Michigan Department of Transportation

I-196
Noise Analysis Report

I-196/32nd Ave Interchange to Kenowa Ave

CS 70024
JN 118616A and 127779A

MDOT Grand Region,
City of Hudsonville
Georgetown and Jamestown Townships,
Ottawa County, MI

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Noise Analysis Report
Table of Contents

Tables

Figures

Appendices

Noise Analysis Technical Report

1. EXECUTIVE SUMMARY

This report evaluated the potential noise impacts of adding a weave/merge lane along EB I-196 from the I-196 / 32nd Avenue interchange to the I-196 / M-6 interchange in Ottawa County. This study extends from the beginning of the EB I-196 exit ramp taper to 32nd Avenue along EB I-196 and the ending of the WB I-196 entrance ramp taper from 32nd Avenue along WB I-196 easterly to the Kenowa Avenue overpass to match the limits of the proposed reconstruction projects (WB I-196 is proposed to be reconstructed in 2019 and WB I-196 is proposed to be reconstructed in 2020), as required by the current Federal regulations. This report was completed in conformance with corresponding Federal regulations and guidance and the National Environmental Policy Act (NEPA). The goal of this project is to address the infrastructure deficiencies.

The project is being studied as a Type I project because a weave/merge lane of more than 2,500 ft is proposed to be added to EB I-196 between the I-196 / 32nd Avenue interchange and the I-196 / M-6 interchange. The addition of the weave/merge lane fits under the definition of a Type I project under 23 CFR 772.5 and such projects are required to undergo a noise analysis. Moreover, under the Type I definition: "(8) If a project is determined to be a Type I project under this definition then the entire project area as defined in the environmental document is a Type I project" which means the noise analysis will also cover WB I-196 and the area between the I-196 / M-6 interchange and the Kenowa Avenue overpass.

The noise analysis presents the existing and future acoustical environment at various receptors located along I-196. The determination of noise abatement measures and locations follows the 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 State Transportation Commission Policy 10136 Noise Abatement,* dated July 31, 2003.

Field noise measurements with concurrent traffic counts were taken to compare with 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 June 20, 2018 at seven (7) representative sites in the project vicinity. Minimum 15-minute measurements were taken at each site during peak and off-peak traffic time periods. Peak traffic periods are generally defined as between 7:00 am and 9:00 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, TNM®2.5, was used to model existing (2019) and Build (2039) 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. The Future 2039 Build traffic noise levels, within the overall project area, would increase by 0 to 1 dB(A), L_{eq} over the existing conditions. It should be noted that the topographic information used to evaluate the areas outside of MDOT's Right-of-Way was extracted from Ottawa County LiDAR data dated April 2017. The development of the residential properties in CNE area J may alter this topography and alter

the anticipated acoustic environment. If the development of this area includes noise reduction features like earthen berms, fewer impacts may be realized.

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

Activity Description [3]			2019	2039
CNE Area A	–	Commercial	0	0
CNE Area B	–	Commercial	0	0
CNE Area C	–	Commercial	0	0
CNE Area D	–	Commercial	0	0
CNE Area E	–	Residential	2	2
CNE Area F	–	Residential and Park Land	4[1]	4[1]
CNE Area G	–	Residential	4	4
CNE Area H	–	Residential	2	2
CNE Area I	–	Residential	0	0
CNE Area J	–	Residential	17[2]	17[2]
CNE Area K	–	Residential	0	0

1. Includes two (2) Dwelling Unit Equivalent receivers. See Appendix C for DUE calculations.
2. Includes future building sites. The layout of the future building sites was obtained from the developers website (www.summersetsouth.com) and is depicted in Appendix C.
3. All CNE Areas were noted as being "Low Density"

CNE areas A, B, C, D, I, and K have no impacted receptors with the future (2039) Build condition, and do not require abatement analysis. Highway noise abatement in the form of noise barriers was evaluated for the impacted receptors in CNE areas E, F, G, H, and J to determine if noise abatement would meet the feasibility and reasonableness requirements. Noise barriers NB-E1, NB-E2, and NB-F2 failed to meet MDOT's feasibility and reasonableness criteria. Noise barriers NB-F1, NB-G1, NB-H1, NB-J1, and NB-J2 were found to satisfy MDOT's feasibility criteria, but failed to meet MDOT's reasonableness criteria. Additional information regarding the feasibility and reasonableness for the evaluated noise barriers is presented in Table 13. The noise barrier layouts are depicted in Appendix C. *Based on the study completed, noise abatement is not anticipated throughout the project limits.*

FHWA encourages local agencies to practice noise compatible land use planning to prevent highway traffic noise impacts on future developments on currently vacant lands. The study estimated 71 dB(A) and 66 dB(A) contours along the I-196 project corridor to identify areas with future (2039) impacts. The decibel levels reflect the impact levels on the land use activity categories in FHWA Noise Abatement Criteria (Table 3). The 71 dB(A) and 66 dB(A) noise contours vary greatly as a result of the rolling topography. These contours are depicted in Appendix C.

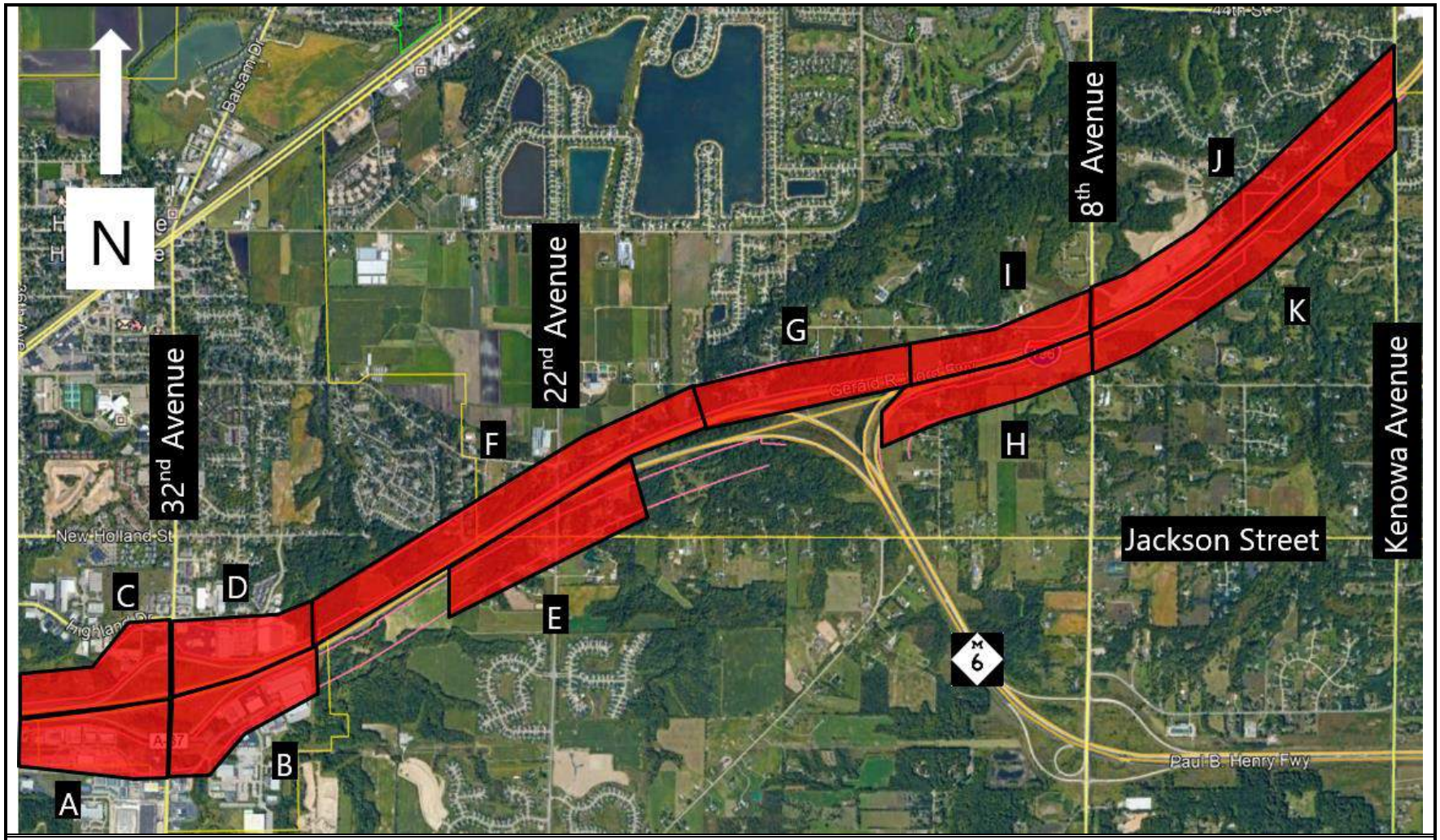


Figure 1: Common Noise Environment Locations along I-196

2. PURPOSE OF THE REPORT

This report evaluates the potential noise impacts within the I-196 corridor in conformance with Federal regulations and guidance, and NEPA. The project is being studied as a Type I project because the construction of a weave/merge lane is proposed along EB I-196 between the I-196 / 32nd Avenue interchange and the I-196 / M-6 interchange. The addition of a new travel lane fits under the definition of a Type I project under 23 CFR 772.5 and such projects are required to undergo a noise analysis. Moreover, under the Type I definition: "(8) If a project is determined to be a Type I project under this definition then the entire project area as defined in the environmental document is a Type I project" which means the noise analysis will also cover the reconstruction limits between the I-196 / M-6 interchange and the Kenowa Avenue overpass.

The determination of noise abatement measures and locations is in compliance with the 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

The I-196 freeway is a major east-west limited access auxiliary Interstate Highway that begins near the City of Benton Harbor in Berrien County, Michigan and ends in the City of Grand Rapids in Kent County, Michigan. The project corridor is a 5 mile, four-lane section of I-196 within the City of Hudsonville, Georgetown Township and Jamestown Township, in Ottawa County and extends from the I-196 / 32nd Avenue interchange (including the 32nd Avenue interchange ramps and EB/WB I-196 roadway through the interchange) easterly to the Kenowa Avenue overpass. The limits of this project are depicted in Figure 2.

The goal of this project is to address the infrastructure deficiencies.

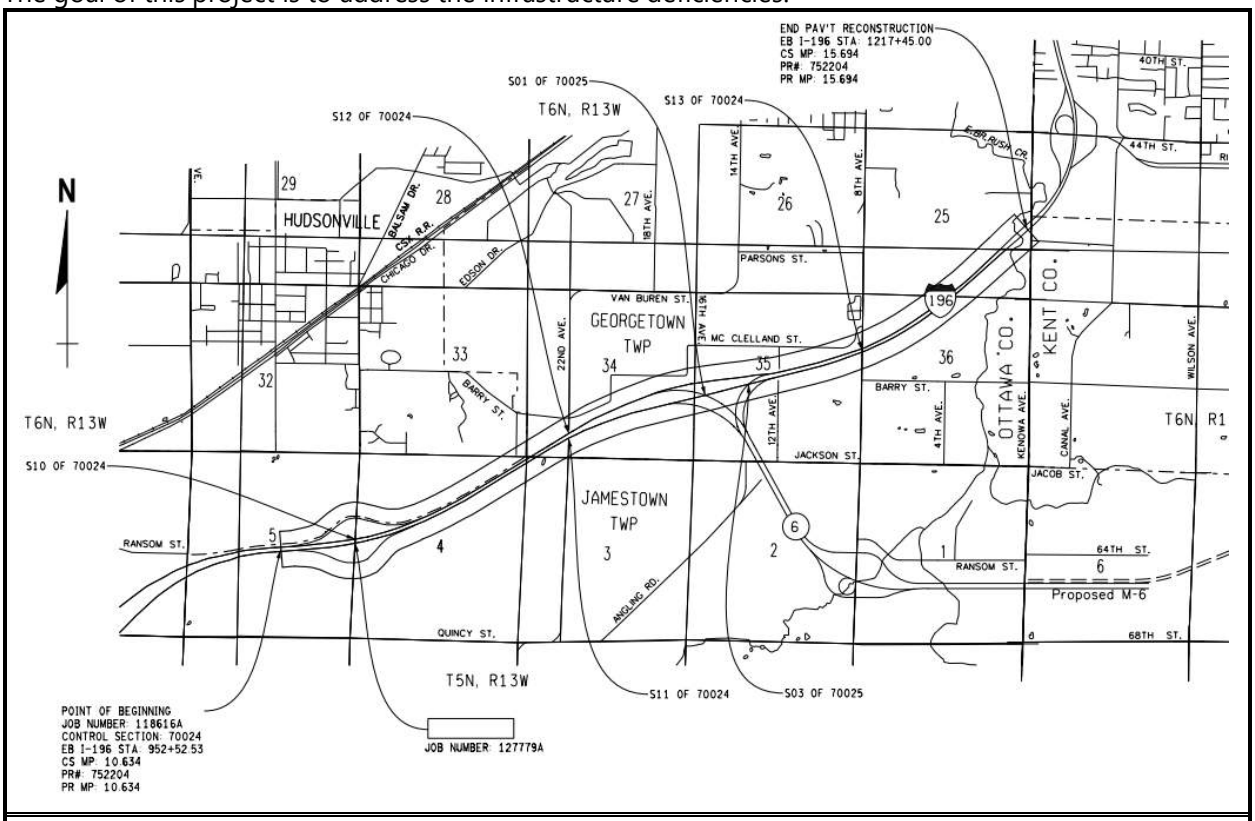


Figure 2: Project Vicinity Map

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 that have been identified as being important to analyzing the subjective community response to noise include: 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 scale to best represent human hearing. 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. Figure 3 depicts how logarithmic decibel scale relates to frequently encountered environments and noise sources.

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).

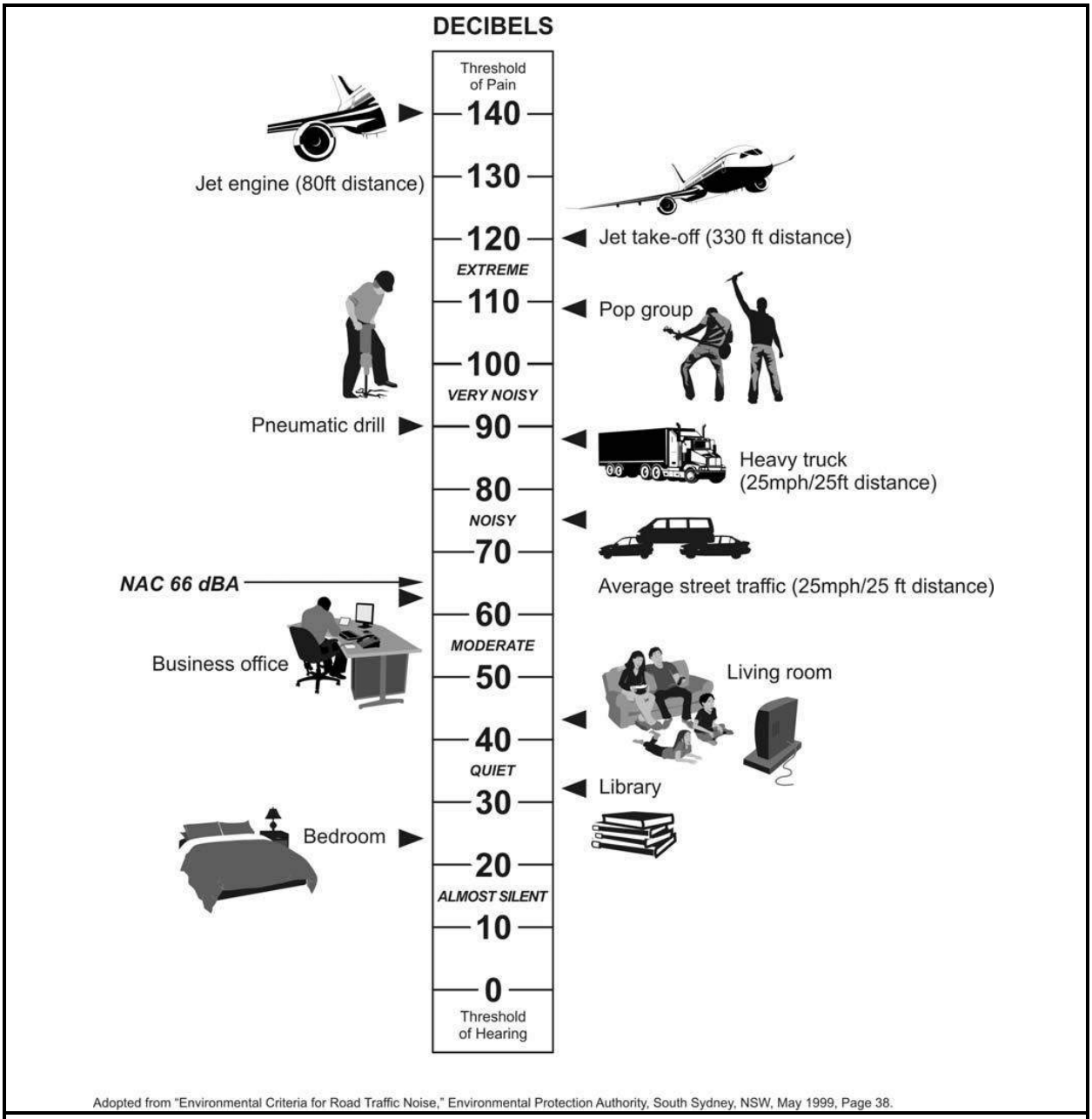


Figure 3: Sound Levels of Typical Noise Sources

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. At lower speeds, especially in trucks and buses, the dominant noise source is the engine and exhaust.

4.2. Federal Regulations and Guidance

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 roadway 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.

As mandated by the FHWA, the most recent version of the Traffic Noise Model® (TNM) software was used to evaluate the acoustic environment associated with the existing and future site conditions. To asses the accuracy of the TNM software, noise measurements with concurrent site conditions and traffic counts were collected from the various sites and compared with noise level outputs from the TNM with similar inputs. Due to the fact that the output from the TNM software and the recorded noise measurements varied by less than 3 dB(A), the noise model was determined to be accurate and acceptable to model current and future sound levels. The existing noise levels for the receivers in the roadway corridor are based on existing site conditions, average weather conditions, and average peak hour traffic volumes. The future (2039) noise levels are based on existing site conditions, average weather conditions, and estimated traffic volumes. Additional information concerning TNM software is provided in Section 5.1 of this report.

A traffic noise impact is defined as a future noise level that approaches or exceeds the FHWA 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 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.

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 3.
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

The potential abatement alternatives are examined after the traffic noise impacts are identified. 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). MDOT's 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. MDOT's reasonableness criteria are provided in Section 4.3.

4.3. State Rules and Procedures

MDOT's *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 milestones 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:

Common Noise Environment (CNE) A group of receptors within the same Activity Category (Table 3) that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and topographic features. Generally, common noise environments occur between two secondary noise sources such as interchanges, intersections, and cross roads

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 $46,967 (year 2018), 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.

Permitted Development: Any presently undeveloped lands that have received a building permit from the local township or municipality.

Dwelling Unit Equivalent (DUE): The receptor count for public areas such as parks, schools, libraries, and churches, which is determined based on the number of employees or attendees and frequency of used. See the *Highway Noise Analysis and Abatement Handbook* for examples of how DUE are calculated.

5. NOISE ANALYSIS

5.1. FHWA Traffic Noise Model (TNM)

TNM is FHWA's computer program for highway traffic noise prediction and analysis. The use of the most recent TNM® software is a mandatory requirement for all traffic noise related projects, under State and Federal regulations. As of the date of this noise analysis, the latest version available is TNM 2.5. 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 single family residential, commercial properties, parks, churches, school, agricultural lands, and undeveloped wooded lands. Sites within the I-196 corridor with similar land use and traffic, i.e. land use and traffic 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[1]	CNE	Site Description[1]	CNE	Site Description[1]
A	Commercial	E	Residential	I	Residential
B	Commercial	F	Residential and Park Land	J	Residential
C	Commercial	G	Residential	K	Residential
D	Commercial	H	Residential		

1. All CNEs were noted as being "Low Density"

Field measurements with concurrent traffic counts were taken to compare with modeled noise levels to validate the TNM for use on this project to predict existing and design year noise levels. Existing noise level measurements were conducted on June 20, 2018 at seven (7) representative sites in the project vicinity. Refer to Figure 4, Appendix A, and Appendix C for maps which include the location of these sites. As shown in Figure 4, field measurements were conducted at sites 2, 3, 4, 6, 7, 8 and 9. Site 1 was eliminated because it was outside of the proposed project limits and site 5 was eliminated because accurate vehicle counts could not be obtained from the accessible measurement sites.

Minimum fifteen-minute measurements were taken at each site, during both peak and off-peak traffic time periods. The measurements were conducted 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 the "floating car method" during the site visits. Concurrent weather readings were obtained from the weather station at the Gerald R. Ford International Airport, for accurate modeling purposes. The data collected at the seven (7) sites are presented in Table 5.

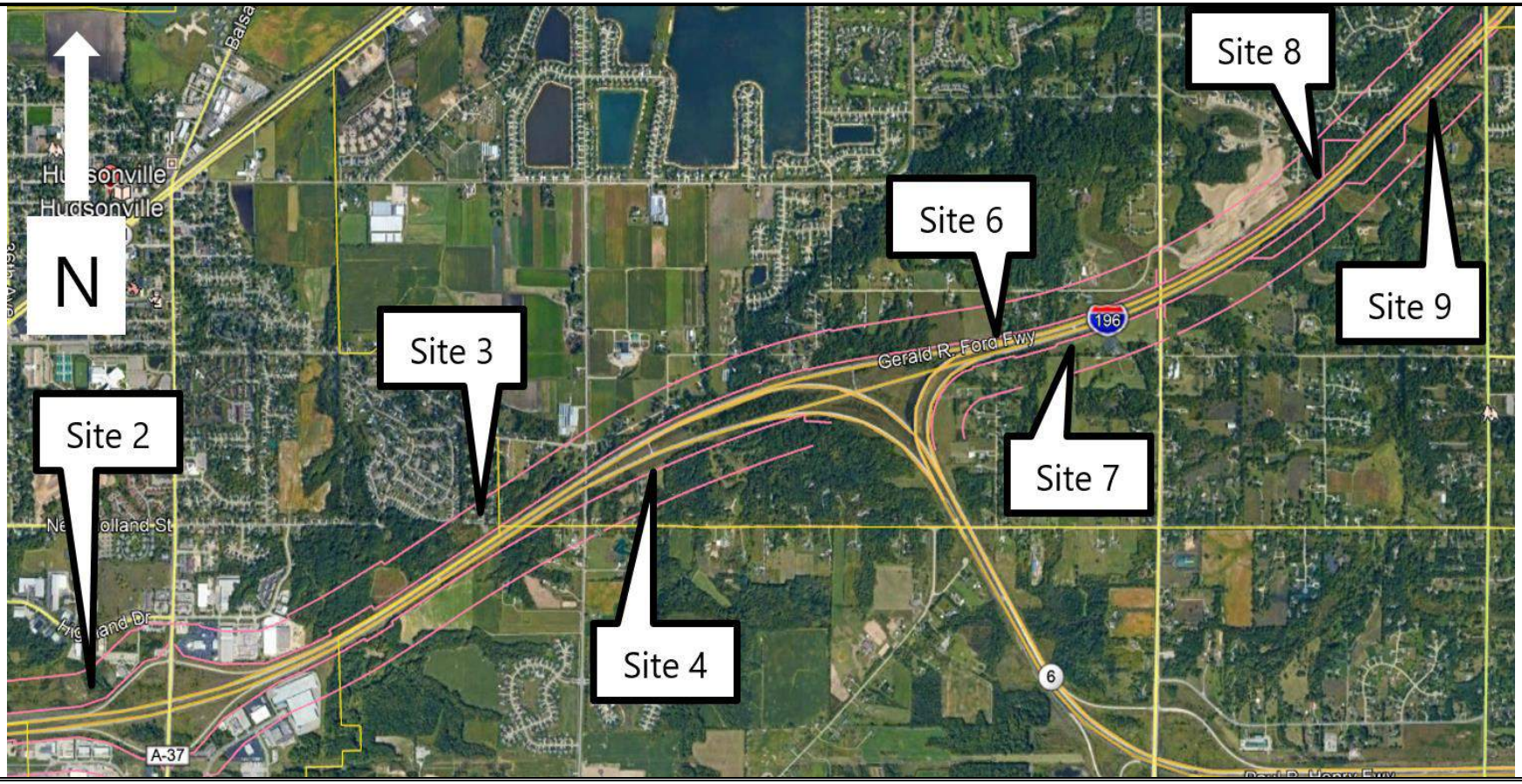


Figure 4: Measurement Location Map

Table 5: Measured Existing Noise Levels during Peak Traffic

Field Site ID[4]	Site Description (Distance From The Outside Edge of the Shoulder)	Date	Start Time	Duration (min)	Traffic[1] (Vehicle/Hour)						Measured Noise Level, dB(A) L_{eq}
					Roadway, Direction[2, 3]	Autos	Medium Trucks	Heavy Trucks	Buses	Motor-cycles	
2	At the ROW fence, near the 22' pt of the WB entrance ramp from 32nd Avenue (60 ft)	6/20/18	5:05 PM	15	I-196, EB I-196, WB	2752 2256	88 68	188 172	8 12	12 8	70
3	At the WB I-196 ROW fence, near the 24th Avenue cul-de-sac (70 ft)	6/20/18	4:00 PM	15	I-196, EB I-196, WB	2788 2208	172 128	180 212	0 0	0 16	72
4	At the EB I-196 ROW fence, near the median cross over east of 22nd Avenue (160 ft)	6/20/18	7:15 AM	15	I-196, EB I-196, WB	2788 3252	88 176	220 188	0 4	0 0	75
6	At the WB I-196 ROW fence, near the 12th Avenue cul-de-sac (85 ft)	6/20/18	4:25 PM	15	I-196, EB I-196, WB	2128 1620	76 92	96 100	0 0	8 4	73
7	At the EB I-196 ROW fence, near the median cross over west of 8th Avenue (80 ft)	6/20/18	8:00 AM	15	I-196, EB I-196, WB	1128 1656	28 104	76 56	0 0	0 0	72
8	At the WB I-196 ROW fence, near the Bloomfield Dr cul-de-sac (75 ft)	6/20/18	8:45 AM	15	I-196, EB I-196, WB	1020 948	84 156	112 104	8 4	0 8	74
9	At the EB I-196 ROW fence, near the median cross over west of Kenowa Avenue (80 ft)	6/20/18	8:20 AM	15	I-196, EB I-196, WB	1388 1356	52 76	104 92	0 4	8 0	75

1) Vehicle counts classifications are according to Section 5.1 of this report.
2) Vehicle speeds for I-196 are 70 mph.
3) Vehicle traffic on the roadways that are adjacent to the I-196 Right-of-Way was insignificant.
4) Site 1 was eliminated because it was outside the project limits. Site 5 was eliminated because accurate vehicle counts could not be obtained from the accessible measurement sites.

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 the specific project. All of the modeled data when compared with the measured data was within 3 dB of each other as shown in Table 6. This 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	Noise Level, dB(A) L_{eq} (1h)		Difference in Noise Level, dB(A) L_{eq} (1h) (Modeled Minus Measured)
	Measured	Modeled	
2	70	73	+3
3	72	74	+2
4	75	72	-3
6	73	73	0
7	72	72	0
8	74	72	-2
9	75	74	-1

5.2.3. Predicted Traffic Noise Levels and Noise Impact Analysis

TNM was then used to model existing and future Build 2039 traffic noise levels within the project area. For analysis purposes, the "loudest noise hours" were used identify the impacted receivers along I-196. The "loudest noise hours" usually occur during peak traffic hours when truck volumes and vehicle speeds are the greatest and when traffic is at or near free-flow conditions. Due to the daily flow of traffic into and out of Grand Rapids, the "loudest noise hours" for the receivers typically occur between 4 and 6 PM. The existing (2019) and future (2039) traffic volumes (AM and PM peak) that were used in the modeling are shown in Table 7 through Table 10. The existing and future traffic volumes were developed by MDOT. Vehicle class distribution information that MDOT provided was refined based on observations that were made during the field investigation. In accordance to Section 2.5.2 of the *Highway Noise Analysis and Abatement Handbook*, the existing and future traffic volumes were assumed to operate under free-flow conditions.

One-hundred-seventy-one (171) receiver locations were included in the noise model. Sixty-four (64) of these locations are single family houses and condominiums that have been platted but have not been constructed. Two (2) of the locations represent the impacted DUEs in the Hudsonville Nature Center. Each of the receivers represent frequently used outdoor areas at the residential properties, future residential properties, commercial properties, and parks that are within 500 ft of the existing Right-of-Way. For additional information concerning the location of the receivers refer to Figures 1-9 in Appendix C.

Future land use plans were obtained from the City of Hudsonville, Georgetown Township, and Jamestown Township to determine if changes to the low density residential and agricultural areas, that are within 500 feet of the outside edge of pavement, are anticipate. As shown in Appendix G, the future land use maps do not show any significant land use changes.

The results of the noise impact analysis are provided in Appendix D. The received location addresses listed in the results table were obtained from the Ottawa County GIS site.

Table 7: Existing 2019 Traffic Volumes (AM Peak)

Roadway Segment[1]	Volumes by Vehicle Type[2]				
	Autos	Medium Trucks	Heavy Trucks	Buses	Motor-cycles
EB - West of 32nd Avenue interchange	1723	106	147	4	2
WB - West of 32nd Avenue interchange	1912	117	163	5	3
EB - Within 32nd Avenue interchange	1592	98	136	4	2
WB - Within 32nd Avenue interchange	1345	83	115	4	2
EB - 32nd Ave interchange to M-6 interchange	2153	132	184	5	3
WB - 32nd Ave interchange to M-6 interchange	1842	113	157	5	3
EB - Within M-6 interchange	1040	64	89	3	2
WB - Within M-6 interchange	1012	62	87	3	2
EB - M-6 interchange to Kenowa Avenue	1267	78	108	3	2
WB - M-6 interchange to Kenowa Avenue	1419	87	121	4	2
Ramp - EB I-196 to 32nd Avenue	94	6	9	1	1
Ramp - 32nd Avenue to EB I-196	592	37	51	2	1
Ramp - WB I-196 to 32nd Avenue	363	23	32	1	1
Ramp - 32nd Avenue to WB I-196	170	11	15	1	1
Ramp - EB I-196 to M-6	1111	68	95	3	2
Ramp - M-6 to EB I-196	232	15	20	1	1
Ramp - WB I-196 to M-6	260	16	23	1	1
Ramp - M-6 to WB I-196	972	60	83	3	2

1) Minor streets within the I-196 corridor were assumed to have an insignificant effect on the number of noise related impacts.
2) Volume distribution based on a traffic study performed by MDOT and field observations.

Table 8: Existing 2019 Traffic Volumes (PM Peak)

Roadway Segment[1]	Volumes by Vehicle Type[2]				
	Autos	Medium Trucks	Heavy Trucks	Buses	Motor-cycles
EB - West of 32nd Avenue interchange	2133	131	182	5	3
WB - West of 32nd Avenue interchange	1767	108	151	5	3
EB - Within 32nd Avenue interchange	1932	118	165	5	3
WB - Within 32nd Avenue interchange	1373	84	117	4	2
EB - 32nd Ave interchange to M-6 interchange	2351	144	201	6	3
WB - 32nd Ave interchange to M-6 interchange	1705	104	146	4	2
EB - Within M-6 interchange	1300	80	111	3	2
WB - Within M-6 interchange	879	54	75	3	2
EB - M-6 interchange to Kenowa Avenue	1716	105	147	4	2
WB - M-6 interchange to Kenowa Avenue	1336	82	114	4	2
Ramp - EB I-196 to 32nd Avenue	174	11	16	1	1
Ramp - 32nd Avenue to EB I-196	441	27	38	2	1
Ramp - WB I-196 to 32nd Avenue	622	38	53	2	1
Ramp - 32nd Avenue to WB I-196	100	7	9	1	1
Ramp - EB I-196 to M-6	1048	64	90	3	2
Ramp - M-6 to EB I-196	291	18	25	1	1
Ramp - WB I-196 to M-6	277	17	24	1	1
Ramp - M-6 to WB I-196	1167	72	100	3	2

1) Minor streets within the I-196 corridor were assumed to have an insignificant effect on the number of noise related impacts.
2) Volume distribution based on a traffic study performed by MDOT and field observations.

Table 9: Future 2039 Traffic Volumes (AM Peak)

Roadway Segment[1]	Volumes by Vehicle Type[2]				
	Autos	Medium Trucks	Heavy Trucks	Buses	Motor-cycles
EB - West of 32nd Avenue interchange	1904	118	163	5	3
WB - West of 32nd Avenue interchange	2113	130	181	6	4
EB - Within 32nd Avenue interchange	1760	109	151	5	3
WB - Within 32nd Avenue interchange	1487	92	128	5	3
EB - 32nd Ave interchange to M-6 interchange	2380	146	204	6	4
WB - 32nd Ave interchange to M-6 interchange	2036	125	174	6	4
EB - Within M-6 interchange	1150	71	99	4	3
WB - Within M-6 interchange	1119	69	97	4	3
EB - M-6 interchange to Kenowa Avenue	1401	87	120	4	3
WB - M-6 interchange to Kenowa Avenue	1568	97	134	5	3
Ramp - EB I-196 to 32nd Avenue	104	7	10	2	2
Ramp - 32nd Avenue to EB I-196	655	41	57	3	2
Ramp - WB I-196 to 32nd Avenue	402	26	36	2	2
Ramp - 32nd Avenue to WB I-196	188	13	17	2	2
Ramp - EB I-196 to M-6	1228	76	105	4	3
Ramp - M-6 to EB I-196	257	17	23	2	2
Ramp - WB I-196 to M-6	288	18	26	2	2
Ramp - M-6 to WB I-196	1075	67	92	4	3

1) Minor streets within the I-196 corridor were assumed to have an insignificant effect on the number of noise related impacts.
2) Volume distribution based on a traffic study performed by MDOT and field observations.

Table 10: Future 2039 Traffic Volumes (PM Peak)

Roadway Segment[1]	Volumes by Vehicle Type[2]				
	Autos	Medium Trucks	Heavy Trucks	Buses	Motor-cycles
EB - West of 32nd Avenue interchange	2357	145	202	6	4
WB - West of 32nd Avenue interchange	1953	120	167	6	4
EB - Within 32nd Avenue interchange	2135	131	183	6	4
WB - Within 32nd Avenue interchange	1518	93	130	5	3
EB - 32nd Ave interchange to M-6 interchange	2598	160	223	7	4
WB - 32nd Ave interchange to M-6 interchange	1885	115	162	5	3
EB - Within M-6 interchange	1437	89	123	4	3
WB - Within M-6 interchange	972	60	83	4	3
EB - M-6 interchange to Kenowa Avenue	1897	117	163	5	3
WB - M-6 interchange to Kenowa Avenue	1477	91	126	5	3
Ramp - EB I-196 to 32nd Avenue	193	13	18	2	2
Ramp - 32nd Avenue to EB I-196	488	30	42	3	2
Ramp - WB I-196 to 32nd Avenue	688	42	59	3	2
Ramp - 32nd Avenue to WB I-196	111	8	10	2	2
Ramp - EB I-196 to M-6	1159	71	100	4	3
Ramp - M-6 to EB I-196	322	20	28	2	2
Ramp - WB I-196 to M-6	307	19	27	2	2
Ramp - M-6 to WB I-196	1290	80	111	4	3

1) Minor streets within the I-196 corridor were assumed to have an insignificant effect on the number of noise related impacts.
2) Volume distribution based on a traffic study performed by MDOT and field observations.

Noise impacts may occur when future Build (2039) noise levels either exceed existing noise levels by 10 dB(A) or more; or approach or exceed the NAC. For this project, the predicted future build loudest noise hour levels for year 2039 range from 54 dB(A) to 75 dB(A). These values are 0 to 1 dB(A) higher than existing loudest hour noise levels. A summary of the noise impact assessment (or the number of receiver locations that approach or exceed the NAC) is provided in Table 11.

Table 11: Number of Locations within CNEs that Approach or Exceed the NAC

Activity Description [3]			2019	2039
CNE Area A	–	Commercial	0	0
CNE Area B	–	Commercial	0	0
CNE Area C	–	Commercial	0	0
CNE Area D	–	Commercial	0	0
CNE Area E	–	Residential	2	2
CNE Area F	–	Residential and Park Land	4[1]	4[1]
CNE Area G	–	Residential	4	4
CNE Area H	–	Residential	2	2
CNE Area I	–	Residential	0	0
CNE Area J	–	Residential	17[2]	17[2]
CNE Area K	–	Residential	0	0

1. Includes two (2) Dwelling Unit Equivalent receivers. See Appendix C for DUE calculations.
2. Includes future building sites. The layout of the future building sites was obtained from the developers website (www.summersetsouth.com) and is depicted in Appendix C.
3. All CNE Areas were noted as being "Low Density"

6. ABATEMENT MEASURES

6.1. Federal and State Abatement Guidance

MDOT's Noise Policy has established the criteria for determining where noise abatement must be provided. 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 public knowledge is the date that the project's environmental analysis and documentation is approved (i.e. the date of approval of a CE, date of the issuance of the Finding of No Significant Impact for an EA, or the date of the Record Decision for an EIS). The date of the clearance of the Categorical Exclusion will be the date of public knowledge. The provision of noise abatement for new developments becomes the responsibility of local governments and private developers.

- 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 ($46,967 in 2018 dollars, based on a $45/square foot unit cost);
    - The public viewpoint reasonableness factor for the environmental clearance phase receives generally positive comments from the benefiting units; 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.

6.1.1. Abatement Measures for I-196

Review of the listed abatement alternatives has determined that reductions of speed limits, although acoustically beneficial, are seldom practical unless the design speed of the proposed roadway is also reduced; restriction or prohibition of trucks is extremely undesirable because I-196 is a major east-west freeway in Michigan; design criteria, project limits, and the existing terrain 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 received in-depth evaluation.

6.2 Noise Barrier Analysis

Ten (10) CNE areas were identified within the project limits. CNE areas A, B, C, D, I and K have no impacted receptors with the future (2039) Build condition, and do not require abatement analysis. Impacted noise receptors were identified at the remaining CNE areas, so noise barriers were analyzed in accordance with the minimum requirement established by the MDOT: *Highway Noise Analysis and Abatement Handbook*. The alignment of the noise barriers that were analyzed are depicted in Appendix C, Figures 1 - 9. The results of the evaluated barriers, including 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 are presented in Table 12. The receivers that are being benefited by the barriers that were evaluated are summarized Appendix E. The receivers that are noted in Appendix D, but are not included in Appendix E, will not receive any measurable reductions in noise levels. The following information is presented for each of the barriers in Table 13:

- The number of substantial noise reduction locations.
- The number of locations with more than 7 dB(A) attenuation.
- The total estimated cost of noise barrier construction (based on $45.00 per square foot).
- The number of benefited receivers (i.e. residential, commercial, and equivalent).
- The cost per benefited receiver.
- The feasibility determination.
- The reasonableness determination.

Table 12: Evaluated Noise Barriers

Noise Barrier ID	Locations (CNE Area)	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-E1	Along the EB I-196 ROW line, just west of 22nd Ave. (CNE E)	66	67	66	1	400	12.75
NB-E2	Along the EB I-196 ROW line, near the median cross over east of 22nd Ave. (CNE E)	66	66	63	3	300	16
NB-F1	Along the WB I-196 ROW line, near the Hudsonville Nature Center. (CNE F)	66-70	66-70	60-63	5-10	2,600	15
NB-F2	Along the WB I-196, just west of 22nd Avenue. (CNE F)	68	68	67	1	500	8.4
NB-G1	Along the WB I-196 ROW line, in the M-6 interchange. (CNE G)	59-67	59-67	58-64	0-7	1,300	15
NB-H1	Along the EB I-196 ROW line, near the M-6 to EB I-196 ramp taper. (CNE H)	72-74	73-74	64-65	9-10	500	12
NB-J1	Along the WB I-196 ROW line, east of 8th Avenue, near the future condominiums. (CNE J)	54-71	54-71	54-64	0-10	1,400	12
NB-J2	Along the WB I-196 ROW line, between Normandy Ct and Covington Ct. (CNE J)	60-69	60-70	56-62	3-10	1,500	18.2

Table 13: Noise Barrier Feasibility and Reasonableness

Barrier ID	# of Total Impacted	Number of Attenuated Locations						Cost	Cost/ Benefit	Feasible	Reasonable
		≥ 5 dB(A)			≥ 7 dB(A)		≥ 10 dB(A)				
		# of Impacted	% of Total Impacted	# of Total Benefitting	#	% of Benefited				(Y/N)	(Y/N)
NB-E1	1	0	0%	0	0	0%	0	$229,500	-	N	N
NB-E2	1	0	0%	0	0	0%	0	$216,000	-	N	N
NB-F1[2]	3	3	100%	3	2	66%	1	$1,755,000	$585,000	Y	N
NB-F2	1	0	0%	0	0	0%	0	$189,000	-	N	N
NB-G1	4	3	75%	3	1	33%	0	$877,500	$292,500	Y	N
NB-H1	2	2	100%	2	2	100%	1	$270,000	$135,000	Y	N
NB-J1	14	14	100%	14	7	50%	1	$756,000	$54,000	Y	N
NB-J2	3	3	100%	5	3	60%	1	$1,228,500	$245,700	Y	N

1. Based on $45.00 per square feet.
2. Includes Dwelling Unit Equivalent (DUE) receivers. See Appendix C for DUE calculations.

The above table presents the modeled barrier analysis results to determine their feasibility and reasonableness. Modeled noise barriers NB-E1, NB-E2, and NB-F2 did not meet the feasibility or reasonableness criteria. Barriers NB-F1, NB-G1, NB-H1, NB-J1, and NB-J2 exceed the $48,376 ($46,967 plus 3%) allowable cost per benefitting unit.

6.3 Noise Compatible Land Use Planning

Noise compatible land use planning along this corridor should be considered by local officials to avoid future highway noise impacts. The land uses which fall under the NAC Activity Categories B and C will be impacted noise levels that exceed 66 dB(A). The land uses which fall under the NAC Activity Category E will be impacted noise levels that exceed 71 dB(A). To denote areas of future (2039) impacts, 66 dB(A) and 71dB(A) noise contours lines have been calculated and plotted for the areas outside on the existing Right-of-Way. These contour lines are depicted in Figures 10 – 18 of Appendix C. Based on the variable nature of existing topography and traffic in the corridor, the offset distances from the roadway to the noise contours is variable.

7. CONCLUSIONS AND RECOMMENDATIONS

MDOT's policy is to install noise abatement measures found to be feasible and reasonable that are associated with transportation improvements. Eight (8) noise barriers were examined to abate the noise impacts anticipated within the I-196 corridor. None of these barriers were found to be feasible and reasonable (see Table 13.

8. CONSTRUCTION NOISE

The noise produced on highway 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_3581567.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

Measurement Site Information:

Noise Measurements

SITE / LOCATION: **Site 2: NW quad of the 32nd ave interchange** DATE: **6/20/18**

Peak Measurement		Period	Measured Leq	Modeled Leq
Time Begin:	5:05 PM	15 MIN	70	73

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	2752	88	188	8	12
WB	2256	68	172	12	8

Off-Peak Measurement		Period	Measured Leq	Modeled Leq
Time Begin:	12:25 PM	15 MIN	71	72

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	1184	92	156	4	0
WB	1240	96	196	12	0

LOCATION AERIAL:

Comments:

SITE PHOTOGRAPHS:

Looking S

Looking W

Looking N

Looking E

Noise Measurements

SITE / LOCATION: **Site 3: 24th ave ant the eastern park entrance** DATE: **6/20/18**

Peak Measurement		Period	Measured Leq	Modeled Leq
Time Begin:	4:00 PM	15 MIN	72	74

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	2788	172	180	0	0
WB	2208	128	212	0	16

Off-Peak Measurement		Period	Measured Leq	Modeled Leq
Time Begin:	10:10 AM	15 MIN	73	74

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	1496	72	224	4	0
WB	1472	88	276	8	0

LOCATION AERIAL:

Comments: _____

SITE PHOTOGRAPHS:

Looking SE

Looking SW

Looking NE

Looking N

Noise Measurements

SITE / LOCATION: **Site 4: Top of berm in the SE quad of the 22nd ave crossing** DATE: **6/20/18**

Peak Measurement		Period	Measured Leq	Modeled Leq
Time Begin:	7:15 AM	15 MIN	75	72

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	2788	88	220	0	0
WB	3252	176	188	4	0

Off-Peak Measurement		Period	Measured Leq	Modeled Leq
Time Begin:	1:00 PM	20 MIN	74	71

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	1428	108	237	0	3
WB	1695	123	276	3	6

LOCATION AERIAL:

Comments:

SITE PHOTOGRAPHS:

Looking W

Looking S

Looking E

Looking N

Noise Measurements

SITE / LOCATION: **Site 6: East of M-6** DATE: **6/20/18**

Peak Measurement		Period	Measured Leq	Modeled Leq
Time Begin:	4:25 PM	15 MIN	73	73

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	2128	76	96	0	8
WB	1620	92	100	0	4

Off-Peak Measurement		Period	Measured Leq	Modeled Leq
Time Begin:	10:40 AM	15 MIN	73	72

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	908	64	108	4	0
WB	1064	60	132	4	4

LOCATION AERIAL:

Comments: _____

SITE PHOTOGRAPHS:

Looking S

Looking W

Looking E

Looking N

Noise Measurements

SITE / LOCATION: **Site 7: East of M-6 interchange** DATE: **6/20/18**

Peak Measurement		Period	Measured Leq	Modeled Leq
Time Begin:	8:00 AM	15 MIN	72.0	72

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	1128	28	76	0	0
WB	1656	104	56	0	0

Off-Peak Measurement		Period	Measured Leq	Modeled Leq
Time Begin:	1:40 PM	15 MIN	72.0	72

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	980	60	108	4	4
WB	1208	72	104	12	4

LOCATION AERIAL:

Comments:

SITE PHOTOGRAPHS:

Looking N

Looking S

Looking W

Looking E

Noise Measurements

SITE / LOCATION: **Site 8: WB near the POE** DATE: **6/20/18**

Peak Measurement		Period	Measured Leq	Modeled Leq
Time Begin:	8:45 AM	15 MIN	74.0	72

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	1020	84	112	8	0
WB	948	156	104	4	8

Off-Peak Measurement		Period	Measured Leq	Modeled Leq
Time Begin:	9:05 AM	15 MIN	74.0	72

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	912	40	124	0	16
WB	1128	100	148	4	0

LOCATION AERIAL:

Comments:

SITE PHOTOGRAPHS:

Looking SE

Looking NE

Looking N

Noise Measurements

SITE / LOCATION: **Site 9: EB near the POE** DATE: **6/20/18**

Peak Measurement	Period	Measured Leq	Modeled Leq
Time Begin: 8:20 AM	15 MIN	75.0	74

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	1388	52	104	0	8
WB	1356	76	92	4	0

Off-Peak Measurement	Period	Measured Leq	Modeled Leq
Time Begin: 2:00 PM	15 MIN	74.0	74

Traffic Counts (Veh/Hr):

	Auto	Med. Truck	Hvy Truck	Bus	Moto.
EB	1028	88	96	0	0
WB	840	108	88	16	0

LOCATION AERIAL:

Comments:

SITE PHOTOGRAPHS:

Looking NW

Looking S

Looking NE

Appendix B
Traffic Data

MDOT Michigan Department of Transportation

OFFICE MEMORANDUM

DATE: March 17, 2015

TO: Nick Jasinski; Grand Region

FROM: Josh Bocks, Asset Management

SUBJECT: TAR # 2871: I-196, CS 70024, JN 118618

Traffic Information

The following tables contain the requested traffic information for I-196 from mile point 10.6 to mile point 15.6 in Ottawa County. Current traffic volumes were calculated from hose counts taken between 2010 and 2015 and 2013 Sufficiency Guide data. A growth rate of 0.5% was used to calculate future traffic volume. This number is based on past growth, regression analysis and population projections in Ottawa County.

I-196 East of M-6	**2015**	**2019**	**2039**
Total Average Daily Traffic (ADT)	34,625	35,325	39,025
Directional ADT	17,350	17,700	19,575
% Commercial of ADT		9%	
Commercial DDHV	172	176	194

I-196 Between M-6 & 32nd Ave	**2015**	**2019**	**2039**
Total Average Daily Traffic (ADT)	54,475	55,575	61,400
Directional ADT	29,025	29,625	32,550
% Commercial of ADT		13%	
Commercial DDHV	417	425	467

I-196 West of 32nd Ave	**2015**	**2019**	**2039**
Total Average Daily Traffic (ADT)	51,825	52,875	58,425
Directional ADT	26,475	27,025	29,850
% Commercial of ADT		13%	
Commercial DDHV	380	388	428

The design hour volume (DHV) is 12%.

ESAL Data

I-196 East of M-6	Rigid	Flexible
Growth Rate	0.85%	0.85%
Growth Type	Compound	Compound
Initial Yearly 18-kip ESAL (both directions)	1,239,700	807,510
Direction Distribution Factor	51%	51%
Lane Distribution Factor	92%	92%
Total 18 Kip Axle Loadings	12,622,430	8,221,940

PrepME Input: Use WIM #5059

ESAL Data

I-196 Between M-6 & 32nd Ave	Rigid	Flexible
Growth Rate	0.85%	0.85%
Growth Type	Compound	Compound
Initial Yearly 18-kip ESAL (both directions)	3,127,770	2,119,640
Direction Distribution Factor	53%	53%
Lane Distribution Factor	92%	92%
Total 18 Kip Axle Loadings	33,095,330	22,428,180

I-196 West of 32nd Ave	Rigid	Flexible
Growth Rate	0.85%	0.85%
Growth Type	Compound	Compound
Initial Yearly 18-kip ESAL (both directions)	2,975,400	2,016,380
Direction Distribution Factor	51%	51%
Lane Distribution Factor	92%	92%
Total 18 Kip Axle Loadings	30,295,040	20,530,460

PrepME Input:

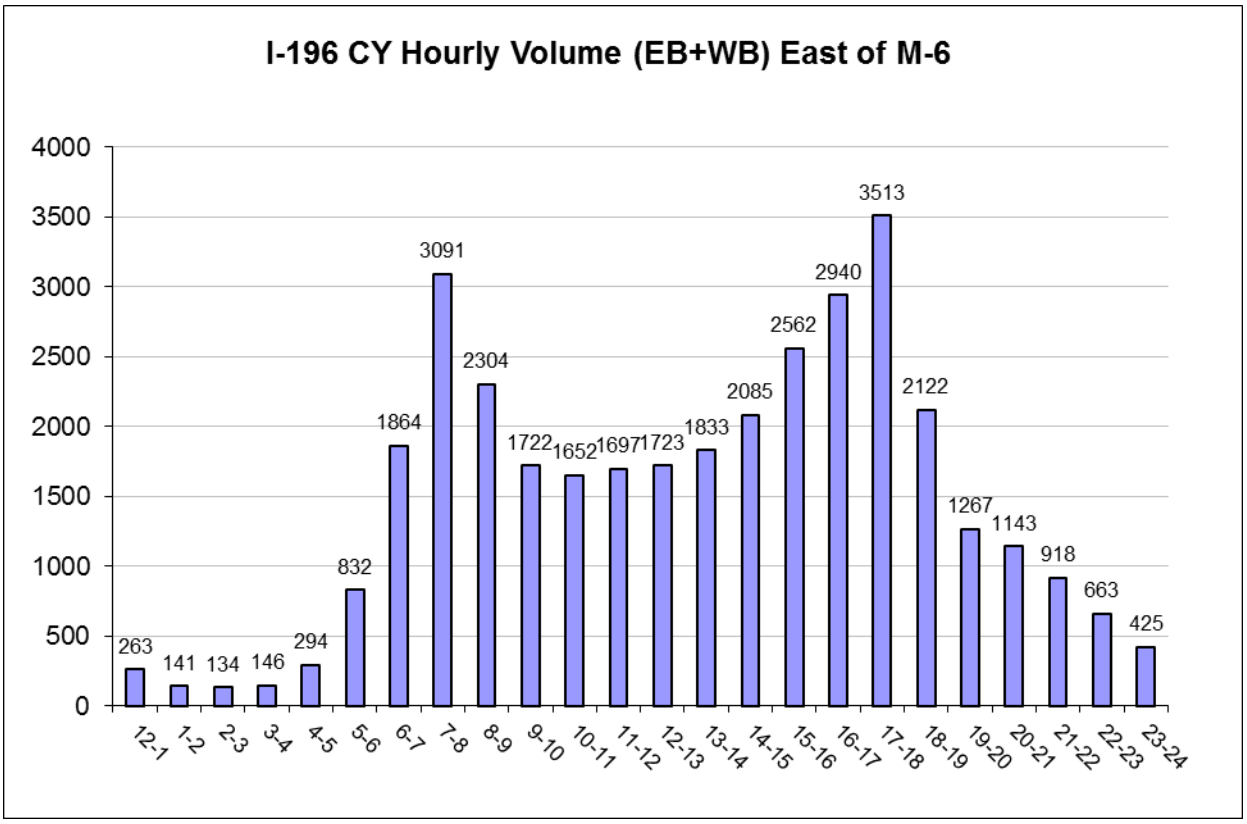
Vehicle Classification Distribution	
4	1.06%
5	9.38%
6	6.66%
7	0.76%
8	10.89%
9	50.08%
10	7.26%
11	2.12%
12	1.82%
13	9.98%

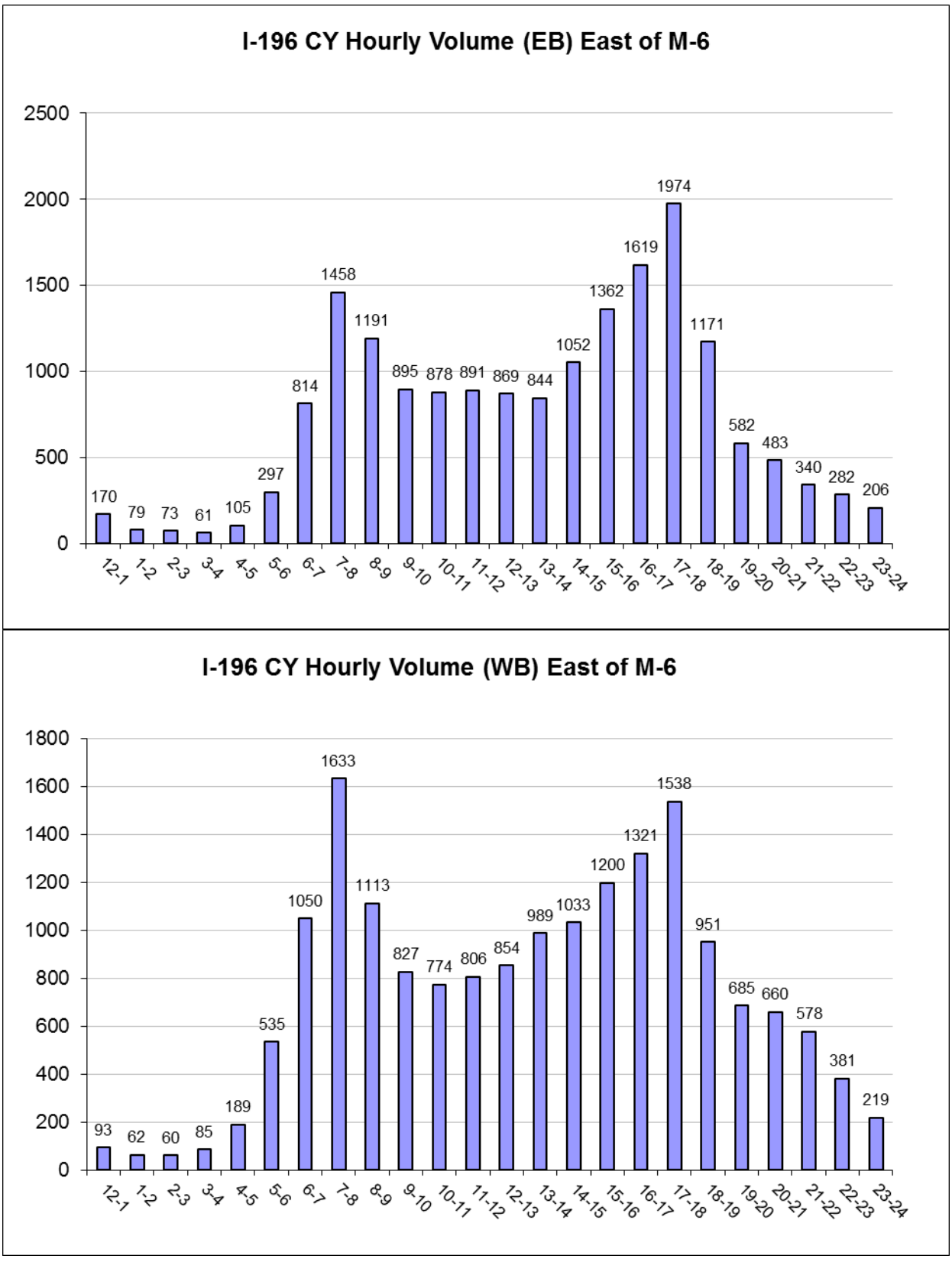
Hourly Adjustment Factors			
12-1	2.01%	**12-13**	6.38%
1-2	1.80%	**13-14**	6.41%
2-3	1.83%	**14-15**	5.92%
3-4	1.74%	**15-16**	4.15%
4-5	2.20%	**16-17**	4.12%
5-6	3.72%	**17-18**	3.08%
6-7	5.80%	**18-19**	4.18%
7-8	5.31%	**19-20**	3.42%
8-9	7.05%	**20-21**	3.05%
9-10	6.84%	**21-22**	2.38%
10-11	6.93%	**22-23**	2.93%
11-12	6.11%	**23-24**	2.63%

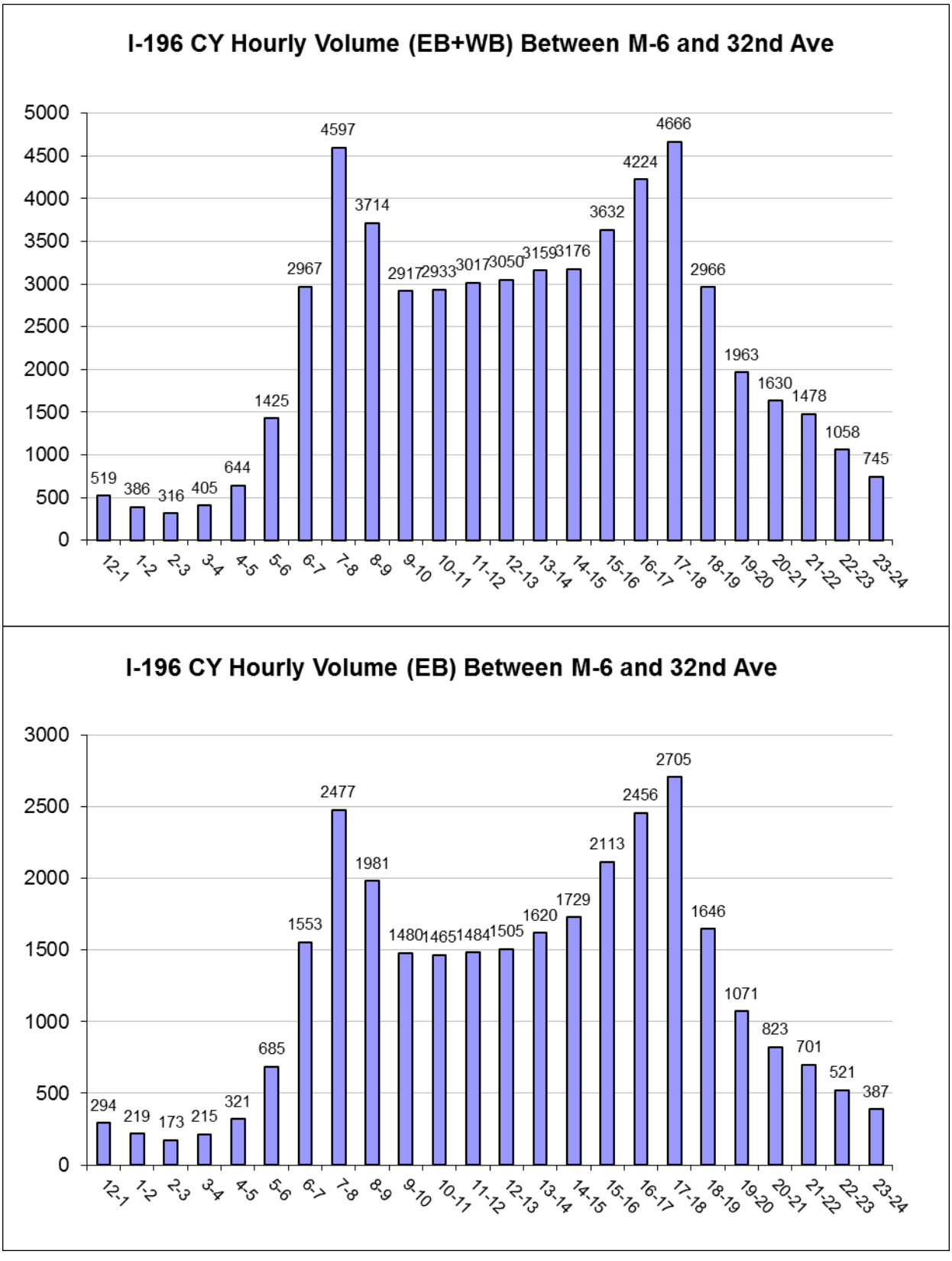
Tandem Axle Load Spectra - CLUSTER NO.	1

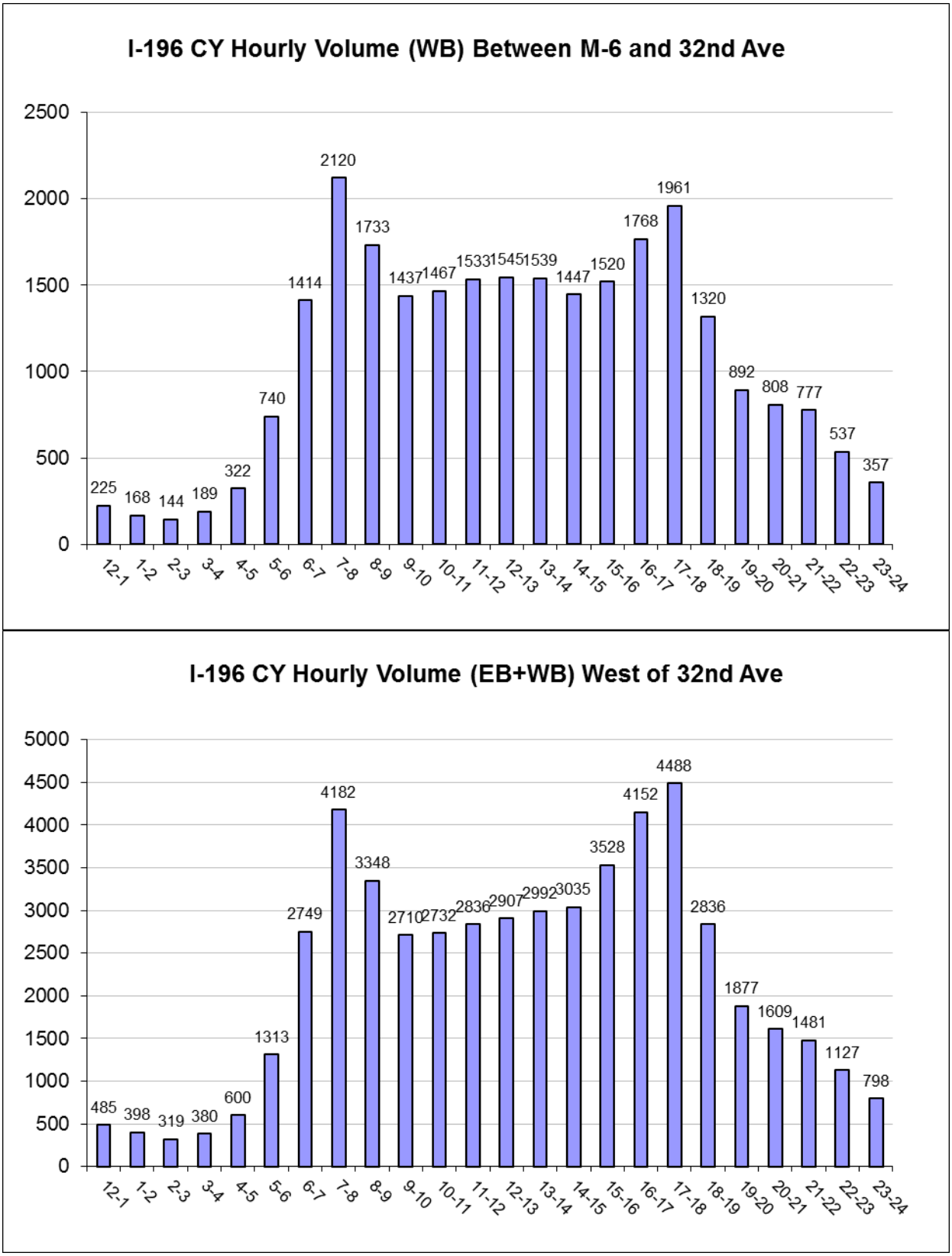
24 Hour/Peak Hour Data

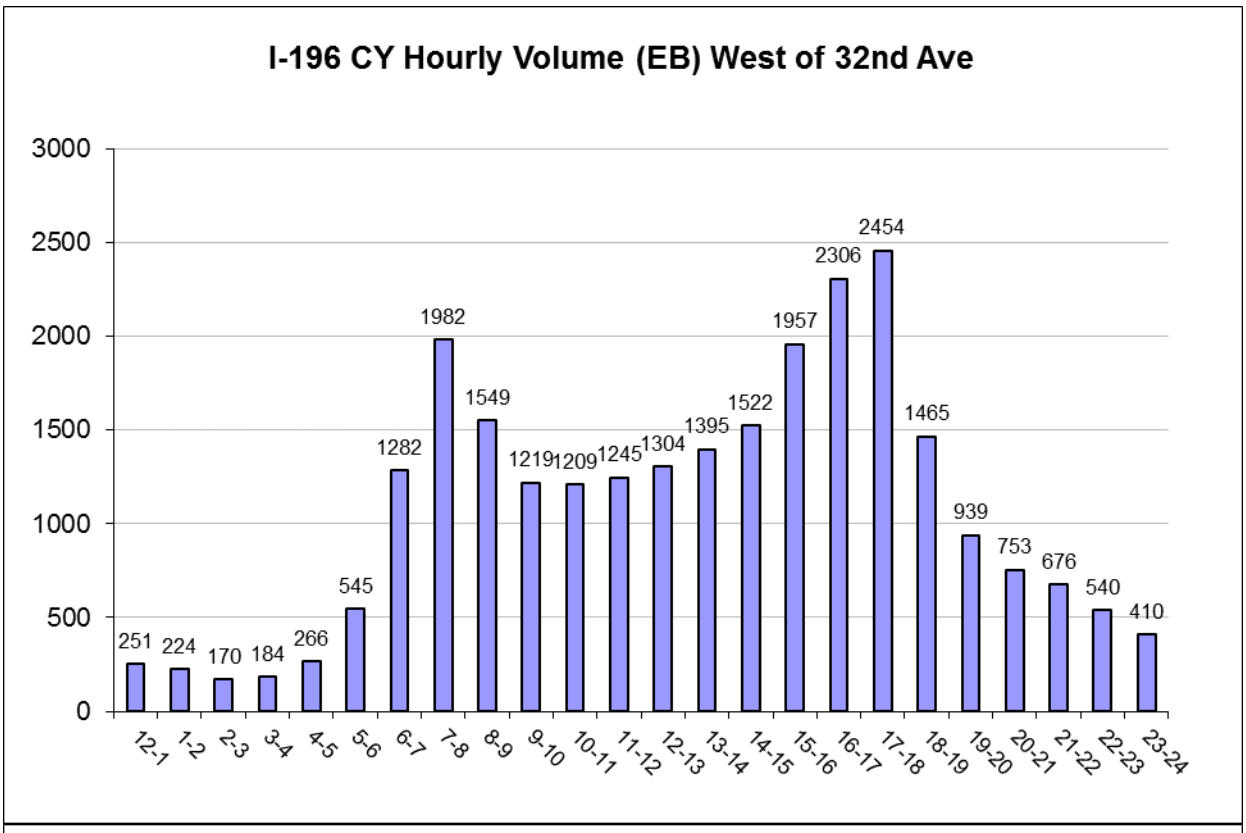
The following tables contain the requested 24 hour distribution and peak hour traffic information for I-196 in Ottawa County. Current traffic volumes were calculated from hose counts taken between 2011 and 2015. A growth rate of 0.5% was used to calculate future traffic volume. This number is based on past growth, regression analysis and population projections in Ottawa County. All numbers are shown in the 2019 construction year.

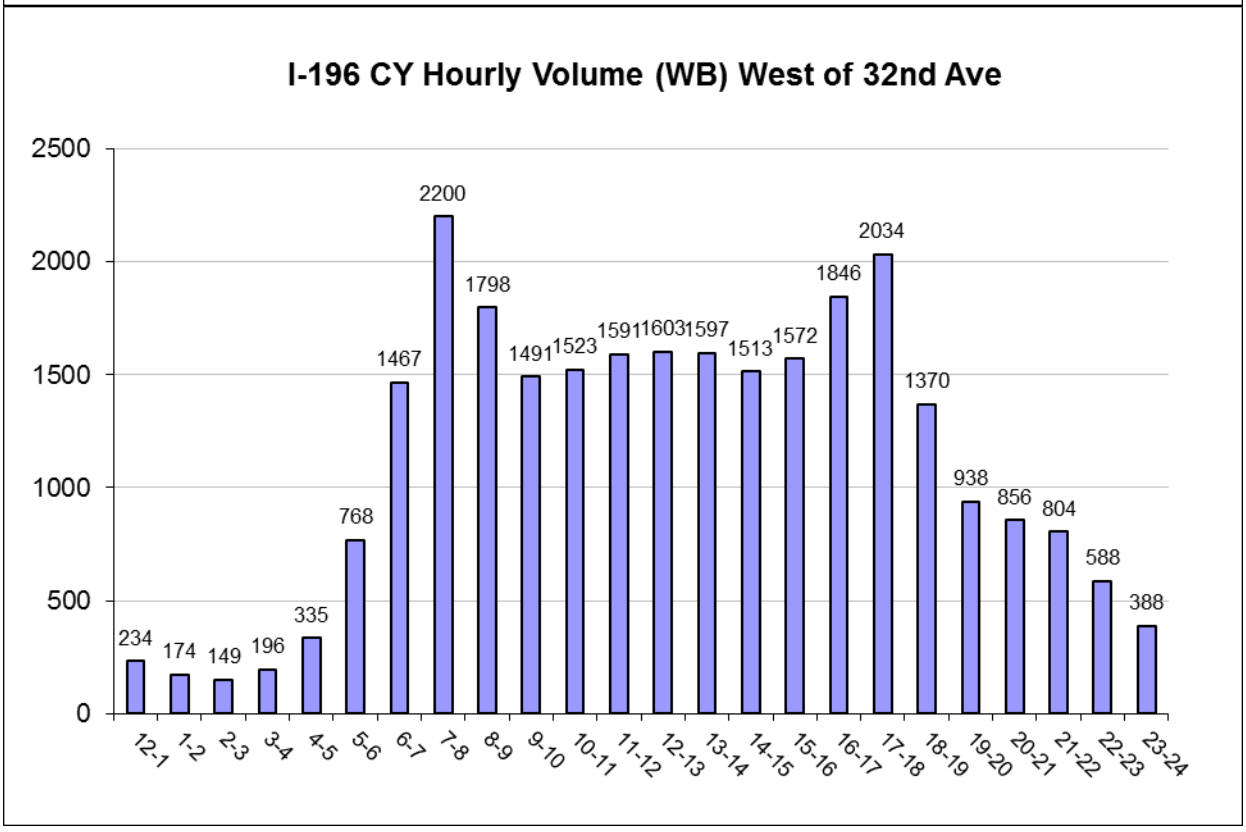



I-196 CY Hourly Volume (EB) East of M-6
2500
2000
1500
1000
500
0
170
79
73
61
105
297
814
1458
1191
895
878
891
869
844
1052
1362
1619
1974
1171
582
483
340
282
206
12-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24
I-196 CY Hourly Volume (WB) East of M-6
1800
1600
1400
1200
1000
800
600
400
200
0
93
62
60
85
189
535
1050
1633
1113
827
774
806
854
989
1033
1200
1321
1538
951
685
660
578
381
219
12-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24


I-196 CY Hourly Volume (EB+WB) Between M-6 and 32nd Ave
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
519
386
316
405
644
1425
2967
4597
3714
2917
2933
3017
3050
3159
3176
3632
4224
4666
2966
1963
1630
1478
1058
745
12-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24
I-196 CY Hourly Volume (EB) Between M-6 and 32nd Ave
3000
2500
2000
1500
1000
500
0
294
219
173
215
321
685
1553
2477
1981
1480
1465
1484
1505
1620
1729
2113
2456
2705
1646
1071
823
701
521
387
12-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24


I-196 CY Hourly Volume (WB) Between M-6 and 32nd Ave
2500
2000
1500
1000
500
0
225
168
144
189
322
740
1414
2120
1733
1437
1467
1533
1545
1539
1447
1520
1768
1961
1320
892
808
777
537
357
12-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24
I-196 CY Hourly Volume (EB+WB) West of 32nd Ave
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
485
398
319
380
600
1313
2749
4182
3348
2710
2732
2836
2907
2992
3035
3528
4152
4488
2836
1877
1609
1481
1127
798
12-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24


I-196 CY Hourly Volume (EB) West of 32nd Ave
3000
2500
2000
1500
1000
500
0
251
224
170
184
266
545
1282
1982
1549
1219
1209
1245
1304
1395
1522
1957
2306
2454
1465
939
753
676
540
410
12-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24


I-196 CY Hourly Volume (WB) West of 32nd Ave
2500
2000
1500
1000
500
0
234
174
149
196
335
768
1467
2200
1798
1491
1523
1591
1603
1597
1513
1572
1846
2034
1370
938
856
804
588
388
12-1
1-2
2-3
3-4
4-5
5-6
6-7
7-8
8-9
9-10
10-11
11-12
12-13
13-14
14-15
15-16
16-17
17-18
18-19
19-20
20-21
21-22
22-23
23-24

32nd Ave AT WB I-196 On/Off Ramps

Turn Movement Diagram:

2019 AM Peak 7:00 - 8:00

Leg 1: 32nd Ave

North Leg

		TOTAL	
	SB	1496	NB
	908		588
157	751	0	
RIGHT	THRU	LEFT	

Leg 4: WB I-196 On/Off Ramps

West Leg

	WB	198	
TOTAL	198	0	LEFT
	EB	0	0 THRU
			0 RIGHT

Leg 2: WB I-196 On/Off Ramps

East Leg

RIGHT	239		
THRU	2	420	WB
LEFT	180		420 TOTAL
		0	EB

Leg 3: 32nd Ave

South Leg

	LEFT	THRU	RIGHT
	39	350	0
931		389	
SB	1321	NB	
	TOTAL		

32nd Ave AT WB I-196 On/Off Ramps

Turn Movement Diagram:

2039 AM Peak 7:00 - 8:00

Leg 1: 32nd Ave

North Leg

		TOTAL	
	SB	1628	NB
	988		640
170	817	0	
RIGHT	THRU	LEFT	

Leg 4: WB I-196 On/Off Ramps

West Leg

	WB	215	
TOTAL	215	0	LEFT
	EB	0	0 THRU
			0 RIGHT

Leg 2: WB I-196 On/Off Ramps

East Leg

RIGHT	259		
THRU	2	457	WB
LEFT	196		457 TOTAL
		0	EB

Leg 3: 32nd Ave

South Leg

	LEFT	THRU	RIGHT
	43	381	0
1013		423	
SB	1437	NB	
	TOTAL		

32nd Ave AT WB I-196 On/Off Ramps

Turn Movement Diagram:

2019 PM Peak 5:00 - 6:00

Leg 1: 32nd Ave

North Leg

		TOTAL	
	SB	1869	NB
	811		1058
74	737	0	
RIGHT	THRU	LEFT	

Leg 4: WB I-196 On/Off Ramps

West Leg

	WB	118	
TOTAL	118	0	LEFT
EB	0	0	THRU
		0	RIGHT

Leg 2: WB I-196 On/Off Ramps

East Leg

RIGHT	485		
THRU	0	716	WB
LEFT	231	716	TOTAL
	0	EB	

Leg 3: 32nd Ave

South Leg

	LEFT	THRU	RIGHT
	44	573	0
968		617	
SB	1585	NB	
	TOTAL		

32nd Ave AT WB I-196 On/Off Ramps

Turn Movement Diagram:

2039 PM Peak 5:00 - 6:00

Leg 1: 32nd Ave

North Leg

		TOTAL	
	SB	2033	NB
	883		1151
80	802	0	
RIGHT	THRU	LEFT	

Leg 4: WB I-196 On/Off Ramps

West Leg

	WB	129	
TOTAL	129	0	LEFT
EB	0	0	THRU
		0	RIGHT

Leg 2: WB I-196 On/Off Ramps

East Leg

RIGHT	527		
THRU	0	778	WB
LEFT	251	778	TOTAL
	0	EB	

Leg 3: 32nd Ave

South Leg

	LEFT	THRU	RIGHT
	48	623	0
1053		671	
SB	1724	NB	
	TOTAL		

32nd Ave AT EB I-196 On/Off Ramps

Turn Movement Diagram:

2019 AM Peak 7:00 - 8:00

Leg 1: 32nd Ave

North Leg

		TOTAL	
	SB	1544	NB
	1043		501
0	606	437	
RIGHT	THRU	LEFT	

Leg 4: EB I-196 On/Off Ramps

West Leg

	WB	0	
TOTAL	111		57 LEFT
	EB	111	0 THRU
			53 RIGHT

Leg 2: EB I-196 On/Off Ramps

East Leg

RIGHT	0		
THRU	0	0	WB
LEFT	0		683 TOTAL
		683	EB

Leg 3: 32nd Ave

South Leg

	LEFT	THRU	RIGHT
	0	444	246
659		690	
SB	1349	NB	
	TOTAL		

32nd Ave AT EB I-196 On/Off Ramps

Turn Movement Diagram:

2039 AM Peak 7:00 - 8:00

Leg 1: 32nd Ave

North Leg

		TOTAL	
	SB	1680	NB
	1134		545
0	659	475	
RIGHT	THRU	LEFT	

Leg 4: EB I-196 On/Off Ramps

West Leg

	WB	0	
TOTAL	120		62 LEFT
	EB	120	0 THRU
			58 RIGHT

Leg 2: EB I-196 On/Off Ramps

East Leg

RIGHT	0		
THRU	0	0	WB
LEFT	0		743 TOTAL
		743	EB

Leg 3: 32nd Ave

South Leg

	LEFT	THRU	RIGHT
	0	483	268
717		751	
SB	1468	NB	
	TOTAL		

32nd Ave AT EB I-196 On/Off Ramps

Turn Movement Diagram:

2019 PM Peak 5:00 - 6:00

Leg 1: 32nd Ave

North Leg

		TOTAL	
	SB	1363	NB
	851		513
0	554	297	
RIGHT	THRU	LEFT	

Leg 4: EB I-196 On/Off Ramps

West Leg

	WB	0	
TOTAL	203	128	LEFT
	EB 203	0	THRU
		75	RIGHT

Leg 2: EB I-196 On/Off Ramps

East Leg

RIGHT	0		
THRU	0	0	WB
LEFT	0	509	TOTAL
		509	EB

Leg 3: 32nd Ave

South Leg

	LEFT	THRU	RIGHT
	0	385	212
629		597	
SB	1226	NB	
	TOTAL		

32nd Ave AT EB I-196 On/Off Ramps

Turn Movement Diagram:

2039 PM Peak 5:00 - 6:00

Leg 1: 32nd Ave

North Leg

		TOTAL	
	SB	1483	NB
	925		558
0	602	323	
RIGHT	THRU	LEFT	

Leg 4: EB I-196 On/Off Ramps

West Leg

	WB	0	
TOTAL	221	139	LEFT
	EB 221	0	THRU
		81	RIGHT

Leg 2: EB I-196 On/Off Ramps

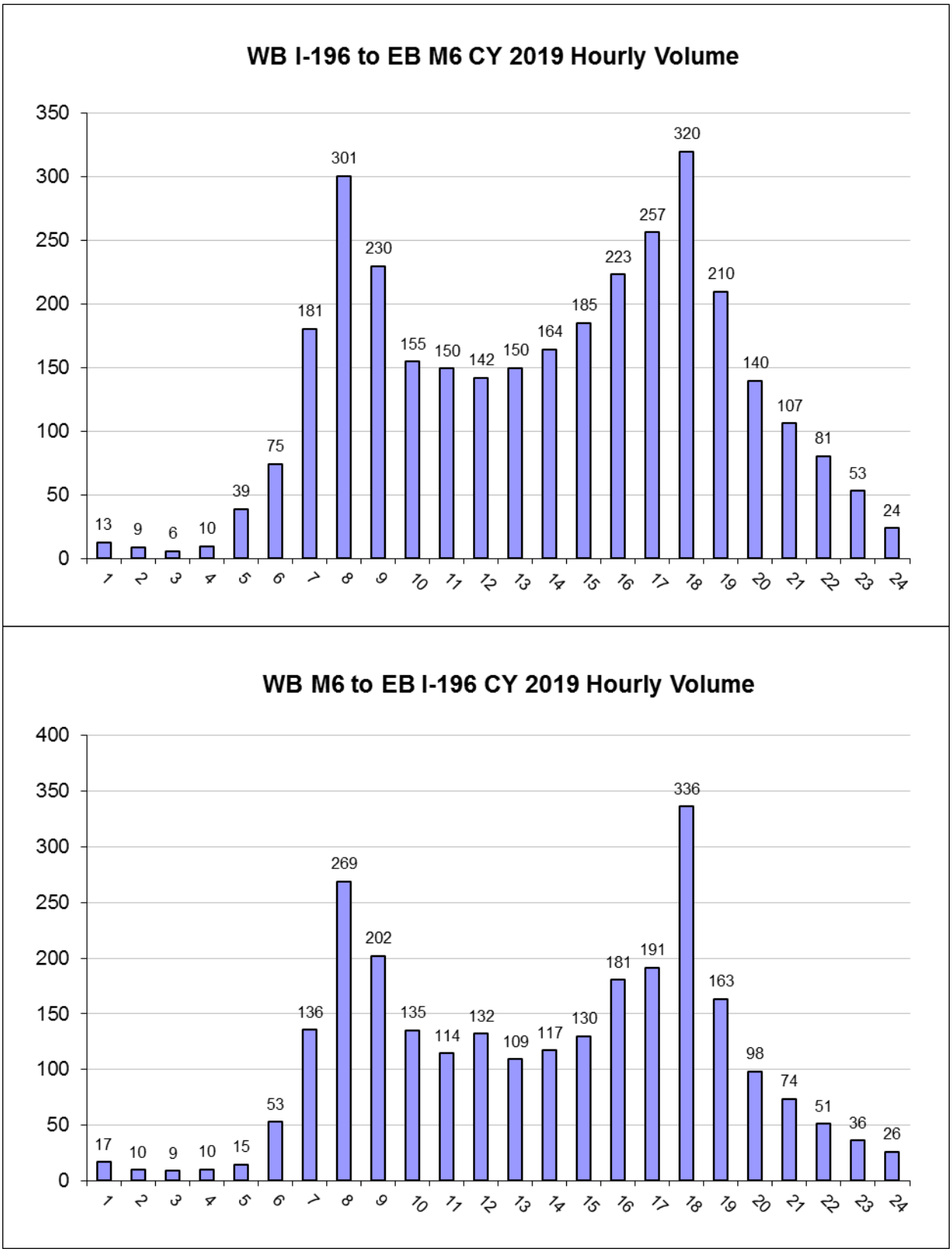
East Leg

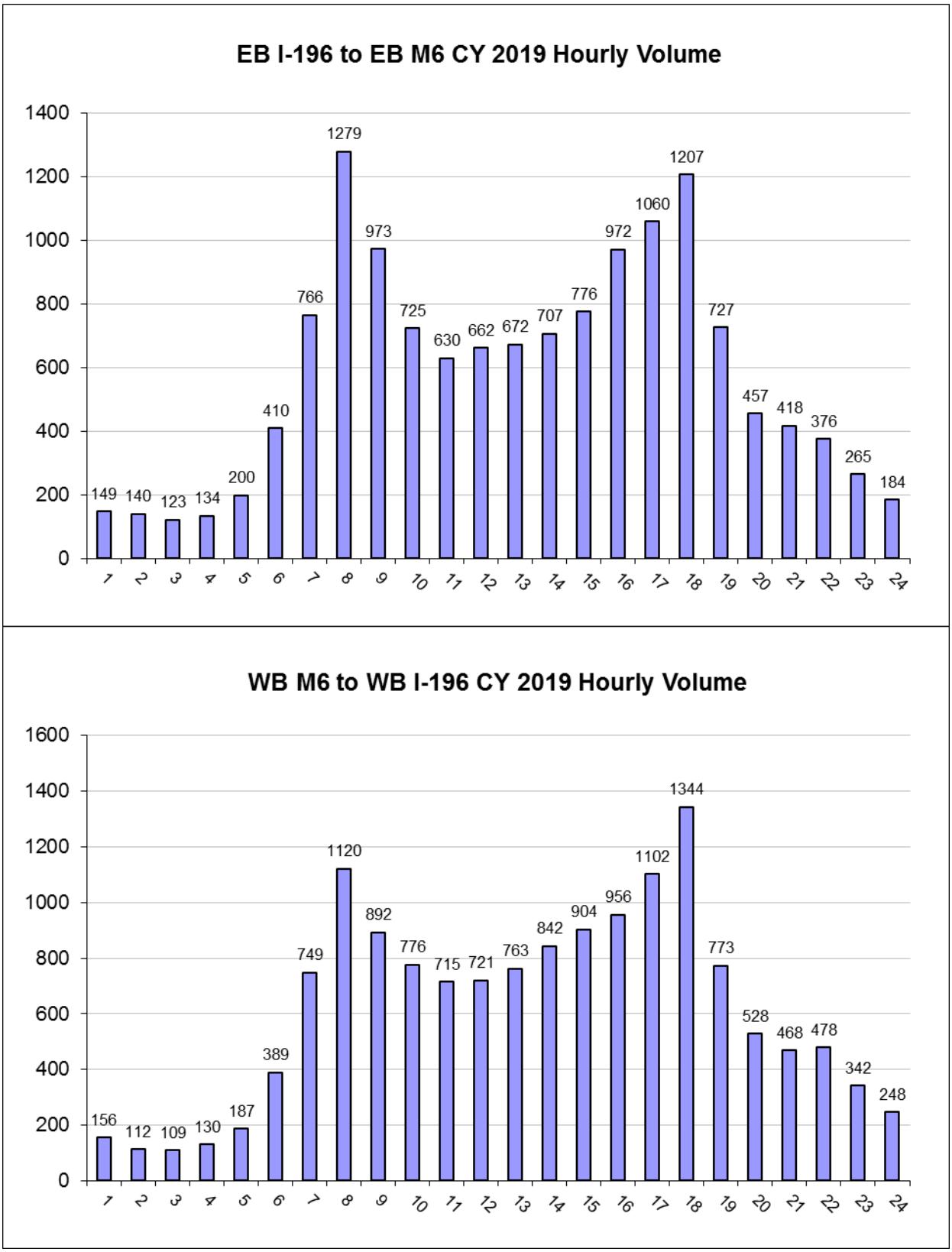
RIGHT	0		
THRU	0	0	WB
LEFT	0	554	TOTAL
		554	EB

Leg 3: 32nd Ave

South Leg

	LEFT	THRU	RIGHT
	0	419	231
684		650	
SB	1333	NB	
	TOTAL		


WB I-196 to EB M6 CY 2019 Hourly Volume
350
300
250
200
150
100
50
0
13 9 6 10 39 75 181 301 230 155 150 142 150 164 185 223 257 320 210 140 107 81 53 24
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
WB M6 to EB I-196 CY 2019 Hourly Volume
400
350
300
250
200
150
100
50
0
17 10 9 10 15 53 136 269 202 135 114 132 109 117 130 181 191 336 163 98 74 51 36 26
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24


EB I-196 to EB M6 CY 2019 Hourly Volume
1400
1200
1000
800
600
400
200
0
149 140 123 134 200 410 766 1279 973 725 630 662 672 707 776 972 1060 1207 727 457 418 376 265 184
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
WB M6 to WB I-196 CY 2019 Hourly Volume
1600
1400
1200
1000
800
600
400
200
0
156 112 109 130 187 389 749 1120 892 776 715 721 763 842 904 956 1102 1344 773 528 468 478 342 248
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24

32nd St Ramps ESAL Data

I-196 EB off Ramp	Rigid	Flexible
Growth Rate	0.85%	0.85%
Growth Type	Compound	Compound
Initial Yearly 18-kip ESAL (both directions)	100,350	63,440
Direction Distribution Factor	100%	100%
Lane Distribution Factor	100%	100%
Total 18 Kip Axle Loadings	2,177,640	1,376,670

I-196 EB on Ramp	Rigid	Flexible
Growth Rate	0.85%	0.85%
Growth Type	Compound	Compound
Initial Yearly 18-kip ESAL (both directions)	163,520	107,460
Direction Distribution Factor	100%	100%
Lane Distribution Factor	100%	100%
Total 18 Kip Axle Loadings	3,548,450	2,331,930

I-196 WB off Ramp	Rigid	Flexible
Growth Rate	0.85%	0.85%
Growth Type	Compound	Compound
Initial Yearly 18-kip ESAL (both directions)	228,120	145,670
Direction Distribution Factor	100%	100%
Lane Distribution Factor	100%	100%
Total 18 Kip Axle Loadings	4,950,300	3,161,100

I-196 WB on Ramp	Rigid	Flexible
Growth Rate	0.85%	0.85%
Growth Type	Compound	Compound
Initial Yearly 18-kip ESAL (both directions)	148,070	94,230
Direction Distribution Factor	100%	100%
Lane Distribution Factor	100%	100%
Total 18 Kip Axle Loadings	3,213,180	2,044,830

I-196 @ 32nd St Ramps ME Input Data

ME Inputs	EB On Ramp	EB Off Ramp	WB On Ramp	WB Off Ramp
AADT (% commercial)	8,875 (7.2%)	2,575 (12.3%)	2,900 (15.9%)	8,750 (8.6%)
Hourly Adjustment	Statewide Avg	Statewide Avg	Statewide Avg	Statewide Avg
Vehicle Class Distribution	Statewide Avg	Statewide Avg	Statewide Avg	Statewide Avg

If you have any questions regarding this traffic analysis, please contact me at 517.241.3874

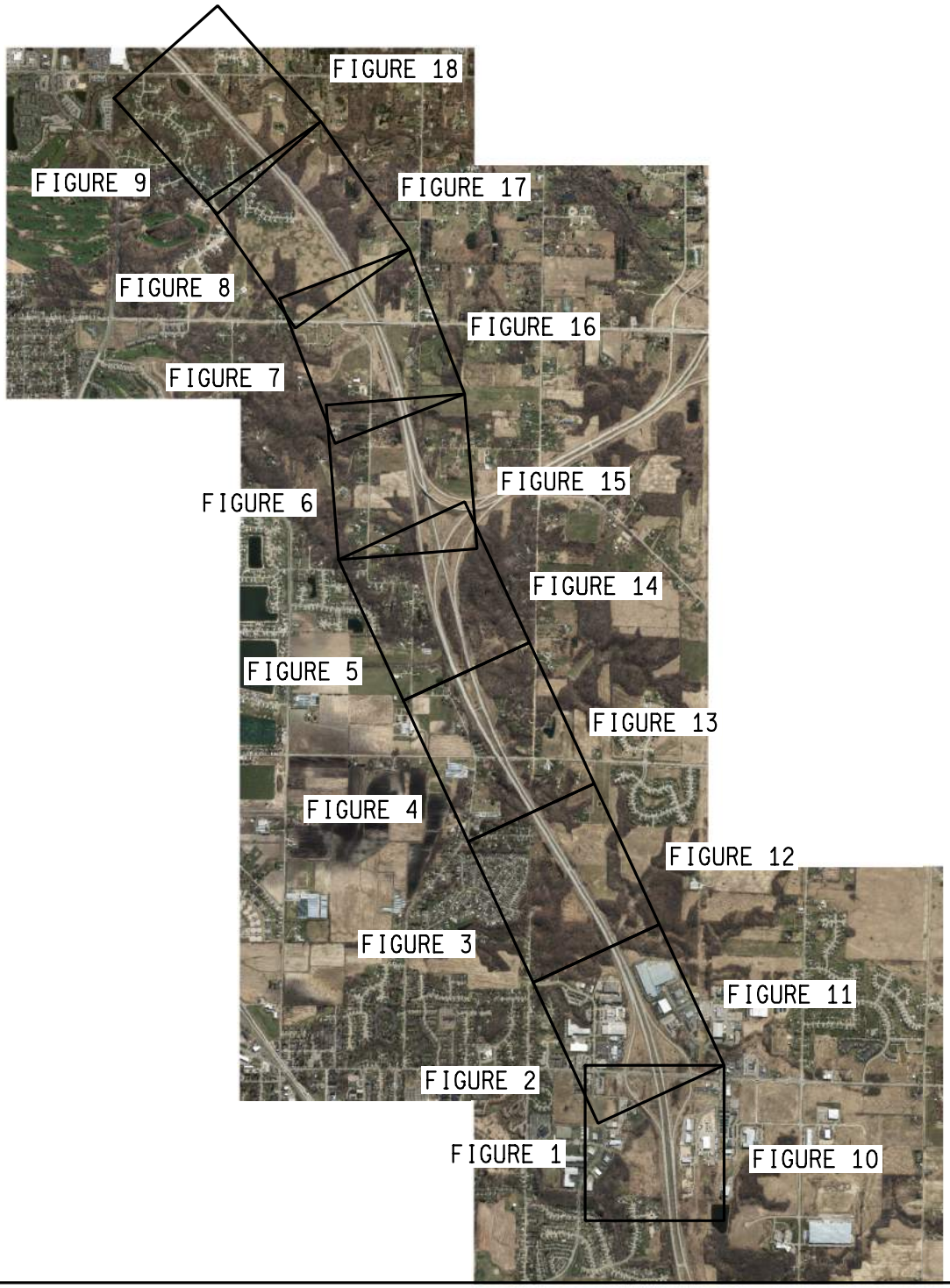
Regards,

Josh Bocks
Asset Management Division
Michigan Department of Transportation

Appendix C

Project Figures

- Project Vicinity Map
- Noise Analysis Figures
- Noise Contours Figures
- DUE Calculations



PROJECT VICINITY MAP

Legend

FIGURE BOUNDRY LIMITS

N

0 1250 2500 3750 5000

I-196
32nd Ave to Kenowa Ave
Ottawa County
Michigan

Legend

A00	Modeled site, not benefited and not impacted
A00	Modeled site, not benefited and impacted
A00	Modeled site, benefited and not impacted
A00	Modeled site, benefited and impacted
SITE 1	Field Measurement Site
	Evaluated Noise Barrier

N

0 75 150 300 450 600

Figure 1

Noise Analysis
West of 32nd Ave

Legend

A00 Modeled site, not benefited and not impacted

A00 Modeled site, not benefited and impacted

A00 Modeled site, benefited and not impacted

A00 Modeled site, benefited and impacted

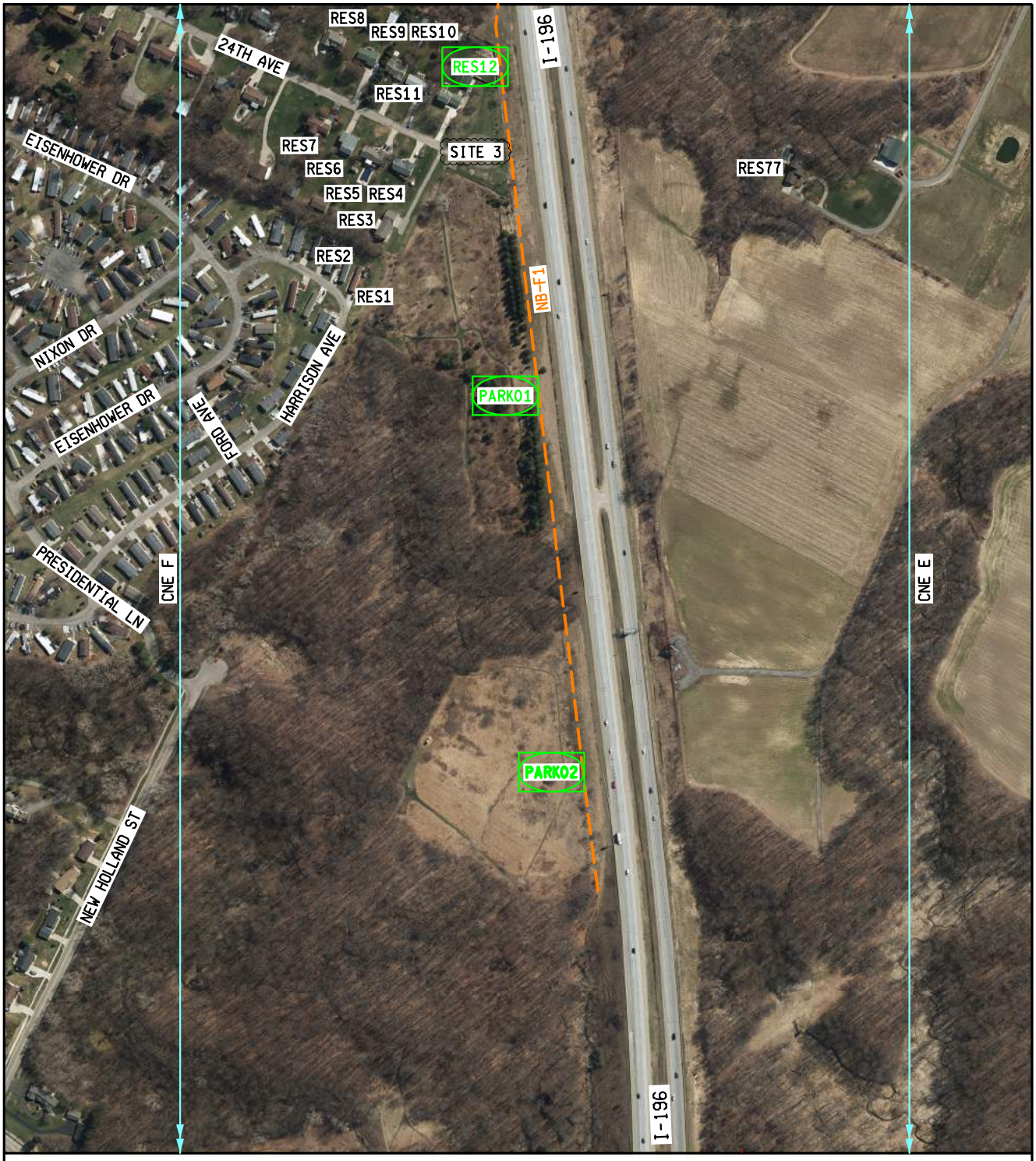
SITE 1 Field Measurement Site

Evaluated Noise Barrier

0 75 150 300 450 600

Figure 2

Noise Analysis
East of 32nd Ave



Legend

A00	Modeled site, not benefited and not impacted
A00	Modeled site, not benefited and impacted
A00	Modeled site, benefited and not impacted
A00	Modeled site, benefited and impacted
SITE 1	Field Measurement Site
— —	Evaluated Noise Barrier

N

0 75 150 300 450 600

Figure 3

Noise Analysis
West of 24th Ave

Legend

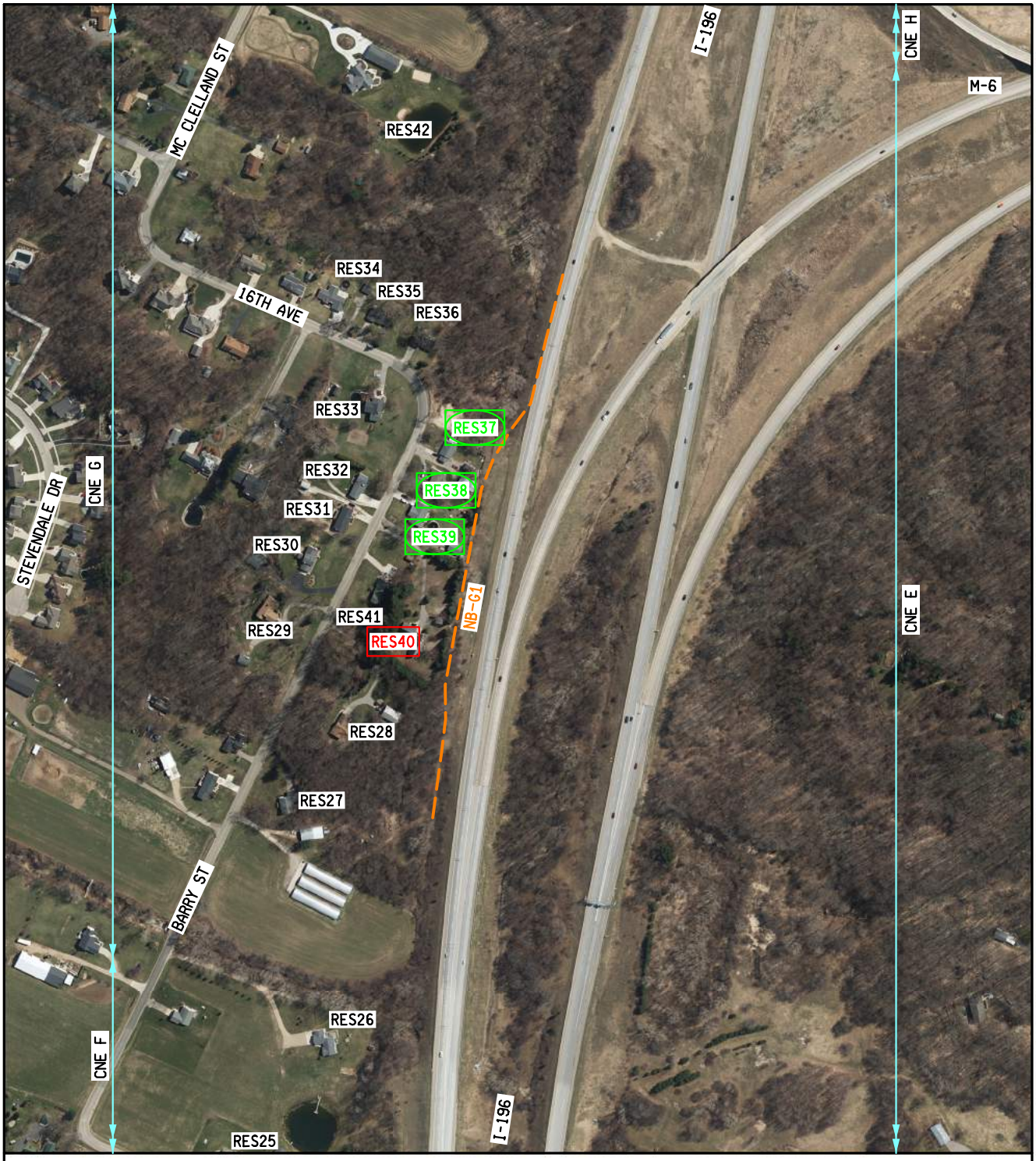
A00	Modeled site, not benefited and not impacted
A00	Modeled site, not benefited and impacted
A00	Modeled site, benefited and not impacted
A00	Modeled site, benefited and impacted
SITE 1	Field Measurement Site
— —	Evaluated Noise Barrier

N

0 75 150 300 450 600

Figure 4

Noise Analysis
At 22nd Ave



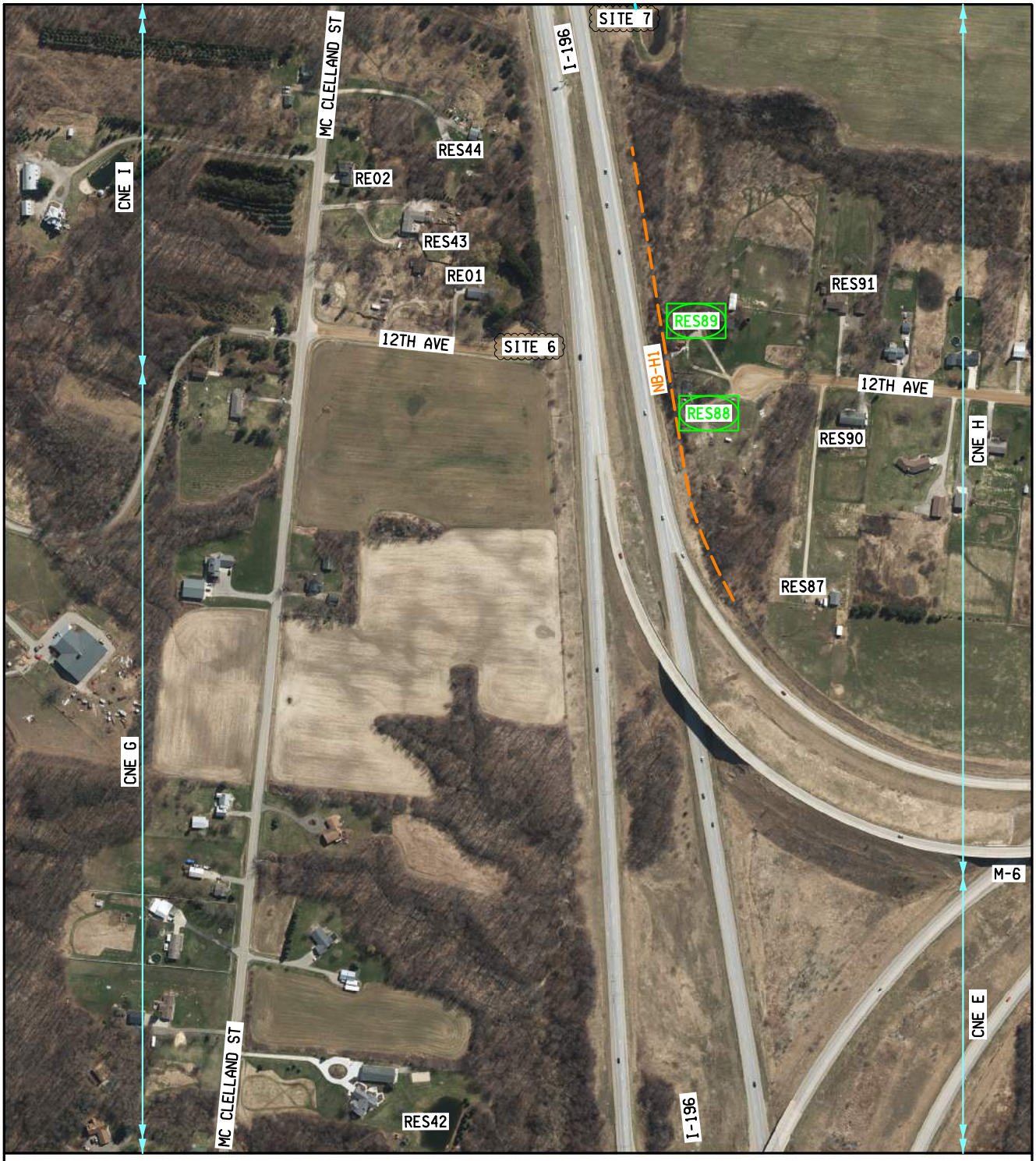
Legend

- A00 — Modeled site, not benefited and not impacted
- A00 — Modeled site, not benefited and impacted
- A00 — Modeled site, benefited and not impacted
- A00 — Modeled site, benefited and impacted
- SITE 1 — Field Measurement Site
- Evaluated Noise Barrier

0 75 150 300 450 600

Figure 5

Noise Analysis
West of M-6



Legend

- A00 — Modeled site, not benefited and not impacted
- A00 — Modeled site, not benefited and impacted
- A00 — Modeled site, benefited and not impacted
- A00 — Modeled site, benefited and impacted
- SITE 1 — Field Measurement Site
- Evaluated Noise Barrier

N

0 75 150 300 450 600

Figure 6

Noise Analysis
East of M-6

Legend

A00 Modeled site, not benefited and not impacted

A00 Modeled site, not benefited and impacted

A00 Modeled site, benefited and not impacted

A00 Modeled site, benefited and impacted

SITE 1 Field Measurement Site

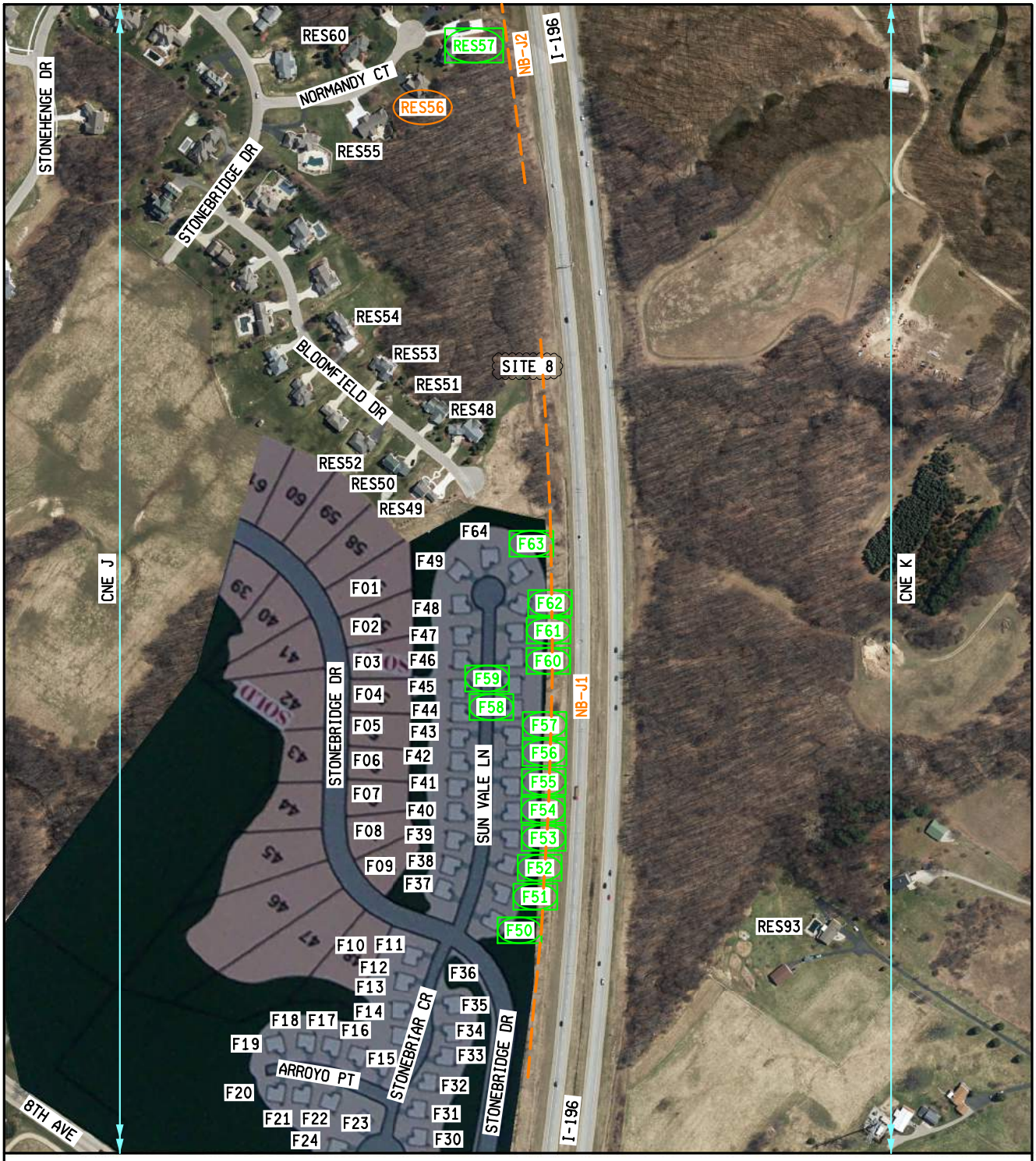
Evaluated Noise Barrier

N

0 75 150 300 450 600

Figure 7

Noise Analysis
At 8th Ave



Legend

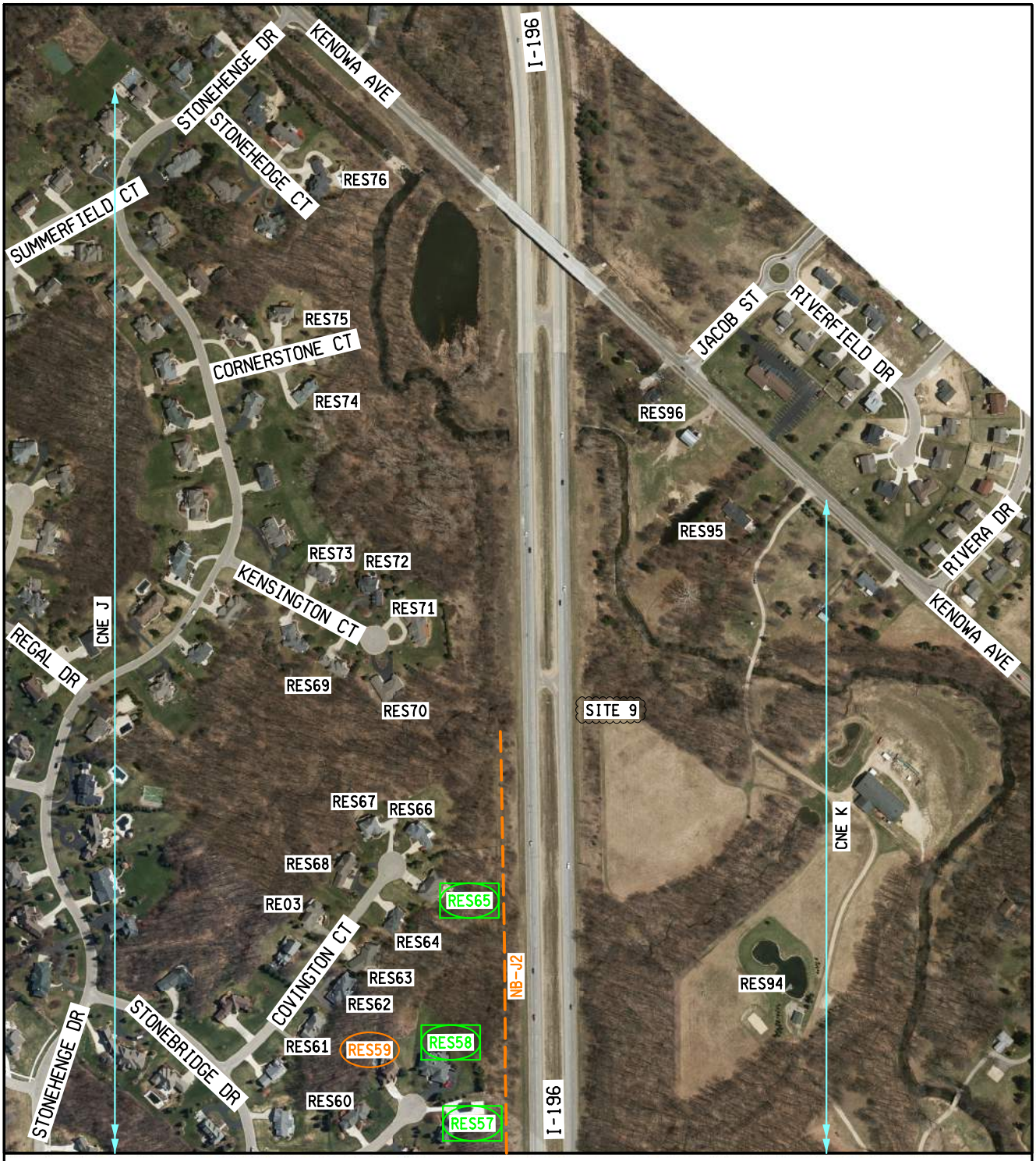
- A00 — Modeled site, not benefited and not impacted
- A00 — Modeled site, not benefited and impacted
- A00 — Modeled site, benefited and not impacted
- A00 — Modeled site, benefited and impacted
- SITE 1 — Field Measurement Site
- Evaluated Noise Barrier

N

0 75 150 300 450 600

Figure 8

Noise Analysis
East of 8th Ave



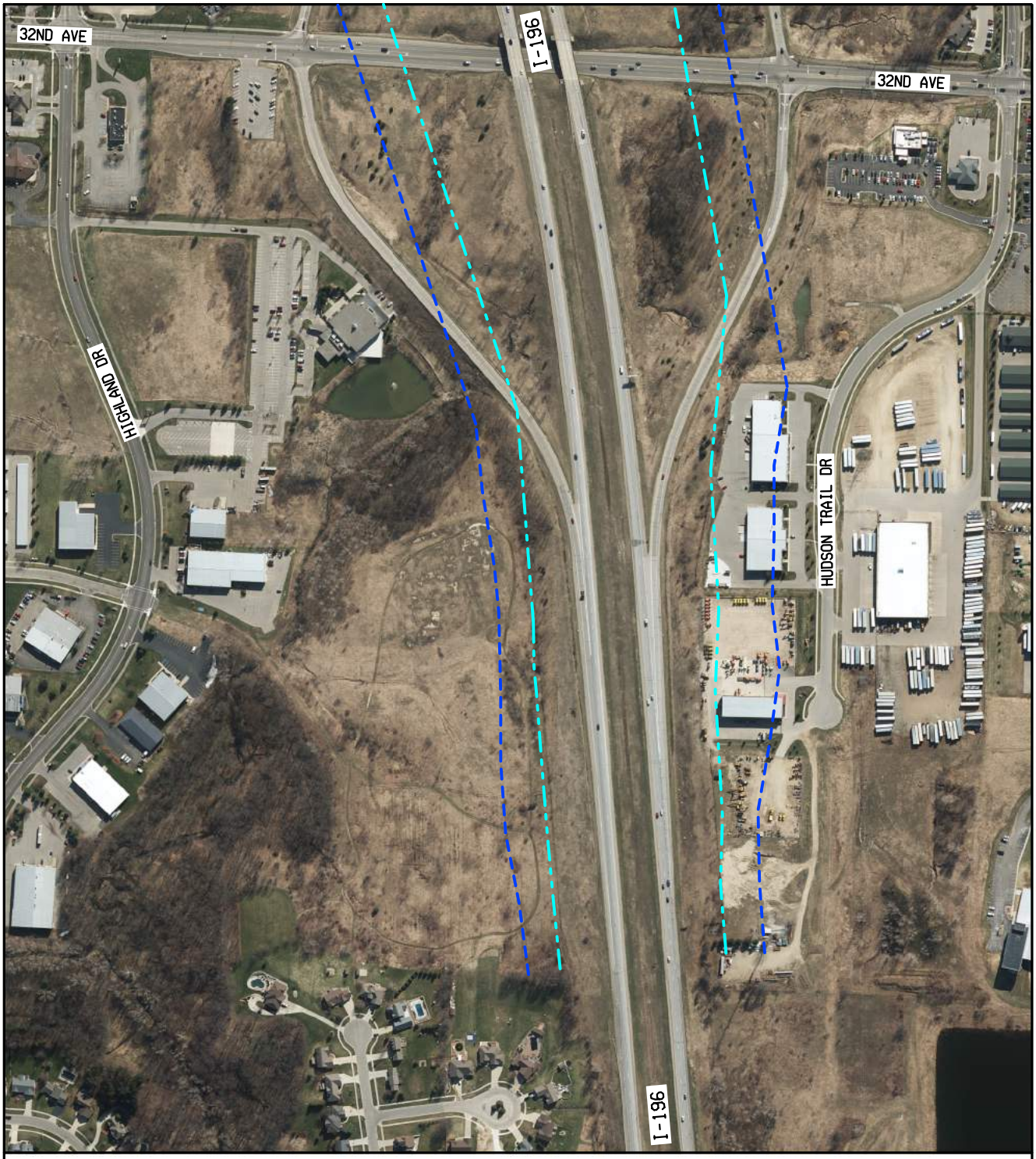
Legend

A00	Modeled site, not benefited and not impacted
A00	Modeled site, not benefited and impacted
A00	Modeled site, benefited and not impacted
A00	Modeled site, benefited and impacted
SITE 1	Field Measurement Site
	Evaluated Noise Barrier

0 75 150 300 450 600

Figure 9

Noise Analysis
West of Kenowa Ave



Legend

66 dB(A) Leq Setback (2039)

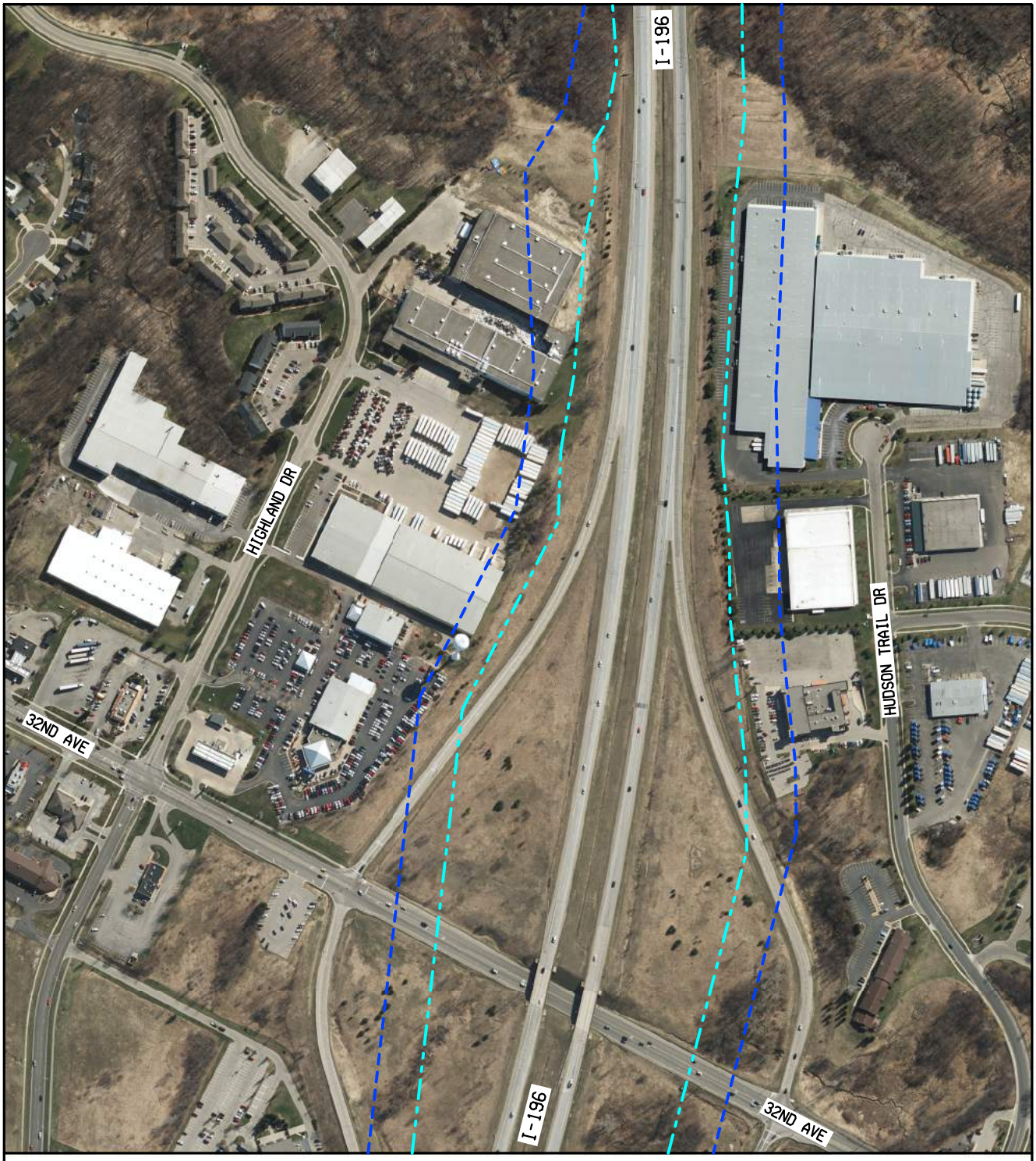
71 dB(A) Leq Setback (2039)

N

0 75 150 300 450 600

Figure 10

Noise Contours
West of 32nd Ave



Legend

66 dB(A) Leq Setback (2039)

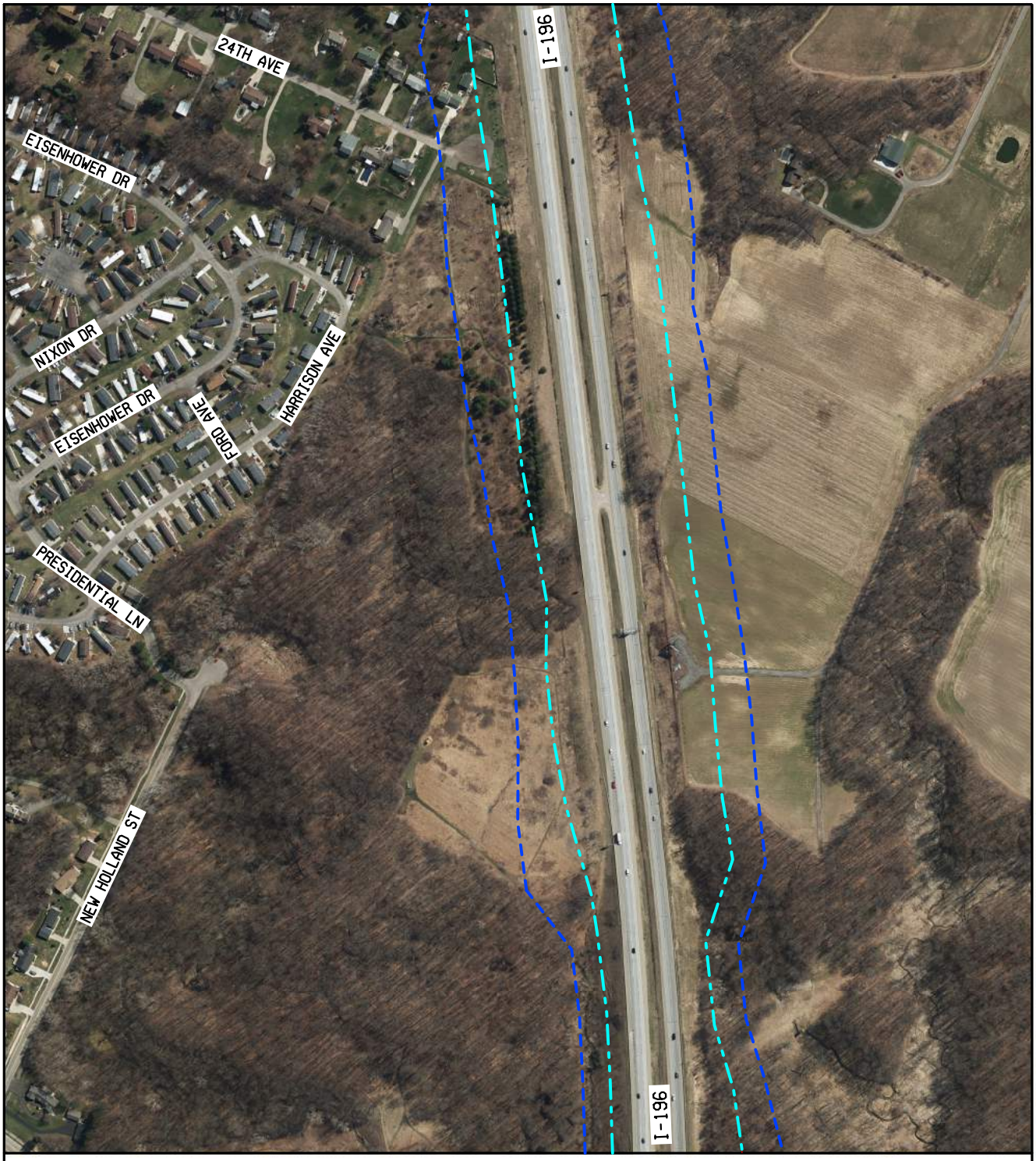
71 dB(A) Leq Setback (2039)

N

0 75 150 300 450 600

Figure 11

Noise Contours
East of 32nd Ave



Legend

66 dB(A) Leq Setback (2039)

71 dB(A) Leq Setback (2039)

N

0 75 150 300 450 600

Figure 12

Noise Contours
West of 24th Ave

Legend

66 dB(A) Leq Setback (2039)

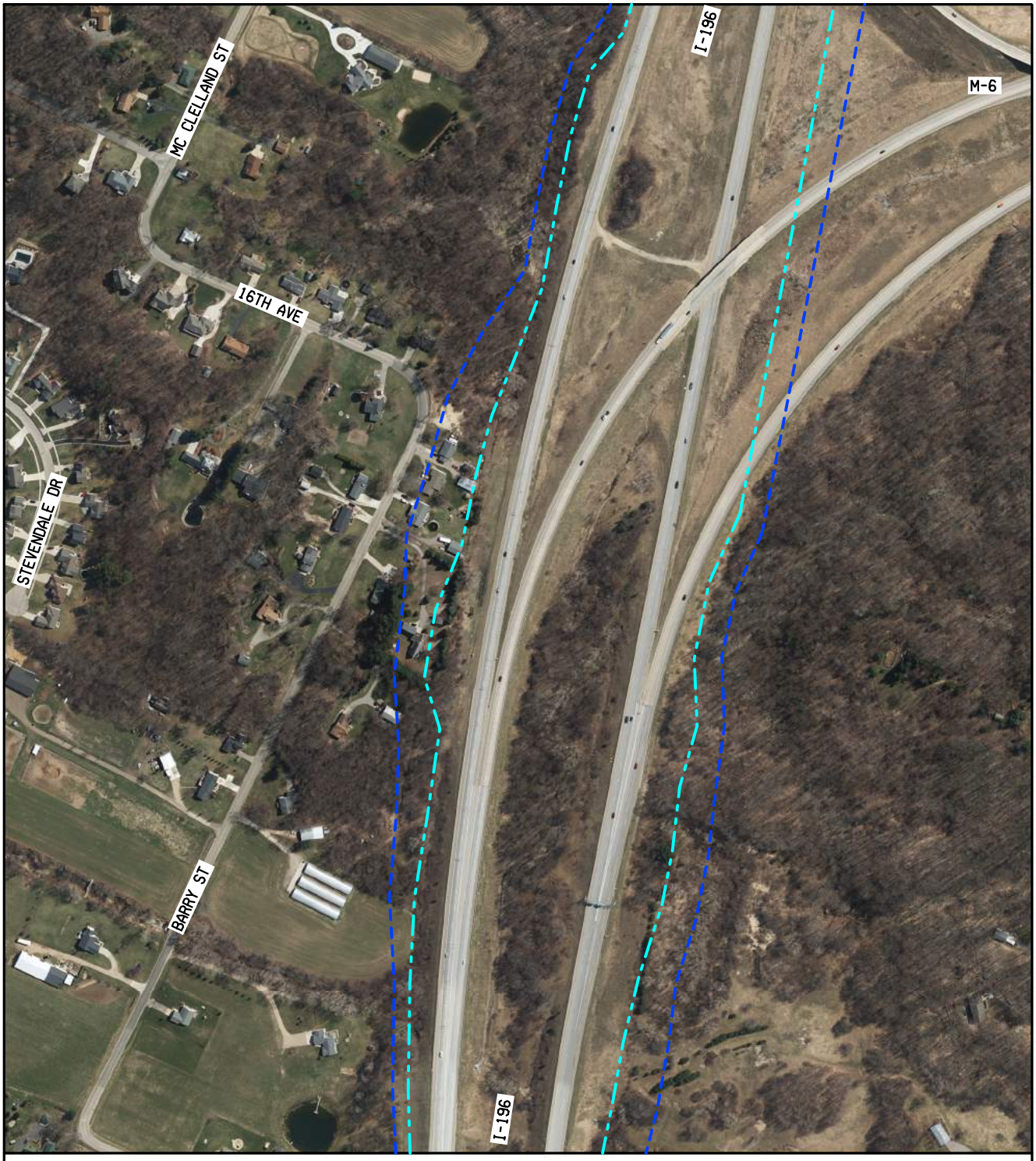
71 dB(A) Leq Setback (2039)

N

0 75 150 300 450 600

Figure 13

Noise Contours
At 22nd Ave



Legend

66 dB(A) Leq Setback (2039)

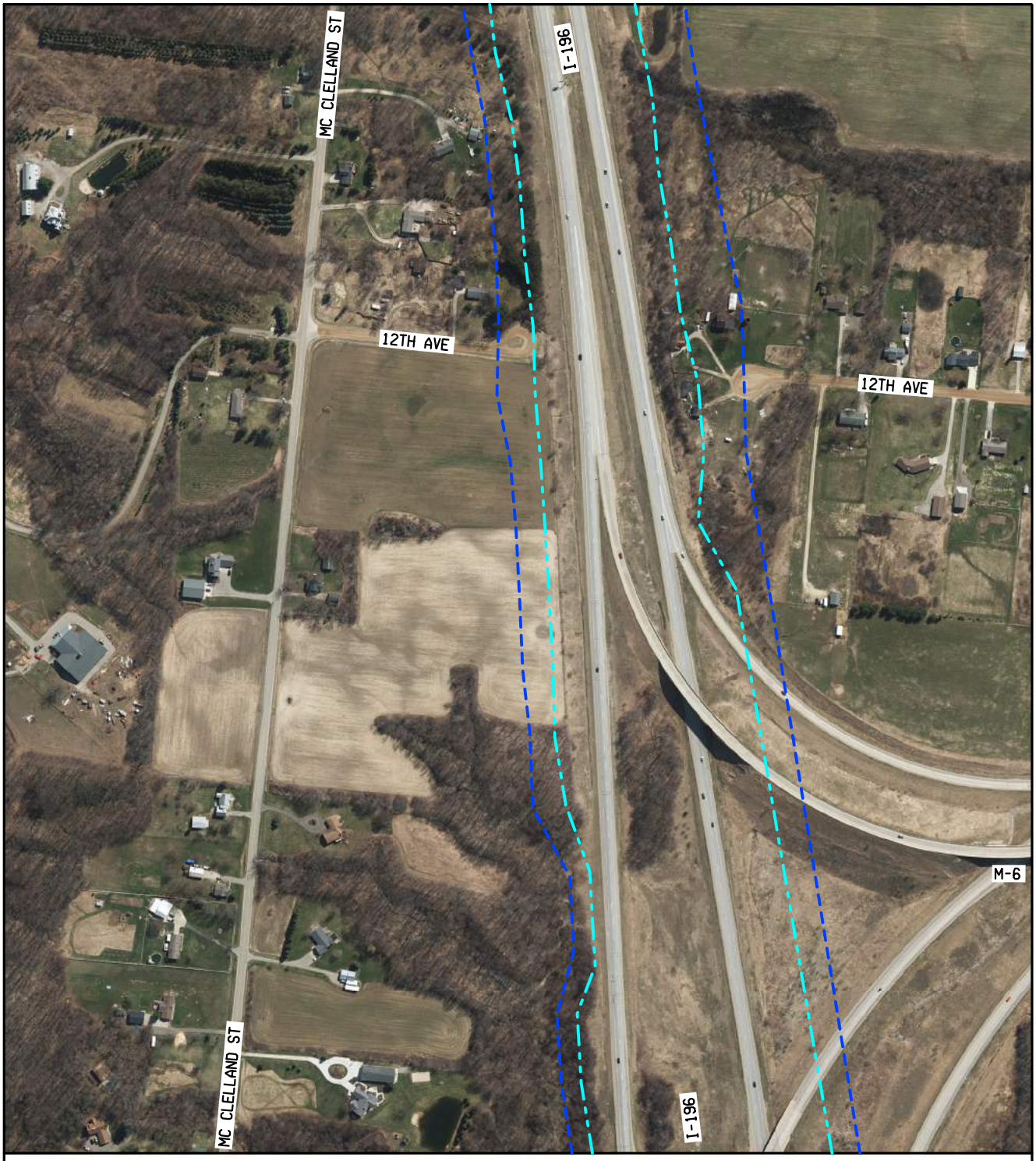
71 dB(A) Leq Setback (2039)

N

0 75 150 300 450 600

Figure 14

Noise Contours
West of M-6



Legend

66 dB(A) Leq Setback (2039)

71 dB(A) Leq Setback (2039)

N

0 75 150 300 450 600

Figure 15

Noise Contours
East of M-6

Legend

66 dB(A) Leq Setback (2039)

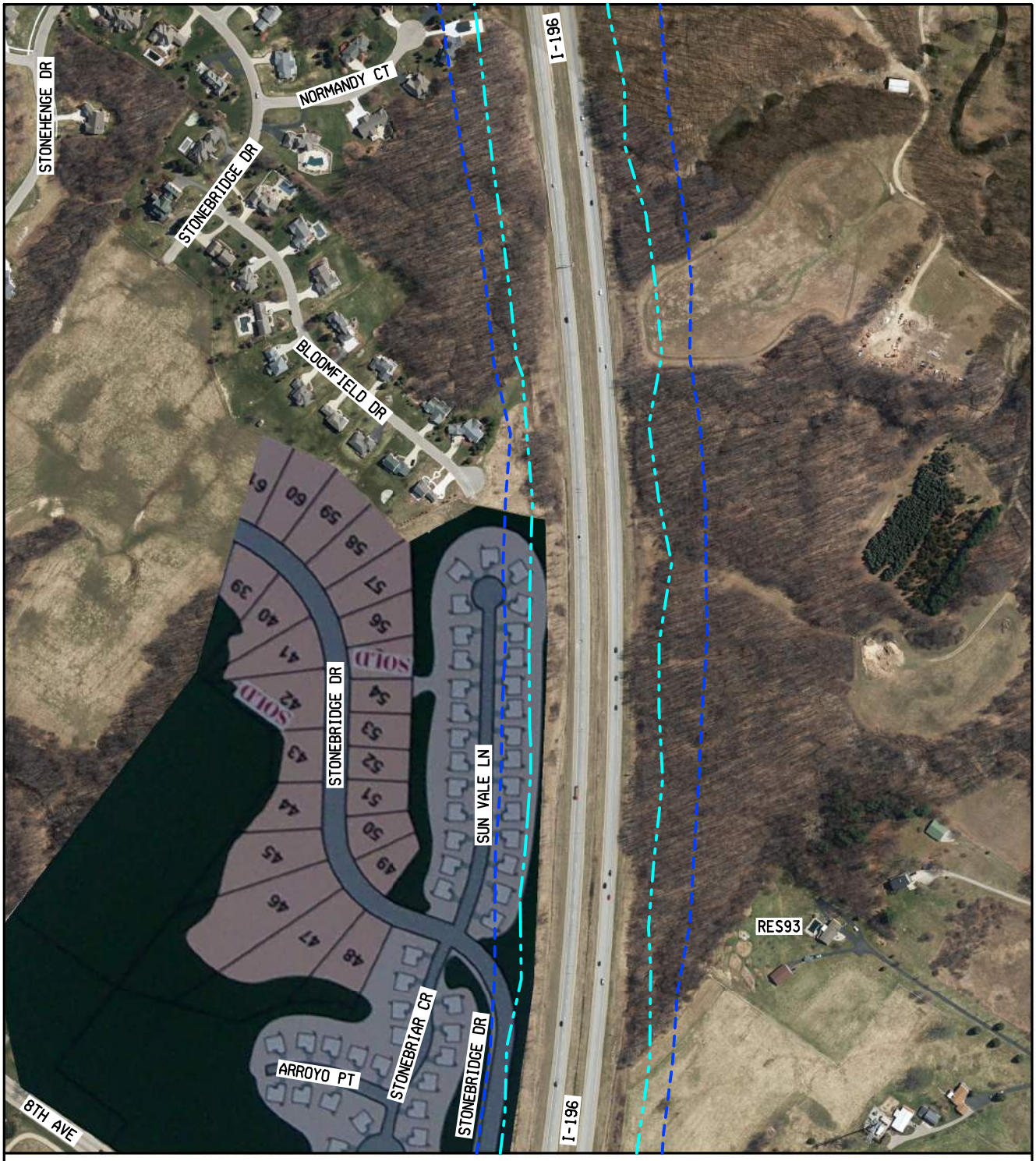
71 dB(A) Leq Setback (2039)

N

0 75 150 300 450 600

Figure 16

Noise Contours
At 8th Ave



Legend

66 dB(A) Leq Setback (2039)

71 dB(A) Leq Setback (2039)

N

0 75 150 300 450 600

Figure 17

Noise Contours
East of 8th Ave

Legend

66 dB(A) Leq Setback (2039)

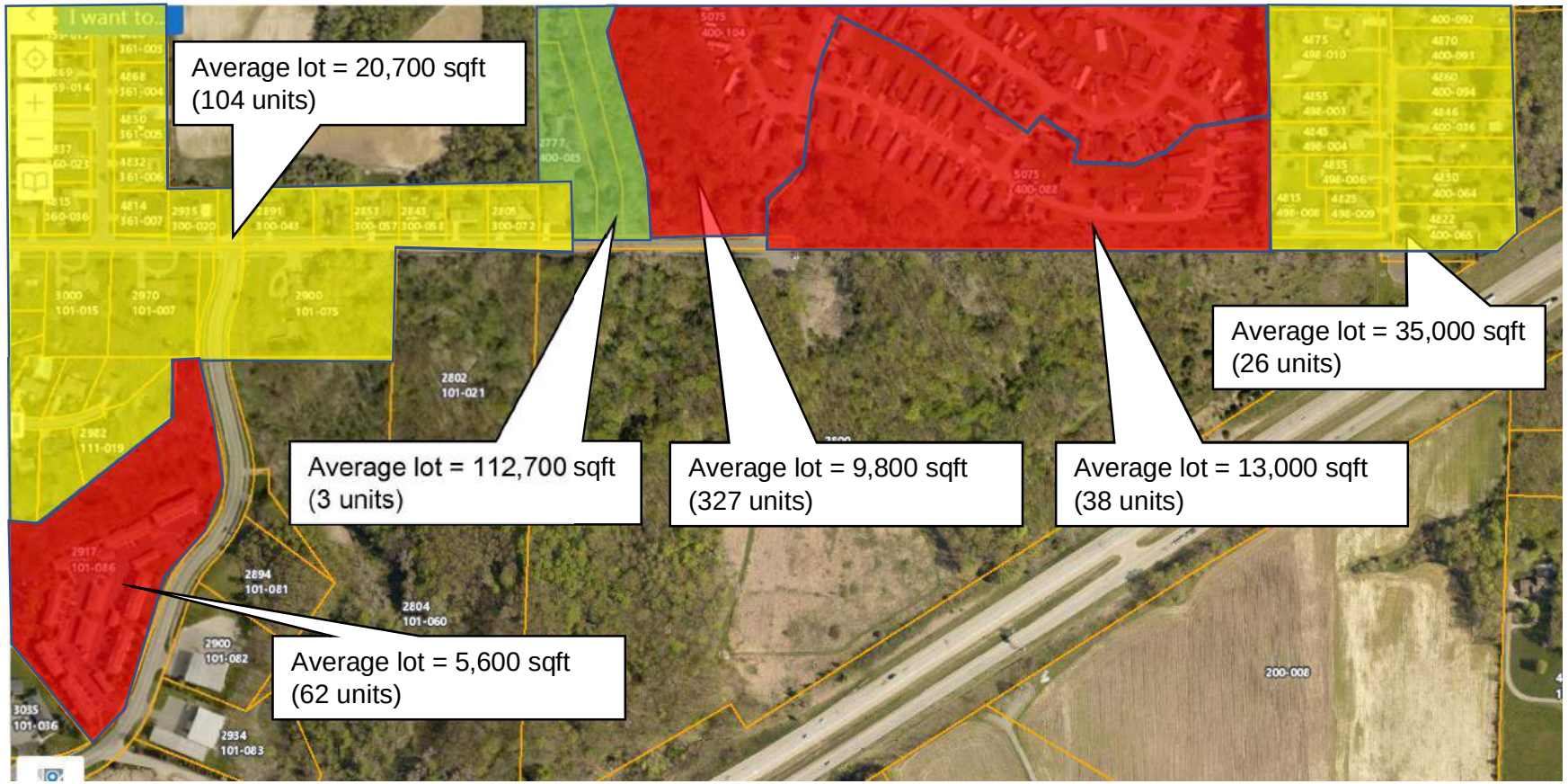
71 dB(A) Leq Setback (2039)

N

0 75 150 300 450 600

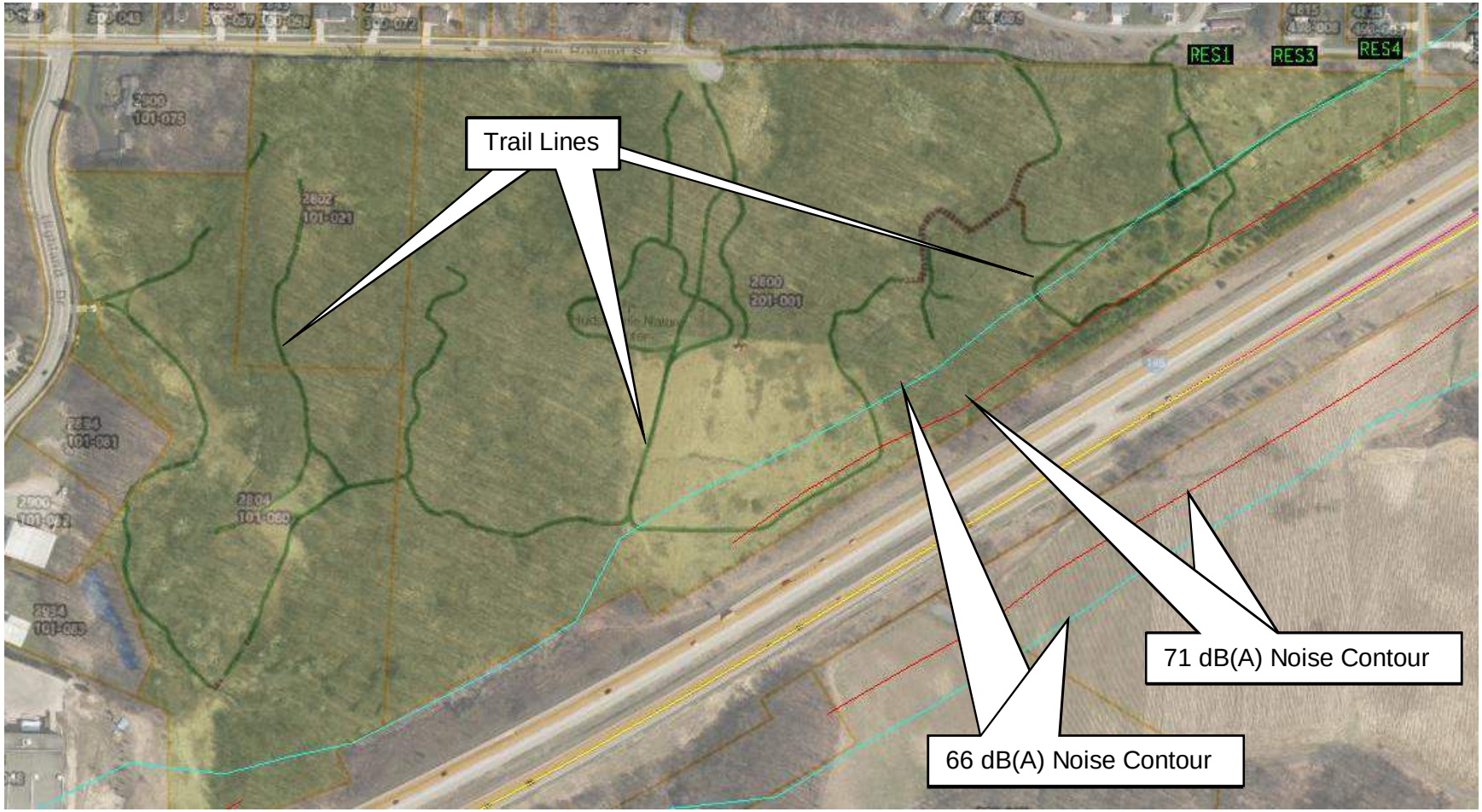
Figure 18

Noise Contours
West of Kenowa Ave



Average lot size = (20700*104+112700*3+9800*327+13000*38+35000*26+5600*62) / (104+3+327+38+26+62)

= 13,300 sqft



Length of trail within the future 66 dB(A) noise contour	=	2,116 ft					
Average trail width	=	10 ft					
Noise impacted area	=	21,160 sqft					
Dwelling unit equivalent	=	Noise impacted area/ Average lot size	=	21,160 / 13,300	=	1.59 units	
	=	2 units (rounded up)					

Appendix D
Loudest Hour Noise Level

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))		
					Existing (2019) [1]	Build (2039) [1]	Change
CNE A							
Com02 (3320 HUDSON TRAILS DR)	Commercial	E	1	72	57	58	1
CNE B							
N/A							
CNE C							
Com01 (3330 HIGHLAND DR)	Commercial	E	1	72	58	58	0
CNE D							
N/A							
CNE E							
RES77 (4615 22ND AVE)	Residential	B	1	67	61	61	0
RE04 (4721 22ND AVE)	Residential	B	1	67	59	59	0
RES78 (2264 JACKSON ST)	Residential	B	1	67	63	63	0
RES79 (4745 22ND AVE)	Residential	B	1	67	58	59	1
RES80 (4775 22ND AVE)	Residential	B	1	67	61	62	1
RES81 (2225 JACKSON ST)	Residential	B	1	67	**66**	**67**	1
RES82 (4796 22ND AVE)	Residential	B	1	67	60	61	1
RES83 (2169 JACKSON ST)	Residential	B	1	67	65	65	0
RES84 (2117 JACKSON ST)	Residential	B	1	67	61	62	1
RE05 (2025 JACKSON ST)	Residential	B	1	67	58	58	0
RES85 (4906 CABINRIDGE CT)	Residential	B	1	67	**66**	**66**	0
RES86 (2025 JACKSON ST)	Residential	B	1	67	57	57	0

1. Noise levels approaching or exceeding NAC levels are (**bold / highlighted**).
2. Addresses obtained from the Ottawa County GIS database or plans from the future building site developer.

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))		
					Existing (2019) [1]	Build (2039) [1]	Change
CNE F							
RES1 (Harrison Ave)	Residential	B	1	67	59	59	0
RES2 (Harrison Ave)	Residential	B	1	67	59	59	0
RES3 (4815 24TH AVE)	Residential	B	1	67	61	61	0
RES4 (4825 24TH AVE)	Residential	B	1	67	62	62	0
RES5 (4835 24TH AVE)	Residential	B	1	67	59	60	1
RES6 (4845 24TH AVE)	Residential	B	1	67	58	59	1
RES7 (4855 24TH AVE)	Residential	B	1	67	57	58	1
RES8 (4860 24TH AVE)	Residential	B	1	67	60	61	1
RES9 (4846 24TH AVE)	Residential	B	1	67	62	63	1
RES10 (4844 24TH AVE)	Residential	B	1	67	63	63	0
RES11 (4830 24TH AVE)	Residential	B	1	67	65	65	0
RES12 (4822 24TH AVE)	Residential	B	1	67	**67**	**68**	1
RES13 (2370 BARRY ST)	Residential	B	1	67	60	60	0
RE06 (2366 BARRY ST)	Residential	B	1	67	61	61	0
RES14 (2358 BARRY ST)	Residential	B	1	67	62	62	0
RES15 (2250 BARRY ST)	Residential	B	1	67	63	64	1
RES16 (4969 22ND AVE)	Residential	B	1	67	64	65	1
RES17 (4941 22ND AVE)	Residential	B	1	67	**68**	**68**	0
RES18 (2196 BARRY ST)	Residential	B	1	67	65	65	0
RES19 (2190 BARRY ST)	Residential	B	1	67	63	63	0
RES20 (2185 BARRY ST)	Residential	B	1	67	63	63	0
RE07 (2191 BARRY ST)	Residential	B	1	67	63	63	0
RES21 (2020 BARRY ST)	Residential	B	1	67	60	60	0
RES22 (2091 BARRY ST)	Residential	B	1	67	62	62	0

1. Noise levels approaching or exceeding NAC levels are (**bold / highlighted**).
2. Addresses obtained from the Ottawa County GIS database or plans from the future building site developer

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))		
					Existing (2019) [1]	Build (2039) [1]	Change
CNE F							
RES23 (2080 BARRY ST)	Residential	B	1	67	60	60	0
RES24 (5112 20TH AVE)	Residential	B	1	67	62	63	1
RES25 (5132 20TH AVE)	Residential	B	1	67	60	60	0
RES26 (1910 BARRY ST)	Residential	B	1	67	62	63	1
Park01 (2800 NEW HOLLAND ST)	Park	C	1	67	**70**	**70**	0
Park02 (2800 NEW HOLLAND ST)	Park	C	1	67	**70**	**70**	0
CNE G							
RES27 (1814 BARRY ST)	Residential	B	1	67	59	59	0
RES28 (1794 BARRY ST)	Residential	B	1	67	64	65	1
RES29 (1709 BARRY ST)	Residential	B	1	67	59	59	0
RES30 (1681 BARRY ST)	Residential	B	1	67	59	59	0
RES31 (1665 BARRY ST)	Residential	B	1	67	60	60	0
RES32 (1651 BARRY ST)	Residential	B	1	67	61	62	1
RES33 (1645 BARRY ST)	Residential	B	1	67	61	62	1
RES34 (5256 16TH AVE)	Residential	B	1	67	59	60	1
RES35 (5238 16TH AVE)	Residential	B	1	67	61	61	0
RES36 (5210 16TH AVE)	Residential	B	1	67	63	63	0
RES37 (1622 BARRY ST)	Residential	B	1	67	**66**	**66**	0
RES38 (1634 BARRY ST)	Residential	B	1	67	**67**	**67**	0
RES39 (1650 BARRY ST)	Residential	B	1	67	**66**	**66**	0
RES40 (1706 BARRY ST)	Residential	B	1	67	**67**	**67**	0
RES41 (1680 BARRY ST)	Residential	B	1	67	65	65	0
RES42 (1540 MCCLELLAND ST)	Residential	B	1	67	58	59	1

1. Noise levels approaching or exceeding NAC levels are (**bold / highlighted**).
2. Addresses obtained from the Ottawa County GIS database or plans from the future building site developer

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))		
					Existing (2019) [1]	Build (2039) [1]	Change
CNE H							
RES87 (5111 12TH AVE)	Residential	B	1	67	61	62	1
RES88 (5175 12TH AVE)	Residential	B	1	67	**74**	**75**	1
RES89 (5188 12TH AVE)	Residential	B	1	67	**72**	**73**	1
RES90 (5095 12TH AVE)	Residential	B	1	67	59	59	0
RES91 (5120 12TH AVE)	Residential	B	1	67	58	59	1
RES92 (5151 8TH AVE)	Residential	B	1	67	59	60	1
CNE I							
RE01 (5224 12TH AVE)	Residential	B	1	67	64	65	1
RE02 (1140 MCCLELLAND ST)	Residential	B	1	67	58	58	0
RES43 (1154 MCCLELLAND ST)	Residential	B	1	67	61	61	0
RES44 (1120 MCCLELLAND ST)	Residential	B	1	67	65	65	0
RES45 (1000 MCCLELLAND ST)	Residential	B	1	67	62	62	0
RES46 (994 MCCLELLAND ST)	Residential	B	1	67	62	63	1
RES47 (830 MCCLELLAND ST)	Residential	B	1	67	65	65	0
CNE J							
F01 (5624 STONEBRIDGE DR)	Residential	B	1	67	56	56	0
F02 (5618 STONEBRIDGE DR)	Residential	B	1	67	54	55	1
F03 (5610 STONEBRIDGE DR)	Residential	B	1	67	54	54	0
F04 (5596 STONEBRIDGE DR)	Residential	B	1	67	53	54	1
F05 (5590 STONEBRIDGE DR)	Residential	B	1	67	54	54	0
F06 (5584 STONEBRIDGE DR)	Residential	B	1	67	54	54	0
F07 (5578 STONEBRIDGE DR)	Residential	B	1	67	54	55	1
F08 (5562 STONEBRIDGE DR)	Residential	B	1	67	56	56	0
F09 (5544 STONEBRIDGE DR)	Residential	B	1	67	56	57	1
F10 (5531 STONEBRIDGE DR)	Residential	B	1	67	56	56	0

1. Noise levels approaching or exceeding NAC levels are (**bold / highlighted**).
2. Addresses obtained from the Ottawa County GIS database or plans from the future building site developer

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))		
					Existing (2019) [1]	Build (2039) [1]	Change
CNE J							
F11 (STONEBRIAR CR UNIT 1)	Residential	B	1	67	57	58	1
F12 (STONEBRIAR CR UNIT 2)	Residential	B	1	67	57	58	1
F13 (STONEBRIAR CR UNIT 3)	Residential	B	1	67	57	58	1
F14 (STONEBRIAR CR UNIT 4)	Residential	B	1	67	58	59	1
F15 (STONEBRIAR CR UNIT 5)	Residential	B	1	67	59	59	0
F16 (ARROYO PT UNIT 6)	Residential	B	1	67	58	58	0
F17 (ARROYO PT UNIT 7)	Residential	B	1	67	56	57	1
F18 (ARROYO PT UNIT 8)	Residential	B	1	67	55	56	1
F19 (ARROYO PT UNIT 9)	Residential	B	1	67	54	54	0
F20 (ARROYO PT UNIT 10)	Residential	B	1	67	56	56	0
F21 (ARROYO PT UNIT 11)	Residential	B	1	67	55	55	0
F22 (ARROYO PT UNIT 12)	Residential	B	1	67	56	57	1
F23 (STONEBRIAR CR UNIT 13)	Residential	B	1	67	57	58	1
F24 (STONEBRIAR CR UNIT 14)	Residential	B	1	67	57	57	0
F25 (STONEBRIAR CR UNIT 15)	Residential	B	1	67	57	57	0
F26 (STONEBRIAR CR UNIT 16)	Residential	B	1	67	57	58	1
F27 (STONEBRIAR CR UNIT 17)	Residential	B	1	67	60	60	0
F28 (STONEBRIAR CR UNIT 18)	Residential	B	1	67	62	63	1
F29 (STONEBRIAR CR UNIT 19)	Residential	B	1	67	63	63	0
F30 (STONEBRIAR CR UNIT 20)	Residential	B	1	67	62	63	1
F31 (STONEBRIAR CR UNIT 21)	Residential	B	1	67	62	62	0
F32 (STONEBRIAR CR UNIT 22)	Residential	B	1	67	62	63	1
F33 (STONEBRIAR CR UNIT 23)	Residential	B	1	67	63	64	1

1. Noise levels approaching or exceeding NAC levels are (bold / highlighted).
2. Addresses obtained from the Ottawa County GIS database or plans from the future building site developer

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))		
					Existing (2019) [1]	Build (2039) [1]	Change
CNE J							
F34 (STONEBRIAR CR UNIT 24)	Residential	B	1	67	64	64	0
F35 (STONEBRIAR CR UNIT 25)	Residential	B	1	67	64	64	0
F36 (STONEBRIAR CR UNIT 26)	Residential	B	1	67	63	64	1
F37 (SUN VALE LN UNIT 1)	Residential	B	1	67	57	58	1
F38 (SUN VALE LN UNIT 2)	Residential	B	1	67	57	58	1
F39 (SUN VALE LN UNIT 3)	Residential	B	1	67	57	57	0
F40 (SUN VALE LN UNIT 4)	Residential	B	1	67	57	57	0
F41 (SUN VALE LN UNIT 5)	Residential	B	1	67	56	57	1
F42 (SUN VALE LN UNIT 6)	Residential	B	1	67	57	57	0
F43 (SUN VALE LN UNIT 7)	Residential	B	1	67	56	56	0
F44 (SUN VALE LN UNIT 8)	Residential	B	1	67	56	56	0
F45 (SUN VALE LN UNIT 9)	Residential	B	1	67	56	56	0
F46 (SUN VALE LN UNIT 10)	Residential	B	1	67	56	56	0
F47 (SUN VALE LN UNIT 11)	Residential	B	1	67	56	57	1
F48 (SUN VALE LN UNIT 12)	Residential	B	1	67	57	57	0
F49 (SUN VALE LN UNIT 13)	Residential	B	1	67	60	60	0
F50 (SUN VALE LN UNIT 14)	Residential	B	1	67	**67**	**68**	1
F51 (SUN VALE LN UNIT 15)	Residential	B	1	67	**70**	**71**	1
F52 (SUN VALE LN UNIT 16)	Residential	B	1	67	**70**	**71**	1
F53 (SUN VALE LN UNIT 17)	Residential	B	1	67	**70**	**71**	1
F54 (SUN VALE LN UNIT 18)	Residential	B	1	67	**69**	**70**	1
F55 (SUN VALE LN UNIT 19)	Residential	B	1	67	**69**	**69**	0
F56 (SUN VALE LN UNIT 20)	Residential	B	1	67	**69**	**69**	0
F57 (SUN VALE LN UNIT 21)	Residential	B	1	67	**68**	**68**	1
F58 (SUN VALE LN UNIT 22)	Residential	B	1	67	**68**	**68**	1

1. Noise levels approaching or exceeding NAC levels are (**bold / highlighted**).
2. Addresses obtained from the Ottawa County GIS database or plans from the future building site developer

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))		
					Existing (2019) [1]	Build (2039) [1]	Change
CNE J							
F59 (SUN VALE LN UNIT 23)	Residential	B	1	67	67	67	0
F60 (SUN VALE LN UNIT 24)	Residential	B	1	67	67	67	0
F61 (SUN VALE LN UNIT 25)	Residential	B	1	67	68	68	0
F62 (SUN VALE LN UNIT 26)	Residential	B	1	67	70	70	0
F63 (SUN VALE LN UNIT 27)	Residential	B	1	67	69	69	0
F64 (SUN VALE LN UNIT 28)	Residential	B	1	67	64	65	1
RES48 (5622 BLOOMFIELD DR)	Residential	B	1	67	64	65	1
RES49 (5625 BLOOMFIELD DR)	Residential	B	1	67	61	61	0
RES50 (5643 BLOOMFIELD DR)	Residential	B	1	67	59	60	1
RES51 (5644 BLOOMFIELD DR)	Residential	B	1	67	62	63	1
RES52 (5657 BLOOMFIELD DR)	Residential	B	1	67	58	58	0
RES53 (5666 BLOOMFIELD DR)	Residential	B	1	67	59	59	0
RES54 (5692 BLOOMFIELD DR)	Residential	B	1	67	57	58	1
RES55 (356 NORMANDY CT)	Residential	B	1	67	60	60	0
RES56 (336 NORMANDY CT)	Residential	B	1	67	63	63	0
RES57 (318 NORMANDY CT)	Residential	B	1	67	69	70	1
RES58 (301 NORMANDY CT)	Residential	B	1	67	66	67	1
RES59 (317 NORMANDY CT)	Residential	B	1	67	60	61	1
RES60 (341 NORMANDY CT)	Residential	B	1	67	58	59	1
RES61 (326 COVINGTON CT)	Residential	B	1	67	57	58	1
RES62 (304 COVINGTON CT)	Residential	B	1	67	59	59	0
RES63 (284 COVINGTON CT)	Residential	B	1	67	60	60	0
RES64 (262 COVINGTON CT)	Residential	B	1	67	62	62	0
RES65 (244 COVINGTON CT)	Residential	B	1	67	67	68	1
RES66 (237 COVINGTON CT)	Residential	B	1	67	65	65	0

1. Noise levels approaching or exceeding NAC levels are (bold / highlighted).
2. Addresses obtained from the Ottawa County GIS database or plans from the future building site developer

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))		
					Existing (2019) [1]	Build (2039) [1]	Change
CNE J							
RES67 (241 COVINGTON CT)	Residential	B	1	67	59	60	1
RES68 (259 COVINGTON CT)	Residential	B	1	67	58	58	0
RE03 (283 COVINGTON CT)	Residential	B	1	67	57	57	0
RES69 (5905 KENSINGTON CT)	Residential	B	1	67	58	58	0
RES70 (5889 KENSINGTON CT)	Residential	B	1	67	62	62	0
RES71 (5892 KENSINGTON CT)	Residential	B	1	67	65	65	0
RES72 (5908 KENSINGTON CT)	Residential	B	1	67	60	61	1
RES73 (5930 KENSINGTON CT)	Residential	B	1	67	58	58	0
RES74 (6001 CORNERSTONE CT)	Residential	B	1	67	57	57	0
RES75 (6006 CORNERSTONE CT)	Residential	B	1	67	57	57	0
RES76 (6052 STONEHENGE CT)	Residential	B	1	67	53	54	1
CNE K							
RES93 (535 BARRY ST)	Residential	B	1	67	59	60	1
RES94 (5713 KENOWA AVE)	Residential	B	1	67	58	59	1
RES95 (5795 KENOWA AVE)	Residential	B	1	67	59	60	1
RES96 (5861 KENOWA AVE)	Residential	B	1	67	65	65	0

1. Noise levels approaching or exceeding NAC levels are (bold / highlighted).
2. Addresses obtained from the Ottawa County GIS database or plans from the future building site developer.

Appendix E
Benefitting Receivers

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))			
					Build (2039)	Noise Level w/ Barrier	Change	Benefiting Unit (Y/N)
CNE E								
RES80 (4775 22ND AVE)	Residential	B	1	67	62	61	-1	N
RES81 (2225 JACKSON ST)	Residential	B	1	67	67	66	-1	N
RES82 (4796 22ND AVE)	Residential	B	1	67	61	60	-1	N
RES83 (2169 JACKSON ST)	Residential	B	1	67	65	63	-2	N
RES84 (2117 JACKSON ST)	Residential	B	1	67	62	61	-1	N
RES85 (4906 CABINRIDGE CT)	Residential	B	1	67	66	63	-3	N
CNE F								
RES1 (Harrison Ave)	Residential	B	1	67	59	57	-2	N
RES2 (Harrison Ave)	Residential	B	1	67	59	56	-3	N
RES3 (4815 24TH AVE)	Residential	B	1	67	61	58	-3	N
RES4 (4825 24TH AVE)	Residential	B	1	67	62	59	-3	N
RES5 (4835 24TH AVE)	Residential	B	1	67	60	58	-2	N
RES6 (4845 24TH AVE)	Residential	B	1	67	59	57	-2	N
RES7 (4855 24TH AVE)	Residential	B	1	67	58	56	-2	N
RES8 (4860 24TH AVE)	Residential	B	1	67	61	59	-2	N
RES9 (4846 24TH AVE)	Residential	B	1	67	63	59	-4	N
RES10 (4844 24TH AVE)	Residential	B	1	67	63	60	-3	N
RES11 (4830 24TH AVE)	Residential	B	1	67	65	61	-4	N
RES12 (4822 24TH AVE)	Residential	B	1	67	68	62	-6	Y
Park01 (2800 NEW HOLLAND ST)	Park	C	1	67	70	60	-10	Y
Park02 (2800 NEW HOLLAND ST)	Park	C	1	67	70	63	-7	Y
RES14 (2358 BARRY ST)	Residential	B	1	67	62	61	-1	N
RES15 (2250 BARRY ST)	Residential	B	1	67	64	63	-1	N
RES16 (4969 22ND AVE)	Residential	B	1	67	65	64	-1	N
RES17 (4941 22ND AVE)	Residential	B	1	67	68	67	-1	N

1 Receiver Locations with a dB(A) reduction of 5 or greater are highlighted to denote the Benefitting Receiver.

2 Addresses obtained from the Ottawa County GIS database or plans from the future building site developer.

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))			
					Build (2039)	Noise Level w/ Barrier	Change	Benefiting Unit (Y/N)
CNE G								
RES28 (1794 BARRY ST)	Residential	B	1	67	65	64	-1	N
RES29 (1709 BARRY ST)	Residential	B	1	67	59	58	-1	N
RES30 (1681 BARRY ST)	Residential	B	1	67	59	58	-1	N
RES31 (1665 BARRY ST)	Residential	B	1	67	60	58	-2	N
RES32 (1651 BARRY ST)	Residential	B	1	67	61	59	-2	N
RES33 (1645 BARRY ST)	Residential	B	1	67	62	59	-3	N
RES34 (5256 16TH AVE)	Residential	B	1	67	60	60	0	N
RES35 (5238 16TH AVE)	Residential	B	1	67	61	61	0	N
RES36 (5210 16TH AVE)	Residential	B	1	67	63	62	-1	N
RES37 (1622 BARRY ST)	Residential	B	1	67	66	61	-5	Y
RES38 (1634 BARRY ST)	Residential	B	1	67	67	60	-7	Y
RES39 (1650 BARRY ST)	Residential	B	1	67	66	61	-5	Y
RES40 (1706 BARRY ST)	Residential	B	1	67	67	64	-3	N
RES41 (1680 BARRY ST)	Residential	B	1	67	65	62	-3	N
RES42 (1540 MCCLELLAND ST)	Residential	B	1	67	59	58	-1	N
CNE H								
RES88 (5175 12TH AVE)	Residential	B	1	67	75	65	-10	Y
RES89 (5188 12TH AVE)	Residential	B	1	67	73	64	-9	Y
RES91 (5120 12TH AVE)	Residential	B	1	67	59	58	-1	N

1 Receiver Locations with a dB(A) reduction of 5 or greater are highlighted to denote the Benefitting Receiver.

2 Addresses obtained from the Ottawa County GIS database or plans from the future building site developer.

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))			
					Build (2039)	Noise Level w/ Barrier	Change	Benefiting Unit (Y/N)
CNE J								
F07 (5578 STONEBRIDGE DR)	Residential	B	1	67	55	54	-1	N
F08 (5562 STONEBRIDGE DR)	Residential	B	1	67	56	55	-1	N
F09 (5544 STONEBRIDGE DR)	Residential	B	1	67	57	56	-1	N
F10 (5531 STONEBRIDGE DR)	Residential	B	1	67	56	55	-1	N
F11 (STONEBRIAR CR UNIT 1)	Residential	B	1	67	58	56	-2	N
F12 (STONEBRIAR CR UNIT 2)	Residential	B	1	67	58	56	-2	N
F13 (STONEBRIAR CR UNIT 3)	Residential	B	1	67	58	57	-1	N
F14 (STONEBRIAR CR UNIT 4)	Residential	B	1	67	59	58	-1	N
F16 (ARROYO PT UNIT 6)	Residential	B	1	67	58	57	-1	N
F17 (ARROYO PT UNIT 7)	Residential	B	1	67	57	56	-1	N
F18 (ARROYO PT UNIT 8)	Residential	B	1	67	56	55	-1	N
F20 (ARROYO PT UNIT 10)	Residential	B	1	67	56	55	-1	N
F22 (ARROYO PT UNIT 12)	Residential	B	1	67	57	56	-1	N
F23 (STONEBRIAR CR UNIT 13)	Residential	B	1	67	58	57	-1	N
F26 (STONEBRIAR CR UNIT 16)	Residential	B	1	67	58	57	-1	N
F32 (STONEBRIAR CR UNIT 22)	Residential	B	1	67	63	62	-1	N
F33 (STONEBRIAR CR UNIT 23)	Residential	B	1	67	64	63	-1	N
F34 (STONEBRIAR CR UNIT 24)	Residential	B	1	67	64	63	-1	N
F35 (STONEBRIAR CR UNIT 25)	Residential	B	1	67	64	63	-1	Y
F36 (STONEBRIAR CR UNIT 26)	Residential	B	1	67	64	62	-2	N
F37 (SUN VALE LN UNIT 1)	Residential	B	1	67	58	56	-2	N
F38 (SUN VALE LN UNIT 2)	Residential	B	1	67	58	56	-2	Y
F39 (SUN VALE LN UNIT 3)	Residential	B	1	67	57	55	-2	Y
F40 (SUN VALE LN UNIT 4)	Residential	B	1	67	57	55	-2	N
F41 (SUN VALE LN UNIT 5)	Residential	B	1	67	57	54	-3	Y
F42 (SUN VALE LN UNIT 6)	Residential	B	1	67	57	54	-3	Y

1 Receiver Locations with a dB(A) reduction of 5 or greater are highlighted to denote the Benefitting Receiver.
2 Addresses obtained from the Ottawa County GIS database or plans from the future building site developer.

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))			
					Build (2039)	Noise Level w/ Barrier	Change	Benefiting Unit (Y/N)
CNE J								
F43 (SUN VALE LN UNIT 7)	Residential	B	1	67	56	55	-1	N
F44 (SUN VALE LN UNIT 8)	Residential	B	1	67	56	54	-2	Y
F45 (SUN VALE LN UNIT 9)	Residential	B	1	67	56	55	-1	N
F46 (SUN VALE LN UNIT 10)	Residential	B	1	67	56	55	-1	N
F47 (SUN VALE LN UNIT 11)	Residential	B	1	67	57	55	-2	N
F48 (SUN VALE LN UNIT 12)	Residential	B	1	67	57	56	-1	N
F49 (SUN VALE LN UNIT 13)	Residential	B	1	67	60	59	-1	N
F50 (SUN VALE LN UNIT 14)	Residential	B	1	67	68	62	-6	Y
F51 (SUN VALE LN UNIT 15)	Residential	B	1	67	71	62	-9	Y
F52 (SUN VALE LN UNIT 16)	Residential	B	1	67	71	62	-9	Y
F53 (SUN VALE LN UNIT 17)	Residential	B	1	67	71	61	-10	Y
F54 (SUN VALE LN UNIT 18)	Residential	B	1	67	70	61	-9	Y
F55 (SUN VALE LN UNIT 19)	Residential	B	1	67	69	60	-9	Y
F56 (SUN VALE LN UNIT 20)	Residential	B	1	67	69	61	-8	Y
F57 (SUN VALE LN UNIT 21)	Residential	B	1	67	68	61	-7	Y
F58 (SUN VALE LN UNIT 22)	Residential	B	1	67	68	62	-6	Y
F59 (SUN VALE LN UNIT 23)	Residential	B	1	67	67	62	-5	Y
F60 (SUN VALE LN UNIT 24)	Residential	B	1	67	67	62	-5	Y
F61 (SUN VALE LN UNIT 25)	Residential	B	1	67	68	63	-5	Y
F62 (SUN VALE LN UNIT 26)	Residential	B	1	67	70	64	-6	Y
F63 (SUN VALE LN UNIT 27)	Residential	B	1	67	69	64	-5	Y
F64 (SUN VALE LN UNIT 28)	Residential	B	1	67	65	63	-2	N
RES54 (5692 BLOOMFIELD DR)	Residential	B	1	67	58	57	-1	N
RES55 (356 NORMANDY CT)	Residential	B	1	67	60	57	-3	N
RES56 (336 NORMANDY CT)	Residential	B	1	67	63	58	-5	Y
RES57 (318 NORMANDY CT)	Residential	B	1	67	70	60	-10	Y

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2 Addresses obtained from the Ottawa County GIS database or plans from the future building site developer.

Receiver Location (Address[2])	Land Use	Activity Category	Units	FHWA/ MDOT NAC	Noise Levels, L_{eq} (1h) (dB(A))			
					Build (2039)	Noise Level w/ Barrier	Change	Benefiting Unit (Y/N)
CNE J								
RES58 (301 NORMANDY CT)	Residential	B	1	67	67	59	-8	Y
RES59 (317 NORMANDY CT)	Residential	B	1	67	61	56	-5	Y
RES60 (341 NORMANDY CT)	Residential	B	1	67	59	55	-4	N
RES61 (326 COVINGTON CT)	Residential	B	1	67	58	54	-4	N
RES62 (304 COVINGTON CT)	Residential	B	1	67	59	55	-4	N
RES63 (284 COVINGTON CT)	Residential	B	1	67	60	56	-4	N
RES64 (262 COVINGTON CT)	Residential	B	1	67	61	57	-4	N
RES65 (244 COVINGTON CT)	Residential	B	1	67	68	61	-7	Y
RES66 (237 COVINGTON CT)	Residential	B	1	67	65	62	-3	N
RES67 (241 COVINGTON CT)	Residential	B	1	67	59	57	-2	N
RES68 (259 COVINGTON CT)	Residential	B	1	67	57	55	-2	N
RES70 (5889 KENSINGTON CT)	Residential	B	1	67	62	61	-1	N
RES72 (5908 KENSINGTON CT)	Residential	B	1	67	61	60	-1	N

1 Receiver Locations with a dB(A) reduction of 5 or greater are highlighted to denote the Benefitting Receiver.

2 Addresses obtained from the Ottawa County GIS database or plans from the future building site developer.

Appendix F
Weather Information

(/)

Search Locations

Log in (/log...

★ (/member/favorites)

Recent Cities
Hudsonville, MI (/weather/us/mi/hudsonville/42.87,-85.87)

Elev **794**ft **42.88** °N, **85.52** °W

Gerald R. Ford International, MI ★

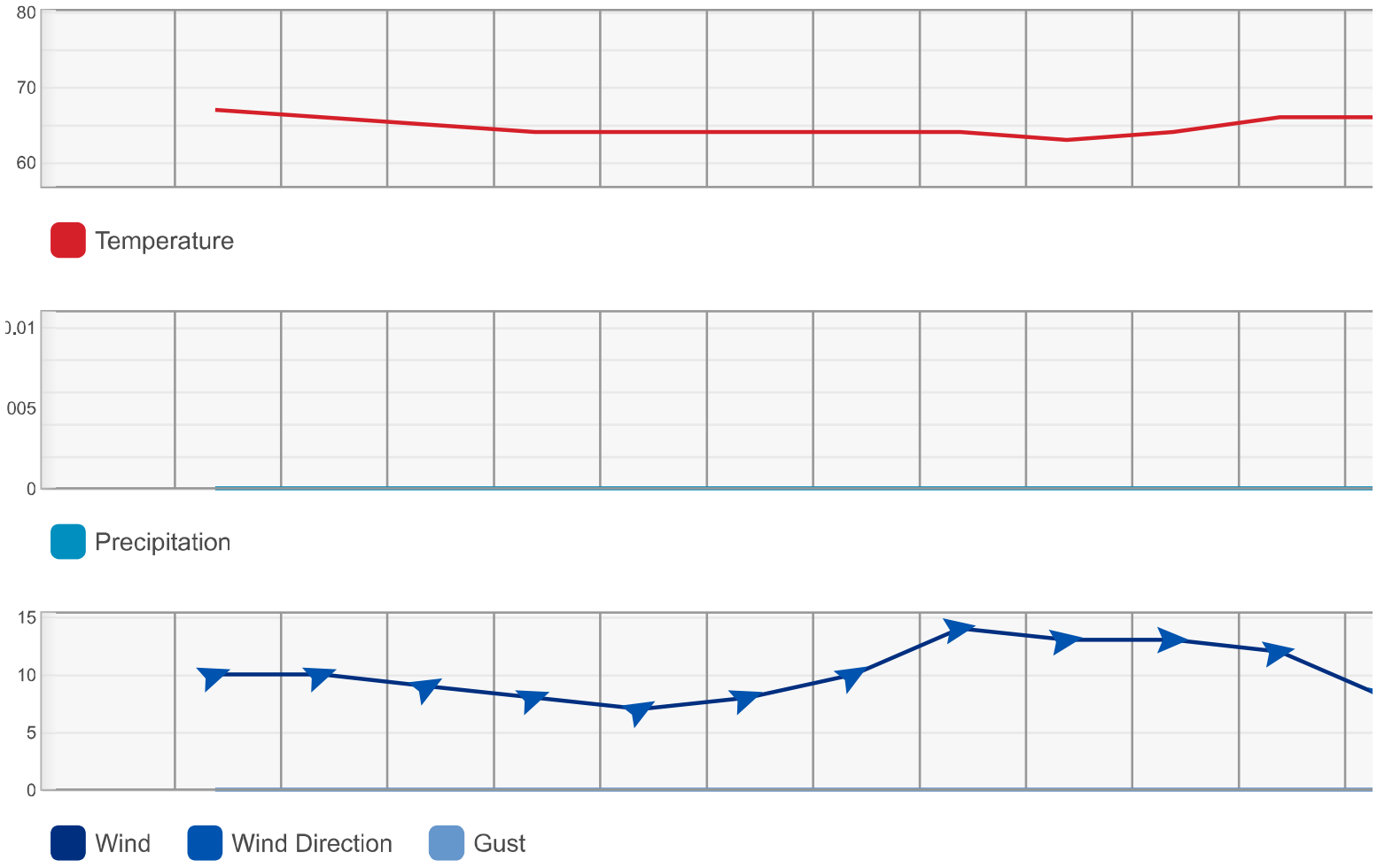
69° GERALD R. FORD INTERNATIONAL STATION (/HISTORY/DAILY/US/MI/GRAND-RAPIDS/KGRR/DATE/2018-7-20?CM_VEN=LOCALWX_PWSDASH) | CHANGE

HISTORY (/HISTORY/DAILY/US/MI/GRAND-RAPIDS/KGRR/DATE/2018-7-20)

- TODAY (/WEATHER/US/MI/CALEDONIA/KMICALED31)
- HOURLY (/HOURLY/US/MI/CALEDONIA/KMICALED31)
- 10-DAY (/FORECAST/US/MI/CALEDONIA/KMICALED31)
- CALENDAR (/CALENDAR/US/MI/GRAND-RAPIDS/KGRR/DATE/2018-7)
- HISTORY (/HISTORY/DAILY/US/MI/GRAND-RAPIDS/KGRR/DATE/2018-7-20)
- WUNDERMAP (/WUNDERMAP?LAT=42.88083267&LON=-85.52278137)

Daily | Weekly | Monthly

June | 20 | 2018 | View



Summary

Temperature (° F)	Actual	Historic Avg.	Record
High Temp	74	81	102
Low Temp	62	59	41
Day Average Temp	68	70	-
Precipitation (Inches)	Actual	Historic Avg.	Record
Precipitation	0.01	0.12	1.84
Month to Date	2.04	2.55	-
Year to Date	18.74	16.13	-
Degree Days (° F)	Actual	Historic Avg.	Record

Temperature (° F)	Actual	Historic Avg.	Record
Heating Degree Days	0	1	-
HDD Month to Date	12	39	-
HDD Since July 1	6456	6479	-
Cooling Degree Days	3	6	-
CDD Month to Date	100	81	-
CDD Year to Date	208	128	-
Growing Degree Days	18	-	-

Dew Point (° F)	Actual	Historic Avg.	Record
Dew Point	60	-	-
High	62	-	-
Low	56	-	-
Average	60	-	-

Wind (MPH)	Actual	Historic Avg.	Record
Max Wind Speed	16	-	-
Visibility	10	-	-

Sea Level Pressure (Hg)	Actual	Historic Avg.	Record
Sea Level Pressure	29.92	-	-

Astronomy	Day Length	Rise	Set
Actual Time	15h 20m	6:04 AM	9:25 PM
Civil Twilight		5:29 AM	10:00 PM
Nautical Twilight		4:43 AM	10:46 PM
Astronomical Twilight		3:46 AM	11:43 PM
Moon: waxing gibbous		1:55 PM	2:00 AM

Daily Observations

Time	Temperature	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Precip Accum
12:53 PM	65 ° F	62 ° F	90 %	ENE	8 mph	0 mph	29.1 in	0.0 in	0.0 in
12:53 AM	67 ° F	60 ° F	79 %	ENE	10 mph	0 mph	29.1 in	0.0 in	0.0 in
2:53 AM	65 ° F	59 ° F	81 %	ENE	9 mph	0 mph	29.1 in	0.0 in	0.0 in
3:53 AM	64 ° F	58 ° F	80 %	ENE	8 mph	0 mph	29.1 in	0.0 in	0.0 in
4:53 AM	64 ° F	59 ° F	84 %	ENE	7 mph	0 mph	29.1 in	0.0 in	0.0 in
5:53 AM	64 ° F	58 ° F	80 %	ENE	8 mph	0 mph	29.1 in	0.0 in	0.0 in
6:53 AM	64 ° F	57 ° F	78 %	ENE	10 mph	0 mph	29.1 in	0.0 in	0.0 in
7:53 AM	64 ° F	56 ° F	75 %	E	14 mph	0 mph	29.1 in	0.0 in	0.0 in
8:53 AM	63 ° F	58 ° F	84 %	E	13 mph	0 mph	29.1 in	0.0 in	0.0 in
9:53 AM	64 ° F	59 ° F	84 %	E	13 mph	0 mph	29.1 in	0.0 in	0.0 in
10:53 AM	66 ° F	59 ° F	78 %	E	12 mph	0 mph	29.1 in	0.0 in	0.0 in
11:53 AM	66 ° F	59 ° F	78 %	E	8 mph	0 mph	29.1 in	0.0 in	0.0 in
12:27 PM	64 ° F	60 ° F	87 %	NE	12 mph	0 mph	29.1 in	0.0 in	0.0 in
1:53 AM	66 ° F	59 ° F	78 %	ENE	10 mph	0 mph	29.1 in	0.0 in	0.0 in
1:53 PM	68 ° F	60 ° F	76 %	E	9 mph	0 mph	29.1 in	0.0 in	0.0 in
2:53 PM	69 ° F	60 ° F	73 %	ENE	7 mph	0 mph	29.1 in	0.0 in	0.0 in
3:42 PM	70 ° F	60 ° F	71 %	E	8 mph	0 mph	29.0 in	0.0 in	0.0 in
3:53 PM	71 ° F	61 ° F	70 %	E	8 mph	0 mph	29.0 in	0.0 in	0.0 in
4:53 PM	73 ° F	61 ° F	66 %	VAR	7 mph	0 mph	29.0 in	0.0 in	0.0 in
5:53 PM	73 ° F	61 ° F	66 %	ENE	9 mph	0 mph	29.0 in	0.0 in	0.0 in
6:19 PM	73 ° F	61 ° F	66 %	E	7 mph	0 mph	29.0 in	0.0 in	0.0 in
6:53 PM	72 ° F	61 ° F	68 %	E	6 mph	0 mph	29.0 in	0.0 in	0.0 in
7:53 PM	72 ° F	61 ° F	68 %	E	6 mph	0 mph	29.0 in	0.0 in	0.0 in
8:53 PM	71 ° F	61 ° F	70 %	E	5 mph	0 mph	29.0 in	0.0 in	0.0 in
9:53 PM	70 ° F	61 ° F	73 %	E	3 mph	0 mph	29.0 in	0.0 in	0.0 in
10:53 PM	66 ° F	61 ° F	84 %	SE	3 mph	0 mph	29.0 in	0.0 in	0.0 in
11:53 PM	66 ° F	60 ° F	81 %	CALM	0 mph	0 mph	29.0 in	0.0 in	0.0 in

Our Apps (/download)

Weather API (/weather/api)

Full Screen Weather (/fullscreenweather)

Personal Weather Stations (/weatherstation/)

Site Map (/sitemap/)

Site Map (/sitemap/)

Terms of Use (/company/legal)

NEW Privacy Policy (/company/privacy-policy)

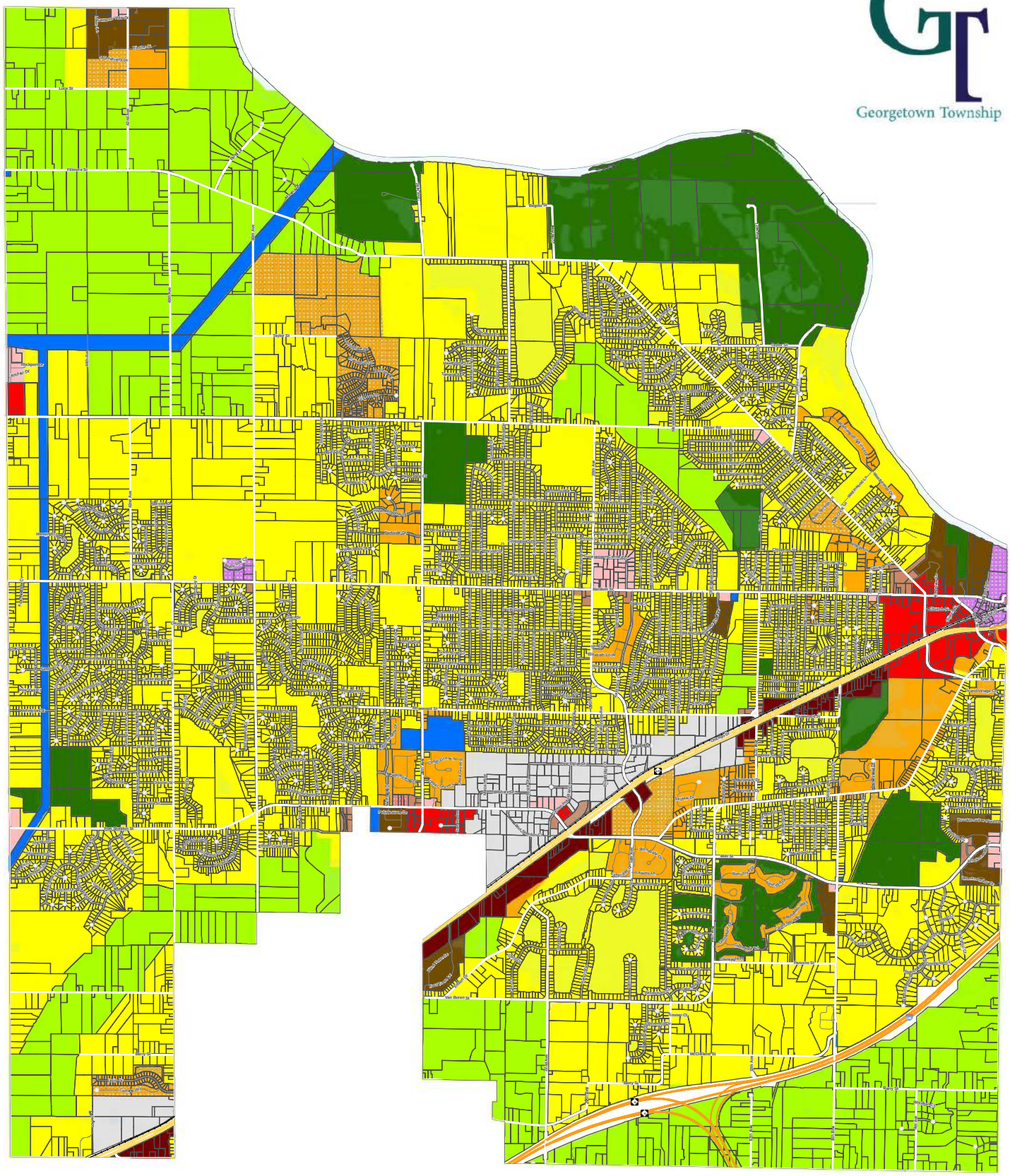
AdChoices (/company/ad-choices)

Data Rights (/privacy-settings)

Appendix G

Local Land Use Planning Information

- Georgetown Twp. Master Plan Map
- Jamestown Twp. Master Plan Map
- City of Hudsonville Master Plan Map



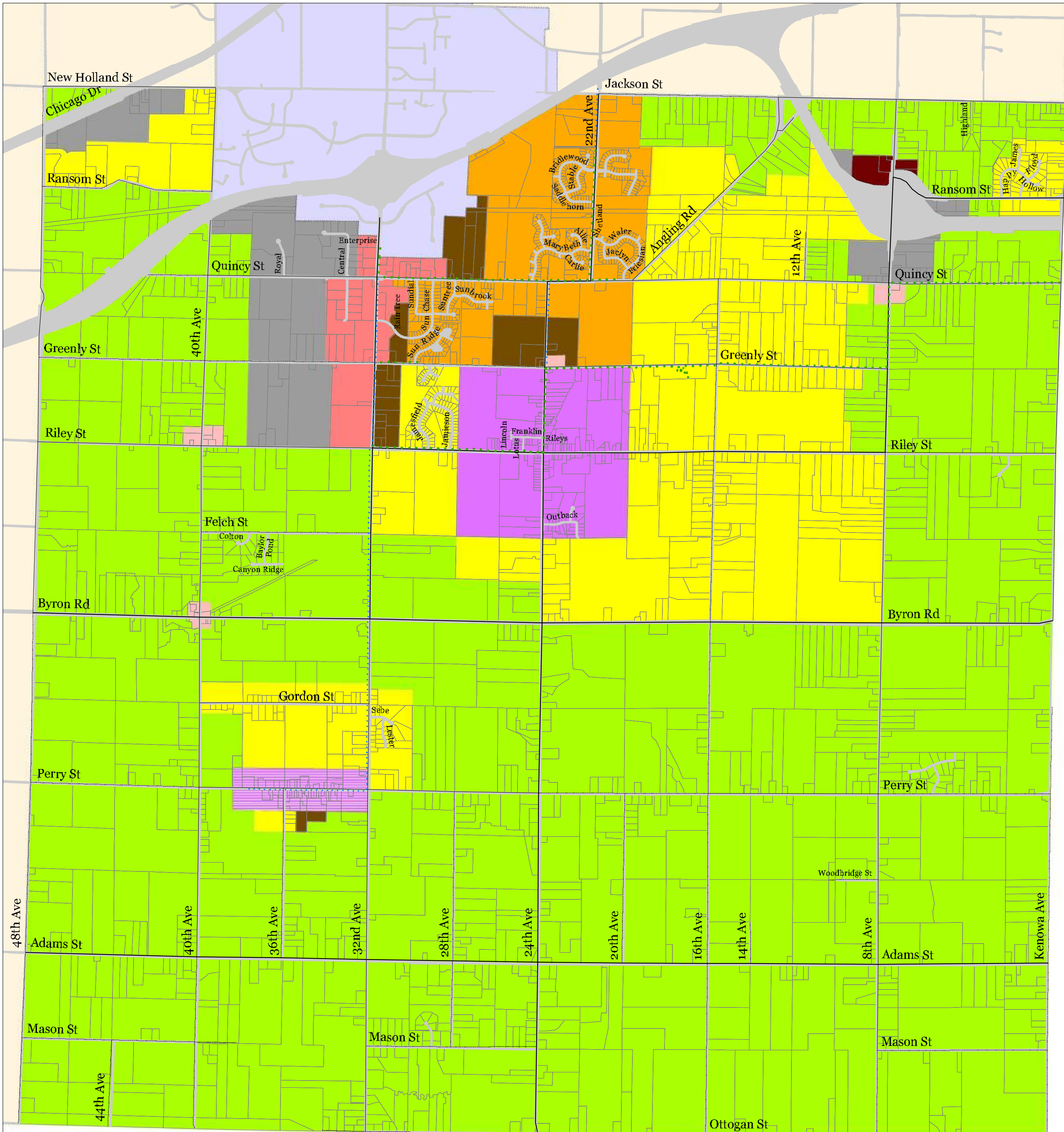
Georgetown Township
Future Land Use Map

November 23, 2015
1 inch = 1,000 feet

0 500 1,000 2,000 3,000 4,000 Feet

GIS Department
12220 Fillmore Street, Suite 320
West Olive, Michigan 49460

Phone (616)-738-4600
www.gis.miottawa.org



FUTURE LAND USE

Legend

- Existing Trail Network
- Future Trail Network
- Right of Way
- Parcels
- City
- Township

Master Plan

Standardized Class (Code)

- Rural/Agricultural Preservation (RAP)
- Low Density Residential (LDR A)
- Medium Density Residential (MDR A)
- High Density Residential (HDR A)
- Neighborhood Commercial (NC)
- Commercial (C)
- Highway Commercial (HC)
- Industrial (GI)
- Village of Jamestown (TC)
- Forest Grove (TC)

N
W
E
S

CHARTER TOWNSHIP OF

JAMESTOWN

Ottawa County, Michigan

Jamestown Charter Township
Established in 1849

Photography date: April 2008

GIS
IT Department
12220 Fillmore Street, Suite 320
West Olive, Michigan 49460

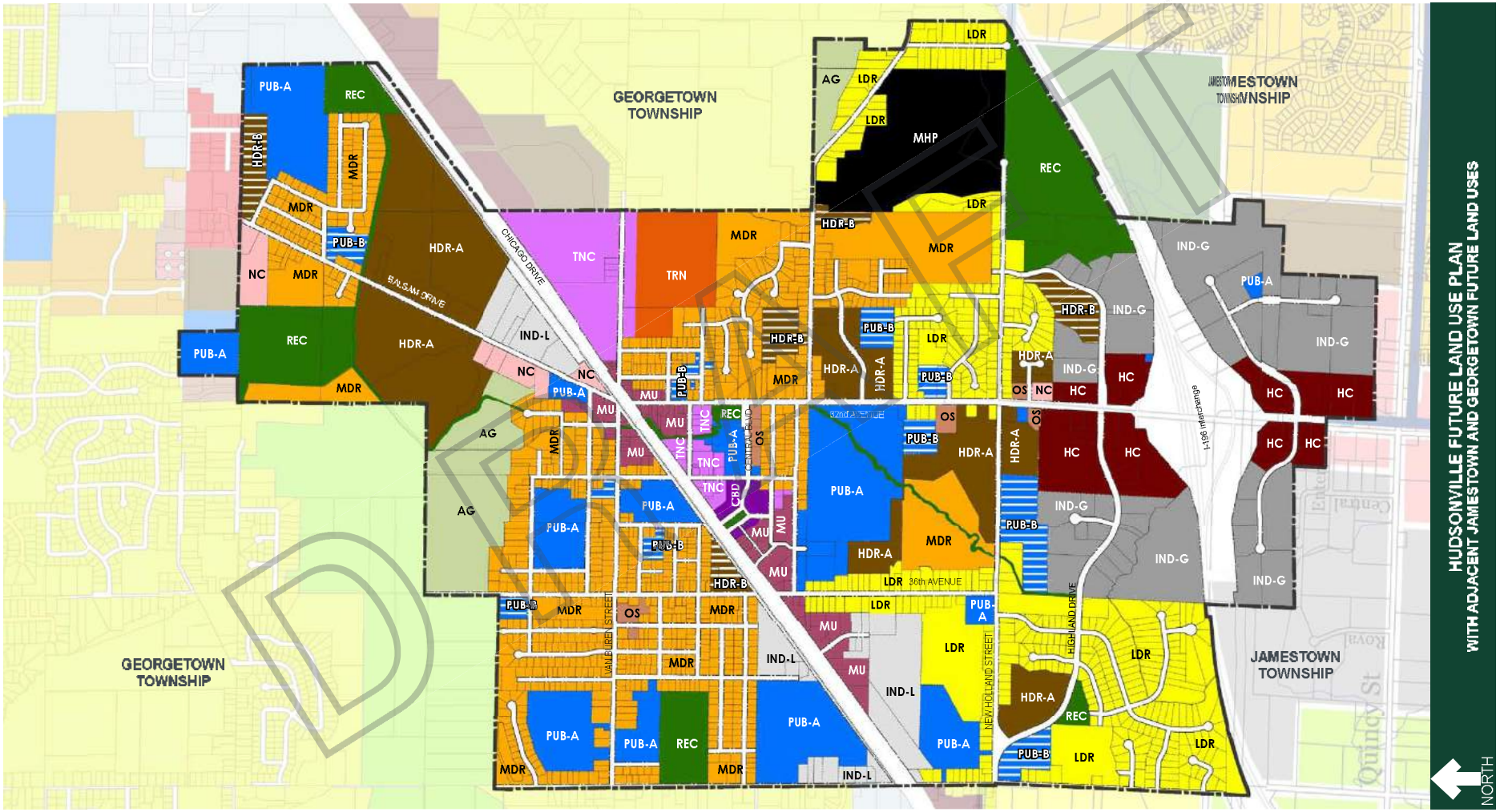
Phone (616) 738-4600
Fax (616) 738-4610
www.gis.miottawa.org

Date: 10/31/2014

Path: S:\Local_Unit_Projects\Jamestown\Masterplan42x54.mxd

PLAN SUMMARY

FUTURE LAND USE PLAN



PLAN SUMMARY

FUTURE LAND USE PLAN LEGEND AND LAND USE DESCRIPTIONS

AG

AGRICULTURAL
This future land use designation represents commercial agricultural land uses such as commercial farming, nurseries, and agricultural support businesses.

REC

PARKS, RECREATION, AND NATURAL AREAS
This future land use designation consists of publicly owned lands for parks, open space, and recreational areas, including the Hudsonville Nature Center.

PUB-A

PUBLIC / QUASI-PUBLIC A
This land use designation includes publicly owned lands designated for schools, public facilities, government uses and the Hudsonville Fair Grounds.

PUB-B

PUBLIC / QUASI-PUBLIC B
This land use designation includes quasi-public lands designated for churches and places of worship.

CBD

CENTRAL BUSINESS DISTRICT
This future land use designation represents the downtown core of Hudsonville, with the highest density of development, the tallest buildings, and a variety of land uses and employment opportunities. It promotes multi-story mixed-use buildings that contain commercial and residential uses, with an emphasis on sidewalk activation with street level retail and restaurants. Its small block structure promotes a walkable and connected network of streets and sidewalks and it has a public realm with wide sidewalks and buildings placed at the front property line in a zero setback condition.

MU

MIXED USE
This future land use designation encourages mixed-use and single story retail buildings that accommodate retail, office and residential uses. It promotes a mix of commercial and residential activities in a variety of forms and building types, although its development intensity is less than that of the Central Business District. Additionally this category may include rowhouses and apartments. Its public realm consists of a tight network of streets and blocks with wide sidewalks and buildings placed close to the street, although not always in a zero setback condition.

TNC

TOWN / NEIGHBORHOOD CENTER
This future land use category is also a mixed-use area and it has a dense, mixed-use urban fabric, that includes mixed-use building, retail structures, live-works, apartments, rowhouses and single-family homes. The intent of this district is to promote high-quality, sensibly-scaled buildings that promote walkable neighborhoods that are in close proximity to downtown. Additionally development is encouraged to use creative solutions and innovative building design to build density and livability that supports the downtown. Signature buildings in the form of civic structures and other building types is strongly encouraged. Building front setbacks are typically more varied than the Mixed Use A designation.

NC

NEIGHBORHOOD COMMERCIAL
This land use category represents a single-use designation that includes small scale retail and service businesses that meet the needs of Hudsonville at the local and neighborhood level. It intends to provide smaller scale economic development opportunities than those created in the downtown mixed use designations and in the highway commercial category.

HC

HIGHWAY COMMERCIAL
This land use category represents a single-use designation that includes commercial services for motorists and vehicular access such as hotels, banks, restaurants drive-throughs, and auto-service establishments. It intends to provide retail and service uses that promote regional access and economic development opportunities.

OS

OFFICE / SERVICE
This land use category represents a single-use designation that promotes low-intensity office and service uses including medical, financial, real estate, insurance, and other related offices and services. These uses may be within a pedestrian-oriented or vehicular-oriented environment, depending on the context of the surrounding neighborhoods.

HDR-A

HIGH DENSITY RESIDENTIAL A
This future land use designation is a single-use residential district that is intended to accommodate residential options for people of varying ages and income levels. This designation includes many areas that are almost fully developed and any new development or redevelopment would primarily consist of attached single-family dwelling units (townhouses) and single-family detached residential units. Varying densities may be appropriate depending on the availability of utilities. The current Zoning Districts for the areas included in this designation are primarily R-2 and R-3.

HDR-B

HIGH DENSITY RESIDENTIAL B
This future land use designation is a single-use residential district that is intended to accommodate high-density residential options for people of varying ages and income levels. This designation includes many areas that are almost fully developed and any new development or redevelopment would primarily consist of multiple-family dwelling units, in the form of attached single-family and apartment-style residential units. The current Zoning Districts for the areas included in this designation are primarily R-4.

TRN

TRADITIONAL RESIDENTIAL NEIGHBORHOOD
This land use category is a single-use residential district that is intended to promote compact development patterns in a walkable block structure with a grid pattern of narrow streets. Many areas in this designation have traditional homes with front porches on small lots. New development or redevelopment would primarily follow this pattern and include small front-yard setbacks and garages oriented to the rear of the lot. Rowhouses may also be included as development opportunities in this designation.

MDR

MEDIUM DENSITY RESIDENTIAL
This land use designation is established to provide a single-use residential district that accommodates single-family, detached residential development on medium-sized lots. This area is primarily suburban in character and has some of the City's newest housing and highest housing values. The current Zoning Districts for the areas included in this designation are R-1-A, R-1-B and R-1-C.

LDR

LOW DENSITY RESIDENTIAL
This land use designation is established to provide a single-use residential district that accommodates single-family, detached residential development on large lots. This area is primarily suburban in character and has some of the City's newest housing and highest housing values. The current Zoning Districts for the areas included in this designation are R-1-D and R-1-E.

MHP

MANUFACTURED HOME PARK
A land use category that is intended to provide areas in the City suitable for planned mobile or modular housing parks. Such developments are often designed to provide some accessory uses, such as clubhouse, pool, or laundry facilities.

IND-L

LIGHT INDUSTRIAL
This land use designation is intended to provide employment and economic development opportunities for area residents and light manufacturing of goods and services for the regional economy. The area is characterized by small scale light industrial and heavy commercial activities such as research and development, showrooms, warehousing, contractors, car repair, equipment rental, and incubator space.

IND-G

GENERAL INDUSTRIAL
This land use designation is intended to provide regional employment, manufacturing of goods and services to meet the needs of the larger West Michigan region. The area is characterized by such uses as warehousing, manufacture and assembly, yards, shipping services, and other heavier industry requiring large truck traffic. New technologies such as battery development and other cutting-edge industrial may also occur in the General Industrial area.