Final Noise Analysis Report

M-153 (Ford Rd) at I-275 Area Traffic and Environmental Study
CS 82292, JN 115177
MDOT Metro Region,
Canton, MI

August 2013

Owner:

Michigan Department of Transportation

Prepared For:

CDM Smith

Prepared By:

Bergmann Associates

Noise Analysis Technical Report

Table of Contents

Tables

Figures

Noise Analysis Technical Report

1. EXECUTIVE SUMMARY

This report has been developed as a part of a Planning and Environmental Linkage (PEL) study. The purpose of the PEL study was completed to identify the likelyhood of impacts and mitigation within the project area. The National Environment Policy Act (NEPA), FHWA regulations (23 CFR 772) and guidance, and MDOT procedures as defined in the MDOT *Highway Noise Analysis and Abatement Handbook* are not required for a PEL study. Despite the fact that not all of the elements in the NEPA, Federal or State regulations, rules or procedures are applicable to this study, key language from NEPA and protocol based on FHWA regulations (23 CFR 772) and the MDOT *Highway Noise Analysis and Abatement Handbook* were used in the development of this noise analysis.

This report evaluated the potential noise impacts of the proposed improvements along a portion of the M-153 from the Fellows Creek crossing, which is located approximately 1600 ft west of Sheldon Road, to the Lotz Road in the City of Canton, in Wayne County, in conformance with corresponding Federal regulations and guidance and the National Environmental Policy Act (NEPA). The purpose of this project is to improve the operational service of M-153 (Ford Road) and support local land use within the study area between Sheldon Road and Lotz Road.

This project is being studied as a Type I project because the capacity of the roadway is being increased with the addition of through lanes, which triggers the requirement for a noise analysis.

The noise analysis presents the existing and future acoustical environment at various receptors located along the M-153 corridor. The determination of noise abatement measures and locations is in compliance with the Federal Highways Administration's (FHWA's) *Procedures for Abatement of Highway Traffic Noise and Construction Noise* as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 722), and the Michigan Department of Transportation (MDOT): *Highway Noise Analysis and Abatement Handbook, July 2011*. The MDOT: *Highway Noise Analysis and Abatement Handbook* is in compliance with the MDOT's *State Transportation Commission Policy 10136 Noise Abatement,* dated July 31, 2003.

Field noise measurements (with concurrent traffic counts) are taken to compare with the modeled noise levels to validate the Traffic Noise Model (TNM) for use on this project to predict existing and design year noise levels. Existing noise level measurements were conducted on October 26, 2012 at seven (7) representative sites in the project vicinity. A minimum 15 minute measurement was taken at each site during peak and off-peak traffic time periods. Peak traffic periods are generally defined as between 7:00 am and 8:30 am and between 4:00 pm and 6:00 pm. Traffic counts were taken at each site, concurrent with the noise measurements.

The traffic noise prediction program, FHWA Traffic Noise Model® version 2.5, was used to model existing, 2035 No-Build, and 2035 Build option for traffic noise levels within the study area. Table 1 lists the number of locations within a Common Noise Environment (CNE) that approach or exceed the FHWA Noise Abatement Criteria (NAC). The limits of the CNEs are depicted in Figure 1 and in Appendix A. Maximum traffic noise level increases of 1 dB(A) and 5 dB(A), L_{eq} over the existing conditions are predicted for the 2035 No-Build option and the 2035 Build option with a boulevard section, respectfully.

Table 1: Number of Locations Within CNEs that Approach or Exceed the NAC

Activity Description	Existing	2035 No Build	2035 Build (Boulevard Section)
CNE Area A – Residential	3	3	4
CNE Area B – Commercial	N/A	N/A	N/A
CNE Area C – Commercial	0	0	0
CNE Area D – Commercial	0	0	0
CNE Area E – Commercial	N/A	N/A	N/A
CNE Area F – Commercial	N/A	N/A	N/A
CNE Area G – Residential	4	4	4
CNE Area H – Residential	3	3	3
CNE Area I – Commercial	0	0	0
CNE Area J – Commercial	0	0	0
CNE Area K – Commercial	N/A	N/A	N/A
CNE Area L – Commercial	0	0	0
CNE Area M – Commercial	0	0	0
CNE Area N – Commercial	0	0	0
CNE Area O – Commercial	0	0	0

* N/A = Not applicable

CNE B, E, F K are commercial properties and have been identified as having an Activity Category NAC E (from FHWA Noise Abatement Criteria [NAC] Table 3). These CNEs where reviewed in the field and evidence of outdoor areas with frequent human use could not be located. Thus, no noise abatement assessments were performed at those locations. The remaining Activity Category NAC E land uses (CNE C, D, I, J, L, M, N, and O) contained at least one property with outdoor dining tables or fuel pumps.

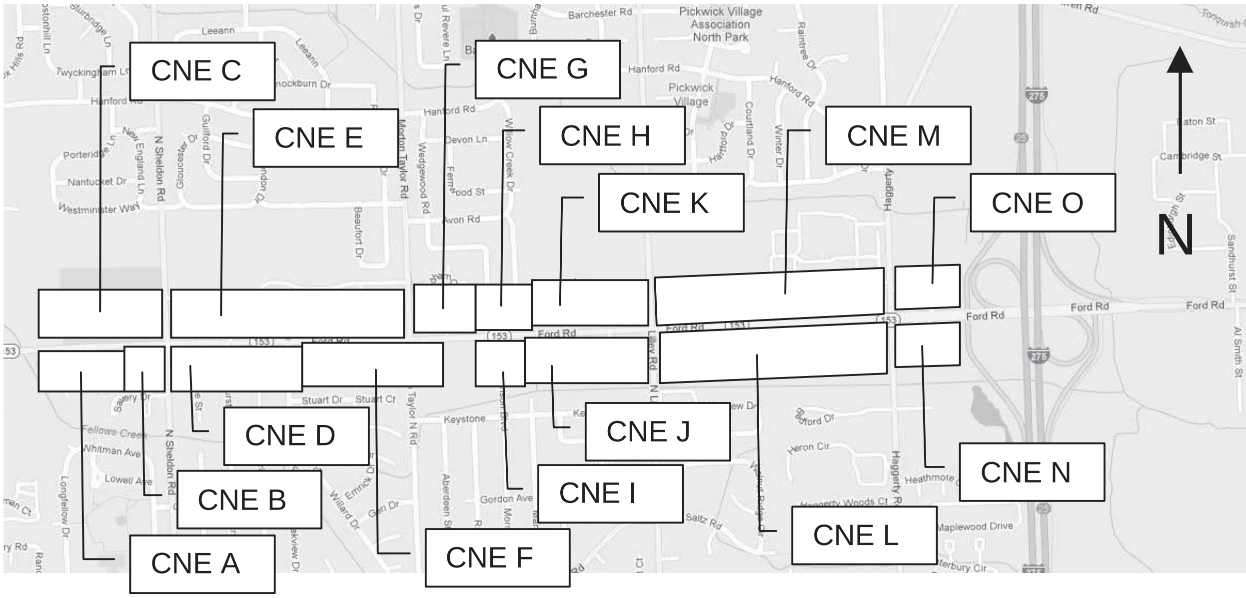


Figure 1: CNE Vicinity Map

Three (3) barriers were evaluated for the Build (with Boulevard Section) (Alternative 3) condition. The Build (with Boulevard Section) (Alternative 3) condition was the only alternative that was analyzed because it was selected as the preferred alternative. A detailed discussion pertaining to why this alternative was selected as the preferred alternative can be found in the main document of the PEL study. These barriers were located at the edge of the Right-of-Way at CNE A, G, and H. The noise barrier at CNE A (proposed noise barrier A [NB A]) failed to satisfy MDOT's feasibility and reasonableness criteria. The noise barriers at CNE G and H (NB G and H) were evaluated separately but an overlap of mitigation was observed. To maximize the number of benefited residences, feasibility, and reasonableness, these barriers were combined and evaluated as a single barrier (NB G/H) with gaps for Fordham Circle and Willow Creek Road. NB G/H was found to satisfy MDOT's feasibility criteria but failed to meet the reasonableness criteria.

MDOT's noise policy states that when noise impacts are identified, feasible and reasonable noise abatement measures shall be incorporated into the transportation improvement project. Based on the study completed, abatement of noise impacts for the Build (with Boulevard Section) (Alternative 3) option does not appear to be feasible and reasonable at any of the sites along M-153.

2. PURPOSE OF THE REPORT

This report has been developed as a part of a Planning and Environmental Linkage (PEL) study. The purpose of the PEL study was completed to identify the likelyhood of impacts and mitigation within the project area. The National Environment Policy Act (NEPA), FHWA regulations (23 CFR 772) and guidance, and MDOT procedures as defined in the MDOT *Highway Noise Analysis and Abatement Handbook* are not required for a PEL study. Despite the fact that not all of the elements in the NEPA, Federal or State regulations, rules or procedures are applicable to this study, key language from NEPA and protocol based on FHWA regulations (23 CFR 772) and the MDOT *Highway Noise Analysis and Abatement Handbook* were used in the development of this noise analysis.

This report evaluates the potential noise impacts of the proposed improvements along a portion of the M-153 corridor, from the Fellows Creek crossing to the Lotz Road, in conformance with corresponding Federal regulations and guidance and the National Environmental Policy Act (NEPA). This project is being studied as a Type I project because the capacity of the roadway is being increased and there is a proposed horizontal alignment modification for WB M-153, which triggers the requirement for a noise analysis. The noise analysis presents the existing and future acoustical environment at various receptors located along the M-153 corridor.

The need for noise abatement measures and the placement of these measures were based on guidance from the Federal Highway Administration's (FHWA's) *Procedures for Abatement of Highway Traffic Noise and Construction Noise* as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 722), and the Michigan Department of Transportation (MDOT): *Highway Noise Analysis and Abatement Handbook, July 2011*. The MDOT: *Highway Noise Analysis and Abatement Handbook* is in compliance with the *State Transportation Commission Policy 10136 Noise Abatement*, dated July 31, 2003.

3. PROJECT DESCRIPTION

M-153 is an east-west route, which runs from Dearborn to Ann Arbor in Michigan. The limits of this project are bound between the Fellows Creek crossing on the west, which is located approximately 1600 ft west of Sheldon Road, to the Lotz Road on the east. The project is located in Canton, Wayne County, Michigan. Existing M-153 is a five-lane facility with intermittent right-turn lanes throughout this segment. The purpose of this project is to improve the operational service of M-153 (Ford Road) and support local land use within the study area between Sheldon Road and Lotz Road. To achieve this goal, the no-build option and build option have been reviewed. The no-build option assumes no capacity improvements are made to the existing system. Only maintenance activities to maintain the existing roadway would be provided. The build option changes the existing five-lane roadway section into a boulevard section. The build option will improve traffic flow by reducing turning movements within the intersections. The reduction in turning movements will reduce delay. This reduction in delay will in turn increasing the capacity of the roadway.

Due to the presence of three distinctly different traffic patterns that presently exist, a review of AM peak, PM peak, and off peak weekday (Monday through Thursday) traffic was required for this noise study.

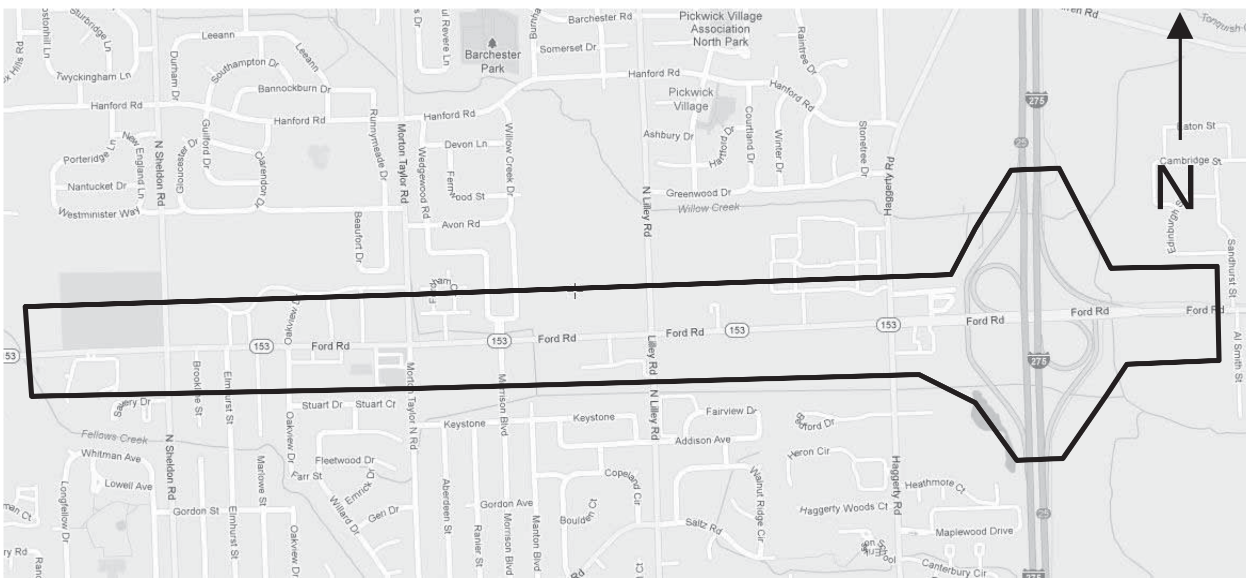


Figure 2: Project Location Map

4. TRAFFIC NOISE CONCEPTS, POLICY AND GUIDELINES

4.1. Basic Acoustic Concepts

Noise can be described as unwanted sound that may interfere with communication, or may disturb the community. Three characteristics of noise have been identified as being important to analyzing the subjective community response to noise: intensity, frequency, and the time-varying characteristics of the noise

Intensity is a measure of the magnitude or energy of the sound, and is directly related to pressure level. The human ear is capable of sensing a wide range of pressure levels. Pressure levels are expressed in terms of a logarithmic scale with units called decibels (dB). As the intensity of a noise increases, it is judged to be more annoying.

The decibel scale is a logarithmic representation of the actual sound pressure variations. The manner in which the logarithmic nature of sound is perceived as loudness, and the accompanying change in traffic volumes is depicted in Table 2: Logarithmic Nature of Sound.

Table 2: Logarithmic Nature of Sound

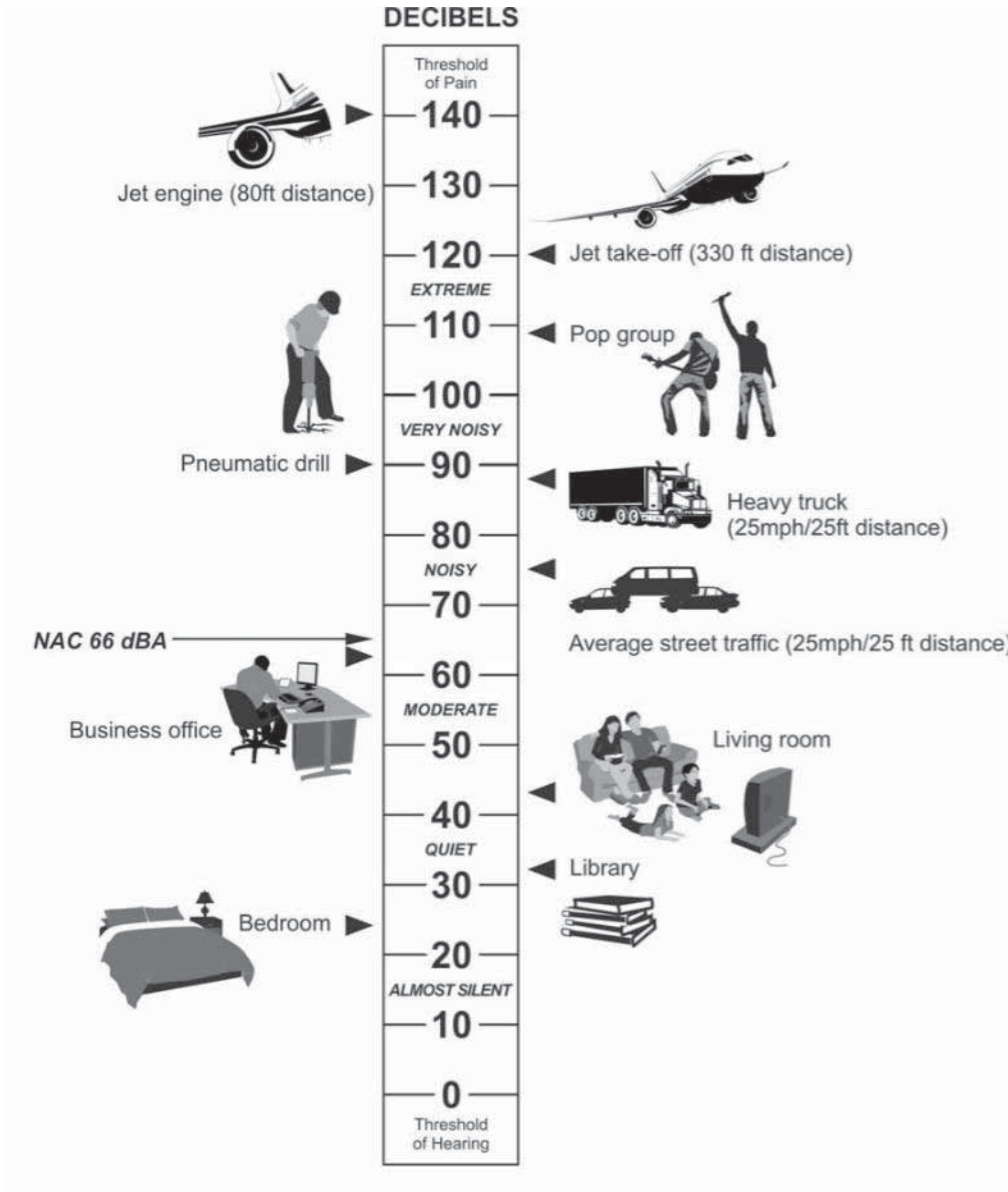
Change in L_{eq} (1h) Sound Level	Relative Loudness in the Natural Environment
+/- 3 dB(A)	Barely Perceptible Change
+/- 5 dB(A)	Readily Perceptible Change
+/- 10 dB(A)	Considered Twice or Half as Loud

Frequency is a measure of the tonal qualities of sound. The spectrum of frequencies provides the identity of a sound. People are most sensitive to sounds in the middle to high frequencies; therefore, higher frequencies tend to cause more annoyance. This sensitivity led to the use of the A-weighted sound level, which provides a single number measure that weighs different frequencies of the frequency spectrum in a manner similar to the sensitivity of the human ear. Thus, the A-weighted sound level in decibels (dB(A)) provides a simple measure of intensity and frequency that correlates well with the human response to environmental noise.

It is necessary to use a method of measure that will account for the time-varying nature of sound when studying environmental noise. The equivalent sound pressure level (L_{eq}) is defined as the continuous steady sound level that would have the same total A-weighted sound energy as the real fluctuating sound measured over a given period of time. As a result, the three characteristics of noise combine to form a single descriptor (L_{eq} in dB(A)) that helps to evaluate human response to noise, and has been chosen for use in this study. The time period used to determine noise levels is typically one hour and uses the descriptor L_{eq}(1h).

Traffic noise at a receiver is influenced by the following major factors: distance from the traffic to the receiver, volume of traffic, speed of traffic, vehicle mix, and acoustical shielding.

Tire sound levels increase with vehicle speed but also depend upon road surface, vehicle weight, tread design and wear. Change in any of these can vary noise levels, however, average tire and pavement conditions are assumed in the noise prediction model.



Adopted from "Environmental Criteria for Road Traffic Noise," Environmental Protection Authority, South Sydney, NSW, May 1999, Page 38.

Figure 3: Sound Levels of Typical Noise Sources

4.2. Federal Regulations and Guidance

The following section summarizes the federal rules and procedures the form the basis for the analysis but are not requirements for the PEL study.

FHWA's *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, 23 CFR 772, requires the following during the planning and design of a highway project:

1) Identification of highway traffic noise impacts;
2) Examination of potential abatement measures;
3) Gather public input approval for reasonable and feasible abatement measures;
4) Incorporation of reasonable and feasible highway traffic noise abatement measures into the highway project;
5) Coordination with local officials to provide helpful information on compatible land use planning and control; and
6) Identification and incorporation of necessary measures to abate construction noise

The highway traffic noise impact identification process involves a review of the existing land use activity categories that parallel the highway corridor and determining existing and future noise levels within those areas. Existing land use of developed lands is identified by inspecting aerial photography and performing site reconnaissance. Highway traffic noise analyses are also performed for undeveloped lands when they are considered permitted developments.

After the existing and proposed land uses are established, the existing noise levels are determined based on a noise model validation process that compares modeled noise levels to actual measured noise levels. The existing noise environment is determined by gathering noise measurements and concurrent site and traffic information. The FHWA mandates the use of the most recent version of the FHWA Traffic Noise Model® (TNM) software be used to construct these models. TNM 2.5 was the most recent version of TNM during the development of this study and was used to model noise levels. Additional information concerning TNM software is provided in Section 5.1 of this report. The noise model must predict noise levels that are within 3 dB(A) of the measured levels in order to be considered valid. Future design year traffic is applied to a model that has been validated for the existing condition, to estimate the future 2035 noise levels.

A traffic noise impact is defined as a future noise level that approaches or exceeds the Noise Abatement Criteria (NAC); or a future noise level that creates a substantial noise increase over existing noise levels. An approaching noise level is defined as being at least 1 dB(A) less than the noise level value listed in the NAC for Activity Category A through E listed in Table 3. The FHWA allows individual states to define a substantial noise increase as an increase of anywhere between 5 and 15 dB(A).

The NAC, which is presented in 23 CFR 772, establishes the noise abatement criteria for various land uses and is presented in Table 3.

After traffic noise impacts are identified, potential abatement alternatives are examined. The following abatement alternatives, which are listed in 23 CFR 772.15(c), are permitted and can be evaluated where applicable:

1) Construction of noise barriers including acquisition of property rights, either within or outside the highway right-of-way;
2) Traffic management measures;
3) Alteration of horizontal and vertical alignments;
4) Acquisition of real property or interests therein to serve as a buffer zone to preempt development;
5) Noise insulation of Activity Category D land use facilities listed in Table 3.

At a minimum, state highway agencies are required to consider noise abatement in the form of noise barriers.

FHWA defines feasible highway traffic noise abatement as objective engineering considerations (e.g., can a barrier be built given the topography of the location; can a substantial noise reduction be achieved given certain access, drainage, safety, or maintenance requirements; are other noise sources present in the area, etc.). An abatement measure must achieve a noise reduction of at least 5 dB(A) to be considered feasible, according 23 CFR 772.13 (d)(1)(i). The MDOT feasibility criteria are provided in Section 4.3.

The FHWA lists three required reasonableness factors when considering noise barriers: cost effectiveness; viewpoints of benefitting receptors; and achievement of noise reduction design goals. For reasonableness, 23 CFR 772.13 (d)(2)(iii) requires state DOTs to define design year reduction goals somewhere between 7 and 10 dB(A). FHWA lists optional reasonableness factors that can be added to, but not overrule, the required reasonableness factors. The MDOT reasonableness criteria are provided in Section 4.3. For the purposes of PEL studies, cost effectiveness and noise reduction criteria are the only elements that are considered for reasonableness.

Table 3: Noise Abatement Criteria [1]

Activity Category	Activity Criteria[2]		Evaluation Location	Description of Activity Category
	L_{eq} (1h)[3]	L_{10} (1h)[4]		
A	57	60	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[5]	67	70	Exterior	Residential
C[5]	67	70	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	55	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72	75	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	-	-		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.

1) MDOT defines a noise impact as a 10 dB(A) increase between the existing noise level to the design year predicted noise level, OR a predicted design year noise level that is 1 dB(A) less than the levels shown in Table 1.
2) Either L_{eq}(h) or L_{10}(h) (but not both) may be used on a project. MDOT only uses L_{eq}(h). The L_{eq}(h) and L_{10}(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.
3) L_{eq} is the equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with L_{eq}(h) being the hourly value of L_{eq}.
4) L_{10} is the sound level that is exceeded 10 percent of the time (90th percentile) for the period under consideration, with L_{10}(h) being the hourly value of L_{10}.
5) Includes undeveloped lands permitted for this activity category

4.3. State Rules and Procedures

The following section summarizes the state rules and procedures the form the basis for the analysis but are not requirements for the PEL study.

The MDOT *Highway Noise Analysis and Abatement Handbook* is the State's tool for implementing 23 CFR 772, which was discussed in Section 4.2. The *Highway Noise Analysis and Abatement Handbook* expands on 23 CFR 772 by refining definitions and establishing mile stones within the design phase for the completion of noise impact analysis and mitigation development.

The *Highway Noise Analysis and Abatement Handbook* includes the following definitions:

Noise Impact: A substantial noise increase or a predicted design year noise level that is 1 dB(A) less, equal to, or greater than the NAC level.

Substantial Noise Increase: A 10 dB(A) or greater increase between the existing noise level and the design year predicted noise level.

Feasible Noise Barrier: A barrier that has no construction impediments, meets safety requirements for the traveling public, and provides at least 5 dB(A) noise reduction at 75% of the impacted receptors.

Reasonable Noise Barrier: A barrier that is cost effective, favorable to benefitting receptors, and achieves noise reduction design goals by meeting or exceeding the reasonableness factor.

Cost Effective Noise Barrier: A noise barrier analyzed for environmental clearance with a preliminary construction cost that is not more than 3% above the allowable cost per benefited receptor unit (CPBU) of $43,410 (year 2013), assuming a $45.00 per square foot noise barrier construction cost.

Benefited Receptor: A receptor that receives a 5 dB(A) or greater insertion loss as a result of a proposed noise barrier.

Attenuation Requirement: Reduce design year traffic noise by 10 dB(A) for at least one benefited receptor and provide at least a 7 dB(A) reduction for 50% or more of the benefited receptor sites.

5. NOISE ANALYSIS

5.1. FHWA Traffic Noise Model (TNM)

TNM is the FHWA computer program for highway traffic noise prediction and analysis. The use of the most resent TNM software is a mandatory requirement for all traffic noise related projects, under State and Federal regulations. The following parameters are used in this model to calculate an hourly L_{eq} at a specific receiver location:

- Distance between roadway and receiver;
- Relative elevations of roadway and receiver;
- Hourly traffic volumes by classification;
- Vehicle speeds;
- Ground absorption;
- Weather conditions; and
- Topographic features, including retaining walls and berms.

Hourly traffic volumes have been divided into five vehicle classifications: automobiles (A); medium trucks (MT); heavy trucks (HT); Buses (B); and Motorcycles (M). Each vehicle class is defined by the *FHWA Traffic Noise Model, User's Guide, (February 1998); TNM v2.5 Update Sheet, Technical Manual: Part 1* as follows:

- Automobiles – all vehicles with two axles and four tires, includes passenger vehicles and light trucks, less than 9,900 pounds.
- Medium trucks – all vehicles having two axles and six tires, vehicle weight between 9,900 and 26,400 pounds.
- Heavy trucks – all vehicles having three or more axles, vehicle weight greater than 26,400 pounds.
- Buses – all vehicles designed to carry more than nine passengers.
- Motorcycles – all vehicles with two or three tires and an open-air driver/passenger compartment.

5.2. Analysis

5.2.1. Land Use and Field Measured Levels

Land use in the project area is a mixture of residential and commercial properties. Sites within the M-153 corridor, with similar characteristics, were grouped into Common Noise Environments (CNEs) for analysis. Descriptions of each CNE within the project limits are provided in Table 4.

Table 4: Project Area Common Noise Environments

CNE	Site Description
A	Residential area located on Franklin Drive (West of Sheldon Road)
B	Commercial use in the southwest quadrant of the M-153/Sheldon Road intersection
C	Commercial use west of Sheldon Road
D	Commercial frontage between Sheldon Road and Oakview Drive
E	Commercial use between Sheldon Road and Morton Taylor Road
F	Commercial use between Oakview Drive and Morton Taylor Road
G	Apartment buildings located on Fordham Circle (East of Morton Taylor Road)
H	Residential area located on Willow Creek Drive (East of Morton Taylor Road)
I	Commercial frontage on Morrison Boulevard
J	Commercial use between Morrison Boulevard and Lilley Road
K	Commercial use between Willow Creek Drive and Lilley Road
L	Commercial use between Lilley Rd and Haggerty Road (EB M-153)
M	Commercial use between Lilley Rd and Haggerty Road (WB M-153)
N	Commercial use between Haggerty Road and I-275 (EB M-153)
O	Commercial use between Haggerty Road and I-275 (WB M-153)

Field noise measurements (with concurrent traffic counts) are taken to compare with the modeled noise levels. This comparison is done to validate the TNM so it can be used to predict existing and design year noise levels. Existing noise level measurements were conducted on October 26, 2012 at seven (7) sites in the project vicinity. These measurements were taken in areas that represent the noise levels in CNE A, D, G, H, J, and M. Two measurements were taken in CNE H to assist in the noise prediction modeling

A minimum fifteen minute measurement was taken at each site, during peak and off-peak traffic time periods. The measurements were made in accordance with FHWA and MDOT guidelines using an integrating sound level analyzer. Traffic counts were taken at each site, concurrent with the noise measurements. Posted traffic speeds in the project area were verified using a “floating car” during the site visits. Concurrent weather readings were obtained from the weather station in Ypsilanti Michigan, for accurate modeling purposes. The data collected at the seven (7) sites are presented in Table 5. The noise measurement sites and CNE boundaries are identified on Figures NB1 – NB4 of Appendix A.

Table 5: Measured Existing Noise Levels during Peak Traffic

Field Site ID	Figure NB	Site Description (Distance From The M-153 Curb And Gutter)	Date	Start Time	Duration (min)	Traffic[1] Roadway, Direction	Autos	Medium Trucks	Heavy Trucks	Buses	Motor-cycles	Measured Noise Level, dB(A) L_{eq}
						I-75 Speed mph	45	45	45	45	45	
A	1	Adjacent to EB M-153, 80 ft east of the Franklin Dr intersection (21 ft)	10/26/12	7:00 AM	15	WB M-153 EB M-153	195 217	3 2	1 4	3 2	0 0	70
D	1	Adjacent to EB M-153, 40 ft east of the Marlowe St intersection (21 ft)	10/26/12	5:00 PM	15	WB M-153 EB M-153	246 224	5 4	2 4	0 1	0 0	71
G	2	Adjacent to WB M-153, 185 ft east of the Fordham Cir intersection (17 ft)	10/26/12	7:25 AM	15	WB M-153 EB M-153	251 262	8 2	1 4	4 0	0 1	72
H1	2	Adjacent to WB M-153, 100 ft west of the Willow Creek Dr intersection (17 ft)	10/26/12	7:45 AM	15	WB M-153 EB M-153	270 267	10 7	5 1	0 5	2 0	74
H2	2	Adjacent to WB M-153, at the Willow Creek Dr intersection (22 5ft)	10/26/12	8:05 AM	15	WB M-153 EB M-153	254 288	8 4	5 4	1 1	0 0	58
J	2	Adjacent to EB M-153, 560 ft east of the Morrison Blvd intersection (24 ft)	10/26/12	4:00 PM	15	WB M-153 EB M-153	245 264	8 6	4 5	1 2	0 1	72
M	3	Adjacent to WB M-153, 780 ft east of the Lilley Rd intersection (21 ft)	10/26/12	4:30 PM	15	WB M-153 EB M-153	255 202	19 6	5 3	1 0	0 0	70

1) Vehicle counts classifications are according to Section 5.1 of this report.

5.2.2. Field Measured vs. Modeled Noise Levels

TNM was used to compare the field measurements to the model using the traffic count information. Comparing the modeled noise levels to the measured noise levels validates the TNM model for use on this M-153 project. Traffic counts were taken concurrently with the noise measurements at all of the sites and used in the model. All of the modeled data compared within 3 dB of the measured levels, which satisfies the MDOT requirement for validating noise measurements. The site by site comparison is presented in Table 6.

Table 6: Comparison of Measured and Modeled Noise Levels for Peak Traffic

Field Site ID	Figure NB	Noise Level, dB(A) L_{eq} (1h)		Difference in Noise Level, dB(A) L_{eq} (1h) (Modeled Minus Measured)
		Measured	Modeled	
A	1	70	70	0
D	1	71	72	+1
G	2	72	72	0
H1	2	74	73	-1
H2	2	58	58	0
J	2	72	72	0
M	3	70	70	0

5.2.3. Predicted Traffic Noise Levels and Noise Impact Analysis

The traffic noise prediction program, TNM, was used to model traffic noise levels within the project area for the existing, No-Build (Alterntative 1), Build, and Build (with Boulevard Section) (Alternative 3) conditions. Multiple traffic volumes were analyzed to account for the daily traffic variability throughout the M-153 corridor. The traffic condition that produced the highest noise level was defined as the worst-case condition for each receiver location. The traffic volumes that were used in the modeling of the existing condition are shown in Table 7, Table 8, and Table 9. The traffic volumes that were used in the modeling of the No-Build condition are shown in Table 10, Table 11, and Table 12. The traffic volumes that were used in the modeling of the Build (with Boulevard Section) (Alternative 3) condition are shown in Table 13, Table 14, and Table 15. The existing and future traffic volume data were generated from a review of the existing traffic. For analysis purposes it was assumed that the traffic volumes that were generated can achieve a free-flow condition. The use of traffic volumes that possess a free-flow LOS is in accordance to Section 2.5.2 of the *Highway Noise Analysis and Abatement Handbook*.

One hundred thirty three (133) receiver locations were identified within the 500 ft buffer zone that is adjacent to the roadway and have been were included in the noise model.

These receivers have been located in outdoor areas with evidence of frequent human use per FHWA requirements. Patio areas with tables and fuel pumps have been identified as frequently used areas for NAC E properties. All of the receivers that were included in the model represent existing sites.

The M-153 corridor within the project limits is fully developed. Thus there are no undeveloped lands that could be considered permitted developments under MDOT Policy.

The receiver locations are identified on Figures NB1A through NB4C in Appendix A. The loudest-hour traffic noise results are presented in Table 19, and in the TNM input and output files that are provided in Appendix E.

Table 7: Existing Traffic Volumes (Weekday AM Peak)

Roadway Segment	Total Traffic Volume	Volumes by Vehicle Type[1]		
		Autos	Medium Trucks	Heavy Trucks
WB M-153: West of Sheldon Road	980	934	28	11
EB M-153: West of Sheldon Road	1016	975	19	15
WB M-153: Between Sheldon Rd and Morton Taylor Rd	963	917	28	11
EB M-153: Between Sheldon Rd and Morton Taylor Rd	1041	999	20	15
WB M-153: Between Morton Taylor Rd and Lilley Rd	948	904	27	10
EB M-153: Between Morton Taylor Rd and Lilley Rd	1156	1109	22	17
WB M-153: Between Lilley Rd and Haggerty Rd	1076	1026	31	12
EB M-153: Between Lilley Rd and Haggerty Rd	1684	1616	32	24
WB M-153: East of Haggerty Rd	1386	1323	39	15
EB M-153: East of Haggerty Rd	2270	2181	42	32

1) Calculated vehicle distributions were based the distribution of vehicles that was observed during the field measurements.

Table 8: Existing Traffic Volumes (Weekday PM Peak)

Roadway Segment	Total Traffic Volume	Volumes by Vehicle Type[1]		
		Autos	Medium Trucks	Heavy Trucks
WB M-153: West of Sheldon Road	1184	1129	34	13
EB M-153: West of Sheldon Road	1286	1235	24	18
WB M-153: Between Sheldon Rd and Morton Taylor Rd	1386	1323	39	15
EB M-153: Between Sheldon Rd and Morton Taylor Rd	1272	1221	24	18
WB M-153: Between Morton Taylor Rd and Lilley Rd	1554	1483	44	17
EB M-153: Between Morton Taylor Rd and Lilley Rd	1419	1363	27	20
WB M-153: Between Lilley Rd and Haggerty Rd	1953	1864	55	21
EB M-153: Between Lilley Rd and Haggerty Rd	1562	1500	29	22
WB M-153: East of Haggerty Rd	2309	2204	65	25
EB M-153: East of Haggerty Rd	1929	1836	36	27

1) Calculated vehicle distributions were based the distribution of vehicles that was observed during the field measurements.

Table 9: Existing Traffic Volumes (Weekday Off Peak)

Roadway Segment	Total Traffic Volume	Volumes by Vehicle Type[1]		
		Autos	Medium Trucks	Heavy Trucks
WB M-153: West of Sheldon Road	1570	1498	45	17
EB M-153: West of Sheldon Road	1698	1630	32	24
WB M-153: Between Sheldon Rd and Morton Taylor Rd	1582	1510	45	17
EB M-153: Between Sheldon Rd and Morton Taylor Rd	1663	1596	31	24
WB M-153: Between Morton Taylor Rd and Lilley Rd	1603	1530	46	17
EB M-153: Between Morton Taylor Rd and Lilley Rd	1625	1559	31	23
WB M-153: Between Lilley Rd and Haggerty Rd	1693	1616	48	18
EB M-153: Between Lilley Rd and Haggerty Rd	1655	1588	31	24
WB M-153: East of Haggerty Rd	2021	1929	57	22
EB M-153: East of Haggerty Rd	1912	1836	36	27

1) Calculated vehicle distributions were based the distribution of vehicles that was observed during the field measurements.

Table 10: No-Build 2035 Traffic Volumes (Weekday AM Peak)

Roadway Segment	Total Traffic Volume	Volumes by Vehicle Type[1]		
		Autos	Medium Trucks	Heavy Trucks
WB M-153: West of Sheldon Road	1099	1049	31	12
EB M-153: West of Sheldon Road	1139	1093	22	16
WB M-153: Between Sheldon Rd and Morton Taylor Rd	1122	1071	32	12
EB M-153: Between Sheldon Rd and Morton Taylor Rd	1163	1116	22	17
WB M-153: Between Morton Taylor Rd and Lilley Rd	1057	1009	30	11
EB M-153: Between Morton Taylor Rd and Lilley Rd	1323	1270	25	19
WB M-153: Between Lilley Rd and Haggerty Rd	1072	1022	31	12
EB M-153: Between Lilley Rd and Haggerty Rd	1889	1814	35	27
WB M-153: East of Haggerty Rd	1047	999	30	11
EB M-153: East of Haggerty Rd	2331	2238	44	33

1) Calculated vehicle distributions were based the distribution of vehicles that was observed during the field measurements.

Table 11: No-Build 2035 Traffic Volumes (Weekday PM Peak)

Roadway Segment	Total Traffic Volume	Volumes by Vehicle Type[1]		
		Autos	Medium Trucks	Heavy Trucks
WB M-153: West of Sheldon Road	1329	1268	38	14
EB M-153: West of Sheldon Road	1442	1383	27	21
WB M-153: Between Sheldon Rd and Morton Taylor Rd	1634	1561	46	17
EB M-153: Between Sheldon Rd and Morton Taylor Rd	1427	1371	27	20
WB M-153: Between Morton Taylor Rd and Lilley Rd	1760	1679	50	19
EB M-153: Between Morton Taylor Rd and Lilley Rd	1635	1569	31	23
WB M-153: Between Lilley Rd and Haggerty Rd	1961	1871	56	21
EB M-153: Between Lilley Rd and Haggerty Rd	1751	1681	33	24
WB M-153: East of Haggerty Rd	2029	1936	58	22
EB M-153: East of Haggerty Rd	1978	1899	37	28

1) Calculated vehicle distributions were based the distribution of vehicles that was observed during the field measurements.

Table 12: No-Build 2035 Traffic Volumes (Weekday Off Peak)

Roadway Segment	Total Traffic Volume	Volumes by Vehicle Type[1]		
		Autos	Medium Trucks	Heavy Trucks
WB M-153: West of Sheldon Road	1761	1680	50	19
EB M-153: West of Sheldon Road	1904	1828	36	27
WB M-153: Between Sheldon Rd and Morton Taylor Rd	1822	1739	52	19
EB M-153: Between Sheldon Rd and Morton Taylor Rd	1866	1792	35	26
WB M-153: Between Morton Taylor Rd and Lilley Rd	1831	1747	52	20
EB M-153: Between Morton Taylor Rd and Lilley Rd	1932	1856	36	27
WB M-153: Between Lilley Rd and Haggerty Rd	1872	1787	53	20
EB M-153: Between Lilley Rd and Haggerty Rd	1906	1830	36	27
WB M-153: East of Haggerty Rd	1808	1726	51	19
EB M-153: East of Haggerty Rd	1921	1845	36	27

1) Calculated vehicle distributions were based the distribution of vehicles that was observed during the field measurements.

Table 13: Build (with Boulevard Section) (Alternative 3) 2035 Traffic Volumes (Weekday AM Peak)

Roadway Segment	Total Traffic Volume	Volumes by Vehicle Type[1]		
		Autos	Medium Trucks	Heavy Trucks
WB M-153: West of Sheldon Road	1329	1268	38	14
EB M-153: West of Sheldon Road	1438	1380	27	20
WB M-153: Between Sheldon Rd and Crossover	1211	1155	35	13
EB M-153: Between Sheldon Rd and Crossover	1486	1426	28	21
WB M-153: Between Crossover and Crossover	1120	1069	32	12
EB M-153: Between Crossover and Crossover	1266	1215	24	18
WB M-153: Between Crossover and Morton Taylor Rd	1296	1237	37	14
EB M-153: Between Crossover and Morton Taylor Rd	1313	1260	25	19
WB M-153: Between Morton Taylor Rd and Crossover	1255	1197	36	14
EB M-153: Between Morton Taylor Rd and Crossover	1375	1320	26	20
WB M-153: Between Crossover and Crossover	1128	1077	32	12
EB M-153: Between Crossover and Crossover	1411	1355	27	20
WB M-153: Between Crossover and Lilley Rd	1437	1372	41	15
EB M-153: Between Crossover and Lilley Rd	1883	1808	35	27
WB M-153: Between Lilley Rd and Crossover	1348	1286	38	15
EB M-153: Between Lilley Rd and Crossover	2196	2109	41	31
WB M-153: Between Crossover and Haggerty Rd	1669	1593	47	18
EB M-153: Between Crossover and Haggerty Rd	2637	2534	49	37
WB M-153: East of Haggerty Rd	1586	1514	45	17
EB M-153: East of Haggerty Rd	2076	1994	39	29

1) Calculated vehicle distributions were based the distribution of vehicles that was observed during the field measurements.

**Table 14: Build (with Boulevard Section) (Alternative 3)
2035 Traffic Volumes (Weekday PM Peak)**

Roadway Segment	Total Traffic Volume	Volumes by Vehicle Type[1]		
		Autos	Medium Trucks	Heavy Trucks
WB M-153: West of Sheldon Road	1842	1758	52	20
EB M-153: West of Sheldon Road	1971	1892	37	28
WB M-153: Between Sheldon Rd and Crossover	1880	1795	53	20
EB M-153: Between Sheldon Rd and Crossover	1808	1735	34	26
WB M-153: Between Crossover and Crossover	1664	1589	47	18
EB M-153: Between Crossover and Crossover	1479	1419	28	21
WB M-153: Between Crossover and Morton Taylor Rd	1965	1875	56	21
EB M-153: Between Crossover and Morton Taylor Rd	1665	1598	31	24
WB M-153: Between Morton Taylor Rd and Crossover	1816	1733	52	19
EB M-153: Between Morton Taylor Rd and Crossover	1667	1600	31	24
WB M-153: Between Crossover and Crossover	1960	1870	56	21
EB M-153: Between Crossover and Crossover	1640	1574	31	23
WB M-153: Between Crossover and Lilley Rd	2815	2688	80	30
EB M-153: Between Crossover and Lilley Rd	2324	2232	43	33
WB M-153: Between Lilley Rd and Crossover	2774	2650	78	29
EB M-153: Between Lilley Rd and Crossover	2087	2004	39	30
WB M-153: Between Crossover and Haggerty Rd	3129	2989	88	33
EB M-153: Between Crossover and Haggerty Rd	2517	2418	47	35
WB M-153: East of Haggerty Rd	2351	2244	67	25
EB M-153: East of Haggerty Rd	2158	2073	40	30

1) Calculated vehicle distributions were based the distribution of vehicles that was observed during the field measurements.

**Table 15: Build (with Boulevard Section) (Alternative 3)
2035 Traffic Volumes (Weekday Off Peak)**

Roadway Segment	Total Traffic Volume	Volumes by Vehicle Type[1]		
		Autos	Medium Trucks	Heavy Trucks
WB M-153: West of Sheldon Road	2182	2083	62	23
EB M-153: West of Sheldon Road	2110	2026	40	30
WB M-153: Between Sheldon Rd and Crossover	1831	1747	52	20
EB M-153: Between Sheldon Rd and Crossover	2176	2089	41	31
WB M-153: Between Crossover and Crossover	1549	1478	44	17
EB M-153: Between Crossover and Crossover	1693	1625	32	24
WB M-153: Between Crossover and Morton Taylor Rd	1778	1697	50	19
EB M-153: Between Crossover and Morton Taylor Rd	1721	1653	32	24
WB M-153: Between Morton Taylor Rd and Crossover	1655	1580	47	18
EB M-153: Between Morton Taylor Rd and Crossover	1769	1699	33	25
WB M-153: Between Crossover and Crossover	1674	1597	48	18
EB M-153: Between Crossover and Crossover	1600	1536	30	23
WB M-153: Between Crossover and Lilley Rd	2307	2203	65	13
EB M-153: Between Crossover and Lilley Rd	2044	1963	38	29
WB M-153: Between Lilley Rd and Crossover	2045	1952	58	22
EB M-153: Between Lilley Rd and Crossover	2175	2088	41	31
WB M-153: Between Crossover and Haggerty Rd	2128	2031	60	23
EB M-153: Between Crossover and Haggerty Rd	1908	1832	36	27
WB M-153: East of Haggerty Rd	1861	1776	53	20
EB M-153: East of Haggerty Rd	1726	1658	32	24

1) Calculated vehicle distributions were based the distribution of vehicles that was observed during the field measurements.

Bergmann associates
architects // engineers // planners

Table 16: Loudest Hour Noise Levels, dB(A) L_{eq} (1h)

Receiver Location	CNE	Fig. NB	Land Use[1]	Activity Category	Units	NAC Level	Noise Levels, L_{eq} (1h) (dB(A))			
							Existing (2012) [2]	No-Build (2035)	Build (Boulevard Section) (2035) [2]	Change
Res1	A	1	Res	B	1	67	50	51	51	+1
Res2	A	1	Res	B	1	67	51	51	52	+1
Res3	A	1	Res	B	1	67	52	53	53	+1
Res4	A	1	Res	B	1	67	54	54	53	-1
Res5	A	1	Res	B	1	67	53	53	53	0
Res6	A	1	Res	B	1	67	54	54	54	0
Res7	A	1	Res	B	1	67	57	57	57	0
Res8	A	1	Res	B	1	67	64	64	65	+1
Res9	A	1	Res	B	1	67	**68**	**69**	**69**	+1
Res10	A	1	Res	B	1	67	**68**	**68**	**69**	+1
Res11	A	1	Res	B	1	67	64	65	65	+1
Res12	A	1	Res	B	1	67	51	52	52	+1
Res13	A	1	Res	B	1	67	53	53	53	0
Res14	A	1	Res	B	1	67	53	54	54	+1
Res15	A	1	Res	B	1	67	55	56	55	0
Res16	A	1	Res	B	1	67	57	58	57	0
Res17	A	1	Res	B	1	67	60	60	59	-1
Res18	A	1	Res	B	1	67	**67**	**67**	**68**	+1
Res19	A	1	Res	B	1	67	65	65	**66**	+1
Res20	A	1	Res	B	1	67	63	63	63	0
Res21	A	1	Res	B	1	67	61	62	61	0
Res22	A	1	Res	B	1	67	60	61	60	0
Res23	A	1	Res	B	1	67	59	60	59	0
Res24	A	1	Res	B	1	67	55	56	55	0
Res25	A	1	Res	B	1	67	54	54	53	-1

1) Res = Residential, Com = Commercial
2) Noise levels approaching or exceeding NAC levels are (**bold / highlighted**).

Table 16: Loudest Hour Noise Levels, dB(A) Leq (1h) (Continued)

Receiver Location	CNE	Fig. NB	Land Use[1]	Activity Category	Units	NAC Level	Noise Levels, L_{eq} (1h) (dB(A))			
							Existing (2012) [2]	No-Build (2035)	Build (Boulevard Section) (2035) [2]	Change
Res26	A	1	Res	B	1	67	54	55	53	-1
Res27	A	1	Res	B	1	67	54	55	54	0
Res28	A	1	Res	B	1	67	59	60	59	0
Res29	A	1	Res	B	1	67	58	59	58	0
Res30	A	1	Res	B	1	67	58	58	58	0
Res31	A	1	Res	B	1	67	57	58	57	0
Res32	A	1	Res	B	1	67	55	56	55	0
Res33	A	1	Res	B	1	67	56	56	55	-1
Res34	A	1	Res	B	1	67	56	57	55	-1
Res35	A	1	Res	B	1	67	57	57	55	-2
Res36	A	1	Res	B	1	67	57	58	56	-1
Res37	A	1	Res	B	1	67	58	58	56	-2
Res38	A	1	Res	B	1	67	59	59	57	-2
Res39	A	1	Res	B	1	67	50	51	51	+1
Res40	A	1	Res	B	1	67	51	52	52	+1
Res41	A	1	Res	B	1	67	52	53	53	+1
Com7	C	1	Com	E	1	72	66	67	69	+3
Res42	D	1	Res	B	1	67	62	63	62	0
Res43	D	1	Res	B	1	67	59	60	58	-1
Res44	D	1	Res	B	1	67	58	58	56	-2
Res45	D	1	Res	B	1	67	56	57	56	0
Res46	D	1	Res	B	1	67	55	56	55	0
Res47	D	1	Res	B	1	67	53	54	54	+1
Res48	D	1	Res	B	1	67	53	54	54	+1
Res49	D	1	Res	B	1	67	54	55	54	0
Res50	D	1	Res	B	1	67	56	56	55	-1
Res51	D	1	Res	B	1	67	58	58	56	-2

1) Res = Residential, Com = Commercial
2) Noise levels approaching or exceeding NAC levels are (**bold / highlighted**).

Bergmann associates
architects // engineers // planners

Table 16: Loudest Hour Noise Levels, dB(A) Leq (1h) (Continued)

Receiver Location	CNE	Fig. NB	Land Use[1]	Activity Category	Units	NAC Level	Noise Levels, L_{eq} (1h) (dB(A))			
							Existing (2012) [2]	No-Build (2035)	Build (Boulevard Section) (2035) [2]	Change
Res52	D	1	Res	B	1	67	60	61	59	-1
Res53	D	1	Res	B	1	67	54	54	54	0
Res54	D	1	Res	B	1	67	56	57	55	-1
Res55	D	1	Res	B	1	67	60	60	58	-2
Res56	D	1	Res	B	1	67	59	60	57	-2
Res57	D	1	Res	B	1	67	55	55	55	0
Res58	D	1	Res	B	1	67	53	53	53	0
Res59	D	1	Res	B	1	67	54	54	54	0
Res60	D	1	Res	B	1	67	57	57	56	-1
Res61	D	1	Res	B	1	67	62	62	61	-1
Res62	D	1	Res	B	1	67	60	60	58	-2
Res63	D	1	Res	B	1	67	58	59	56	-2
Res64	D	1	Res	B	1	67	57	57	55	-2
Res65	D	1	Res	B	1	67	55	55	54	-1
Res66	D	1	Res	B	1	67	53	54	53	0
Res67	D	1	Res	B	1	67	56	56	55	-1
Res68	D	1	Res	B	1	67	54	55	54	0
Res69	D	1	Res	B	1	67	56	57	55	-1
Res70	D	1	Res	B	1	67	59	59	56	-3
Res71	D	1	Res	B	1	67	54	54	54	0
Res72	D	1	Res	B	1	67	55	55	54	-1
Res73	D	1	Res	B	1	67	57	58	55	-2
Res74	D	1	Res	B	1	67	59	59	57	-2
Res75	D	1	Res	B	1	67	61	62	59	-2

1) Res = Residential, Com = Commercial
2) Noise levels approaching or exceeding NAC levels are (**bold / highlighted**).

Bergmann associates
architects // engineers // planners

Table 16: Loudest Hour Noise Levels, dB(A) Leq (1h) (Continued)

Receiver Location	CNE	Fig. NB	Land Use[1]	Activity Category	Units	NAC Level	Noise Levels, L_{eq} (1h) (dB(A))			
							Existing (2012) [2]	No-Build (2035)	Build (Boulevard Section) (2035) [2]	Change
Res107	G	2	Res	B	1	67	52	52	52	0
Res108	G	2	Res	B	1	67	54	54	53	-1
Res109	G	2	Res	B	1	67	55	56	54	-1
Res110	G	2	Res	B	1	67	55	56	54	-1
Res111	G	2	Res	B	1	67	60	61	59	-1
Res112	G	2	Res	B	1	67	63	63	63	0
Res113	G	2	Res	B	1	67	**68**	**68**	**69**	+1
Res114	G	2	Res	B	1	67	**67**	**68**	**69**	+2
Res115	G	2	Res	B	1	67	63	63	62	-1
Res116	G	2	Res	B	1	67	60	61	59	-1
Res117	G	2	Res	B	1	67	60	61	59	-1
Res118	G	2	Res	B	1	67	63	64	64	+1
Res119	G	2	Res	B	1	67	**67**	**68**	**69**	+2
Res120	G	2	Res	B	1	67	**67**	**68**	**69**	+2
Res121	G	2	Res	B	1	67	62	63	62	0
Res122	G	2	Res	B	1	67	60	61	59	-1
Res123	G	2	Res	B	1	67	56	57	55	-1
Res124	G	2	Res	B	1	67	55	56	55	0
Res125	G	2	Res	B	1	67	53	54	54	-1

1) Res = Residential, Com = Commercial
2) Noise levels approaching or exceeding NAC levels are (**bold / highlighted**).

Bergmann associates
architects // engineers // planners

Table 16: Loudest Hour Noise Levels, dB(A) Leq (1h) (Continued)

Receiver Location	CNE	Fig. NB	Land Use[1]	Activity Category	Units	NAC Level	Noise Levels, L_{eq} (1h) (dB(A))			
							Existing (2012) [2]	No-Build (2035)	Build (Boulevard Section) (2035) [2]	Change
Res84	H	2	Res	B	1	67	59	60	57	-2
Res85	H	2	Res	B	1	67	53	54	53	0
Res86	H	2	Res	B	1	67	54	55	54	0
Res87	H	2	Res	B	1	67	56	56	54	-2
Res88	H	2	Res	B	1	67	58	59	56	-2
Res89	H	2	Res	B	1	67	60	60	58	-2
Res90	H	2	Res	B	1	67	63	64	64	+1
Res91	H	2	Res	B	1	67	**68**	**69**	**69**	+1
Res92	H	2	Res	B	1	67	**68**	**69**	**70**	+2
Res93	H	2	Res	B	1	67	58	59	56	-2
Res94	H	2	Res	B	1	67	54	55	53	-1
Res95	H	2	Res	B	1	67	52	53	52	0
Res96	H	2	Res	B	1	67	51	51	51	0
Res97	H	2	Res	B	1	67	51	52	51	0
Res98	H	2	Res	B	1	67	53	54	52	-1
Res99	H	2	Res	B	1	67	55	56	54	-1
Res100	H	2	Res	B	1	67	58	59	56	-2
Res101	H	2	Res	B	1	67	**68**	**69**	**70**	+2
Res102	H	2	Res	B	1	67	63	64	63	0
Res103	H	2	Res	B	1	67	58	59	57	-1
Res104	H	2	Res	B	1	67	56	57	55	-1
Res105	H	2	Res	B	1	67	54	54	53	-1
Res106	H	2	Res	B	1	67	52	52	52	0

1) Res = Residential, Com = Commercial
2) Noise levels approaching or exceeding NAC levels are (**bold / highlighted**).

Bergmann associates
architects // engineers // planners

Table 16: Loudest Hour Noise Levels, dB(A) Leq (1h) (Continued)

Receiver Location	CNE	Fig. NB	Land Use[1]	Activity Category	Units	NAC Level	Noise Levels, L_{eq} (1h) (dB(A))			
							Existing (2012) [2]	No-Build (2035)	Build (Boulevard Section) (2035) [2]	Change
Res76	I	2	Res	B	1	67	62	63	61	-1
Res77	I	2	Res	B	1	67	60	60	58	-2
Res78	I	2	Res	B	1	67	58	59	56	-2
Res79	I	2	Res	B	1	67	56	57	55	-1
Res80	I	2	Res	B	1	67	55	55	55	0
Res81	I	2	Res	B	1	67	55	55	55	0
Res82	I	2	Res	B	1	67	56	56	56	0
Res83	I	2	Res	B	1	67	58	58	56	-2
Com39	J	3	Com	E	1	72	68	69	70	+2
Com45	L	3	Com	E	1	72	63	63	64	+1
Com62	M	3	Com	E	1	72	66	66	70	+4
Com70	M	3	Com	E	1	72	66	67	69	+3
Com71	M	3	Com	E	1	72	65	65	67	+2
Com80	N	3	Com	E	1	72	67	66	69	+2
Com77	O	3	Com	E	1	72	66	66	68	+2

1) Res = Residential, Com = Commercial
2) Noise levels approaching or exceeding NAC levels are (**bold / highlighted**).

Bergmann associates
architects // engineers // planners

Noise impacts occur when the Build condition produces noise levels that either exceed existing noise levels by 10 dB(A) or more; or approach or exceed the NAC. The predicted for loudest hour noise levels for Build (with Boulevard Section) (Alternative 3) condition in 2035 range from 51 dB(A) to 71 dB(A). These values are 0 to 5 dB(A) higher than existing loudest hour noise levels, with the loudest increases being in the commercial areas near the I-275/M-153 interchange. A summary of the noise impact assessment (or the number of receiver locations that approach or exceed the NAC) is provided in Table 17.

Table 17: Number of Locations within CNEs that Approach or Exceed the NAC

Activity Description	Existing	2035 No Build	2035 Build (Boulevard Section)
CNE Area A – Residential	3	3	4
CNE Area B – Commercial	N/A	N/A	N/A
CNE Area C – Commercial	0	0	0
CNE Area D – Commercial	0	0	0
CNE Area E – Commercial	N/A	N/A	N/A
CNE Area F – Commercial	N/A	N/A	N/A
CNE Area G – Residential	4	4	4
CNE Area H – Residential	3	3	3
CNE Area I – Commercial	0	0	0
CNE Area J – Commercial	0	0	0
CNE Area K – Commercial	N/A	N/A	N/A
CNE Area L – Commercial	0	0	0
CNE Area M – Commercial	0	0	0
CNE Area N – Commercial	0	0	0
CNE Area O – Commercial	0	0	0

* N/A = Not applicable

CNE B, E, F K are commercial properties and have been identified as having an Activity Category NAC E (from FHWA Noise Abatement Criteria [NAC] Table 3). These CNEs where reviewed in the field and evidence of outdoor areas with frequent human use could not be located. Thus, no noise abatement assessments were performed at those locations. The remaining Activity Category NAC E land uses (CNE C, D, I, J, L, M, N, and O) contained at least one property with outdoor dining tables or fuel pumps.

6. ABATEMENT MEASURES

6.1. Federal and State Abatement Guidance

The following section summarizes the state rules and procedures the form the basis for the analysis but are not requirements for the PEL study.

MDOT's Noise Policy has established the criteria for determining where noise abatement must be provided. A complete copy of this policy is provided in Appendix E. The policy is summarized as follows:

- Where adverse noise impacts are expected to occur, noise abatement will be considered and will be implemented if found feasible and reasonable for existing developments, and future developments that were approved before the date of public knowledge of the project (approved means that a building permit has been received). After the date of public knowledge, MDOT is not responsible for providing noise abatement for new developments. The date of the clearance of the Categorical Exclusion (CE), EA, and/or EIS will be the date of public knowledge. The provision of noise abatement for new developments after the date of public knowledge becomes the responsibility of local governments and private developers.

- All sites will be considered, however, it is generally known that commercial and industrial sites prefer that there be no interference with the view to their establishments. Therefore, when commercial and residential sites expected to convert to a commercial or industrial land use (e.g., some of the residential units have converted to commercial/industrial, or the area has been re-zoned commercial) are found to be reasonable and feasible, they will be asked if they want noise abatement. If they do not want it, it will not be provided.

- Feasible - This refers to engineering considerations such as: constructability of a noise barrier on the existing topography; achievement of substantial noise reductions; the presence of other noise sources in the area; and the ability to maintain access, drainage, safety, utilities in the area. While every reasonable effort should be made to obtain a substantial noise reduction, a noise abatement measure is not feasible if it cannot achieve at least a 5 dB(A) noise reduction for 75% of impacted receivers during design year traffic noise.

- Reasonable - Noise mitigation will be considered reasonable if:
  - During the environmental clearance phase, the preliminary cost per benefiting unit is less than 3% above allowable per benefitting unit level ($43,410 in 2013 dollars); and
  - The noise barrier provides a design year traffic noise reduction of 10 dB(A) for at least one benefitted unit and at least a 7 dB(A) for 50% or more of the benefitted units.

Highway traffic noise abatement alternatives, which are listed in 23 CFR 772.15(c) include:

1) Construction of noise barriers including acquisition of property rights, either within or outside the highway right-of-way;
2) Traffic management measures;
3) Alteration of horizontal and vertical alignments;
4) Acquisition of real property or interests therein to serve as a buffer zone to preempt development;
5) Noise insulation of Activity Category D land use facilities listed in Table 3

Upon review of the listed abatement alternatives, it has been determined that the following were not feasible: reductions of speed limits would impact signal optimization and impact the flow of traffic within the vicinity of M-153; restriction or prohibition of trucks is not practical because some of the truck destinations are located on M-153 within the project limits; existing features, like buildings, that are adjacent to the roadway preclude substantial horizontal and vertical alignment shifts that could potentially produce noticeable changes in the projected acoustical environment; cost restrictions typically prohibit the acquisition of property for any reason; and the construction of noise berms is neither feasible nor reasonable because of the amount of space that would be required. Therefore, the construction of noise barriers within the existing Right-of-Way was the only mitigation measure that was reviewed in-depth evaluation.

6.2 Noise Barrier Analysis

Fifteen CNE areas were identified within the project limits. CNE areas A, G, and H were found to contain at least one impacted receptor and require abatement analysis. The remaining CNE areas were found to contain no impacted receptors and did not require an abatement analysis. At a minimum, the MDOT: *Highway Noise Analysis and Abatement Handbook* requires that noise barriers be analyzed as a noise abatement measure. To satisfy this requirement, a noise barrier has been evaluated for each of the CNE areas with impacted noise receptors as a part of this noise study.

The noise barriers that were evaluated for the Build (with Boulevard Section) (Alternative 3) condition are presented in Table 18. This table summarizes barrier related information like barrier location, future $L_{eq}(1h)$ noise levels without and with a barrier, barrier length and height, and the noise reduction provided by the barrier. Information pertaining to the number of substantial noise reduction locations, the number of locations with more than 7 dB(A) attenuation, total estimated cost (based on $45.00 per square foot), the number of benefited receivers (i.e. residential or commercial), the cost per benefited receiver, feasibility determination, and reasonableness determination has been summarized in Table 19. The evaluated noise barriers are presented on Figures NB1A – NB4C of Appendix A.

Table 18: Evaluated Noise Barriers for the Build (with the Boulevard Section) (Alternative 3) Condition

Noise Barrier ID	Sheet #	Locations	Existing L_{eq} (1hr) Noise Levels, dB(A)	Range of Future L_{eq}(1hr) Noise Levels, dB(A)		Noise Reduction (dB(A))	Barrier Characteristics	
				w/o Barrier	With Barrier		Length (ft)	Avg. Ht. (ft)
NB-A	NB1	Franklin Drive west to subdivision limits (EB M-153)	50-68	51-69	50-67	0-10	320	14.00
NB-G/H	NB2	In front of Fordham Rd and Willow Creek Rd subdivisions (WB M-153)	51-68	51-70	48-63	1-13	1100	15.40

Table 19: Noise Barrier Feasibility and Reasonableness for the Build (with the Boulevard Section) (Alternative 3) Condition

Noise Barrier ID	Number of Attenuated locations					Cost [1]	Cost / Benefited	Feasible	Reasonable
	≥ 10 dB(A)	≥ 7 dB(A)		≥ 5 dB(A) (Benefited Receivers)					
		#	% of Benefited	#	% of Impacted			(Y/N)	(Y/N)
NB-A	1	2	50%	4	50%	$201,600	$50,400	N	N
NB-G/H	3	9	75%	12	100%	$762,300	$63,525	Y	N

1) Based on $45.00 per square feet

None of the noise barriers that were evaluated for the Build (with Boulevard Section) (Alternative 3) condition satisfied both of MDOT's criteria for feasibility and reasonableness. The noise barrier at CNE A (NB A) failed to satisfy MDOT's feasibility and reasonableness criteria. The noise barrier CNE G and H (NB G/H) were found to satisfy MDOT's feasibility criteria, but failed to meet the reasonableness criteria.

7. CONCLUSIONS

MDOT's policy is to install noise abatement measures found to be feasible and reasonable that are associated with transportation improvements. Based on the preliminary analysis that has been preformed, noise abatement does not appear to be feasible and reasonable at any of the common noise environment sites along M-153.

8. CONSTRUCTION NOISE

The noise produced on roadway construction sites originates from a variety of sources, which can be described by identifying those phases of construction applicable to the recommended project. Specifically, each phase of construction has its own scope, objective, mix of equipment, and therefore, its own noise characteristics. For most projects these phases will overlap due to time constraints and interdependency of activities.

Considering the relatively short-term nature of construction noise, impacts are not expected to be substantial. The transmission loss characteristics of nearby structures are believed to be sufficient to moderate the effects of intrusive construction noise.

9. REFERENCES

Anderson, G. S., C.S.Y. Lee, G.G. Fleming and C. Menge, "FHWA Traffic Noise Model®, Version 1.0 User's Guide", Federal Highway Administration, January 1998, p. 60.

"Commission Policy", (Guidance Document 10136), Michigan Transportation Commission, Michigan Department of Transportation, July 31, 2003.

Lau, Michael C., Cynthia S. Y. Lee, Gregg G. Judith L. Rochat, Eric R. Boeker, and Gregg C. Fleming. FHWA Traffic Noise Model® Users Guide (Version 2.5 Addendum). Federal Highway Administration, April 2004.

"Highway Noise Analysis and Abatement Handbook" Michigan Department of Transportation, July 13, 2011.
http://michigan.gov/documents/mdot/MDOT_HighwayNoiseAnalysis_and_AbatementHandbook_358156_7.pdf

"Highway Traffic Noise: Analysis and Abatement Guidance", Federal Highway Administration, January 2011.
http://www.fhwa.dot.gov/Environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/revguidance.pdf

Reherman, Clay N., Rochat, Judith L., Thalheimer, Erich S., Lau, Michael C., Fleming, Gregg G., Ferroni, Mark, and Corbisier, Christopher, FHWA Roadway Construction Noise Model, Version 1.0 User's Guide. Federal Highway Administration, January 2006.

"Report to the President and Congress on Noise", National Service Center for Environmental Publications, February 1972.

Title 23 CFR Part 772, "Procedure for abatement of Highway Traffic Noise and Construction Noise", Code of Federal Regulations
http://www.fhwa.dot.gov/hep/23cfr772.htm

Appendix A
Project Figures

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:________)

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

MDOT Michigan Department of Transportation

VERT. (FT) 0 20
HORZ. (FT) 0 200

FILE: 115177_M153_NOISE001.DGN

DATE: 02-08-13
DESIGN UNIT: ____________
TSC: ____________

CS: 82292
JN: 115177

M-153
NOISE MODELING MAP
NO-BUILD CONDITION

SECT 1
NB1A

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:_______)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

MDOT Michigan Department of Transportation

VERT. (FT) 0 20
HORZ. (FT) 0 200

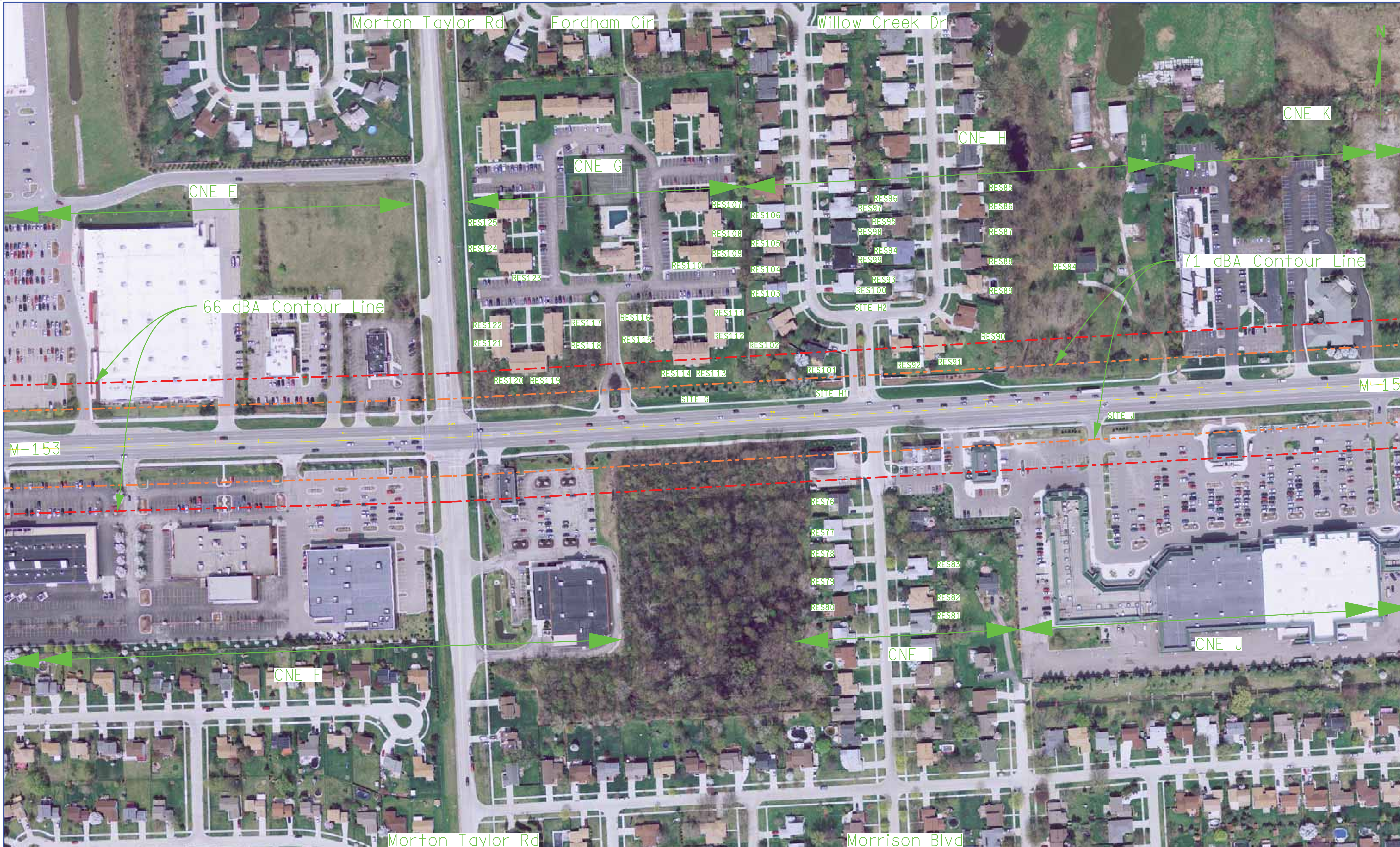
FILE:115177_M153_NOISE001.DGN

DATE: 02-08-13
DESIGN UNIT: __________
TSC: __________

CS: 82292
JN: 115177

M-153
NOISE MODELING MAP
BUILD (BOULEVARD SECTION) CONDITION

SECT 1
NB1C



FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:________)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

MDOT
Michigan Department of Transportation

VERT. (FT) 0 20
HORZ. (FT) 0 200

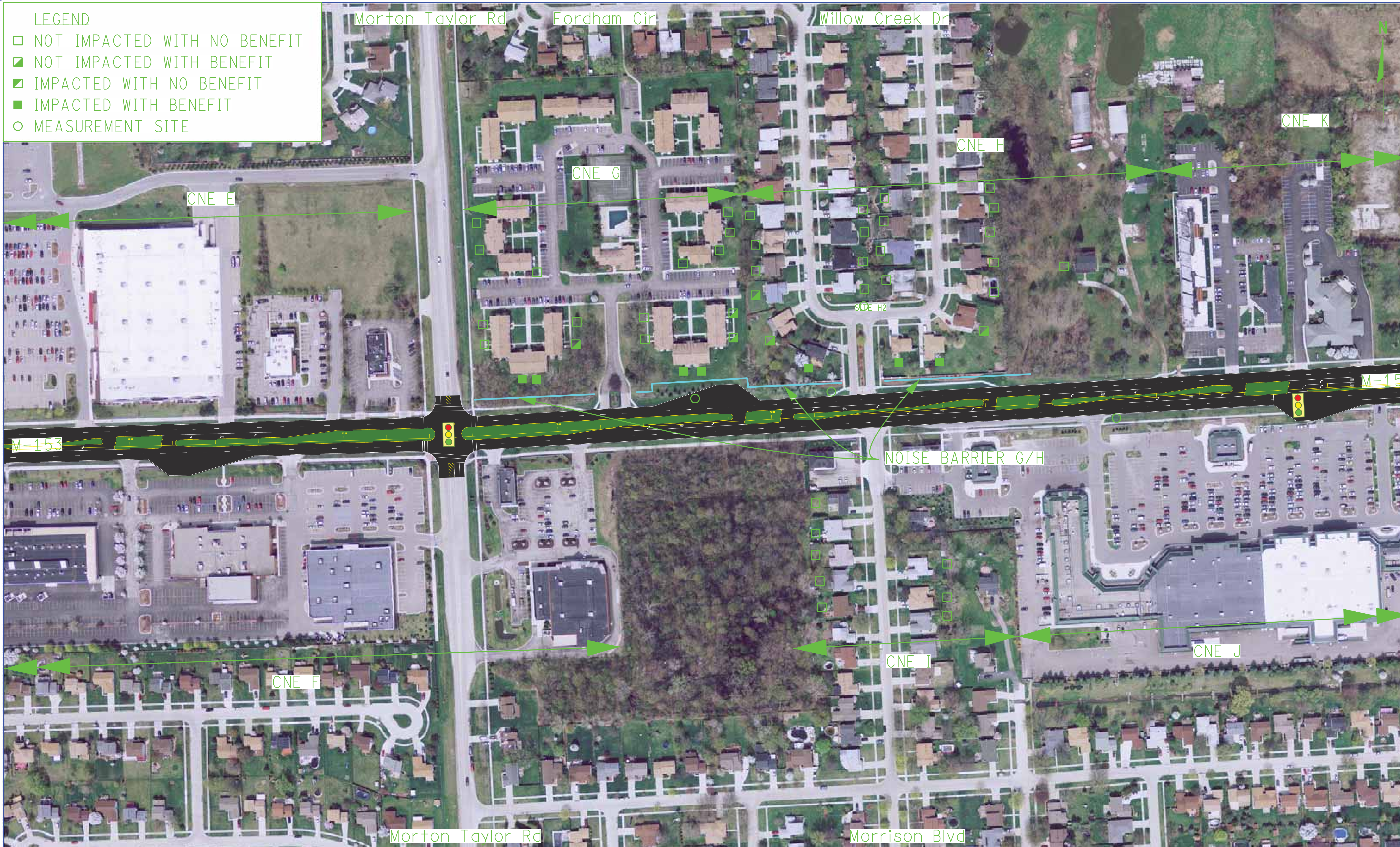
FILE:115177_M153_NOISE001.DGN

DATE: 02-08-13
DESIGN UNIT: ____________
TSC: ____________

CS: 82292
JN: 115177

M-153
NOISE MODELING MAP
NO-BUILD CONDITION

DRAWING ______ ______
SHEET SECT 1 NB2A



FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:______)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

MDOT Michigan Department of Transportation

VERT. (FT) 0 – 20; HORZ. (FT) 0 – 200

FILE:115177_M153_NOISE001.DGN

DATE: 02-08-13
DESIGN UNIT: ______
TSC: ______

CS: 82292
JN: 115177

M-153
NOISE MODELING MAP
BUILD (BOULEVARD SECTION) CONDITION

DRAWING ____ SHEET SECT 1 NB2C

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:________)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

MDOT
Michigan Department of Transportation

0 VERT. (FT) 20
0 HORZ. (FT) 200

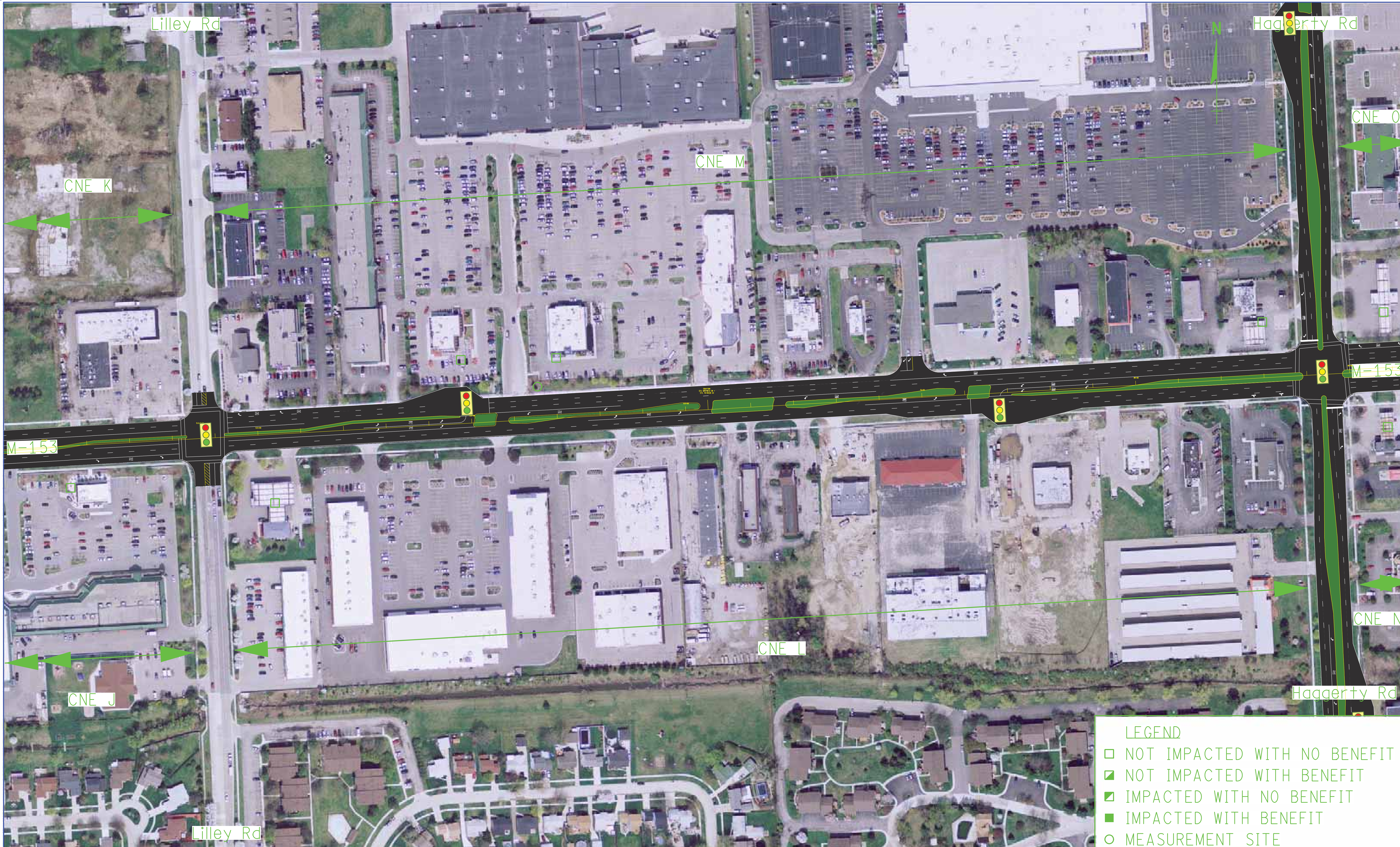
FILE:115177_M153_NOISE001.DGN

DATE: 02-08-13
DESIGN UNIT: ____________
TSC: ____________

CS: 82292
JN: 115177

M-153
NOISE MODELING MAP
NO-BUILD CONDITION

DRAWING ______
SHEET SECT 1 NB3A



FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:________)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

MDOT
Michigan Department of Transportation

0 VERT. (FT) 20
0 HORZ. (FT) 200

FILE:115177_M153_NOISE001.DGN

DATE: 02-08-13
DESIGN UNIT: ____________
TSC: ____________

CS: 82292
JN: 115177

M-153
NOISE MODELING MAP
BUILD (BOULEVARD SECTION) CONDITION

DRAWING ______
SHEET SECT 1 NB3C

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:______)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

MDOT
Michigan Department of Transportation

VERT. (FT) 0 – 20
HORZ. (FT) 0 – 200

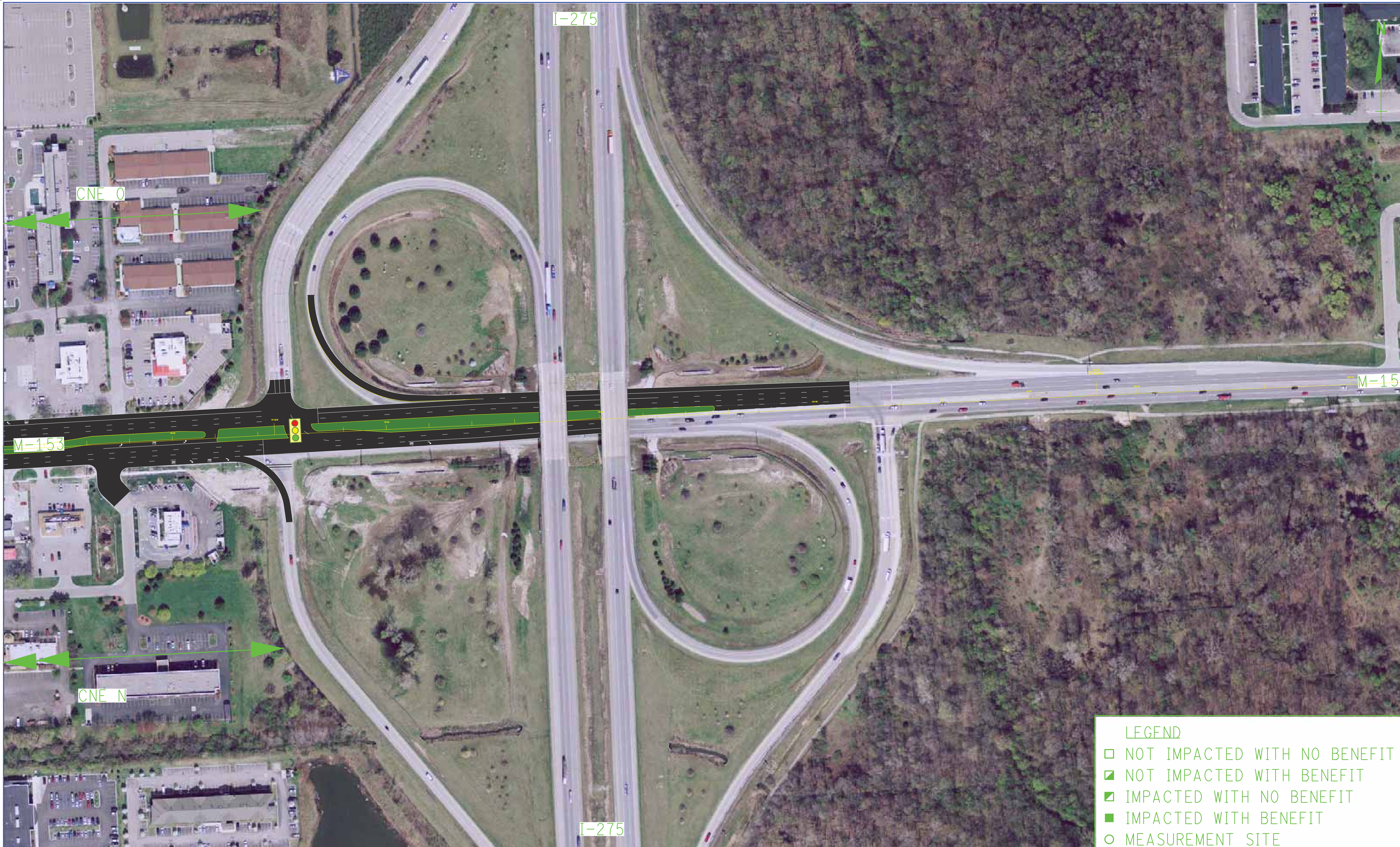
FILE: 115177_M153_NOISE004.DGN

DATE: 02-08-13
DESIGN UNIT: ____________
TSC: ____________

CS: 82292
JN: 115177

M-153
NOISE MODELING MAP
NO-BUILD CONDITION

DRAWING ____
SHEET SECT 1
NB4A



LEGEND

- ☐ NOT IMPACTED WITH NO BENEFIT
- ◪ NOT IMPACTED WITH BENEFIT
- ◪ IMPACTED WITH NO BENEFIT
- ■ IMPACTED WITH BENEFIT
- ○ MEASUREMENT SITE

FINAL ROW PLAN REVISIONS (SUBMITTAL DATE:________)							
NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION

MDOT
Michigan Department of Transportation

0 VERT. (FT) 20
0 HORZ. (FT) 200

FILE:115177_M153_NOISE004.DGN

DATE: 02-08-13
DESIGN UNIT: ______________
TSC: ____________________

CS: 82292
JN: 115177

M-153
NOISE MODELING MAP
BUILD (BOULEVARD SECTION) CONDITION

DRAWING: ______
SHEET: SECT 1 NB4C

Appendix B
Measurement Site Information

SITE / LOCATION: **A / CNE A** APPROX. MILE POINT: ________ DATE: **10/26/12**

Peak Measurement

		Period			
Time Begin:	7:00 AM	15 minutes	**Leq** **70**		

Traffic Counts:

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	195	3	1	3	0
EB M-153	217	2	4	2	0

Off-Peak Measurement

		Period			
Time Begin:	9:30 AM	20 minutes	Leq 69		

Traffic Counts:

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	330	7	3	3	0
EB M-153	279	9	7	2	0

LOCATION AERIAL:

Comments: Air traffic overhead skews off-peak data

SITE PHOTOGRAPHS: Looking North

Looking Southwest

SITE / LOCATION: **D / CNE D** APPROX. MILE POINT: ______ DATE: **10/26/12**

Peak Measurement

Time Begin:	5:00 PM	Period 15 minutes	**Leq 72**		

Traffic Counts:

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	246	5	2	0	0
EB M-153	224	4	4	1	0

Off-Peak Measurement

Time Begin:	3:30 PM	Period 15 minutes	Leq 72		

Traffic Counts:

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	246	5	2	0	0
EB M-153	224	4	4	1	0

LOCATION AERIAL:

Comments: Air traffic overhead skews off-peak data

SITE PHOTOGRAPHS: Looking West

Looking Northeast

SITE / LOCATION: **G / CNE G** APPROX. MILE POINT: DATE: **10/26/12**

Peak Measurement | Period

Time Begin:	7:25 AM	15 minutes	**Leq 72**		

Traffic Counts:

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	251	8	1	4	0
EB M-153	262	2	4	0	1

Off-Peak Measurement | Period

Time Begin:	10:30 AM	15 minutes	Leq 72		

Traffic Counts:

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	268	4	0	0	0
EB M-153	260	5	4	1	0

LOCATION AERIAL:

Comments:

SITE PHOTOGRAPHS: Looking South

Looking North

SITE / LOCATION: **H1 / CNE H** APPROX. MILE POINT: ________ DATE: **10/26/12**

Peak Measurement | Period
Time Begin: 7:45 AM | 15 minutes | **Leq 74**

Traffic Counts:

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	270	10	5	0	2
EB M-153	267	7	1	5	0

Off-Peak Measurement | Period
Time Begin: 11:00 AM | 15 minutes | Leq 73

Traffic Counts:

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	282	10	3	1	0
EB M-153	225	4	2	1	0

LOCATION AERIAL:

Comments: ________________

SITE PHOTOGRAPHS: Looking South

Looking North

Noise Measurements

SITE / LOCATION: **H2 / CNE H** APPROX. MILE POINT: ______ DATE: **10/26/12**

Peak Measurement

Time Begin:	8:05 AM	Period: 15 minutes	**Leq**
			58

Traffic Counts:

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	254	8	5	1	0
EB M-153	288	4	4	1	0

Off-Peak Measurement

Time Begin:	11:25 AM	Period: 15 minutes	Leq
			57

Traffic Counts:

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	309	8	2	3	0
EB M-153	285	2	1	2	0

LOCATION AERIAL:

Comments: ______

SITE PHOTOGRAPHS: Looking South

Looking North

SITE / LOCATION: **J / CNE J** APPROX. MILE POINT: ______ DATE: **10/26/12**

Peak Measurement — Period
Time Begin: 4:00 pm — 15 minutes — **Leq 72**

Traffic Counts:

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	245	8	4	1	0
EB M-153	264	6	5	2	1

Off-Peak Measurement — Period
Time Begin: 11:45 AM — 15 minutes — Leq 65

Traffic Counts:

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	320	5	4	1	0
EB M-153	137	5	3	0	0

LOCATION AERIAL:

Comments: EB traffic congested in for the off peak measurement

SITE PHOTOGRAPHS: Looking Southwest

Looking North

SITE / LOCATION: **M / CNE M** APPROX. MILE POINT: DATE: **10/26/12**

Peak Measurement

Time Begin:	4:30 pm	Period 15 minutes	**Leq 70**		
Traffic Counts:					
	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153	255	19	5	1	0
EB M-153	202	6	3	0	0

Off-Peak Measurement

Time Begin:	3:00 pm	Period 15 minutes	Leq 70		
Traffic Counts:					
	Auto	Med. Truck	Hvy Truck	Bus	Moto.
WB M-153					
EB M-153					

LOCATION AERIAL:

Comments: EB traffic congested in for the off peak measurement

SITE PHOTOGRAPHS: Looking South

Looking North

Appendix C
Weather information

History for Ypsilanti, MI

Friday, October 26, 2012

Friday, October 26, 2012

« Previous Day | October | 26 | 2012 | View | Next Day »

Daily | Weekly | Monthly | Custom

	Actual	Average	Record
Temperature			
Mean Temperature	**57** °F	-	
Max Temperature	**71** °F	**58** °F	**74** °F (1989)
Min Temperature	**46** °F	**41** °F	**26** °F (2006)
Degree Days			
Heating Degree Days	8		
Growing Degree Days	7 (Base 50)		
Moisture			
Dew Point	**41** °F		
Average Humidity	67		
Maximum Humidity	80		
Minimum Humidity	56		
Precipitation			
Precipitation	**0.03** in	-	- ()
Sea Level Pressure			
Sea Level Pressure	**30.11** in		
Wind			
Wind Speed	**13** mph (NW)		
Max Wind Speed	**23** mph		
Max Gust Speed	**29** mph		
Visibility	**10** miles		
Events	Rain		

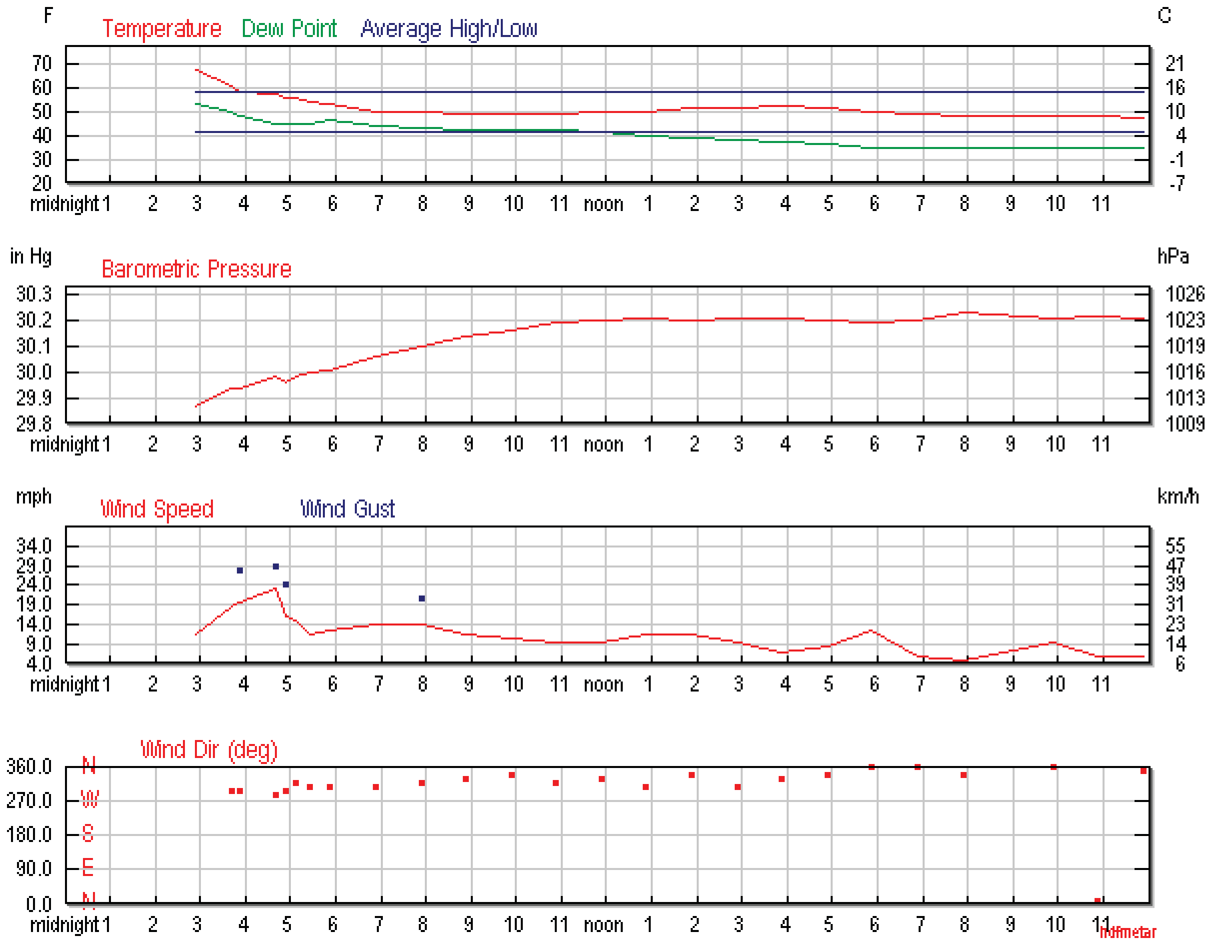
Averages and records for this station are not official NWS values.

Click here for data from the nearest station with official NWS data (KDTW).

T = Trace of Precipitation, **MM** = Missing Value

Source: NWS Daily Summary

Seasonal Weather Averages



Certify This Report

Hourly Observations

Time (EDT)	Temp.	Dew Point	Humidity	Pressure	Visibility	Wind Dir	Wind Speed	Gust Speed	Precip	Ev
2:53 AM	**66.9** °F	**53.1** °F	61%	**29.87** in	**10.0** mi	SW	**11.5** mph	-	N/A	
METAR KYIP 260653Z 22010KT 10SM CLR 19/12 A2989 RMK AO2 SLP115 T01940117										
3:41 AM	**60.8** °F	**50.0** °F	68%	**29.94** in	**10.0** mi	WNW	**18.4** mph	**28.8** mph	N/A	
SPECI KYIP 260741Z 30016G25KT 10SM SCT015 SCT042 16/10 A2994 RMK AO2 PK WND 30026/0721 WSHFT 0721										
3:53 AM	**57.9** °F	**48.0** °F	70%	**29.94** in	**10.0** mi	WNW	**19.6** mph	**27.6** mph	N/A	

Show Hourly Obs Only | Hide full METARS | METAR FAQ | Comma Delimited File

Time (EDT)	Temp.	Dew Point	Humidity	Pressure	Visibility	Wind Dir	Wind Speed	Gust Speed	Precip	Ev
METAR KYIP 260753Z 30017G24KT 10SM FEW015 BKN042 14/09 A2995 RMK AO2 PK WND 30026/0721 WSHFT 0721 SLP136 T01440089										
4:40 AM	**57.2** °F	**44.6** °F	63%	**29.98** in	**10.0** mi	WNW	**23.0** mph	**28.8** mph	N/A	
SPECI KYIP 260840Z 29020G25KT 10SM BKN029 OVC038 14/07 A2998 RMK AO2 PK WND 30026/0808										
4:53 AM	**55.9** °F	**45.0** °F	67%	**29.96** in	**10.0** mi	WNW	**16.1** mph	**24.2** mph	N/A	
METAR KYIP 260853Z 30014G21KT 10SM OVC029 13/07 A2998 RMK AO2 PK WND 30026/0808 SLP146 T01330072 52036										
5:06 AM	**55.4** °F	**44.6** °F	67%	**29.98** in	**10.0** mi	NW	**15.0** mph	-	N/A	
SPECI KYIP 260906Z AUTO 32013KT 10SM OVC031 13/07 A2998 RMK AO2 TSNO										
5:26 AM	**53.6** °F	**44.6** °F	72%	**30.00** in	**10.0** mi	NW	**11.5** mph	-	N/A	
SPECI KYIP 260926Z AUTO 31010KT 10SM BKN014 OVC034 12/07 A3000 RMK AO2 TSNO										
5:53 AM	**53.1** °F	**46.0** °F	77%	**30.01** in	**10.0** mi	NW	**12.7** mph	-	N/A	
METAR KYIP 260953Z AUTO 31011KT 10SM OVC011 12/08 A3002 RMK AO2 SLP163 T01170078 TSNO										
6:53 AM	**50.0** °F	**44.1** °F	80%	**30.06** in	**10.0** mi	NW	**13.8** mph	**23.0** mph	**0.01** in	Ra
METAR KYIP 261053Z AUTO 31012G20KT 10SM -RA BKN015 OVC021 10/07 A3007 RMK AO2 RAB22 SLP180 P0001 T01000067 TSNO										
7:53 AM	**50.0** °F	**43.0** °F	77%	**30.10** in	**10.0** mi	NW	**13.8** mph	**20.7** mph	**0.00** in	
METAR KYIP 261153Z AUTO 32012G18KT 10SM OVC015 10/06 A3011 RMK AO2 RAE15 SLP191 P0000 60001 70001 T01000061 10217 201(										
8:53 AM	**48.9** °F	**42.1** °F	77%	**30.14** in	**10.0** mi	NNW	**11.5** mph	-	**0.01** in	Ra
METAR KYIP 261253Z 33010KT 10SM -RA BKN018 OVC090 09/06 A3015 RMK AO2 RAB03 SLP206 P0001 T00940056										
9:53 AM	**48.9** °F	**42.1** °F	77%	**30.16** in	**10.0** mi	NNW	**10.4** mph	-	**0.00** in	
METAR KYIP 261353Z 34009KT 10SM BKN020 OVC095 09/06 A3016 RMK AO2 RAE08B41E50 SLP211 P0000 T00940056										
10:53 AM	**48.9** °F	**42.1** °F	77%	**30.19** in	**10.0** mi	NW	**9.2** mph	-	**0.01** in	Ra
METAR KYIP 261453Z 32008KT 10SM -RA BKN020 BKN070 OVC100 09/06 A3019 RMK AO2 RAB09 SLP221 P0001 60002 T00940056 51028										
11:53 AM	**50.0** °F	**41.0** °F	71%	**30.20** in	**10.0** mi	NNW	**9.2** mph	-	**0.00** in	
METAR KYIP 261553Z 33008KT 10SM OVC019 10/05 A3021 RMK AO2 RAE21 SLP225 P0000 T01000050										
12:53 PM	**50.0** °F	**39.9** °F	68%	**30.21** in	**10.0** mi	NW	**11.5** mph	-	N/A	
METAR KYIP 261653Z 31010KT 10SM OVC023 10/04 A3022 RMK AO2 SLP229 T01000044										
1:53 PM	**51.1** °F	**39.0** °F	63%	**30.20** in	**10.0** mi	NNW	**11.5** mph	**19.6** mph	N/A	
METAR KYIP 261753Z 34010G17KT 10SM OVC025 11/04 A3021 RMK AO2 SLP227 60002 T01060039 10111 20089 50006										
2:53 PM	**51.1** °F	**37.9** °F	61%	**30.21** in	**10.0** mi	NW	**9.2** mph	-	N/A	
METAR KYIP 261853Z 31008KT 10SM OVC027 11/03 A3022 RMK AO2 SLP230 T01060033										
3:53 PM	**52.0** °F	**37.0** °F	57%	**30.21** in	**10.0** mi	NNW	**6.9** mph	-	N/A	
METAR KYIP 261953Z 33006KT 10SM BKN031 11/03 A3021 RMK AO2 SLP230 T01110028										
4:53 PM	**51.1** °F	**36.0** °F	56%	**30.20** in	**10.0** mi	NNW	**8.1** mph	-	N/A	

Show Hourly Obs Only | Hide full METARS | METAR FAQ | Comma Delimited File

Time (EDT)	Temp.	Dew Point	Humidity	Pressure	Visibility	Wind Dir	Wind Speed	Gust Speed	Precip	Ev
METAR KYIP 262053Z 34007KT 10SM SCT120 11/02 A3020 RMK AO2 SLP226 T01060022 58005										
5:53 PM	**50.0** °F	**35.1** °F	57%	**30.19** in	**10.0** mi	North	**12.7** mph	-	N/A	
METAR KYIP 262153Z AUTO 36011KT 10SM CLR 10/02 A3019 RMK AO2 SLP222 T01000017 TSNO										
6:53 PM	**48.9** °F	**35.1** °F	59%	**30.20** in	**10.0** mi	North	**5.8** mph	-	N/A	
METAR KYIP 262253Z AUTO 36005KT 10SM BKN110 09/02 A3020 RMK AO2 PK WND 33074/2226 SLP226 T00940017 TSNO										
7:53 PM	**48.0** °F	**35.1** °F	61%	**30.23** in	**10.0** mi	NNW	**4.6** mph	-	N/A	
METAR KYIP 262353Z AUTO 34004KT 10SM FEW120 09/02 A3022 RMK AO2 SLP235 T00890017 10111 20089 53008 TSNO										
9:53 PM	**48.0** °F	**35.1** °F	61%	**30.21** in	**10.0** mi	North	**9.2** mph	-	N/A	
METAR KYIP 270153Z AUTO 36008KT 10SM BKN110 09/02 A3021 RMK AO2 SLP230 T00890017 TSNO										
10:53 PM	**48.0** °F	**35.1** °F	61%	**30.22** in	**10.0** mi	North	**5.8** mph	-	N/A	
METAR KYIP 270253Z AUTO 01005KT 10SM FEW120 09/02 A3022 RMK AO2 SLP233 T00890017 57002 TSNO										
11:53 PM	**46.9** °F	**35.1** °F	63%	**30.21** in	**10.0** mi	North	**5.8** mph	-	N/A	
METAR KYIP 270353Z 35005KT 10SM CLR 08/02 A3021 RMK AO2 SLP230 T00830017										

Show Hourly Obs Only | Hide full METARS | METAR FAQ | Comma Delimited File

Appendix D
Traffic Data:
Existing Traffic
No-build 2035 Traffic
Boulevard Section 2035 Traffic

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION
			FINAL ROW PLAN REVISIONS (SUBMITTAL DATE)				

Bergmann associates — architects // engineers // planners

MDOT — Michigan Department of Transportation

VERT. (FT) 0 12
HORZ. (FT) 0 12

FILE: M-99 TYP01.dgn

DATE:
DESIGN UNIT:
TSC:

CS:
JN:

I-275 & M-153 INTERCHANGE
TRAFFIC VOLUMES

DRAWING | SHEET

NO.	DATE	AUTH	DESCRIPTION	NO.	DATE	AUTH	DESCRIPTION
			FINAL ROW PLAN REVISIONS / PLAN REVISIONS				

CDM Smith

MDOT — Michigan Department of Transportation

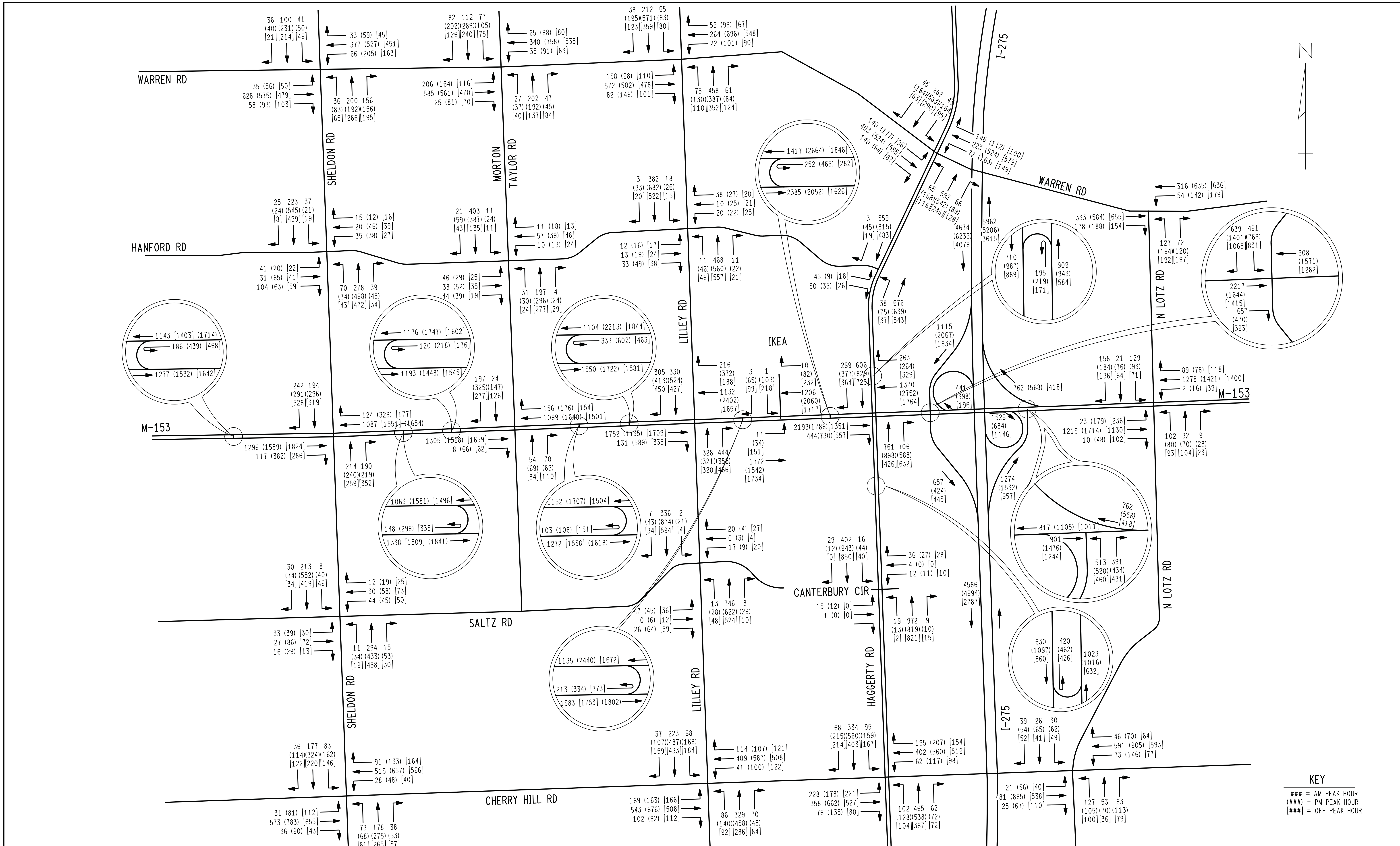
VERT. (FT) 0 12
HORZ. (FT) 0 12

DATE:
DESIGN UNIT:
TSC:

CS:
JN:

I-275 & M-153 INTERCHANGE
ALTERNATIVE 1 - NO-BUILD
2035 PEAK HOUR TURNING VOLUMES

DRAWING | SHEET



CDM Smith | MDOT Michigan Department of Transportation

DATE:
DESIGN UNIT: YUNG
TSC: TAYLOR

CS: 82292
JN: 115177

I-275 & M-153 INTERCHANGE
ALTERNATIVE 3 BOULEVARD
2035 PEAK HOUR TURNING VOLUMES

DRAWING | SHEET