MEMO

TO: Michelle O'Neill, PE

FROM: Lauren Warren, PE, PTOE; Trevor J. Kirsch, MS, EIT; Matt Hill, PE, PTOE

SUBJECT: **Base Conditions Memo**

DATE: **November 11, 2019**

PURPOSE

The intent of this memorandum is to summarize the performance of the base conditions microsimulation model. Base conditions represent the PM peak period (3:00pm – 7:00pm) with traffic count data from March of 2018 and September of 2019 as described in the previously prepared ***VISSIM Modeling Methodology and Assumptions Memo*** dated 10/1/2019 by WSP. The model was prepared in VISSIM and was validated and calibrated as described in the previously prepared ***Calibration and Validation Memo*** dated 10/30/2019 by WSP. Figure 1 illustrates the modeled study area of the WB I-94 corridor at US-131.

TRAFFIC VOLUMES

A balanced set of traffic volumes in 15-minute intervals was established for the study area for the entire four hour PM peak period (3:00pm – 7:00pm). VISSIM requires that all traffic be balanced within the model, as the software does not allow vehicles to enter or exit the network at internal junctions. In other words, all vehicles which are generated in the model must enter and exit the network appropriately. To develop the balanced volume set, one mainline count on each freeway segment was considered as ground truth, as well as all the entry and exit ramp counts. Using this information, the subsequent mainline segment volumes were adjusted accordingly to balance based on the entry and exit ramp counts. The volume exhibits in Figure 2 through Figure 6 reflect the established balanced volume set during the PM peak hour (4:45 PM to 5:45 PM) within the study area.

MEASURES OF EFFECTIVENESS

The base condition model was run ten times using different random number seeds and the MOEs from these runs averaged together. The 10 runs were based on previous confidence interval calculations in the ***Calibration and Validation Memo*** dated 10/30/2019 by WSP. Ten simulation runs should capture all reasonable variability in MOE results when reporting the average of these runs.

Figure 1. Study Area

Figure 2. Westnedge Ave Volume Exhibit

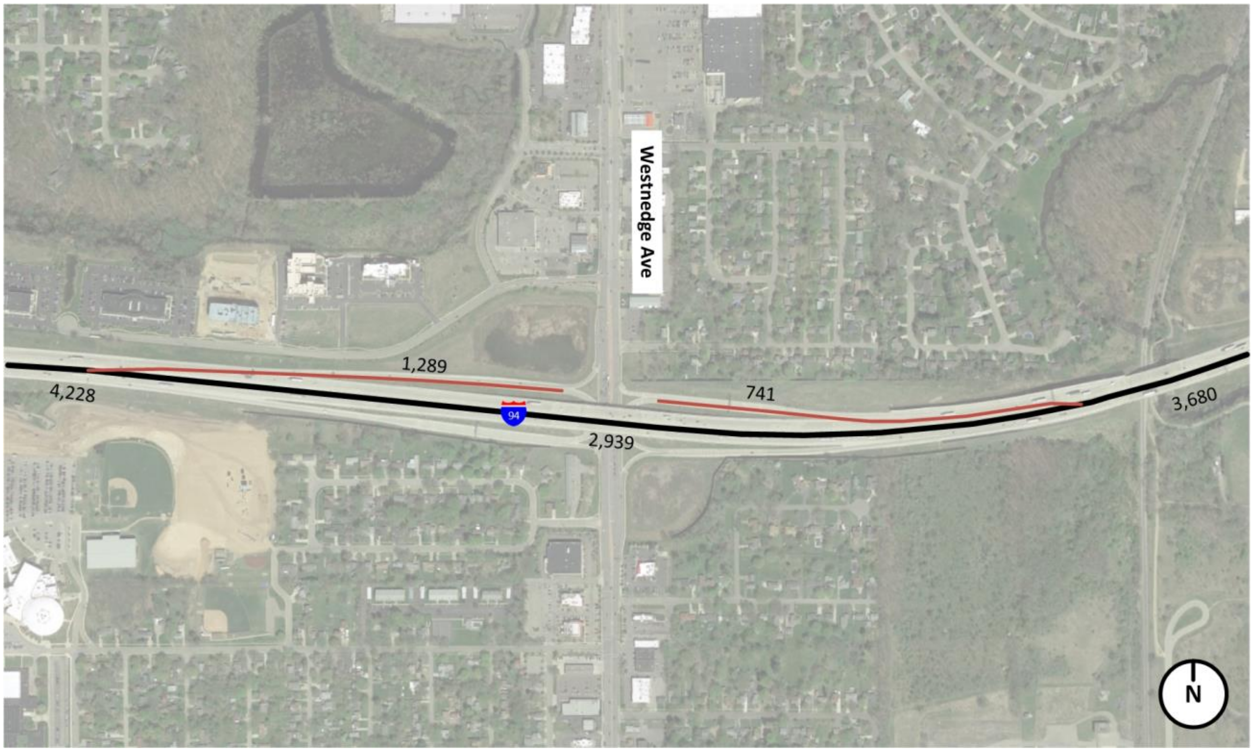


Figure 3. Oakland Dr Volume Exhibit

Figure 4. I-94 and US-131 Interchange Volume Exhibit

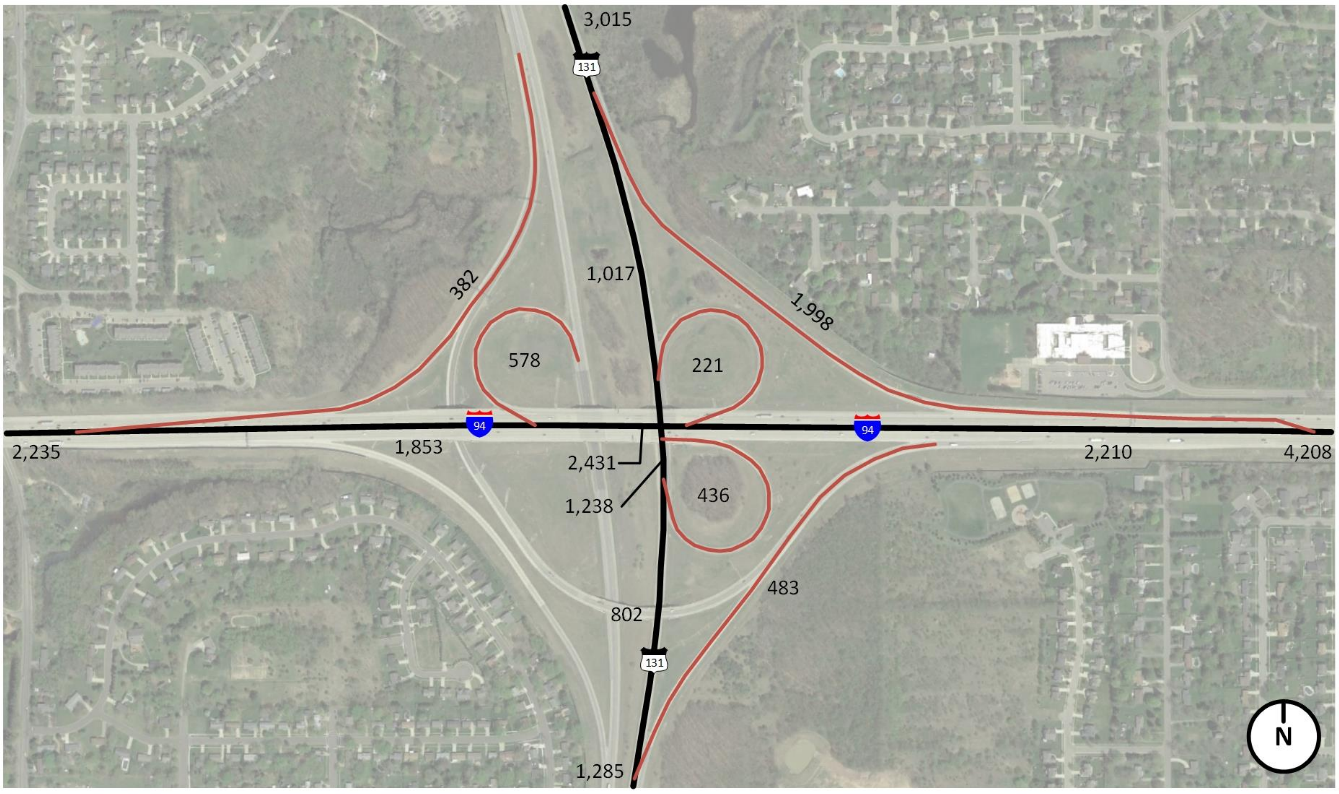


Figure 5. 9th St Volume Exhibit

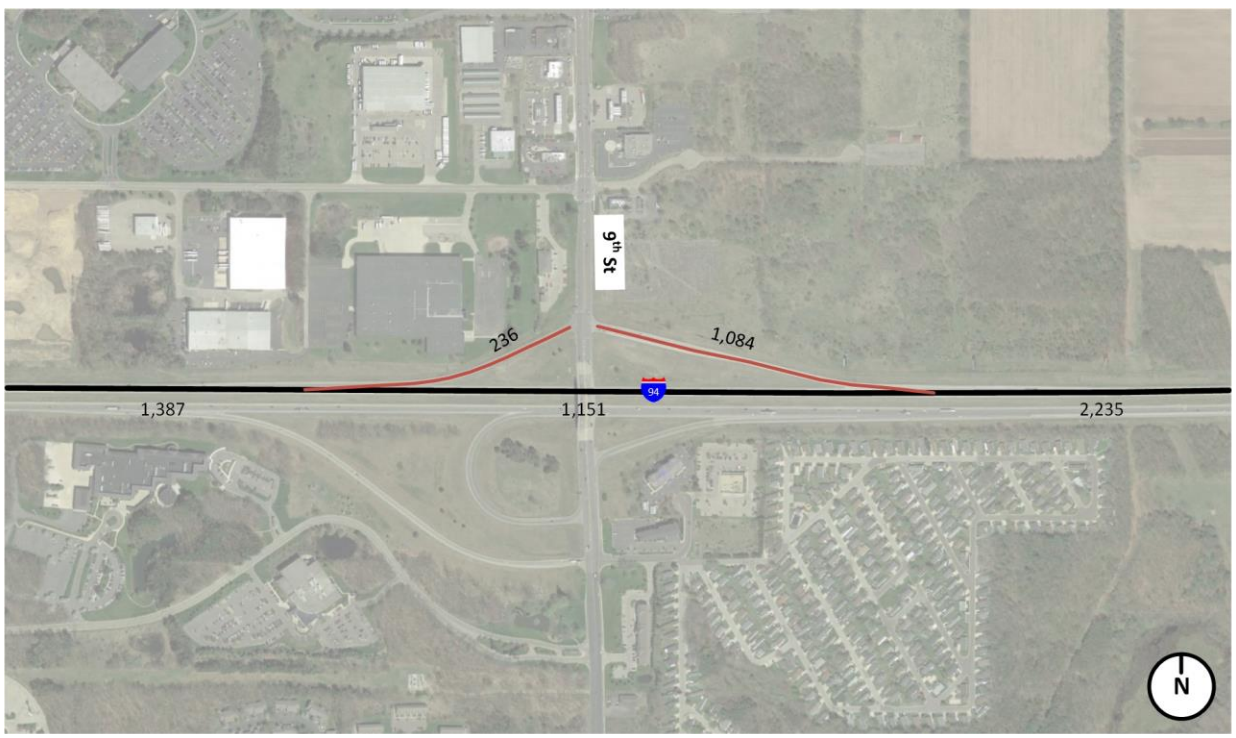
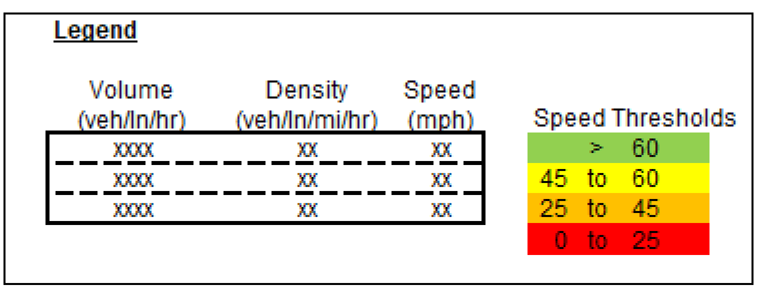


Figure 6. Stadium Dr Volume Exhibit

FREEWAY MOES

Lane schematics were created for both I-94 WB and US-131 NB. The lane schematics depict various MOEs, including volume (vehicle throughput), density, and speed per lane. Figure 7 contains a legend that depicts the layout of the MOEs for each lane segment, the units for each MOE, and how the segments are color coded:

Figure 7. Lane Schematic Legend



Note that the results displayed within the following schematics are averaged over the ten simulation runs and include MOEs during the peak hour of the PM peak period (4:45 PM to 5:45 PM). Figure 8 contains the lane schematic for I-94 WB, while Figure 9 contains the lane schematic for US-131 NB.

Figure 8. I-94 WB Corridor Lane Schematic

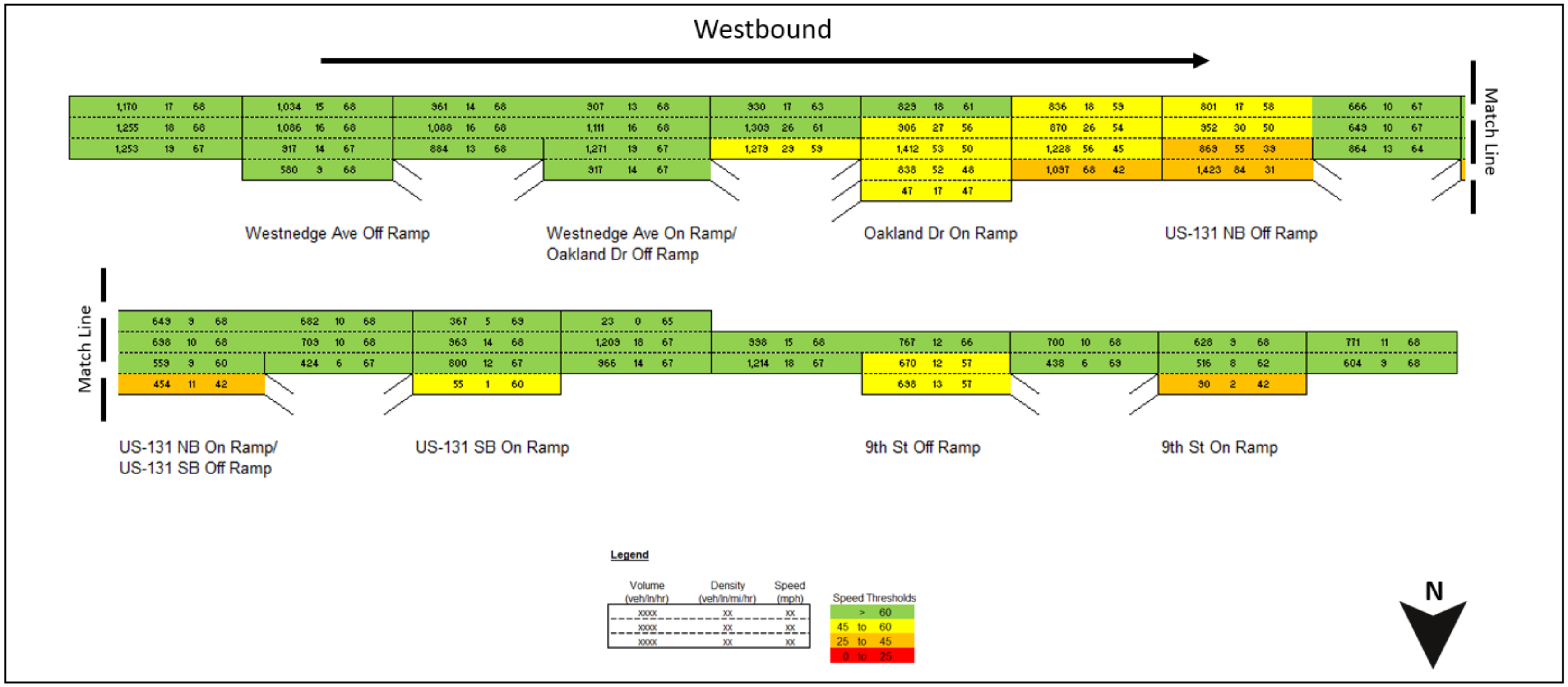
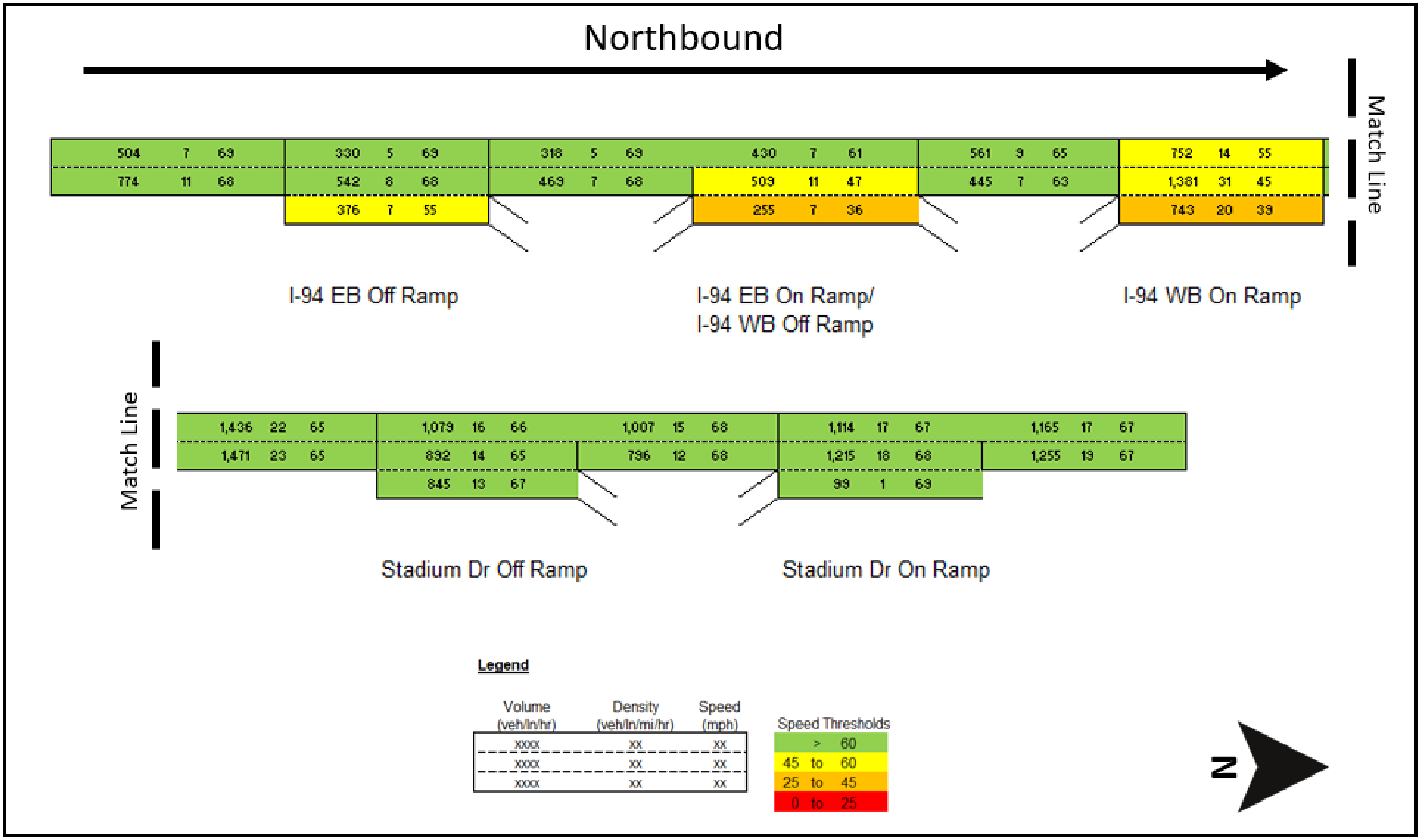


Figure 9. US-131 NB Corridor Lane Schematic



SURFACE STREET MOES

The intersections within the study area were analyzed to determine the base operational performance of the surface street network. The MOEs used to measure the performance of intersections in this analysis were intersection delay and queue length.

Delay can be converted to a level of service (LOS) benchmark at an individual movement, approach, and an intersection-level. The LOS is a scale-based metric for the amount of experienced delay. The LOS criteria utilized in this analysis are from the *Highway Capacity Manual (2016)* and are displayed in Table 1. LOS D or better are typically considered acceptable in urban areas.

Table 1. Highway Capacity Manual (2016) LOS Thresholds for Signalized Intersections

LOS	Description	Average Control Delay Per Vehicle (s)
A	Operations with very low control delay occurring with favorable progression and/or short cycle lengths.	≤ 10.0
B	Operations with low control delay occurring with good progression and/or short cycle lengths.	> 10.0 and ≤ 20.0
C	Operations with average control delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures begin to appear.	> 20.0 and ≤ 35.0
D	Operations with longer control delays due to a combination of unfavorable progression, long cycle lengths, or high volume-to-capacity ratios. Many vehicles stop and individual cycle failures are noticeable.	> 35.0 and ≤ 55.0
E	Operations with high control delay values indicating poor progression, long cycle lengths, and high volume-to-capacity ratios. Individual cycle failures are frequent occurrences. This is considered the limit of acceptable delay.	> 55.0 and ≤ 80.0

The other surface street MOE considered in this analysis is queue length. The queue length at an approach is related to the congestion experienced, as a longer queue typically means more congestion. For the intersections within the study area, two queue-related MOEs were collected: (1) average queue length and (2) maximum queue length. Each of these parameters were collected during the PM peak hour and averaged over the ten simulation runs.

The surface street MOEs are summarized in Table 2 and Table 3. Table 2 displays the LOS results, while Table 3 contains the queue length information. Note that the results in both tables are averaged over ten simulation runs during the PM peak (4:45 PM to 5:45 PM).

Table 2. Surface Street LOS Results

Intersection	Northbound				Southbound				Eastbound				Westbound				Total
	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	LT	TH	RT	Approach	
I-94 and Westnedge Ave	E	C	A	C	E	C	A	C	E	NA	C	D	E	NA	B	E	D
I-94 EB and Oakland Dr	NA	C	B	C	C	A	NA	A	D	NA	C	D	NA	NA	NA	NA	B
I-94 WB and Oakland Dr	E	A	NA	B	NA	D	C	C	NA	NA	NA	NA	D	NA	C	D	C

Table 3. Surface Street Queue Results

Intersection	Northbound		Southbound		Eastbound		Westbound	
	Average (ft)	Maximum (ft)	Average (ft)	Maximum (ft)	Average (ft)	Maximum (ft)	Average (ft)	Maximum (ft)
I-94 and Westnedge Ave	68	320	53	246	102	416	125	431
I-94 EB and Oakland Dr	170	968	34	413	92	282	NA	NA
I-94 WB and Oakland Dr	31	396	310	1,042	NA	NA	82	301

SUMMARY

WB I-94

Based on the results depicted in Figure 8, most of the congestion on I-94 WB is related to the interchange ramp between I-94 WB and US-131 NB. During the PM peak period, the speeds on the lanes near this diverge are below 35 mph. Additionally, the congestion is focused between the area of the diverge to US-131 NB and the Oakland Dr on ramp, as shown by the various MOEs. This modeled congestion is similar to the congestion that was identified through MDOT feedback, field review, and video observations. This congestion is due to the heavy volume of I-94 WB traffic exiting to US-131 NB during this time period (1,998 during the PM peak hour, which is approximately **47%** of the I-94 WB traffic approaching the system interchange). Outside of this area, few lanes experience significantly reduced speeds due to congestion during the PM peak with the exception of some localized slowing of the WB I-94 weave lane between the US-131 NB on ramp and the US-131 SB off ramp.

NB US-131

Based on the results shown in Figure 9 , there are two locations with reduced speeds on US-131 NB within the study area. As expected, one location with reduced speeds is at the merge of the I-94 WB entrance ramp to US-131 NB. The other segment with reduced speeds is the weave lane between the I-94 EB on ramp and the I-94 WB off ramp.

Oakland Drive Ramp Terminals

The I-94 EB and Oakland Dr intersection has one approach with an LOS D. This approach is the ramp terminal from I-94 EB to the Oakland Dr surface street. The eastbound approach at this intersection has a LOS D for the left-turn movement and an LOS C for the right-turn movement. The other approaches (i.e. northbound and southbound) have an LOS C and LOS A, respectively. Overall, the intersection has an LOS B. Considering the queue analysis, the longest average queue length among all approaches at this intersection is the northbound approach, with an average queue length of 170 ft. This approach also has the greatest maximum queue length at 968 ft.

The I-94 WB and Oakland Dr intersection has similar results to the previous intersection. At this intersection, the ramp terminal is also the approach with an LOS D. Similarly, the left-turn movement has an LOS D and the right-turn movement has an LOS C. The other approaches (i.e. northbound and southbound) have an LOS B and LOS C, respectively. Additionally, the SB through movement has an LOS D at this location. Ultimately, the entire intersection operates at a LOS C. Considering the queue analysis, the results are also similar to the previous intersection, as the longest average queue is 310 ft along the southbound approach. Likewise, the greatest maximum queue length is 1,042 ft for the same approach.

Westnedge Avenue Ramp Terminals

As displayed in Table 2, two of the approaches have a LOS C for the intersection of I-94 and Westnedge Ave. These approaches (i.e. northbound and southbound) have identical LOS results, with a LOS E for the left-turn movement, LOS C for the through movement, and LOS A for the right-turn movement. The eastbound approach has a LOS E for the left-turn movement and a LOS C for the right-turn movement, with a LOS D for the approach. The westbound approach has a LOS E for the left-turn movement and a LOS B for the right-turn movement. This approach has an overall LOS E. As a whole, the intersection has a LOS D. The queue results in Table 3 show that the longest average queue is 125 ft for the westbound approach. This approach also has the longest maximum queue with a length of 431 ft.