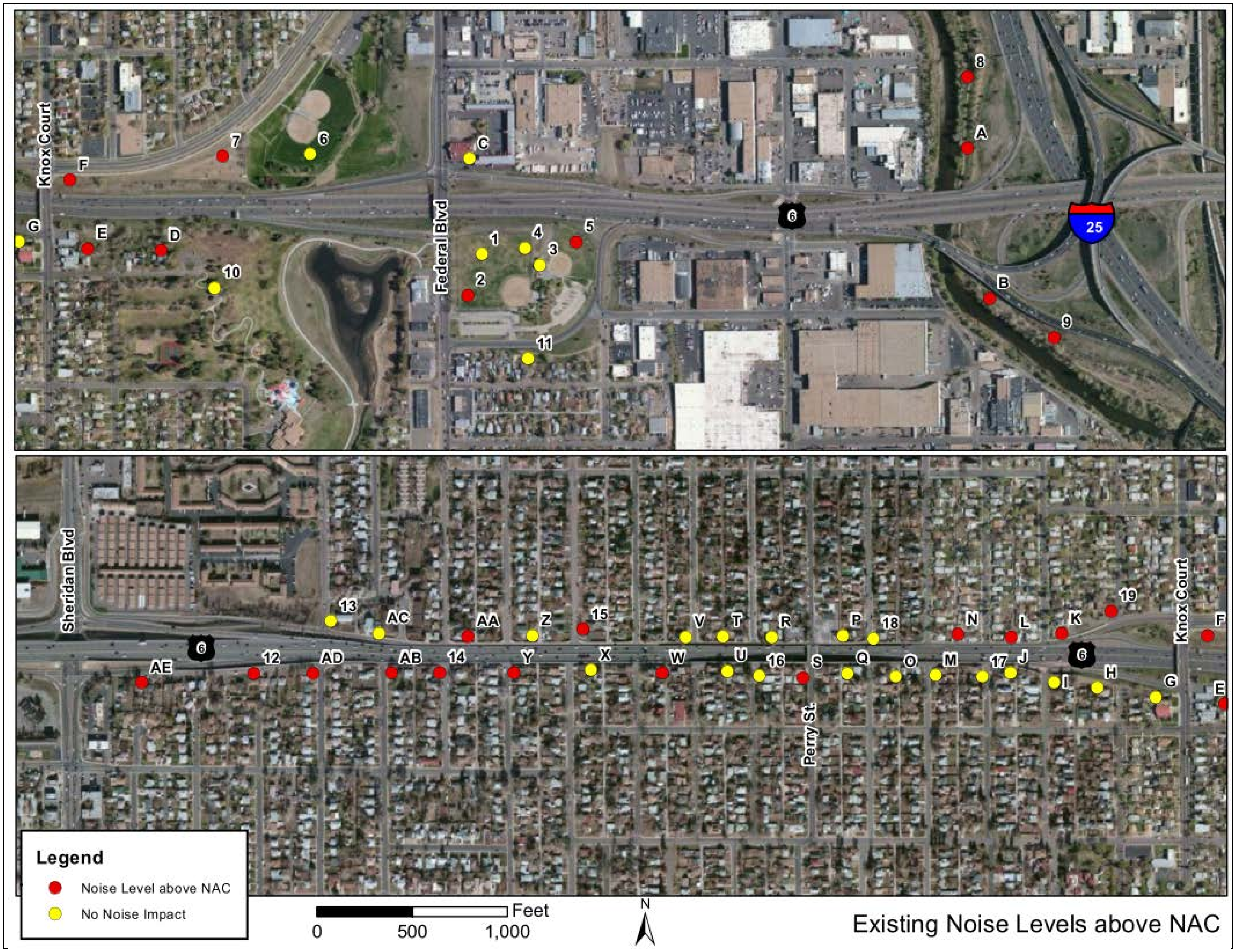

Figure 6: Sites with Existing Noise Levels Above Noise Abatement Criteria

8 Future Noise Levels

For the portion of the 2006 FEIS that included the Project, noise impacts were predicted at Barnum Parks (North and East), Frog Hollow Park, and at residences located at West 5th Avenue and West Short Place.

The noise analysis for the Project resulted in noise impacts at Barnum Parks (North and East), Frog Hollow Park, Milstein Park, South Platte River Trail, one hotel, and at many first and second row residences located north and south of US6 between Knox Court and Sheridan Boulevard.

The evaluation of the Project noise impacts looks at the future Year 2035 No Build condition (without the Project) and the Year 2035 Build condition (with the Project). When compared with the existing conditions at the same measured and modeled sites, Project noise impacts can be determined. The following sections summarize impacts for these two conditions. Table 5 summarizes these impacts for the 19 measured and 31 modeled sites and compares them to the CDOT NAC. Noise receptor sites that are at or over the NAC are highlighted in red. Modeled sites may represent more than one actual residence that demonstrate a similar noise setting and immediate geographic proximity.

8.1 Traffic Noise Analysis

8.1.1 No Build Alternative

The Year 2035 No Build noise levels along the current roadways are dependent upon distance and shielding conditions present between the receptor and the roadway Project components. Noise levels for the No Build Alternative would increase over time due to increased traffic volumes on the roadway network. Figure 7 shows what receptor locations will be over the NAC. Noise levels for the No Build Alternative are predicted to range from 63 dBA $L_{eq(h)}$ to 76 dBA $L_{eq(h)}$ at the same 50 modeled sites. No Build noise levels would increase by 1 to 3 dBA over the existing noise levels with an average increase of 1 dBA at the majority of modeled locations, as summarized in Table 5.

8.1.2 Project Year 2035 Build Alternative

The Build Alternative noise levels along the proposed roadway improvements would be dependent upon distance and shielding conditions present as well as changes to the roadway design and geometry. Project improvements such as the on-ramp from Federal Boulevard to US 6 east bound would move traffic noise closer to Barnum Park East and further from residences along West 5th Avenue.

Noise levels for the Build Alternative would range from 62 dBA $L_{eq(h)}$ to 77 dBA $L_{eq(h)}$. The future Build Alternative noise levels would increase by 1 to 5 dBA over the existing noise levels with an average increase of 1 dBA at most modeled sites. Build noise levels at the lower athletic fields at Barnum Park East, represented by Site 5, are predicted to decrease by 5 dBA compared to existing noise levels. A reduction in traffic noise levels at Site 5 is due to shielding of US6 mainline traffic noise by the new elevated east bound on-ramp from Federal Boulevard. This shielding results from a lower roadway elevation than the rest of Barnum Park East.

Noise levels for the Build Alternative would be within 1 to 3 dBA of predicted No Build Alternative noise levels with an average Build Alternative increase of 1 dBA at most modeled sites. Figure 8 shows which site locations will be over the NAC in 2035 with the Project. Supporting analysis data are summarized in Table 5.

8.1.3 Summary of Traffic Noise Impacts

As shown in Table 5, traffic noise levels currently meet or exceed the NAC at 24 modeled receptors representing 84 residences, 6 park uses, and 2 trails under the Existing Conditions. Under the Year 2035 No Build, the NAC is met or exceeded at 35 modeled receptors representing 107 residences, 10 park uses, 2 trails, and 1 hotel. These impacts are the same for the 2035 the Build Alternative (2035). The difference in impacts between the No Build and Build Alternatives is at Site 5 at the lower Barnum Park East fields where the NAC is reached only with the No Build Alternative. Impacts to Site 6 (Barnum Park North) only occur with the Build Alternative. No substantial increases of 10 dBA L_{eq} or greater were identified as a result of the Project.

Table 5: Predicted Noise Levels and Impact Conditions

Site Identification Number and Description	Dwelling Units	CDOT Criteria[1]/ NAC	Existing Noise Level dBA Leq(h)	No Build Noise Level dBA Leq(h) (2035)	No Build 2035 Increase over Existing Noise Level dBA Leq(h)	Build Noise Level dBA Leq(h)(2035)	Build 2035 Increase over Existing Noise Level dBA Leq(h)[2]	Number of 2035 Build Impacts
1 – Barnum Park East	1	C/66	65	67	2	69	4	1
2 – Barnum Park East	1	C/66	66	69	3	70	4	1
3 – Barnum Park East	1	C/66	64	67	3	66	2	1
4 – Barnum Park East	1	C/66	64	66	2	69	5	1
5 – Barnum Park East	1	C/66	70	72	2	65	-5	0
6 – Barnum Park North	1	C/66	64	65	1	67	3	1
7 – Barnum Park North	1	C/66	66	67	1	69	3	1
8 – Frog Hollow Park	1	C/66	69	69	0	68	-1	1
9 – Phil Milstein Park	1	C/66	68	69	1	69	1	1
10 – Barnum Park	1	C/66	65	67	2	67	2	1
11 – W 5th/Barnum Park	6	B/66	64	66	2	65	0	0
12 - W 6th S/Xavier St	6	B/66	66	67	1	68	2	6
13 - W 6th N/Wolff St	14	B/66	62	63	1	63	1	0
14 – W 6th N/Tennyson St	4	B/66	67	68	1	68	1	4
15 – W 6th S/Vrain St	4	B/66	66	67	1	67	1	4
16 – W 6th S/Quitman St	4	B/66	63	64	1	64	1	0
17 – W 6th N/ Osceola St	4	B/66	65	66	1	66	1	4
18 – W 6th S/Meade St	4	B/66	64	65	1	65	1	0
19 – W 6th N/ King St	4	B/66	67	68	1	68	1	4
A – S Platte River Trail	4	B/66	70	71	1	71	1	4
B – S Platte River Trail	1	B/66	70	71	1	70	0	1
C – Days Inn Hotel	1	E/71	70	72	2	75	5	1
D – W 5th/Barnum Park	4	B/66	70	72	2	73	3	4

Site Identification Number and Description	Dwelling Units	CDOT Criteria[1]/ NAC	Existing Noise Level dBA Leq(h)	No Build Noise Level dBA Leq(h) (2035)	No Build 2035 Increase over Existing Noise Level dBA Leq(h)	Build Noise Level dBA Leq(h)(2035)	Build 2035 Increase over Existing Noise Level dBA Leq(h)[2]	Number of 2035 Build Impacts
E – W 5th/Julian St	1	B/66	70	72	2	72	2	1
F – Barnum Park North	4	C/66	75	76	1	77	2	4
G – Fire Station	4	E/71	62	64	2	64	2	0
H – W 6th S/King St	4	B/66	64	65	1	65	1	0
I – W 6th S/Lowell St	4	B/66	64	65	1	65	1	0
J - W 6th S/Meade St	4	B/66	65	67	2	67	2	4
K – W 6th N/Lowell St	4	B/66	71	72	1	72	1	4
L – W 6th N/Meade St	4	B/66	74	75	1	75	1	4
M – W 6th S/Newton St	4	B/66	65	66	1	66	1	4
N – W 6th N/Newton St	4	B/66	71	72	1	72	1	4
O – W 6th S/Osceola St	4	B/66	63	64	1	64	1	0
P – W 6th N/Osceola St	4	B/66	64	65	1	65	1	0
Q - W 6th S/Osceola St	4	B/66	63	64	1	64	1	0
R – W 6th N/Quitman St	4	B/66	63	64	1	64	1	0
S – W 6th S/Perry St	4	B/66	68	69	1	69	1	4
T – W 6th N/Raleigh St	4	B/66	64	65	1	65	1	0
U - W 6th S/Raleigh St	4	B/66	62	64	1	64	1	0
V – W 6th N/Stuart St	4	B/66	65	66	1	66	1	4
W – W 6th S/Stuart St	4	B/66	67	68	1	68	1	4
X – W 6th S/Tennyson St	4	B/66	64	65	1	65	1	0
Y – W 6th S/Utica St	4	B/66	66	68	2	68	2	4
Z – W 6th N/Utica St	4	B/66	65	66	1	66	1	4
AA – W 6th N/Vrain St	6	B/66	68	69	1	69	1	4
AB – W 6th S/Winona Ct	4	B/66	66	67	1	67	1	4

Site Identification Number and Description	Dwelling Units	CDOT Criteria[1]/ NAC	Existing Noise Level dBA Leq(h)	No Build Noise Level dBA Leq(h) (2035)	No Build 2035 Increase over Existing Noise Level dBA Leq(h)	Build Noise Level dBA Leq(h)(2035)	Build 2035 Increase over Existing Noise Level dBA Leq(h)[2]	Number of 2035 Build Impacts
AC – W 6th N/Winona Ct	22	B/66	65	66	1	66	1	4
AD – W 6th S/Wolff St	4	B/66	67	68	1	68	1	4
AE – W 6th S/Zenobia St	4	B/66	68	68	0	70	2	4

[1] See Table 2 for information on noise abatement criteria activity categories.
[2] A substantial increase is defined by CDOT as being an increase over the existing conditions of 10 dBA $L_{eq\ (h)}$ or greater.

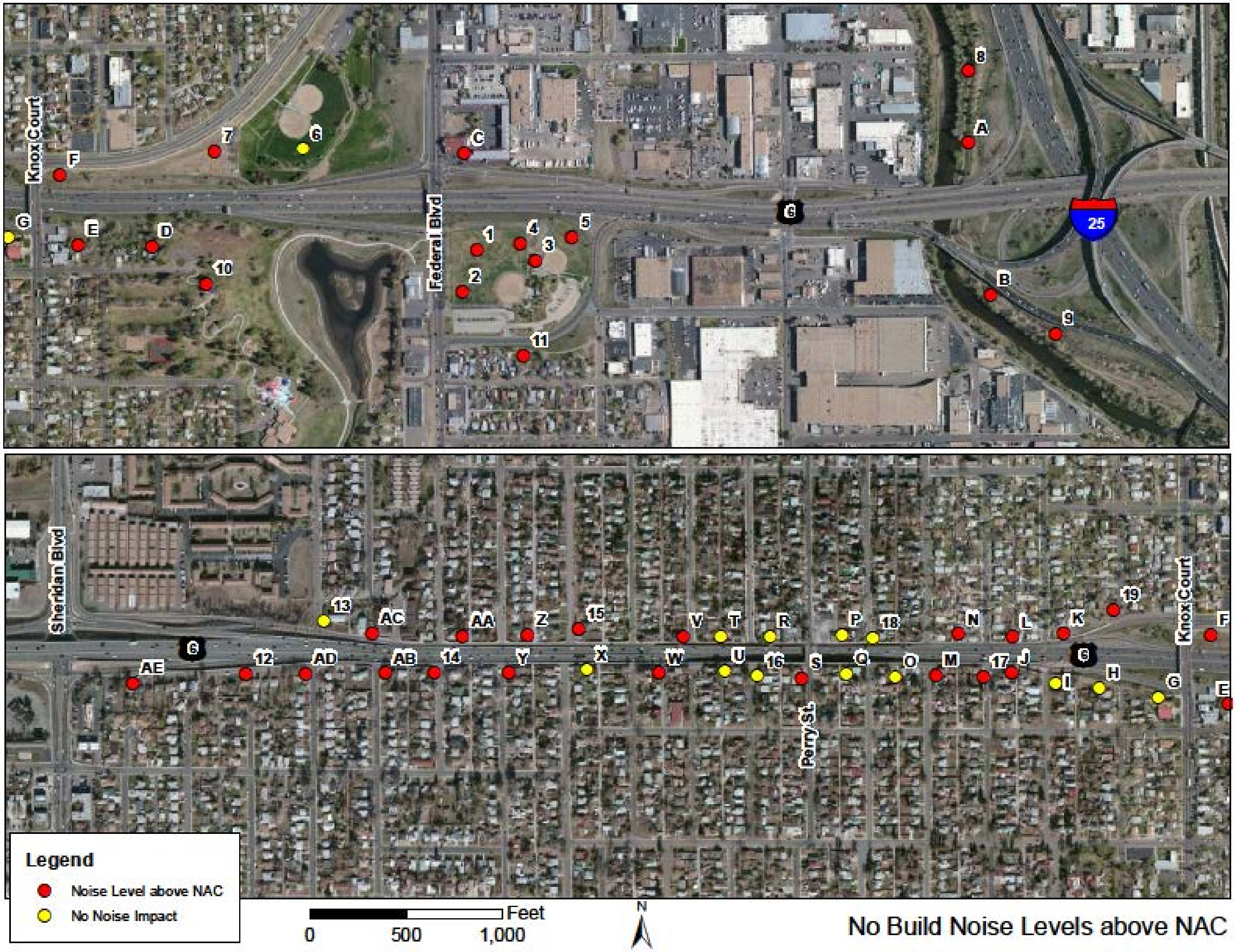

Figure 7: Sites with 2035 No Build (without the Project) Noise Levels Above Noise Abatement Criteria

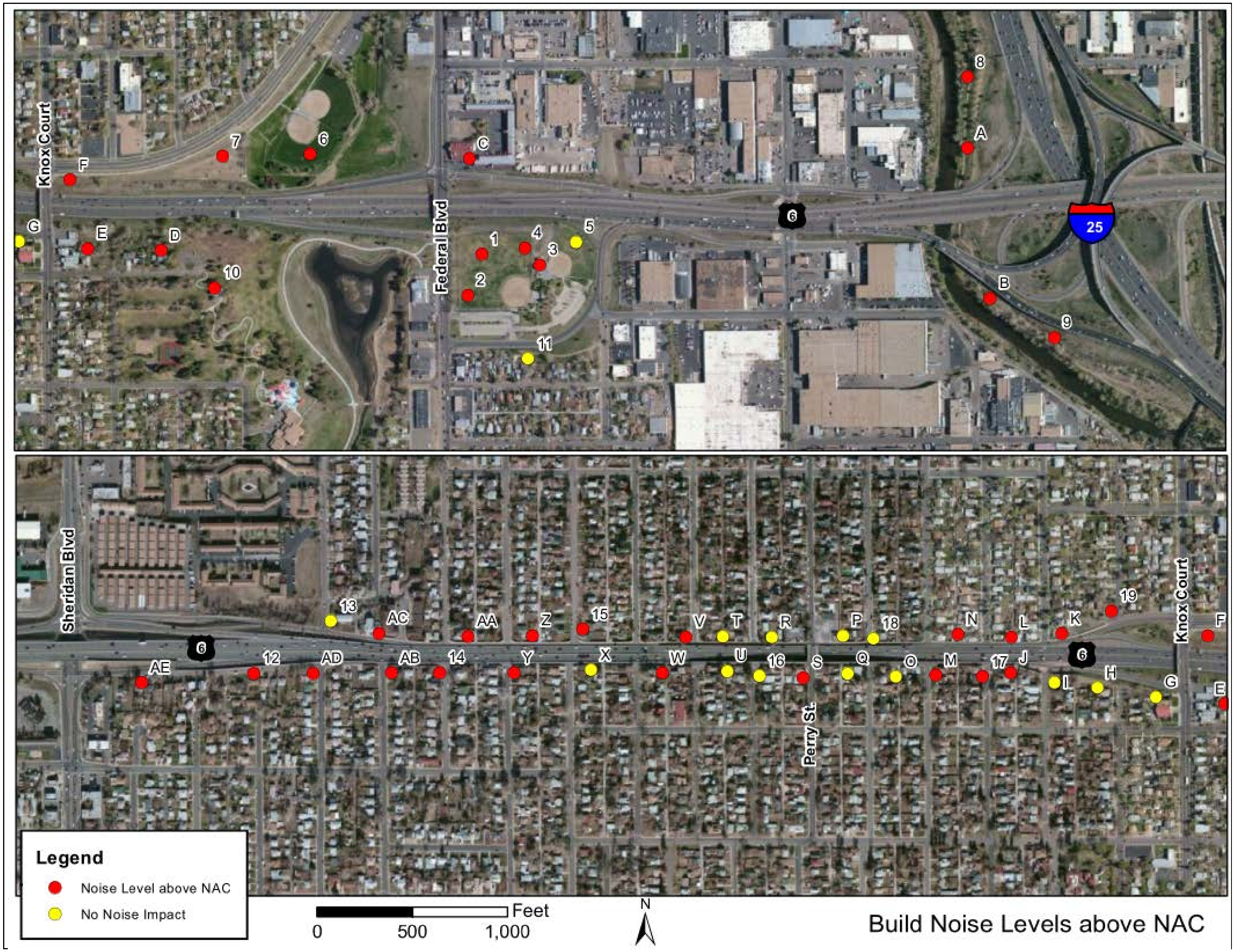

Figure 8: Sites with 2035 Build (with the Project) Noise Levels Above Noise Abatement Criteria

9 Noise Mitigation

For the portion of the Valley Highway EIS that included the Project, noise barriers were evaluated for all impact locations. No noise abatement was recommended for the FEIS mitigation sites because they did not meet the feasibility and reasonable criteria denoted in the CDOT Noise Analysis and Abatement Guidelines (2002). Noise barriers were reevaluated for impacts within the Project area. No abatement was considered feasible and reasonable as they did not meet CDOT 2011 guidance.

Noise abatement is considered for all identified impacts within the Project area.

Several different traffic noise abatement measures are considered whenever noise impacts are expected. For example, noise generated from long-term operation of the Project can be reduced by implementing traffic management measures, acquiring land as buffer zones, realigning the roadway, soundproofing public use or non-profit institutional structures, and constructing noise barriers or berms.

9.1 Traffic Management Measures

Typical traffic management measures include modifying speed limits and traffic control devices and restricting or prohibiting truck traffic. Restricting truck use or reducing speeds on US 6 or Federal Boulevard would conflict with mobility along the corridor. Providing a substantial noise reduction through traffic management measures would not be feasible.

9.2 Realignment of the Roadway

The Project's horizontal alignment is already defined by the existing US 6 and right-of-way. The vertical alignment is constrained by the need to match grade at existing roadways. Lowering US 6 or locating it on a completely new alignment would be prohibitively expensive and would provide only marginal improvement.

9.3 Land Acquisition for Noise Buffers or Barriers

Acquiring land for noise buffer purposes at the impacted sites would require relocating residences and removing access points for residences to the US 6 corridor. Relocating residences would be unreasonably expensive for the purpose of noise mitigation. Providing new access would also be unreasonably expensive for the purpose of noise mitigation.

9.4 Noise Insulation of Buildings

Insulation of buildings could be feasible, but this remedy only applies to public or non-profit institutional buildings, such as schools, churches, or libraries. No impacts are identified at the one public or non-profit institutional building in the project area; therefore, soundproofing options are not applicable.

9.5 Noise Barriers

Noise barriers include noise walls, berms, and buildings that are not sensitive to noise. A noise barrier's effectiveness is determined by its height and length and by project site topography. To be effective, the barrier must block the line-of-sight between the highest point of a noise source (i.e., a truck's exhaust stack) and the receptor. It must be long enough (at least eight times as long as the distance from the home or receptor to the barrier) to prevent sounds from passing around the ends, have no openings (i.e., driveway connections), and be dense enough so that noise would not be transmitted through it. Existing buildings provide shielding benefits to abatement.

CDOT evaluates many factors to determine whether barriers would be feasible and reasonable. Any specific abatement measure recommended as noise mitigation for the Project must be both feasible and reasonable. CDOT's Noise Analysis and Abatement Guidelines (2011) define each of these two criteria:

- For abatement to be feasible, CDOT requires that a barrier design achieve a perceptible noise reduction of at least 5 decibels at one or more receptors; and
- Constructability factors such as barrier height, safety, topography, drainage, utilities, and access issues must meet normal engineering requirements and standards.

Reasonable: For abatement to be reasonable, all three of the following criteria must be successfully met:

- The abatement measure must provide a design goal minimum reduction of 7 dBA noise reduction for at least one receptor;
- A cost-effectiveness index for the abatement measure must be less than $6,800 per residence per decibel reduced; and
- Survey the residents and property owners that benefit from the proposed abatement to determine whether the noise abatement measure is wanted.

9.5.1 Barrier Evaluation

Noise barriers were evaluated at 13 locations shown on Figure 9. Multiple scenarios were evaluated at each barrier location to reduce traffic noise levels at noise impacted receptors. A system of existing noise barriers are located north of and south of US 6 from Knox Court to Sheridan Boulevard. Existing noise barriers from Knox Court to Sheridan Boulevard are generally 8 feet tall and located along private property lines at locations where US 6 is at the same grade as the surrounding community. At the Perry Street undercrossing, existing noise barriers are located atop the retaining walls north and south of US 6 that divide US 6 from the US 6 frontage roadways to the north and south. The barriers located atop the US 6 retaining walls are also generally 8 feet tall after combining the 3 to 4 foot tall jersey barrier located at the bottom of each wall. The location of each existing noise barrier and evaluated noise barrier is shown on Figure 9. A summary of all 13 noise barriers evaluated is provided in Table 6.

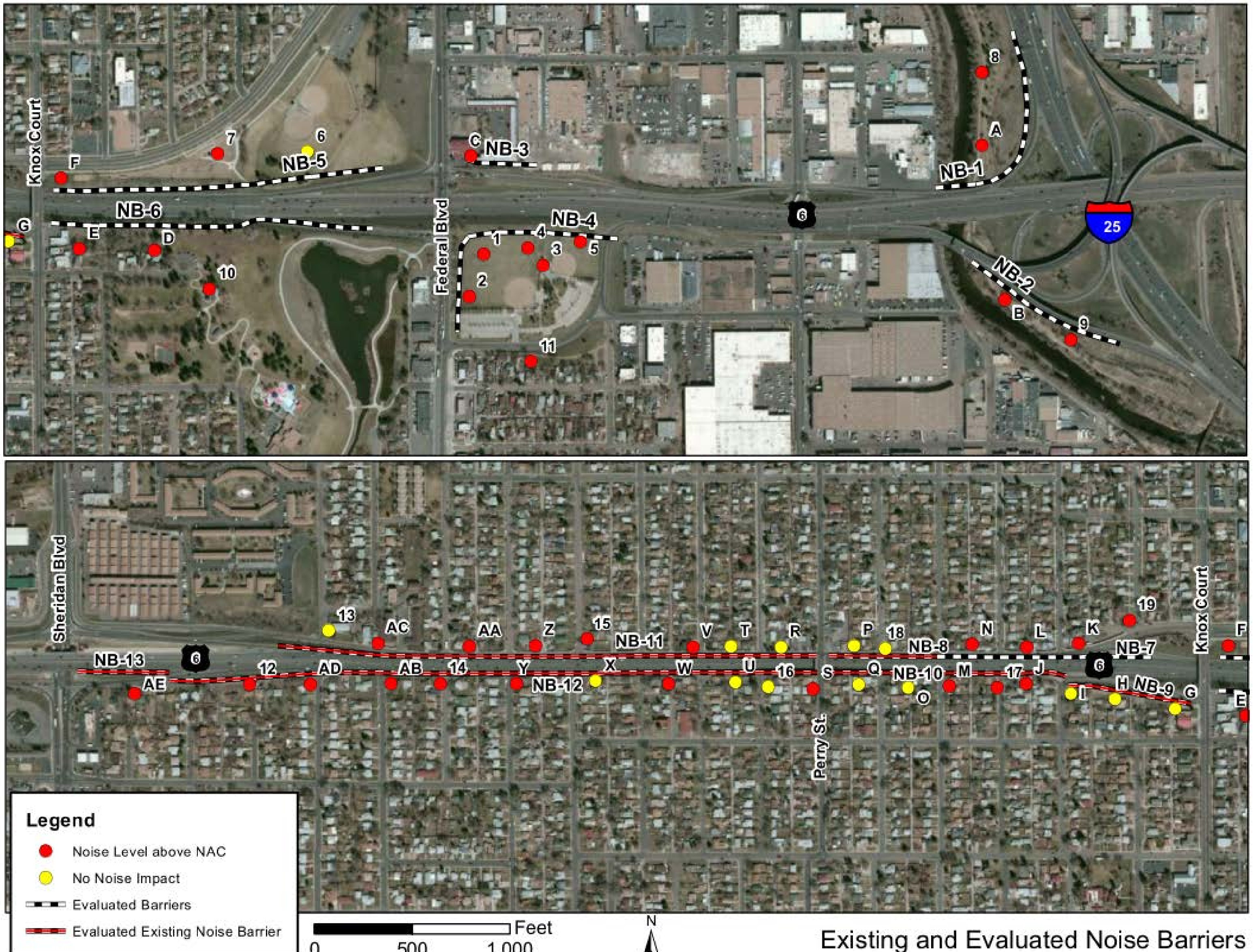

Figure 9: Existing and Evaluated Noise Barriers

Table 6: Noise Barriers Evaluation Summary

Barrier Number Barrier Evaluation Scenario	Barrier Feasible Criteria 7 dBA Noise Reduction Goal and 5 dBA Reduction at Impacted Receptors	Barriers Reasonableness Calculation (no more than $6,800/Decibel/Receptor)	Cost-Benefit Index Calculation for Each Evaluated Barrier (Barrier Height, Number Benefited, Total Barrier Cost)
Barrier 1	No (2 impacted sites, 0 receive > 7dBA + 5 dBA)	NA	NA
Barrier 2	No (2 impacted sites, 2 receive > 7dBA + 5 dBA)	No ($22K/decibel/benefitted receptor at 8 feet tall)	8 Feet: 2 benefited, $313,920 10 Feet: 2 benefited, $392,400 12 Feet: 2 benefited, $470,880 14 Feet: 2 benefited, $549,360 16 Feet: 2 benefited, $627,840 18 Feet: 2 benefited, $706,320 20 Feet: 2 benefited, $784,800
Barrier 3	No (1 impacted sites, 1 receive > 7dBA + 5 dBA)	No ($33K/decibel/benefitted receptor at 12 feet tall)	8 Feet: 0 benefited 10 Feet: 0 benefited 12 Feet: 1 benefited, $231,660 14 Feet: 1 benefited, $270,270 16 Feet: 1 benefited, $308,880 18 Feet: 1 benefited, $347,490 20 Feet: 1 benefited, $386,100
Barrier 4	No (4 impacted sites, 3 receive > 7dBA + 5 dBA)	No ($41K/decibel/benefitted receptor at 14 feet tall)	8 Feet: 0 benefited 10 Feet: 1 benefited, $507,600 12 Feet: 1 benefited, $609,120 14 Feet: 2 benefited, $710,640 16 Feet: 2 benefited, $812,160 18 Feet: 2 benefited, $913,680 20 Feet: 2 benefited, $1,015,200
Barrier 5	No (3 impacted sites, 3 receive > 7dBA + 5 dBA)	No ($64K/decibel/benefitted receptor at 14 feet tall)	8 Feet: 1 benefited, $628,200 10 Feet: 1 benefited, $785.250 12 Feet: 1 benefited, $942,300 14 Feet: 2 benefited, $1,099,350 16 Feet: 2 benefited, $1,256,400 18 Feet: 2 benefited, $1,413,450 20 Feet: 2 benefited, $1,570,500
Barrier 6	No (6 impacted sites, 7 receive > 7dBA + 5 dBA)	No ($20K/decibel/benefitted receptor at 16 feet tall)	8 Feet: 0 benefited 10 Feet: 0 benefited 12 Feet: 0 benefited 14 Feet: 6 benefited, $859,320 16 Feet: 7 benefited, $982,080 18 Feet: 7 benefited, $1,104,840 20 Feet: 7 benefited, $1,227,600

Barrier Number Barrier Evaluation Scenario	Barrier Feasible Criteria 7 dBA Noise Reduction Goal and 5 dBA Reduction at Impacted Receptors	Barriers Reasonableness Calculation (no more than $6,800/Decibel/Receptor)	Cost-Benefit Index Calculation for Each Evaluated Barrier (Barrier Height, Number Benefited, Total Barrier Cost)
Barrier 7	No (16 impacted sites, 12 receive > 7dBA + 5 dBA)	No ($7,802/decibel/benefitted receptor)	8 Feet: 4 benefited, $395,280 10 Feet: 8 benefited, $494,100 12 Feet: 12 benefited, $592,920 14 Feet: 12 benefited, $691,740 16 Feet: 12 benefited, $790,560 18 Feet: 12 benefited, $889,380 20 Feet: 12 benefited, $988,200
Barrier 8	NA	NA	NA
Barrier 9	NA	NA	NA
Barrier 10	NA	NA	NA
Barrier 11	NA	NA	NA
Barrier 12	NA	NA	NA
Barrier 13	NA	NA	NA

Source: Parsons Brinckerhoff, 2012.
NA – Not Applicable as existing mitigation shown achieve CDOT 7 dBA Noise Reduction Design Goal.

Noise Barrier 1

Noise Barrier 1 was evaluated along the southbound I-25 off-ramp to westbound US 6 as shown in Figure 9. It would potentially reduce predicted noise impacts at Sites A and 8 (see Table 5). At a length of up to 900 linear feet and up to 20 feet tall, Noise Barrier 1 was not able to achieve the necessary 7 dBA noise reduction design goal for further consideration. This barrier is therefore not reasonable under CDOT *Noise Analysis and Abatement Guidelines* and will not be included in the Project.

Noise Barrier 2

Noise Barrier 2 was evaluated along the southbound I-25 on-ramp from US 6 eastbound (Figure 9) to mitigate for noise impacts at Sites B and 9. The analysis looked at a length of approximately 872 linear feet at heights from 8 feet to 20 feet. At 8 feet high, Noise Barrier 2 meets the 7 dBA noise reduction design goal by providing benefit to two receptors and is therefore feasible. At a cost of $22,423 per decibel reduction per benefited receptor, the barrier is not reasonable, relative to CDOT's Cost Benefit Index of $6,800 per decibel per benefitted receptor. Higher noise barrier heights up to 20 feet would be more costly per decibel per benefitted receptor. Barrier 2 is therefore not reasonable under CDOT *Noise Analysis and Abatement Guidelines* and will not be included in the Project.

Noise Barrier 3

Noise Barrier 3 was evaluated to reduce predicted noise impacts at Sites C (Table 5). Noise Barrier 3 was evaluated along the westbound US 6 off-ramp at Federal Boulevard as shown in Figure 9. Noise

Barrier 3 was evaluated at approximately 429 linear feet at heights from 8 feet to 20 feet. At a height of 12 feet, Noise Barrier 3 is feasible as it meets the noise reduction design goal by providing 7 dBA benefit to one receptor. However, the cost-benefit index of $33,094 per decibel reduction per benefited receptor is well in excess of CDOT's reasonableness Cost Benefit Index of $6,800 per decibel per benefitted receptor. Additional noise barrier heights up to 20 feet are more costly per decibel per benefitted receptor. Barrier 3 is therefore not reasonable under CDOT *Noise Analysis and Abatement Guidelines* and will not be included in the Project.

Noise Barrier 4

Noise Barrier 4 was evaluated along northbound Federal Boulevard and the planned US 6 eastbound on-ramp from Federal Boulevard (Figure 9) to reduce predicted noise impacts at Sites 1, 2, 3, and 4. Barrier dimensions were approximately 1,128 linear feet long at heights from 8 feet to 20 feet. At a height of 14 feet, Noise Barrier 4 meets the 7 dBA noise reduction design goal by providing benefit to three receptors, but the cost of $41,802 per decibel reduction per benefited receptor is well in excess of CDOT's Cost Benefit Index reasonableness criteria of $6,800 per decibel per benefitted receptor. Additional noise barrier heights up to 20 feet are more costly per decibel per benefitted receptor. Barrier 4 is therefore not reasonable under CDOT *Noise Analysis and Abatement Guidelines* and will not be included in the Project.

Noise Barrier 5

Noise Barrier 5 was evaluated along the US 6 westbound on-ramp from Federal Boulevard and along US 6 westbound mainlines to reduce predicted noise impacts at Sites 6, 7, and F. Barriers were analyzed at approximately 1,745 linear feet long and at heights from 8 feet to 20 feet. At a height of 14 feet, Noise Barrier 5 meets the 7 dBA noise reduction design goal by providing benefit to three receptors. At a cost of $64,668 per decibel reduction per benefited receptor, the barrier is not reasonable when compared to CDOT's Cost Benefit Index of $6,800 per decibel per benefitted receptor. Additional noise barrier heights up to 20 feet are more costly per decibel per benefitted receptor. Noise Barrier 5 is therefore not reasonable under CDOT *Noise Analysis and Abatement Guidelines* and will not be included in the Project.

Noise Barrier 6

Noise Barrier 6 was evaluated along US 6 eastbound mainline and along the US 6 eastbound off-ramp to Federal Boulevard to reduce predicted noise impacts at Sites D, E, and 10. Barriers were analyzed at approximately 1,364 linear feet in length and at heights from 8 feet to 20 feet. At a height of 16 feet, Noise Barrier 6 meets the 7 dBA noise reduction design goal by providing benefit to seven receptors. The cost of $20,895 per decibel reduction per benefited receptor does not meet the $6,800 per residence per decibel cost-benefit index criteria. At a height of 16 feet, Noise Barrier 6 is not reasonable under CDOT's Cost Benefit Index of $6,800 per decibel per benefitted receptor. Additional noise barrier heights up to 20 feet are more costly per decibel per benefitted receptor. Noise Barrier 6 is therefore not reasonable under CDOT *Noise Analysis and Abatement Guidelines* and will not be included in the Project.

Noise Barrier 7

Noise Barrier 7 was evaluated along US 6 westbound mainline between the Knox Court and Perry Street overcrossings to reduce predicted noise impacts at Sites 18, 19, K, L, N, and P. Barriers were analyzed at approximately 1,098 linear feet in length and at heights from 8 feet to 20 feet. At a height of 12 feet, Noise Barrier 7 meets the 7 dBA noise reduction design goal by providing benefit to 12 receptors. At a cost of $7,802 per decibel reduction per benefited receptor, it does not meet CDOT's Cost Benefit Index of $6,800 per decibel per benefitted receptor and is therefore not reasonable. Additional noise barrier heights up to 20 feet are more costly per decibel per benefitted receptor. Noise Barrier 7 is therefore not reasonable under CDOT *Noise Analysis and Abatement Guidelines* and will not be included in the Project.

Noise Barriers 8 to 13

Noise Barriers 8 to 13 were evaluated to reduce predicted noise impacts at residential sites located north and south of US 6 between Knox Court and Sheridan Boulevard. Each evaluation area is shown on Figure 9. Noise barriers were placed between the US 6 mainlines and the one-way US 6 eastbound and westbound frontage roads running along the north and south sides of the US 6 mainline. As provided in CDOT's Noise Analysis and Abatement Guidelines, existing noise barriers located throughout this area were evaluated to determine if they would achieve the CDOT 7 dBA noise reduction design goal with the 2035 Build project. At least one impacted receptor behind each wall was provided a minimum 7 dBA noise reduction with the current noise barriers. Additionally, most receptors located behind each existing noise barrier receiving at least 5 dBA noise reduction. These existing noise walls would therefore continue to provide adequate noise mitigation for impacted receptors.

9.6 Noise Mitigation Analysis Findings

One-hundred and seven residential units, 10 park uses, 2 trails, and 1 hotel represented by Sites 1-4, 6-10, 12, 14, 15, 17, 19, D, E, J, K, L, M,N, S, V, W, and Y, Z, AA, AB, AC, AD, AE are predicted to be impacted by the Project Build Alternative noise conditions (Table 5). No substantial increase impacts of 10 dBA or more above existing conditions were predicted with the Project.

Noise barriers were evaluated for each of these receptor sites and found to be not feasible and reasonable due to the inability of barriers to reduce traffic noise at these sites to the CDOT Cost-Benefit Index. The existing noise barriers (8 through 13) will continue to provide adequate noise mitigation consistent with CDOT guidelines.

10 Construction Noise Analysis

If the Project were to be constructed, areas adjacent to the Project would be exposed to construction noise. Although of a temporary nature, the additional noise can be annoying to the public.

Effects on adjacent communities during construction would include noise from the operation of construction equipment and noise from hauling and delivery vehicles traveling to and from the construction site. The level of impact would depend on the noise characteristics of the equipment, activities involved, construction schedule, and distance of equipment from sensitive receptors.

At a typical noise receptor, the noise levels would be highest during the early phases of construction, when excavation and heavy daily truck traffic would occur. Average noise levels for typical construction equipment, measured at 50 feet from the construction site, range from 81 dBA for generators and pumps to 89 dBA for asphalt spreaders. The total hourly energy average dBA noise level, $L_{eq(h)}$, at a distance of 50 feet from the construction activity is usually approximately 85 dBA.

Estimates of maximum noise levels (L_{max}) at a distance of 50 feet for various pieces of construction equipment used on highway projects are provided in Table 7. The L_{max} represents the loudest monitored noise level from a specific piece of construction equipment whereas the $L_{eq(h)}$ is the average sound level of all construction equipment over a period of time, in this case one hour. While actual noise levels would vary due to particular equipment, phase of construction, and the influence of the person using the equipment, every effort should be made to minimize the adverse effects of construction noise whenever possible. Given the circumstances, the City and County of Denver may grant variances that would allow certain construction activities during after-hour periods or during weekends.

Construction noise is typically regulated on a project-specific basis in the form of Standard Specifications or Special Provisions in the contractor's documents. The City and County of Denver Noise Code, Title 18, Noise Control, states that the allowable noise limits are 55 dBA L_{eq} between the hours of 7:00 a.m. to 9:00 p.m.. The ordinance makes exceptions for sound created by construction activities and for vehicle traffic on public roads.

Table 7: Construction Equipment Noise Levels

Equipment Description	Impact Device (Yes/No)[1]	Acoustic Usage Factor (%)[2]	Specified Limit dBA L_{max} @ 50 feet[3]	Actual Measured dBA L_{max} @ 50 feet[4]
All other equipment > 5 HP	No	50	85	N/A
Auger drill rig	No	20	85	84
Backhoe	No	40	80	78
Bar bender	No	20	80	N/A
Blasting	Yes	N/A	94	N/A
Boring jack power unit	No	50	80	83
Chain saw	No	50	85	84
Clam shovel (dropping)	Yes	20	93	87
Compactor (ground)	No	20	80	83
Compressor (air)	No	40	80	78
Concrete batch plant	No	15	83	N/A
Concrete mixer truck	No	40	85	79
Concrete pump truck	No	20	82	81
Concrete saw	No	20	90	90
Crane	No	16	85	81
Dozer	No	40	85	82
Drill rig truck	No	20	84	79
Drum mixer	No	50	80	80
Dump truck	No	40	84	76
Excavator	No	40	85	81
Flat bed truck	No	40	84	74
Front end loader	No	40	80	79
Generator	No	50	82	81
Generator (<25 KVA, VMS signs)	No	50	70	73
Gradall	No	40	85	83
Grader	No	40	85	83
Grapple (on backhoe)	No	40	85	87
Horizontal boring hydraulic jack	No	25	80	82
Hydra break ram	Yes	10	90	N/A
Impact pile driver	Yes	20	95	101
Jackhammer	Yes	20	85	89
Man lift	No	20	85	75
Mounted impact hammer (hoe ram)	Yes	20	90	90
Pavement scarafier	No	20	85	90
Paver	No	50	85	77

Equipment Description	Impact Device (Yes/No)[1]	Acoustic Usage Factor (%)[2]	Specified Limit dBA L_{max} @ 50 feet[3]	Actual Measured dBA L_{max} @ 50 feet[4]
Pickup truck	No	40	55	75
Pneumatic tools	No	50	85	85
Pumps	No	50	77	81
Refrigerator Unit	No	100	82	73
Rivet buster/chipping gun	Yes	20	85	79
Rock drill	No	20	85	81
Roller	No	20	85	80
Sand blasting (single nozzle)	No	20	85	96
Scraper	No	40	85	84
Shears (on Backhoe)	No	40	85	96
Slurry plant	No	100	78	78
Soil mix drill rig	No	50	80	N/A
Tractor	No	40	84	N/A
Vacuum excavator (Vac-truck)	No	40	85	85
Vacuum street sweeper	No	10	80	82
Ventilation fan	No	100	85	79
Vibrating hopper	No	50	85	79
Vibratory concrete mixer	No	20	80	80
Vibratory pile driver	No	20	95	101
Warning horn	No	5	85	83
Welder/torch	No	40	73	74

Source: USDOT, FHWA 2006

[1] An indication as to whether or not the equipment is an impact device.
[2] The acoustical usage factor to assume for modeling purposes.
[3] The specification "spec" limit for each piece of equipment expressed as an L_{max} level in dBA at a reference distance of 50 feet.
[4] The measured "ACTUAL" noise level at 50 feet for each piece of equipment.

10.1 Construction Noise Abatement

The following measures could be taken to the extent practicable to avoid, minimize, and mitigate temporary adverse noise impacts:

- The contractor should comply with all state and local sound control and noise level rules, regulations, and ordinances that would apply to any work performed pursuant to the contract.
- All equipment shall comply with pertinent equipment noise standards of the EPA.
- All equipment used shall have sound control devices no less effective than those provided on the original equipment. Equipment and vehicles without muffled exhaust systems will not be allowed on the work site.
- All equipment shall comply with the pertinent equipment noise standards found in the FHWA Roadway Construction Noise Model as shown in Table 7.

Should specific noise complaints occur during the construction of the Project, one or more of the following noise abatement measures may be required at the Contractor's expense, as directed by CDOT's Project Manager:

- Locate stationary construction equipment as far from the nearby noise-sensitive properties as possible.
- Shut off idling equipment.
- Use alternative methods or equipment which produce less noise.
- Reschedule construction operations to avoid periods of noise annoyance identified in the complaint.
- Notify nearby residences whenever extremely noisy work will be occurring.
- Install temporary or portable acoustic barriers around stationary construction noise sources as necessary and viable.
- Operate electric-powered equipment using line voltage power instead of on-site generators.

Use manually-adjustable or new broadband backup alarms which can be localized and focused to the danger zone and set to the low noise setting on all construction vehicles used during nighttime hours.

11 Coordination with Local Government Officials

11.1 Report Distribution

A copy of this report will be made available to the City and County of Denver Community Planning and Development Department by CDOT. This report will serve to inform City and County Planning staff of the effects of the highway and highway-construction-related noise in the area studied. The information contained within this report can assist the City and County in its planning process. It is recommended that the City of and County use this information as a guide when developing future land use plans, zoning, or building code requirements. The use of this information may assist local government with future development plans and thereby result in development that is consistent with the noise environment.

At the time of this report, there are no undeveloped or vacant portions of the area studied along the Project (City and County of Denver, 2012). According to the CDOT Noise Analysis and Abatement Guidelines Manual, if building permits have been submitted for undeveloped properties, the proposed development needs to be included in the noise study. As of July 29, 2012, the City and County of Denver Community Planning and Development Department indicated that no building permits had been submitted to develop structures such as residences, commercial uses, or other NAC B, C, D, or F properties along the corridor.

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Appendix A – Introduction to Acoustics

Sound is created when objects vibrate, resulting in a minute variation in surrounding atmospheric pressure called sound pressure. The human response to sound depends on the magnitude of a sound as a function of its frequency and time pattern (EPA 1974). Magnitude measures the physical sound energy in the air. The range of magnitude, from the faintest to the loudest sound the ear can hear, is very large so, for convenience, sound pressure is expressed on a logarithmic scale in units called decibels (dB). Loudness, compared with physical sound measurement, refers to how people subjectively judge a sound. This varies from person to person. Table A-1 shows the magnitudes of typical noise sources.

Table A-1: Typical Noise Levels

Transportation Sources	Sound Level (dBA)	Other Sources	Description
	130		Painfully loud
Jet takeoff (200 feet)	120		
Car horn (3 feet)	110		Maximum vocal effort
	100	Shout (0.5 feet)	
	95		Very annoying
Heavy truck (50 feet)	90	Jack hammer (50 feet)	Loss of hearing with prolonged exposure
		Home shop tools (3 feet)	
Train on a structure (50 feet)	85	Backhoe (50 feet)	
City bus (50 feet)	80	Bulldozer (50 feet)	Annoying
		Vacuum cleaner (3 feet)	
Train (50 feet)	75	Blender (3 feet)	
City bus at stop (50 feet)			
Freeway traffic (50 feet)	70	Lawn mower (50 feet)	
		Large office	
Train in station (50 feet)	65	Washing machine (3 feet)	Intrusive
	60	TV (10 feet)	
Light traffic (50 feet)	55	Talking (10 feet)	
Light traffic (100 feet)	50		Quiet
	45	Refrigerator (3 feet)	
	40	Library	
	30	Soft whisper (15 feet)	Very quiet

Sources: USDOT (1995); EPA (1971, 1974).

Humans respond to a sound's frequency or pitch. The human ear can very effectively perceive sounds with a frequency between approximately 500 and 5,000 Hz, but the efficiency decreases outside this range. Environmental noise is composed of many frequencies, each occurring simultaneously at its own sound pressure level. Frequency weighting, which is applied electronically by a sound level meter, combines the overall sound spectrum into one sound level that simulates how a typical person hears sounds. The commonly used frequency weighting for environmental noise is weighting (dBA), which is most similar to how humans perceive sounds of low to moderate magnitude.

Because of the logarithmic decibel scale, a doubling of the number of sound sources (such as the number of cars operating on a roadway) increases noise levels by 3 dBA. A ten-fold increase in the number of sound sources would add 10 dBA. As a result, a sound source emitting a sound level of 60 dBA combined with another sound source of 60 dBA yields a combined sound level of 63 dBA, not 120 dBA. The human ear can barely perceive a 3-dBA increase, but a 5- or 6-dBA increase is readily noticeable and appears as if the sound is about one and one-half times as loud. A 10-dBA increase appears to be a doubling in sound level to most listeners.

Noise levels from traffic sources depend on traffic volume, vehicle speed, type of vehicle, and pavement surface conditions. Generally, an increase in traffic volume, speed, or vehicle size increases traffic noise levels. Vehicular noise is a combination of noises from the engine, exhaust, and tires. Other conditions affecting the propagation of traffic noise include defective mufflers, steep grades, terrain, vegetation, distance from the roadway, and shielding by barriers and buildings.

Sound levels decrease with distance from the source. For a line source, such as a roadway, sound levels decrease 3 dBA over hard ground (concrete, pavement) or 4.5 dBA over soft ground (grass) for every doubling of distance between the source and the receptor. For a point source, such as construction sources, sound levels would decrease between 6 and 7.5 dBA for every doubling of distance from the source.

The propagation of sound can be greatly affected by terrain and the elevation of the receptor relative to the sound source. Level ground is the simplest scenario: sound travels in a straight line-of-sight path between the source and receptor. If the sound source is depressed or the receptor is elevated, sound generally travels directly to the receptor. Sound levels may be reduced because the terrain crests between the source and receptor, resulting in a partial sound barrier near the receptor. If the sound source is elevated or the receptor is depressed, sound often is reduced at the receptor. The edge of the roadway can act as a partial sound barrier, blocking some sound transmission between the source and receptor.

Even a short barrier, such as a solid concrete jersey-type safety barrier, can be effective at further reducing traffic noise levels. However, to be truly effective, a noise barrier must break the line-of-sight between a noise source and the listener. Breaking the line-of-sight between the receptor and the highest sound source typically results in a noise reduction of approximately 5 dBA. Noise levels can be reduced by as much as 15 dBA with a well-designed and properly constructed noise barrier.

Sound Level Descriptors

A widely used descriptor for environmental noise is the equivalent sound level (L_{eq}). The L_{eq} can be considered a measure of the average sound energy during a specified period of time. L_{eq} is defined as the constant level that, over a given period of time, transmits to the receptor the same amount of acoustical energy as the actual time-varying sound. For example, two sounds, one of which contains twice as much energy but lasts only half as long, have the same L_{eq} sound levels. L_{eq} measured over a one-hour period is the hourly L_{eq} [$L_{eq(h)}$], which is used for highway noise impact and abatement analyses.

Short-term sound levels, such as those from a single truck passing by, can be described by either the total sound energy or the highest instantaneous sound level that occurs during the event. The sound exposure level (SEL) is a measure of total sound energy from an event and is useful in determining what the L_{eq} would be over a period of time when several sound events occur. The maximum sound level (L_{max}) is the greatest short-duration sound level that occurs during a single event. L_{max} is related to impacts on speech interference and sleep disruption. In comparison, L_{min} is the minimum sound level during a period of time.

People generally find a moderately high, constant sound level more tolerable than a quiet background level interrupted by frequent high-level noise intrusions. An individual's response to sound depends greatly on the range that the sound varies in a given environment. For example, steady traffic noise from a highway is normally less bothersome than occasional aircraft flyovers in a relatively quiet area. In light of this subjective response, it is often useful to look at a statistical distribution of sound levels over a given time period in addition to the average sound level. Such distributions identify the sound level exceeded and the percentage of time exceeded. It therefore allows for a more thorough description of the range of sound levels during the given measurement period. These distributions are identified with an L_n where n is the percentage of time that the levels are exceeded. For example, the L_{10} level is the noise level that is exceeded 10 percent of the time.

Effects of Noise

Environmental noise at high intensities directly affects human health by causing the disease of hearing loss. Prolonged exposure to very high levels of environmental noise can cause hearing loss. The EPA has established a protective level of 70 dBA L_{eq} (24), below which hearing is conserved for exposure over a 40-year period (EPA 1974). OSHA exposure standards for noise under working conditions are a different set of health-related criteria, not related to the ambient FHWA Highway Traffic Noise criteria or EPA recommendation. Although scientific evidence is not currently conclusive, noise is suspected of causing or aggravating other diseases. Environmental noise indirectly affects human welfare by interfering with sleep, thought, and conversation. The FHWA noise abatement criteria are based on speech interference, which is a well-documented impact that is relatively reproducible in human response studies. Noise also can affect wildlife.

Appendix B – Traffic Data

For this noise study, traffic volume data was developed and provided by Parsons Brinckerhoff for the existing conditions, No Build Alternative, and Build Alternative worst hourly condition. The TNM® model uses three categories of traffic vehicles, namely automobiles, medium trucks, and heavy trucks. Automobiles are defined as vehicles with two axles and four wheels, including pickup trucks, SUVs, and vans. Medium trucks have two axles with six wheels and include most buses. Heavy trucks are defined as vehicles having more than two axles.

Table B-1. Existing Conditions Modeled Traffic Volumes

Existing Conditions - Roadways	Total	Cars	MT	HT	Numer of Lanes	Maximum Traffic Per Lane	Speed	Total per Lane	Cars	MT	HT
EB 6th PM between Knox and Sheridan	4200	4081	51	68	4	2000	55	1050	1020	13	17
WB 6th PM between Knox and Sheridan	5000	4858	61	81	3	2000	55	1667	1619	20	27
EB 6th PM between Knox and BNSF	4400	4275	54	71	4	2000	55	1100	1069	13	18
WB 6th PM between Knox and BNSF	5800	5635	71	94	4	2000	55	1450	1409	18	23
WB 6th PM between Knox and BNSF	5800	5635	71	94	3	2000	55	1933	1878	24	31
SB I-25 PM	7200	6691	167	342	4	1800	65	1800	1673	42	86
NB I-25 PM	7200	6691	167	342	4	1800	65	1800	1673	42	86
WB on Ramp PM From Federal	715	670	35	11	2	1600	45	358	335	17	5
WB off Ramps PM To Federal	570	534	28	9	2	1600	35	285	267	14	4
Federal SB PM	1350	1264	65	20	2	1600	35	675	632	33	10
Federal NB PM	1400	1311	68	21	2	1600	35	700	656	34	11
EB Off PM To Federal	545	510	26	8	2	800	35	273	255	13	4
EB on from 5th Ave PM	700	656	34	11	1	800	35	700	656	34	11
WB Off to Bryant PM	310	290	15	5	1	800	35	310	290	15	5
WB From Bryant PM	230	215	11	3	1	800	35	230	215	11	3
EB Ramp to Bryant PM	180	169	9	3	1	800	37	180	169	9	3
I-25 Ramps On SB PM from EB 6th	1180	1094	56	29	1	1400	45	1180	1094	56	29
I-25 Ramp Off SB PM To WB 6th	1400	1298	67	35	1	1400	45	1400	1298	67	35
I-25 Ramp Off NB PM From EB 6th	1585	1470	76	39	2	1400	45	793	735	38	20
I-25 Ramps On SB PM From WB 6th	520	482	25	13	2	1400	45	260	241	12	6
I-25 Ramp SB I26 to EB 6th PM	385	357	18	10	1	700	45	385	357	18	10
I-25 NB Rampto WB 6th PM	700	649	33	17	1	700	45	700	649	33	17
WB 6th to NB I-25 PM	350	325	17	9	1	700	45	350	325	17	9
Ramps at 45	1500	1405	72	23	2	750	45	750	702	36	11
Ramps at 35	1600	1499	77	24	2	1600	45	800	749	39	12
5th Street	631	591	30	10	1	700	35	631	591	30	10
5th Street On Ramp	660	618	32	10	1	1400	35	660	618	32	10

Source: Parsons Brinckerhoff, 2012

Note: Where traffic volumes reached maximum traffic volumes, maximum volumes were used per CDOT guidance.

Table B-2. 2035 No Build Modeled Traffic Volumes

2035 No Build - Roadways	Total	Cars	MT	HT	Numer of Lanes	Speed	Maximum Traffic Per Lane	Total per Lane	Cars	MT	HT
EB 6th PM between Knox and Sheridan	6000	5830	73	97	3	55	2000	2000	1943	24	32
WB 6th PM between Knox and Sheridan	6000	5830	73	97	3	55	2000	2000	1943	24	32
EB 6th PM between Knox and BNSF	8000	7773	98	129	4	55	2000	2000	1943	24	32
WB 6th PM between Knox and BNSF	8000	7773	98	129	4	55	2000	2000	1943	24	32
SB I-25 PM	7200	6691	167	342	4	65	1800	1800	1673	42	86
NB I-25 PM	7200	6691	167	342	4	65	1800	1800	1673	42	86
WB on Ramp PM From Federal	1200	1124	58	18	2	45	1600	600	562	29	9
WB off Ramps PM To Federal	1100	1030	53	17	2	35	1600	550	515	27	8
Federal SB PM	3200	2997	154	48	2	35	1600	1600	1499	77	24
Federal NB PM	2400	2248	116	36	2	35	1600	1200	1124	58	18
EB Off PM To Federal	800	749	39	12	2	35	800	400	375	19	6
EB on from 5th Ave PM	800	749	39	12	2	35	800	400	375	19	6
WB Off to Bryant PM	250	234	12	4	1	35	800	250	234	12	4
WB From Bryant PM	410	384	20	6	1	35	800	410	384	20	6
EB Ramp to Bryant PM	125	117	6	2	1	37	800	125	117	6	2
I-15 Ramps On SB PM from EB 6th	1400	1298	67	35	1	50	1400	1400	1298	67	35
I-15 Ramp Off SB PM To WB 6th	1400	1298	67	35	1	50	1400	1400	1298	67	35
I-15 Ramp Off NB PM From EB 6th	1400	1298	67	35	1	50	1400	1400	1298	67	35
I-25 Ramps On SB PM From WB 6th	700	649	33	17	2	50	1400	350	325	17	9
I-25 Ramp SB I25 to EB 6th PM	385	357	18	10	1	45	700	385	357	18	10
I-25 NB Rampto WB 6th PM	700	649	33	17	1	45	700	700	649	33	17
WB 6th to NB I-25 PM	440	408	21	11	1	45	700	440	408	21	11
Ramps at 45	1500	1405	72	23	2	45	750	750	702	36	11
Ramps at 35	1600	1499	77	24	2	45	1600	800	749	39	12
5th Street	700	656	34	11	1	35	700	700	656	34	11
5th Street On Ramp	1400	1311	68	21	1	35	1400	1400	1311	68	21

Source: Parsons Brinckerhoff, 2012

Note: Where traffic volumes reached maximum traffic volumes, maximum volumes were used per CDOT guidance.

Table B-3. 2035 Build Modeled Traffic Volumes

2035 Build - Roadways	Total	Cars	MT	HT	Numer of Lanes	Speed	Maximum Traffic Per Lane	Total per Lane	Cars	MT	HT
EB 6th PM between Knox and Sheridan	6000	5830	73	97	3	55	2000	2000	1943	24	32
WB 6th PM between Knox and Sheridan	6000	5830	73	97	3	55	2000	2000	1943	24	32
EB 6th PM between Knox and BNSF	8000	7773	98	129	4	55	2000	2000	1943	24	32
WB 6th PM between Knox and BNSF	8000	7773	98	129	4	55	2000	2000	1943	24	32
SB I-25 PM	7200	6691	167	342	4	65	1800	1800	1673	42	86
NB I-25 PM	7200	6691	167	342	4	65	1800	1800	1673	42	86
WB on Ramp PM From Federal	1200	1124	58	18	2	45	1600	600	562	29	9
WB off Ramps PM To Federal	1310	1227	63	20	2	35	1600	655	614	32	10
Federal SB PM	3300	3091	159	50	3	35	1600	1100	1030	53	17
Federal NB PM	3350	3138	162	51	3	35	1600	1117	1046	54	17
EB Off PM To Federal	800	749	39	12	2	35	800	400	375	19	6
EB On PM from Federal	400	375	19	6	2	45	1400	200	187	10	3
EB on to I-25 from Federal PM	940	880	45	14	2	45	1400	470	440	23	7
I-15 Ramps On SB PM from EB 6th	2890	2680	138	72	2	50	1400	1445	1340	69	36
I-15 Ramp Off SB PM To WB 6th	2800	2597	134	69	2	50	1400	1400	1298	67	35
I-15 Ramp Off NB PM From EB 6th	2800	2597	134	69	2	45	1400	1400	1298	67	35
I-25 Ramps On SB PM From WB 6th	700	649	33	17	2	45	1400	350	325	17	9
I-25 Ramp SB I25 to EB 6th PM	385	357	18	10	1	45	1400	385	357	18	10
I-25 NB Rampto WB 6th PM	1400	1298	67	35	1	45	1400	1400	1298	67	35
WB 6th to NB I-25 PM	1400	1298	67	35	2	45	1400	700	649	33	17
Ramps at 45	1500	1405	72	23	2	45	750	750	702	36	11
Ramps at 35	1600	1499	77	24	2	45	1600	800	749	39	12
5th Street EB	265	248	13	4	1	700	35	265	248	13	4
5th Street WB	225	211	11	3	1	700	35	225	211	11	3

Source: Parsons Brinckerhoff, 2012

Note: Where traffic volumes reached maximum traffic volumes, maximum volumes were used per CDOT guidance.

Table B-4. Traffic Counts during Noise Measurements

Noise Receptor Number	Date	Time	Observed Traffic Volumes (10 minutes count - US6)		Observed Traffic Speed US6 (mph)	Observed Traffic Volumes (10 minutes count - US6 Ramps)		Observed Traffic Speed US6 (mph)	Observed Traffic Volumes (10 minutes count - Federal Blvd)		Observed Traffic Speed US6 (mph)
			Eastbound	Westbound		Eastbound	Westbound		Northbound	Southbound	
Site 1	5/16/2012	1:15 PM	Autos: 582 Medium Trucks: 3 Heavy Trucks: 4 Moto: 1; Buses: 2	Autos: 798 Medium Trucks: 6 Heavy Trucks: 3 Moto: 2; Buses: 2	55-60	Autos: 29 Medium Trucks: 2 Heavy Trucks: 0 Moto: 0; Buses: 1	Autos: 64 Medium Trucks: 2 Heavy Trucks: 0 Moto: 0; Buses: 1	55-60	Autos: 169 Medium Trucks: 2 Heavy Trucks: 3 Moto: 0; Buses: 2	Autos: 219 Medium Trucks: 1 Heavy Trucks: 5 Moto: 2; Buses: 1	25-30
Site 2	5/16/2012	1:39 PM	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0		Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0		Autos: 157 Medium Trucks: 4 Heavy Trucks: 2 Moto: 1; Buses: 3	Autos: 230 Medium Trucks: 2 Heavy Trucks: 3 Moto: 2; Buses: 2	30-35
Site 3	5/16/2012	2:10 PM	Autos: 654 Medium Trucks: 6 Heavy Trucks: 5 Moto: 2; Buses: 2	Autos: 697 Medium Trucks: 5 Heavy Trucks: 4 Moto: 1; Buses: 2	50-55	Autos: 90 Medium Trucks: 4 Heavy Trucks: 1 Moto: 1; Buses: 0	Autos: 41 Medium Trucks: 2 Heavy Trucks: 1 Moto: 1; Buses: 0	50-55	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	
Site 4	5/17/2012	10:45 AM	Autos: 556 Medium Trucks: 4 Heavy Trucks: 4 Moto: 0; Buses: 2	Autos: 558 Medium Trucks: 7 Heavy Trucks: 5 Moto: 2; Buses: 0	50-55	Autos: 80 Medium Trucks: 4 Heavy Trucks: 0 Moto: 0; Buses: 0	Autos: 64 Medium Trucks: 4 Heavy Trucks: 0 Moto: 4; Buses: 0	EBon = 25 WBoff = 45	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	
Site 5	5/17/2012	10:45 AM	Autos: 556 Medium Trucks: 4 Heavy Trucks: 4 Moto: 0; Buses: 2	Autos: 558 Medium Trucks: 7 Heavy Trucks: 5 Moto: 2; Buses: 0	50-55	Autos: 80 Medium Trucks: 4 Heavy Trucks: 0 Moto: 0; Buses: 0	Autos: 64 Medium Trucks: 4 Heavy Trucks: 0 Moto: 4; Buses: 0	EBon = 25 WBoff = 45	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	
Site 6	5/17/2012	12:15 PM	Autos: 610 Medium Trucks: 8 Heavy Trucks: 4 Moto: 2; Buses: 1	Autos: 598 Medium Trucks: 8 Heavy Trucks: 5 Moto: 1; Buses: 2	50-55	Autos: 77 Medium Trucks: 5 Heavy Trucks: 6 Moto: 0; Buses: 0	Autos: 69 Medium Trucks: 4 Heavy Trucks: 2 Moto: 0; Buses: 0	WBon = 25 EBoff = 45	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	
Site 7	5/17/2012	12:40 PM	Autos: 674 Medium Trucks: 8 Heavy Trucks: 9 Moto: 1; Buses: 0	Autos: 574 Medium Trucks: 6 Heavy Trucks: 8 Moto: 0; Buses: 2	50-55	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0		Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	
Site 8*	5/18/2012	9:55 AM	Autos: 854 Medium Trucks: 14 Heavy Trucks: 40 Moto: 6; Buses: 0	Autos: 828 Medium Trucks: 28 Heavy Trucks: 46 Moto: 0; Buses: 2	I-25 NB&SB = 55-60	Autos: 164 Medium Trucks: 11 Heavy Trucks: 4 Moto: 2; Buses: 0	Autos: 190 Medium Trucks: 10 Heavy Trucks: 7 Moto: 0; Buses: 0	I-25 toNBOn=45 SBOffto6th=30	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	
Site 9*	5/18/2012	10:20 AM	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0		Autos: 136 Medium Trucks: 2 Heavy Trucks: 2 Moto: 0; Buses: 0	Autos: 72 Medium Trucks: 6 Heavy Trucks: 2 Moto: 0; Buses: 0	I-25 toNBOn=45 SBOffto6th=30	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	
Site 10	5/18/2012	10:50 AM	Autos: 604 Medium Trucks: 12 Heavy Trucks: 0 Moto: 0; Buses: 1	Autos: 600 Medium Trucks: 4 Heavy Trucks: 8 Moto: 3; Buses: 1	55	Autos: 108 Medium Trucks: 4 Heavy Trucks: Moto: 2; Buses: 0	Autos: 52 Medium Trucks: 1 Heavy Trucks: Moto: 0; Buses: 2	EBOff = 45 WBOn = 35	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	
Site 11	5/18/2012	11:23 AM	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0		Autos: 47 Medium Trucks: 2 Heavy Trucks: 2 Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	EBon Only = 25	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	

* Traffic counted during Site 8 and Site 9 measurements were only from vehicles travelling on I-25 and I-25 ramps.
Traffic counts collected by Parsons Brinckerhoff, 2012.
Shaded areas represent roadways that were not audible at the time of monitoring and were not counted.

Table B-5. Traffic Counts during Noise Measurements (Continued)

Noise Receptor Number	Date	Time	Observed Traffic Volumes (10 minutes count - US6)		Observed Traffic Speed US6 (mph)	Observed Traffic Volumes (10 minutes count - US6 Ramps)		Observed Traffic Speed US6 (mph)	Observed Traffic Volumes (10 minutes count - W. 6th Ave)		Observed Traffic Speed US6 (mph)
			Eastbound	Westbound		Eastbound	Westbound		W 6th Ave Frontage (one-way)	Westbound Access to Intersection	
Site A/12	7/16/2012	3:08 PM	Autos: 462 Medium Trucks: 4 Heavy Trucks: 4 Moto: 1; Buses: 0	Autos: 514 Medium Trucks: 10 Heavy Trucks: 4 Moto: 1; Buses: 1	55-60	Autos: 116 Medium Trucks: 4 Heavy Trucks: 4 Moto: 0; Buses: 0	Autos: 128 Medium Trucks: 2 Heavy Trucks: 2 Moto: 0; Buses: 0	WB Off = 45 EB On = 35	Autos: 20 Medium Trucks: 0 Heavy Trucks: 0 Moto: 0; Buses: 0	Autos: 12 Medium Trucks: 0 Heavy Trucks: 0 Moto: 0; Buses: 0	WB Frontage = 25; WB Acces = 25
Site B/13	7/16/2012	2:17 PM	Autos: 483 Medium Trucks: 3 Heavy Trucks: 5 Moto: 0; Buses: 2	Autos: 525 Medium Trucks: 6 Heavy Trucks: 4 Moto: 2; Buses: 2	55-60	Autos: 99 Medium Trucks: 2 Heavy Trucks: 3 Moto: 0; Buses: 0	Autos: 110 Medium Trucks: 1 Heavy Trucks: 3 Moto: 2; Buses: 0	WB Off = 45 EB On = 35	Autos: 18 Medium Trucks: 0 Heavy Trucks: 0 Moto: 1; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: ; Buses:	EB Frontage = 25
Site C/14	5/21/2012	12:50 PM	Autos: 482 Medium Trucks: 11 Heavy Trucks: 8 Moto: 0; Buses: 1	Autos: 520 Medium Trucks: 5 Heavy Trucks: 4 Moto: 3; Buses: 0	55-60	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0		Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	**EB Frontage:** Autos: 9 Medium Trucks: 0 Heavy Trucks: 0 Moto: 0; Buses: 0	EB Frontage = 25
Site D/15	7/18/2012	2:50 PM	Autos: 650 Medium Trucks: 4 Heavy Trucks: 6 Moto: 0; Buses: 4	Autos: 730 Medium Trucks: 6 Heavy Trucks: 4 Moto: 0; Buses: 5	55-60	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0		**WB Frontage**: Autos: 12 Medium Trucks: 0 Heavy Trucks: 0 Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	WB Frontage = 25
Site E/16	5/21/2012	1:20 PM	Autos: 505 Medium Trucks: 8 Heavy Trucks: 7 Moto: 2; Buses: 2	Autos: 532 Medium Trucks: 4 Heavy Trucks: 6 Moto: 2; Buses: 1	55-60	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0		Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	**EB Frontage:** Autos: 8 Medium Trucks: 0 Heavy Trucks: 0 Moto: 0; Buses: 0	EB Frontage = 25
Site F/17	7/18/2012	2:15 PM	Autos: 629 Medium Trucks: 3 Heavy Trucks: 5 Moto: 2; Buses: 1	Autos: 698 Medium Trucks: 8 Heavy Trucks: 5 Moto: 1; Buses: 2	55-60	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0		**WB Frontage**: Autos: 10 Medium Trucks: 0 Heavy Trucks: 0 Moto: 0; Buses: 0	Autos: Medium Trucks: Heavy Trucks: Moto: 0; Buses: 0	WB Frontage = 25
Site G/18	7/16/2012	3:41 PM	Autos: 654 Medium Trucks: 2 Heavy Trucks: 4 Moto: 1; Buses: 0	Autos: 808 Medium Trucks: 4 Heavy Trucks: 4 Moto: 0; Buses: 2	55-60	**WB onramp**: Autos: 12 Medium Trucks: 0 Heavy Trucks: 0 Moto: 0; Buses: 0	**WB offramp**: Autos: 64 Medium Trucks: 2 Heavy Trucks: 0 Moto: 0; Buses: 0	25-35 All ramps in this area	**EB onramp**: Autos: 22 Medium Trucks: 0 Heavy Trucks: 0 Moto: 0; Buses: 0	**EB offramp**: Autos: 4 Medium Trucks: 0 Heavy Trucks: 0 Moto: 0; Buses: 0	25-35 All ramps in this area
Site H/19	7/16/2012	4:03 PM	Autos: 670 Medium Trucks: 4 Heavy Trucks: 6 Moto: 2; Buses: 6	Autos: 668 Medium Trucks: 2 Heavy Trucks: 4 Moto: 1; Buses: 0	55-60	**WB onramp**: Autos: 10 Medium Trucks: 0 Heavy Trucks: 0 Moto: 0; Buses: 0	**WB offramp**: Autos: 57 Medium Trucks: 0 Heavy Trucks: 0 Moto: 0; Buses: 0	25-35 All ramps in this area	**EB onramp**: Autos: 19 Medium Trucks: 1 Heavy Trucks: 0 Moto: 0; Buses: 0	**EB offramp**: Autos: 5 Medium Trucks: 0 Heavy Trucks: 0 Moto: 0; Buses: 0	25-35 All ramps in this area

Traffic counts collected by Parsons Brinckerhoff, 2012.
Shaded areas represent roadways that were not audible at the time of monitoring and were not counted.

Appendix C – TNM® 2.5 Files

TNM® models included electronically upon request.

Noise Analysis and Abatement Guidelines

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # SDR7002 Date of Analysis: SEPT 2012

Project Name & Location: Valley Hwy EIS US6 Bridges DB Project ; Denver, CO (Barrier 1)
I-25 SB off-ramp to US6 WB.

A. FEASIBILITY:

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☐ YES ☑ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ■ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☐ YES ☑ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ■ NO N/A

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☐ YES ☑ NO

   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
   ☐ YES ☐ NO

   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
   ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☐ YES ☑ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: Patrick Romero Date: 10-5-12

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # SDR7002 Date of Analysis: SEPT 2012

Project Name & Location: Valley Hwy EIS US 6 Bridges DB Project, Denver, Co (Barrier 2) (US6 EB off-ramp to I-25SB)

A. FEASIBILITY:

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☑ YES ☐ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☑ YES ☐ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO N/A

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☑ YES ☑ NO
   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
      ☐ YES ☐ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
      ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☑ YES ☑ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: Patrick Romero Date: 10/5/12

Noise Analysis and Abatement Guidelines

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # SDR7002   Date of Analysis: Sept 2012

Project Name & Location: Valley Hwy EIS US6 Bridges DB Project, Denver, Co (Barrier 3, US6 EB off-ramp to Federal Blvd)

A. FEASIBILITY:

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☑ YES ☐ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☑ YES ☐ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO N/A

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☐ YES ☑ NO

   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
   ☐ YES ☐ NO

   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
   ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☑ YES ☐ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: Patrick Romero   Date: 10/5/12

DOT
DEPARTMENT OF TRANSPORTATION

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # SDR 7002 Valley Hwy EIS Date of Analysis: September 2012

Project Name & Location: US6 Bridges DB - Denver, CO

A. FEASIBILITY: (Barrier 4, Federal Blvd NB to US6 EB on-ramp)

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☑ YES ☐ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☑ YES ☐ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO N/A

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☐ YES ☑ NO
   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
   ☐ YES ☐ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
   ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☑ YES ☐ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: Patrick Romero Date: 10/5/12

DOT DEPARTMENT OF TRANSPORTATION

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # SDR 7002   Date of Analysis: September 2012

Project Name & Location: Valley Hwy EIS US6 Bridges DB - Denver, Co

A. FEASIBILITY: (Barrier 5 - US6 WB on ramp from Federal Blvd)

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☑ YES ☐ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☑ YES ☐ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO N/A

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☐ YES ☑ NO

   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
      ☐ YES ☐ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
      ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☑ YES ☐ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: Patrick Romero   Date: 10/5/12

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # SDR7002 Date of Analysis: September 2012

Project Name & Location: Valley Hwy EIS US6 Bridges DB - Denver, Co

A. FEASIBILITY: (Barrier 6 – EB US6 off-ramp at Federal Blvd)

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   [x] YES [ ] NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   [ ] YES [x] NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   [x] YES [ ] NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   [x] YES [ ] NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   [ ] YES [x] NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   [ ] YES [ ] NO N/A

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   [ ] YES [x] NO
   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
   [ ] YES [ ] NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
   [ ] YES [ ] NO

D. ADDITIONAL CONSIDERATIONS:

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   [x] YES [ ] NO
2. Are noise mitigation measures reasonable?
   [ ] YES [x] NO
3. Is insulation of buildings both feasible and reasonable?
   [ ] YES [x] NO
4. Shall noise abatement measures be provided?
   [ ] YES [x] NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: Patrick Romero Date: 10/5/12

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # SDR 7002 Date of Analysis: September 2012

Project Name & Location: Valley Hwy EIS US6 Bridges DB – Denver, Co

A. FEASIBILITY: (Barrier 7 – WB US6 at Knox Ct)

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☑ YES ☐ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☑ YES ☐ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO N/A

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☐ YES ☑ NO
   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
   ☐ YES ☐ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
   ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

Existing noise barriers are located in this area and provide required noise reduction.

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☑ YES ☐ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: Patrick Romano Date: 10/5/12

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # SDR7002   Date of Analysis: September 2012

Project Name & Location: Valley Hwy EIS US6 Bridges DB - Denver, Co (Barrier 8 - US6 WB east of Perry St)

A. FEASIBILITY:

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☐ YES ☑ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☐ YES ☑ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO N/A

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☐ YES ☑ NO

   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
      ☐ YES ☐ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
      ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

Existing Noise Barriers located in this area provide required noise reduction

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☐ YES ☑ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: Patrick Romero   Date: 10/5/12

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # SDR7002 Date of Analysis: September 2012

Project Name & Location: Valley Hwy EIS US6 Bridges DB - Denver, CO

A. FEASIBILITY: (Barrier 9 - US6 EB off-ramp to Knox Ct)

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☐ YES ☑ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☐ YES ☑ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO N/A

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☐ YES ☑ NO

   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
      ☐ YES ☐ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
      ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

Existing noise barriers are located in this area that provide required noise reduction.

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☐ YES ☑ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: Patrick Romero Date: 10/5/12

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # SDR 7002 Date of Analysis: September 2012

Project Name & Location: Valley Hwy EIS US6 Bridges DB - Denver, CO

A. FEASIBILITY: (Barrier 10 - US6 EB start at Knox Ct)

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ❒ YES ☑ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ❒ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ❒ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ❒ YES ☑ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ❒ YES ☑ NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   ❒ YES ❒ NO N/A

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ❒ YES ☑ NO
   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
   ❒ YES ❒ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
   ❒ YES ❒ NO

D. ADDITIONAL CONSIDERATIONS:

Existing noise barriers are located in this area that provide required noise reduction.

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ❒ YES ☑ NO
2. Are noise mitigation measures reasonable?
   ❒ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ❒ YES ☑ NO
4. Shall noise abatement measures be provided?
   ❒ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: Patrick Romero Date: 10/5/12

DEPARTMENT OF TRANSPORTATION

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # SDR7002 Date of Analysis: September 2012

Project Name & Location: Valley Hwy EIS US6 Bridges DB - Denver, Co

A. FEASIBILITY: (Barrier 1A – US6 WB East of Perry St)

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☐ YES ☑ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☐ YES ☑ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO N/A

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☐ YES ☑ NO

   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
   ☐ YES ☐ NO

   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
   ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

Existing noise barriers are located in this area that provide required noise reduction.

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☐ YES ☑ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: [signature] Date: 10/5/12

Noise Analysis and Abatement Guidelines

DEPARTMENT OF TRANSPORTATION

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # *SDR7002* Date of Analysis: *September 2012*

Project Name & Location: *Valley Hwy EIS* *US6 Bridges DB - Denver, Co*

(Barrier 12 - US6 EB East of Perry St)

A. FEASIBILITY:

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☐ YES ☑ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☐ YES ☑ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO *N/A*

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☐ YES ☑ NO
   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
   ☐ YES ☐ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
   ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

Existing noise barriers are located in this area and provide required noise reduction.

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☐ YES ☑ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: *[signature]* Date: *10/5/12*

DEPARTMENT OF TRANSPORTATION

Noise Analysis and Abatement Guidelines

COLORADO DEPARTMENT OF TRANSPORTATION NOISE ABATEMENT DETERMINATION WORKSHEET

Instructions: To complete this form refer to CDOT Noise Analysis Guidelines

STIP # SDR7002 Date of Analysis: September 2012

Project Name & Location: Valley Hwy EIS US6 Bridges DB - Denver, Co

A. FEASIBILITY: (Barrier 13 - US6 EB On-Ramp from Sheridan Blvd)

1. Can a 5dBA noise reduction be achieved by constructing a noise barrier or berm?
   ☐ YES ☑ NO
2. Are there any fatal flaw drainage, terrain, safety, or maintenance issues involving the proposed noise barrier or berm?
   ☐ YES ☑ NO
3. Can a noise barrier or berm less than 20 feet tall be constructed?
   ☑ YES ☐ NO

B. REASONABLENESS:

1. Has the Design goal of 7 dBA noise reduction for abatement measure been met for at least one impacted receptor?
   ☐ YES ☑ NO
2. Is the Cost Benefit Index below $6800 per receptor per dBA?
   ☐ YES ☑ NO
3. Are more than 50% of benefited resident/owners in favor of the recommended noise abatement measure?
   ☐ YES ☐ NO N/A

C. INSULATION CONSIDERATION:

1. Are normal noise abatement measures physically infeasible or economically unreasonable?
   ☐ YES ☑ NO
   If the answer to 1 is YES, then:
2. a. Does this project have noise impacts to NAC Activity Category D?
   ☐ YES ☐ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings?
   ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

Existing Noise Barriers are located in the area that provide required noise reduction.

E. STATEMENT OF LIKELIHOOD:

1. Are noise mitigation measures feasible?
   ☐ YES ☑ NO
2. Are noise mitigation measures reasonable?
   ☐ YES ☑ NO
3. Is insulation of buildings both feasible and reasonable?
   ☐ YES ☑ NO
4. Shall noise abatement measures be provided?
   ☐ YES ☑ NO

F. ABATEMENT DECISION DESCRIPTION AND JUSTIFICATION:

Completed by: Patrick Romero Date: 10/5/12