Appendix C

Noise Analysis

Bridgeport Viaduct

NOISE ANALYSIS REPORT

Prepared by the Nebraska Department of Transportation
October 2018

Reevaluated November 2023

PROJECT NO. RRZ-TMT-26-1(161)
C.N. 51299
Bridgeport, Nebraska

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PROJECT BACKGROUND

This report documents the noise analysis completed in support of the Nebraska Department of Transportation (NDOT) Bridgeport Viaduct project. The proposed project would replace the existing BNSF Railway Company (BNSF) at-grade crossing with a viaduct on Nebraska Highway 92 and U.S. Highway 26 in Bridgeport, NE. A preferred alternative (Alternative 2) has been selected for the location of the overpass. This alternative shifts the alignment of the overpass to the south. The alternative would require reconstructing approximately 1,200 feet of roadway east and west of the existing crossing. The location of the proposed alternative is illustrated in the attached **Noise Receiver Location Map**. The purpose of this noise report is to:

- Provide a discussion of the fundamentals of noise and traffic noise analysis
- Evaluate existing traffic noise levels within the corridor
- Predict the future traffic noise levels (2040) of sensitive receivers. Sensitive receivers are adjacent to the studied corridor (such as houses, businesses, parks and schools) that might be affected by traffic noise
- Quantify the number of properties that are predicted to experience roadway noise levels that approach or exceed the noise abatement criteria (NAC). These properties are referred to as impacted receivers.
- If applicable, evaluate potential mitigation measures for sensitive receivers adjacent to the new alignment that approach or exceed the NAC.

NATURE OF NOISE

Noise may be defined as unwanted sound. Sound is the sensation produced when the movement of an object creates vibrations, or waves, that pass through the ears. The relative impact of sound waves depends on the amount of pressure they generate. The unit of measure for sound pressure is the decibel (dB). Decibels are based on a logarithmic scale because the range of sound pressures is too great to be accommodated on a linear scale. The range of sound pressure levels most frequently encountered in evaluating traffic-generated noise on highways is 50 to 95 dB.

The measured noise level from a given source does not necessarily correspond to our perception of “loudness.” For instance, a three (3) decibel increase from a noise source represents a doubling of the noise level (as measured in sound pressure) on the logarithmic scale. However, this change is barely perceptible for human beings. Furthermore, an increase in 10 decibels from a noise source is a tenfold increase in noise pressure, but is only perceived as a doubling in the loudness by the human ear.

For highway traffic noise analysis, the Federal Highway Administration (FHWA) has specified that noise be predicted and evaluated in decibels weighted with the A-level frequency response; this unit of measure is referred to as dBA. Measurements in dBA incorporate a human’s reduced sensitivity to both low frequency and very high frequency noises to better correlate with our subjective impression of loudness.

Table 1 displays noise levels common to everyday activities.

TABLE 1. Common Exterior Noise Levels (dBA)

Common Noise Levels	Noise Level (dBA)
Rock Band at 16 ft	110
Jet Flyover at 985 ft	105
Gas Lawn Mower at 3 ft	95
Diesel Truck at 50 ft	85
Same Truck at 110 ft	80
Gas Lawn Mower at 100 ft	70
Normal Speech at 3 ft	65
Birds Chirping	50
Leaves Rustling	40
Very Quiet Soft Whisper	30
Threshold of Hearing	0

23 CFR Part 772 Standards

23 Code of Federal Regulations (CFR) Part 772 was written by the Federal Highway Administration (FHWA). Its purpose is to provide procedures for noise studies, and noise abatement measures to help protect the public health and welfare, to supply noise abatement criteria, and to establish requirements for traffic noise information to be given to those officials who have planning and zoning authority in the project area. 23 CFR 772 contains noise abatement criteria, which are based on the equivalent level (L_{eq}), noise descriptor. L_{eq} (h) is the equivalent steady state sound level, which during the hour under consideration contains the same acoustic energy as the time-varying traffic sound level during that same hour. The following table contains the upper limits of hourly L_{eq} desirable noise levels that are part of the noise abatement criteria established by 23 CFR 772. Any noise levels that approach or exceed these criteria would not be desirable and would be referred to as a noise impact.

TABLE 2. Noise Abatement Criteria, Hourly A-Weighted Sound Level

Activity Category	Activity[1] Leq(h)	Activity Description
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve and important public need where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[2]	67 (exterior)	Residential
C[2]	67 (exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structure, radio stations, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, trail crossings.
D	52 (Interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structure, radio studios, recording studios, schools, television studios.
E[2]	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-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

[1]The Leq(h) Activity Criteria values are for impacted determination only, and are not design standards for noise abatement.

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

The selection and analysis of all individual noise sensitive receptors are based on the data included in the above table. Most areas come under Activity Category "B" or "C" and “E”. Activity "E" typically consists of commercial land use or business offices. Category “F” and Category “G” sites are not considered to be noise sensitive areas. Primary consideration is to be given to exterior areas; therefore, all noise levels referred to in this study are exterior noise levels unless otherwise stated. Activity Category "D" is not normally used since interior noise depends on the type of windows, doors or wall structures of each building; however, sometimes a specific receptor might warrant its use. Category “A” sites are extremely rare as only a few exist in the entire nation.

NOISE PREDICTION METHOD

Traffic noise levels associated with existing conditions, no-build and build scenario were predicted for this noise study:

> ***The Existing Conditions Scenario*** assumed current (2015) traffic volumes, vehicle mix (broken down by autos, medium trucks and heavy trucks) and roadway characteristics.
>
> ***The 2040 No-Build Scenario*** assumed that future (2040) forecasted traffic would be traveling on the existing alignment without a physical change to the road.
>
> ***The 2040 Build Scenario*** analyzed traffic noise levels associated with the preferred viaduct alternative and assumed that future (2040) forecasted traffic would be traveling on the newly constructed viaduct.

Traffic noise levels shown in this study resemble "peak hour" noise levels and are predicted in hourly L_{eq} dBA. The L_{eq} descriptor is reliable for low volume as well as high volume roadways, is simpler in most instances for highway designers to work with, and is more flexible in terms of permitting noise levels from different sources to be included in the analysis of the total ambient noise.

The "FHWA Highway Traffic Noise Prediction Model" is the method used in this report to predict L_{eq} dBA noise levels. This method was developed and approved for use by the U.S. Department of Transportation Federal Highway Administration. The procedures included in the FHWA Model permit an analysis of variations in traffic noise in terms of traffic parameters, roadway and observer characteristics. These parameters are then identified for a particular traffic situation and transformed into noise level estimates through the use of this prediction method, which has been set up on a computer, using the FHWA Traffic Noise Model (TNM) Version 2.5.

NOISE MODEL PARAMETERS

The following parameters were considered when applying the traffic noise prediction methodology:

- Traffic levels, vehicle composition (whether auto, medium truck or heavy truck)
- Current posted speed limits: 65 mph rural, 45 mph near BNSF crossing, 30 mph east of I Street.
- Design Speed: 65 mph rural, 45 mph on viaduct, 30 mph east of I Street, 25 mph on residential.
- Plan and profile information for roadways
- Location and elevation of sensitive noise receivers by activity category
- Location of terrain and man-made features that act to shield traffic noise
- Ground cover type

TRAFFIC PARAMETERS

The traffic volume used to predict the traffic noise levels is the Design Hourly Volume (DHV) traffic. Heavy trucks include vehicles having three or more axles, generally having a gross vehicle weight greater than 26,000 lbs. Medium trucks include all vehicles having two axles and six wheels, generally having a gross vehicle weight greater than 10,000 lbs but less than 26,000 lbs. **Table 3** below shows traffic volumes used for noise modeling.

TABLE 3. Bridgeport Viaduct Traffic Data (N-92)

Segment	Scenario	ADT[1]	DHV	%HCV[2]	Cars	Heavy Trucks	Medium Trucks
N-92/US-26	Existing	3000	320	14	275	34	11
N-92/US-26	No-build	3120	390	14	335	40	15
N-92/US-26	Build	3679	390	14	335	40	15
J Street	Existing	125	13	5%	11	1	1
J Street	No-build	125	13	5%	11	1	1
J Street	Build	850	90	15%	76	10	4

[1]ADT = Average Daily Traffic
[2]HCV = Heavy Commercial Vehicles

Field Noise Measurements

Table 4 documents the field measurements used to verify TNM 2.5. Two 15 minute readings were taken at each location. Traffic volumes were counted for 15 minutes and multiplied by 4 obtain the hourly volumes. The model reasonably reflected the measured noise levels deviating by less than 3 dB(A). Locations of field noise measurements are illustrated on the attached **Noise Receiver Location Map**.

Table 4. Monitored Noise Levels

Location		Distance to pavement (ft)	Measured Leq (dBA)	Modeled Leq (dBA)	hourly volume			speed (mph)
					cars	HT	MT	
I Street	Reading 1	20	67.0	64.6	224	36	20	35
	Reading 2	20	65.2	63.0	188	20	20	35
J Street	Reading 1	20	66.1	64.8	216	28	24	35
	Reading 2	20	65.5	64.4	200	28	16	35

TRAFFIC NOISE ANALYSIS

In analyzing the preceding traffic noise table, emphasis will be given to the two main noise criteria of a traffic noise impact as set forth in 23 CFR 772. A comparison will be made between the predicted traffic noise levels and the noise abatement criteria (NAC) to determine if a traffic noise impact exists due to the noise levels approaching or exceeding the criteria. Also, a comparison will be made between existing noise levels and future predicted traffic noise levels to determine if a noise impact occurs due to a substantial increase in noise. Nebraska Department of Transportation considers that an impact occurs and abatement measures will be considered for receptors if:

1. The predicted design year noise levels approach or exceed the NAC. NDOT has established that a noise level of one decibel less than the NAC in the FHWA Noise Standards constitutes "approaching" the NAC. For residential receptors 66 dBA is considered "approaching" while 71 dBA is considered "approaching" for commercial receptors.

2. Predicted future noise levels are 15 dBA or more above existing levels. For purposes of interpreting the FHWA noise standards, this would be considered "substantially exceeding" existing levels.

Land use consisted primarily of Category B receivers (residential) east of the N-92/BNSF railroad crossing. Land use west of the railroad crossing and north of N-92 is primarily commercial. Most of the commercial businesses in the area are retail facilities or industrial facilities that are not noise sensitive and therefore do not warrant traffic noise analysis. The exceptions are receivers E1 (nail salon) and E2 (insurance office) which were analyzed for noise impacts. There are three properties classified as Category C which include a church (C1 and C2), a horseshoe pit (C3) and a basketball court (C4).

PREDICTED NOISE LEVELS

The primary tasks for the noise study were to identify receivers that approached or exceeded the NAC and to determine the relative change in traffic noise levels anticipated due to the changed alignment and profile. Noise levels were predicted for existing conditions (2015), 2040 no-build conditions, and 2040 build conditions for Alternative 2. TNM was applied using the appropriate roadway, traffic and sensitive receiver information to predict the noise levels for each of the scenarios. The predicted noise levels are summarized as follows:

- There are no instances of build condition traffic noise level impacts (66 dBA for residential and 71 dBA).
- There are no instances of build condition traffic noise levels substantially exceeding existing noise levels in the study area (increase of 15 dB(A) over the existing levels).
- Because no impacts were identified, noise abatement measures were not considered for this project.

Table 5 lists all those noise sensitive receptors within the limits of this project. The table details the following: computed noise levels in hourly L_{eq} dBA for the existing system (2015 traffic volumes), and computed noise levels in hourly L_{eq} dBA for future design year 2040 (no-build and build alternative). Also shown are the hourly L_{eq} dBA noise abatement criteria (NAC) that are part of the 23 CFR Part 772 guidelines used in determining a noise impact.

TABLE 5. Noise Levels at Project Receptors

Receptor ID	Activity Category	Noise Levels (dBA)				NAC	Impacted
		Existing	No Build	Build	Change*		
1	B	60	60	52	-8	66	no
2	B	55	56	51	-4	66	no
3	B	59	60	54	-5	66	no
4	B	53	54	52	-1	66	no
5	B	59	60	55	-4	66	no
6	B	55	56	54	-1	66	no
7	B	58	59	56	-2	66	no
8	B	53	54	54	1	66	no
9	B	59	59	56	-3	66	no
10	B	61	62	59	-2	66	no
11	B	58	59	57	-1	66	no
12	B	55	55	56	1	66	no
13	B	63	64	62	-1	66	no
14	B	61	62	62	1	66	no
15	B	59	60	59	0	66	no
16	B	58	59	59	1	66	no
17	B	60	61	62	1	66	no
18	B	59	60	60	1	66	no
19	B	57	57	58	1	66	no
20	B	58	59	59	1	66	no
21	B	54	55	55	1	66	no
22	B	61	62	62	1	66	no
23	B	56	57	59	3	66	no
24	B	54	54	59	4	66	no
25	B	41	42	49	8	66	no
26	B	58	59	59	1	66	no
27	B	60	61	61	1	66	no
28	B	60	61	61	1	66	no
29	B	60	61	61	1	66	no
30	B	57	58	58	1	66	no
31	B	56	56	57	1	66	no
32	B	52	52	57	4	66	no
33	B	51	51	56	5	66	no
34	B	49	49	54	5	66	no
35	B	49	48	55	7	66	no
36	B	48	47	55	7	66	no
37	B	47	47	55	8	66	no

Receptor ID	Activity Category	Noise Levels (dBA)				NAC	Impacted
		Existing	No Build	Build	Change		
38	B	46	46	54	8	66	no
C1	C	46	46	53	7	66	no
C2	C	48	48	56	8	66	no
C3	C	49	49	58	8	66	no
C4	C	46	46	51	5	66	no
E1	E	62	63	59	-3	71	no
E2	E	61	62	54	-7	71	no

*difference between existing noise levels and build noise levels

Table 5 shows that the project influences noise levels differently depending on the location of the receptor and the alternative proposed. The noise levels at receptors along the highway for Alternative 2 would experience decrease in noise where the proposed viaduct shift south and away from the receptors. A small increase in noise is predicted where there is no shift due to the slight increase in traffic volumes.

Noise levels at receptors adjacent to J Street are predicted to increase to a greater extent than other areas of the project. Due to the construction of the proposed viaduct, there would no longer be direct access from Highway 26 onto Recreation Road or Railroad Ave from the west. Traffic would therefore travel south on J Street and north on Railroad Ave to connect back to Recreation Road. This increase in traffic volume is expected to increase noise levels 4 dB(A) to 8 dB(A) on J Street. However, this increase is less than the 15 dB(A) increase needed to constitute a traffic noise impact defined by the NDOT Noise Analysis and Abatement Policy.

Because traffic noise levels at project receptors do not exceed 66 dB(A) and there are no instances of a substantial increase in noise levels (15 dB(A) increase or greater) no noise abatement analysis is required.

Information for Local Officials: Recommended Setbacks

For informational purposes and planning by local governments, the future (2040) recommended setback of residential properties and Category C properties from edge of the viaduct pavement is estimated to be approximately 40 feet. There are no recommended setbacks for noise sensitive commercial properties (Category E).

CONSTRUCTION NOISE

The evaluation and control of construction noise must be considered as well as the traffic noise. The noise sensitive receptors that are located directly adjacent to this project are those that are of major concern in this study of construction noise. These same receptors were also of concern in the traffic noise study.

The following are some basic categories of mitigation measures for construction noise.

Community Awareness: It is important for people to be made aware of the possible inconvenience and to know its approximate duration so they can plan their activities accordingly. It is the policy of the Nebraska Department of Transportation that information concerning the upcoming project construction be submitted to all local news media.

Source Control: This involves reducing noise impacts from construction by controlling the noise emissions at their source. This can be accomplished by specifying proper muffler systems, either as a requirement in the plans and specifications on this project or through an established local noise ordinance requiring mufflers. Contractors generally maintain proper muffler systems on their equipment to ensure efficient operation and to minimize noise for the benefit of their own personnel as well as the adjacent receptors.

Site Control: Site control involves the specification of certain areas where extra precautions should be taken to minimize construction noise. One way to reduce construction noise impact at sensitive receptors is to operate stationary equipment, such as air compressors or generators, as far away from the sensitive receptors as possible. Another method might be placing a temporary noise barrier in front of the equipment. As a general rule, good coordination between the project engineer, the contractor, and the affected receptors is less confusing, less likely to increase the cost of the project, and is a more personal approach to work out ways to minimize construction noise impacts in the more noise-sensitive areas. No specific construction-noise, site-control specifications will be included in the plans.

Time and Activity Constraints**:** Limiting work hours on a construction site can be very beneficial during the hours of sleep or on Sundays and holidays. However, most construction activities do not occur at night and usually not on Sundays. Exceptions due to weather, schedule, and a time-related phase of construction work could occur. No specific constraints will be incorporated in the plans of this improvement. Enforcement of these constraints could be handled through a general city or county ordinance, either listing the exceptions or granting them on a case-by-case basis.

SUMMARY

The noise analysis completed for the NDOT Bridgeport Viaduct project indicates that there are no noise impacts for the future build scenario. Because there were no impacts, noise abatement was not analyzed for the proposed project.

In the event that any changes in the nature, design, or location of the project are planned, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed and conclusions of this report modified or verified in writing.

REFERENCES

23 Code of Federal Regulations (CFR) Part 772 was used throughout the study.

Predicted noise levels were based upon the method presented in FHWA-RD-77-108 "FHWA HIGHWAY TRAFFIC NOISE PREDICTION MODEL."

Nebraska Department of Transportation “Noise Analysis and Abatement Policy,” October 2018.

The introductory section of this study was taken in part from "Guide on Evaluation and Attenuation of Traffic Noise" prepared by American Association of State Highway and Transportation Officials. It is included to familiarize the reader with some of the basic technical terminology and to discuss the guidelines and standards used in the development of the report.

Methods for evaluation and control of construction noise were taken from the FHWA Special Report - 'Highway Construction Noise: Measurement, Prediction and Mitigation'.

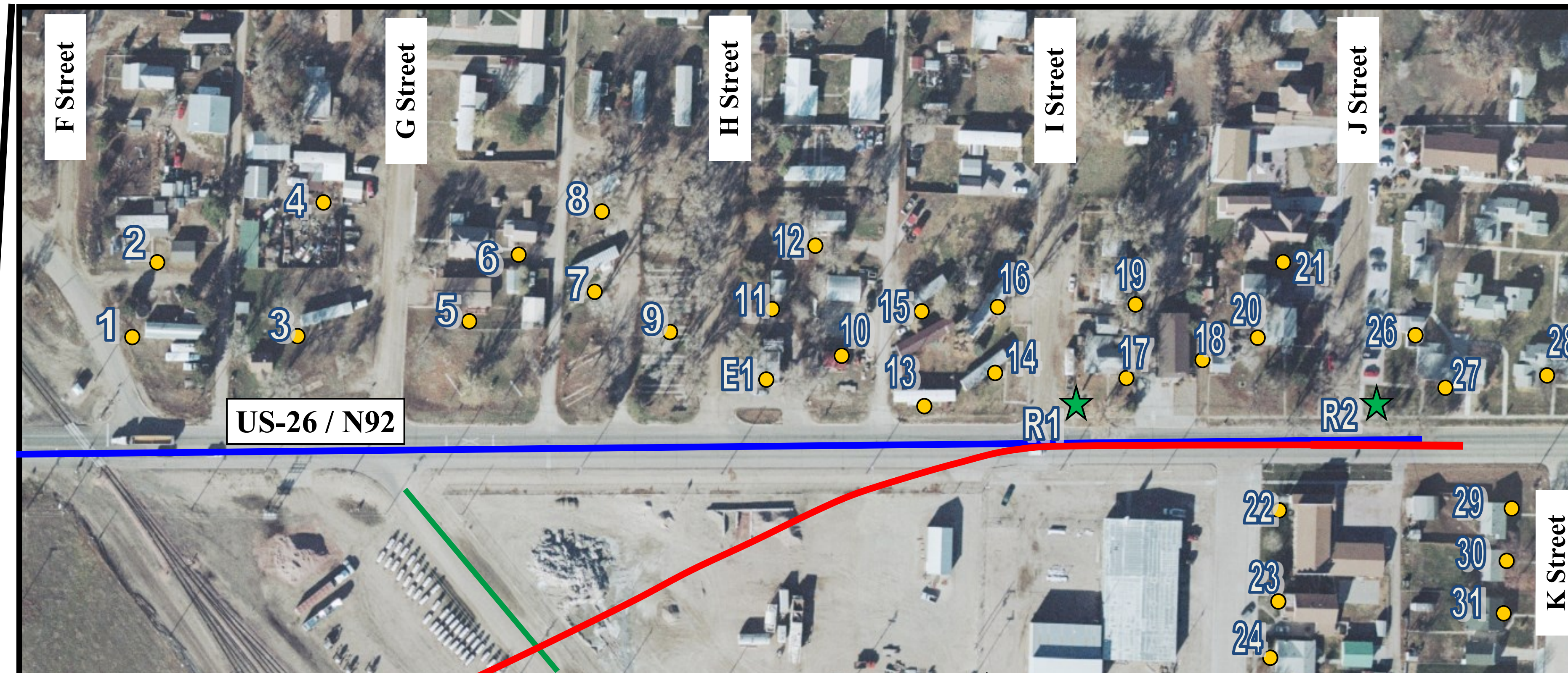
Attachment – Figure 1 and 2. Noise Receiver Location Map

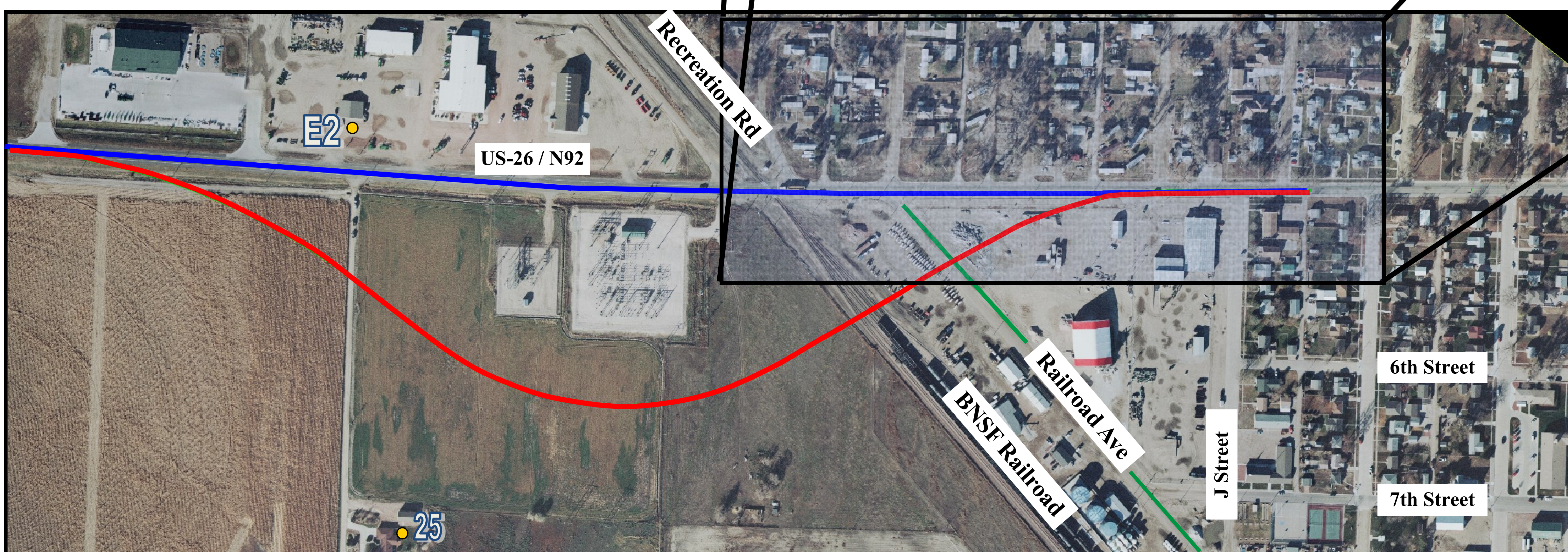
Figure 1
Noise Receiver Location Map
Bridgeport Viaduct

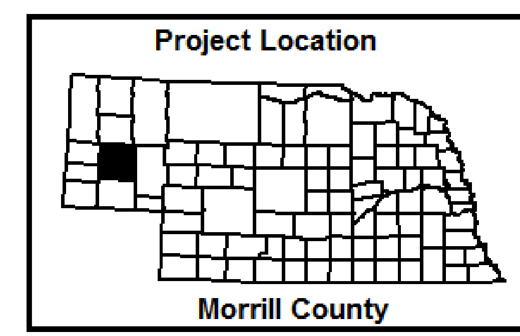
Control No. 51299
Project No. RRZ-TMT-26-1(161)

Legend

- Receptor Location
- Receptor ID 10
- Existing US-26/N-92
- Proposed Alternative
- Noise Field Reading







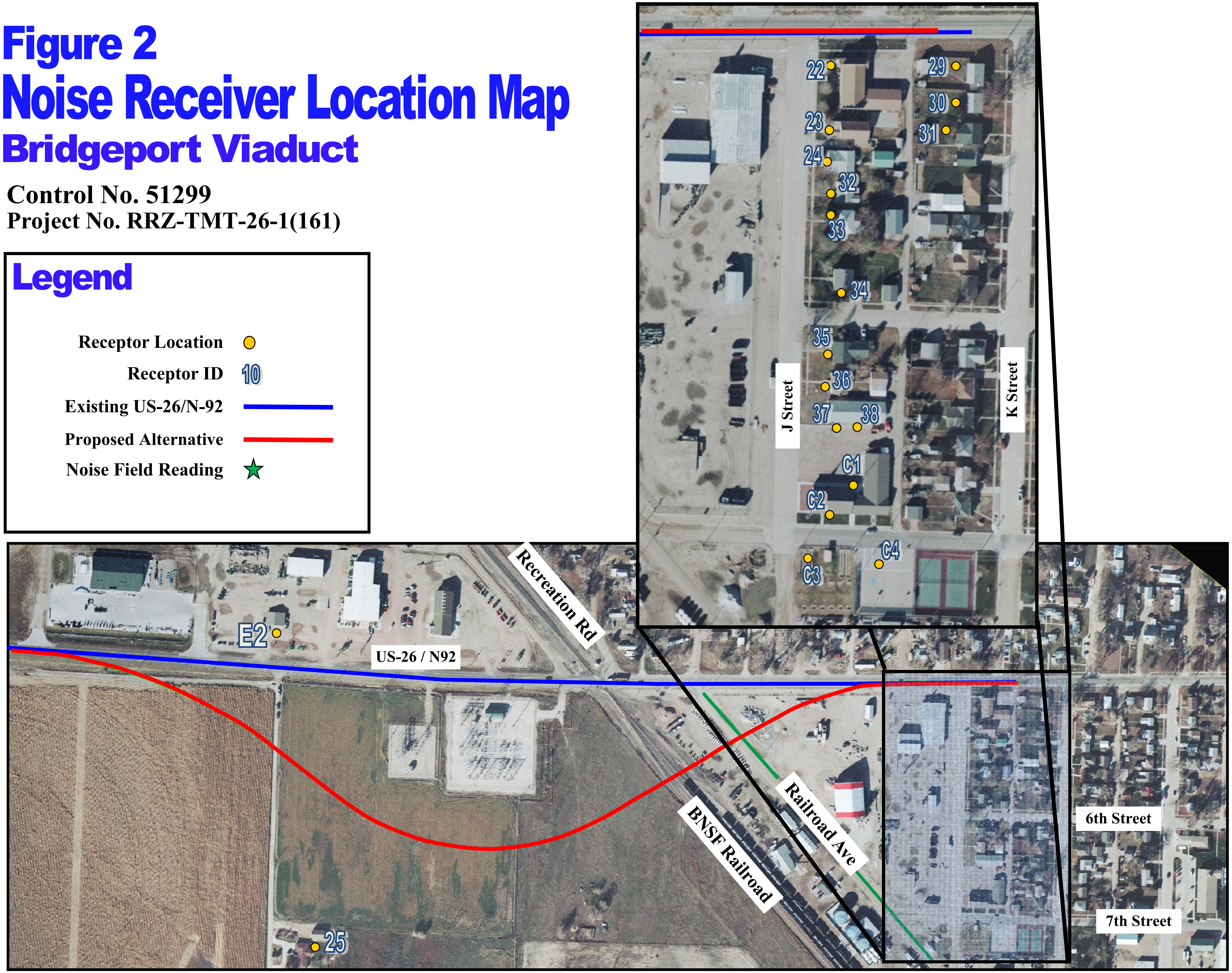
NEBRASKA
Good Life. Great Journey.
DEPARTMENT OF TRANSPORTATION

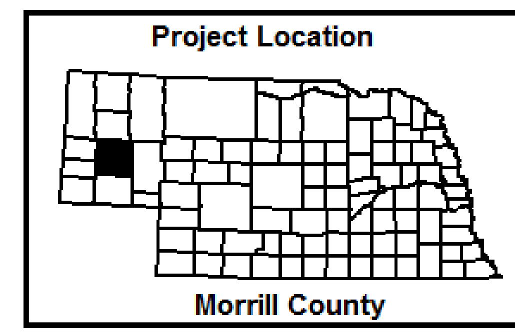
Figure 2
Noise Receiver Location Map
Bridgeport Viaduct

Control No. 51299
Project No. RRZ-TMT-26-1(161)

Legend

Receptor Location
Receptor ID 10
Existing US-26/N-92
Proposed Alternative
Noise Field Reading





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