

# Western Kentucky Parkway Traffic Analysis and Methodology

## Introduction

The traffic operational analysis was conducted using the capacity screening methodology from the *Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual* (NCHRP Report 825)<sup>1</sup> to evaluate the potential for operational issues. Given that the volumes in the corridor appeared to be below the capacity of the facility even in the highest volume areas, this screening approach was determined to be the most appropriate method for quickly and effectively determining if a detailed traffic operational analysis was needed. Where the volume to capacity ratio was calculated to be 0.80 or greater, a Highway Capacity Manual analysis was performed.

## Methodology

NCHRP Report 825 presents a service volume approach to examining capacity on freeways. The method uses information from the *Highway Capacity Manual 6th Edition* (HCM6) to develop peak hour directional volume thresholds for LOS A-C, LOS D, and LOS E. The relevant material for this approach is provided in **Figure 1**.

As outlined in the first yellow highlighted section of **Figure 1**, comparing the forecasted volume to a service volume capacity can highlight where capacity issues could be expected and where a detailed HCM6 analysis is warranted. The second highlighted section goes on to point out that comparing the volumes to a LOS threshold can be used to exclude sections from more detailed analysis. This screening analysis used the more conservative second approach and compared the projected 2045 volumes to the LOS D service volume threshold. It also examined the volumes to see if they fell in the LOS A through LOS C range.

The highlighted portion of the table in **Figure 1** shows the peak hour service volume thresholds for rural freeways in rolling terrain by LOS category. These values are based on an estimate of 12% trucks. The Western Kentucky Parkway has truck percentages that range between 15% and 32%, therefore, new lower thresholds were derived for each of the truck percentages. The adjusted customized thresholds are presented in **Table 1**. These are vehicle per hour per lane volumes.

**Table 1: Peak Hour Service Volume Thresholds**

LOS	Service Volume Thresholds (veh/hr/ln) by Truck %				
	15%	17%	19%	30%	32%
A – C	1250	1210	1180	1020	990
D	1530	1480	1440	1240	1210
E	1740	1680	1640	1410	1380

<sup>1</sup> [Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual | NCHRP](#)

Figure 1: Page 45 from Planning and Preliminary Engineering Applications Guide to the Highway Capacity Manual (NCHRP Report 825)

#### 4. Scoping and Screening Method

##### Generalized Service Volume Table

Whether or not a more detailed freeway facility analysis is needed can be determined by comparing the counted or forecasted peak hour or daily traffic volumes for the sections of the freeway between each on- and off-ramp to the values given in Exhibit 19. If all of the section volumes fall in the LOS E range or better, there will be no congestion spillover requiring a full facility analysis to better quantify the facility's performance. One can then use the HCM segment analysis procedures with defaults for some of the inputs to evaluate the performance of each segment. (Note that "segments" have a special definition in the HCM, while "sections" are defined in this Guide by the freeway on- and off-ramps.)

The service volumes in Exhibit 19 can also be used to quickly determine the geographic and temporal extent of the freeway facility that will require analysis. If the counted or forecasted volumes for a section fall below the agency's target LOS standard, then the section can be excluded from a more detailed analysis. If the volumes fall near or above the volume threshold for the agency's target LOS, then the section may require more detailed analysis.

Any section that exceeds the capacity values in Exhibit 19 will have queuing that may impact upstream sections and reduce downstream demands. In such a situation, a full freeway facility analysis is required to ascertain the freeway's performance. The facility analysis can be performed either using the HCM method with defaults, or the simplified HCM method, both of which are described later in this section.

The analyst may also use the capacities shown in Exhibit 19 to compute the peak hour, peak direction demand-to-capacity ratio for each segment under various improvement options. These options can then be quickly ranked according to their forecasted demand-to-capacity ratios for the critical sections of the freeway.

**Exhibit 19. Daily and peak hour service volume and capacity table for freeways.**

Area Type	Terrain	Peak Hour Peak Direction (veh/h/ln)			AADT (2-way veh/day/ln)		
		LOS A-C	LOS D	LOS E (capacity)	LOS A-C	LOS D	LOS E (capacity)
Urban	Level	1,550	1,890	2,150	14,400	17,500	19,900
Urban	Rolling	1,480	1,810	2,050	13,700	16,700	19,000
Rural	Level	1,460	1,770	2,010	12,100	14,800	16,800
Rural	Rolling	1,310	1,600	1,820	11,000	13,400	15,200

Source: Adapted from HCM (2016), Exhibit 12-39 and 12-40.

Notes: Entries are maximum vehicle volumes per lane that can be accommodated at stated LOS.

AADT = annual average daily traffic. AADT per lane is two-way AADT divided by the sum of lanes in both directions.

Urban area assumptions: Free-flow speed = 70 mph, 5% trucks, 0% buses, 0% RVs, peak hour factor = 0.94, 3 ramps/mi, 12-ft lanes, K-factor = 0.09, and D-factor = 0.60.

Rural area assumptions: Free-flow speed = 70 mph, 12% trucks, 0% buses, 0% RVs, peak hour factor = 0.94, 0.2 ramps/mi, capacity adjustment factor for driver population = 1.00, 12-ft lanes, 6-ft lateral clearance, K-factor = 0.10, and D-factor = 0.60.

Similar tables can be developed by adjusting input values to reflect other assumptions.

The K-factor is the ratio of weekday peak hour two-way traffic to AADT. The D-factor is the proportion of peak hour traffic in the peak direction.

## Traffic Operations Screening

While LOS E is the maximum capacity, for this analysis LOS D was selected as the “capacity” threshold to provide a conservative capacity test for further evaluation. The DHVs calculated for the corridor were compared to the LOS D threshold to determine if any segments warranted further analysis.

The eastbound (EB) and westbound (WB) mainline results are presented in **Table 2** and **Table 3**, respectively. **Figure 2** and **Figure 3** graph the demand volume and the LOS D threshold service volume. Using the LOS D threshold, the highest V/C ratio is 0.80 between the US 31W Bypass and I-65. An HCM6 analysis was performed on this segment and is described in more detail in the following section. A check was made for all of the ramps and weave facilities as well to compare the ramp volumes to the capacity of a single lane ramp and no issues were identified, with the highest ramp volume reaching 1,260 vehicle per hour in 2045.

**Table 2: Western Kentucky Parkway Mainline EB Capacity Screening Analysis (2045 Volumes)**

Segment Start	Segment End	Type	Lanes	Speed Limit (mph)	Truck %	2045 DHV (veh/hr, all lanes)	2045 DHV (pcphpl)	Max Capacity for LOS D (pcphpl)	V/C Ratio	LOS Estimate
West of I-165	I-165	Basic	2	70	32	550	275	1210	0.23	LOS A-C
I-165	KY 79	Basic	2	70	30	510	255	1240	0.21	LOS A-C
KY 79	KY 259	Basic	2	70	30	620	310	1240	0.25	LOS A-C
KY 259	KY 224	Basic	2	70	17	780	390	1480	0.26	LOS A-C
KY 224	KY 84	Basic	2	70	17	990	495	1480	0.33	LOS A-C
KY 84	KY 3005	Basic	2	70	19	1130	565	1440	0.39	LOS A-C
KY 3005	US 31W Bypass	Basic	2	70	19	1410	705	1440	0.49	LOS A-C
US 31W Bypass	I-65	Basic	2	70	15	2440	1220	1530	0.80	LOS A-C
I-65	US 31W	Basic	2	55	15	1810	905	1530	0.59	LOS A-C

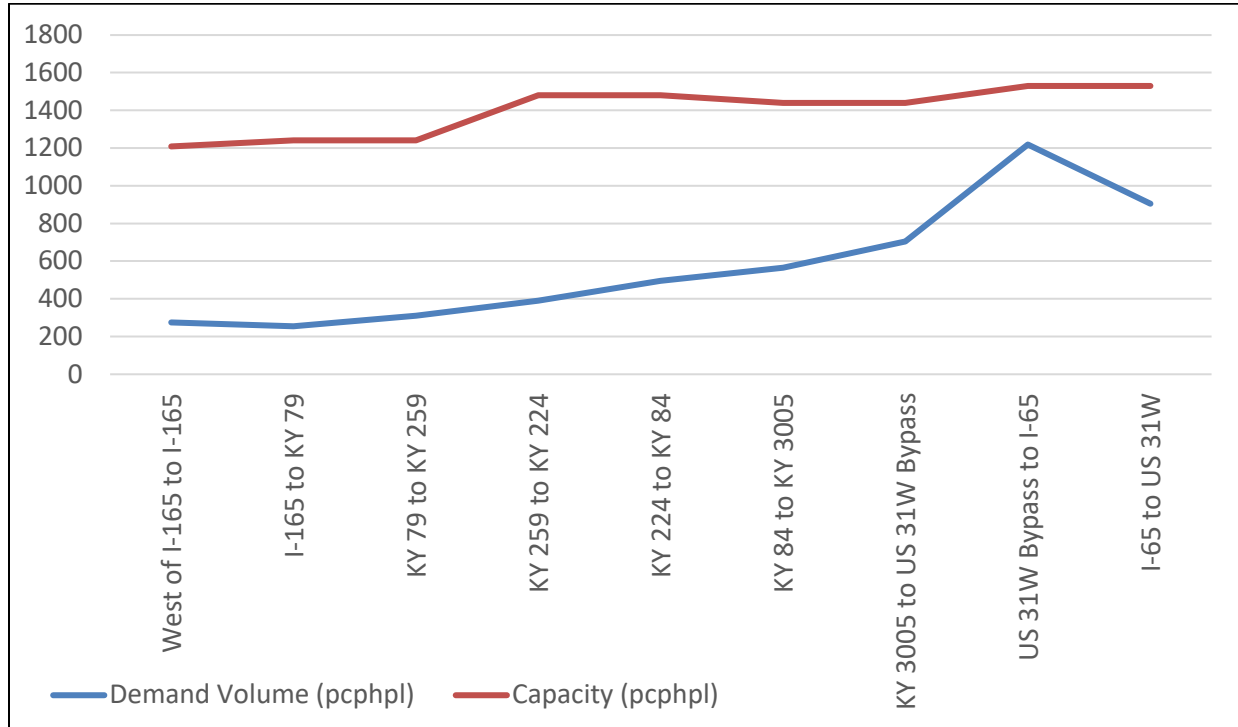
Note: veh/hr = vehicles per hour; pcphpl = passenger cars per hour per lane; LOS = Level of Service; V/C = volume to capacity

**Table 3: Western Kentucky Parkway Mainline WB Capacity Screening Analysis (2045 Volumes)**

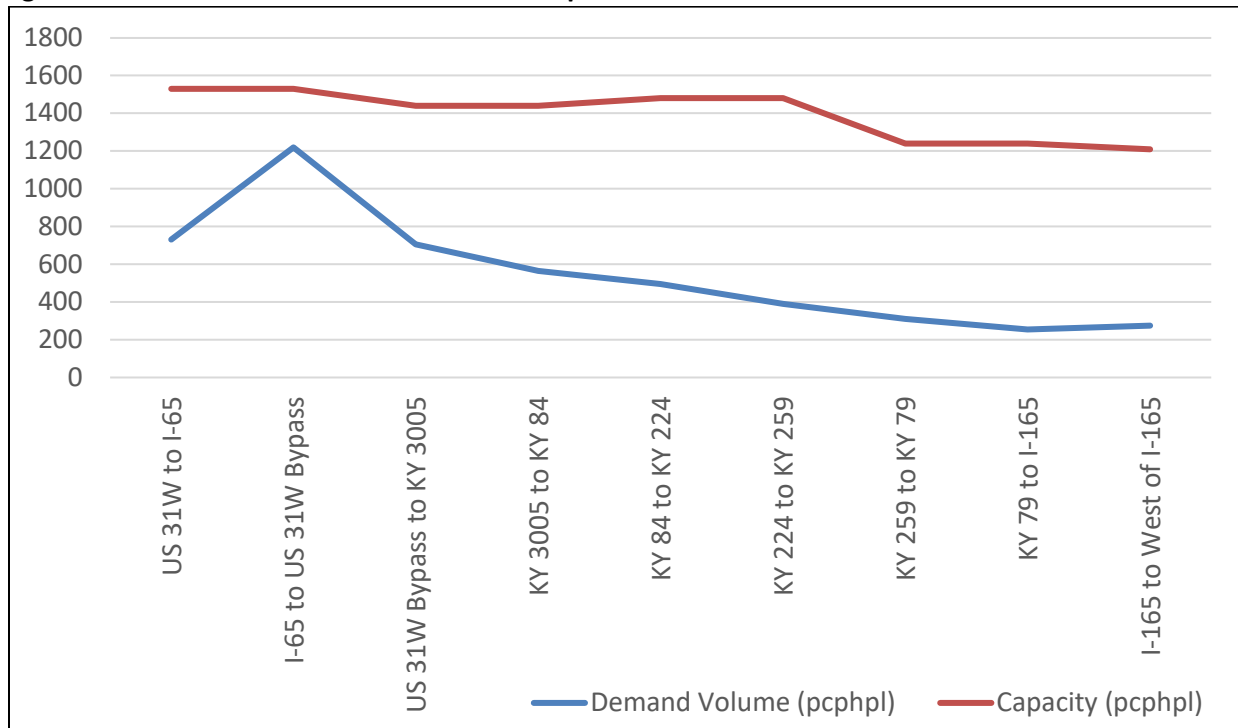
Segment Start	Segment End	Type	Lanes	Speed Limit (mph)	Truck %	2045 DHV (veh/hr, all lanes)	2045 DHV (pcphpl)	Max Capacity for LOS D (pcphpl)	V/C Ratio	LOS Estimate
US 31W	I-65	Basic	2	55	15	1460	730	1530	0.48	LOS A-C
I-65	US 31W Bypass	Basic	2	70	15	2440	1220	1530	0.80	LOS A-C
US 31W Bypass	KY 3005	Basic	2	70	19	1410	705	1440	0.49	LOS A-C
KY 3005	KY 84	Basic	2	70	19	1130	565	1440	0.39	LOS A-C
KY 84	KY 224	Basic	2	70	17	990	495	1480	0.33	LOS A-C
KY 224	KY 259	Basic	2	70	17	780	390	1480	0.26	LOS A-C
KY 259	KY 79	Basic	2	70	30	620	310	1240	0.25	LOS A-C
KY 79	I-165	Basic	2	70	30	510	255	1240	0.21	LOS A-C
I-165	West of I-165	Basic	2	70	32	550	275	1210	0.23	LOS A-C

Note: veh/hr = vehicles per hour; pcphpl = passenger cars per hour per lane; LOS = Level of Service; V/C = volume to capacity

**Figure 2: Eastbound 2045 Per Lane DHVs Compared to LOS D Service Volume Threshold**



**Figure 3: Westbound 2045 Per Lane DHVs Compared to LOS D Service Volume Threshold**



## Highway Capacity Manual Analysis

The section of the Parkway between I-65 and the US 31W Bypass screened at a volume to capacity ration of 0.80, therefore, a more detailed HCM6 analysis was completed using Highway Capacity Software (HCS7) to better determine how this segment would operate at anticipated 2045 traffic volumes.

In the eastbound direction, the ramp merge from US31 W Bypass to the Western Kentucky Parkway will operate at a LOS C in 2045, with both the mainline section between US 31W Bypass and I-65 and the diverge to I-65 southbound operating at a LOS D. In the westbound direction merge, diverge, and weaving segments between I-65 and the US 31W Bypass interchange will operate at LOS C. The results of this analysis are shown in **Table 4** and the HCS7 output files are included in **Appendix A**.

**Table 4: HCS7 2045 Analysis Results**

Segment	Direction	Movement	v/c		Avg. Speed (mph)		Avg. Density (pc/mi/ln)		Level of Service
			Mainline	Ramp	Mainline	Ramp	Mainline	Ramp	
US 31W Bypass Ramp to Parkway	EB	Merge	0.70	0.85	58.3	58.3	27.2	26.3	C
Parkway between US 31W Bypass and I-65	EB	Basic	0.69		55.9		28.4		D
Parkway Ramp to I-65 SB	EB	Diverge	0.70	0.18	55.9	55.9	28.4	29.8	D
Parkway Weave at I-65	EB	Weave	0.76		50.6		23.6		C
I-65 SB Ramp to Parkway	WB	Merge	0.70	0.63	58.2	58.2	27.3	26.7	C
Parkway between I-65 and US 31W Bypass	WB	Basic	0.69		63.6		24.0		C
Parkway Ramp to US 31W Bypass	WB	Diverge	0.70	0.85	52.8	52.8	30.0	27.2	C

## Conclusions

Based on this screening analysis, segments of the Western Kentucky Parkway currently operate at an acceptable level of service and are operating below capacity. In the future year of 2045, the majority of the Western Kentucky Parkway is expected to operate at an acceptable LOS, with the exception of some segments between the I-65 and US 31W Bypass interchange in Elizabethtown.



# Appendix A

## HCS7 Output Files

*Western Kentucky Parkway*

# HCS7 Freeway Facilities Report

## Project Information

Analyst	AR	Date	
Agency		Analysis Year	2045
Jurisdiction		Time Period Analyzed	
Project Description	EB-Western Kentucky Parkway	Unit	United States Customary

## Facility Global Input

Jam Density, pc/mi/ln	190.0	Density at Capacity, pc/mi/ln	45.0
Queue Discharge Capacity Drop, %	7	Total Segments	7
Total Time Periods	1	Time Period Duration, min	15
Facility Length, mi	1.43		

## Facility Segment Data

No.	Coded	Analyzed	Name	Length, ft	Lanes
1	Basic	Basic	WKY at US 31W Bypass	1750	2
2	Merge	Merge	US 31W bypass on-ramp to WKY	860	2
3	Basic	Overlap	WKY from US31 W Bypass to I-65	860	2
4	Diverge	Diverge	WKY off-ramp to I-65 SB	860	2
5	Basic	Basic	WKY off-ramp to I-65 SB to I-65 SB on-ramp	1660	2
6	Weaving	Weaving	I-65 Weave	1000	3
7	Basic	Basic	off-Ramp to on-Ramp	565	2

## Facility Segment Data

### Segment 1: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.769	1534	4418	0.35	58.2	13.2	B

### Segment 2: Merge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.769	0.769	3172	1638	4550	1936	0.70	0.85	58.3	58.3	27.2	26.3	C

### Segment 3: Basic

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.769	3173	4612	0.69	55.9	28.4	D

### Segment 4: Diverge

Time Period	PHF		fHV		Flow Rate (pc/h)		Capacity (pc/h)		d/c Ratio		Speed (mi/h)		Density (pc/mi/ln)		LOS
	F	R	F	R	Freeway	Ramp	Freeway	Ramp	F	R	F	R	Freeway	Ramp	
1	1.00	1.00	0.769	0.769	3173	351	4550	1936	0.70	0.18	55.9	55.9	28.4	29.8	D

**Segment 5: Basic**

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.769	2822	4612	0.61	66.6	20.9	C

**Segment 6: Weaving**

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.769	3589	4702	0.76	50.6	23.6	C

**Segment 7: Basic**

Time Period	PHF	fHV	Flow Rate (pc/h)	Capacity (pc/h)	d/c Ratio	Speed (mi/h)	Density (pc/mi/ln)	LOS
1	1.00	0.769	2276	4418	0.52	56.1	19.6	C

**Facility Time Period Results**

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	57.6	21.9	16.9	1.50	C

**Facility Overall Results**

Space Mean Speed, mi/h	57.6	Density, veh/mi/ln	16.9
Average Travel Time, min	1.50	Density, pc/mi/ln	21.9

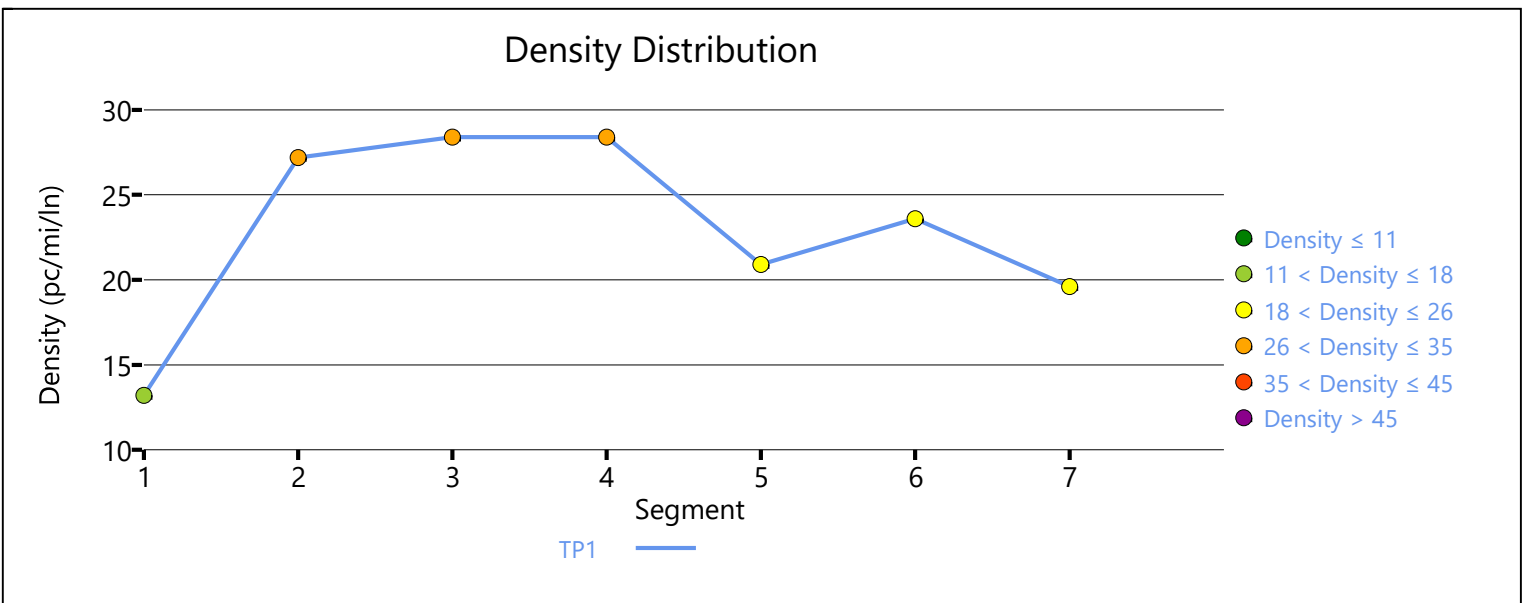
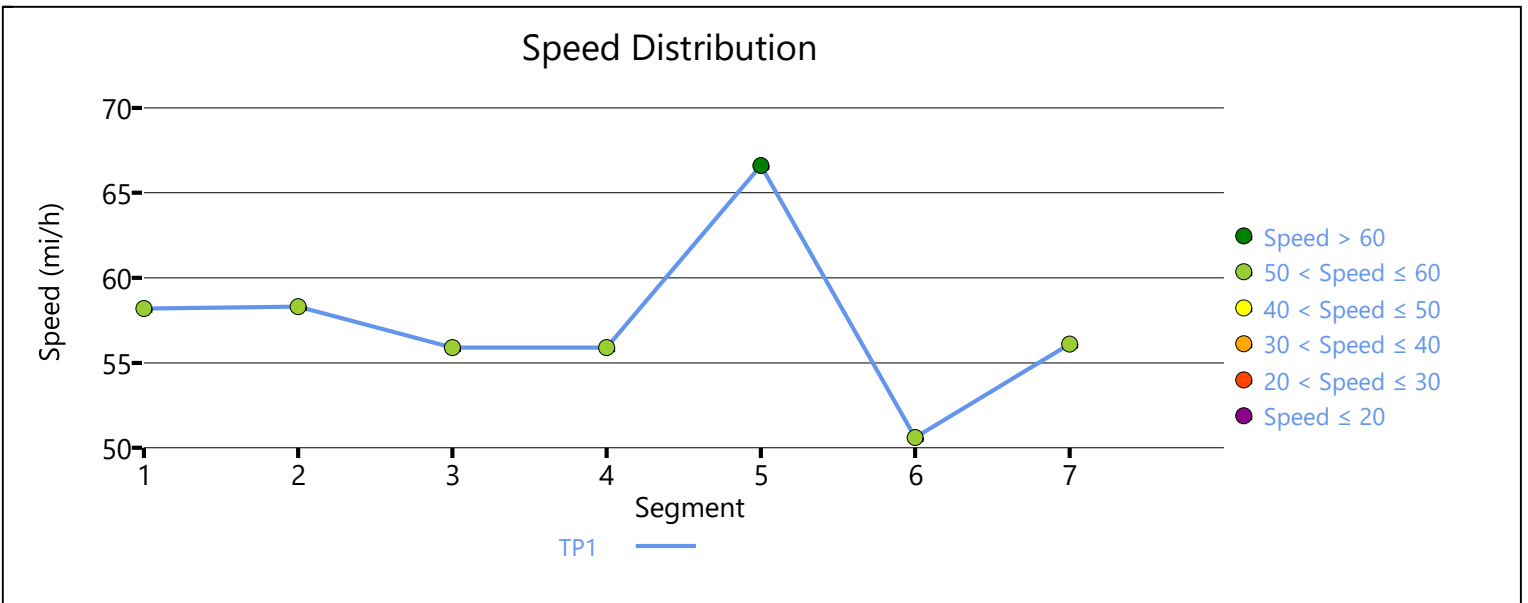
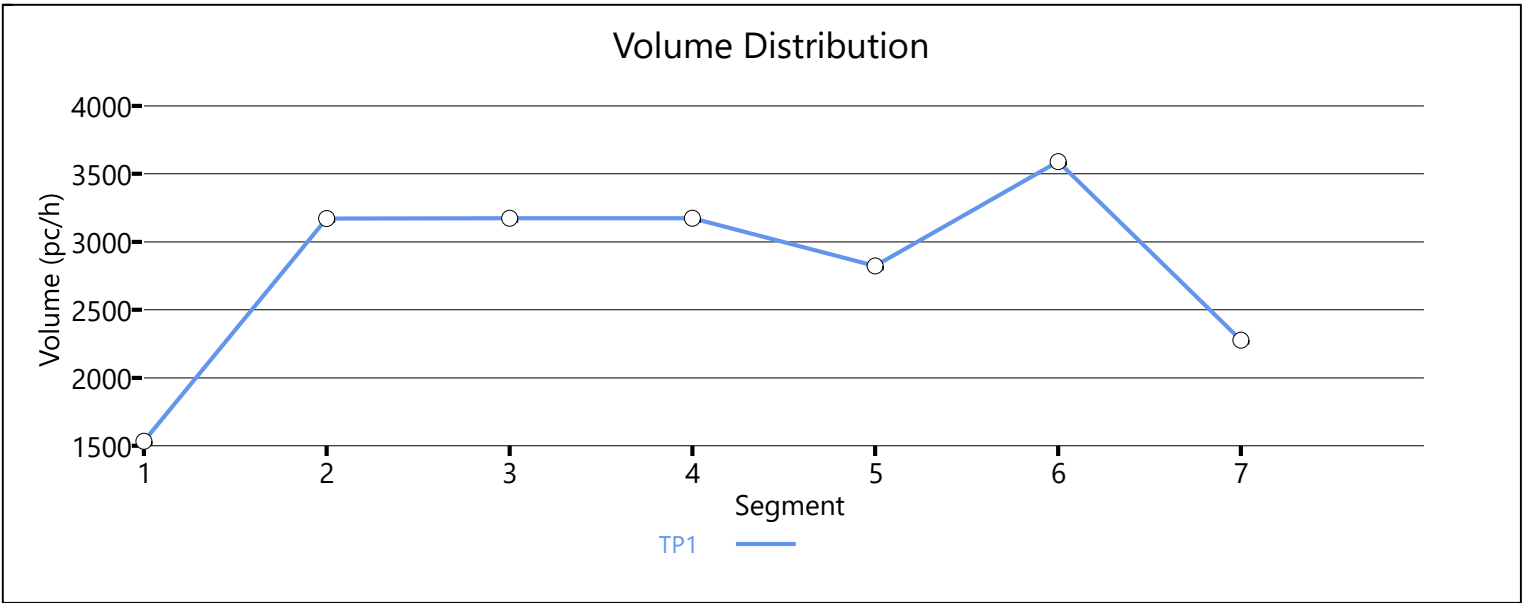
**Messages**

WARNING 1	Weaving Segment (segment 6) is shorter than the segment short length allows. Weaving segments include 500 feet upstream and downstream of gore point. Short length is at a maximum the gore to gore length, and is reduced for any barrier markings (solid white lines) that prohibit or discourage lane changing. Review the values set for Segment length on the Segments page and Short Length on the details page.
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**Comments**

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1	1.00	0.769	1534	4612	0.33	65.8	11.2	B
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### Facility Time Period Results

T	Speed, mi/h	Density, pc/mi/ln	Density, veh/mi/ln	Travel Time, min	LOS
1	62.3	17.2	13.2	0.80	C

### Facility Overall Results

Space Mean Speed, mi/h	62.3	Density, veh/mi/ln	13.2
Average Travel Time, min	0.80	Density, pc/mi/ln	17.2

### Messages

### Comments

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