Background

In September 2012, FHWA approved Metro’s Request to Experiment with an In-Roadway Warning Light (IRWL) system at 10 intersections along the Metro Gold Line Eastside Extension (MGLEE) in the City of Los Angeles and the County of Los Angeles. In May 2013, 2 more intersections on the Metro Blue Line were approved for a total of 12 experiment locations. The IRWL system is meant to supplement existing traffic signal indications at these intersections for the left turn lanes adjacent to the light rail corridor. This non-standard traffic control system, which uses a series of LED lights embedded in the roadway and is designed to increase the awareness of the presence of street running light rail trains among motorists when trains approach the intersections and deter them from making illegal left turns. The experiment is meant to evaluate any reductions in left turn violations associated with installation of the IRWL system.

The 2-year experiment period began after the installation of IRWLs at the 12 locations in May 2015. The original evaluation plan submitted to FHWA is based on data collected by Metro’s Photo Enforcement Camera program. One intersection (1st /Indiana) is not included in the Photo Enforcement Camera program, so manual counts of left turn violations were to be taken and analyzed. The proposed analysis used a before and after evaluation of left turn violation data to determine the effectiveness of the IRWLs. Attached is the original MGLEE evaluation proposal and approval from FHWA for your reference. Also included is the request and approval to expand the experiment to include two locations on the Metro Blue Line.

Update

During the evaluation period, two issues affecting the reliability and quality of the data have been noted. First, there appears to have been an issue with the installation of some of the equipment. The contractors hired for the installation of the IRWLs were also tasked with inspecting the equipment for two years after the installation. Over the first year, several operational failures were experienced and the contractor has had to troubleshoot and replace equipment. Due to these operation and maintenance issues, it has been difficult to assess any level of effectiveness attributed to the IRWLs. We have been monitoring the equipment closely and have seen very few equipment issues between July 2016 and January 2017. In early February 2017, additional equipment issues arose and efforts are being taken to understand if the affected equipment was
from the initial installation. Overall, we feel many of the installation issues have been resolved and a good amount of the equipment has been operational for the past seven months.

Second, the photo enforcement program replaced the photo enforcement cameras with higher resolution digital equipment, which included the cameras used at the experiment locations. After the installation of the high resolution cameras, an increase in the number of violations was observed in the data. It is probable that due to the higher resolution the new cameras are able to capture more violations than the previous ones, so the increase appears to be linked to the installation of the new cameras and not related to the IRWLs. All cameras have now been upgraded and no further interruptions in equipment changes are anticipated.

**Modified Evaluation Proposal**

Based on these data collection issues, Metro is proposing to adjust the evaluation plan submitted to FHWA. Metro has partnered with California State University Fullerton Institute of Transportation Engineers (CSUF ITE) to assist in assessing the effectiveness of the IRWL system. A preliminary study has been completed that evaluated 4 intersections along the MGLEE by using manual counts to record the number of left turn violations. The results of this preliminary study indicate that IRWLs are effective in deterring motorists from making illegal left turns. Therefore, in light of the installation issues and change in photo enforcement equipment, Metro in partnership with CSUF ITE is proposing a modification to the original evaluation plan.

A two month evaluation period is being proposed from February – March 2017. One month the IRWLs will be in operation (February), and the next month the IRWLs will be turned off to simulate a “before” scenario (March). This will allow for an “apples to apples” comparison of enforcement camera data with and without the use of IRWLs. Previously, the evaluation plan compared monthly violation rates over a two year period (24 data points at each site) with and without IRWLs in operation. This modified proposal evaluates daily violation rates for one month with the IRWLs in operation and another month with the IRWLs not in operation (28-31 data points at each site). Attached is the full Modified Evaluation Proposal for your review and consideration.

**Terms**

In recent conversations with the California Traffic Control Devices Committee, a recommendation was made to utilize the term “Internally Illuminated Raised Pavement Marker” in lieu of “In Roadway Warning Light” for this equipment. The §4N.01 of the MUTCD states that “In-Roadway Lights shall be flashed and shall not be steadily illuminated”. FHWA has published material (FHWA-SA-09-007, attached for your reference) that describes Internally Illuminated Raised Pavement Markers. Since this experiment utilizes equipment that illuminates steadily, per CTCDC recommendations, we have used this term in the modified evaluation proposal.
August 7, 2012

Submitted to:
California Traffic Control Device Committee
Federal Highway Administration, Office of Transportation Operations

RE: Permission to Demonstrate In-Roadway Warning Lights

The Los Angeles County Metropolitan Transportation Authority ("Metro") respectively requests permission to conduct a demonstration of an In-Roadway Warning Light (IRWL) system that would supplement existing traffic signal indications at ten (10) intersections along the Metro Gold Line Eastside Extension, a Light Rail Train system located in Los Angeles, California. This non-standard traffic control system, which is composed of a series of LED lights embedded in the roadway is designed to increase the awareness of the presence of street running light rail trains among motorists approaching the intersection. The proposed application of IRWLS focuses on enhancing the warning for motorists when trains approach the intersections and deterring them from making illegal left turns. This in turn will reduce violations and accidents by increasing compliance with Red traffic signal indications.

1. Statement of Problem

Metro Gold Line Eastside Extension (MGLEE)

The MGLEE is a six-mile light rail transit (LRT) project, which extends the Metro Gold Line from Downtown Los Angeles at Union Station and proceeds easterly to the terminus near the intersection of Atlantic Avenue and Pomona Boulevard. The MGLEE opened for revenue service on November 16, 2009. For approximately four miles of the alignment, the light rail trains operate in a center median separated from adjacent vehicular traffic by a six-inch high curb. Where at-grade intersection crossings occur, the movement of trains, vehicles, and pedestrians are controlled by traffic signals, train signals, striping, and signage. The California Public Utilities Commission (CPUC) regulations limit speed on surface light rail systems to the legal speed of parallel traffic, but not to exceed 35 miles per hour. Attachment A contains a map of the MGLEE alignment and indicates the locations of the at-grade crossings.

While the MGLEE has maintained a safe standard of operations during its first 30 months of operation, the Metro Board has directed staff to increase awareness of the light rail system, enhance safety measures at at-grade crossings and further reduce left turn violations.
A review of the MGLEE incident summaries revealed that illegal turn violations are responsible for 13 of 17 (76%) incidents that occurred since service began. While a number of industry-wide best practices have already been incorporated into the design of the MGLEE to reduce the risk of left turn violations, additional refinements have been identified by Metro to further reduce this risky behavior. These include refinements to traffic signal phasing at selected intersections, improved advanced train detection, and trial demonstrations of In-Roadway Warning Lights (IRWLs). All of the improvements are designed to increase predictability of traffic signal systems and increase public awareness of train operations.

2. Proposed Solution: In-Roadway Warning Lights System

The predominant cause of train-vehicle incidents occurring on the MGLEE are left turn violations. Metro, in close coordination with the County of Los Angeles Department of Public Works (DPW) and the City of Los Angeles Department of Transportation (LADOT) has initiated improvements that specifically target left turn violations and aim to reduce the number of violations. These improvements have included adjustments to the traffic signal heads to increase the visibility of the left turn arrows at greater distances, and improvements to the advance train detection system along a portion of the alignment so that traffic signals can be programmed with maximum efficiency and predictability. Additionally, Metro is proposing to install IRWLs at ten at-grade intersection crossings to reinforce the existing traffic signals and active "Train Approaching" warning signs.

While limited data has been collected to demonstrate the effectiveness of IRWLs at reducing left turn violations, various applications of IRWLs have demonstrated the ability to change motorist behavior and reduce the tendency of motorists to violate red light signals. The proposed IRWL system would serve as a reinforcement to the standard traffic signal control devices. It would not conflict with any existing traffic control device, but would provide an additional visual warning to motorists and pedestrians that a train is approaching the intersection. A single row of lights would be embedded in the pavement parallel to the train tracks in the direct line of sight of the motorists waiting at or approaching the intersection. The lights will be embedded in the pavement at two different angles in order to be visible to all motorists approaching the intersection. In an alternating fashion, the lights will be placed at 90-degree and 45-degree angles. The series of lights that will be angled towards motorists in the eastbound and westbound left turn lanes will be adjusted to the most appropriate angle for maximum visibility. Attachment B illustrates the proposed application of warning lights.

This application would be unique, compared to other applications tested at County of Los Angeles transit crossings. The IRWLs would not be exclusively applied to stop bars as was done on a recent project on the Blue line by LACMTA. In this project, instead of a single row of lights being applied to the left turn stop bar, a row of lights would be applied parallel to the LRT tracks and run the full width of the intersection. The lights would be installed along both sides of the LRT right-of-way to create a visual barrier along the tracks. Additionally, the IRWLs would be synchronized with
the active Train Approaching warning signs, so that the lights would be illuminated 
ONLY when a train approaches and crosses the intersection. During other red light 
signal phases, when no trains are detected as approaching the intersection, the 
warning lights would not be illuminated. Since there are many factors which can 
limit the effectiveness of IRWL applications, we believe it is critical that the warning 
lights be linked directly to the train activity rather than the red light signal phase, 
which may or may not indicate the presence of a train.

The maintenance and reliability of the warning light devices is another key factor that 
can limit the effectiveness of the warning system. Several agencies, including the City 
of Santa Monica, have tested multiple applications of IRWLs and documented their 
best practices with regards to installation and selection of a reliable manufacturer, as 
well as product maintenance. This proposal will incorporate these lessons learned to 
select the most durable equipment and to minimize maintenance issues.

3. Supporting Data

There is limited data on the use of IRWLs to increase motorist awareness at at-grade 
transit crossings. This application summarizes data collected from two transit 
agencies: Houston METRO and LACMTA. In addition, it cites a study by the City of 
Santa Monica which evaluated the effectiveness of IRWLS to increase motorist 
awareness at various pedestrian crossings. While Houston METRO and the City of 
Santa Monica both demonstrated positive results, LACMTA's tests were inconclusive.

Houston METRO – The transit agency operates a 7.5 mile stretch of light rail transit 
that runs through the Houston downtown. The rail system experienced several 
crashes due to motorists running red lights, creeping through intersections, or 
making prohibited right turns on Red. In 2006, the agency employed an application 
of IRWLs at one intersection in the downtown area. A double row of in-pavement 
lights were installed at the stop bar at the Jefferson Street approach to Main Street, in 
an attempt to reduce both through-traffic red light violations and right-turn-on-red 
violations. At this location there is no left turn movement available, therefore, 
reducing left turn violations was not a component of the study. While the trial 
demonstration was not finalized, preliminary results indicated that the IRWLS 
reduced right-turn-on-red violations by more than 50%.

LACMTA – LACMTA in coordination with LADOT installed IRWLs at two 
intersections, located on distinct transit lines, in an attempt to reduce red light 
violations. The first installation, which aimed to reduce left turn violations at a Metro 
Blue Line Light Rail Train crossing, applied a single row of in-pavement lights to the 
stop bars of the eastbound and westbound left turn pockets. The lights were 
iluminated each time the red light signal phase would occur, for the full red phase 
interval. Photo enforcement camera data was used to compare the before and after 
red light violation rates. In addition, the data collected was compared to a similar 
intersection where no IRWLs had been installed. The data indicated a reduction in 
left turn violation rates at the test location but also an equal or greater reduction in
violation rates at the non-test location. Therefore, it could not be concluded that the lights helped reduce the left turn violations.

A second installation of IRWLS was applied to a Metro Orange Line Bus Rapid Transit crossing to reinforce traffic signal indications and aimed to reduce through-traffic red light violations. The installation was located at Woodman Avenue near Oxnard Street at a place where the Metro Orange Line crosses Woodman Avenue at a slight diagonal angle. A single row of IRWLS was applied to the northbound and southbound stop bars on Woodman. Since there are no left turn or right turn movements for either the northbound or southbound traffic, reduction of left turn violations or right-turn-on-red violations was not a component of this test. The lights were illuminated each time the red light signal phase would occur, for the full red light interval. Photo enforcement camera data was used to compare the before and after red light violation rates. In addition, the data collected was compared to a similar crossing where no IRWLS had been installed. The before and after data indicated an inexplicably large increase in the northbound violation rates and a slight increase in the southbound violation rates for both the test location and the non-test location. Therefore, the test application was not able to conclude any benefit from the application of the IRWLS at the stop bars.

City of Santa Monica – The City has installed IRWLS at seventeen different crosswalk locations in an effort to increase driver awareness of pedestrian crossings. The City performed an evaluation of six test sites to evaluate the effectiveness of the devices in increasing driver’s awareness of pedestrians, and also did a comparative analysis of the effectiveness of various manufacturers’ devices. Their findings are documented in a report titled In-Roadway Warning Lights Comparative Study, dated July 13, 2010. The City evaluated the motorist yielding distances at the test locations when the devices were in operation and again when they were not in operation. The results showed a slight increase in yielding distances at most locations during the daytime and a very notable increase in night-time compliance when the devices were in operation (from 66% to 90%). The night time yielding distances were effectively increased to the level of daytime yielding distances, which are measurably higher. The results suggest that the devices can be particularly effective at increasing driver’s awareness at dusk and during the nighttime.

Conclusions

While trials of IRWLS to increase motorist compliance of red light signal indications have been limited, there are applications of IRWLS which have demonstrated the ability to increase motorist awareness and compliance with traffic signal indications or other traffic signs. The proposed trial would specifically target left turn violations at ten intersections on the MGLEE. The existing photo enforcement camera program provides the benefit of continuous and consistent data collection at 8 of 10 trial demonstration intersections. It also provides comparative data for seven other intersections. We believe this would allow for an excellent opportunity to test and document the effectiveness of these devices.
4. No Patent or Copyright

Metro certifies that the concept of the In-Roadway Warning Lights is not protected by patent or copyright. More than one vendor can provide similar devices.

5. Demonstration Schedule and Locations

a. Design and Engineering  January-February 2013
b. Installation            March 2013
d. Bi-annual Progress Reports  After each 6-month period
e. Final Report            September 2015

The proposed demonstration would include applications of IRWLs at the ten at-grade intersection crossings listed below. All but two of the intersections in the demonstration group have photo enforced left turns.

<table>
<thead>
<tr>
<th>Demonstration Locations</th>
<th>Photo Enforced Left Turns</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Temple &amp; Alameda</td>
<td>No</td>
</tr>
<tr>
<td>2. 1st &amp; Indiana</td>
<td>No</td>
</tr>
<tr>
<td>3. 3rd &amp; Rowan Avenue</td>
<td>Yes</td>
</tr>
<tr>
<td>4. 3rd &amp; Gage Avenue</td>
<td>Yes</td>
</tr>
<tr>
<td>5. 3rd &amp; Downey Road</td>
<td>Yes</td>
</tr>
<tr>
<td>6. 3rd &amp; Ford Blvd.</td>
<td>Yes</td>
</tr>
<tr>
<td>7. 3rd &amp; McDonnell Avenue</td>
<td>Yes</td>
</tr>
<tr>
<td>8. 3rd &amp; Mednik Avenue</td>
<td>Yes</td>
</tr>
<tr>
<td>9. 3rd &amp; Civic Center Way</td>
<td>Yes</td>
</tr>
<tr>
<td>10. 3rd &amp; La Verne Avenue</td>
<td>Yes</td>
</tr>
</tbody>
</table>

The following is a list of the MGLEE at-grade crossings which will remain unchanged during the demonstration. This list includes seven intersections with photo enforced left turns, which will serve as the control group.

<table>
<thead>
<tr>
<th>Non-Demonstration Locations</th>
<th>Photo Enforced Left Turns</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 1st &amp; Alameda</td>
<td>No</td>
</tr>
<tr>
<td>2. 1st &amp; Hewitt</td>
<td>No</td>
</tr>
<tr>
<td>3. 1st &amp; Vignes</td>
<td>No</td>
</tr>
<tr>
<td>4. 1st &amp; Mission</td>
<td>Yes (control group)</td>
</tr>
<tr>
<td>5. 1st &amp; Anderson</td>
<td>Yes (control group)</td>
</tr>
<tr>
<td>6. 1st &amp; Utah</td>
<td>Yes (control group)</td>
</tr>
<tr>
<td>7. 1st &amp; Clarence</td>
<td>Yes (control group)</td>
</tr>
<tr>
<td>8. 1st &amp; Lorena</td>
<td>Yes (control group)</td>
</tr>
<tr>
<td>9. 1st &amp; Indiana</td>
<td>No</td>
</tr>
<tr>
<td>10. 3rd &amp; Indiana</td>
<td>No</td>
</tr>
<tr>
<td>11. 3rd &amp; SR-60 Ramps</td>
<td>No</td>
</tr>
<tr>
<td>12. 3rd &amp; Eastern</td>
<td>Yes (control group)</td>
</tr>
<tr>
<td>13. 3rd &amp; Arizona</td>
<td>Yes (control group)</td>
</tr>
</tbody>
</table>
6. Evaluation Plan

The evaluation plan will focus around the data collected by Metro's Photo Enforcement Camera program. The strength of the evaluation plan is the consistent and comprehensive monthly tracking reports that are produced as a part of the photo enforcement camera program. The photo enforcement cameras have been recording left turn traffic activity at 15 at-grade intersection crossings (which include 25 separate left turn movements) since the MGLE opened for operation in November 2009. This provides us with the ability to analyze approximately 2 years of data prior to the installation of IRWLs and to compare it to data collected after the IRWLs are in operation. Additionally, the demonstration will install IRWLs at ten intersections (which include 13 photo enforced left turns and 4 non-photo enforced left turns) and use the other seven photo enforced intersections (which include 12 photo enforced left turn movements) as the control group. This will allow us to analyze before and after data and also compare the performance of the IRWLs to the control group. Specifically, we will analyze average monthly left turn volumes and violations for each of 25 left turn movements and quantify whether there has been a statistically significant change in the number of monthly or annual violations. For the two intersections that are not photo enforced (Temple/Alameda and 1st/Indiana) data will be collected over a series of weekdays while the lights are in operation and again while the lights are not in operation and left turn violation counts will be analyzed. Metro will prepare and submit biannual progress reports (at 6-month intervals) which summarize the photo enforcement data collected for that period and compare it to the pre-IRWL data. Attachment C provides a sample data tracking form, illustrating the type of data that will be collected and analyzed.

At the end of the demonstration period, Metro in coordination with DPW and LADOT will produce a final report of the demonstration project. At that time, if the project shows a significant increase in pedestrian and drivers' awareness of the train at the test locations and meets other project goals, Metro, DPW and LADOT will develop recommendations on the continued use and/or expansion of the program.

7. Evaluation Procedures

Metro in coordination with DPW and LADOT will prepare the design and engineering drawings and provide construction oversight. Field observations will be conducted by Metro to help evaluate the effectiveness of the installation. Metro will be responsible for collecting and evaluating project data, preparing semiannual progress reports for the duration of the experimentation and providing a copy of the final results to the Office of Transportation Operations (HOTO) within six months of the conclusion of the experiment.

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1 The Photo Enforcement Program contract expires on June 30, 2013 and the Metro Board is expected to make a determination prior to that date on whether to continue or end the program. If the program is discontinued prior to the end of the experiment, staff will utilize data collected by the County and City of Los Angeles traffic signal systems to track left turn violations and statistically evaluate any changes.
8. Restore to Before Conditions

Metro, LADOT and DPW agree to restore the demonstration sites to a condition that complies with the provisions of the MUTCD within 3 months following the completion of the demonstration, if the experiment determines that the IRWLs were ineffective. We will also terminate the demonstration at any time if we determine that the experiment directly or indirectly causes significant safety hazards. However, if the experiment demonstrates an improvement, the devices will remain in place as a request is made to update the MUTCD and an official rulemaking action occurs.

Thank you for considering the request for experimentation. If you have any questions, comments or suggestions, please contact Mr. Eric Carlson of Metro at 213-922-3052.

Sincerely,

Frank Alejandro
Chief Operations Officer
Operations
Los Angeles County Metropolitan Transportation Authority

Vijay Khawani
Executive Officer, Corporate Safety
Los Angeles County Metropolitan Transportation Authority

Bruce Shelburne
Interim Executive Director, Rail Operations
Los Angeles County Metropolitan Transportation Authority

Zaki Mustafa
Executive Officer
City of Los Angeles
Department of Transportation

John T. Walker
Assistant Deputy Director
County of Los Angeles
Department of Public Works

cc: FHWA's District Office in California
650 Capitol Mall, Suite 4-100
Sacramento, CA 95814
Proposed Demonstrations

At-grade Intersection Crossings

Trial Demonstrations of In-Roadway Warning Lights (IRWLs)
Standard Ideal Intersection

Assumptions:
2 - 11' Travel Lanes East-West Directions
20' Travel Lanes North-South Direction
10' Sidewalks
20' Crosswalks
### MGLEE Performance Tracking Form - SAMPLE

<table>
<thead>
<tr>
<th>Intersections</th>
<th>Turn Movements</th>
<th>IRWL Demonstration Location</th>
<th>Pre-Installation Data*</th>
<th>Post-Installation Data</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Daily Turn Volumes</td>
<td>Avg. Monthly Violations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Daily Turn Volumes</td>
<td>Avg. Monthly Violations</td>
</tr>
<tr>
<td>Temple &amp; Alameda**</td>
<td>NB to EB:</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Temple &amp; Alameda**</td>
<td>SB to EB:</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1st &amp; Indiana**</td>
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<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1st &amp; Indiana**</td>
<td>NB to WB:</td>
<td>Yes</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>1st &amp; Mission</td>
<td>EB to NB:</td>
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<td>1,797</td>
<td>86</td>
</tr>
<tr>
<td>1st &amp; Mission</td>
<td>WB to SB:</td>
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<td>379</td>
<td>41</td>
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<tr>
<td>1st &amp; Anderson</td>
<td>WB to SB:</td>
<td>No</td>
<td>121</td>
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<tr>
<td>1st &amp; Utah</td>
<td>WB to SB:</td>
<td>No</td>
<td>80</td>
<td>8</td>
</tr>
<tr>
<td>1st &amp; Clarence</td>
<td>EB to NB:</td>
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<td>173</td>
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<tr>
<td>1st &amp; Clarence</td>
<td>WB to SB:</td>
<td>No</td>
<td>577</td>
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<tr>
<td>1st &amp; Lorena</td>
<td>EB to NB:</td>
<td>No</td>
<td>920</td>
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<tr>
<td>1st &amp; Lorena</td>
<td>WB to SB:</td>
<td>No</td>
<td>565</td>
<td>10</td>
</tr>
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<td>3rd &amp; Rowan</td>
<td>EB to NB:</td>
<td>Yes</td>
<td>379</td>
<td>84</td>
</tr>
<tr>
<td>3rd &amp; Rowan</td>
<td>WB to SB:</td>
<td>Yes</td>
<td>504</td>
<td>62</td>
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<tr>
<td>3rd &amp; Gage</td>
<td>EB to NB:</td>
<td>Yes</td>
<td>574</td>
<td>25</td>
</tr>
<tr>
<td>3rd &amp; Gage</td>
<td>WB to SB:</td>
<td>Yes</td>
<td>1,237</td>
<td>78</td>
</tr>
<tr>
<td>3rd &amp; Downey</td>
<td>WB to SB:</td>
<td>Yes</td>
<td>919</td>
<td>64</td>
</tr>
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<td>EB to NB:</td>
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<td>323</td>
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<tr>
<td>3rd &amp; Ford</td>
<td>EB to NB:</td>
<td>Yes</td>
<td>502</td>
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</tr>
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<td>3rd &amp; Ford</td>
<td>WB to SB:</td>
<td>Yes</td>
<td>706</td>
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<tr>
<td>3rd &amp; McDonnell</td>
<td>EB to NB:</td>
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<tr>
<td>3rd &amp; McDonnell</td>
<td>WB to SB:</td>
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<td>389</td>
<td>26</td>
</tr>
<tr>
<td>3rd &amp; Arizona</td>
<td>EB to NB:</td>
<td>No</td>
<td>303</td>
<td>27</td>
</tr>
<tr>
<td>3rd &amp; Arizona</td>
<td>WB to SB:</td>
<td>No</td>
<td>220</td>
<td>8</td>
</tr>
<tr>
<td>3rd &amp; Mednik</td>
<td>EB to NB:</td>
<td>Yes</td>
<td>840</td>
<td>35</td>
</tr>
<tr>
<td>3rd &amp; Mednik</td>
<td>WB to SB:</td>
<td>Yes</td>
<td>525</td>
<td>14</td>
</tr>
<tr>
<td>3rd &amp; Civic Center</td>
<td>EB to NB:</td>
<td>Yes</td>
<td>277</td>
<td>45</td>
</tr>
<tr>
<td>3rd &amp; La Verne</td>
<td>WB to SB:</td>
<td>Yes</td>
<td>804</td>
<td>83</td>
</tr>
</tbody>
</table>

* The Pre-installation Data reflects averages recorded as of 8-31-11. This data will be updated prior to commencement of the trial demonstrations.
** These intersections do not have photo enforced left turns. Therefore, data will be collected for these intersections over a period of days.
In Reply Refer to:  
HOTO-1

Mr. Frank Alejandro  
Chief Operations Officer  
Los Angeles County MTA

Mr. Bruce Shelburne  
Interim Executive Director, Rail Operations  
Los Angeles County MTA

Mr. Vijay Khawani  
Executive Officer, Corporate Safety  
Los Angeles County MTA

Mr. Zaki Mustafa  
Executive Officer  
City of Los Angeles DOT

Mr. John T. Walker  
Assistant Deputy Director  
County of Los Angeles DPW

(via e-mail transmittal)

Dear Sirs:

Thank you for your letter of August 7 transmitting your request to experiment (RTE) with an In-Roadway Lights system at ten intersections along the Metro Gold Line Eastside Extension in the City of Los Angeles and the County of Los Angeles, California. The system would use red In-Roadway Lights on each side of the LRT grade crossing that would steadily illuminate when LRT traffic is approaching or occupying the crossing. The purposes of the red In-Roadway Lights are to make road users more aware that LRT traffic is approaching and to serve as a supplement to (not a substitute for) the circular red signal indications being shown to the cross-street traffic and the red left-turn arrow signal indications being shown to the traffic in the left-turn lanes on the roadway that is parallel to and on both sides of the LRT tracks.

We have reviewed your RTE. Your request for experimentation is approved and we look forward to receiving your semi-annual progress reports and your final evaluation report at the end of the study period.
For recordkeeping purposes, we have assigned the following official experimentation number and title: “8(09)-8 (E) – Red In-Roadway Lights at LRT Grade Crossings – Los Angeles, CA.” Please refer to this number in future correspondence.

Thank you for your interest in improving the operational capability and traffic safety for road users and LRT operators through the use of In-Roadway Lights.

Sincerely yours,

[Signature]

Mark R. Kehrli
Director, Office of Transportation Operations
May 2, 2013
Submitted to:
Federal Highway Administration, Office of Transportation Operations

RE: Amendment to HOTO-1 Request to Demonstrate In-Roadway Warning Lights
(HOTO-1 was originally approved in September 2012)

The Los Angeles County Metropolitan Transportation Authority ("Metro") respectively requests permission to conduct a demonstration of an In-Roadway Warning Light (IRWL) system that would supplement existing traffic signal indications at two (2) intersections along the Metro Blue Line, a Light Rail Train system located in Los Angeles, California. This non-standard traffic control system, which is composed of a series of LED lights embedded in the roadway is designed to increase the awareness of the presence of street running light rail trains among motorists approaching the intersection. The proposed application of IRWLs focuses on enhancing the warning for motorists when trains approach the intersections and deterring them from making illegal left turns. This in turn will reduce violations and accidents by increasing compliance with Red traffic signal indications.

1. Statement of Problem

Metro Blue Line

The Blue Line is a twenty-two-mile light rail transit (LRT) project, which extends from Downtown Los Angeles to the City of Long Beach. For approximately eleven miles of the alignment, the light rail trains operate in a center median separated from adjacent vehicular traffic by a six-inch high curb. Where at-grade intersection crossings occur, the movement of trains, vehicles, and pedestrians are controlled by traffic signals, train signals, striping, and signage. The California Public Utilities Commission (CPUC) regulations limit speed on surface light rail systems to the legal speed of parallel traffic, but not to exceed 35 miles per hour.

Since illegal left turns account for approximately fifty percent of the overall accidents on the Blue Line, the Metro Board has directed staff to increase awareness of the light rail system, enhance safety measures at at-grade crossings and further reduce left turn violations.

While a number of industry-wide best practices have already been incorporated into the design of the Blue Line to reduce the risk of left turn violations, additional refinements have been identified by Metro to further reduce this risky behavior. One of these includes a trial demonstration of In-Roadway Warning Lights (IRWLs). All of the improvements are designed increase public awareness of train operations.

AN EQUAL EMPLOYMENT OPPORTUNITY – AFFIRMATIVE ACTION EMPLOYER
2. Proposed Solution: In-Roadway Warning Lights System

The proposed solution to mitigate left turn accidents is identical to what has been already approved by FHWA in application HOTO#1 for the Metro Gold Line experiment. Metro is proposing to install IRWLs at the following two at-grade crossings to reinforce the existing traffic signals and active "Train Approaching" warning signs.

Washington and Los Angeles
Washington and San Pedro

An earlier installation which aimed to reduce left turn violations at a Metro Blue Line Light Rail Train crossing, included a single row of in-pavement lights perpendicular to the tracks, at the stop bars of the eastbound and westbound left turn pockets. This proposal will differ in that, the lights will be installed parallel to the tracks to provide better visibility of the in-pavement lights. The operation and testing of the lights will be similar to that described in the application for the Metro Gold Line IRWL experimentation referenced above.

Conclusions

While trials of IRWLs to increase motorist compliance with red light signal indications have been limited, there are applications of IRWLs which have demonstrated the ability to increase motorist awareness and compliance with traffic signal indications or other traffic signs. The proposed trial would specifically target left turn violations at two intersections on the Blue Line in an application and configuration that have to date has not been tested. The existing photo enforcement camera program provides the benefit of continuous and consistent data collection at both trial demonstration intersections. We believe this would allow for an excellent opportunity to test and document the effectiveness of these devices.

Thank you for considering the request for experimentation. If you have any questions, comments or suggestions, please contact Mr. Eric Carlson of Metro at (213) 922-3052.

Sincerely,

Zaki Mustafa
Executive Officer
LADOT
City of Los Angeles

Frank Alejandro
Chief Operations Officer
Rail Operations
Los Angeles County Metropolitan
Transportation Authority

cc: FHWA’s District Office in California
650 Capitol Mall, Suite 4-100
Sacramento, CA 95814
In Reply Refer to:
HOTO-1

Mr. Zaki Mustafa
Executive Officer
City of Los Angeles DOT
100 South Main Street, 10th Floor
Los Angeles, CA 90012

Dear Mr. Mustafa:

Thank you for your letter of May 2 requesting to expand Experiment 8(09)-8 to two additional intersections on the Metro Blue Line, at East Washington Boulevard and South Los Angeles Street, and at East Washington Boulevard and South San Pedro Street in the City of Los Angeles. Similar to the 10 initial intersections on the Metro Gold Line, the experiment would involve the use of red In-Roadway Lights on each side of the LRT grade crossing that would steadily illuminate when LRT traffic is approaching or occupying the crossing. The purposes of the red In-Roadway Lights are to make road users more aware that LRT traffic is approaching and to serve as a supplement to (not a substitute for) the circular red signal indications being shown to the cross-street traffic and the red left-turn arrow signal indications being shown to the traffic in the left-turn lanes on the roadway that is parallel to and on both sides of the LRT tracks.

We have reviewed your request to expand your experiment. Your request to expand Experiment 8(09)-8 is approved and we look forward to receiving your semi-annual progress reports and your final evaluation report at the end of the study period.

For recordkeeping purposes, we will continue to use the following official experimentation number and title: "8(09)-8 (E) – Red In-Roadway Lights at LRT Grade Crossings – Los Angeles, CA.” Please refer to this number in future correspondence.

Thank you for your interest in improving the operational capability and traffic safety for road users and LRT operators through the use of In-Roadway Lights.

Sincerely yours,

Mark R. Kehrl
Director, Office of Transportation Operations
LED Raised Pavement Markers

Purpose
Light Emitting Diode (LED) pavement markers improve the safety of intersection approaches, as well as pedestrian, bicycle and other crossings. These markers enhance delineation and driver awareness, especially in low visibility conditions.

Alternative Names
Daylight-visible or solar-powered LED raised pavement markers, LED-illuminated pavement markers, solar road markers or studs.

Operation
- Light Emitting Diode (LED) Raised Pavement Markers (RPM) function similarly to standard reflective pavement markers, but have small LEDs located inside of them instead of (or in addition to, retroreflective components).
- LED RPMs have built in sensors that can automatically turn on the LEDs when ambient light drops below a preset level or can be wired to operate as an active treatment in conjunction with vehicle detection.
- LED RPMs are currently powered either by a solar photocell charger in each marker, or by wiring to a power source such as a signal controller.
- LED RPMs should not be operated in flash-mode to comply with the Manual on Uniform Traffic Control Devices (MUTCD).

Potential Benefits
- LED RPMs increase the visibility of intersections during low-visibility conditions (e.g., darkness and inclement weather). Illumination of intersection approaches and crossings helps improve road user recognition of intersection location and features.
- At intersections with vertical or horizontal curves causing limited sight distance for traffic entering the intersection, LED RPMs activated by vehicle detectors can help provide advance notification to drivers of potential vehicle conflicts.
- LED RPMs are more visible than retroreflective RPMs under conditions that reduce the effectiveness of headlights and retroreflective material (e.g., inclement weather).
- At rural intersections, where powered lighting may not be available, the use of solar-powered LED RPMs may provide an alternative safety treatment.

This summary is one in a series describing Innovative Intersection Safety Treatments. The summaries identify newer technologies and techniques for intersection safety developed since NCHRP Report 500, Volumes 5 and 12, were published in 2003 and 2004, respectively. These treatments show promise for improving safety but comprehensive effectiveness evaluations are not yet available.
Agency Experience

- LED RPMs have been used in Texas in advance of horizontal curves to notify drivers that they are approaching the curve too quickly. The Texas Department of Transportation has installed LED RPMs on roadway edgelines and centerlines, including near intersections and in conjunction with other treatments such as rumble strips or flashing beacons on the sign posts.

- LED RPMs have been employed in Florida in several locations, and Florida DOT standard drawings provide for LED RPMs at intersections along lane lines and areas of channelization.


- The known uses of LED RPMs include steady, nighttime only operation, as well as a flashing operation implemented in Texas based on speed detection, which is engaged when vehicles are travelling at excessive speeds. Note that this flashing operation does not comply with the MUTCD, as described below.

Implementation Considerations

- Hardwired LED RPMs have been found to be brighter than the solar-powered models.

- LED RPMs could potentially be implemented anywhere traditional RPMs are currently placed, including lane line delineation, gore areas, or painted channelization.

- An Institute of Traffic Engineers (ITE) study found that snow melts on LED RPMs faster than on the adjacent roadway, allowing snow plow damage to be avoided.

MUTCD Specifications

- Allow light sources, including LEDs, within raised pavement markers to accentuate their visibility, and specifies raised pavement marker design, colors, location, spacing, and usage. MUTCD, Sections 3B.11 – 3B.13.

- In-roadway lights (i.e. illuminated markers level with the pavement) are reserved for pedestrian crossings, even though in-roadway lights may be preferred to raised pavement markers from a maintenance standpoint. MUTCD, Sections 4L.01 – 4L.02.

- Internally illuminated RPMs used as positioning guides or to supplement or substitute for other markings must operate in a steady (non-flashing) mode. MUTCD, Section 3B.14.

- Flashing LED lights in or on the roadway are considered to be an in-roadway version of a traditional flashing beacon warning signal. Therefore, the use of flashing in-roadway lights is currently limited to use for uncontrolled marked crosswalks. At this time, any other use of flashing LED markers must receive official experimentation approval from FHWA per MUTCD Section 1A.10. MUTCD, Section 4L.02.

Costs

- A photocell powered LED RPM unit costs approximately $50 including material and installation costs.

- MUTCD, Sections 3B.11 and 3B.14 provide standards for LED RPM placement. Placement frequency will depend on the specific application.

Learn More:

Carlos Ibarra, Texas Department of Transportation
cibarra@dot.state.tx.us

Ed Rice, Intersection Safety Team Leader
FHWA Office of Safety
202-366-9064
ed.rice@dot.gov
May 27, 2008

California Traffic Control Device Committee (CTCDC)
1120 N St., MS 36
Sacramento, CA 95814

Proposal for Experimental Use of a Non-standard Traffic Control Device
In-Roadway Warning Lights
USDOT Reference #: HOTO-1 4-341(E) Steady Red Stop Line Lights-Los Angeles

Dear Sir/Madam:

Attached please find an application for a trial installation of In-roadway Warning Lights in the City of Los Angeles. A conditional approval has been granted by the USDOT and this project was assigned the following Reference #:

HOTO-1 4-341(E) Steady Red Stop Line Lights-Los Angeles

Also attached please find copies of USDOT’s approval, the Los Angeles County Metropolitan Transportation Authority’s, and the Los Angeles Department of Transportation’s agreement to the conditions set forth by the USDOT.

Your prompt approval will be greatly appreciated.

Sincerely,

Abdul Zohbi
System Safety Manager
LACMTA
June 27, 2017

Mr. Sean Skehan
Principal Transportation Engineer
Los Angeles Department of Transportation
100 S. Main Street
Los Angeles, CA 90012

Subject: Los Angeles Department of Transportation (LADOT) Affidavit of Support

Dear Mr. Skehan:

As you are aware, the Los Angeles County Metropolitan Transportation Authority (Metro) has requested approval from FHWA and the California Traffic Control Devices Committee (CTCDC) to experiment with the installation of Internally Illuminated Raised Pavement Marker (IIRPM) systems at intersections on Canoga Avenue adjacent to the Orange Line busway. The purpose of this experiment is to supplement traffic controls for the exclusive right-turn movements for northbound right-turns. The experiment would be similar in nature to other ongoing experiments in the City of Los Angeles where LED lights embedded in the roadway supplement traffic signal indications near light rail crossings. In this experiment, LED lights would be embedded in the roadway to supplement existing traffic signal indications for the right turn lanes where no turns are allowed on red during the presence of a red right-turn arrow.

Pursuant to your conversations with Mr. Abdul Zohbi of Metro on Monday June 26, 2017, Metro is seeking written support for this request to experiment. The written support will greatly assist the CTCDC in reviewing and hopefully approving this request at the next meeting scheduled for Thursday August 10, 2017 in San Diego.

Please review the attached statement and return a signed copy (an electronic signature or PDF scan of signed letter is acceptable) if you are in agreement.

Best regards,

[Signature]

Sam Morrissey, MBA, PE, TE
Associate Vice President
Iteris, Inc.
M: 619.917.7478
E: sgm@iteris.com

Attachment
Los Angeles Department of Transportation (LADOT) Affidavit of Support
June 27, 2017
Page 2 of 2

Subject: Los Angeles County Metropolitan Transportation Authority
Request to Experiment with Internally Illuminated Raised Pavement Markers (IIRPMs)
Los Angeles Department of Transportation (LADOT) Affidavit of Support

LADOT is in support of Metro's efforts to test the Internally Illuminated Raised Pavement Markers (IIRPMs)
at the four identified locations on the Metro Orange Line. LADOT has been and will be included in all
phases of the experiments starting with planning and ending with installation and testing of the IIRPMs.

Sean Skehan, Principal Engineer, LADOT

Date: 7-5-17