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TRAFFIC SAFETY IMPACTS

FOR

Outdoor Advertising Sign

IAAT Services

605 Route 202

Block 34.04 Lots 8 & 8.01

Borough of Raritan

Somerset County, New Jersey

August 8, 2025

Our File No. 25-106

PREPARED BY:

Hal Simoff, P.E., P.P.
P.E. License No. 28278
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INTRODUCTION

SIMOFF ENGINEERING ASSOCIATES, INC. (SEA) has prepared this Traffic Safety Impact analysis for a proposed digital billboard, on the property located on Southwest corner of Route 202 & Second Avenue, known as Block 34, Lots 8 & 8.01, in Borough of Raritan, Somerset County, New Jersey. The sign location is at milepost 23.96 ± of Route 202. New Jersey Department of Transportation Straight Line Diagram depicting the site location is noted as Figure 2 of this report.

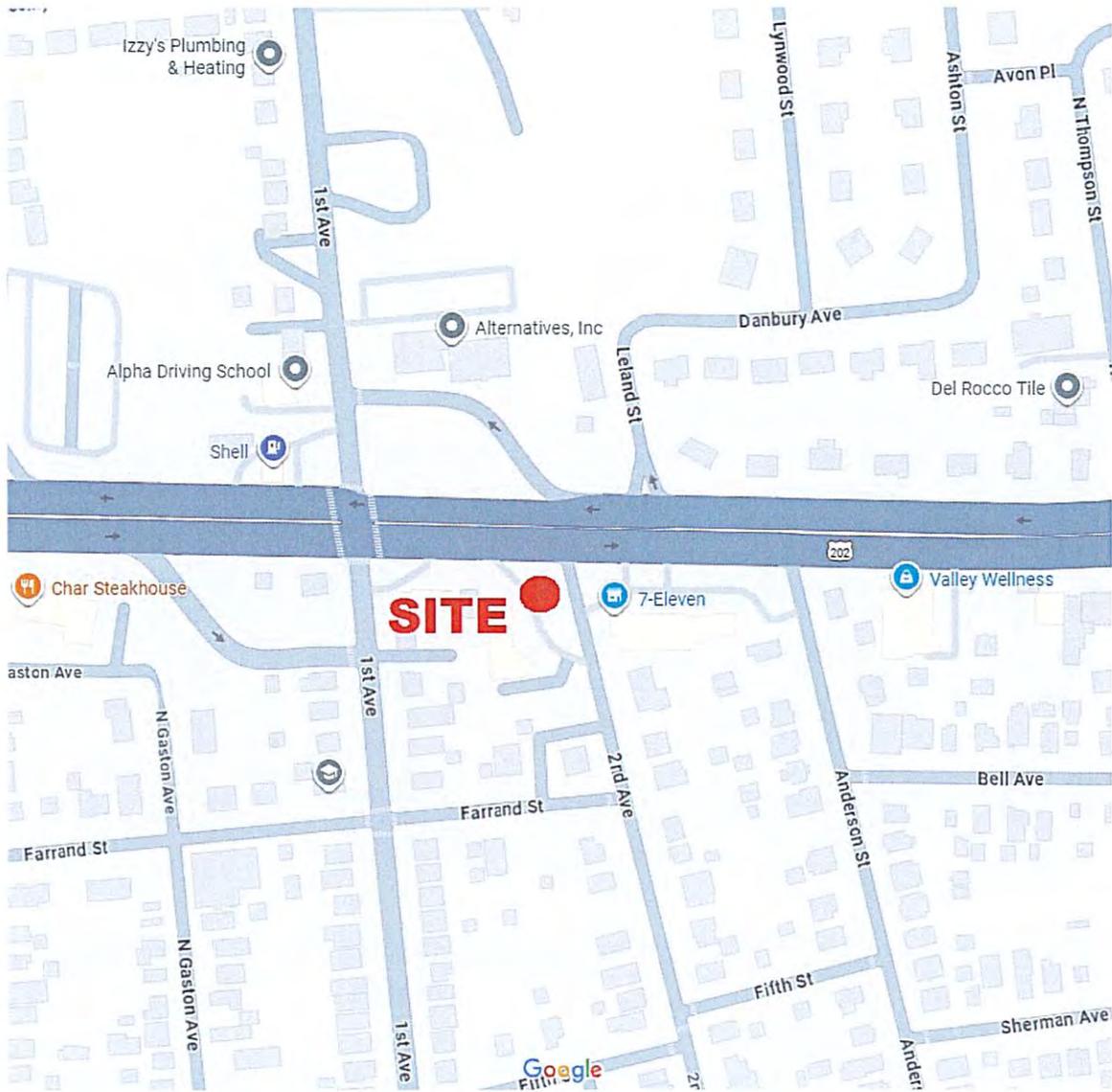


Figure 1. Location Map

The proposed sign dimensions are as follows:

Overall Height:	62'
Sign Width:	48'
Sign Height:	14'

The purpose of this analysis is to evaluate the traffic safety impacts of the construction of the proposed outdoor advertising sign. Accordingly, this analysis includes the following:

- A review of the Site Plan prepared by Dynamic Engineering
- A review of existing roadways and traffic conditions in the vicinity of the site;
- Perform a “Cone of Vision” Analysis, to evaluate if the proposed sign will be located within the peripheral vision of the drivers, and if so, will not create any safety distractions;
- Review of NJDOT Outdoor Advertising Permit
- Crash records compiled for Route 202, and
- Conclusions of this study.

Our findings indicate that construction of the sign will not have any detrimental effects on safety and traffic flow along Route 202.

ANALYSIS

The basic alignment of Route 202 is straight and level. As mentioned previously, the proposed sign will be located at milepost 23.96 ± of Route 202. Figure 2 depicts the sign location on NJDOT Straight Line Diagram.

The latest available Annual Average Daily Traffic (AADT) count for Route 202 is 62,863 for the year 2022. We assumed this count in our analysis.

The US Department of Transportation, Federal Highway Administration published a study entitled **DRIVER VISUAL BEHAVIOR IN THE PRESENCE OF**

COMMERCIAL ELECTRONIC VARIABLE MESSAGE SIGNS (CEVMS) – see exhibit E for the executive summary of the study. The purpose of the “Cone of Vision” Analysis was to determine whether the proposed sign is within the driver’s cone of vision and evaluate the length of the area that drivers will be able to observe the sign. Exhibit B delineates the cone of visions for the approaching traffic.

The placement of the sign allows optimum visibility to maximize the time that the driver will need to view the advertisement. The posted speed limit on Route 202 is 45 mph (66 feet/second). The visibility of the sign within the cone of vision is as follows:

- Route 202 NB – 690 feet, 10.45 seconds
- Route 202 SB – 630 feet 9.55 seconds

The US Department of Transportation, Federal Highway Administration study (**CEVMS**) noted above determined that motorist’s average fixation duration of billboards was approximately .3 seconds. The cone of vision that was studied allows visibility of the sign in excess of 10 seconds – 33 times the required time for northbound traffic, and 9.55 seconds for southbound traffic – 32 times the average required observation time. The sign placement and height allow motorists to observe the sign without being distracted from the driving task. The study indicated that billboards were not associated with long glances away from the driver’s field of view.

The 40-degree cone of vision plotting allows more than adequate time for the sign to be in the driver’s field of view. This viewing angle was used in the CEVMS analysis.

The billboard will have no impact on the safety of the operation of the highway nor the time that motorists require to see and react to the highway signs and perform other driving tasks. This finding was reinforced in the US Department of Transportation research.

US 202 (South to North)

Mile Posts: 23.000 - 26.000

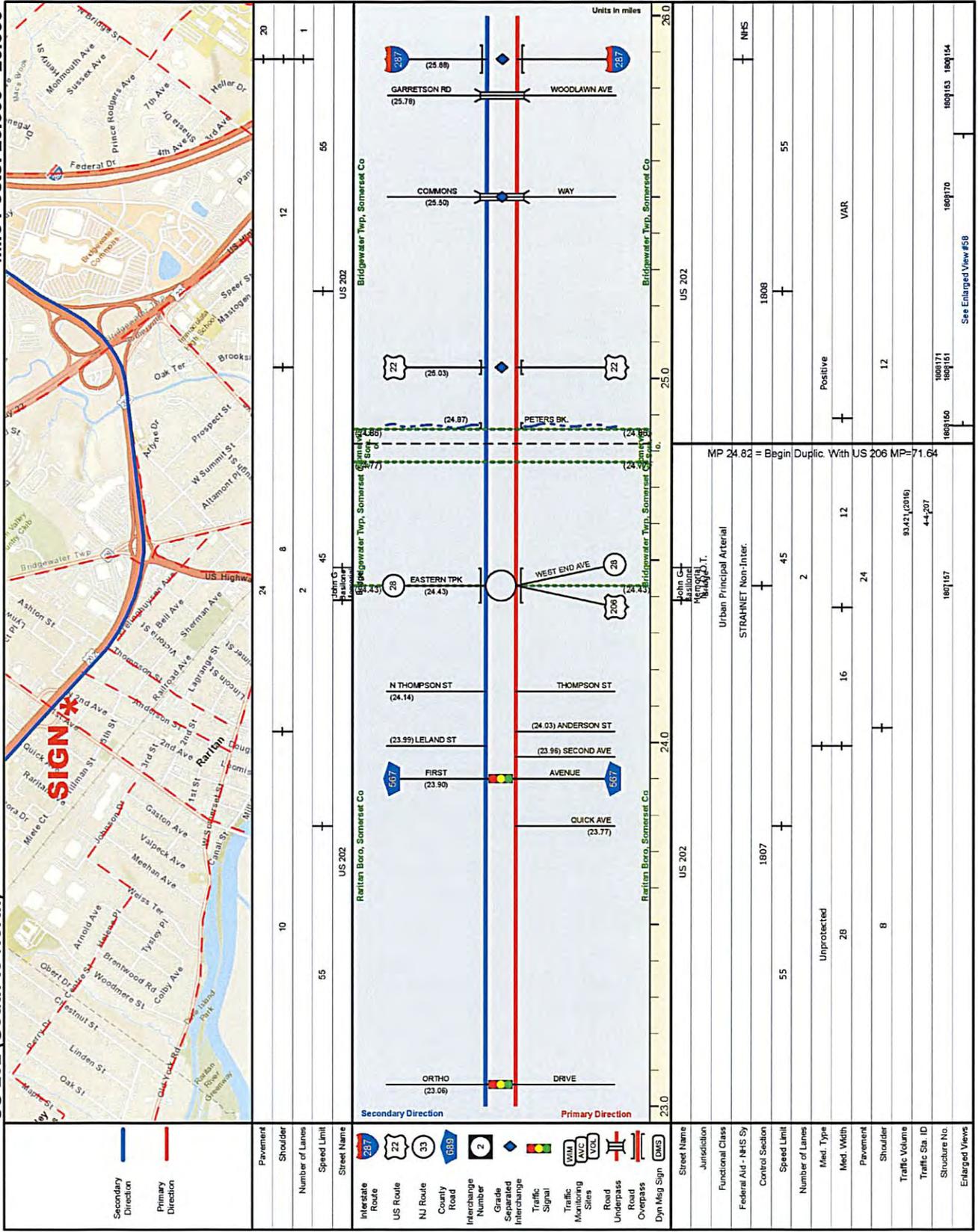


Figure 2. Straight Line Diagram.

EXISTING CRASH RATES

We studied the crash rates along this section of Route 202. Statistics available from the NJDOT website were analyzed for the years 2020 to 2022. The analysis included 500 feet section of Route 202 before and after the proposed billboard. The analysis revealed the following number of crashes:

YEAR	CRASHES
2022	10 (4 Southbound/6 Northbound)
2021	14 (7 Southbound/7 Northbound)
2020	5 (2 Southbound/3 Northbound)

Three-year average 10 crashes/year

Using the published AADT (Average Annual Daily Traffic) of 62,863 vehicles per day for Route 202 equates to 37.8 million vehicles pass the site in a year. The study area before the billboard is .95 miles. These statistics indicate that the crash rate for the 500' viewing area of the proposed billboard is .28 crashes per million motor vehicle miles. This calculation indicates a very low crash rate. Although the traffic volumes are relatively high, the crash rate does not indicate an unsafe location. We note that the billboard does not generate traffic.

CONCLUSION

Based on what has been presented in the previous sections, the following summarized view can be concluded:

- The geometric alignment of Route 202 in the vicinity of the proposed sign provides the motorists proper viewing angles. Therefore, it will not present any distractions or safety hazards;
- A “Cone of Vision” Analysis was performed, and it determines that the proposed sign will be located within the driver’s cone of vision without creating distractions and/or conflicts;
- The existing crash rates in the viewing area of the proposed billboard are low and based on the reference material there is no indication that the rate will increase.
- All these factors are evaluated before the NJDOT Outdoor Advertising permit is issued

Vehicles travelling at 65 Miles per Hour i.e., 95 feet per second will have more than adequate time to digest the copy of the billboard without being distracted from the driving task. Grant of the variance relief will not create adverse impacts from a traffic engineering point of view.

In conclusion, the findings of this analysis indicate that the construction of the billboard can be implemented without adversely impacting driver safety and without detriment to the health, safety, and welfare of the community.

EXHIBITS A, B, C, D, E & F



 INDICATES LOCATION AND DIRECTION PHOTO WAS TAKEN

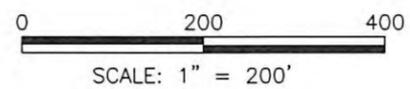
0 200 400
SCALE: 1" = 200'



SEA
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PHOTO KEY MAP
PROPOSED OUTDOOR
ADVERTISING SIGN
605 ROUTE 202
BLOCK 34, LOTS 8 & 8.01
BOROUGH OF RARITAN, SOMERSET COUNTY, NEW JERSEY

FILE No: 25-106
EXHIBIT "A"




Simoff Engineering Associates
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VIEWING STUDY
PROPOSED OUTDOOR
ADVERTISING SIGN
 605 ROUTE 202
 BLOCK 34, LOTS 8 & 8.01
 BOROUGH OF RARITAN, SOMERSET COUNTY, NEW JERSEY

FILE No: 25-106
EXHIBIT "B"



PHOTO #1. NJSH 202 NB. APPROXIMATELY 200 FEET SOUTH OF PROPOSED SIGN

SEA
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Phone: (973) 966-9000 Fax: (973) 805-2310 WWW.SIMOFF.COM

PROPOSED BILLBOARD SIMULATION
**PROPOSED OUTDOOR
ADVERTISING SIGN**
605 ROUTE 202
BLOCK 34, LOTS 8 & 8.01
BOROUGH OF RARITAN, SOMERSET COUNTY, NEW JERSEY

FILE No: 25-106
EXHIBIT "C"



PHOTO #5. NJSH 202 SB. APPROXIMATELY 200 FEET NORTH OF PROPOSED SIGN

PROPOSED BILLBOARD SIMULATION

SEA
Simoff Engineering Associates
2 Shurpik Road Madison New Jersey 07940
Phone: (973) 966-9000 Fax: (973) 805-2310 WWW.SIMOFF.COM

**PROPOSED OUTDOOR
ADVERTISING SIGN**
605 ROUTE 202
BLOCK 34, LOTS 8 & 8.01
BOROUGH OF RARITAN, SOMERSET COUNTY, NEW JERSEY

FILE No: 25-106
EXHIBIT "D"



PHOTO #3. NJSH 202 NB. APPROXIMATELY 600 FEET SOUTH OF PROPOSED SIGN

PROPOSED BILLBOARD SIMULATION


Simoff Engineering Associates
 2 Shunpike Road Madison New Jersey 07940
 Phone: (973) 966-9000 Fax: (973) 805-2310 WWW.SIMOFF.COM

**PROPOSED OUTDOOR
 ADVERTISING SIGN**
 605 ROUTE 202
 BLOCK 34, LOTS 8 & 8.01
 BOROUGH OF RARITAN, SOMERSET COUNTY, NEW JERSEY

FILE No: 25-106
EXHIBIT "E"



PHOTO #7. NJSH 202 SB. APPROXIMATELY 600 FEET NORTH OF PROPOSED SIGN

PROPOSED BILLBOARD SIMULATION

	Simoff Engineering Associates <small>2 Shunpike Road Madison New Jersey 07940 Phone: (973) 966-9000 Fax: (973) 805-2310 WWW.SIMOFF.COM</small>

PROPOSED OUTDOOR ADVERTISING SIGN <small>805 ROUTE 202 BLOCK 34, LOTS 8 & 8.01 BOROUGH OF RARITAN, SOMERSET COUNTY, NEW JERSEY</small>

<small>FILE No: 25-106</small>
EXHIBIT "F"

EXHIBIT G
EXECUTIVE SUMMARY OF
FHWA REPORT

**DRIVER VISUAL BEHAVIOR IN THE PRESENCE OF COMMERCIAL
ELECTRONIC VARIABLE MESSAGE SIGNS (CEVMS)**

SEPTEMBER 2012



U.S. Department of Transportation
**Federal Highway
Administration**

FHWA-HEP-

FOREWORD

The advent of electronic billboard technologies, in particular the digital Light-Emitting Diode (LED) billboard, has necessitated a reevaluation of current legislation and regulation for controlling outdoor advertising. In this case, one of the concerns is possible driver distraction. In the context of the present report, outdoor advertising signs employing this new advertising technology are referred to as Commercial Electronic Variable Message Signs (CEVMS). They are also commonly referred to as Digital Billboards and Electronic Billboards.

The present report documents the results of a study conducted to investigate the effects of CEVMS used for outdoor advertising on driver visual behavior in a roadway driving environment. The report consists of a brief review of the relevant published literature related to billboards and visual distraction, the rationale for the Federal Highway Administration research study, the methods by which the study was conducted, and the results of the study, which used an eye tracking system to measure driver glances while driving on roadways in the presence of CEVMS, standard billboards, and other roadside elements. The report should be of interest to highway engineers, traffic engineers, highway safety specialists, the outdoor advertising industry, environmental advocates, Federal policymakers, and State and local regulators of outdoor advertising.

Monique R. Evans
Director, Office of Safety
Research and Development

Nelson Castellanos
Director, Office of Real Estate
Services

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TECHNICAL DOCUMENTATION PAGE

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		14. Sponsoring Agency Code	
15. Supplementary Notes The Contracting Officer's Technical Representatives (COTR) were Christopher Monk and Thomas Granda.			
16. Abstract This study was conducted to investigate the effect of CEVMS on driver visual behavior in a roadway driving environment. An instrumented vehicle with an eye tracking system was used. Roads containing CEVMS, standard billboards, and control areas with no off-premise advertising were selected. Data were collected on arterials and freeways in the day and nighttime. Field studies were conducted in two cities where the same methodology was used but there were differences in the roadway visual environment. The gazes to the road ahead were high across the conditions; however, the CEVMS and billboard conditions resulted in a lower probability of gazes as compared to the control conditions (roadways not containing off-premise advertising) with the exception of arterials in Richmond where none of the conditions differed from each other. Examination of where drivers gazed in the CEVMS and standard billboard conditions showed that gazes away from the road ahead were not primarily to the billboards. Average and maximum fixations to CEVMS and standard billboards were similar across all conditions. However, four long dwell times were found (sequential and multiple fixations) that were greater than 2,000 ms. One was to a CEVMS on a freeway in the day time, two were to the same standard billboard on a freeway once in the day and once at night; and one was to a standard billboard on an arterial at night. In Richmond, the results showed that drivers gazed more at CEVMS than at standard billboards at night; however, in Reading the drivers were equally likely to gaze towards CEVMS or standard billboards in day and night. The results of the study are consistent with research and theory on the control of gaze behavior in natural environments. The demands of the driving task tend to affect the driver's self-regulation of gaze behavior.			
17. Key Words Driver visual behavior, visual environment, billboards, eye tracking system, commercial electronic variable message signs, CEVMS, visual complexity		18. Distribution Statement No restrictions.	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages	22. Price

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
AREA				
in ²	square inches	645.2	square millimeters	mm ²
ft ²	square feet	0.093	square meters	m ²
yd ²	square yard	0.836	square meters	m ²
ac	acres	0.405	hectares	ha
mi ²	square miles	2.59	square kilometers	km ²
VOLUME				
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft ³	cubic feet	0.028	cubic meters	m ³
yd ³	cubic yards	0.765	cubic meters	m ³
NOTE: volumes greater than 1000 L shall be shown in m ³				
MASS				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
TEMPERATURE (exact degrees)				
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
ILLUMINATION				
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m ²	cd/m ²
FORCE and PRESSURE or STRESS				
lbf	poundforce	4.45	newtons	N
lbf/in ²	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
AREA				
mm ²	square millimeters	0.0016	square inches	in ²
m ²	square meters	10.764	square feet	ft ²
m ²	square meters	1.195	square yards	yd ²
ha	hectares	2.47	acres	ac
km ²	square kilometers	0.388	square miles	mi ²
VOLUME				
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m ³	cubic meters	35.314	cubic feet	ft ³
m ³	cubic meters	1.307	cubic yards	yd ³
MASS				
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
TEMPERATURE (exact degrees)				
°C	Celsius	1.8C+32	Fahrenheit	°F
ILLUMINATION				
lx	lux	0.0929	foot-candles	fc
cd/m ²	candela/m ²	0.2919	foot-Lamberts	fl
FORCE and PRESSURE or STRESS				
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in ²

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.
(Revised March 2003)

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LIST OF ACRONYMS AND SYMBOLS

CEVMS	Commercial Electronic Variable Message Sign
EB	Empirical Bayes
DCZ	Data Collection Zone
ROI	Region of Interest
LED	Light-Emitting Diode
IR	Infra-Red
CCD	Charge-Coupled Device
MAPPS	Multiple-Analysis of Psychophysical and Performance Signals
GEE	Generalized Estimating Equations
FHWA	Federal Highway Administration
DOT	Department of Transportation

EXECUTIVE SUMMARY

This study examines where drivers look when driving past commercial electronic variable message signs (CEVMS), standard billboards, or no off-premise advertising. The results and conclusions are presented in response to the three research questions listed below:

1. Do CEVMS attract drivers' attention away from the forward roadway and other driving-relevant stimuli?
2. Do glances to CEVMS occur that would suggest a decrease in safety?
3. Do drivers look at CEVMS more than at standard billboards?

This study follows a Federal Highway Administration (FHWA) review of the literature on the possible distracting and safety effects of off-premise advertising and CEVMS in particular. The review considered laboratory studies, driving simulator studies, field research vehicle studies, and crash studies. The published literature indicated that there was no consistent evidence showing a safety or distraction effect due to off-premise advertising. However, the review also enumerated potential limitations in the previous research that may have resulted in the finding of no distraction effects for off-premise advertising. The study team recommended that additional research be conducted using instrumented vehicle research methods with eye tracking technology.

The eyes are constantly moving and they fixate (focus on a specific object or area), perform saccades (eye movements to change the point of fixation), and engage in pursuit movements (track moving objects). It is during fixations that we take in detailed information about the environment. Eye tracking allows one to determine to what degree off-premise advertising may divert attention away from the forward roadway. A finding that areas containing CEVMS result in significantly more gazes to the billboards at a cost of not gazing toward the forward roadway would suggest a potential safety risk. In addition to measuring the degree to which CEVMS may distract from the forward roadway, an eye tracking device would allow an examination of the duration of fixations and dwell times (multiple sequential fixations) to CEVMS and standard billboards. Previous research conducted by the National Highway Traffic Safety Administration (NHTSA) led to the conclusion that taking your eyes off the road for 2 seconds or more presents a safety risk. Measuring fixations and dwell times to CEVMS and standard billboards would also allow a determination as to the degree to which these advertising signs lead to potentially unsafe gaze behavior.

Most of the literature concerning eye gaze behavior in dynamic environments suggests that task demands tend to override visual salience (an object that stands out because of its physical properties) in determining attention allocation. When extended to driving, it would be expected that visual attention will be directed toward task-relevant areas and objects (e.g., the roadway, other vehicles, speed limit signs) and that other salient objects, such as billboards, would not necessarily capture attention. However, driving is a somewhat automatic process and conditions generally do not require constant, undivided attention. As a result, salient stimuli, such as CEVMS, might capture driver attention and produce an unwanted increase in driver distraction. The present study addresses this concern.

This study used an instrumented vehicle with an eye tracking system to measure where drivers were looking when driving past CEVMS and standard billboards. The CEVMS and standard billboards were measured with respect to luminance, location, size, and other relevant variables to characterize these visual stimuli extensively. Unlike previous studies on digital billboards, the present study examined CEVMS as deployed in two United States cities. These billboards did not contain dynamic video or other dynamic elements, but changed content approximately every 8 to 10 seconds. The eye tracking system had nearly a 2-degree level of resolution that provided significantly more accuracy in determining what objects the drivers were looking at compared to an earlier naturalistic driving study. This study assessed two data collection efforts that employed the same methodology in two cities.

In each city, the study examined eye glance behavior to four CEVMS, two on arterials and two on freeways. There were an equal number of signs on the left and right side of the road for arterials and freeways. The standard billboards were selected for comparison with CEVMS such that one standard billboard environment matched as closely as possible that of each of the CEVMS. Two control locations were selected that did not contain off-premise advertising, one on an arterial and the other on a freeway. This resulted in 10 data collection zones in each city that were approximately 1,000 feet in length (the distance from the start of the data collection zone to the point that the CEVMS or standard billboard disappeared from the data collection video).

In Reading, Pennsylvania, 14 participants drove at night and 17 drove during the day. In Richmond, Virginia, 10 participants drove at night and 14 drove during the day. Calibration of the eye tracking system, practice drive, and the data collection drive took approximately 2 hours per participant to accomplish.

The following is a summary of the study results and conclusions presented in reference to the three research questions the study aimed to address.

Do CEVMS attract drivers' attention away from the forward roadway and other driving relevant stimuli?

- On average, the drivers in this study devoted between 73 and 85 percent of their visual attention to the road ahead for both CEVMS and standard billboards. This range is consistent with earlier field research studies. In the present study, the presence of CEVMS did not appear to be related to a decrease in looking toward the road ahead.

Do glances to CEVMS occur that would suggest a decrease in safety?

- The average fixation duration to CEVMS was 379 ms and to standard billboards it was 335 ms across the two cities. The average fixation durations to CEVMS and standard billboards were similar to the average fixation duration to the road ahead.
- The longest fixation to a CEVMS was 1,335 ms and to a standard billboard it was 1,284 ms. The current widely accepted threshold for durations of glances away from the road ahead that result in higher crash risk is 2,000 ms. This value comes from a NHTSA

naturalistic driving study that showed a significant increase in crash odds when glances away from the road ahead were 2,000 ms or longer.

- Four dwell times (aggregate of consecutive fixations to the same object) greater than 2,000 ms were observed across the two studies. Three were to standard billboards and one was to a CEVMS. The long dwell time to the CEVMS occurred in the daytime to a billboard viewable from a freeway. Review of the video data for these four long dwell times showed that the signs were not far from the forward view while participant's gaze dwelled on them. Therefore, the drivers still had access to information about what was in front of them through peripheral vision.
- The results did not provide evidence indicating that CEVMS, as deployed and tested in the two selected cities, were associated with unacceptably long glances away from the road. When dwell times longer than the currently accepted threshold of 2,000 ms occurred, the road ahead was still in the driver's field of view. This was the case for both CEVMS and standard billboards.

Do drivers look at CEVMS more than at standard billboards?

- When comparing the probability of a gaze at a CEVMS versus a standard billboard, the drivers in this study were generally more likely to gaze at CEVMS than at standard billboards. However, some variability occurred between the two locations and between the types of roadway (arterial or freeway).
- In Reading, when considering the proportion of time spent looking at billboards, the participants looked more often at CEVMS than at standard billboards when on arterials (63 percent to CEVMS and 37 percent to a standard billboard), whereas they looked more often at standard billboards when on freeways (33 percent to CEVMS and 67 percent to a standard billboard). In Richmond, the drivers looked at CEVMS more than standard billboards no matter the type of road they were on, but as in Reading, the preference for gazing at CEVMS was greater on arterials (68 percent to CEVMS and 32 percent to standard billboards) than on freeways (55 percent to CEVMS and 45 percent to standard billboards). When a gaze was to an off-premise advertising sign, the drivers were generally more likely to gaze at a CEVMS than at a standard billboard.
- In Richmond, the drivers showed a preference for gazing at CEVMS versus standard billboards at night, but in Reading the time of day did not affect gaze behavior. In Richmond, drivers gazed at CEVMS 71 percent and at standard billboards 29 percent at night. On the other hand, in the day the drivers gazed at CEVMS 52 percent and at standard billboards 48 percent.
- In Reading, the average gaze dwell time for CEVMS was 981 ms and for standard billboards it was 1,386 ms. The difference in these average dwell times was not statistically significant. In contrast, the average dwell times to CEVMS and standard billboards were significantly different in Richmond (1,096 ms and 674 ms, respectively).

The present data suggest that the drivers in this study directed the majority of their visual attention to areas of the roadway that were relevant to the task at hand (e.g., the driving task). Furthermore, it is possible, and likely, that in the time that the drivers looked away from the forward roadway, they may have elected to glance at other objects in the surrounding environment (in the absence of billboards) that were not relevant to the driving task. When billboards were present, the drivers in this study sometimes looked at them, but not such that overall attention to the forward roadway decreased.

It also should be noted that, like other studies in the available literature, this study adds to the knowledge base on the issues examined, but does not present definitive answers to the research questions investigated.

SITE PHOTOS



PHOTO #1. NJSH 202 NB. APPROXIMATELY 200 FEET SOUTH OF PROPOSED SIGN



PHOTO #2. NJSH 202 NB. APPROXIMATELY 400 FEET SOUTH OF PROPOSED SIGN



PHOTO #3. NJSH 202 NB. APPROXIMATELY 600 FEET SOUTH OF PROPOSED SIGN



PHOTO #4. NJSH 202 NB. APPROXIMATELY 800 FEET SOUTH OF PROPOSED SIGN



PHOTO #5. NJSH 202 SB. APPROXIMATELY 200 FEET NORTH OF PROPOSED SIGN

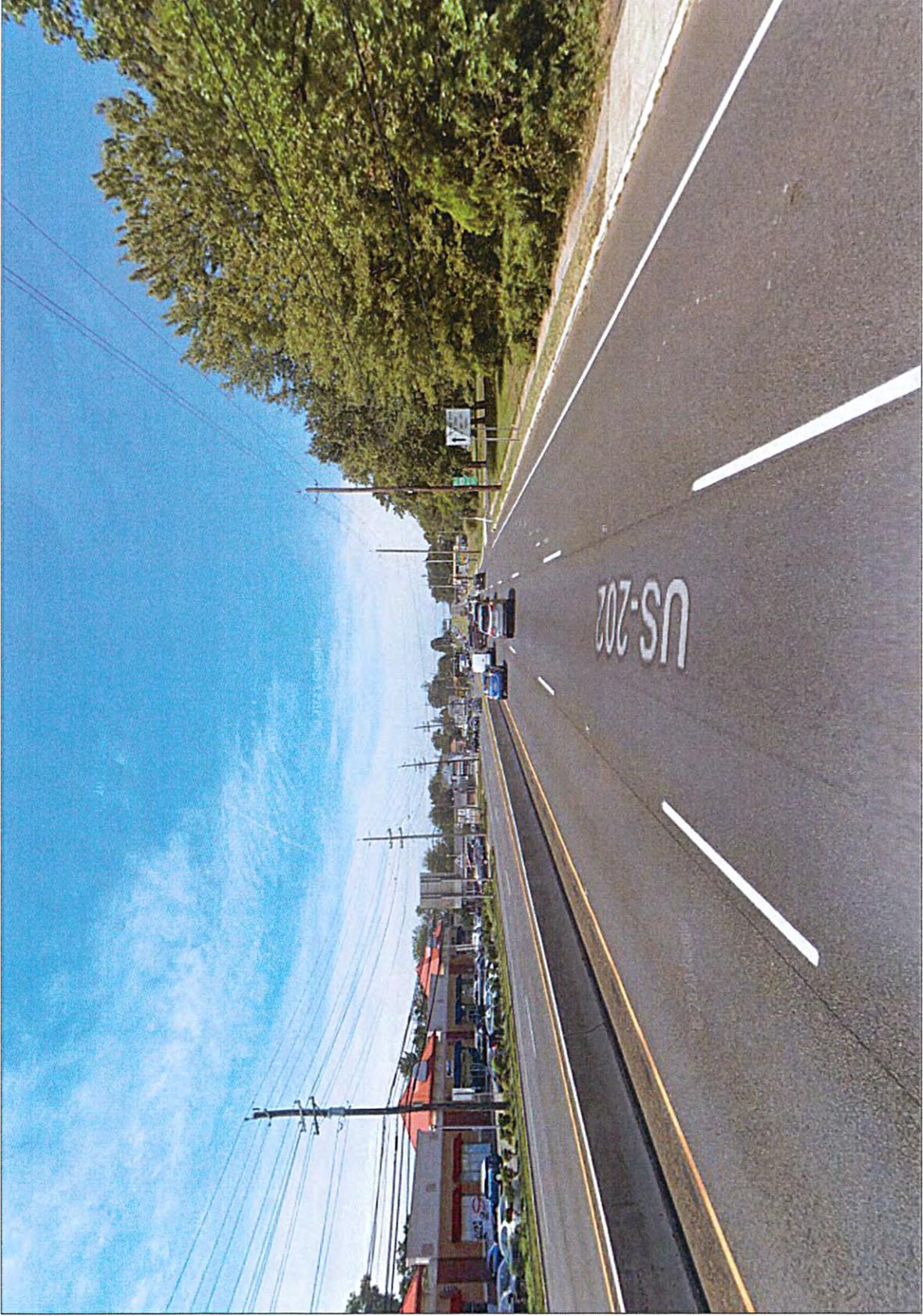


PHOTO #6. NJSH 202 SB. APPROXIMATELY 400 FEET NORTH OF PROPOSED SIGN

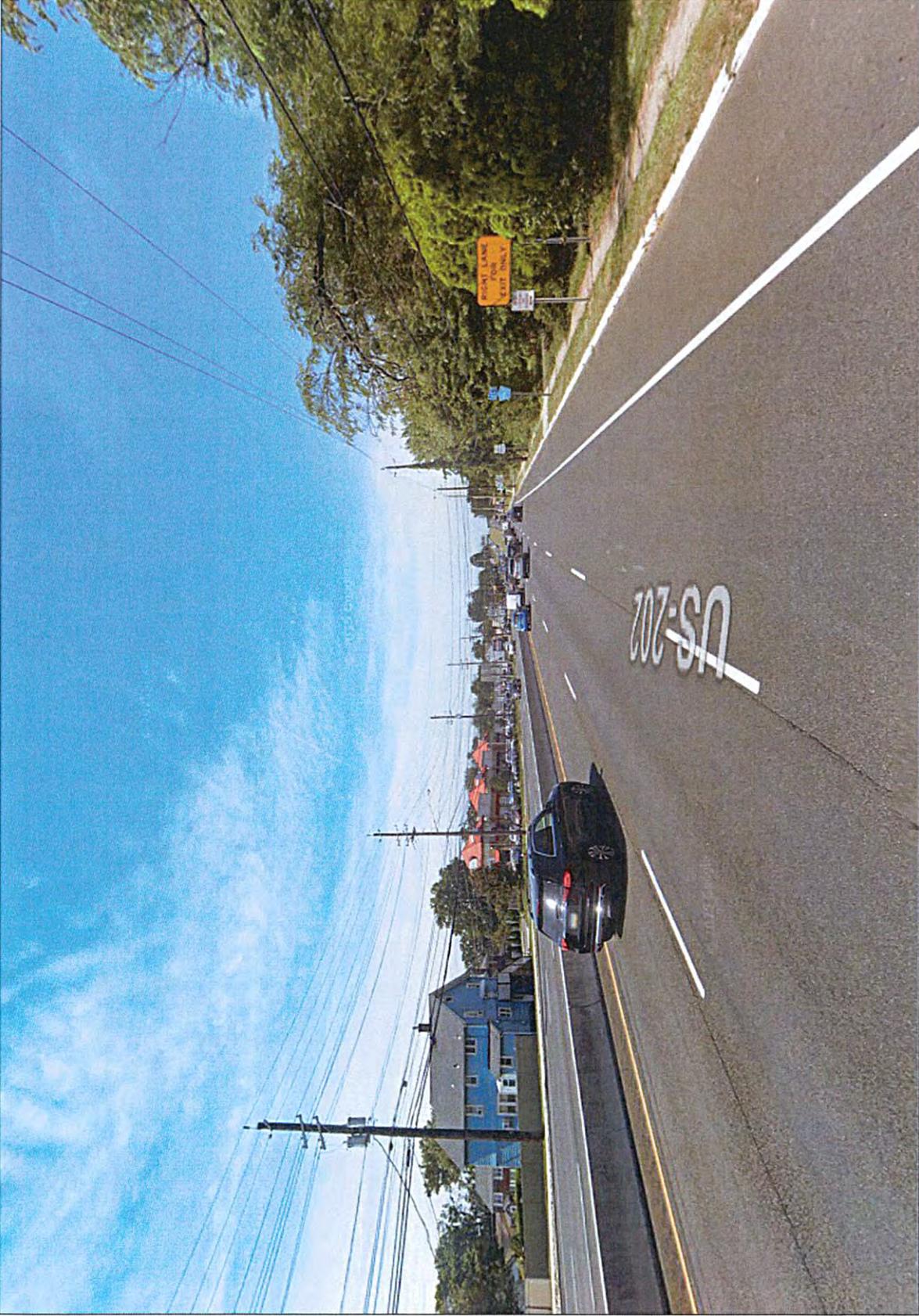


PHOTO #7. NJSH 202 SB. APPROXIMATELY 600 FEET NORTH OF PROPOSED SIGN

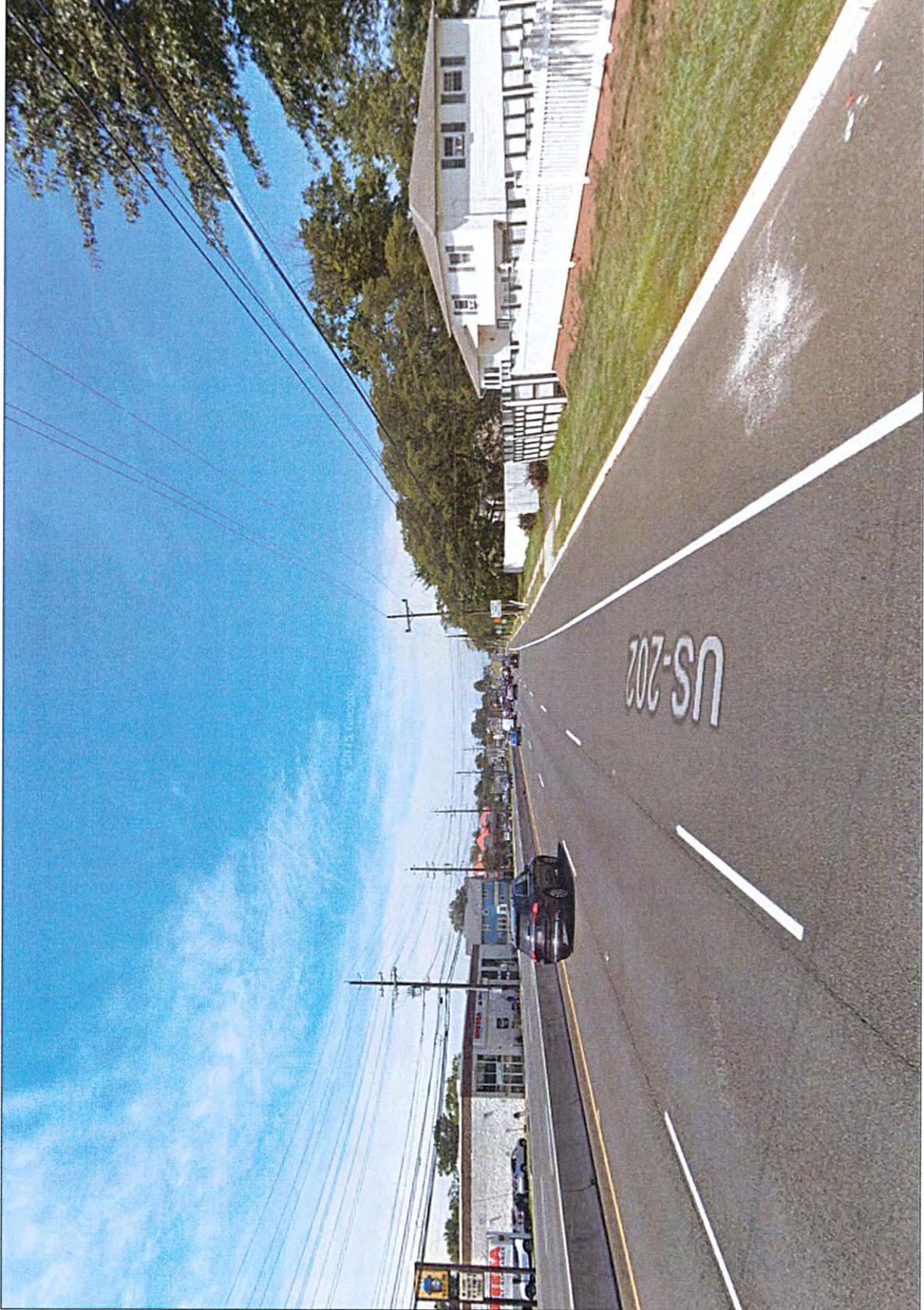


PHOTO #8. NJSH 202 SB. APPROXIMATELY 800 FEET NORTH OF PROPOSED SIGN