Test Plan

prepared for

Minnesota Department of Transportation (MnDOT)

for

Rural Intersection Conflict Warning Systems II Deployment

December 22, 2014

Acknowledgements

This Test Plan was originally developed by the Minnesota Department of Transportation (MnDOT) for the statewide Rural Intersection Conflict Warning System (RICWS) project in October 2012. Carver County asked SRF Consulting Group to develop a modified test plan to enable the installation of Intersection Conflict Warning Systems (ICWS) on T.H. 212 in Carver County. MnDOT participated in the development of this project and the associated systems engineering documents. This test plan was then reviewed by SRF Consulting Group for use on MnDOT's second deployment Rural Intersections Conflict Warning Systems II (RICWS II).

Document Purpose

MnDOT's test plan for the statewide RICWS project included additional tests required for the design/build contracting method. This original test plan included component acceptance, validation testing, integration testing, and reliability testing that were successfully completed by MnDOT. Since the system being used for this project is identical to the MnDOT RICWS systems, it was decided that it was unnecessary to duplicate these tests. The one remaining test, a one-day turn on test, is covered by this Test Plan. This Test Plan also incorporates procedures from the MnDOT RICWS project.

Introduction

MnDOT developed the RICWS deployment project to reduce crashes at stop-controlled intersections. MnDOT is currently deploying RICWS systems at up to 150 rural, stop-controlled intersections throughout the state. These systems will address crashes at stop-controlled intersections by providing drivers – on both the major and minor road – with a dynamic warning of other vehicles approaching the intersection. ICWS typically consist of static signing, detection and dynamic elements as illustrated in Figure 1.

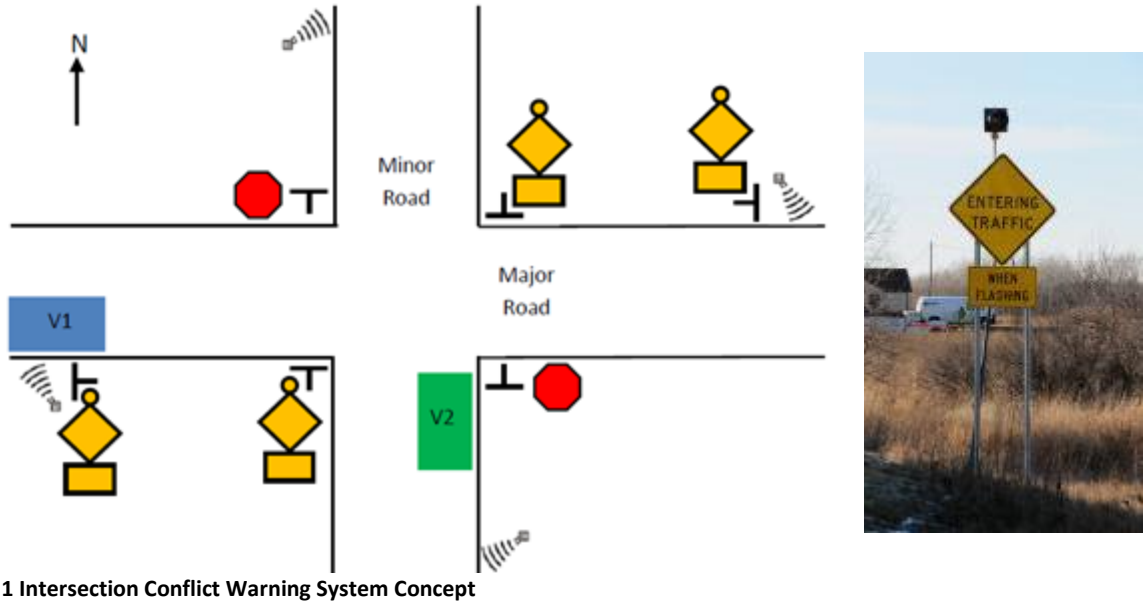

Figure 1 Intersection Conflict Warning System Concept

The primary goal of these systems is to reduce crashes at stop-controlled intersections by deploying intersection conflict warning systems throughout Minnesota. This project will also allow MnDOT and its partners to more conclusively evaluate the effectiveness these systems at reducing crashes under certain conditions (i.e., road types, traffic volumes, etc.), as well as their longer term operational and maintenance needs. A Concept of Operations was prepared for this project to identify fundamental stakeholder needs. Needs were then translated into high-level and detailed requirements in the System Requirements document.

Test Plan

Testing is necessary to ensure that requirements, as specified in the System Requirements document and subsequent design documents, are met. For this project, testing consists of a one-day turn on test where project oversight personnel will observe and verify that the system is properly installed and functions as required. The Table below presents further detail for the test that will be used for system acceptance testing.

Turn-On Test Procedure

Environment: All ICWS Installation Sites

Process: All installations shall be subject to the following Turn-On Test.

Participants: Shall include, at a minimum, the Contractor and Project Personnel.

Verification Process	System Requirement	Verification Procedure
Note: Record the result of each run on the Tracking Log at the end of this document.		
1. Verify that **ICWS minor road warning is active** within the user-configured lag time between 4 and 9 seconds, in increments of 0.1 seconds, for vehicles approaching the intersection on the major road.	1.3.2.3	1. Observe traffic on the major road for one hour to determine if the system timing is correct. a. Determine approximate locations for "active zones" such that vehicles within these areas are within the configured lag time from the intersection. b. Verify that the minor road warning is active when vehicles are within the active zones on the major road and inactive when no vehicles are within the active zones on the major road. c. Unless directed by the Project Engineer, the system should become inactive within one flash of the vehicle being within the intersection. Note: Vehicles that are decelerating should not be considered for this test.
2. Verify that **ICWS is active within the user-configured lag time whenever** vehicle speeds are ±10 MPH of the posted speed.	1.3.2.5	1. Verify 6.5 second lag time during test runs at speed limit a. Access the Main Interval Timers: Main Menu 6, 2 screen on the ASC 3 controller. Confirm VEH EXT value to 6.5. b. Trigger major approach loop farthest from intersection with vehicle driving at a constant speed at the approach speed limit. c. Verify that flasher is active for 6.5 seconds. d. Verify that flasher turns off while the vehicle is in the intersection. Repeat steps (b) and (c) five times from each major road approach.

Verification Process	System Requirement	Verification Procedure
3. Verify that **ICWS detection malfunction** is detected and indicated within 1 minute of the onset of the malfunction. This will require a force malfunction not related to power supply.	2.2.1.6, 2.3.1.1	2. Access main menu 6,5 screen on ASC 3 and set ACT value to 1 3. Repeat set PRES to 1 4. Repeat set COUNT to 2. 5. Unplug detector interface card from input file. 6. Navigate to ASC 3 Detector Diagnostic (event) data log (Main Menu 8,6,1,2). 7. Verify that detection error is shown within 120 seconds of detector interface card removal. 8. Re-seat detector interface card. 9. Disconnect single lead wire running from input file to ASC 3 controller to simulate constant call condition. 10. Navigate to ASC 3 Detector Diagnostic (event) data log (Main Menu 8,6,1,2). 11. Verify that detection error is shown within 120 seconds of wire removal. 12. Reconnect wire from input file to controller. 13. Observe greater than two vehicles have passed detection within a minute (i.e. Erratic Counts). 14. Navigate to ASC 3 Detector Diagnostic (event) data log (Main Menu 8,6,1,2). 15. Verify that detection error is shown within 60 seconds. Access main menu and set ACT value to 255, PRES to 5 and COUNT to 100.
4. Verify that **ICWS malfunction** is recorded and categorized in data management according to the malfunctioning component and time/date stamped according to when failure began/ended.	3.3.1.1	1. Access main menu and set ACT value to 1, PRES to 1 and COUNT to 2. 2. Remove and re-seat each detector interface card connected to ASC 3 controller three times. 3. Record time of each card removal. 4. Navigate to ASC 3 Detector Diagnostic (event) data log (Main Menu 8,6,1,2). Verify that the detector events in ASC 3 log match recorded times of detector interface card removal.

Verification Process	System Requirement	Verification Procedure
5. Verify that ICWS automatically returns to a fully operational state when power is restored after a power outage	2.2.1.9	1. Access the Main Interval Timers: Main Menu 2, 1 screen on the ASC 3 controller and record the VEH EXT, MIN GRN and MAX1 values. 2. Locate main breaker on RICWS electrical service. 3. Turn off main breaker and leave system powered off for 60 seconds. 4. Turn on main breaker. 5. Verify that the ASC 3 controller and detector cards regain functionality. Access the Main Interval Timers: Main Menu 2, 1 on the ASC 3 controller and verify the VEH EXT, MIN GRN and MAX1 values match the original settings.
6. Verify that **ICWS operates without dependence on external systems.**	2.2.2	1. Verify that RICWS breakers from the electrical service are not shared with any other lighting, signal or ITS components in the immediate area. 2. Verify that the Canoga and pre-formed loop detectors are connected independently with designated cabling to detector cards in 334 cabinet. 3. Verify that detector cards are seated in designated input file within 334 cabinet. 4. Verify that ASC 3 controller is connected to input file with independent cabling harness not used by any other devices or hardware. 5. Verify that active flashers on major and minor approach signs are connected to ASC 3 controller with independent cabling runs not used by any other devices or hardware. 6. Verify the system is controlled locally.

Verification Process	System Requirement	Verification Procedure
7. Verify that **ICWS components** are physically accessible for maintenance within the right of way with one Transportation Agency vehicle and a 1-2 person crew.	2.9.1	1. Verify that parking locations are available within 200 feet of RICWS signs, hand holes and 334 cabinet. 2. Verify that none of the RICWS components are placed behind fencing, retaining walls or other obstructions from the roadway. 3. Verify that cabinet is mounted at a height that provides adequate accessibility.

After performing the test, return all controller configurations that were adjusted for this test to their proper values and states.

Verify controller settings in controller match table in the cabinet's Operations Manual.

Test Tracking Log

Control Number	Date/ Time	System Requirement Test No.	Tester Initials	Pass/Fail	Comments
1					
2					
3					
4					
5					
6					
7					
8					

Control Number	Date/ Time	System Requirement Test No.	Tester Initials	Pass/Fail	Comments
9					
10					
11					
12					
13					
14					
15					
16					