



Texas Department of Transportation

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May 27, 2011

Mr. Hari Kalla
MUTCD Team Leader, Office of Operations (HOTO-1)
Federal Highway Administration
1200 New Jersey Avenue SE, E84-316
Washington, DC 20590

RE: Request to Experiment – Low Mounted Do Not Enter and Wrong Way Signs

Dear Mr. Kalla:

After discussing and receiving comments from FHWA, the North Texas Tollway Authority (NTTA), through the Texas Department of Transportation (TxDOT), is resubmitting the request for permission to experiment with lowered Wrong Way and Do Not Enter signage in an attempt to increase safety by reducing the instances of wrong way driving on exit ramps onto a highway.

All of the test locations will be located on streets under the jurisdiction of the NTTA. None of the test locations will be on the TxDOT highway system.

Through the attached request, we agree with the NTTA's request in seeking permission to experiment for the low mounted Do Not Enter and Wrong Way signs.

If you have any questions, please contact Michael Chacon at (512) 416-3120.

Sincerely,

Carol T. Rawson, P.E., Director
Traffic Operations Division

Attachment

cc: Eric Hemphill, NTTA

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NORTH TEXAS TOLLWAY AUTHORITY

5900 West Plano Parkway • Plano, Texas 75093 • (214) 461-2000 • www.ntta.org

May 25, 2011

Carol T. Rawson, P.E.
Traffic Operations Division
Texas Department of Transportation
125 East Eleventh Street
Austin, Texas 78701

RE: Revised Request for Experimental Status of low mounted Do Not Enter and Wrong Way signage

Dear Ms. Rawson,

In accordance with the procedures set forth in the MUTCD, the North Texas Tollway Authority (NTTA) is requesting permission to experiment with lowered Wrong Way and Do Not Enter signage in an attempt to increase safety by reducing the instances of wrong-way driving.

Issue

Pursuant to Chapter 366, Texas Transportation Code, the NTTA is a political subdivision of the State of Texas empowered to acquire, construct, maintain, repair, and operate turnpike projects. The NTTA Board of Directors consists of representatives from Collin, Dallas, Denton, and Tarrant counties and one director from an adjoining county appointed by the Governor. The NTTA is a partner in the DFW Metroplex on regional transportation issues.

Since 2007, the NTTA observed an increase in accidents caused by wrong-way drivers. In fact, the NTTA has had 22 crashes resulting in 5 fatalities from wrong-way drivers on the NTTA system since 2007. All of the wrong-way drivers on the NTTA system involved in crashes since 2007 have been intoxicated. In addition to the crashes, the NTTA has detected 29 incidents of wrong-way driving on the NTTA system since January 2010.

As a result of the wrong-way driving accidents, the NTTA formed a wrong-way driver task force and began to investigate methods to reduce occurrences. As part of the research, the task force discovered *Project 0-04218: Countermeasures for Wrong Way Movements on Freeways: Guidelines and Recommended Practices* by Cooner, Cothron, and Ranft of the Texas Transportation Institute (TTI), published in 2004. The research report identified and recommended various countermeasures, including installing raised pavement markings, installing inductive loops for detection, utilizing a wrong way entry checklist for reviewing intersections, and the lowering Do Not Enter (or Wrong Way) signs. These countermeasures, along with thirteen others, were assessed by the task force.

The NTTA has already implemented nine of the assessed countermeasures, including installation of wrong-way arrow raised pavement markings at ramps and partnering with adjacent municipalities for proper signage and pavement markings at intersections. The NTTA was also

able to utilize existing loops at some roadway ramps used for tolling for the detection of wrong-way drivers, and created a graphical user interface to push that detection from the ramp to our continuously monitored Command Center. The detection is verified by staff using cameras where available and police are immediately dispatched in an attempt to intervene before a crash. However, the tolling equipment only exists at 51 of our 142 exit ramps.

Additionally, the equipment does not serve as an active deterrent for a wrong-way driver; by the time we receive the detection, the wrong way movement has already occurred. The NTTA continues to seek solutions to the problem and believes there is viability for lowered sign assemblies as a system-wide approach at deterrence.

In 2010, the NTTA proceeded with designing, fabricating, and crash testing a lowered sign height based on the success with a similar sign used by the California Department of Transportation (Caltrans) and the previously mentioned research by TTI. The TTI research indicated lowered mounting heights make the signs more visible at night because they are in the path of headlights. There is an increased chance of an impaired driver recognizing the signs because they tend to drive with their eyes low looking for visual cues along the pavement.

Proposed Change/Device Development

The NTTA is requesting experimentation with the standard mounting height as described in MUTCD Section 2A.18 - Mounting Height. The NTTA experiment would be with mounting heights of Do Not Enter (R5-1) and Wrong Way (R5-1a) signs at a height of two (2) feet measured vertically from the bottom of the sign to the elevation of the near edge of the pavement.

Wrong Way (R5-1a) Signs

Using a standard 24" x 36" size sign, the sign assembly would have a total height of four (4) feet measured from the top of the sign to the elevation of the near edge of the pavement.

Do Not Enter (R5-1) Signs

Using a standard 36" x 36" Do Not Enter sign for a total height of five (5) feet measured from the top of the sign to the elevation of the near edge of the pavement.

The experiment is not intended for, and will not include, lower mounting heights for any signs other than Do Not Enter (R5-1) and Wrong Way (R5-1a).

The mounting height of the sign was developed by trying to determine a height capable of catching an impaired driver's attention while still being able to alert unimpaired drivers of restricted movements. In addition, the sign must also be capable of passing crash in the event an errant right way driver impacts the sign.

Although the NTTA was aware the mounting height of three feet was an option, we were unable to locate any crash tests to verify the sign would not be a hazard to an errant vehicle that was traveling the right way on the system. In addition, researchers at the Texas Transportation Institute (TTI) had concerns regarding how a sign mounted at three feet would perform in a crash test using the latest crash test criteria in the AASHTO Manual for Assessing Safety Hardware (MASH). As part of our research we contacted Dr. Roger Bligh, Ph.D., P.E., a Research Engineer and Manager

of the Roadside Safety Program at TTI, for an opinion regarding the likely performance of the allowable 3-foot sign as compared to our proposed 2-foot sign.

The following is from Dr. Roger Bligh regarding the two sign mounting heights.

"I have confirmed that the "wrap-around" distance (i.e., the distance from the ground, up around the front bumper, and along the hood to the base of the windshield) is approximately 5 ft-6 inches.

A yielding sign support system (e.g. wedge and socket system with thin wall tubing) will deform around the front of the vehicle. This causes the sign panel to slap down on the vehicle as the system is released from its base/socket. If the overall height of the sign is kept below the wrap-around distance, there is little opportunity for any secondary contact of the sign support or sign panel with the windshield. If the wrap-around distance is exceeded, contact with the windshield is likely. Under MASH evaluation criteria, if the test article penetrates the plastic liner in the laminated windshield glass, the test is unacceptable.

Your "wrong way" sign system with a 3 ft x 3 ft sign panel at a 2-ft mounting height has an overall height of 5 ft which is less than the wrap-around distance. It was successfully crash tested and met all of the applicable evaluation criteria of MASH.

If the mounting height is increased to 3ft, the overall height would be 6 ft (which exceeds the wrap around distance). In this case, contact with the windshield is probable."

The majority of our incidents involving wrong way crashes happen during the night time and early morning hours when ambient light is low meaning the signs rely on headlights to provide conspicuity. Therefore, the NTTA evaluated headlight height, driver eye height and potential retroreflectivity of signs prior to determining a mounting height of two feet. The law in Texas regarding headlights establishes a mounting height between 24 and 54 inches. Therefore, the proposed mounting height of two feet with a total sign height of five feet covers the minimum and maximum headlight height allowed by Texas, another contributor to our decision to seek a two foot sign height.

In addition, as shown in the attached letter report dated May 3, 2011 from Paul J. Carlson, Ph.D., P.E. a Research Engineer and TTI Division Head, "the results show that the 2 ft mounting height produces a sign almost twice as bright (an average of 74% more bright throughout the approach range of 500 to 50 ft) as the 3 ft mounting height. A brighter sign is believed to be more conspicuous to the wrong way driver, and therefore help lead to a safer road environment."

During the research conducted by the NTTA task force, it was discovered Caltrans allows a mounting height of 2' for their Do Not Enter package. As mentioned in TTI Research Project 0-04218, Caltrans' lowered sign height reduced wrong-way driver occurrences for 90 percent of the locations that had a problem with wrong-way entries.

Once the sign mounting height was determined, the NTTA contracted with TTI to determine if the sign would meet the provisions of the AASHTO Manual for Assessing Safety Hardware (MASH). The testing was conducted and the findings were submitted to the FHWA Office of Safety for

review. On December 7, 2010 the NTTA received a letter from FHWA finding the 2-foot high by 3-foot wide Wrong Way sign mounted 2 feet above the ground was acceptable to use on the National Highway System under the provisions of the AASTHO MASH.

On January 31, 2011 TTI completed a crash test on a 36" x 36" Do Not Enter sign mounted at a two foot height for a total height of 5 feet measured from the top of the sign to the elevation of the near edge of the pavement. The preliminary results are that the test assembly and sign passed, and upon receipt of the final report the NTTA will submit the information to FHWA Office of Safety requesting a Letter of Acceptance for the device.

The NTTA also understands that placement of lowered signs may pose an issue with pedestrian access and traffic sight visibility. However, the NTTA system is a mixture of high speed roadways with one-way frontage roads and low speed exit ramps that approach street intersections controlled by stop signs or traffic lights. The NTTA system does not have sidewalks, and pedestrians are prohibited on our roadways. Cross traffic sight visibility will be a consideration when the signs are to be placed on exit ramps near intersections.

Experiment Locations

The NTTA has 142 exits ramps on its system; of these 51 are tolled, meaning we have in-ground loops sending wrong way driver alerts to our Command Center. The proposal is to experiment with the signage at 28 exit ramps, using 11 tolled and 17 non-tolled locations. In addition to a mixture of tolled and non-tolled ramps, the NTTA is proposing to experiment with three configurations of the Wrong Way and Do Not Enter signage. The experiment will look at the geometry of the ramps and tolled versus non-tolled to determine which configuration will be deployed. In the experiment the existing signs will be replaced based on the configuration at each location. The proposed configurations are:

1. Do Not Enter (R5-1) signage at the proposed 2' mounting height and Wrong Way (R5-1a) signage at standard mounting height
2. Do Not Enter (R5-1) signage at standard mounting height and Wrong Way (R5-1a) signage at the proposed 2' mounting height
3. Do Not Enter (R5-1) and Wrong Way (R5-1a) both at the proposed 2' mounting height.
4. Do Not Enter (R5-1) and Wrong Way (R5-1a) at standard mounting height per the Texas MUTCD.

The experiment will use all three configurations to provide the flexibility to implement any of these configurations on the identified ramps, and to determine which configuration may have the most impact on reducing wrong-way driving occurrences. If granted approval for the experiment, the NTTA will install the signs within 30 calendar days and the experiment will have a duration of 12 months from the installation of the signs. However, the proposed 12 month experimentation period will be extended an additional 12 months if in the opinion of TxDOT and/or FHWA additional data is needed.

Configuration 1

The proposal is to install the Do Not Enter signage at a lower mounting height, but to continue to have the Wrong Way signage at the standard height. The installation of a lower Do Not Enter sign will theoretically catch the attention of an impaired driver prior to making a movement to enter the

ramp. This configuration will be installed at locations in which pedestrians and sight visibility issues will not be an issue as determined by the NTTA Traffic Engineer. The following 12 locations are proposed to have Configuration 1 installed.

| Roadway: | Direction | Cross-Street | Tolled Ramp |
|--------------------------------|-----------|-----------------|-------------|
| Dallas North Tollway | NB | Lovers Ln | No |
| Dallas North Tollway | NB | Beltline Road | Yes |
| Dallas North Tollway | SB | Frankford Rd | Yes |
| Dallas North Tollway | NB | Legacy Dr | No |
| Dallas North Tollway | SB | SRT (SH-121) | No |
| Dallas North Tollway | SB | Warren Pkwy | No |
| Dallas North Tollway | NB | Stonebrook Pkwy | Yes |
| Dallas North Tollway | NB | US 380 | No |
| President George Bush Turnpike | SB | Royal Ln | Yes |
| President George Bush Turnpike | WB | Old Denton Rd | No |
| President George Bush Turnpike | EB | Josey Ln | Yes |
| President George Bush Turnpike | EB | Renner Rd | Yes |

Configuration 2

This configuration will be to install Do Not Enter signs at the standard mounting heights and install the Wrong Way signs at the lower mounting height. This configuration will primarily be used in locations in which the lower Do Not Enter sign may cause an issue with sight visibility or pedestrians at cross streets. This configuration is also being considered at these ramps because the slope of the ramp may make the lowered Wrong Way signs more visible from the intersection than standard mounted height signs. The following 2 locations are proposed to have Configuration 2 installed.

| Roadway: | Direction | Cross-Street | Tolled Ramp |
|----------------------|-----------|--------------|-------------|
| Dallas North Tollway | SB | Oaklawn Ave | No |
| Dallas North Tollway | SB | WyCliff Ave | No |

Configuration 3

This configuration will have both signs installed with lower mounting heights. This configuration will be used to determine if the second lowered sign is reinforcement if the first sign is passed by the wrong way driver. The following 14 locations are proposed to have Configuration 3 installed.

| Roadway: | Direction | Cross-Street | Tolled Ramp |
|--------------------------------|-----------|------------------|-------------|
| Dallas North Tollway | SB | Harry Hines Blvd | No |
| Dallas North Tollway | SB | Northwest Hwy | Yes |
| Dallas North Tollway | NB | Eldorado Pkwy | No |
| President George Bush Turnpike | NB | Belt Line/Luna | Yes |
| President George Bush Turnpike | EB | Midway Rd | No |
| President George Bush Turnpike | WB | Campbell Rd | Yes |
| President George Bush Turnpike | WB | Brand | No |

| | | | |
|---------------------|----|--------------|-----|
| Sam Rayburn Tollway | SB | Denton Tap | No |
| Sam Rayburn Tollway | SB | Business 121 | No |
| Sam Rayburn Tollway | SB | Standridge | No |
| Sam Rayburn Tollway | NB | Main/Josey | Yes |
| Sam Rayburn Tollway | SB | Parkwood | No |
| Sam Rayburn Tollway | NB | Coit Rd | Yes |
| Sam Rayburn Tollway | NB | Lake Forest | No |

The installation of all three configurations will take into consideration guardrail, light poles, fences, etc., that may pose a visibility issue to lower mounted signs. The goal is to have all of the signs visible so the full effect of the reflectivity will be utilized to attract the driver's attention.

Configuration 4

At the remaining ramps not identified above, the signs will remain in their existing configuration for location, size and mounting height. In addition, if new ramps open during the experimentation timeframe the signs will be installed per the MUTCD. This configuration will serve as a control during our evaluation plan.

Evaluation Plan

As stated previously, at the 51 tolled ramps the NTTA currently has the ability to detect a wrong way movement using the pavement loops already in place. The NTTA has monitored these ramps since January 14, 2010 and has confirmed 33 wrong-way drivers, despite early signage and pavement marking improvements. If approved for experimentation, the NTTA will continue to monitor the pavement loops at the 11 tolled experiment locations and determine if the number of wrong-way driving incidents increases or decreases during the experiment duration.

The remaining 91 ramps do not have pavement loops. Therefore, if approved for experimentation, the NTTA will track the number of crashes and other wrong-way driving incidents confirmed by other means and perform an investigation into the possible entry point for each. This investigation will include review of 911 phone calls, use of the ITS cameras on the system where available, review of the official police reports, and talking to witnesses if available. If the exact entry ramp is not able to be determined the investigation will conclude with the list of possible locations, including any with the lowered signs.

The evaluation will include a comparison of wrong way incidents at each proposed configuration to the ramps with standard sign heights and sizes.

The NTTA is proposing a 12 month experimentation period. However, the proposed 12 month experimentation period will be extended as much as 12 months, or as requested, if in the opinion of TxDOT and/or FHWA additional data is needed.

No Patent or Copyright

The general concept of traffic signs at lower mounting heights is not protected by copyright or patent.

Site Restoration

Upon conclusion of a successful experiment, the NTTA anticipates requesting the Manual be changed to include this mounting height as an option, and as a result we anticipate requesting that these signs remain in place until an official rulemaking action has occurred. However, the NTTA understands and agrees the Texas Department of Transportation (TxDOT) and/or the FHWA may terminate this experiment at any time. In addition, the NTTA agrees to restore the experimental sites to a condition that complies with the provisions of the MUTCD within three months of the end of the experiment or as directed by TxDOT and/or FHWA.

Progress Reporting

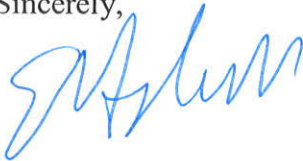
The NTTA will provide TxDOT and FHWA semiannual progress reports for the duration of the experiment. A final report of the experiment will also be provided to TxDOT and FHWA within three months following the completion of the proposed 12-month long experiment.

The NTTA has provided the following items attached for further information and support for approval of our request:

1. NTTA System Map with proposed experimental locations;
2. Proposed Experimental Sign Assembly sketch;
3. TTI Letter report dated May 3, 2011 from Paul J. Carlson, Ph.D., P.E.

Please consider this our request for experimentation. It is our understanding TxDOT will review this request and, if approved, will forward it to FHWA to request the experiment. If you have any questions or need any additional information, please do not hesitate to contact me at 214-224-2166 or by email at ehemphill@ntta.org.

Sincerely,

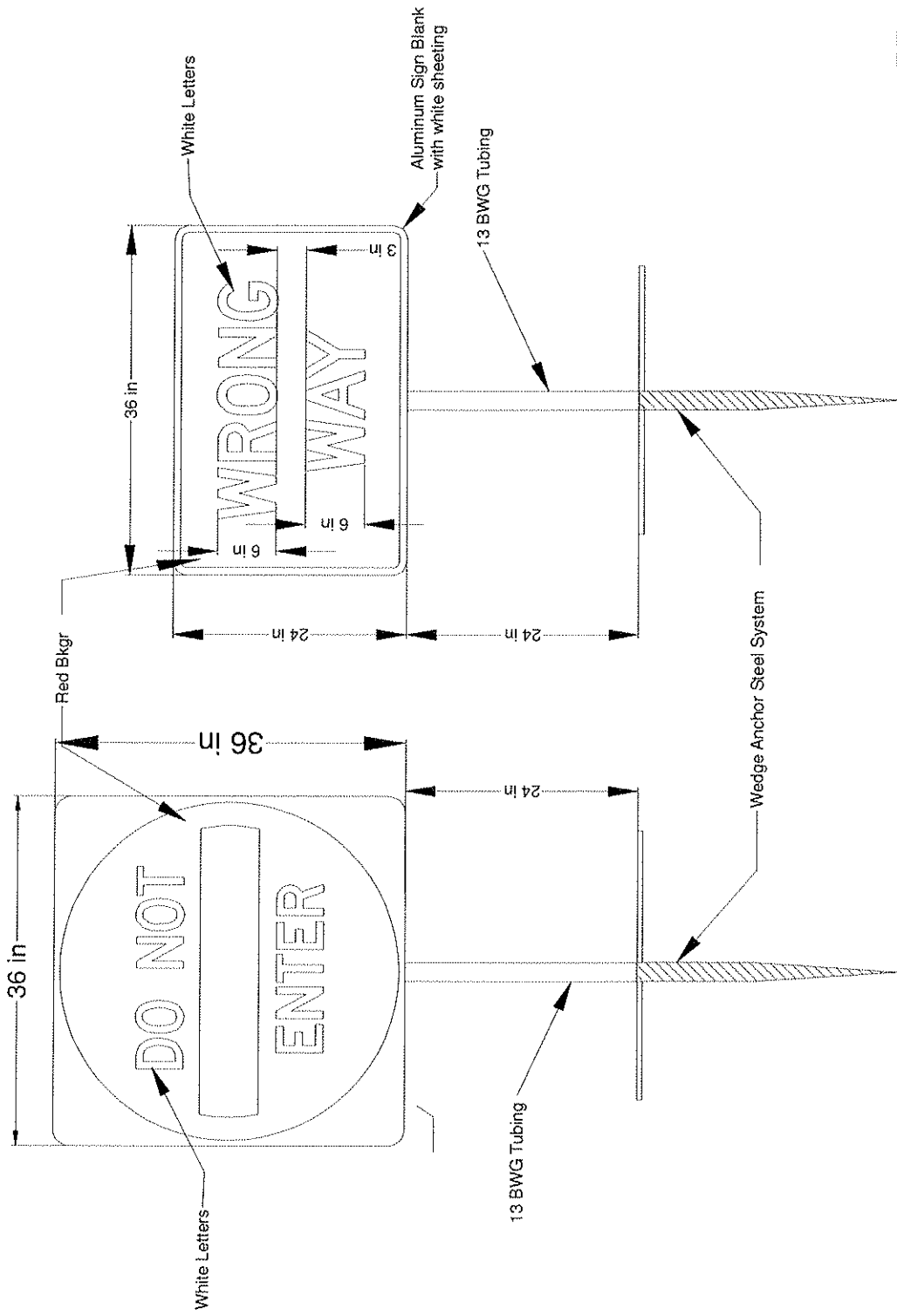


Eric Hemphill, PE
Assistant Director of Maintenance – Operations

Attachments

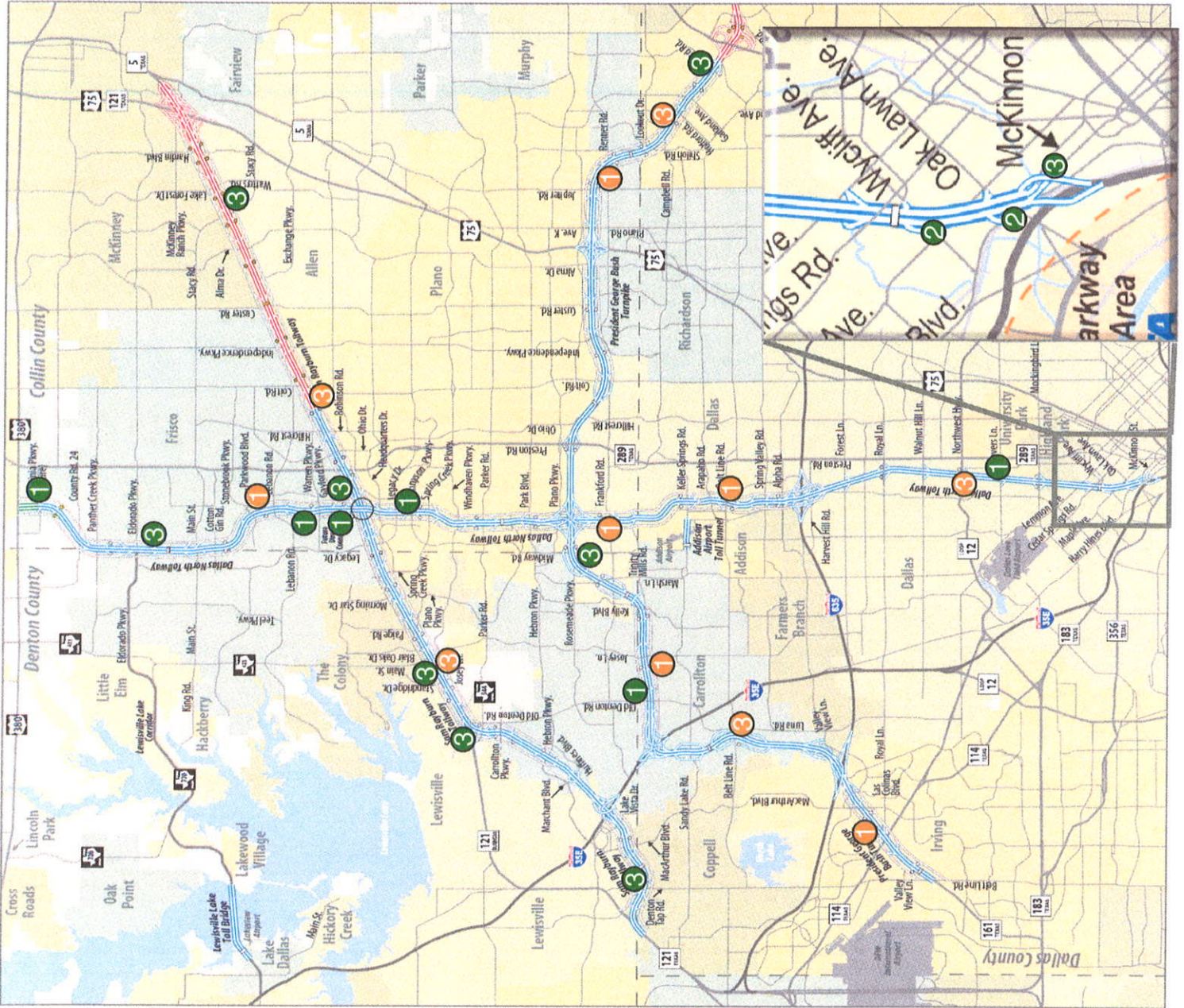
cc: Marty Legé, Director of System and Incident Management
Yang Ouyang, PE, PTOE, Traffic Operations Engineer

PROPOSED EXPERIMENTAL SIGN ASSEMBLIES



Proposed Locations for the Experimental Sign Assemblies on NTTA Roadways

- 1 Configuration #1 at Free Exit Ramp
- 2 Configuration #2 at Free Exit Ramp
- 3 Configuration #3 at Free Exit Ramp
- 1 Configuration #1 at Tolled Exit Ramp
- 2 Configuration #2 at Tolled Exit Ramp
- 3 Configuration #3 at Tolled Exit Ramp





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May 3, 2011

Eric Hemphill, PE
Assistant Director of Maintenance- Operations
North Texas Tollway Authority
214-224-2166 (office)
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ehemphill@ntta.org

Dear Eric:

This letter report is intended to be used to support the NTTA's request to FHWA to use 2 feet mounting heights for wrong way movement signs that have been successfully crash tested.

Introduction

With a letter dated March 1, 2011, the North Texas Tollway Authority (NTTA), through the Texas Department of Transportation (TxDOT), requested permission to experiment with lowered Wrong Way and Do Not Enter signs. The goal of the lowered sign request is to increase safety by reducing the instances of wrong way driving on exit ramps.

NTTA's request includes a mounting height of 2 ft, which is lower than the existing MUTCD guidelines. The 2 ft mounting height was decided because of its successful use in other states and discussions with the Texas Transportation Institute (TTI) regarding crashworthiness. This led to an NTTA sponsored a crash test demonstrating that the 2 ft mounting height is crashworthy. In this memorandum, TTI has summarized the results of a nighttime visibility simulation showing that the 2 ft mounting height also provides a brighter sign during nighttime conditions.

Nighttime Visibility Simulation

Using a standard sized car with a low-beam headlamp profile described as representing the 50th percentile headlamp from market-weighted sales in the US in 2004 (UMTRI), TTI modeled the nighttime visibility (luminance of the sign) of two different sign heights. The simulation included a straight roadway with the vehicle centered in a 12 ft lane. The 3 ft square sign was offset 12 ft from the edge of the right edge line. The sign was modeled with 3M Diamond Grade sheeting (ASTM D4956 Type IX). Two different simulations were run; one with a mounting height at 2 ft and one with a mounting height at 3 ft. The results show that the 2 ft mounting height produces a sign almost twice as bright (an

average of 74% more bright throughout the approach range of 500 to 50 ft) as the 3 ft mounting height. A brighter sign is believed to be more conspicuous to the wrong way driver, and therefore help lead to a safer road environment. The results of the visibility simulation are shown in the graph below.

