Appendix G

NOISE

Noise Analysis Technical Memorandum

Noise Analysis Technical Memorandum

US 50 North Vernon Project
Jennings County
DES. NO.
0401402
September 2011

PREPARED BY

PARSONS

101 W. Ohio Street, Suite 2121

Indianapolis, IN 46204

This page left blank intentionally

Executive Summary

A Noise Impact Analysis was conducted for the U.S. 50 North Vernon Project in Jennings County, Indiana in the spring of 2011. This study analyzed two alignments in each segment of the project, Alternative S1, S2-Modified, M1, M2, N3, and N6-Modified. The Federal Highway Administration (FHWA) Traffic Noise Model (TNM) Version 2.5 was used to model existing and proposed noise levels. Measured in A-weighted decibels (dBA), existing noise levels in the corridor range from 57.2 dBA to 60.3 dBA. Design year (2032) modeled traffic generated noise levels range from 39.6 dBA to 67.1 dBA. Because one design year noise level has been predicted to approach or exceed the FHWA Noise Abatement Criteria (NAC) for Category B the project has been found to have a traffic noise impact. Based on the Indiana Department of Transportation (INDOT) *Traffic Noise Analysis Procedure*, the feasibility and reasonableness of a noise barrier was evaluated at the location of the impacted receiver. Noise abatement in this area at this time has not been found to be reasonable based on the cost effectiveness criteria. During construction of the project, noise from construction activities may intermittently dominate the noise environment in the immediate area of construction.

TABLE OF CONTENTS

LIST OF TABLES

APPENDICES

LIST OF ABBREVIATED TERMS

CFR	Code of Federal Regulations
dB	Decibel
dBA	A-weighted Decibels
EA	Environmental Assesment
FHWA	Federal Highway Administration
INDOT	Indiana Department of Transportation
Leq(h)	1-Hour A-weighted Equivalent Sound Level
LOS	Level of Service
NAC	Noise Abatement Criteria
NEPA	National Environmental Policy Act
TNM	FHWA Traffic Noise Model Version 2.5

1.0 INTRODUCTION

1.1 Purpose of the Noise Analysis Technical Memorandum

The purpose of this Noise Analysis Technical Memorandum is to evaluate noise impacts and abatement under the requirements of Title 23, Part 772 of the Code of Federal Regulations (23 CFR 772) "Procedures for Abatement of Highway Traffic Noise" for the North Vernon New Roadway Project. 23 CFR 772 provides procedures for preparing operational and construction noise studies and evaluating noise abatement considered for federal and federal-aid highway projects. According to 23 CFR 772.3, all highway projects that are developed in conformance with this regulation are deemed to be in conformance with Federal Highway Administration (FHWA) noise standards.

The Indiana Department of Transportation (INDOT) *Traffic Noise Analysis Procedure* (INDOT 2011) establishes INDOT policy for implementing 23 CFR 772 in Indiana. The *Traffic Noise Analysis Procedure* outlines the requirements for analyzing highway traffic noise. Noise impacts associated with this project under the National Environmental Policy Act (NEPA) will be included in the project's Environmental Assessment (EA).

1.2 Project Purpose and Need

The purpose of this project is to seek a cost-effective solution to the four documented transportation problems in the U.S. 50/North Vernon area. These problems include: reducing congestion along U.S. 50 and SR3/SR7 around the north and west sides of North Vernon; providing a safer transportation facility for both truck and passenger vehicles around the north and west sides of North Vernon; providing an efficient transportation link between the existing and growing industrial area on the north side of North Vernon to U.S. 50 west of town; and supporting state and local transportation planning.

2.0 METHODOLOGY

2.1 Fundamentals of Traffic Noise

The human ear perceives noise as a form of vibration that causes pressure variations. The ear is sensitive to this variation and perceives it as sound. The intensity of these pressure variations causes the ear to discern different levels of loudness. These pressure differences are commonly measured in decibels (dB). The decibel scale that is audible to the human ear spans about 140 decibels. A dB level of zero is barely audible to the human ear while 140 dB is an unrecognizable sound which is painful to the listener. The decibel scale is a logarithmic representation of the actual sound pressure variation. This means that a 26 percent change in energy level only changes the sound level 1 dB. It would be possible for the human ear to detect this difference only in a laboratory. Increasing the energy level 100 percent would result in a 3 dB increase, which would be barely perceptible outdoors. A tripling in energy sound level would result in a clearly noticeable change of 5 dB in the sound level. An increase of ten times the energy level would result in a 10 dB increase in the sound level, which would be perceived as a doubling of the sound level.

The human ear has a non-linear sensitivity to noise. To account for this in noise measurement, electronic weighting scales are used to define the relative loudness of different frequencies. The

"A" weighting scale, expressed as dBA, is widely used in environmental work because it most nearly matches the non-linear nature of human hearing.

The measurement that is most commonly used to express dBA levels for traffic noise is the Hourly Equivalent Sound Level [L_{eq}(h)]. The L_{eq}(h) describes a noise-sensitive receptor's cumulative exposure from all noise-producing events over a 1-hour period.

Traffic noise studies for road projects in Indiana are performed in accordance with 23 CFR 772 and INDOT's *Traffic Noise Analysis Procedure*. There are five main steps comprising traffic noise studies: (1) identify noise sensitive receptors, (2) determine existing ambient peak noise levels, (3) predict future peak noise levels, (4) identify traffic noise impacts, and (5) evaluate mitigation measures for sensitive receptors where traffic noise impacts occur.

Traffic-generated L_{eq}(h) noise levels were predicted for the design year (2032) using FHWA's Traffic Noise Model (TNM) Version 2.5, a computer simulation model. This computer model takes into account anticipated traffic volumes, vehicle types, vehicle speeds, topography, roadway geometry, and sensitive receptor locations to calculate future traffic-generated noise levels. Noise levels were predicted for the outdoor living areas at each sensitive receptor using the worst traffic conditions likely to occur on a regular basis during the design year. Future noise levels were predicted for the Non-preferred Alignment, a combination of segments S1, M1 and N3 and the Preferred Alignment, a combination of S2-Modified, M2, and N6-Modified (See Table B-1).

According to FHWA and INDOT noise policies, a traffic noise impact occurs when either of the following conditions result at a sensitive receptor:

- The future predicted L_{eq}(h) noise level approaches (is within 1 dBA) or exceeds the Noise Abatement Criteria (NAC) shown in Table 1.
- The future predicted L_{eq}(h) noise level substantially exceeds (by 15 or more dBA) the existing L_{eq}(h) noise level. Traffic-generated noise level increases of 15 dBA or more are typically associated with roadway improvements on a new alignment.

2.2 Methods for Identifying Land Uses and Selecting Noise Measurement and Modeling Receptor Locations

A field investigation was conducted to identify land uses that could be subject to traffic and construction noise impacts from the proposed project. Land uses in the project area were categorized by land use type, Activity Category as defined in Table 1, and the extent of frequent human use. As stated in the *Traffic Noise Analysis Procedure*, noise abatement is only considered for areas of frequent human use that would benefit from a lowered noise level. Although all developed land uses are evaluated in this analysis, the focus is on locations of frequent human use that would benefit from a lowered noise level. Accordingly, this impact analysis focuses on locations with defined outdoor activity areas, such as residential backyards and common use areas at recreational facilities.

Table 1
Activity Categories and Noise Abatement Criteria

Activity Category	Activity Leq(h)	Evaluation Location	Activity Description
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67	Exterior	Residential.
C	67	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	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	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A-D or F.
F	-	-	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	-	-	Undeveloped lands that are not permitted.

Source: 23 CFR 772

2.3 Traffic Noise Level Prediction Methods

Traffic noise levels were predicted using the TNM 2.5. Key inputs to the traffic noise model were the locations of roadways, shielding features (e.g., topography and buildings), ground type, and receptors. Three-dimensional representations of these inputs were developed using survey data drawings and aerials provided by the Indiana Spatial Data Portal.

Traffic noise was evaluated under design year conditions for each project alternative. Loudest-hour traffic volumes, vehicle classification percentages, and traffic speeds under design-year (2032) conditions were developed for input into the traffic noise model. The loudest hour is generally characterized by free-flowing traffic at the highway design speed (i.e., Level of Service [LOS] C or better). Peak traffic volumes for the new roadway alternatives are not predicted to exceed LOS B, therefore peak traffic volumes were used in this analysis. Hourly traffic volumes used in this study were taken from the *Indiana Department of Transportation Traffic Volume Forecast: U.S. Route 50 Western By-Pass for North Vernon Jennings County* (AECOM 2011) prepared for this project.

2.4 Methods for Identifying Traffic Noise Impacts and Consideration of Abatement

Traffic noise impacts are considered to occur at receptor locations where predicted design-year noise levels are at least 15 dBA greater than existing noise levels, or where predicted design year noise levels approach or exceed the NAC for the applicable activity category. Where traffic noise impacts are identified, noise abatement must be considered for reasonableness and feasibility as required by 23 CFR 772 and the *Traffic Noise Analysis Procedure*.

According to the *Traffic Noise Analysis Procedure*, abatement measures are considered acoustically feasible if a minimum noise reduction of 7 dBA at impacted first row receptor locations is predicted with implementation of the abatement measures. Other factors that affect feasibility include topography, access requirements for driveways and ramps, presence of local cross streets, utility conflicts, other noise sources in the area, and safety considerations. The overall reasonableness of noise abatement is determined by considering factors such as:

- Cost;
- Absolute predicted noise levels;
- Predicted future increase in noise levels;
- Expected noise abatement benefits;
- Build date of surrounding residential development along the highway;
- Environmental impacts of abatement construction;
- Opinions of affected residents;
- Input from the public and local agencies; and
- Social, legal, and technological factors.

Details of this evaluation are provided in Section 4.2 below.

3.0 EXISTING NOISE ENVIRONMENT

3.1 Existing Land Uses

A field investigation was conducted in May 2011 to identify land uses that could be subject to traffic and construction noise impacts from the proposed project. Single-family residences, a recreational facility, and a church were identified as Activity Category B and C land uses in the project area.

As required by the *Traffic Noise Analysis Procedure*, although all developed land uses are evaluated in this analysis, noise abatement is only considered for areas of frequent human use that would benefit from a lowered noise level. Accordingly, this impact analysis focuses on locations with defined outdoor activity areas, such as residential backyards and common use areas at recreational facilities.

For this project one receptor was modeled for a single corresponding dwelling unit or area of frequent outdoor use.

3.2 Noise-Sensitive Receptors and Existing Noise Conditions

Noise-sensitive receptors are those locations where activities that could be affected by increased traffic noise levels occur (e.g., residences, motels, churches, schools, parks, and libraries). Existing noise levels are determined for the most commonly used outdoor living area at sensitive receptors. For residences, this is typically the backyard or front porch. Noise-sensitive receptors are located throughout the project corridor (see Appendix A). A total of 71 sensitive receptors representing 71 dwelling units or areas of frequent outdoor use were identified in the project area for analysis as part of the noise study. These receptors include all Category B and C land uses located within approximately 500 feet of the alignments.

Existing noise levels at representative receptors throughout the corridor ranged from 57.2 to 60.3 dBA with a corridor average of 58.8 dBA. Measurement ST1, taken adjacent to existing U.S. 50 was, as expected, slightly higher than the measurements taken adjacent to county roads. Table 2 summarizes the results of the existing noise measurements taken.

Table 2

Summary of Short-Term Measurements

Position	NSA	Address	Land Uses	Start Time	Duration (minutes)	Measured $L_{eq(h)}$
ST1	3	3645 W U.S. Highway 50	Residential	9: 32 a.m.	20	60.3
ST2	5	2805 W CR 200 N	Residential	12:50 p.m.	20	57.2
ST3	8	1785 W CR 300 N	Residential	1:29 p.m.	20	59.1
ST4	9	3330 N SR 9	Church	10:29 a.m.	20	58.5

TNM 2.5 was used to compare measured traffic noise levels to modeled noise levels at the measurement locations. As shown in Table 3, comparing the modeled and measured noise levels using observed traffic counts confirms the applicability of the model to the study area. Modeled noise levels are within 2 decibels of measured noise levels at both locations. This comparison used measurement ST1 and ST4 because these measurement sites were located adjacent to roadways (U.S. 50 and S.R. 3) that had traffic in sufficient quantity for input into the TNM 2.5 noise model. The result of this comparison represents reasonable correlation. Existing traffic noise levels and predicted traffic noise levels for the existing condition are within +/- 3 dBA. Therefore, this model is validated per 23 CFR 722.11(d)(2) and no calibration of the model was made.

Table 3

Comparison of Measured to Predicted Sound Levels in the TNM Model

Measurement Position	Measured Sound Level (dBA)	Predicted Sound Level (dBA)	Measured minus Predicted (dB)
ST1	60.3	60.4	-0.1
ST4	58.5	57.1	1.4

4.0 FUTURE NOISE ENVIRONMENT, IMPACTS, AND CONSIDERED ABATEMENT

4.1 Future Noise Environment and Impacts

As described in Section 2.2, these predictions utilize forecasted peak hour traffic conditions to ensure a conservative estimate of noise levels for the loudest noise hour. The comparison to existing conditions is included in the analysis to identify traffic noise impacts under 23 CFR 772.

Predicted noise levels for Category B and C receptors under the Preferred and Non-Preferred Alternative range from 39.6 dBA to 67.1 dBA and 42.5 dBA to 61.9 dBA, respectively. Modeling results, shown in Table B-1 in Appendix B indicate that predicted traffic noise levels for the design-year with-project conditions approach or exceed the NAC of 67 dBA Leq(h) at one dwelling unit that would not be displaced by the project. Modeled traffic generated noise levels do not account for ambient background noise, which was the dominant noise source for the existing measurements, resulting in modeled traffic noise levels lower than existing measured levels. Noise level increases of less than three dBA are generally not perceptible to the human ear and are well below the threshold that INDOT defines as substantial.

As shown in Appendix A, undeveloped areas adjacent to the corridor are not predicted to approach or exceed the NAC based on the 66 dBA contour line.

4.2 Noise Abatement Analysis

In accordance with 23 CFR 772, noise abatement is considered where noise impacts are predicted in areas of frequent human use that would benefit from a lowered noise level. One impacted receiver was identified as part of this project. Therefore a noise abatement analysis was done which concluded that a barrier benefitting the impacted receiver would exceed the 1000 sq. ft. per benefitted receiver cost effective criteria. This barrier would not meet both the reasonable and feasible criteria and will not be constructed for this project. A summary of the results of this analysis are shown in Table 4.

Table 4

Summary of Noise Barrier Analysis

Barrier	NSA	Existing Level	Future Level W/O Barrier	Future Level with Barrier	Noise Reduction (dBA)	Barrier Area (sq. ft)	Feasible Limit (sq. ft)	Feasible and Reasonable
1	9	60.3	67.1	62.1	5.0	3,598	1,000	N

If pertinent parameters change substantially during the continuing project design, the noise abatement decision may be reconsidered.

5.0 CONSTRUCTION NOISE

During construction of the project, noise from construction activities may intermittently dominate the noise environment in the immediate area of construction.

Table 5 summarizes noise levels produced by construction equipment that is commonly used on roadway construction projects. Construction equipment is expected to generate noise levels ranging from 70 to 90 dB at a distance of 50 feet, and noise produced by construction equipment would be reduced over distance at a rate of about 6 dBA per doubling of distance.

Table 5
Construction Equipment Noise

Equipment	Maximum Noise Level (dBA at 50 feet)
Scrapers	89
Bulldozers	85
Heavy Trucks	88
Backhoe	80
Pneumatic Tools	85
Concrete Pump	82

Source: U.S. Environmental Protection Agency 1971.

No adverse noise impacts from construction are anticipated because construction noise would be short-term and intermittent. Measures to minimize the temporary impacts will include requiring equipment to have sound-control devices that are no less effective than those provided on the original equipment and requiring all equipment to be muffled.

6.0 STATEMENT OF LIKELIHOOD

Based on the studies thus far accomplished, the State of Indiana has not identified any locations where noise abatement is likely. Noise abatement at these locations is based upon preliminary design costs and design criteria. Noise abatement has not been found to be reasonable based on the cost effectiveness criteria. A reevaluation of the noise analysis will occur during final design. If during final design it has been determined that conditions have changed such that noise abatement is feasible and reasonable, the abatement measures might be provided. The final decision of the installation of any abatement measure will be made upon the completion of the project's final design and the public involvement process.

7.0 REFERENCES

23 CFR 772 (2011). "Procedures for Abatement of Highway Traffic Noise and Construction Noise." Accessed June 21, 2011.

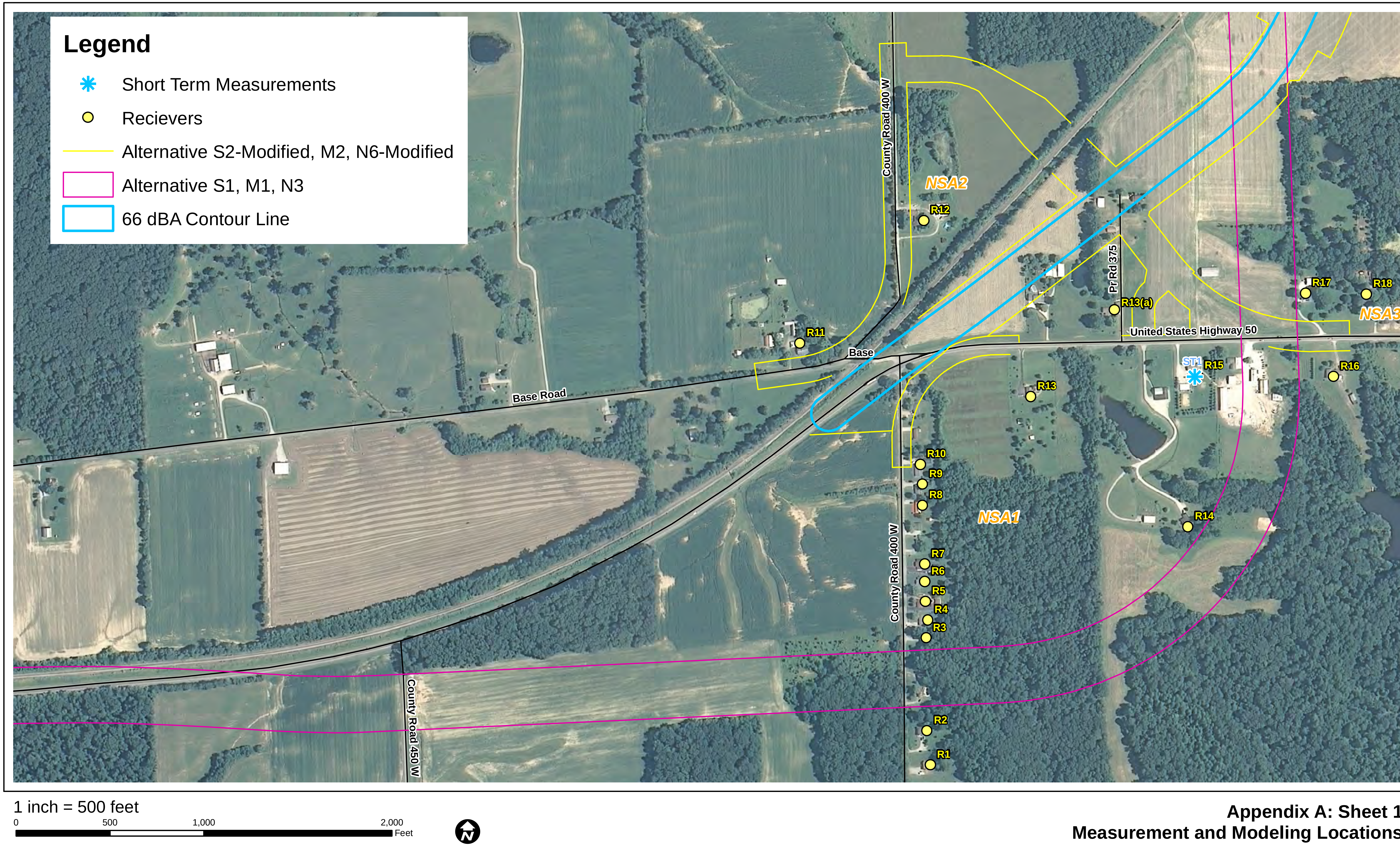
Indiana Department of Transportation (INDOT). 2011. *Traffic Noise Analysis Procedure.*

AECOM. July, 2011. *Indiana Department of Transportation Traffic Volume Forecast: U.S. Route 50 Western By-Pass for North Vernon Jennings County*

U.S. Environmental Protection Agency, "Noise from Construction Equipment and Operations, Building Equipment and Home Appliances," NTID300.1, December 31, 1971.

Appendix A

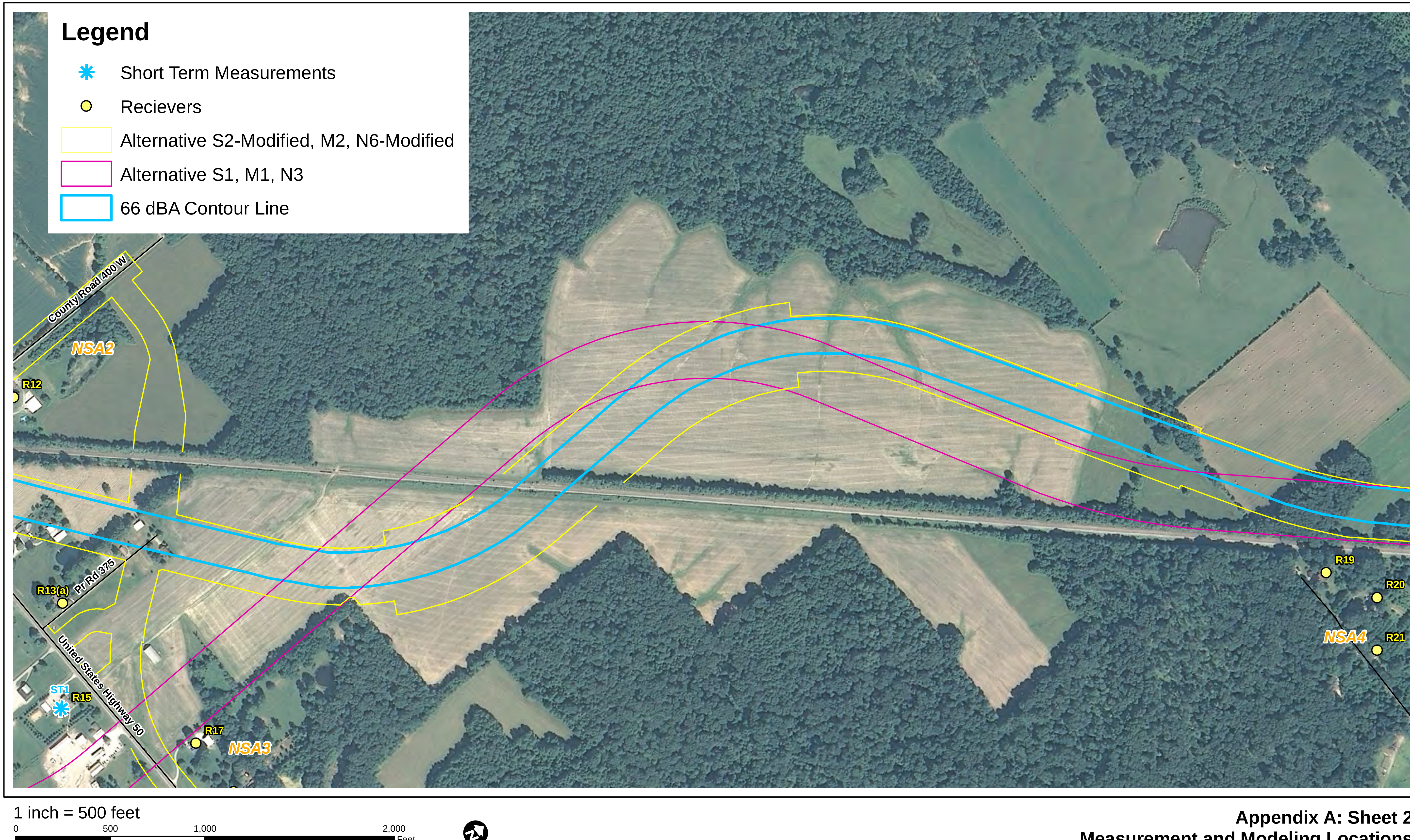
Measurement and Modeling Locations



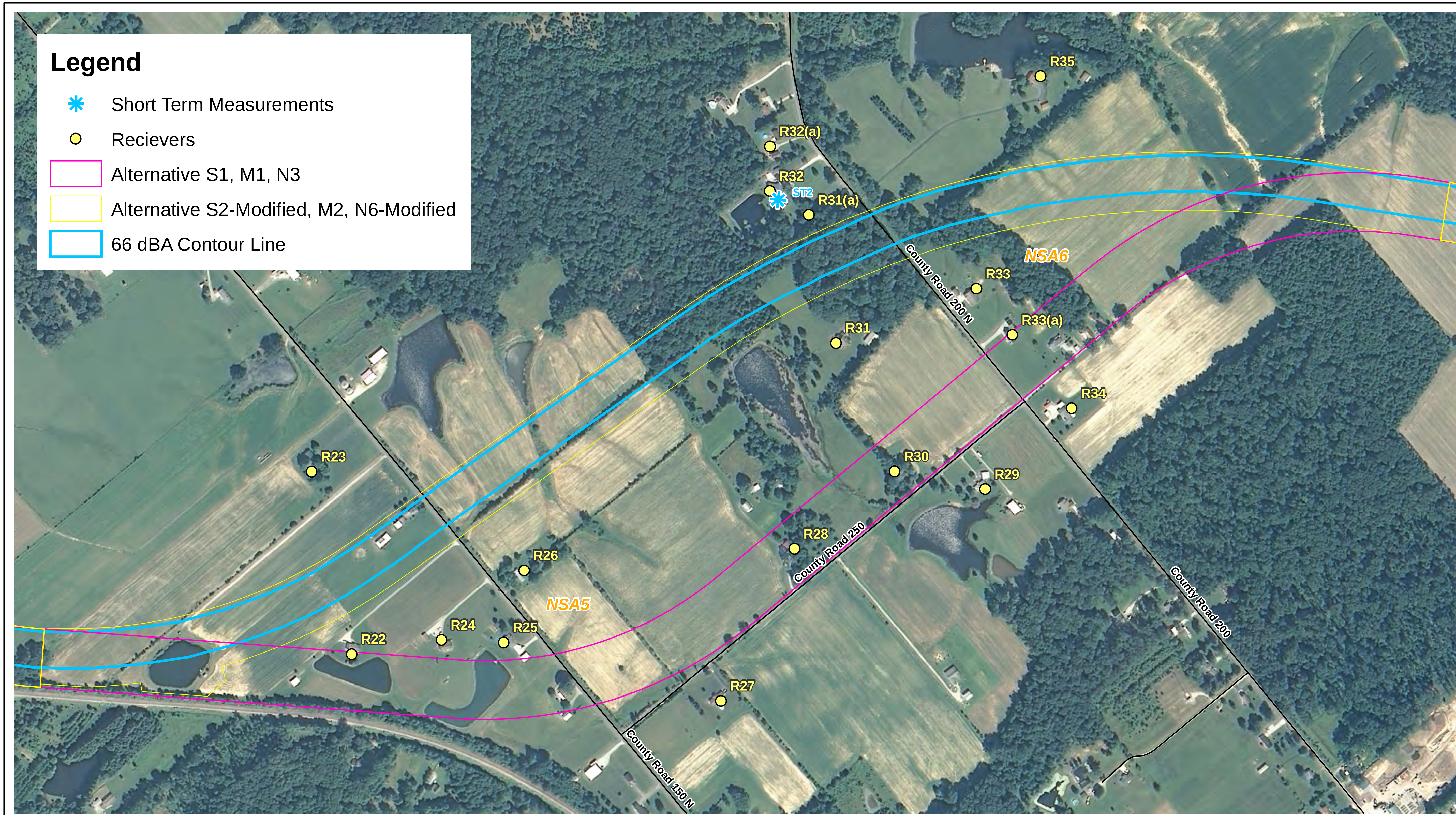
Appendix A: Sheet 1
Measurement and Modeling Locations

US-50 North Vernon Project
Jennings County, Indiana

Noise Analysis Technical Memorandum



Appendix A: Sheet 2
Measurement and Modeling Locations



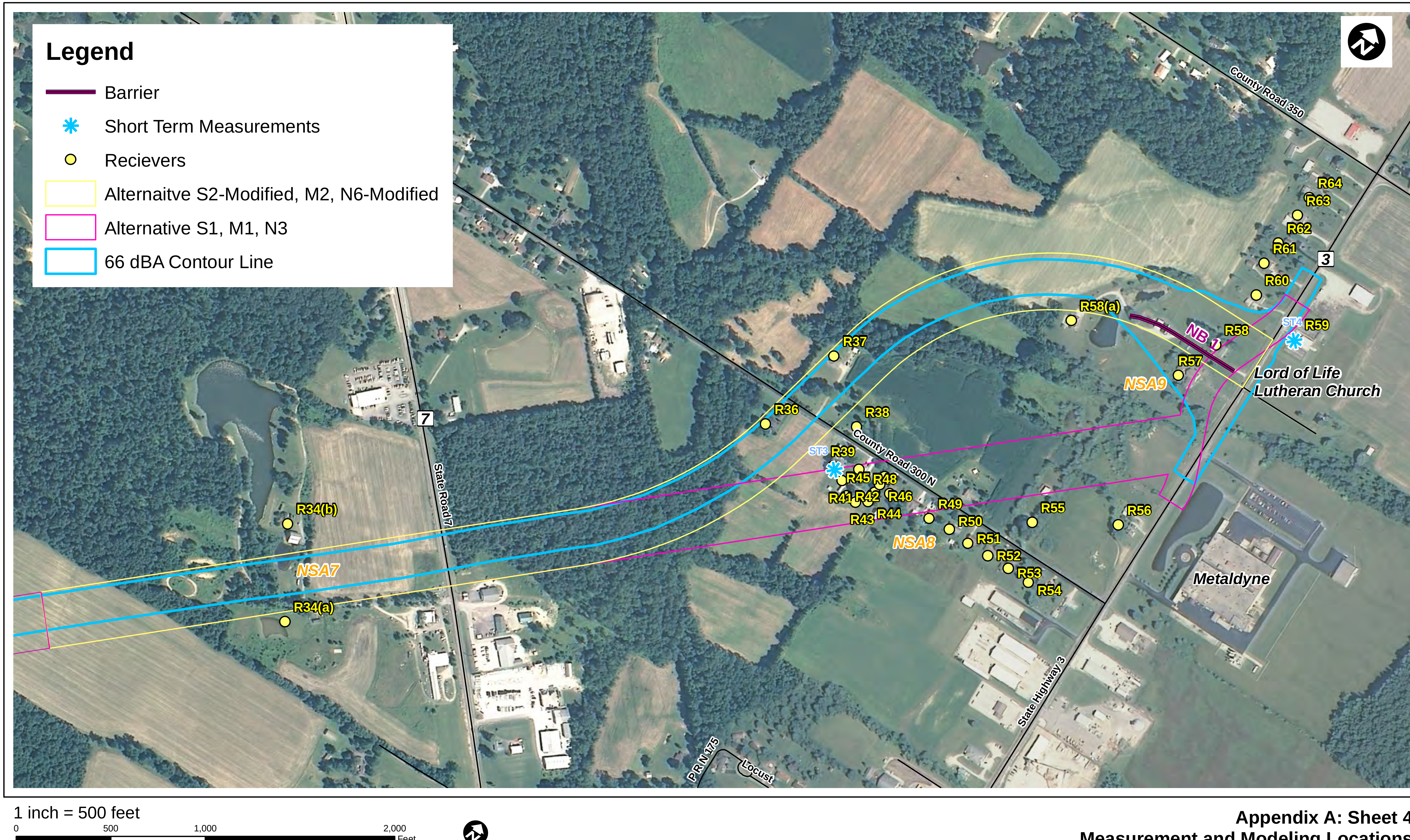
1 inch = 500 feet

0 500 1,000 2,000 Feet

Appendix A: Sheet 3
Measurement and Modeling Locations

US-50 North Vernon Project
Jennings County, Indiana

Noise Analysis Technical Memorandum



Appendix A: Sheet 4
Measurement and Modeling Locations

US-50 North Vernon Project
Jennings County, Indiana

Noise Analysis Technical Memorandum

Appendix B

Traffic Data

Table B-1, Traffic Data for Proposed Conditions

Traffic Direction	Segment	# of Lanes	AADT*	DHV** %	Peak Hour Traffic Volume (vph)		Speed (AT/HT)
					Auto Volume	Heavy Truck Volume	
New Roadway							
Northbound	Existing US 50 to Base Road Intersection	1	4,270	6	195	61	55/50
Northbound	Base Road to O&M Avenue	1	2,690	6	108	53	55/50
Northbound	O&M Avenue to CR 200 N	1	2,430	6	95	51	55/50
Northbound	CR 200 N to SR 7	1	2,210	9	163	45	55/50
Northbound	SR 7 to SR 3	1	3,490	8	270	44	55/50
Southbound	Existing US 50 to Base Road Intersection	1	4,380	6	194	68	55/50
Southbound	Base Road to O&M Avenue	1	2,770	6	106	60	55/50
Southbound	O&M Avenue to CR 200 N	1	2,580	6	98	57	55/50
Southbound	CR 200 N to SR 7	1	2,580	7	179	2	55/50
Southbound	SR 7 to SR 3	1	3,070	7	219	27	55/50
Cross Streets							
Eastbound	Existing US 50	2	2,120	10	204	8	45/40
Westbound	Existing US 50	2	2,140	8	166	5	45/40
Eastbound	Base Road	1	100	6	6	0	35/30
Westbound	Base Road	1	90	7	6	0	35/30
Eastbound	O&M Avenue East of Bypass	1	580	9	49	3	35/30
Eastbound	O&M Avenue West of Bypass	1	410	5	19	1	35/30
Westbound	O&M Avenue East of Bypass	1	570	10	54	3	35/30
Westbound	O&M Avenue West of Bypass	1	460	7	31	2	35/30
Eastbound	CR 200 N East of bypass	1	620	11	65	3	35/30
Eastbound	CR 200 N West of bypass	1	520	8	40	2	35/30
Westbound	CR 200 N East of bypass	1	630	11	67	3	35/30
Westbound	CR 200 N West of bypass	1	530	10	51	2	35/30
Southbound	SR 7 South of Bypass	1	6,700	9	561	42	45/40
Northbound	SR 7 South of Bypass	1	7,260	8	540	41	45/40
Southbound	SR 7 North of Bypass	1	8,120	9	680	51	45/40
Northbound	SR 7 North of	1	8,110	8	603	45	45/40

Table B-1, Traffic Data for Proposed Conditions

	Bypass						
Southbound	SR 3 South of Bypass	1	3970	8	468	89	45/40
Northbound	SR 3 South of Bypass	1	3,630	9	274	52	45/40
Southbound	SR 3 North of Bypass	1	2,470	8	176	22	45/40
Northbound	SR 3 North of Bypass	1	2,560	11	251	31	45/40

*Average Annual Daily Traffic (AADT)
**Design Hourly Volume (DHV)
Source: Indiana Department of Transportation Traffic Volume Forecast, July 2011

Appendix C

Predicted Noise Levels

Table C-1 – Predicted Noise Levels

Receiver ID	Noise Study Area (NSA)	Land Use	Activity Category	NAC level	Number of Noise Sensitive Receptors	Build Alternative Noise Analysis				
						Non-Preferred Alternative (S1, M1, N3)	Impact Type	Preferred Alternative (S2-Modified, M2, N6-Modified)	Barrier Reduction	Impact Type
R01	1	Residential	B	67	1	51.5	None	39.6	N/A	None
R02	1	Residential	B	67	1	55.7	None	40.3	N/A	None
R03	1	Residential	B	67	1	60.4	None	42.4	N/A	None
R04	1	Residential	B	67	1	56.6	None	43.0	N/A	None
R05	1	Residential	B	67	1	54.1	None	43.7	N/A	None
R06	1	Residential	B	67	1	52.2	None	44.5	N/A	None
R07	1	Residential	B	67	1	50.8	None	45.3	N/A	None
R08	1	Residential	B	67	1	47.1	None	49.0	N/A	None
R09	1	Residential	B	67	1	46.4	None	50.2	N/A	None
R10	1	Residential	B	67	1	45.3	None	52.7	N/A	None
R11	2	Residential	B	67	1	42.6	None	54.5	N/A	None
R12	2	Residential	B	67	1	42.5	None	52.9	N/A	None
R13	3	Residential	B	67	1	45.2	None	53.3	N/A	None
R13(a)	3	Residential	B	67	1	48.0	None	55.5	N/A	None
R14	3	Residential	B	67	1	59.1	None	44.0	N/A	None
R15	3	Residential	B	67	1	54.0	None	50.8	N/A	None
R16	3	Residential	B	67	1	50.9	None	48.0	N/A	None
R17	3	Residential	B	67	1	56.4	None	51.7	N/A	None
R18	3	Residential	B	67	1	48.8	None	47.0	N/A	None
R19	4	Residential	B	67	1	54.4	None	53.9	N/A	None
R20	4	Residential	B	67	1	52.7	None	52.6	N/A	None
R21	4	Residential	B	67	1	48.2	None	48.0	N/A	None
R22	5	Residential	B	67	1	†	None	54.2	N/A	None
R23	5	Residential	B	67	1	45.4	None	51.4	N/A	None
R24	5	Residential	B	67	1	†	None	49.9	N/A	None
R25	5	Residential	B	67	1	†	None	47.7	N/A	None
R26	5	Residential	B	67	1	51.4	None	52.3	N/A	None
R27	5	Residential	B	67	1	53.7	None	42.0	N/A	None
R28	6	Residential	B	67	1	†	None	43.9	N/A	None
R29	6	Residential	B	67	1	53.8	None	43.1	N/A	None
R30	6	Residential	B	67	1	†	None	45.0	N/A	None
R31	6	Residential	B	67	1	50.3	None	52.8	N/A	None

Table C-1 – Predicted Noise Levels

Receiver ID	Noise Study Area (NSA)	Land Use	Activity Category	NAC level	Number of Noise Sensitive Receptors	Build Alternative Noise Analysis				
						Non-Preferred Alternative (S1, M1, N3)	Impact Type	Preferred Alternative (S2-Modified, M2, N6-Modified)	Barrier Reduction	Impact Type
R31(a)	6	Residential	B	67	1	58.6	None	58.6	N/A	None
R32	6	Residential	B	67	1	42.9	None	51.0	N/A	None
R32(a)	7	Residential	B	67	1	41.3	None	47.8	N/A	None
R33	6	Residential	B	67	1	55.0	None	52.5	N/A	None
R33(a)	6	Residential	B	67	1	†	None	49.8	N/A	None
R34	6	Residential	B	67	1	55.1	None	44.1	N/A	None
R34(a)	7	Recreational	C	67	1	55.1	None	55.7	N/A	None
R34(b)	7	Recreational	C	67	1	54.5	None	54.6	N/A	None
R35	6	Residential	B	67	1	43.9	None	47.5	N/A	None
R36	8	Residential	B	67	1	52.8	None	†	N/A	None
R37	8	Residential	B	67	1	48.7	None	†	N/A	None
R38	8	Residential	B	67	1	54.3	None	56.7	N/A	None
R39	8	Residential	B	67	1	†	None	55.0	N/A	None
R40	8	Residential	B	67	1	†	None	52.7	N/A	None
R41	8	Residential	B	67	1	†	None	53.2	N/A	None
R42	8	Residential	B	67	1	†	None	51.7	N/A	None
R43	8	Residential	B	67	1	†	None	50.9	N/A	None
R44	8	Residential	B	67	1	†	None	50.3	N/A	None
R45	8	Residential	B	67	1	†	None	50.5	N/A	None
R46	8	Residential	B	67	1	†	None	50.7	N/A	None
R47	8	Residential	B	67	1	†	None	51.0	N/A	None
R48	8	Residential	B	67	1	†	None	49.9	N/A	None
R49	8	Residential	B	67	1	†	None	48.2	N/A	None
R50	8	Residential	B	67	1	54.8	None	47.8	N/A	None
R51	8	Residential	B	67	1	53.7	None	47.8	N/A	None
R52	8	Residential	B	67	1	53.2	None	48.1	N/A	None
R53	8	Residential	B	67	1	53.5	None	48.6	N/A	None
R54	8	Residential	B	67	1	54.5	None	49.5	N/A	None
R55	8	Residential	B	67	1	55.8	None	50.2	N/A	None
R56	8	Residential	B	67	1	61.9	None	61.5	N/A	None
R57	9	Residential	B	67	1	†	None	67.1	5.0	A/E
R58	9	Residential	B	67	1	56.9	None	†	N/A	None
R58(a)	9	Residential	B	67	1	51.6	None	†	N/A	None

Table C-1 – Predicted Noise Levels

Receiver ID	Noise Study Area (NSA)	Land Use	Activity Category	NAC level	Number of Noise Sensitive Receptors	Build Alternative Noise Analysis				
						Non-Preferred Alternative (S1, M1, N3)	Impact Type	Preferred Alternative (S2-Modified, M2, N6-Modified)	Barrier Reduction	Impact Type
R59	9	Church	C	67	1	58.1	None	60.9	N/A	None
R60	9	Residential	B	67	1	55.4	None	60.4	N/A	None
R61	9	Residential	B	67	1	53.6	None	57.2	N/A	None
R62	9	Residential	B	67	1	53.0	None	56.3	N/A	None
R63	9	Residential	B	67	1	51.7	None	55.6	N/A	None
R64	9	Residential	B	67	1	50.4	None	55.0	N/A	None

†– Residence corresponding to receiver location displaced by this alternative.
A/E– Approach or Exceed.

Appendix D

Field Survey Forms

FIELD SURVEY FORM

PROJECT: US 50

ENGINEER: R.Connolly, A. Ball

DATE: 5-09-2011

MEASUREMENT ADDRESS: 3645 US 50

CITY: N. Vernon

☒ Single-Family ☐ Recreational
☐ Multi-Family ☐ Commercial

SITE NO.: ST-1

SOUND LEVEL METER:
☐ LD-870 ☒ LD-820
☐ LD-824 ☐ LD-812
☐ LD-2900 ☐ ________

SERIAL #: ~~870A0555~~ 2716

MICROPHONE: ☒ WIND SCREEN
☐ NON-POLAR ☐ POLARIZED
☒ 1/2-INCH ☐ FREEFIELD
☐ 1-INCH ☐ RANDOM

SERIAL #: 2141

PRE AMP:
☒ LD-900
☐ LD-828
☐ ________

SERIAL #:

NOTES:

SYSTEM PWR: ☒ BAT ☐ AC

(observations at start of measurement)

TEMP: 67.1 °F R.H.: 56.2 %

WIND SPEED: 1.6 MPH

TOWARD (DIR): SE

SKIES: Clear

CAMERA ________

PHOTO NOs. ________

CALIBRATOR:
☐ LD CA250
☐ ________
S/N ________

Freq, Hz.
☐ 250
☐ 1000
☐

CALIBRATION RECORD:

Input, dB / Reading, dB / Offset, dB / Time

Before 114.0 / 113.9 / 0.08 / 9:26

After 114.0 / 113.9 / 0.08 / 9:54

METER SETTINGS:
☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☐ INTERVALS ______- MINUTE
☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☐ L_N PERCENTILE VALUES

NOTES:
1 motorcycle (quiet) 9:13

Dist. to Center of Nearest Lane 80

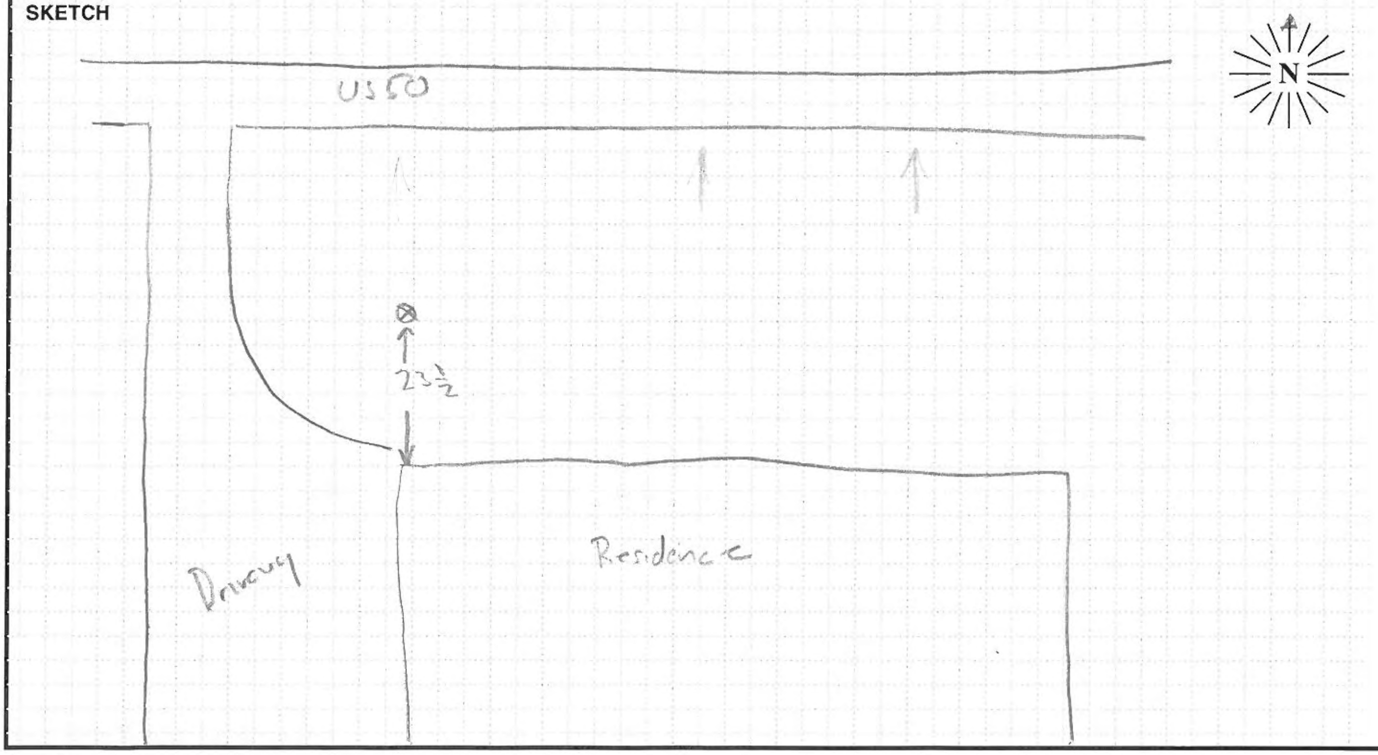
☐ Video
☐ Radar

Counts	AT	MT	HT
20 min	126	7	27
x3	378	21	81

MEAS. TYPE:
☐ Long Term
☒ Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:
5-9	9:32	9:52									60.3	20 min

SKETCH



PARSONS

FIELD SURVEY FORM

PROJECT: US 50		ENGINEER: R.Connolly, A. Ball	DATE: 5-09-2011
MEASUREMENT ADDRESS: 2805 W. CR 200N	CITY: N. Vernon	☒ Single-Family ☐ Multi-Family ☐ Recreational ☐ Commercial	SITE NO.: ST-2

SOUND LEVEL METER: ☐ LD-870 ☒ LD-820 ☐ LD-824 ☐ LD-812 ☐ LD-2900 ☐ ________

SERIAL #: ~~870A0555~~ 2716

MICROPHONE: ☒ WIND SCREEN ☐ NON-POLAR ☐ POLARIZED ☒ 1/2-INCH ☐ FREEFIELD ☐ 1-INCH ☐ RANDOM

SERIAL #:2141

PRE AMP: ☐ LD-900 ☐ LD-828 ☐ ________

SERIAL #:

NOTES:

SYSTEM PWR: ☐ BAT ☐ AC

(observations at start of measurement)

TEMP: 76.5 °F R.H.: 48.3 %

WIND SPEED: 1.5 MPH

TOWARD (DIR): W

SKIES: Clear

CAMERA ________

PHOTO NOs. ________

CALIBRATOR: ☐ LD CA250 ☐ ________ S/N ________

Freq, Hz. ☐ 250 ☐ 1000 ☐

CALIBRATION RECORD:

Input, dB / Reading, dB / Offset, dB / Time

Before 114.0 / 114.0 / 0.8 / 12:47

After 114.0 / 113.9 / 0.8 / 13:11

METER SETTINGS: ☒ A-WTD ☐ C-WTD ☐ LINEAR ☐ IMPULSE ☒ SLOW ☐ FAST ☐ 1/1 OCT ☐ 1/3 OCT ☐ INTERVALS ________- MINUTE ☐ L_N PERCENTILE VALUES

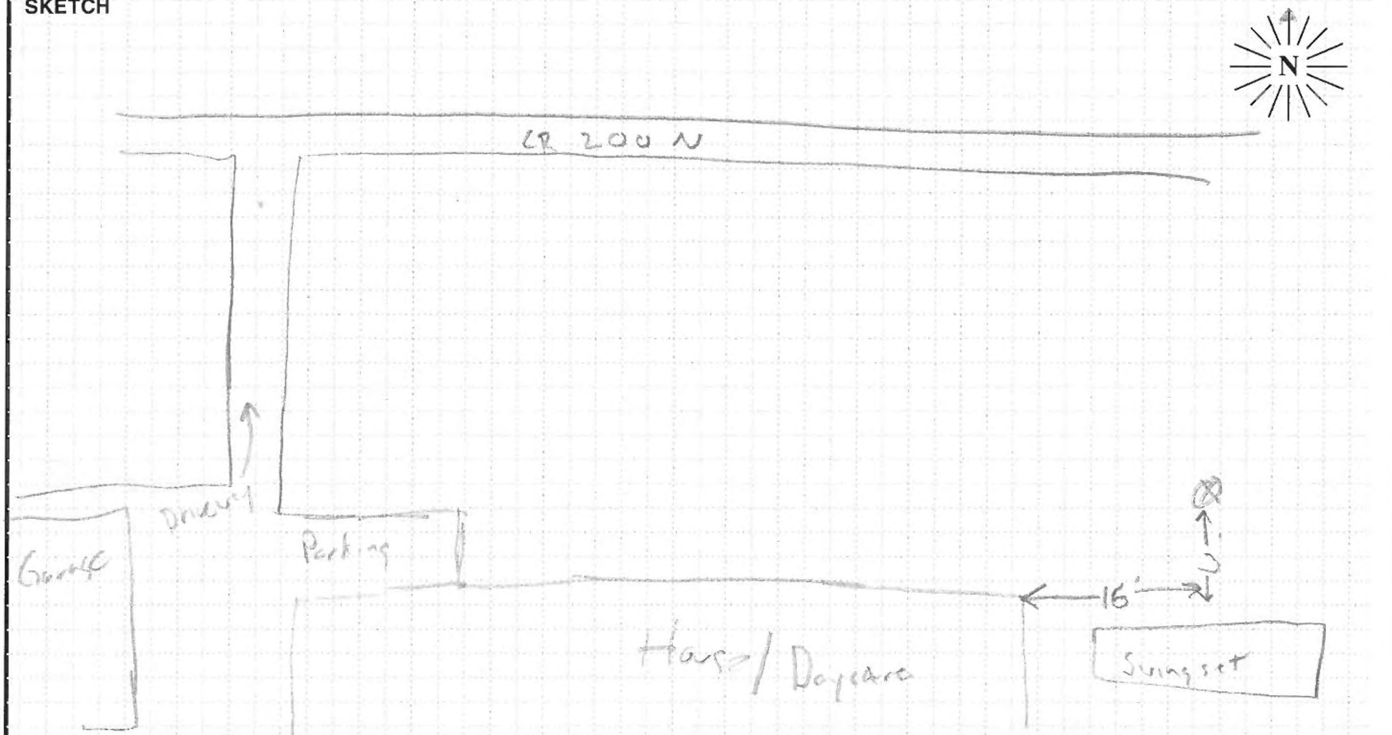
NOTES: 3 bikes at 12:52

Dist. to Center of Nearest Lane ________ ☐ Video ☐ Radar Counts AT MT HT

MEAS. TYPE: ☐ Long Term ☒ Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:
5-9	12:50	13:10									57.2	

SKETCH



PARSONS

FIELD SURVEY FORM

PROJECT: **US 50**	ENGINEER: R.Connolly, A. Ball		DATE: 5-09-2011
MEASUREMENT ADDRESS: Morin Rentals 1785 W CR 300 N	CITY: N. Vernon	☒ Single-Family ☐ Multi-Family ☐ Recreational ☐ Commercial	SITE NO.: ST-3

SOUND LEVEL METER: ☐ LD-870 ☒ LD-820 ☐ LD-824 ☐ LD-812 ☐ LD-2900 ☐ ______

SERIAL #: 67920555 2716

MICROPHONE: ☒ WIND SCREEN ☐ NON-POLAR ☐ POLARIZED ☒ 1/2-INCH ☐ FREEFIELD ☐ 1-INCH ☐ RANDOM

SERIAL #: 2141

PRE AMP: ☐ LD-900 ☐ LD-828 ☐ ______

SERIAL #:

CALIBRATOR: ☐ LD CA250 ☐ ______ S/N ______

Freq, Hz. ☐ 250 ☐ 1000 ☐

CALIBRATION RECORD:

	Input, dB	Reading, dB	Offset, dB	Time
Before	114.0	113.9	0.8	13:25
After	114.0	113.9	0.8	13:52

METER SETTINGS: ☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☐ INTERVALS ______ - MINUTE ☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☐ L_N PERCENTILE VALUES

NOTES:

SYSTEM PWR: ☐ BAT ☐ AC

(observations at start of measurement)

TEMP: 77 °F R.H.: 45.5 %

WIND SPEED: 3.1 MPH

TOWARD (DIR): NE

SKIES: Clear

CAMERA ______

PHOTO NOs. ______

NOTES: M Cycle 13:40

Dist. to Center of Nearest Lane ______

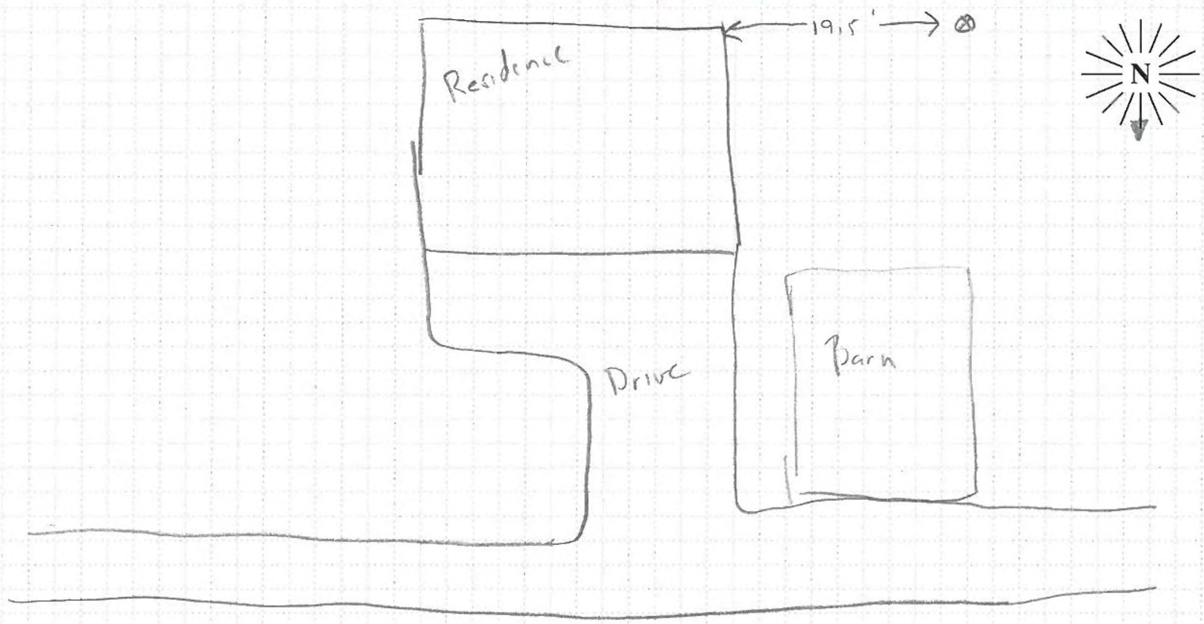
☐ Video ☐ Radar

Counts: AT MT HT

MEAS. TYPE: ☐ Long Term ☒ Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:
5-9	13:29	13:49									59.1	

SKETCH



PARSONS

FIELD SURVEY FORM

PROJECT: **US 50**	ENGINEER: R.Connolly, A. Ball	DATE: 5-09-2011
MEASUREMENT ADDRESS: Lord of Life Lutheran Church 3330 N SR 3 N Vernon	CITY: N. Vernon	☐ Single-Family ☐ Multi-Family ☐ Recreational ☐ Commercial church — SITE NO.: ST-4

SOUND LEVEL METER:	MICROPHONE: ☒ WIND SCREEN	PRE AMP:	NOTES:
☐ LD-870 ☒ LD-820	☐ NON-POLAR ☐ POLARIZED	☒ LD-900	SYSTEM PWR: ☒ BAT ☐ AC
☐ LD-824 ☐ LD-812	☒ 1/2-INCH ☐ FREEFIELD	☐ LD-828	(observations at start of measurement)
☐ LD-2900 ☐ ____	☐ 1-INCH ☐ RANDOM	☐ ____	TEMP: 66.2 °F R.H.: 67.6 %
SERIAL #: ~~070A0565~~ 2716	SERIAL #: 2141	SERIAL #: 4327	WIND SPEED: 3.7 MPH

CALIBRATOR:

☒ LD CA250
☐ ____
S/N ____

Freq, Hz.
☐ 250
☐ 1000
☐

CALIBRATION RECORD:

	Input, dB	Reading, dB	Offset, dB	Time
Before	114.0	114.0	0.8	10:27
After	114.0	114.0	0.8	10:53

TOWARD (DIR): W

SKIES: Clear

CAMERA ____

PHOTO NOs. ____

METER SETTINGS:

☒ A-WTD ☐ LINEAR ☒ SLOW ☐ 1/1 OCT ☐ INTERVALS ____ - MINUTE
☐ C-WTD ☐ IMPULSE ☐ FAST ☐ 1/3 OCT ☐ L_N PERCENTILE VALUES

NOTES: 10:35 Semi- Jake Break
10:36 Loud car

Dist. to Center of Nearest Lane 84'

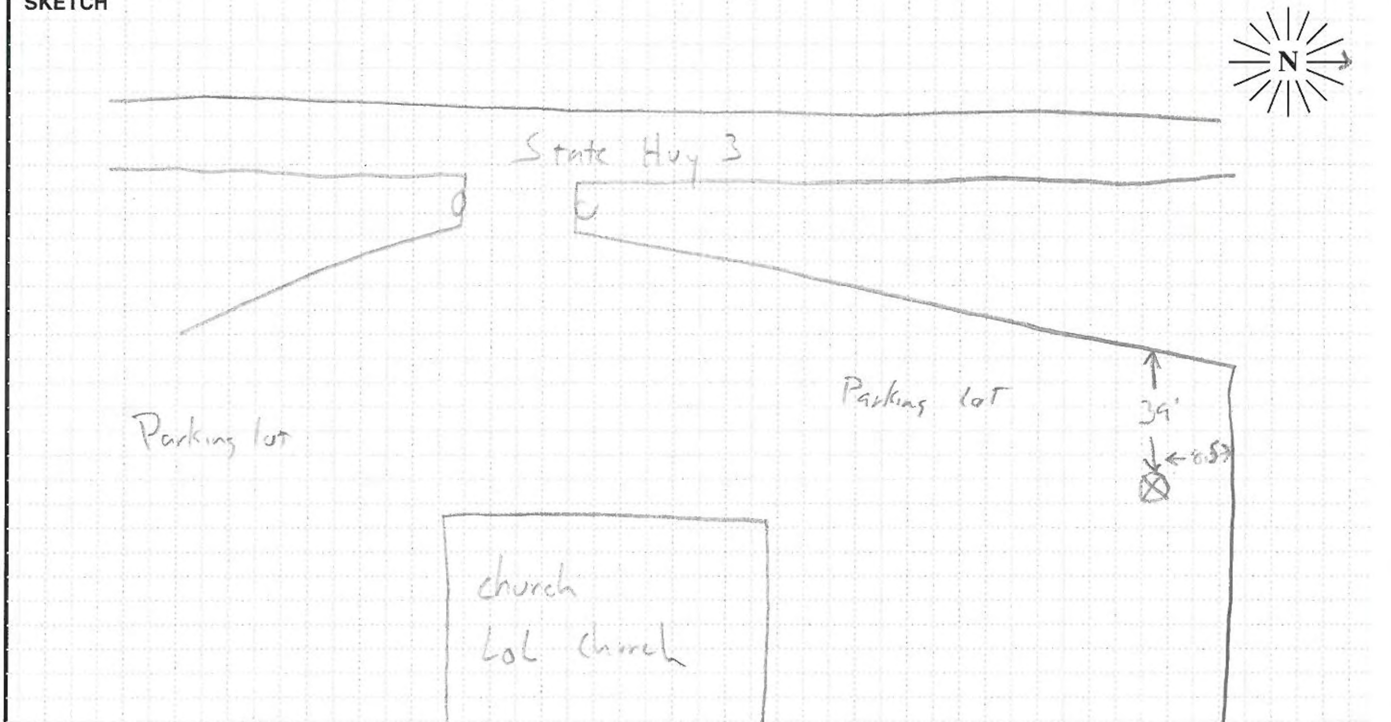
☐ Video
☐ Radar

Counts	AT	MT	HT
	46		40
20 min	34	0	6
x3	102	0	18

MEAS. TYPE:
☐ Long Term
☒ Short Term

DATE	START TIME	STOP TIME	L_{MIN}	L_{99}	L_{90}	L_{50}	L_{25}	L_{10}	L_{01}	L_{MAX}	L_{EQ}	NOTES:
5-9	10:29	10:49									58.5	20 min

SKETCH



PARSONS