APPENDIX C

NOISE STUDY TECHNICAL REPORT

1) 9/25/06 Noise Study Technical Report; revised 05/08
2) 9/4/09 Memo Regarding Option 3 Noise Impacts to Pelican Lake Game Production Area

Noise Study Technical Report

Watertown South Connector – SD 20 to US 81
SDDOT Project EM 4020(01); PCN 00RW
Codington County, South Dakota

September 25, 2006; revised May 2008

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EXECUTIVE SUMMARY

On behalf of South Dakota Department of Transportation (SDDOT), HDR Engineering, Inc. (HDR) performed a traffic noise analysis on the proposed Watertown South Connector from SD 20 to US 81. The analysis included traffic noise monitoring and modeling. Traffic noise measurements were performed at locations that are representative of residences adjacent to the ROW throughout the project area.

HDR used the Federal Highway Administration (FHWA) Traffic Noise Model (TNM) Version 2.5 to evaluate future traffic noise levels under both the "Build" and "No-build" alternatives. Traffic noise impacts were identified in accordance with the SDDOT Noise Analysis and Abatement Policy and FHWA Noise Abatement Criteria (NAC). No receptors are predicted to be impacted with noise levels that approach or exceed the NAC within the Study area of this Project. Therefore, noise mitigation was not evaluated as part of the project.

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1.0 Introduction

The South Dakota Department of Transportation (SDDOT) proposes to construct a roadway connecting Highway 212 to I-29 on the south side of the city of Watertown, SD (South Connector). The South Connector is needed to relieve congestion and reduce accidents on Highway 212. It is also needed to provide good access, especially for trucks, to the rapidly developing industrial area on the City's south side. This Project is classified as a Type I project because it proposes both new construction and an increase in the number of through-traffic lanes in the Project area. As a Type I project, a noise analysis is required because potentially impacted noise-sensitive receivers exist in the Project area.

HDR Engineering, Inc. (HDR) performed a highway traffic noise analysis for SDDOT in support of the Project. Three separate options were evaluated as part of the analysis from SD 20 to US 81 (Options 1, 2, and 4). The analysis is based on SDDOT Noise Analysis and Abatement Policy (December 1999) and Federal Highway Administration (FHWA) Traffic Noise Analysis and Abatement Policy and Guidance (FHWA 1995). Where future predicted traffic noise levels approach or exceed the SDDOT Noise Abatement Criteria (NAC), noise mitigation was evaluated. Results of the analysis are presented in this report.

2.0 Nature of Noise

Noise is defined as unwanted sound and is measured in decibels (dB) - a logarithmic scale. Because human hearing is not equally sensitive to all frequencies of sound, certain frequencies are given more "weight". The A-weighted scale corresponds to the sensitivity range for human hearing. Therefore, noise levels are measured in dBA, the A-weighted sound level in decibels. When noise levels change 3-dBA, the change is considered to be barely perceptible to human hearing. However, a 5-dBA change in noise level is clearly noticeable. A 10-dBA change in noise level is perceived as a doubling or halving of noise loudness, while a 20-dBA change is considered a dramatic change in loudness. Table 1 shows noise levels associated with common, everyday sources and helps the reader more fully understand the magnitude of noise levels discussed in this report.

Table 1
Common Noise Sources and Levels

Sound Pressure Level (dB)	Typical Sources
120	Jet aircraft takeoff at 100 feet
110	Same aircraft at 400 feet
90	Motorcycle at 25 feet
80	Garbage disposal
70	City street corner
60	Conversational Speech
50	Typical office
40	Living room (without TV)
30	Quiet bedroom at night

Source: Environmental Impact Analysis Handbook, ed. by Rau and Wooten, 1980

3.0 SDDOT Noise Analysis and Abatement Policy

The SDDOT Noise Analysis and Abatement Policy (Policy), upon which this analysis is based, is intended to supplement FHWA traffic noise analysis and abatement regulations and guidance. The Policy provides procedures for noise studies and noise abatement measures to help protect the public health and welfare, to supply noise abatement criteria and to establish requirements for traffic noise information to be given to those officials who have planning and zoning authority in the Project area.

The Policy contains noise abatement criteria that are based on the Leq(h) which is used to analyze traffic noise levels and identify noise impacts. The Leq(h) is defined as the equivalent steady-state sound level that, in a stated period of time, contains the same acoustic energy as the time-varying sound level during the same period. Therefore, for the purposes of this analysis, Leq can be considered the average sound level and Leq(h) can be considered the average sound level occurring over a one-hour period. It is representative of the overall (average) traffic-generated noise level expressed on an hourly basis.

Land uses are assigned to an activity category based on the type of activities occurring in each respective land use (i.e. picnic areas, churches, commercial land and undeveloped land). Activity categories are then ordered based on their sensitivity to traffic noise levels. NAC are assigned to each activity category. These NAC represent the maximum traffic noise levels that allow uninterrupted land use within each activity category. Table 2 lists the five land use categories

included in the SDDOT NAC and the Leq(h) associated with each activity category. Traffic noise impacts are identified relative to the NAC and the Policy.

The federal (23 Code of Federal Regulations (CFR) 772) and SDDOT definition of a traffic noise impact contains three criteria of which only one has to be met. Traffic noise impacts are defined as impacts that occur when the predicted traffic noise levels:

- approach or equal the noise abatement criteria given on Table 2; or,
- exceed the noise abatement criteria given on Table 2; or,
- substantially exceed the existing noise levels.

Table 2
Noise Abatement Criteria

Activity Category	L_{eq} (h)	Description of Activity Category
A	57-dBA (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	67-dBA (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries and hospitals.
C	72-dBA (Exterior)	Developed lands, properties or activities not included in Categories A or B above.
D	No Limit	Undeveloped Lands
E	52-dBA (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

SOURCE: Federal-Aid Highway Program Manual 7-7-3, "Procedures for Abatement of Highway Traffic Noise and Construction Noise", dated August 1982.

The SDDOT Policy defines "approach the NAC" as being within one dBA of the NAC, therefore traffic noise levels of 66-dBA are considered a traffic noise impact (for land use category B), a noise level greater than 67-dBA exceeds the NAC (for category B) and a 15-dBA increase in existing noise levels is a substantial increase.

4.0 Noise Prediction Method

Future "Build" traffic noise levels were determined by using the FHWA Traffic Noise Model (TNM) Version 2.5. The Basic model inputs are:

- Preliminary project concept and geometry.
- 2030 Traffic volumes for the South Connector, Highway 81, 29th Street SE, I-29, and 41st Street SE in the Study area. (See Traffic Data on page 11.)
- The operational speed for the South Connector from US 81 to 29th Street SE: 40 miles per hour (mph); South Connector from SD 20 to US 81: 35 mph; Highway 81: 40 mph.

The traffic volume used for this hour time period is the Peak Hourly Volume (PHV) traffic. Traffic noise levels for the existing condition were determined from noise monitoring data collected throughout the Project area (Section 8).

5.0 Traffic Parameters

The traffic volumes and vehicle mix used on this Project were obtained from the SDDOT Office of Planning and Engineering. (See Traffic Data on page 11.) Vehicle classifications used in this analysis include cars (90 percent), medium trucks (3 percent), and heavy trucks (7 percent).

6.0 Adjacent Land Use

Land use adjacent to this Project is primarily agricultural, with scattered residential and commercial land uses, throughout the project area. The Pelican Game Production Area (GPA) is also located in the project area, however, there are no defined areas of outdoor human activity existing in the GPA. Figure C-1 includes an aerial view of the project area.

7.0 Noise Measurements

HDR performed noise measurements at representative receptors in the Project area to determine the existing traffic noise levels.

7.1 FIELD TESTING PROCEDURE

On September 25, 2006, HDR staff measured noise levels in the Project area. Traffic noise measurements were conducted in accordance with the FHWA-PD-96-046 Measurement of Highway-Related Noise (May 1996). The average meteorological conditions are reported in Table 3.

Table 3
Meteorological Conditions

TEMPERATURE	September 25 = 52° F
HUMIDITY	September 25 ≅ 69 percent
WIND	September 25 ≅ 8 mph
CONDITIONS	September 25: clear
BAROMETRIC PRESSURE	September 25 = 30.07 inches

7.2 INSTRUMENTATION

The noise monitoring was done utilizing a Larson-Davis model 820 Type I Sound Level Meter whose microphone was set at a height of approximately 5 feet above the ground.

7.3 FIELD MEASUREMENT METHODS

The sound level meter was programmed to compute the hourly equivalent sound level Leq(h). As mentioned previously (Section 2.0), Leq(h) is the steady-state, A-weighted sound level that contains the same amount of acoustic energy as the actual time varying, A-weighted sound level over a 1-hour period. Leq(h) is measured in A-weighted decibels (dBA), which closely approximates the range of frequencies a human ear can hear.

The following procedures were used for noise monitoring:

- The duration of the measurements was approximately 15 minutes.
- The meter was calibrated before and after monitoring. No significant calibration drifts were detected during the duration of the study.
- The height of the microphone was 5 feet above the ground.
- The microphone was covered with a windscreen.

7.4 FIELD MEASUREMENT LOCATIONS AND RESULTS

Monitoring locations are shown on Figure C-1 and are as follows:

Site M1 – Commercial Building: SW intersection of Hwy 212 and Hwy 20

Site M2 – Residence: 1333 S. Broadway Street

Site M3 – Residence: Mobile Home Park, NW corner of Broadway St. S and 20th Ave. S.

Site M4 – AcroTech Midwest, Inc.: 20th Avenue S.

Table 4 identifies the locations of each of the monitoring sites relative to the nearest roadway centerline and the respective noise levels measured at each location.

Table 4
Noise Monitoring Results

Measurement Location	Duration	Distance to Centerline (feet)	NAC (dBA)	Measured L_{eq} During Peak Hour
M1 (C)	15 min.	≈ 75	71	51 dBA
M2 (R)	15 min.	≈ 145	66	56 dBA
M3 (R)	15 min.	≈ 140	66	55 dBA
M4 (C)	15 min.	≈ 225	71	49 dBA

Note: (R) is residential receptor.

8.0 Traffic Noise Prediction

HDR used the FWHA Traffic Noise Model (TNM) Version 2.5 to evaluate future traffic noise levels at noise sensitive receptors within the limits of this Project. The predicted traffic noise levels reflect the elevation differences and the proposed roadway alignment in relation to the noise sensitive sites. Table 5 lists the NAC, existing Leq, and the future (2030) predicted Leq for both the "Build" and "No-build" alternatives. Noise levels were not predicted within the Pelican GPA as there are no defined areas of outdoor human activity (no picnic tables, campsites, etc.). Noise levels within 40 feet of the proposed roadway centerline would be predicted to be 66 dBA or greater, defined as approaching the NAC for a Recreational Area. This would be approximately at the roadway right-of-way line.

Table 5
Predicted Noise Levels (Leq) at Receptors

Receptor ID	Land Use	NAC (dBA)	Hourly Leq(h) dBA						Approaches or Exceeds Standards in 2030 Build
			2006	2030				Difference Between Existing/ Build	
			Existing	"No-build"	"Build" Option 2	"Build" Option 3	"Build" Option 4		
Receiver1	Commercial	72	51	51	61	61	61	+10/+10/+10	NO
Receiver2	Residential	67	56	56	46[1]	45[1]	43[1]	-10/-9/-13	NO
Receiver3	Residential	67	55	55	55	55	NA[2]	0/0/NA[2]	NO
Receiver4	Residential	67	55	55	55	55	NA[2]	0/0/NA[2]	NO
Receiver5	Residential	67	55	60	59	59	NA[2]	+4/+4/NA[2]	NO
Receiver6	Residential	67	55	58	57	57	57	+2/+2/+2	NO
Receiver7	Residential	67	55	58	57	57	57	+2/+2/+2	NO
Receiver8	Residential	67	55	55	55	55	55	0/0/0	NO
Receiver9	Commercial	72	49	49	55	55	55	+6/+6/+6	NO
Receiver10	Commercial	72	49	58	61	61	61	+11/+12/+12	NO

Notes: [1] Options 2, 3, and 4 will locate traffic further away from Receiver2.

[2] Not applicable since Option 4 would entail acquisition of these residences.

9.0 Noise Abatement Measures

Noise abatement measures are considered where predicted traffic noise levels approach or exceed the NAC or when the predicted traffic noise levels substantially exceed the existing noise levels. As shown in Table 6, no modeled receptors exceed the NAC. Therefore, noise abatement measures do not need to be evaluated.

10.0 Construction Noise and Vibration

Construction of the Project would result in temporary noise and vibration increases within the Project area. The evaluation and control of construction noise and vibration must be considered as well as traffic noise. This Project is bordered by scattered residential receptors and these receptors are also a concern for impacts caused by construction noise and vibration.

The following are basic categories for mitigation measures for construction noise. Due to the interrelatedness of construction noise and vibration, some of these measures will also apply for vibration resulting from construction activities.

Design Considerations: Design considerations include measures in the plans and specifications to minimize or eliminate adverse impacts. The design for this Project includes the construction of and expansion of new and exiting roadway. The proposed changes and their proximity to noise sensitive receptors were factors during design considerations.

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

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

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

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

11.0 Conclusion

No receptors are predicted to be impacted with noise levels that approach or exceed the NAC within the Study area of this Project. Therefore, noise mitigation was not evaluated as part of the project.

12.0 References

South Dakota Department of Transportation, "Noise Analysis and Abatement Guidelines/Policy," December 1999.

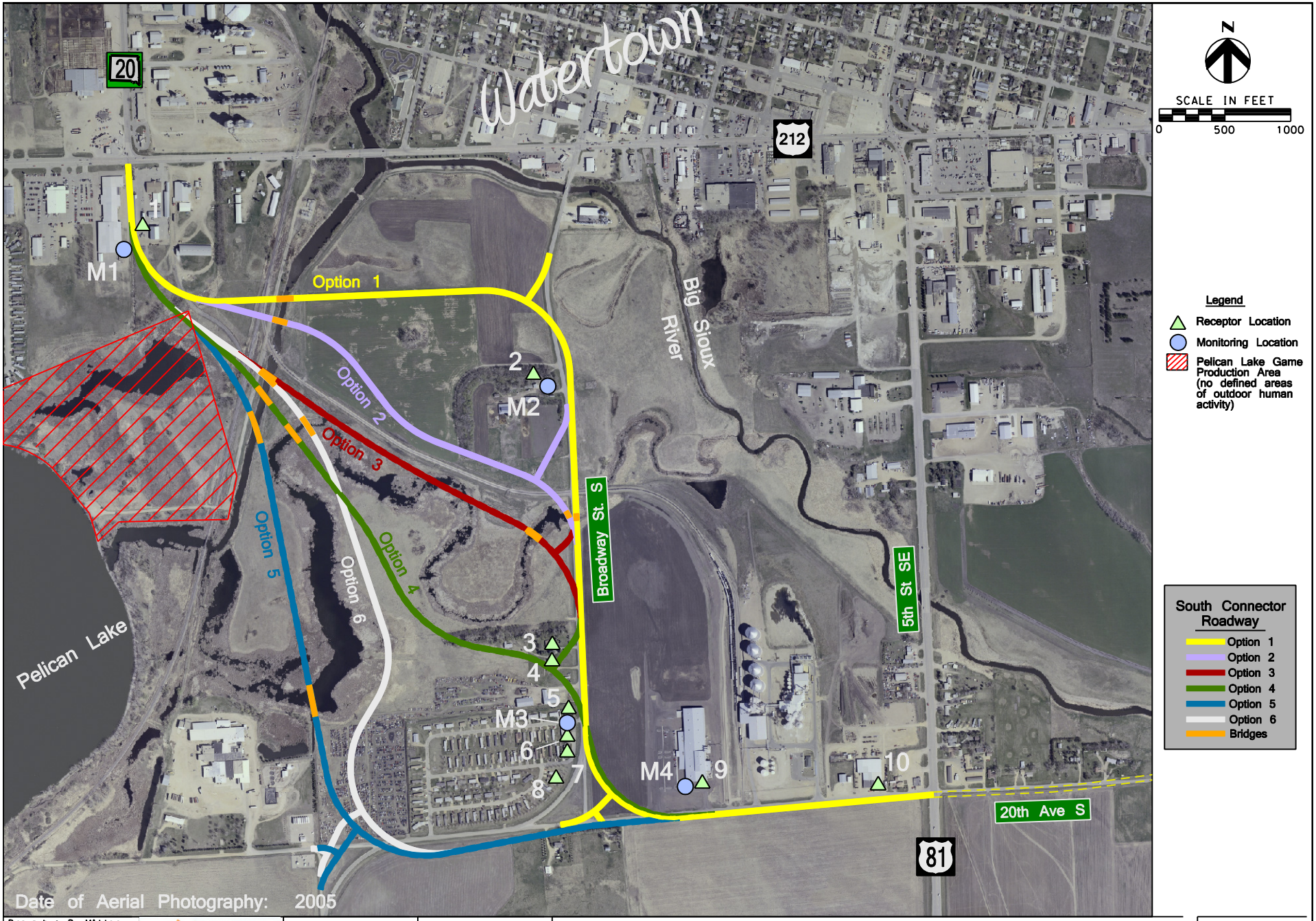
Federal Highway Administration (FHWA) Traffic Noise Analysis and Abatement Policy and Guidance, 1995.

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

DATA FOR NOISE ANALYSIS

Traffic Data

Peak Hour Traffic Volumes for the Following Roadways					
Roadway 2030 No-Build	ADT	PHV (12% of ADT)	Autos	Medium Trucks	Heavy Trucks
Broadway Street S	3300	396	356	12	28
20th Avenue S	1000	120	108	4	8
29th Street SE	6500	780	702	23	55
Highway 81	8200	984	886	30	69
I-29	12800	1536	1382	46	108
41st Street SE	900	108	97	3	8
Roadway 2030 Build	ADT	PHV (12% of ADT)	Autos	Medium Trucks	Heavy Trucks
20th Avenue S from US 81 to 29th Street SE	8300	996	896	30	70
29th Street SE from 20th Avenue S to US 212	6100	732	659	22	51
South Connector from SD 20 to US 81 Options 1, 2, and 4	7100	852	767	26	60
South Connector from 29th Street SE to I-29	3500	420	378	13	29
South Connector East of I-29	1000	120	108	4	8
Highway 81	5400	648	583	19	45
I-29	9100	1092	983	33	76
41st Street SE	4000	480	432	14	34



Drawn by: B. Miller
Date: 03/06/07

Checked by: J. Unruh
Date: 03/06/07

Revision Date:
January 2008

Noise Monitoring and Receptor Locations

Watertown South Connector - SD 20 to US 81

Project EM 4020(01) PCN 00RW

Figure C-1

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Memo

To:	Terry Keller (SDDOT Office of Project Development)
From:	HDR
Project:	Watertown South Connector – SD20 to US81
CC:	SD Dept. of Game Fish and Parks US Fish and Wildlife Service FHWA Dept. of Public Safety/Emergency Management US Army Corps of Engineers City of Watertown SD Dept. of Environment and Natural Resources
Date:	September 4, 2009
Proj. No:	EM 4020(01) PCN 00RW

RE: Option 3 Noise Impacts at Pelican Lake Game Production Area

Background

Concerns have been raised by FHWA reviewers of the Environmental Assessment (EA) regarding noise impacts at the Pelican Lake Game Production Area (GPA). This memo will document:

- the existing noise levels within the GPA
- the noise levels that will be experienced with the proposed South Connector Roadway Option 3
- applicable noise standards
- noise impacts
- potential noise mitigation measures

Existing Noise Levels

Noise monitoring was conducted within the vicinity of the GPA on September 25, 2006 and on July 31, 2009. Results of the monitoring are shown in the table below:

Measurement Location	Duration	Distance to Centerline (feet)	Measured L_{eq} During Peak Hour
M1	15 min.	≈ 75	51 dBA
M5	15 min.	≈ 400	52 dBA
M6	15 min.	≈ 60	53 dBA

Attached Figure 3-4b shows the monitoring locations.

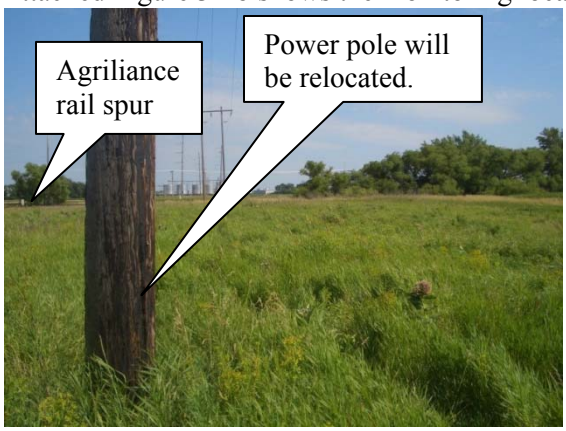


Photo at left is at the approximate location of receptor M6. The direction of the photo is toward the southeast along the south roadway edge of Option 3.

Future Noise Levels with South Connector Option 3

Figure 3-4b shows the peak hour noise contours along Option 3 for the following conditions:

- Operating speed – 40 mph (based on City of Watertown indications of future speed limit)
- Year 2030 traffic volume – 7100 vehicles per day (per traffic analysis)
- Peak hour volume – 12% of ADT
- Peak hour vehicle composition – 90% cars, 3% medium trucks, 7% heavy trucks

Option 3 has been identified as the preferred option for the South Connector project. Noise impacts for Options 4, 5, and 6 would be similar to Option 3. Noise impacts for Options 1 and 2 would be less than Option 3.

Noise Standards

Due to uncertainties in noise impacts on wildlife, FHWA does not promulgate specific noise abatement criteria (NAC) for a game production area. (The Pelican Lake GPA is considered a Section 4(f) property in the South Connector EA.) For this project, FHWA recommended that the GPA be analyzed as a recreational land use. (See 6/12/07 meeting notes – EA Appendix H, item 4, page 3.) The NAC for a recreational land use is 67 dBA.

Noise Impacts

The proposed right-of-way (ROW) for the South Connector Option 3 will infringe on a corner of the GPA. The proposed ROW line will be 100' from the extreme northeast corner of the GPA and a total of 0.25 acres of the GPA will be acquired. The South Dakota Department of Game, Fish, and Parks has officially concurred with a *de minimis* impact for the ROW taking.

The difficulty in assessing noise impacts to a large area such as the GPA is that there are no defined areas of specific activity. At the new ROW line, the noise level will be approximately 63 to 64 dBA which is below the NAC of 67 dBA. However, this would be an increase of 10 to 11 dBA from the existing measured noise level of 53 dBA at monitored location M6. This is below the 15 dBA that FHWA and the South Dakota Department of Transportation (SDDOT) define as a "significant" noise level increase for which mitigation measures must be considered. Therefore at the South Connector ROW line, there would be no requirement to analyze potential noise mitigation measures based on standard FHWA and SDDOT criteria.

Noise Mitigation

To address FHWA comments on the EA, noise mitigation options were reviewed. Options include:

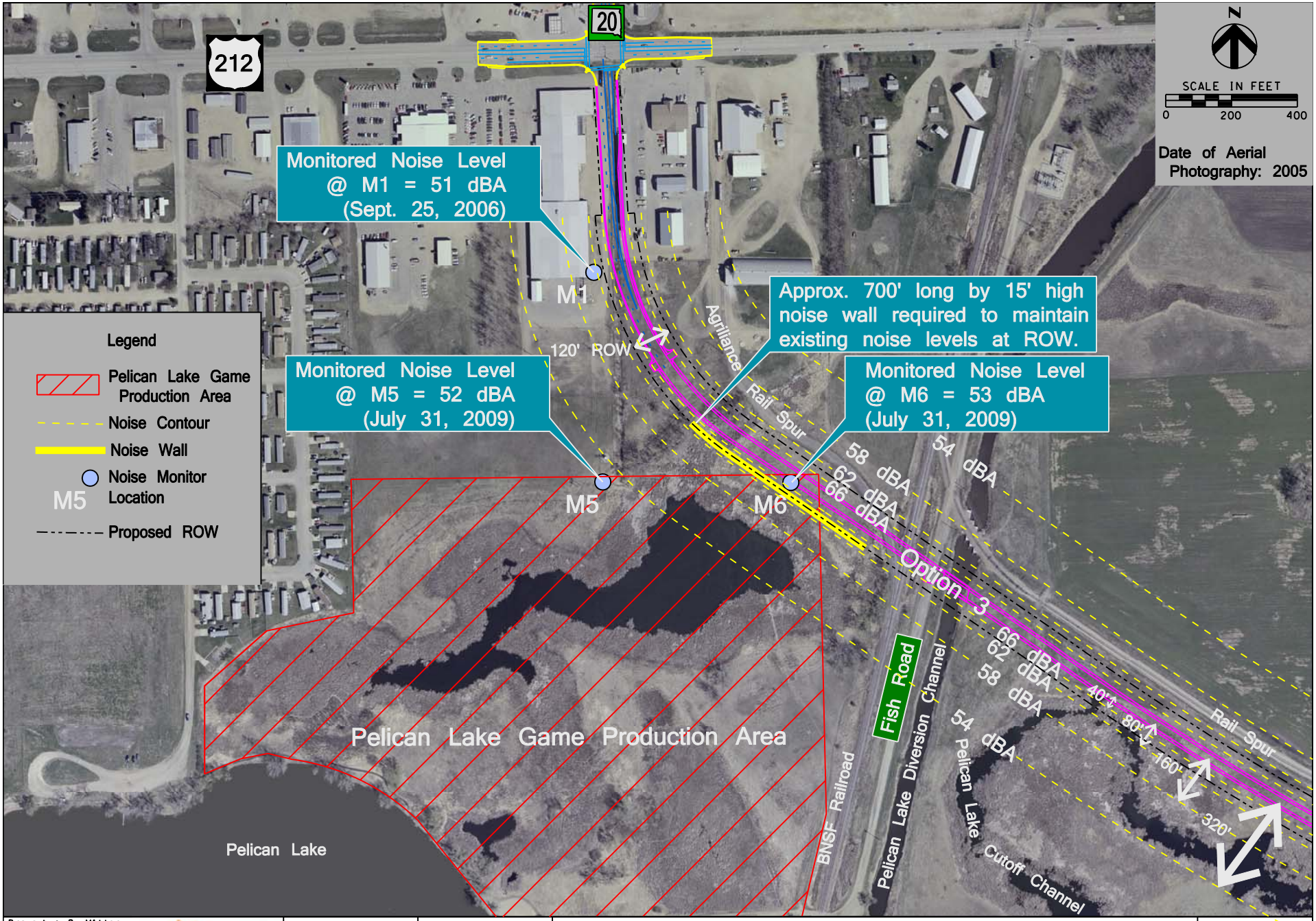
- Roadway alignment – Six roadway alignment options were analyzed for the South Connector project from SD20 to US81. The bases for the selection of Option 3 are documented in the EA. The alignment of Option 3 has already been refined to minimize impacts to adjacent land uses.
- Traffic management – The purpose and need of the South Connector project is to divert truck traffic from US212 to reduce congestion and improve safety on US212. Limiting traffic, specifically trucks to reduce noise levels would be in contradiction of the purpose and need of the project.
- Roadside barrier via mounding – Linear mounds along the South Connector would have to be 10' to 15'higher to provide appreciable noise mitigation. The mounds would have to be 60' to 100' wide. The impact of the mound to the wetland area of the GPA would be a greater impact than the increase in noise levels.
- Noise wall – A noise wall 700 feet long by 15 feet high would at the proposed ROW line would keep noise levels within the GPA at approximately the existing levels. At an assumed cost of $30 per square foot for a wood noise wall, the total cost to provide noise mitigation via a wall would be well over $300,000. SDDOT feasibility and cost reasonableness for a noise wall is based on the cost of the wall and the number of benefitted residences. Therefore no defined method of analyzing the feasibility/cost reasonableness of noise wall is available.

Railroad Considerations

The BNSF railroad tracks run along the eastern edge of the GPA. Based on information provided by BNSF, the rail line carries 2 to 3 trains per day throughout the year with a peak volume of 4 to 5 trains per day. The disruption to wildlife by the existing train noise is likely to be greater than the impact from the relatively constant noise of vehicular traffic flow.

Recommendation

It is recommended that a SDGFP issue a statement of concurrence with a de minimis impact finding for the GPA noise impacts.



Drawn by: B. Miller
Date: 09/04/2009

Checked by: J. Unruh
Date: 09/04/2009

Revision Date:

WATERTOWN

South Dakota DOT Department of Transportation

HDR

Noise at Pelican Lake Game Production Area-Option 3

Watertown South Connector - SD 20 to US 81
Project EM 4020(01) PCN 00RW

Figure 3-4b