Highway Noise Analysis Report

I-29 and 85th Street Interchange

Lincoln County, SD
South Dakota DOT

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Prepared for the South Dakota Department of Transportation (SDDOT).

1 Project Overview

The purpose of this analysis is to evaluate and document the effect of the proposed interchange improvements at I-29 and 85th Street and surrounding proposed local roadway improvements on traffic noise levels in the project area. The project area is located in Lincoln and Minnehaha Counties in South Dakota, and includes the Cities of Sioux Fall and Tea and Delapre Township.

1.1 Project Background and History

The City of Sioux Falls, in cooperation with SDDOT and the Sioux Falls Metropolitan Planning Organization (MPO), completed an Environmental Assessment (EA) in March of 2018 for the reconstruction of 85th Street between Sundowner Avenue and Louise Avenue and for the construction of an overpass at I-29. The Federal Highway Administration (FHWA) determined that the proposed improvements would have no significant impact on the human environment and issued a Finding of no Significant Impact (FONSI) on March 1, 2018. The Overpass EA did not include analysis or consideration for an interchange at I-29 and 85th Street. During the preparation of the Overpass EA, representatives of the 85th Street Joint Venture (JV) came forward with a request to evaluate an interchange at I-29 and 85th Street. In October 2018, the recommended interchange concept was accepted by FHWA. For additional project history and background, see Section 1 of the I-29 and 85th Street Interchange Environmental Assessment. Since the proposed interchange improvements qualify the project as a Type I project, a new traffic noise analysis was completed for incorporation into the new Environmental Assessment.

1.2 Project Description and Limits

The project includes the construction of a Diverging Diamond Interchange (DDI) along I-29 at 85th Street, including a connector ramp from southbound I-229 to the 85th Street exit ramp and a braided exit ramp from southbound I-29. The proposed action also includes the following improvements to the surrounding transportation system:

- Reconstruction of the I-229 NB exit ramp at S Louise Avenue as a two-lane exit ramp.
- Construction of an Auxiliary Lane on I-229 NB from the proposed 85th Street entrance ramp to the I-229 NB exit ramp at S Louise Avenue.
- Two-lane pavement of 270th Street from the proposed interchange at I-29 west to Ellis Road.
- Two-lane pavement of Sundowner Avenue from 69th Street to 270th Street.
- Two-lane pavement of 85th Street from S Tallgrass Avenue to S Louise Avenue.

The noise modeling limits include the following roadway limits: 469th Avenue to the west, S Louis Avenue to the east, the I-29/271st Street interchange to the south and various northern termini including I-229 NB auxiliary lane (proposed) to the I-229 NB exit ramp at S Louise Avenue, connector ramp from southbound I-229 to the 85th Street exit ramp and a braided exit ramp from southbound I-29.

It should be noted the roadway limits extend further than the project noise areas in order to capture the entire noise environment; the project noise areas are defined in **Section 5** of this report.

1.3 Project Assessment

This study was conducted in accordance with the Noise Analysis and Abatement Guidance for SDDOT (2011) and Federal Highway Administration (FHWA) Noise Regulation found at 23 CFR 772.

The analysis utilized FHWA's Traffic Noise Model 2.5 (TNM 2.5) software model. The analysis includes modeling of existing conditions (2015) and future (2045) build conditions.

2 Noise Overview

Noise is defined as any unwanted sound. Sound travels in a wave motion and produces a sound pressure level. This sound pressure level is commonly measured in decibels. For highway traffic noise, an adjustment, or weighting, of the high- and low-pitched sounds, is made to approximate the way that an average person hears sounds. The adjusted sound levels are stated in units of "A-weighted decibels" (dBA).

A-weighted decibels (dBA) represent the logarithmic increase (decrease) in sound energy relative to a reference energy level. A sound increase of 3 dBA is barely perceptible to the human ear, a 5 dBA increase is clearly noticeable, and a 10 dBA increase is heard as twice as loud. For example, if the sound energy is doubled (e.g., the amount of traffic doubles), there is a three dBA increase in noise, which is just barely noticeable to most people. On the other hand, if the traffic volumes increase by a factor of ten the sound energy level increases by 10 dBA, which is heard as a doubling of the loudness.

The following **Figure 1** provides a rough comparison of the noise levels of some common noise sources.

Figure 1 – Decibel Levels of Common Noise Sources

150	Jet take off (at close range on the ground)
130	Machine gun, riveting machine
120	Thunderclap
117	jet plane (at passenger ramp)
107	Loud power mower
94	Pneumatic jackhammer
90	Sports car, truck, shouted conversation
50-60	Normal conversation
50	Quiet street
40	Quiet room
0	Threshold of Audibility

Source: “City Noise: Designers Can Restore Quiet, at a Price,” by Harold W. Bredlin, *Product Engineering*, (November 1968) as cited in “The Audible Landscape: A Manual for Highway Noise and Land Use; Appendix B” (June 2017) Federal Highway Administration, https://www.fhwa.dot.gov

Along with traffic volumes, vehicle speeds, roadway grades, and topography, the distance of a receptor from a sound’s source is also a significant factor that contributes to the level of traffic noise. Sound level decreases as the distance from the source increases. A general rule regarding sound level decrease due to increasing distance is: outside of approximately 50 feet, every time the distance between a line source, such as a roadway, and a receptor is doubled, the sound level decreases by either 3 dBA over hard surfaces or 4.5 dBA over soft surfaces.

2.1 Federal Regulations

The Federal Noise Abatement Criteria (23 CFR 772, Procedures for Abatement of Highway Traffic Noise and Construction Noise) established the noise criteria for various land uses. The criteria are in terms of the Leq descriptor. Leq is an equivalent steady-state sound level which contains the same acoustic energy as the time-varying sound level during the same time period.

Federal Noise Abatement Criteria (NAC) apply to all Type I projects requiring FHWA approval, regardless of funding source, or Type I projects requiring Federal-aid highway funds.

This project includes the construction of a new interchange at I-29 and 85th Street. The addition of a new interchange qualifies it as a Type I project. For the full definition of Type I projects see the definitions at link:

https://dot.sd.gov/media/documents/FinalNoiseAnalysisandAbatementGuidance071311.pdf

According to 23 CFR 772, a noise impact is defined as occurring when the predicted traffic noise levels:

- Approach or exceed the noise abatement criteria (see **Table 1**)
- Substantially exceed the existing noise levels

Table 1 – FHWA Noise Abatement Criteria

Activity Category	Activity Criteria[1,2] Leq(h) dBA	Evaluation Location	Activity Description
A	57	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[3]	67	Exterior	Residential
C[3]	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 structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E[3]	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 that are not permitted.

Notes:
(1) Leq(h) shall be used for impact assessment
(2) Leq(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement
(3) Includes undeveloped lands permitted for this activity category

2.2 State Regulations

South Dakota DOT has defined “approach or exceed” as when the predicted Leq is within one dBA, or less, or exceeds the Leq given for the activity category in the NAC (Table 1), and “substantially exceed” as an increase of 15 dBA or more over existing noise levels.

In South Dakota, traffic noise impacts are evaluated by measuring and/or modeling the traffic noise levels that exceed the equivalent steady-state sound level of the time during the worst hour traffic volumes for the design year. This number is identified as the Leq levels; the Leq value is compared to FHWA noise abatement criteria.

3 Methodology

3.1 Affected Environment

The purpose of this noise analysis is to determine the impacts the proposed project has on traffic noise levels in the immediate vicinity of the project at noise sensitive receptors (residences, businesses, etc). It is important to note that this analysis only includes traffic generated noise. There are other noise sources in the project area that have some effect on the ambient noise levels.

The project will construct a diverging diamond interchange at I-29 and 85th Street, as well as various other roadway improvements associated with the project.

3.2 Field Monitoring

Noise level monitoring is required for noise studies to document existing noise levels and assist in validating the noise prediction model. Monitored noise levels can also be used as a baseline of the possible ambient noise levels that can occur with a new roadway alignment.

The existing noise levels in the I-29/85th Street project area were monitored at four sites on July 2nd, 2019. The monitoring location sites are illustrated in **Figure 2**, Existing Conditions. The four sites were selected to have field measurements done, to capture existing noise along the study limits; most of the project area where proposed improvements occur are undeveloped or very few sensitive receptors nearby. Site M1 was selected based on the close proximity to the large number of homes on the northwest side of the project area. Site M2 was selected based on the close proximity to the existing I-29 traffic and to represent the few homes still left along the west side of I-29. Site M3 was selected to represent sensitive receptors on the east side of the I-29, along 85th Street. Site M4 was selected to represent sensitive receptors located at/near the Avera hospital location and because of its close proximity to existing I-229 traffic.

Short-term noise measurements of 30 minutes were conducted at each of these locations and were used to validate the model. Concurrent traffic data was collected for the duration of each monitoring session, which was then used to develop hourly volumes for each site for the validation model. The noise level monitoring results are shown on the monitoring summary sheets in **Appendix D**, and ranged from 53.1 dBA (L_{eq}) to 64.6 dBA (L_{eq}). The monitoring time periods had good weather (no precipitation with winds less than 12 mph), and dry pavement; the sound level meter utilized was a Larson Davis model 831 that was laboratory calibrated in March of 2019.

Field data sheets were generated for each site, including collected traffic data, weather, wind speed, time and location of measurement, as well as any other observed noise sources that occurred during the measurement. Field data sheets and photographs of each measurement location and can be found in **Appendix D**.

Figure 2 – Existing Conditions – Monitor Locations and Project Area

3.3 Noise Model Validation

The noise modeling for both the existing noise levels and future build noise levels was done using the noise prediction program TNM 2.5, which was developed for FHWA. The model uses the roadway alignment (horizontal and vertical), traffic volumes, traffic speeds, vehicle classification, and the distances from the roadway center-of-lanes to the receptors as well as relative elevation differences. In general, higher traffic volumes, vehicle speeds, and numbers of heavy trucks increases the loudness of highway traffic noise.

To verify the accuracy of the noise model, the modeled noise level results must be within +/- 3 dBA of the monitored noise levels (*Highway Traffic Noise: Analysis and Abatement Guidance*, Federal Highway Administration, Washington, DC, December 2011, pp. 31–32). The monitoring results are provided in **Table 2,** which shows the results of the validation modeling to be within the 3 dBA limits for the L_{eq} for 3 of the 4 sites. The modeled results for Site M1, near 69th Street and Sundowner Avenue, was 6.1 dBA lower than what was measured at the site. This difference is attributed to the ambient noise surrounding the site at the time of monitoring being louder than the noise generated by the nearby traffic, especially since there was very little traffic occurring near this site during the monitoring session. Also, during the field monitoring, it was observed that the air conditioners were audible from the nearby homes at the monitoring location and there were 3 instances of water trucks with back-up beepers going during the monitoring, as well as an audible airplane overhead. All of these events contributed to the difference in the validation results at this location. It is important to note that the TNM 2.5 program only accounts for noise generated from vehicles and not background noise. Since the other three sites were within 3 dBA difference between the measured and modeled results, the model is considered validated.

Table 2 – Noise Monitoring Locations & Results

Site ID	Location/Description	Measurement Date/Time	Measured Levels, dBA	Modeled Levels, dBA	Difference dBA
			Leq	Leq	Leq
M1	NE Quadrant of 69th Street and Sundowner Avenue	July 2, 2019 10:10 am to 10:40 am	53.9	47.8	-6.1
M2	At 270th Street and I-29 (West of I-29 SB)	July 2, 2019 11:02 am to 11:32 am	64.6	67.1	+2.5
M3	At NW Quadrant of 85th Street and Tallgrass Avenue	July 2, 2019 12:04 am to 12:34 am	53.1	51.3	-1.8
M4	At Avera Hospital Grounds (South of I-229 EB)	July 2, 2019 1:13 pm to 1:43 pm	64.6	62.3	-2.3

4 Noise Analysis

4.1 Noise Modeling

Traffic noise impacts were assessed by modeling noise levels at noise sensitive receptor locations likely to be affected by the construction of the proposed project. SDDOT Noise Analysis and Abatement Guidance defines the noise study area for the build alternative to be from the beginning project construction point to the ending project construction point. The minimum distance to look for receptors is 300 feet from the edge of pavement. If an impact is identified at 300 feet, the next closest receptor would need to be analyzed until a distance where impacts are no longer identified is reached. If no receptors are located within the 300 foot zone, then the closest receptor(s) should be analyzed.

The project receptors were divided up into 15 separate noise areas based on proximity of adjacent receptors and roadway access locations, as shown in **Appendix A Figure 1; Noise Analysis Overview Map.** Using worst hour traffic volumes for the design year and future posted speed limits, traffic noise levels were modeled at a total of 169 representative receptor locations throughout the project area. The majority of the receptors represent residential receptors located throughout the project area, with the exception of two medical facilities, three commercial properties, and an elementary school. The locations of the existing and future build modeled receptor sites are illustrated in **Appendix C Figures 1 through 6**; Noise Analysis Future Build and Barrier Results.

The attached **Table 3** includes the predicted results, receptor site ID and land use for each receptor.

The following assumptions were used in modeling the noise levels for this project:

- Traffic data input into the noise model included Existing (year 2015) and Build (year 2045) forecast traffic volumes from the Intersection Justification Report (IJR). Year 2045 was identified as the design year for the proposed project.
- Existing 24-hour vehicle data was used to determine that the peak hourly traffic occurs between 4:45 p.m. and 5:45 p.m.
- Vehicular fleet composition was determined based on truck percentages generated for the IJR and from traffic counts collected during field monitoring.

4.2 Noise Model Results

Results of the noise modeling analysis are tabulated in the attached **Table 3, Noise Analysis Summary Table**. The following describes the results of the traffic noise analysis for existing (2015) and future (2045) Build condition.

Existing (2015) modeled noise levels at the modeled receptor locations range from 37.0 dBA (L_{eq}) to 68.2 dBA (L_{eq}). Modeled noise receptors exceeded FHWA Noise Criteria (L_{eq}) at 1 of 167 modeled receptor locations under existing (2015) conditions.

Future (2045) Build modeled noise levels at the modeled receptor locations range from 42.0 dBA (L_{eq}) to 70.7 dBA L_{eq}). Modeled noise receptors exceeded FHWA criteria (L_{eq}) at 65 of 167 modeled receptor locations under Build (2045) conditions, with 29 of these being from a “substantial increase” in traffic noise due to the proposed project.

Modeled noise level changes range from 0.5 dBA to 20.7 dBA for existing receptor locations when comparing the Build (2045) to the existing (2015) conditions.

Generally, traffic noise levels are increased with the proposed build project due to many factors. A few of the major changes that influence the increases are as follows:

- Traffic demands will increase between the existing (2015) conditions and future (2045) conditions.
- The proposed 85th Street interchange will create new access to I-29, which will direct new traffic along 85th Street.
- Additional residential development will continue along 85th Street, east of the proposed interchange

5 Noise Abatement Analysis

Because Federal Noise Abatement Criteria (NAC) are both approached and exceeded at modeled receptor locations throughout the project area, noise abatement must be considered.

Noise mitigation measures have been considered, as listed in 23 CFR 772.13(c) and are addressed below:

- Traffic management measures: The primary purpose of the facility is to move people and goods. Restrictions of certain vehicles or speeds would be inconsistent with the purpose of the project.
- Alteration of horizontal and vertical alignments: The proposed interchange location was selected based on the proposed demands for existing and proposed land use. The majority of current land use where the proposed interchange will be constructed is open space. Adjacent land use is primarily residential, which will provide people with alternate access to the I-29/I-229 interchange. Redesigning the horizontal and vertical alignments to minimize noise impacts would be impractical for this project.
- Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development that would be adversely impacted by traffic noise: Exclusive land use designations or acquisition of property to serve as a buffer zone between the roadway and adjacent lands would not be feasible because land has already been developed along the project corridor.
- Noise insulation of public use or nonprofit institutional structures: Under FHWA guidelines, only public buildings such as schools and hospitals should be considered for acoustical insulation. Within the project area, there is not a noise exceedance near the buildings’ location for these types of land uses.
- Construction of Noise Barriers: including acquisition of property rights, either within or outside the highway right of way.

Noise barriers have been chosen as the most cost-effective noise mitigation measure available for this project.

The use of quieter pavements is not an acceptable noise abatement measure for Federal-aid projects. Planting of vegetation or landscaping is not an acceptable Federal-aid noise abatement measure because only dense stands of evergreen vegetation at least 100 feet deep will reduce noise levels by a noticeable amount.

5.1 Noise Barrier Evaluation

When noise impacts are identified, a noise barrier evaluation analysis must be performed. Noise barrier construction decisions are determined based on the evaluation of the feasibility and reasonableness of the noise barriers.

Feasibility of the noise barrier is determined by engineering feasibility (i.e., whether a noise barrier could feasibly be constructed on the site) and by acoustic feasibility (a minimum of 60% of front row receptors directly behind the noise wall achieve a 5 dBA noise reduction). The feasibility of noise barrier construction is sometimes dependent on design details that are not known until the final design of the project. The following analysis assumes that noise barriers could be feasibly constructed throughout the project area, up to 20 feet high along the corridor.

Reasonableness is based on three factors determined by the number of benefited receptors from the noise abatement that must be met. A benefited receptor is any receptor behind the noise barrier that receives a minimum noise level reduction of 5 dBA or more. The three reasonableness factors are as follows:

- A cost effectiveness (CE) threshold of $21,000 per individual benefited receptor has been established, based on an estimated construction cost of $44 per square foot for noise barriers. The cost calculations for the noise abatement measure should include all items directly related to the construction of the noise abatement measure, including additional costs of some items such as right-of-way, drainage modifications, utility relocation, traffic control, retaining walls, landscaping for graffiti abatement and standard aesthetic treatments.
- At least 40% of benefited receptors must achieve a 7 dBA noise reduction in order for noise abatement to be reasonable.
- The viewpoints of the property owners and residents of all benefited receptors shall be solicited and considered in reaching a decision on the abatement measure to be provided. See Section 9 of the SDDOT Noise Analysis and Abatement Guidance (effective date: July 13, 2011) for a detailed explanation of the voting system.

All barriers evaluated must meet SDDOT's 7 dBA noise reduction design goal for at least 40% of the benefited receptors for each noise abatement measure evaluated. If a barrier is unable to achieve the design goal, further evaluation will not be completed.

5.1.1 Project Summary

Federal Noise Abatement Criteria (NAC) are currently predicted to be both approached and exceeded throughout portions of the study area. Noise barriers were evaluated at 10 barrier locations within the project's 15 noise areas. **Appendix C Build Condition Figures 1-6** illustrates the analysis summary of noise barriers that were considered.

Noise barrier cost-effectiveness results are tabulated in **Appendix B Noise Barrier Tables**.

5.1.2 Vehicle Sight Lines

Along 85th Street, there are side street stop control access locations and driveways. Intersection sight lines were evaluated at each access point to determine where any proposed barrier must not encroach, to ensure propose and safe sight lines for all users. Barriers would need to follow along the sight line, requiring additional right-of-way and/or easements. Based on the American Association of State Highway and Transportation Officials (AASHTO) Guide, at 40 mph, sight distance requirements for left-turning single-unit vehicles from the minor, stop-controlled road is 685 feet, for Beal Avenue and Tuscan Club Circle.

There are multiple residences along 270th Street and 85th Street where the only direct access to those residences is those roadways. Since access will need to be maintained for these homes, there are some impacted residences where noise barriers were not considered feasible.

5.2 Noise Barrier Results

The previous Overpass EA analyzed eight noise areas for noise abatement based on the receptors surrounding the overpass construction limits, located along 270th Street and 85th Street. Abatement for seven of the noise areas were found to be either not feasible or not reasonable.

The project receptors were divided up into 15 separate noise areas based on proximity of adjacent receptors and highway access locations (see **Figure 1** in **Appendix A**).

5.2.1 Noise Area 1 – Sundowner Avenue (West)

Land uses west of Sundowner Avenue consist of 1 residential receptor. The proposed project in this noise area will pave Sundowner Avenue along its existing profile.

Noise levels were modeled at 1 receptor location in Noise Area 1. Modeled noise levels approached or exceeded the Federal NAC at 0 of 1 receptor locations with future (2045) Build conditions. With no impacted receptor in Noise Area 1, no mitigation was evaluated for this noise area.

5.2.2 Noise Area 2 – Sundowner Avenue (East)

Land uses east of Sundowner Avenue consist of 2 residential receptors. The proposed project in this noise area will pave Sundowner Avenue along its existing profile.

Noise levels were modeled at 2 receptor locations in Noise Area 2. Modeled noise levels had a significant increase impact at Receptor 2-1 with future (2045) Build conditions. Noise abatement at this receptor was not feasible due to the need of direct access to the property off Sundowner Avenue. No mitigation was evaluated for this noise area.

5.2.3 Noise Area 3 – South of I-229 Northbound

Land uses south of I-229 Northbound consist of non-residential hospital facilities on the south side of I-229. The proposed project in this noise area constructs an auxiliary lane from 85th Street entrance ramp to I-229 northbound exit ramp at Louise Avenue, along the existing edge of pavement.

Noise levels were modeled at 4 receptor locations in Noise Area 3. Receptors 3-3 and 3-4 represents exterior land use at the Encompass Health Rehabilitation Hospital of Sioux Falls, which is currently under construction. Modeled noise levels approached or exceeded the Federal NAC at 0 of 4 receptor locations with future (2045) Build conditions.

5.2.4 Noise Area 4 – South of I-229 NB Exit Ramp at Louise Avenue

Land uses south of I-229 Northbound exist ramp at Louise Avenue consist of commercial buildings on the south side of the Louise Avenue ramp. The proposed project in this noise area constructs an auxiliary lane from 85th Street entrance ramp to I-229 northbound exit ramp at Louise Avenue, along the existing edge of pavement.

Noise levels were modeled at 3 receptor locations in Noise Area 4. Modeled noise levels approached or exceeded the Federal NAC at 0 of 3 receptor locations with future (2045) Build conditions.

5.2.5 Noise Area 5 – 270th Street (between Ellis Road and Sundowner Avenue)

Land uses along 270th Street, between Ellis Road and Sundowner Avenue consists of 2 residential receptors. The proposed project in this noise area will pave Sundowner Avenue along its existing profile.

Noise levels were modeled at 2 receptor locations in Noise Area 5. Modeled noise levels had a significant increase impact at Receptor 5-1 with future (2045) Build conditions. Noise abatement at this receptor was not feasible due to the need of direct access to the property off 270th Street. No mitigation was evaluated for this noise area.

5.2.6 Noise Area 6 – Sundowner Avenue (North of 270th Street)

Land uses along Sundowner Avenue, north of 270th Street consists of 3 residential receptors. The proposed project in this noise area will pave Sundowner Avenue along its existing profile.

Noise levels were modeled at 3 receptor locations in Noise Area 6. Modeled noise levels approached or exceeded the Federal NAC at 0 of 3 receptor locations with future (2045) Build conditions.

5.2.7 Noise Area 7 – 270th Street (Between Sundowner Avenue and Interchange)

Land uses along 270th Street, between Sundowner Avenue and the proposed I-29 interchange consists of 6 residential receptors. The proposed project in this noise area will widen 270th Street, providing two through-lanes and right and left turn lanes on all approaches. The intersection of 270th Street and Sundowner Avenue will also be signalized.

Noise levels were modeled at 5 receptor locations in Noise Area 7. Modeled noise levels had a significant increase impact at Receptors 7-1 and 7-2 with future (2045) Build conditions. Noise abatement at these receptors was not feasible due to the need of direct access to the property off 270th Street. No mitigation was evaluated for this noise area. Receptors 7-4 and 7-5 will be demolished during the proposed design.

5.2.8 Noise Area 8 – 85th Street North (Interchange to Tallgrass Avenue)

Land uses along the north side of 85th Street, from the proposed I-29 interchange to Tallgrass Avenue consists of 4 residential receptors. The proposed project in this noise area will raise the profile at the 85th Street/Tallgrass Avenue intersection, widen 85th Street and Tallgrass to accommodate two through-lanes, right and left turn lanes on all approaches. The intersection will also be signalized.

Noise levels were modeled at 4 receptor locations in Noise Area 8. Modeled noise levels approached or exceeded the Federal NAC at 3 of 4 receptor locations with future (2045) Build conditions. Noise abatement at these receptors was not feasible due to the need of direct access to the property off 85th Street. No mitigation was evaluated for this noise area. Receptor 8-1 will be demolished during the proposed design.

5.2.9 Noise Area 9 – 85th Street North (Tallgrass Avenue to Beal Avenue)

Land uses along the north side of 85th Street, from Tallgrass Avenue to Beal Avenue consists of residential receptors, including multiple single family homes and townhouse complexes. The proposed project in this noise area will lower the profile along 85th Street approximately 2-3 feet, widen 85th Street and Tallgrass to accommodate two through-lanes, right and left turn lanes and signalize the intersections of Tallgrass Avenue, Townsley Avenue, and Beal Avenue.

Noise levels were modeled at 21 receptor locations in Noise Area 9. Modeled noise levels approached or exceeded the Federal NAC at 13 of 21 receptor locations with future (2045) Build conditions.

For receptors 9-2, 9-6, 9-7 and 9-8, modeled noise levels had a significant increase impact with future (2045) Build conditions. Noise abatement at these receptors was not feasible due to the need of direct access to the property off 85th Street. No mitigation was evaluated for this noise area.

For receptors 9-4 and 9-5, modeled noise levels had a significant increase impact with future (2045) Build conditions. Since receptors 9-4 and 9-5 both have direct access off Cactus Place, a noise barrier was modeled along both parcels on 85th Street.

For receptors 9-9A, 9-9B, 9-10 and 9-11, modeled noise levels exceeded the Federal NAC with the future build, while receptors 9-13, 9-14, and 9-17 had a significant increase impacts with future (2045) Build conditions. A noise barrier was modeled behind the proposed sidewalk location along 85th Street to mitigate traffic noise to these multi-family dwellings.

5.2.9.1 Barrier 9-1

An approximately 170 foot long, 15 foot high noise barrier was modeled on the north side of 85th Street, east of Tallgrass Avenue, to mitigate impacts to the residential receptor “9-4”. The barrier provides a reduction of 2.3 dBA for receptor 9-4 and 0.7 dBA reduction for receptor 9-3. Iterating the barrier height higher did not provide any additional noise reduction. The noise barrier does not meet SDDOT’s 7 dBA noise reduction design goal and is therefore not proposed.

5.2.9.2 Barrier 9-2

An approximately 180 foot long, 16 foot high noise barrier was modeled on the north side of 85th Street, east of Tallgrass Avenue, to mitigate impacts to the residential receptor “9-5”. The barrier provides a reduction of 2.2 dBA. Iterating the barrier height higher did not provide any additional noise reduction. The noise barrier does not meet SDDOT’s 7 dBA noise reduction design goal and is therefore not proposed.

5.2.9.3 Barrier 9-3

An approximately 235 foot long, 6 foot high noise barrier was modeled on the north side of 85th Street, east of Tallgrass Avenue, to mitigate impacts to the residential receptors 9-9A, 9-9B, 9-10, 9-11, 9-13, 9-14 and 9-17. The barrier provides a reduction that varies from 0.2 to 9.2 dBA. 5 out of 5 (100%) of the benefited receptors achieve a noise reduction of 7.0 dBA or more. Due to limited existing right-of-way, the proposed barrier layout will require the purchase of easements. The cost of the proposed barrier with the proposed easements (10 feet behind the barrier) is $18,355 per benefited receptor. Since the barrier design meets both reasonableness and feasibility requirements, the noise barrier will be presented to the benefited residents and owners for voting as outlined in the SDDOT Noise Analysis and Abatement Guidance (effective date: July 13, 2011).

5.2.10 Noise Area 10 – 85th Street North (Beal Avenue to Hughes Avenue)

Land use along the north side of 85th Street, from Beal Avenue to Hughes Avenue consists of residential receptors, consisting of multiple single family homes and townhouse complexes. The proposed project in this noise area will lower the profile along 85th Street approximately 2-3 feet, widen 85th Street and Tallgrass to accommodate two through-lanes, right and left turn lanes and signalize the intersections of Beal Avenue and Hughes Avenue.

Noise levels were modeled at 31 receptor locations in Noise Area 10. Modeled noise levels approached or exceeded the Federal NAC at 17 of 31 receptor locations with future (2045) Build conditions.

5.2.10.1 Barrier 10-1

An approximately 1,387 foot long, 6 foot high noise barrier was modeled on the north side of 85th Street, east of Beal Avenue, to mitigate impacts to the residential receptors 10-1 through 10-14 and 10-28 through 10-30. The barrier provides a reduction that varies from 2.6 to 8.3 dBA. 7 out of 13 (54%) of the benefited receptors achieve a noise reduction of 7.0 dBA or more. However, the cost per benefited receptor is $28,167, which exceeds the allowable CE threshold of $21,000 benefited receptor.

A second alternative noise barrier design was modeled of the same 1,387 foot length, but that had a more cost-effective average height of 5.4 feet, to mitigate impacts to the residential receptors 10-1 through 10-14 and 10-28 through 10-30. The barrier provides a reduction that varies from 2.4 to 7.5 dBA. Only 5 out of 13 (38%) of the benefited receptors achieve a noise reduction of 7.0 dBA or more, which does not meet the 7.0 dBA or more noise reduction goal for 40% of benefited receptors. Also, the cost per benefited receptor is $25,397, which exceeds the allowable CE threshold of $21,000 benefited receptor and therefore, is not proposed.

5.2.11 Noise Area 11 – 85th Street North (Hughes Avenue to S Louise Avenue)

Land uses along the north side of 85th Street, from Hughes Avenue to S Louise Avenue consists of residential receptors, consisting of multiple single family homes. The proposed project in this noise area will lower the profile approximately 1 foot in some areas along 85th Street. 85th Street will be widened to accommodate two through-lanes, right and left turn lanes at Hughes Avenue and signalize the intersection of Hughes Avenue.

Noise levels were modeled at 22 receptor locations in Noise Area 11. Modeled noise levels approached or exceeded the Federal NAC at 4 of 22 receptor locations with future (2045) Build conditions.

5.2.11.1 Barrier 11-1

An approximately 745 foot long, 6.4 foot high noise barrier was modeled on the north side of 85th Street, east of Hughes Avenue, to mitigate impacts to the residential receptors 11-1 through 11-4. The barrier provides a reduction that varies from 0.5 to 7.7 dBA. 3 out of 6 (50%) of the benefited receptors achieve a noise reduction of 7.0 dBA or more. However, the cost per benefited receptor is $34,801, which exceeds the allowable CE threshold of $21,000 benefited receptor.

A second alternative noise barrier design was modeled of the same 745 foot length, but that had a more cost-effective average height of 5.7 feet, to mitigate impacts to the residential receptors 11-1 through 11-4. The barrier provides a reduction that varies from 0.4 to 7.0 dBA. Only 1 out of 6 (17%) of the benefited receptors achieve a noise reduction of 7.0 dBA or more, which does not meet the 7.0 dBA or more noise reduction goal for 40% of benefited receptors. Also, the cost per benefited receptor is $30,977, which exceeds the allowable CE threshold of $21,000 benefited receptor and therefore, is not proposed.

5.2.12 Noise Area 12 – 85th Street South (Townsley Avenue to Brett Avenue)

Land uses along the south side of 85th Street, from Townsley Avenue to Brett Avenue consist of residential receptors, including multiple townhouse complexes. The proposed project in this noise area will lower the profile along 85th Street approximately 2-3 feet, widen 85th Street and Townsley Avenue to accommodate two through-lanes, right and left turn lanes and signalize the intersections of Townsley Avenue and Brett Avenue.

Noise levels were modeled at 29 receptor locations in Noise Area 12. Modeled noise levels approached or exceeded the Federal NAC at 14 of 29 receptor locations with future (2045) Build conditions.

5.2.12.1 Barrier 12-1

An approximately 650 foot long, 6 foot high noise barrier was modeled on the south side of 85th Street, west of Brett Avenue, to mitigate impacts to the residential receptors 12-1 through 12-11 and 12-13 through 12-15. The barrier provides a reduction that varies from 0.1 to 9.2 dBA. 14 out of 15 (93%) of the benefited receptors achieve a noise reduction of 7.0 dBA or more. The cost per benefited receptor for the barrier alone is $11,440. However, the proposed barrier would be located along the Lewis & Clark waterline and within the Lewis & Clark permanent utility easement, making construction of this barrier not feasible. Approximately 650 feet of this utility would be impacted by the construction of the barrier. Additional costs incurred from relocating the waterline, acquiring the additional right-of-way for construction of the barrier, and maintaining access of water to residents in the area would far exceed the allowable CE threshold of $21,000 benefited receptor.

5.2.13 Noise Area 13 – 85th Street South (Brett Avenue to Hughes Avenue)

Land use along the south side of 85th Street, from Brett Avenue to Hughes Avenue consists of residential receptors, consisting of multiple single family homes. The proposed project in this noise area will lower the profile along 85th Street approximately 2-3 feet and widen 85th Street to accommodate two through-lanes, right and left turn lanes.

Noise levels were modeled at 10 receptor locations in Noise Area 13. Modeled noise levels approached or exceeded the Federal NAC at 6 of 10 receptor locations with future (2045) Build conditions. For Receptor 13-4, the modeled noise level had a significant increase impact with future (2045) Build conditions. Noise abatement at this receptor was not feasible due to the need of direct access to the property off 85th Street. No mitigation was evaluated for this receptor.

5.2.13.1 Barrier 13-1

An approximately 225 foot long, 9.2 foot high noise barrier was modeled on the south side of 85th Street, west of S Tuscan Club Circle, to mitigate impacts to the residential receptors 13-1 and 13-5. The barrier provides a reduction that varies from 1.7 to 7.0 dBA. Only one of the residences is benefited by the noise barrier, with a 7.0 dBA reduction, making the cost per benefited receptor is $83,164, which exceeds the allowable CE threshold of $21,000 benefited receptor.

5.2.13.2 Barrier 13-2

An approximately 505 foot long, 20 foot high noise barrier was modeled on the south side of 85th Street, east of S Tuscan Club Circle, to mitigate impacts to the residential receptors 13-2, 13-3 and 13-7. The barrier provides a reduction that varies from 0.9 to 6.6 dBA. The noise barrier does not meet SDDOT's 7 dBA noise reduction design goal and is therefore not proposed.

5.2.14 Noise Area 14 – 85th Street South (Hughes Avenue to S Louise Avenue)

Land uses along the south side of 85th Street, from Hughes Avenue to S Louise Avenue consists of residential receptors, consisting of multiple single family homes and apartment complexes. The proposed project in this noise area will lower the profile approximately 1 foot in some areas along 85th Street. 85th Street will be widened to accommodate two through-lanes, right and left turn lanes at Hughes Avenue and signalized Hughes intersection.

Noise levels were modeled at 24 receptor locations in Noise Area 11. Modeled noise levels approached or exceeded the Federal NAC at 4 of 24 receptor locations with future (2045) Build conditions.

5.2.14.1 Barrier 14-1

An approximately 445 foot long, 8.5 foot high noise barrier was modeled on the south side of 85th Street, east of Hughes Avenue, to mitigate impacts to the residential receptors 14-1 through 14-4. The barrier provides a reduction that varies from 0.9 to 7.5 dBA. 2 out of 4 (50%) of the benefited receptors achieve a noise reduction of 7.0 dBA or more. However, the cost per benefited receptor is $41,363, which exceeds the allowable CE threshold of $21,000 benefited receptor.

5.2.15 Noise Area 15 – Northbound I-29 (East)

Land use east of I-29 Northbound consists of Sioux Fall Lutheran School, including various outdoor sports and recreational areas, which are located adjacent to the interstate. Closest receptors to the interstate represent a soccer field (Receptor 15-1) and track & field areas (receptors 15-2, 15-3 and 15-4). The school building itself is located further west from the interstate. The proposed project in this noise area constructs an auxiliary lane from 85th Street entrance ramp to I-229 northbound exit ramp at Louise Avenue, along the existing edge of pavement.

Noise levels were modeled at 4 receptor locations in Noise Area 15. Modeled noise levels approached or exceeded the Federal NAC at 1 of 4 receptor locations with future (2045) Build conditions.

5.2.15.1 Barrier 15-1

An approximately 320 foot long, 20 foot high noise barrier was modeled on the west side of I-29 Northbound, to mitigate impacts to the exterior receptor 15-1. The barrier provides a reduction that varies from 0.6 to 3.6 dBA. The noise barrier does not meet SDDOT's 7 dBA noise reduction design goal and is therefore not proposed.

5.3 Previous Overpass EA Results

The previous Overpass EA analyzed eight noise areas for noise abatement based on the receptors surrounding the overpass construction limits, located along 270th Street and 85th Street. Abatement for seven of the noise areas were found to be either not feasible or not reasonable. Only one noise barrier, located along 85th Street, west to Beal Avenue, was determined to be reasonable and feasible. This noise barrier was modeled to mitigate impacts to the multi-family residential receptors at this location. The noise barrier was presented to the benefited residents and owners for voting as outlined in the SDDOT Noise Analysis and Abatement Guidance (effective date: July 13, 2011), as a part of the previous Overpass EA. More than 50% of the balloted voters were in favor of the construction of the noise barrier.

Barrier 9-3 was modeled to mitigate impacts to these same multi-family residential receptors along 85th Street at Beal Avenue for the proposed future (2045) Build conditions. Since this barrier was also determined to be reasonable and feasible, a new vote will be conducted for the benefited property owners and residents based on the barrier layout shown in Appendix C.

6 Construction Noise

The construction activities associated with implementation of the proposed project will result in increased noise levels relative to existing conditions. These impacts will primarily be associated with construction equipment and pile driving.

The following table (**Table 4**) shows peak noise levels monitored at 50 feet from various types of construction equipment. This equipment is primarily associated with site grading/site preparation, which is generally the roadway construction phase associated with the greatest noise levels.

Table 4 – Typical Construction Equipment Noise Levels at 50 Feet

Equipment Type	Manufacturers Sampled	Total Number of Models in Sample	Peak Noise Levels (dBA)	
			Range	Average
Backhoes	5	6	74-92	83
Front Loaders	5	30	75-96	85
Dozers	8	41	65-95	85
Graders	3	15	72-92	84
Scrapers	2	27	76-98	87
Pile Drivers	N/A	N/A	95-105	101

Source: United States Environmental Protection Agency and Federal Highway Administration

Elevated noise levels are, to a degree, unavoidable for this type of project. SDDOT will require that contractors comply with the sound control requirements identified in the SDDOT Standard Specifications for Roads and Bridges. Construction noise abatement will be determined by weighing the duration of the project, benefits achieved, overall adverse social, economic and environmental effects, and cost of abatement measures.

It is anticipated that night construction may be required to minimize traffic impacts and to improve safety. However, construction will be limited to daytime hours as much as possible. If necessary, a detailed nighttime construction mitigation plan will be developed during the project final design stage.

Any associated high-impact equipment noise, such as pile driving, pavement sawing, or jack hammering, will be unavoidable with construction of the proposed project. Pile-driving noise is associated with any bridge construction and sheet piling necessary for retaining wall construction. High-impact noise construction activities will be limited in duration to the greatest extent possible. While pile-driving equipment results in the highest peak noise level, as shown in **Table 4**, it is limited in duration to the activities noted above (e.g., bridge construction). The use of pile drivers, jack hammers, and pavement sawing equipment will be prohibited during nighttime hours.

7 Conclusions

Noise levels surrounding the 85th Street project area exceed Federal NAC criteria for several single and multi-family receptors under the future build (2045) conditions, as well as at the outdoor soccer field at the Sioux Falls Lutheran School along I-29 Northbound.

In general, the construction of the I-29 interchange at 85th Street will result in increases in traffic noise levels compared to the existing conditions. Modeled build (2045) condition noise levels vary from 0.5 dBA to 20.7 dBA from existing (2015) conditions.

Generally, traffic noise levels are increased with the proposed build project due to many factors. Some of the major changes that influence the increases are as follows:

- Traffic demands will increase between the existing (2015) conditions and future (2045) conditions.
- The 85th Street corridor will be widened to two through-lanes, plus left and/or right turn lanes at various side roads along the corridor. The construction of additional lanes along 85th Street shifts the traffic closer to the existing receptors, resulting in increased noise levels.

Acoustic reasonableness and cost effectiveness were calculated for each of the 10 noise barriers that were evaluated for this study. One of the noise barriers (B9-3) was found to be reasonable and feasible and will follow the voting process for possible incorporation into this project, as outlined in the SDDOT Noise Analysis and Abatement Guidance (effective date: July 13, 2011).

If there are any significant changes to the final design of the I-29 and 85th Street Interchange project, the environmental document may need to be re-evaluated.

Tables

Table 3 – Noise Analysis Summary Table

Table 3
Noise Analysis Summary
Existing and Future Scenarios

Noise Level Comparison to Standards	
XX	**Bold**; Approach or Exceeds FHWA Activity Criteria
XX	Underline; substantial increase (15 dBA) in noise levels
N/A	Receptor does not exist in Scenario

***Medical - Land Use is inpatient rehabilitation facility**

Receiver		FHWA Activity (dBA)		Existing Modeled 2015 Conditions	Future Build Conditions	Difference - Existing and Build
Receptor ID	Land Use	Activity Category	Criteria L_{eq}	L_{eq}	L_{eq}	L_{eq}
Noise Area 1 & 2 - Sundowner Ave						
1-1	Residential	B	67	46.7	57.4	10.7
2-1	Residential	B	67	49.4	64.5	15.1
2-2	Residential	B	67	47.9	54.1	6.2
Noise Area 3 & 4 - South of I-229 Northbound						
3-1	Hospital	C	67	59.2	60.7	1.5
3-2	Commercial	E	72	56.6	58.5	1.9
3-3	Medical*	C	67	61.8	63.3	1.5
3-4	Medical*	C	67	58.0	59.6	1.6
4-1	Commercial	E	72	65.0	66.7	1.7
4-2	Commercial	E	72	58.4	59.6	1.2
4-3	Commercial	E	72	60.2	60.7	0.5
Noise Area 5 - 270th Street (Between Ellis Rd and Sundowner Ave)						
5-1	Residential	B	67	40.9	58.6	17.7
5-2	Residential	B	67	40.2	49.8	9.6
Noise Area 6 - Sundowner Ave, North of 270th Street						
6-1	Residential	B	67	47.2	53.6	6.4
6-2	Residential	B	67	47.1	54.1	7.0
6-3	Residential	B	67	47.5	55.6	8.1
Noise Area 7 - 270th Street (Between Sundowner Ave and Interchange)						
7-1	Residential	B	67	48.3	63.3	15.0
7-2	Residential	B	67	49.0	65.8	16.8
7-3	Residential	B	67	51.6	61.3	9.7
7-4	Residential	B	67	48.2	N/A	
7-5	Residential	B	67	58.4	N/A	
Noise Area 8 - 85th Street (Interchange to Tallgrass Ave)						
8-1	Residential	B	67	52.8	N/A	
8-2	Residential	B	67	49.0	**69.0**	20.0
8-3	Residential	B	67	50.0	64.5	14.5
8-4	Residential	B	67	50.9	**69.1**	18.2
Noise Area 9 - 85th Street (Tallgrass Ave to Beal Ave)						
9-1	Residential	B	67	49.8	64.3	14.5
9-2	Residential	B	67	47.6	64.1	16.5
9-3	Residential	B	67	48.9	62.1	13.2
9-4	Residential	B	67	47.4	63.9	16.5
9-5	Residential	B	67	46.2	62.7	16.5
9-6	Residential	B	67	46.8	63.4	16.6
9-7	Residential	B	67	46.7	63.2	16.5
9-8	Residential	B	67	47.0	63.8	16.8
9-9A	Residential	B	67	50.5	**70.4**	19.9
9-9B	Residential	B	67	50.3	**70.6**	20.3
9-10	Residential	B	67	50.2	**70.6**	20.4
9-11	Residential	B	67	50.1	**70.4**	20.3

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XX	Underline; substantial increase (15 dBA) in noise levels
N/A	Receptor does not exist in Scenario

Receiver		FHWA Activity (dBA)		Existing Modeled 2015 Conditions		
					Future Build Conditions	Difference - Existing and Build
Receptor ID	Land Use	Activity Category	Criteria L_{eq}	L_{eq}	L_{eq}	L_{eq}
Noise Area 9 - 85th Street WB (Tallgrass Ave to Beal Ave)						
9-12	Residential	B	67	42.6	57.4	14.8
9-13	Residential	B	67	41.4	57.1	15.7
9-14	Residential	B	67	41.9	58.6	16.7
9-15	Residential	B	67	40.9	54.6	13.7
9-16	Residential	B	67	39.9	52.7	12.8
9-17	Residential	B	67	40.2	56.0	15.8
9-18	Residential	B	67	50.8	63.1	12.3
9-19	Residential	B	67	51.3	63.3	12.0
9-20	Residential	B	67	49.8	58.3	8.5
Noise Area 10 - 85th Street WB (Beal Ave to Hughes Ave)						
10-1	Residential	B	67	48.2	**67.6**	19.4
10-2	Residential	B	67	48.3	**66.8**	18.5
10-3	Residential	B	67	49.3	**68.1**	18.8
10-4	Residential	B	67	48.5	**66.9**	18.4
10-5	Residential	B	67	48.8	**67.3**	18.5
10-6	Residential	B	67	48.6	**67.0**	18.4
10-7	Residential	B	67	48.7	**66.8**	18.1
10-8	Residential	B	67	48.9	**67.1**	18.2
10-9	Residential	B	67	48.8	**66.8**	18.0
10-10	Residential	B	67	49.0	**66.9**	17.9
10-11	Residential	B	67	50.2	**68.3**	18.1
10-12	Residential	B	67	49.1	65.7	16.6
10-13	Residential	B	67	51.9	**68.9**	17.0
10-14	Residential	B	67	43.7	59.0	15.3
10-15	Residential	B	67	43.0	57.3	14.3
10-16	Residential	B	67	43.5	57.5	14.0
10-17	Residential	B	67	43.5	57.5	14.0
10-18	Residential	B	67	43.6	57.4	13.8
10-19	Residential	B	67	43.6	57.4	13.8
10-20	Residential	B	67	43.7	57.5	13.8
10-21	Residential	B	67	43.9	57.5	13.6
10-22	Residential	B	67	44.0	57.5	13.5
10-23	Residential	B	67	45.5	59.1	13.6
10-24	Residential	B	67	44.4	57.7	13.3
10-25	Residential	B	67	48.2	62.6	14.4
10-26	Residential	B	67	46.0	58.9	12.9
10-27	Residential	B	67	44.9	57.4	12.5
10-28	Residential	B	67	45.8	64.0	18.2
10-29	Residential	B	67	43.9	61.3	17.4
10-30	Residential	B	67	42.6	58.4	15.8
10-31	Residential	B	67	42.5	57.1	14.6

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Noise Level Comparison to Standards	
XX	**Bold**; Approach or Exceeds FHWA Activity Criteria
XX	Underline; substantial increase (15 dBA) in noise levels
N/A	Receptor does not exist in Scenario

Receiver		FHWA Activity (dBA)		Existing Modeled 2015 Conditions	Future Build Conditions	Difference - Existing and Build
Receptor ID	Land Use	Activity Category	Criteria L_{eq}	L_{eq}	L_{eq}	L_{eq}
Noise Area 11 - 85th Street WB (Hughes Avenue to S Louise Avenue)						
11-1	Residential	B	67	56.6	**69.5**	12.9
11-2	Residential	B	67	56.9	**69.5**	12.6
11-3	Residential	B	67	57.4	**69.5**	12.1
11-4	Residential	B	67	58.2	**69.5**	11.3
11-5	Residential	B	67	50.7	62.6	11.9
11-6	Residential	B	67	52.3	63.8	11.5
11-7	Residential	B	67	54.1	65.9	11.8
11-8	Residential	B	67	53.5	65.4	11.9
11-9	Residential	B	67	55.2	64.4	9.2
11-10	Residential	B	67	47.8	58.7	10.9
11-11	Residential	B	67	48.3	58.8	10.5
11-12	Residential	B	67	49.4	58.3	8.9
11-13	Residential	B	67	49.7	57.9	8.2
11-14	Residential	B	67	49.4	56.1	6.7
11-15	Residential	B	67	53.9	60.7	6.8
11-16	Residential	B	67	53.3	59.1	5.8
11-17	Residential	B	67	46.5	57.1	10.6
11-18	Residential	B	67	47.1	57.1	10.0
11-19	Residential	B	67	48.3	56.4	8.1
11-20	Residential	B	67	49.1	56.0	6.9
11-21	Residential	B	67	52.0	56.8	4.8
11-22	Residential	B	67	53.1	57.9	4.8
Noise Area 12 - 85th Street EB (S Townsley Ave to S Brett Ave)						
12-1	Residential	B	67	50.6	**69.6**	19.0
12-2	Residential	B	67	50.3	**69.8**	19.5
12-3	Residential	B	67	50.2	**69.8**	19.6
12-4	Residential	B	67	50.2	**70.0**	19.8
12-5	Residential	B	67	50.0	**70.6**	20.6
12-6	Residential	B	67	50.0	**70.7**	20.7
12-7	Residential	B	67	49.6	**70.0**	20.4
12-8	Residential	B	67	42.3	57.6	15.3
12-9	Residential	B	67	38.4	54.2	15.8
12-10	Residential	B	67	40.1	57.7	17.6
12-11	Residential	B	67	39.5	55.1	15.6
12-12	Residential	B	67	37.1	49.0	11.9
12-13	Residential	B	67	38.2	55.9	17.7
12-14	Residential	B	67	45.2	63.5	18.3
12-15	Residential	B	67	43.2	60.1	16.9
12-16	Residential	B	67	40.2	48.7	8.5
12-17	Residential	B	67	38.0	44.0	6.0
12-18	Residential	B	67	37.6	43.2	5.6
12-19	Residential	B	67	37.0	42.2	5.2

Table 3
Noise Analysis Summary
Existing and Future Scenarios

Noise Level Comparison to Standards	
XX	**Bold**; Approach or Exceeds FHWA Activity Criteria
XX	Underline; substantial increase (15 dBA) in noise levels
N/A	Receptor does not exist in Scenario

Receiver		FHWA Activity (dBA)		Existing Modeled 2015 Conditions	Future Build Conditions	Difference - Existing and Build
Receptor ID	Land Use	Activity Category	Criteria L_{eq}	L_{eq}	L_{eq}	L_{eq}
Noise Area 12 - 85th Street EB (S Townsley Ave to S Brett Ave)						
12-20	Residential	B	67	37.2	42.0	4.8
12-21	Residential	B	67	37.4	47.0	9.6
12-22	Residential	B	67	43.3	56.2	12.9
12-23	Residential	B	67	40.2	52.8	12.6
12-24	Residential	B	67	38.3	48.7	10.4
12-25	Residential	B	67	38.0	47.8	9.8
12-26	Residential	B	67	37.9	48.1	10.2
12-27	Residential	B	67	38.1	49.4	11.3
12-28	Residential	B	67	41.5	55.5	14.0
12-29	Residential	B	67	41.3	54.5	13.2
Noise Area 13 - 85th Street EB (Brett Ave to Hughes Ave)						
13-1	Residential	B	67	49.1	**68.9**	19.8
13-2	Residential	B	67	47.0	64.3	17.3
13-3	Residential	B	67	54.0	**70.3**	16.3
13-4	Residential	B	67	43.9	60.1	16.2
13-5	Residential	B	67	44.1	59.7	15.6
13-6	Residential	B	67	44.3	59.1	14.8
13-7	Residential	B	67	49.0	64.1	15.1
13-8	Residential	B	67	46.5	60.7	14.2
13-9	Residential	B	67	45.0	58.4	13.4
13-10	Residential	B	67	42.2	56.0	13.8
Noise Area 14 - 85th Street EB (Hughes Ave to S Louise Ave)						
14-1	Residential	B	67	56.2	**69.6**	13.4
14-2	Residential	B	67	54.9	**67.4**	12.5
14-3	Residential	B	67	55.9	**68.6**	12.7
14-4	Residential	B	67	55.3	**67.6**	12.3
14-5	Residential	B	67	53.5	64.2	10.7
14-6	Residential	B	67	53.6	64.3	10.7
14-7	Residential	B	67	53.7	64.3	10.6
14-8	Residential	B	67	54.0	64.4	10.4
14-9	Residential	B	67	49.7	60.4	10.7
14-10	Residential	B	67	47.8	58.3	10.5
14-11	Residential	B	67	42.8	47.0	4.2
14-12	Residential	B	67	43.9	46.0	2.1
14-13	Residential	B	67	45.5	47.2	1.7
14-14	Residential	B	67	49.2	54.0	4.8
14-15	Residential	B	67	49.9	60.1	10.2
14-16	Residential	B	67	46.9	57.2	10.3
14-17	Residential	B	67	46.4	58.3	11.9
14-18	Residential	B	67	46.8	57.4	10.6

Table 3
Noise Analysis Summary
Existing and Future Scenarios

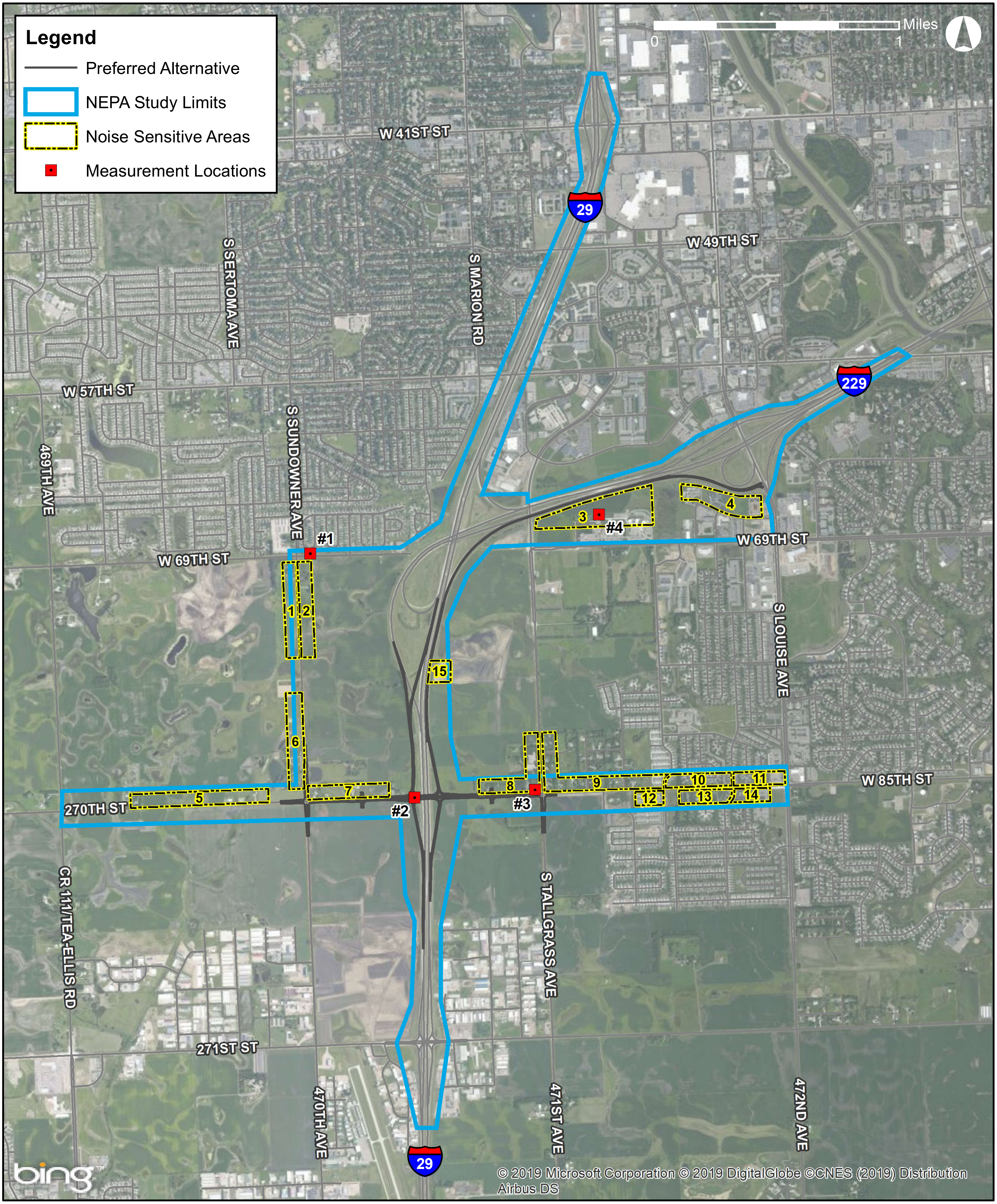
Noise Level Comparison to Standards	
XX	**Bold**; Approach or Exceeds FHWA Activity Criteria
XX	Underline; substantial increase (15 dBA) in noise levels
N/A	Receptor does not exist in Scenario

****School - Land Use is outdoor school sports areas**

Receiver		FHWA Activity (dBA)		Existing Modeled 2015 Conditions	Future Build Conditions	Difference - Existing and Build
Receptor ID	Land Use	Activity Category	Criteria L_{eq}	L_{eq}	L_{eq}	L_{eq}
Noise Area 14 - 85th Street EB (Hughes Ave to S Louise Ave)						
14-19	Residential	B	67	46.5	56.2	9.7
14-20	Residential	B	67	45.6	56.0	10.4
14-21	Residential	B	67	44.8	50.9	6.1
14-22	Residential	B	67	46.4	52.4	6.0
14-23	Residential	B	67	47.9	53.9	6.0
14-24	Residential	B	67	50.4	56.1	5.7
Noise Area 15 - I-29 Northbound (East)						
15-1	School**	C	67	**68.2**	**70.3**	2.1
15-2	School**	C	67	62.0	64.0	2.0
15-3	School**	C	67	62.6	64.7	2.1
15-4	School**	C	67	62.7	64.9	2.2

Appendix A

Noise Analysis Overview Map (1)



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Print Date: 1/2/2020
Source: Bing Maps, Lincoln County

Map by: mfalk
Projection: State Plane South Dakota S

Noise Analysis Overview Map

I-29 and 85th Street Interchange
Lincoln County, SD

Appendix B

Noise Barrier Tables

Table B1
Build Noise Barrier Cost Effectiveness (Noise Area 9)
Noise Barrier 9-1

				Future Noise Levels		Acoustic Effectiveness			Cost Effectiveness ($44/SF)					
Noise Barrier	Receiver	Land Use	FHWA Noise Standard (Leq dBA)	Build (Leq dBA)	Build with Barriers (Leq dBA)	dBA Reduction	Number of Receptors	Benefited Receptors (-5 dBA)	Barrier Length (ft)	Average Barrier Height (ft)	Area of Barrier (SF)	Total Cost	Cost per Benefited Receptor	NOISE WALL RESULTS
B9-1	9-3	Residential	67	62.1	61.4	-0.7	1	0	170	15	2550	$112,200	N/A*	NO
	9-4	Residential	67	63.9	61.6	-2.3	1	0						

Number of Benefited Receptors (Front Row) = 0 (0%)
Total Number of Benefited Receptors = 0
Number of Receptors meeting Design Goal (7 dBA Reduction) = 0 (0%)

*Design Goal and Acoustic Feasibility was not achieved since there are no Benefited Receptors

Table B2
Build Noise Barrier Cost Effectiveness (Noise Area 9)
Noise Barrier 9-2

				Future Noise Levels		Acoustic Effectiveness			Cost Effectiveness ($44/SF)					
Noise Barrier	Receiver	Land Use	FHWA Noise Standard (Leq dBA)	Build (Leq dBA)	Build with Barriers (Leq dBA)	dBA Reduction	Number of Receptors	Benefited Receptors (-5 dBA)	Barrier Length (ft)	Average Barrier Height (ft)	Area of Barrier (SF)	Total Cost	Cost per Benefited Receptor	NOISE WALL RESULTS
B9-2	9-5	Residential	67	62.7	60.5	-2.2	1	0	180	16	2880	$126,720	N/A*	NO

Number of Benefited Receptors (Front Row) = 0 (0%)
Total Number of Benefited Receptors = 0
Number of Receptors meeting Design Goal (7 dBA Reduction) = 0 (0%)

*Design Goal and Acoustic Feasibility was not achieved since there are no Benefited Receptors

Table B3
Build Noise Barrier Cost Effectiveness (Noise Area 9)
Noise Barrier 9-3

				Future Noise Levels		Acoustic Effectiveness			Cost Effectiveness ($44/SF)					
Noise Barrier	Receiver	Land Use	FHWA Noise Standard (Leq dBA)	Build (Leq dBA)	Build with Barriers (Leq dBA)	dBA Reduction	Number of Receptors	Benefited Receptors (-5 dBA)	Barrier Length (ft)	Average Barrier Height (ft)	Area of Barrier (SF)	Total Cost	Cost per Benefited Receptor	NOISE WALL RESULTS
B9-3	9-9A	Residential	67	70.4	66.5	-3.9	1	0	257	6	1542	$67,848	$13,570	YES
	9-9B	Residential	67	70.6	62.9	-7.7	1	1						
	9-10	Residential	67	70.6	61.7	-8.9	2	2						
	9-11	Residential	67	70.4	62.0	-8.4	2	2						
	9-12	Residential	67	57.4	57.4	0.0	2	0						
	9-13	Residential	67	57.1	57.1	0.0	4	0						
	9-14	Residential	67	58.6	58.6	0.0	2	0						
	9-15	Residential	67	54.6	54.6	0.0	2	0						
	9-16	Residential	67	52.7	52.7	0.0	4	0						
	9-17	Residential	67	56.0	55.8	-0.2	2	0						

Number of Benefited Receptors (Front Row) = 5 (83%)
Total Number of Benefited Receptors = 5
Number of Receptors meeting Design Goal (7 dBA Reduction) = 5 (100%)

Approx easements needed = 4785 SF
Estimated Cost/SF = $5
Cost / Benefited Receptor = $4,785
TOTAL Cost / Benefited Receptor = $18,355
(Includes Wall + Proposed Easements)

Table B4
Build Noise Barrier Cost Effectiveness (Noise Area 10)
Noise Barrier 10-1

Noise Barrier	Receiver	Land Use	FHWA Noise Standard (Leq dBA)	Future Noise Levels		Acoustic Effectiveness			Cost Effectiveness ($44/SF)					NOISE WALL RESULTS
				Build (Leq dBA)	Build with Barriers (Leq dBA)	dBA Reduction	Number of Receptors	Benefited Receptors (-5 dBA)	Barrier Length (ft)	Average Barrier Height (ft)	Area of Barrier (SF)	Total Cost	Cost per Benefited Receptor	
B10-1	10-1	Residential	B	67.6	62.6	-5.0	1	1	1387	6	8322	$366,168	$28,167	NO
	10-2	Residential	B	66.8	59.2	-7.6	1	1						
	10-3	Residential	B	68.1	60.6	-7.5	1	1						
	10-4	Residential	B	66.9	60.4	-6.5	1	1						
	10-5	Residential	B	67.3	60.8	-6.5	1	1						
	10-6	Residential	B	67.0	60.2	-6.8	1	1						
	10-7	Residential	B	66.8	59.3	-7.5	1	1						
	10-8	Residential	B	67.1	59.3	-7.8	1	1						
	10-9	Residential	B	66.8	59.4	-7.4	1	1						
	10-10	Residential	B	66.9	59.2	-7.7	1	1						
	10-11	Residential	B	68.3	60.0	-8.3	1	1						
	10-12	Residential	B	65.7	59.3	-6.4	1	1						
	10-13	Residential	B	68.9	62.3	-6.6	1	1						
	10-14	Residential	B	59.0	55.3	-3.7	1	0						
	10-15	Residential	B	57.3	54.1	-3.2	1	0						
	10-16	Residential	B	57.5	54.5	-3.0	1	0						
	10-17	Residential	B	57.5	54.5	-3.0	1	0						
	10-18	Residential	B	57.4	54.4	-3.0	1	0						
	10-19	Residential	B	57.4	54.4	-3.0	1	0						
	10-20	Residential	B	57.5	54.3	-3.2	1	0						
	10-21	Residential	B	57.5	54.3	-3.2	1	0						
	10-22	Residential	B	57.5	54.4	-3.1	1	0						
	10-23	Residential	B	59.1	55.7	-3.4	1	0						
	10-24	Residential	B	57.7	54.2	-3.5	1	0						
	10-25	Residential	B	62.6	59.1	-3.5	1	0						
	10-26	Residential	B	58.9	56.3	-2.6	1	0						
	10-27	Residential	B	57.4	54.8	-2.6	1	0						
	10-28	Residential	B	64.0	60.1	-3.9	1	0						
	10-29	Residential	B	61.3	57.3	-4.0	1	0						
	10-30	Residential	B	58.4	55.0	-3.4	1	0						
	10-31	Residential	B	57.1	53.7	-3.4	1	0						

Number of Benefited Receptors (Front Row) = 13 (100%)
Total Number of Benefited Receptors = 13
Number of Receptors meeting Design Goal (7 dBA Reduction) = 7 (54%)

Table B5
Build Noise Barrier Cost Effectiveness (Noise Area 10)
Noise Barrier 10-1 Alt 2

				Future Noise Levels		Acoustic Effectiveness			Cost Effectiveness ($44/SF)					
Noise Barrier	Receiver	Land Use	FHWA Noise Standard (Leq dBA)	Build (Leq dBA)	Build with Barriers (Leq dBA)	dBA Reduction	Number of Receptors	Benefited Receptors (-5 dBA)	Barrier Length (ft)	Average Barrier Height (ft)	Area of Barrier (SF)	Total Cost	Cost per Benefited Receptor	NOISE WALL RESULTS
B10-1	10-1	Residential	B	67.6	62.6	-5.0	1	1	1387	5.4	7504	$330,161	$25,397	NO
	10-2	Residential	B	66.8	59.3	-7.5	1	1						
	10-3	Residential	B	68.1	60.8	-7.3	1	1						
	10-4	Residential	B	66.9	61.0	-5.9	1	1						
	10-5	Residential	B	67.3	62.3	-5.0	1	1						
	10-6	Residential	B	67.0	61.8	-5.2	1	1						
	10-7	Residential	B	66.8	60.0	-6.8	1	1						
	10-8	Residential	B	67.1	60.0	-7.1	1	1						
	10-9	Residential	B	66.8	60.1	-6.7	1	1						
	10-10	Residential	B	66.9	59.8	-7.1	1	1						
	10-11	Residential	B	68.3	60.8	-7.5	1	1						
	10-12	Residential	B	65.7	59.8	-5.9	1	1						
	10-13	Residential	B	68.9	62.8	-6.1	1	1						
	10-14	Residential	B	59.0	55.3	-3.7	1	0						
	10-15	Residential	B	57.3	54.1	-3.2	1	0						
	10-16	Residential	B	57.5	54.9	-2.6	1	0						
	10-17	Residential	B	57.5	55.0	-2.5	1	0						
	10-18	Residential	B	57.4	55.0	-2.4	1	0						
	10-19	Residential	B	57.4	54.9	-2.5	1	0						
	10-20	Residential	B	57.5	54.8	-2.7	1	0						
	10-21	Residential	B	57.5	54.8	-2.7	1	0						
	10-22	Residential	B	57.5	54.9	-2.6	1	0						
	10-23	Residential	B	59.1	55.9	-3.2	1	0						
	10-24	Residential	B	57.7	54.4	-3.3	1	0						
	10-25	Residential	B	62.6	59.4	-3.2	1	0						
	10-26	Residential	B	58.9	56.5	-2.4	1	0						
	10-27	Residential	B	57.4	54.9	-2.5	1	0						
	10-28	Residential	B	64.0	60.1	-3.9	1	0						
	10-29	Residential	B	61.3	57.3	-4.0	1	0						
	10-30	Residential	B	58.4	55.0	-3.4	1	0						
	10-31	Residential	B	57.1	53.7	-3.4	1	0						
		Number of Benefited Receptors (Front Row) =						13	(100%)					
		Total Number of Benefited Receptors =						13						
		Number of Receptors meeting Design Goal (7 dBA Reduction) =						5	(38%)					

Table B6
Build Noise Barrier Cost Effectiveness (Noise Area 11)
Noise Barrier 11-1

Noise Barrier	Receiver	Land Use	FHWA Noise Standard (Leq dBA)	Future Noise Levels		Acoustic Effectiveness			Cost Effectiveness ($44/SF)					NOISE WALL RESULTS
				Build (Leq dBA)	Build with Barriers (Leq dBA)	dBA Reduction	Number of Receptors	Benefited Receptors (-5 dBA)	Barrier Length (ft)	Average Barrier Height (ft)	Area of Barrier (SF)	Total Cost	Cost per Benefited Receptor	
B11-1	11-1	Residential	67	69.5	64.4	-5.1	1	1	745	6.4	4746	$208,809	$34,801	NO
	11-2	Residential	67	69.5	63.6	-5.9	1	1						
	11-3	Residential	67	69.5	61.8	-7.7	1	1						
	11-4	Residential	67	69.5	62.5	-7.0	1	1						
	11-5	Residential	67	62.6	60.0	-2.6	1	0						
	11-6	Residential	67	63.8	59.5	-4.3	1	0						
	11-7	Residential	67	65.9	59.7	-6.2	1	1						
	11-8	Residential	67	65.4	58.4	-7.0	1	1						
	11-9	Residential	67	64.4	62.0	-2.4	1	0						
	11-10	Residential	67	58.7	56.9	-1.8	1	0						
	11-11	Residential	67	58.8	56.7	-2.1	1	0						
	11-12	Residential	67	58.3	55.3	-3.0	1	0						
	11-13	Residential	67	57.9	55.1	-2.8	1	0						
	11-14	Residential	67	56.1	54.1	-2.0	1	0						
	11-15	Residential	67	60.7	60.0	-0.7	1	0						
	11-16	Residential	67	59.1	58.6	-0.5	1	0						
	11-17	Residential	67	57.1	55.6	-1.5	1	0						
	11-18	Residential	67	57.1	55.2	-1.9	1	0						
	11-19	Residential	67	56.4	54.1	-2.3	1	0						
	11-20	Residential	67	56.0	53.8	-2.2	1	0						
	11-21	Residential	67	56.8	56.1	-0.7	1	0						
	11-22	Residential	67	57.9	57.5	-0.4	1	0						

Number of Benefited Receptors (Front Row) =	4	(100%)
Total Number of Benefited Receptors =	6	
Number of Receptors meeting Design Goal (7 dBA Reduction) =	3	(50%)

Table B7
Build Noise Barrier Cost Effectiveness (Noise Area 11)
Noise Barrier 11-1 Alt 2

Noise Barrier	Receiver	Land Use	FHWA Noise Standard (Leq dBA)	Future Noise Levels		Acoustic Effectiveness			Cost Effectiveness ($44/SF)					NOISE WALL RESULTS
				Build (Leq dBA)	Build with Barriers (Leq dBA)	dBA Reduction	Number of Receptors	Benefited Receptors (-5 dBA)	Barrier Length (ft)	Average Barrier Height (ft)	Area of Barrier (SF)	Total Cost	Cost per Benefited Receptor	
B11-1	11-1	Residential	67	69.5	64.4	-5.1	1	1	745	5.7	4224	$185,863	$30,977	NO
	11-2	Residential	67	69.5	64.3	-5.2	1	1						
	11-3	Residential	67	69.5	62.5	-7.0	1	1						
	11-4	Residential	67	69.5	63.6	-5.9	1	1						
	11-5	Residential	67	62.6	60.1	-2.5	1	0						
	11-6	Residential	67	63.8	59.7	-4.1	1	0						
	11-7	Residential	67	65.9	60.7	-5.2	1	1						
	11-8	Residential	67	65.4	59.0	-6.4	1	1						
	11-9	Residential	67	64.4	62.2	-2.2	1	0						
	11-10	Residential	67	58.7	57.0	-1.7	1	0						
	11-11	Residential	67	58.8	56.8	-2.0	1	0						
	11-12	Residential	67	58.3	55.6	-2.7	1	0						
	11-13	Residential	67	57.9	55.4	-2.5	1	0						
	11-14	Residential	67	56.1	54.4	-1.7	1	0						
	11-15	Residential	67	60.7	60.1	-0.6	1	0						
	11-16	Residential	67	59.1	58.6	-0.5	1	0						
	11-17	Residential	67	57.1	55.6	-1.5	1	0						
	11-18	Residential	67	57.1	55.3	-1.8	1	0						
	11-19	Residential	67	56.4	54.3	-2.1	1	0						
	11-20	Residential	67	56.0	54.1	-1.9	1	0						
	11-21	Residential	67	56.8	56.1	-0.7	1	0						
	11-22	Residential	67	57.9	57.5	-0.4	1	0						

Number of Benefited Receptors (Front Row) = 3 (75%)
Total Number of Benefited Receptors = 6
Number of Receptors meeting Design Goal (7 dBA Reduction) = 1 (17%)

Table B8
Build Noise Barrier Cost Effectiveness (Noise Area 12)
Noise Barrier 12-1

Noise Barrier	Receiver	Land Use	FHWA Noise Standard (Leq dBA)	Future Noise Levels		Acoustic Effectiveness			Cost Effectiveness ($44/SF)					NOISE WALL RESULTS
				Build (Leq dBA)	Build with Barriers (Leq dBA)	dBA Reduction	Number of Receptors	Benefited Receptors (-5 dBA)	Barrier Length (ft)	Average Barrier Height (ft)	Area of Barrier (SF)	Total Cost	Cost per Benefited Receptor	
B12-1	12-1	Residential	67	69.6	61.0	-8.6	3	3	650	6	3900	$171,600	$11,440	YES *
	12-2	Residential	67	69.8	60.6	-9.2	2	2						
	12-3	Residential	67	69.8	61.0	-8.8	2	2						
	12-4	Residential	67	70.0	61.4	-8.6	2	2						
	12-5	Residential	67	70.6	62.4	-8.2	2	2						
	12-6	Residential	67	70.7	63.3	-7.4	3	3						
	12-7	Residential	67	70.0	63.4	-6.6	1	1						
	12-8	Residential	67	57.6	57.5	-0.1	3	0						
	12-9	Residential	67	54.2	54.0	-0.2	2	0						
	12-10	Residential	67	57.7	53.7	-4.0	2	0						
	12-11	Residential	67	55.1	51.6	-3.5	2	0						
	12-12	Residential	67	49.0	49.0	0.0	2	0						
	12-13	Residential	67	55.9	51.1	-4.8	3	0						
	12-14	Residential	67	63.5	62.4	-1.1	1	0						
	12-15	Residential	67	60.1	59.4	-0.7	2	0						
	12-16	Residential	67	48.7	48.7	0.0	3	0						
	12-17	Residential	67	44.0	44.0	0.0	2	0						
	12-18	Residential	67	43.2	43.3	0.1	2	0						
	12-19	Residential	67	42.2	42.2	0.0	2	0						
	12-20	Residential	67	42.0	42.1	0.1	2	0						
	12-21	Residential	67	47.0	47.0	0.0	3	0						
	12-22	Residential	67	56.2	55.7	-0.5	2	0						
	12-23	Residential	67	52.8	52.8	0.0	2	0						
	12-24	Residential	67	48.7	48.8	0.1	3	0						
	12-25	Residential	67	47.8	47.8	0.0	2	0						
	12-26	Residential	67	48.1	48.1	0.0	2	0						
	12-27	Residential	67	49.4	49.5	0.1	3	0						
	12-28	Residential	67	55.5	55.2	-0.3	1	0						
	12-29	Residential	67	54.5	54.2	-0.3	2	0						

Number of Benefited Receptors (Front Row) =	15	(100%)
Total Number of Benefited Receptors =	15	
Number of Receptors meeting Design Goal (7 dBA Reduction) =	14	(93%)

* Barrier is not feasible to construct due to Lewis & Clark Water utility, which cannot be impacted or relocated.

Table B9
Build Noise Barrier Cost Effectiveness (Noise Area 13)
Noise Barrier 13-1

Noise Barrier	Receiver	Land Use	FHWA Noise Standard (Leq dBA)	Future Noise Levels		Acoustic Effectiveness			Cost Effectiveness ($44/SF)					NOISE WALL RESULTS
				Build (Leq dBA)	Build with Barriers (Leq dBA)	dBA Reduction	Number of Receptors	Benefited Receptors (-5 dBA)	Barrier Length (ft)	Average Barrier Height (ft)	Area of Barrier (SF)	Total Cost	Cost per Benefited Receptor	
B13-1	13-1	Residential	67	68.9	61.9	-7.0	1	1	205	9.2	1890.1	$83,164	$83,164	NO
	13-5	Residential	67	59.7	58.0	-1.7	1	0						

Number of Benefited Receptors (Front Row) = 1 (100%)

Total Number of Benefited Receptors = 1

Number of Receptors meeting Design Goal (7 dBA Reduction) = 1 (100%)

Table B10
Build Noise Barrier Cost Effectiveness (Noise Area 13)
Noise Barrier 13-2

Noise Barrier	Receiver	Land Use	FHWA Noise Standard (Leq dBA)	Future Noise Levels		Acoustic Effectiveness			Cost Effectiveness ($44/SF)					NOISE WALL RESULTS
				Build (Leq dBA)	Build with Barriers (Leq dBA)	dBA Reduction	Number of Receptors	Benefited Receptors (-5 dBA)	Barrier Length (ft)	Average Barrier Height (ft)	Area of Barrier (SF)	Total Cost	Cost per Benefited Receptor	
B13-2	13-2	Residential	67	64.3	59.0	-5.3	1	1	505	18.0	9090	$399,960	$99,990	NO
	13-3	Residential	67	70.3	63.7	-6.6	1	1						
	13-6	Residential	67	59.1	56.3	-2.8	1	0						
	13-7	Residential	67	64.1	58.3	-5.8	1	1						
	13-8	Residential	67	60.7	55.7	-5.0	1	1						
	13-9	Residential	67	58.4	54.0	-4.4	1	0						

Number of Benefited Receptors (Front Row) = 2 (100%)

Total Number of Benefited Receptors = 4

Number of Receptors meeting Design Goal (7 dBA Reduction) = 0 (0%)

Table B11
Build Noise Barrier Cost Effectiveness (Noise Area 14)
Noise Barrier 14-1

Noise Barrier	Receiver	Land Use	FHWA Noise Standard (Leq dBA)	Future Noise Levels		Acoustic Effectiveness			Cost Effectiveness ($44/SF)					NOISE WALL RESULTS
				Build (Leq dBA)	Build with Barriers (Leq dBA)	dBA Reduction	Number of Receptors	Benefited Receptors (-5 dBA)	Barrier Length (ft)	Average Barrier Height (ft)	Area of Barrier (SF)	Total Cost	Cost per Benefited Receptor	
B14-1	14-1	Residential	67	69.6	63.8	-5.8	1	1	445	8.5	3760	$165,451	$41,363	NO
	14-2	Residential	67	67.4	60.9	-6.5	1	1						
	14-3	Residential	67	68.6	61.1	-7.5	1	1						
	14-4	Residential	67	67.6	60.6	-7.0	1	1						
	14-9	Residential	67	60.4	57.8	-2.6	1	0						
	14-10	Residential	67	58.3	55.5	-2.8	1	0						
	14-15	Residential	67	60.1	57.3	-2.8	1	0						
	14-16	Residential	67	57.2	54.5	-2.7	1	0						
	14-17	Residential	67	58.3	57.4	-0.9	1	0						
	14-18	Residential	67	57.4	55.7	-1.7	1	0						
	14-19	Residential	67	56.2	53.9	-2.3	1	0						
	14-20	Residential	67	56.0	53.3	-2.7	1	0						

Number of Benefited Receptors (Front Row) =	4	(100%)
Total Number of Benefited Receptors =	4	
Number of Receptors meeting Design Goal (7 dBA Reduction) =	2	(50%)

Table B12
Build Noise Barrier Cost Effectiveness (Noise Area 15)
Noise Barrier 15-1

Noise Barrier	Receiver	Land Use	FHWA Noise Standard (Leq dBA)	Future Noise Levels		Acoustic Effectiveness			Cost Effectiveness ($44/SF)					NOISE WALL RESULTS
				Build (Leq dBA)	Build with Barriers (Leq dBA)	dBA Reduction	Number of Receptors	Benefited Receptors (-5 dBA)	Barrier Length (ft)	Average Barrier Height (ft)	Area of Barrier (SF)	Total Cost	Cost per Benefited Receptor	
B15-1	15-1	School	67	70.3	66.7	-3.6	1	0	320	20	6400	$281,600	N/A*	NO
	15-2	School	67	64.0	62.6	-1.4	1	0						
	15-3	School	67	64.7	63	-1.7	1	0						
	15-4	School	67	64.9	64.3	-0.6	1	0						

Number of Benefited Receptors (Front Row) =	0	(100%)
Total Number of Benefited Receptors =	0	
Number of Receptors meeting Design Goal (7 dBA Reduction) =	0	(0%)

*Design Goal and Acoustic Feasibility was not achieved since there are no Benefited Receptors

Appendix C

Future Build and Barrier Results Figure (1-6)

SEH

401 East 8th Street
Suite 309
Sioux Falls, SD 57103
(605) 330-7000

Print Date: 1/2/2020
Source: Bing Maps,
Lincoln County

Map by: mfalk
Projection: State Plane
South Dakota S

Noise Analysis Future Build Results and Barrier Locations: NSA's 1, 2 and 6

I-29 and 85th Street Interchange
Lincoln County, SD

Feet
0 175 350 525 700

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SEH

401 East 8th Street
Suite 309
Sioux Falls, SD 57103
(605) 330-7000

Print Date: 1/22/2020
Source: Bing Maps,
Lincoln County

Map by: mfalk
Projection: State Plane
South Dakota S

Noise Analysis Future Build Results and Barrier Locations: NSA's 3 and 4

I-29 and 85th Street Interchange
Lincoln County, SD

0 175 350 525 700 Feet

SEH

401 East 8th Street
Suite 309
Sioux Falls, SD 57103
(605) 330-7000

Print Date: 1/22/2020
Source: Bing Maps,
Lincoln County

Map by: mfalk
Projection: State Plane
South Dakota S

Noise Analysis Future Build Results and Barrier Locations: NSA 5

I-29 and 85th Street Interchange
Lincoln County, SD

0 175 350 525 700 Feet

SEH

401 East 8th Street
Suite 309
Sioux Falls, SD 57103
(605) 330-7000

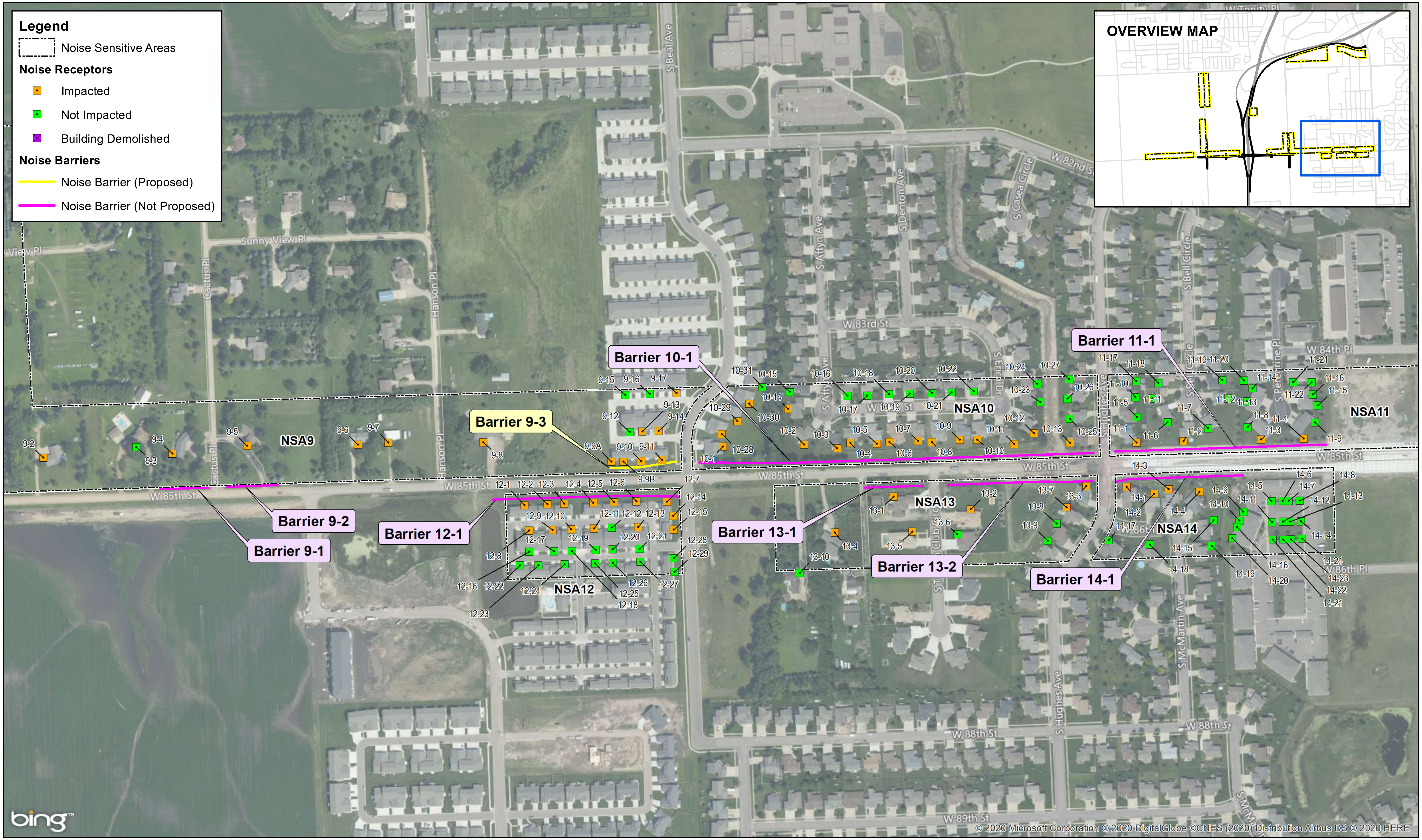
Print Date: 1/22/2020
Source: Bing Maps, Lincoln County

Map by: mfalk
Projection: State Plane South Dakota S

Noise Analysis Future Build Results and Barrier Locations: NSA's 7 and 8

I-29 and 85th Street Interchange
Lincoln County, SD

Feet
0 175 350 525 700



SEH

401 East 8th Street
Suite 309
Sioux Falls, SD 57103
(605) 330-7000

Print Date: 5/26/2020
Source: Bing Maps, Lincoln County

Map by: mfalk
Projection: State Plane South Dakota S

Noise Analysis Future Build Results and Barrier Locations: Barrier Analysis Results - NSA's 9-14

I-29 and 85th Street Interchange
Lincoln County, SD

Feet
0 150 300 450 600

SEH

401 East 8th Street
Suite 309
Sioux Falls, SD 57103
(605) 330-7000

Print Date: 1/22/2020
Source: Bing Maps,
Lincoln County

Map by: mfalk
Projection: State Plane
South Dakota S

Noise Analysis Future Build Results and Barrier Locations: Barrier Analysis Results - NSA 15

I-29 and 85th Street Interchange
Lincoln County, SD

Feet
0 100 200 300 400

Appendix D

Noise Monitoring Data

Summary

File Name on Meter	831_Data.007
File Name on PC	SLM_0004132_831_Data_007.00.ldbin
Serial Number	0004132
Model	Model 831
Firmware Version	2.314
User	Justin Anibas
Location	
Job Description	85th Street Interchange Project
Note	

Monitor Location 1:
North of 69th St, East of Sundowner Ave
Coords:
43° 29' 24.5"N 096° 48' 18.7"W
Traffic (Cars/MT/HT estimated hourly from short count):
EB - 4 / 0 / 0
WB - 4 / 0 / 0

Measurement

Description	
Start	2019-07-02 10:10:02
Stop	2019-07-02 10:40:04
Duration	00:30:02.5
Run Time	00:30:02.5
Pause	00:00:00.0
Pre Calibration	2019-07-02 10:06:44
Post Calibration	None
Calibration Deviation	---

Overall Settings

RMS Weight	A Weighting		
Peak Weight	A Weighting		
Detector	Fast		
Preamp	PRM831		
Microphone Correction	Off		
Integration Method	Linear		
Gain	0.0 dB		
Overload	145.2 dB		
	A	**C**	**Z**
Under Range Peak	**77.8**	74.8	79.8 dB
Under Range Limit	**27.0**	27.6	33.8 dB
Noise Floor	17.8	18.4	24.1 dB

Results

LAeq	53.9	
LAE	86.5	
EA	49.152 µPa²h	
LApeak (max)	2019-07-02 10:34:22	96.7 dB
LAFmax	2019-07-02 10:34:23	83.6 dB
LAFmin	2019-07-02 10:37:38	37.6 dB
SEA	-99.9 dB	
LAF > 65.0 dB (Exceedance Counts / Duration)	7	21.1 s
LAF > 85.0 dB (Exceedance Counts / Duration)	0	0.0 s
LApeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0 s
LApeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0 s
LApeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0 s

Community Noise	**Ldn**	**LDay 07:00-23:00**	**LNight 23:00-07:00**	**Lden**	**LDay 07:00-19:00**	**LEvening 19:00-23:00**	**LNight 23:00-07:00**
	53.9	53.9	-99.9	53.9	53.9	-99.9	-99.9

LCeq	63.5 dB
LAeq	53.9 dB
LCeq - LAeq	9.6 dB
LAIeq	57.0 dB
LAeq	53.9 dB
LAIeq - LAeq	3.1 dB

	A		**C**		**Z**	
	dB	**Time Stamp**	**dB**	**Time Stamp**	**dB**	**Time Stamp**
Leq	53.9		63.5		67.5	
LS(max)	80.9	2019/07/02 10:34:23	88.6	2019/07/02 10:34:23	89.7	2019/07/02 10:34:23
LF(max)	83.6	2019/07/02 10:34:23	91.4	2019/07/02 10:34:23	92.7	2019/07/02 10:34:23
LI(max)	84.4	2019/07/02 10:34:23	92.6	2019/07/02 10:34:23	94.0	2019/07/02 10:34:23
LS(min)	39.0	2019/07/02 10:31:45	52.6	2019/07/02 10:32:47	55.4	2019/07/02 10:23:20
LF(min)	37.6	2019/07/02 10:37:38	50.5	2019/07/02 10:32:46	53.7	2019/07/02 10:19:08
LI(min)	38.5	2019/07/02 10:32:23	53.3	2019/07/02 10:32:44	56.2	2019/07/02 10:23:18
LPeak(max)	96.7	2019/07/02 10:34:22	101.1	2019/07/02 10:34:23	102.5	2019/07/02 10:34:23

# Overloads	0
Overload Duration	0.0 s

Statistics

LAI5.00	54.4 dB
LAI10.00	51.7 dB
LAI33.30	45.4 dB
LAI50.00	43.8 dB
LAI66.60	42.9 dB
LAI90.00	41.0 dB

Calibration History

Preamp	**Date**	**dB re. 1V/Pa**	**6.3**	**8.0**	**10.0**	**12.5**
PRM831	2019-07-02 10:06:39	-27.8	46.5	45.9	42.4	44.4
PRM831	2019-07-02 09:03:47	-27.8	58.2	64.9	63.3	60.1
PRM831	2019-06-13 09:39:04	-27.8	66.9	69.7	55.0	61.1
PRM831	2019-06-06 09:54:09	-27.8	54.5	56.4	64.1	69.3
PRM831	2019-06-06 09:53:46	-27.8	50.2	48.1	52.6	50.2
PRM831	2019-06-05 19:18:32	-27.7	58.2	56.4	51.0	60.3
PRM831	2019-06-05 19:13:22	-27.7	53.0	55.2	54.7	52.1
PRM831	2019-06-05 11:53:15	-27.9	63.3	57.9	60.0	58.9
PRM831	2019-04-18 13:26:43	-27.8	60.1	51.2	50.0	64.6
PRM831	2019-03-22 11:28:03	-27.6				
PRM831	2019-03-22 11:01:16	-26.0	27.7	50.3	137.6	72.3

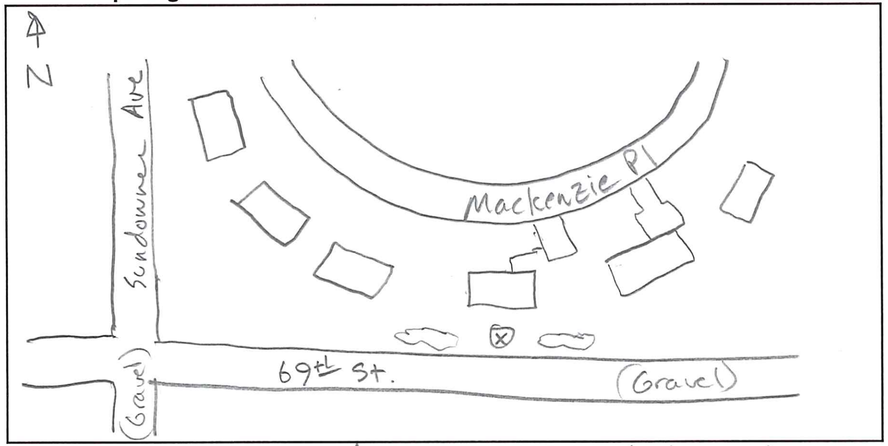
I-29 / 85th St (noise monitoring)

Date: 7-2-19
Location: #1 - (east of Sundowner; nort of 69th)
GPS Coordinates: 43.49014° (N) 96.80519 (w)
Start time: 10:10am
Finish time: 10:40am
831_Data.007

Photos Taken: [✓ Yes]/No
Calibration of Unit: [✓ Yes]/No
Weather: 76°
partly cloudy
wind 5-6mph (N)

	Vehicle Count		**Total**
passenger car	wb	II	2
	eb	II	2
single-unit truck			
bus			
semi truck / heavy truck			
	Total		4

Site Set-up Diagram



Noise Comments

- AC units running in houses north of setup during monitoring
- 10:10am - water truck on Sundowner (backup beeper)
- 10:15am - " "
- 10:17 am - " "
- 10:31 am - airplane

* talked to homeowner and she had no issue with setting up in her backyard.

Site M1: 69th Street, east of Sundowner Avenue
Camera Facing South (07/02/2019)

Summary

File Name on Meter	831_Data.008
File Name on PC	SLM_0004132_831_Data_008.00.ldbin
Serial Number	0004132
Model	Model 831
Firmware Version	2.314
User	Justin Anibas
Location	
Job Description	85th Street Interchange Project
Note	

Monitor Location 2:
East end of 85th St near I-29 Southbound
Coords:
43° 28' 31.7"N 096° 47' 51.4"W
Traffic (Cars/MT/HT estimated hourly from short count):
NB - 1276 / 32 / 184
SB - 1046 / 28 / 154

Measurement

Description	
Start	2019-07-02 11:02:27
Stop	2019-07-02 11:32:58
Duration	00:30:31.0
Run Time	00:30:31.0
Pause	00:00:00.0
Pre Calibration	2019-07-02 10:55:46
Post Calibration	None
Calibration Deviation	---

Overall Settings

RMS Weight	A Weighting		
Peak Weight	A Weighting		
Detector	Fast		
Preamp	PRM831		
Microphone Correction	Off		
Integration Method	Linear		
Gain	0.0 dB		
Overload	145.1 dB		
	A	**C**	**Z**
Under Range Peak	**77.7**	74.7	79.7 dB
Under Range Limit	**27.0**	27.5	33.7 dB
Noise Floor	17.8	18.4	24.0 dB

Results

LAeq	64.6	
LAE	97.2	
EA	582.407 µPa²h	
LApeak (max)	2019-07-02 11:31:26	92.9 dB
LAFmax	2019-07-02 11:11:19	77.7 dB
LAFmin	2019-07-02 11:19:15	48.6 dB
SEA	-99.9 dB	
LAF > 65.0 dB (Exceedance Counts / Duration)	100	624.7 s
LAF > 85.0 dB (Exceedance Counts / Duration)	0	0.0 s
LApeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0 s
LApeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0 s
LApeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0 s

Community Noise	**Ldn**	**LDay 07:00-23:00**	**LNight 23:00-07:00**	**Lden**	**LDay 07:00-19:00**	**LEvening 19:00-23:00**
	64.6	64.6	-99.9	64.6	64.6	-99.9

LCeq	75.0 dB
LAeq	64.6 dB
LCeq - LAeq	10.4 dB
LAIeq	65.8 dB
LAeq	64.6 dB
LAIeq - LAeq	1.2 dB

	A		**C**		**Z**	
	dB	**Time Stamp**	**dB**	**Time Stamp**	**dB**	**Time Stamp**
Leq	64.6		75.0		76.5	
LS(max)	75.7	2019/07/02 11:31:27	90.0	2019/07/02 11:10:06	90.4	2019/07/02 11:10:06
LF(max)	77.7	2019/07/02 11:11:19	90.9	2019/07/02 11:10:06	91.3	2019/07/02 11:10:06
LI(max)	78.5	2019/07/02 11:11:19	91.4	2019/07/02 11:10:06	91.8	2019/07/02 11:10:06
LS(min)	50.3	2019/07/02 11:19:15	61.9	2019/07/02 11:19:17	65.9	2019/07/02 11:21:10
LF(min)	48.6	2019/07/02 11:19:15	60.4	2019/07/02 11:19:12	63.7	2019/07/02 11:19:20
LI(min)	49.3	2019/07/02 11:19:15	62.6	2019/07/02 11:19:14	66.7	2019/07/02 11:21:09
LPeak(max)	92.9	2019/07/02 11:31:26	98.5	2019/07/02 11:31:27	97.6	2019/07/02 11:31:27

# Overloads	0
Overload Duration	0.0 s

Statistics

LAI5.00	69.7 dB
LAI10.00	67.9 dB
LAI33.30	64.1 dB
LAI50.00	62.2 dB
LAI66.60	60.7 dB
LAI90.00	57.7 dB

Calibration History

Preamp	**Date**	**dB re. 1V/Pa**	**6.3**	**8.0**	**10.0**
PRM831	2019-07-02 10:55:36	-27.7	68.6	64.6	51.9
PRM831	2019-07-02 10:06:39	-27.8	46.5	45.9	42.4
PRM831	2019-07-02 09:03:47	-27.8	58.2	64.9	63.3
PRM831	2019-06-13 09:39:04	-27.8	66.9	69.7	55.0
PRM831	2019-06-06 09:54:09	-27.8	54.5	56.4	64.1
PRM831	2019-06-06 09:53:46	-27.8	50.2	48.1	52.6
PRM831	2019-06-05 19:18:32	-27.7	58.2	56.4	51.0
PRM831	2019-06-05 19:13:22	-27.7	53.0	55.2	54.7
PRM831	2019-06-05 11:53:15	-27.9	63.3	57.9	60.0
PRM831	2019-04-18 13:26:43	-27.8	60.1	51.2	50.0
PRM831	2019-03-22 11:28:03	-27.6			

1/6

I-29 / 85th St (noise monitoring)

Date: July 2, 2019
Location: #2 - 85th St (east end)
GPS Coordinates: 43.47546° - 96.79760°
Start time: 11:02 am
Finish time: 11:32 am
831_Data.008

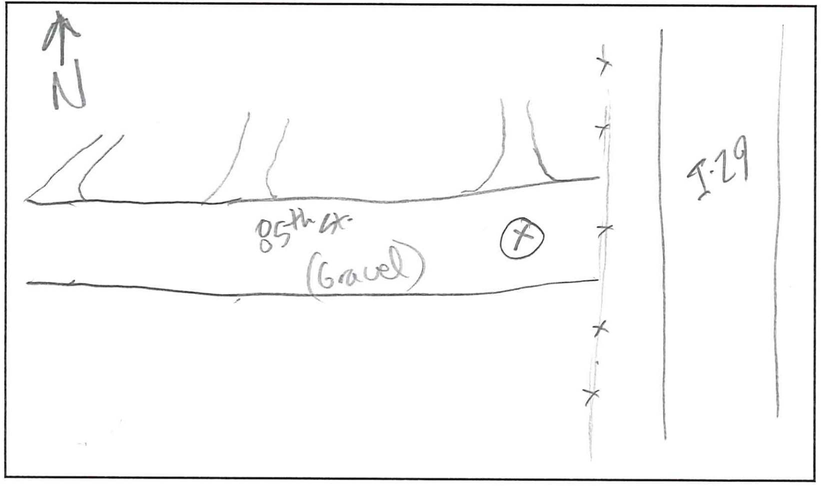
Photos Taken: [✓ Yes]/No
Calibration of Unit: [✓ Yes]/No

79°
partly cloudy
wind 6-7mph (N)

Vehicle Count

			Total
passenger car	NB	20 55 70 121	141
	SB	60 80	106
single-unit truck	NB	|||	3
	SB	||||	4
bus	NB	|	1
	SB		-
semi truck / heavy truck	NB	㉑	21
	SB	⑭	14
Total			

Site Set-up Diagram



Noise Comments

\\sp3020-1\Projects\KO\O\OWNJV\149418\9-survey\Noise Monitoring\field vehicle count sheet

2/6

I-29 / 85th St (noise monitoring)

Date: ______________________

Location: ______________________

GPS Coordinates: ______________________

Start time: ______________________

Finish time: ______________________

Photos Taken: Yes/No

Calibration of Unit: Yes/No

Vehicle Count ⑪ 100 104

			Total
passenger car	NB		115
	SB		93
single-unit truck	NB		3
	SB		3
bus	NB		—
	SB		–
semi truck / heavy truck	NB		15
	SB		22
Total			

Site Set-up Diagram

Noise Comments

\\sp3020-1\Projects\KO\O\OWNJV\149418\9-survey\Noise Monitoring\field vehicle count sheet

3/6

I-29 / 85th St (noise monitoring)

Date: ______________________

Location: ______________________

GPS Coordinates: ______________________

Start time: ______________________

Finish time: ______________________

Photos Taken: Yes/No

Calibration of Unit: Yes/No

Vehicle Count

Vehicle Count			Total
passenger car	NB	(16) (99)	115
	SB	(98)	98
single-unit truck	NB		2
	SB		2
bus	NB		—
	SB		—
semi truck / heavy truck	NB		12
	SB		11
Total			

Site Set-up Diagram

Noise Comments

\\sp3020-1\Projects\KO\O\OWNJV\149418\9-survey\Noise Monitoring\field vehicle count sheet

4/6

I-29 / 85th St (noise monitoring)

Date: ____________

Location: ____________

GPS Coordinates: ____________

Start time: ____________

Finish time: ____________

Photos Taken: Yes/No

Calibration of Unit: Yes/No

Vehicle Count

⑨ (93)

Vehicle Count			Total
passenger car	NB		102
	SB		92
single-unit truck	NB		7
	SB		2
bus	NB		1
	SB		—
semi truck / heavy truck	NB		15
	SB		13
Total			

Site Set-up Diagram

Noise Comments

\\\\sp3020-1\Projects\KO\O\OWNJV\149418\9-survey\Noise Monitoring\field vehicle count sheet

5/6

I-29 / 85th St (noise monitoring)

Date: ____________________
Location: ____________________
GPS Coordinates: ____________________
Start time: ____________________
Finish time: ____________________

Photos Taken: Yes/No
Calibration of Unit: Yes/No

Vehicle Count			**Total**
passenger car	NB	⑮ ㊴	104
	SB		83
single-unit truck	NB		1
	SB		2
bus	NB		2
	SB		—
semi truck / heavy truck	NB		22
	SB		10
Total			

Site Set-up Diagram

Noise Comments

\\sp3020-1\Projects\KO\O\OWNJV\149418\9-survey\Noise Monitoring\field vehicle count sheet

831_Data,008

6/6

I-29 / 85th St (noise monitoring)

Date:
Location:
GPS Coordinates:
Start time:
Finish time:

Photos Taken: Yes/No
Calibration of Unit: Yes/No

Vehicle Count

Vehicle Count			Total
passenger car	NB		61
	SB		51
single-unit truck	NB		–
	SB		1
bus	NB		–
	SB		–
semi truck / heavy truck	NB		7
	SB		7
Total			

Site Set-up Diagram

Noise Comments

Site M2: 270th Street, west of I-29 SB
Camera Facing East (07/02/2019)

Summary

File Name on Meter	831_Data.009
File Name on PC	SLM_0004132_831_Data_009.00.ldbin
Serial Number	0004132
Model	Model 831
Firmware Version	2.314
User	Justin Anibas
Location	
Job Description	85th Street Interchange Project
Note	

Monitor Location 3:
NW Quadrant of 85th St and Tallgrass Ave Intersection
Coords:
43° 28' 32.3"N 096° 47' 15.8"W
Traffic (Cars/MT/HT estimated hourly from short count):
NB - 23 / 0 / 0
SB - 33 / 0 / 0
EB - 12 / 0 / 0
WB - 0 / 0 / 4

Measurement

Description	
Start	2019-07-02 12:04:48
Stop	2019-07-02 12:34:49
Duration	00:30:01.0
Run Time	00:27:52.6
Pause	00:02:08.4
Pre Calibration	2019-07-02 12:02:59
Post Calibration	None
Calibration Deviation	---

Overall Settings

RMS Weight	A Weighting		
Peak Weight	A Weighting		
Detector	Fast		
Preamp	PRM831		
Microphone Correction	Off		
Integration Method	Linear		
Gain	0.0 dB		
Overload	145.1 dB		
	A	**C**	**Z**
Under Range Peak	**77.7**	74.7	79.7 dB
Under Range Limit	**26.9**	27.5	33.7 dB
Noise Floor	17.8	18.4	24.0 dB

Results

LAeq	53.1	
LAE	85.4	
EA	38.178 µPa²h	
LApeak (max)	2019-07-02 12:27:28	84.3 dB
LAFmax	2019-07-02 12:27:10	70.0 dB
LAFmin	2019-07-02 12:14:43	37.4 dB
SEA	-99.9 dB	
LAF > 65.0 dB (Exceedance Counts / Duration)	10	16.3 s
LAF > 85.0 dB (Exceedance Counts / Duration)	0	0.0 s
LApeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0 s
LApeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0 s
LApeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0 s

Community Noise	**Ldn**	**LDay 07:00-23:00**	**LNight 23:00-07:00**	**Lden**	**LDay 07:00-19:00**	**LEvening 19:00-23:00**
	53.1	53.1	-99.9	53.1	53.1	-99.9

LCeq	65.6 dB
LAeq	53.1 dB
LCeq - LAeq	12.4 dB
LAIeq	55.1 dB
LAeq	53.1 dB
LAIeq - LAeq	2.0 dB

	A		**C**		**Z**	
	dB	**Time Stamp**	**dB**	**Time Stamp**	**dB**	**Time Stamp**
Leq	53.1		65.6		67.2	
LS(max)	68.0	2019/07/02 12:20:29	80.6	2019/07/02 12:20:32	81.1	2019/07/02 12:20:32
LF(max)	70.0	2019/07/02 12:27:10	83.0	2019/07/02 12:20:32	83.5	2019/07/02 12:20:32
LI(max)	74.0	2019/07/02 12:27:10	83.6	2019/07/02 12:20:32	84.2	2019/07/02 12:20:32
LS(min)	38.7	2019/07/02 12:14:49	54.8	2019/07/02 12:05:43	58.4	2019/07/02 12:14:46
LF(min)	37.4	2019/07/02 12:14:43	52.3	2019/07/02 12:08:23	55.7	2019/07/02 12:14:42
LI(min)	38.7	2019/07/02 12:14:49	55.9	2019/07/02 12:06:21	59.6	2019/07/02 12:10:58
LPeak(max)	84.3	2019/07/02 12:27:28	90.0	2019/07/02 12:20:28	90.5	2019/07/02 12:20:28

# Overloads	0
Overload Duration	0.0 s

Statistics

LAI5.00	57.7 dB
LAI10.00	56.5 dB
LAI33.30	52.1 dB
LAI50.00	47.9 dB
LAI66.60	44.4 dB
LAI90.00	41.1 dB

Calibration History

Preamp	**Date**	**dB re. 1V/Pa**	**6.3**	**8.0**	**10.0**
PRM831	2019-07-02 12:02:56	-27.7	51.2	46.5	47.5
PRM831	2019-07-02 10:55:36	-27.7	68.6	64.6	51.9
PRM831	2019-07-02 10:06:39	-27.8	46.5	45.9	42.4
PRM831	2019-07-02 09:03:47	-27.8	58.2	64.9	63.3
PRM831	2019-06-13 09:39:04	-27.8	66.9	69.7	55.0
PRM831	2019-06-06 09:54:09	-27.8	54.5	56.4	64.1
PRM831	2019-06-06 09:53:46	-27.8	50.2	48.1	52.6
PRM831	2019-06-05 19:18:32	-27.7	58.2	56.4	51.0
PRM831	2019-06-05 19:13:22	-27.7	53.0	55.2	54.7
PRM831	2019-06-05 11:53:15	-27.9	63.3	57.9	60.0
PRM831	2019-04-18 13:26:43	-27.8	60.1	51.2	50.0

I-29 / 85th St (noise monitoring)

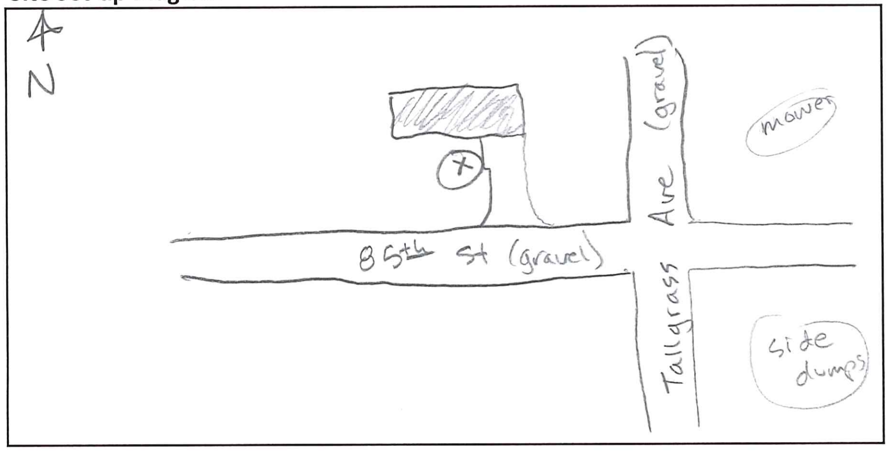
Date: July 2, 2019
Location: #3 – 85th St. (just west of Tallgrass)
GPS Coordinates: 43.47564 (N) 96.78773 (W)
Start time: 12:04pm
Finish time: 12:34pm
831_Data.009

Photos Taken: [✓ Yes]/No
Calibration of Unit: [✓ Yes]/No
Weather: 81°
partly cloudy
wind 2-5mph (N)

	Vehicle Count		**Total**
passenger car	N –	卌 I	6
	S –	卌 卌 I	11
	W → N/S –	卌 卌 I	11
	S → E –	I	1
	N → E –	卌	5
single-unit truck			
bus			
semi truck / heavy truck	side dumps	II	2
Total			

counts @ 85th / Tallgrass Ave intersection

Site Set-up Diagram



Noise Comments

+3:00 – paused to talk to homeowner
+12:15 – paused to talk to guy driving by looking for Minnesota Ave
+15:35 – airplane flew over
+18:09 – side dump unloaded dirt (SE corner of 85th/Tallgrass)
+21:25 – mower started @ NE corner of 85th/Tallgrass) (ran until end of recording)
+22:00 – side dump unloaded dirt (same location)
+28:25 – airplane flew over

Site M3: 85th Street, east of Tallgrass Avenue
Camera Facing South (07/02/2019)

Summary

File Name on Meter	831_Data.010
File Name on PC	SLM_0004132_831_Data_010.00.ldbin
Serial Number	0004132
Model	Model 831
Firmware Version	2.314
User	Justin Anibas
Location	
Job Description	85th Street Interchange Project
Note	

Monitor Location 4:
Avera Hospital Grounds, South of I-229
Coords:
43° 29' 30.3"N 096° 46' 53.5"W
Traffic (Cars/MT/HT estimated hourly from short count):
NB - 1118 / 52 / 38
SB - 1210 / 52 / 38

Measurement

Description	
Start	2019-07-02 13:13:20
Stop	2019-07-02 13:43:37
Duration	00:30:17.0
Run Time	00:29:57.1
Pause	00:00:19.9
Pre Calibration	2019-07-02 13:08:23
Post Calibration	None
Calibration Deviation	---

Overall Settings

RMS Weight	A Weighting
Peak Weight	A Weighting
Detector	Fast
Preamp	PRM831
Microphone Correction	Off
Integration Method	Linear
Gain	0.0 dB
Overload	145.1 dB

	A	**C**	**Z**
Under Range Peak	**77.7**	74.7	79.7 dB
Under Range Limit	**26.9**	27.5	33.7 dB
Noise Floor	17.8	18.4	24.0 dB

Results

LAeq	64.6	
LAE	97.2	
EA	577.284 µPa²h	
LApeak (max)	2019-07-02 13:27:24	95.3 dB
LAFmax	2019-07-02 13:30:40	77.3 dB
LAFmin	2019-07-02 13:43:33	57.9 dB
SEA	-99.9 dB	
LAF > 65.0 dB (Exceedance Counts / Duration)	58	852.6 s
LAF > 85.0 dB (Exceedance Counts / Duration)	0	0.0 s
LApeak > 135.0 dB (Exceedance Counts / Duration)	0	0.0 s
LApeak > 137.0 dB (Exceedance Counts / Duration)	0	0.0 s
LApeak > 140.0 dB (Exceedance Counts / Duration)	0	0.0 s

Community Noise	**Ldn**	**LDay 07:00-23:00**	**LNight 23:00-07:00**	**Lden**	**LDay 07:00-19:00**	**LEvening 19:00-23:00**
	64.6	64.6	-99.9	64.6	64.6	-99.9

LCeq	74.7 dB
LAeq	64.6 dB
LCeq - LAeq	10.1 dB
LAIeq	65.8 dB
LAeq	64.6 dB
LAIeq - LAeq	1.2 dB

	A		**C**		**Z**	
	dB	**Time Stamp**	**dB**	**Time Stamp**	**dB**	**Time Stamp**
Leq	64.6		74.7		75.9	
LS(max)	73.7	2019/07/02 13:22:47	88.5	2019/07/02 13:38:19	89.0	2019/07/02 13:38:19
LF(max)	77.3	2019/07/02 13:30:40	89.7	2019/07/02 13:38:19	90.3	2019/07/02 13:38:19
LI(max)	80.7	2019/07/02 13:30:40	90.2	2019/07/02 13:38:19	90.7	2019/07/02 13:38:19
LS(min)	58.4	2019/07/02 13:43:33	69.1	2019/07/02 13:14:56	71.2	2019/07/02 13:14:58
LF(min)	57.9	2019/07/02 13:43:33	67.8	2019/07/02 13:14:56	69.8	2019/07/02 13:15:00
LI(min)	58.2	2019/07/02 13:43:33	69.4	2019/07/02 13:14:52	72.2	2019/07/02 13:14:58
LPeak(max)	95.3	2019/07/02 13:27:24	96.0	2019/07/02 13:22:47	96.2	2019/07/02 13:30:40

# Overloads	0
Overload Duration	0.0 s

Statistics

LAI5.00	68.2 dB
LAI10.00	67.2 dB
LAI33.30	65.1 dB
LAI50.00	63.6 dB
LAI66.60	62.1 dB
LAI90.00	60.3 dB

Calibration History

Preamp	**Date**	**dB re. 1V/Pa**	**6.3**	**8.0**	**10.0**
PRM831	2019-07-02 13:08:20	-27.7	45.1	45.3	54.7
PRM831	2019-07-02 12:02:56	-27.7	51.2	46.5	47.5
PRM831	2019-07-02 10:55:36	-27.7	68.6	64.6	51.9
PRM831	2019-07-02 10:06:39	-27.8	46.5	45.9	42.4
PRM831	2019-07-02 09:03:47	-27.8	58.2	64.9	63.3
PRM831	2019-06-13 09:39:04	-27.8	66.9	69.7	55.0
PRM831	2019-06-06 09:54:09	-27.8	54.5	56.4	64.1
PRM831	2019-06-06 09:53:46	-27.8	50.2	48.1	52.6
PRM831	2019-06-05 19:18:32	-27.7	58.2	56.4	51.0
PRM831	2019-06-05 19:13:22	-27.7	53.0	55.2	54.7
PRM831	2019-06-05 11:53:15	-27.9	63.3	57.9	60.0

831_Data.010

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I-29 / 85th St (noise monitoring)

Date: July 2, 2019

Location: #4 / Avera Heart Hosp't

GPS Coordinates: N·43.49175 W·96.78153°

Start time: 1:13 pm

Finish time: 1:43 pm

Photos Taken: [✓ Yes]/No

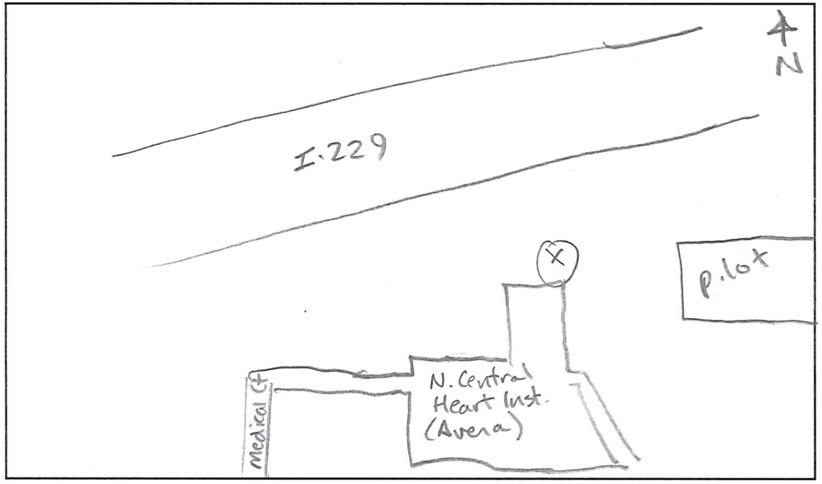
Calibration of Unit: [✓ Yes]/No

82° deg - 2-6 mph (NW) wind
partly cloudy

Vehicle Count

			Total
passenger car	N/E	⑦ (107)	114
	S/W		113
single-unit truck	N/E		8
	S/W		3
bus	N/E		–
	S/W		–
semi truck / heavy truck	N/E		5
	S/W		4
Total			

Site Set-up Diagram



Noise Comments

- duration - (minor const. @ pilot)
(hauling out dirt)

\\sp3020-1\Projects\KO\O\OWNJV\149418\9-survey\Noise Monitoring\field vehicle count sheet

I-29 / 85th St (noise monitoring)

Date: ____________________

Location: ____________________

GPS Coordinates: ____________________

Start time: ____________________

Finish time: ____________________

Photos Taken: Yes/No

Calibration of Unit: Yes/No

Vehicle Count			**Total**
passenger car	N/E		92
	S/W		111
single-unit truck	N/E	|	1
	S/W	||||	4
bus	N/E		–
	S/W	|	1
semi truck / heavy truck	N/E	||||	4
	S/W	||||	4
Total			

Site Set-up Diagram

Noise Comments

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I-29 / 85th St (noise monitoring)

Date: ______________________

Location: ______________________

GPS Coordinates: ______________________

Start time: ______________________

Finish time: ______________________

Photos Taken: Yes/No

Calibration of Unit: Yes/No

Vehicle Count ⑮

			Total	
passenger car	N/E			110
	S/W			111
single-unit truck	N/E		8	
	S/W		2	
bus			—	
			—	
semi truck / heavy truck	N/E		2	
	S/W		4	
Total				

Site Set-up Diagram

Noise Comments

\\sp3020-1\Projects\KO\O\OWNJV\149418\9-survey\Noise Monitoring\field vehicle count sheet

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I-29 / 85th St (noise monitoring)

Date: ____________________

Location: ____________________

GPS Coordinates: ____________________

Start time: ____________________

Finish time: ____________________

Photos Taken: Yes/No

Calibration of Unit: Yes/No

Vehicle Count

		Total	
N/E passenger car S/W			102 119
N/E single-unit truck S/W		2 5	
bus		– –	
N/E semi truck / heavy truck S/W		4 6	
Total			

Site Set-up Diagram

Noise Comments

+17.00 paused briefly

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Vehicle Count

<table>
<tr><th></th><th></th><th></th><th>TOTAL</th><th></th></tr>
<tr><td>passenger car</td><td>N/E</td><td>|||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||</td><td></td><td>101</td></tr>
<tr><td></td><td>S/W</td><td>||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||||</td><td></td><td>128</td></tr>
<tr><td>single-unit truck</td><td>N/E</td><td>||||||</td><td>6</td><td></td></tr>
<tr><td></td><td>S/W</td><td>||||||||||</td><td>10</td><td></td></tr>
<tr><td>Bus</td><td>N/E</td><td>|</td><td>1</td><td></td></tr>
<tr><td></td><td>S/W</td><td>|</td><td>1</td><td></td></tr>
<tr><td>Semi Truck/ Heavy Truck</td><td>N/E</td><td>||||</td><td>4</td><td></td></tr>
<tr><td></td><td>S/W</td><td>|</td><td>1</td><td></td></tr>
</table>

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		Vehicle count	Total
passenger car	N/E	||||||||||||||||||||||||||||||||||||||||	40
	S/W	|||||||||||||||||||||||	23
single-unit truck	N/E	|	1
	S/W	||	2
bus	N/E		–
	S/W		–
semi-truck/ heavy truck	N/E		–
	S/W		–

Site M4: Avera Hospital Grounds, south of I-229 EB
Camera Facing North (07/02/2019)

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