LOR-254 Signal Retiming Project Operational Report

Ohio Department of Transportation
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Engineering
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Overview

As part of ODOT's Statewide Signal Timing Program, the LJB/TEC team reviewed current traffic conditions on the State Route (SR) 254 (Detroit Rd) and SR 301 (Abbe Rd) corridor between the Transportation Dr & Detroit Rd and Hoag Dr & Abbe Rd intersections in Lorain County, Ohio. Following a review of the existing conditions, LJB developed improved signal timing plans to reduce congestion, improve safety and facilitate traffic progression along the corridor.

SR 254 and SR 301 are both minor arterials. SR 254 is an east-westbound roadway while SR 301 is north-southbound. The SR 254 corridor typical section is a five-lane section with two through travel lanes in each direction and left turn lanes at intersections. SR 301 is a five-lane section with two through travel lanes in each direction and a center two-way left-turn lane (TWLTL). The study corridor is approximately 4500 feet in length, with a posted speed limit of 35 miles per hour.

The 2022 AADT on SR 254, was 17,500 vpd west of the I-90 ramps and 27,500 vpd east of the I-90 ramps. The 2022 AADT on SR 301 was 22,400 vpd. The May 2022 ATR on SR 254 west of Transportation Dr (24-hour volume) was 15,600 vpd. A second ATR on SR 301 south of Hoag Dr recorded an ADT of 20,692 vpd.

Six signalized intersections make up the Signal Timing Analysis study area. Sheffield Village maintains all 6 signals. The intersections are listed below and shown on Figure 1.

1. SR 254 & Transportation Dr
2. SR 254 & I-90 WB Ramps
3. SR 254 & I-90 EB Ramps
4. SR 254 & Sheffield Crossing
5. SR 254 & SR 301
6. SR 301 & Hoag Dr

FIGURE 1: STUDY AREA OVERVIEW

Field Implementation Notes

The proposed timing was implemented during the week of May 8, 2023. A post-implementation field visit was conducted on June 13, 2023 during the PM peak. Traffic was observed progressing effectively on the west end of the project, with no multi-cycle queues or storage over capacity. However, consistent with prior feedback from the Sheffield Village Police Department, north bound vehicles turning left from SR 301 onto SR 254 were blocking the intersection due to backups of westbound through vehicles at the SR 254 & Sheffield Crossing intersection. On June 15, 2023, offsets were modified at the SR 254 & SR 301 intersection for the PM and Weekend plans to allow more time for westbound through vehicles to clear at SR 254 & Sheffield Crossing prior to the northbound left turn phase at SR 254 & SR 301. Observations showed improved progression after the timing was changed. No additional comments were received.

Analysis

Signal Operational Analysis

Synchro Version 11 was used to analyze traffic signal operations. Models were developed for the following conditions:

- AM Peak (Timing Plan 10)
- Midday (MD) Peak (Timing Plan 20)
- PM Peak (Timing Plan 30)
- Offpeak (Timing Plan 40)
- Weekend Peak (Timing Plan 60)
- High Volume (Timing Plan 70)
- High Volume NB (Timing Plan 71)
- High Volume SB (Timing Plan 72)

High volume timing plans use 30% higher volumes. Timing was coordinated for the through phases at all signals (eastbound/westbound for signals on SR 254, northbound/southbound at SR 301 & Hoag Dr). Models were also considered that used the northbound left and southbound right as coordinated phases at SR 254 & SR 301. However, queuing would be anticipated in the eastbound direction with this scenario. In addition, the signal lacks stop line detection for the eastbound and westbound movements, which currently operate on recall. In part due to the decision to coordinate the SR 254 approaches, the SR 301 & Hoag Dr signal achieves better performance by operating Free in all scenarios.

Intersections are graded using a level of service (LOS) designation expressed in terms of letter grades. Level of service is a quality measure describing operational conditions of a traffic stream with LOS A representing the highest quality traffic flow and minimal delay, and LOS F representing poor traffic operations, delay, and substantial queuing. Level of service is defined in terms of vehicle delay, as published in the Highway Capacity Manual. Levels of service thresholds are summarized for signalized intersections in **Table 1**.

TABLE 1: LEVEL OF SERVICE THRESHOLDS FOR INTERSECTIONS

LEVEL OF SERVICE	CONTROL DELAY (SEC/VEH) SIGNALIZED INTERSECTIONS
A	≤ 10
B	> 10 and ≤ 20
C	> 20 and ≤ 35
D	> 35 and ≤ 55
E	> 55 and ≤ 80
F	> 80

Table 2 shows a comparison of LOS at the intersection-level before and after optimization per Synchro. As shown, all intersections operate at LOS D or better. With the optimized timing, some intersections experienced slightly longer overall delay. The "before" condition cycle lengths were 100 seconds or less for Mid-day, Off-peak and PM peak, whereas the optimized condition cycle lengths are longer between 110 seconds and 125 seconds, resulting in overall intersection delay under some TOD plans. These longer cycle lengths were necessary for improved traffic flow and platoon progression. The with AM peak (6:15-7:15 am) was operating free under "before" condition until 7 AM, and the optimized AM peak plan will operate at 115 second cycle length.

TABLE 2: LEVEL OF SERVICE SUMMARY BY INTERSECTION

INTERSECTION		SR 254 & TRANSPORTATION	SR 254 & I-90 WB RAMPS	SR 254 & I-90 EB RAMPS	SR 254 & SHEFFIELD CROSSING	SR 254 & SR 301	SR 301 & HOAG
AM Peak	Before	A (9.5)	C (24.1)	A (9.6)	B (12.6)	C (27.1)	B (11.4)
	Optimized	A (9.1)	C (21.4)	B (10.2)	B (11.7)	C (28.4)	B (10.9)
	Change (Secs)	-(.4)	-(2.7)	(.6)	-(.9)	(1.3)	-(.5)
MD Peak	Before	B (14.1)	C (23.4)	B (10.5)	C (20.9)	C (25.4)	C (21.8)
	Optimized	B (14.4)	C (24.9)	B (11.6)	B (19.7)	C (30.9)	C (20.3)
	Change (Secs)	(.3)	(1.5)	(1.1)	-(1.2)	(5.5)	-(1.5)
PM Peak	Before	B (13.1)	C (33.2)	B (15.6)	B (19.4)	D (41.)	B (19.6)
	Optimized	B (16.2)	C (30.9)	B (13.9)	C (24.8)	D (45.3)	B (19.)
	Change (Secs)	(3.1)	-(2.3)	-(1.7)	(5.4)	(4.3)	-(.6)
Offpeak	Before	A (8.9)	C (20.)	B (10.1)	B (12.8)	D (51.6)	B (18.1)
	Optimized	A (8.)	C (27.7)	B (12.6)	B (16.8)	C (25.9)	B (16.2)
	Change (Secs)	-(.9)	(7.7)	(2.5)	(4.)	-(25.7)	-(1.9)
Weekend Peak	Before	A (5.8)	C (24.)	B (10.7)	C (20.6)	C (22.9)	C (23.9)
	Optimized	A (8.)	C (27.7)	B (12.6)	B (16.8)	C (25.9)	B (16.2)
	Change (Secs)	(2.2)	(3.7)	(1.9)	-(3.8)	(3.)	-(7.7)

Measures of Effectiveness

INRIX data was used to compare measures of effectiveness (MOEs) for the LOR-254 corridor. MOEs were assessed one month prior to implementation (April 6 to May 6, 2023) and for a one-month period after implementation (August 16 to September 16, 2023). The MOEs assessed include speed and travel time and are shown in **Table 3**.

Improvements to travel time and speed were made for the AM peak, PM peak and Weekend peak. The most dramatic shift was in the PM peak, where travel time was reduced by 8.4% eastbound and 6.1% westbound with corresponding speed increases of 6.4% and 9.1%. During the Mid-day peak, the delay and speeds are similar between before and optimized conditions. During the off-peak period, along the EB direction of SR 254, a slight increase in travel time and reduction in travel speed (0.8 mph) is noted. The overall analysis showed improvement in both travel time and speed.

TABLE 3: MEASURES OF EFFECTIVENESS SUMMARY

Time Period	Direction	Travel Time (s)	Average Speed (mph)
Overall (AM, MD, and PM)			
Before	EB	196	24.9
Optimized		194	25.4
Change (%)		-0.9%	2.1%
Before	WB	261	24.4
Optimized		250	25.4
Change (%)		-4.2%	4.3%
AM Peak			
Before	EB	187	26.4
Optimized		186	26.6
Change (%)		-0.5%	0.6%
Before	WB	240	26.7
Optimized		238	26.9
Change (%)		-0.8%	0.8%
MD Peak			
Before	EB	201	24.5
Optimized		202	24.4
Change (%)		0.4%	-0.4%
Before	WB	267	24.0
Optimized		257	24.9
Change (%)		-3.6%	3.7%

Time Period	Direction	Travel Time (s)	Average Speed (mph)
PM Peak			
Before	EB	208	23.7
Optimized		195	25.3
Change (%)		-6.1%	6.4%
Before	WB	285	22.5
Optimized		261	24.5
Change (%)		-8.4%	9.1%
Offpeak			
Before	EB	189	26.2
Optimized		194	25.4
Change (%)		3.0%	-3.3%
Before	WB	253	25.2
Optimized		245	26.1
Change (%)		-3.2%	3.3%
Weekend			
Before	EB	192	26.0
Optimized		190	26.0
Change (%)		-1.3%	0.1%
Before	WB	255	25.1
Optimized		240	26.6
Change (%)		-5.9%	6.3%

Figures 2-5 show travel time and speed comparisons on weekdays. **Figures 6-9** show travel time and speed comparisons on weekends. The values vary throughout the day, but travel times are generally lower and speeds higher in the post-implementation ('after') scenario.

The resulting estimated annual signal retiming benefits calculation using ODOT's spreadsheet shows savings in terms of delay, emissions, crash reduction, and fuel. The overall benefit cost ratio when compared to the $40,423.0 invested in this signal timing study is **14:1**.

FIGURE 2: WEEKDAY TRAVEL TIME COMPARISON FOR SR 254 EB/SR 301 SB

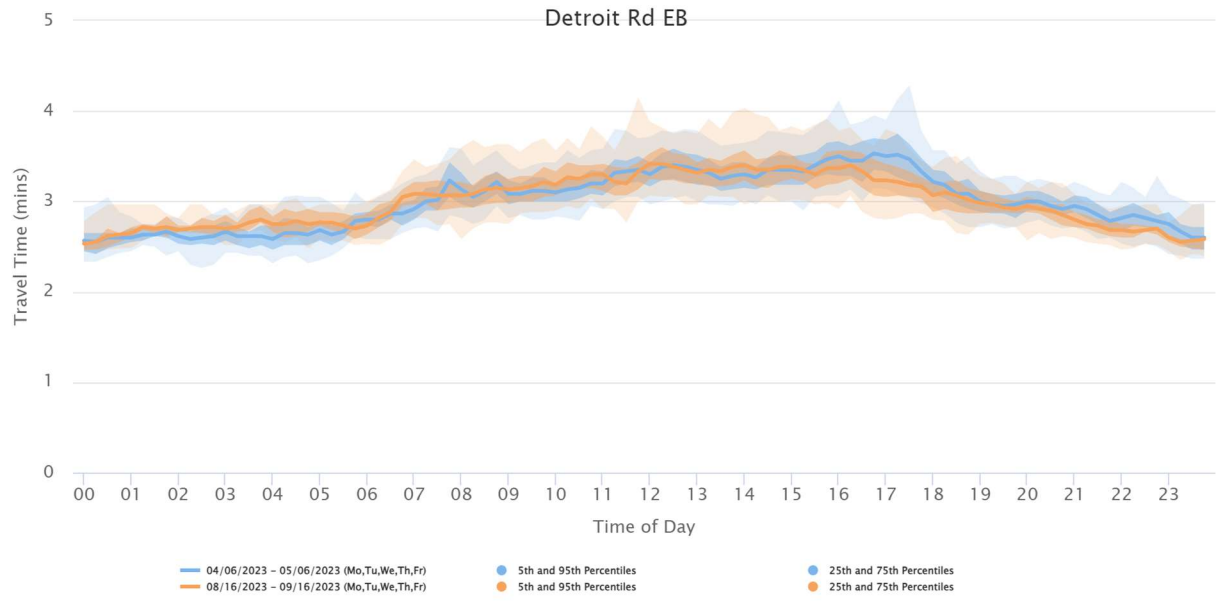


FIGURE 3: WEEKDAY TRAVEL TIME COMPARISON FOR SR 254 WB/SR 301 NB

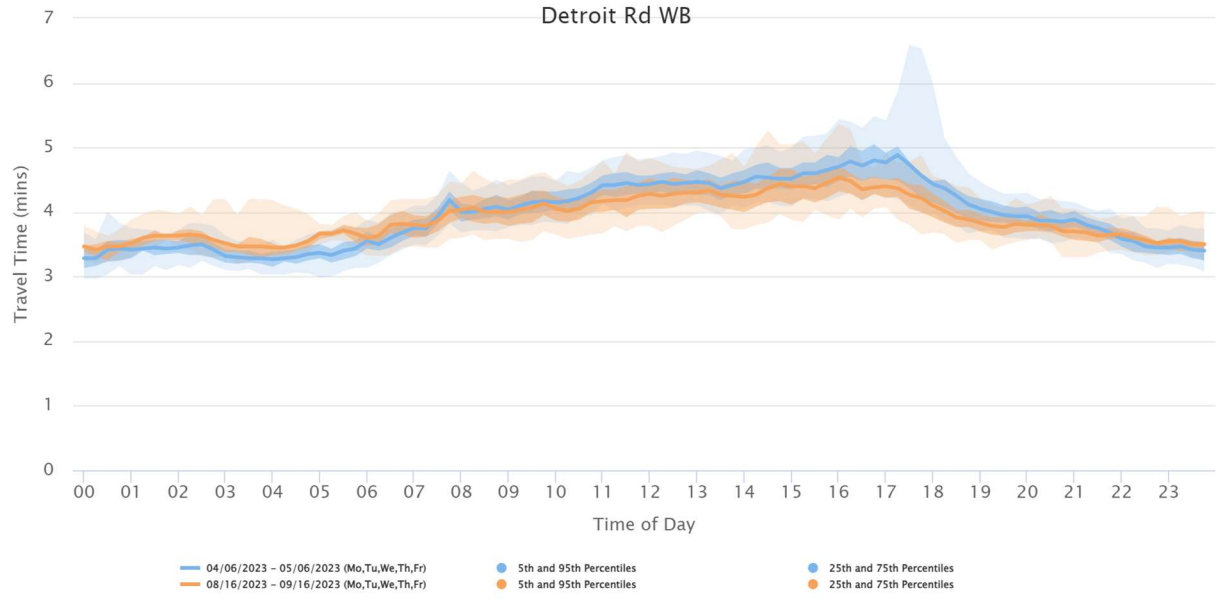


FIGURE 4: WEEKDAY AVERAGE SPEED COMPARISON FOR SR 254 EB/SR 301 SB

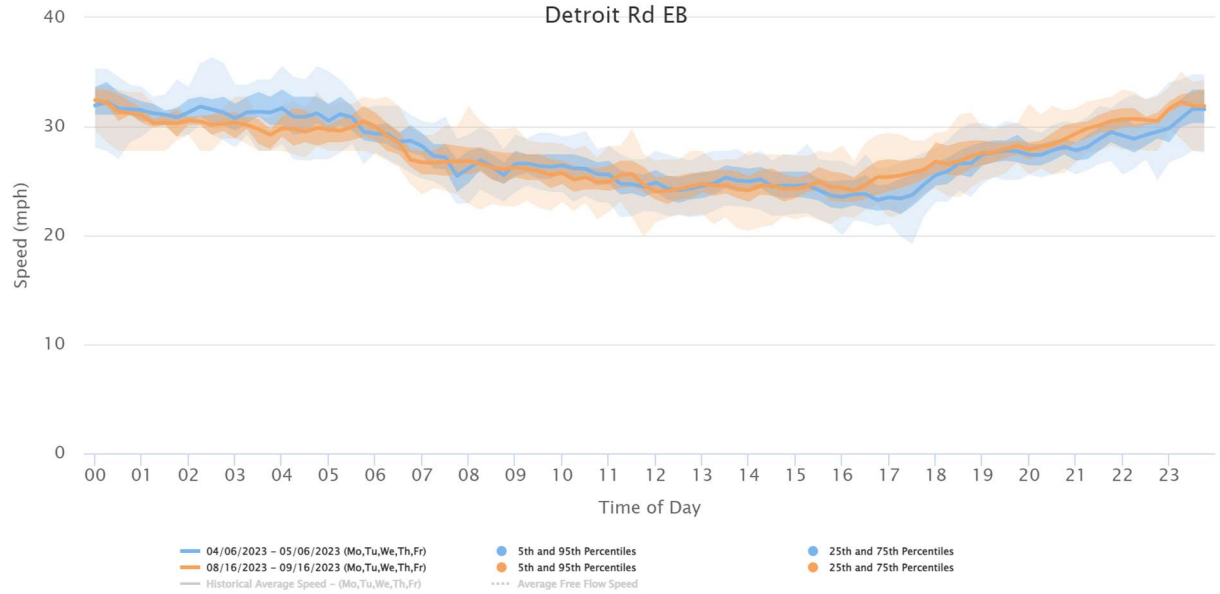


FIGURE 5: WEEKDAY AVERAGE SPEED COMPARISON FOR SR 254 WB/SR 301 NB

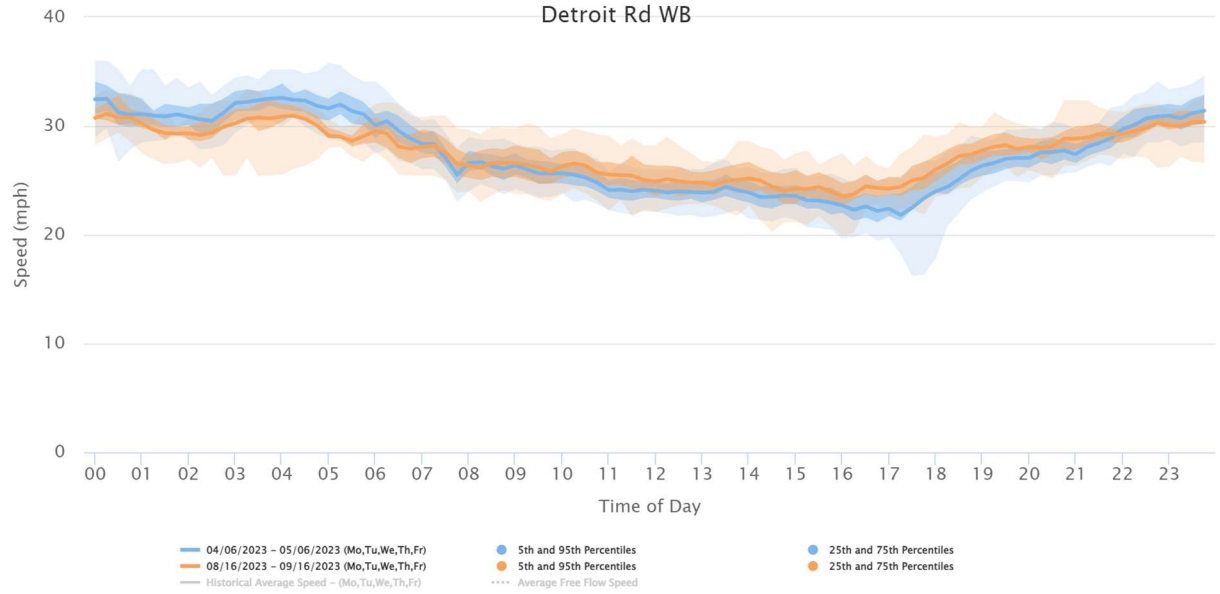


FIGURE 6: WEEKEND TRAVEL TIME COMPARISON FOR SR 254 EB/SR 301 SB

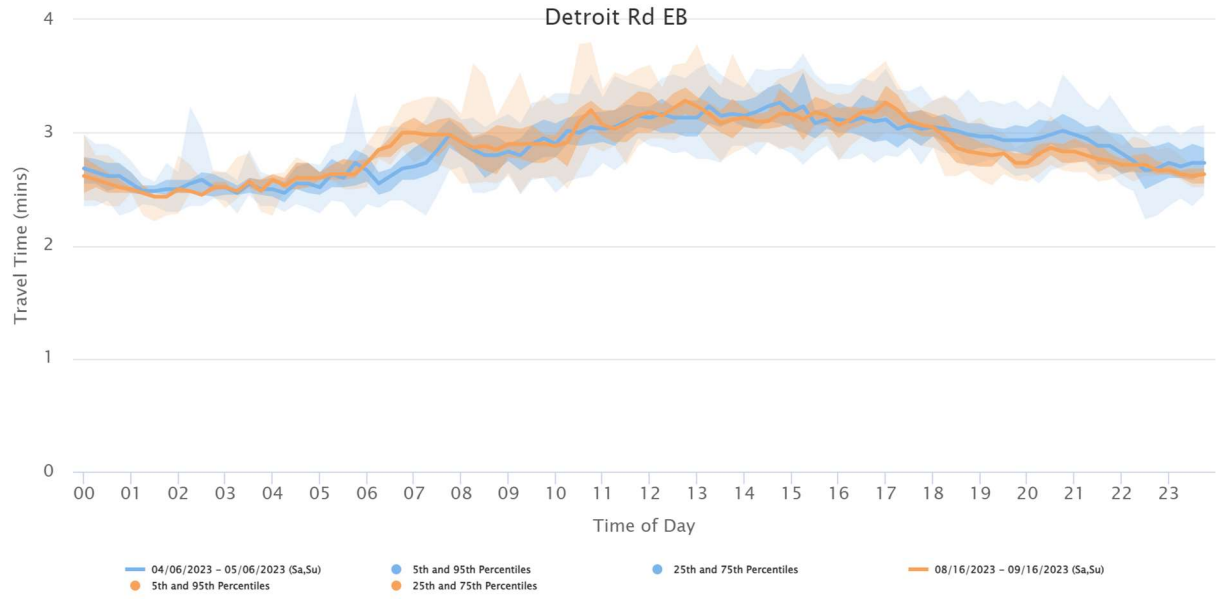


FIGURE 7: WEEKEND TRAVEL TIME COMPARISON FOR SR 254 WB/SR 301 NB

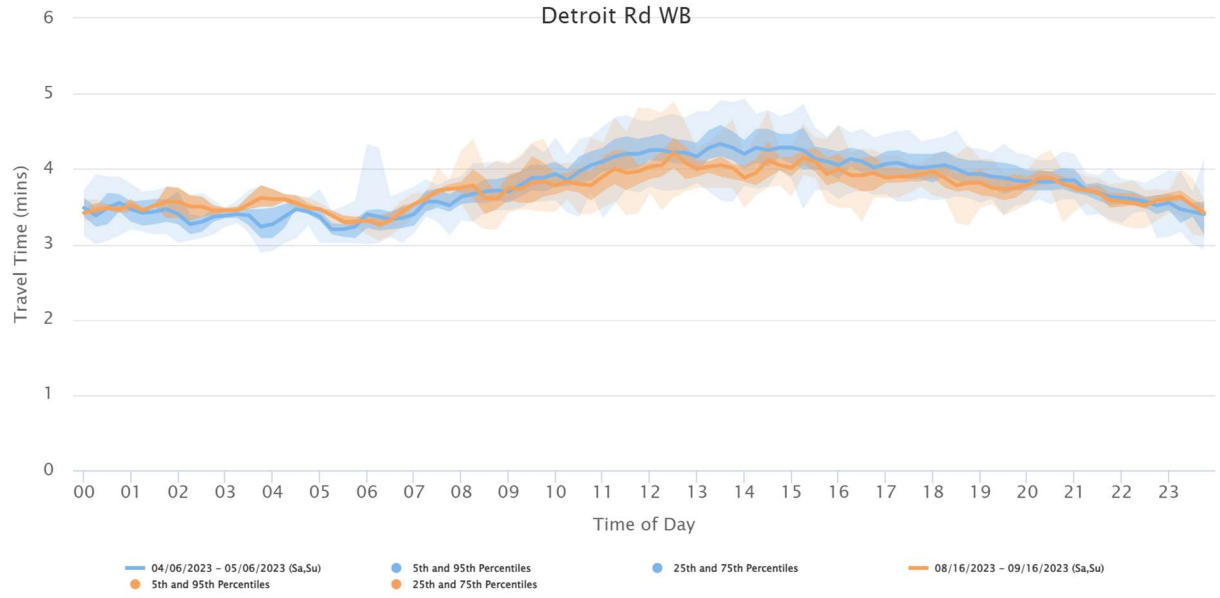


FIGURE 8: WEEKEND AVERAGE SPEED COMPARISON FOR SR 254 EB/SR 301 SB

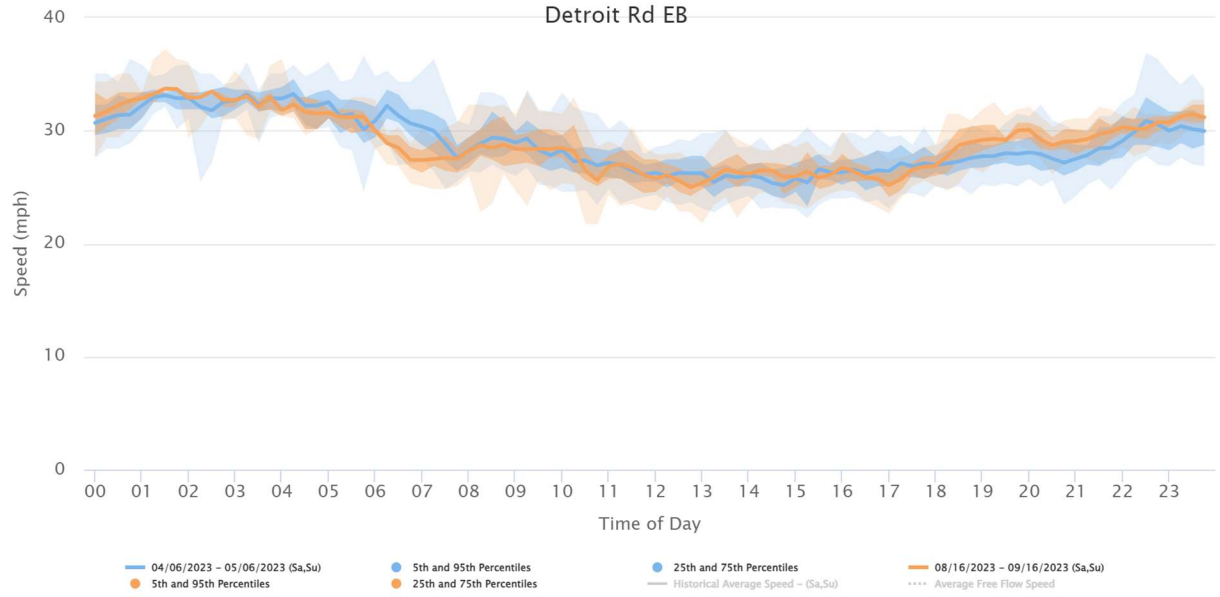
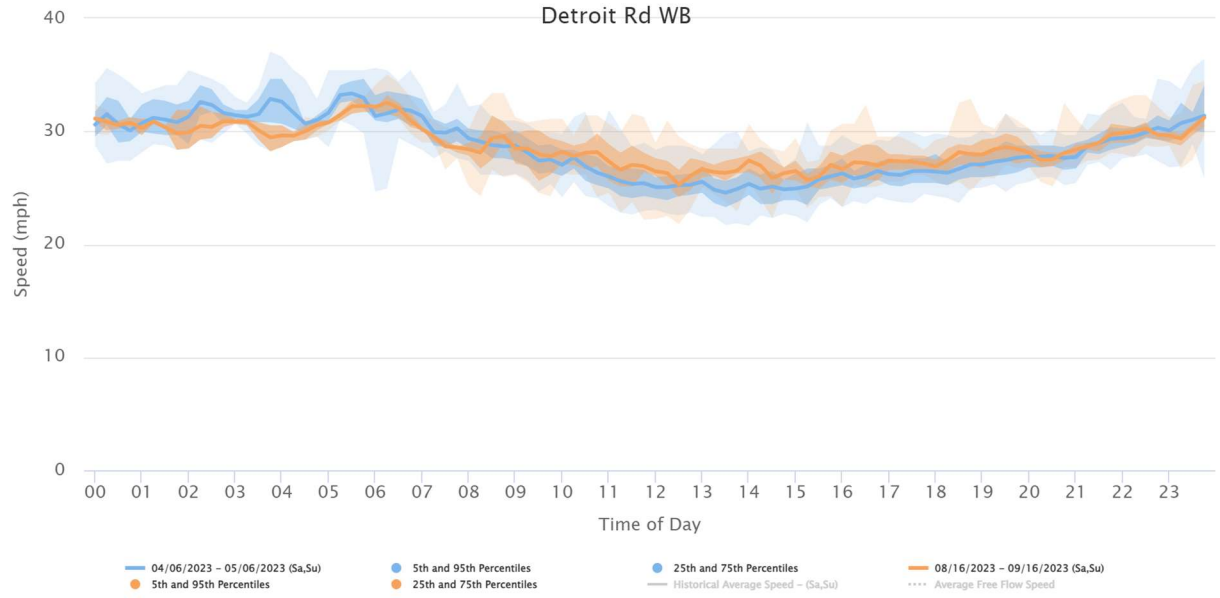


FIGURE 9: WEEKEND AVERAGE SPEED COMPARISON FOR SR 254 WB/SR 301 NB



LOR-254/LOR-301
Estimated Signal Retiming Benefits