

City of Columbia, Missouri
Request to Experiment:
Bicycle Pavement Marking Detection Symbol - 2014



Prepared by: City of Columbia, Missouri Non-Motorized Transportation Pilot Program (NMTTP)

Approved:

 9/17/2014
John Glascock, PE
City of Columbia, Missouri Public Works Director

Table of Contents	
ELEMENT	PAGE
Background	2
Nature of the Problem	2
Description of Proposed Experiment	3
Scope and Work Plan	9
Schedule	10
Evaluation Procedure/Measures of Effectiveness	10
Reporting	11
Administration	11
Removal of Experiment	11
References	11

For more information on this request to experiment, please contact
City of Columbia Bike/Pedestrian Coordinator Ted Curtis
at 573.489.8853 or via e-mail at CTCURTIS@GoColumbiaMO.com.

BACKGROUND

The City of Columbia, Missouri has a growing network of bicycle and pedestrian facilities including bike lanes, shared roadways, shared use paths, greenways, sidewalks and side paths (or pedways). The City is also home to the University of Missouri at Columbia that includes internal campus paths that are interconnected to the City's non-motorized network. These facilities serve a wide geographic area within the city and are intended to both encourage bicycling and pedestrian activity and increase motorist awareness of the presence of bicyclists and pedestrians. The City of Columbia has addressed requirements for new bicycle and pedestrian facilities in a 2006 update to the City Street Design Standards¹.

Columbia was designated as one of four Federal Non-Motorized Transportation Pilot Program (NTPP) communities. These funds have been used to plan, design and construct additional bicycle and pedestrian facilities in an effort to encourage a modal shift to non-motorized transportation. With Columbia's population growth and modal shift that has taken place since the beginning of the pilot program, the potential exists to incorporate additional experimental facilities to address specific issues that arise from implementation. This document is a request to the Federal Highway Administration to experiment with the use of alternative bicyclist detection pavement marking treatments for existing and planned on-street bikeways, bicycle boulevards and side paths that will improve users' experience at signalized intersections.

NATURE OF THE PROBLEM

Many bicyclists do not recognize, or understand, the MUTCD-approved bicycle detection pavement marking (9C-05) that is used to demarcate the location at an intersection where bicyclists should wait to activate a green signal phase. This lack of understanding means that bicyclists waiting at signalized intersections often position themselves on the roadway where the loop detector (expressly calibrated to detect the presence of bicyclists) will not detect them. This causes bicyclists to either remain waiting on red until another vehicle approaches the intersection and triggers the loop detector, or in the absence of another vehicle at the intersection, increases the likelihood that the bicyclist will illegally travel through the intersection without a green phase. Because of sign clutter and other distractions, a supplemental R10-22 sign, if used, may be overlooked.

Problem: The existing MUTCD symbol (9C-05) does not accurately convey its meaning to users.

Recent research from Portland State University indicates that only 23.5% of bicyclists wait over the MUTCD marking (9C-05) when installed alone and just 34.8% wait when the symbol is accompanied by the standard MUTCD R10-22 sign. Moreover, some bicyclists do end up positioning themselves over the bicycle detector symbol at signalized intersection, but without understanding that this positioning results in activating a green signal phase². Additional research was borne out in both technical and user oriented focus groups conducted for the purpose of developing alternative pavement markings for this experiment.



9C-05



R10-22

DESCRIPTION OF PROPOSED EXPERIMENT

The Manual on Uniform Traffic Control Devices (MUTCD) includes guidance on the use of bike detection symbol markings and signage. The intent of this experiment is to test alternate pavement markings that can be applied in a variety of intersection contexts. For example, how do riders respond to a new marking where a bicycle boulevard terminates at an intersection, versus where a bike lane terminates at a multi-lane intersection?

This experiment will test three types of markings. Type 1 uses the standard bicyclist symbol with the words “Wait Here for Green” and a green circle to symbolize a green signal lens framed with four corner “tabs” to frame the marking (Fig. 1). Type 2 builds on the existing 9C-05 marking to include the same “Wait Here for Green” text and green circle (Fig. 2). Type 3 will be the 9C-05 pavement marking, currently in the MUTCD, except with green behind it for enhanced

visibility (Fig. 3). These symbols were selected based on feedback received from active transportation professionals and a group of non-professionals that regularly commute by bicycle. Additional pavement markings that were considered, but not selected for this experiment are in Appendix - A.

The City of Columbia proposes to test the marking under controlled conditions in the University of Missouri - Columbia vehicle simulator. The UMC simulator has a flexible framework that uses a large screen and two side screens, as well as virtual reality (VR) glasses. The simulator is being used on different projects, but the signs and marking are a good example of a simulator application. University staff will modify the simulator for bicyclist testing. The key detail of the transition of the simulator for a motor vehicle to a bicycle will be to simulate the position of the bicyclist in the simulator by using a handlebar and /or a bike and trainer stand.

The goal of the simulation will be to evaluate the effectiveness of the candidate pavement marking on bicyclist positioning when encountering a red signal phase on the approach to an intersection.

This experiment seeks to evaluate the effectiveness of bicycle detection pavement markings with cyclists, who have a demonstrated understanding of the rules of the road. The test group is defined as a sample of between 20 to 50 participants, who will be recruited through PEDNET, a local advocacy organization, and incentivized with a small promotional item to take part in the simulation.

Volunteers will be fitted to the simulator bicycle. The volunteer will ride through a series of ten signalized intersections, with a randomly assigned pavement marking examples at each. The rides will include the MUTCD 9C-05 pavement marking, the 9C-05 marking and complementary R10-22 signage, and each of the proposed bicycle detection pavement markings.

Evaluation measures include lane positioning by pavement marking and qualitative assessments of the markings' meanings.

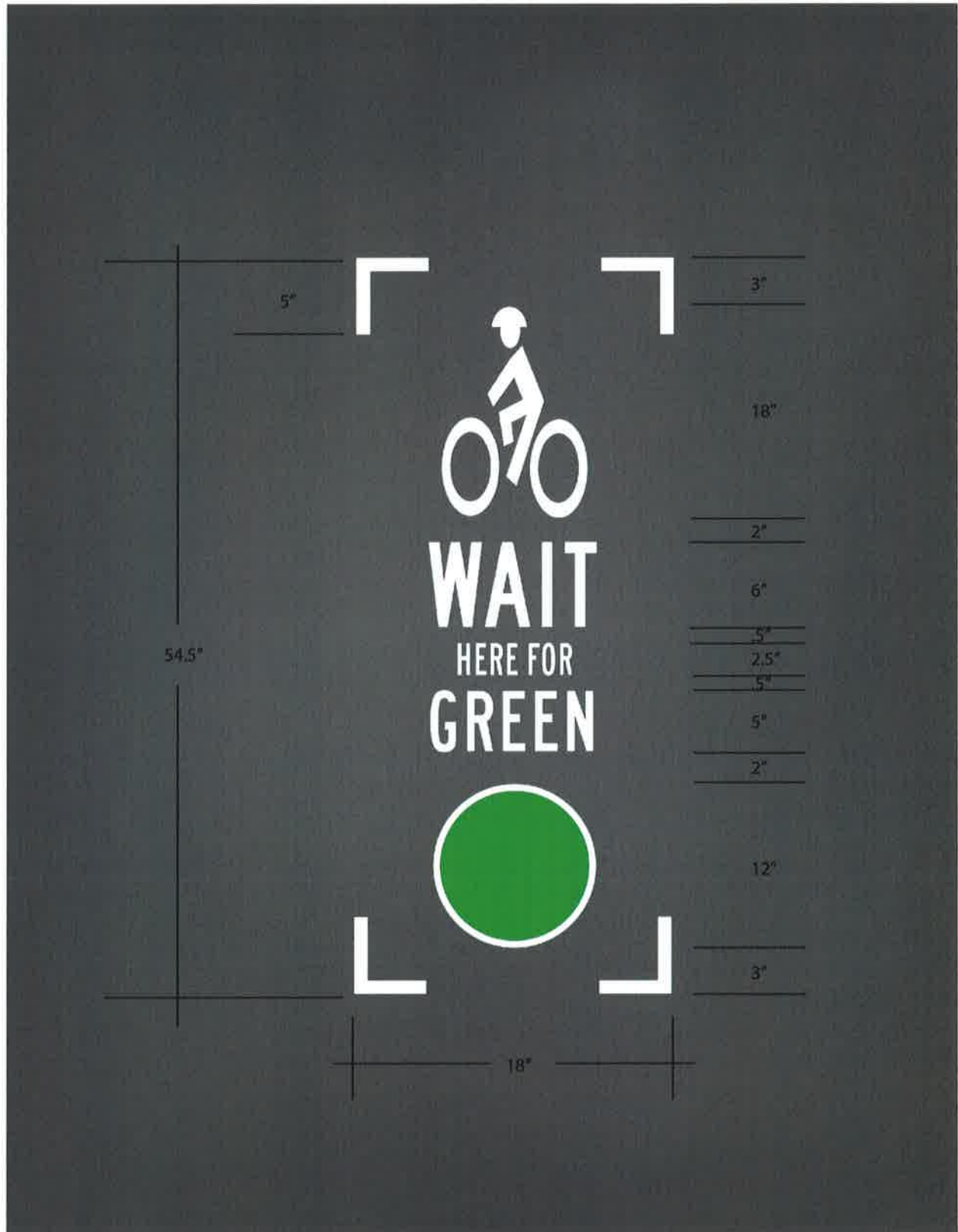


Figure 1. Type 1 Proposed Pavement Marking

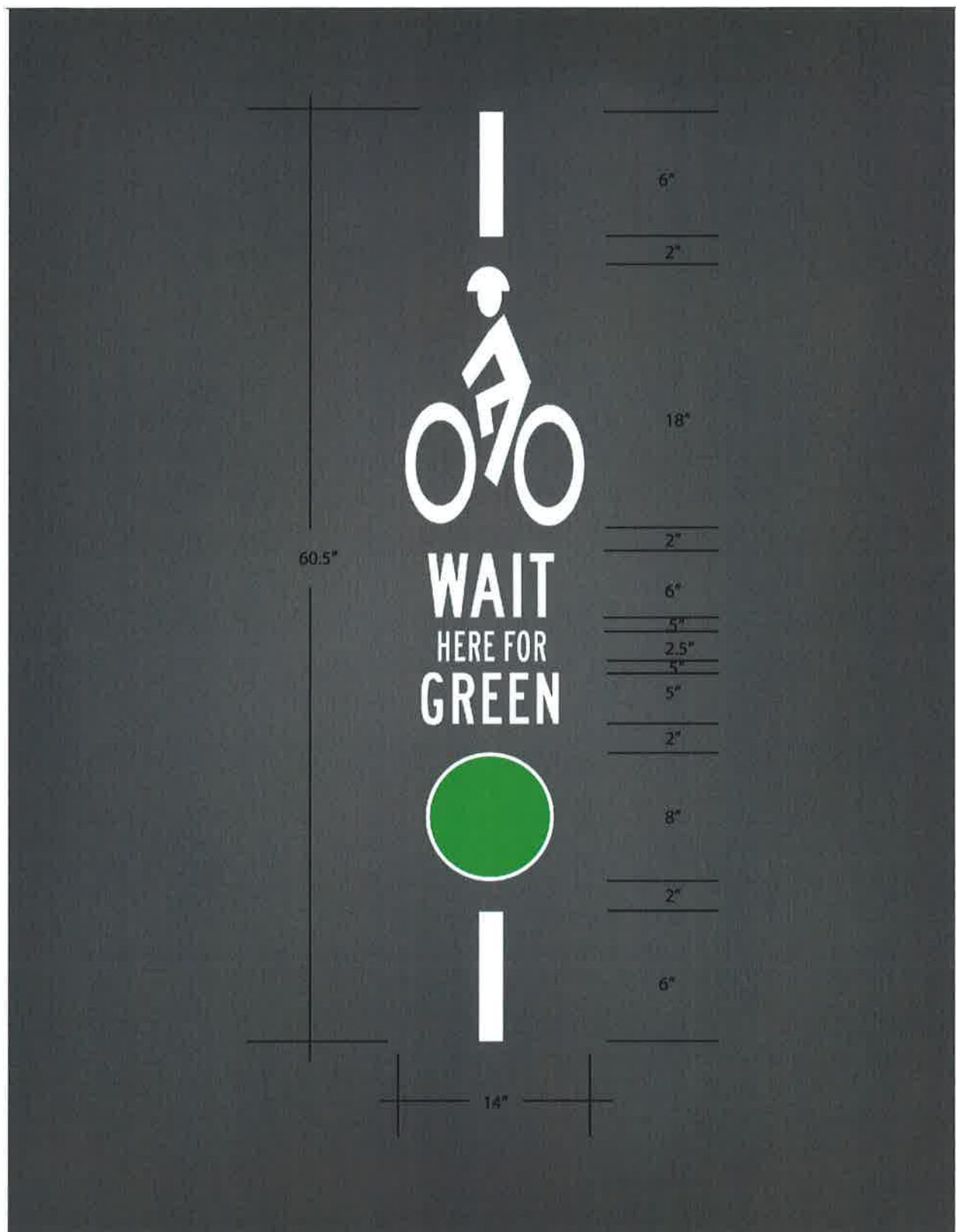


Figure 2. Type 2 Proposed Pavement Marking

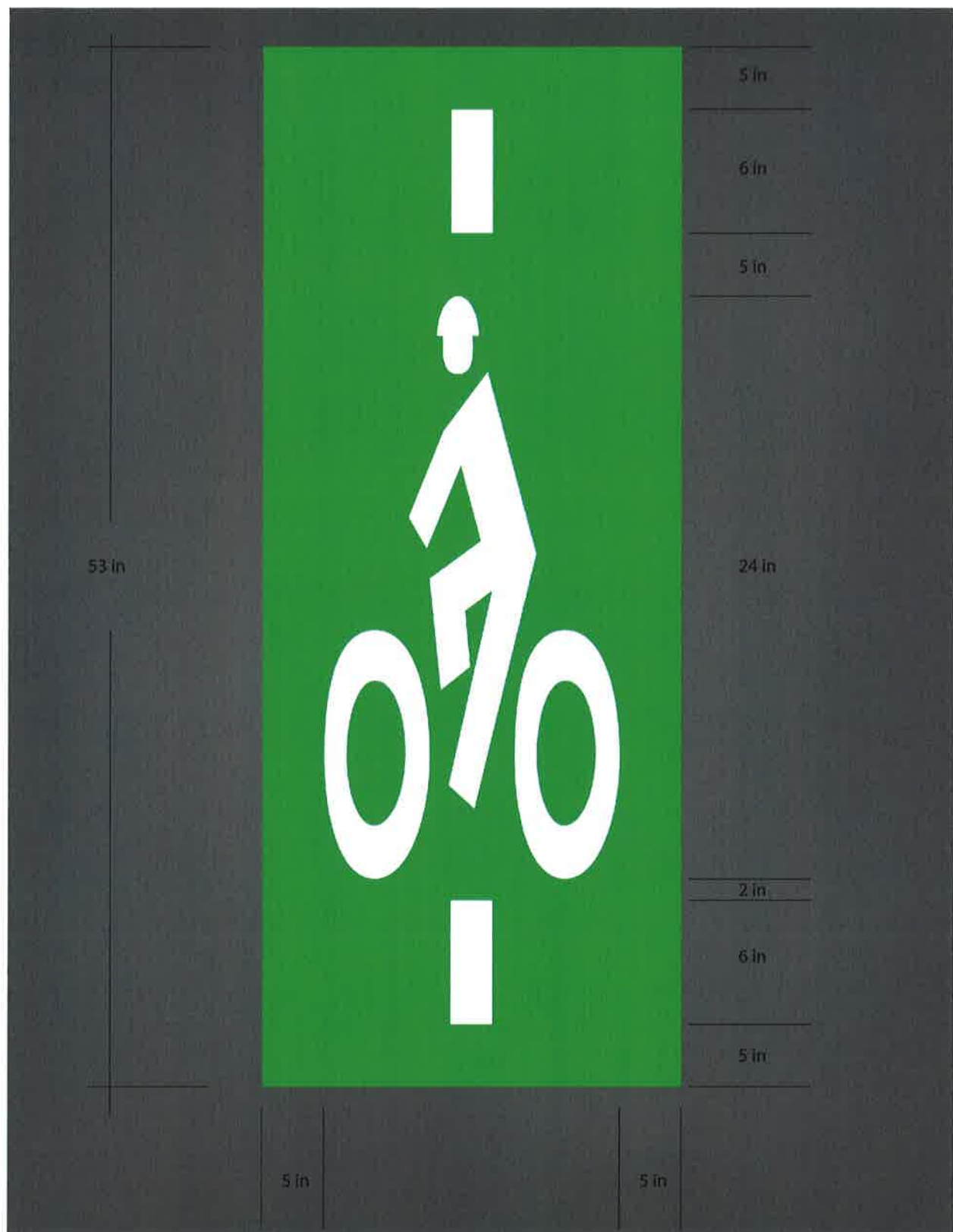


Figure 3. Type 3 Proposed Pavement Marking (9C-05 Green Back)

SCOPE AND WORK PLAN

The City of Columbia proposes to collect data from the test group of volunteers. Data collection will focus on behavior exhibited by the participants with respect to pavement markings selected for the experiment. Three pavement markings were selected for the experiment: Type 1 uses the standard bicyclist symbol with the words “Wait Here for Green” and a green circle to symbolize a green signal lens framed with four corner “tabs” to frame the marking. Type 2 builds on the existing 9C-05 marking to include the same “Wait Here for Green” text and green circle. Type 3 will be the 9C-05 pavement marking, currently in the MUTCD, except with green behind it for enhanced visibility. The markings will be general enough for use in any part of the United States.

This experiment will be accomplished along with the RTE for assessment of wayfinding pavement markings detailed in a separate RTE document. The two RTE’s will use the same participant and data collection times in the traffic simulator. The course ridden in the simulator will include both experimental elements that are the subject of the experiments.

Proposed Selection Criteria for Participants in the Study

As noted above, this experiment will utilize a test group of cyclists familiar with being on the road, as opposed to novice riders. PEDNET, a local advocacy organization will help to identify participants. An equal number of males and females will be selected. The size of the test group will range from no fewer than 20, and no more than 50 participants total. In an effort to streamline the experiment, we plan only one test group.

Proposed Data Collection Methodology

Phase 1 - Simulator Testing of Proposed Pavement Markings in a controlled Environment

The City of Columbia has contracted with Alta Planning + Design (Alta) and the University of Missouri to coordinate experiment and data collection activities. Alta in coordination with the City and University of Missouri staff will develop a questionnaire designed to gather user information related to demographics, rider experience, and interpretation of the markings. The data will be collected by University of Missouri staff and graduate students using the UMC Simulator on campus. The simulation will focus on observed measurable behavior through the questionnaire, as well as video tape of the participant in the simulator.

The riders will traverse the same route with ten signalized intersections treated with a random assignment of pavement markings:

- 1) MUTCD 9C-05 pavement marking,
- 2) MUTCD 9C-05 marking and complementary R10-22 signage
- 3) Type 1 proposed pavement marking alone
- 4) Type 2 proposed pavement marking alone
- 5) Type 3 proposed pavement marking (MUTCD 9C-05 on top of a green rectangle)

The following performance metrics will be recorded for each condition:

- Bicyclist positioning relative to marking
- Response to subjective survey questions assessing level of confidence in decision-making, recognition of pavement markings and signs, and other questions to assess the perceived differences between the markings.

Phase 2 Implementation and Public Opinion On-Line survey (by City staff)

After the simulator testing, evaluation and analysis, and interim reporting, the City will field test the preferred marking at selected intersections throughout the City.

Once implemented the City will create and publicize an on-line survey to solicit community comments, suggestions and effectiveness. The results of the survey would be included in the final report.

SCHEDULE

Table 1 presents the proposed bike detection pavement markings experiment schedule. Since there are not weather related issues or implementation of markings involved, we can begin the experiment once the RTE is approved and the simulator is adapted to the bicycle simulation discussed above. The schedule assumes FHWA approval by September 2014.

Table 1 – Proposed Bike Detection Pavement Markings Experiment Schedule

Task	Summer 2014	Fall 2014	Winter 2014	Spring 2015	Summer 2015	Fall 2015	Winter 2016
Submit RTE to FHWA	X						
Prepare Simulator for Experiment		X	X				
Select Participants			X				
Collect Data			X				
Synthesize and Analyze Data				X			
Select locations and implement markings					X		
On-Line Public Opinion Survey						X	
Final Report							X

EVALUATION PROCEDURES/MEASURES OF EFFECTIVENESS

After data collection is complete, City of Columbia staff will work with Alta to determine if there were measurably significant changes in the following behavioral areas listed below. If positive changes are noted, the City of Columbia will suggest that the bike detection pavement marking treatments be considered as an option and included in a future MUTCD revision. These behavioral changes include:

- Demonstration of proper lane placement for activating signal
- Demonstrated community understanding of pavement marking

REPORTING

Reporting will be submitted as specified by FHWA and submitted to the Columbia City Council, Missouri Department of Transportation, and FHWA National Headquarters Office. This will include semi-annual progress reports for the duration of the experimentation and a copy of the final results to the FHWA's Office of Transportation Operations within three months of the conclusion of the experiment.

ADMINISTRATION

The City of Columbia will be the sponsoring agency with support as needed from consultants including Alta and University of Missouri. The proposed bicycle detection pavement markings are not protected by patent or copyright.

REMOVAL OF EXPERIMENT

The City of Columbia agrees to remove the on-street markings within three months of completion of the study if necessary, based on the ultimate decision by FHWA. In the event FHWA reaches a decision that changes to the MUTCD are warranted to consider the pavement markings, the experiment will be permanent. In the event the experiment creates substantial safety hazards that warrant removal prior to the planned end of the experiment, the City of Columbia will discontinue the experiment, and remove the markings.

REFERENCES

1. City of Columbia, *Street Standards*, Accessed https://www.gocolumbiamo.com/Council/Code_of_Ordinances_PDF/Street_Standards/ on June 7, 2004.
2. Stefan W. Bussey, *The Effect of the Bicycle Detector Symbol and R10-22 Sign on Cyclist Queuing Position at Signalized Intersections*, Portland State University Undergraduate Honors Theses, Civil and Environmental Engineering Department (Dec. 2013).



**ACTIVATE
GREEN**



HERE

「
ACTIVATE
GREEN



「
HERE

|

**WAIT
HERE FOR
GREEN**

