

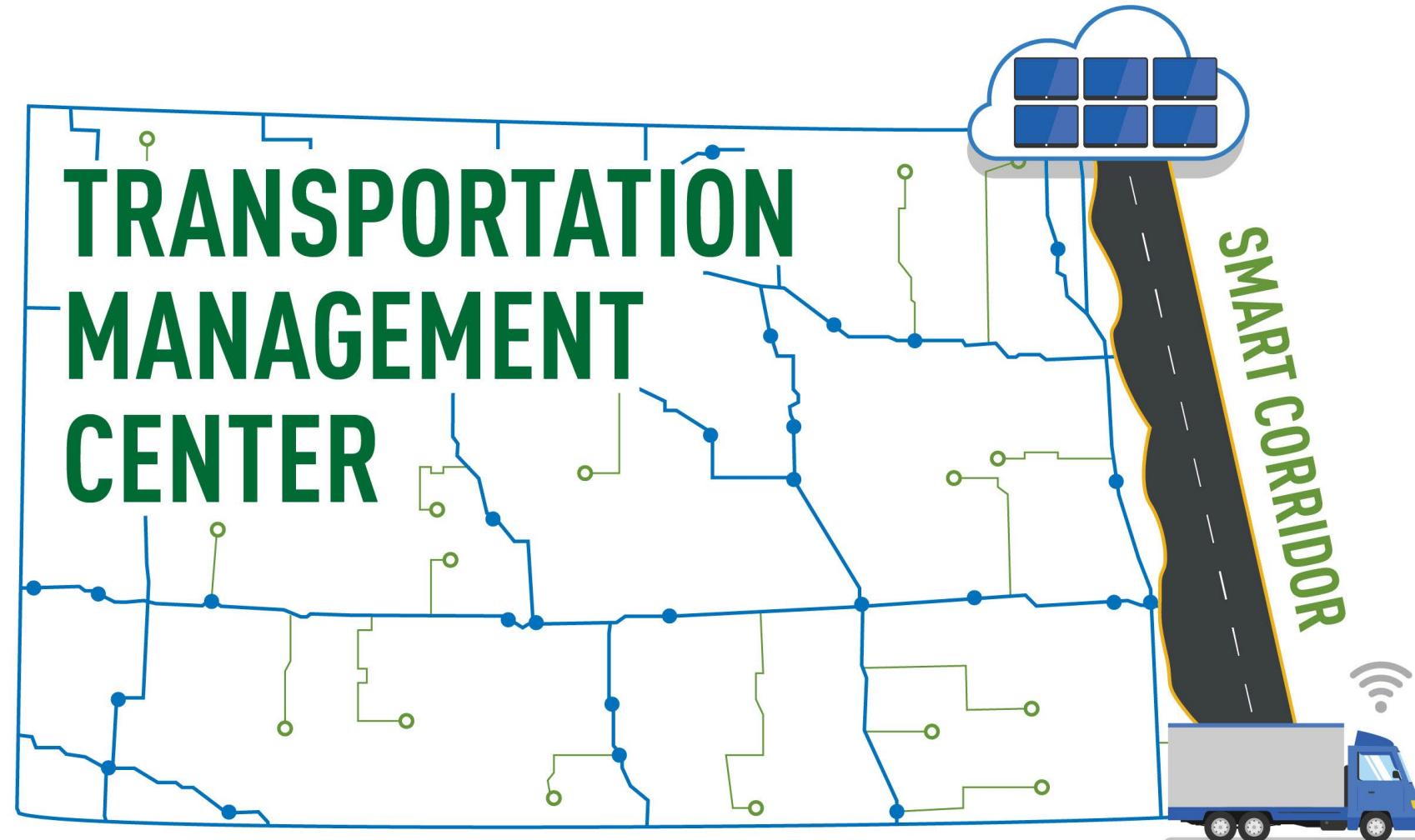


From Variable Speeds to Dashboard Feeds

ND TMC and I-29 SMART Corridor Plan

Project Background

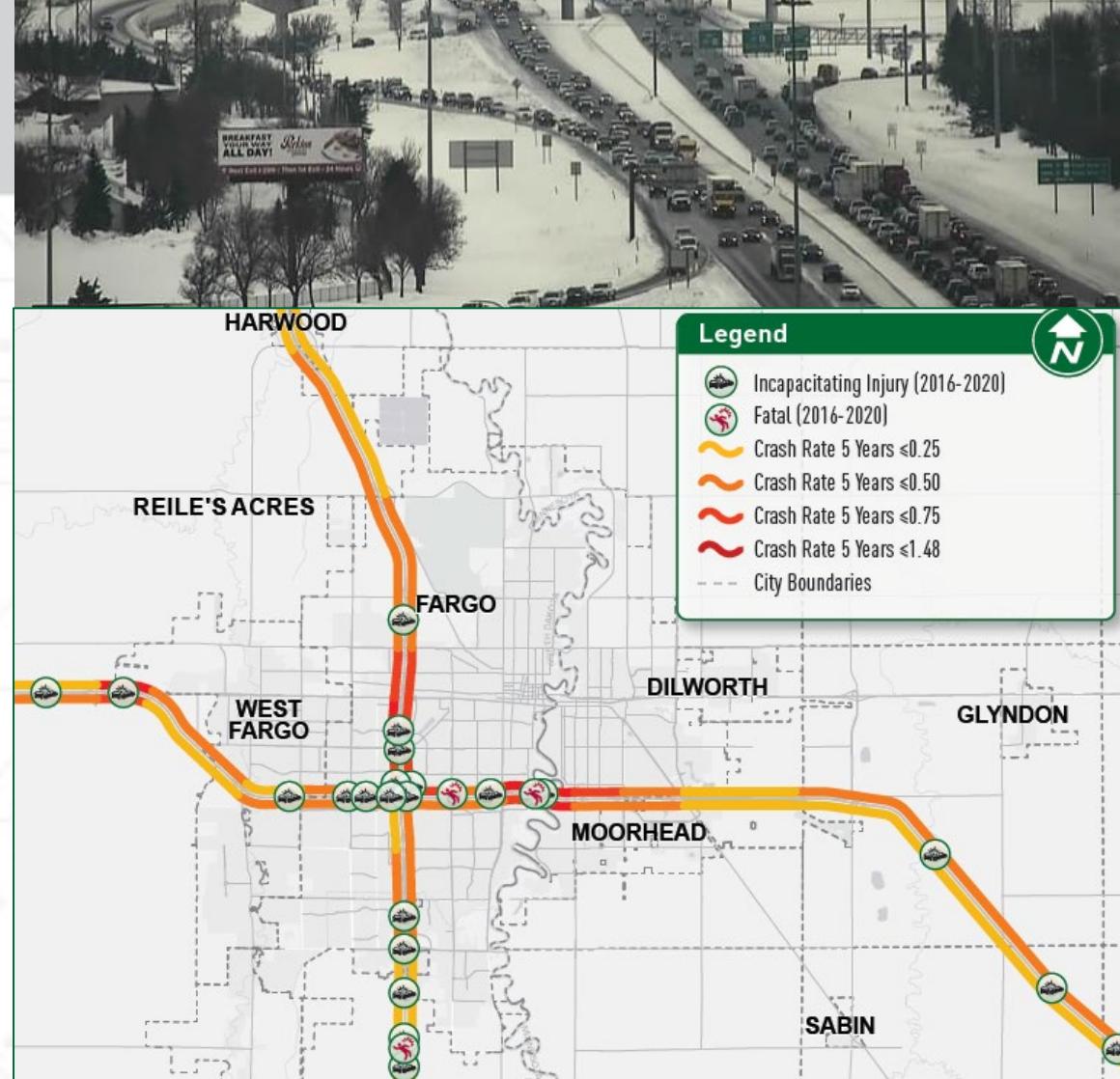
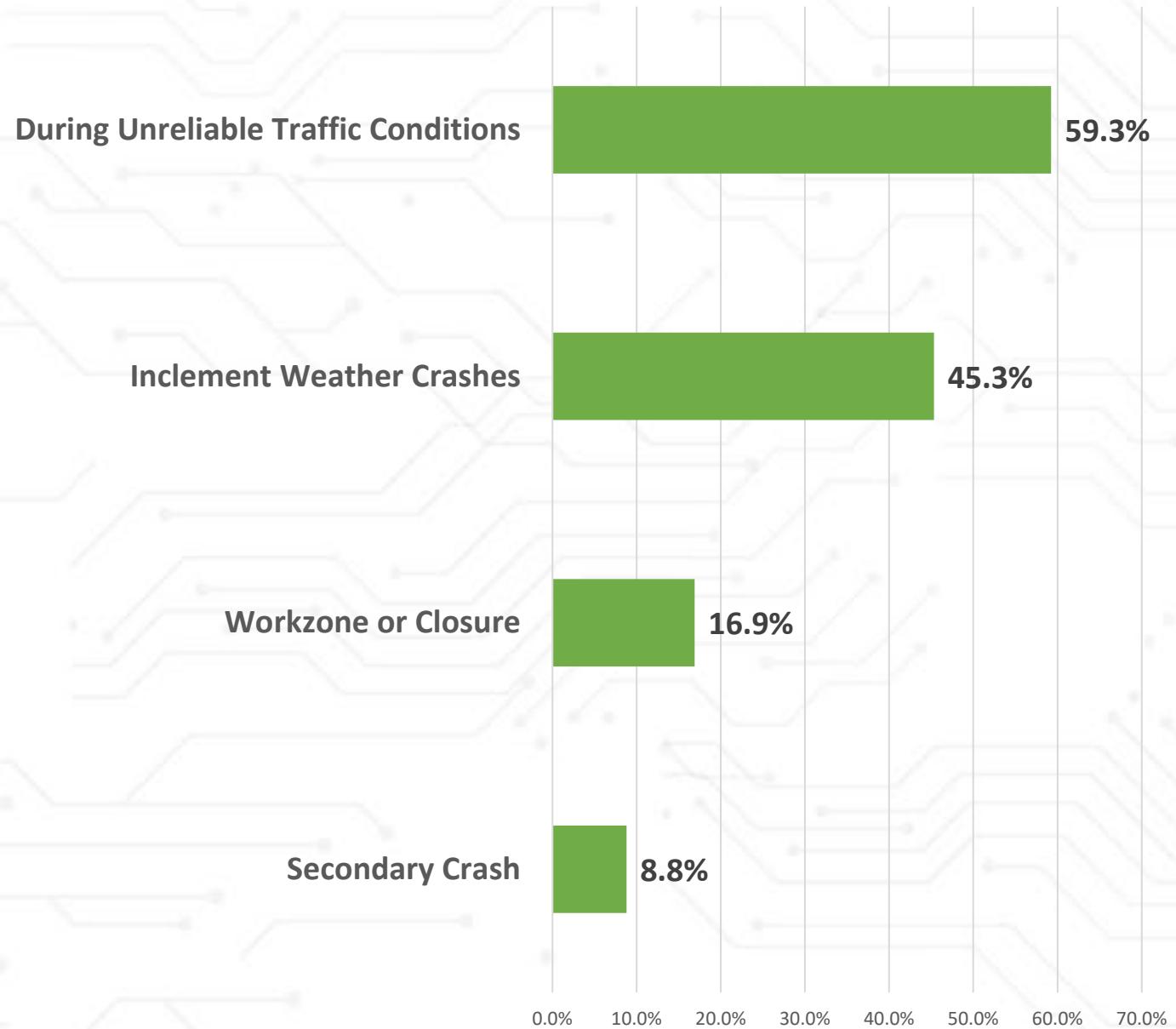
- \$1.1M RAISE Grant Funded Plan
- The TMC Needed the SMART Corridor to Build Excitement
- The SMART Corridor Needed the TMC to Operate



Video Link

<https://youtu.be/9 JY4row2U0?si=h u1cJvM3y2G1Sh4>

Safety



**60% of Crashes Occur
During ~10-15% of the
Time**

Clearance

+2.8%

Increase in Secondary
Crash Potential for Every
Minute of Clearance
Time (FHWA)

>2X

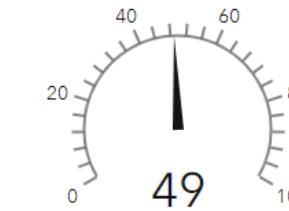
Identification and
Response Times in
Rural Areas

State Radio Response Data (2019-2021)

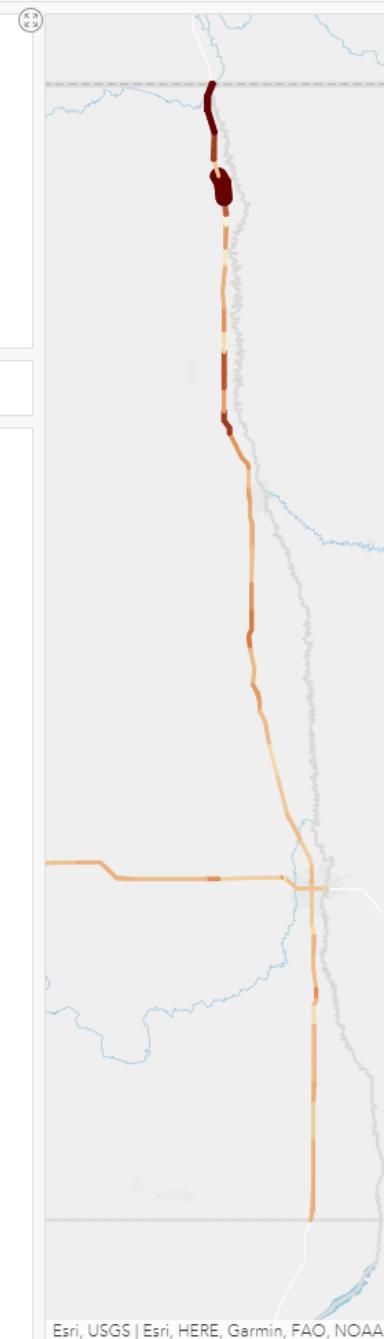
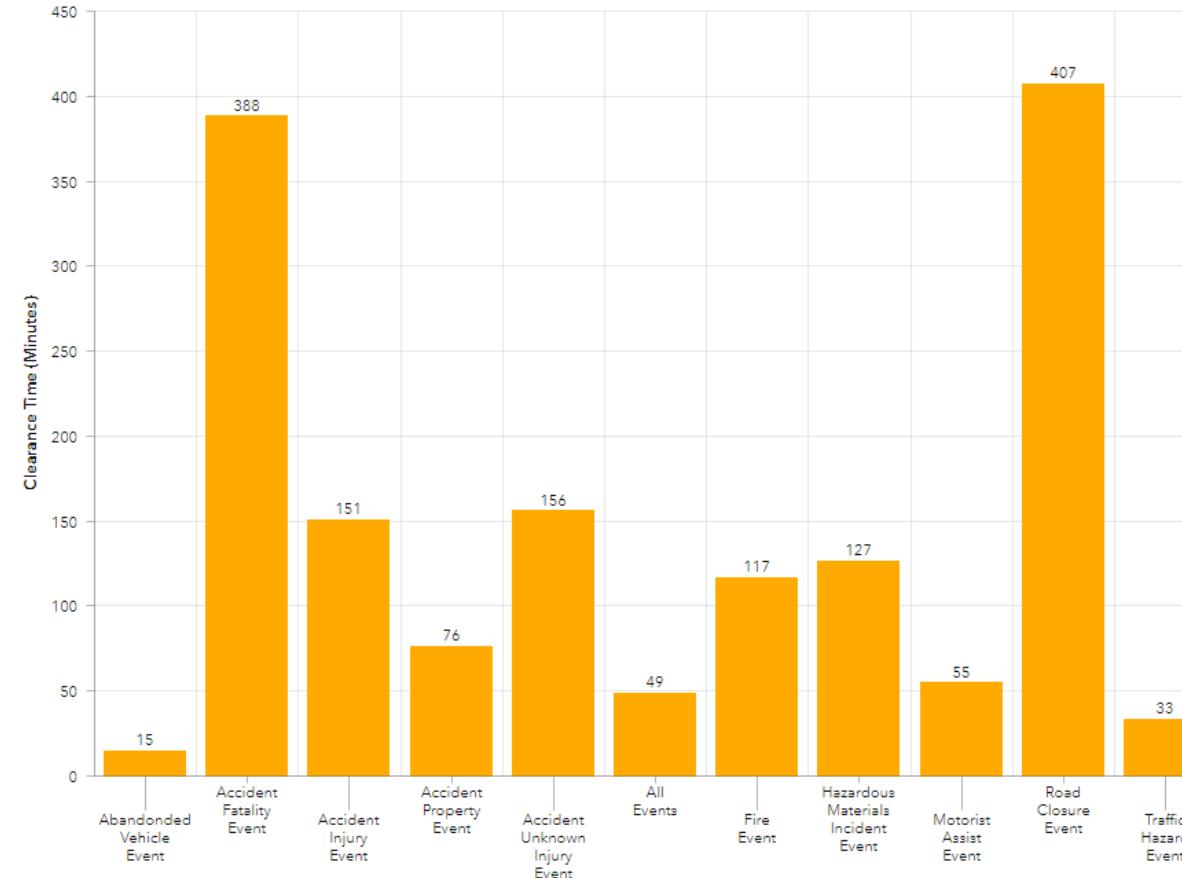
Response Events

14.2k

Average Clearance Time (Minutes)

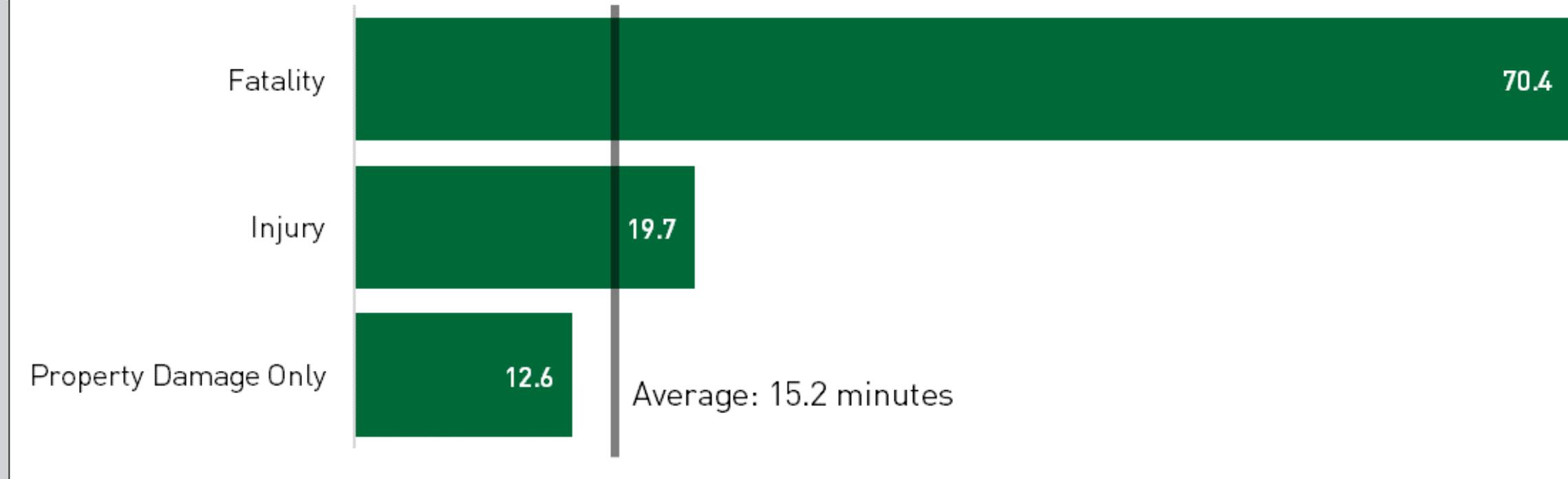


[Box Plot Graphics: I-29 & I-94 Clearance Box Plot](#) [I-29 Clearance Box Plot](#) [I-94 Clearance Box Plot](#)



Survivability

Response Times by Severity (ND Interstates, 2019-2021)



0 Minutes
BREATHING STOPS; THE HEART
WILL SOON STOP BEATING

4-6 Minutes
POSSIBILITY OF LONG-TERM
BRAIN DAMAGE

6-10 Minutes
HIGH PROBABILITY OF
LONG-TERM BRAIN DAMAGE

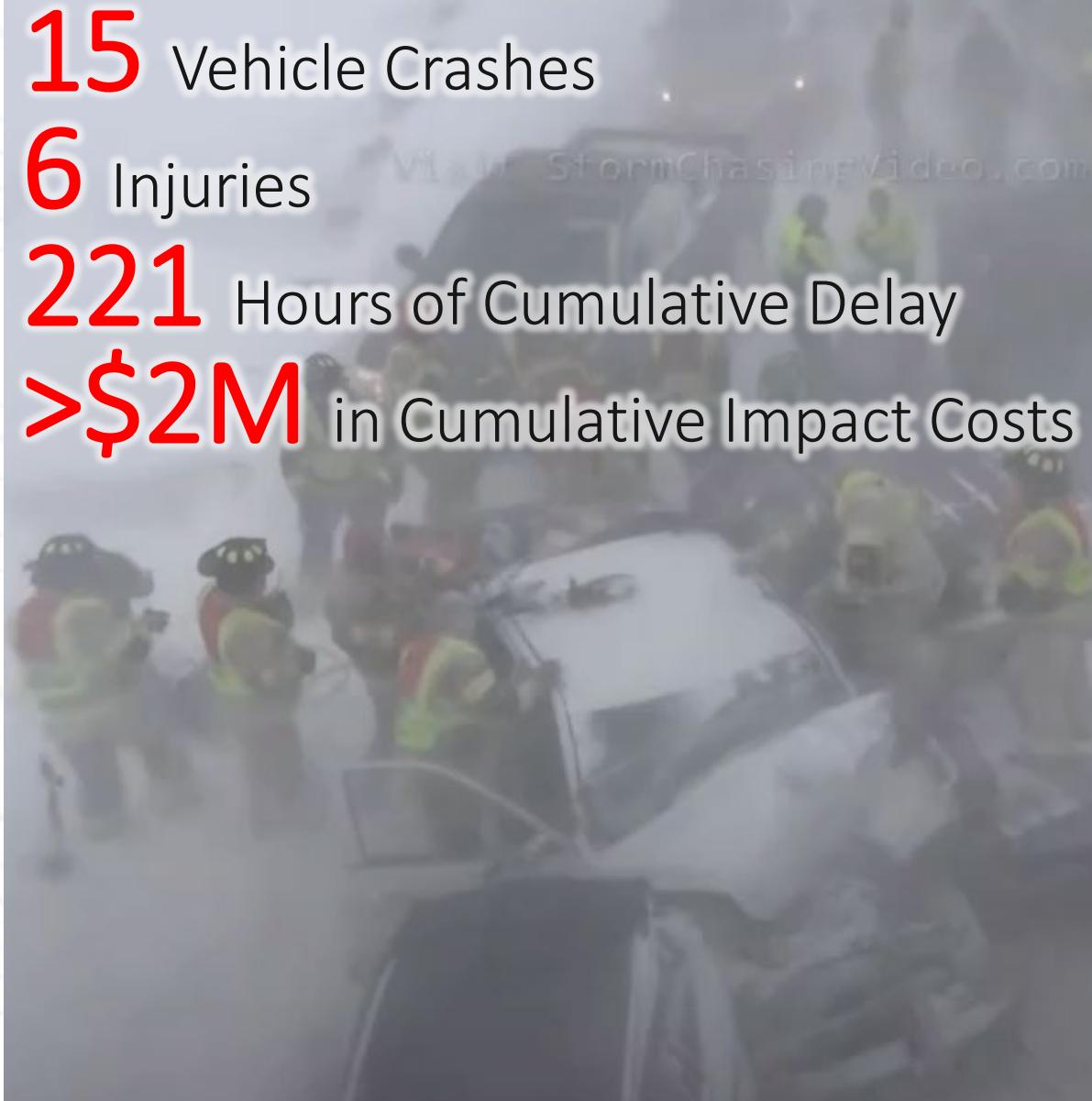
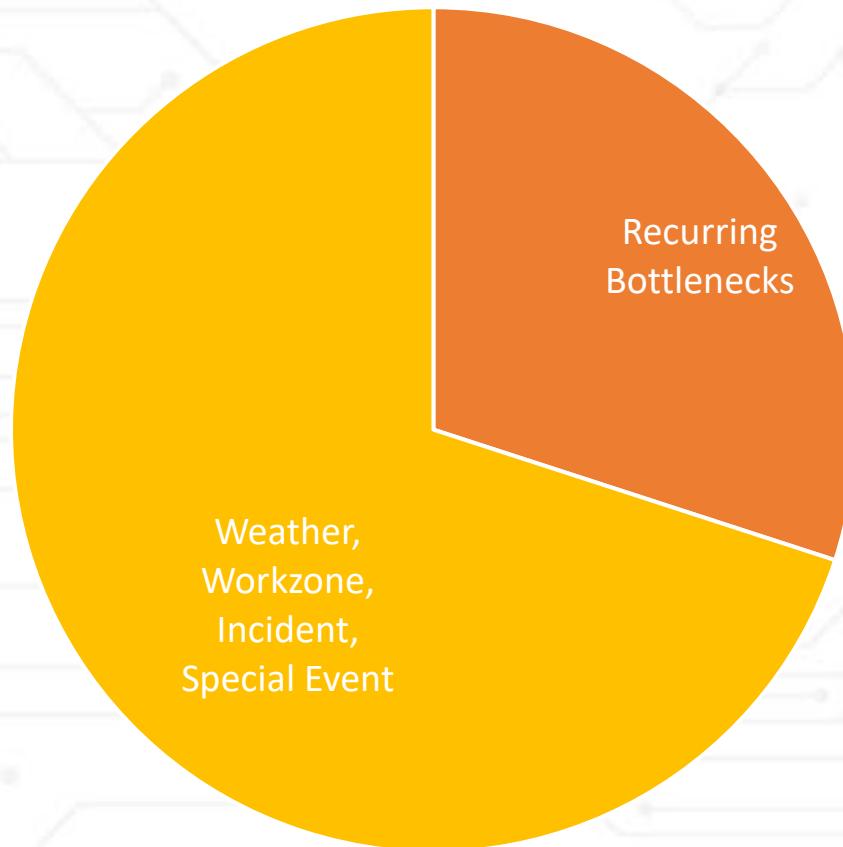
Over 10-15 Minutes
CERTAIN IRREVERSIBLE BRAIN
DAMAGE RESULTING IN DEATH



Rescuing Stranded Driver
After-Hours Can Take as
Many as 16 Calls by State
Radio

Reliability

Sources of Congestion (Interstate Only)

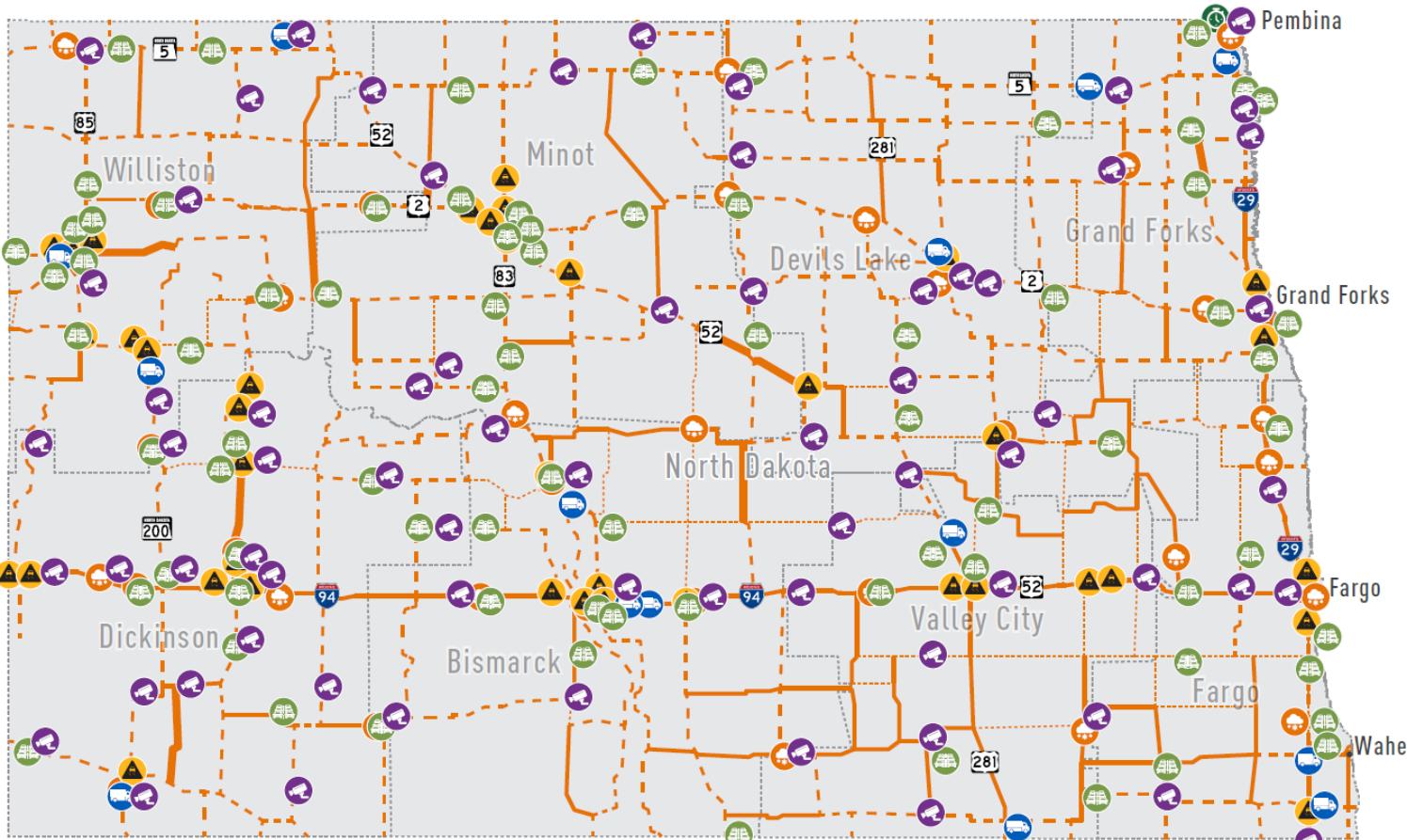


15 Vehicle Crashes
6 Injuries
221 Hours of Cumulative Delay
>\$2M in Cumulative Impact Costs



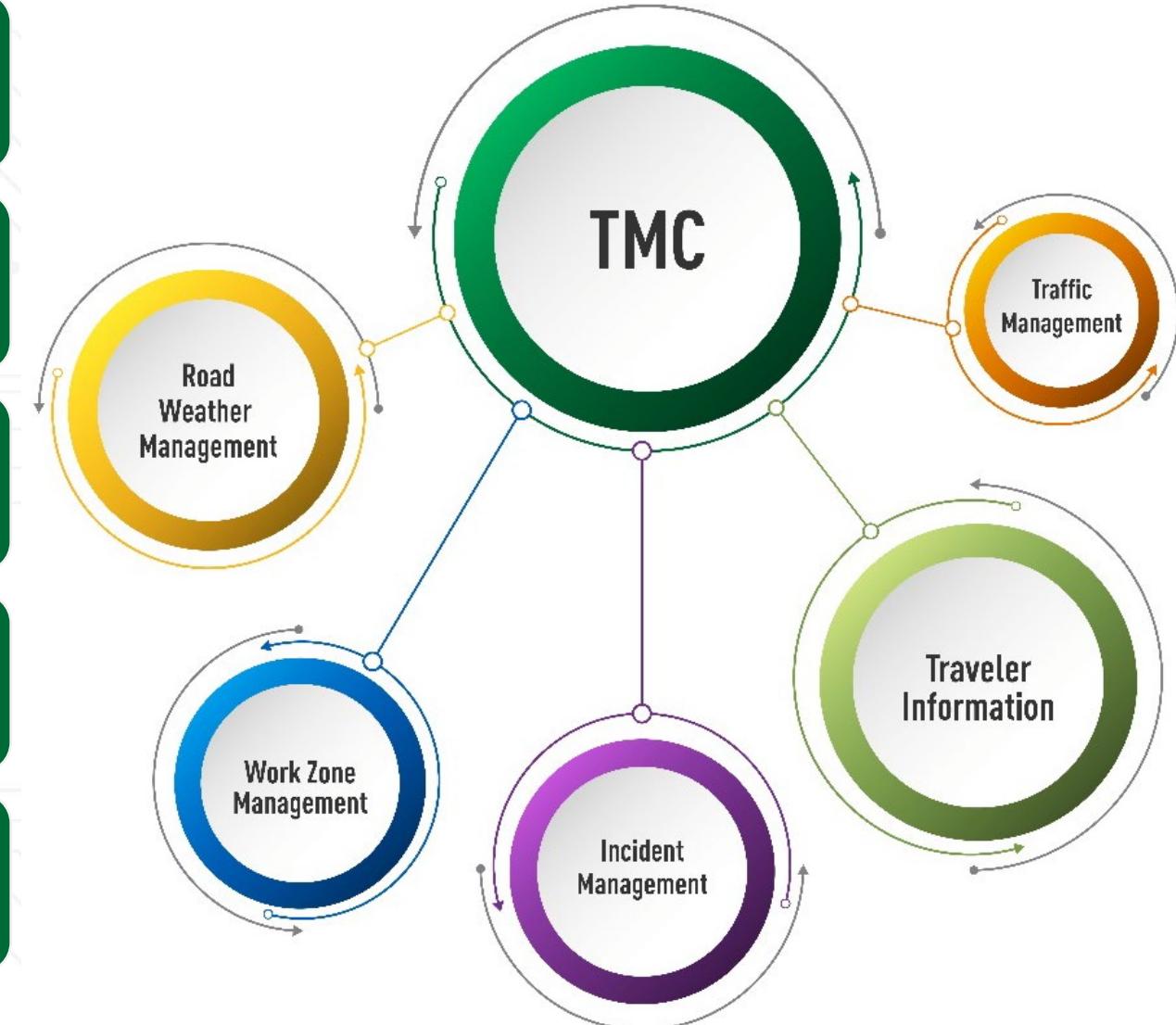
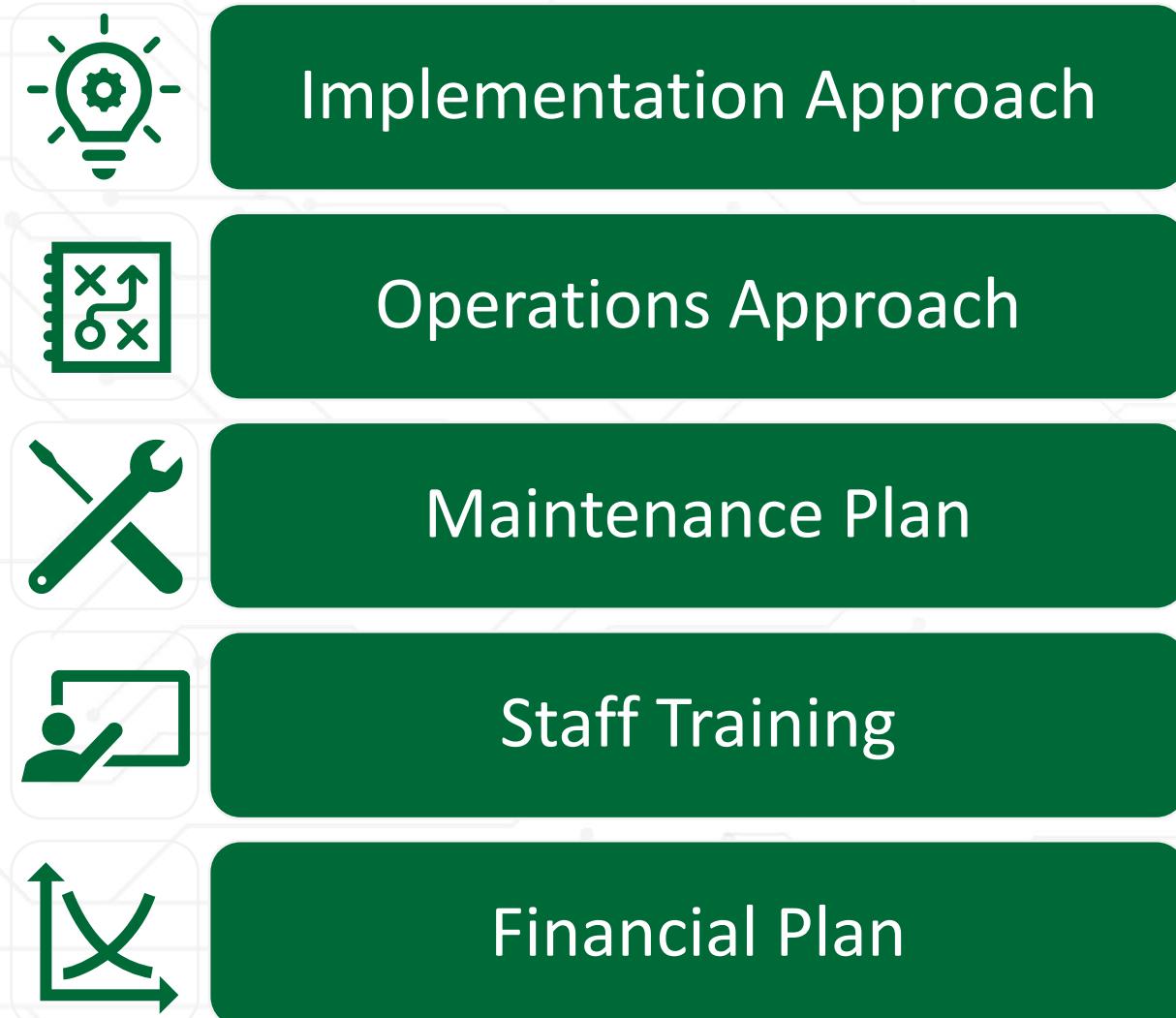
Transportation Management Center

Transportation Management Center



- Way to Effectively Operate >300 Field Devices
- Staff to Monitor and Respond 24/7/365
- Facility to House People and Equipment

Operations Plan



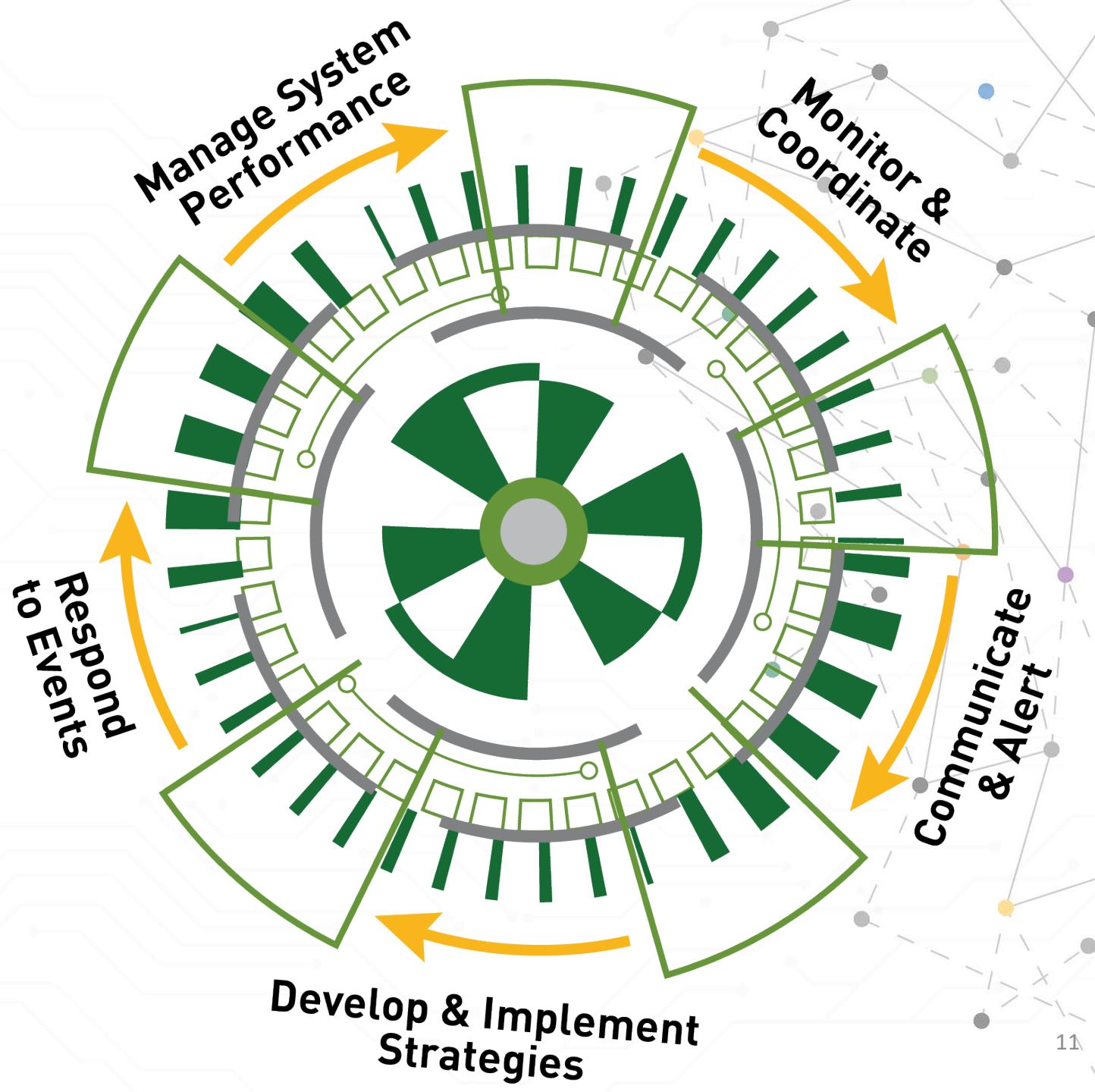
TMC Stakeholders

Internal (NDDOT) Stakeholders:

- Maintenance Division (CO)
- Planning and Asset Management (CO)
- Construction Services (CO)
- Districts

External Stakeholders:

- State Radio Communications
- Highway Patrol
- Department of Information Technology
- Division of Homeland Security
- Cities & Counties
- Drivers



Concept of Operations

- User oriented description
- Defines TMC functions
- Identifies partner agencies
 - Interaction with TMC
- Documents challenges, opportunities, needs
- Delineates user interaction, roles and responsibilities
- Defines institutional and policy frameworks



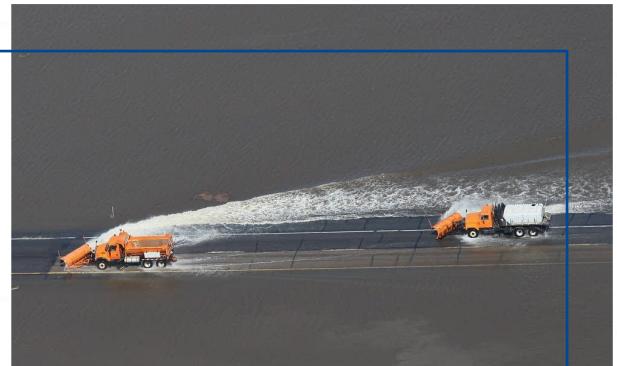
Peak Period Operations



Traffic Incident



Winter Weather



Emergency Event



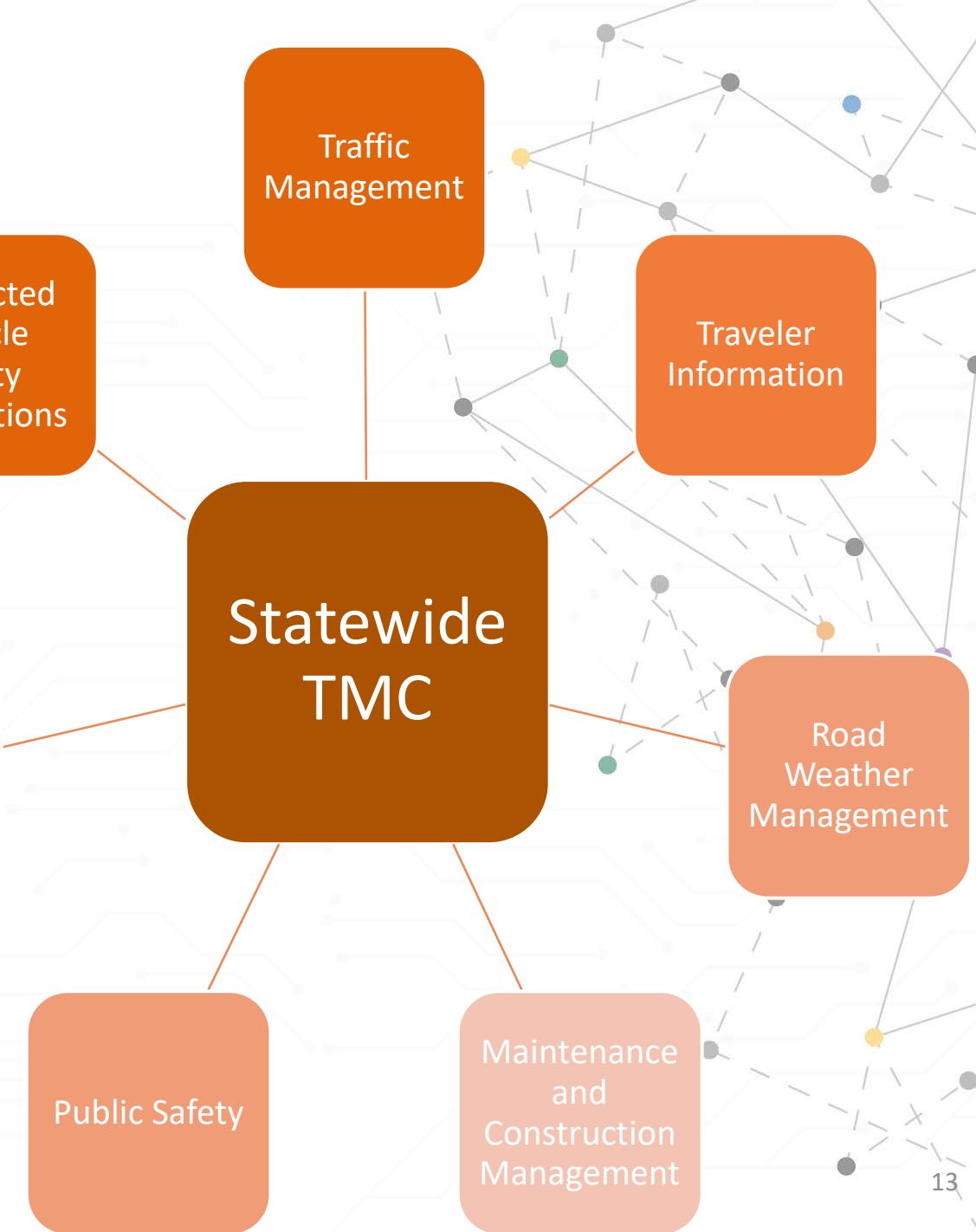
Special Event



Equipment Failure

TMC Requirements

Category	ID		Requirement	NDDOT Status
Road Weather Management	RWM	7.1	The TMC shall support the following transportation services within the Road Weather Management functional area.	Required-Existing
	RWM	7.1.1	Weather Data Collection	Required-Existing
	RWM	7.1.1.1	The TMC shall monitor environmental data from roadside environmental sensors.	Required-Existing
	RWM	7.1.1.2	The TMC shall monitor environmental data from on-board vehicle sensors (e.g., snowplows).	Required-Existing
	RWM	7.1.1.3	The TMC shall monitor environmental data from third party weather data providers.	Required-Existing
	RWM	7.1.1.4	The TMC may monitor environmental data from connected vehicles.	Desired
	RWM	7.1.1.5	The TMC shall monitor operational data (e.g., snowplow blade and material application systems) from vehicle on-board systems.	Required-Existing
	RWM	7.1.2	Weather Information Processing and Distribution	Required-Existing
	RWM	7.1.2.1	The TMC shall disseminate current weather conditions.	Required-Existing
	RWM	7.1.2.2	The TMC shall disseminate forecasted weather conditions.	Required-Existing
	RWM	7.1.2.3	The TMC shall disseminate forecasted road conditions.	Required-Planned
	RWM	7.1.3	Spot Weather Impact Warning	Required-Planned
	RWM	7.1.3.1	The TMC shall monitor the operational status of ITS equipment that automatically disseminate spot weather impact warnings.	Required-Planned



Short-Term Facility Plan

- 3rd Floor NDDOT Central Office in Bismarck
- Key Elements
 - Staffing for 5 New (or Repurposed) Staff Members
 - Repurposed Space
 - New Technology and Licenses
- Design and Capital Cost:
\$1,900,000



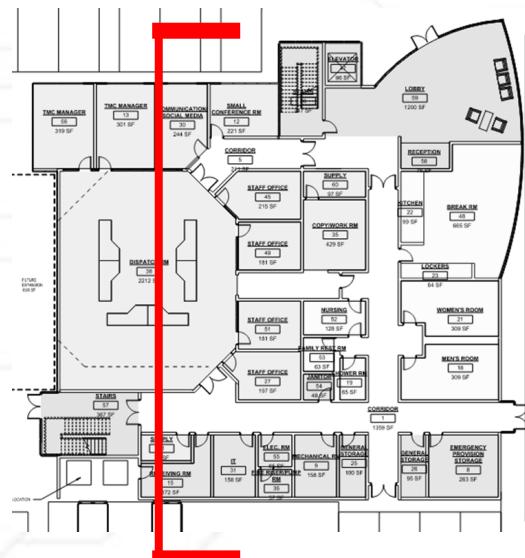
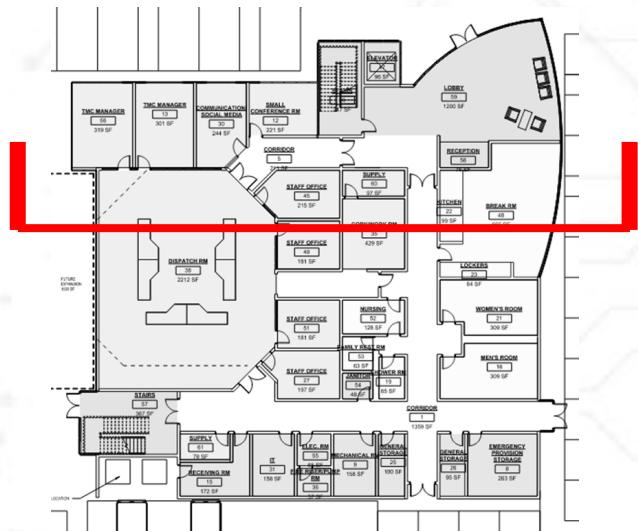
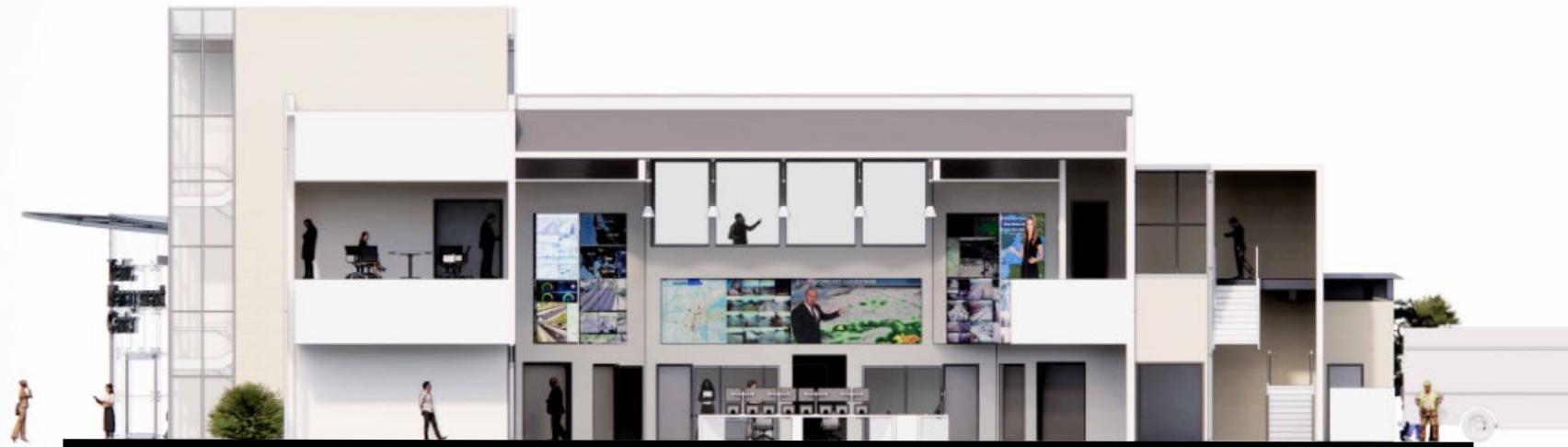
Long-Term Facility

General design criteria and standards for:

- Civil and Landscape
- Architecture and Structure
- Mechanical, Electrical, Plumbing, Fire Protection,
- IT / Comms
- Security



Building Section

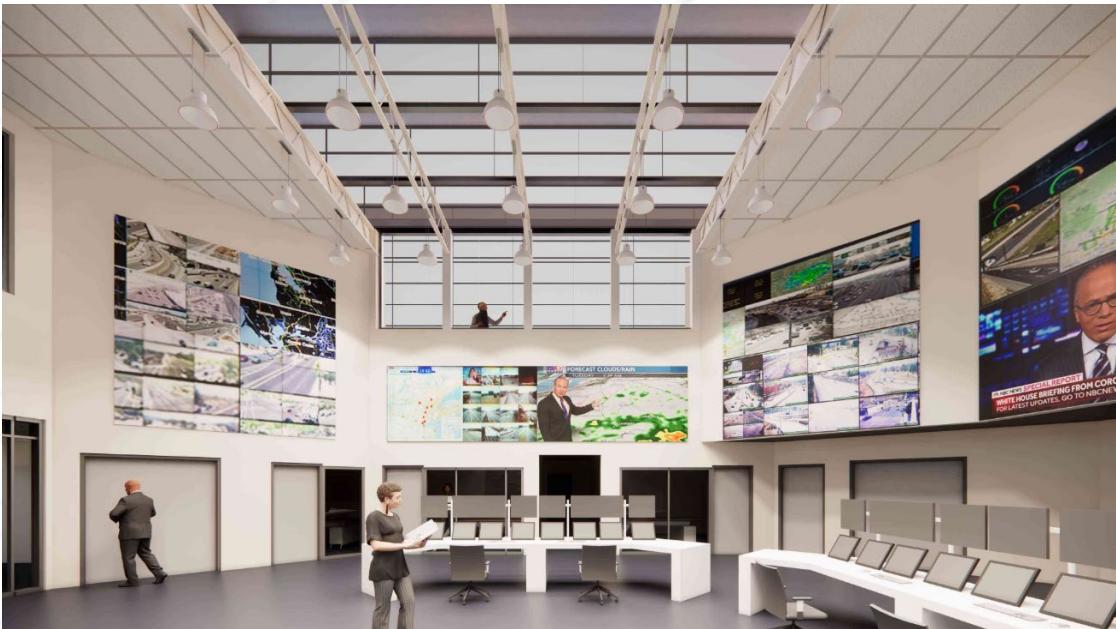


Renderings



Dispatch Room - Images

- Estimating approximately \$3.5M in facility costs
- Estimating approximately \$1.5M in technology costs
- Estimating approximately \$2M in site costs





I-29 SMART Corridor Concept

Variable Speed Limits



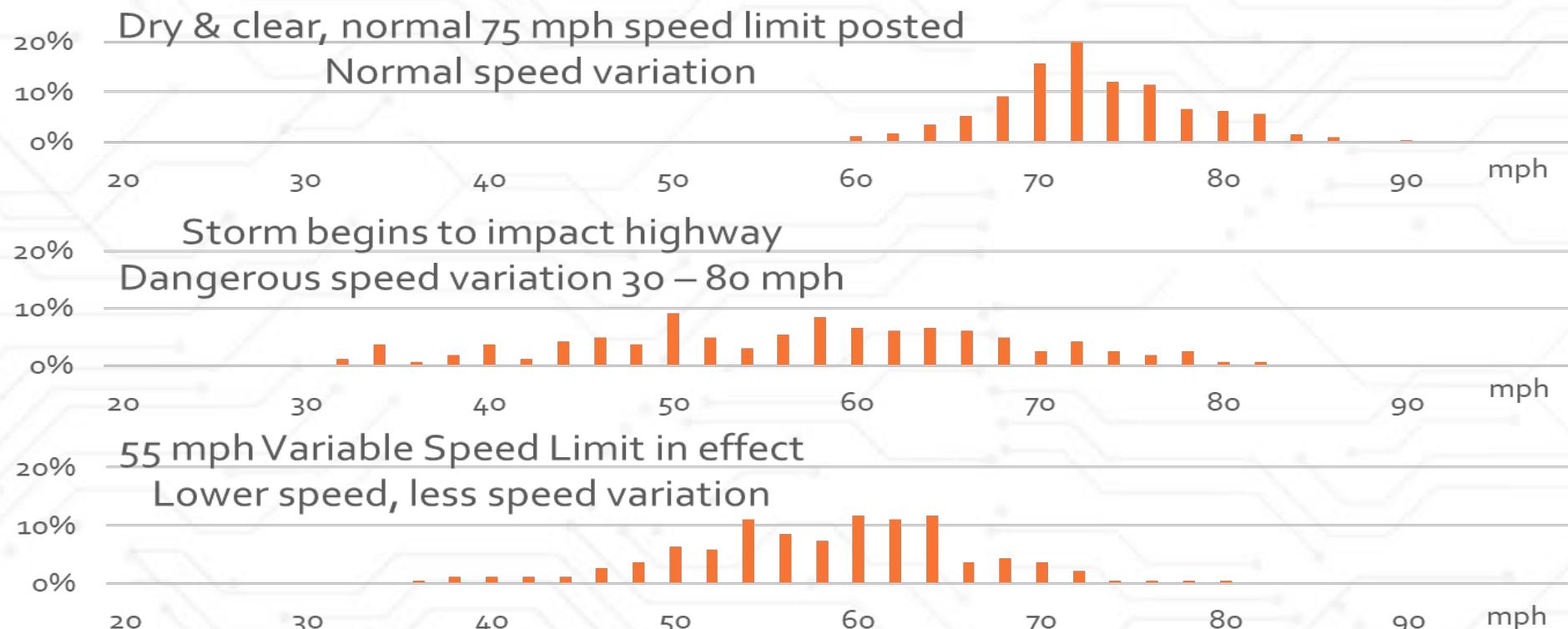
Safety Benefits:
VSLs can reduce crashes
on freeways up to:

34%
for total crashes.¹

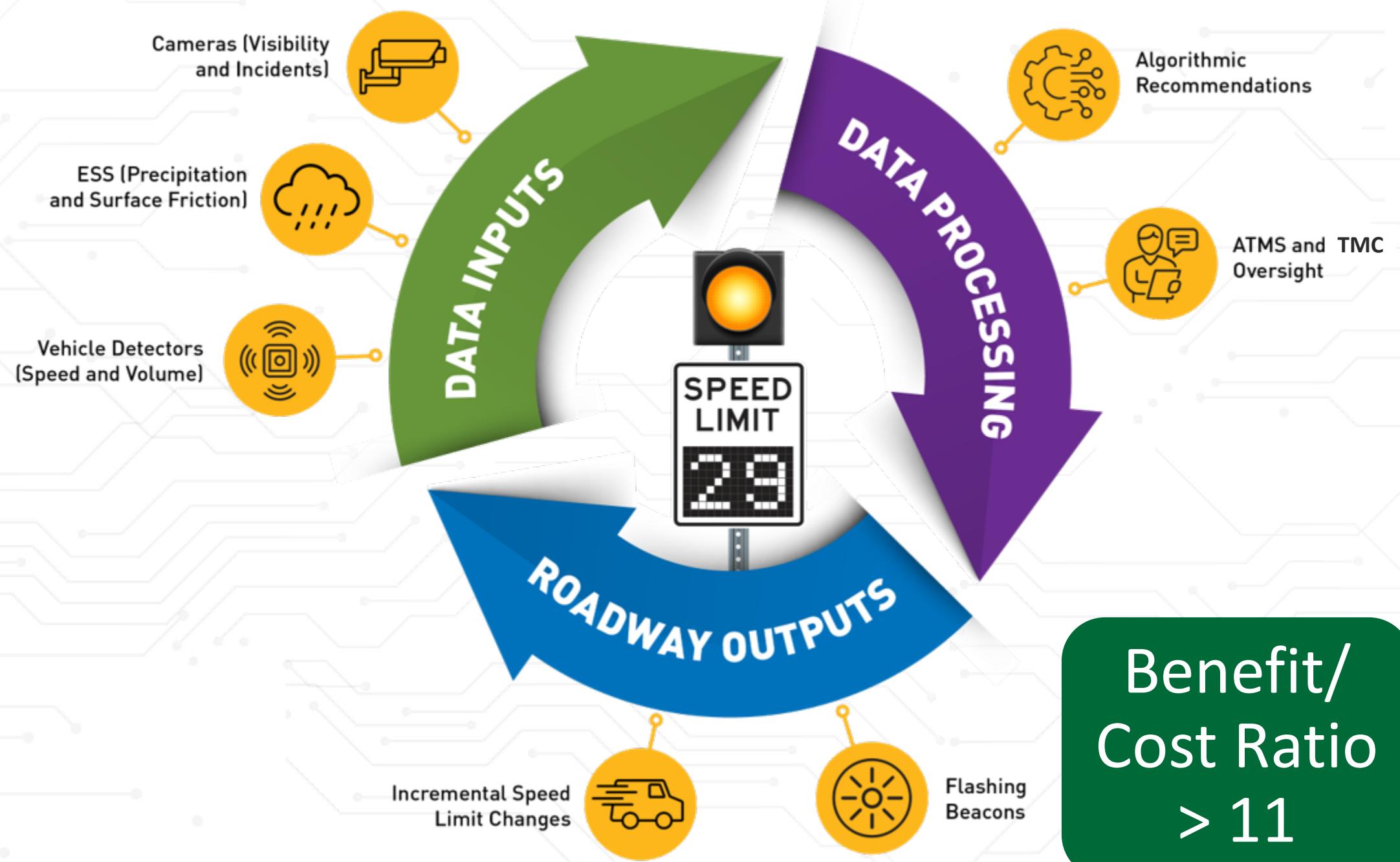
65%
for rear-end crashes.¹

51%
for fatal and injury crashes.¹

Benefit/Cost Ratios
range between¹
9:1-40:1



Variable Speed Limits



Variable Speed Limits

- Future Keys to Success
 - Integration into Advanced Traffic Management System (IRIS)
 - Selection, Validation, and Calibration of Algorithm
 - Staff Assigned to Management and Operations of System
 - Outage Operations



S



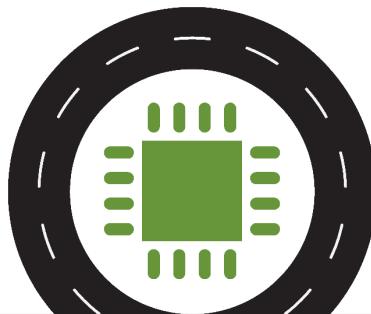
SAFETY

M



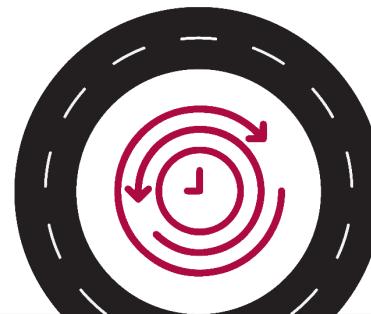
MOBILITY

A



AUTOMATED

R

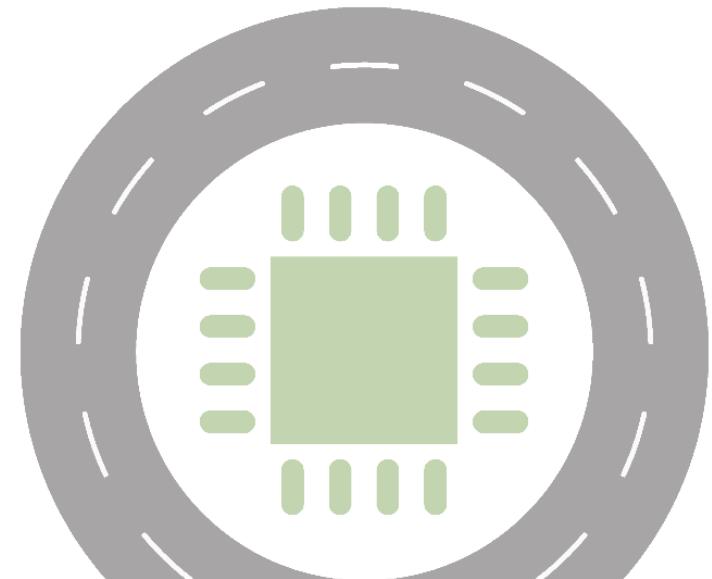


REAL-TIME

T



TRAFFIC MANAGEMENT



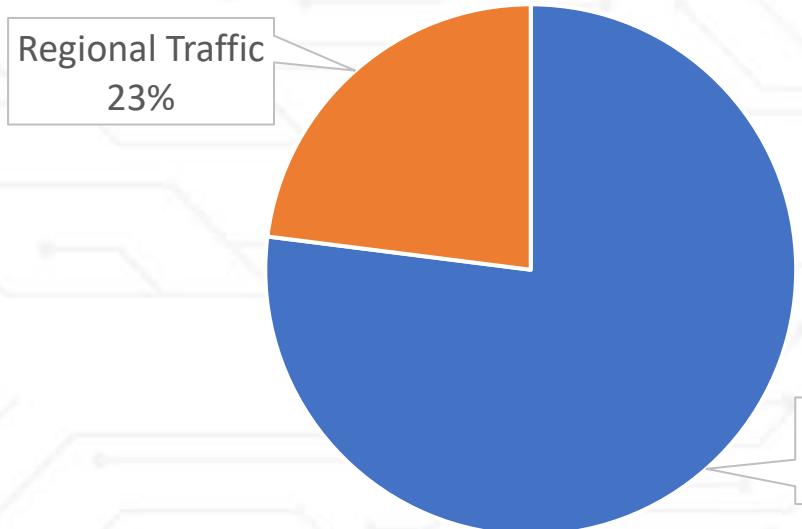
SAFETY

MOBILITY

AUTOMATED

Ramp Metering

Traffic Usage

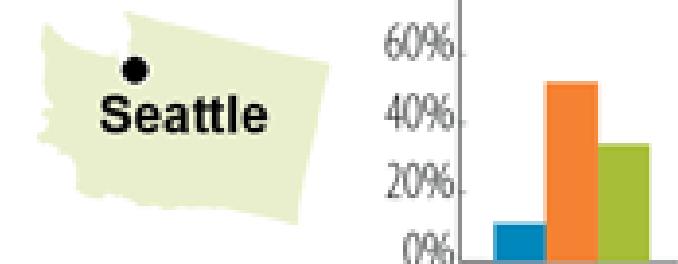
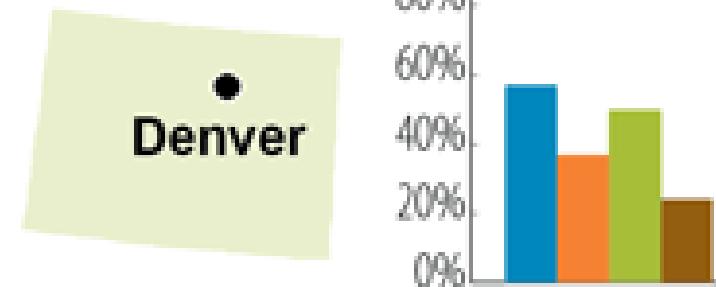
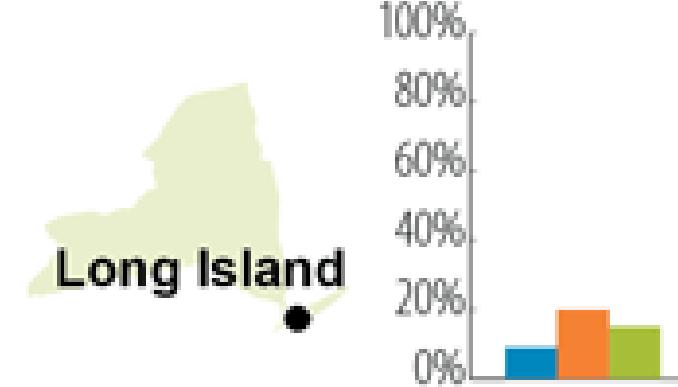
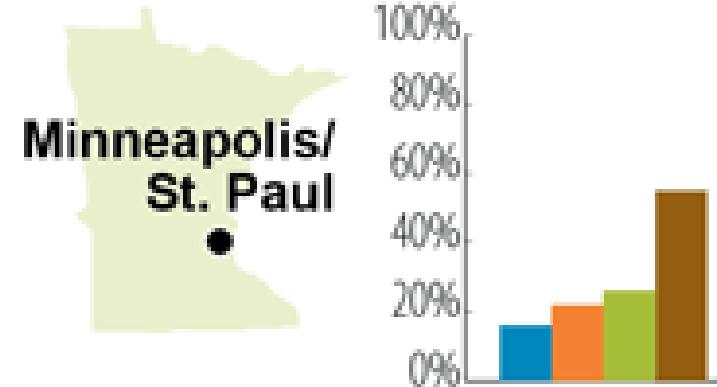
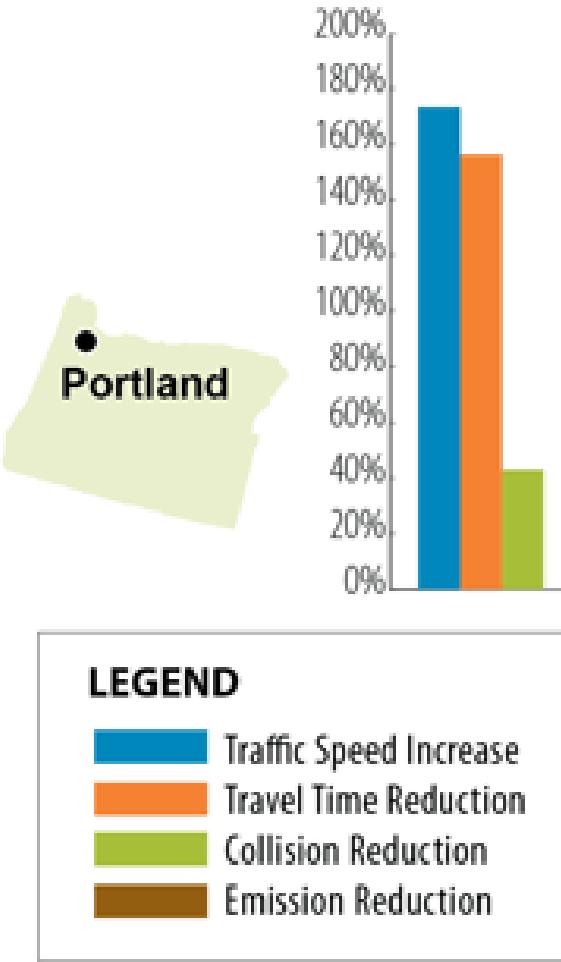


Benefit/ Cost Ratio > 190
Interstate Benefits Only

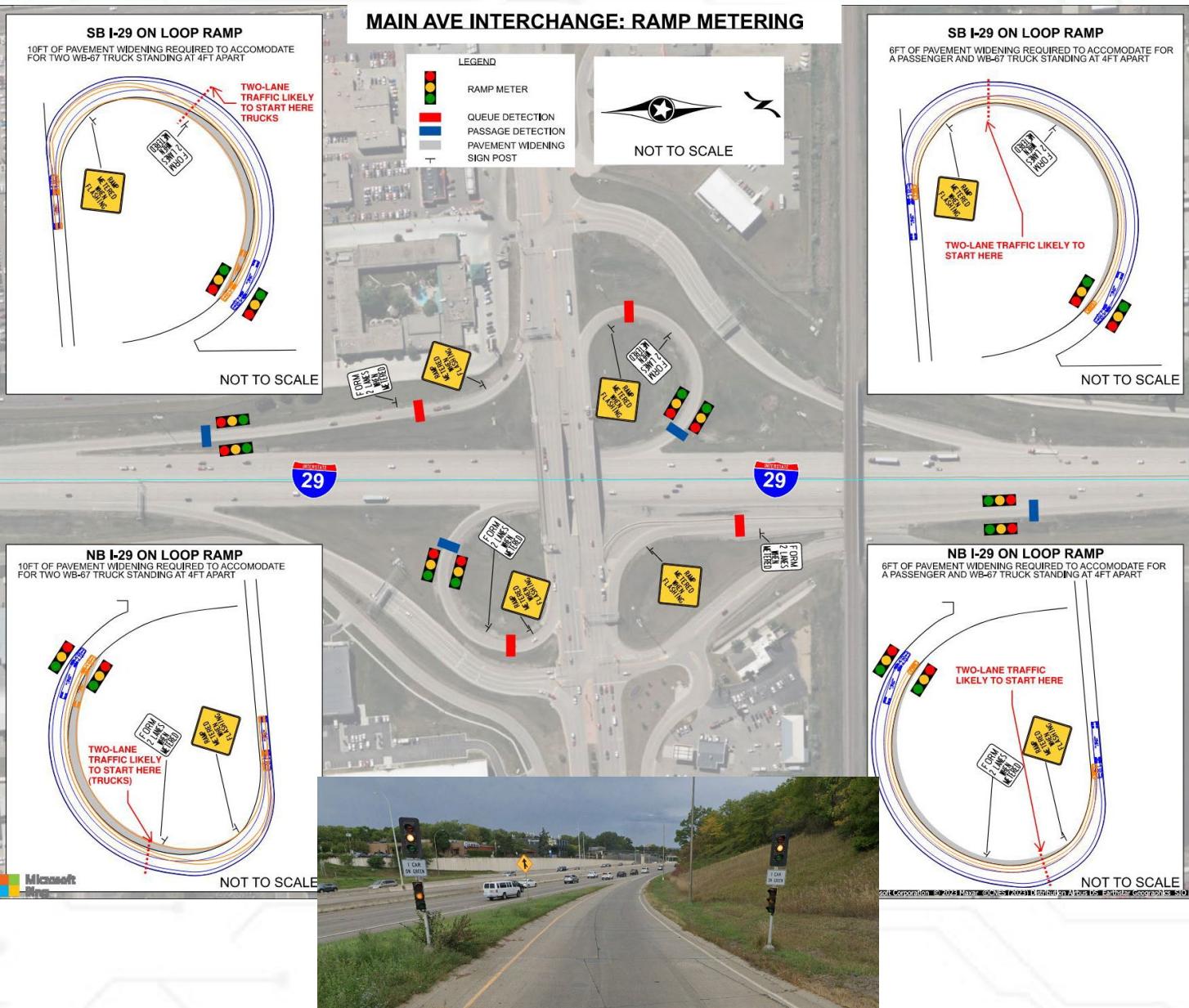


Ramp Metering

- Successful Implementation Across Major Metros Across the Nation
- Recent Advancements in Similarly Sized Communities like Des Moines (IA), Omaha (NE), and Grand Rapids (MI)



Ramp Metering



- Future Keys to Success:
 - Detailed Modeling and Operations Plan during Project Development for
 - Ramp Metering Timing Plans
 - Queue Analysis and Design
 - System Activation Algorithms
 - Emergency Response Protocols
 - Local Traffic Redistribution Analysis
 - Collaboration with MnDOT for Moorhead Interchanges
 - MnDOT has IRIS Platform for Ramp Control Systems
 - TMC Oversight and Calibration

S



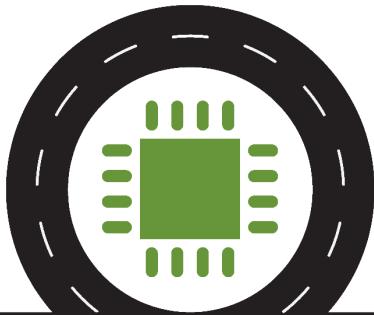
SAFETY

M



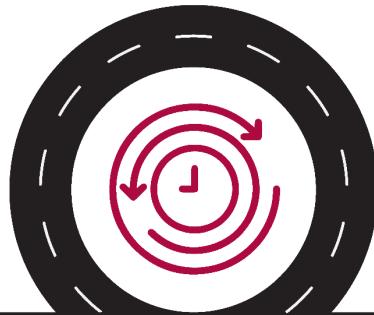
MOBILITY

A



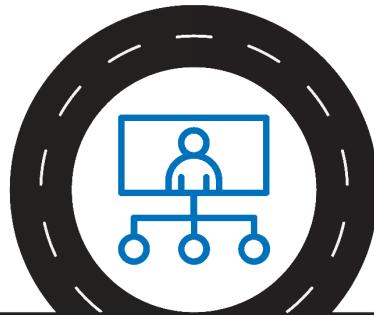
AUTOMATED

R

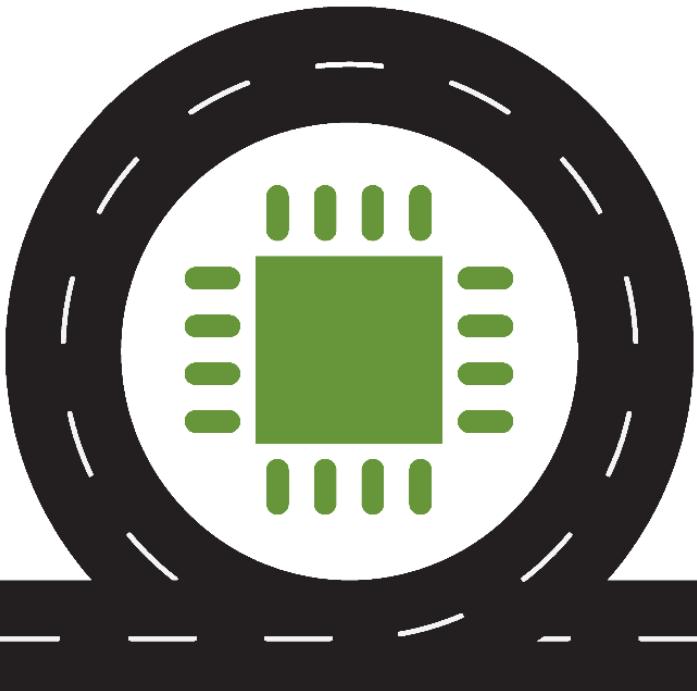


REAL-TIME

T



TRAFFIC MANAGEMENT



MOBILITY

AUTOMATED

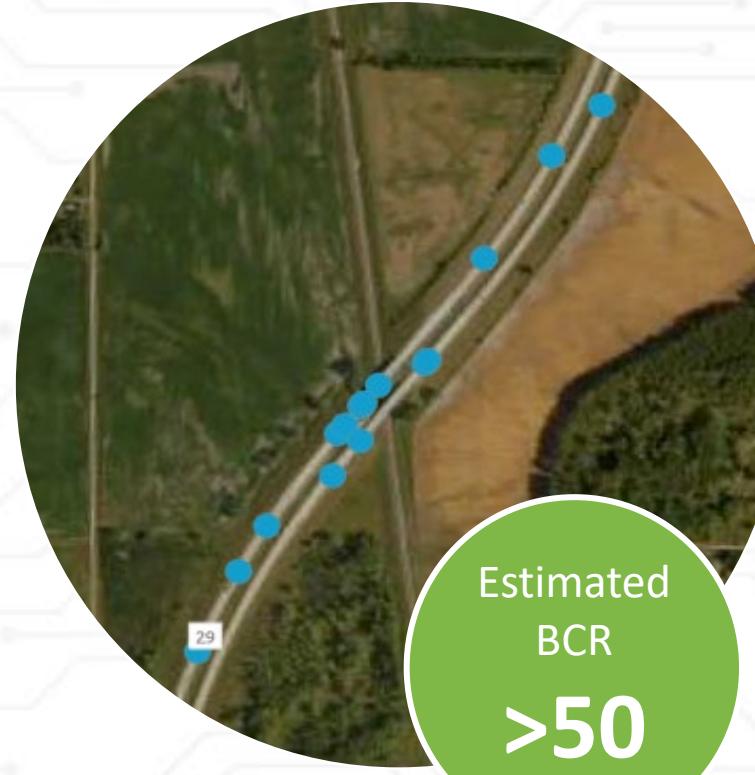
REAL-TIME

Curve Warning System



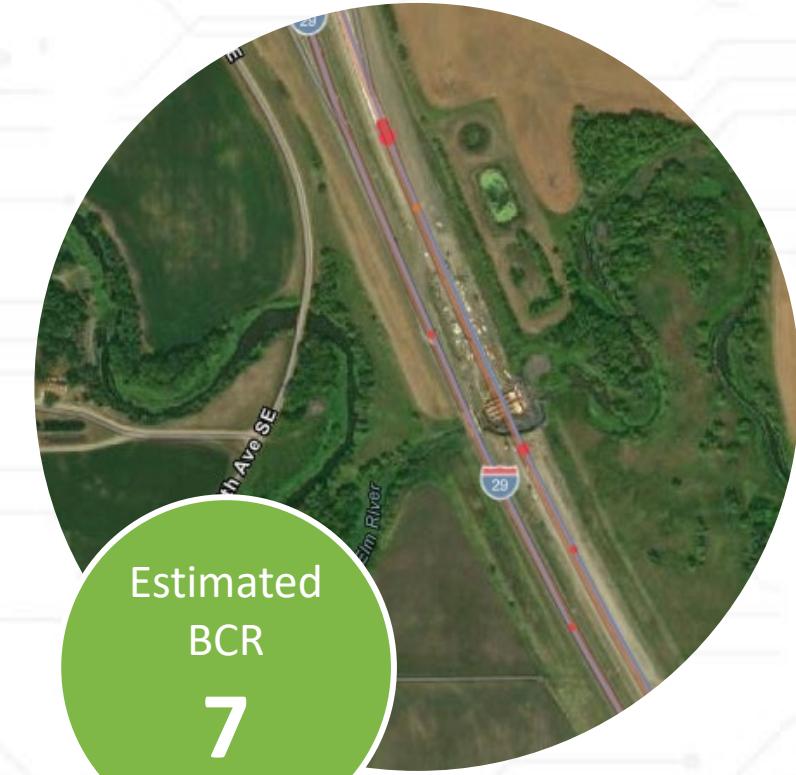
- 58% Reduction in Run-Off-The-Road Crashes
- \$40,000 construction cost per site

Over BNSF Railroad in Traill County



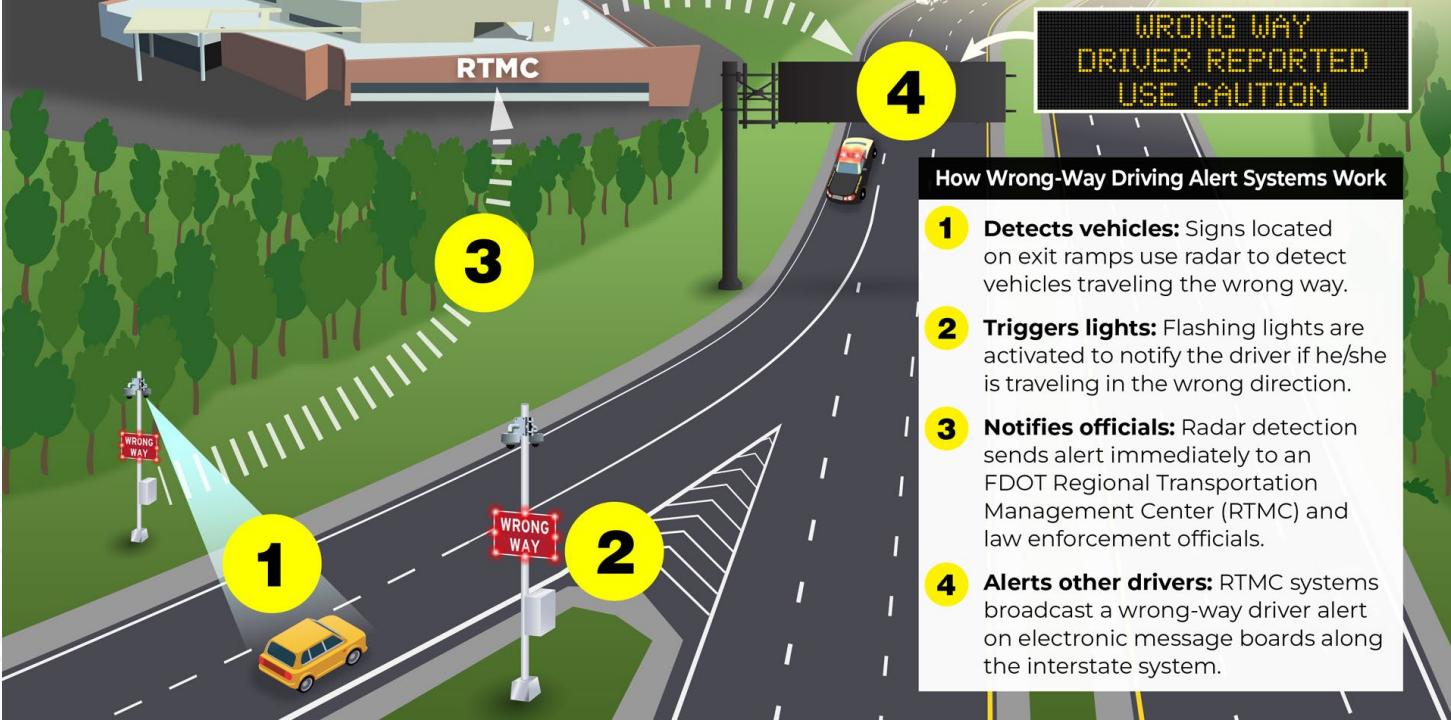
11 potential curve-related crashes,
including 2 injuries 2019-2021

South of rest area between Grand Forks and Fargo

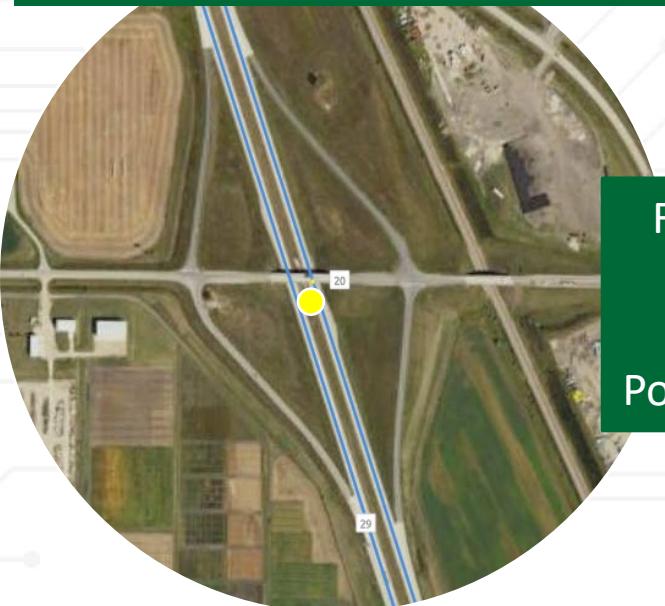


6 Run-Off-The-Road Crashes with 2 Injuries (2019-2021)

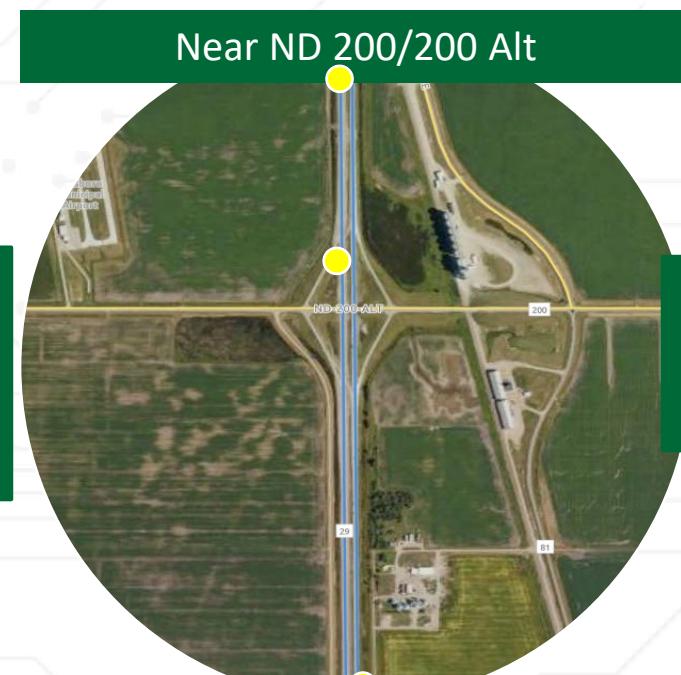
Wrong-Way Running Prevention



At CR 20 north of Fargo (planned)



Frequent Confusion
due to Railroad
Overpass
Potentially Redesigned

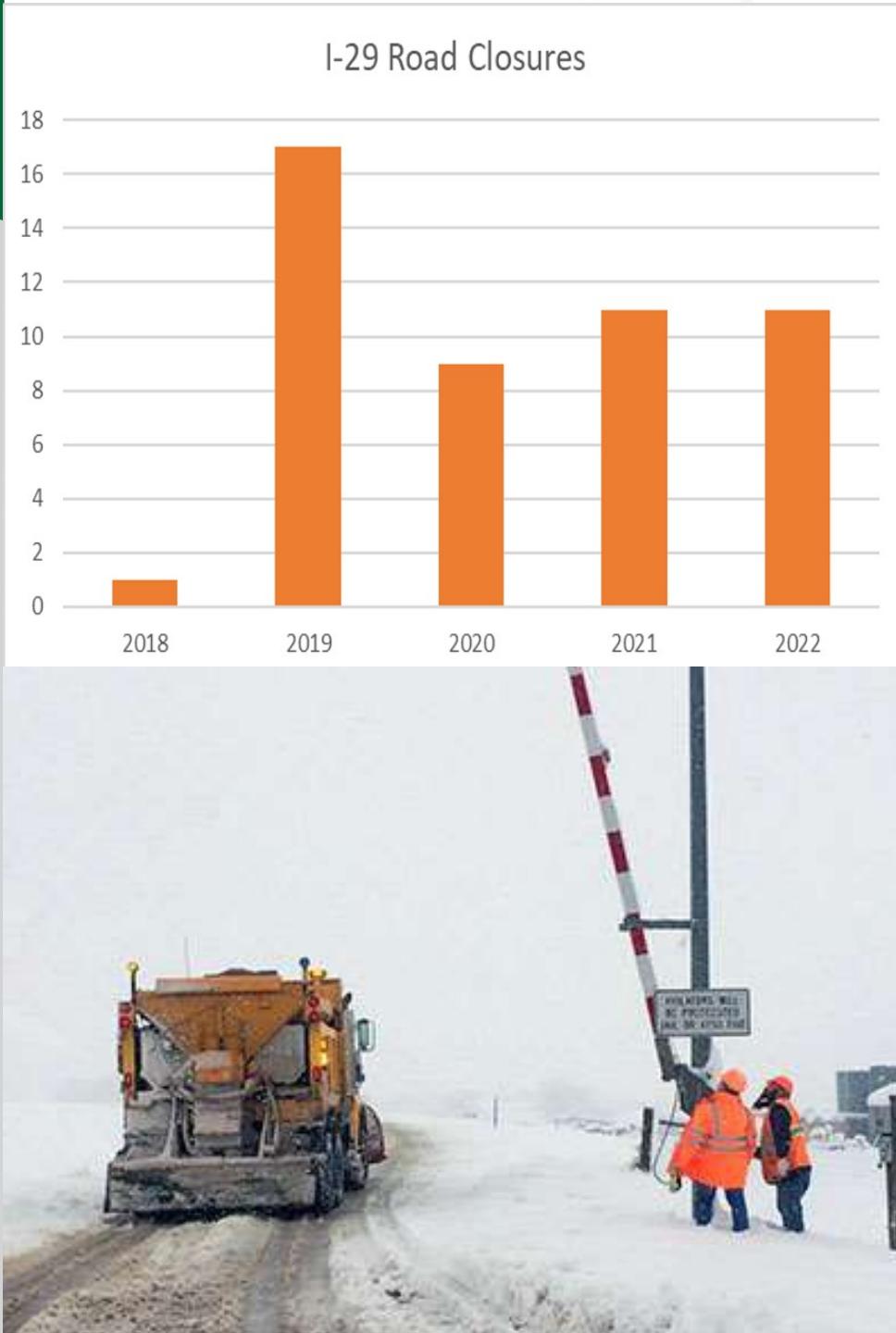


Three potential wrong-way crashes (including one injury) 2019-2021

Estimated
BCR
4

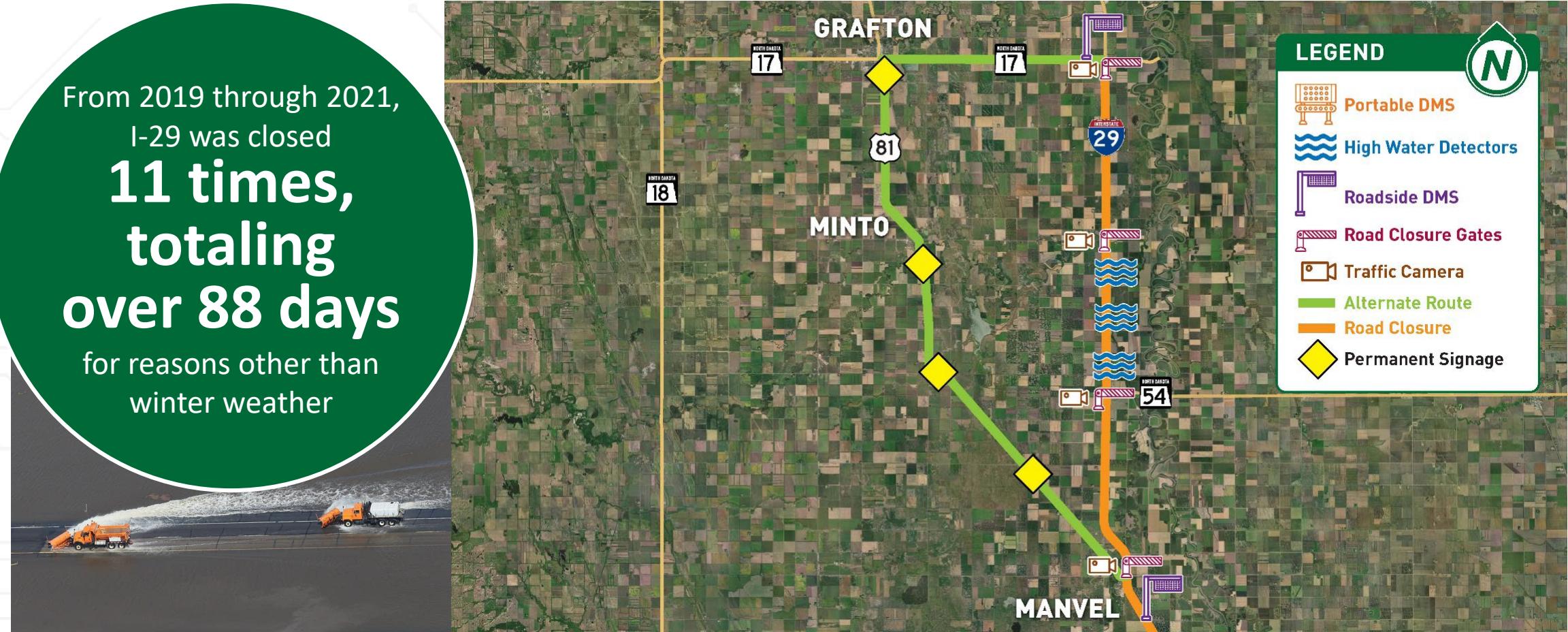
- Head-On is Most Serious Crash Type
- Typical Cost: \$100,000 per Location

Electronic Road Closure Gates



- TMC Controlled or Handheld Remote Control like Nebraska DOT
- 22 Gates on I-29 Currently
- Opportunity to Add Rural Closure Sites:
 - Thompson
 - Manvel

Alternative Routing System



Permanent signs are deployed along alternate route in anticipation of spring flooding

High water sensors activate

High water is verified by TMC via cameras

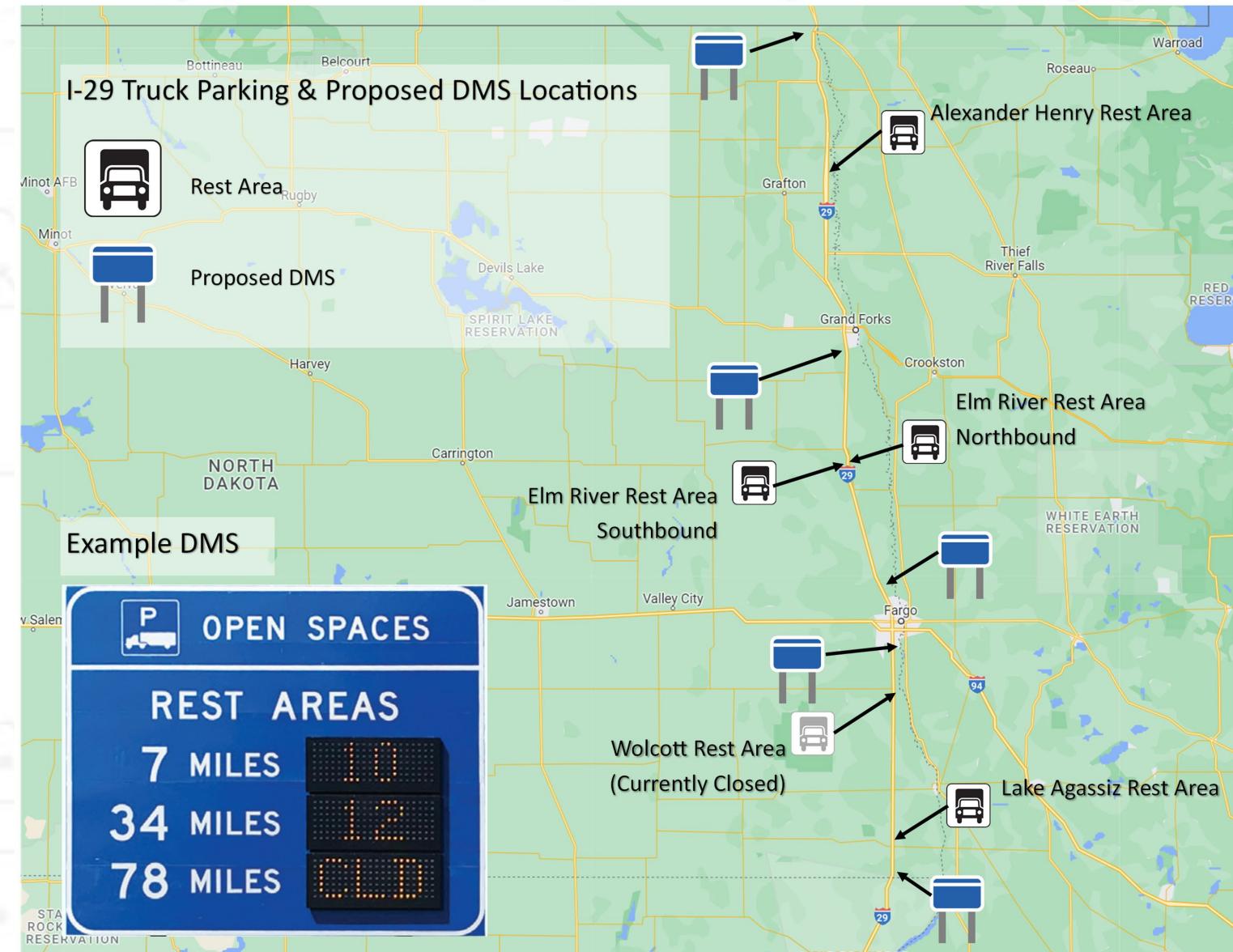
Automated messages are shown on roadside DMS on I-29

Automatic road closure gates are closed by TMC or maintenance staff

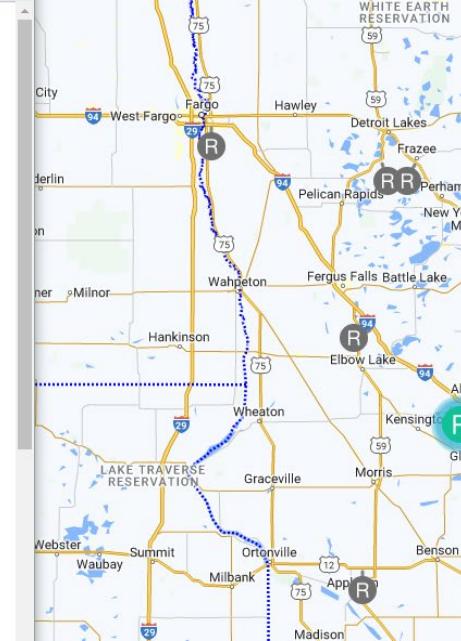
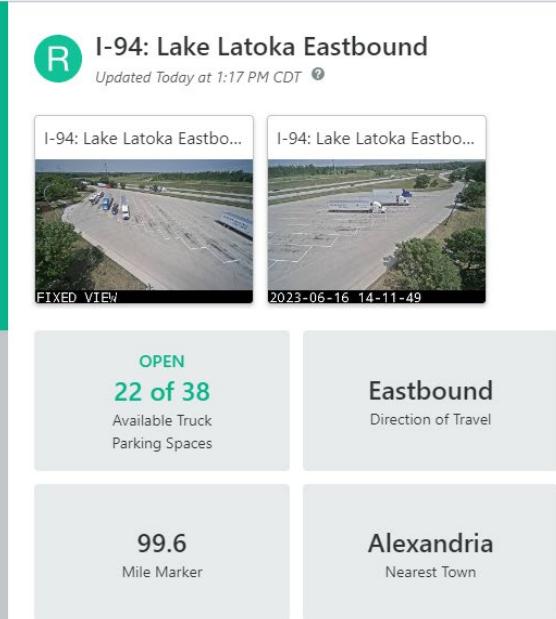
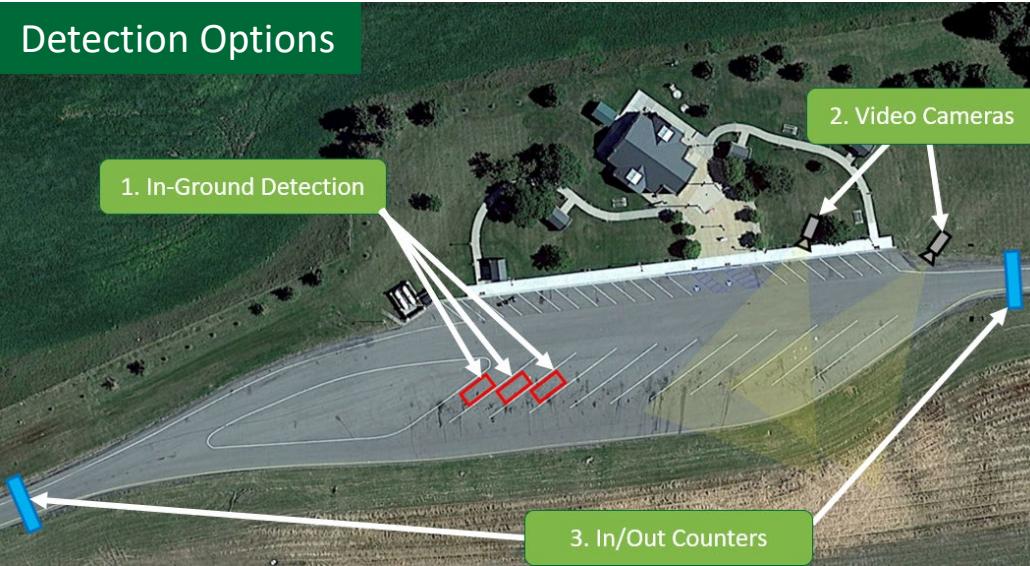
Alternate route and high water area is monitored by the TMC using cameras

Truck Parking Information Management System

(TPIMS)



Detection Options



Port of Entry Enhancements

Technology

- Weigh-In-Motion Sensors
- Transponder Readers
- License Plate Reader
- Overheight Detection
- Tire Anomaly Sensors
- Infrared Brake Sensors

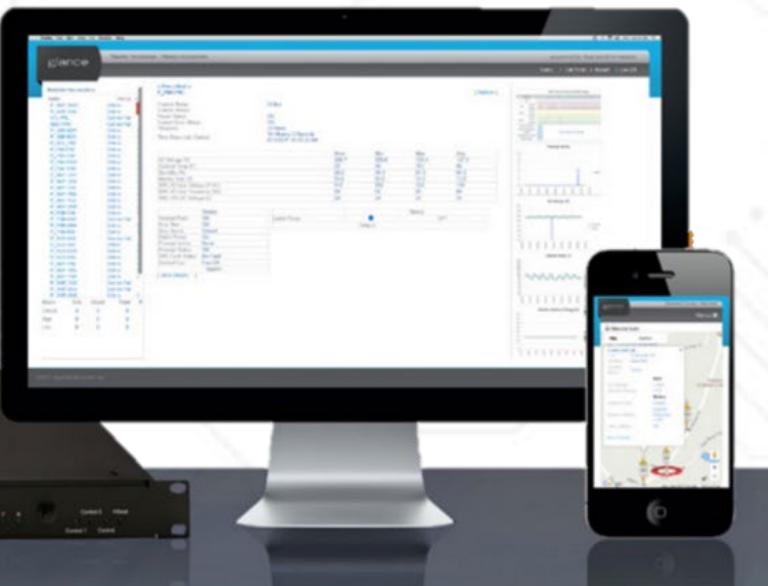


Benefit/Cost Ratio > 2

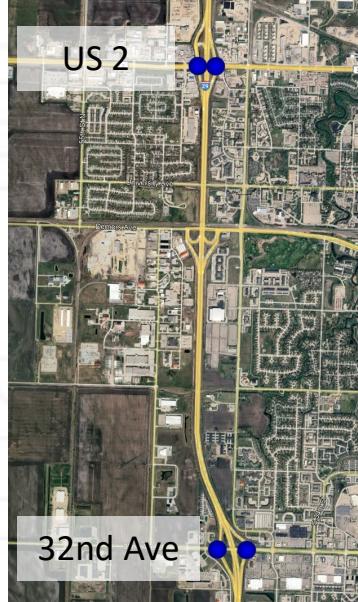
- Better for Pavement
- Faster for Freight

Signal Monitoring

- Remote Network Unit
 - Installed in signal cabinet
 - Connects to signal controller
 - Optional connection to CCTV cameras
- Monitoring
 - Real-time remote monitoring
 - Phone and email alerts
 - Generate reports on signal system
 - Update signal timing plans remotely



Grand Forks
(City Maintained)



US-Canada Border



Fargo



52nd Ave

AV-Ready Survey

- Survey Completed by VSI Labs
- There are 10 call-out items to Improve Upon
- Challenge through Workzone
- Improvements Part of Phased Implementation



Categories: Off Ramp (no dash)

Item: 4

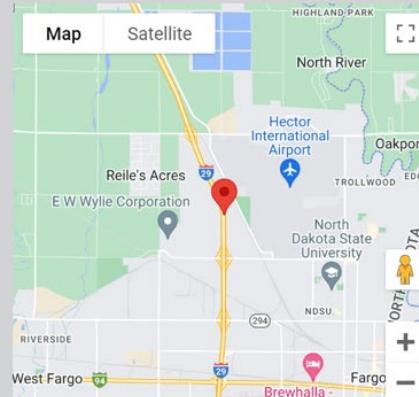
Situation: On ramp blend area not dashed followed by second blend area not dashed, vehicle would attempt to center itself in both areas

Length: 651 frames

Recommendation: Dashed marking throughout both blend area

Start Lat: 46.90746384984358 Lon: -96.83924261246402

End Lat: 46.91773292142119 Lon: -96.8401555385031



Categories: Missing Markings

Item: 2

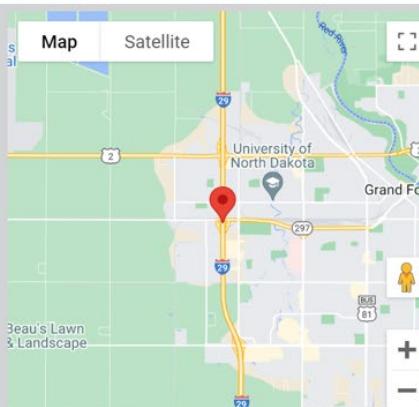
Situation: Missing markings in a short area cause brief misdetection

Length: 172 frames

Recommendation: Repair

Start Lat: 47.918512160027234 Lon: -97.0936871629418

End Lat: 47.916115820804265 Lon: -97.09367337163198



S



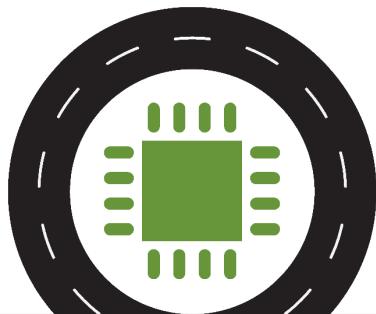
SAFETY

M



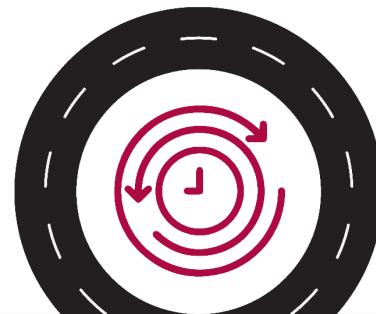
MOBILITY

A



AUTOMATED

R

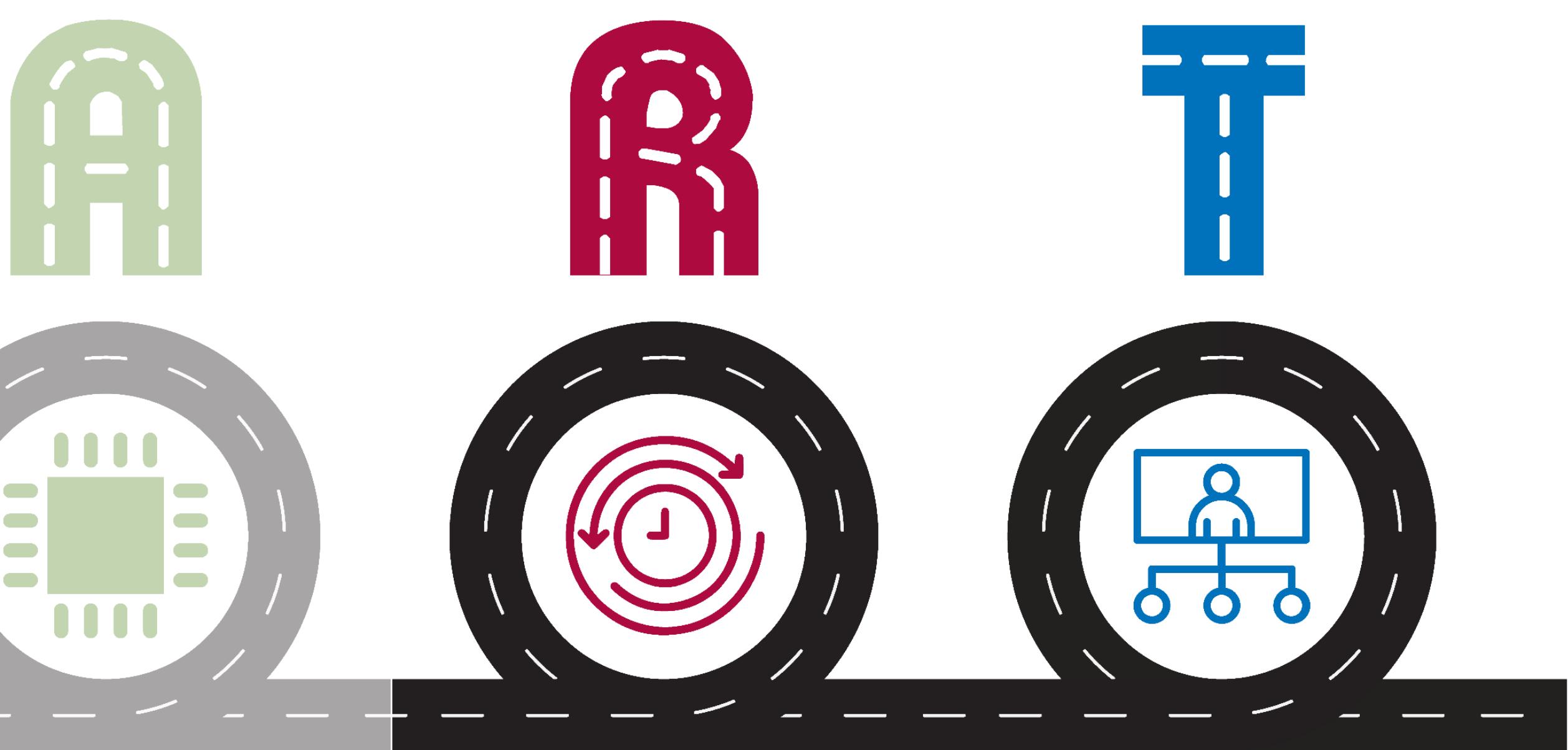


REAL-TIME

T



TRAFFIC MANAGEMENT



AUTOMATED

REAL-TIME

TRAFFIC MANAGEMENT

Active Traffic Monitoring

-50%

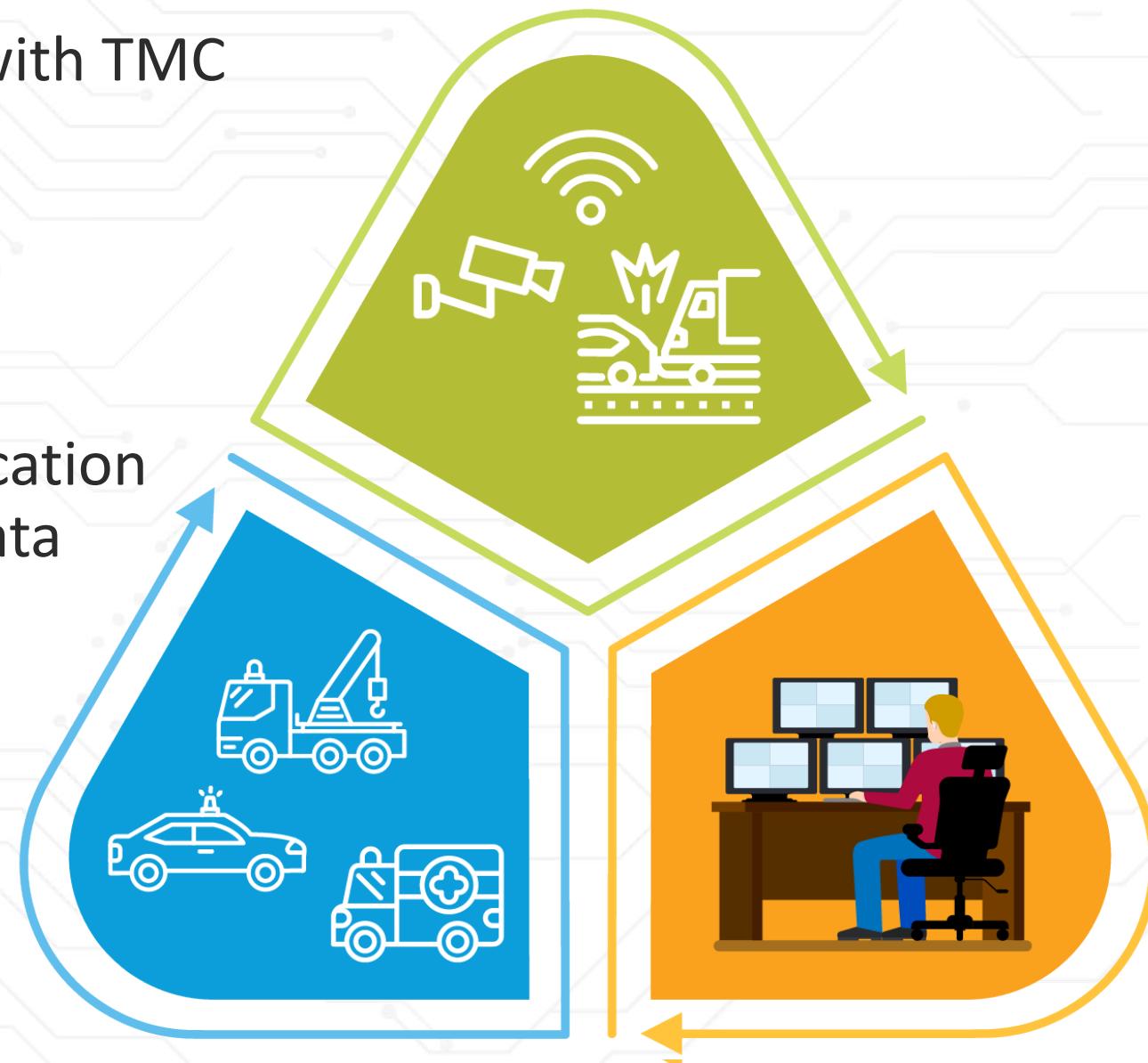
Clearance Times with TMC
(Wyoming DOT)

-30-50%

Incident Identification
Time with Big Data
(Iowa DOT)

7

Benefit/Cost Ratio



Incident Monitoring and Response

- Future Keys to Success:
 - Integration of Computer Aided Dispatch
 - Selection of Probe Data and Integration
 - Staff to Review Alerts and Develop Response Plans
 - Smart Phone Application Enhancements

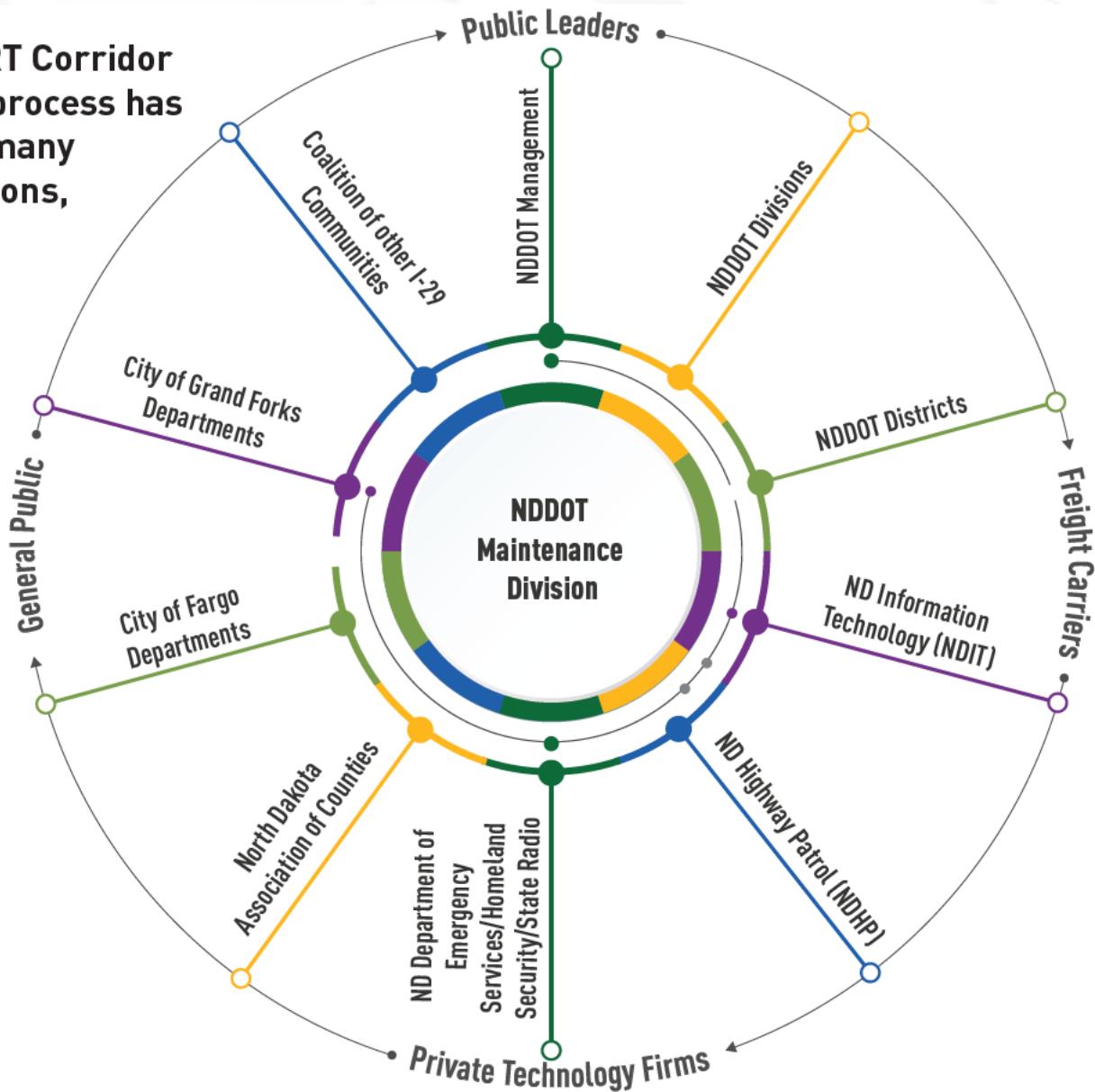




I-29 SMART Corridor Implementation

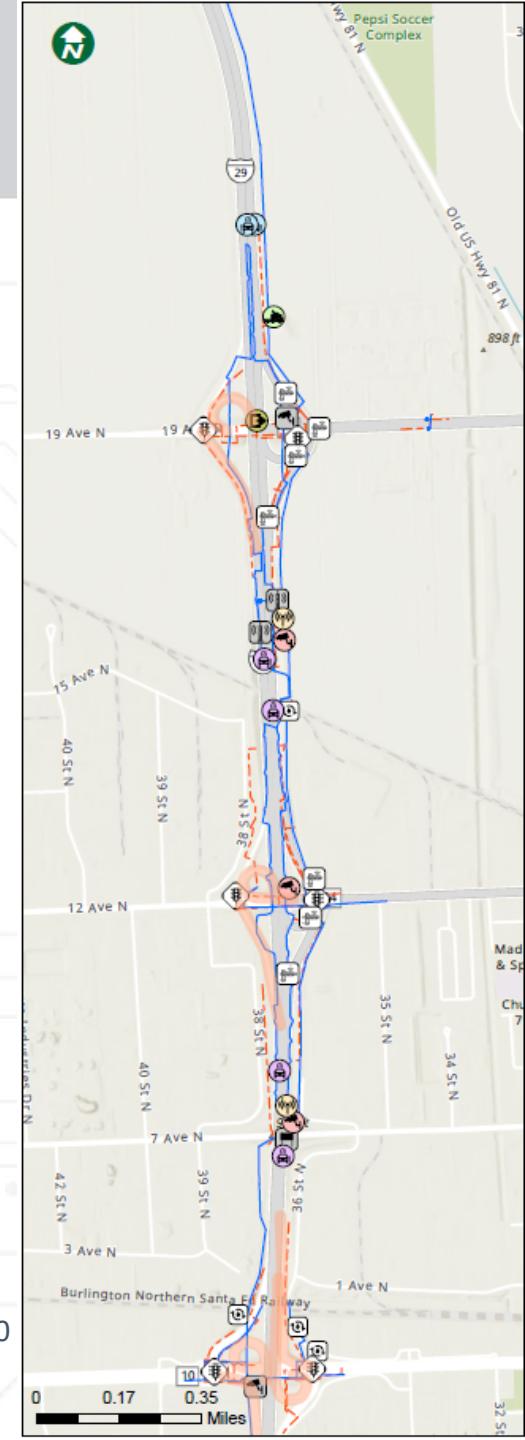
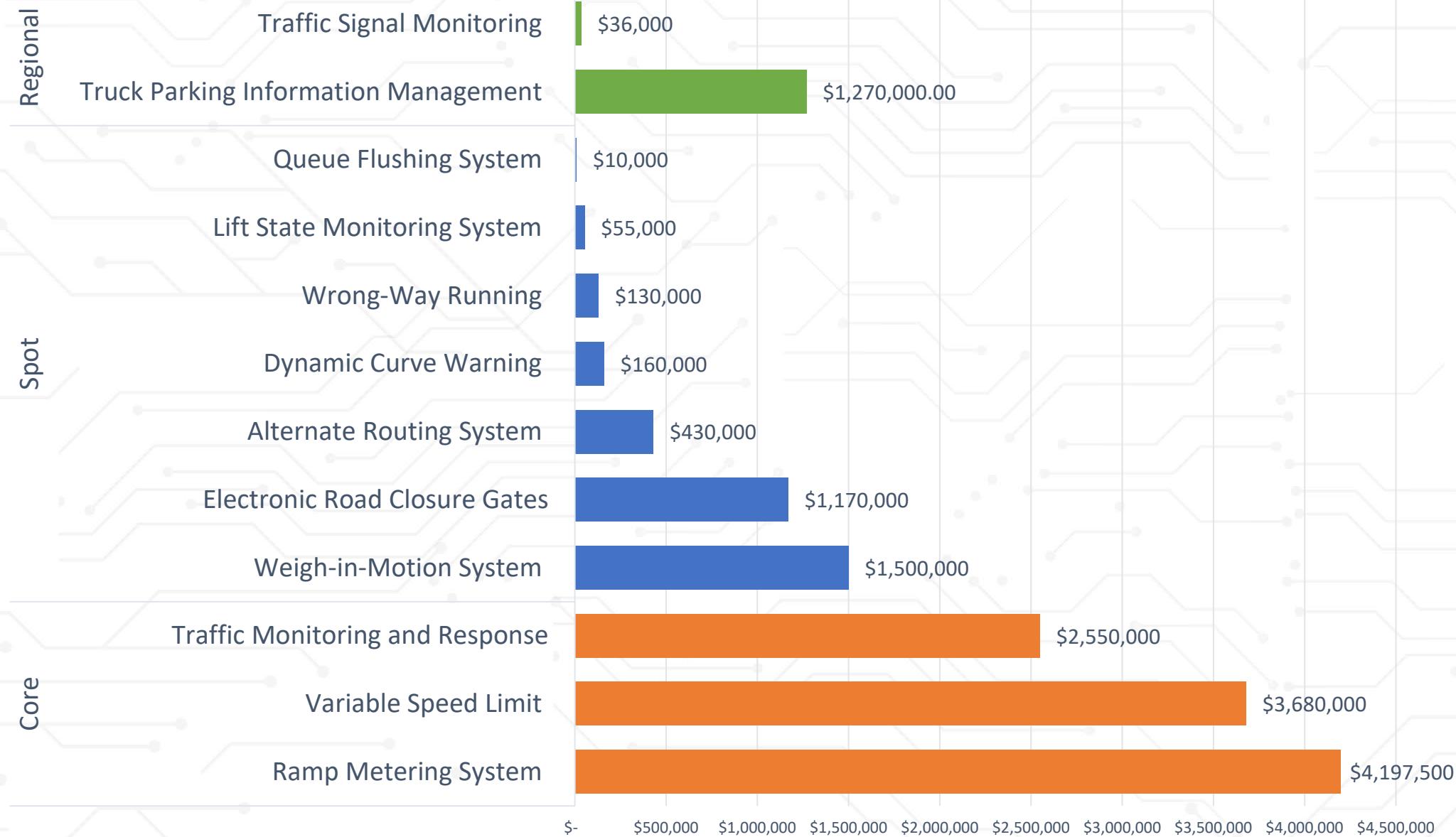
Public Engagement

The SMART Corridor planning process has included many organizations, including:

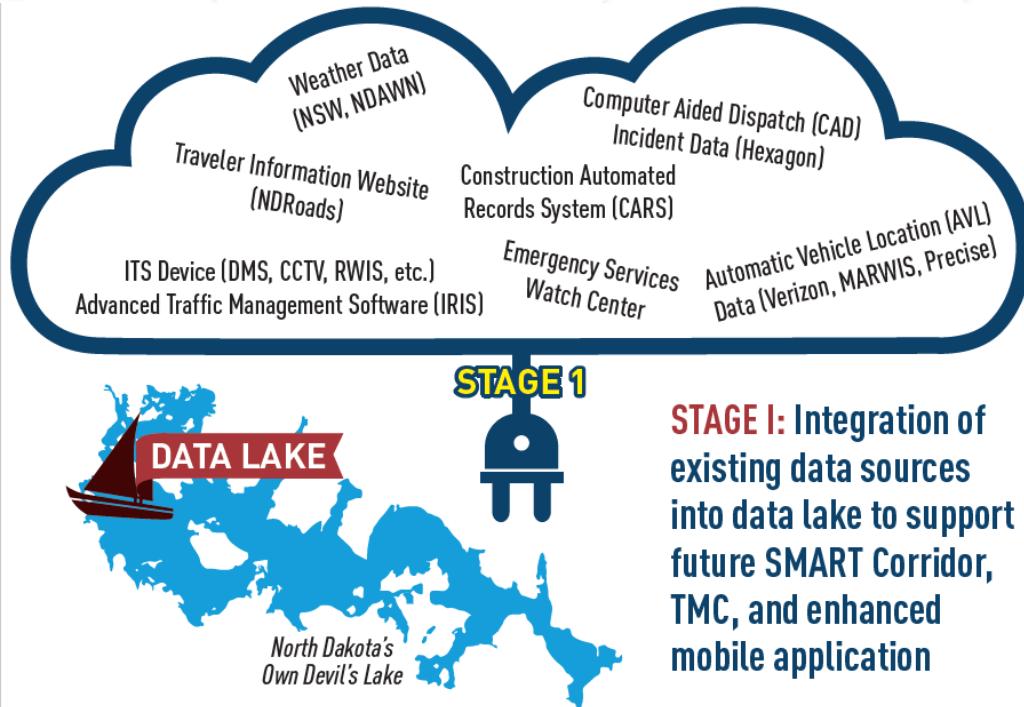


- >120 Direct Invitations to more than 60 Statewide and Local Organizations
- Sponsored Geo-Located Social Media Advertisements Reaching >10,000 People
- Traditional Media through Grand Forks Herald and Fargo Forum
- Multiple News Stories via Written, TV, and Radio Media

Concept Refinement



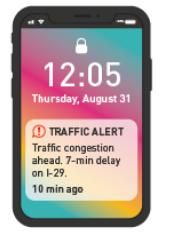
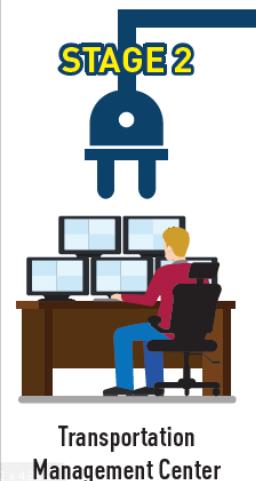
Grant Funding Opportunities



STAGE I: Integration of existing data sources into data lake to support future SMART Corridor, TMC, and enhanced mobile application

Criteria	Existing	Future
Traveler Information	ND Roads Website and Sister Phone Application (Portal)	Expanded Website and Integrated 511 Application with Push Notifications
Weather	Existing Weather Conditions	Future Weather Conditions
Special Events	Incidents Greater than Two Hours Once Confirmed	All Incidents in Real Time
Maintenance	Long-Term Construction	All Construction and Maintenance Activities
Commercial	Static Restriction and Parking Information	Dynamic Parking, Travel Time, and Routing Information
Accessibility	Primarily NDDOT Business Hours	24/7/365
NDDOT Operations	Data Rich, Information Poor	Integrated and Automated

- SMART Grant and V2X Grant
- TOMIS:
 - Transportation
 - Operations
 - Management
 - Integration
 - Strategy
- RAISE Grant Continuation
- ATTAIN Grant
- INFRA Grant



NDSU UPPER GREAT PLAINS
TRANSPORTATION INSTITUTE
Data Analytics Center

Phasing

Technologically Phased

Phase 1 - High Benefit/Cost Ratio, Minimal Implementation Challenges

Variable Speed Limits Incident Surveillance and Monitoring Curve Warning Queue Flushing Lift Station Monitoring Wrong-way Running



Phase 2 - High Benefit/Cost Ratio, Potential Implementation Challenges

Ramp Metering



Phase 3 - Qualitative Benefits without Implementation Challenges

Electronic Closure Gates Alternative Routing Virtual Weigh Stations



Phase 4 - Qualitative Benefits with Potential Implementation Challenges

TPIMS

Remote Signal Monitoring

Bridge De-icing

Geographically Phased

Phase 1: Grand Forks to north of Fargo

Phase 2: Fargo

Phase 3: North of Grand Forks and South of Fargo

