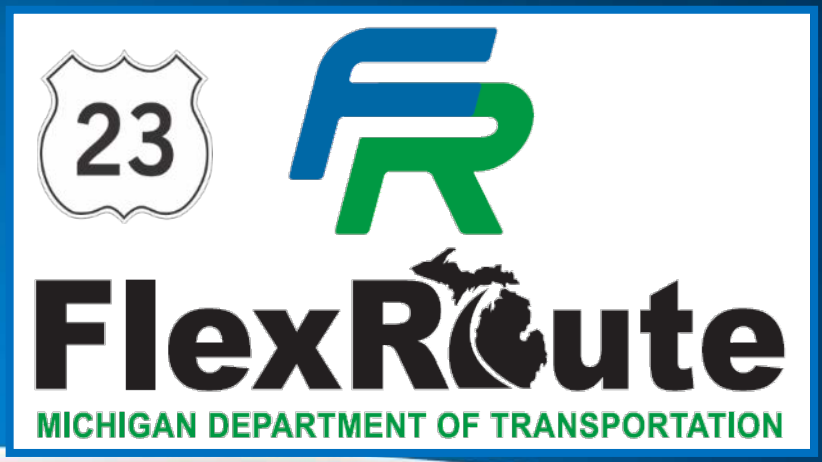
US-23 Flex Route
Part-Time Shoulder Operations



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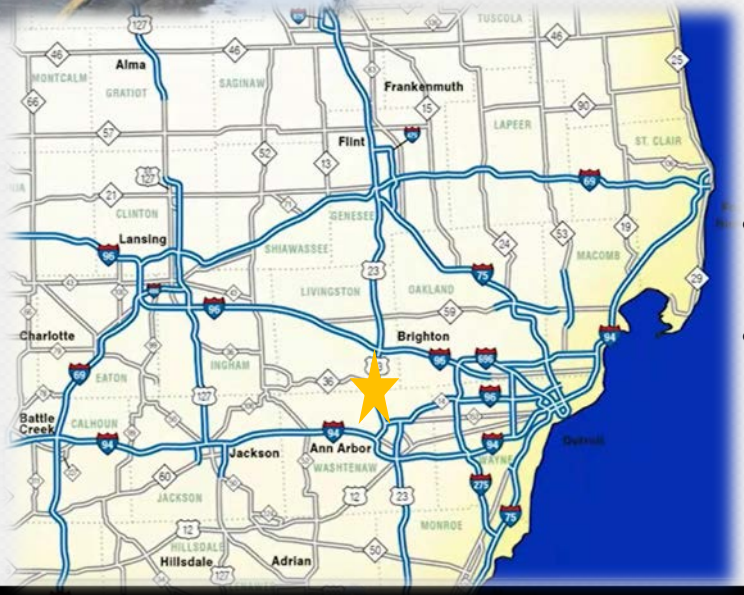
University Region
Michigan Department of Transportation
April 23rd , 2019

US-23 Background



- Located North of Ann Arbor
- Recurring Directional Peak Hour Congestion
- Non-Recurring Congestion
  - Incidents
  - Special events
- Interchange and Mainline Operational Issues
- Road and bridge improvements already planned

US-23 Active Traffic Management

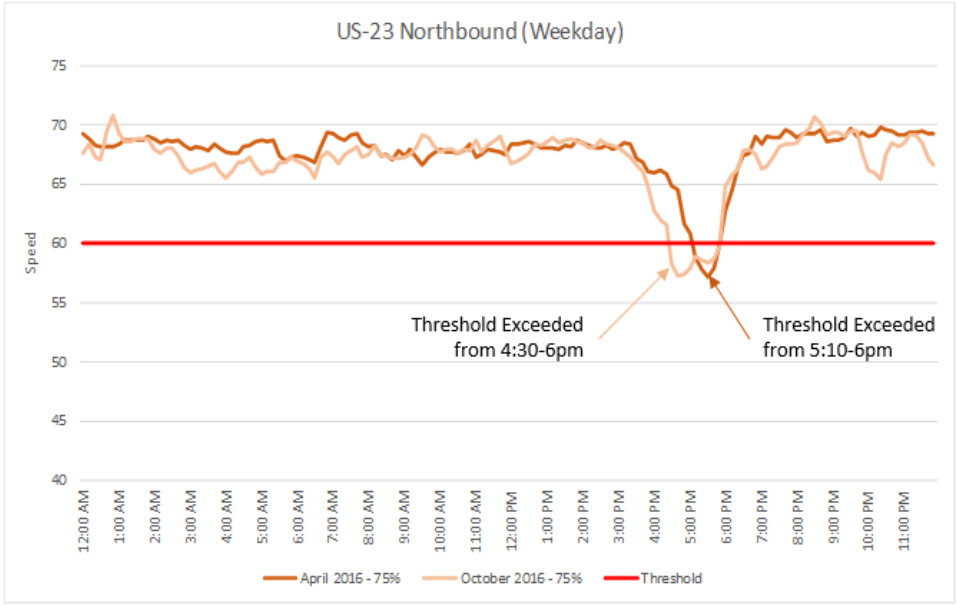
- System Details:
  - 8.5 Miles long
  - Truss style gantry system spaced at ½ mile
  - 5’ x 5.5’ Lane Control Signs
  - 9 Small DMS
  - Cameras and detection
- ATM Strategies:
  - Dynamic Shoulder Use
  - Dynamic Lane Use
  - Variable Speed Advisories
  - Queue Warning

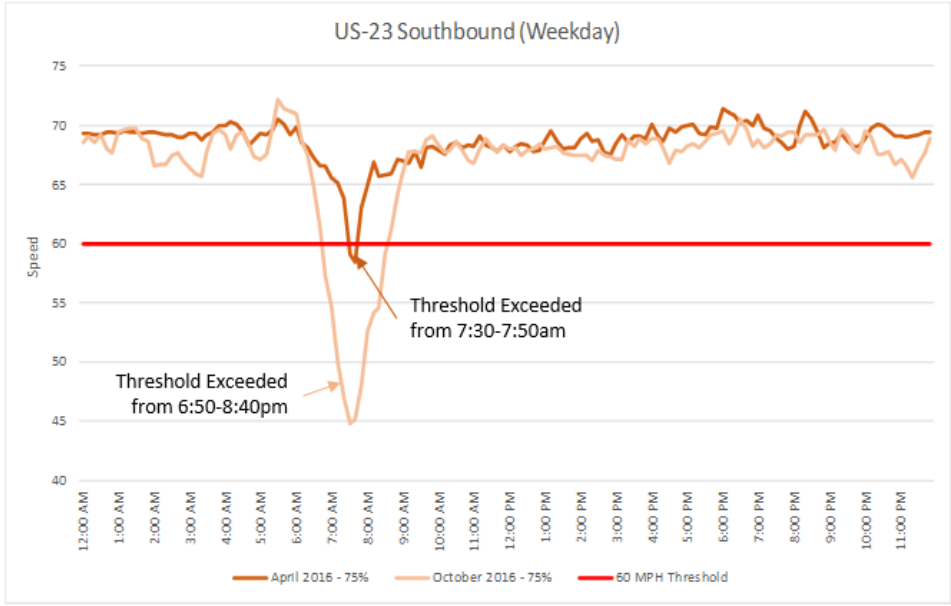
Dynamic Shoulder Use

- Using the median shoulder for directional peaks
- Scheduled to open during weekday peaks:
  - Southbound from 6:00 to 9:30 AM
  - Northbound from 3:00 to 7:00 PM
- Also an alert when congestion thresholds are met

Speed Thresholds

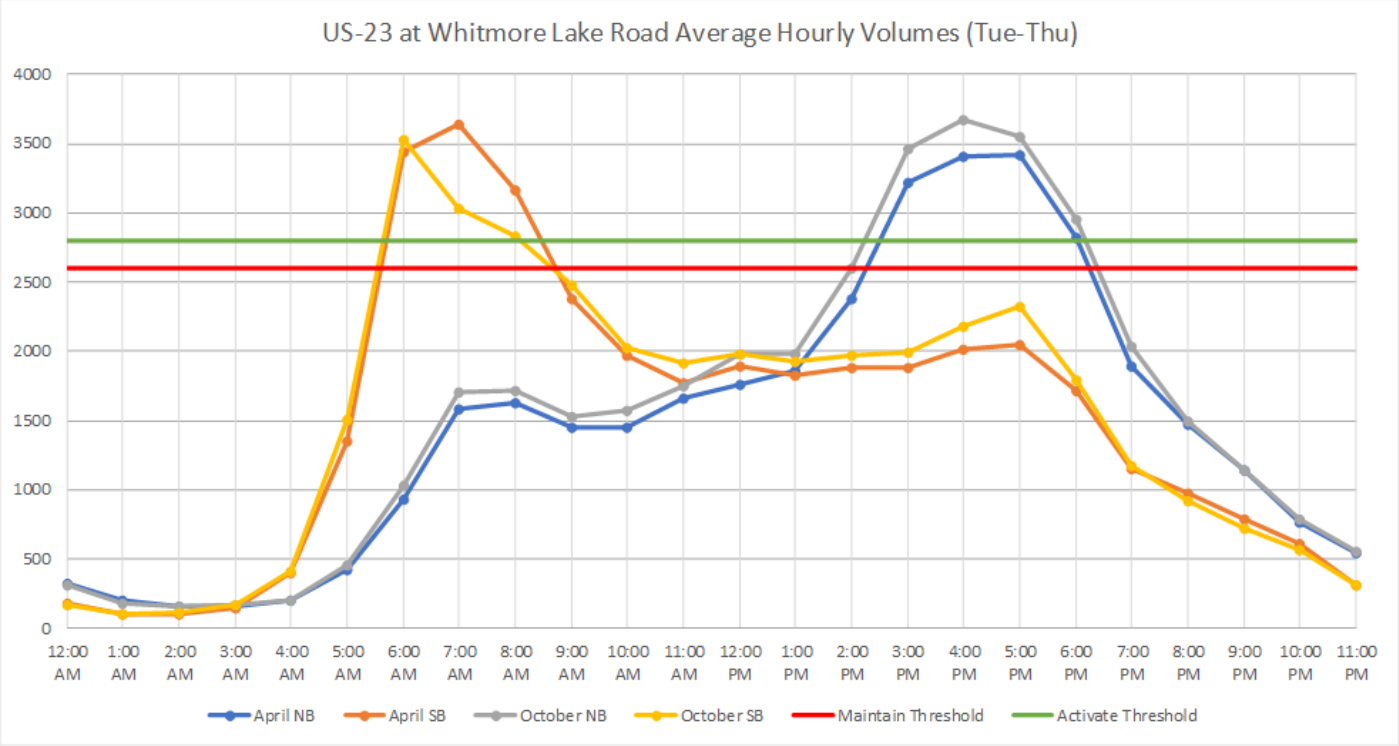
US-23 Flex Route Speed Threshold





Volume Thresholds

US-23 Flex Route Volume Threshold



Hourly Weekday Traffic Volume (Avg Tue-Thu)*

	12:00 AM	1:00 AM	2:00 AM	3:00 AM	4:00 AM	5:00 AM	6:00 AM	7:00 AM	8:00 AM	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM	5:00 PM	6:00 PM	7:00 PM	8:00 PM	9:00 PM	10:00 PM	11:00 PM
NB - April 2016	330	204	158	163	198	421	931	1585	1629	1449	1447	1662	1755	1865	2374	3219	3404	3419	2817	1899	1477	1141	768	550
NB - October 2016	318	184	156	175	208	458	1031	1702	1718	1529	1569	1747	1977	1981	2595	3465	3667	3552	2955	2037	1498	1140	785	559
SB - April 2016	182	109	108	153	401	1350	3442	3633	3166	2382	1973	1771	1897	1829	1884	1880	2016	2043	1718	1150	980	786	611	319
SB - October 2016	175	108	119	168	408	1510	3533	3033	2837	2481	2031	1919	1984	1929	1965	1989	2175	2324	1792	1181	921	723	568	312

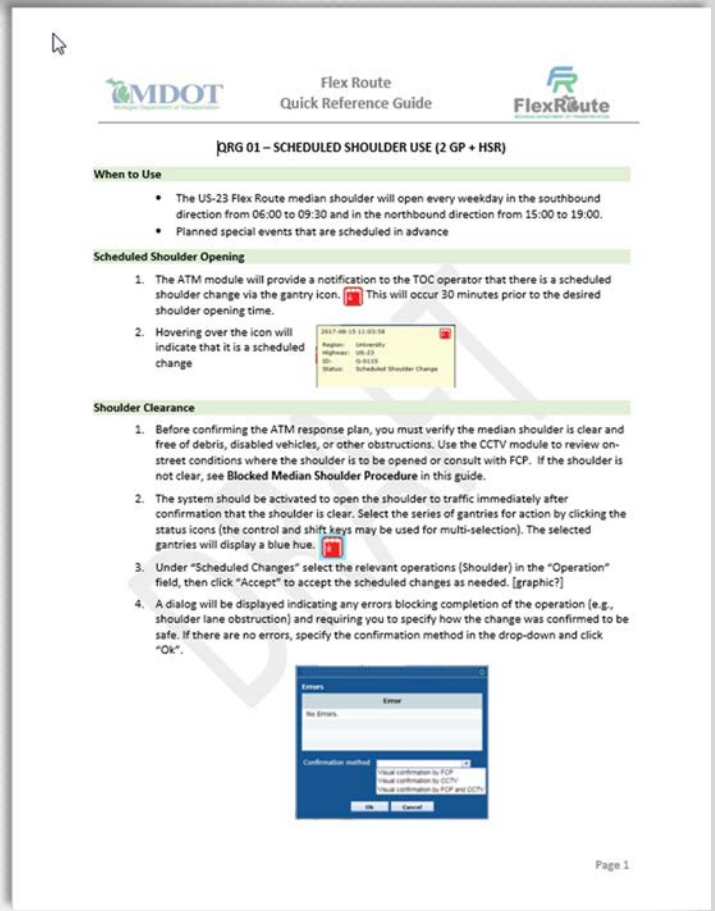
*Assumes 50/50 lane split

Maintain Threshold = volume exceeds "Maintain" threshold of 1300 vehicles per hour per lane (2600 total volume)

Activate Threshold = volume exceeds "Activate" threshold of 1400 vehicles per hour per lane (2800 total volume)

Opening the Dynamic Shoulder

- Operator must verify that the shoulder is free from obstructions before opening
  - Freeway Courtesy Patrol
  - Low Light Cameras
- Developed Standard Operating Procedures
  - Developed Quick Reference Guides to assist operators



MDOT Flex Route Quick Reference Guide

FlexRoute

QRG 01 – SCHEDULED SHOULDER USE (2 GP + HSR)

When to Use

- The US-23 Flex Route median shoulder will open every weekday in the southbound direction from 06:00 to 09:30 and in the northbound direction from 15:00 to 19:00.
- Planned special events that are scheduled in advance

Scheduled Shoulder Opening

1. The ATM module will provide a notification to the TOC operator that there is a scheduled shoulder change via the gantry icon. This will occur 30 minutes prior to the desired shoulder opening time.
2. Hovering over the icon will indicate that it is a scheduled change

Shoulder Clearance

1. Before confirming the ATM response plan, you must verify the median shoulder is clear and free of debris, disabled vehicles, or other obstructions. Use the CCTV module to review on-street conditions where the shoulder is to be opened or consult with FCP. If the shoulder is not clear, see **Blocked Median Shoulder Procedure** in this guide.
2. The system should be activated to open the shoulder to traffic immediately after confirmation that the shoulder is clear. Select the series of gantries for action by clicking the status icons (the control and shift keys may be used for multi-selection). The selected gantries will display a blue hue.
3. Under "Scheduled Changes" select the relevant operations (Shoulder) in the "Operation" field, then click "Accept" to accept the scheduled changes as needed. [graphic?]
4. A dialog will be displayed indicating any errors blocking completion of the operation (e.g., shoulder lane obstruction) and requiring you to specify how the change was confirmed to be safe. If there are no errors, specify the confirmation method in the drop-down and click "Ok".

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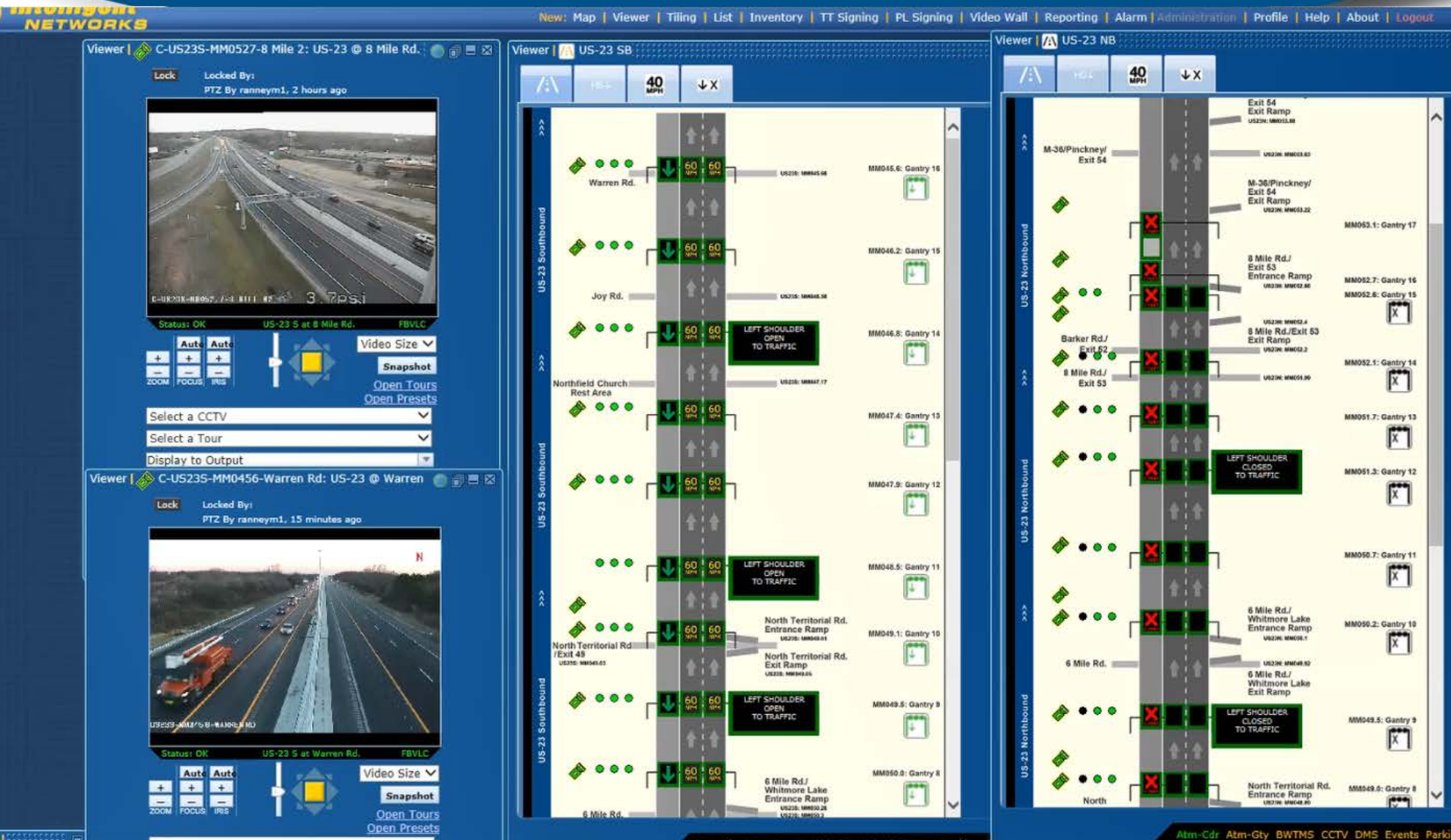
Removing Obstruction from Dynamic Shoulder

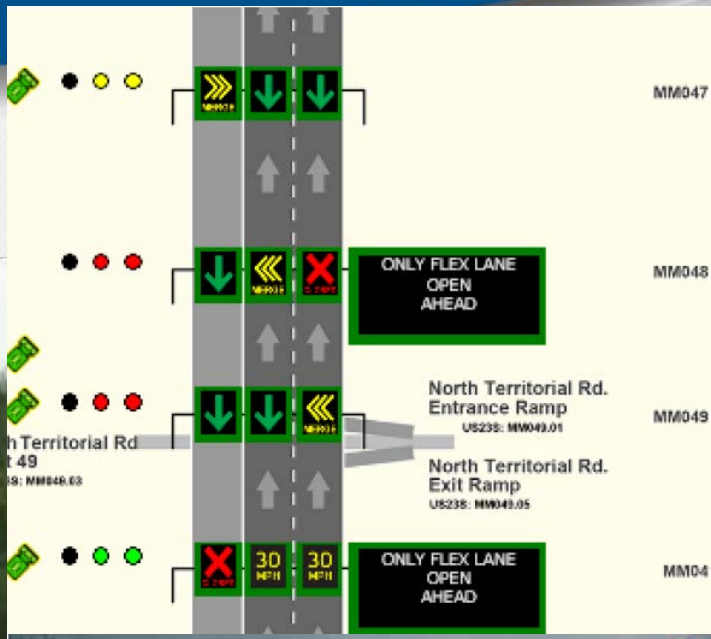
- Determined how each blockage should be handled
- Normal procedures for most types of blockages
- Disabled vehicle procedure involved an agreement with MSP

Cause of Blocked Shoulder	MDOT Procedure
Vehicle crash	• Will follow procedure currently in place. • Law enforcement is lead through dispatch (911/sheriff).
Disabled vehicle	• Will follow procedure currently in place for general purpose lane. • FCP to notify STOC.
Abandoned vehicle	• Will follow procedure currently in place for a general purpose lane.
Debris	• Will follow procedure currently in place. • FCP to move debris if possible. • For items FCP cannot move, FCP to notify STOC, STOC to notify MDOT TSC maintenance for removal. • After hours, MDOT TSC maintenance to remove.
Dead wildlife	• Will follow procedure currently in place. • FCP does not move dead animals. • FCP/County notifies STOC, STOC notifies MDOT TSC maintenance for removal.
Spilled hazardous material	• Will follow procedure currently in place. • STOC to notify MDOT TSC maintenance.
Damaged roadway	• Will follow procedure currently in place. • STOC to notify MDOT TSC maintenance.
Snow accumulation	• STOC to notify MDOT TSC maintenance. • During off hours, dispatch calls county. • Dynamic shoulder lane to be cleared as normal travel lane. • All snow will get pushed to outside shoulder.
Police activity	• Will follow procedure currently in place. • STOC to monitor situation.

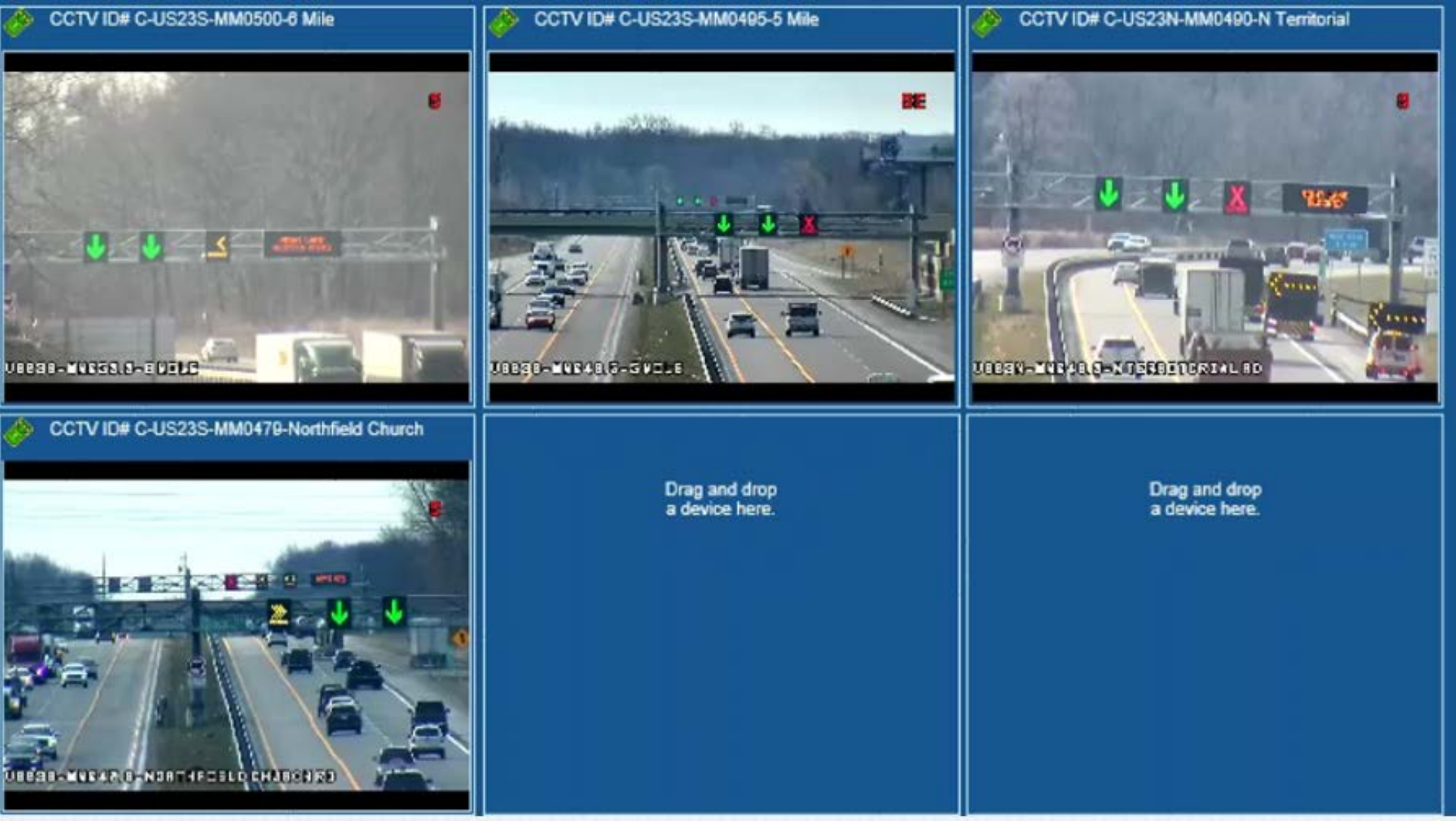
23 Dynamic Shoulder Operation



Shoulder Use for Incident Management



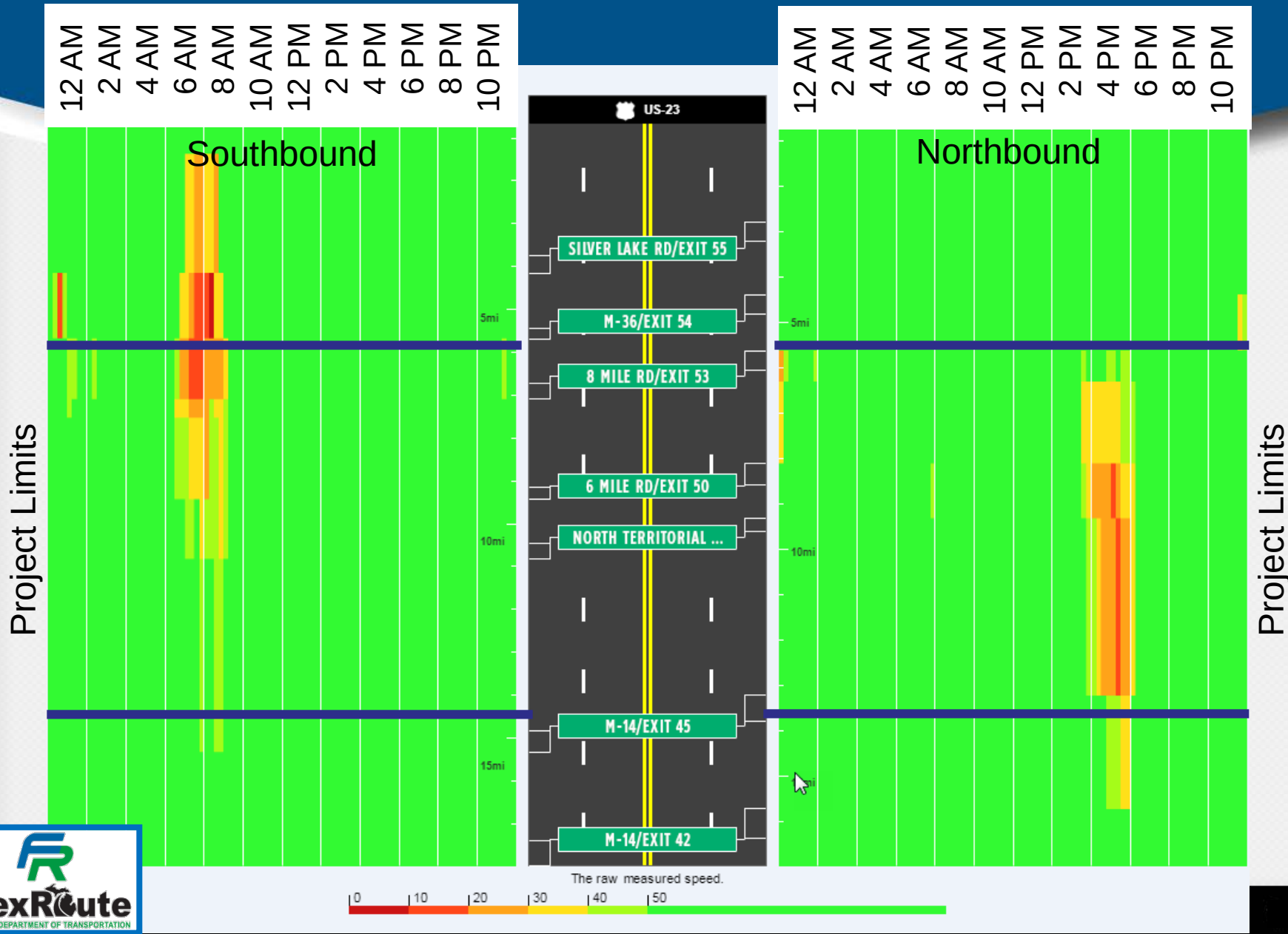
Shoulder Use for Maintenance Operations



Flex Route ITS System Reliability

- Goal of 97.5 percent system reliability
- ITS maintenance efficiencies used to improve overall repair times
- Winter Weather
  - Treat shoulder as 3rd lane
  - Snow removal of median shoulder
  - Opening the shoulder during winter snow event (especially morning peak)

Speed Performance Before



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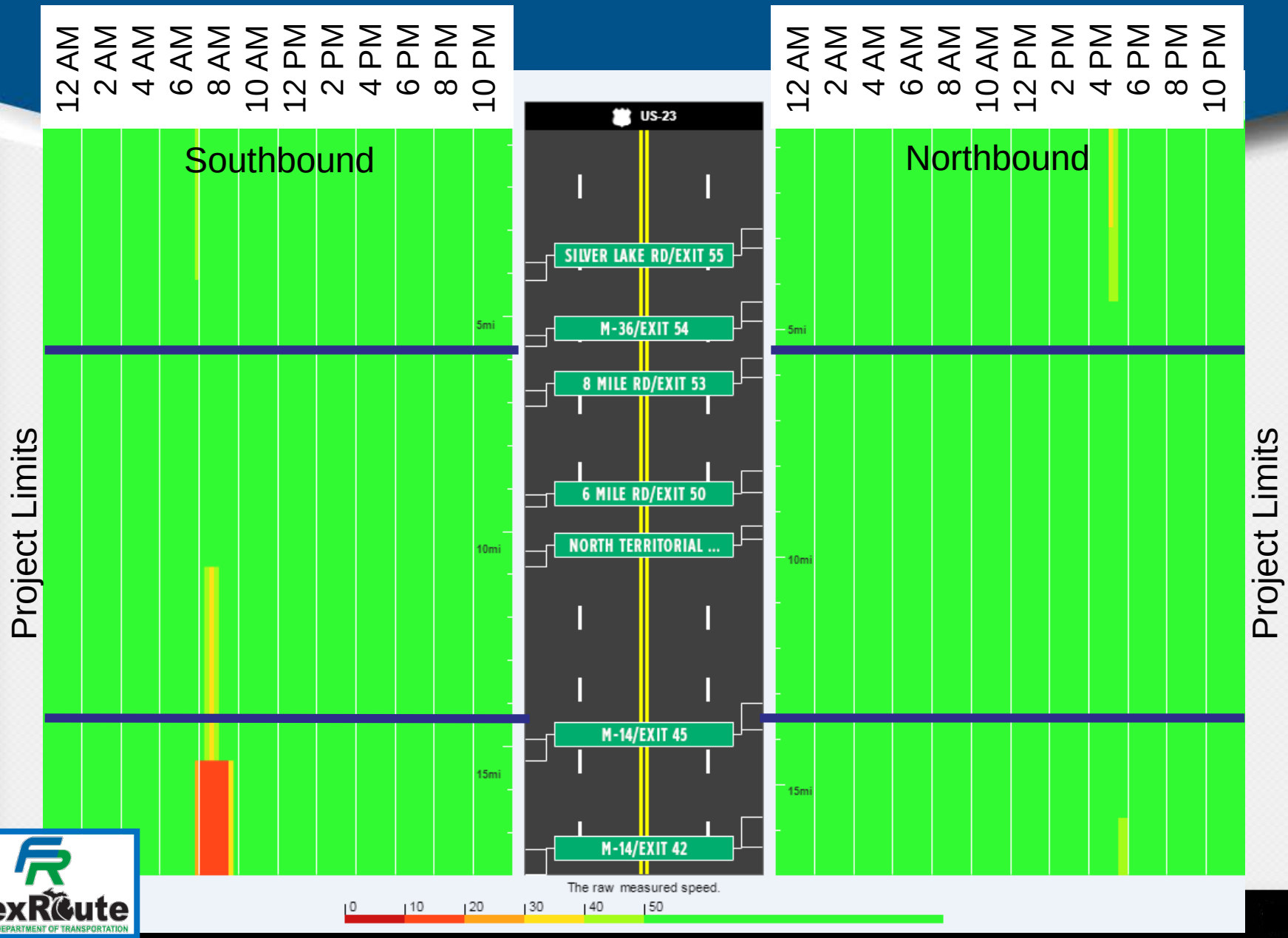
Speed Performance After



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Flex Route Performance Summary

- Early Results- improvements in travel time and reliability- especially for southbound US-23
  - SB US-23 planning time improvement over 50% (from 22 mins to 10 mins)
  - SB US-23 average travel time savings of about 5 minutes (for 8.5 miles)
  - SB US-23 speed increases of 19 mph (from 43 mph to 62 mph)
  - NB US-23 also showing improvements
- Current research project will further investigate performance

Questions?

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MDOT