APPENDIX C

NOISE STUDY TECHNICAL REPORT

Noise Study Technical Report

Watertown South Connector – US 81 to 29th Street SE

Watertown, South Dakota

September 25, 2006; revised May 2007

HDR Project No. 39319

Prepared by

HDR Engineering Inc.

6300 So. Old Village Place
Suite 100
Sioux Falls, SD 57108

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 ***US 81 to 29th Street SE***. 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 noise 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). A total of 2 residences are predicted to experience traffic noise impacts under the "Build" alternative. One of these residences will be moved further away from the roadway and the other taken as a result of this 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. Figure C-1 shows the Project area. 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. South Connector Route-US 81 to 29th Street SE is the part of the project along 20th Avenue South between Highway 81 and 29th Street SE and along 29th Street SE from 20th Avenue South to approximately one-half mile north of 20th Avenue South (see Figure C-1). The traffic analysis covered the Study Area for the South Connector Route- US 81 to 20th Street SE, which is a 300-foot corridor along 29th Street Southeast from about 2,200 feet south of US Highway (US 212) to 20th Avenue South and along 20th Avenue South from 29th Street Southeast to US 81. 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 levels 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 (Appendix A).
- The operational speed for South Connector Route- US 81 to 29th Street SE: 40 miles per hour (mph); Highway 81: 40 mph; I-29: 65 mph; 29th Street SE: 35 mph; and 41st Street SE: 55 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 used on this Project were obtained from the Watertown regional travel demand model developed by URS Corporation for the "Watertown Area Transportation Plan – 2005 Update" (see Appendix A). Vehicle classifications used in this analysis include cars (90 percent), medium trucks (3 percent), and heavy trucks (7 percent) and are based on roadway type and future land use along the roadway.

6.0 Adjacent Land Use

Existing land use adjacent to this Project is primarily agricultural, with scattered residential and commercial land uses, throughout the project area. 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 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 at the time of the measurements 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 1 (page 2) and are as follows:

Site M1 – Residence: 1808 5th Street SE

Site M2 – Residence: 922 20th Avenue SE

Site M3 – Residence: Trailer home north of 20th Ave, just east of Willow Creek

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 (R)	15 min.	≈ 75	66	53 dBA
M2 (R)	15 min.	≈ 120	66	51 dBA
M3 (R)	15 min.	≈ 85	66	46 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.

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"		
RECEIVER1	Residential	67	53	58	64	11	No
RECEIVER2	Residential	67	53	57	63	10	No
RECEIVER3	Residential	67	53	53	59	6	No
RECEIVER4	Residential	67	53	56	65	12	No
RECEIVER5	Residential	67	51	54	60	9	No
RECEIVER6	Residential	67	46	58	65[1]	19	Yes
RECEIVER7	Residential	67	46	57	69[2]	23	Yes

Notes: [1] Trailer house to be relocated further from road

[2] Home will be acquired or relocated on property as part of project

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, two of the seven modeled receptors have predicted noise levels which exceed the NAC, however, one of the impacted receptors (Receiver 6) will be moved further from the roadway as part of the project and the other impacted receptor (Receiver 7) will be taken as part of the project. 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

A total of 2 residences are predicted to be impacted with noise levels that approach or exceed the NAC within the Study area of this Project. Noise mitigation was not evaluated as one of the residences will be relocated further from the road, and the other will be acquired or relocated further from the road 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.

13.0 Data for Noise Analysis

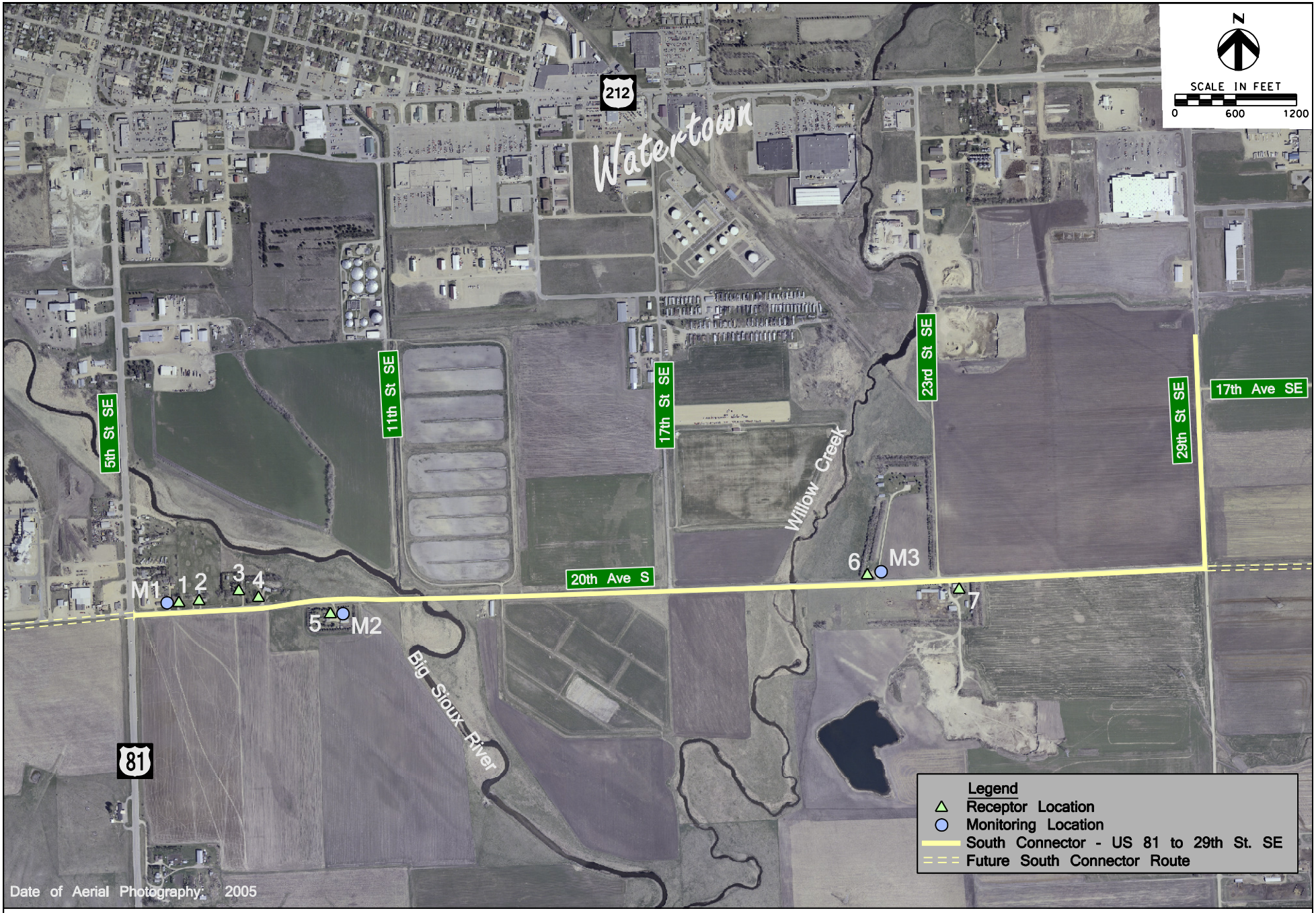
Traffic Data

Peak Hour Traffic Volumes for the Following Roadways					
Roadway 2030 No-Build	ADT	PHV (12% of ADT)	Autos[1]	Medium Trucks[2]	Heavy Trucks[3]
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
US 81 to 29th St. SE- West/East	8300	996	896	30	70
US 81 to 29th St SE- North/South	6100	732	659	22	51
SD 20 to US 81- Options 1&2	7100	852	767	26	60
29th St SE to I-29- Options 1-3	3500	420	378	13	29
29th St SE to I-29- 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

1 90% of Peak Hour Volume

2 3% of Peak Hour Volume

3 7% of Peak Hour Volume



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WATERTOWN South Dakota's Rising Star

South Dakota DOT Department of Transportation

HDR

Noise Monitoring and Receptor Locations

Watertown South Connector, Codington County, SD
Project EM 4411(01) PCN 00RV

Figure
C-1