I-94/US-131 Ramp Improvement Project Draft Noise Report

Kalamazoo County, Michigan

October 2024

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1.0 PROJECT STUDY AREA AND PURPOSE AND NEED

The proposed I-94/US-131 ramp improvement project, located in Kalamazoo, Michigan, covers approximately 1.5 miles of reconstruction on northbound US-131 and widening of the westbound I-94 ramp to northbound US-131. The project is being studied as a Type I roadway improvement and therefore was completed in conformance with federal regulations codified under 23 CFR 772 and National Environmental Policy Act (NEPA). The noise study area limits were broken up into seven Common Noise Environment (CNE) areas illustrated in **Figure 1** and **Figure 1A**. The Federal Highway Administration (FHWA) Traffic Noise Model (TNM) version 2.5 was used to estimate peak-hour 2023 existing and 2045 future build noise levels at noise sensitive areas within each CNE.

The purpose of the study is to determine if the existing noise walls in the northeast quadrant of the I-94/US-131 interchange maintain adequate noise reduction at the homes located behind the existing noise barrier walls with the proposed ramp improvement and additionally determine if new noise impacts are found to occur in other residential communities that presently do not have abatement. The existing noise barrier walls are depicted by the solid green lines in **Figure 1,** while the yellow dots represent modeling locations where noise levels were determined and assessed for impact under 2023 existing and 2045 peak-hour traffic conditions. The portion of the project study area north of Parkview Avenue is shown in **Figure 1A**.

1.1 Summary of Abatement Analysis Findings

A summary of the number of modeling locations within each CNE area is provided in **Table 1** with the number of modeling locations exceeding the FHWA Noise Abatement Criteria (NAC) shown in parentheses. The general findings within each CNE area are as follows:

Common Noise Environment 1:

The CNE 1 study area consists of a large area of residential (NAC B) land uses and Angling Road Elementary School (NAC C). The modeling results indicate that within the CNE 1 study area, there were no noise levels at or above 66 dBA impact threshold at the 74 TNM receiver locations, representing 208 equivalent dwellings, modeled under 2023 existing and 2045 future build traffic conditions with the ramp improvement. Similarly, there will be no impacts at the elementary school. Therefore, based on these analysis findings, none of the existing noise walls in CNE 1 study area requires replacement because they were shown to be effective at reducing noise based on Michigan Department of Transportation (MDOT) criteria.

Common Noise Environment 2:

The CNE 2 study consists entirely of residential properties (NAC B) of which the TNM modeling indicates there will be no impact under future 2045 Build conditions. Therefore, noise abatement consideration is not warranted.

Common Noise Environment 3:

CNE 3 study area consist of academic (NAC C) land uses associated with Western Michigan University. The analysis findings indicate that no noise impacts under future 2045 Build conditions are projected to occur. Therefore, noise abatement measures are not warranted.

Common Noise Environment 4:

The CNE 4 study area consists entirely of NAC C land uses where the Kalamazoo Christan Middle School is located in the northern section; the 12th Street Baptist Church and baseball field are in the southern section. Noise levels at the middle school remain below the 66 dBA impact level under 2045 Build conditions. However, noise levels at the church and baseball field are projected to exceed the 66 dBA impact threshold under future 2045 Build condition. As part of the CNE 5 noise abatement analysis, the baseball field is provided mitigation because the proposed noise wall in the CNE 5 area extends north past the baseball infield. On the other hand, the 12th Street Baptist Church does not have exterior frequent human uses where noise reduction benefits would occur from a noise barrier wall, thus extending the CNE 5 noise wall further north past the church property is not warranted. In addition, the interior noise levels inside the church without abatement are estimated to remain below the 51 dBA interior impact threshold.

Common Noise Environment 5:

Land uses in the CNE 5 consists of a combination of single and multi-family residential dwellings and is the only residential community in the project study area that does not have an existing noise barrier wall. As indicated in **Table 1,** 15 modeling locations would experience peak-hour noise levels loud enough to consider a noise wall. Thus, based on federal guidance, a noise wall was evaluated for this community. The analysis findings show the proposed noise wall would satisfy all MDOT feasibility and reasonableness requirements. Therefore, the proposed noise wall is recommended and must be voted upon by the affected homeowners and renters and should be evaluated in more detail in a future final design noise study. The details of the barrier analysis completed for the CNE 5 study area are described in more detail in Section 4.

Common Noise Environment 6:

Land uses in the CNE 6 consists of a single and multi-family residential dwellings. The CNE 6 is the only residential community in the project study area where there are projected noise impacts at residential properties behind the existing noise walls under future peak-hour 2045 Build conditions. Impacts are projected to occur at three modeling locations representing six dwellings. As a result of these impacts, abatement was considered by extending the existing noise barrier wall approximately 400 feet further north from its current terminus location. The abatement analysis findings indicate that proposed barrier extension did not satisfy MDOT's 10 dBA noise reduction reasonableness criteria and, therefore, is not recommended. The details of the barrier analysis completed within the CNE 6 study area are described in more detail in Section 4 of this report.

Common Noise Environment 7:

Land uses in the CNE 7 consists of a single residential dwelling fronting Parkview Avenue and several NAC C/D and E land uses located adjacent to southbound US-131. These include two places of worship, a daycare facility, several hotels and a conference center. The analysis findings indicate that no noise impacts occur under existing conditions nor are there under future 2045 Build conditions; therefore, noise abatement consideration is not warranted.

Common Noise Environment 8:

Land uses within the CNE 8 consist of a family medical practice (NAC C/D) fronting S Drake Road with US-131 facing the rear of the medical building and several small NAC C land uses. One of these outdoor NAC C areas is used by the medical practice staff and patients. The other NAC C land use is located further south closer to the Parkview Avenue/S Drake Road intersection. The analysis findings indicate that no noise impacts occur under existing conditions nor are there under future 2045 Build conditions; therefore, noise abatement consideration is not warranted.

Table 1 – Total Number of Modeled NAC Locations Within Each CNE and Number of NAC Exceedances Shown in Parathesis

COMMON NOISE ENVIRONMENT (CNE) AREA	LAND USE DESCRIPTIONS	2023 EXISTING	2045 BUILD
CNE 1	Residential and Academic (NAC B and NAC C/D)	74[1] (0)	74[1] (0)
CNE 2	Residential (NAC B)	13 (0)	13 (0)
CNE 3	Academic (NAC C/D)	9 (0)	9 (0)
CNE 4	Academic and Place of Worship (NAC C/D)	7 (2)	7 (2)
CNE 5	Residential (NAC B)	51 (15)	51 (15)
CNE 6	Residential (NAC B)	32 (3)	32 (3)
CNE 7	Single Residential Property and Place of Worship, Daycare facility, Hotels (NAC B and NAC C/D and E)	7 (0)	7 (0)
CNE 8	Medical Facility and Active Recreational	14 (0)	14 (0)

[1] Composed of 67 NAC B land uses and 7 NAC C land uses.

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Figure 1 – I-94/US-131 Noise Study Area Limits

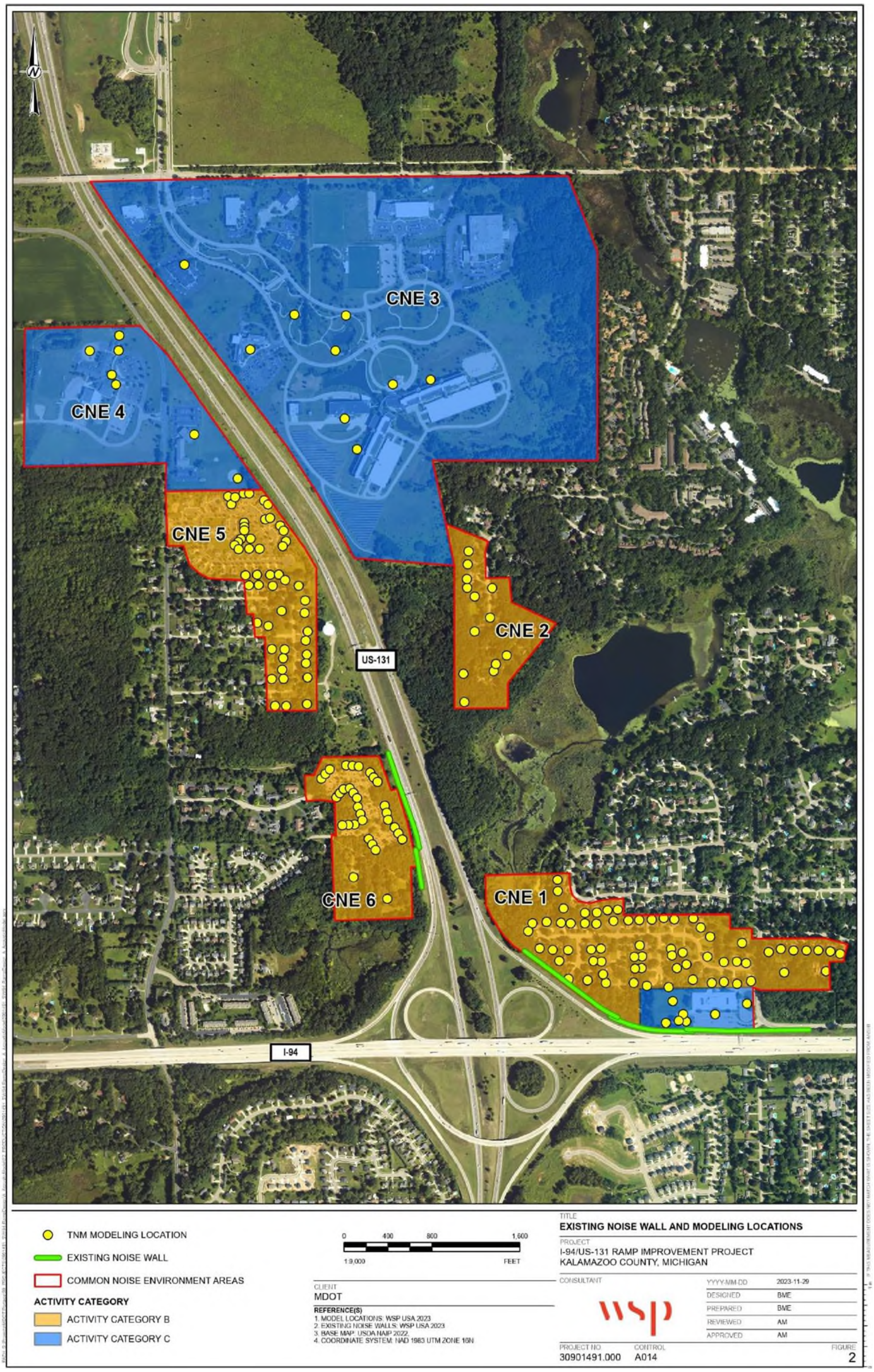
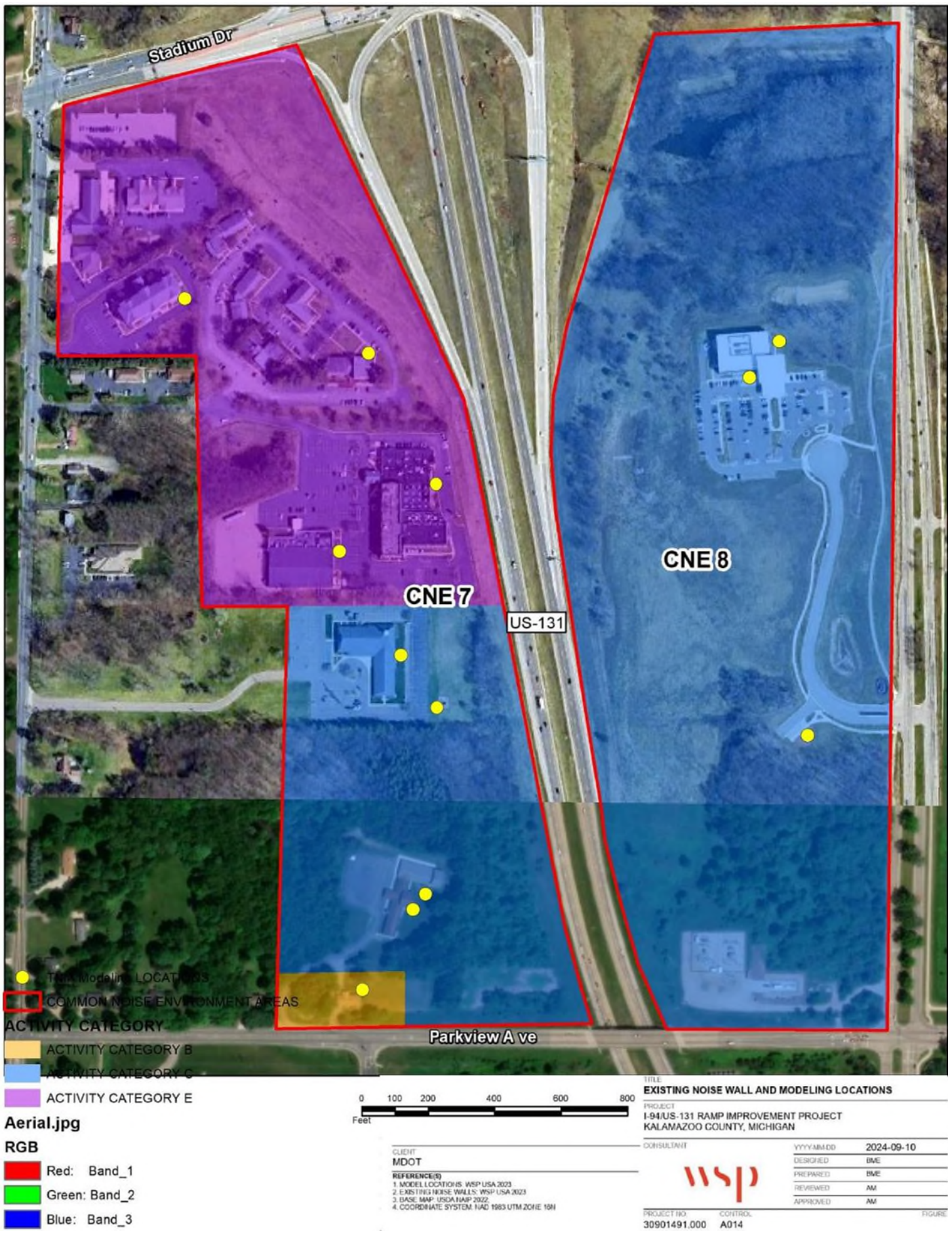


Figure 1A – I-94/US 131 Noise Study Area Limits North of Parkview Avenue



2.0 FUNDAMENTAL CONCEPTS OF ROADWAY NOISE

In the natural physical environment, sound is generated by the vibration of the air molecules. The vibrations of the air molecules result in small fluctuations in air pressure. A sound wave is created when a series of these pressure waves move through the air. Sound waves vibrate at different rates or what is referred to as "frequencies." The faster an object vibrates, the higher the frequency of the sound wave; conversely, slower vibration rates produce lower frequencies. The human ear can detect a wide range of frequencies from about 20 Hz to 17,000 Hz. The logarithmic decibel scale denoted as "dB" was developed to quantify the varying loudness of sound energy. Because human hearing sensitivity varies with the frequency of the sound, the A-weighting scale was devised to provide a single numeric measure that better accounts for the human responses to noise. The following sections describe several noise descriptors and impact criteria developed associated with human hearing response and annoyance.

2.1 A-Weighted Sound Level

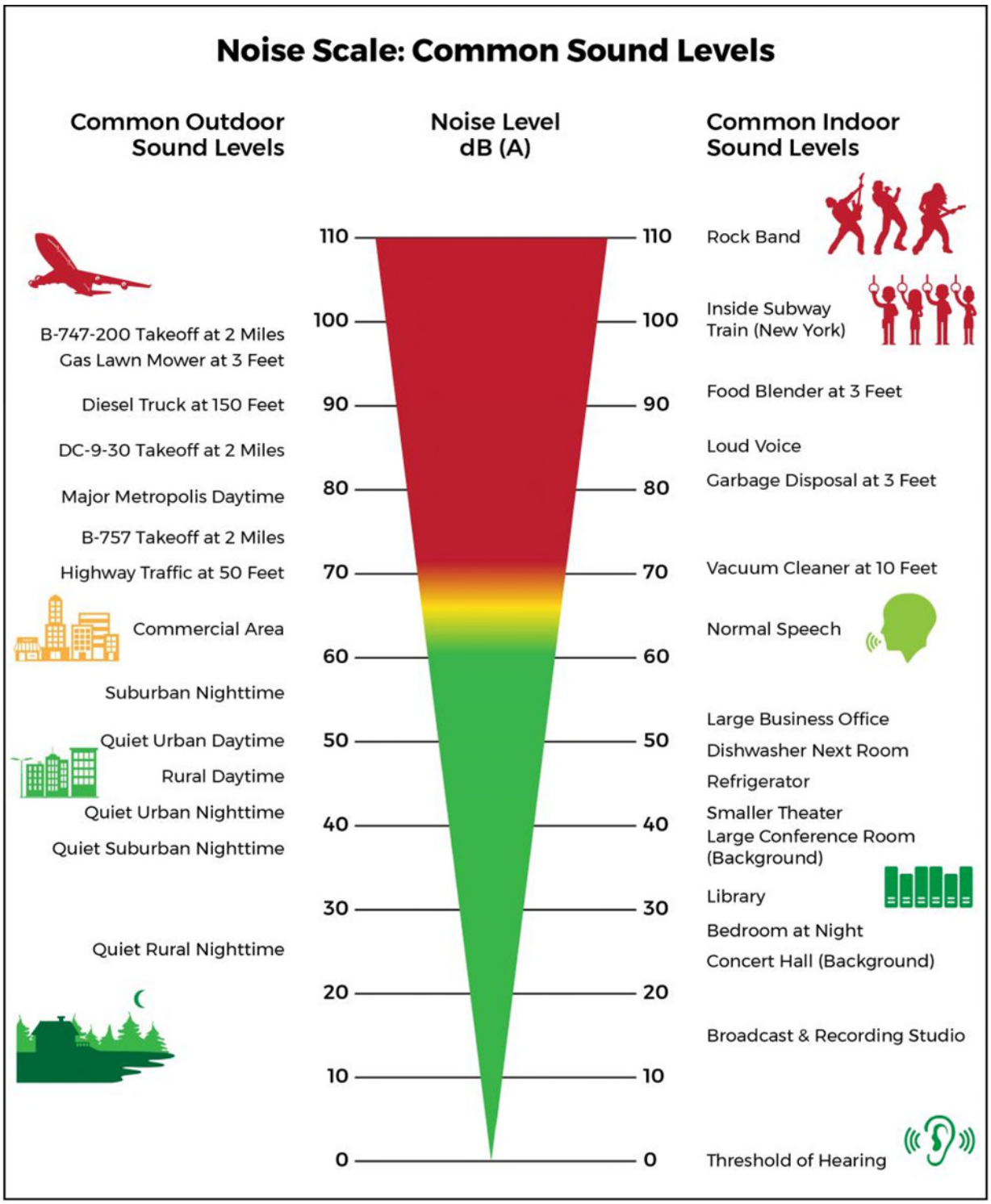
Sounds affecting humans occur in the natural environment. Some sounds are necessary or desirable for communication, some are pleasurable, while others go unnoticed, but many sounds are truly unwanted or irritating. These unwanted sounds result in annoyance and disturbance to people living or working in communities. This unwanted sound is referred to as noise.

Thanks to the results of many experiments with human participants, scientists have found that, unlike animals, the human ear is more sensitive to midrange frequencies as compared to either low or high frequencies. Thus, people perceive to hear midrange frequencies louder than low or high frequencies. This characteristic of the human ear is accounted for by adjusting or weighting the spectrum of the measured sound level for the sensitivity of human hearing range. The weighting scale that best accounts for the sensitivity of the human hearing range is referred to as the A-weighted scale and is denoted by the "dB(A)" notation. Acousticians accept the A-weighted sound level as a preferred descriptor for assessing human exposure and annoyance from environmental noise. **Figure 2** below illustrates common indoor and outdoor noise levels generated by various activities.

Sound is described on a logarithmic scale; therefore, an understanding of the following relationships below is helpful in providing a subjective impression humans experience due to the degree in the magnitude of the A-weighted sound level change:

- A **3 dB(A) decrease** in A-weighted noise level is considered Barely Perceptible and represents a 50 percent loss in sound energy.
- A **5 dB(A) decrease** in A-weighted noise level is considered Readily Perceptible and represents a 67 percent loss in sound energy.
- A **10 dB(A) decrease** in A-weighted noise level is considered Half as Loud and represents a 90 percent loss in sound energy.
- A **20 dB(A) decrease i**n A-weighted noise level is considered One-Fourth as Loud and represents a 99 percent loss in sound energy.

Figure 2 – Common Indoor and Outdoor Noise Levels



Source: Bruel and Kjaer: Environmental Noise, Sound and Vibration Measurements, 2000.

2.2 Noise Level Descriptors

A basic characteristic of environmental noise, particularly near roadways, is its time-varying and fluctuating nature. Because traffic noise intensity varies over time, it is customary practice to condense all the sound energy observed at a point of interest into a single number, called the "equivalent sound level," abbreviated as "L_{eq}." The L_{eq} noise descriptor contains the same sound energy as the time varying sound energy for a specific time period. Typically, this time period is one hour, which is expressed as L_{eq} (1-hr). The A-weighted L_{eq} noise descriptor is well correlated with humans to sound; therefore, this descriptor is widely used for assessing environmental noise exposure and has been adopted by FHWA as the preferred noise descriptor when assessing noise impacts from proposed roadway improvement projects.

2.3 Noise Impact Criteria

The proposed I-94/US-131 Ramp Improvement Project is defined as a Type I roadway improvement. This classification refers to projects that include federal funding for construction of highways on a new location alignment or the alteration of an existing highway resulting in a substantial change in either the horizontal or vertical alignment and/or an increase in the number of through-traffic lanes. The noise analysis for this project was conducted in compliance with Code of Federal Regulations (CFR), Title 23, Part 772, the United States Department of Transportation, FHWA, *Highway Traffic Noise Analysis and Abatement - Policy and Guidance* (FHWA, 2011). The basic goals of the federal noise criteria, as they apply to highway projects, is to minimize potential noise impacts on adjacent communities abutting the proposed project alignment and to consider abatement measures to eliminate projected impacts. However, abatement measures are not guaranteed and must satisfy feasibility and reasonableness requirements developed by each state DOT. These requirements are outlined in Section 2.4. The FHWA Traffic Noise Model (TNM) version 2.5 is currently required and was used for the noise analysis for this proposed project.

To determine if highway noise levels are compatible with various land uses, the FHWA developed noise abatement criteria and procedures to be used in the planning and design of highways. A summary of the FHWA Noise Abatement Criteria (NAC) for various land uses is presented in **Table 2**. These NAC noise levels represent the lower limit of what would constitute as a highway traffic noise impact for specific exterior land uses and activities and for certain indoor activities. Noise impacts occur when the predicted noise level at a qualified receptor approaches or exceeds the FHWA NAC, or when the difference between existing and future noise levels results in a substantial increase in noise level.

The MDOT interpretation of the federal requirement is outlined in MDOT's *Highway Noise Analysis and Abatement Handbook,* dated July 2011. MDOT defines "approach" as being within 1 decibel (dB(A)) of each NAC category. Therefore, for example, all residential properties that have an exterior L_{eq} noise level of 66 dB(A) or higher is considered to "approach or exceed" the NAC "Category B" land use activity criteria and are thus considered impacted. In addition to the approach threshold impact, MDOT also considers an impact to occur if there is a projected "substantial" noise level increase. A substantial noise level increase is defined as a projected build design noise level increase of 10 dB(A) or more above the

comparable existing noise levels. Therefore, a noise impact can occur in two independent situations and both types of impact are treated equally.

When changes to the horizontal or vertical alignment of existing roadways are proposed, and because of these roadway modifications, traffic noise impacts are identified and noise mitigation must be considered. A noise abatement measure is any positive action taken to reduce the impact of traffic noise within a proposed project activity area. Consideration for noise abatement does not in itself guarantee the abatement is warranted. In impacted communities, several assessment steps are evaluated to determine the *feasibility and reasonableness* of the abatement consideration. The evaluation is based on many factors and considerations, which in equal order of importance include the following:

- Engineering constructability.
- Restriction to traffic flow or property access.
- Cost effectiveness.
- Wall height constraints.
- Effectively reduces traffic noise at impacted residents.
- Whether zoning revisions to the existing land use are expected in the near future.

Table 2 – FHWA Noise Abatement Criteria (NAC)[1] Hourly A-Weighted Sound Level in dB(A)

ACTIVITY CATEGORY	ACTIVITY CRITERIA[2]		EVALUATION LOCATION	ACTIVITY DESCRIPTION
	$L_{eq}(h)$[3]	L10(h)[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, daycare 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, daycare 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[5]	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 and warehousing.
G	--	--		Undeveloped lands that are not permitted.

1 MDOT defines a noise impact as a 10 dB(A) increase between the existing noise level to the design year predicted noise level or a predicted design year noise level that is 1 dB(A) less than the levels shown in Table 1.

2 Either L_{eq}(h) or L10(h) (but not both) may be used on a project. MDOT uses L_{eq}(h). The L_{eq}(h) and L10(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 that in a stated period 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 L10 is the sound level that is exceeded 10 percent of the time (90th percentile) for the period under consideration, with L10 being the hourly value of L10.

5 Includes undeveloped lands permitted for this activity category.

2.4 Feasibility and Reasonableness

In the communities where impacts are predicted to occur, MDOT has defined a specific two-step process required to determine if abatement is possible. The following two steps, in respective order, must be considered. It should be noted that if a proposed sound barrier does not pass the *feasibility* phase, the second step of analysis for the *reasonableness* phase is not required. If a proposed sound barrier does not meet the requirements in the feasibility analysis phase, it is not eligible for funding.

Step 1: Is it **feasible** to provide highway traffic noise abatement from engineering, safety and the acoustic effectiveness standpoint?

Step 2: Is it **reasonable** to provide highway traffic noise abatement based on the consideration of the cost/benefit analysis, viewpoint of a majority of the benefiting residences and property owners, and in providing sufficient traffic noise reduction?

Step 1: Feasibility Consideration: Once the future build highway design noise modeling analysis has been completed and the properties that exceed the NAC are identified, the noise abatement design is evaluated and assessed for feasibility. If a proposed sound barrier does not pass the feasibility phase, it does not move forward to the reasonableness phase. The following factors must all be met in the feasibility (Step 1) phase to continue to the reasonableness (Step 2) phase:

(1) Can a noise reduction of at least 5 dB(A) be achieved by 75 percent of the impacted homes or other receptors?
(2) Can the sound barrier be designed and physically constructed at the proposed barrier location?
(3) Will placement of the sound barrier cause a visual safety problem?
(4) Will placement of the sound barrier restrict access to vehicular or pedestrian travel?
(5) Will the sound barrier impact utilities or will the utilities impact the sound barriers?
(6) Will the sound barrier impact drainage or will the drainage impact the sound barrier?

Step 2: Reasonableness Consideration: Once the feasibility phase has been evaluated and each feasible requirement above is satisfied, a proposed sound barrier is evaluated for reasonableness. All of the following cost and acoustic requirements must be satisfied for a proposed sound barrier to be considered reasonable:

(1) Determine if the cost per benefiting unit (CPBU) will remain below Fiscal Year 2023 limit of $52,248 by first estimating the total square footage (length multiplied by height) followed by multiplying by a $45 per square foot unit cost and dividing the resultant cost value by the number of benefiting dwelling.
(2) A benefited receptor is a receptor that achieves a 5 dB(A) or greater noise reduction as a result of the noise barrier wall.
(3) The reasonableness phase requires a proposed noise barrier wall to achieve a noise reduction of 10 dB(A) or greater at a minimum of one benefiting receptor and provide at least a 7 dB(A) reduction for 50 percent or more of the benefiting receptor sites.

2.5 Public Involvement Phase

In general, the public involvement phase takes place during the early preliminary engineering (EPE) and preliminary engineering (PE) phases as part of MDOT's Context Sensitive Solution (CSS) process. The public coordination phase with the community occurs when information concerning the noise barrier wall location, its physical dimensions and surface treatments to enhance its aesthetics are proposed.

2.6 Third Party Funds

Third party funding for abatement enhancements beyond what MDOT is responsible for is limited to aesthetics or functional elements such as vegetation plantings and specific wall graphics or illustrations. Moreover, third party funds cannot be used to contribute to the cost of a barrier that exceeds the $52,248 per benefit reasonableness cost criteria. Regardless of contribution sharing, no sound barrier wall will be funded by MDOT that does not meet the feasibility and reasonableness requirements.

2.7 Traffic Data

The baseline 2023 traffic data used for the noise study was collected by MDOT the week of June 19, 2023, for the entirety of the US-131/I-94 system interchange. These utilized 24-hour classification counts can be obtained from the MDOT Transportation Data Management System (TDMS) website. Using the TDMS, the annual average daily traffic (AADT) and additional traffic statistics for the roadway segments were developed. In addition to the counts collected by this process, other historic short counts were available for download and use. The 2045 Build year traffic volumes were derived by applying a 0.5 percent annualized compounded growth factor to the original 2023 existing traffic volumes. This growth factor was determined and supplied by the MDOT Bureau of Transportation Planning.

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3.0 2023 EXISTING CONDITIONS

Activities completed and associated with the 2023 existing conditions include collecting ambient noise measurements, collecting simultaneous traffic counts, completing noise model validations and predicting existing noise levels using peak-hour traffic volume data. These elements of the noise analysis are discussed in the sections that follow.

3.1 Noise Measurements and TNM Model Validation

The study area was surveyed and five representative noise measurement sites approved by MDOT and depicted in **Figure 3** were selected for ambient noise measurement. The selected monitoring sites provide good geographic coverage of the project location area. In the case of measurement, Sites 1, 2 and 3 are near or behind existing noise barrier walls. The noise measurements were recorded using a Larson Davis LD 831C sound level meter and were collected on June 28, 2023, during the period from 11 a.m. to 5 p.m. Weather conditions were favorable for noise monitoring and at each location the noise meter microphone was fitted with a windshield, mounted on a tripod at 5 feet height above the ground. The field note measurement sheets and noise monitoring equipment calibration certificates are provided in the appendix of this report.

Simultaneous noise measurement and traffic counts of 20 minutes duration were collected at each site and used to validate the TNM model to ensure predicted noise levels provided an accurate estimate of traffic noise levels. The traffic count data and roadway geometry were inputted into a TNM validation model created using the roadway geometry and measurement site coordinate location developed from Micro-Station CAD files of the study area. By definition, a TNM model is considered validated when the TNM values are within plus or minus 3 dBA of the measured levels. Once the validation is achieved, the model can be expanded to include all roadways and receptor sites within the extended project study area.

A summary of the measured noise levels and TNM validation results is provided in **Table 3**. Two sets of noise measurements were collected at Sites 1, 2, and 3, while one noise measurement was collected at Sites 4 and 5. The findings indicate that all measured and TNM-predicted noise levels are within plus or minus 3 dBA range. The largest difference between measured and predicted noise levels occurred at receptor site R5, a residential property located at 4514 Horton Drive, where a 2.9 dBA difference between measured and TNM predicted noise level occur. These validation findings demonstrate the TNM model-estimated noise levels for each measurement site are in reasonably good agreement with measured levels. The traffic count data and measured noise levels collected at the five monitoring locations used in completing the TNM validation are summarized in **Table 4**. The traffic volume classification consisted of the following four categories:

- Automobiles – Passenger cars and light trucks weighing less than 9,900 pounds.
- Medium trucks – Trucks having two axles and six tires, weighing between 9,900 to 26,400 pounds.
- Heavy trucks – Trucks having three or more axles, weighing greater than 26,400 pounds.
- Buses – All vehicles designed to carry nine or more passengers.

Figure 3 – Noise Measurement Validation Sites

Table 3 – TNM Validation: Comparison of Measured Versus TNM-Predicted Noise Levels

RECEPTOR	STREET ADDRESS	LAND USE AND (NAC)	TIME OF MEASUREMENT	MEASURED NOISE LEVEL L_{EQ} (1-HR) (DBA)	PREDICTED EXISTING NOISE LEVEL L_{EQ} (1-HR) (DBA)	DIFFERENCE PREDICTED MINUS MEASURED LEVEL (DBA)
Site 1	3902 Wedgewood Drive	Residential (NAC B)	1 - 2 p.m.	60.7	61.8	+ 1.1
			1 - 2 p.m.	61.0	61.9	+ 0.9
Site 2	5334 Tamworth St.	Residential (NAC B)	2 - 3 p.m.	55.8	54.8	- 1.0
			2 - 3 p.m.	55.4	54.0	- 1.4
Site 3	3130 Vincent Ave.	Residential (NAC B)	11 a.m. - noon	69.6	70.9	+ 1.3
			11 a.m. - noon	69.1	70.8	+ 1.7
Site 4	3911 S. 12th St.	Church (NAC C and D)	4 - 5 p.m.	63.1	64.2	+ 1.1
Site 5	4514 Horton Drive	Residential (NAC B)	3 - 4 p.m.	66.6	69.5	+2.9

Table 4 – Summary of Traffic Counts and Measured Noise Levels Collected Simultaneously at the Noise Monitoring Sites

FIELD SITE ID	SITE DESCRIPTION (DISTANCE FROM THE OUTSIDE EDGE OF THE SHOULDER)	DATE	START TIME	DURATION	TRAFFIC[1] (VEHICLE/HOUR)[1]						MEASURED NOISE LEVEL, DB(A) L_{EQ}
					ROADWAY DIRECTION[2]	AUTOS	MEDIUM TRUCKS				
1	Approximately 245 feet from the edge of the shoulder of the westbound I-94 ramp to northbound US-131.	June 28, 2023	12:53 - 1:13 p.m.	20	I-94 ramp to US-131	1,059	18	147	3	0	60.7
					Northbound US-131	912	27	105	0	0	
					Westbound I-94 inside lane	811	23	0	3	6	
					Westbound I-94 outside lanes	1,646	46	489	6	0	
1A	Approximately 245 feet from the edge of the shoulder of the westbound I-94 ramp to northbound US-131.	June 28, 2023	1:16 - 1:36 p.m.	20	I-94 ramp to US-131	1,134	48	114	0	3	61.0
					Northbound US-131	1,152	3	99	3	6	
					Westbound I-94 inside lane	858	23	0	0	3	
					Westbound I-94 outside lanes	1,743	46	552	0	0	
2	Approximately 271 feet from the edge of the shoulder of the westbound I-94 ramp to northbound US-131.	June 28, 2023	1:50 - 2:10 p.m.	20	I-94 ramp to US-131	1,059	18	147	3	0	55.8
					Northbound US-131	1,506	51	399	0	0	
					Westbound I-94 inside lane	844	13	0	0	9	
					Westbound I-94 outside lanes	1,715	26	513	0	0	
2A	Approximately 271 feet from the edge of the shoulder of the westbound I-94 ramp to northbound US-131.	June 28, 2023	2:14 - 2:34 p.m.	20	I-94 ramp to US-131	1,254	54	102	0	3	55.4
					Northbound US-131	987	33	90	0	3	
					Westbound I-94 inside lane	936	19	0	0	3	
					Westbound I-94 outside lanes	1,899	36	525	0	4	

Table 4 – Summary of Traffic Counts and Measured Noise Levels Collected Simultaneously at the Noise Monitoring Sites (Continued)

FIELD SITE ID	SITE DESCRIPTION (DISTANCE FROM THE OUTSIDE EDGE OF THE SHOULDER)	DATE	START TIME	DURATION	TRAFFIC[1] (VEHICLE/HOUR)[1]						MEASURED NOISE LEVEL, DB(A) L_{EQ}
					ROADWAY DIRECTION[2]						
3[3]	Approximately 50 feet from the edge of pavement (EOP) along Vincent Avenue.	June 28, 2023	10:55 - 11:15 a.m.	20	Westbound I-94 inside lane	572	21	0	0	0	69.6
					Westbound I-94 outside lanes	1,162	42	351	0	0	
					Eastbound I-94 inside lane	600	4	0	0	0	
					Eastbound I-94 outside lanes	1,258	8	447	0	0	
3A[3]	Approximately 50 feet from the EOP along Vincent Avenue.	June 28, 2023	11:17 - 11:37 a.m.	20	Westbound I-94 inside lane	521	17	0	0	9	69.1
					Westbound I-94 outside lanes	1,057	34	363	0	0	
					Eastbound I-94 inside lane	569	22	0	0	0	
					Eastbound I-94 outside lanes	1,156	44	396	3	0	
4	Approximately 357 feet from the edge of the shoulder of southbound US-131.	June 28, 2023	4:19 - 4:40 p.m.	20	Northbound US-131	2,829	48	145	0	0	63.1
					Southbound US-131	3,225	33	153	6	9	
5	Approximately 188 feet from the edge of the shoulder of southbound US-131.	June 28, 2023	3:50 - 4:10 p.m.	20	Northbound US-131	2,937	45	147	0	3	66.6
					Southbound US-131	3,240	60	153	0	9	

[1]Vehicle counts classifications and TNM model traffic data used for 2045 Build Year modeling were categorized according to Section 3.1 definition.

[2]Vehicle speeds for I-94 are 70 mph for autos and motorcycles and 65 mph for buses, MT and HT.

[3]Vehicle traffic on Vincent Avenue adjacent to the I-94 corridor was insignificant.

3.2 TNM Predicted Existing and Build Peak-Hour Noise Levels

Using TNM, the 2023 Existing and future Build Year 2045 noise levels were determined at noise-sensitive properties within the project study area. Noise levels were determined for both the peak hour a.m. and p.m. time periods. However, the peak p.m. time period levels were found to be generally 1 decibel higher than the corresponding peak a.m. levels; therefore, the report documentation focused solely on the peak p.m. time period noise level estimates.

A summary of the number of TNM receiver impacts within each of the seven CNE areas illustrated in **Figure 1** and **Figure 1A** is provided in **Table 5**. Additionally, **Table 6** provides a summary of the noise level estimates for each individual TNM modeling receiver, in addition to providing the number of equivalent dwelling units each receiver represents and which CNE area the TNM modeling receiver resides. Furthermore, illustrations depicting each of the receivers and their noise exposure conditions are shown graphically in **Figure 4A** through **Figure 4F** for 2023 existing conditions and **Figure 5A** through **Figure 5F** for the future 2045 Build conditions. TNM modeling locations that are projected to be at or above the impact threshold are shown in bold font in **Table 6** and identified by a red square on the figures. Overall, the findings indicate that noise impacts that are found to occur under future peak-hour 2045 Build traffic conditions similarly occur under 2023 existing peak-hour conditions. Therefore, the proposed ramp improvement itself will not cause any new traffic noise impacts. The findings for each CNE area are described below.

Common Noise Environment 1

CNE 1 area consists of 74 TNM receivers, of which 67 are NAC B residential land uses and seven NAC C/D academic land uses. This community is located closest to the proposed ramp improvement and is protected from traffic noise by three existing noise barrier walls as illustrated in **Figure 5E**. The analysis findings indicate that under future build conditions, no noise impacts are projected to occur at any of the residential properties and no NAC C and D impacts are projected to occur at the Angling Road Elementary School. Therefore, the three existing noise walls within the CNE 1 area are expected to provide adequate noise reduction effectiveness under future 2045 Build conditions.

Common Noise Environment 2

The CNE 2 area consists of 13 NAC B residential TNM modeling land uses, of which none are projected to be impacted. The general CNE 2 modeling area is shown in the right side of **Figure 5C.**

Common Noise Environment 3

The CNE 3 area consists of nine NAC C and D modeling land uses, all comprising Western Michigan University. No noise impacts are expected in this area. The general CNE 3 modeling areas are shown in the right side of **Figure 5A** and **Figure 5B.**

Common Noise Environment 4

The CNE 4 study area consists of seven NAC C and D modeling land uses. Noise impacts are projected to occur at two of the seven modeling locations. Exterior noise impacts are projected to occur at the 12th Street Baptist Church (R97) and the adjacent church baseball field (R98), as indicated in **Table 6** and illustrated in **Figure 5B**. However, interior noise levels inside the church are expected to remain below the NAC D 51 dBA impact threshold with the windows closed. Thus, no abatement for the church is warranted. On the other hand, the baseball field borders the CNE 5 residential area located to its immediate south, where a noise wall is considered. To provide adequate noise reduction to the CNE 5 homes closest to the ball field, the proposed noise wall must extend past the infield, thus providing noise reduction benefit to the baseball field as well. The dwelling count benefits from the baseball field are included in the CNE 5 noise abatement analysis.

Common Noise Environment 5

The CNE 5 community is composed of a combination of single and multi-family residential dwellings (NAC B) and is located adjacent to southbound US-131. The community does not have any existing noise barrier walls. As a result, noise levels under build conditions were found to exceed the 66 dBA impact threshold at 15 TNM modeling locations identified in **Table 6** as receivers R102 - R111, R130 - R132, R136 and R137, and are depicted by the red square dots in **Figure 5B** and **Figure 5C.** Therefore, based on these findings and in accordance with federal requirements outlined under CFR 23 772, consideration for noise abatement is warranted. The proposed noise barrier within the CNE 5 area and its analysis findings are described in detail in Section 4.

Common Noise Environment 6

The CNE 6 community consist of NAC B land uses located adjacent to southbound US-131. The community today is protected by a noise barrier wall as illustrated by the solid green line in **Figure 5D**. However, as indicated in **Table 6**, noise levels at three receivers identified as R156, R157 and R158 were found to exceed the 66 dBA impact threshold. The existing noise barrier wall and impacted properties are depicted by the red square dots shown in **Figure 5D.** A 400-foot-long barrier wall extension was evaluated in an attempt to eliminate the projected impacts. The abatement findings are described in Section 4.

Common Noise Environment 7

The CNE 7 area consists of one NAC B land use fronting Parkview Avenue, plus three NAC C/D land uses and three NAC E all located adjacent to southbound US-131. Peak-hour noise level estimates at the single-family residential property, identified as R182, is 10 decibels below the 66 dBA impact threshold under both existing and future 2045 Build conditions. The other land uses within the CNE 7 area consisting of NAC C/D and E land uses are comprised of several combination hotels/conference centers, two houses of worship and a daycare facility. These non-residential receptors show little or no change from 2023 existing to 2045 Build peak-hour traffic noise conditions, with all locations remaining below the impact thresholds. Noise level estimates within the CNE 7 area are shown toward the bottom of **Table 6**. The CNE 7 modeling receptor sites are depicted in **Figure 4F** for existing conditions and **Figure 5F** under future 2045 Build conditions.

Common Noise Environment 8

Land uses within the CNE 8 consist of a family medical practice (NAC C/D) fronting S Drake Road with US-131 facing the rear of the medical building and several small NAC C land uses. One of these outdoor NAC C areas is used by both the medical practice staff and patients. The other NAC C land use is located further south, closer to the Parkview Avenue/S Drake Road intersection. These non-residential receptors show little or no change from 2023 existing to 2045 Build peak-hour traffic noise conditions, with all locations remaining well below the impact thresholds. Noise level estimates within the CNE 8 area are shown at the bottom of **Table 6**. The CNE 8 modeling receptor sites are depicted in **Figure 4F** for existing conditions and **Figure 5F** under future 2045 Build conditions.

Table 5 – Total Number of TNM Receivers Modeled Within Each CNE and Number of NAC Exceedances Shown in Parathesis

COMMON NOISE ENVIRONMENT (CNE)	LAND USE DESCRIPTIONS	2023 EXISTING	2045 BUILD
CNE 1	Residential and Academic (NAC B and NAC C/D)	74[1] (0)	74[1] (0)
CNE 2	Residential (NAC B)	13 (0)	13 (0)
CNE 3	Academic (NAC C/D)	9 (0)	9 (0)
CNE 4	Academic and Place of Worship (NAC C/D)	7 (2)	7 (2)
CNE 5	Residential (NAC B)	51 (15)	51 (15)
CNE 6	Residential (NAC B)	32 (3)	32 (3)
CNE 7	Single Residential Property and Place of Worship, Daycare Facility, Hotels (NAC B and NAC C/D and E)	7 (0)	7 (0)
CNE 8	Medical Facility (NAC C/D) and Active Recreational (NAC C)	14 (0)	14 (0)

[1]Composed of 67 NAC B land uses and 7 NAC C land uses.

Table 6 – 2023 Existing and Future 2045 Build Peak PM Noise Levels

TNM RECEIVER ID	NAC	CNE AREA	DWELLING UNITS	LOCATION	2023 EXISTING NOISE LEVEL LEQ (ONE-HOUR) DB(A)[1]	2045 BUILD NOISE LEVEL LEQ (ONE-HOUR) DB(A)[1]	DELTA BUILD MINUS EXISTING DB
R 1	B	1	1	Bryn Mawr Drive	58	59	+ 1
R2	B	1	1	Bryn Mawr Drive	58	58	0
R3	B	1	1	Bryn Mawr Drive	55	56	+ 1
R4	B	1	1	Bryn Mawr Drive	55	55	0
R5	B	1	1	Bryn Mawr Drive	55	56	+ 1
R6	B	1	1	Bryn Mawr Drive	55	56	+ 1
R7	B	1	1	Bryn Mawr Drive	53	54	+ 1
R8	B	1	1	Vincent Avenue	60	61	+ 1
R9	B	1	1	Angling Road	59	60	+ 1
R10	C	1	5	Angling Road School Playground	62	62	0
R11	C/D	1	100	Angling Road Elementary School	64 (44)*	63 (44)*	-1
R12	C	1	5	Angling Road Elementary School	62	62	0
R13	C	1	5	Angling Road Elementary School	63	62	-1
R14	C	1	5	Angling Road Elementary School	63	62	-1
R15	C	1	5	Angling Road Elementary School	61	61	0
R16	C	1	15	Angling Road Elementary School	59	59	0
R17	B	1	1	Angling Road	58	59	+ 1
R18	B	1	1	Wedgewood Drive	59	60	+ 1
R19	B	1	1	Wedgewood Drive	59	59	0
R20	B	1	1	Wedgewood Drive	59	59	0
R21	B	1	1	Wedgewood Drive	58	58	0
R22	B	1	1	Wedgewood Drive	54	54	0
R23	B	1	1	Wedgewood Drive	54	54	0
R24	B	1	1	Rugby Street	52	52	0
R25	B	1	1	Rugby Street	54	54	0
R26	B	1	1	Rugby Street	55	55	0
R27	B	1	1	Rugby Street	58	58	0
R28	B	1	1	Rugby Street	58	58	0
R29	B	1	1	Rugby Street	54	55	+ 1
R30	B	1	1	Rugby Street	57	58	+ 1
R31	B	1	2	Rugby and Tamsworth Street	56	57	+ 1
R32	B	1	1	Tamsworth Street	55	55	0
R33	B	1	1	Tamsworth Street	53	54	+ 1

Table 6 – 2023 Existing and Future 2045 Build Peak PM Noise Levels (Continued)

TNM RECEIVER ID	NAC	CNE AREA	DWELLING UNITS	LOCATION	2023 EXISTING NOISE LEVEL LEQ (ONE-HOUR)	2045 BUILD NOISE LEVEL LEQ (ONE-HOUR) DB(A)[1]	DELTA BUILD MINUS EXISTING DB
R34	B	1	1	Tamsworth Street	56	57	+ 1
R35	B	1	1	Tamsworth Street	56	57	+ 1
R36	B	1	1	Tamsworth Street	55	56	+ 1
R37	B	1	1	Tamsworth Street	56	56	0
R38	B	1	1	Wedgewood Drive	54	55	+ 1
R39	B	1	1	Lynnhill Street	50	51	+ 1
R40	B	1	1	Lynnhill Street	54	54	0
R41	B	1	1	Lynnhill Street	57	57	0
R42	B	1	1	Lynnhill Street	59	59	0
R43	B	1	1	Lynnhill Street	59	60	+ 1
R44	B	1	1	Wedgewood Drive	53	54	+ 1
R45	B	1	1	Wedgewood Drive	55	56	+ 1
R46	B	1	1	Wedgewood Drive	59	61	+ 2
R47	B	1	1	Wedgewood Drive	62	64	+ 2
R48	B	1	1	Wedgewood Drive	60	61	+ 1
R49	B	1	1	Wedgewood Drive	56	57	+ 1
R50	B	1	1	Wedgewood Drive	54	55	+ 1
R51	B	1	1	Wedgewood Drive	54	55	+ 1
R52	B	1	1	Wedgewood Drive	54	55	+ 1
R53	B	1	1	Wedgewood Drive	54	54	+ 1
R54	B	1	1	Wedgewood Drive	55	55	+ 1
R55	B	1	1	Wedgewood Drive	55	56	+ 1
R56	B	1	1	Wedgewood Drive	54	55	+ 1
R57	B	1	1	Wedgewood Drive	54	54	0
R58	B	1	1	Wedgewood Drive	53	54	+ 1
R59	B	1	1	Wedgewood Drive	53	54	+ 1
R60	B	1	1	Wedgewood Drive	52	53	+ 1
R61	B	1	1	Wedgewood Drive	51	51	0
R62	B	1	1	Wedgewood Drive	51	52	+ 1
R63	B	1	1	Wedgewood Drive	54	54	0
R64	B	1	1	Wedgewood Drive	54	54	0
R65	B	1	1	Wedgewood Drive	54	54	+ 1
R66	B	1	1	Angling Road	54	55	+ 1
R67	B	1	1	Angling Road	52	53	+ 1
R68	B	1	1	Fleetwood Drive	50	51	+ 1
R69	B	1	1	Fleetwood Drive	50	51	+ 1

Table 6 – 2023 Existing and Future 2045 Build Peak PM Noise Levels (Continued)

TNM RECEIVER ID	NAC	CNE AREA	DWELLING UNITS	LOCATION	2023 EXISTING NOISE LEVEL LEQ (ONE-HOUR)	2045 BUILD NOISE LEVEL LEQ (ONE-HOUR) DB(A)[1]	DELTA BUILD MINUS EXISTING DB
R70	B	1	1	Fleetwood Drive	51	52	+ 1
R71	B	1	1	Fleetwood Drive	53	53	0
R72	B	1	1	Fleetwood Drive	53	54	+ 1
R73	B	1	1	Fleetwood Drive	54	56	+ 2
R74	B	1	1	Fleetwood Drive	54	55	+ 1
R75	B	2	1	Old Field Trail	61	62	+ 1
R76	B	2	1	Old Field Trail	61	61	0
R77	B	2	1	Old Field Trail	58	57	- 1
R78	B	2	1	Old Field Trail	56	56	0
R79	B	2	1	Old Field Trail	57	56	-1
R80	B	2	1	Old Field Trail	57	56	-1
R81	B	2	1	Old Field Trail	57	56	-1
R82	B	2	1	Old Field Trail	57	56	-1
R76A	B	2	1	Old Field Trail	55	54	-1
R76B	B	2	1	Old Field Trail	53	53	0
R76C	B	2	1	Old Field Trail	55	55	0
R77A	B	2	1	Old Field Trail	54	53	0
R78A	B	2	1	Old Field Trail	54	53	-1
R83	E	3	1	Western Michigan University	58	59	+ 1
R84	E	3	1	Western Michigan University	57	59	+ 2
R85	C	3	1	Western Michigan University Parkview	50	52	+ 2
R86	E	3	1	Western Michigan University	46	49	+ 3
R87	C	3	1	Western Michigan University	53	56	+ 3
R88	C	3	1	Western Michigan University	51	54	+ 3
R89	C	3	1	Western Michigan University	54	56	+ 2
R90	E	3	1	Western Michigan University	59	60	+ 1
R91	E	3	1	ESP Security	64	64	0
R92	C	4	5	Kalamazoo Middle School - Playground	56	57	+ 1
R93	C	4	5	Kalamazoo Middle School - Recreational Field	64	65	+ 1
R94	E	4	1	Kalamazoo Middle School Mobile Classes	62	63	+ 1
R95	E	4	1	Kalamazoo Middle School	59	60	+ 1
R96	E	4	1	Kalamazoo Middle School	59	60	+ 1
R97	C/D	4	1	12th Street Baptist Church	**66** (46)*	**67** (47)*	+ 1

Table 6 – 2023 Existing and Future 2045 Build Peak PM Noise Levels (Continued)

TNM RECEIVER ID	NAC	CNE AREA	DWELLING UNITS	LOCATION	2023 EXISTING NOISE LEVEL LEQ (ONE-HR) DB(A)[1]	2045 BUILD NOISE LEVEL LEQ (ONE-HR) DB(A)[1]	DELTA BUILD MINUS EXISTING DB
R98	C	4	4	12th St Baptist Church Recreational Ball Field	**69**	**69**	0
R99	B	5	3	Rosewood Town Homes	63	64	+ 1
R100	B	5	3	Rosewood Town Homes	62	62	0
R101	C	5	5	Rosewood Town Homes Playground	64	64	0
R102	B	5	4	Rosewood Town Homes	**67**	**68**	+ 1
R103	B	5	4	Rosewood Town Homes	**70**	**70**	0
R104	B	5	4	Rosewood Town Homes	**73**	**74**	+ 1
R105	B	5	4	Rosewood Town Homes	**74**	**74**	0
R106	B	5	2	Rosewood Town Homes	**67**	**67**	0
R107	B	5	2	Rosewood Town Homes	**71**	**71**	0
R108	B	5	2	Rosewood Town Homes	**73**	**74**	+ 1
R109	B	5	2	Rosewood Town Homes	**73**	**74**	+ 1
R110	B	5	2	Rosewood Town Homes	**72**	**72**	0
R111	B	5	2	Rosewood Town Homes	**69**	**69**	0
R112	B	5	1	Rosewood Town Homes	59	59	0
R113	B	5	2	Rosewood Town Homes	59	59	0
R114	B	5	1	Rosewood Town Homes	58	59	0
R115	C	5	5	Rosewood Town Homes Playground	58	58	0
R116	B	5	1	Rosewood Town Homes	56	56	0
R117	B	5	2	Rosewood Town Homes	54	55	+ 1
R118	B	5	1	Rosewood Town Homes	53	53	0
R119	B	5	2	Kaline Avenue	54	54	0
R120	B	5	2	Kaline Avenue	55	56	+ 1
R121	B	5	2	Kaline Avenue	58	59	+ 1
R122	B	5	1	Kaline Avenue	52	53	+ 1
R123	B	5	1	Kaline Avenue	53	53	0
R124	B	5	1	Kaline Avenue	57	57	0
R125	B	5	1	Kaline Avenue	60	61	+ 1
R126	B	5	1	Starlite Avenue	53	54	+ 1
R127	B	5	1	Starlite Avenue	56	56	0
R128	B	5	1	Starlite Avenue	59	59	0
R129	B	5	1	Starlite Avenue	64	64	0
R130	B	5	1	Starlite Avenue	**70**	**70**	0
R131	B	5	1	Siesta Street	**70**	**70**	0

Table 6 – 2023 Existing and Future 2045 Build Peak PM Noise Levels (Continued)

TNM RECEIVER ID	NAC	CNE AREA	DWELLING UNITS	LOCATION	2023 EXISTING NOISE LEVEL LEQ (ONE-HOUR) DB(A)[1]	2045 BUILD NOISE LEVEL LEQ (ONE-HOUR) DB(A)[1]	DELTA BUILD MINUS EXISTING DB
R132	B	5	1	Siesta Street	**68**	**68**	0
R133	B	5	1	Eventide Avenue	58	58	0
R134	B	5	1	Eventide Avenue	54	54	0
R135	B	5	1	Eventide Avenue	50	51	+ 1
R136	B	5	1	Siesta Street	**67**	**67**	0
R137	B	5	1	Siesta Street	**66**	**66**	0
R138	B	5	1	Siesta Street	65	65	0
R139	B	5	1	Siesta Street	65	65	0
R140	B	5	1	Siesta Street	64	64	0
R141	B	5	1	Eventide Avenue	52	52	0
R142	B	5	1	Eventide Avenue	56	56	0
R143	B	5	1	Siesta Street	53	54	+ 1
R144	B	5	1	Siesta Street	52	52	0
R145	B	5	1	Siesta Street	51	51	0
R146	B	5	1	Moonlite Avenue	52	52	0
R147	B	5	1	Moonlite Avenue	55	55	0
R148	B	5	1	Moonlite Avenue	56	56	0
R149	B	5	1	Moonlite Avenue	61	62	+ 1
R150	B	6	2	Hermitage Townhomes	54	54	0
R151	B	6	2	Hermitage Townhomes	56	56	0
R152	B	6	2	Hermitage Townhomes	58	58	0
R153	B	6	2	Hermitage Townhomes	61	61	0
R154	B	6	2	Hermitage Townhomes	63	63	0
R155	B	6	2	Hermitage Townhomes	64	64	0
R156	B	6	2	Hermitage Townhomes	**66**	**66**	0
R157	B	6	2	Hermitage Townhomes	**66**	**66**	0
R158	B	6	2	Hermitage Townhomes	**66**	**66**	0
R159	B	6	2	Hermitage Townhomes	61	61	0
R160	B	6	2	Hermitage Townhomes	61	61	0
R161	B	6	2	Hermitage Townhomes	61	61	0
R162	B	6	2	Hermitage Townhomes	62	63	+ 1
R163	B	6	2	Hermitage Townhomes	63	64	0
R164	B	6	2	Hermitage Townhomes	65	65	0
R165	B	6	2	Hermitage Townhomes	55	55	0
R166	B	6	2	Hermitage Townhomes	56	56	0
R167	B	6	2	Hermitage Townhomes	58	58	0

Table 6 – 2023 Existing and Future 2045 Build Peak PM Noise Levels (Continued)

TNM RECEIVER ID	NAC	CNE AREA	DWELLING UNITS	LOCATION	2023 EXISTING NOISE LEVEL LEQ (ONE-HOUR) DB(A)[1]	2045 BUILD NOISE LEVEL LEQ (ONE-HOUR) DB(A)[1]	DELTA BUILD MINUS EXISTING DB
R168	B	6	2	Hermitage Townhomes	54	54	0
R169	B	6	2	Hermitage Townhomes	52	52	0
R170	B	6	2	Hermitage Townhomes	53	54	+ 1
R171	B	6	2	Hermitage Townhomes	53	54	0
R172	B	6	2	Hermitage Townhomes	53	54	+ 1
R173	B	6	2	Hermitage Townhomes	58	58	0
R174	B	6	2	Hermitage Townhomes	61	61	0
R175	B	6	2	Hermitage Townhomes	60	60	0
R176	B	6	2	Hermitage Townhomes	59	59	0
R177	B	6	2	Hermitage Townhomes	56	57	+ 1
R178	B	6	2	Hermitage Townhomes	57	57	0
R179	B	6	2	Hermitage Townhomes	60	60	0
R180	B	6	1	Raborn Court	60	60	0
R181	B	6	1	Raborn Court	63	64	0
R182	B	7	1	Parkview Avenue	56	56	0
R183	C/D	7	1	House of Worship at Kalamazoo Conference Center Church	59 (39)*	60 (60)*	+ 1
R183B	C/D	7	1	House of Worship at Kalamazoo Conference Center Second Church Building	58 (38)*	59 (39)*	+ 1
R184	C/D	7	1	House of Worship at Kalamazoo Conference Center	61 (41)*	61 (41)*	0
R184B	C	7	4	House of Worship at Kalamazoo Conference Center Outdoor Playground	63	64	+ 1
R185	E	7	1	Hotel at Kalamazoo Conference Center	55	55	0
R186	E	7	1	Hotel at Kalamazoo Conference Center	68	68	0
R187	C/D	7	1	Daycare Facility at Kalamazoo Conference Center	64 (44)*	64 (44)*	0
R188	E	7	1	Hotel at Kalamazoo Conference Center	53	53	0
R189A	C/D	8	6	Dr. Robert C Kiser, DO MSPH Medical Practice	57	57	0
R189B	C	8	4	Dr. Robert C Kiser, DO MSPH Medical Practice Outdoor Seating Area	47	47	0

Table 6 – 2023 Existing and Future 2045 Build Peak PM Noise Levels (Continued)

TNM RECEIVER ID	NAC	CNE AREA	DWELLING UNITS	LOCATION	2023 EXISTING NOISE LEVEL LEQ (ONE-HOUR)	2045 BUILD NOISE LEVEL LEQ (ONE-HOUR) DB(A)[1]	DELTA BUILD MINUS EXISTING DB
R189C	C	8	4	Business Tech and Research Outdoor Area	58	59	+ 1
TOTAL NUMBER OF TNM Modeling RECEIVER IMPACTS					55	55	0

[1]All noise level and noise reduction estimates shown are rounded to nearest whole number; noise level values in bold text represent impacted receptors.

* Interior noise level estimate in parathesis.

Figure 4B – Peak-Hour PM 2023 Existing Noise Level Estimates With Existing Noise Walls

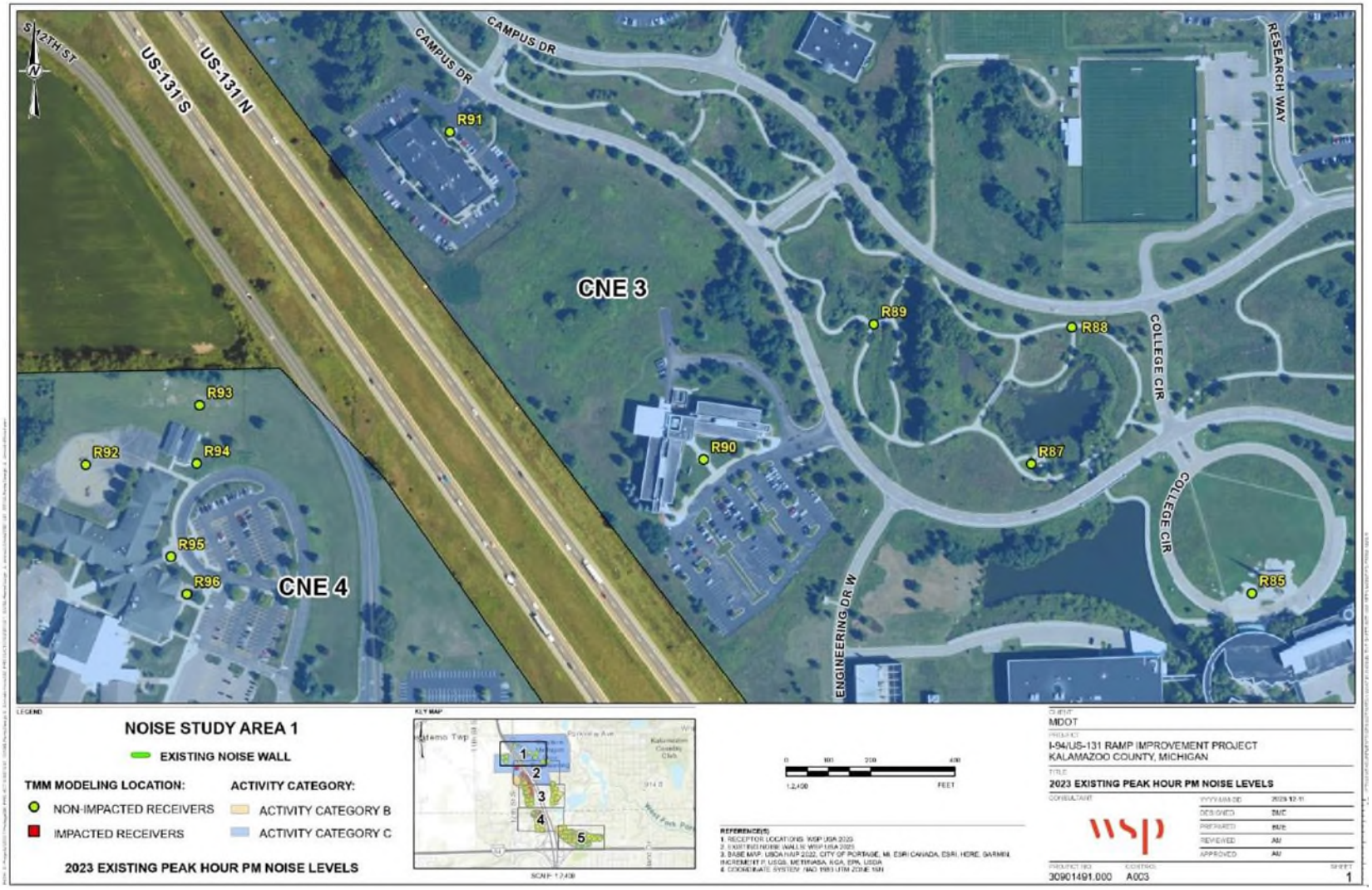


Figure 4C – Peak-Hour PM 2023 Existing Noise Level Estimates With Existing Noise Walls

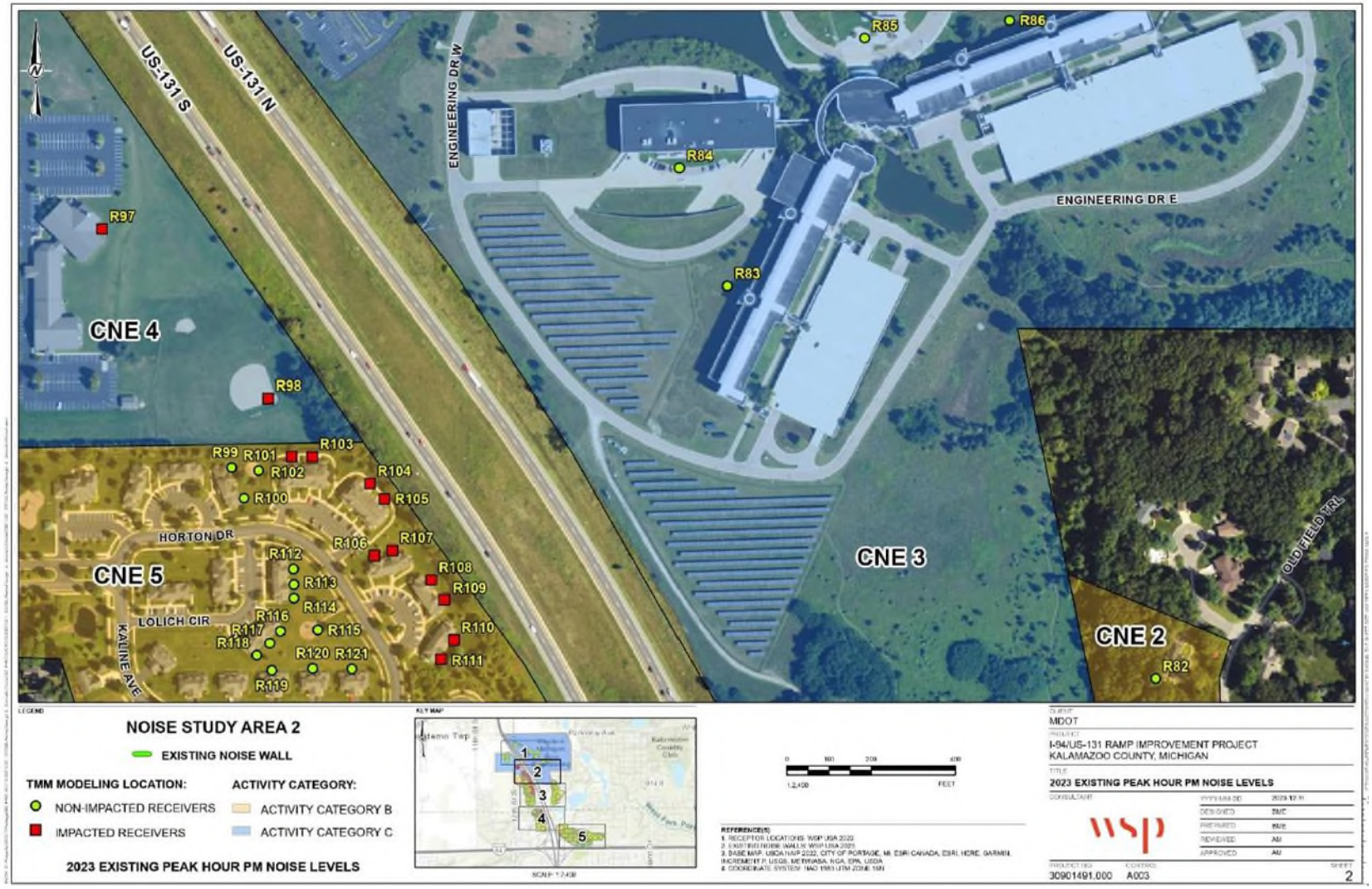


Figure 4D – Peak-Hour PM 2023 Existing Noise Level Estimates With Existing Noise Walls

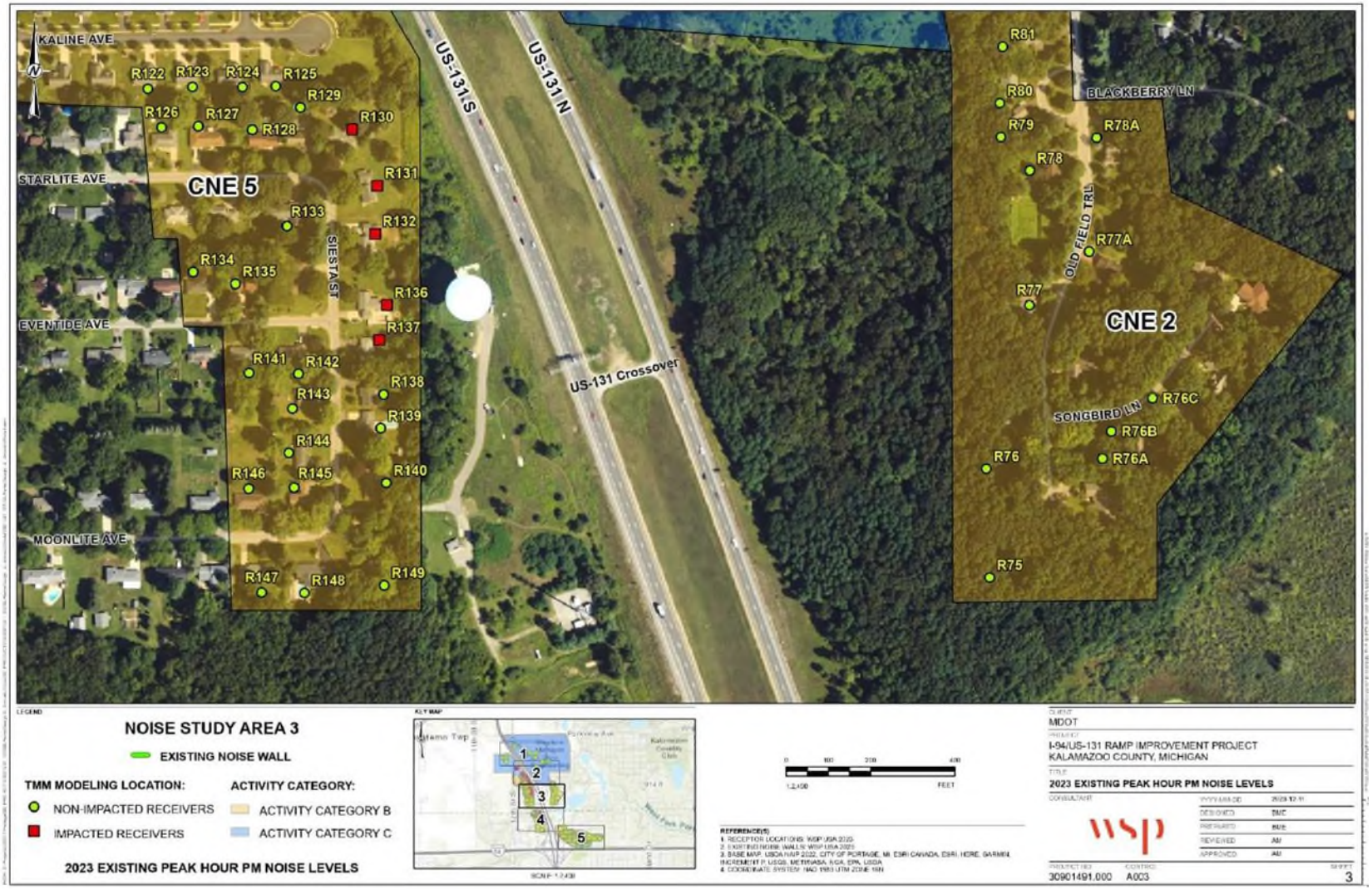


Figure 4E – Peak-Hour PM 2023 Existing Noise Level Estimates With Existing Noise Walls

Figure 4F – Peak-Hour PM 2023 Existing Noise Level Estimates With Existing Noise Walls

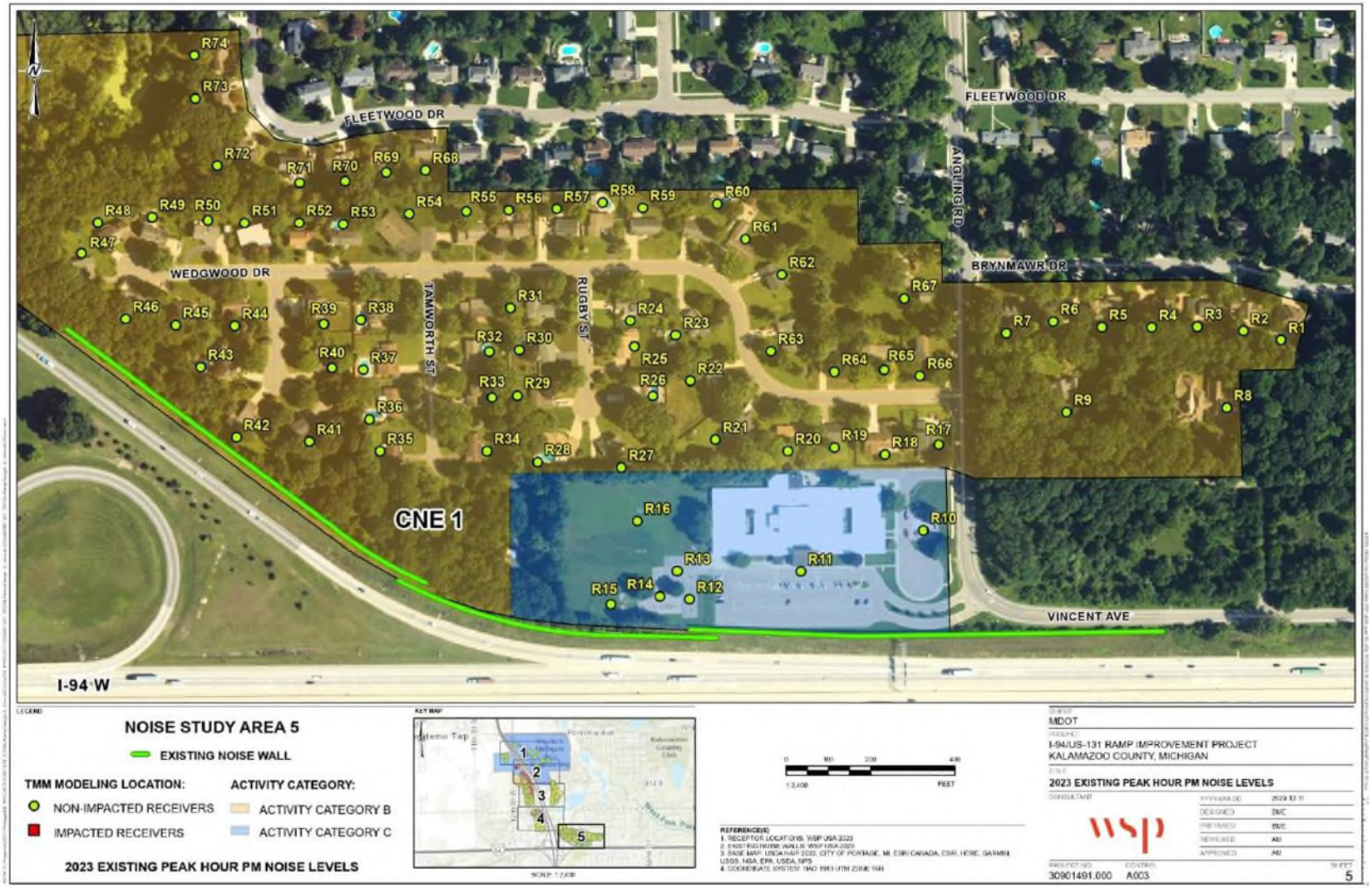


Figure 4G – Peak-Hour PM 2023 Existing Noise Level Estimates With Existing Noise Walls

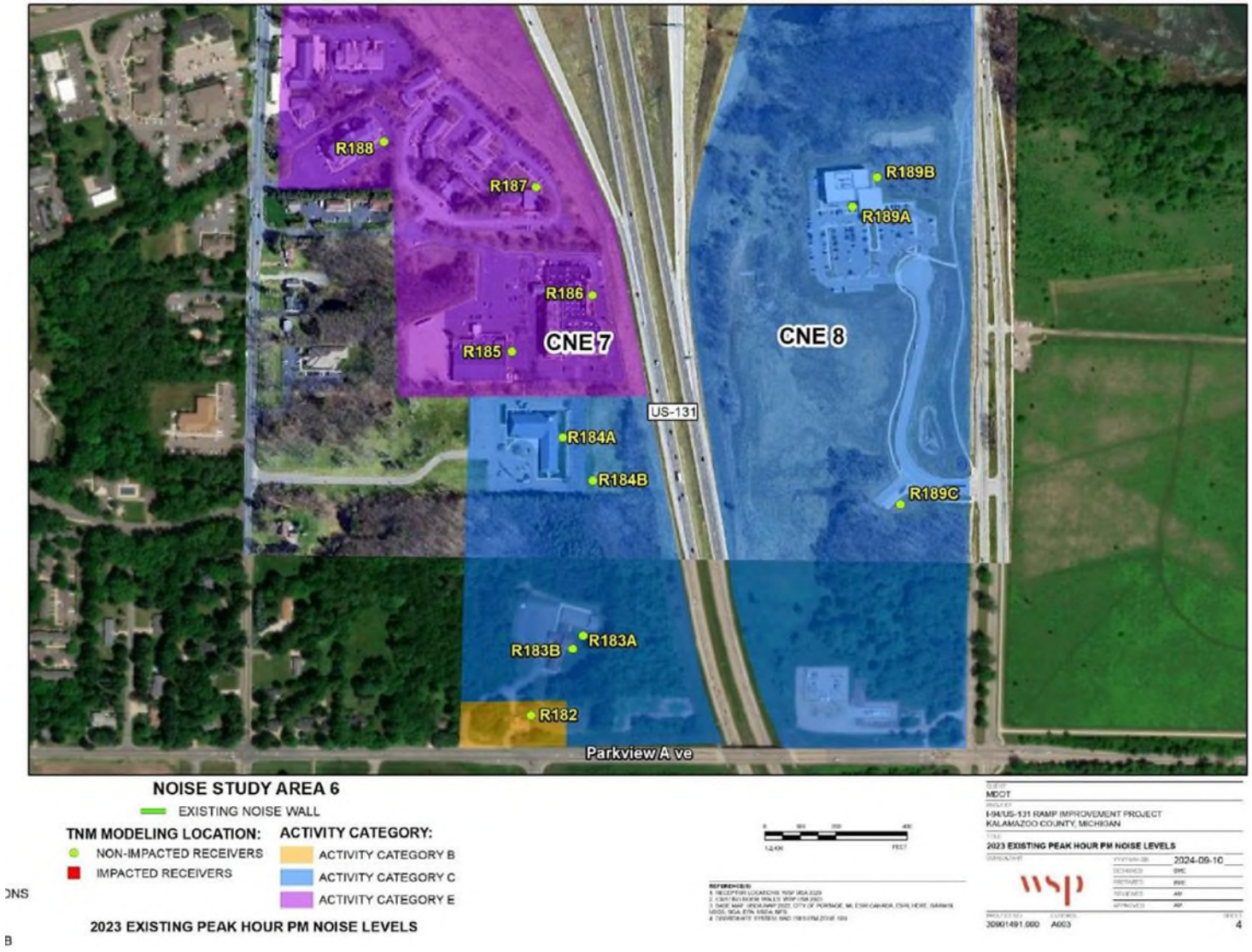


Figure 5A – Peak-Hour PM 2045 Build Noise Level Estimates With Existing Noise Walls

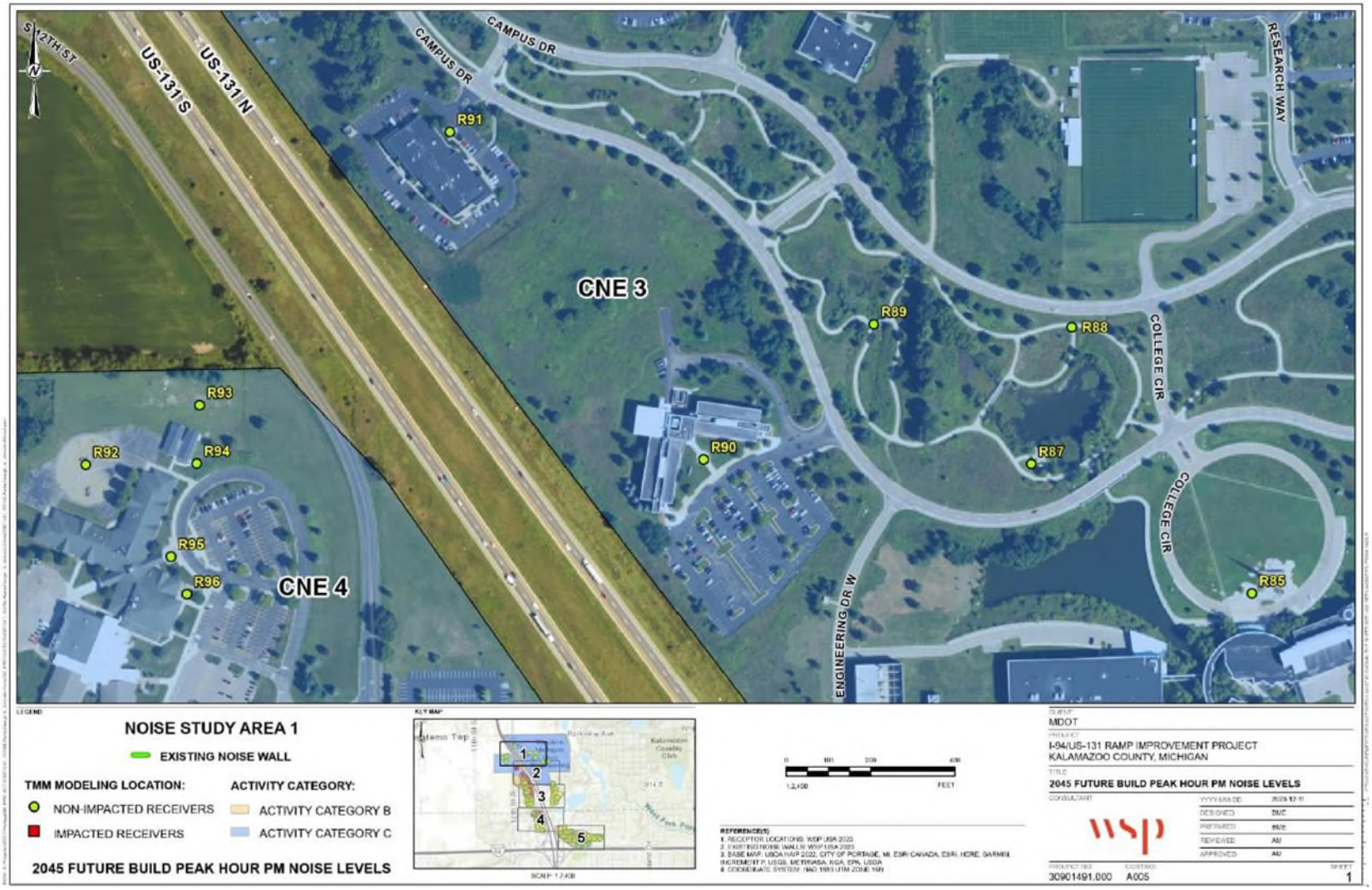


Figure 5B – Peak-Hour PM 2045 Build Noise Level Estimates With Existing Noise Walls

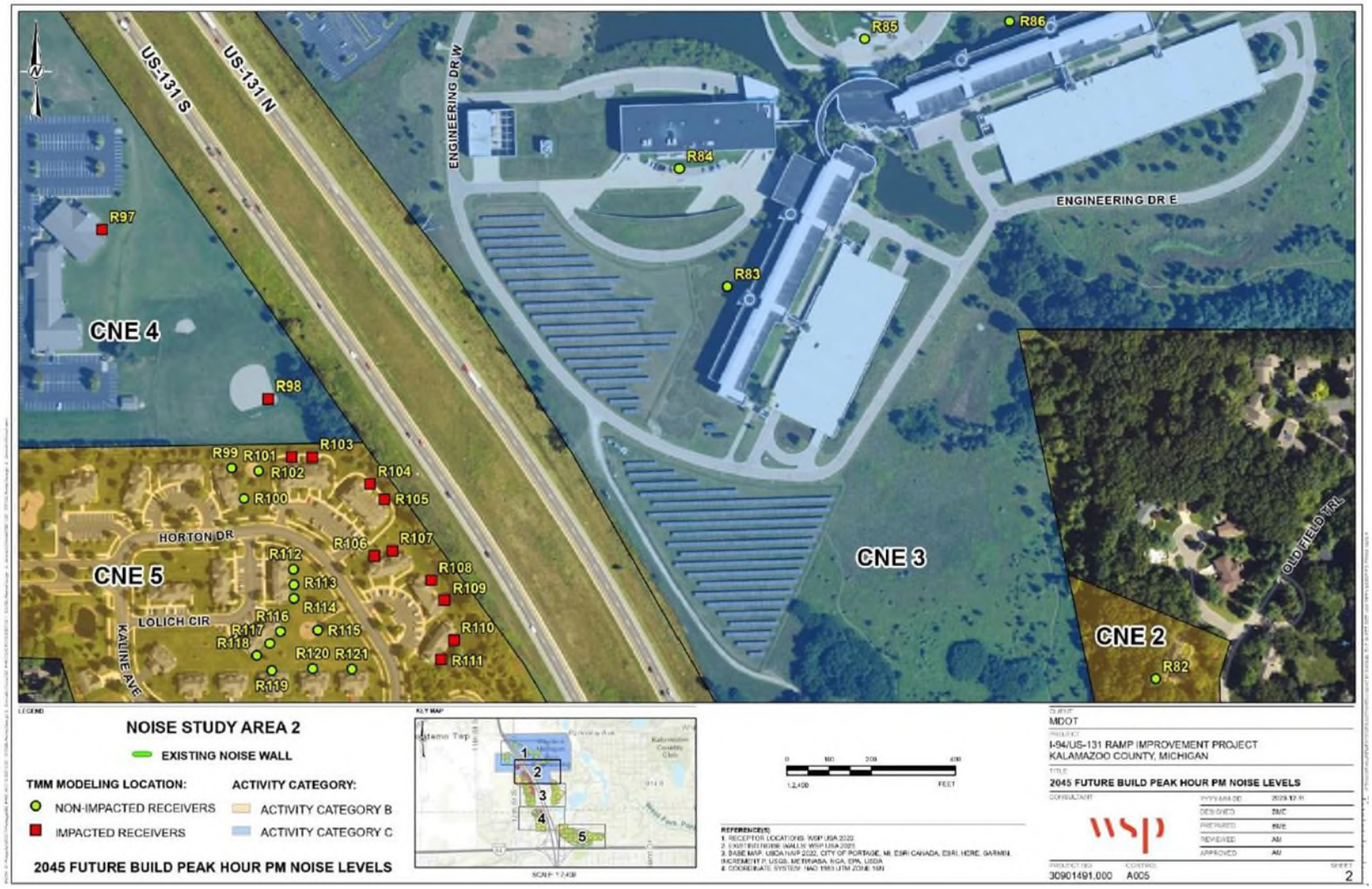


Figure 5C – Peak-Hour PM 2045 Build Noise Level Estimates With Existing Noise Walls

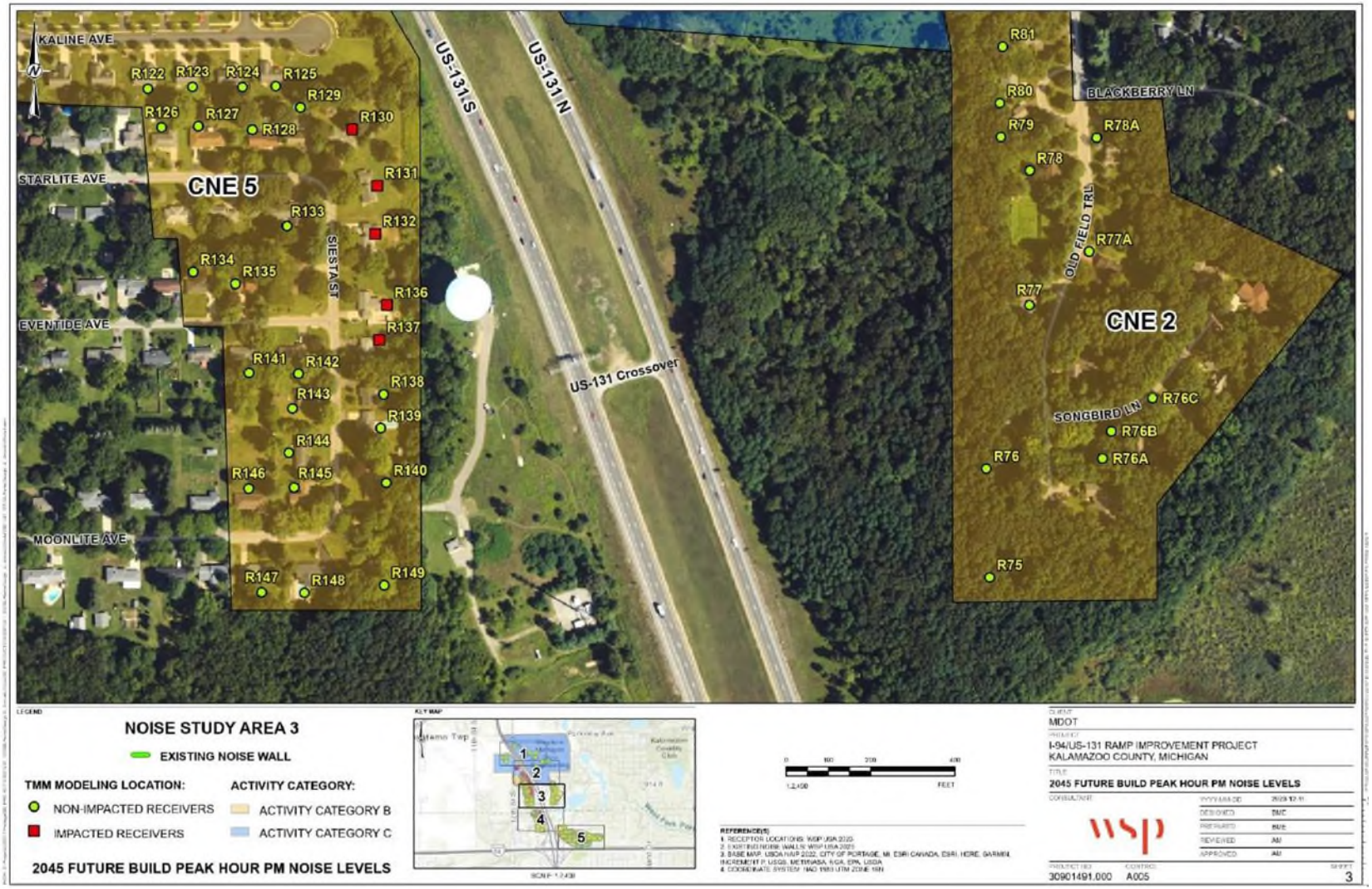


Figure 5D – Peak-Hour PM 2045 Build Noise Level Estimates With Existing Noise Walls

Figure 5E – Peak-Hour PM 2045 Build Noise Level Estimates With Existing Noise Walls

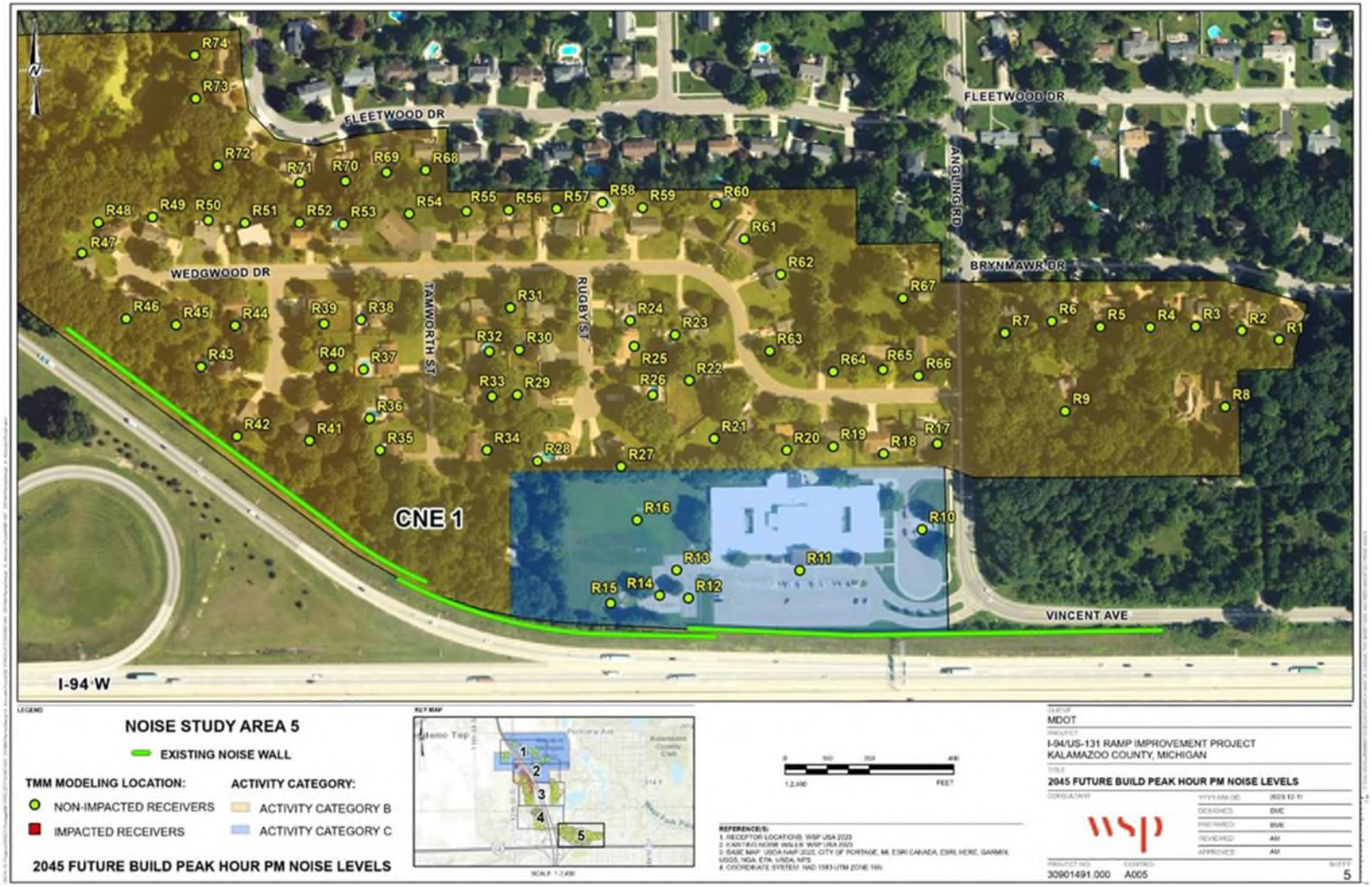
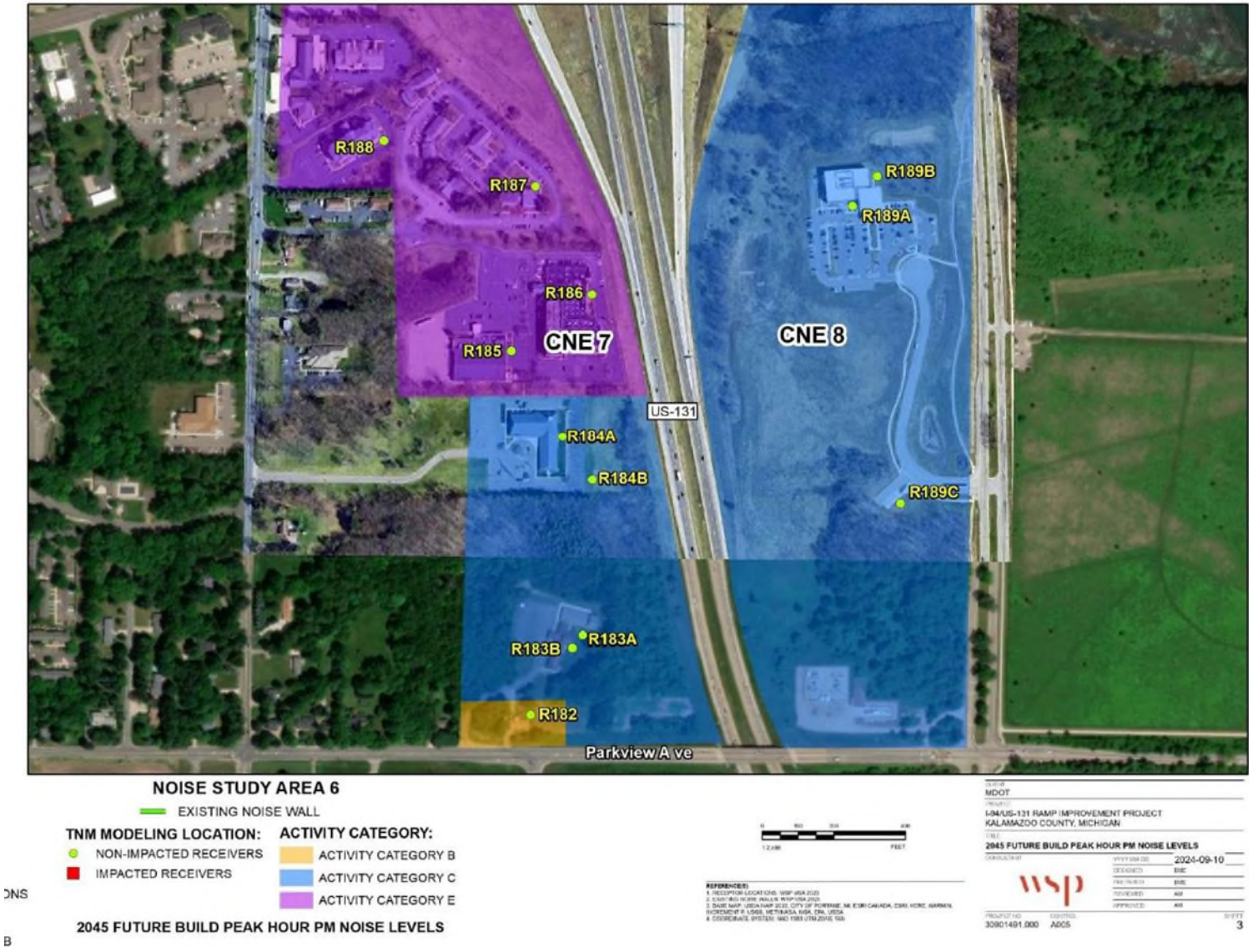


Figure 5F – Peak-Hour PM 2045 Build Noise Level Estimates With Existing Noise Walls



4.0 FUTURE 2045 BUILD CONDITIONS WITH ABATEMENT

4.1 Noise Abatement Analysis Findings

In accordance with federal requirements outlined in 23 CFR 772, noise impacts reported at residential properties adjacent to US-131 along the southbound travel lanes were considered for noise abatement. The noise abatement analysis findings within each common noise environment are as follows:

Common Noise Environment 1

Residences within the CNE 1 area do not experience noise impacts with proposed construction of the ramp improvements under 2045 Build traffic conditions. An assessment of the noise reduction effectiveness of the existing barrier walls was completed and found the following:

The three existing noise barrier walls consist of a combined length of 2,911 linear feet, 51,998 square feet and range in height from 11.8 to 25 feet. The combined existing noise barrier walls provide 5 dBA or greater noise reduction benefit at 57 dwellings, with 45 dwelling experiencing a 7 dBA benefit, resulting in an CPBU of $41,052 dollars. These findings confirm the three existing walls provide cost-effective noise reduction benefit to the CNE 1 community as they currently are configured; therefore, no modifications to the existing noise barrier design are necessary.

Common Noise Environment 2

No traffic noise impacts are projected to occur under future 2045 Build conditions within this residential area; therefore, no noise abatement consideration is necessary.

Common Noise Environment 3

No traffic noise impacts are projected to occur under future 2045 Build conditions within this NAC C land use area consisting of Western Michigan University; therefore, no noise abatement consideration is necessary.

Common Noise Environment 4

No impacts are projected to occur at the Kalamazoo Christian Middle School located within the northern section of CNE 4. However, impacts are projected to occur at exterior areas of the 12 Street Baptist Church and adjoining baseball field, though no impacts are projected to occur inside the church itself, where interior noise levels are expected to remain below the 51 dBA impact threshold. Therefore, only the baseball field area is considered an impact under future 2045 Build conditions. However, because the baseball field borders the CNE 5 impacted residential area located just to its immediate south, a proposed noise barrier wall considered for the CNE 5 area would also provide noise reduction benefit to the baseball field as well. Therefore, mitigation for the ballfield is included as part of the CNE 5 noise barrier analysis consideration.

Common Noise Environment 5

The CNE 5 residential area does not have an existing noise barrier wall. Under future 2045 Build conditions, impacts are projected to occur at 15 TNM receivers, representing 33 residential dwellings. Therefore, a noise barrier was evaluated for this community. **Table 7** provides a summary of the receiver sites where impacts are projected to occur, the noise reduction levels achieved with a noise barrier wall and the number of benefitting dwellings for each modeled TNM receiver site. Impacted receptors, benefitting dwellings and the number of benefiting dwellings represented by that receiver are all shown in bold font. A benefiting receiver must achieve a minimum 5 decibel noise reduction. The noise barrier must extend north into the CNE 4 area in order to provide the noise reduction benefit at CNE 5 receptors R102 and R103. The TNM model identified 37 impacted dwellings consisting of the 33 residential dwellings within CNE 5 and 4-equivalent dwellings derived for the adjacent CNE 4 baseball field estimated using the procedures described on pages 65 and 66 of the MDOT Noise Analysis and Abatement Handbook. Therefore, the proposed noise barrier wall would provide benefit to 47 total benefitting dwellings, comprised of 35 impacted dwelling benefits and 12 non-impacted dwelling benefits. A depiction of the proposed noise barrier along the southbound US-131 right of way is shown by the blue line in **Figure 6**.

A summary of the feasibility and reasonableness assessment of the proposed southbound US-131 sound barrier is provided in **Table 8**. The proposed noise barrier satisfies all MDOT cost and noise reduction effectiveness requirements for feasibility and reasonableness. A noise reduction benefit of 5 dB(A) or more would be realized at 95 percent of the impacted dwellings and a 7 dB(A) or greater noise reduction benefit would be achieved at 70 percent of the dwellings. In addition, a 10 dB(A) or greater noise reduction would occur at 18 impacted dwellings. On a cost basis, the proposed noise barrier would provide abatement at a CPBU of $30,847, which is below the maximum MDOT cost limit of $52,248. Based on MDOT's $45 per square foot planning cost, the total construction cost of the proposed noise barrier is estimated to be approximately $1.45 million. Physically, the barrier wall would consist of an average height of 14.3 feet and be 2,253 feet in length. Therefore, based on the abatement analysis completed to date, the proposed noise barrier is recommended for public comment and final design consideration.

Common Noise Environment 6

The CNE 6 residential area currently receives benefit from an existing noise barrier wall. However, under future 2045 Build conditions, impacts are projected to occur at three TNM receivers, representing six residential dwellings located at or near the northern terminus of the existing noise wall. Therefore, an additional 400-foot-long noise barrier extension was evaluated for this community. The impacted receivers are identified as R156, R157 and R158, as shown in **Figure 5D**. A summary of the receiver locations achieving a noise reduction benefit is provided in **Table 9**. Impacted receivers, the benefitting dwellings and the number of benefiting residential dwellings represented by that receiver are all shown in bold font. A benefiting receiver must achieve a minimum 5 decibel noise reduction. The noise barrier design consisted of a 400-foot total length wall that was stepped up in height in 2-foot increments for each 100 feet in height, with a starting height of 14 feet and ending at 20 feet, resulting in an average height of 17 feet. The proposed noise barrier extension would provide benefit to a total of eight

residential dwelling units consisting of six impacted and two non-impacted benefits. A depiction of the proposed noise barrier extension along the southbound US-131 travel lanes is illustrated by the solid red line in **Figure 7.**

A summary of the feasibility and reasonableness assessment for the proposed southbound US-131 noise barrier extension is provided in **Table 10.** A noise reduction benefit of 5 dB(A) would be realized at 100 percent of the impacted dwellings and a 7 dB(A) noise reduction would be achieved at 75 percent of the benefitting dwellings, but no dwelling which achieved a 10 dBA reduction benefit. Based on cost, the proposed noise barrier wall extension would provide abatement at a CPBU of $38,250 and total cost of $306,000. Because the proposed noise barrier extension did not achieve the required 10 dB(A) noise reduction at one benefitting dwelling, it does not meet MDOT's reasonableness criteria. Therefore, it is not recommended.

Common Noise Environment 7

Within the CNE 7 study area, no traffic noise impacts are projected to occur under future 2045 Build conditions. Therefore, no noise abatement consideration is necessary.

Common Noise Environment 8

Within the CNE 8 study area, no traffic noise impacts are projected to occur under future 2045 Build conditions. Therefore, no noise abatement consideration is necessary.

Table 7 – CNE 5 Noise Reduction Levels at Receivers Behind Proposed Southbound US-131 Barrier

TNM RECEIVER ID	LAND USE DESCRIPTION	2045 BUILD NOISE LEVEL LEQ (ONE-HOUR) dB(A)[1]	MDOT/FHWA IMPACT YES/NO (NUMBER OF DWELLINGS)	NOISE REDUCTION LEVEL ACHIEVED WITH ABATEMENT[1] (dB)	NUMBER OF BENEFITTING DWELLINGS
R133	Residential	58	No	3	0
R135	Residential	51	No	0	0
R119	Residential	54	No	3	0
R118	Residential	53	No	2	0
R117	Residential	55	No	2	0
R98	Active Recreation	**69**	**Yes (4)**	**7**	**4**
R99	Residential	64	No	**5**	**3**
R100	Residential	62	No	**5**	**3**
R101	Active Recreation	64	No	**6**	**5**
R102	Residential	**68**	**Yes (4)**	**7**	**4**
R103	Residential	**70**	**Yes (4)**	**8**	**4**
R104	Residential	**74**	**Yes (4)**	**11**	**4**
R105	Residential	**74**	**Yes (4)**	**11**	**4**
R106	Residential	**67**	**Yes (2)**	**10**	**2**
R107	Residential	**71**	**Yes (2)**	**12**	**2**
R108	Residential	**74**	**Yes (2)**	**11**	**2**
R109	Residential	**74**	**Yes (2)**	**11**	**2**
R110	Residential	**72**	**Yes (2)**	**10**	**2**
R111	Residential	**69**	**Yes (2)**	**9**	**2**
R112	Residential	59	No	4	0
R113	Residential	59	No	4	0
R114	Residential	59	No	4	0
R115	Active Recreation	58	No	4	0
R116	Residential	56	No	3	0
R120	Residential	56	No	2	0
R121	Residential	59	No	3	0
R124	Residential	57	No	0	0
R125	Residential	61	No	4	0
R128	Residential	59	No	3	0
R129	Residential	64	No	**5**	**1**
R130	Residential	**70**	**Yes (1)**	**7**	**1**
R131	Residential	**70**	**Yes (1)**	**6**	**1**
R132	Residential	**68**	**Yes (1)**	**5**	**1**
R134	Residential	54	No	0	0
R136	Residential	**67**	**Yes (1)**	3	0
R137	Residential	**66**	**Yes (1)**	1	0
R138	Residential	65	No	1	0
R139	Residential	64	No	1	0
R140	Residential	64	No	0	0
Total Number of Impacts and Benefits			**37**	NA	**47**

1 All noise level and noise reduction estimates shown are rounded to nearest whole number.

Table 8 – CNE 5 Area Feasibility and Reasonableness of Proposed Southbound US-131 Noise Barrier

FEASIBILITY CONSIDERATION	YES OR NO
Engineering Consideration: Can the abatement measure be built?	Yes (1)
Acoustic Consideration: Does the proposed abatement measure provide a reduction of at least 5 dB(A) at 75 percent of the impacted receptors?	Yes (1)
REASONABLENESS CONSIDERATION	
Design Goal: Does the proposed abatement measure provide a reduction of 10 dB(A) for one benefiting receptor and at least 7 dB(A) at 50 percent or more of the benefiting receptor sites?	Yes (1)
Design Goal: Does the proposed abatement measure cost less than $52,248 per benefiting receptor site?	Yes (1)
Viewpoint of Benefiting Property Owners and Residences: Were positive responses in favor of the abatement measure obtained from at least 50 percent or more of the tallied votes?	Next Phase
DETAILS OF THE ABATEMENT MEASURE COST AND ACOUSTIC EFFECTIVE FINDINGS	
Impacted Receptors Behind Proposed Sound Barrier(s)	37
Number of Impacted Receptors With 5 dB(A) Noise Reduction	35
Number of Impacted and Non-Impacted Receptors With 5 dB(A) Noise Reduction	47
Percent of Impacted Receptors With 5 dB(A)Noise Reduction	95%
Number of Benefiting Receptors With 7 dB(A) Noise Reduction	33
Percent of Benefiting Receptors with 7 dB(A) Noise Reduction	70%
Number of Impacted Receptors with 10 dB(A)Noise Reduction	18
Total Cost (Dollars)	$1,449,806
Cost Per Benefitting Receptor Unit (CPBU in Dollars)	$30,847
Total Length (Feet)	2,253 feet
Average Height (Feet)	14.3 feet
Total Square Footage	32,218 feet^2

(1) If all the questions can be answered "Yes," then the abatement measure is considered feasible and reasonable.

Figure 6 – CNE 5 Proposed Southbound US-131 Noise Barrier

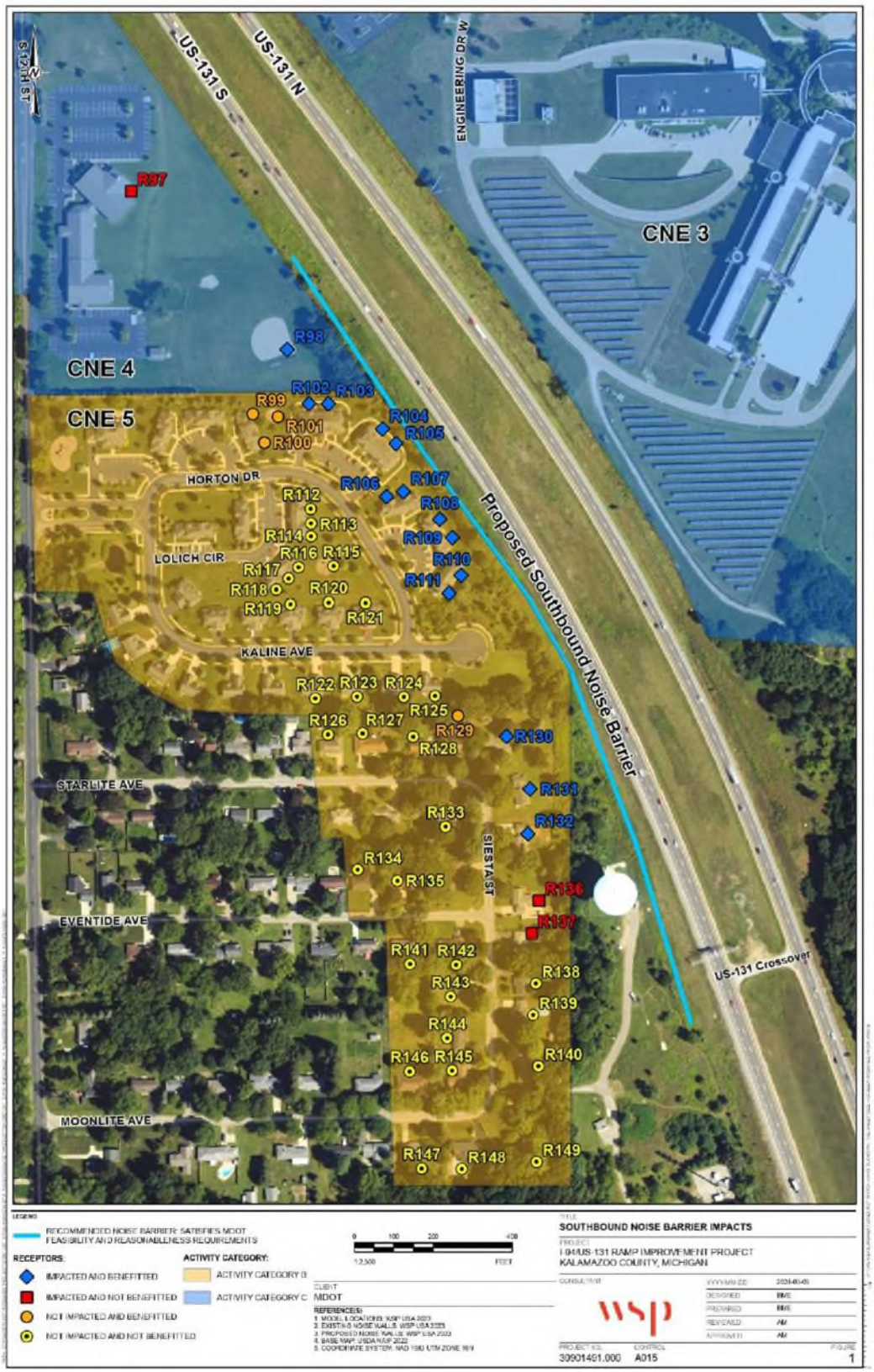


Table 9 – Noise Reduction Levels at Receivers Behind Proposed Southbound US-131 Barrier Extension Within CNE 6 Area

TNM RECEIVER ID	LAND USE DESCRIPTION	2045 BUILD NOISE LEVEL LEQ (ONE-HOUR) dB(A)[1]	MDOT/FHWA IMPACT YES/NO (NUMBER OF DWELLINGS)	NOISE REDUCTION LEVEL ACHIEVED WITH ABATEMENT[1] (dB)	NUMBER OF BENEFITTING DWELLINGS
R150	Residential	54	No	1	0
R151	Residential	56	No	1	0
R152	Residential	58	No	2	0
R153	Residential	62	No	4	0
R154	Residential	64	No	4	0
R155	Residential	65	No	**5**	**2**
R156	Residential	**69**	**Yes (2)**	**7**	**2**
R157	Residential	**70**	**Yes (2)**	**7**	**2**
R158	Residential	**71**	**Yes (2)**	**7**	**2**
Total Number of Impacts and Benefits			**6**	**NA**	**8**

1 All noise level and noise reduction estimates shown are rounded to nearest whole number.

Table 10 – CNE 6 Area Feasibility and Reasonableness Assessment of Proposed Southbound US-131 Noise Barrier Extension

FEASIBILITY CONSIDERATION	YES OR NO
Engineering Consideration: Can the abatement measure be built?	Yes (1)
Acoustic Consideration: Does the proposed abatement measure provide a reduction of at least 5 dB(A) at 75 percent of the impacted receptors?	Yes (1)
REASONABLENESS CONSIDERATION	
Design Goal: Does the proposed abatement measure provide a reduction of 10 dB(A) for one benefiting receptor and at least 7 dB(A) at 50 percent or more of the benefiting receptor sites?	**No** (1)
Design Goal: Does the proposed abatement measure cost less than $52,248 per benefiting receptor site?	Yes (1)
Viewpoint of Benefiting Property Owners and Residences: Were positive responses in favor of the abatement measure obtained from at least 50 percent or more of the tallied votes?	Barrier Not Recommended
DETAILS OF THE ABATEMENT MEASURE COST AND ACOUSTIC EFFECTIVE FINDINGS	
Impacted Receptors Behind Proposed Sound Barrier(s)	6
Number of Impacted Receptors With 5 dB(A) Noise Reduction	6
Number of Impacted and Non-Impacted Receptors With 5 dB(A) Noise Reduction	8
Percent of Impacted Receptors With 5 dB(A)Noise Reduction	100%
Number of Benefiting Receptors With 7 dB(A) Noise Reduction	6
Percent of Benefiting Receptors With 7 dB(A) Noise Reduction	75%
Number of Impacted Receptors With 10 dB(A)Noise Reduction	0
Total Cost (Dollars)	$306,000
Cost Per Benefitting Receptor Unit (CPBU in Dollars)	$38,250
Total Length (Feet)	400 feet
Average Height (Feet)	17 feet
Total Square Footage	6,800 feet[2]

(1) If all the questions can be answered "Yes," then the abatement measure is considered feasible and reasonable.

Figure 7 – CNE 6 Proposed Southbound US-131 Noise Barrier

4.2 Statement of Likelihood

Based on the latest noise barrier analysis, MDOT intends to install highway traffic noise abatement measures, in the form of a sound barrier, within the CNE area 5 residential community based on the documented feasibility and reasonableness assessment summarized in **Table 8** and illustrated in **Figure 6.** However, if it subsequently develops during the final design step that these conditions have substantially changed, the abatement measure may not be provided. The final decision for the installation and aesthetics of the abatement measure will be made upon completion of the proposed project final design and the content sensitive design process.

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5.0 CONSTRUCTION NOISE

In general, the noise generated by highway-related construction work is created from a variety of noise sources and can be best defined by identifying those phases of construction that would produce the greatest noise. Moreover, each phase of construction has its own mix of equipment and, therefore, its own sound characteristics. For most highway projects, these construction phases overlap due to time constraints and interdependency of activities. Noise generated from construction activity would be highest typically during the early phase when excavation equipment and jack hammers are used, and when delivery vehicles travel to and from the site. However, these activities are not stagnant. They move from place to place as the work progresses along the roadway improvement corridor. Therefore, the noise exposure at adjacent sensitive properties will vary over time.

Specifically, for the I-94/US-131 roadway improvement project, given its relatively short 1.5 miles of length, the duration of the construction work can be best characterized as short-term. The construction work has the potential to increase ambient noise levels for several continuous hours at a time on land uses within 250 feet that have at least a partial line of sight to the construction zone. However, the nearest residential areas closest to the proposed major roadway improvements are protected by existing noise walls and favorable ground terrain. Therefore, these shielding elements are expected to mitigate most of the potential construction noise at these closest sensitive sites.

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6.0 CONCLUSION

A traffic noise study was completed to determine general noise exposure under 2045 peak-hour traffic conditions as a result of the proposed ramp improvement within the I-94 and US-131 study area. A synopsis of the analysis findings are as follows:

- **CNE 1:** This community is located closest to the proposed ramp improvement. The analysis findings show that all residential properties behind the existing noise barrier walls located in the northeast quadrant of the I-94/US-131 interchange area would provide sufficient noise reduction effectiveness under future peak-hour 2045 Build traffic conditions.

- **CNE 2:** No noise impacts are projected to occur under future peak-hour 2045 Build traffic conditions in this residential area. Therefore, no noise barrier consideration was necessary.

- **CNE 3:** No noise impacts are projected to occur under future peak-hour 2045 Build traffic conditions in this Western Michigan University campus area. Therefore, no noise barrier consideration was necessary.

- **CNE 4:** Exterior noise impacts are projected to occur at 12th Street Baptist Church and adjoining baseball field. However, interior noise levels inside the church would remain below the 51 dBA impact level. All other land uses do not experience noise impact. A proposed noise barrier extending north from within the CNE 5 area would also provide noise reduction benefit to the baseball field.

- **CNE 5:** Impacts were found to occur at 15 modeling site locations consisting of 33 residential dwellings. To provide adequate noise reduction at the 33 impacted residential dwellings, the proposed noise barrier wall would have to extend north into the CNE 4 area and thus provides noise reduction benefit to the CNE 4 baseball field. The proposed noise barrier was found to satisfy all MDOT cost and noise reduction requirements and thus is recommended for public final design consideration.

- **CNE 6:** This community has an existing noise barrier wall; however, noise impacts were found to occur at three modeling sites representing six residential dwellings along the northern terminus of the existing barrier wall. A proposed 400-foot-long noise barrier wall extension was evaluated but did not satisfy MDOT's 10 dBA noise reduction reasonableness criteria requirement. Therefore, it is not recommended.

- **CNE 7:** No noise impacts are projected to occur at any of the receptor sites within the CNE 7 study area under future peak-hour 2045 Build traffic conditions. Therefore, no noise barrier consideration is warranted.

- **CNE 8:** No noise impacts are projected to occur at any of the receptor sites within the CNE 8 study area under future peak-hour 2045 Build traffic conditions. Therefore, no noise barrier consideration is warranted.

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Noise Appendix:
Calibration Certificates and Noise Measurement Field Notes

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West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

PRECISION INTEGRATING SOUND LEVEL METER
Manufactured by: LARSON DAVIS
Model No: 831C
Serial No: 10313
Calibration Recall No: 33942

Submitted By:

Customer: EMILY ROBINSON
Company: WSP USA, INC.
Address: 434 FAYETTEVILLE STREET
RALEIGH NC 27601

The subject instrument was calibrated to the indicated specification using standards traceable to the SI through the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No. WIC LARS

Upon receipt for Calibration, the instrument was found to be:

Within (X

tolerance of the indicated specification. See attached Report of Calibration.
The information supplied certifies that the item listed above meets acceptance criteria under the decision rule: A—(L-(U95)), where A is the acceptance criteria, L is manufacturer specifications, and U95 is confidence level of 95% at The decision rule has been communicated and approved by customer during contract review. Measurements marked with (*) are not covered by the scope of current A2LA accreditation.

West Caldwell Calibration Laboratories' calibration control system meets the following requirements: ANSINCSL Z540-1, ISO 9001, and ISO 17025.

Note: With This Certificate, Report of Calibration is Included.

Approved by:

James Zhu
Quality Man Cr

Calibration Date: 13-Apr-23
Certificate Issue Date: I9-Apr-23
Certificate No: 33942 -2

QADoc-4105.1 Rev. 30 5/29/20

Certificate Page 1 of 1

ISO/IEC 17025

ACCREDITED
Calibration Lab. *Cert.* # 1533.01

West **Caldwell Calibration Laboratories, Inc.**
unCOmprorniseel Calibration
1575 State Route 96, Victor, NY 14564, U.S.A.

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

PRECISION ACOUSTIC CALIBRATOR
Manufactured by: LARSON DAVIS
Model No: CAL200
Serial No: 15187
Calibration Recall No: 33942

Submitted By:

Customer: EMILY ROBINSON
Company: WSP USA, INC.
Address: 434 FAYETTEVILLE STREET
RALEIGH NC 2760 I

The subject instrument was calibrated to the Indicated specification using standards traceable to the SI through the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No. CAL200 LARS

Upon receipt for Calibration, the instrument was found to be:

Within x)

tolerance of the indicated specification. See attached Report of Calibration.
The information supplied certifies that the item listed above meets acceptance criteria under the decision rule: A—(L-(1195)), where A is the acceptance criteria, L is manufacturer specifications, and U95 is confidence level of 95% at k=2. The decision rule has been communicated and approved by customer during contract review. Measurements marked with (*) are not covered by the scope of current A2LA accreditation.

West Caldwell Calibration Laboratories' calibration control system meets the following requirements: ANSENCSL Z540-1, ISO 9001, and ISO 17025.

Note: With this CeniMate, Report of Calibration is included.

Approved by:

James Zh

Quality M- ager

Calibration Date: **13-Apr-23**
Certificate Issue Date: **19-Apr-23**
Certificate No: **33942 -**

OA Doc. 41051 Rev. 3.0 5/29/20 **Certificate Pane 1 of** ISO/ C 17025

4Ilest Caldwell Calibration
uncompromised calibration **Laboratories, Inc.**
1575 State Route 96, Victor, NY 14564

CCREDITED,
Calibration Lab. Cert. # 1533.01

West Caldwell Calibration Laboratories Inc.

Certificate of Calibration

for

MICROPHONE

Manufactured by: PCB PIEZOTRONICS
Model No: 377C20
Serial No: 173837
Calibration Recall No: 33942

Submitted By:

Customer: EMILY ROBINSON
Company: WSP USA, INC.
Address: 434 FAYETTEVILLE STREET
RALEIGH NC 27601

The subject instrument was calibrated to the indicated specification using standards traceable to the SI through the National Institute of Standards and Technology or to accepted values of natural physical constants. This document certifies that the instrument met the following specification upon its return to the submitter.

West Caldwell Calibration Laboratories Procedure No. 377C20 PCB PI

Upon receipt for Calibration, the instrument was found to be:

Within X

tolerance of the indicated specification. See attached Report of Calibration.
The information supplied certifies that the item listed above meets acceptance criteria under the decision rule: A—(L-(U95)), where A is the acceptance criteria, L is manufacturer specifications, and U95 is confidence level of 95% at k=2. The decision rule has been communicated and approved by customer during contract review. Measurements marked with (*) are not covered by the scope of current A2LA accreditation.

West Caldwell Calibration Laboratories' calibration control system meets the following requirements: ANSI/NCSL Z540-1, ISO 9001, and ISO 17025.

Note: With this Certificate, Report of Calibration is included.

Approved by:

James Z
Quality Ma ger

Calibration Date: 13-Apr-23
Certificate Issue Date: 19-Apr-23
Certificate No: 33942 -4

CIA o... 51051 Rev. 3.0 5/20/20 **Certificate Page 1 of 1**

ISO/IE 17025

ACCREDITED

Calibration Lab. Cert. a 1533.01

kNest Caldwell Calibration Laboratories, Inc.
uncompromIsocI calibration **1575 State Route 96,** victor, **NY** 14564, U.S.A.

PROJECT: 1-96 /131 MDOT

MEAS SITE: Site 1

DATE: June/28/2023 STAFF: Sam Pendyala

MEAS NO	1	**1A**	
START TIME	12:53 PM	1:16 PM	
END TIME	1:13 PM	1:36 PM	
INSTRUMENT	831C	831C	
BATTERY	100%	99.4%	
LEQ	60.7 dBA	61 dBA	
FILE NAME	MDOT.004	MDOT.005	
CALIBRATION	-0.03/-0.06	-0.01/-0.01	/

TRAFFIC

ROADWAY	1-96/131 Ramp &I-4/1-131		
VEH SPEED	75 mph 60mph		
AUTO			
MT			
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			

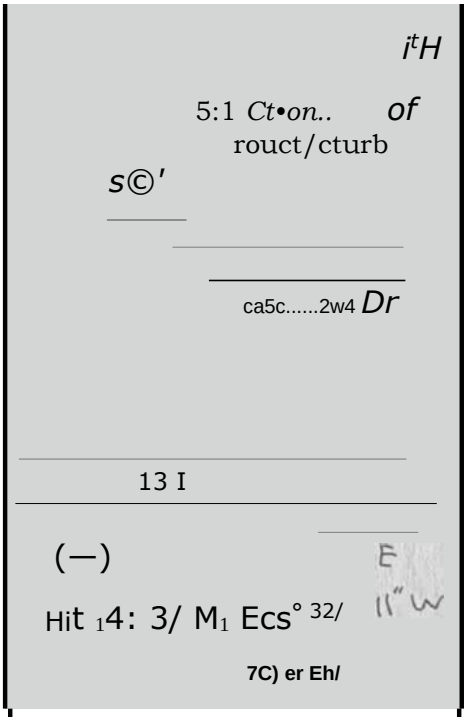
WEATHER

GENERAL	Clear
TEMP	84 F
% RH	40.8
WIND SPD/DIR	0, 3.2 mph @ 15 min / South
ROAD COND.	Ramp Asphalt

SITE

LATITUDE			
LONGITUDE			
PICTURES			

SITE SKETCH I NOTES:



NOISE SOURCES: Free flow traffic

Very quiet neighborhood no local traffic, Traffic noise dominant, birds, some truck applying engine break

EVENT LOG

MEASUREMENT SITE: Site 1

START TIME: 1= 12:53; 2=13:16. Constant bird chirping

MINUTE	EVENT DESCRIPTION
18	Truck Engine Break
MELLII	
6:50 min	Truck Engine Break
9:43 min	Fast Truck
14:53	Loud truck

PROJECT: 1-96 /131 MDOT

MEAS SITE: Site 2

DATE: June/28/2023 STAFF: Sam/ Devin

MEAS NO	2	2A	
START TIME	1:56 PM	2:14 PM	
END TIME	2:10 PM	2:36 PM	
INSTRUMENT	831C	831C	
BATTERY	96%	93.5%	
LEQ	-55.8 dBA	-55.4 dBA	
FILE NAME	MDOT.007	MDOT.008	
CALIBRATION	-0.04/-0.07	/0.01	/

TRAFFIC

ROADWAY	Ramp 131 / 131 SB		
VEH SPEED	60-65 mph		
AUTO			
MT			
HT			
BUS			
MOTO			

ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			

ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			

WEATHER

GENERAL	Clear, cloudy
TEMP	85 F
% RH	36%
WIND SPD/DIR	3 MPH
ROAD COND.	Ramp Asphalt

SITE

LATITUDE			
LONGITUDE			
PICTURES			

SITE SKETCH NOTES:

X

(.load)

1-12.° 16123"Pf ge3b' z"

Al+ 2s *F*

NOISE SOURCES: Free flow traffic

Occasional bird chirpping

PROJECT: 1-96 /131 MDOT

MEAS SITE: Site 3

DATE: June/28/2023 **STAFF:** Sam

MEAS NO	3	3A	
START TIME	10:15 AM	11:17 AM	
END TIME	11:15 AM	11:37 AM	
INSTRUMENT	831C	831C	
BATTERY	100%	100%	
LEQ	69.6 dBA	69.1 dBA	
FILE NAME	MDOT.002	MDOT.003	
CALIBRATION	-0.01	1-0.02	/

TRAFFIC

ROADWAY	Vincent Avenue WB		
VEH SPEED	35 mph		
AUTO	12	17	
MT	1		
HT			
BUS			
MOTO			
ROADWAY	Vincent Avenue EB		
VEH SPEED	35 mph		
AUTO	20	23	
MT	1		
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			

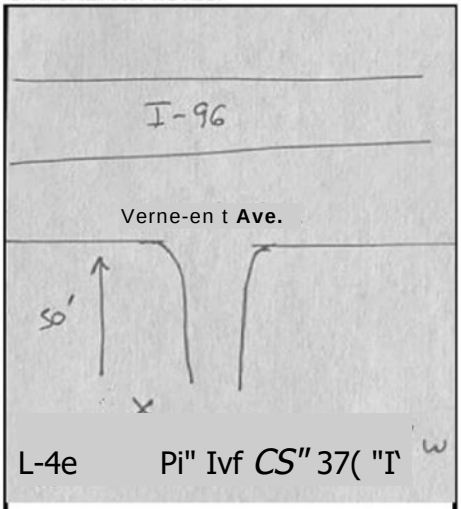
WEATHER

GENERAL	Clear
TEMP	84.4 F
% RH	52%
WIND SPD/DIR	
ROAD COND.	Asphalt

SITE

LATITUDE			
LONGITUDE			
PICTURES	Yes		

SITE SKETCH NOTES:



NOISE SOURCES: Hgihway 1-94

PROJECT: I-96 /131 MDOT

MEAS SITE: Site 4

DATE: June/28/2023 **STAFF:** Sam / Devin

MEAS NO	4		
START TIME	4:19 PM		
END TIME	4:40 PM		
INSTRUMENT	831C		
BATTERY	0.9		
LEQ A	63.1 dBA		
FILE NAME	MDOT.010		
CALIBRATION	0.01 / -0.03		/

TRAFFIC

ROADWAY	131 Free Flow		
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			

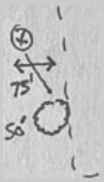
WEATHER

GENERAL	Clear, sky
TEMP	91.4 F
% RH	29.2%
WIND SPD/DIR	3 mph
ROAD COND.	Asphalt

SITE

LATITUDE			
LONGITUDE			
PICTURES			

SITE SKETCH NOTES:



Fend

i-tz: is' ti" SS 33'x' t's

elcw-kon

NOISE SOURCES: Free Flow Traffic on 131

PROJECT: 1-96 /131 MDOT

MEAS SITE: Site 5

DATE: June/28/2023 **STAFF:** Sam / Devin

MEAS NO	5		
START TIME	3:50 PM		
END TIME	4:10 PM		
INSTRUMENT	831C		
BATTERY	93.7%		
LEQ A	66.6 dBA		
FILE NAME	MDOT.009		
CALIBRATION	0.02 / 0.05		/

TRAFFIC

ROADWAY	131 Free Flow		
VEH SPEED	75 mph		
AUTO			
MT			
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			

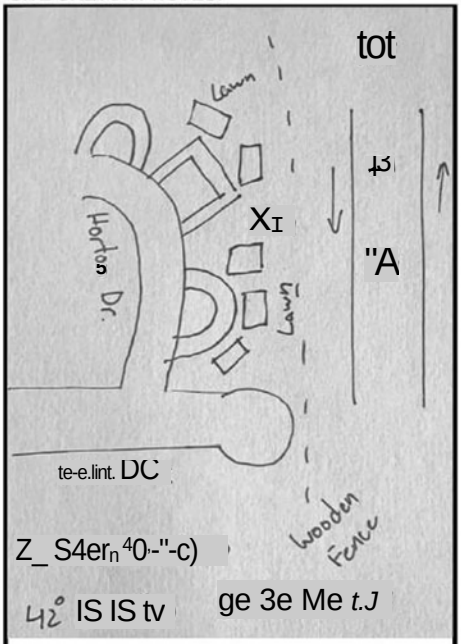
WEATHER

GENERAL	Clear, sky
TEMP	90.6 F
% RH	30.9%
WIND SPD/DIR	1.5 mph
ROAD COND.	Asphalt

SITE

LATITUDE			
LONGITUDE			
PICTURES			

SITE SKETCH / NOTES:



NOISE SOURCES: Free Flow Traffic on 131

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