US 34 Environmental Assessment

US 287 to Larimer County Road No. 3

Appendix D. CDOT Noise Analysis and Abatement Guidelines

Appendix D. CDOT Noise Analysis and Abatement Guidelines and Project Noise Technical Report

D.1 CDOT Noise Analysis and Abatement Guidelines

See the CDOT website for the complete contents of these guidelines at:

http://www.dot.state.co.us/environmental/CulturalResources/Noise/CDOT%20Noise%20Guidelines%20Dec%2002.pdf

D.2 Highway Noise Technical Report

HIGHWAY NOISE TECHNICAL REPORT

US 34: US 287 to Larimer County Road 3
Environmental Assessment

February 2007

Prepared for
Colorado Department of Transportation
Region 4

Prepared by
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EXECUTIVE SUMMARY

This report describes the noise impact and mitigation analyses conducted in support of the US 34: US 287 to Larimer County Road 3 Environmental Assessment (EA). The noise analysis was conducted according to CDOT noise guidelines, which are set forth in the document entitled *CDOT Noise Analysis and Abatement Guidelines*, December 1, 2002.

Pursuant to these guidelines, traffic noise levels were predicted along the Corridor for both existing and design-year conditions, and these levels were compared to CDOT's Noise Abatement Criteria and Increase Criterion. The Action Alternative was analyzed using design data provided in January 2007, and projected 2030 traffic volumes and speeds. Existing conditions were modeled using existing topography data, and 2005 traffic volumes and speeds. No Action conditions were also analyzed, which used existing topography data and projected 2030 No Action traffic volumes and speeds. Noise levels were predicted using the Traffic Noise Model (TNM v2.5).

Existing loudest hour traffic noise levels in the corridor range from 53 to 72 dBA, with an overall average level of 64 dBA. In 2030, under the No Action Alternative, loudest hour noise levels are predicted to remain virtually unchanged. This is because no capacity would be added to the roadway. In 2030, under the Action Alternative, loudest hour traffic noise levels are predicted to increase by approximately 2 dBA due to the increased capacity of the road to carry free-flow traffic.

Under the Action Alternative, 11 residential areas (~18 single family homes & ~12 multi-family homes), 5 hotels, and 6 commercial areas are predicted to be impacted by noise. The use of noise barriers (walls or earthen berms) was investigated for mitigation for these locations. It was determined that a 660 foot long barrier (wall, berm or combination) is feasible and reasonable at The Reserve Apartments off McWhinney Blvd. It is recommended that this barrier be approximately 10 feet tall. Noise barriers at other impacted residential locations were determined to be either infeasible or unreasonable due to having direct access to the highway, and/or being isolated such that only one property benefits from the barrier. Mitigation is not recommended for any of the impacted commercial facilities, as there are no outdoor use areas that would benefit, and/or it was assumed that the facilities would prefer the direct exposure to the highway.

1.0 INTRODUCTION

In accordance with the Federal Highway Administration (FHWA), the Colorado Department of Transportation (CDOT), through its consultant team of J.F. Sato and Associates, has initiated the US 34: US 287 to Larimer County Road (LCR) 3 Environmental Assessment (EA). The project area is located in Loveland, Colorado, as shown in Figure 1-1. This noise analysis does not include any proposed improvements to the US 34 interchange, or any improvements along the I-25 corridor, as these are separate projects.

For the US 34 and I-25 interchange, the separate noise study resulted in no noise mitigation being provided as a part of that project. This project does not consider any improvements to the US 34 Corridor as a part of their analysis. Four noise impacts were found around the interchange, but noise mitigation was not considered to be feasible and/or reasonable. This project also suggested that the North I-25 EIS project and/or this US 34 EA project were better suited to analyze noise impacts for these receivers. Refer to *Noise Analysis, US 34 and I-25 Interim Safety Improvements*, Wilson and Company, March 3, 2006 for more information.

The North I-25 EIS project will also consider noise impacts for the area around the US 34 interchange though it is unknown exactly which properties will be considered. It is anticipated that the shopping areas and any other properties bordering the US 34 and I-25 Interchange will be a part of their noise analysis. At the time of this report, the DEIS for this project has not been submitted.

This US 34 Corridor EA identifies future transportation needs in the US 34 Corridor, examines roadway improvements that meet those needs, and assesses the environmental impacts of the proposed improvements. This project assumes an interim condition for the US 34 and I-25 Interchange, but does not include any impacts due to the I-25 Corridor. Properties around the interchange were included in this analysis except the shopping areas which were felt to be more affected by the I-25 Corridor and thus the North I-25 EIS project.

The noise analysis was conducted according to CDOT noise guidelines, which are set forth in the document entitled *CDOT Noise Analysis and Abatement Guidelines*, December 1, 2002. CDOT guidelines are consistent with those of the Federal Highway Administration (23 CFR 772) and have been approved by the FHWA for use on Federal-aid projects in Colorado. Pursuant to these guidelines, traffic noise levels were predicted along the Corridor for both existing and design-year conditions, and these levels were compared to CDOT's Noise Abatement Criteria and Increase Criterion. A noise mitigation analysis was conducted at each area where the criteria were exceeded.

The report is organized into the following sections: Applicable Noise Standards, Noise Prediction Methodology, Noise Impact Assessment, and Noise Mitigation Analysis. Attachments include: Relevant Noise Terminology, Excerpts from CDOT's Noise Guidelines, Noise Model Input Data, Noise Measurement Information, Noise Site Plan Figures, and CDOT Noise Abatement and Determination Forms.

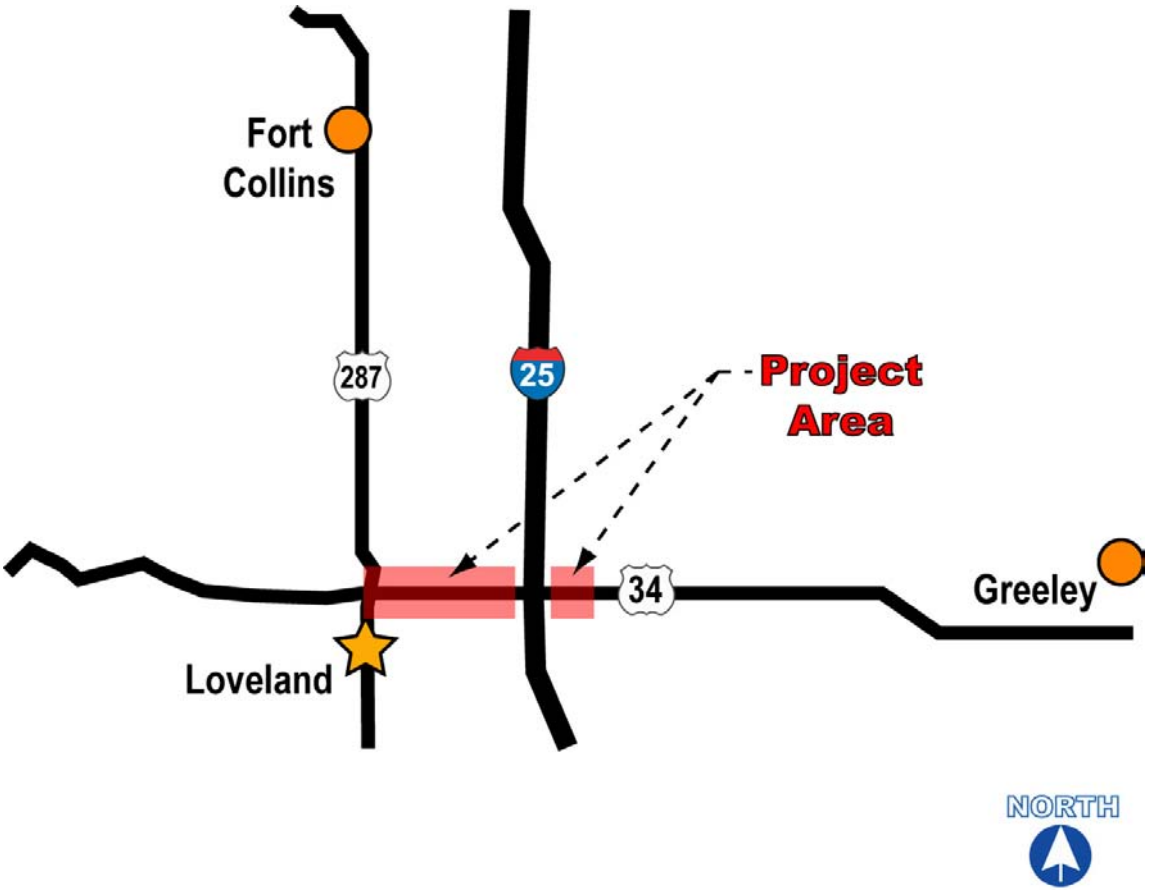

FIGURE 1-1: US 34: US287 TO LCR 3 EA – PROJECT AND NOISE ANALYSIS AREAS

2.0 APPLICABLE NOISE STANDARDS

This project is subject to CDOT to the provisions of CDOT's *Noise Analysis and Abatement Guidelines*, December 1, 2002. The CDOT Noise Guidelines are consistent with those of the Federal Highway Administration (FHWA) (23 CFR 772) and have been approved by the FHWA for use on Federal-aid projects in Colorado. CDOT's Guidelines establish noise abatement criteria and design requirements for noise mitigation. The Guidelines state that noise mitigation should be considered for any receptor or group of receptors where predicted traffic noise levels, using design-year traffic volumes and roadway conditions, equal or exceed CDOT's Noise Abatement Criteria (NAC), which are shown in Table 2-1. The Guidelines also state that noise mitigation should be considered for any receptors where predicted noise levels for design-year conditions are greater than existing noise levels by 10 dBA or more. This standard is referred to hereafter as the Increase Criterion. A flow-chart showing the noise analysis process is provided in Figure 2-1 and excerpts from CDOT's Noise Guidelines are provided in Attachment B.

To be included in a project, a proposed noise mitigation measure must first be found to be feasible. A summary of the feasibility criteria is as follows:

- Most importantly, the proposed mitigation measure must be predicted to achieve at least 5 dBA of noise reduction at front row receptors, and preferably 10 dBA.
- The proposed mitigation measure must not create any "fatal flaw" safety or maintenance issues such as reduced sight distances, shadowing of ice-prone areas, and interference with snow/debris removal.
- Noise barriers must be constructed in a continuous manner, as gaps in noise barriers, e.g. for driveways, significantly degrade their performance.

If a mitigation measure is found to be feasible, it is then analyzed for its "reasonableness" as follows:

- The cost benefit index of the proposed measure should not exceed $4,000 per dB of reduction per benefited receptor.
- The predicted design-year noise levels should be equal to or exceed the Noise Abatement Criteria shown in Table 2-1.
- At least 50% of the affected property owners should approve of the proposed noise reduction measure.
- Land use in the affected area should be at least 50% Category B (refer to Table 2-1).

TABLE 2-1
CDOT Noise Abatement Criteria
(based on FHWA Noise Abatement Criteria, 23 CFR 772)

Activity Category	L_{eq} [1],[2] (dBA)	Description of Activity Category
A	56 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	66 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries and hospitals.
C	71 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	--	Undeveloped lands.
E	51 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

[1] Hourly A-weighted equivalent level for the noisiest hour of the day in the design-year
[2] CDOT noise impact criteria are 1 dBA lower (more stringent) than FHWA values in 23 CFR 772

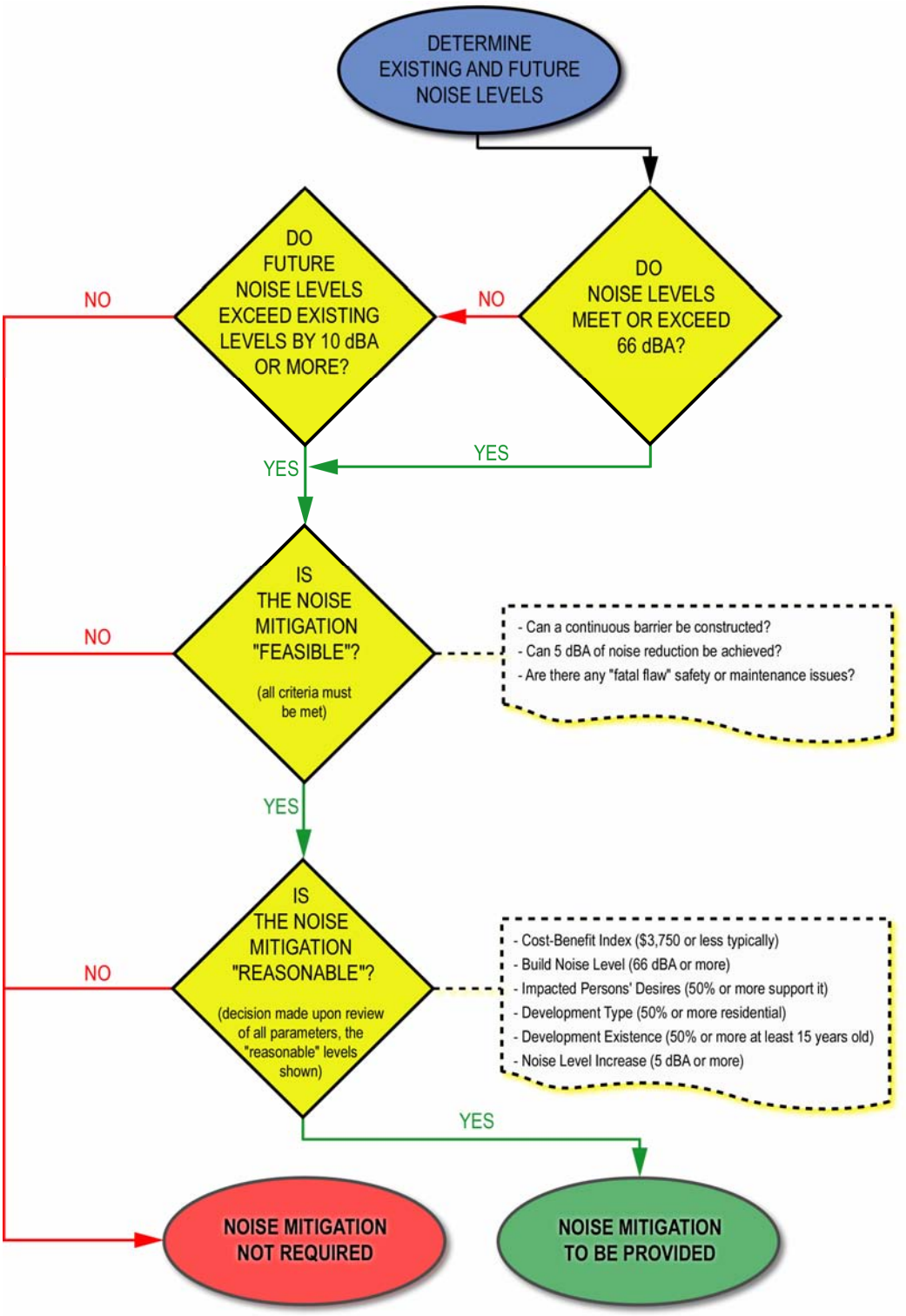

Figure 2-1: CDOT Noise Analysis Procedure (December 2002)

3.0 NOISE PREDICTION METHODOLOGY AND VALIDATION

The *FHWA Traffic Noise Model* (TNM v2.5) and *CDOT TNM Guidelines* were used for all noise predictions which included existing and future noise levels as well as the effect of any noise mitigation. The TNM model calculates the hourly, A-weighted L_{eq} (equivalent noise level) at a receptor location given the noise emission level of automobiles, medium, and heavy trucks; the volume and speed of each of these vehicle types on each roadway of interest; the relative location of all roadways, receptors, and terrain features (i.e., natural and man-made barriers); and the type of terrain that exists between each receptor and each roadway. Roadway and terrain data were obtained from CAD files (2-foot elevation contours). The location and land-use of receptors were obtained by conducting a field survey. Traffic data was obtained from JF Sato and Associates and corresponds to Level-of-Service (LOS) "C" conditions. More detailed model input information is provided in Attachment C.

A model of existing conditions was constructed and "validated" by comparing measured noise levels to noise level predictions (TNM) using the traffic volumes monitored during the noise measurements. Noise levels and concurrent traffic volumes and speeds were measured in April 2005 at three locations along US 34. Details of these measurements are provided in Attachment D. A TNM model was constructed for the areas around each of the locations. The models included existing roads, the traffic volumes and speeds present during the noise level measurements, and receptor points representing the measurement locations.

A comparison of measured and predicted noise levels is provided in Table 3-1. In all cases the predictions using the noise model are about 1 dBA louder than the measured levels. The desired model accuracy is ±3 dBA, which was achieved at all three locations. Thus, this noise model is acceptable for use on this project.

TABLE 3-1

Noise Model Validation Results

Measurement Location	*Measured Noise Level (dBA)*	*Predicted Noise Level (dBA)*	*Predicted Level Minus Measured Level (dBA)*
M1	61.8	62.8	1.0
M2	52.5	53.6	1.1
M3	53.2	54.1	0.9
	Average Difference:		**1.0**

4.0 NOISE IMPACT ASSESSMENT

4.1 Direct Noise Impacts

A home or business located within the project study area is considered "impacted" by noise under CDOT Guidelines when either of two conditions exist: 1) when the predicted design-year, loudest-hour noise level equals or exceeds 66 dBA for Category B receivers (residential type) and 71 dBA for Category C (commercial) receivers, or 2) when the design-year noise level is predicted to exceed the existing level by 10 dBA or more.

Table 4-1 lists the noise levels predicted for this project for each noise receptor and for each condition under study (Existing, Action, and No-Action). A noise receptor can represent a single building, multiple structures, or an area. For example, noise receptor location R18 represents The Reserve Apartments, which consists of multiple apartment homes. When a noise receptor representing multiple structures is found to be impacted, more detail is applied during the noise mitigation analysis. Also shown in the table is the predicted noise level increase over existing levels for the Action Alternative, and whether or not the receptor is considered impacted by noise. The location of each impacted area is shown in Figures 4-1 and 4-2. More detailed mapping can be found in Attachment E.

TABLE 4-1

Predicted Loudest Hour Noise Levels - dBA

No.	DESCRIPTION	ACTIVITY CATEGORY	PREDICTED LEVELS			INCREASE	IMPACTED?
			Existing 2005	Action 2030	No Action 2030	Action 2030	Action 2030
R1	Mixed Use (SE of LCR 3)	C	62	65	64	3	
R2	Northern CO Rehab Hospital (SE of LCR 3E)	B	63	65	64	2	
R3	New Bank (SE of LCR 5)	C	64	66	65	2	
R4	Gas Station (SE of I-25)	C	68	70	69	2	
R5	Best Western (SW of I-25)	B	67	69	68	2	Yes (B)
R6	Gas Station (SW of I-25)	C	70	71	70	1	Yes (C)
R7	Schmer Farm (SW of I-25)	B	71	72	72	1	Yes (B)
R8	Hampton Inn (NW of I-25)	B	58	59	58	1	
R9	International House of Pancakes (NW of I-25)	C	65	67	65	2	
R10	Visitor Center & Chamber of Commerce (NW of I-25)	C	64	66	64	2	
R11	Chili's & Johnny Carinos Restaurants (NW of Rocky Mtn)	C	65	68	66	3	
R12	removed	---	---	---	---		
R13	Black Eyed Pea and Good Times Restaurants (NE of Fall River)	C	68	71	69	3	Yes (C)
R14	McDonough Farm (S of Fall River)	B	68	70	69	2	Yes (B)
R15	Mimi's Café (NW of Fall River	C	70	72	71	2	Yes (C)
R16	Bank (NE of Hahn's Peak)	C	71	73	72	2	Yes (C)

TABLE 4-1

Predicted Loudest Hour Noise Levels - dBA

No.	DESCRIPTION	ACTIVITY CATEGORY	PREDICTED LEVELS			INCREASE	IMPACTED?
			Existing 2005	Action 2030	No Action 2030	Action 2030	Action 2030
R17	Loveland RV Village and Campground	B	62	65	64	3	
R18	The Reserve Apartments (NE of McWhinney)	B	70	72	71	2	Yes (B)
R19	Bank and Offices (NW of Boyd Lake Ave)	C	65	67	66	2	
R20	Church (SW of Boyd Lake Ave)	B	56	63	62	7	
R21	Mountain View HS (MVHS): Fields (S of US 34)	B	57	59	58	2	
R22	Hill Farm (in front of MVHS)	B	71	73	71	2	Yes (B)
R23	MVHS (S of US 34)	B	57	60	58	3	
R24	MVHS: Ballfield (S of US 34)	B	58	60	58	2	
R25	J-B Investments Commercial (3227 US 34)	C	72	73	73	1	Yes (C) *
R26	Loveland Tall Pines (3167 US 34)	C	69	71	70	2	Yes (C)
R27	Residence (3228 US 34) south side	B	69	71	70	2	Yes (B)
R28	Residence (3053 US 34) north side	B	62	64	63	2	
R29	Lowe's (SE of Sculptor)	C	58	60	59	2	
R30	Skyline Urgent Care (SW of Sculptor)	C	65	67	65	2	
R31	Retail Shops (NW of Denver)	C	64	66	65	2	
R32	Old Metro Lux Theaters (SE of Denver)	C	65	68	66	3	
R33	Residential Neighborhood (NE of Denver)	B	60	60	59	0	
R34	Residential Neighborhood (NE of Cheyenne)	B	59	60	59	1	
R35	Offices and Commercial (SW of Denver)	C	62	65	64	3	
R36	Comfort Inn (NE of Cheyenne)	B	68	71	70	3	Yes (B)
R37	Multi-Family Residential (NE of Boise off 16th)	B	54	56	55	2	
R38	Residential Duplexes (NE of Boise off 15th)	B	57	58	57	1	
R39	Super 8 (NW of Cheyenne)	B	68	69	68	1	Yes (B)
R40	Quality Inn (NE of Boise)	B	66	67	66	1	Yes (B)
R41	Commercial/Retail/Restaurant (SE of Boise)	C	62	64	62	2	
R42	Residential Area (SE of Boise off Sandstone Dr)	B	56	57	57	1	
R43	Residential Area (SW if Boise off Sylmar Pl)	B	58	59	58	1	

TABLE 4-1

Predicted Loudest Hour Noise Levels - dBA

No.	DESCRIPTION	ACTIVITY CATEGORY	PREDICTED LEVELS			INCREASE	IMPACTED?
			Existing 2005	Action 2030	No Action 2030	Action 2030	Action 2030
R44	Commercial/Retail (north side Madison – Boise)	C	67	67	66	0	
R45	Residential (north side off 16th)	B	53	54	53	1	
R46	Apartments (north side 15th and Madison)	B	65	65	65	0	
R47	Sam's Club (SW of Madison)	C	63	64	62	1	
R48	Highway Motel (NW of Redwood)	B	65	66	65	1	Yes (B)
R49	Residential Area (NE off 16th and Redwood)	B	58	59	58	1	
R50	Monroe Elementary: Fields (NE of Monroe)	B	64	65	65	1	
R51	Monroe Elementary School (NE of Monroe)	B	60	62	60	2	
R52	Rosebud Motel (SW of Monroe)	B	59	59	59	0	
R53	Gateway Motel (north side Jefferson - Washington)	B	66	72	67	6	Yes (B) *
R54	Residential (behind Gateway Motel)	B	59	65	62	6	
R55	Mobile Home Park (south side Jefferson – Washington)	B	62	62	63	0	
R56	Residences (SW of Jefferson)	B	60	61	60	1	
R57	Residences (NE of Lincoln)	B	60	61	60	1	
R58	Residences (SW of Lincoln)	B	66	67	65	1	Yes (B)
R59	Residences (SW of Cleveland)	B	65	66	65	1	Yes (B)
R60	Residences north side Garfield – BNRR tracks	B	67	68	67	1	Yes (B)
R61	Residences (south side Garfield - BNRR tracks)	B	68	69	68	1	Yes (B)
R62	Residences (SW of Garfield)	B	66	67	67	1	Yes (B)
R63	Residences (NW of Garfield)	B	67	69	67	2	Yes (B)

* property acquired as a part of this project

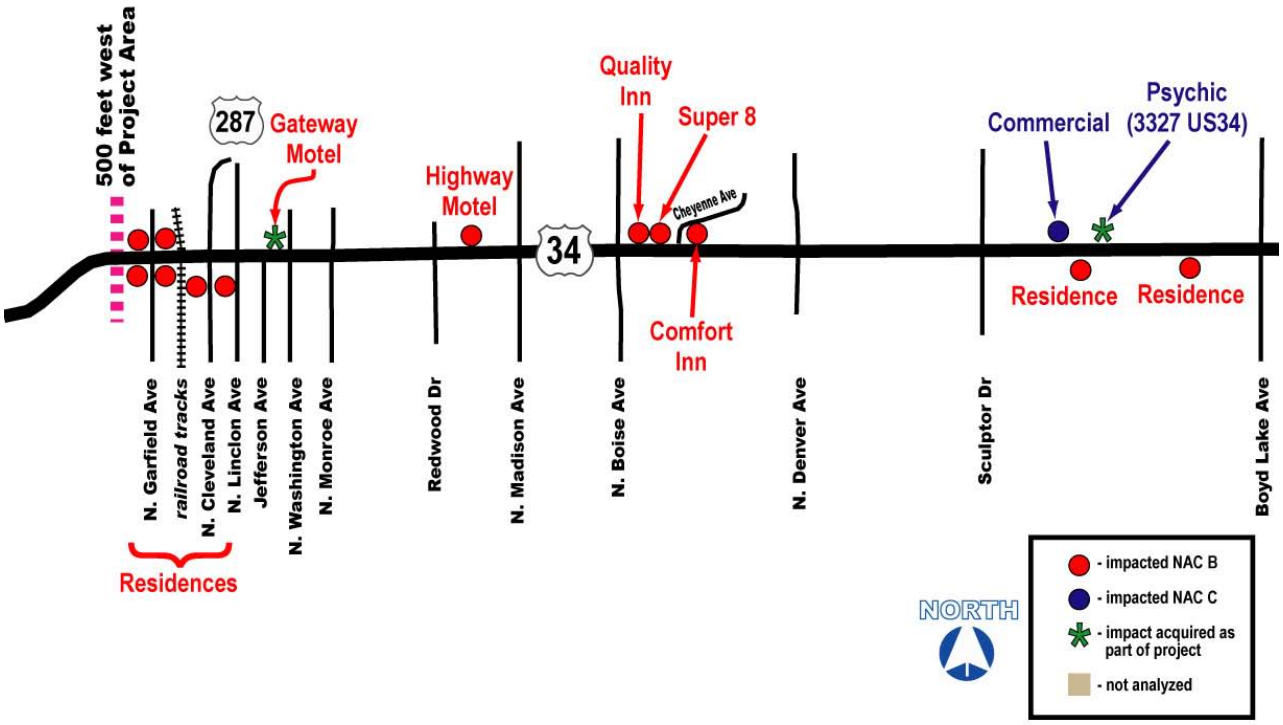

Figure 4-1: Noise Impacted Areas for Action Alternative 2030 – N. Garfield Ave to Boyd Lake Ave

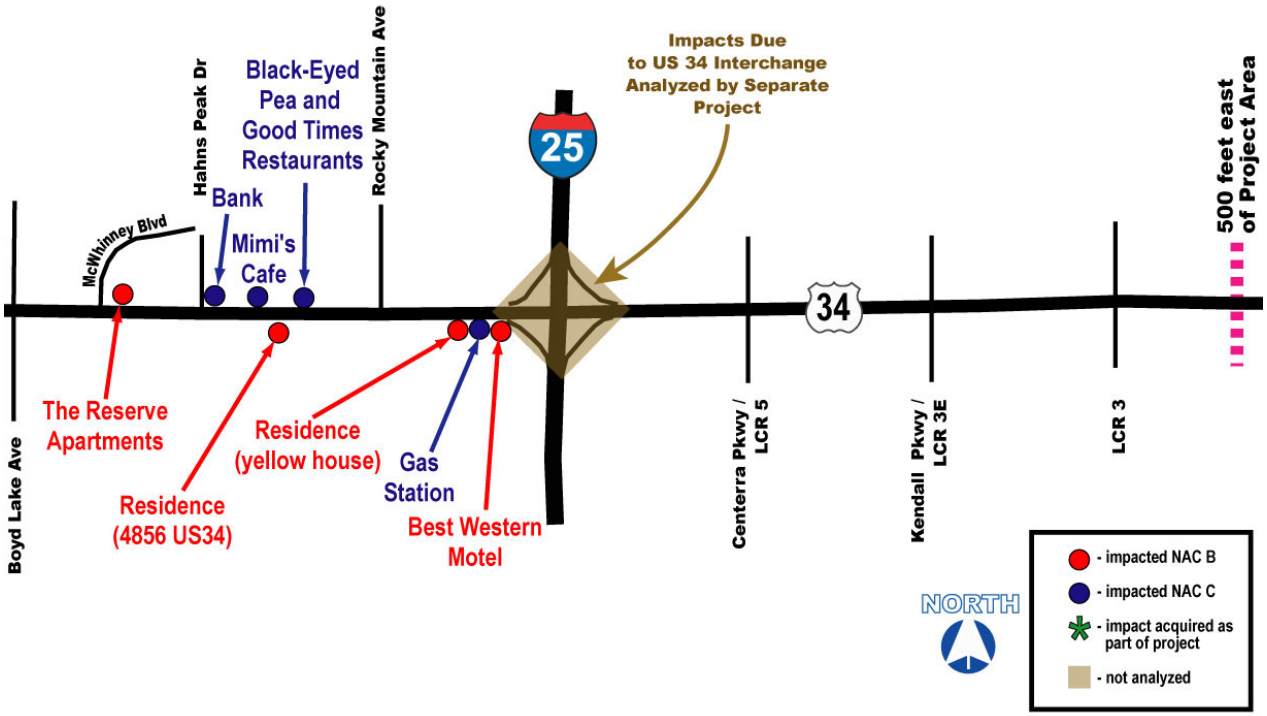

Figure 4-2: Noise Impacted Areas for Action Alternative 2030 – Boyd Lake Ave to LCR 3

Noise impact was predicted within 22 areas under the Action Alternative not including two impacted areas being acquired as a part of this Alternative. Of these, 16 are NAC B receptors and 6 are NAC C receptors. Of the 16 impacted NAC B areas, 11 are residential areas (~18 single family homes and ~12 multi-family homes), and five are hotels. All of these noise impacts are due to meeting or exceeding the maximum noise level in the Noise Abatement Criteria (see Table 1-1). The largest predicted noise level increase under the Action Alternative is 7 dBA, and this occurs at the church off of South Boyd Lake Ave. The overall average increase across the entire noise study area is 2 dBA. Noise mitigation analyses for each impacted area are discussed in Section 5.0.

The 66 dBA noise contour line for the Action Alternative is shown graphically in Attachment E. All of the area between the roadways and the contour has a predicted noise level equal to or greater than 66 dBA. Thus, any NAC B receptors (e.g. residences, parks, hotels, schools, etc.) located between the roadways and the contour are considered impacted under CDOT's noise policy. The 66 dBA noise contour lies approximately 120 feet from the centerline of US 34 west of N. Denver Avenue, and approximately 260 feet from the centerline of US 34 east of N. Denver Ave. The contour does not include the effect of the noise mitigation that is recommended as a part of this project.

The 71 dBA noise contour for Category C receptors (commercial) is not shown, but lies anywhere from 100 feet to 180 feet from the center of US 34 and would be between the 66 dBA noise contour line and US 34. The 71 dBA noise contour line is not shown is for a few reasons: (1) the 71 dBA noise contour line only applies to commercial receptors which typically do not receive or desire any noise mitigation, (2) noise contour lines are for planning purposes only and should not be used by themselves to locate a noise impact, and (3) showing the 71 dBA noise contour line in the figures makes it more difficult to visually discern the other information.

4.2 Construction Noise Impacts

Construction of the Action Alternative will generate noise from diesel-powered earth moving equipment such as dump trucks and bulldozers, back-up alarms on certain equipment, compressors, and pile drivers (near bridge abutments and retaining walls, if necessary). Construction noise at off-site receptor locations will usually be dependent on the loudest one or two pieces of equipment operating at the moment. Noise levels from diesel-powered equipment range from 80 to 95 dBA at a distance of 50 feet. Impact equipment such as rock drills and pile drivers can generate louder noise levels. Construction noise impacts, while temporary, can be mitigated by limiting work to daylight hours and requiring the contractor to use well-maintained equipment (particularly with respect to mufflers). The need for construction noise controls is dependent on local noise ordinances.

5.0 NOISE MITIGATION ASSESSMENT

A noise mitigation analysis was conducted for each of the 22 areas considered impacted by noise from the implementation of the Action Alternative. This analysis was conducted in accordance with *CDOT Noise Analysis and Abatement Guidelines*, December 2002, as previously described. The range of noise mitigation options includes shifting the highway away from residences, depressing the highway into the ground, reducing the design speed, installing low noise pavement, and constructing barriers along the highway. The feasibility and reasonableness of applying each of these measures to this project are as follows:

5.1 Shift Highway

Noise reduction at adjacent receptors can be achieved by shifting the highway away from the receptors, and by depressing the highway into the ground such that it is not visible from these receptors. There is development or proposed development along both sides of US 34 through much of the Corridor. Shifting the road only shifts the impact.

5.2 Reduce Design Speed

Approximately 1 dBA of noise reduction is achieved for each 5 mph decrease in traffic speed. Design speeds identified for the US 34 Action Alternative take into account forecast 2030 traffic flows and desired levels of service throughout the corridor together. Further reduction in design speed and posted speeds is not recommended by the project team.

5.3 Install Low Noise Pavement

The use of a particular pavement type is not considered an approved method for noise mitigation by either FHWA or CDOT at this time. This is because the influence of the pavement type on the traffic noise level at a property has not been clearly defined. Also, the longevity of any noise reduction benefit due to a particular pavement type has not been clearly defined. Studies have shown that certain pavement types and surface treatment are louder than others. The decision to use concrete versus asphalt is made on the basis of load (volume of cars and trucks), durability, life-cycle-cost, etc. For concrete, it has been found that saw-cutting grooves into the surface for water control is the quietest of the methods currently in common use. For asphalt, CDOT has had good success with Stone Mastic Asphalt (SMA). Noise reductions in the 2 to 4 dBA range have been measured in Colorado. It is recommended that low noise pavement options be examined in conjunction with final design for this project, but again the use of a lower noise pavement is not an approved method for noise mitigation by either FHWA or CDOT at this time.

5.4 Construct Noise Barriers

Noise barriers, such as walls, berms, or some combination, are potentially a feasible and reasonable noise mitigation measure for use on this project. An analysis was conducted for each of the 22 areas predicted to be impacted by noise under CDOT policy to determine if a barrier is recommended. The results of the analyses are listed in Table 5-1. As described therein, a technical analysis was considered necessary for only three of the areas: the Reserve Apartments (R18), the single family homes located between N. Garfield Avenue and the railroad tracks on the north side (R60) and south side (R61) of US 34. Results of these analyses are provided below.

TABLE 5-1

Review of Noise Mitigation Analyses

No.	DESCRIPTION	ACTIVITY CATEGORY	MITIGATION REVIEW	MITIGATION ANALYSIS NEEDED?
R5	Best Western (SW of I-25)	B	Typically hotels desire direct exposure to the highway & direct access.	no
R6	Gas Station (SW of I-25)	C	Direct access to US 34	no
R7	Schmer Farm (SW of I-25)	B	Direct access to US 34	no
R13	Black Eyed Pea and Good Times Restaurants (NE of Fall River)	C	No Outdoor Use located. Typically restaurants desire direct exposure to the highway.	no
R14	McDonough Farm (S of Fall River)	B	Direct access to US 34	no
R15	Mimi's Café (NW of Fall River)	C	There is Outdoor Use on west side, but typically restaurants desire direct exposure to the highway.	no
R16	Bank (NE of Hahn's Peak)	C	No outdoor use.	no
R18	The Reserve Apartments (NE of McWhinney)	B	Standard noise mitigation analysis possible.	YES
R22	Hill Farm (in front of MVHS)	B	Direct access to US 34	no
R26	Loveland Tall Pines (3167 US 34)	C	Direct access to US 34, and no outdoor use located.	no
R27	Residence (3228 US 34) south side	B	Direct access to US 34.	no
R36	Comfort Inn (NE of Cheyenne)	B	Typically hotels desire direct exposure to the highway & direct access.	no
R39	Super 8 (NW of Cheyenne)	B	Typically hotels desire direct exposure to the highway & direct access.	no
R40	Quality Inn (NE of Boise)	B	Typically hotels desire direct exposure to the highway & direct access.	no
R48	Highway Motel (NW of Redwood)	B	Typically hotels desire direct exposure to the highway & direct access.	no
R58	Residences (SW of Lincoln)	B	Properties impacted due to Lincoln Ave, in which they have direct access.	no
R59	Residences (SW of Cleveland)	B	Properties impacted due to Cleveland Ave, in which they have direct access.	no
R60	Residences (north side Garfield – BNRR tracks)	B	Standard noise mitigation analysis possible.	YES
R61	Residences (south side Garfield - BNRR tracks)	B	Standard noise mitigation analysis possible.	YES
R62	Residences (SW of Garfield)	B	Direct access to US 34.	no
R63	Residences (NW of Garfield)	B	Direct access to US 34.	no

Some notes regarding Table 5-1 are as follows:

- When a residence has direct access (e.g. a driveway) onto US 34, a large opening in the noise barrier is required to safely enter and exit the property. This significantly degrades the performance of the noise wall such that it will not achieve the minimum 5 dBA of noise reduction required by the CDOT Noise Guidelines to be considered feasible.
- When a residence is isolated from other properties, the cost-benefit of the noise barrier is excessive. The cost-benefit is the cost of the barrier divided by the number of homes the barrier is protecting divided by the average noise reduction provided by the barrier. The cost-benefit is just one of several criteria considered within the CDOT Guidelines, but for isolated homes the cost-benefit becomes excessive. Thus, noise barriers are not typically constructed for isolated homes.
- Noise barriers are not considered feasible or reasonable at any of the hotels on this project due to direct access issues, the fact that many of the rooms are elevated and will not benefit from a barrier, lack of outdoor use, desire of hotel operators to be seen from the highway, etc.
- Noise barriers are not considered feasible or reasonable at any of the NAC C receptors (commercial) located along in the project study area because none have any active outdoor use areas that would benefit from a barrier and/or most desire direct exposure to the highway.

The Reserve Apartments

The Reserve Apartments (R18) are located on the north side of US 34 off McWhinney Blvd. Each building appeared to contain five ground floor units each based on visual inspection. The predicted noise level for these apartments under the Action Alterative (Year 2030) is 72 dBA, which is a 2 dBA increase over the existing levels. A 660 foot long barrier was modeled along the proposed CDOT ROW, which fortunately happens to be on top of the existing terrain that currently provides some noise reduction. The easternmost 100 feet of the barrier diverts from the CDOT ROW and wraps around to the north along McWhinney Blvd. Figure 5-1 shows where the barrier was placed in the model.

The amount of noise reduction (dBA) that will be achieved by the barrier was predicted for barrier heights ranging from 6 to 12 feet. Predictions were made using both the "Wall" and "Berm" Barrier Type in the TNM model. Figure 5-2 shows the predicted noise level reductions and cost-benefit. The desired noise reduction is 5 to 10 dBA. From Figure 5-2, a 10 foot tall barrier is appropriate. The cost benefit ratios for all of the barriers modeled is less than CDOT's standard of $4,000 per dB of noise reduction per benefited receptor. The cost of each modeled barrier was calculated using a unit cost of $30 per square foot for walls and $10 per cubic yard for berms. Noise reduction was calculated using TNM. The number of benefited receptors is calculated as the number of homes where at least 3 dBA of noise reduction was predicted, and for the 10 foot tall barrier there are 14 benefited receptors. Based on this analysis, it is recommended that a 10 foot tall barrier be considered for this area in the approximate location shown in Figure 5-1. This analysis should be re-examined during the final design phase of the project.

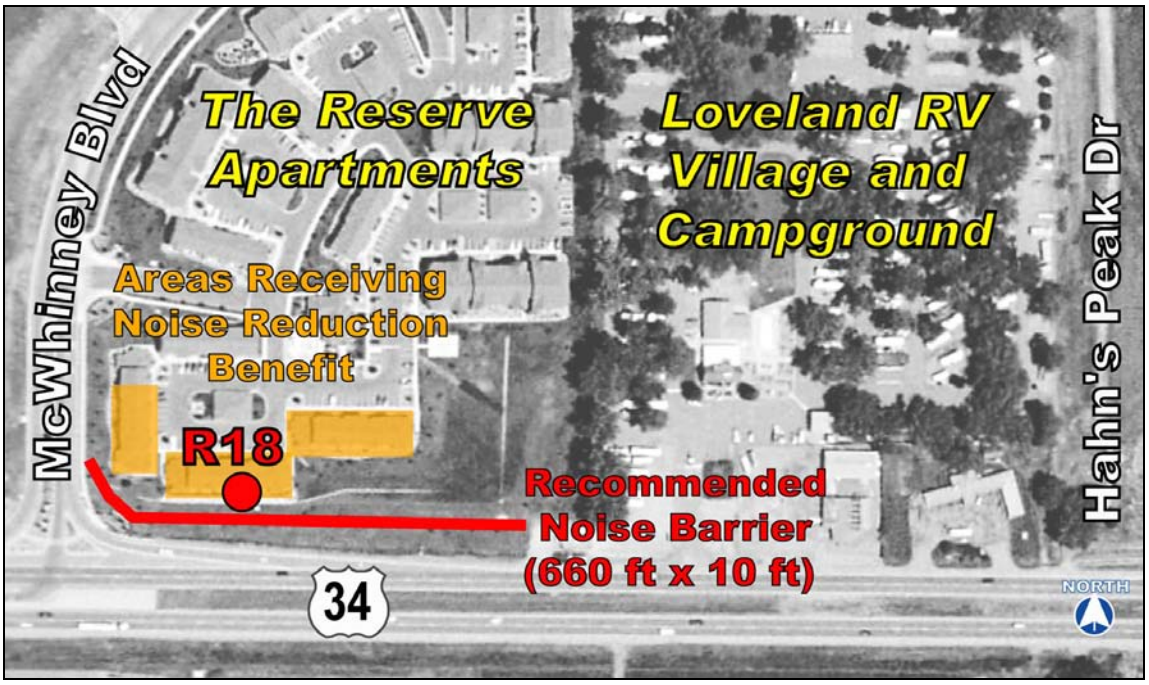

Figure 5-1: Location of Noise Barrier Analyzed for the Reserve Apartments

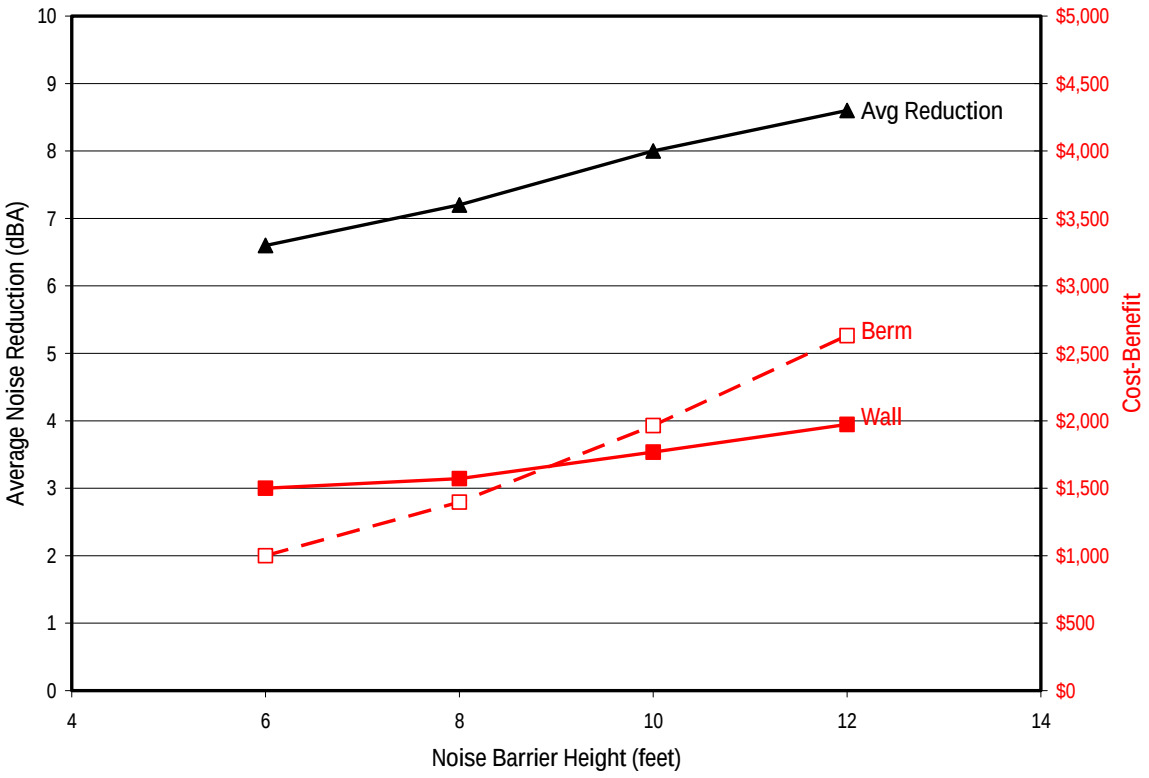

Figure 5-2: Results of Noise Mitigation Analysis for the Reserve Apartments

Residences between N. Garfield Avenue and the Railroad Tracks

Noise impacts were predicted for the single family homes (R60 and R61) adjacent to US 34 between N. Garfield Ave and the railroad tracks as shown in Figure 5-3. The predicted noise levels for these homes under the Action Alterative (Year 2030) are 68 to 69 dBA, which is a 1 dBA increase over the existing levels.

The home on the northeast corner of US 34 and N. Garfield is within about 10 feet of the western travel lane, and there is a sidewalk in between. Construction of a wall does not appear to be physically feasible. Also, this home is located between two access points for US 34, which limits the length of the wall (walls need to protrude beyond a receptor in order to be effective). Thus, a wall here is not considered feasible. For the second home in this area located closer to the railroad tracks, direct access to US 34 again limits the length of the wall. Such a wall does not provide enough benefit to warrant its cost. A closed rail safety barrier along the bridge structure just east of this location should be considered during final design, which if extended west of the bridge will provide some noise reduction for this property.

For the homes located south of US 34 between N. Garfield Ave and the railroad tracks, a wall appears to be feasible up to Arthur Ave. A 280 foot long by 6 foot tall noise wall was analyzed for this area as shown in Figure 5-3. While this wall was just feasible by one home achieving the minimum 5 dBA reduction, it was not considered reasonable due to the small number of homes that would receive a 3 dBA benefit. In this case, traffic noise from N. Garfield Ave limits the amount of noise reduction possible for many of these homes. The impacted area to the east of Arthur Ave is a similar situation to the area directly across US 34 in that a barrier would not be reasonable due to the limited number of homes that could receive a benefit. A closed rail safety barrier, as shown in Figure 5-3, would provide some noise reduction for this area and should be considered. This analysis should be re-examined during the final design phase of the project.

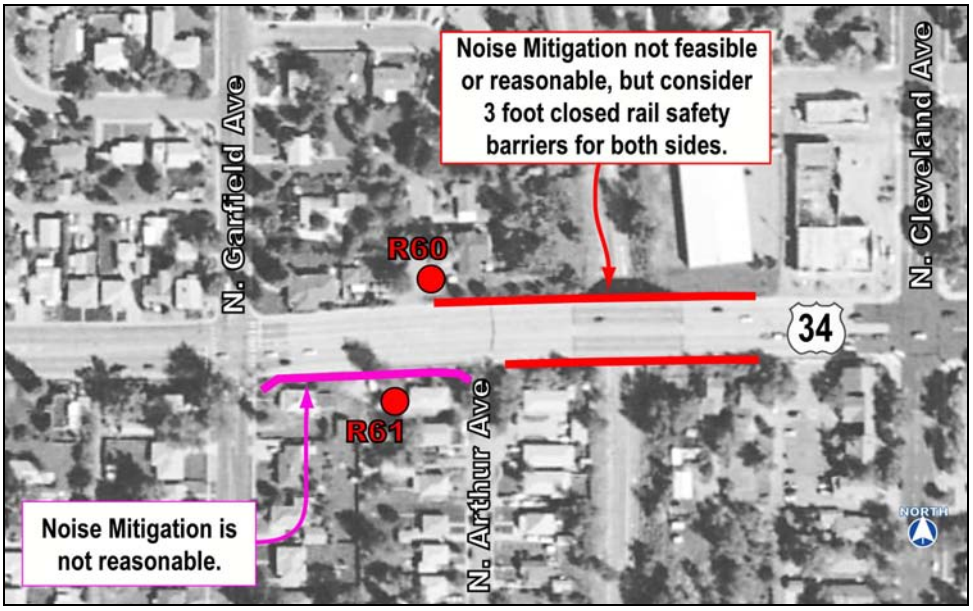

Figure 5-3: Noise Mitigation Analysis for Residences between N. Garfield Avenue and the Railroad Tracks

ATTACHMENT A

Relevant Noise Terminology

A-Weighted Sound Level (dBA) – The A-weighting system was developed to mimic the ear's varying sensitivity to frequency and is applied to either measured or predicted noise levels. Resulting levels are expressed as dBA. Table A-1 shows the A-weighted noise levels of some common sources.

TABLE A-1
Typical Noise Levels

Noise Source	Noise Level (dBA)
Amplified rock band	115 – 120
Commercial jet takeoff at 200 feet	105 – 115
Community warning siren at 100 feet	95 – 105
Busy urban street	85 – 95
Construction equipment at 50 feet	75 – 85
Freeway traffic at 50 feet	65 – 75
Normal conversation at 6 feet	55 – 65
Typical office interior	45 – 55
Soft radio music	35 – 45
Typical residential interior	25 – 35
Typical whisper at 6 feet	15 – 25
Human breathing	5 – 15
Threshold of hearing	0 – 5

Berm – Man-made hill constructed using dirt.

Decibel (dB) – See Sound Pressure Level.

Equivalent Sound Level (L_{eq}) - The steady state sound level that contains the same acoustical energy as the actual time-varying sound level during a stated time period. The time period used for highway noise analysis is one hour. All noise levels described in this report are hourly, A-weighted L_{eq}'s.

Frequency (f) - The number of oscillations per second of a periodic sound wave expressed in units of Hertz (Hz). The value is the reciprocal (1/x) of the period of oscillations in seconds. The human ear is, in general, capable of detecting frequencies between 20 to 20,000 Hertz. The human ear is more sensitive to high frequency sounds than to low frequency sounds.

Mitigation – Mitigation refers to the reduction or abatement of noise using a measure such as a barrier or low-noise pavement. The Noise Reduction provided by a mitigation measure is expressed as the noise level without the measure in place minus the level with the measure in place (dB).

Noise – Unwanted sound, usually loud or unexpected.

Noise Receptors – A location where noise impact is assessed. A receptor can represent a single residence, an entire neighborhood, a business, hotel, park, etc. The receptor is using located on the façade of a structure that faces the roadway.

Pascal (Pa) – A unit of pressure (in acoustics, normally RMS sound pressure) equal to one Newton per square meter (N/m^2). The reference pressure for computing sound pressure levels is 20 μPa (20 micro Pascal).

Sound – Pressure fluctuations in the air generated by a variety of phenomenon, such as a vibrating surface (e.g. engine casing), an explosion, or a pneumatic event such (e.g. compression and release of air under moving vehicle tires).

Sound Absorption – The conversion of sound to another form of energy, such as heat. One way this occurs is when sound waves encounter materials that contain trapped air, such as fiberglass insulation.

Sound Pressure Level (SPL) – The range of sound pressure fluctuations that the human ear can detect is enormous (0.00002 to 200 Pascals). To facilitate easier discussion, sound pressure is expressed on the logarithmic scale. The sound pressure level is equal to $10Log_{10}(p^2/p_o^2)$, where p is the instantaneous sound pressure and p_o is the reference sound pressure of 0.00002 Pa. This results in a scale of 0 dB (threshold of audibility) to 120 dB (threshold of pain).

Sound Reflection – The reflection of sound occurs when an object is able to significantly increase the impedance when compared to the surrounding air. This would require an object to be non-porous and to have enough density, stiffness and thickness.

Sound Transmission Loss (STL) – The reduction in sound level from one room to the next due to the conversion of sound energy to another form of energy (usually heat).

ATTACHMENT B

Excerpts From CDOT Noise Guidelines

5.4 Feasibility

Feasibility deals with physical considerations and concerns with the construction of an acoustically effective noise barrier at a particular site and project.

5.4.1 Noise Reduction

The major feasibility criterion that is to be considered is to whether or not a substantial noise reduction can be obtained based on constraints that are inherent to the individual project. If a substantial reduction cannot be provided a noise barrier is not feasible and will not be recommended for inclusion in the project.

CDOT defines a substantial reduction goal as a barrier that is predicted to reduce noise levels to at least one adjacent front row receiver by at least 10 dBA. The initial barrier evaluation shall be performed to determine what will be required to achieve a 10 dBA reduction. If the barrier's height that is required for this reduction is found to be 25 feet or greater, then it can be considered not feasible and the barrier evaluation will take place at a lower height. Each barrier that is evaluated shall also be evaluated under the reasonableness criteria.

It is desired that barriers be optimized in terms of overall reduction (height) and cost-benefit, which is one of the factors for reasonableness. In this case, it is desired that a point be identified where a potential noise barrier provides the best balance between cost and benefit. This is not a trivial task, as the benefit versus cost relationship is not linear and a point of diminishing returns will be reached. An iterative process, however, can result in a barrier that will be optimal within the scope of the reduction goal (10 dBA or greater), and the minimum reduction required (5 dBA). **In any case, no barrier shall be deemed feasible if an absolute minimum reduction of 5 dBA cannot be achieved for at least one front-row receiver.**

A benefited receiver is one, impacted or not, which receives at least 3 dBA of noise reduction, corresponding to at least a perceptible benefit. This is reduction that is based on the addition of the noise barrier only, which is only considered after any shielding affects, such as for rows of buildings, are taken into account.

The overall noise environment should also be considered in whether or not a noise barrier will be feasible. If the area in question is one where aircraft or rail activity exists, a barrier that only mitigates highway noise might not be enough to reduce the overall background levels appreciably. In those cases, it would not normally be feasible to construct a highway traffic noise barrier. Other considerations that need to be taken into account are situations where a barrier will shield a main highway, but not a frontage road. In these cases, the overall noise environment shall be the basis for the determination if a substantial noise reduction is possible, not just the reduction to the mitigated source.

5.4.2 Safety and Maintenance Considerations

As is the case with any structure, there are obvious engineering, safety and maintenance issues that must be considered to determine its constructability, and thus, be a feasible proposition. If any of these issues are significant enough to cause a fatal flaw condition, then the barrier can be deemed not feasible. Examples of situations that can be considered fatal flaws include, but are not limited to, the following:

- Excessive reduction of sight distance.
- Creation of a continuous shadowing condition that may cause excessive icing of driving lanes through the winter months.
- Inability to provide for adequate snow/debris removal.

5.4.3 Constructability

If reliable and common engineering practices could be employed to construct a noise barrier, then that barrier is considered to be a feasible proposition. Other factors that are sometimes considered concurrently, such as costs, are to be evaluated separately under the reasonableness criteria described in section 5.5.

If it is obvious that the constructability of a noise barrier due to site limitations or engineering considerations is not possible without major modifications to the site or technological efforts, the barrier can be considered not to be feasible and no further analysis is required, however, this should only be used for situations that are very clear. If it may be possible that a barrier(s) can be constructed, the evaluation with the computer model will take place in order to determine if a substantial reduction can take place. Decisions such as these shall be thoroughly documented and justified in the noise study report.

A very common issue to consider in this case is the ability to construct a continuous barrier for the entire length of the impacted area. An effective noise barrier cannot be built if breaks for driveways, sidewalks, streets, utilities, drainage facilities or streams are needed, as these breaks drastically reduce the barrier's performance. One possible solution in a case such as this is to consider overlapping the barriers.

5.4.4 Berms

Most of the above feasibility discussions have focused on the construction of noise barrier walls. Berms, however, can be considered as an alternative to walls where possible, as they are generally more aesthetically pleasing and have a more natural appearance. Limitations with berms do need to be considered in the feasibility evaluation, as they do require a much larger footprint. Ideally, this will be enough of a footprint to provide no steeper than a 3:1 slope.

5.4.5 Considerations for Parallel Barriers

Due to multiple sound reflections, performance degradation of parallel barriers needs to be investigated if the width-to-height ratio is less than 10:1 (distance between the barriers is less than 10 times the height of the barriers) or if the barriers are closer together than 200 feet. In these cases, if it is found that the overall noise reduction has decreased, steps need to be taken to reduce this degradation. Possible solutions include raising the height of the barriers to overcome the degradation or investigating the use of absorptive treatments on either or both barriers to reduce the reflections. In these cases, retaining walls, if they are present, should be treated as barriers in the analysis.

If all noise barriers that have been evaluated for a particular project are deemed not to be feasible (i.e. no barrier can be constructed that will result in a 5 dBA reduction to at least one receiver), the reasonableness criteria are not assessed and the noise analysis is considered complete. This decision is to be discussed and documented in the noise study report.

5.5 Reasonableness

The reasonableness determination is a more subjective process than what is done to determine feasibility. It implies that common sense and good judgment have been used in the consideration of noise abatement. The process for evaluating the reasonableness of abatement is meant to be flexible enough to meet individual situations but able to be applied in as consistent and uniform a manner as possible on a statewide basis. The main consideration in this evaluation is whether or not the barrier is a practical solution for a certain situation.

The FHWA regulations are meant to give the states flexibility in complying with the requirements of 23CFR772, and many of the criteria that are to be considered are based on a range of possible solutions, many of which are to be determined by the individual states. While the determination of impacts is fairly standard and must be done by all states, the evaluation of any potential mitigation does not contain any mandates as to when mitigation is to be provided, other than after a determination of feasibility and reasonableness. In this determination, there is only one "absolute" criterion that is considered by CDOT in these guidelines: Even if a barrier meets all feasibility requirements and is deemed to be reasonable, it will not be built if the majority of the affected property owners do not want it to be built. A property is considered to be "affected" if it is predicted to receive at least a 3 dBA benefit from the barrier (i.e. is considered to be a "benefited" receiver).

The final determination of reasonableness of noise mitigation will be made only after a careful and thorough consideration of a wide range of criteria. The following are the criteria that will be considered by CDOT in its noise abatement evaluation. None of the following reasonableness factors by itself shall be sole grounds for acceptance or rejection of mitigation.

Each reasonableness factor discussed below will have one of four possible values:

- EXTREMELY REASONABLE – The proposed mitigation can be accomplished through minimal financial or social costs, or reflects a situation that warrants high consideration for mitigation.
- REASONABLE – The proposed mitigation can be accomplished through acceptable financial or social costs, or reflects a situation which warrants greater consideration for mitigation.
- MARGINALLY REASONABLE – The proposed mitigation can be ac-accomplished through moderate financial or social costs, or reflects a situation that is moderately warranted for mitigation consideration.
- UNREASONABLE – The proposed mitigation cannot be accomplished without excessive financial or social costs, or reflects a situation in which mitigation consideration should be minimal at best.

5.5.1 Cost Benefit Index

In consideration of the cost of each potential noise barrier segment, the barrier benefit index shall be evaluated based on an estimate of cost per receiver per decibel of reduction. This will determine the "cost-reasonableness" of the abatement.

The cost benefit index, calculated as a ratio, is not intended to function as an accurate itemization of all of the different costs that are prevalent in the construction of a noise barrier, but rather to determine a consistent level of consideration that will be used for all CDOT noise abatement evaluations under these guidelines.

EXTREMELY REASONABLE: Less than $3000/receiver/decibel
REASONABLE: $3000-$3750/receiver/decibel
MARGINALLY REASONABLE: $3750-$4000/receiver/decibel
UNREASONABLE: More than $4000/receiver/decibel

This value will be determined by dividing the approximate cost of the barrier (length * height * unit cost) by the total decibel reduction that is predicted to occur. For evaluation purposes, the unit cost that will be used for this cost calculation will be a typical cost of $30 per exposed square foot, which will approximate all costs in construction of a standard concrete/masonry barrier that does not require special site considerations. If berms are possible and are potentially feasible, use the unit cost of $10 per square yard of earth for the berm portion of the calculation.

The total decibel reduction is the cumulative sum of all of the decibel reductions projected for each receiver that receives at least a 3 dBA benefit directly due to the noise barrier (all benefited or affected receivers).

For example, consider a barrier 10 feet high and 1000 feet long to protect a development of 16 homes. If 6 receivers are predicted to receive a 5 dBA benefit and 10 are predicted to receive a 7 dBA benefit, the cost benefit index value will be calculated as follows:

Cost = (10 ft. ht.) * (1000 ft. l.) * ($30/sq. ft) = $300000;
Benefit = (6 rec. * 5 dBA) + (10 rec. * 7 dBA) = 100 total dBA reduction;
Cost-Reasonableness Value = $300000/100 dBA = $3000/receiver/decibel.
This barrier would be considered REASONABLE.

As mentioned earlier, receiver points that were used in the modeling usually represent several actual receivers. It is very important to properly quantify these receivers to obtain an accurate count of the benefits achieved to be used for the calculation. For the calculation, each benefited individual residence, business, etc. is to be counted as one receiver. For multi-family residences, each unit adjacent to the highway should count as one receiver. If the multi-family structure is predicted to receive an overall benefit of 8 dBA, for example, but there are 4 separate units, then an overall benefit of 32 dBA (4*8) must be used in the calculation.

In many cases, the number of receivers and their locations are not easily defined. The noise analyst in this case must use good judgment in determining these values, with the overall social benefit being the primary consideration in this evaluation. Special use facilities, such as parks and churches, should be handled with the same consideration and judgment on a case-by-case basis.

5.5.2 Build Noise Level

The future projected noise levels with the completion of the project should, on average, be at least 66 dBA for consideration of noise mitigation for the front row receivers.

EXTREMELY REASONABLE: Design-year noise levels 70 dBA or more
REASONABLE: Noise levels of 66-70 dBA
MARGINALLY REASONABLE: Noise levels 63-66 dBA
UNREASONABLE: Levels less than 63 dBA

This criterion gives greater consideration to areas, which are or will be subjected to a higher absolute level of noise.

5.5.3 Impacted Persons' Desires

The opinions and desires of the impacted community should be of primary importance in the evaluation of reasonableness of a noise barrier. At least 50% of the affected property owners should want the noise barrier.

EXTREMELY REASONABLE: More than 75% in support
REASONABLE: 50-75% supportive
MARGINALLY REASONABLE: 25-50% supportive
UNREASONABLE: Less than 25% supportive

These values are normally based on residential areas, as normally mitigation for commercial and special-use areas by themselves are not reasonable. The percentages are to be based on the properties that benefit from the noise barrier (i.e. receive at least a 3 dBA benefit). In all cases, each individual property owner or their official designee or representative shall be the party to be consulted in this manner.

5.5.4 Development Type

The mixture of development types plays a major role in determining the reasonableness of mitigation. To be considered, the amount of residential development should be at least 75% of the overall development in the area around the project.

EXTREMELY REASONABLE: Greater than 75% residential
REASONABLE: 50-75% residential
MARGINALLY REASONABLE: 25-50% residential
UNREASONABLE: Less than 25% residential

In general, the term "residential" as described above also includes other category "B" type development, such as parks, churches, hospitals, hotels, etc.

5.5.5 Development Existence

To be fully considered for a reasonable project, the majority of the development in the area of a highway improvement should have been in existence for at least 15 years before the consideration of the project.

EXTREMELY REASONABLE: Greater than 75% of properties at least 15 years old
REASONABLE: 50-75% at least 15 years old
MARGINALLY REASONABLE: 25-50% at least 15 years old
UNREASONABLE: Less than 25% at least 15 years old

The spirit of this criterion is to give greater consideration to long-term residents.

5.5.6 Build Noise Level vs. Existing Noise Level

The future build noise levels over the existing levels will be more of an issue if there is to be a readily perceptible increase with the completion of the project.

EXTREMELY REASONABLE: Greater than a 10 dBA increase
REASONABLE: 5-10 dBA increase
MARGINALLY REASONABLE: 0-5 dBA increase
UNREASONABLE: A project that will result in a decrease in projected noise levels.

This criterion allows greater consideration for projects that receive a perceptible increase in noise levels. In any case, this criterion is to still give consideration and not dismiss a potential barrier just because the project is not contributing any additional noise, especially if the overall noise levels are projected to be very high (70 dBA or greater).

Upon review of these criteria, the decision that is made should be well documented in the noise study report. To aid in this documentation, completion of CDOT form 1209 is required and is to be included within the noise study report (the NAD forms for this project are included in Attachment F). This form is to be filled out for each barrier segment or each distinct area of the project that were evaluated in the analysis.

5.6 Special Considerations for Severe Impacts

If a private-use residential property is determined to be severely impacted by noise (75 dBA exterior levels or a 30 dBA or more increase in noise levels), then extra-ordinary abatement measures may be considered if no other possible abatement is determined to be feasible and reasonable. One such method that can be used in these cases is noise insulation of the structure, which can include such measures as sealing windows and doors, filling voids in the structure, installation of an air-conditioning system, or other use of noise-absorbing material.

The consideration of extraordinary abatement measures in the case of severe highway traffic noise impacts can be made on a case-by-case basis and is not a mandatory requirement at this time.

5.7 Special Considerations for Non-Profits

Public use or nonprofit institutional structures, such as churches and schools, may be considered for noise insulation in accordance with 23CFR772.13.c(6). This evaluation is strictly voluntary and can be made on a case-by-case basis. Care must be taken in this evaluation as to the condition of the structure, its current amenities, and overall use characteristics to be sure that any proposals consider fully the implications of providing the abatement. One such case is for a facility that is not subjected to high interior noise levels unless the windows are open, but must remain open for the purposes of ventilation, and thus, provide proper use and enjoyment of the facility. Any decisions in this regard must be thoroughly and completely documented in the text of the noise report.

ATTACHMENT C

TNM Input Data

Default TNM Input Data

All analyses were conducted using the English coordinate system and results were calculated as hourly L_{eq} (dBA). The default temperature and relative humidity values of 50°F and 68% were used along with the default ground type of 'lawn'. Also, TNM's built-in noise emission levels for Automobiles, Medium Trucks, and Heavy Trucks were used. Vehicle emission levels refer to the noise level of vehicles measured at a reference distance and a reference speed. TNM v2.5 has separate emission levels for automobiles, medium trucks (generally, trucks with two axles, six tires, and a gross vehicle weight greater than 9,900 lbs and less than 26,400 lbs), and heavy trucks (generally, trucks with three or more axles and a gross vehicle weight greater than 26,400 lbs).

Location of Roadways, Receptors, Terrain, and Barriers

The location of each modeled entity (i.e. roadways, receptor locations, buildings, barriers) was determined using CAD data provided by the project team. This included aerial photographs, planemetrics, and topography information. Note that the aerial photograph used does not reflect all of the existing development in the area. US 34 was represented in the TNM model using one "Roadway" element for each direction of travel. One Roadway element was used to represent both directions of travel for all cross streets. US 34 was modeled beyond the noise study area by over 2,000 feet to ensure that all of the noise generated by the highway was represented. Receptor points were placed in the model at 63 locations. These locations are representative of all the residential and commercial development located along the highway. Per CDOT policy, points were located up to 500 feet beyond the limits of construction as necessary. The receptors points were chosen based on an on-site review. The locations of significant local features that influence noise propagation, such as large buildings, hillsides, and existing noise walls, were also determined by conducting an on-site review. Elevations of these features, as well those of the existing road and receptor points, were determined using the CAD topography data.

Traffic Volumes and Speeds

Loudest-hour traffic volumes and speeds were provided by the project team which were from *US 34: US 287 East to LCR 3, Traffic and Safety Analysis, September 6, 2005, J.F. Sato and Associates as adjusted for noise analysis requirements*, J.F. Sato and Associates, May 31, 2006 and January 26, 2007. Tables C-1 and C-2 show the traffic data used to model Existing Conditions (Year 2005). Tables C-3 and C-4 show the traffic data used to model the Action Alternative (Year 2030). Tables C-5 and C-6 show the traffic data used to model the No-Action Alternative (Year 2030). In order to model loudest-hour conditions, all of the volumes represent Level-of-Service (LOS) C conditions or better. That is, where traffic projections indicated that the LOS would be A, B, or C, all of which represent free-flowing traffic conditions, the projected volumes were used directly. This only occurred for traffic volumes east of I-25 for the Existing (Year 2005) conditions. When traffic projections indicated that the LOS would be D, E, or F, which represents some degree of congestion and therefore lower speeds, the volumes were reduced to replicate LOS C conditions. Posted speeds were used in all of the predictions.

TABLE C-1
Existing (2005) Loudest Hour Mainline Traffic Volumes

	Total Volume	Autos	Medium Trucks	Heavy Trucks	Speed
US 34 WESTBOUND					
West of N Cleveland Ave	*1353*	1272	54	27	35
N Cleveland to N Lincoln	*1372*	1290	55	27	35
N Lincoln to N Washington	*1225*	1151	49	25	35
N Washington to N Monroe	*1370*	1288	55	27	35
N Monroe to Redwood	*1508*	1418	60	30	35
Redwood to N Madison	*1461*	1374	58	29	40
N Madison to N Boise	*2150*	2021	86	43	40
N Boise to Cheyenne	*1798*	1690	72	36	40
Cheyenne to N Denver	*1595*	1499	64	32	45
N Denver to Boyd Lake	*1785*	1678	71	36	55
Boyd Lake to McWhinney	*1594*	1498	64	32	55
McWhinney to Rocky Mtn	*1522*	1431	61	30	55
Rocky Mtn to I-25	*1588*	1492	64	32	55
I-25 to Centerra Pkwy	*1611*	1515	64	32	50
Centerra Pkwy to Kendall Pkwy	*1611*	1515	64	32	50
Kendall Pkwy to LCR 3	1611	1515	64	32	50
LCR 3 to East	*1614*	1517	65	32	50
US 34 EASTBOUND					
West of N Cleveland Ave	*1204*	1132	48	24	35
N Cleveland to N Lincoln	*1338*	1257	54	27	35
N Lincoln to N Washington	*1358*	1277	54	27	35
N Washington to N Monroe	*1326*	1246	53	27	35
N Monroe to Redwood	*1475*	1386	59	30	35
Redwood to N Madison	*1453*	1366	58	29	40
N Madison to N Boise	*1544*	1451	62	31	40
N Boise to Cheyenne	*1347*	1266	54	27	40
Cheyenne to N Denver	*1288*	1210	52	26	45
N Denver to Boyd Lake	*1318*	1239	53	26	55
Boyd Lake to McWhinney	*1249*	1174	50	25	55
McWhinney to Rocky Mtn	*1344*	1263	54	27	55
Rocky Mtn to I-25	*1617*	1520	65	32	55
I-25 to Centerra Pkwy	*1602*	1506	64	32	50
Centerra Pkwy to Kendall Pkwy	*1602*	1506	64	32	50
Kendall Pkwy to LCR 3	1602	1506	64	32	50
LCR 3 to East	*1602*	1506	64	32	50

TABLE C-2
Existing (2005) Loudest Hour Cross-Street Traffic Volumes

	Total Volume	Autos	Medium Trucks	Heavy Trucks	Speed
N Cleveland North	*1212*	1140	48	24	35
N Cleveland South	*1129*	1061	45	23	35
N Lincoln North	*1558*	1465	62	31	35
N Lincoln South	*1675*	1574	67	34	35
N Washington North	*46*	43	2	1	35
N Washington South	*255*	240	10	5	35
N Monroe North	*189*	177	8	4	35
N Monroe South	*180*	169	7	4	35
Redwood North	*207*	195	8	4	35
Redwood South	*608*	572	24	12	35
N Madison North	*1421*	1336	57	28	35
N Madison South	*1325*	1245	53	27	35
N Boise North	*959*	902	38	19	35
N Boise South	*542*	509	22	11	35
Cheyenne North	*165*	155	7	3	35
N Denver North	*924*	869	37	18	35
N Denver South	*1101*	1035	44	22	35
Boyd Lake North	*462*	435	18	9	35
Boyd Lake South	*176*	165	7	4	35
McWhinney North	*295*	277	12	6	35
Rocky Mtn North	*1212*	1140	48	24	35
Centerra Pkwy North	*0*	0	0	0	n/a
Centerra Pkwy South	*0*	0	0	0	n/a
Kendall Pkwy North	*0*	0	0	0	n/a
Kendall Pkwy South	*0*	0	0	0	n/a
LCR 3 North	*152*	143	6	3	35
LCR 3 South	*174*	164	7	3	35

TABLE C-3
Future Action (2030) Loudest Hour Mainline Traffic Volumes

	Total Volume	Autos	Medium Trucks	Heavy Trucks	Speed
US 34 WESTBOUND					
West of N Cleveland Ave	*1944*	1827	78	39	35
N Cleveland to N Lincoln	*2054*	1931	82	41	35
N Lincoln to N Washington	*2232*	2098	89	45	35
N Washington to N Monroe	*2204*	2072	88	44	35
N Monroe to Redwood	*2154*	2025	86	43	35
Redwood to N Madison	*2270*	2134	91	45	35
N Madison to N Boise	*2876*	2703	115	58	35
N Boise to Cheyenne	*3222*	3029	129	64	35
Cheyenne to N Denver	*3259*	3064	130	65	45
N Denver to Sculptor	*3365*	3163	135	67	50
Sculptor to Boyd Lake	*3399*	3195	136	68	50
Boyd Lake to McWhinney	*3620*	3403	145	72	50
McWhinney to Hahn's Peak	*3616*	3399	145	72	50
Hahn's Peak to Rocky Mtn	*3258*	3063	130	65	50
Rocky Mtn to I-25	*3298*	3100	132	66	50
I-25 to Centerra Pkwy	*3346*	3145	134	67	50
Centerra Pkwy to Kendall Pkwy	*2680*	2519	107	54	50
Kendall Pkwy to LCR 3	3185	2994	127	64	50
LCR 3 to East	*3172*	2982	127	63	50
US 34 EASTBOUND					
West of N Cleveland Ave	*1569*	1475	63	31	35
N Cleveland to N Lincoln	*1709*	1607	68	34	35
N Lincoln to N Washington	*1853*	1742	74	37	35
N Washington to N Monroe	*1777*	1670	71	36	35
N Monroe to Redwood	*1751*	1646	70	35	35
Redwood to N Madison	*2075*	1950	83	42	35
N Madison to N Boise	*2477*	2328	99	50	35
N Boise to Cheyenne	*2595*	2439	104	52	35
Cheyenne to N Denver	*2653*	2494	106	53	45
N Denver to Sculptor	*2671*	2511	107	53	50
Sculptor to Boyd Lake	*2755*	2590	110	55	50
Boyd Lake to McWhinney	*3052*	2869	122	61	50
McWhinney to Hahn's Peak	*3042*	2859	122	61	50
Hahn's Peak to Rocky Mtn	*2642*	2483	106	53	50
Rocky Mtn to I-25	*2724*	2561	109	54	50
I-25 to Centerra Pkwy	*2727*	2563	109	55	50
Centerra Pkwy to Kendall Pkwy	*2197*	2065	88	44	50
Kendall Pkwy to LCR 3	2607	2451	104	52	50
LCR 3 to East	*2585*	2430	103	52	50

TABLE C-4
Future Action (2030) Loudest Hour Cross-Street Traffic Volumes

	Total Volume	Autos	Medium Trucks	Heavy Trucks	Speed
N Cleveland North	*1436*	1350	57	29	35
N Cleveland South	*1422*	1337	57	28	35
N Lincoln North	*1899*	1785	76	38	35
N Lincoln South	*1548*	1455	62	31	35
N Washington North	*286*	269	11	6	35
N Washington South	*267*	251	11	5	35
N Monroe North	*228*	214	9	5	35
N Monroe South	*226*	212	9	5	35
Redwood North	*298*	280	12	6	35
Redwood South	*1099*	1033	44	22	35
N Madison North	*1795*	1687	72	36	35
N Madison South	*1328*	1248	53	27	35
N Boise North	*1301*	1223	52	26	35
N Boise South	*1265*	1189	51	25	35
Cheyenne North	*85*	80	3	2	35
N Denver North	*750*	705	30	15	35
N Denver South	*1210*	1138	48	24	35
Sculptor Dr North	*543*	510	22	11	35
Sculptor Dr South	*587*	552	23	12	35
Boyd Lake North	*1681*	1580	67	34	35
Boyd Lake South	*1310*	1232	52	26	35
McWhinney North	*93*	87	4	2	35
Hahn's Peak Dr	*894*	840	36	18	35
Rocky Mtn North	*2714*	2551	109	54	35
Centerra Pkwy North	*1484*	1395	59	30	35
Centerra Pkwy South	*1541*	1448	62	31	35
Kendall Pkwy North	*703*	661	28	14	35
Kendall Pkwy South	*482*	453	19	10	35
LCR 3 North	*782*	735	31	16	35
LCR 3 South	*729*	685	29	15	35

TABLE C-5
Future No Action (2030) Loudest Hour Mainline Traffic Volumes

	Total Volume	Autos	Medium Trucks	Heavy Trucks	Speed
US 34 WESTBOUND					
West of N Cleveland Ave	*1534*	1442	61	31	35
N Cleveland to N Lincoln	*1620*	1523	65	32	35
N Lincoln to N Washington	*1761*	1656	70	35	35
N Washington to N Monroe	*1739*	1634	70	35	35
N Monroe to Redwood	*1699*	1597	68	34	35
Redwood to N Madison	*1791*	1683	72	36	35
N Madison to N Boise	*2268*	2132	91	45	35
N Boise to Cheyenne	*2542*	2389	102	51	35
Cheyenne to N Denver	*2571*	2417	103	51	45
N Denver to Sculptor	*2655*	2496	106	53	50
Sculptor to Boyd Lake	*2682*	2521	107	54	50
Boyd Lake to McWhinney	*2856*	2685	114	57	50
McWhinney to Hahn's Peak	*2853*	2682	114	57	50
Hahn's Peak to Rocky Mtn	*2570*	2416	103	51	50
Rocky Mtn to I-25	*2601*	2445	104	52	50
I-25 to Centerra Pkwy	*2795*	2627	112	56	50
Centerra Pkwy to Kendall Pkwy	*2239*	2104	90	45	50
Kendall Pkwy to LCR 3	2660	2501	106	53	50
LCR 3 to East	*2650*	2491	106	53	50
US 34 EASTBOUND					
West of N Cleveland Ave	*1238*	1163	50	25	35
N Cleveland to N Lincoln	*1348*	1267	54	27	35
N Lincoln to N Washington	*1462*	1375	58	29	35
N Washington to N Monroe	*1402*	1318	56	28	35
N Monroe to Redwood	*1381*	1298	55	28	35
Redwood to N Madison	*1637*	1539	65	33	35
N Madison to N Boise	*1954*	1837	78	39	35
N Boise to Cheyenne	*2047*	1924	82	41	35
Cheyenne to N Denver	*2093*	1967	84	42	45
N Denver to Sculptor	*2107*	1981	84	42	50
Sculptor to Boyd Lake	*2173*	2043	87	43	50
Boyd Lake to McWhinney	*2408*	2264	96	48	50
McWhinney to Hahn's Peak	*2400*	2256	96	48	50
Hahn's Peak to Rocky Mtn	*2084*	1959	83	42	50
Rocky Mtn to I-25	*2149*	2020	86	43	50
I-25 to Centerra Pkwy	*2278*	2141	91	46	50
Centerra Pkwy to Kendall Pkwy	*1835*	1725	73	37	50
Kendall Pkwy to LCR 3	2177	2046	87	44	50
LCR 3 to East	*2159*	2030	86	43	50

TABLE C-6
Future No Action (2030) Loudest Hour Cross-Street Traffic Volumes

	Total Volume	Autos	Medium Trucks	Heavy Trucks	Speed
N Cleveland North	*1133*	1065	45	23	35
N Cleveland South	*1122*	1055	45	22	35
N Lincoln North	*1498*	1408	60	30	35
N Lincoln South	*1221*	1148	49	24	35
N Washington North	*226*	212	9	5	35
N Washington South	*211*	199	8	4	35
N Monroe North	*180*	169	7	4	35
N Monroe South	*178*	167	7	4	35
Redwood North	*235*	221	9	5	35
Redwood South	*867*	815	35	17	35
N Madison North	*1416*	1331	57	28	35
N Madison South	*1048*	985	42	21	35
N Boise North	*1027*	965	41	21	35
N Boise South	*998*	938	40	20	35
Cheyenne North	*67*	63	3	1	35
N Denver North	*591*	555	24	12	35
N Denver South	*954*	897	38	19	35
Sculptor Dr North	*428*	402	17	9	35
Sculptor Dr South	*463*	435	19	9	35
Boyd Lake North	*1326*	1246	53	27	35
Boyd Lake South	*1033*	971	41	21	35
McWhinney North	*73*	69	3	1	35
Hahn's Peak Dr	*705*	663	28	14	35
Rocky Mtn North	*2141*	2012	86	43	35
Centerra Pkwy North	*1240*	1165	50	25	35
Centerra Pkwy South	*1287*	1210	51	26	35
Kendall Pkwy North	*588*	552	24	12	35
Kendall Pkwy South	*402*	378	16	8	35
LCR 3 North	*653*	614	26	13	35
LCR 3 South	*609*	573	24	12	35

ATTACHMENT D

Noise Measurement Information

HANKARD ENVIRONMENTAL
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MEMORANDUM

TO:	Joanna Morsicato – *J.F. Sato*	DATE:	April 12, 2005
FROM:	Joshua Leasure	MEMO REF:	---
SUBJECT:	Noise Measurement Summary	PROJECT:	US 34
CC:	Michael Hankard – Hankard Environmental		

This memorandum describes the results of a noise measurements conducted for the US 34, US 287 to Larimer County Road 3 Project on March 23rd and 24th, 2005. Noise levels were measured along US 34 at the three locations labeled M1, M2, and M3 in Figures 1 – 3. Measurements were conducted using a Larson Davis Model 820 Sound Level Meter (ANSI Type 1). The windscreen-protected microphone was located five-feet above the ground. The meter was set to continuously monitor the A-weighted equivalent noise level and log the average 5-minute L_{eq}. The noise meter was field calibrated prior to the noise measurements and re-checked after the noise measurements. Wind conditions were calm during the measurements.

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Results At M1

As shown in Figure 1, M1 is located at 311 McWhinney Boulevard. The measurement was taken at a distance of 105 feet from US 34. Six 5-minute A-weighted measurements were taken from 4:05 to 4:35 on March 23rd. Traffic in both directions on US 34 was counted and separated into three vehicle classes: autos, medium trucks, and heavy trucks. Table 1 lists the measured noise levels, and Table 2 lists the traffic counts.

Table 1 – Noise Measurements at M1

Start Time	5-Minute Leq (dBA)
16:05	62.1
16:10	62.2
16:15	62.6
16:20	61.1
16:25	61.8
16:30	62.2

Table 2 – Traffic Counts at M1

	West Bound			East Bound		
Start Time	Number of Autos	Number of Medium Trucks	Number of Heavy Trucks	Number of Autos	Number of Medium Trucks	Number of Heavy Trucks
16:05	136	3	1	97	1	1
16:10	137	3	1	94	0	2
16:15	121	3	3	99	1	1
16:20	100	5	0	114	0	1
16:25	217	0	0	47	0	2

Figure 1 – Location of M1

Results At M2

As shown in Figure 2, M3 is located at 1988 N Cheyenne Avenue. The measurement was taken at a distance of 320 feet from US 34. Five 5-minute A-weighted measurements were taken from 7:55 to 8:20 on March 24th. Traffic in both directions on US 34 was counted and separated into three vehicle classes: autos, medium trucks, and heavy trucks. Table 3 lists the measured noise levels, and Table 4 lists the traffic counts.

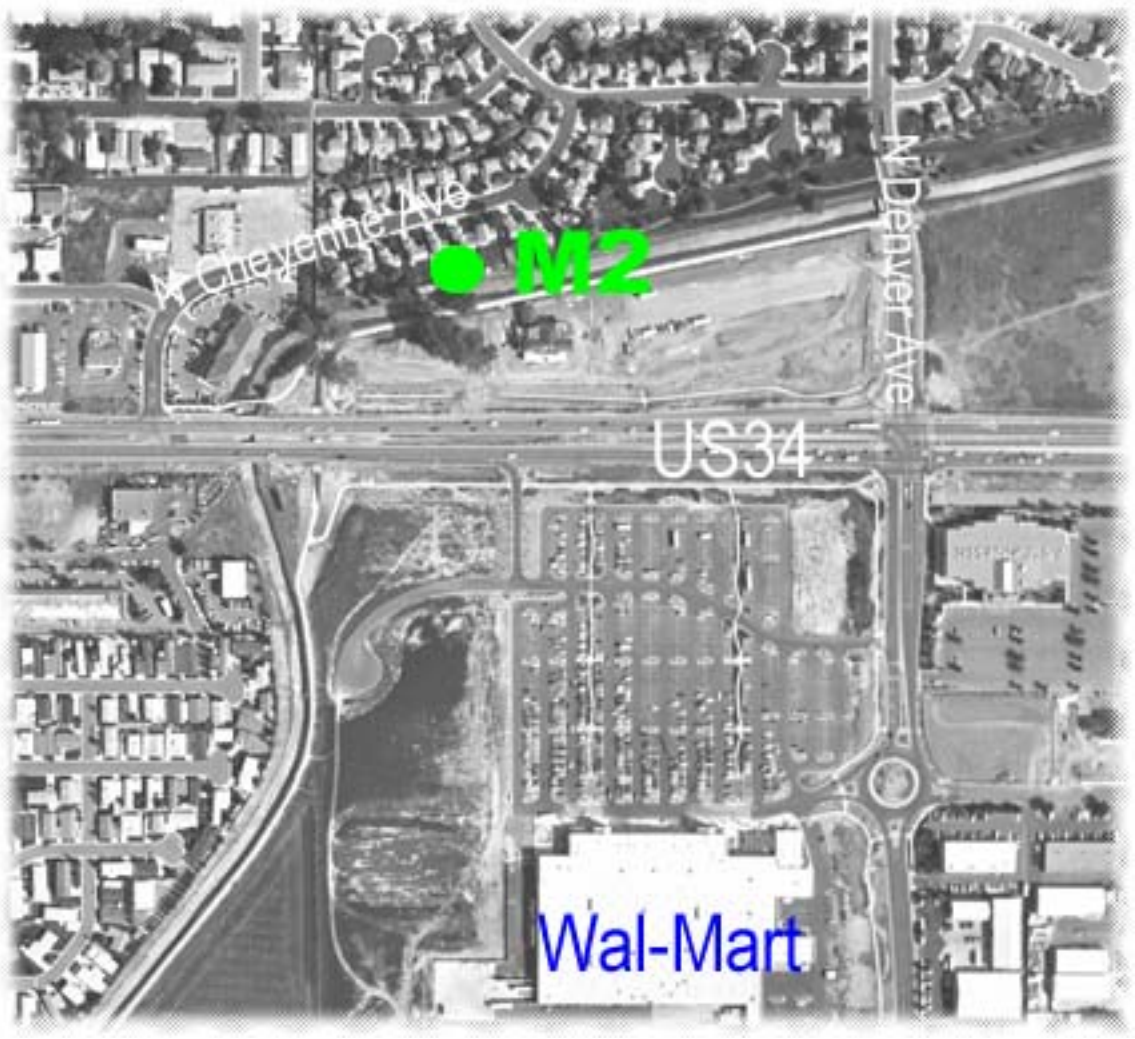
Table 3 – Noise Measurements at M2

Start Time	5-Minute Leq (dBA)
7:55	54.2
8:00	53.0
8:05	52.3
8:10	52.3
8:15	52.4

Table 4 – Traffic Counts at M2

Start Time	Number of Autos	Number of Medium Trucks	Number of Heavy Trucks	Number of Autos	Number of Medium Trucks	Number of Heavy Trucks
7:55	116	5	6	115	3	2
8:00	70	3	2	102	1	2
8:05	49	4	2	92	4	1
8:10	68	1	1	71	2	1
8:15	71	5	1	101	1	2

Figure 2 – Location of M2



Results At M3

As shown in Figure 3, M3 is located at 1108 15th Street. The measurement was taken at a distance of 260 feet from US 34. Five 5-minute A-weighted measurements were taken from 8:35 to 9:00 on March 24th. Traffic in both directions on US 34 was counted and separated into three vehicle classes: autos, medium trucks, and heavy trucks. Table 5 lists the measured noise levels, and Table 6 lists the traffic counts.

Table 5 – Noise Measurements at M3

Start Time	5-Minute Leq (dBA)
8:35	53.2
8:40	52.6
8:45	54.1
8:50	52.4
8:55	53.6

Table 6 – Traffic Counts at M3

	West Bound			East Bound		
Start Time	Number of Autos	Number of Medium Trucks	Number of Heavy Trucks	Number of Autos	Number of Medium Trucks	Number of Heavy Trucks
8:35	46	0	0	76	2	5
8:40	59	3	4	72	1	0
8:45	71	0	2	67	3	1
8:50	65	1	1	66	2	4
8:55	59	3	2	66	2	2

Figure 3 – Location of M3

ATTACHMENT E

Noise Analysis Site Plans for the Action Alternative

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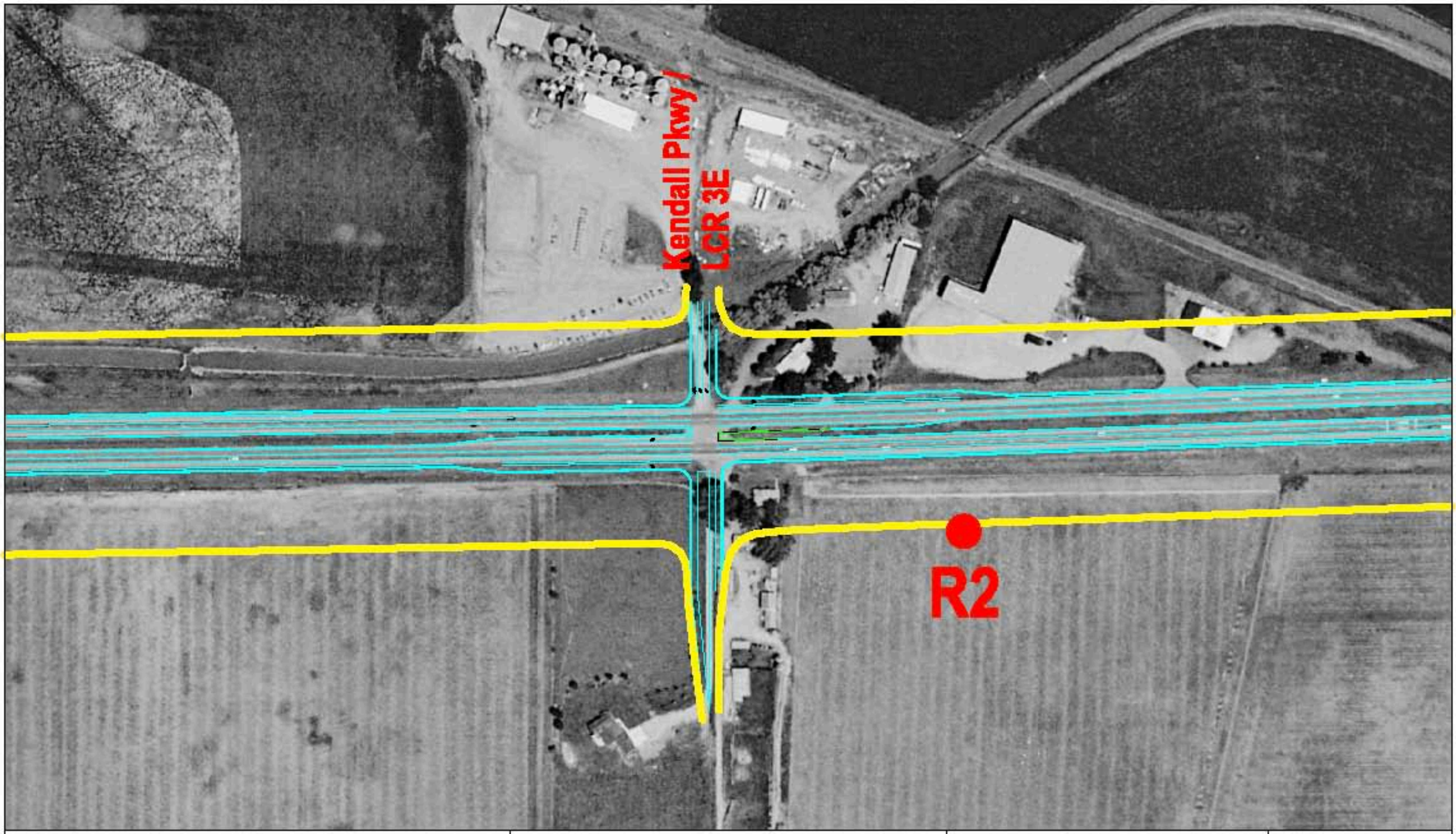
Action Alternative
Year 2030

Figure E-1



NORTH

0 100' 50' 200'

- Noise Receptor Locations
- Property Acquisition
- Existing Barrier modeled in TNM
- 66 dBA Noise Level Contour (2030)

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Figure E-2

NORTH

0 100' 50' 200'

- Noise Receptor Locations
- Property Acquisition
- Existing Barrier modeled in TNM
- 66 dBA Noise Level Contour (2030)

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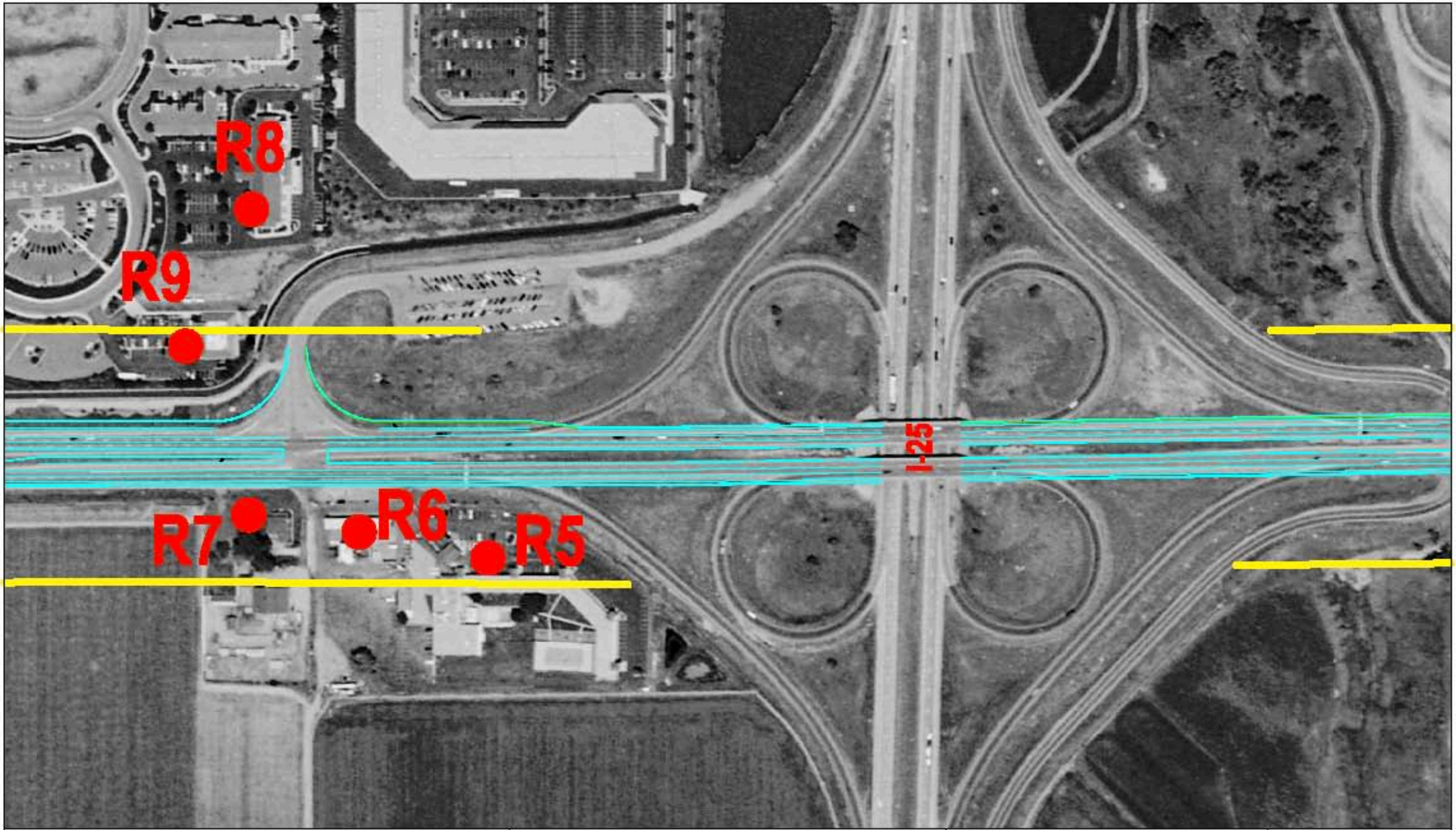
Figure E-3



NORTH

0 100'

50' 200'

- Noise Receptor Locations
- Property Acquisition
- Existing Barrier modeled in TNM
- 66 dBA Noise Level Contour (2030)

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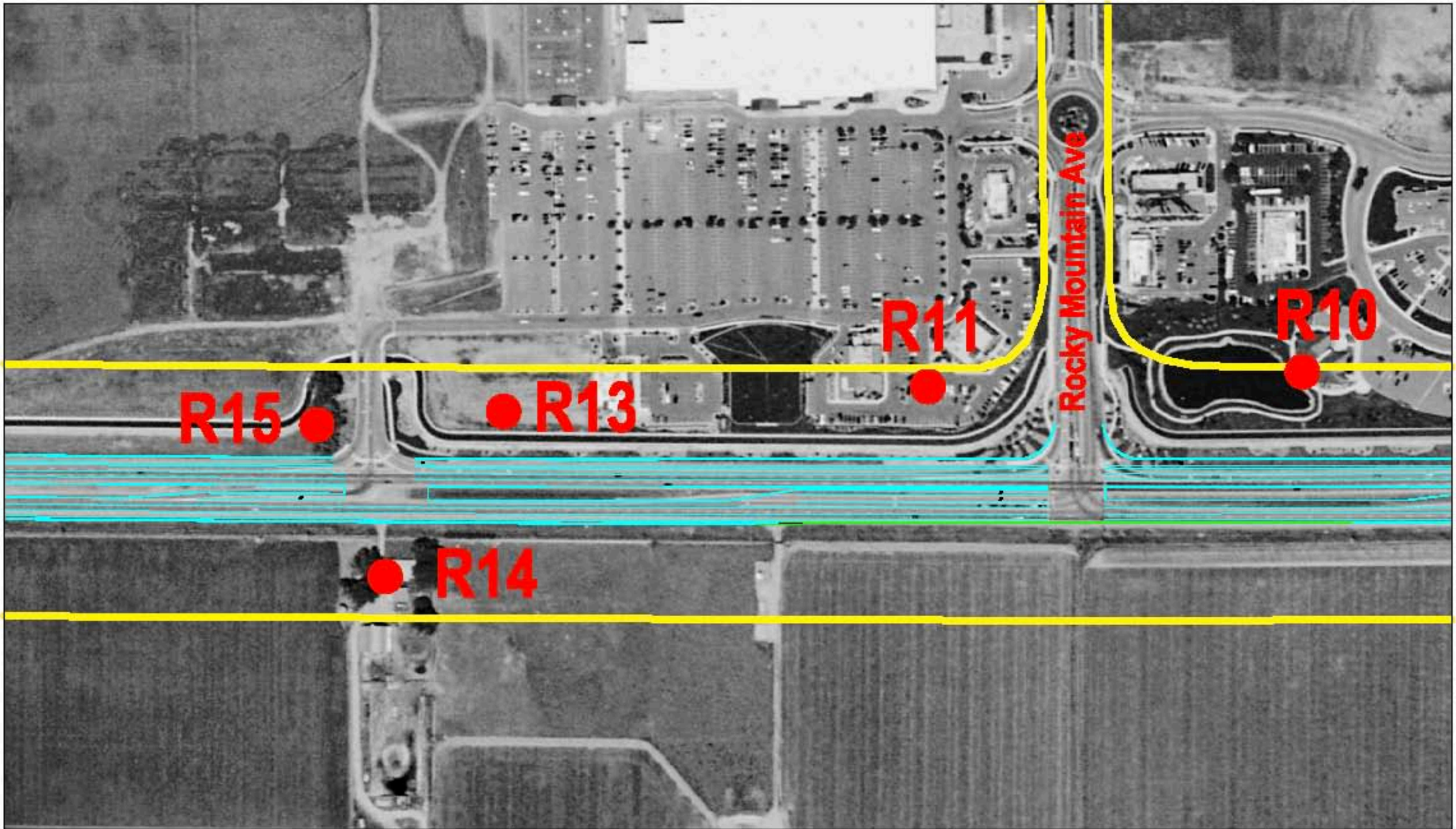
Figure E-4



NORTH

0 100'

50' 200'

- Noise Receptor Locations
- Property Acquisition
- Existing Barrier modeled in TNM
- 66 dBA Noise Level Contour (2030)

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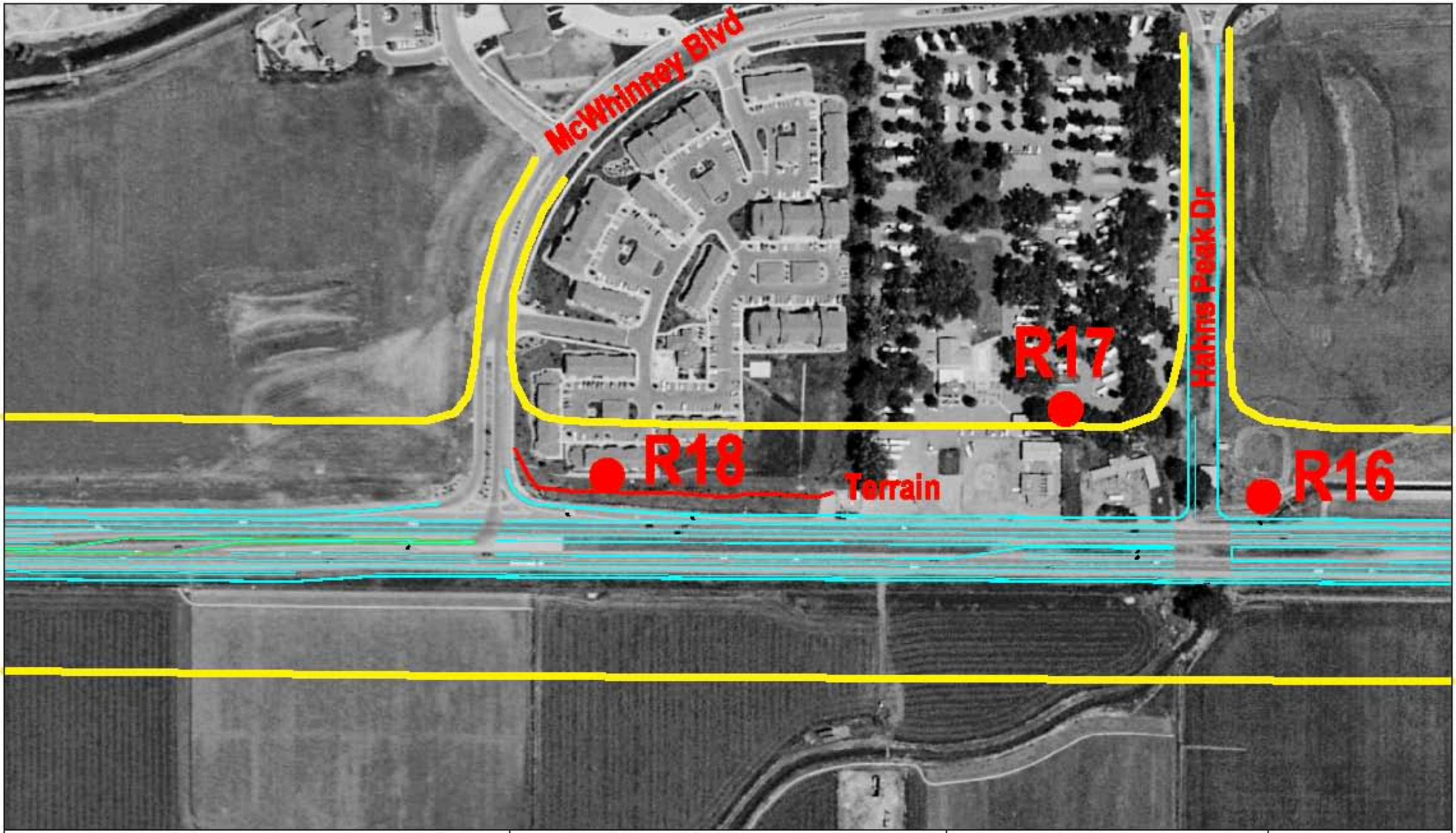
Figure E-5



NORTH

0 100' 50' 200'

- Noise Receptor Locations
- Property Acquisition
- Existing Barrier modeled in TNM
- 66 dBA Noise Level Contour (2030)

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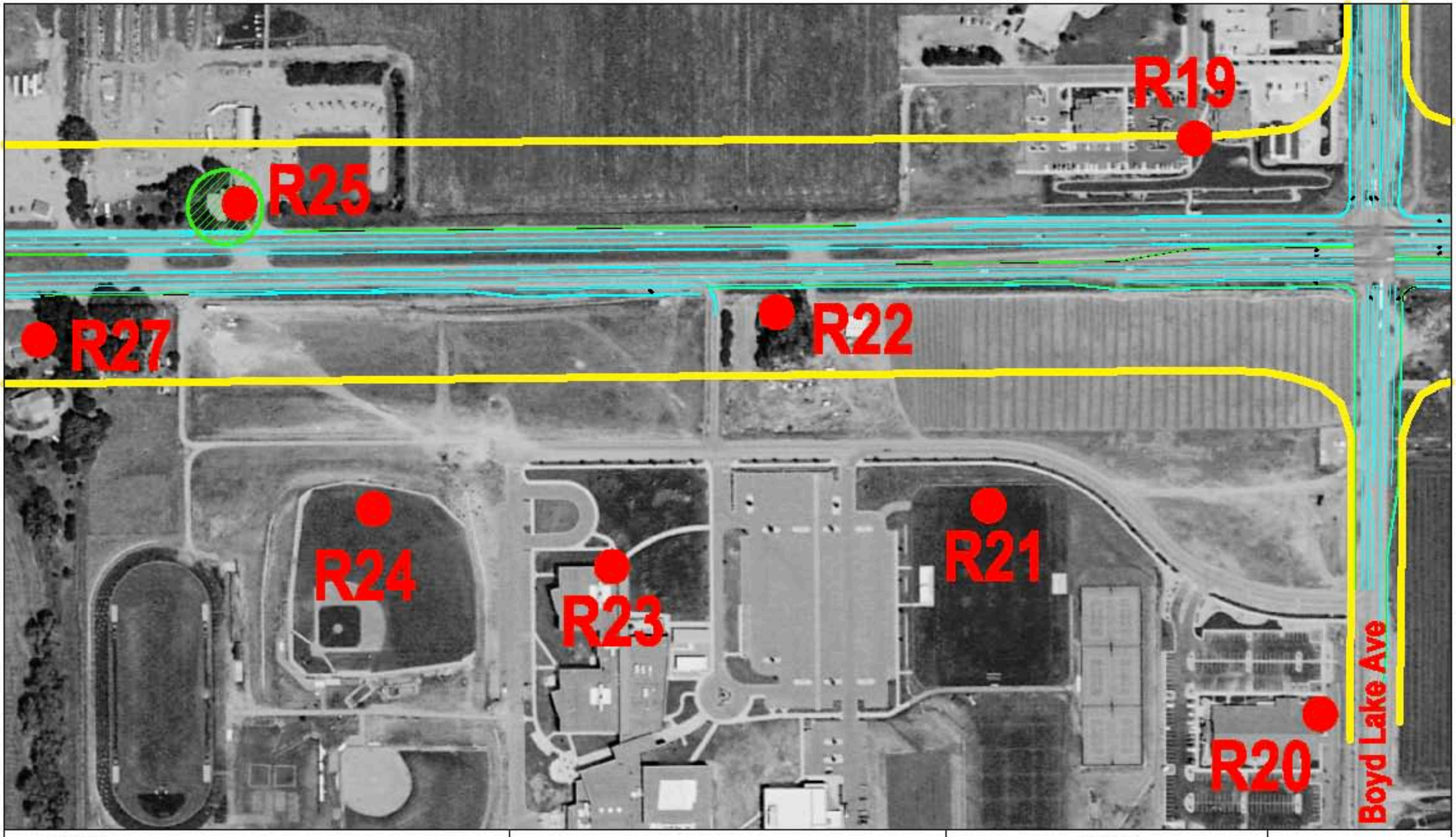
Figure E-6



NORTH

0 100' 50' 200'

- Noise Receptor Locations
- Property Acquisition
- Existing Barrier modeled in TNM
- 66 dBA Noise Level Contour (2030)

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Figure E-7

NORTH

0 100' 200'

- Noise Receptor Locations
- Property Acquisition
- Existing Barrier modeled in TNM
- 66 dBA Noise Level Contour (2030)

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Figure E-8

NORTH

0 100'

80' 200'

- Noise Receptor Locations
- Property Acquisition
- Existing Barrier modeled in TNM
- 66 dBA Noise Level Contour (2030)

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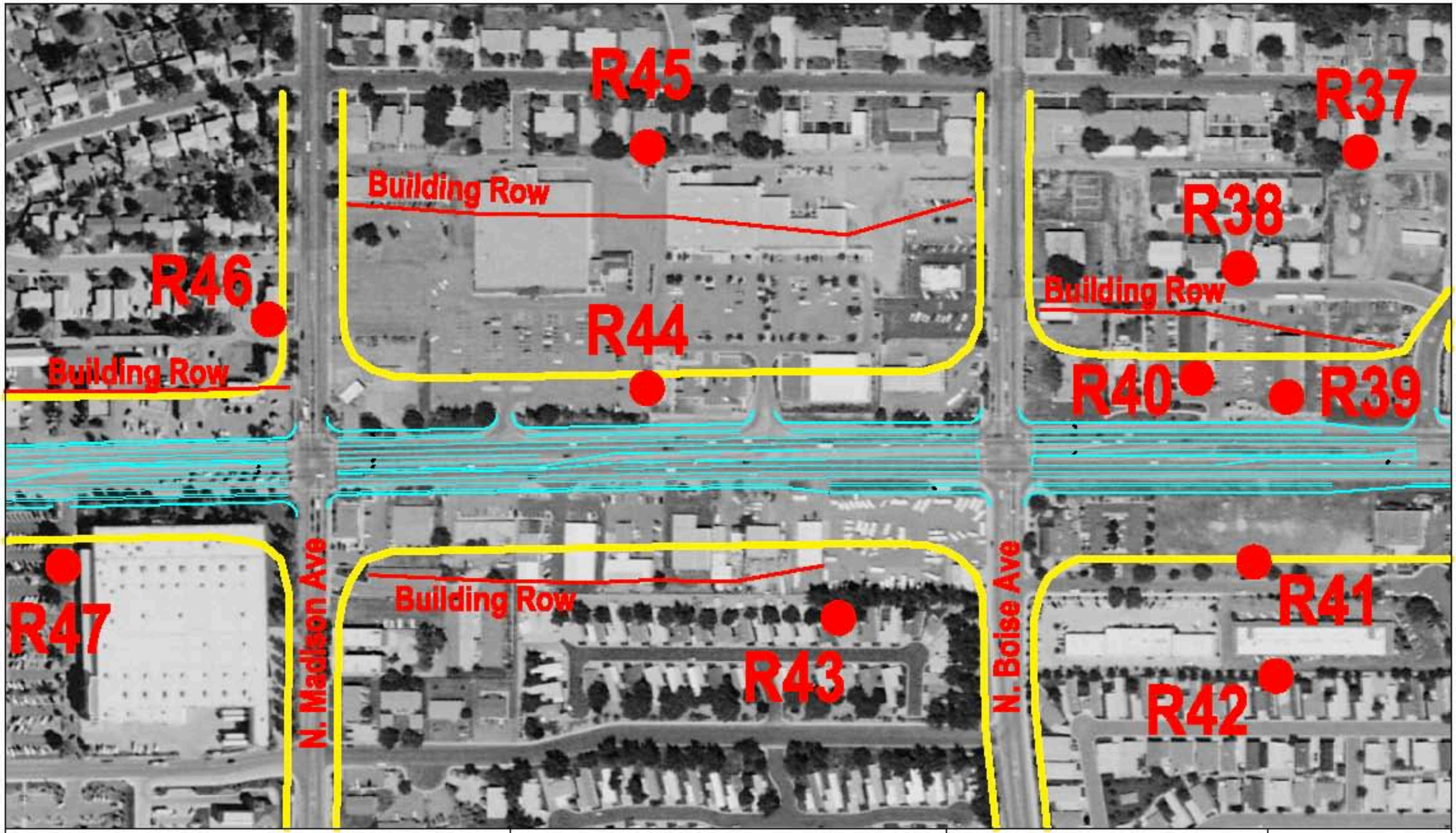
Figure E-9



NORTH

0 100' 200'

- Noise Receptor Locations
- Property Acquisition
- Existing Barrier modeled in TNM
- 66 dBA Noise Level Contour (2030)

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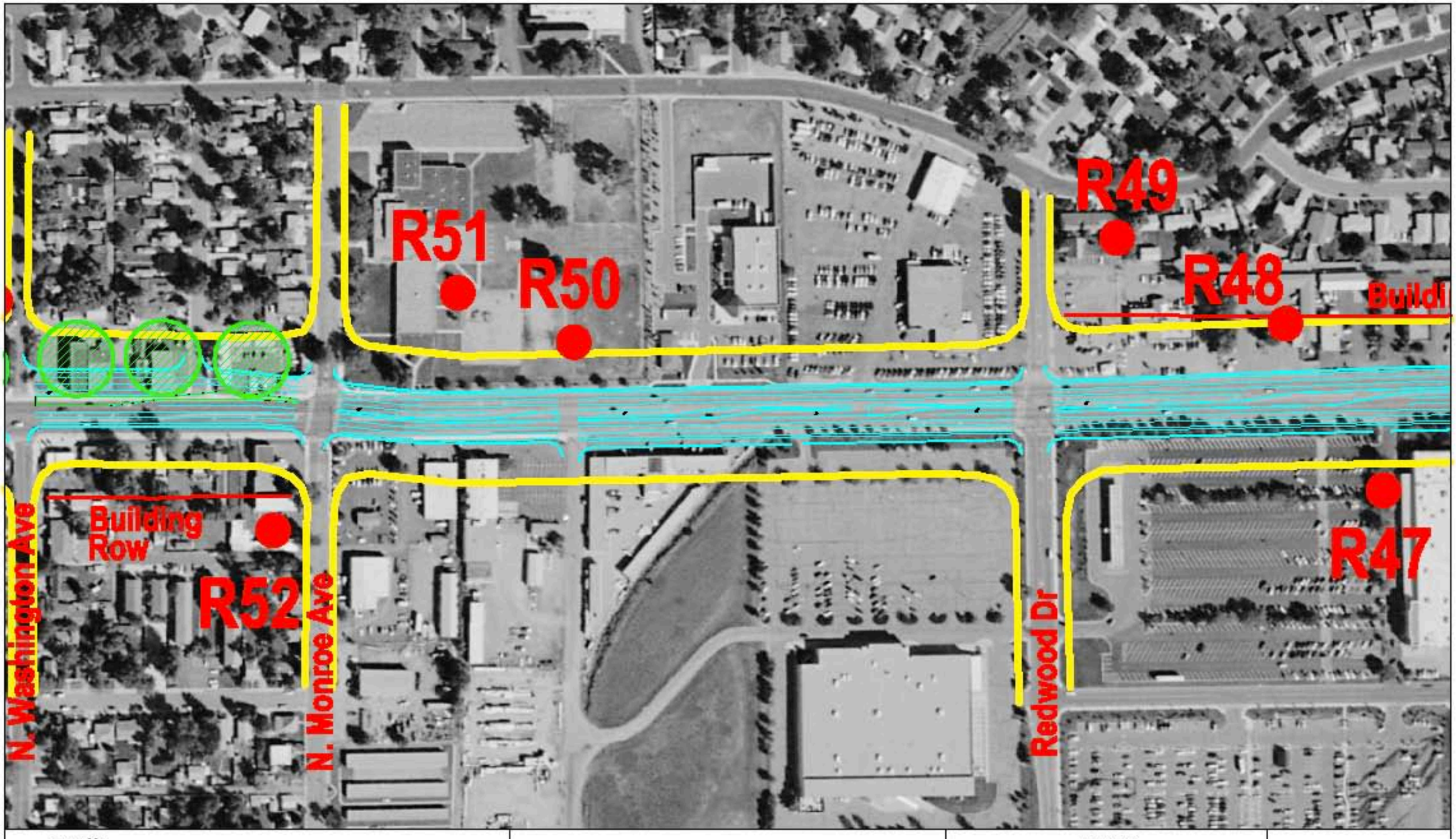
Figure E-10



NORTH

0 100' 200'

- Noise Receptor Locations
- Property Acquisition
- Existing Barrier modeled in TNM
- 66 dBA Noise Level Contour (2030)

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Figure E-11

NORTH

0 100' 200'

- Noise Receptor Locations
- Property Acquisition
- Existing Barrier modeled in TNM
- 66 dBA Noise Level Contour (2030)

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Figure E-12

ATTACHMENT F

Noise Abatement Determination Forms

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION

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

Project # NH 0341-060	Project code (SA#)	STIP #	Project Location: US34 EA: The Reserve Apartments

A. FEASIBILITY:

1. Can a continuous noise barrier or berm be constructed? ☑ YES ☐ NO
2. Can a substantial noise reduction be achieved by constructing a noise barrier or berm?...
   10 dBA: ☐ YES ☐ NO 7-10 dBA: ☑ YES ☐ NO 5-7 dBA: ☐ YES ☐ NO
3. Are there any "fatal flaw" safety or maintenance issues involving the proposed noise barrier or berm? ☐ YES ☑ NO

B. REASONABLENESS:

	EXTREMELY REASONABLE	REASONABLE	MARGINALLY REASONABLE	UNREASONABLE
1. Cost Benefit Index (per receiver per dBA)	☑ Less than $3000	☐ $3000-$3750	☐ $3750-$4000	☐ More than $4000
2. Average Build Noise Level	☑ 70 dBA or More	☐ 66 - 70 dBA	☐ 63 - 66 dBA	☐ Less than 63 dBA
3. Impacted persons' desires	☐ More than 75%	☐ 50% - 75%	☐ 25% - 50%	☐ Less than 25%
4. Development Type (Category B*)	☑ More than 75%	☐ 50% - 75%	☐ 25% - 50%	☐ Less than 25%
5. Development Existence (15 years or more)	☐ More than 75%	☐ 50% - 75%	☐ 25% - 50%	☑ Less than 25%
6. Build Noise Level vs. Existing Noise Level	☐ Greater than 10 dBA	☐ 5 - 10 dBA	☑ 0 - 5 dBA	☐ Noise Level Decrease

***Category B – Residential, School, Hospital, Park, Picnic/Active Sports Area, Motel, Church, Library**

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 public or non-profit buildings? ☐ YES ☐ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings? ☐ YES ☐ NO
3. a. Is private residential property affected by a 30 dB(A) or more noise level increase? ☐ YES ☐ NO
   b. Are private residences impacted by 75 dB(A) or more? ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

E. DECISION:

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 mitigation measures be provided? ☑ YES ☐ NO

F. DECISION DESCRIPTION AND JUSTIFICATION

A 660 foot x 10 foot noise barrier in this area benefits 14 apartment residences. This barrier could be a berm, wall or a combination of the two. It was found that a higher or shorter barrier would also be well within the cost-benefit limits, but a shorter barrier would not benefit as many homes. A majority of this barrier is within the proposed CDOT ROW, but the western 100 feet is outside of CDOT ROW.

Completed by:	Date:
Jeff Cerjan - Hankard Environmental Inc.	*January 22, 2007*

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION

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

Project # NH 0341-060	Project code (SA#)	STIP #	Project Location: US34 EA: Res. bet Garfield Ave and RR Tracks N (R60)

A. FEASIBILITY:

1. Can a continuous noise barrier or berm be constructed? ☐ YES ☑ NO
2. Can a substantial noise reduction be achieved by constructing a noise barrier or berm?...
   10 dBA: ☐ YES ☐ NO 7-10 dBA: ☐ YES ☐ NO 5-7 dBA: ☐ YES ☑ NO
3. Are there any "fatal flaw" safety or maintenance issues involving the proposed noise barrier or berm? ☑ YES ☐ NO

B. REASONABLENESS:

	EXTREMELY REASONABLE	REASONABLE	MARGINALLY REASONABLE	UNREASONABLE
1. Cost Benefit Index (per receiver per dBA)	☐ Less than $3000	☐ $3000-$3750	☐ $3750-$4000	☑ More than $4000
2. Average Build Noise Level	☐ 70 dBA or More	☑ 66 - 70 dBA	☐ 63 - 66 dBA	☐ Less than 63 dBA
3. Impacted persons' desires	☐ More than 75%	☐ 50% - 75%	☐ 25% - 50%	☐ Less than 25%
4. Development Type (Category B*)	☑ More than 75%	☐ 50% - 75%	☐ 25% - 50%	☐ Less than 25%
5. Development Existence (15 years or more)	☑ More than 75%	☐ 50% - 75%	☐ 25% - 50%	☐ Less than 25%
6. Build Noise Level vs. Existing Noise Level	☐ Greater than 10 dBA	☐ 5 - 10 dBA	☑ 0 - 5 dBA	☐ Noise Level Decrease

***Category B – Residential, School, Hospital, Park, Picnic/Active Sports Area, Motel, Church, Library**

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 public or non-profit buildings? ☐ YES ☑ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings? ☐ YES ☐ NO
3. a. Is private residential property affected by a 30 dB(A) or more noise level increase? ☐ YES ☑ NO
   b. Are private residences impacted by 75 dB(A) or more? ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

E. DECISION:

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 mitigation measures be provided? ☐ YES ☑ NO

F. DECISION DESCRIPTION AND JUSTIFICATION

Portions of this area have direct access to US 34 making a barrier infeasible while other portions, where a barrier may be possible, will not benefit multiple properties making it unreasonable. As this location is just west of a bridge, it is recommended that a closed rail barrier be used for this bridge and be extended to the west if possible to provide some noise reduction.

Completed by:	Date:
Jeff Cerjan - Hankard Environmental Inc.	*January 22, 2007*

COLORADO DEPARTMENT OF TRANSPORTATION
NOISE ABATEMENT DETERMINATION

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

Project # NH 0341-060	Project code (SA#)	STIP #	Project Location: US34 EA: Res. bet Garfield Ave and RR Tracks on S (R61)

A. FEASIBILITY:

1. Can a continuous noise barrier or berm be constructed? ☑ YES ☐ NO
2. Can a substantial noise reduction be achieved by constructing a noise barrier or berm?...
   10 dBA: ☐ YES ☐ NO 7-10 dBA: ☐ YES ☐ NO 5-7 dBA: ☑ YES ☐ NO
3. Are there any "fatal flaw" safety or maintenance issues involving the proposed noise barrier or berm? ☐ YES ☑ NO

B. REASONABLENESS:

		EXTREMELY REASONABLE	REASONABLE	MARGINALLY REASONABLE	UNREASONABLE
1.	Cost Benefit Index (per receiver per dBA)	☐ Less than $3000	☐ $3000-$3750	☐ $3750-$4000	☑ More than $4000
2.	Average Build Noise Level	☐ 70 dBA or More	☑ 66 - 70 dBA	☐ 63 - 66 dBA	☐ Less than 63 dBA
3.	Impacted persons' desires	☐ More than 75%	☐ 50% - 75%	☐ 25% - 50%	☐ Less than 25%
4.	Development Type (Category B*)	☑ More than 75%	☐ 50% - 75%	☐ 25% - 50%	☐ Less than 25%
5.	Development Existence (15 years or more)	☑ More than 75%	☐ 50% - 75%	☐ 25% - 50%	☐ Less than 25%
6.	Build Noise Level vs. Existing Noise Level	☐ Greater than 10 dBA	☐ 5 - 10 dBA	☑ 0 - 5 dBA	☐ Noise Level Decrease

***Category B – Residential, School, Hospital, Park, Picnic/Active Sports Area, Motel, Church, Library**

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 public or non-profit buildings? ☐ YES ☑ NO
   b. If yes, is it reasonable and feasible to provide insulation for these buildings? ☐ YES ☐ NO
3. a. Is private residential property affected by a 30 dB(A) or more noise level increase? ☐ YES ☑ NO
   b. Are private residences impacted by 75 dB(A) or more? ☐ YES ☐ NO

D. ADDITIONAL CONSIDERATIONS:

E. DECISION:

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 mitigation measures be provided? ☐ YES ☑ NO

F. DECISION DESCRIPTION AND JUSTIFICATION

For the homes located between N. Garfield Ave and Arthur Ave, a 280 foot long by 6 foot tall barrier was just feasible in that one home achieved the required 5 dBA of noise reduction. This wall was not reasonable due to traffic noise from N. Garfield Ave which limited the noise reduction the barrier could provide for the rest of the homes. Thus, this barrier is not recommended. For the homes located between Arthur Ave and the railroad tracks, a barrier would not be reasonable due to the limited number of homes that could receive a benefit. It is recommended that a closed rail safety barrier be used for the bridge structure along US 34 to provide some noise reduction.

Completed by:	**Date:**
Jeff Cerjan - Hankard Environmental Inc.	*January 22, 2007*