

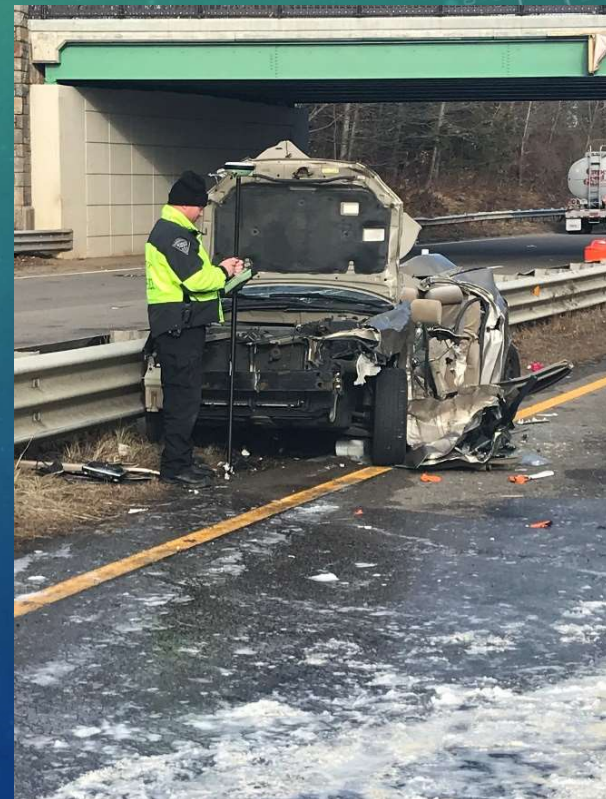
The background features a green-to-blue gradient with faint, stylized circular patterns and a scale. The scale is a semi-circular arc on the left side, with numerical markings from 140 to 260 in increments of 10. Several concentric circles and dashed lines are scattered across the background, some with arrows indicating direction.

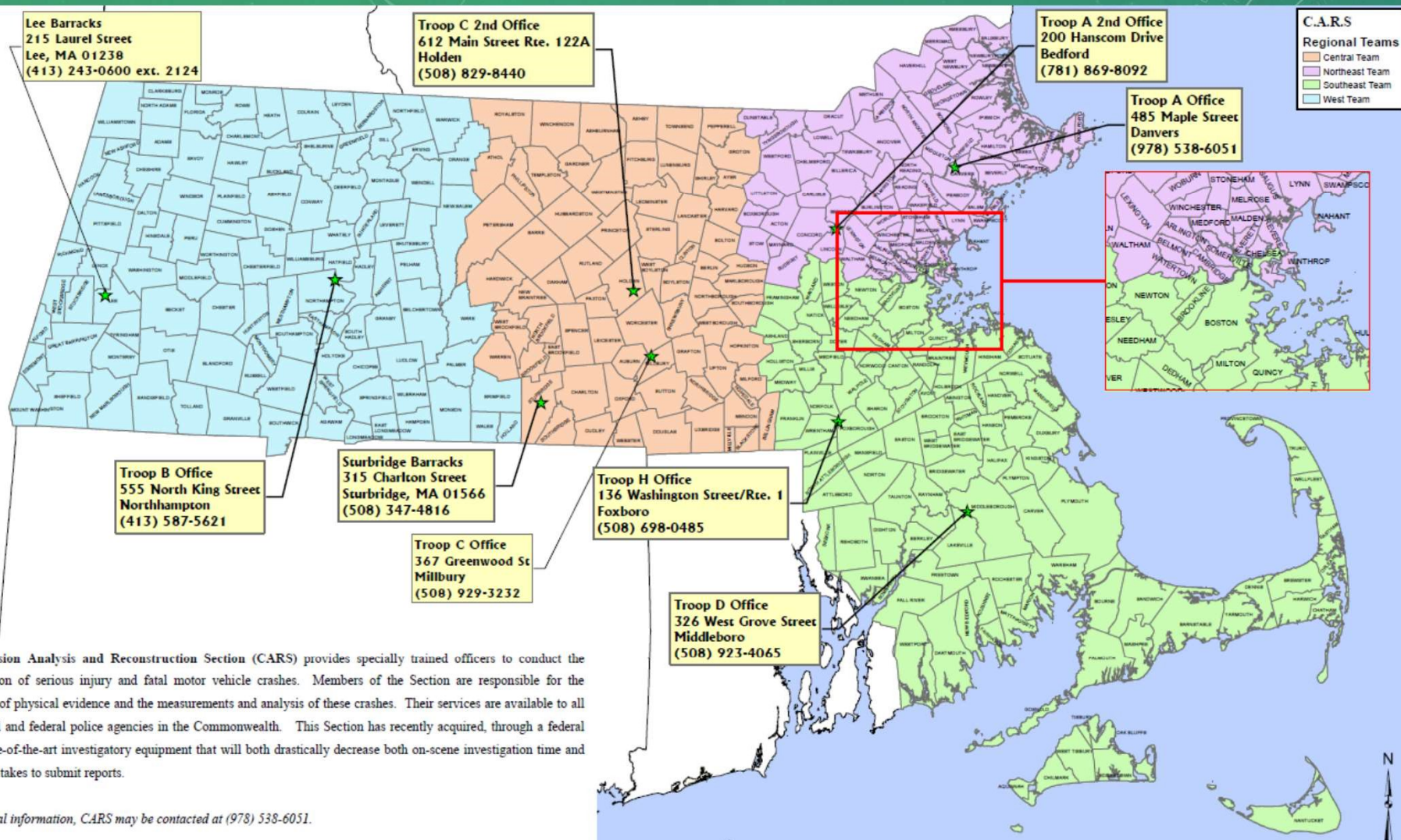
UPDATED ELECTRONIC SURVEY EQUIPMENT FOR THE STATE POLICE CRASH RECONSTRUCTION UNIT

PRESENTED BY SERGEANT RICHARD WOLANSKI,
C.A.R.S. UNIT COMMANDER

COLLISION ANALYSIS & RECONSTRUCTION SECTION

- Statewide Unit
- 21 Troopers, 3 Sergeants
- Divided into Four Teams:
 - Northeast (Essex, Middlesex)
 - Southeast (Norfolk, Suffolk, Bristol, Plymouth, Cape & Islands)
 - Central (Worcester)
 - West (Hampden, Franklin/Hampshire, Berkshire)





The Collision Analysis and Reconstruction Section (CARS) provides specially trained officers to conduct the investigation of serious injury and fatal motor vehicle crashes. Members of the Section are responsible for the collection of physical evidence and the measurements and analysis of these crashes. Their services are available to all state, local and federal police agencies in the Commonwealth. This Section has recently acquired, through a federal grant, state-of-the-art investigatory equipment that will both drastically decrease both on-scene investigation time and the time it takes to submit reports.

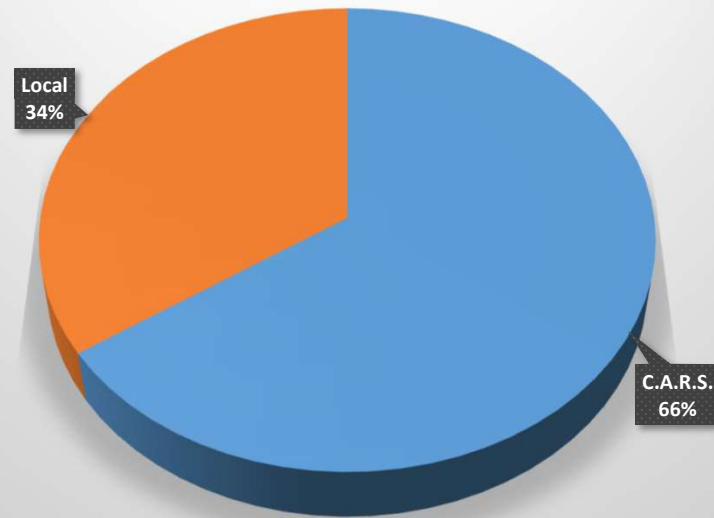
For general information, CARS may be contacted at (978) 538-6051.

C.A.R.S – RESPONSE PROTOCOL

MSP General Order TRF-12

1. When any crash involves a fatality;
2. When any “serious injury” crash involves a strong possibility of criminal charges being filed;
3. When any Department vehicle collision involves serious injury or death;
4. When any serious injury occurs at a work zone where a member is working a paid detail;
5. When any Department pursuit results in serious injury or death;
6. Upon request by another police department/agency (#1 and/or #2 should be present)
7. Upon request of any Local, State or Federal agency, for the purpose of forensic mapping of crime scenes. (after consultation and approval of the CARS Section Commander through the Team Leader)
8. As directed by the Troop/Section Commander.

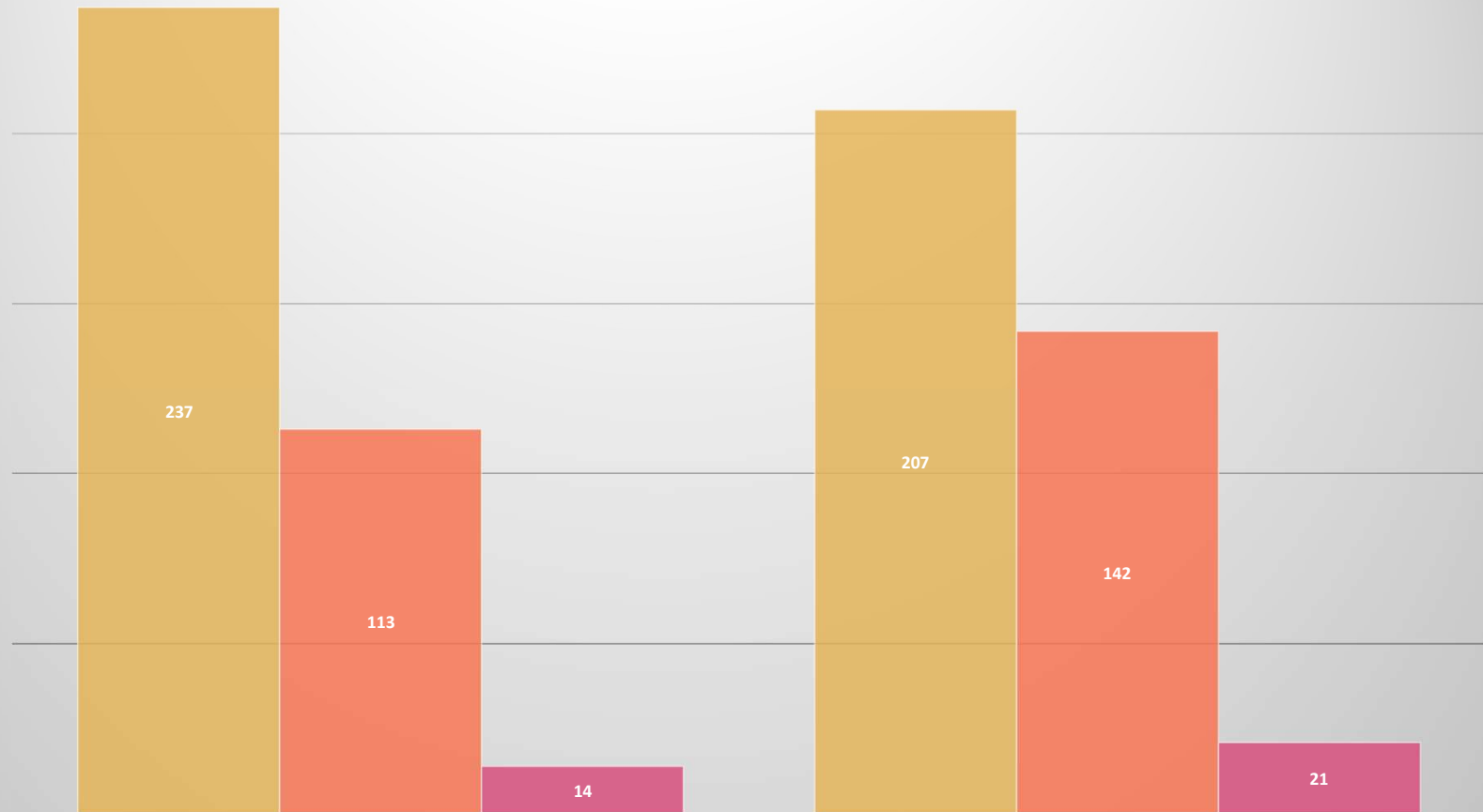
Fatal Crashes: 2019-2020



AGENCY	2019	2020
C.A.R.S.	237	207
Local	100	133
Totals:	337	340

Data from MassDOT IMPACT web portal

C.A.R.S. Investigations



■ Fatal
■ Serious Injury
■ Forensic Mapping

2019

237

113

14

2020

207

142

21

PROJECT GOALS

- Increase data collection for fatal & serious injury crashes by 50%
- Increase data accuracy by 150%
- Increase C.A.R.S. available mapping equipment by 50%
- Provide accurate, to-scale diagrams to relevant stakeholders
 - Prosecuting District Attorneys in criminal cases
 - MassDOT
 - RMV
- Reduce traffic congestion related to road closures due to crash investigations

PROPOSAL

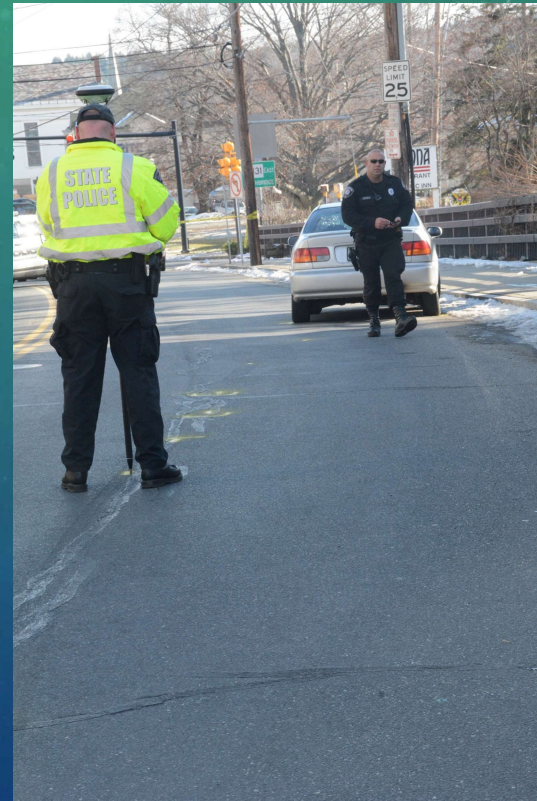
- Purchase four (4) Leica GS18 GNSS Receivers, including CS20 Data Collectors
 - \$24,185.00 per unit, for a total of \$96,740.00
- Purchase two (2) Leica TS13 Total Stations, including CS20 Data Collectors
 - \$24,778.00 per unit, for a total of \$49,556.00
- Total cost of project: \$146,296.00
- Training/familiarization for current members of the State Police Collision Analysis & Reconstruction Section

GNSS RTK ROVER & TOTAL STATION



GNSS RTK Rover

- Collects data quickly (2-3 seconds per point)
- Minimal equipment
- One-person unit
- Utilizes the Massachusetts Continuously Operating Reference Station (MaCORS) Network
- Accurate and reliable
- Records location data in 3-dimensions: longitude, latitude, and elevation



What is MaCORS?

From mass.gov:

MaCORS is a system of continuously operating Global Navigation Satellite System (GNSS) reference stations located throughout Massachusetts. It is designed to assist surveying, engineering, and GIS mapping professionals in a variety of static and real-time differential GNSS positioning applications. It is comprised of 20 GNSS base stations approximately 50 km apart, throughout Massachusetts.

Access to MaCORS allows Troopers to obtain location data accurate up to 3 centimeters. More traditional methods of obtaining latitude & longitude coordinates (e.g. through laptop computers, phone GPS, or vehicle navigation systems) are inaccurate and error-prone.

CURRENT C.A.R.S. EQUIPMENT

GNSS RTK ROVER

- Northeast Team
 - 6 Troopers
 - 2 GNSS RTK Rovers (GS14)
- Central Team
 - 4 Troopers
 - 2 GNSS RTK Rovers (GS14)
- Southeast Team
 - 7 Troopers
 - 4 GNSS RTK Rovers (GS14)
- West Team
 - 4 Troopers
 - 1 GNSS RTK Rover (GS14)

UPDATED EQUIPMENT



New to the GS18:

- Greater satellite access
 - Allows for expanded coverage in areas where cell signals are difficult to obtain
 - Allows for expanded coverage in areas where obstructions (tall structures, tree coverage) block signals
- “Tilt” feature
 - Antenna no longer needs to be level and plumb above the data point
 - This allows access to evidence previously unobtainable; for example, evidence located under a vehicle or alongside a tall structure or box trailer
- “Scan” feature
 - Captures images through integrated cameras
 - Creates “pointcloud” for 3-dimensional images





UPDATED CAPABILITIES



TOTAL STATION



- Does not require satellite acquisition
- Two-person operation
- Measures using distance and angles from a fixed point
- Records in 3-dimensions, including elevation

CURRENT C.A.R.S. EQUIPMENT

- NORTHEAST TEAM
 - 6 Troopers
 - 2 GNSS RTK Rovers (GS14)
 - 2 Total Stations
- Central Team
 - 4 Troopers
 - 2 GNSS RTK Rovers (GS14)
 - 1 Total Station
- Southeast Team
 - 7 Troopers
 - 3 GNSS RTK Rovers (GS14)
 - 1 Total Station
- West Team
 - 4 Troopers
 - 1 GNSS RTK Rover (GS14)
 - 0 Total Station

Currently 57% of C.A.R.S. Troopers equipped with mapping equipment

UPDATED EQUIPMENT



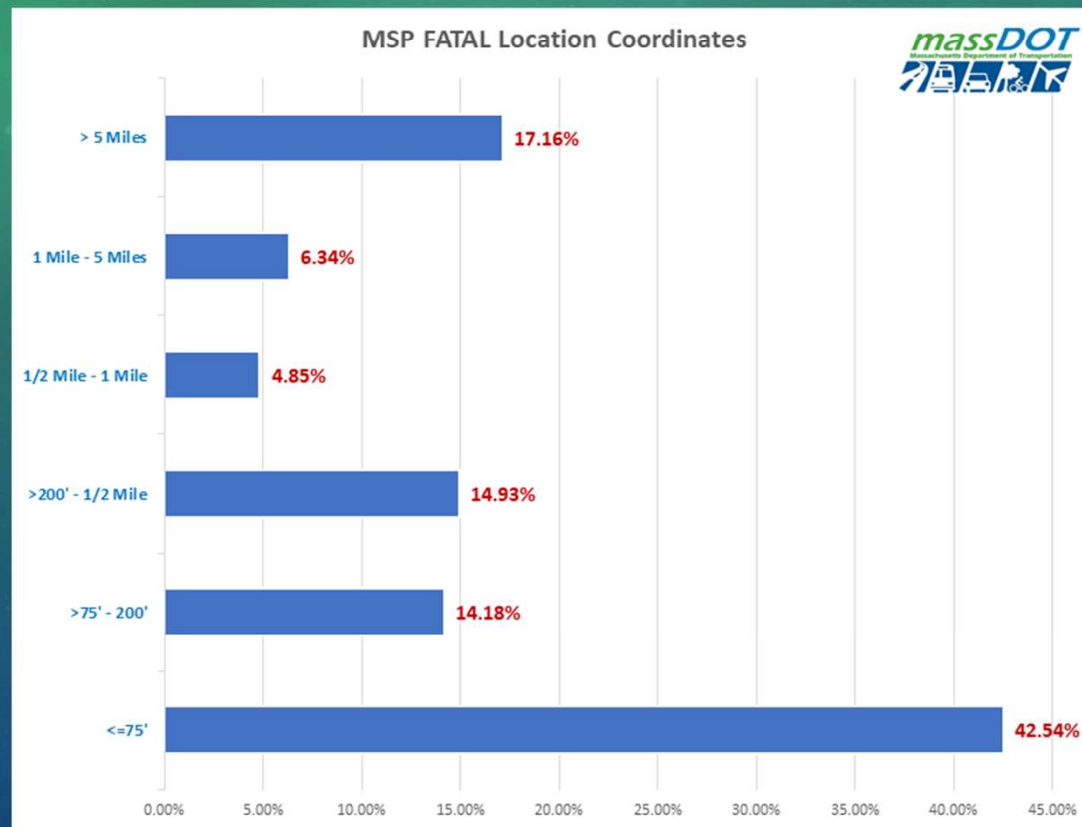
New to the TS13:

- “Robotic” capabilities
 - Equipped with Automatic Target Recognition, which tracks the prism pole and records data points
 - Allows for one-person operation
- “Prism-less” target acquisition
- Updated coding and line work features significantly reduces time in the field

ISSUES TO BE ADDRESSED

- Accuracy of location data
- Expanded data capture
- Data element reporting
- Accuracy in citation & adjudication data
- Reduction in scene investigation time

ISSUES TO BE ADDRESSED – ACCURACY OF LOCATION DATA

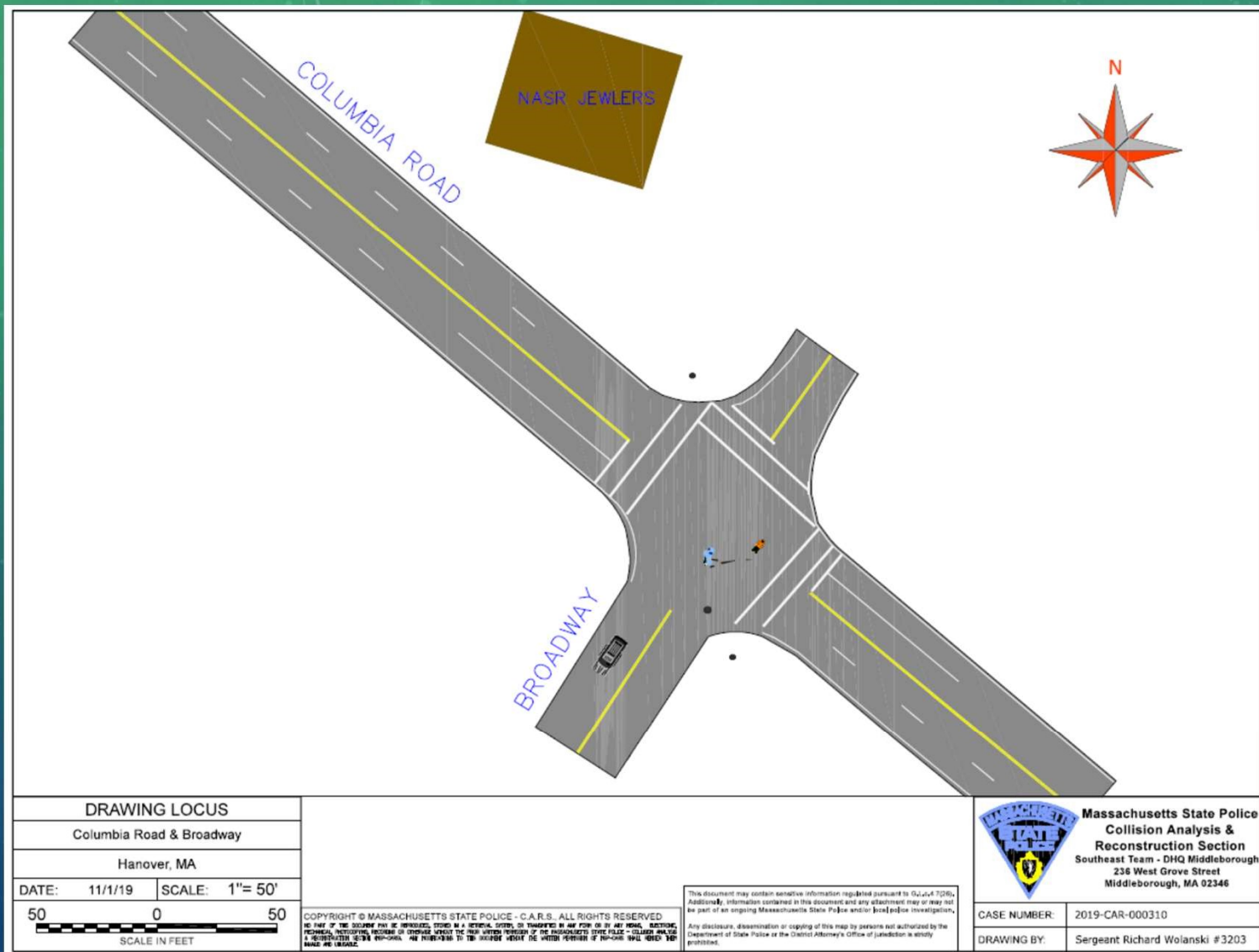


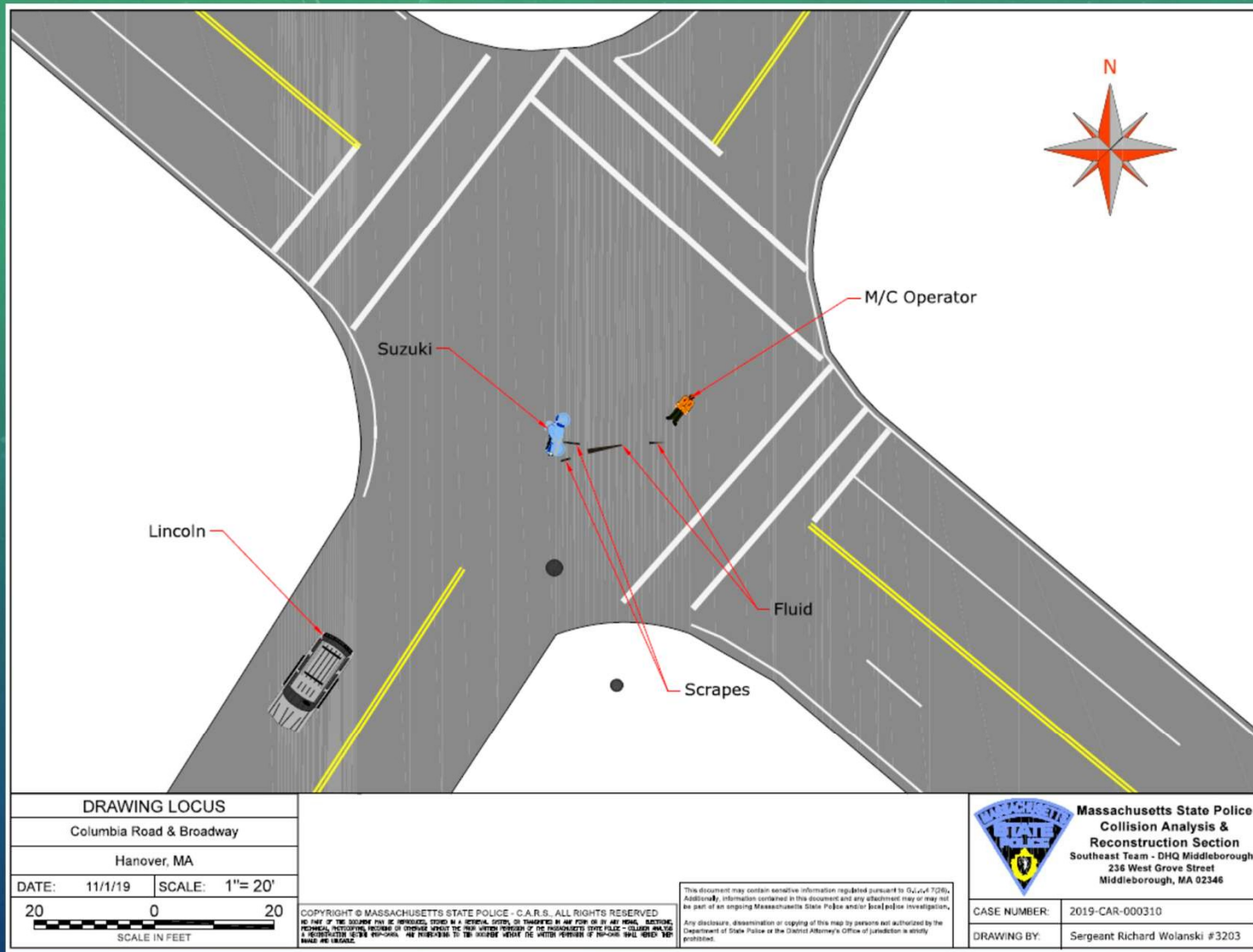
Source: D. Valovcin, Law Enforcement Technical Liason, MassDOT

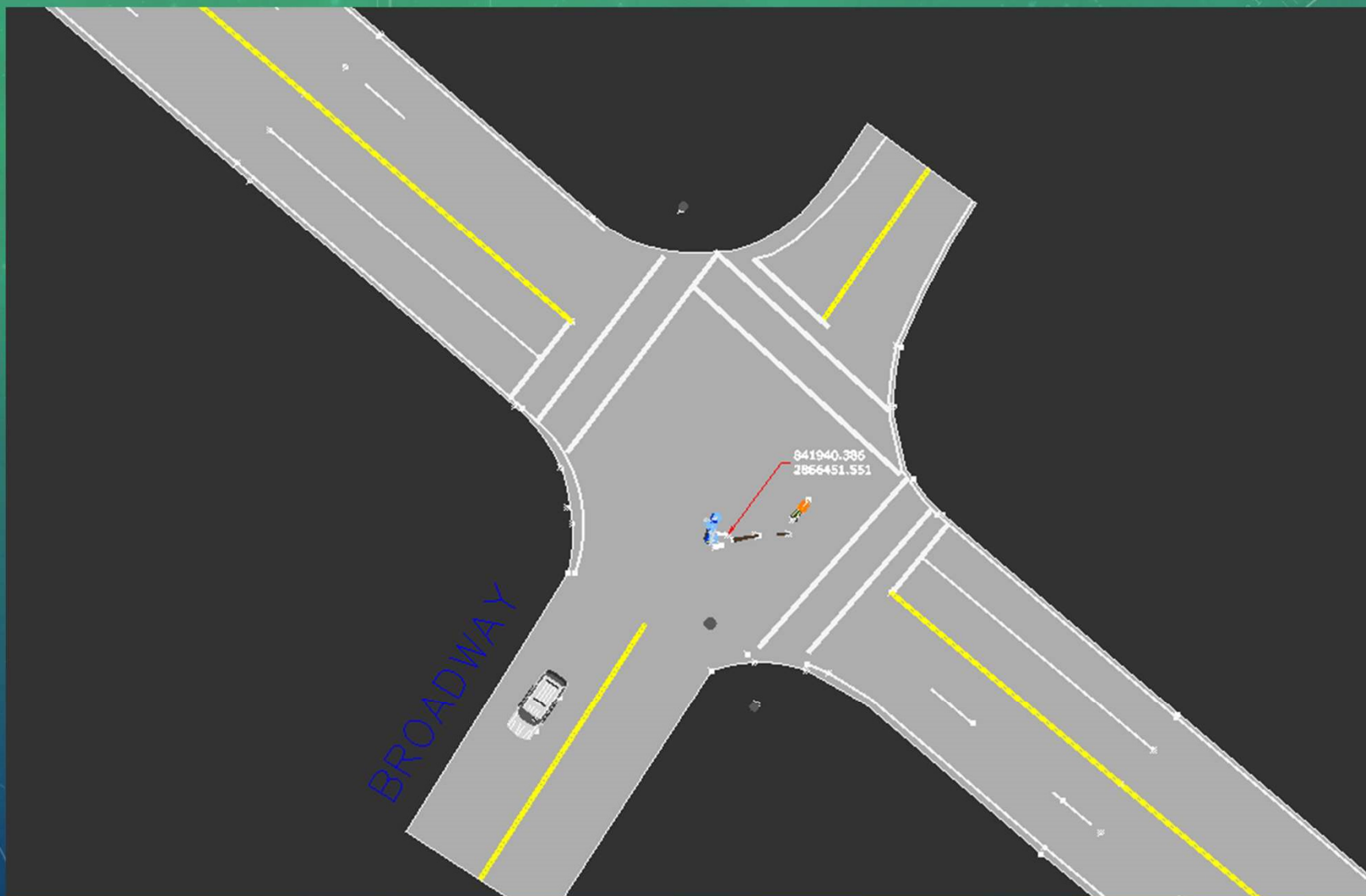
ISSUES TO BE ADDRESSED – ACCURACY OF LOCATION DATA

- Data sourced from 268 crashes investigated by C.A.R.S. in 2019-2020
- 57% of coordinates entered had an error in excess of 75 feet
- 43% of coordinates had an error in excess of 200 feet
- Inaccurate coordinates originated in a number of ways:
 - Phone GPS
 - On-Board Vehicle navigation Systems
 - On-line Maps (Google, Bing)
 - Unavailability of GPS equipment
 - West of the Route 495 corridor, GNSS RTK Rovers were available or operational ~50%

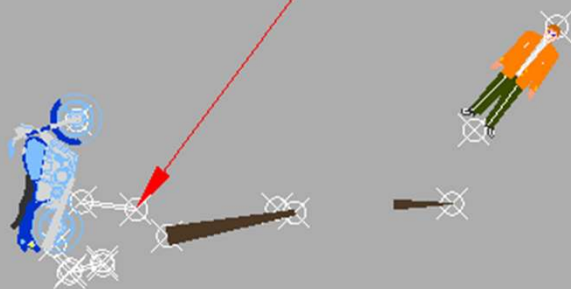
SOLUTION: State Plane Coordinates Acquired through the MaCORS Network







841940.386
2866451.551



Earth Point

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Worldwide Utilities

Excel To Google Earth

Coordinate Grids

Polygon Area

Convert Coordinates

Batch Convert

USA Utilities

Township & Range

BLM Grid

Search By Description

Search By Lat Long

Alternate Grid

Louisiana Twp & Rng

Louisiana Original PLSS

California Twp & Rng

California Grid

Search By Description

Search By Lat Long

Texas Land Survey

Abstract Grid

Search By Description

Search By Lat Long

State Plane

USA Topo Map

Other

Help

State Plane Coordinate System - Convert, View on Google Earth.

A user account is **not** needed for the features on this web page.

This page converts United States State Plane coordinates to other coordinate systems. For more information about the state plane system, Wikipedia has an [article](#). WGS84 Datum.

Convert State Plane to Latitude and Longitude

Enter the Zone, Easting, and Northing. View the results on this web page or fly there on Google Earth.

Type in the zone number or select from the list.

2001 2001 - Massachusetts Mainland

Easting/X (US Survey Feet) Northing/Y (US Survey Feet)

841940.386 2866451.551

XY Unit of Measure

☐ Meters

☒ US Survey Feet (3937 yards = 3600 meters)

☐ International Feet (1 foot = .3048 meters)

Calc

Fly To On Google Earth

Free. User account is not needed.

Position 2001 841940.386UsFtE 2866451.551UsFtN

Zone 2001 - Massachusetts Mainland

Meters US Survey Feet International Feet

X 256623.943 841940.386 841942.070


Y 873696.180 2866451.551 2866457.284

Calculated Values - based on Degrees Lat Long to seven decimal places.

Position Type	State Plane - Massachusetts Mainland
Degrees Lat Long	42.1116372°, -070.8153262°
Degrees Minutes	42°06.69823', -070°48.91957'
Degrees Minutes Seconds	42°06'41.8939", -070°48'55.1742"
State Plane X Y (Meters)	2001 256623.943mE 873696.179mN
X Y (US Survey Feet)	2001 841940.386ftUSE 2866451.548ftUSN
X Y (International Feet)	2001 841942.070ftE 2866457.281ftN
UTM	19T 349919mE 4663765mN
UTM centimeter	19T 349919.49mE 4663765.89mN
MGRS	19TCG4991963765
Grid North	-1.2°
GARS	219MA36
Maidenhead	FN42OC26DT80
GEOREF	HJEN11080669

For illustration only. User to verify all information. www.earthpoint.us

42.1116372°, -070.8153262°



42°06'41.9"N 70°48'55.2"W

42.111637, -70.815326

Directions

Save

Nearby

Send to your phone

Share

231 Broadway, Hanover, MA 02339


456M+MV Hanover, Massachusetts

Add a missing place

Add your business

Add a label

Photos





209 Broadway, Hanover, MA 02339, US

[Directions](#)

[Nearby](#)

[Save to calendar](#)

Things to do

[See all](#)



John F. Kennedy Presidential Libra...
 ●●●●● TripAdvisor
 (3918)
 Museums · Library · Architecture



Spectacle Island
 ●●●●● TripAdvisor
 (117)
 Beaches · Hiking · Swimming · Wildlife



Adams Historical
 ●●●●● TripAdvisor
 (638)
 Historic pl. Parks · Par

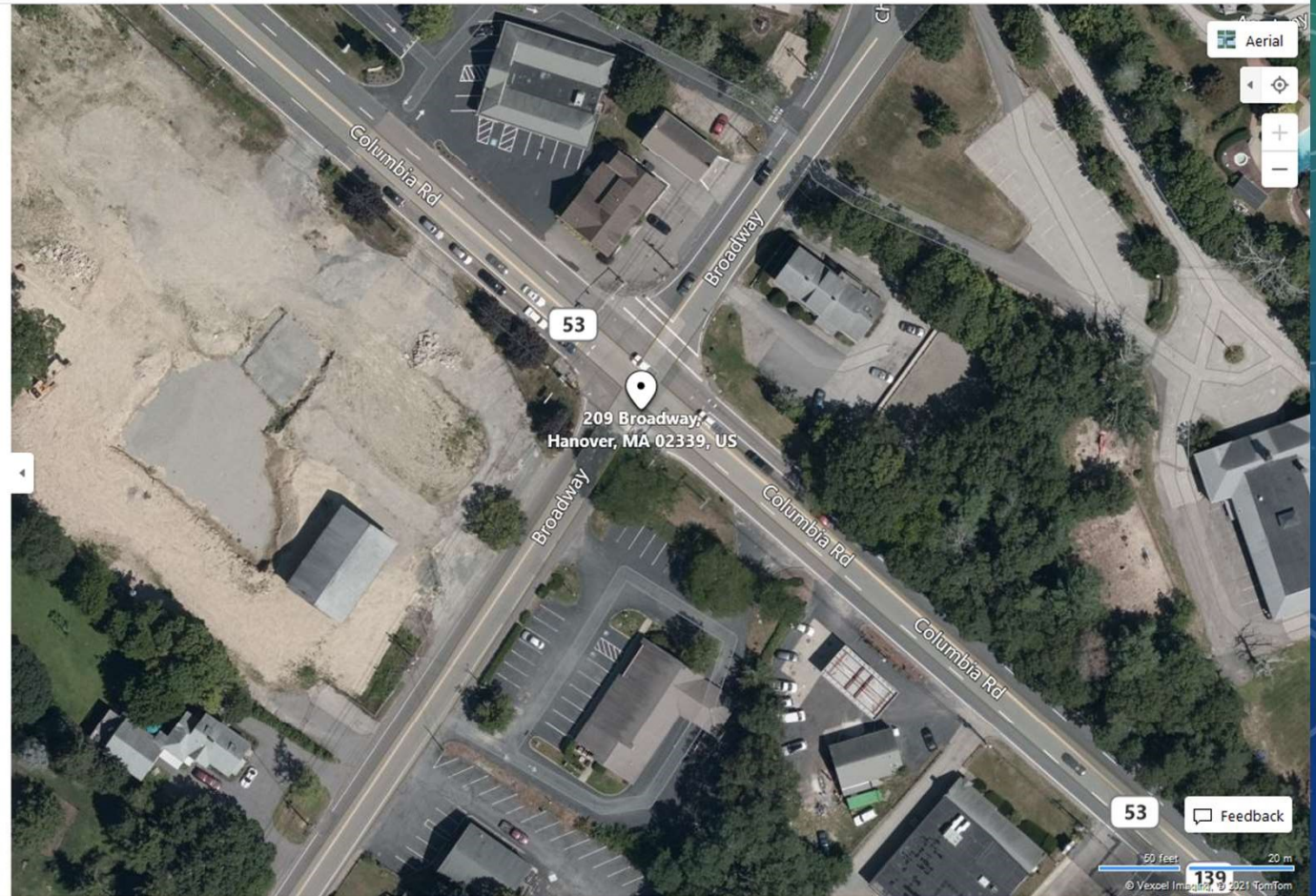
Nearby

Coffee Shops

Gas Stations

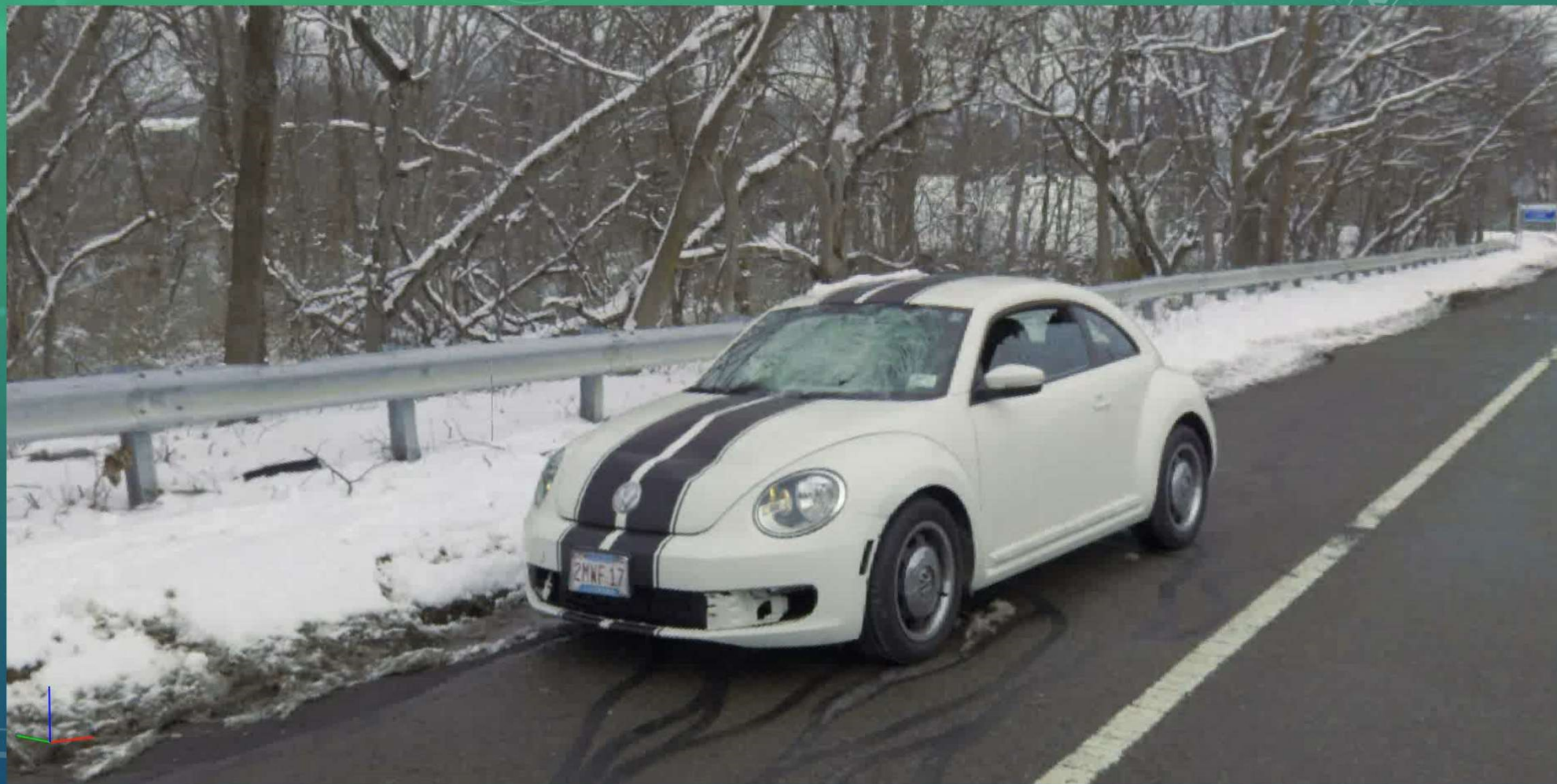
Restaurants

Grocery Stores



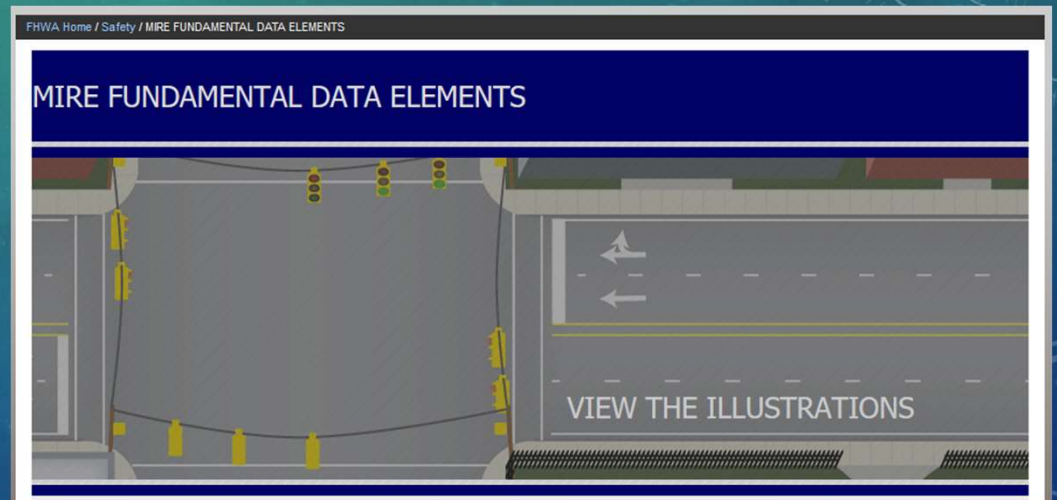
ISSUES TO BE ADDRESSED – EXPANDED DATA CAPTURE



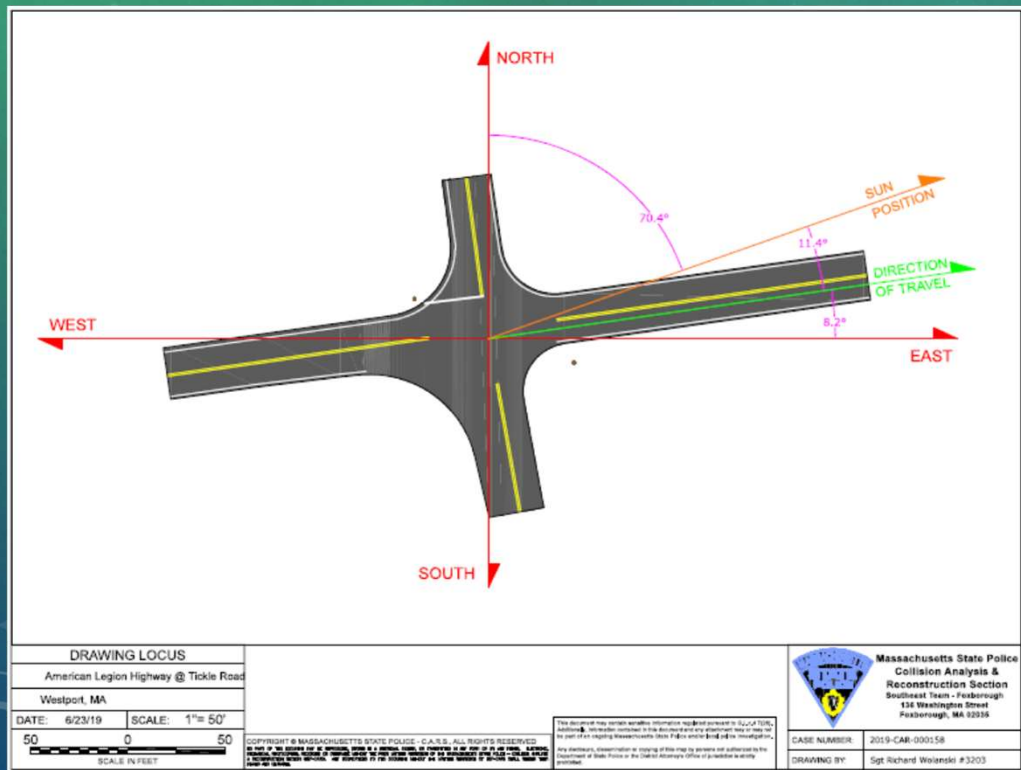


ISSUES TO BE ADDRESSED - DATA ELEMENT REPORTING

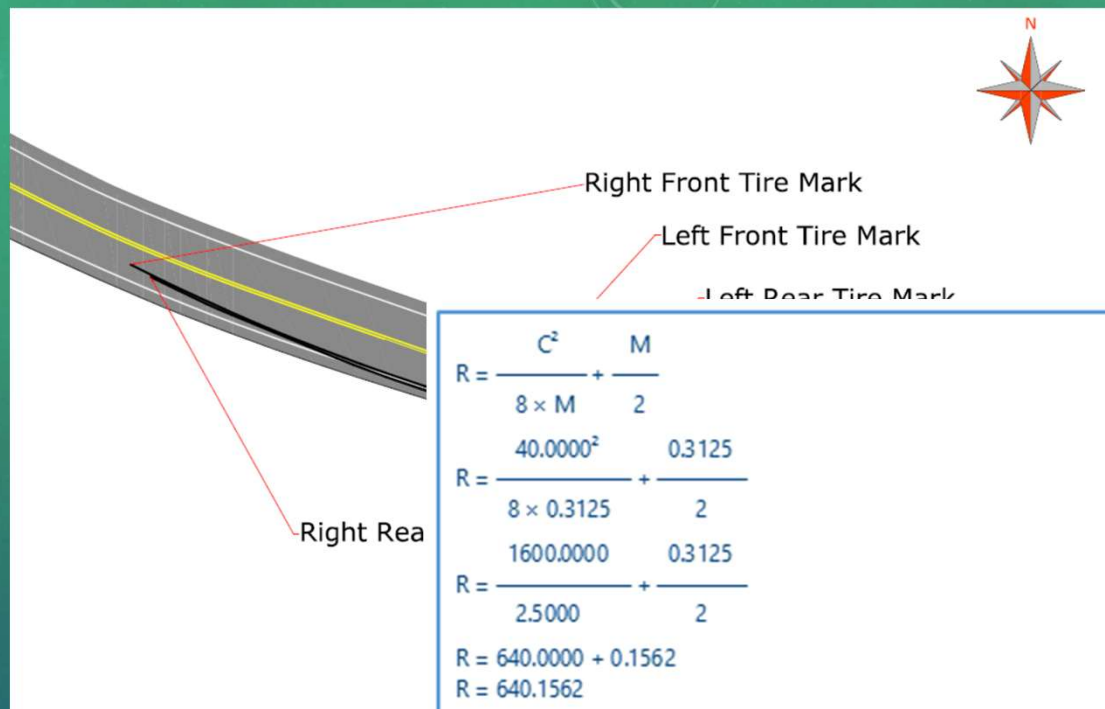
- MIRE Fundamental Data Elements
 - Paved Surface Characteristics
 - Number/Type Travel Lanes
 - Shoulder, Median, & Roadside Descriptors
 - Traffic Control Devices
 - Intersection Features



ISSUES TO BE ADDRESSED – ACCURACY IN CITATION & ADJUDICATION DATA



- Courtroom Testimony
- Roadway Design
- Safety Assessment



$$R = \frac{C^2}{8 \times M} + \frac{M}{2}$$

$$R = \frac{40.0000^2}{8 \times 0.3125} + \frac{0.3125}{2}$$

$$R = \frac{1600.0000}{2.5000} + \frac{0.3125}{2}$$

$$R = 640.0000 + 0.1562$$

$$R = 640.1562$$

$$AR = (R \pm \text{Cntr of Mass Adjustment})$$

$$AR = 640.1562 + 2.7500$$

$$AR = 642.9062$$

R = The Radius in Feet.
 C = The Chord in Feet.
 M = The Middle Ordinate in Feet.
 8 = A Constant.
 2 = A Constant.

AR = The Adjusted Radius in Feet

$$S = 3.86 \times \sqrt{R \times (\mu \pm e)}$$

$$S = 3.86 \times \sqrt{642.9000 \times (0.7500 + 0.0020)}$$

$$S = 3.86 \times \sqrt{642.9000 \times 0.7520}$$

$$S = 3.86 \times \sqrt{483.4608}$$

$$S = 3.86 \times 21.9877$$

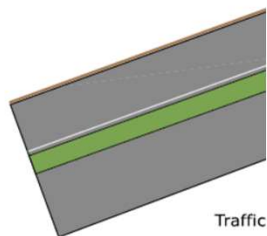
$$S = 84.8725$$

S = The Speed in MPH.
 3.86 = A Constant.
 R = The Radius in Feet.
 μ = The Coef. of Friction, Level Surface.
 e = The Superlevation.



Operator
Final Rest

Cadillac
Final Rest

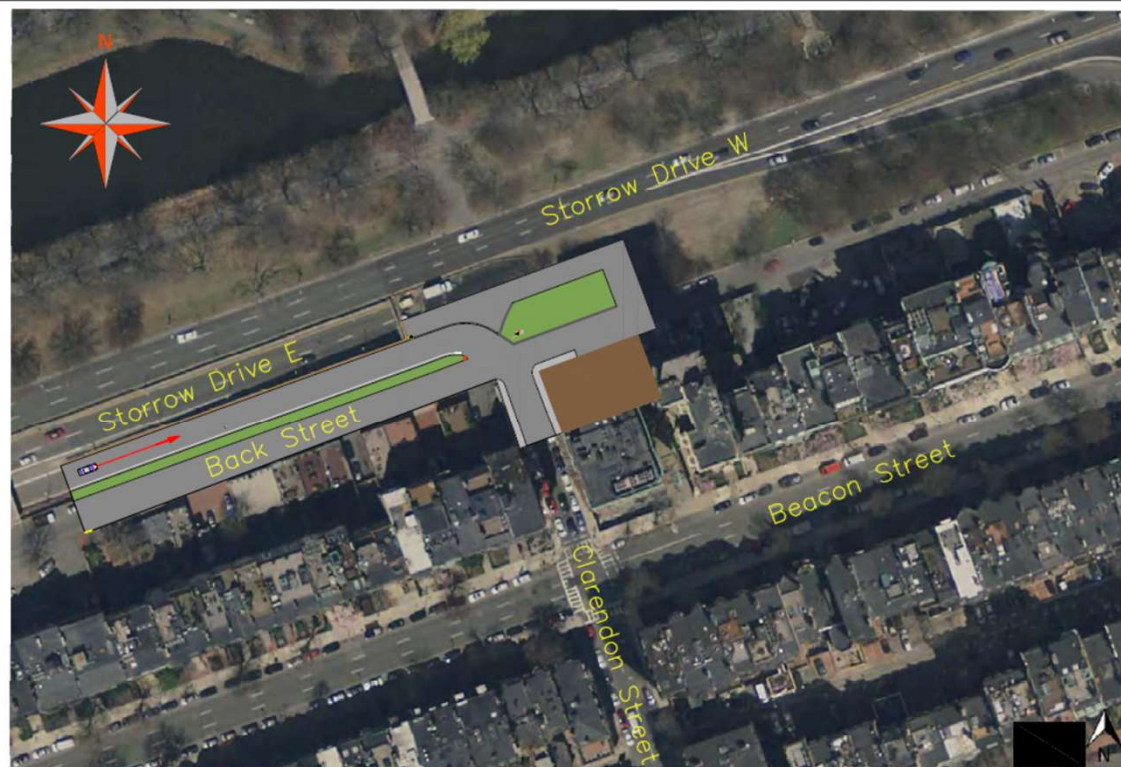


Traffic

Guardrail

Arrow Sign

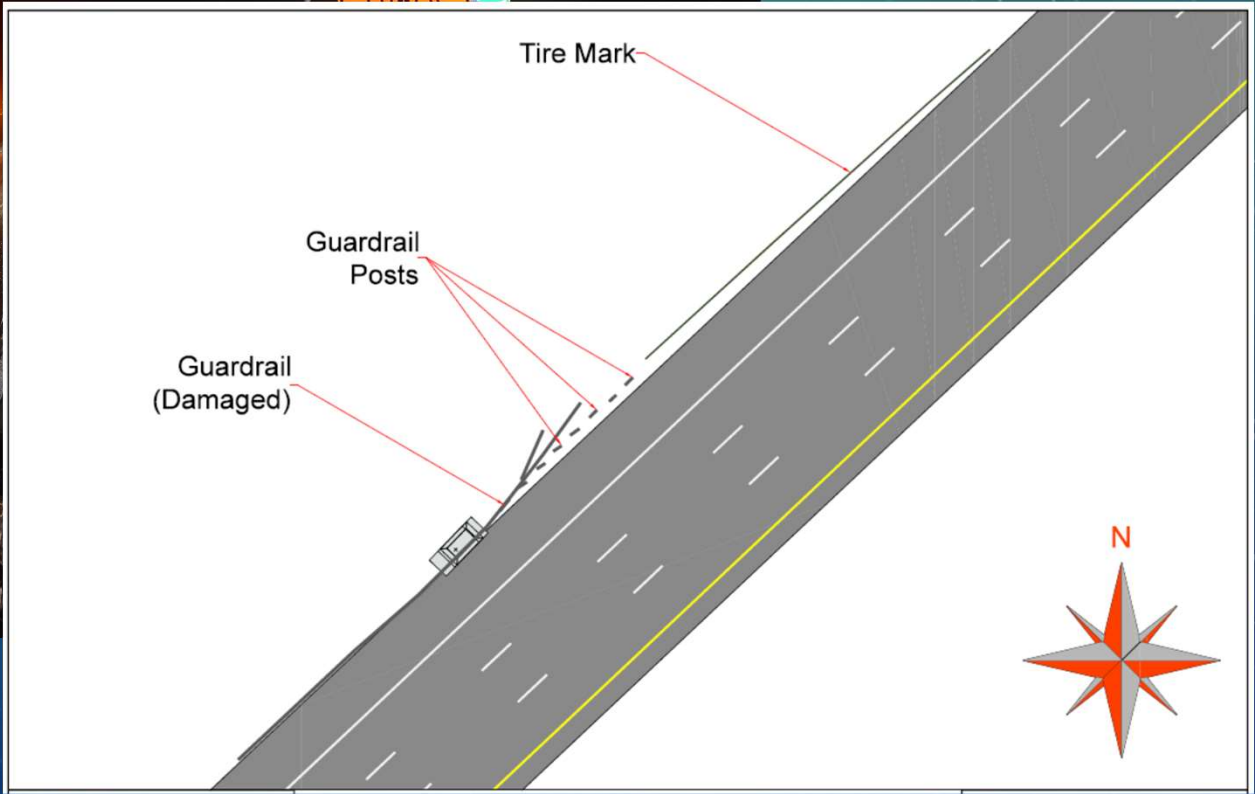
Tire Marks



































TRUCK DRIVERS

TRUCK DRIVERS
LOWER

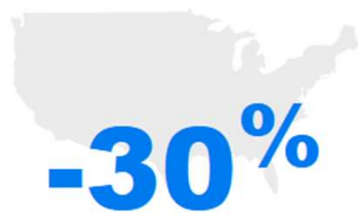


ISSUES TO BE ADDRESSED – REDUCTION IN SCENE INVESTIGATION TIME

- According to a study conducted by INRIX, Boston ranked number 1 in traffic congestion in 2019
- The average cost per driver in 2019 was \$2,205; the city of Boston lost an estimated \$4.1 Billion
- Serious injury and fatal crashes can cause delays up to 2-3 hour, and often have “downstream” effects

2019 CONGESTION RANK (2018)	URBAN AREA	HOURS LOST IN CONGESTION	2018-2019 CHANGE	2017-2018 CHANGE	INCIDENT IMPACT	COST PER DRIVER	TOTAL COST PER CITY	BIKE	TRANSIT	LAST MILE SPEED (MPH)
1 (1)	Boston, MA	149	-5%	3%		\$2,205	\$4.1B			12
2 (3)	Chicago, IL	145	4%	0%		\$2,146	\$7.6B			11
3 (5)	Philadelphia, PA	142	4%	5%		\$2,102	\$4.5B			10
4 (2)	New York City, NY	140	-4%	-3%		\$2,072	\$11B			11
5 (3)	Washington DC	124	-11%	4%		\$1,835	\$4.1B			10
6 (7)	Los Angeles, CA	103	4%	-8%		\$1,524	\$8.2B			16
7 (6)	San Francisco, CA	97	-8%	-4%		\$1,436	\$3B			10
8 (9)	Portland, OR	89	10%	-7%		\$1,317	\$1.2B			14
9 (11)	Baltimore, MD	84	5%	9%		\$1,243	\$1.3B			10
10 (12)	Atlanta, GA	82	9%	-3%		\$1,214	\$3.0B			12

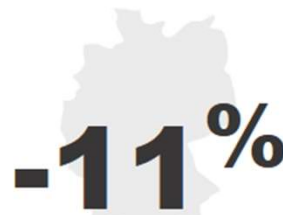
Collisions dropped from last year...



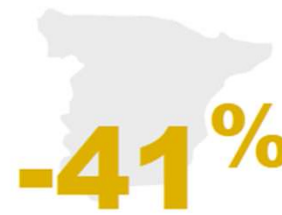
in the United States



in the United Kingdom



in Germany



in Spain



in Canada

... but became **more deadly** over time.

As traffic volume dropped due to the global pandemic, vehicle speeds increased, which has played a significant role in the rise of fatality rates around the world.

2020 saw a significant decrease in congestion. However, fatality rates did not decrease in Massachusetts. Fatal crash investigations remain a significant cause of traffic delays.

2019

140,573 Total Crashes

Fatal Injury Crashes

* **325**

Serious Injury Crashes

🚑 **2,310**

Minor Injury Crashes

👤 **15,355**

Possible Injury Crashes

❓ **15,220**

No Injury Crashes

🚧 **99,848**

Other Crashes (unknown, not reported, etc.)

⚠️ **7,515**

2020

99,284 Total Crashes

Fatal Injury Crashes

* **323**

Serious Injury Crashes

🚑 **2,001**

Minor Injury Crashes

👤 **12,402**

Possible Injury Crashes

❓ **9,497**

No Injury Crashes

🚧 **69,279**

Other Crashes (unknown, not reported, etc.)

⚠️ **5,782**

Data from MassDOT IMPACT web portal

BENEFITS OF QUICK CLEARANCE

- SAFETY
 - Reduction in secondary crashes
 - Safety of first responders in crash scene
- FINANCIAL
 - Financial cost of delays to Commonwealth & individual motorists
 - Overtime of personnel on scene
- INVESTIGATIVE
 - Ability to collect more data points
 - Accurate data collection allows for precise analysis in the future

The background is a gradient of green and blue, transitioning from a lighter green at the top to a darker blue at the bottom. On the left side, there are several circular and semi-circular patterns. One prominent circle has a scale around its perimeter with numbers ranging from 140 to 260. Other circles are partially visible, some with arrows indicating a clockwise direction. The overall aesthetic is technical and scientific.

QUESTIONS?