APPENDIX E

EAW ITEM 17 - NOISE

TH 10
TRAFFIC NOISE STUDY

TH 10 (SB I-35W TO CSAH 96)
SP 6205-39
ARDEN HILLS, MINNESOTA

Prepared for
Minnesota Department of Transportation

October 2017

HNTB

Traffic Noise Study
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Traffic Noise Study

1.0 INTRODUCTION

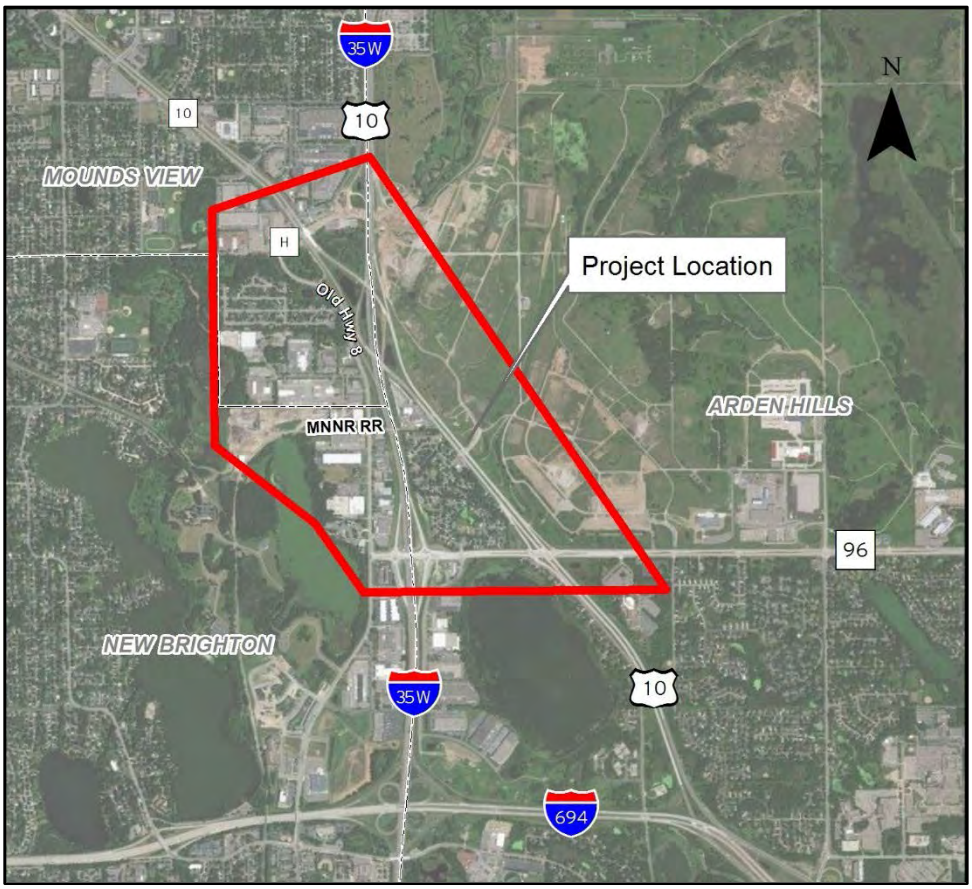
The Minnesota Department of Transportation (MnDOT) is proposing modifications to Trunk Highway (TH) 10 in Arden Hills, Ramsey County. The purpose of the noise analysis is to document the effect of the project on traffic generated noise levels and analyze the possible installation of noise walls for properties along the project area in order to mitigate noise impacts.

Federal and state funding sources are included in the proposed project. Traffic noise impacts of the project will be evaluated based on Federal Noise Abatement Criteria and Minnesota State Noise Standards (see discussion in Section 3.0).

2.0 PROJECT DESCRIPTION AND LOCATION

MnDOT is proposing the construction of an auxiliary lane on eastbound Trunk Highway (TH) 10 from southbound Interstate (I)-35W to County State Aid Highway (CSAH) 96 in Arden Hills, Ramsey County, including constructing the second lane on the exit ramp from southbound I-35W to eastbound TH 10.

Figure 1 provides an overview of the project location.



Source: HNTB Corporation

Figure 1: Project Location Map

3.0 NOISE ANALYSIS OVERVIEW

This report evaluates the potential traffic noise impacts of the proposed improvements to TH 10 from I-35W to CSAH 96 in Ramsey County in conformance with corresponding Federal and State regulations and guidance, and the National Environmental Policy Act (NEPA).

Basic Noise Information

Noise is defined as any unwanted sound. Sound travels in a wave motion and is measured as a sound pressure level. This sound pressure level is commonly measured in decibels. Decibels (dB) represent the logarithm of the ratio of a sound energy relative to a reference sound energy. For highway traffic noise, an adjustment, or weighting, of the high-and low-pitched sound is made to approximate the way that an average person hears sound. The adjusted sound levels are stated in units of “A-weighted decibels” (dBA). A sound level increase of 3 dBA is barely noticeable by 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 (i.e., the amount of traffic doubles), there is a 3 dBA increase in noise, which is just barely noticeable to most people. On the other hand, if traffic increases by a factor of ten times, the resulting sound level will increase by about 10 dBA and be heard to be twice as loud.

Traffic noise impacts in Minnesota are evaluated by measuring and/or modeling the traffic noise levels that are exceeded 10 percent and 50 percent of the time during the hours of the day and/or night that have the loudest traffic noise scenario. These numbers are identified as the L_{10} and L_{50} levels, respectively. The L_{10} value is the noise level that is exceeded for a total of 10 percent, or 6 minutes, of an hour. The L_{50} value is the noise level that is exceeded for a total of 50 percent, or 30 minutes, of an hour.

Traffic volume, types of vehicles, operating speed, topography and distance from the road to the receptor influences the traffic noise level at the receptor. The sound level decreases as distance from a source increases. A rule of thumb regarding sound level decrease due to increasing distance from a line source (roadway) that is commonly used is: beyond approximately 50 feet from the sound source, each doubling of distance from the line source over hard ground (such as pavement or water) will reduce the sound level by 3 dBA, whereas each doubling of distance over soft ground (such as vegetated or grassy ground) results in a sound level decrease of 4.5 dBA.

Table 1 provides a rough comparison of the noise levels of common noise sources.

Table 1: Decibel Levels of Common Noise Sources

Sound Pressure Level (dBA)	Noise Source	Source:
140	Jet Engine (at 25 meters)	"A Guide to Noise Control in Minnesota," Minnesota Pollution Control Agency **http://www.pca.state.mn.us/programs/pubs/noise.pdf;** and "Highway Traffic Noise," FHWA, **http://www.fhwa.dot.gov/environment/htnoise.htm**
130	Jet Aircraft (at 100 meters)	
120	Rock and Roll Concert	
110	Pneumatic Chipper	
100	Jointer/Planer	
90	Chainsaw	
80	Heavy Truck Traffic	
70	Business Office	
60	Conversational Speech	
50	Library	
40	Bedroom	
30	Secluded Woods	
20	Whisper	

Minnesota State Noise Standards

Minnesota state noise standards have been established for daytime and nighttime periods. The state standards for residential land uses (identified as Noise Area Classification 1 or NAC-1) are 65 dBA L_{10}, daytime and 55 dBA L_{10}, nighttime. The L_{50} standards are 60 dBA and 50 dBA for daytime and nighttime, respectively. The Minnesota Pollution Control Agency (MPCA) defines daytime as 7:00 a.m. to 10:00 p.m. and nighttime from 10:00 p.m. to 7:00 a.m. The state noise standards are depicted in **Table 2**.

Table 2: MPCA State Noise Standards

Land Use	Code	Day (7:00 AM to 10:00 PM) dBA		Night (10:00 PM - 7:00 AM) dBA	
		L_{10}	L_{50}	L_{10}	L_{50}
Residential[1]	NAC - 1	65	60	55	50
Commercial[2]	NAC - 2	70	65	70	65
Industrial[3]	NAC - 3	80	75	80	75

1 NAC-1 includes household units, transient lodging and hotels, educational, religious, cultural, entertainment, camping, and picnicking land uses. Note the daytime standards apply during the nighttime for NAC-1 activities that do not include overnight sleeping/lodging.
2 NAC-2 includes retail and restaurants, transportation terminals, professional offices, parks, recreational and amusement land uses.
3 NAC-3 includes industrial manufacturing, transportation facilities (except terminals), and utilities land uses.

State noise standards apply to all Interstate and trunk highways in Minnesota. The proposed project includes construction of a new auxiliary lane on TH 10, which is a trunk highway. Exemptions to State noise standards are found in Minnesota Statues 2000, Section 116.07 subd. (2a). Minnesota State Statutes 2000, Section 116.07 subd. (2a) identifies the conditions and roadway types that are exempt from the State noise standards.

Federal Noise Abatement Criteria

The Federal Highway Administration's (FHWA) Procedures for Abatement of Highway Traffic Noise and Construction Noise is presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 772). 23 CFR 772 requires the identification of highway traffic noise impacts and the evaluation of potential noise abatement measures, along with other

considerations, in conjunction with the planning and design of a Federal-aid highway project. The MnDOT policy for implementation of the requirements of 23 CFR 772 is described in the *MnDOT Noise Policy for Type I Federal-aid Projects* (effective June 15, 2015). The *MnDOT Highway Noise Policy* applies to all projects that receive Federal-aid funds or projects that are subject to FHWA approval.

A traffic noise impact analysis is required for all Type I Federal-aid projects. Type I projects are defined in 23 CFR 772.5. The proposed project meets the definition of a Type I project due to the addition of auxiliary lane). Therefore, a traffic noise analysis following the requirements of 23 CFR 772 is required for the project.

This regulation established the noise abatement criteria (NAC) for various land uses. Noise abatement measures will be considered when the predicted noise levels approach or exceed those values shown for the appropriate activity category in **Table 3**, or when the predicted traffic noise levels substantially exceed the existing noise levels.

The FHWA defines a traffic noise impact as follows: A traffic noise impact occurs if predicted traffic noise levels approach (within 1 dBA) or exceed the FHWA noise abatement criteria (NAC), or when the predicted traffic noise levels substantially exceed existing noise levels (MnDOT considers an increase of 5 dBA or greater in the L_{10} a substantial noise level increase). In predicting noise levels and assessing noise impacts, traffic characteristics are used which yield the worst hourly traffic noise impact on a regular basis for the design year.

Since the Residential NAC-1 MPCA L_{10} noise level of 65 dBA in **Table 2** is an absolute level and is lower than the FHWA NAC L_{10} noise level of 70 dBA for Activity Category B land use (residential) shown in **Table 3**, traffic noise impacts of the project will be identified based on MPCA daytime and nighttime standards.

Table 3: FHWA Noise Abatement Criteria

Activity Category	Activity Criteria L_{10} (h), dBA [(1) (2)]	Description of Activity Category
A	60 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[(3)]	70 dBA (Exterior)	Residential
C[(3)]	70 dBA (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	55 dBA (Interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, pubic meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools and television studios.
E[(3) (4)]	75 dBA (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.

(1) L_{10} (h) shall be used for impact assessment.
(2) The L_{10} (h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.
(3) Includes undeveloped lands permitted for this activity category.
(4) Hotels and motels that function as apartment buildings are classified under Activity Category B.

4.0 AFFECTED ENVIRONMENT

The adjacent land within the project area falls under State Land use categories NAC-1, NAC-2, and NAC-3 and Federal Land Use Categories B, C, E, and F. Primary land uses consist of residential and commercial land uses. The existing noise environment is controlled by traffic noise from Old Highway 8, I-35W, CSAH 96 and TH 10.

The study area includes I-35W from north of the CTH H overpass to approximately 800’ south of the railroad trestle over I-35W south of the TH 10/I-35W interchange; TH 10 from north of the CTH H overpass to 1,500’ south of the CSAH 96/TH 10 interchange; CSAH 96 from I-35W through the CSAH 96/TH 10 interchange; Old Highway 8 from CTH H to 800’ south of the railroad crossing; and Mounds View Boulevard from CTH H through the I-35W interchange. Receptors within approximately 500’ of the proposed additional lane on the southbound TH 10 ramp from I-35W and within approximately 500’ of the proposed auxiliary lane were modeled.

For the traffic noise study, the project area was divided into four noise sensitive areas (NSA):

- NSA-A represents the residential area at the north end Arden Manor just north of the access from TH 10 northwest of CSAH 96. It also includes a lumber yard north of Arden Manor.
- NSA-B represents the residential area in the southern section of Arden Manor south of the access from TH 10 northwest of CSAH 96. This area also includes a restaurant (commercial land use/Activity Category E), an office (commercial land use/Activity Category E), and an outdoor pool within Arden Manor Park (recreational land use/Activity Category C).
- NSA-C represents a residential area (Townsedge Terrace) just west of Old US-8 in the northwest portion of the project area. This NSA also includes a recreational trail (recreational land use/Activity Category C), an office (commercial land use/Activity Category E), a hotel (residential land use/Activity Category E) and a car wash (industrial land use/Activity Category F).
- NSA-D represents the undeveloped lands of the proposed Rice Creek Commons development along westbound TH 10. The proposed development will have a mixture of commercial and residential development along with trails and open space.

The NSAs are shown on **Figures 2 and 3**.

5.0 NOISE MEASUREMENTS

Noise level monitoring is performed during a noise study to document existing noise levels. Existing noise levels can be used as a "baseline" against which future scenarios are compared. In addition, when studying future noise levels projected with computer models, monitored noise levels for existing conditions are compared to modeled results for existing conditions to validate the computer modeling techniques and results.

Existing noise level measurements were conducted on May 11, 2017 at three representative sites in the project vicinity. Twenty-minute measurements were taken at each site in the AM and in the PM. The measurements were made in accordance with FHWA and MnDOT guidelines using an integrating sound level analyzer meeting ANSI and IEC Type 1 specifications. Traffic counts were taken at each site, concurrent with the noise measurements. Monitored noise L_{10} noise levels can be found in **Table 4**.

MINNOISEV31, a version of the FHWA's "STAMINA" model adapted by MnDOT, was used to model the three field sites using traffic counts taken in the field. MINNOISEV31 uses traffic volumes, speed, vehicle classes, and the typical characteristics of the roadway being analyzed (e.g., roadway horizontal and vertical alignment). The results of the MINNOISEv31 modeling were then compared to the measured noise levels. Comparing the modeled noise levels to the measured noise levels confirms the applicability of the computer model to the specific project. The site by site comparison is presented in **Table 4**.

Table 4: Existing Noise Levels and Model Validation

Location	Date	Time	L_{10} (dBA) Monitored	L_{10} (dBA) Modeled	Difference
AM					
FS-1	5/11/2017	10:22 am	75.6	75.9	0.3
FS-2	5/11/2017	11:02 am	71.4	72.7	1.3
FS-3	5/11/2017	11:50 am	67.2	68.6	1.4
PM					
Location	**Date**	**Time**	**L_{10} (dBA) Monitored**	**L_{10} (dBA) Modeled**	**Difference**
FS-1	5/11/2017	1:20 pm	75.5	76.3	0.8
FS-2	5/11/2017	1:45 pm	69.3	73.8	4.5
FS-3	5/11/2017	2:30 pm	65.3	67.7	2.4

Modeled noise levels at 5 of the 6 measurements were within ±3 decibels of the measured noise levels. The 1:45 PM FS-2 noise data did not validate. TH 10 Traffic counts in the PM were greater than the AM **(See Appendix B)** while measured noise levels were less. Since the MINNOISE models were identical except for the traffic data, the higher traffic volumes produced louder PM modeled noise levels. Combining the increased modeled noise levels with decreased measured noise levels resulted in larger differences. The weather data was not significantly different between the two noise measurements and the field notes do not indicate anything that would have caused the PM measured noise level to be lower than the AM measured data. Even though not all sites were within ±3.0 dB, the model did produce conservatively higher noise levels. Field measurement locations are shown on **Figures 2 and 3 (see Appendix A)**. Noise measurement data sheets are provided in **Appendix B**.

6.0 NOISE MODELING

Traffic noise models were run for existing conditions (2016), Future No Build conditions (2040) and Future Build Conditions (2040).

Worst Hourly Traffic Noise Analysis

In general, higher traffic volumes, vehicle speeds, and numbers of heavy trucks increases the loudness of highway traffic noise. The worst hourly traffic noise impact typically occurs when traffic is flowing more freely and when heavy truck volumes are the greatest. For determining the worst-case traffic noise hour, traffic noise levels for one nighttime and four daytime periods were modeled at four representative receptor locations along the TH 10 project corridor under existing conditions, considering the appropriate vehicle mix (i.e., cars, medium trucks, heavy trucks), and directional split in traffic volume (i.e., northbound versus southbound). The nighttime period modeled was selected based on the highest nighttime volume. The daytime periods started with highest truck volumes and ended with the highest automobile volumes.

The daytime L_{10} and L_{50} levels for each of the five modeled time periods are summarized in **Table 5** below. Based on this analysis, it was determined that the time periods from 6:00 AM to 7:00 PM and 1:00 PM to 2:00 PM represents the worst-case traffic noise hours for the nighttime and daytime periods, respectively.

Table 5: Worst Hourly Traffic Noise Summary

Receptor ID	Modeled Level (dBA) by Time Period									
	6:00 – 7:00 AM		1:00 – 2:00 PM		3:00-4:00 PM		4:00-5:00 PM		5:00-6:00 PM	
	L10	L50	L10	L50	L10	L50	L10	L50	L10	L50
N2	**68.7**	**62.4**	**<u>74.5</u>**	**68.3**	**<u>72.9</u>**	**67.4**	**<u>72.3</u>**	**67.0**	**<u>71.9</u>**	**66.6**
N14	**68.0**	**62.5**	**<u>72.1</u>**	**66.9**	**<u>71.9</u>**	**67.0**	**<u>71.4</u>**	**66.8**	**<u>71.0</u>**	**66.5**
N20	**<u>69.5</u>**	**62.4**	**<u>74.2</u>**	**67.9**	**<u>74.0</u>**	**67.8**	**<u>73.3</u>**	**67.3**	**<u>72.8</u>**	**66.8**
N42	59.4	56.2	63.2	**60.4**	63.2	**60.5**	62.8	**60.3**	62.4	**60.1**

Bold numbers are above State daytime standards for residential land uses.
<u>Underline</u> numbers approach or exceed Federal noise abatement criteria B (NAC B)

Noise modeling was done using the noise prediction program MINNOISEV31, a version of the FHWA's STAMINA model adapted by MnDOT. This model uses traffic volumes, speed, vehicle classes, and the typical characteristics of the roadway being analyzed (e.g., roadway horizontal and vertical alignment). Noise model input files were developed based on the following assumptions:

- Traffic data used in the MINNOISEV31 noise model included existing (2016) and future No Build and Build (2040) forecasted traffic volumes.
- The 6:00 AM to 7:00 AM period, just prior to the start of the morning rush hour, with the highest nighttime traffic volumes was identified as the loudest nighttime hour.
- The 1:00 PM to 2:00 PM period of the day was selected as the loudest daytime hour based on hourly northbound and southbound traffic counts on TH 10, approximately 2,200' northeast of CSAH 96.
- An acoustically "soft" surface (alpha=0.5) was assumed between modeled receptor locations and modeled roadways in noise model input files.

Noise impacts were assessed by modeling noise levels at 66 representative locations in the project area. These receivers were selected to model the noise levels at two office building, one restaurant, one hotel, two industrial facilities, 13 recreational facilities (pool, playground and trail), and 124 residential receptors (modeled as 82 noise receivers). The locations of the receivers are shown on **Figures 2 and 3 (Appendix A)**. Land uses (residential, commercial, etc.) and the number of receptors per receiver are listed for each receiver location in **Tables 6 and 7**.

7.0 NOISE MODELING RESULTS

The results of the modeling are presented in **Table 6 and 7**. These tables present the receiver identifications, the land use, the number of receptors per receiver, the modeled Existing, future No-Build and future Build L10 and L50 noise levels, the dBA difference between future No-Build and Existing, the difference between future Build and Existing, and the MPCA Noise Standards, and the FHWA NAC. Noise levels that exceed the MPCA Noise Standards are **boldfaced**, while noise levels that approach or exceed the FHWA NAC are <u>underlined</u>.

Existing L_{10}: The existing daytime L_{10} noise levels at modeled receptors varied between 61.9 dBA and 74.5 dBA, exceeding state noise standards at 99 receptors. The existing nighttime L_{10} noise levels at modeled receptors varied between 57.5 dBA and 71.3 dBA,

exceeding state noise standards at 134 receptors. The existing daytime L_{10} noise levels approach or exceed federal noise abatement criteria at 40 receptors.

Existing L_{50}: The existing daytime L_{50} noise levels at modeled receptors varied between 58.5 dBA and 68.6 dBA, exceeding state noise standards at 136 receptors. The existing nighttime L_{50} noise levels at modeled receptors varied between 53.7 dBA and 65.5 dBA, exceeding state noise standards at 129 receptors.

Future No Build L_{10}: Future 2040 No Build daytime L_{10} noise levels were predicted to range between 62.9 dBA and 75.6 dBA, exceeding state noise standards at 121 receptors. The 2040 No Build nighttime L_{10} noise levels were predicted to range between 58.6 dBA and 72.3 dBA, exceeding state noise standards at 135 receptors. The future 2040 No build daytime L_{10} noise levels approach or exceed federal noise abatement criteria at 43 receptors.

Future No Build L_{50}: The future 2040 No Build daytime L_{50} noise levels at modeled receptors varied between 59.9 dBA and 70.2 dBA, exceeding state noise standards at 137 receptors. The Future No Build nighttime L_{50} noise levels at modeled receptors varied between 55.2 dBA and 67.1 dBA, exceeding state noise standards at 135 receptors.

Future Build L_{10}: Future 2040 Build daytime L_{10} noise levels were predicted to range between 63.0 dBA and 75.8 dBA, exceeding state noise standards at 121 receptors. The 2040 Build nighttime L_{10} values were predicted to range between 58.6 dBA and 72.3 dBA, exceeding state noise standards at 135 receptors. The 2040 build daytime L_{10} noise levels approach or exceed federal noise abatement criteria at 43 receptors.

Future Build L_{50}: The 2040 Build daytime L_{50} noise levels at modeled receptors varied between 60.0 dBA and 70.2 dBA, exceeding state noise standards at 139 receptors. The 2040 Build nighttime L_{50} noise levels at modeled receptors varied between 55.2 dBA and 67.1 dBA, exceeding state noise standards at 135 receptors.

In general, the proposed improvements would result in minor changes in traffic noise levels compared to existing conditions. Changes in daytime L_{10} noise levels under the future Build conditions will range from 1.0 to 1.4 decibels compared to existing conditions. Changes in daytime L_{50} noise levels under the future Build conditions will range from 1.2 to 1.8 decibels compared existing conditions. Nighttime L_{10} and L_{50} noise levels would increase 1.0 to 1.4 and 1.2 to 1.9 decibels, respectively, over existing conditions.

Specific results for the 82 representative receivers modeled can be found in **Table 6** (daytime model results) and **Table 7** (nighttime model results).

Table 6: Daytime Model Results (1:00 p.m. – 2:00 p.m.)

Receiver ID	NSA	Land Use	FHWA NAC	MnDOT NAC	Number of Receptors	Existing Conditions (2016)		Future No-Build (2040)		Difference No-Build (2040) - Existing (2016)		Future Build (2040)		Difference Build (2040) - Existing (2016)	
						L10	L50	L10	L50	L10	L50	L10	L50	L10	L50
N1	A	Industrial	F	NAC-3	1	73.0	68.0	74.0	69.5	1.0	1.5	74.2	69.6	1.2	1.6
N2	A	Residential	B	NAC-1	2	**73.2**	**67.4**	**74.3**	**69.0**	1.1	1.6	**74.4**	**68.9**	1.2	1.5
N3	A	Residential	B	NAC-1	3	**74.1**	**68.3**	**75.2**	**69.9**	1.1	1.6	**75.2**	**69.7**	1.1	1.4
N4	A	Residential	B	NAC-1	2	**71.9**	**66.9**	**73.0**	**68.4**	1.1	1.5	**73.1**	**68.4**	1.2	1.5
N5	A	Residential	B	NAC-1	3	**70.7**	**66.0**	**71.7**	**67.6**	1.0	1.6	**71.8**	**67.6**	1.1	1.6
N6	A	Residential	B	NAC-1	2	**69.7**	**65.4**	**70.7**	**66.9**	1.0	1.5	**70.8**	**66.9**	1.1	1.5
N7	A	Residential	B	NAC-1	3	**67.5**	**64.3**	**68.5**	**65.6**	1.0	1.3	**68.5**	**65.6**	1.0	1.3
N8	A	Residential	B	NAC-1	4	**67.4**	**64.1**	**68.4**	**65.5**	1.0	1.4	**68.4**	**65.5**	1.0	1.4
N9	A	Residential	B	NAC-1	1	**67.8**	**64.2**	**68.8**	**65.6**	1.0	1.4	**68.8**	**65.6**	1.0	1.4
N10	A	Residential	B	NAC-1	2	**66.0**	**63.0**	**67.0**	**64.3**	1.0	1.3	**67.0**	**64.3**	1.0	1.3
N11	A	Residential	B	NAC-1	2	**66.3**	**63.1**	**67.3**	**64.4**	1.0	1.3	**67.3**	**64.4**	1.0	1.3
N12	B	Office	E	NAC-2	1	**74.5**	**68.6**	**75.6**	**70.2**	1.1	1.6	**75.8**	**70.2**	1.3	1.6
N13	B	Residential	B	NAC-1	2	**70.3**	**65.7**	**71.4**	**67.2**	1.1	1.5	**71.5**	**67.2**	1.2	1.5
N14	B	Restaurant	E	NAC-2	1	**72.1**	**66.9**	**73.1**	**68.5**	1.0	1.6	**73.3**	**68.5**	1.2	1.6
N15	B	Residential	B	NAC-1	2	**71.2**	**65.8**	**72.2**	**67.4**	1.0	1.6	**72.4**	**67.4**	1.2	1.6
N16	B	Residential	B	NAC-1	3	**71.0**	**65.7**	**72.1**	**67.2**	1.1	1.5	**72.3**	**67.3**	1.3	1.6
N17	B	Residential	B	NAC-1	2	**69.6**	**64.7**	**70.7**	**66.2**	1.1	1.5	**70.8**	**66.3**	1.2	1.6
N18	B	Residential	B	NAC-1	2	**73.9**	**68.0**	**75.0**	**69.6**	1.1	1.6	**75.0**	**69.6**	1.1	1.6
N19	B	Residential	B	NAC-1	1	**74.5**	**68.3**	**75.6**	**69.9**	1.1	1.6	**75.6**	**69.9**	1.1	1.6
N20	B	Residential	B	NAC-1	1	**74.2**	**67.9**	**75.4**	**69.5**	1.2	1.6	**75.4**	**69.5**	1.2	1.6
N21	B	Residential	B	NAC-1	2	**74.4**	**68.3**	**75.5**	**70.0**	1.1	1.7	**75.6**	**70.1**	1.2	1.8
N22	B	Residential	B	NAC-1	3	**68.6**	**64.1**	**69.7**	**65.6**	1.1	1.5	**69.7**	**65.7**	1.1	1.6
N23	B	Residential	B	NAC-1	2	**66.5**	**63.1**	**67.6**	**64.5**	1.1	1.4	**67.6**	**64.5**	1.1	1.4
N24	B	Residential	B	NAC-1	3	**66.5**	**62.9**	**67.5**	**64.3**	1.0	1.4	**67.5**	**64.4**	1.0	1.5
N25	B	Residential	B	NAC-1	1	**67.3**	**63.4**	**68.3**	**64.8**	1.0	1.4	**68.4**	**64.9**	1.1	1.5
N26	B	Residential	B	NAC-1	1	**66.2**	**62.6**	**67.2**	**64.0**	1.0	1.4	**67.3**	**64.1**	1.1	1.5
N27	B	Residential	B	NAC-1	3	**66.6**	**62.9**	**67.6**	**64.3**	1.0	1.4	**67.7**	**64.3**	1.1	1.4
N28	B	Residential	B	NAC-1	2	**66.4**	**62.6**	**67.4**	**64.0**	1.0	1.4	**67.4**	**64.1**	1.0	1.5
N29	B	Residential	B	NAC-1	3	**66.9**	**62.9**	**68.0**	**64.4**	1.1	1.5	**68.0**	**64.4**	1.1	1.5
N30	B	Residential	B	NAC-1	2	**66.7**	**62.8**	**67.8**	**64.2**	1.1	1.4	**67.8**	**64.3**	1.1	1.5
N31	B	Residential	B	NAC-1	2	**66.6**	**62.7**	**67.7**	**64.1**	1.1	1.4	**67.7**	**64.2**	1.1	1.5
N32	B	Residential	B	NAC-1	2	**66.4**	**62.6**	**67.5**	**64.1**	1.1	1.5	**67.5**	**64.1**	1.1	1.5
N33	B	Residential	B	NAC-1	2	**67.1**	**63.2**	**68.1**	**64.6**	1.0	1.4	**68.2**	**64.7**	1.1	1.5
N34	B	Residential	B	NAC-1	4	**66.0**	**61.9**	**67.1**	**63.4**	1.1	1.5	**67.1**	**63.5**	1.1	1.6
N35	B	Residential	B	NAC-1	3	**65.4**	**62.3**	**66.4**	**63.7**	1.0	1.4	**66.5**	**63.7**	1.1	1.4
N36	B	Residential	B	NAC-1	2	64.4	**61.3**	**65.4**	**62.7**	1.0	1.4	**65.5**	**62.7**	1.1	1.4
N37	B	Residential	B	NAC-1	2	64.8	**61.6**	**65.8**	**63.0**	1.0	1.4	**65.8**	**63.0**	1.0	1.4

If noise level exceeds MPCA daytime Standard – **Boldface**; approach or exceeds FHWA NAC – Underlined										
MPCA Residential Daytime Standard	**65.0**	**60.0**	**65.0**	**60.0**	-	-	**65.0**	**60.0**	-	-
FHWA Activity Category B, C	70.0	-	70.0	-	-	-	70.0	-	-	-
FHWA Activity Category E	75.0	-	75.0	-	-	-	75.0	-	-	-
MPCA Commercial Daytime Standard	**70.0**	**65.0**	**70.0**	**65.0**	-	-	**70.0**	**65.0**	-	-
MPCA Industrial Daytime Standard	**80.0**	**75.0**	**80.0**	**75.0**	-	-	**80.0**	**75.0**	-	-

Receiver ID	NSA	Land Use	FHWA NAC	MnDOT NAC	Number of Receptors	Existing Conditions (2016)		Future No-Build (2040)		Difference No-Build (2040) - Existing (2016)		Future Build (2040)		Difference Build (2040) - Existing (2016)	
						L10	L50	L10	L50	L10	L50	L10	L50	L10	L50
N38	B	Residential	B	NAC-1	1	**65.2**	**61.8**	**66.3**	**63.2**	1.1	1.4	**66.3**	**63.3**	1.1	1.5
N39	B	Residential	B	NAC-1	2	64.7	**61.4**	**65.7**	**62.8**	1.0	1.4	**65.8**	**62.9**	1.1	1.5
N40	B	Residential	B	NAC-1	1	64.6	**61.3**	**65.6**	**62.7**	1.0	1.4	**65.6**	**62.8**	1.0	1.5
N41	B	Residential	B	NAC-1	1	**65.2**	**61.7**	**66.2**	**63.2**	1.0	1.5	**66.2**	**63.2**	1.0	1.5
N42	B	Residential	B	NAC-1	2	63.2	**60.4**	64.3	**61.7**	1.1	1.3	64.3	**61.8**	1.1	1.4
N43	B	Residential	B	NAC-1	1	63.7	**60.7**	64.7	**62.1**	1.0	1.4	64.8	**62.1**	1.1	1.4
N44	B	Residential	B	NAC-1	1	63.7	**60.7**	64.7	**62.1**	1.0	1.4	64.8	**62.1**	1.1	1.4
N45	B	Residential	B	NAC-1	1	63.0	**60.2**	64.0	**61.5**	1.0	1.3	64.0	**61.5**	1.0	1.3
N46	B	Residential	B	NAC-1	3	64.1	**60.9**	**65.1**	**62.3**	1.0	1.4	**65.1**	**62.4**	1.0	1.5
N47	B	Residential	B	NAC-1	3	64.0	**60.9**	**65.0**	**62.3**	1.0	1.4	**65.1**	**62.3**	1.1	1.4
N48	B	Recreational	C	NAC-2	1	63.0	60.2	64.1	61.5	1.1	1.3	64.1	61.6	1.1	1.4
N49	B	Residential	B	NAC-1	2	63.1	**60.2**	64.1	**61.6**	1.0	1.4	64.2	**61.6**	1.1	1.4
N50	B	Residential	B	NAC-1	2	63.1	**60.2**	64.1	**61.6**	1.0	1.4	64.2	**61.6**	1.1	1.4
N51	B	Residential	B	NAC-1	1	63.2	**60.1**	64.2	**61.6**	1.0	1.5	64.3	**61.6**	1.1	1.5
N52	B	Residential	B	NAC-1	2	61.9	58.5	62.9	59.9	1.0	1.4	63.0	**60.0**	1.1	1.5
N53	C	Recreational	C	NAC-2	1	**72.0**	62.8	**73.4**	64.6	1.4	1.8	**73.4**	64.6	1.4	1.8
N54	C	Recreational	C	NAC-2	1	**72.7**	64.5	**74.0**	**66.3**	1.3	1.8	**74.0**	**66.3**	1.3	1.8
N55	C	Recreational	C	NAC-2	1	**74.0**	**66.4**	**75.3**	**68.2**	1.3	1.8	**75.3**	**68.2**	1.3	1.8
N56	C	Recreational	C	NAC-2	1	**74.1**	**67.3**	**75.3**	**69.0**	1.2	1.7	**75.3**	**69.0**	1.2	1.7
N57	C	Recreational	C	NAC-2	1	**74.1**	**67.4**	**75.3**	**69.1**	1.2	1.7	**75.3**	**69.0**	1.2	1.6
N58	C	Recreational	C	NAC-2	1	**73.9**	**67.2**	**75.1**	**68.9**	1.2	1.7	**75.1**	**68.8**	1.2	1.6
N59	C	Recreational	C	NAC-2	1	**73.7**	**67.5**	**74.9**	**69.1**	1.2	1.6	**74.9**	**69.1**	1.2	1.6
N60	C	Hotel	E	NAC-1	1	**71.7**	**67.8**	**72.7**	**69.2**	1.0	1.4	**72.7**	**69.2**	1.0	1.4
N61	C	Recreational	C	NAC-2	1	**73.7**	**67.5**	**74.9**	**69.2**	1.2	1.7	**74.9**	**69.2**	1.2	1.7
N62	C	Recreational	C	NAC-2	1	**74.1**	**67.5**	**75.3**	**69.1**	1.2	1.6	**75.3**	**69.1**	1.2	1.6
N63	C	Industrial	F	NAC-3	1	69.2	66.8	70.2	68.1	1.0	1.3	70.2	68.1	1.0	1.3
N64	C	Recreational	C	NAC-2	1	**74.3**	**67.5**	**75.5**	**69.2**	1.2	1.7	**75.5**	**69.2**	1.2	1.7
N65	C	Recreational	C	NAC-2	1	**74.0**	**67.2**	**75.1**	**68.8**	1.1	1.6	**75.1**	**68.8**	1.1	1.6
N66	C	Office	E	NAC-2	1	**72.5**	**67.0**	**73.6**	**68.6**	1.1	1.6	**73.6**	**68.6**	1.1	1.6
N67	C	Recreational	C	NAC-2	1	69.1	**66.1**	**70.1**	**67.5**	1.0	1.4	**70.1**	**67.5**	1.0	1.4
N68	C	Residential	B	NAC-1	1	**67.8**	**65.2**	**68.9**	**66.5**	1.1	1.3	**68.9**	**66.5**	1.1	1.3
N69	C	Residential	B	NAC-1	1	**67.0**	**64.7**	**68.1**	**66.0**	1.1	1.3	**68.1**	**66.0**	1.1	1.3
N70	C	Residential	B	NAC-1	2	**65.4**	**63.4**	**66.4**	**64.7**	1.0	1.3	**66.4**	**64.7**	1.0	1.3
N71	C	Residential	B	NAC-1	2	**65.3**	**63.3**	**66.3**	**64.6**	1.0	1.3	**66.3**	**64.6**	1.0	1.3
N72	C	Residential	B	NAC-1	1	**66.8**	**64.5**	**67.9**	**65.8**	1.1	1.3	**67.9**	**65.8**	1.1	1.3
N73	C	Residential	B	NAC-1	1	**66.3**	**64.2**	**67.3**	**65.4**	1.0	1.2	**67.3**	**65.4**	1.0	1.2
N74	C	Residential	B	NAC-1	2	64.4	**62.6**	**65.5**	**63.9**	1.1	1.3	**65.5**	**63.9**	1.1	1.3
N75	C	Residential	B	NAC-1	1	**66.1**	**64.0**	**67.2**	**65.3**	1.1	1.3	**67.1**	**65.3**	1.0	1.3
N76	C	Residential	B	NAC-1	1	**65.6**	**63.6**	**66.6**	**64.9**	1.0	1.3	**66.6**	**64.8**	1.0	1.2
N77	C	Residential	B	NAC-1	2	64.3	**62.5**	**65.3**	**63.7**	1.0	1.2	**65.3**	**63.7**	1.0	1.2

If noise level exceeds MPCA daytime Standard – **Boldface**; approach or exceeds FHWA NAC – Underlined										
MPCA Residential Daytime Standard	**65.0**	**60.0**	**65.0**	**60.0**	-	-	**65.0**	**60.0**	-	-
FHWA Activity Category B, C	70.0	-	70.0	-	-	-	70.0	-	-	-
FHWA Activity Category E	75.0	-	75.0	-	-	-	75.0	-	-	-
MPCA Commercial Daytime Standard	**70.0**	**65.0**	**70.0**	**65.0**	-	-	**70.0**	**65.0**	-	-
MPCA Industrial Daytime Standard	**80.0**	**75.0**	**80.0**	**75.0**	-	-	**80.0**	**75.0**	-	-

Receiver ID	NSA	Land Use	FHWA NAC	MnDOT NAC	Number of Receptors	Existing Conditions (2016)		Future No-Build (2040)		Difference No-Build (2040) - Existing (2016)		Future Build (2040)		Difference Build (2040) - Existing (2016)	
						L10	L50	L10	L50	L10	L50	L10	L50	L10	L50
N78	C	Residential	B	NAC-1	2	63.7	**62.0**	64.7	**63.2**	1.0	1.2	64.7	**63.2**	1.0	1.2
N79	C	Residential	B	NAC-1	2	64.8	**62.9**	**65.9**	**64.2**	1.1	1.3	**65.8**	**64.2**	1.0	1.3
N80	C	Residential	B	NAC-1	2	64.3	**62.5**	**65.3**	**63.8**	1.0	1.3	**65.3**	**63.7**	1.0	1.2
N81	C	Residential	B	NAC-1	2	63.7	**61.9**	64.7	**63.2**	1.0	1.3	64.7	**63.2**	1.0	1.3
N82	C	Residential	B	NAC-1	3	62.8	**61.1**	63.8	**62.4**	1.0	1.3	63.8	**62.4**	1.0	1.3
If noise level exceeds MPCA daytime Standard – **Boldface**; approach or exceeds FHWA NAC – Underlined															
MPCA Residential Daytime Standard						**65.0**	**60.0**	65.0	**60.0**	**-**	**-**	**65.0**	**60.0**	**-**	**-**
FHWA Activity Category B, C						70.0	**-**	70.0	**-**	**-**	**-**	70.0	**-**	**-**	**-**
FHWA Activity Category E						75.0	**-**	75.0	**-**	**-**	**-**	75.0	**-**	**-**	**-**
MPCA Commercial Daytime Standard						**70.0**	**65.0**	**70.0**	**65.0**	**-**	**-**	**70.0**	**65.0**	**-**	**-**
MPCA Industrial Daytime Standard						**80.0**	**75.0**	**80.0**	**75.0**	**-**	**-**	**80.0**	**75.0**	**-**	**-**

Table 7: Nighttime Model Results (6:00 a.m. – 7:00 a.m.)

Receiver ID	NSA	Land Use	FHWA NAC	MnDOT NAC	Number of Receptors	Existing Conditions (2016)		Future No-Build (2040)		Difference No-Build (2040) - Existing (2016)		Future Build (2040)		Difference Build (2040) - Existing (2016)	
						L10	L50	L10	L50	L10	L50	L10	L50	L10	L50
N1	A	Industrial	F	NAC-3	1	69.1	64.0	70.1	65.5	1.0	1.5	70.3	65.6	1.2	1.6
N2	A	Residential	B	NAC-1	2	**68.7**	**62.4**	**69.8**	**64.1**	1.1	1.7	**69.9**	**64.0**	1.2	1.6
N3	A	Residential	B	NAC-1	3	**69.9**	**63.8**	**71.0**	**65.5**	1.1	1.7	**71.0**	**65.1**	1.1	1.3
N4	A	Residential	B	NAC-1	2	**67.8**	**62.5**	**68.9**	**64.0**	1.1	1.5	**69.0**	**64.0**	1.2	1.5
N5	A	Residential	B	NAC-1	3	**66.7**	**61.7**	**67.7**	**63.2**	1.0	1.5	**67.8**	**63.2**	1.1	1.5
N6	A	Residential	B	NAC-1	2	**65.7**	**61.1**	**66.7**	**62.6**	1.0	1.5	**66.7**	**62.6**	1.0	1.5
N7	A	Residential	B	NAC-1	3	**63.8**	**60.4**	**64.8**	**61.8**	1.0	1.4	**64.8**	**61.8**	1.0	1.4
N8	A	Residential	B	NAC-1	4	**63.6**	**60.2**	**64.6**	**61.5**	1.0	1.3	**64.6**	**61.6**	1.0	1.4
N9	A	Residential	B	NAC-1	1	**63.9**	**60.1**	**64.9**	**61.5**	1.0	1.4	**64.9**	**61.5**	1.0	1.4
N10	A	Residential	B	NAC-1	2	**62.3**	**59.0**	**63.3**	**60.4**	1.0	1.4	**63.3**	**60.4**	1.0	1.4
N11	A	Residential	B	NAC-1	2	**62.5**	**59.0**	**63.5**	**60.4**	1.0	1.4	**63.5**	**60.4**	1.0	1.4
N12	B	Office	E	NAC-2	1	**70.4**	64.2	**71.5**	**65.8**	1.1	1.6	**71.7**	**65.9**	1.3	1.7
N13	B	Residential	B	NAC-1	2	**66.3**	**61.3**	**67.3**	**62.9**	1.0	1.6	**67.4**	**62.9**	1.1	1.6
N14	B	Restaurant	E	NAC-2	1	68.0	62.5	69.1	64.1	1.1	1.6	69.2	64.1	1.2	1.6
N15	B	Residential	B	NAC-1	2	**66.7**	**60.6**	**67.8**	**62.3**	1.1	1.7	**67.9**	**62.4**	1.2	1.8
N16	B	Residential	B	NAC-1	3	**66.5**	**60.5**	**67.6**	**62.1**	1.1	1.6	**67.8**	**62.2**	1.3	1.7
N17	B	Residential	B	NAC-1	2	**65.2**	**59.6**	**66.3**	**61.2**	1.1	1.6	**66.4**	**61.3**	1.2	1.7
N18	B	Residential	B	NAC-1	2	**69.7**	**63.3**	**70.8**	**65.0**	1.1	1.7	**70.7**	**64.9**	1.0	1.6
N19	B	Residential	B	NAC-1	1	**70.1**	**63.5**	**71.3**	**65.2**	1.2	1.7	**71.3**	**65.1**	1.2	1.6
N20	B	Residential	B	NAC-1	1	**69.5**	**62.4**	**70.7**	**64.1**	1.2	1.7	**70.7**	**64.1**	1.2	1.7
N21	B	Residential	B	NAC-1	2	**70.1**	**63.7**	**71.3**	**65.4**	1.2	1.7	**71.4**	**65.5**	1.3	1.8
N22	B	Residential	B	NAC-1	3	**64.4**	**59.4**	**65.5**	**60.9**	1.1	1.5	**65.5**	**61.0**	1.1	1.6
N23	B	Residential	B	NAC-1	2	**62.7**	**59.0**	**63.7**	**60.4**	1.0	1.4	**63.7**	**60.4**	1.0	1.4
N24	B	Residential	B	NAC-1	3	**62.6**	**58.7**	**63.6**	**60.1**	1.0	1.4	**63.6**	**60.1**	1.0	1.4
N25	B	Residential	B	NAC-1	1	**63.3**	**58.9**	**64.3**	**60.4**	1.0	1.5	**64.4**	**60.5**	1.1	1.6
N26	B	Residential	B	NAC-1	1	**62.2**	**58.3**	**63.2**	**59.7**	1.0	1.4	**63.3**	**59.8**	1.1	1.5
N27	B	Residential	B	NAC-1	3	**62.6**	**58.5**	**63.6**	**59.9**	1.0	1.4	**63.7**	**60.0**	1.1	1.5
N28	B	Residential	B	NAC-1	2	**62.3**	**58.1**	**63.3**	**59.5**	1.0	1.4	**63.4**	**59.6**	1.1	1.5
N29	B	Residential	B	NAC-1	3	**62.8**	**58.2**	**63.8**	**59.8**	1.0	1.6	**63.9**	**59.8**	1.1	1.6
N30	B	Residential	B	NAC-1	2	**62.6**	**58.0**	**63.6**	**59.5**	1.0	1.5	**63.6**	**59.6**	1.0	1.6
N31	B	Residential	B	NAC-1	2	**62.5**	**58.0**	**63.5**	**59.5**	1.0	1.5	**63.5**	**59.5**	1.0	1.5
N32	B	Residential	B	NAC-1	2	**62.3**	**57.9**	**63.3**	**59.4**	1.0	1.5	**63.4**	**59.5**	1.1	1.6
N33	B	Residential	B	NAC-1	2	**63.0**	**58.6**	**64.1**	**60.1**	1.1	1.5	**64.1**	**60.1**	1.1	1.5
N34	B	Residential	B	NAC-1	4	**61.8**	**57.1**	**62.9**	**58.6**	1.1	1.5	**62.9**	**58.7**	1.1	1.6
N35	B	Residential	B	NAC-1	3	**61.6**	**58.2**	**62.6**	**59.6**	1.0	1.4	**62.6**	**59.6**	1.0	1.4
N36	B	Residential	B	NAC-1	2	**60.6**	**57.2**	**61.5**	**58.6**	0.9	1.4	**61.6**	**58.6**	1.0	1.4
N37	B	Residential	B	NAC-1	2	**60.9**	**57.3**	**61.9**	**58.7**	1.0	1.4	**61.9**	**58.8**	1.0	1.5

If noise level exceeds MPCA nighttime Standard – **Boldface**; approach or exceeds FHWA NAC – Underlined										
MPCA Residential Nighttime Standard	**55.0**	**50.0**	55.0	**50.0**	-	-	**55.0**	**50.0**	-	-
FHWA Activity Category B, C	70.0	-	70.0	-	-	-	70.0	-	-	-
FHWA Activity Category E	75.0	-	75.0	-	-	-	75.0	-	-	-
MPCA Commercial Nighttime Standard	**70.0**	**65.0**	**70.0**	**65.0**	-	-	**70.0**	**65.0**	-	-
MPCA Industrial Nighttime Standard	**80.0**	**75.0**	**80.0**	**75.0**	-	-	**80.0**	**75.0**	-	-

Receiver ID	NSA	Land Use	FHWA NAC	MnDOT NAC	Number of Receptors	Existing Conditions (2016)		Future No-Build (2040)		Difference No-Build (2040) - Existing (2016)		Future Build (2040)		Difference Build (2040) - Existing (2016)	
						L10	L50	L10	L50	L10	L50	L10	L50	L10	L50
N38	B	Residential	B	NAC-1	1	**61.3**	**57.4**	**62.3**	**58.9**	1.0	1.5	**62.3**	**58.9**	1.0	1.5
N39	B	Residential	B	NAC-1	2	**60.7**	**56.9**	**61.7**	**58.3**	1.0	1.4	**61.7**	**58.4**	1.0	1.5
N40	B	Residential	B	NAC-1	1	**60.5**	**56.7**	**61.5**	**58.2**	1.0	1.5	**61.6**	**58.2**	1.1	1.5
N41	B	Residential	B	NAC-1	1	**61.1**	**57.1**	**62.1**	**58.6**	1.0	1.5	**62.1**	**58.6**	1.0	1.5
N42	B	Residential	B	NAC-1	2	**59.4**	**56.2**	**60.4**	**57.6**	1.0	1.4	**60.4**	**57.6**	1.0	1.4
N43	B	Residential	B	NAC-1	1	**59.8**	**56.5**	**60.8**	**57.9**	1.0	1.4	**60.8**	**57.9**	1.0	1.4
N44	B	Residential	B	NAC-1	1	**59.8**	**56.4**	**60.8**	**57.8**	1.0	1.4	**60.9**	**57.9**	1.1	1.5
N45	B	Residential	B	NAC-1	1	**59.1**	**55.9**	**60.1**	**57.3**	1.0	1.4	**60.1**	**57.3**	1.0	1.4
N46	B	Residential	B	NAC-1	3	**60.1**	**56.5**	**61.1**	**57.9**	1.0	1.4	**61.1**	**58.0**	1.0	1.5
N47	B	Residential	B	NAC-1	3	**60.0**	**56.4**	**61.0**	**57.8**	1.0	1.4	**61.1**	**57.9**	1.1	1.5
N48	B	Recreational	C	NAC-2	1	59.1	55.7	60.1	57.1	1.0	1.4	60.1	57.2	1.0	1.5
N49	B	Residential	B	NAC-1	2	**59.1**	**55.7**	**60.1**	**57.1**	1.0	1.4	**60.1**	**57.2**	1.0	1.5
N50	B	Residential	B	NAC-1	2	**59.0**	**55.6**	**60.1**	**57.0**	1.1	1.4	**60.1**	**57.1**	1.1	1.5
N51	B	Residential	B	NAC-1	1	**59.0**	**55.4**	**60.1**	**56.9**	1.1	1.5	**60.1**	**56.9**	1.1	1.5
N52	B	Residential	B	NAC-1	2	**57.5**	**53.7**	**58.6**	**55.2**	1.1	1.5	**58.6**	**55.2**	1.1	1.5
N53	C	Recreational	C	NAC-2	1	67.4	58.1	68.8	60.0	1.4	1.9	68.8	60.0	1.4	1.9
N54	C	Recreational	C	NAC-2	1	68.4	60.3	69.8	62.2	1.4	1.9	69.7	62.1	1.3	1.8
N55	C	Recreational	C	NAC-2	1	69.8	62.4	**71.1**	64.2	1.3	1.8	**71.1**	64.2	1.3	1.8
N56	C	Recreational	C	NAC-2	1	**70.0**	63.6	**71.3**	**65.3**	1.3	1.7	**71.2**	**65.3**	1.2	1.7
N57	C	Recreational	C	NAC-2	1	**70.3**	64.0	**71.4**	**65.7**	1.1	1.7	**71.4**	**65.6**	1.1	1.6
N58	C	Recreational	C	NAC-2	1	**70.2**	64.1	**71.4**	**65.8**	1.2	1.7	**71.3**	**65.7**	1.1	1.6
N59	C	Recreational	C	NAC-2	1	**70.3**	64.8	**71.4**	**66.4**	1.1	1.6	**71.3**	**66.4**	1.0	1.6
N60	C	Hotel	E	NAC-1	1	**68.5**	**65.2**	**69.5**	**66.6**	1.0	1.4	**69.5**	**66.6**	1.0	1.4
N61	C	Recreational	C	NAC-2	1	**70.4**	**65.2**	**71.5**	**66.7**	1.1	1.5	**71.5**	**66.7**	1.1	1.5
N62	C	Recreational	C	NAC-2	1	**71.0**	**65.4**	**72.0**	**67.0**	1.0	1.6	**72.0**	**67.0**	1.0	1.6
N63	C	Industrial	F	NAC-3	1	66.5	64.1	67.5	65.4	1.0	1.3	67.5	65.4	1.0	1.3
N64	C	Recreational	C	NAC-2	1	**71.3**	**65.5**	**72.3**	**67.1**	1.0	1.6	**72.3**	**67.1**	1.0	1.6
N65	C	Recreational	C	NAC-2	1	**71.0**	**65.3**	**72.0**	**66.9**	1.0	1.6	**72.0**	**66.8**	1.0	1.5
N66	C	Office	E	NAC-2	1	68.5	63.5	69.7	**65.1**	1.2	1.6	69.6	**65.0**	1.1	1.5
N67	C	Recreational	C	NAC-2	1	65.6	63.0	66.7	64.3	1.1	1.3	66.7	64.3	1.1	1.3
N68	C	Residential	B	NAC-1	1	**64.4**	**62.1**	**65.5**	**63.4**	1.1	1.3	**65.5**	**63.4**	1.1	1.3
N69	C	Residential	B	NAC-1	1	**63.8**	**61.6**	**64.9**	**62.9**	1.1	1.3	**64.8**	**62.9**	1.0	1.3
N70	C	Residential	B	NAC-1	2	**62.3**	**60.4**	**63.4**	**61.7**	1.1	1.3	**63.4**	**61.7**	1.1	1.3
N71	C	Residential	B	NAC-1	2	**62.2**	**60.3**	**63.3**	**61.5**	1.1	1.2	**63.3**	**61.5**	1.1	1.2
N72	C	Residential	B	NAC-1	1	**63.6**	**61.4**	**64.6**	**62.7**	1.0	1.3	**64.6**	**62.7**	1.0	1.3
N73	C	Residential	B	NAC-1	1	**63.1**	**61.1**	**64.2**	**62.4**	1.1	1.3	**64.2**	**62.4**	1.1	1.3
N74	C	Residential	B	NAC-1	2	**61.4**	**59.6**	**62.5**	**60.8**	1.1	1.2	**62.5**	**60.8**	1.1	1.2
N75	C	Residential	B	NAC-1	1	**62.9**	**60.9**	**64.0**	**62.2**	1.1	1.3	**64.0**	**62.2**	1.1	1.3
N76	C	Residential	B	NAC-1	1	**62.5**	**60.5**	**63.5**	**61.8**	1.0	1.3	**63.5**	**61.8**	1.0	1.3

If noise level exceeds MPCA nighttime Standard – **Boldface**; approach or exceeds FHWA NAC – Underlined										
MPCA Residential Nighttime Standard	**55.0**	**50.0**	55.0	**50.0**	-	-	**55.0**	**50.0**	-	-
FHWA Activity Category B, C	70.0	-	70.0	-	-	-	70.0	-	-	-
FHWA Activity Category E	75.0	-	75.0	-	-	-	75.0	-	-	-
MPCA Commercial Nighttime Standard	**70.0**	**65.0**	**70.0**	**65.0**	-	-	**70.0**	**65.0**	-	-
MPCA Industrial Nighttime Standard	**80.0**	**75.0**	**80.0**	**75.0**	-	-	**80.0**	**75.0**	-	-

Receiver ID	NSA	Land Use	FHWA NAC	MnDOT NAC	Number of Receptors	Existing Conditions (2016)		Future No-Build (2040)		Difference No-Build (2040) - Existing (2016)		Future Build (2040)		Difference Build (2040) - Existing (2016)	
						L10	L50	L10	L50	L10	L50	L10	L50	L10	L50
N77	C	Residential	B	NAC-1	2	**61.3**	**59.4**	**62.3**	**60.7**	1.0	1.3	**62.3**	**60.7**	1.0	1.3
N78	C	Residential	B	NAC-1	2	**60.7**	**58.9**	**61.8**	**60.2**	1.1	1.3	**61.8**	**60.2**	1.1	1.3
N79	C	Residential	B	NAC-1	2	**61.7**	**59.8**	**62.8**	**61.1**	1.1	1.3	**62.8**	**61.1**	1.1	1.3
N80	C	Residential	B	NAC-1	2	**61.3**	**59.5**	**62.3**	**60.7**	1.0	1.2	**62.3**	**60.7**	1.0	1.2
N81	C	Residential	B	NAC-1	2	**60.6**	**58.9**	**61.7**	**60.1**	1.1	1.2	**61.7**	**60.1**	1.1	1.2
N82	C	Residential	B	NAC-1	3	**59.8**	**58.1**	**60.8**	**59.3**	1.0	1.2	**60.8**	**59.3**	1.0	1.2
If noise level exceeds MPCA nighttime Standard – **Boldface**; approach or exceeds FHWA NAC – Underlined															
MPCA Residential Nighttime Standard						**55.0**	**50.0**	55.0	**50.0**	**-**	**-**	**55.0**	**50.0**	**-**	**-**
FHWA Activity Category B, C						70.0	**-**	70.0	**-**	**-**	**-**	70.0	**-**	**-**	**-**
FHWA Activity Category E						75.0	**-**	75.0	**-**	**-**	**-**	75.0	**-**	**-**	**-**
MPCA Commercial Nighttime Standard						**70.0**	**65.0**	**70.0**	**65.0**	**-**	**-**	**70.0**	**65.0**	**-**	**-**
MPCA Industrial Nighttime Standard						**80.0**	**75.0**	**80.0**	**75.0**	**-**	**-**	**80.0**	**75.0**	**-**	**-**

8.0 CONSIDERATION OF NOISE ABATEMENT

Noise Abatement Measures

According to the definitions in 23 CFR 772 the proposed project is considered a Type I project. 23 CFR 772.15(c) describes noise abatement measures that are to be considered when a noise impact has been identified with a Type I highway project. These noise abatement measures include:

- Construction of noise barriers, including acquisition of property rights, either within or outside the highway right-of-way. Landscaping is not a viable noise abatement measure.
- Traffic management measures including, but not limited to, traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations.
- Alteration of horizontal and vertical alignments.
- Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise.
- Noise insulation of certain facilities, including: auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, pubic meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools and television studios.

Noise Mitigation Evaluation

MnDOT's policies and procedures for evaluating noise barrier feasibility and reasonableness are set forth in Section 5.2 (Feasibility) and Section 5.3 (Reasonableness) of the 2015 MnDOT Highway Noise Policy. The factors for determining noise barrier feasibility and reasonableness as described in the MnDOT noise policy are summarized below. Noise barrier construction decisions are based on a study of feasibility and reasonableness.

Acoustic feasibility requires that a noise abatement measure must achieve a 5-dBA reduction at an impacted receptor for that receptor to be considered benefited. Engineering feasibility is determined by physical and/or engineering constraints taking into consideration safety topography, drainage, utilities and maintenance. MnDOT has established a maximum noise barrier height of 20 feet above the finished ground line at the noise barrier.

There are three reasonableness factors that must be met for a noise abatement measure to be considered reasonable;

- One benefited receptor must achieve the noise reduction design goal of at least 7 dBA,
- The cost effectiveness (CE) of the noise barrier cannot exceed $43,500 per benefited receptor based on an estimated noise barrier construction cost of $20/sq. ft. plus any additional costs for rub rails, retaining wall reinforcement, etc., and
- The viewpoints of benefited residents and property owners must be solicited, recorded and considered in reaching a decision on the proposed noise abatement measure.

The feasibility of noise barrier construction is sometimes dependent on design details that are not known until the final design phase of the project. It is assumed that any utilities located within the project corridor can be relocated to accommodate noise walls. The proposed improvement project is to be constructed entirely within the existing right-of-way.

There are several steps to assessing the reasonableness of a noise barrier. First, the noise barrier must achieve the noise reduction design goal of at least 7 dBA at one benefited receptor. Then the cost per benefited receptor is determined by dividing the total cost of the noise barrier by the number of benefited receptors.

Noise barriers were evaluated at all modeled receivers that would exceed either the MPCA L_{10} or L_{50} daytime and/or nighttime noise standards or the FHWA's NAC with the future (2040) Build Alternative. The noise barriers are identified throughout the report, in **Tables 8, 9, 10 and 11** and on **Figures 2 and 3 (Appendix A)** with the following nomenclature, NB1 through NB3.

The noise reduction provided by a noise barrier is a function of vehicle mix (percent automobiles, medium trucks and heavy trucks), the height of the traffic noise sources, the distance from the traffic noise source to the receiver, and the height of the noise barrier. As shown in **Tables 8** and **9**, NB1 and NB 2 are very effective. The daytime effectiveness and reasonableness of these two noise barriers make both noise barriers proposable, therefore the nighttime cost effectiveness calculations are unnecessary. Since the daytime noise mitigation results indicated that NB 3, **Table 10**, was not very effective, the nighttime results, **Table 11**, were also presented. MnDOT's noise barrier cost-effectiveness analysis methodology uses only the L_{10} levels to determine cost-effectiveness; therefore, only those results are shown. The locations of the modeled noise barriers are shown on **Figures 2 and 3 (Appendix A)**.

9.0 NOISE MITIGATION RESULTS

NB1

Eastbound TH 10 from Prior Avenue to Bayan Street (Arden Manor residential area)

Receivers N1 to N11.

The land use in this area is 24 residential receptors and one industrial receptor. The 2040 build L_{10} noise levels would range from 67.0 to 75.2 dBA L_{10}, with 24 receptors exceeding the daytime MPCA L_{10} noise standard.

A noise barrier approximately 529 feet long wall was modeled within MnDOT right-of-way and clear zone along TH 10 from Prior Avenue just past Bayan Street. The noise barrier was modeled at a height of 20 feet, with tapered ends. This wall predicts noise level reductions ranging from 0.0 to 11.5 decibels and would cost $209,145 at a cost of $20 per sq. ft., including the addition of 529 ft. of guardrail at $25 per ft. The cost per benefited receptor was $29,878 which is below MnDOT's cost effectiveness threshold of $43,500 per benefited receptor. Since this barrier did not exceed the cost effectiveness threshold of $43,500 per benefited receptor and attained the 7-dBA reduction design goal, noise barrier NB1 is proposed.

Noise barrier calculations for NB1 are shown in **Table 8**.

Table 8: Noise Mitigation Cost Effectiveness Results (Daytime) – NB1

20 Foot Barrier NB1 (Eastbound TH 10 from Prior Ave to Bayan St – Figure 2, Appendix A)									
Receptors	Build2040 (No Barrier)	Build 2040 (20 ft Barrier)	Reduction (in dBA) with 20 ft noise barrier	Number of residences	Number of benefited receptors	Length of barrier (feet)	Barrier Area (SF) (1)	Total cost of barrier $20/sq ft(2)	Cost / benefitted receptor
N1	74.2	74.2	0.0	1	0	529	9,796	$209,145	$29,878
N2	**74.4**	64.3	10.1	2	2				
N3	**75.2**	63.7	11.5	3	3				
N4	**73.1**	65.7	7.4	2	2				
N5	**71.8**	67.9	3.9	3	0				
N6	**70.8**	66.6	4.2	2	0				
N7	**68.5**	66.8	1.7	3	0				
N8	**68.4**	66.0	2.4	4	0				
N9	**68.8**	65.3	3.5	1	0				
N10	**67.0**	64.2	2.8	2	0				
N11	**67.3**	65.0	2.3	2	0				

(1) Barrier area incorporates wall tapers at both ends

(2) Cost includes the addition of 529 ft. guardrail at a cost of $25 per ft.

NB2

Eastbound TH 10 from Prior Avenue to CSAH 96 (Arden Manor residential area)

Receivers N12 to N52

The land use for 76 receptors is residential, one receptor for a restaurant, and one receptor for a recreation area (pool). The 2040 build daytime L_{10} noise levels would range from 63.0 to 75.8 dBA L_{10}, with 67 receptors exceeding the daytime MPCA L_{10} noise standard.

A noise barrier approximately 1,419 feet long wall was modeled within MnDOT right-of-way along TH 10 from Prior Avenue to CSAH 96. 1,210 ft. of the noise barrier will be located between the proposed auxiliary lane and the Frontage Road/slip ramp. This section of the noise barrier will require a guardrail. The noise barrier was modeled at a height of 20 feet, with tapered ends. This wall predicts noise level reductions ranging from 0.4 to 10.4 decibels and would cost $576,430 at a cost of $20 per sq. ft., including 1,210 ft. of guardrail at $25 per ft. The guardrail is only along the south side of TH 10 east of the entrance to the restaurant, and does not include the 209 feet of noise barrier west of the entrance. The cost per benefited receptor was $25,057 which is below MnDOT's CE threshold of $43,500 per benefited receptor. Since this barrier did not exceed this threshold and attained the 7-dBA reduction design goal, noise barrier NB2 is proposed.

Noise barrier calculations for NB2 are shown in **Table 9**.

Table 9: Noise Mitigation Cost Effectiveness Results (Daytime) – NB2

20 Foot Barrier

NB2 (Eastbound TH 10 from Prior Avenue to CSAH 96 (Arden Manor residential area) Figure 2, Appendix A)

Receptors	Build 2040 (No Barrier)	Build 2040 (20 ft Barrier)	Reduction (in dBA) with 20 ft noise barrier	Number of residences	Number of benefited receptors	Length of barrier (feet)	Barrier Area (SF) (1)	Total cost of barrier $20/sq ft(2)	Cost / benefitted receptor
N12	**75.8**	73.4	2.4	1	0				
N13	**71.5**	69.1	2.4	2	0				
N14	**73.3**	66.2	7.1	1	1				
N15	**72.4**	62.5	9.9	2	2				
N16	**72.3**	61.9	10.4	3	3				
N17	**70.8**	61.2	9.6	2	2				
N18	**75.0**	64.7	10.3	2	2				
N19	**75.6**	65.7	9.9	1	1				
N20	**75.4**	70.1	5.3	1	1				
N21	**75.6**	75.2	0.4	2	0				
N22	**69.7**	68.4	1.3	3	0				
N23	**67.6**	65.4	2.2	2	0				
N24	**67.5**	63.5	4.0	3	0				
N25	**68.4**	61.6	6.8	1	1				
N26	**67.3**	61.1	6.2	1	1				
N27	**67.7**	60.6	7.1	3	3				
N28	**67.4**	60.7	6.7	2	2				
N29	**68.0**	61.7	6.3	3	3				
N30	**67.8**	63.0	4.8	2	0				
N31	**67.7**	64.2	3.5	2	0				
N32	**67.5**	65.4	2.1	2	0	1,419	27,309	$576,430	$25,057
N33	**68.2**	67.1	1.1	2	0				
N34	**67.1**	63.4	3.7	4	0				
N35	**66.5**	64.1	2.4	3	0				
N36	**65.5**	60.9	4.6	2	0				
N37	**65.8**	60.5	5.3	2	2				
N38	**66.3**	60.5	5.8	1	1				
N39	**65.8**	64.2	1.6	2	0				
N40	**65.6**	64.2	1.4	1	0				
N41	**66.2**	64.7	1.5	1	0				
N42	64.3	59.8	4.5	2	0				
N43	**64.8**	59.9	4.9	1	0				
N44	**64.8**	60.0	4.8	1	0				
N45	64.0	59.8	4.2	1	0				
N46	**65.1**	61.4	3.7	3	0				
N47	**65.1**	62.6	2.5	3	0				
N48	64.1	62.5	1.6	1	0				
N49	64.2	62.8	1.4	2	0				
N50	64.2	62.9	1.3	2	0				
N51	64.3	63.2	1.1	1	0				
N52	63.0	62.4	0.6	2	0				

(1) Barrier area incorporates wall tapers at both ends

(2) Cost includes the addition of 1,210 ft. of guardrail at a cost of $25 per ft.

NB3 (Daytime and Nighttime)

East side of Old Highway 8 in front of the Townsedge Terrace residential area.

Receivers N53 to N82

The land use for this area is represented by 11 receptors representing a trail, one hotel, one industrial site, one office and 26 residential receptors. The 2040 build L_{10} daytime noise levels would range from 63.8 to 75.5 dBA L_{10}, with 32 receptors exceeding the daytime MPCA L_{10} noise standard. The 2040 build L_{10} nighttime noise levels would range from 60.8 to 72.3 dBA L_{10}, with 36 receptors exceeding the nighttime MPCA L_{10} noise standard.

A noise barrier approximately 2,363 feet long wall was modeled within MnDOT right-of-way along TH 10 from in front of the Townsedge Terrace residential area. The noise barrier was modeled at height of 20 feet, with tapered ends. This wall predicts noise level reductions ranging from 1.0 to 4.8 decibels and would cost $930,640 at a cost of $20 per sq. ft. Since the noise barrier did not achieve a 5-dBA noise reduction to meet the feasibility criteria or the 7-dBA noise reduction goal to meet reasonableness criteria, the analyzed noise barrier is not proposed.

The daytime noise barrier calculations for NB3 are shown in **Table 10** with the nighttime calculations presented in **Table 11**. NB3 was modeled along the east side of Old Highway 8 to mitigate the additional traffic noise that would be created by traffic using the additional lane on the TH 10 ramp from southbound I-35W to TH 10 eastbound. With the local traffic on Old Highway 8 NB3 could not achieve a 5-dBA noise reduction to meet MnDOT's feasibility criteria. Since Old Highway 8 is not part of the TH 10 project, the mitigation measures were not modeled outside MnDOT's right-of-way. A noise barrier was analyzed in the same location for the recent I-35W North Corridor Preliminary Design Project. The results of the analysis were the same as the noise barrier was not proposed.

Table 10: Noise Mitigation Cost Effectiveness Results (Daytime) – NB3

20 Foot Barrier

NB3 (East side of Old Highway 8 in front of the Townsedge Terrace residential area. Figure 3, Appendix A)

Receptors	Build 2040 (No Barrier)	Build 2040 (20 ft Barrier)	Reduction (in dBA) with 20 ft noise barrier	Number of residences	Number of benefited receptors	Length of barrier (feet)	Barrier Area (SF) (1)	Total cost of barrier $20/sq ft	Cost / benefitted receptor
N53	**73.4**	72.4	1.0	1	0	2,363	46,532	$930,640	N/A
N54	**74.0**	71.3	2.7	1	0				
N55	**75.3**	71.6	3.7	1	0				
N56	**75.3**	70.8	4.5	1	0				
N57	**75.3**	70.9	4.4	1	0				
N58	**75.1**	70.8	4.3	1	0				
N59	**74.9**	70.8	4.1	1	0				
N60	**72.7**	68.9	3.8	1	0				
N61	**74.9**	70.8	4.1	1	0				
N62	**75.3**	71.2	4.1	1	0				
N63	70.2	66.0	4.2	1	0				
N64	**75.5**	71.5	4.0	1	0				
N65	**75.1**	71.0	4.1	1	0				
N66	**73.6**	69.2	4.4	1	0				
N67	**70.1**	65.3	4.8	1	0				
N68	**68.9**	64.7	4.2	1	0				
N69	**68.1**	63.8	4.3	1	0				
N70	**66.4**	62.1	4.3	2	0				
N71	**66.3**	61.8	4.5	2	0				
N72	**67.9**	64.0	3.9	1	0				
N73	**67.3**	63.3	4.0	1	0				
N74	**65.5**	61.3	4.2	2	0				
N75	**67.1**	63.5	3.6	1	0				
N76	**66.6**	62.8	3.8	1	0				
N77	**65.3**	61.4	3.9	2	0				
N78	64.7	60.9	3.8	2	0				
N79	**65.8**	62.7	3.1	2	0				
N80	**65.3**	62.2	3.1	2	0				
N81	64.7	62.1	2.6	2	0				
N82	63.8	61.5	2.3	3	0				

(1) Barrier area incorporates wall tapers at both ends

Table 11: Noise Mitigation Cost Effectiveness Results (Nighttime) – NB3

20 Foot Barrier

NB3 (East side of Old Highway 8 in front of the Townsedge Terrace residential area. Figure 3, Appendix A)

Receptors	Build 2040 (No Barrier)	Build 2040 (20 ft Barrier)	Reduction (in dBA) with 20 ft noise barrier	Number of residences	Number of benefited receptors	Length of barrier (feet)	Barrier Area (SF) (1)	Total cost of barrier $20/sq ft	Cost / benefitted receptor
N53	**68.8**	67.4	1.4	1	0	2,363	46,532	$930,640	$84,604
N54	**69.7**	66.0	3.7	1	0				
N55	**71.1**	66.4	4.7	1	0				
N56	**71.2**	65.7	5.5	1	1				
N57	**71.4**	65.9	5.5	1	1				
N58	**71.3**	65.8	5.5	1	1				
N59	**71.3**	66.0	5.3	1	1				
N60	**69.5**	64.7	4.8	1	0				
N61	**71.5**	66.0	5.5	1	1				
N62	**72.0**	66.4	5.6	1	1				
N63	67.5	62.1	5.4	1	1				
N64	72.3	66.6	5.7	1	1				
N65	**72.0**	66.2	5.8	1	1				
N66	**69.6**	64.5	5.1	1	1				
N67	66.7	61.3	5.4	1	1				
N68	65.5	60.8	4.7	1	0				
N69	**64.8**	60.0	4.8	1	0				
N70	**63.4**	58.6	4.8	2	0				
N71	**63.3**	58.4	4.9	2	0				
N72	**64.6**	60.3	4.3	1	0				
N73	**64.2**	59.6	4.6	1	0				
N74	**62.5**	58.0	4.5	2	0				
N75	**64.0**	59.9	4.1	1	0				
N76	**63.5**	59.3	4.2	1	0				
N77	**62.3**	58.1	4.2	2	0				
N78	**61.8**	57.6	4.2	2	0				
N79	**62.8**	59.2	3.6	2	0				
N80	**62.3**	58.8	3.5	2	0				
N81	**61.7**	58.7	3.0	2	0				
N82	**60.8**	58.2	2.6	3	0				

(1) Barrier area incorporates wall tapers at both ends

10.0 ALTERNATIVE NOISE ABATEMENT

Noise abatement measures other than noise barriers were considered for the proposed project. These measures are summarized below.

- Traffic Management Measures: These measures include such items as prohibition of certain vehicle types and time-use restrictions for certain vehicle types. These traffic management measures are not reasonable for TH 10 or I-35W because this would be inconsistent with the need for the proposed project and the functional classification of these roadways, which is to provide flexibility to travelers and increase highway capacity.
- Modified Speed Limits: Reducing speed limits would reduce noise levels adjacent to project area roadways. A general rule of thumb is that a decrease in speed of approximately 20 miles per hour is necessary for a noticeable decrease in noise levels. Reduced speed limits are not reasonable because this would be inconsistent with the need of the proposed project and the functional classification of these roadways. In addition, reductions of speed limits, although acoustically beneficial, are seldom practical unless the design speed of the proposed improvement is also reduced.
- Vertical and Horizontal Alignment: The proposed improvement project will take place within the existing right-of-way closely following the existing horizontal and vertical alignments. Changes in the horizontal and vertical alignment are not feasible without substantial impacts to adjacent properties and resources.
- Landscaping/Natural Noise Screening: The use of vegetation as a noise screen can be effective only if at least 75 to 100 feet of dense, evergreen vegetation (evergreen vegetation maintains its foliage year around) is provided between the source and receptor. It is not feasible to plant enough vegetation within the right-of-way to achieve substantial noise level reductions. As such, vegetation is not a reasonable noise mitigation measure.
- Exclusive Land Use Designations: Buffer zones are undeveloped, open spaces adjacent to a highway corridor. Acquisition of property to serve as a buffer zone between the roadway and adjacent lands is not feasible because the project corridor is already developed.
- Acoustical Insulation of Houses: Under MnDOT policy, only public buildings such as schools and hospitals should be considered for acoustical insulation. None of these land uses exist within the project area.

<u>Land Use Planning and Traffic Noise</u>

The prevention of future traffic noise impacts is an important component of noise control. Local governments, through their authority to regulate land development, can help prevent future traffic noise impacts through proper zoning of non-noise-sensitive land uses adjacent to a highway or by ensuring that developments are planned, designed and implemented is such a way to minimize traffic noise impacts. The following analysis provides information regarding modeled noise levels in the proposed Rice Creek Commons adjacent to westbound TH 10 for use in community and land use planning.

Traffic noise levels were modeled at 100 ft. increments from 100 ft. from the edge of the nearest pavement to 500 ft. adjacent to westbound TH 10. The analysis was based on existing topography without any intervening barriers or structures. The resulting noise levels are presented in **Table 12**.

Table 12: Land Use Planning and Traffic Noise

Distance from Edge of Pavement	Modeled Future Build (2040) Noise Levels, dBA			
	Daytime		Nighttime	
	L10	L50	L10	L50
100 feet	**72.7**	**68.2**	**68.8**	**63.1**
200 feet	**69.0**	**65.6**	**65.3**	**61.0**
300 feet	**66.7**	**63.8**	**63.0**	**59.5**
400 feet	**65.0**	**62.4**	**61.3**	**58.3**
500 feet	63.5	**61.3**	**59.9**	**57.2**
State and FHWA Standards				
MPCA Residential	**65.0**	**60.0**	55.0	**50.0**
FHWA Activity Category B, C	70.0	**-**	70.0	**-**
FHWA Activity Category E	75.0	**-**	75.0	**-**
MPCA Commercial	**70.0**	**65.0**	**70.0**	**65.0**
MPCA Industrial	**80.0**	**75.0**	**80.0**	**75.0**

The noise levels presented in **Table 12** indicate that the daytime state residential L10 standard would be exceeded within 400 ft. of the nearest edge pavement. The FHWA L10 criteria would be approached or exceeded within 200 ft. of the nearest edge pavement. The daytime state commercial L10 standard would be exceeded within 100 ft. of the nearest edge pavement, while the FHWA standard would not be exceeded. The state industrial noise standard would not be exceeded. These distances were developed to assist local planning authorities in developing land use control over the remaining undeveloped lands adjacent to westbound TH 10 to prevent further development of incompatible land use.

11.0 CONSTRUCTION NOISE

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

Table 13 shows peak noise levels monitored at 50 feet from various types of construction equipment. This equipment is primarily associated with site grading, site preparation and roadway construction and is associated with the higher noise levels due to construction.

Table 13: Typical Construction Equipment Noise Levels at 50 Feet

Equipment Type	Manufacturers Sampled	Total Number of Models in Sample	Peak Noise Level (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	NA	NA	95-105	101

Source: United States Environmental Protection Agency and Federal Highway Administration

Mitigation

Elevated noise levels are to a degree unavoidable for this type of project. MnDOT will require that construction equipment be properly muffled and in proper working order. While MnDOT and its contractor(s) are exempt from local noise ordinances, it is the practice to require that the contractor(s) comply with applicable local noise restrictions to the extent possible. Notice will be provided to affected communities for any abnormally loud construction activities. It is anticipated that nighttime construction may sometimes be required to minimize traffic impacts and improve safety. However, construction will be limited to daytime hours as much as possible. This project is anticipated to be under construction from May 2019 to November 2019. Any proposed noise barriers will be constructed as early as the construction staging allows. Any associated high-impact equipment noise such as pile driving, pavement sawing, or jack hammering will be unavoidable with construction of the Preferred Alternative. Pile driving noise is associated with any sheet piling necessary for any retaining wall construction. The use of pile drivers, pavement sawing and jack-hammering equipment will be prohibited during nighttime hours.

12.0 CONCLUSION

Traffic noise levels were modeled at 143 representative receptor locations along the TH 10 project corridor. Traffic noise levels were modeled for existing (2016) conditions, the future (2040) No Build condition, and the future (2040) Build condition. A summary of the impacted noise receptors is provided in **Table 14**.

Table 14: Summary of Impacted Noise Receptors

Modeled Year	Existing (2016)	Future No Build (2040)	Future Build Alternative (2040)
Receptors Exceed MPCA Standards Daytime	L_{10} – 99 of 143 L_{50} – 136 of 143	L_{10} – 121 of 143 L_{50} – 137 of 143	L_{10} – 121 of 143 L_{50} – 139 of 143
Receptors Exceed MPCA Standards Nighttime	L_{10} – 134 of 143 L_{50} – 129 of 143	L_{10} – 135 of 143 L_{50} – 135 of 143	L_{10} – 135 of 143 L_{50} – 135 of 143
Receptors Exceed FHWA Noise Abatement Criteria	40 of 143	43 of 143	43 of 143
Day Time L_{10} Modeled Noise level ranges (low/high)	61.9 to 74.5 dBA	62.9 to 75.6 dBA	63.0 to 70.2 dBA
Day Time L_{50} Modeled Noise level ranges (low/high)	58.5 to 68.6 dBA	59.9 to 70.2 dBA	60.0 to 70.2 dBA
Night Time L_{10} Modeled Noise level ranges (low/high)	57.5 to 71.3 dBA	58.6 to 72.3 dBA	58.6 to 72.3 dBA
Night Time L_{50} Modeled Noise level ranges (low/high)	53.7 to 65.5 dBA	55.2 to 67.1 dBA	55.2 to 67.1 dBA

In general, the proposed improvements would result in minor changes without noise barriers in traffic noise levels compared to existing conditions. The analysis shows that under the Future No Build alternative, L_{10} modeled traffic noise levels (daytime and nighttime) vary 0.9 dBA to 1.4 dBA over existing conditions. Modeled L_{10} noise levels under the Build Alternative (daytime and nighttime) vary 1.0 dBA to 1.4 dBA from existing (2016) conditions.

Three noise barriers were analyzed along the corridor. Barrier NB3 did not achieve the 7-dBA noise reduction design goal to be considered reasonable and was eliminated from further consideration. Barriers NB1 and NB2 were both found to meet MnDOT's cost effectiveness reasonableness threshold of $43,500 per receptor. Therefore, NB1 and NB2 are proposed for the project and will move forward to collect the viewpoints of benefitted receptors. A brief summary of each proposed barrier can be found below:

- Barrier NB1 has a preliminary cost per benefited receptor of $29,878. There are a total of 7 benefited receptors, and the wall is proposed at 20 feet high with a length of 529 feet.
- Barrier NB2 has a preliminary cost per benefited receptor of $25,062. There are a total of 23 benefited receptors, and the wall is proposed at 20 feet high with a length of 1,419 feet.

Viewpoints of the residents and owners of the benefitted receptors will be collected in the fall of 2017.

<u>Statement of Likelihood</u>

The traffic noise analysis for the proposed noise barriers described above is based upon preliminary design studies completed to date. Final mitigation decisions will be subject to final design considerations and the viewpoint of benefited residents and property owners. If it subsequently develops during final design that conditions have substantially changed, noise abatement measures may not be provided. Affected benefited receptors and local officials would be notified of plans to eliminate or substantially modify a noise abatement measure prior to the completion of the final design process. This notification would explain changes in site conditions (if any), additional site information, any design changes

implemented during the final design process, and an explanation of noise barrier feasibility and reasonableness. A final decision regarding installation of the proposed abatement measure will be made upon completion of the project's final design and the public involvement process.

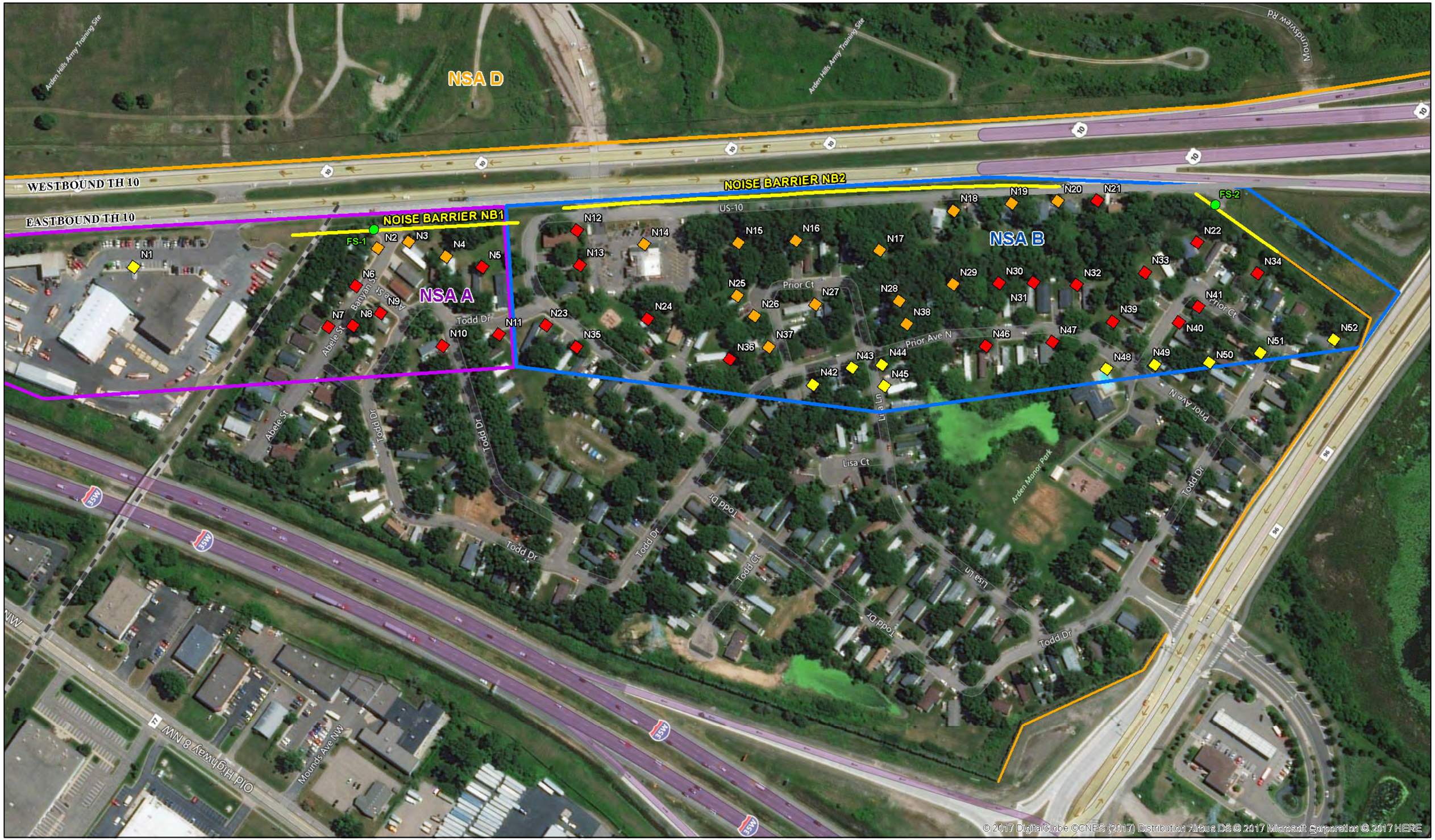
13.0 REFERENCES

FHWA Noise Standard, 23 CFR 772 – Procedures for Abatement of Highway Traffic Noise and Construction Noise (http://www.dot.state.mn.us/environment/noise/pdf/guidance/fhwa-noise-procedures.pdf).

MnDOT Noise Policy for Type I Federal-aid Projects, Minnesota Department of Transportation, effective date: June 15, 2015.

I-35W North Corridor Preliminary Design Project, (County Road C to Sunset Avenue), S.P. 6284-172, Traffic Noise Analysis Report, pages 31-33 and Map 10, Appendix A, April 2016.

APPENDIX A
Figure 2 and 3 – Noise Receptor Locations



BELOW MINNESOTA STANDARDS/NOT BENEFITTED
ABOVE MINNESOTA STANDARDS/BENEFITTED
ABOVE MINNESOTA STANDARDS/NOT BENEFITTED

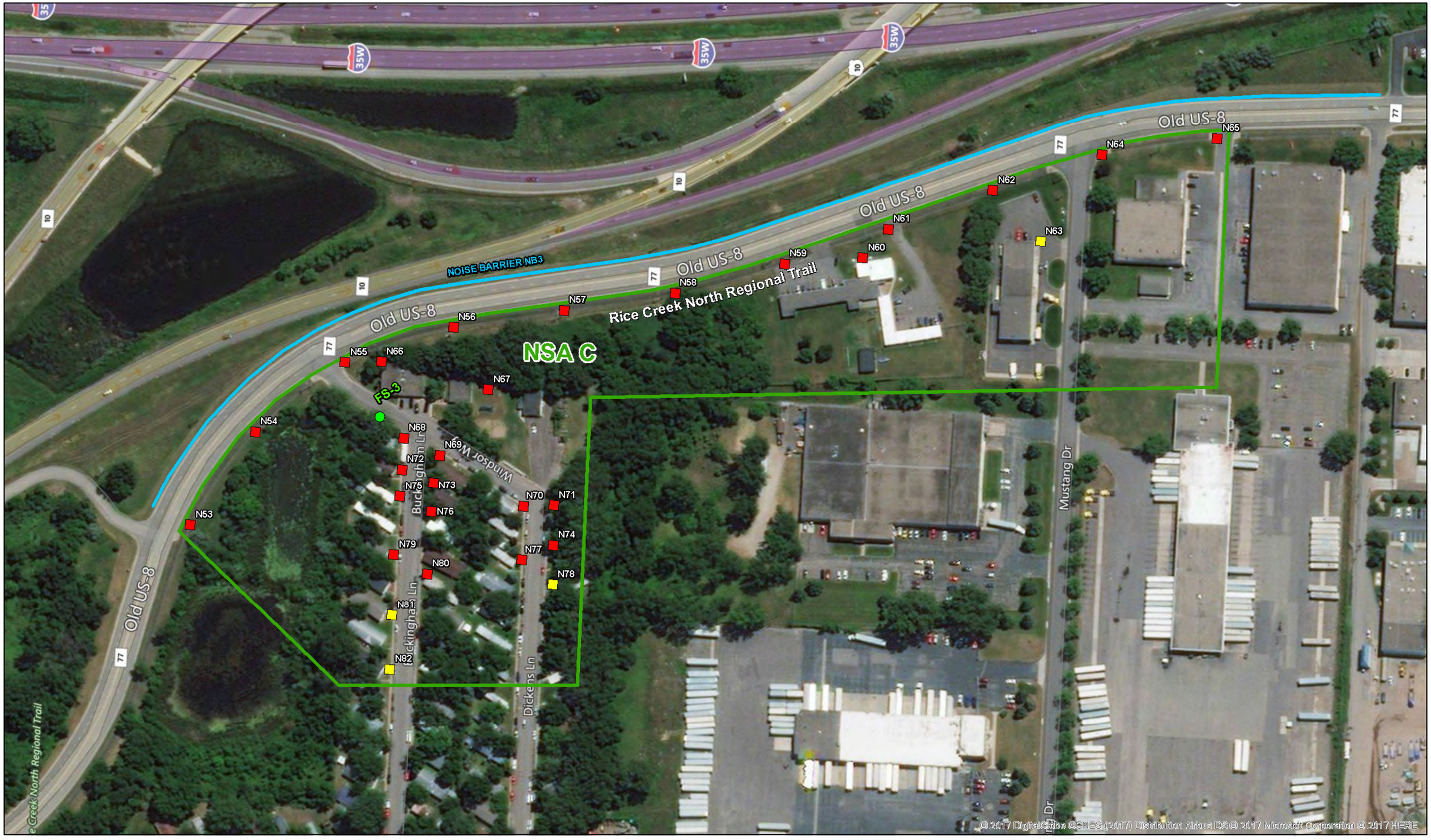
NOISE MONITORING SITES
PROPOSED NOISE BARRIER
ANALYZED NOISE BARRIER - NOT PROPOSED
EXISTING NOISE BARRIER

NOISE STUDY AREA A
NOISE STUDY AREA B
NOISE STUDY AREA C
NOISE STUDY AREA D

0 100 200 400 Feet

Traffic Noise Analysis for TH 10
Arden Hills, Minnesota

FIGURE 2



BELOW MINNESOTA STANDARDS/NOT BENEFITTED
ABOVE MINNESOTA STANDARDS/BENEFITTED
ABOVE MINNESOTA STANDARDS/NOT BENEFITTED

NOISE MONITORING SITES
PROPOSED NOISE BARRIER
ANALYZED NOISE BARRIER - NOT PROPOSED
EXISTING NOISE BARRIER

NOISE STUDY AREA A
NOISE STUDY AREA B
NOISE STUDY AREA C
NOISE STUDY AREA D

0 100 200 400 Feet

Traffic Noise Analysis for TH 10
Arden Hills, Minnesota

FIGURE 3

APPENDIX B
Field Data Measurement Sheets

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: US-10 Arden Hills, MN JOB #: 70141-PL-001-001 BY: MFZ

SITE: FS-1 DATE: 05-11-17 TIME: 10:22 AM / 13:20 PM

CALIBRATION: 113.8 at 1k Hz dB. Red - AM Blue - PM

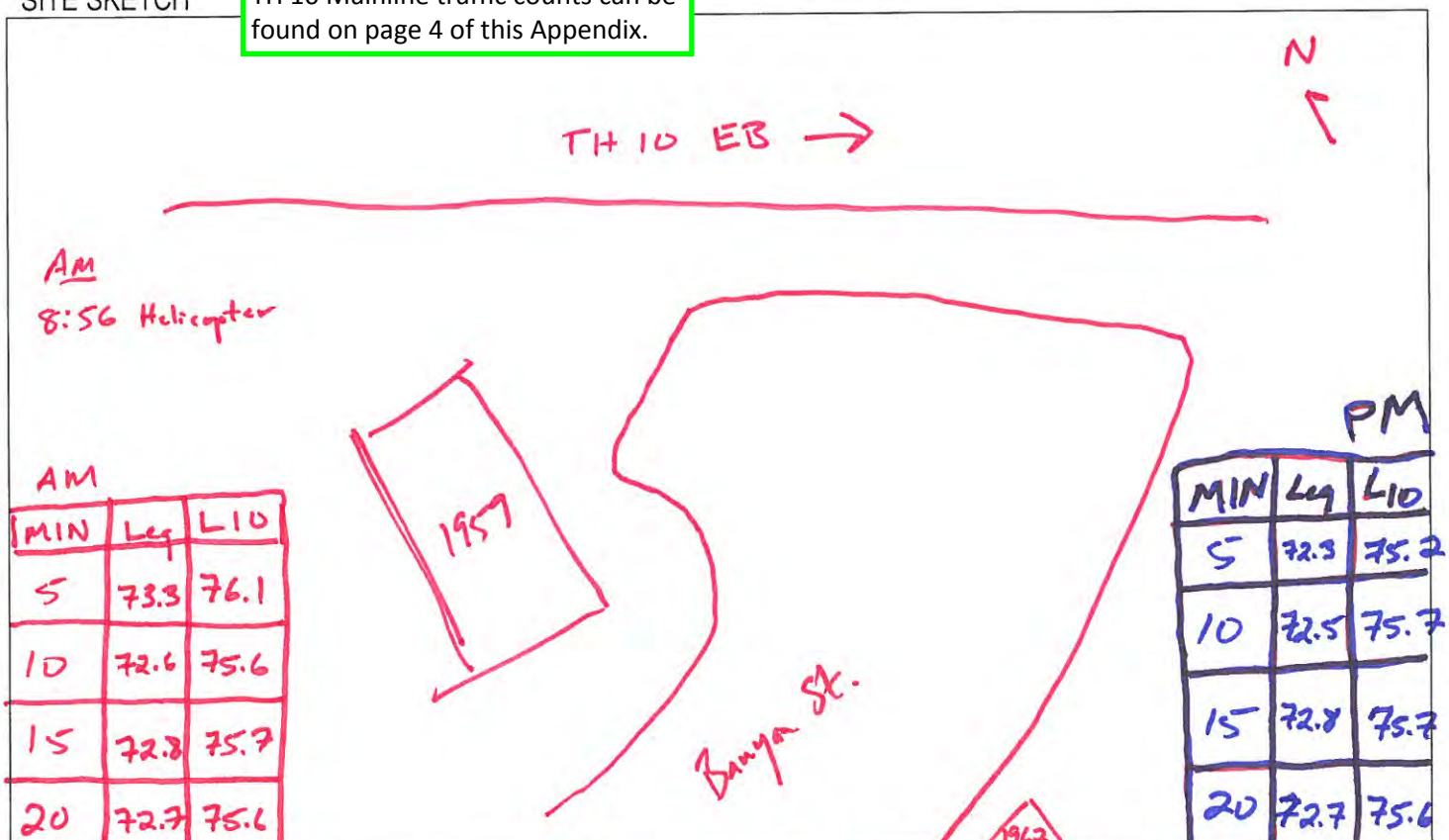
RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)	N/A	
AUTOS		
MED TRKS		
HVY TRKS		
BUS		
MOTORCYCLE		
SPEED		

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH

TH 10 Mainline traffic counts can be found on page 4 of this Appendix.



AM

MIN	Leq	L10
5	73.3	76.1
10	72.6	75.6
15	72.8	75.7
20	72.7	75.6

PM

MIN	Leq	L10
5	72.3	75.2
10	72.5	75.7
15	72.8	75.7
20	72.7	75.6

MEASUREMENT DATA	Duration 20min / 20 min	Leq 72.7 / 72.7	L10 72.7 / 75.6

WEATHER DATA WIND SPEED (MPH) DIR. TEMP. HUMIDITY CLOUD COVER CLR/CLR

BACKGROUND NOISE 5-7/5-8 N/N 61.7/62.3

MAJOR SOURCES TH 10

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: US-10 Arden Hills, MN JOB #: 70141-PL-001-001 BY: MFZ

SITE: FS-2 DATE: 05-11-17 TIME: 11:02 AM / 13:45 PM

CALIBRATION: 113.8 at 1k Hz dB.

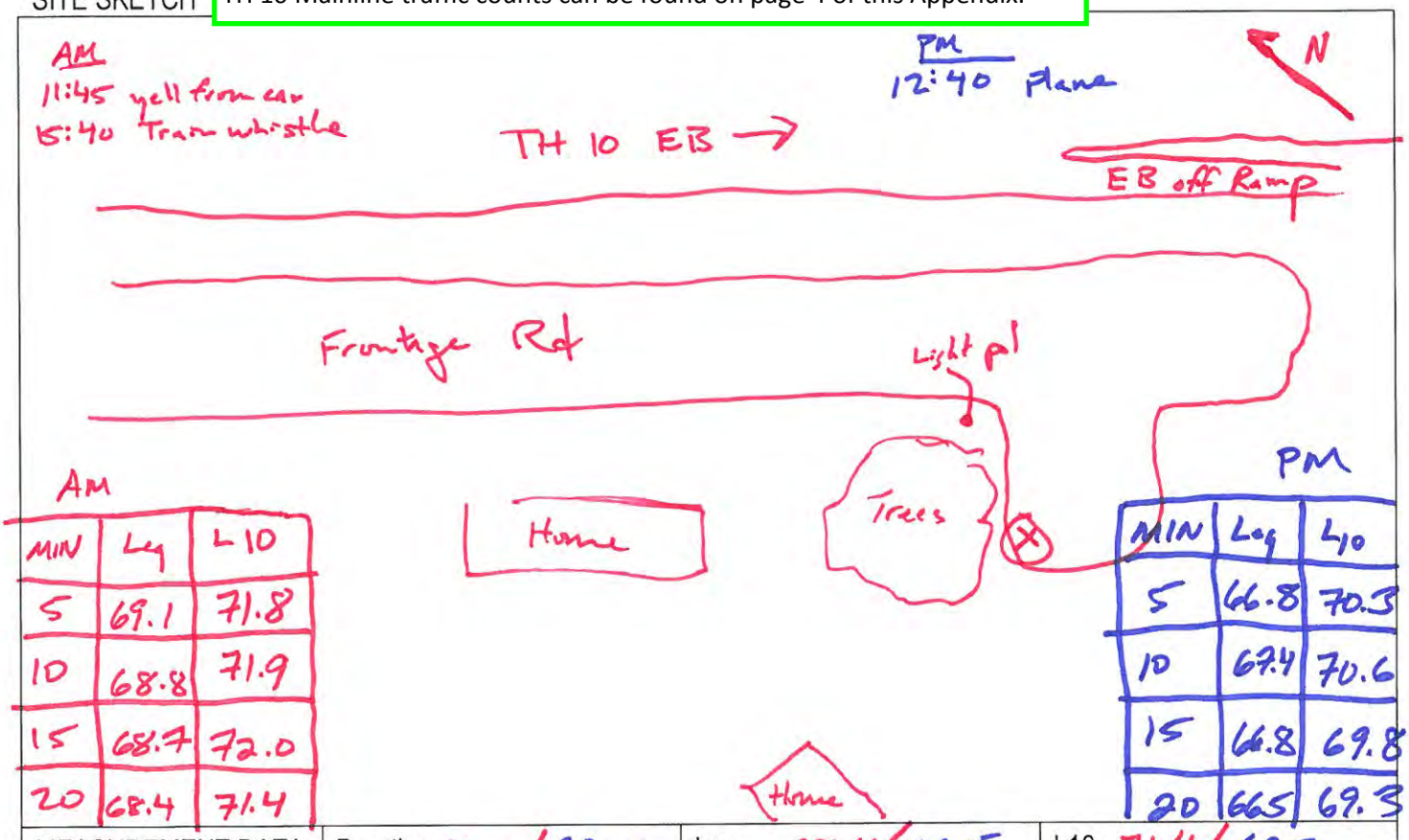
Red - AM
Blue - PM

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)	AM off Ramp EB	PM off Ramp EB
AUTOS	99	95
MED TRKS	2	1
HVY TRKS	1	3
BUS	–	4
MOTORCYCLE	2	0
SPEED	40-50	40-45

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH TH 10 Mainline traffic counts can be found on page 4 of this Appendix.



AM

MIN	Leq	L10
5	69.1	71.8
10	68.8	71.9
15	68.7	72.0
20	68.4	71.4

PM

MIN	Leq	L10
5	66.8	70.3
10	67.4	70.6
15	66.8	69.8
20	66.5	69.3

MEASUREMENT DATA	Duration 20 min / 20 min	Leq 68.4 / 66.5	L10 71.4 / 69.3

WEATHER DATA	WIND SPEED (MPH)	DIR.	TEMP.	HUMIDITY	CLOUD COVER CLR/CLR
	5-8/6-10	NE/NE	67.9/62.1		

BACKGROUND NOISE Birds

MAJOR SOURCES TH 10; EB off ramp

UNUSUAL EVENTS

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: US-10 Arden Hills, MN JOB #: 70141-PL-001-001 BY: MFZ

SITE: FS-3 DATE: 05-11-17 TIME: 11:50 AM / 14:30 PM

CALIBRATION: 113.8 at 1k Hz dB.

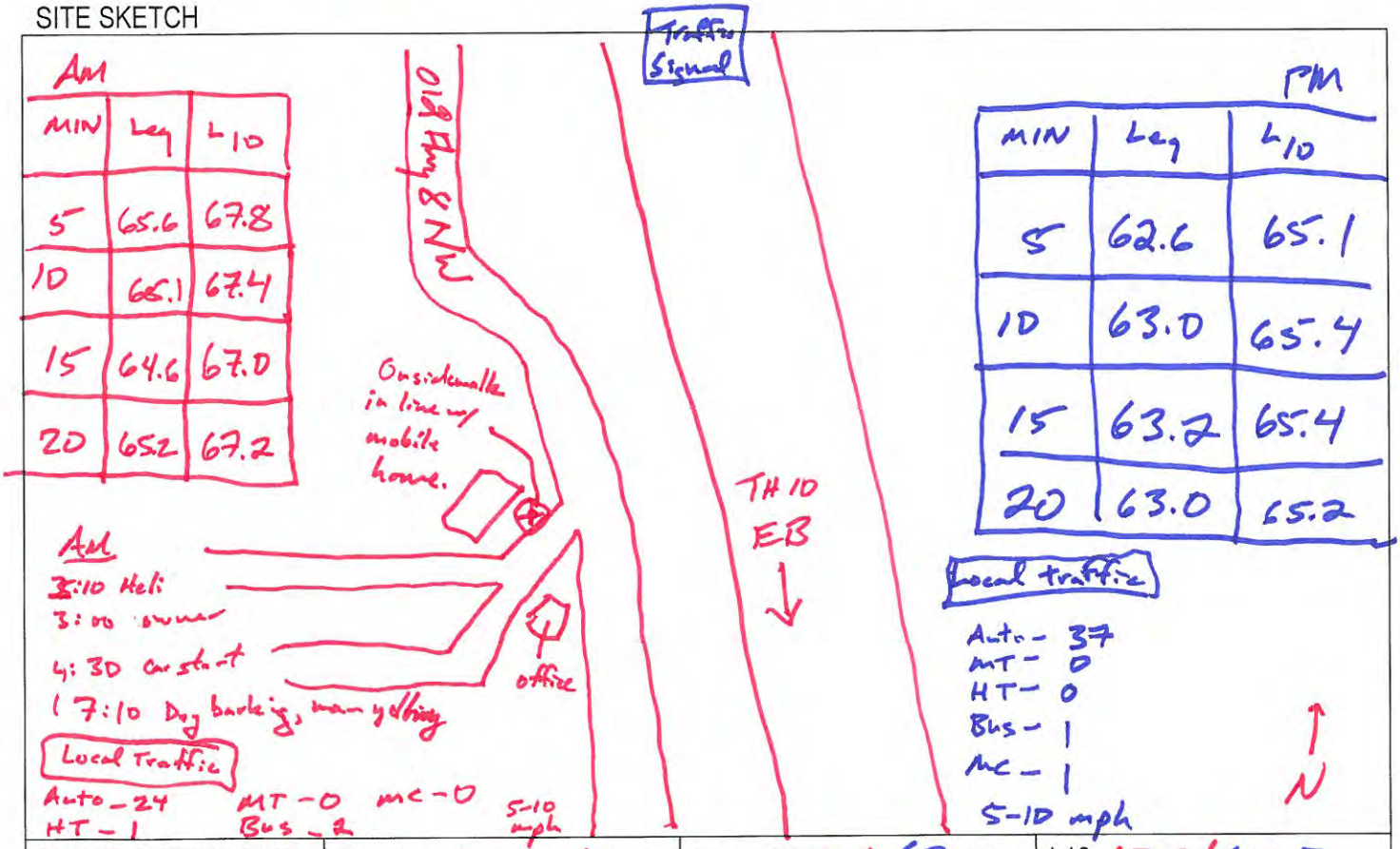
Red - AM
Blue - PM

RESPONSE: FAST / SLOW WEIGHTING: A / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)	Hwy 8 - Both Dir	TH 10 EB
AUTOS	119 / 45	187 / 242
MED TRKS	2 / 3	3 / 11
HVY TRKS	10 / 4	7 / 6
BUS	2 / 1	2 / 1
MOTORCYCLE	0 / 5	0 / 1
SPEED	30-50 / 30-50	50-60 / 50-60

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31361
PREAMPLIFIER – Type 1206	S / N 30396
MICROPHONE – Type 1225	S / N 48094
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



AM

MIN	Leq	L10
5	65.6	67.8
10	65.1	67.4
15	64.6	67.0
20	65.2	67.2

PM

MIN	Leq	L10
5	62.6	65.1
10	63.0	65.4
15	63.2	65.4
20	63.0	65.2

MEASUREMENT DATA	Duration 20 min / 20 min	Leq 65.2 / 63.0	L10 67.2 / 65.2

WEATHER DATA	WIND SPEED (MPH)	DIR.	TEMP.	HUMIDITY	CLOUD COVER CLR/CLR
BACKGROUND NOISE	Local traffic 3-5/1-2	W/N	65.7/64.3		

MAJOR SOURCES: TH 10, I-35W, Old Hwy 8

UNUSUAL EVENTS:

OTHER NOTES:

I-35W Mainline traffic counts can be found on page 4 of this Appendix.

Noise Measurement Simultaneous Traffic Counts
TH 10, Arden Hills, MN

FS-1 AM

	WB TH 10					
Vehicle Type	10:21	10:26	10:31	10:36	**20 min.**	**1 hour**
Auto	93	76	86	90	**345**	**1035**
MT	17	23	24	26	**90**	**270**
HT	3	6	8	13	**30**	**90**
Bus	5	1	2	0	**8**	**24**
MC	0	1	0	1	**2**	**6**
Speed	55	55	55	55	55	55

Vehicle Type	EB TH 10					
	10:21	10:26	10:31	10:36	**20 min.**	**1 hour**
Auto	43	31	38	43	**155**	**465**
MT	5	9	6	13	**33**	**99**
HT	4	5	1	7	**17**	**51**
Bus	1	0	0	0	**1**	**3**
MC	2	0	0	0	**2**	**6**
Speed	55	55	55	55	55	55

	EB TH 10 off ramp					
Vehicle Type					**20 min.**	**1 hour**
Auto					**99**	**297**
MT					**2**	**6**
HT					**1**	**3**
Bus					**0**	**0**
MC					**2**	**6**
Speed					40-50	40-50

FS-2 AM

	WB TH 10					
	11:04	11:09	11:14	11:19	**20 min.**	**1 hour**
Auto	71	77	89	95	**332**	**996**
MT	28	21	23	36	**108**	**324**
HT	8	10	9	8	**35**	**105**
Bus	0	0	1	0	**1**	**3**
MC	0	2	0	1	**3**	**9**
Speed	55	55	55	55	55	55

	EB TH 10					
	11:04	11:09	11:14	11:19	**20 min.**	**1 hour**
Auto	42	40	27	42	**151**	**453**
MT	8	9	14	12	**43**	**129**
HT	1	1	1	0	**3**	**9**
Bus	0	0	0	1	**1**	**3**
MC	1	0	0	0	**1**	**3**
Speed	55	55	55	55	55	55

FS-3 AM

	SB I-35W					
	11:50	11:55	12:00	12:05	**20 min.**	**1 hour**
Auto	221	210	206	190	**827**	**2481**
MT	62	58	70	60	**250**	**750**
HT	22	29	21	23	**95**	**285**
Bus	1	4	3	4	**12**	**36**
MC	0	1	1	1	**3**	**9**
Speed	70	70	70	70	70	70

	NB I-35W					
	11:50	11:55	12:00	12:05	**20 min.**	**1 hour**
Auto	196	172	170	180	**718**	**2154**
MT	34	51	54	62	**201**	**603**
HT	22	21	26	32	**101**	**303**
Bus	2	2	3	0	**7**	**21**
MC	1	1	1	1	**4**	**12**
Speed	70	70	70	70	70	70

	Old Hwy 8 (both directions)		TH 10 EB	
Vehicle Type	**20 min.**	**1 hour**	**20 min.**	**1 hour**
Auto	**119**	**357**	**187**	**561**
MT	**2**	**6**	**3**	**9**
HT	**10**	**30**	**7**	**21**
Bus	**2**	**6**	**2**	**6**
MC	**0**	**0**	**0**	**0**
Speed	30-50	30-50	50-60	50-60

FS-1 PM

	WB TH 10					
Vehicle Type	13:20	13:25	13:30	13:35	**20 min.**	**1 hour**
Auto	98	76	91	84	**349**	**1047**
MT	16	28	25	13	**82**	**246**
HT	5	6	6	10	**27**	**81**
Bus	2	0	1	2	**5**	**15**
MC	1	1	1	2	**5**	**15**
Speed	55	55	55	55	55	55

	EB TH 10					
Vehicle Type	13:20	13:25	13:30	13:35	**20 min.**	**1 hour**
Auto	56	43	55	64	**218**	**654**
MT	8	13	11	19	**51**	**153**
HT	3	5	0	3	**11**	**33**
Bus	1	1	1	0	**3**	**9**
MC	1	0	2	1	**4**	**12**
Speed	55	55	55	55	55	55

Vehicle Type	EB TH 10 off ramp					
					20 min.	**1 hour**
Auto					**95**	**285**
MT					**1**	**3**
HT					**3**	**9**
Bus					**4**	**12**
MC					**0**	**0**
Speed					40-45	40-45

FS-2 PM

	WB TH 10					
	13:45	13:50	13:55	14:00	**20 min.**	**1 hour**
Auto	110	72	97	95	**374**	**1122**
MT	31	26	17	25	**99**	**297**
HT	7	9	4	3	**23**	**69**
Bus	2	3	1	2	**8**	**24**
MC	0	0	0	0	**0**	**0**
Speed	55	55	55	55	55	55

	EB TH 10					
	13:45	13:50	13:55	14:00	**20 min.**	**1 hour**
Auto	51	62	57	69	**239**	**717**
MT	15	17	19	20	**71**	**213**
HT	5	4	1	2	**12**	**36**
Bus	2	0	0	0	**2**	**6**
MC	2	0	0	0	**2**	**6**
Speed	55	55	55	55	55	55

FS-3 PM

	SB I-35W					
	14:30	14:35	14:40	14:45	**20 min.**	**1 hour**
Auto	225	295	299	272	**1091**	**3273**
MT	47	59	75	65	**246**	**738**
HT	28	13	18	23	**82**	**246**
Bus	1	2	2	3	**8**	**24**
MC	0	5	3	1	**9**	**27**
Speed	70	70	70	70	70	70

	NB I-35W					
	14:30	14:35	14:40	14:45	**20 min.**	**1 hour**
Auto	340	340	360	335	**1375**	**4125**
MT	105	108	104	85	**402**	**1206**
HT	25	19	23	26	**93**	**279**
Bus	4	1	1	1	**7**	**21**
MC	1	0	2	2	**5**	**15**
Speed	70	70	70	70	70	70

	Old Hwy 8 (both directions)		TH 10 EB	
	20 min.	**1 hour**	**20 min.**	**1 hour**
Auto	**45**	**135**	**242**	**726**
MT	**3**	**9**	**11**	**33**
HT	**4**	**12**	**6**	**18**
Bus	**1**	**3**	**1**	**3**
MC	**5**	**15**	**1**	**3**
Speed	30-50	30-50	50-60	50-60