

# Minnesota Autonomous Bus Pilot

## Minnesota Public Transit Conference

October 17, 2017

# Presentation

- Pilot Overview
- Pilot Requirements
- Status
- Future Vision
- Q & A



# MN Autonomous Bus Team

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# Minnesota Autonomous Bus Pilot

## Project

- Research vehicle and infrastructure requirements to safely operate an **autonomous bus in cold weather** climate conditions

## Objective 1

- Define project pilot, perform feasibility study, perform preliminary engineering and solicit for autonomous vehicle technology vendors

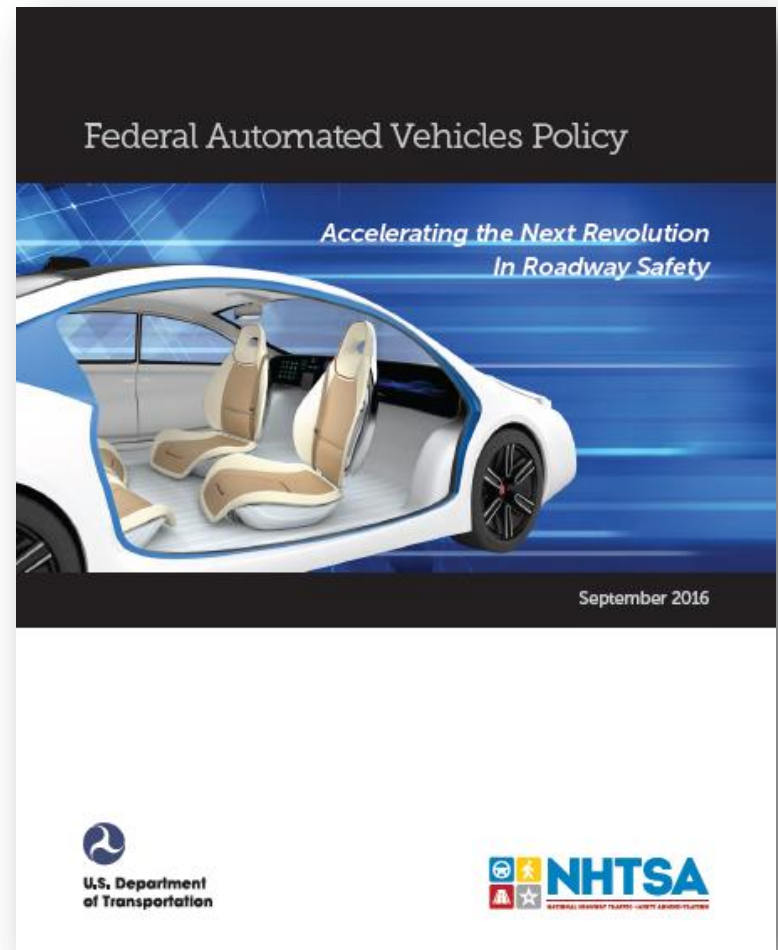
## Objective 2

- Finalize demonstration plan with technology vendor and conduct pilot



# Minnesota & Automated Vehicles

- MN is “**OPEN for Business**”
- Minnesota Jurisdictional AV/CV Committee
- Minnesota Guidestar
- MnDOT Examining Statutes/Rules
  - ID Statutes/Rules Limiting AVs
  - ID Possibilities within Current Statutes/Rules
  - Perform Pilot before Promoting Legislation



# Project Goals

## Why are we doing this?

### SNOW & ICE

Prepare autonomous vehicle industry for snow & ice conditions

### OPERATIONS

Identify challenges and strategies for safe operation of third party autonomous vehicles on MnDOT's transportation system

### MOBILITY

Prepare for improved mobility services through autonomous vehicles

### INFRASTRUCTURE

Identify the infrastructure that is needed to ensure safe operation of autonomous vehicles

### INFLUENCE

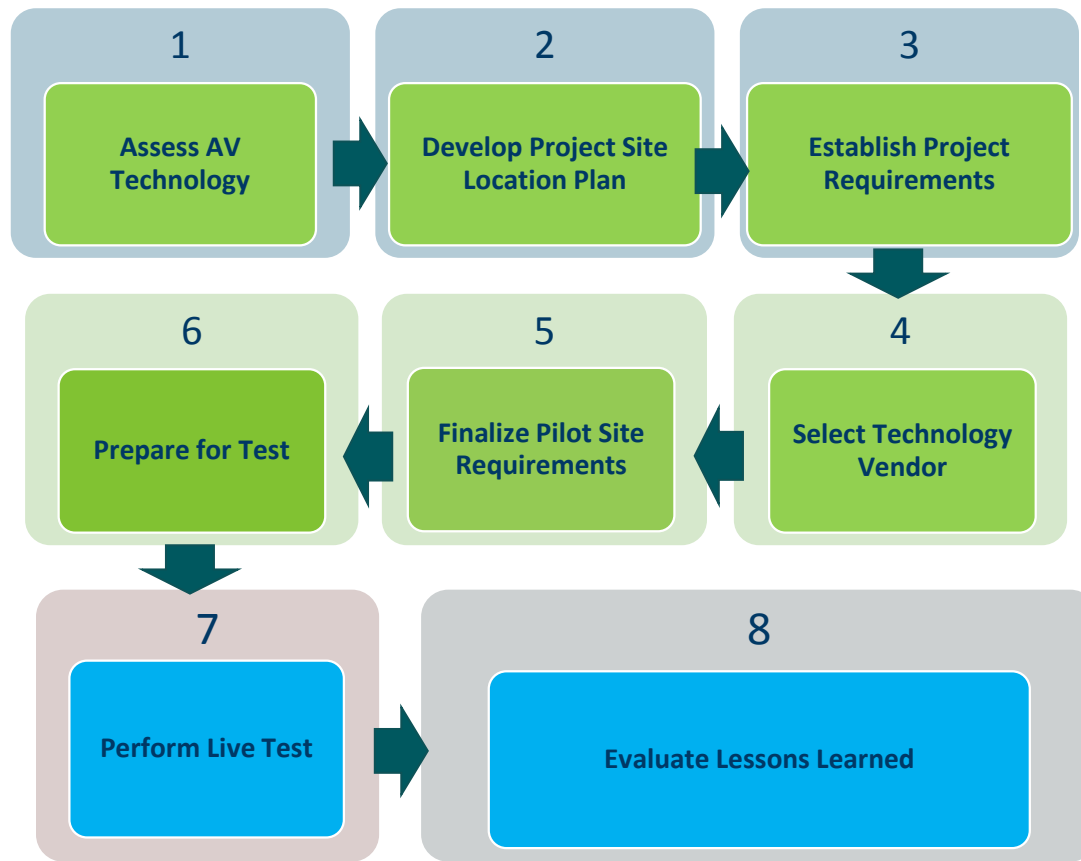
Increase Minnesota's visibility and influence on advancing autonomous & connected vehicles

### PARTNERSHIPS

Enhance partnerships between government and the autonomous vehicle industry

# Project Activities

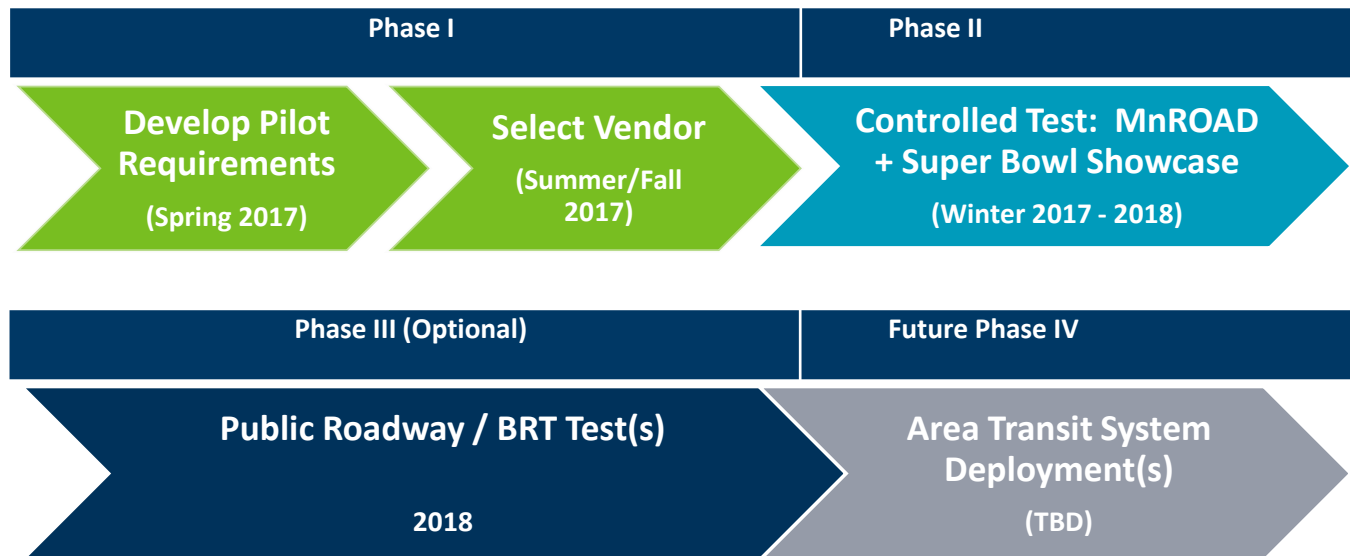
## What are we doing?



**Project Status** – beginning to work with autonomous vehicle provider

# Pilot Schedule

## When will this happen?



**Testing Schedule** – allows for testing during winter 2017 - 2018



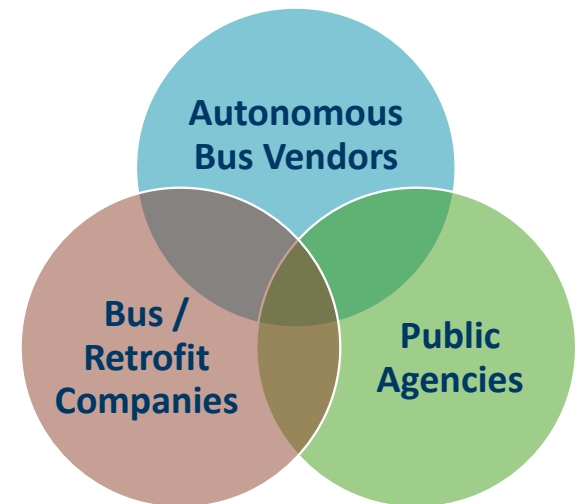
# Industry / Stakeholder Interest

Company
Navya
EasyMile
Local Motors
2getthere
Autonomous Solutions Inc. (ASI)
Romarc Corporation
Velodyne Lidar
New Flyer Industries
Gillig
Hyundai-Kia America Technical Center, Inc. (HATCI)
SB Drive
Yutong
Proterra
DOTs – Colorado, Connecticut
Transit Agencies – RTD (Denver), MVTA & DTA (MN)
Other – Mayo Clinic, FedEx, 3M, University of MN

## April 20 Industry Forum

Vendor / Stakeholder Outreach

[www.dot.state.mn.us/autonomous/](http://www.dot.state.mn.us/autonomous/)



# Autonomous Bus Vendor Selection

- MnDOT Solicitation
  - June/July 2017
- Vendor Proposals
  - Local Motors
  - EasyMile
- Vendor NTP issued 9/15/17



# Autonomous Bus Vendor

- **EZ10 Shuttle**

- 91 Deployments
- 14 Countries, 4 Continents
- 160,000 People
- 60,000 Miles

- **Previous Pilots**

- Finland
- Norway
- Netherlands
- Spain
- Dubai
- Singapore
- California
- U.S. Road Tour



# EasyMile EZ10 Shuttle

Criteria	Easy Mile
Size	13.13'
Capacity	12
Speed	Avg. 12-15 mph, up to 25 mph
SAE Autonomy Level (0-5)	4
Federal Standards	Have received exemptions
Previous Demos	Fixed Routes
Super Bowl	Prefer Private Roads
Public Opportunity to Ride	Yes
Work Plan	Includes Safety Assessments

# SAE Levels of Automation

SAE Level	Definition
Level 0	Human driver does everything
Level 1	Automated system on vehicle can sometimes assist the human driver conduct some parts of the driving task
Level 2	Automated system on the vehicle can actually conduct some parts of the driving task, while the human continues to monitor the driving environment and performs the rest of the driving task
Level 3	Automated system can both actually conduct some parts of the driving task and monitor the driving environment in some instances, but the human driver must be ready to take back control when the automated system requests
Level 4	Automated system can conduct the driving task and monitor the driving environment, and the human need not take back control, but the automated system can operate only in certain environments and under certain conditions
Level 5	Automated system can perform all driving tasks, under all conditions that a human driver could perform them

# Proposed Pilot Phases

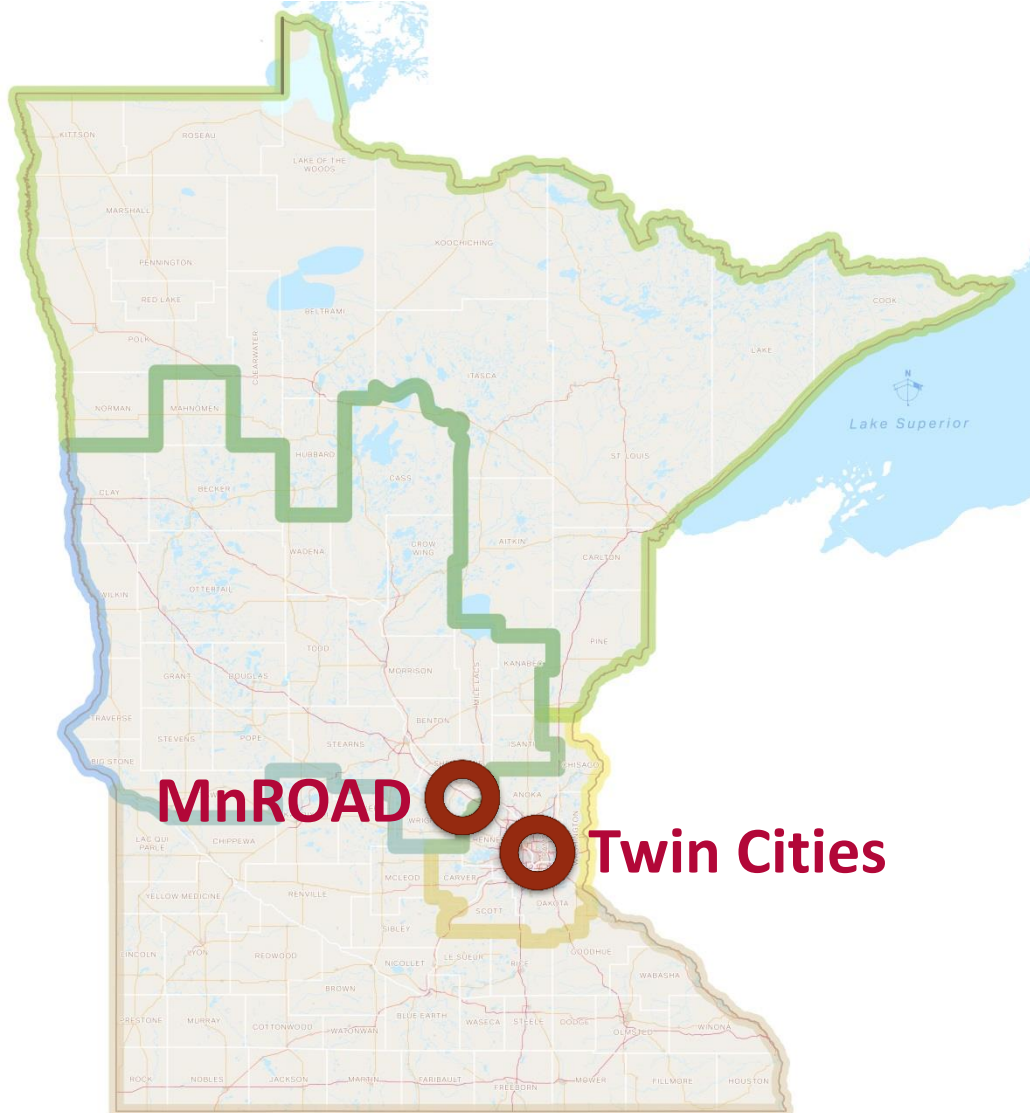
Phase	Target Date
<b>Phase I: Pilot Testing Preparation</b> <ul style="list-style-type: none"> <li>• Finalize Testing Requirements</li> <li>• Provide Vehicle</li> <li>• Prepare Site</li> <li>• Engage in Super Bowl Showcase Discussions</li> </ul>	<b>Summer/Fall 2017</b>
<b>Phase II: Controlled Test</b> <ul style="list-style-type: none"> <li>• Clear Weather Testing</li> <li>• Winter Weather Testing</li> <li>• Conduct Group Tours / Demonstrations</li> </ul>	<b>Nov. 2017 – Feb. 2018</b>
<b>Phase III: Public Road Showcase</b> <ul style="list-style-type: none"> <li>• Conduct Showcases during Super Bowl Festivities</li> </ul>	<b>Jan.- Feb. 2018</b>
<b>Phase IV: Public Roadway / BRT Test(s) (Optional)</b> <ul style="list-style-type: none"> <li>• TBD / Negotiated</li> </ul>	<b>2018</b>

# Pilot Demonstration Focus

- **Vehicle**
  - Provided / operated by vendor
- **Observe Behavior**
  - Winter weather focus
- **Public Tours**
  - Public Agencies
  - Legislature
  - Special Interest Groups
  - Others
- **Super Bowl Demos**
  - Public rides



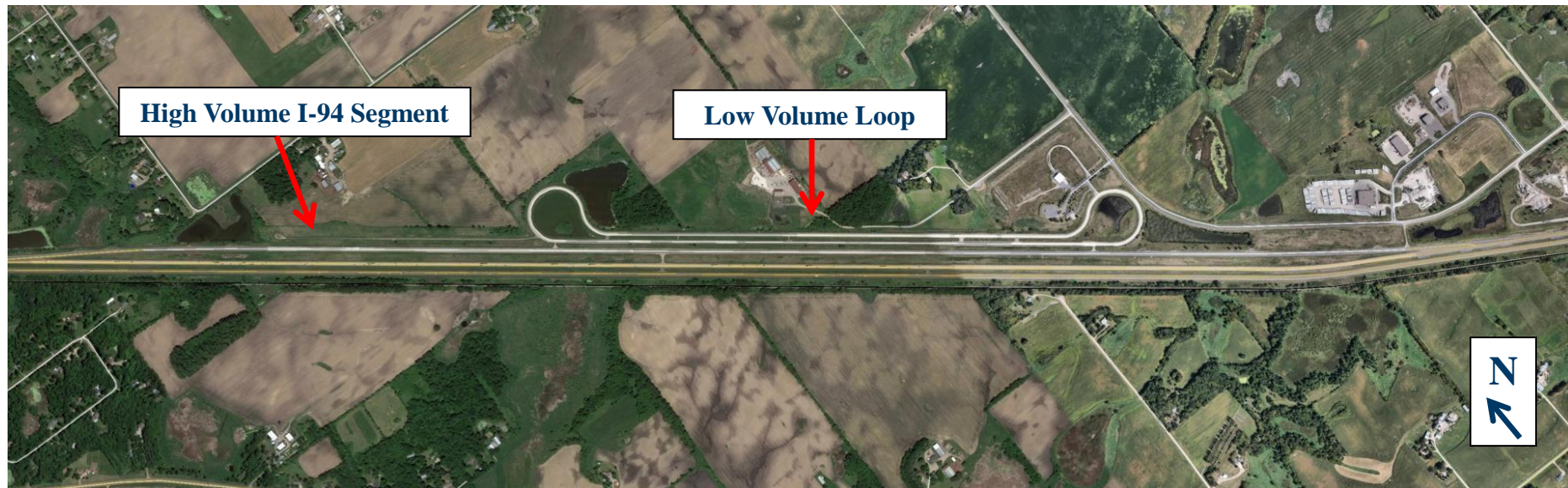
# Controlled Test Site - MnROAD





# Controlled Test Site

## Minnesota DOT MnROAD Facility



- MnDOT owned and operated
- Low and high speed testing available (30 – 70 MPH)
- Closed loop = 2.5 miles; I-94 high speed segment = 3.0 miles
- Enabling environment, easily accessible and readily available
- Ability to create varying test conditions
- Is an AV proving ground site

# Controlled Test Site

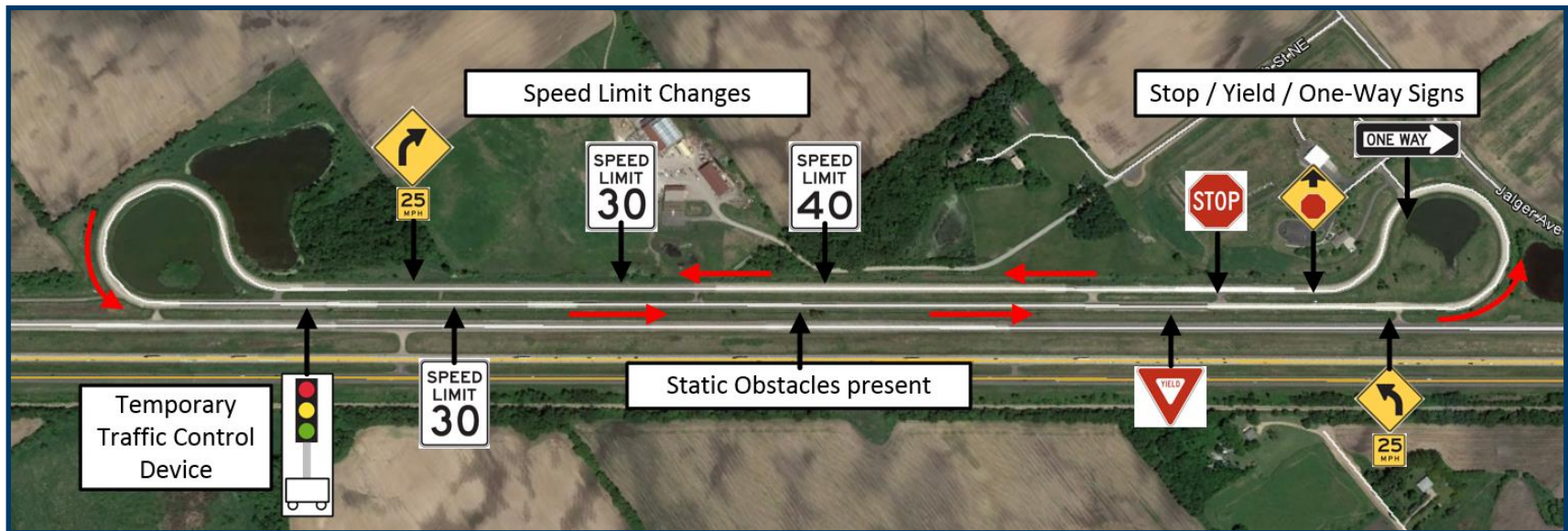
## Minnesota DOT MnROAD Facility



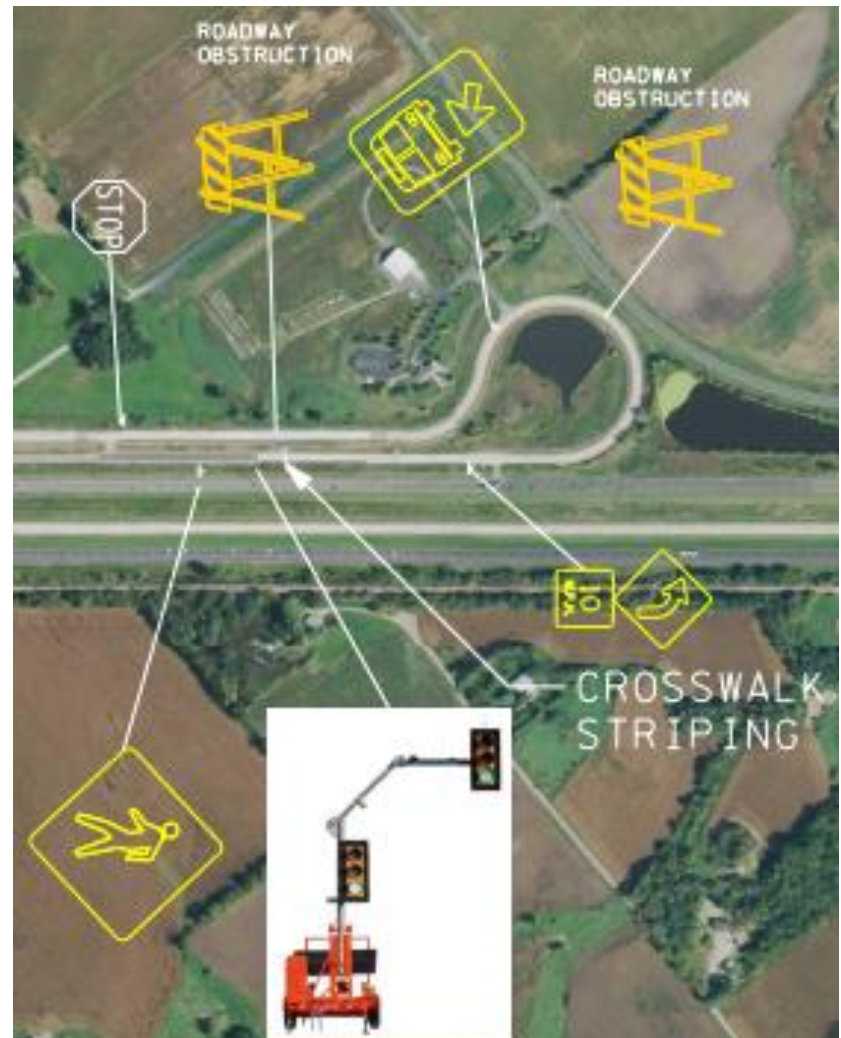
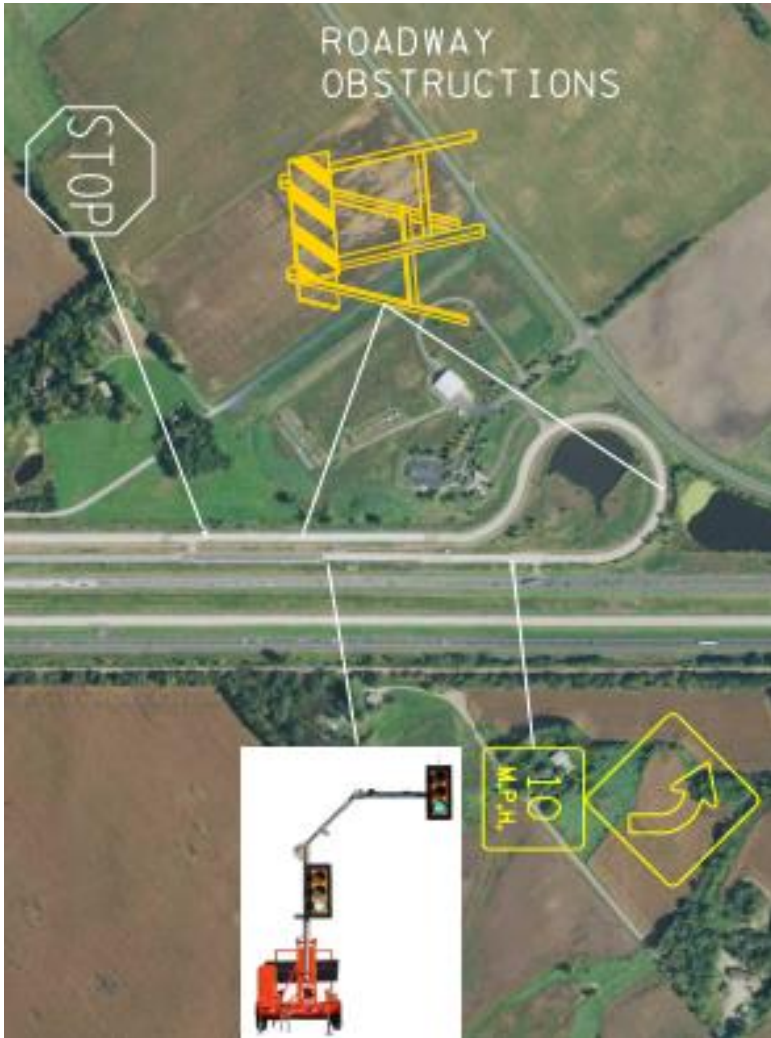
# Demonstration Plan

## Testing Scenarios, Schedule & Responsibilities

- **MnROAD Clear Weather**
- **MnROAD Winter Weather**
- **Observe - Various Traffic, Pavement, Visibility & Temperature Conditions**



# Demonstration Plan



# Demonstration Concepts

## Observations / Conditions

Dry Weather	Winter / Cold Weather	Snow / Ice / Salt
Varying Visibility	Various Lighting	Obstacles
On-coming Vehicles	Slow / Stopped Vehicles	Car Following
Intersection Turns	Stop / Yield Signs	Traffic Signals
Pedestrians	Bicycles	Right-of-Way Decisions
Parking	Transit Stops	Pick-up/Drop-off Passengers
Other	Other	Other

# Possible Super Bowl Venue Showcase

## Super Bowl LII

- Possible test showcase for Technology Vendor
- On-going discussions with
  - Minneapolis
  - Saint Paul
  - Bloomington
  - Super Bowl Planning Committees
- Option for non-public roadway showcases
  - Super Bowl event parking in private lots



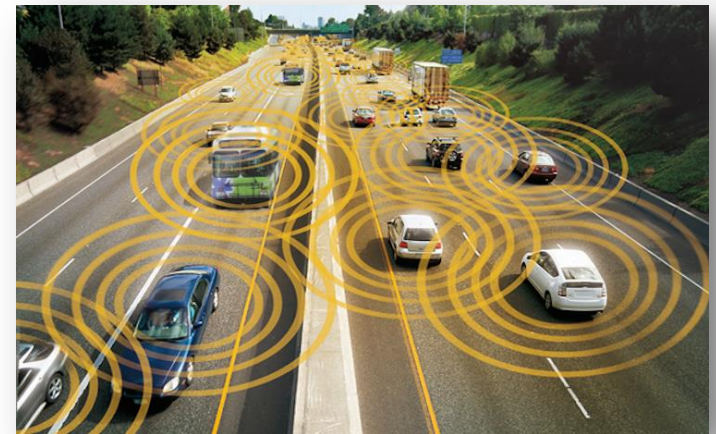
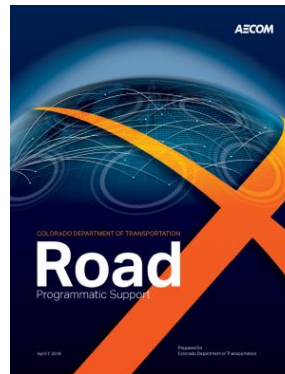
# National Participation

- **U.S. National Partners**

- Colorado DOT – committed
- Other interest expressed

- **CDOT Participation**

- Advisor
- Controlled testing participation



# Future – Public Roadway / BRT Site(s)

## Possible Local Sites

- UofM Transitway
- Duluth Canal Park
- Mayo Clinic
- MVTA Route





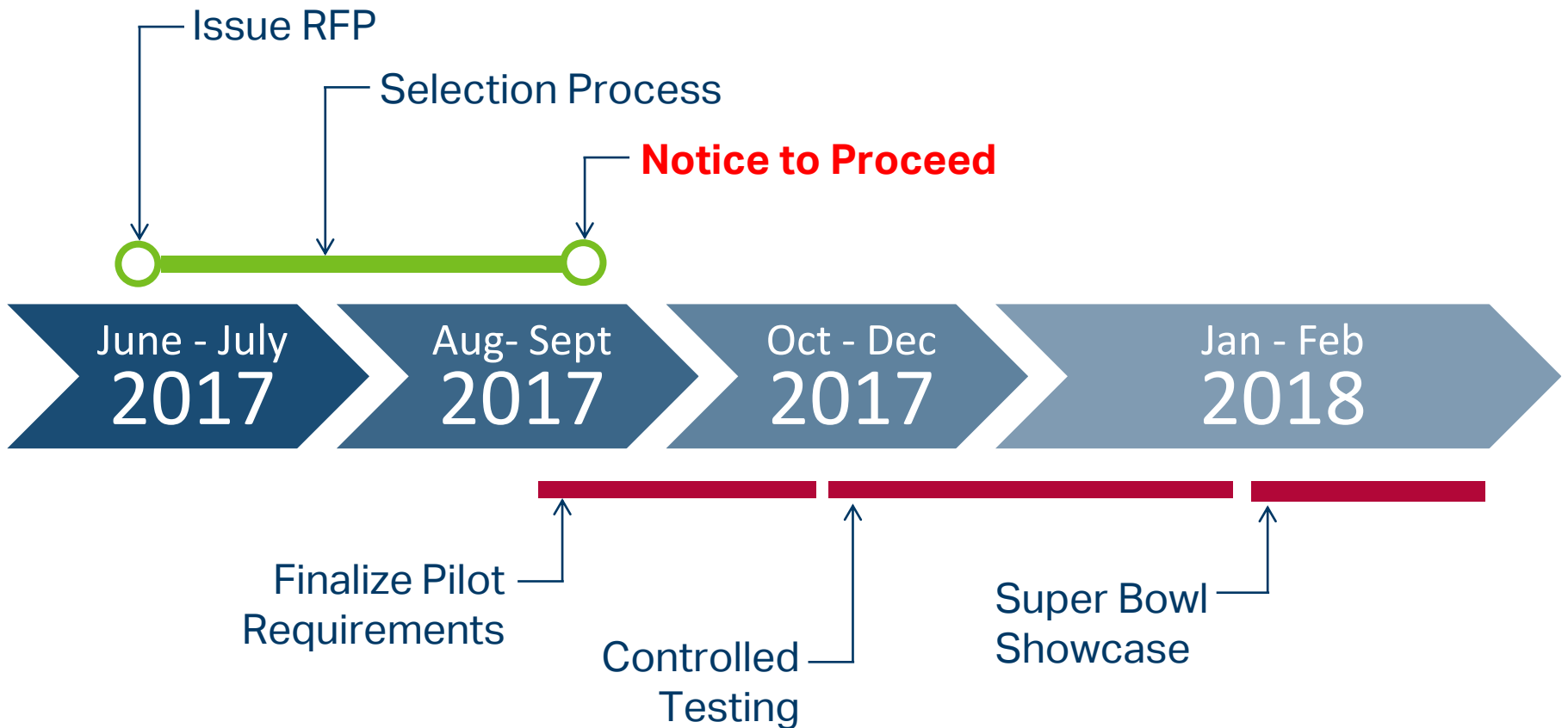
# Future Private Sites ?

## Private Company Campuses

- 3M Campus
- FedEx – expressed interest
- Amazon?



# Upcoming Activities



## Key Contract Milestones

# Questions & Answers

**Thank You!**



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