APPENDIX A

Development of Proposed Level of Service Breakpoints for the Bay Bridge

Chesapeake BAY CROSSING STUDY
TIER 2 NEPA

DEVELOPMENT OF PROPOSED LEVEL OF SERVICE BREAKPOINTS FOR THE BAY BRIDGE

Maryland Transportation Authority
MDTA

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TABLE OF CONTENTS

1. INTRODUCTION 1-1
2. PURPOSE OF ADDITIONAL ANALYSES 2-2
3. DESCRIPTION OF ADDITIONAL ANALYSES 3-5
1.1 IDENTIFICATION OF A SINGLE "PER LANE" CAPACITY (VEHICLES PER HOUR) 3-5
1.1.1 IDENTIFICATION OF A SINGLE "PER LANE" CAPACITY (PASSENGER CARS PER HOUR) 3-8
4. LEVEL OF SERVICE BREAKPOINTS 4-15
5. SUMMARY 5-16

LIST OF FIGURES

Figure 1-1: Capacity of the Bay Bridge 2-2
Figure 1-2: Figure 1-2: HCS LOS E/F Breakpoint Analyses 3-13

LIST OF TABLES

Table 1-1: Peak Hourly Volumes, by Direction 3-7
Table 1-2: Eastbound Peak Hourly Truck Volumes and Truck Percentages 3-10
Table 1-3: LOS Criteria for Basic Freeway and Multilane Highway Segments 3-12
Table 1-4: Best-Case Condition Level of Service Breakpoints for Bay Bridge 4-155

1. INTRODUCTION

The capacity of the William Preston Lane Jr. Memorial (Bay) Bridge has been studied by the Maryland Transportation Authority (MDTA) on a number of occasions over the years. The Bay Bridge is actually two bridges: a two-lane span which handles eastbound traffic under normal conditions and a three-lane span which handles westbound traffic under normal conditions. For the purposes of this document, the "Bridge" refers to both spans; if one span or the other is discussed, that span is specifically identified. Traditional capacity analyses performed by the MDTA have consistently recognized that the Bay Bridge, even under ideal operating conditions, has a lower capacity than what would otherwise be anticipated considering the number of lanes and the operation of those lanes on the Bridge.

All five lanes on the Bridge are capable of being reversed (that is, being operated in contraflow fashion) in order to accommodate the broadest possible range of conditions, including: peak eastbound flow during the weekday PM peak period; peak eastbound flow on Fridays and Saturdays during the summer; and lane closures due to incidents or maintenance operations. The most frequent departure from normal operation is a reversal of the southernmost lane on the three-lane span to provide a third eastbound lane. This condition is known locally as "two-way traffic".[1]

A number of factors contribute to the Bay Bridge having a lower capacity than would otherwise be expected. Among these factors are:

1. Absence of shoulders.

2. Uphill grade.

3. Horizontal curve.

4. Physical environment, including the Bay itself, the expansive views from the Bridge under clear weather conditions (which can lead some drivers to slow down to look at the viewshed of the Bay and/or ships on the Bay), the lack of any roadside view under inclement weather conditions (which can lead some drivers to slow down due to uncertainty regarding what is present just beyond the Bridge parapet), the movement of the Bridge (particularly in windy conditions), and the presence of the Bridge towers (which are physically striking in their appearance and can lead some drivers to slow down to look at them).

5. Lane restrictions for vehicles exceeding 5 tons gross vehicle weight/gross vehicle weight rating (GWV/GWVR). Such vehicles are restricted to the right lane on both spans and are prohibited in the two-way lane.

[1] Weather permitting, "two-way traffic" is implemented on more than 200 days per year. It is not implemented during inclement weather or during windy conditions.

6. Speed limits, which vary by span and by location on the span. On the southern bridge (which is normally used for eastbound traffic), the speed limit is 40 miles per hour (mph) at the beginning of the span, increasing to 50 mph partway across. When two-way traffic is in effect on the southern span, westbound traffic has a speed limit of 40 mph through the entire length. On the northern span (which is normally used for westbound traffic), the speed limit is 50 mph through the entire length. When two-way traffic is in effect on the northern span, eastbound traffic has a speed limit of 40 mph through the entire length.

7. In addition, when either structure is accommodating traffic in both directions, there is a reduction in capacity, due to the lack of a divider between the directions of travel.

Currently, MDTA identifies the capacity of the Bay Bridge as shown in Figure 1-1.[2]

Figure 1-1: Capacity of the Bay Bridge

Traffic Capacity (both spans):
1,300 - 1,500 vehicles per lane, per hour*
*This capacity assumes idealized conditions—factors such as adverse weather, two-way operations, roadwork, and roadway incidents typically reduce capacity

This range of capacity values provides MDTA and others interested in traffic operations on the Bridge with a valuable method of determining when congestion is likely to occur, which hours of a particular day might be subject to congestion if there is a closure of one or more lanes, and a means of understanding when two-way traffic is appropriate.

Over the years, the reported capacity of the Bay Bridge has varied slightly. Factors influencing the capacity are likely to have included changes in the type and number of traffic control devices in use on the Bridge, removal of the toll plaza from the westbound direction in 1989, elimination of cash toll collection in the eastbound direction in 2020, complete removal of the eastbound toll plaza in 2021, changes in driver behavior, and changes in the number of drivers not familiar with the Bridge.

2. PURPOSE OF ADDITIONAL ANALYSES

While the capacity of the Bay Bridge is a vitally important measure, it does not, by itself, quantify the degree of congestion which can exist when volumes are approaching capacity but still below capacity. For the purposes of the Bay Crossing Study Tier 2 NEPA (BCST2), quantifying congestion

[2] https://mdta.maryland.gov/Toll_Facilities/WPL.html

is an important analytical step when evaluating potential alternatives and comparing their abilities to accommodate traffic.

In a study like the BCST2, this quantification is typically established by using the Highway Capacity Manual (HCM)[3] to evaluate traffic operations in terms of level of service (LOS). LOS as defined by the HCM "is a quantitative stratification of a performance measure or measures that represents quality of service, measured on an A through F scale, with LOS A representing the best operating conditions from the traveler's perspective and LOS F the worst."

At LOS D, flow is still stable, and travel times are relatively predictable. At LOS E, flow is volatile, and travel times can vary widely. Capacity is the breakpoint between LOS E and LOS F. Accepted transportation planning and traffic engineering expertise and practice suggest that achieving at least a LOS D is preferred, but LOS E or even LOS F may be all that is possible for some facilities.

The BCST2 will assess multiple alternatives to provide additional capacity across the Bay. In addition to a No-Build, the BCST2 will consider alternatives providing additional lanes on a new crossing and/or modifying operations on the existing Bridge. In order to provide a constant frame of reference for evaluating the capacity and traffic performance of these alternatives, identifying a single "per lane capacity" for the existing Bridge is an essential first step. "Per lane capacity" will assist the Study Team by providing a consistent means of computing the LOS for each alternative and allowing a direct comparison between the alternatives and to the No-Build.

The single "per lane capacity" will be used to establish a best-case condition for the existing Bridge. Such a single "per lane capacity" is intended only for use in the BCST2 or similar planning studies. There are a number of factors which can reduce the capacity of the Bridge on any given day or even during any given hour, including incident management, inclement weather, and debris on the roadway surface. These factors are not considered in the "per lane capacity".

This single "per lane capacity" may be used as an initial assumption, but may be modified in the analysis of any alternatives which consider a new crossing because any new crossing proposed could have physical characteristics which differ from those on the existing Bridge. These could include grade, horizontal curvature, lane widths, and offsets from travel lanes to physical barriers. Those characteristics will be defined for any such alternatives, and a modified single "per lane capacity" may be used in those analyses.

[3] National Academies of Sciences, Engineering, and Medicine. 2022. *Highway Capacity Manual 7th Edition: A Guide for Multimodal Mobility Analysis*. Washington, DC: The National Academies Press. https://doi.org/10.17226/26432.

The purpose of performing additional analyses is to:

1. Identify appropriate adjustment factors to HCM procedures, so that the observed best-case condition capacity of the Bay Bridge can be reflected.
2. Identify appropriate LOS breakpoints for the existing Bay Bridge, based on that best-case condition capacity. (For the purposes of BCST2, an LOS breakpoint is defined as the traffic volume at which one LOS ends and the next one begins.)

These analyses are described on the following pages.

3. DESCRIPTION OF ADDITIONAL ANALYSES

1.1 Identification of a Single "Per Lane" Capacity (Vehicles per Hour)

As noted in the Introduction, it is recognized that the capacity of the Bay Bridge is affected by a number of factors, including the presence/absence of two-way traffic. Because these factors are variable from day-to-day, and even from hour-to-hour, the range of capacities shown in Figure 1-1 has been observed over the years by MDTA.

Traffic volume data incorporated for these analyses covered the period April 1, 2022 through September 11, 2022. This range of dates was selected for the following reasons:

1. It was the most recent data available when the analyses were initiated.
2. Both non-summer and summer conditions were represented.
3. The entire summer period (typically thought of as beginning on Memorial Day weekend and ending on Labor Day weekend) was covered.

1. Toll system data, for the eastbound direction, by hour, by number of vehicles and by number of axles per vehicle.[4]
2. Automatic traffic recorder (ATR) data, for the westbound direction, counted by MDTA's Wavetronix counters, by hour, by number of vehicles.
3. An events/incident log kept by MDTA, indicating, among other data, when two-way traffic was in operation at the Bridge.

A few construction projects were in progress on the Bridge and its approach roadways during the data collection period. This is not unusual, given the need for ongoing maintenance and repairs to the Bridge, and none of the projects involved lane closures during peak periods. Thus, the data collection period was felt to adequately represent typical conditions.

The eastbound toll system data was reviewed, to determine the highest hourly volumes served. The events/incident log was also checked to confirm that three eastbound lanes were in operation (that is, two-way traffic was in effect) during the hours with the highest volumes. The westbound Wavetronix data was also reviewed, to determine the highest hourly volumes served in that

[4] There is no westbound toll system data, because tolls are not collected in the westbound direction.

direction, and the events/incident log was checked to confirm that three westbound lanes were in operation during those hours. The results of this review are summarized in Table 1-1.

Table 1-1: Peak Hourly Volumes, by Direction

				EB Volume (vehicles per hour)	
Peak Eastbound Hourly Volumes	Day	Date	Hour	From Toll System Data	Average Vehicles per Lane (1)
	Thursday	6/16/2022	5:00 - 6:00 PM	4552	1517
	Thursday	7/28/2022	3:00 - 4:00 PM	4540	1513
	Thursday	8/25/2022	5:00 - 6:00 PM	4450	1483
	Friday	6/10/2022	4:00 - 5:00 PM	4416	1472
	Friday	5/13/2022	2:00 - 3:00 PM	4267	1422

				WB Volume (vehicles per hour)	
Peak Westbound Hourly Volumes	Day	Date	Hour	From Wavetronix Data	Average Vehicles per Lane (1)
	Sunday	8/21/2022	1:00 - 2:00 PM	4329	1443
	Monday	9/5/2022	11:00 - 12:00 Noon	4246	1415
	Sunday	4/24/2022	3:00 - 4:00 PM	4221	1407
	Sunday	4/24/2022	4:00 5:00 PM	4170	1390
	Sunday	7/31/2022	2:00 - 3:00 PM	4165	1388

(1) Volume divided by three lanes, rounded to closest whole number of vehicles.

Examination of Table 1-1 reveals:

1. Using the five hours of data with the largest volumes in each direction, the per lane capacity of the Bay Bridge ranged from 1388 to 1517 vehicles per hour, with eight of the ten values between 1407 and 1483. These values are consistent with the approximate values shown in Figure 1-1.
2. The four hours of data with the largest volumes were in the eastbound direction.

The analyzed data covered 164 days, which equates to 3,936 hours of volume data in each direction. The broadest possible range of conditions, ranging from overnight hours in non-summer conditions to congested peak hours during summer conditions, are represented by this data. It is reasonable to conclude that the volumes in Table 1-1 represent the highest possible volumes, under best-case conditions, which can be accommodated on the Bridge today.

For the purposes of BCST2, a best-case condition capacity of 1,517 vehicles per lane per hour will be used for the Bay Bridge. Since this volume (and the next three highest hourly volumes) were all observed in the eastbound direction, the analyses discussed below use data only from the eastbound direction. The results will be used to represent best-case conditions for both the eastbound and westbound directions.

1.1.1 Identification of a Single "Per Lane" Capacity (Passenger Cars per Hour)

Effect of Heavy Vehicles

Heavy vehicles, such as trucks and buses, are known to have a larger impact on traffic operations than passenger cars. For example, according to the HCM: "The lengths, acceleration characteristics, and deceleration (braking) characteristics of trucks are different from those of passenger cars, which affects the amount of road capacity used by trucks. Length affects the amount of road space occupied by the truck in comparison with a passenger car. Acceleration and deceleration characteristics affect trucks' safe vehicle following distances on level, uphill, and downhill grades. They also affect trucks' maximum safe downhill speed and maximum sustainable uphill speed (crawl speed) on extended upgrades."[5]

In order to address trucks and other heavy vehicles in a consistent manner throughout a wide variety of analyses, the HCM suggests converting each truck into an equivalent number of passenger cars. The passenger car equivalent (PCE) of a truck depends upon the type of truck, the number of trucks in the vehicle stream, and the type of terrain in which the trucks are being driven.

[5] Highway Capacity Manual, p. 203.

The impact of trucks on traffic operations is noticeable on relatively level roadways, and is even more pronounced on uphill sections of roadways, due to the factors discussed above.

The HCM defines level terrain as "any combination of grades and horizontal or vertical alignment that permits heavy vehicles to maintain the same speed as passenger cars. This type of terrain typically contains short grades of no more than 2%". Rolling terrain has some additional hills, and is defined by the HCM as "any combination of grades and horizontal or vertical alignment that causes heavy vehicles to reduce their speed below those of passenger cars but that does not cause heavy vehicles to operate at crawl speeds for any significant length".

The terrain on the Queen Anne's County approach to the Bay Bridge along US 50/US 301 can be described as "level". On the Anne Arundel County side of the Bridge, the terrain can be described as "level" between the Bridge and MD 179; to the west of MD 179, the terrain can be described as "rolling".

According to the HCM, a heavy vehicle in rolling terrain is generally equivalent to 3.0 passenger cars; a heavy vehicle in level terrain is generally equivalent to 2.0 passenger cars. These passenger car equivalents (PCEs) will be used in HCM analyses to be performed in BCST2 for the approach roadways.

The Bay Bridge itself has a significant grade for a significant distance in each direction of travel. In instances like this, the HCM recommends that those specific grades and lengths be used to compute the PCE[6]. The PCE increases as the percentage of heavy vehicles in the traffic stream gets larger, and increases further as the ratio of tractor-trailers (TTs) to single-unit trucks (SUTs) increases. (The HCM treats all heavy vehicles as being either TTs or SUTs.)

The eastbound volume data shown in Table 1-1 was further examined to identify the number of trucks in the traffic stream and the types of those trucks. (This information was available from the toll system data.) The results of this effort are shown in Table 1-2.

[6] Highway Capacity Manual, page 691.

Table 1-2: Eastbound Peak Hourly Truck Volumes and Truck Percentages

	Day	Date	Hour	Hourly Volume from Toll System Data (1)	Number of Trucks Included in this Hourly Volume (2)	Hourly Truck Percentage ((1)/(2), Expressed as a Percentage)	3-axle Vehicles, Assumed to Be Single Unit Trucks (SUTs)	>3-axle vehicles, Assumed to Be Tractor-trailers (TTs)	SUT/TT Percentage of Hourly Truck Volume
Peak Eastbound Hourly Volumes	Thursday	6/16/2022	5:00 - 6:00 PM	4552	190	4.2	40	150	21.1/78.9
	Thursday	8/25/2022	5:00 - 6:00 PM	4450	170	3.8	33	137	19.4/80.6
	Friday	6/10/2022	4:00 - 5:00 PM	4416	133	3.0	33	100	24.8/75.2
	Friday	5/13/2022	2:00 - 3:00 PM	4267	181	4.2	44	137	24.3/75.7
	Friday	9/2/2022	1:00 - 2:00 PM	4246	177	4.2	47	130	26.6/73.4

Examination of Table 1-2 reveals:

1. During the hour with the largest volume, approximately 21 percent of the trucks were SUTs; approximately 79% of the trucks were TTs.
2. During the four hours with the next highest volumes, the proportion of SUTs and TTs was stable, and similar to the values found in the hour with the largest volume. The proportion ranged from a low of 26.6 percent/73.4 percent to a high of 19.4 percent/80.6 percent.

For the purposes of BCST2, a peak hour truck percentage of 4.2 percent will be used, with 21 percent of those trucks being SUTs and 79% being TTs.

Effect of Uphill Grades

In the eastbound direction, the Bay Bridge has an uphill grade for a distance of approximately 1.5 miles; the steepest grade in that ascent is 3.5 percent. In the westbound direction, the steepest grade is 1.9 percent, in an ascent of approximately 2.0 miles. For this combination of grades and lengths, the eastbound direction provides the better representation of actual conditions at the Bridge for HCM analysis.

Highway Capacity Manual Computations

The HCM uses density, measured in passenger cars per mile per lane (pc/mi/ln), to assess LOS. The range of densities for each LOS are shown in Table 1-3. The capacity of a roadway is the upper limit of the density for LOS E, or 45 pc/mi/ln[7].

[7] Highway Capacity Manual, page 671.

Table 1-1: LOS Criteria for Basic Freeway and Multilane Highway Segments

LOS	Density (pc/mi/ln)	HCM Description of This LOS
A	≤11	• Free-flow operations • Vehicles are almost completely unimpeded
B	>11—18	• Reasonably free-flow operations • Ability to maneuver within the traffic stream is only slightly restricted
C	>18—26	• Flow with speeds near the free-flow speed • Freedom to maneuver within the traffic stream is noticeably restricted
D	>26—35	• Speeds begin to decline with increasing flows • Freedom to maneuver within the traffic stream is seriously limited
E	>35—45	• Operation at or near capacity • Operations are highly volatile because there are virtually no usable gaps within the traffic stream
F	Demand exceeds capacity OR density > 45	• Unstable flow

Based on the 2022 data discussed above, the capacity of the Bridge is 4,552 vehicles per hour, with 4.2 percent of those vehicles being trucks. Thus, HCM computations for the Bay Bridge, using these traffic volumes, will show a density of just under 45 pc/mi/ln.

The computational procedures found in the HCM are typically executed through use of Highway Capacity Software (HCS). The HCS analyses performed for the peak hour on the Bay Bridge, using the values derived above, are summarized in Figure 1-2[8].

[8] HCS 2023, the current version of the software which implements the HCM, was used.

Figure 1-2: HCS LOS E/F Breakpoint Analyses

HCS Multilane Highway Report			
Project Information			
Analyst		Date	March 2023
Agency		Analysis Year	
Jurisdiction		Time Analyzed	Peak Hour
Project Description		Units	U.S. Customary
Direction 1 Geometric Data			
Direction 1	Eastbound		
Number of Lanes (N), ln	3	Terrain Type	Specific Grade
Measured or Base Free-Flow Speed	Base	Percent Grade, %	3.50
Base Free-Flow Speed (BFFS), mi/h	49.0	Grade Length, mi	1.50
Lane Width, ft	12	Access Point Density, pts/mi	0.0
Median Type	Divided	Left-Side Lateral Clearance (LC_R), ft	0
Free-Flow Speed (FFS), mi/h	45.1	Total Lateral Clearance (TLC), ft	0
Direction 1 Adjustment Factors			
Driver Population	All Familiar	Final Speed Adjustment Factor (SAF)	1.000
Driver Population SAF	1.000	Final Capacity Adjustment Factor (CAF)	1.000
Driver Population CAF	1.000		
Direction 1 Demand and Capacity			
Volume (V) veh/h	4552	Heavy Vehicle Adjustment Factor (f_{HV})	0.859
Peak Hour Factor	0.93	Flow Rate (V_p), pc/h/ln	1899
Total Trucks, %	4.20	Capacity (c), pc/h/ln	1902
Single-Unit Trucks (SUT), %	21	Adjusted Capacity (c_{adj}), pc/h/ln	1902
Tractor-Trailers (TT), %	79	Volume-to-Capacity Ratio (v/c)	1.00
Direction 1 Speed and Density			
Lane Width Adjustment (f_{LW})	0.0	Average Speed (S), mi/h	42.3
Total Lateral Clearance Adj. (f_{LC})	3.9	Density (D), pc/mi/ln	44.9
Median Type Adjustment (f_M)	0.0	Level of Service (LOS)	E
Access Point Density Adjustment (f_A)	0.0		

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Examination of Figure 1-2 shows that the analyses make use of geometric data, such as the number of lanes, the width of those lanes, the lateral clearance, the specific grade and the length of that grade. Traffic demand data is also used, including the hourly volume and percentage of trucks. On the Bridge, lane width and lateral clearance vary slightly from location to location. Lane width ranges from 10'7" to 12'6", and lateral clearance ranges from 0 feet to 2 feet. For the purposes of these analyses, a uniform lane width of 12 feet, a left-side lateral clearance of 0 feet and a total lateral clearance of 0 feet were used as representative of existing conditions.

The HCS also allows the analyst to enter site-specific information to reflect local operating conditions. Such site-specific adjustments were made, so that the analyses would reflect capacity conditions—that is, a density just below 45.0 pc/mi/ln. The site-specific information used in Figure 1-2 is described below:

Base Free-Flow Speed

The HCM suggests that the posted speed limit, which is 40 miles per hour (mph) on the eastbound span's uphill grade, plus 7 mph, could be an appropriate free-flow speed for the computations[9]. Thus, 47 mph was used as a starting point in the analyses, and was adjusted through an iterative process to a final base free-flow speed of 49 mph.

Peak Hour Factor

Peak hour factor is a measure of the uniformity of traffic volume over the course of the peak hour. A peak hour factor of 1.00 indicates completely uniform flow throughout the peak hour. The lower the peak hour factor is, the greater the variability of flow is within the peak hour. The HCS uses a default peak hour factor of 0.94. This value was used as a starting point in the analyses, and was adjusted, in conjunction with the adjustments to base free flow speed, to a final peak hour factor of 0.93.

With these values for these factors, the computed density is 44.9 pc/mi/ln.

"Per Lane" Capacity (Passenger Cars per Hour)

Figure 1-2 also shows that the capacity of the Bay Bridge is 1,902 passenger cars per hour per lane (pc/hr/ln). At a density of 44.9 pc/mi/ln, the maximum flow rate would be 1,899 pc/hr/ln.

[9] Highway Capacity Manual, page 683.

4. LEVEL OF SERVICE BREAKPOINTS

Using the results of the preceding computations, HCS analyses were performed iteratively, in order to identify the maximum hourly volumes for levels of service A through D. The results of these additional analyses are shown in Table 1-4. These values will be used in BCST2.

Table 1-2: Best-Case Condition Level of Service Breakpoints for Bay Bridge

		Bay Bridge Maximum Hourly Volumes			
		Per Lane		Total (in 3 lanes)	
Level of Service	**Maximum Density (pc/mi/ln)**	**Passenger Cars**	**Vehicles (1)**	**Passenger Cars**	**Vehicles**
A	11	498	398	1,494	1,194
B	18	814	651	2,442	1,952
C	26	1,174	938	3,522	2,814
D	35	1,559	1,246	4,677	3,737
E	45	1,899	1,517	5,697	4,551
F	>45	n/a	n/a	n/a	n/a

n/a: not applicable

Source: (1) Vehicles Per Lane are rounded to the nearest whole number.

5. SUMMARY

The results of the analyses described above may be summarized as follows:

1. Based on traffic volume data from April 1, 2022 through September 11, 2022, using the five hours of data with the largest volumes in each direction, the per lane capacity of the Bay Bridge ranged from 1388 to 1517 vehicles per hour, with eight of the ten values between 1407 and 1483. These values are consistent with the capacity range of 1300 to 1500 vehicles per lane per hour currently posted on the MDTA website.
2. As noted above, the best-case condition capacity of the Bay Bridge is 4,552 vehicles per hour in three lanes, or an average of 1,517 vehicles per lane per hour. This value was observed for eastbound traffic, and will be used for best-case analyses for both directions.
3. When the effects of heavy vehicles are considered, the best-case condition capacity of the Bay Bridge is 1,902 passenger cars per lane per hour.
4. The procedures found in the Highway Capacity Manual are appropriate for use in capacity analyses of current conditions at the Bay Bridge.

The best-case condition maximum hourly volumes that can accommodated at each level of service are shown in Table 1-4.

APPENDIX B

Derivation of “Queue Start Volume” on the Approaches to the Bay Bridge

Chesapeake BAY CROSSING STUDY TIER 2 NEPA

DERIVATION OF "QUEUE START VOLUME" ON THE APPROACHES TO THE BAY BRIDGE

MDTA Maryland Transportation Authority

January 2025

INTRODUCTION

The capacity of the William Preston Lane Jr. Memorial (Bay) Bridge has been studied by the Maryland Transportation Authority (MDTA) on a number of occasions over the years. The Bay Bridge is actually two bridges: a two-lane span which handles eastbound traffic under normal conditions and a three-lane span which handles westbound traffic under normal conditions. For the purposes of this document, the "Bridge" refers to both spans; if one span or the other is discussed, that span is specifically identified.

Traditional Highway Capacity Manual (HCM) analyses performed by the MDTA have consistently recognized that the Bay Bridge, even under ideal operating conditions, has a lower capacity than what would otherwise be anticipated considering the number of lanes and the operation of those lanes on the Bridge. Therefore, detailed additional HCM analyses were performed to:

1. Identify appropriate adjustment factors to HCM procedures, so that the observed best-case condition capacity of the Bay Bridge could be reflected.
2. Identify appropriate LOS breakpoints for the existing Bay Bridge, based on that best-case condition capacity. (For the purposes of the Bay Crossing Study Tier 2 NEPA (BCST2), an LOS breakpoint is defined as the traffic volume at which one LOS ends and the next one begins.)

This analysis is described in a project document titled, "Development of Proposed Level of Service Breakpoints for the Bay Bridge, Version 3.4". The results of that analysis were used in the Study and are summarized in **Table 1**.

Table 1: Best-Case Condition LOS Breakpoints for Bay Bridge (Maximum Hourly Volumes)

LOS	Maximum Density (pc/mi/ln)	Vehicles per Lane (1)	Vehicles in 3 Lanes
A	11	398	1,194
B	18	651	1,952
C	26	938	2,814
D	35	1,246	3,737
E	45	1,517	4,551
F	>45	Not Applicable	Not Applicable

Vehicles Per Lane are rounded to the nearest whole number.

PURPOSE OF ADDITIONAL ANALYSES

While the capacity of the Bay Bridge is a vitally important measure, it does not, by itself, quantify the degree of congestion which can exist when volumes are approaching capacity but still below capacity. Observations of traffic operations at the Bay Bridge have shown that queues begin to develop at a traffic volume level well below the capacity of the Bridge. For the purposes of BCST2, queue lengths approaching the Bridge, and the duration of those queues, were felt to be important parameters which could assist in evaluating potential alternatives and comparing their abilities to accommodate traffic.

The purpose of these additional analyses was to:

1. Identify the volume above which queues begin to develop
2. Identify the length and duration of those queues

DESCRIPTION OF ADDITIONAL ANALYSES

Identification of Actual Queue Lengths

MDTA provides information to the public about current and upcoming conditions at the Bay Bridge through a number of means, including e-mail. Current queue length is among the information often provided in these e-mails. The e-mails are sent with some frequency, but not on a regular schedule.

By obtaining e-mails from the summer of 2022, the BCST2 Team was able to tabulate reported queue lengths for a number of days, including some days during which multiple e-mails were sent. (These e-mails are discussed further below.)

Queue lengths at the Bridge are dependent on a number of factors, including:

1. Traffic volume
2. Number of lanes available on the Bridge
3. Number of lanes available on the approaches to the Bridge
4. The length of an existing queue when two-way traffic is implemented
5. The length of an existing queue when two-way traffic is discontinued
6. Incidents on the Bridge or on the approaches to the Bridge
7. Weather and other environmental factors

The variability of these factors presents a challenge in attempting to correlate queue length and traffic volume. These challenges were addressed in the following manner:

1. Typically, on a summer Sunday (or the Monday of a holiday weekend), MDTA does not operate in two-way at any point during the day. Stated differently, three lanes are always provided in the westbound direction and two lanes are always provided in the eastbound direction. Thus, only summer Sundays or summer holiday Mondays were used in the analyses.
2. It was assumed that there would be no queues at the start of the day (that is, at midnight).
3. Hourly traffic volumes for each Sunday or holiday Monday, for each direction, were obtained from MDTA.

With these assumptions and data, the first five factors in the list above could be considered.

There did not appear to be a straightforward method to account for incidents in the computations. There is a broad range of incident severity, ranging from a disabled vehicle on the shoulder of an approach roadway to a multi-vehicle crash which closes all travel lanes, and a broad range of times for clearing of an incident. As a result, incidents were not explicitly considered in this evaluation.

Weather and other environmental factors are also difficult to quantify, and can vary not only from day-to-day but from hour-to-hour. As a result, these factors were not explicitly considered in this evaluation.

One further assumption was made prior to the analyses: The longest queue reported via MDTA e-mails in a specific direction was assumed to be the longest queue for that day. This assumption was felt to be reasonable, given MDTA's desires to provide timely and accurate information to the public.

Computation of Queue Lengths

An Excel spreadsheet was developed to compute the length and duration of queues for combinations of hourly approach volumes and number of lanes on both the Bridge and its approach roadways. A sample of this spreadsheet is shown in Figure 1.

				Queue Start Volume (veh/h/ln)	Number of Lanes for Eastbound traffic	"Capacity" for Queuing	Capacity with LOS E	Total Number of Lanes	Number of Queuing Lanes	Jam Density (Veh/mile)
			Input Parameters:	1150	3	3450	4551	5	3	570
					2	2300	3034			
Eastbound	SWED (Fri)									
Time	Hourly Volume	3 Lanes Speed	Density	LOS	Lanes	Capacity	V/C ratio	Unmet	Queue	Queue Longer than 1 Mile
12-1AM	342	45.1	3.2	A	3	3450	0.075	0	0.0	
1-2AM	254	45.1	2.4	A	3	3450	0.056	0	0.0	
2-3AM	186	45.1	1.7	A	3	3450	0.041	0	0.0	
3-4AM	222	45.1	2.1	A	3	3450	0.049	0	0.0	
4-5AM	347	45.1	3.2	A	3	3450	0.076	0	0.0	
5-6AM	718	45.1	6.6	A	3	3450	0.158	0	0.0	
6-7AM	1,496	45.1	13.8	B	3	3450	0.329	0	0.0	
7-8AM	2,216	45.1	20.5	C	3	3450	0.487	0	0.0	
8-9AM	2,359	45.1	21.8	C	3	3450	0.518	0	0.0	
9-10AM	2,697	45.1	24.9	C	3	3450	0.593	0	0.0	
10-11AM	3,490	44.9	32.4	D	3	3450	0.767	40	0.1	
11AM-12PM	3,809	44.3	35.9	E	3	3450	0.837	399	0.7	
12-1PM	3,955	44.0	37.5	E	3	3450	0.869	904	1.6	x
1-2PM	3,865	44.2	36.5	E	3	3450	0.849	1319	2.3	x
2-3PM	3,720	44.5	34.9	D	3	3450	0.817	1589	2.8	x
3-4PM	3,724	44.5	34.9	D	3	3450	0.818	1863	3.3	x
4-5PM	3,890	44.1	36.8	E	3	3450	0.855	2303	4.0	x
5-6PM	3,864	44.2	36.5	E	3	3450	0.849	2717	4.8	x
6-7PM	3,201	45.1	29.6	D	3	3450	0.703	2468	4.3	x
7-8PM	2,547	45.1	23.6	C	3	3450	0.560	1564	2.7	x
8-9PM	2,320	45.1	21.5	C	3	3450	0.510	434	0.8	
9-10PM	1,651	45.1	15.3	B	3	3450	0.363	0	0.0	
10-11PM	1,114	45.1	10.3	A	3	3450	0.245	0	0.0	
11PM-12AM	765	45.1	7.1	A	3	3450	0.168	0	0.0	
Total	52751					Max	0.869	Max	4.8	8

Figure 1: Queueing Spreadsheet

The premise of the spreadsheet is straightforward. During the first hour of the day during which the approach volume is greater than the "queue start volume" (QSV), a queue begins to develop. The queued volume from the first hour must be processed before the approach volume for the second hour can be processed. If the sum of the queued volume from the first hour plus the approach volume from the second hour exceeds the QSV, a queue exists at the end of the second hour, and may be longer than the queue at the end of the first hour.

This computation is repeated for each hour until the queue is completely dissipated. The spreadsheet allowed for experimentation with a variety of QSVs.

The data provided by the MDTA e-mails is shown in Table 2, along with several methods of computing the mean maximum queue length for the observed days. These methods were:

1. Use the data for every day, even if no e-mails reporting queues had been received for a

This is the most straightforward approach, although it doesn't seem entirely likely that there would have been no queues on a given Sunday or holiday Monday. Thus, this approach may understate the mean maximum queue. It is conceivable that the queues on the days without e-mails were not particularly severe, but that is not certain.

This is a reasonable approach, but it may overstate the mean maximum by eliminating days with shorter or non-existent queues which did not lead to the generation of an e-mail.

3. Use the data for every day for which an e-mail had reported a queue, but exclude the

It is reasonable to assume that the two days with queues longer than 10 miles were unusual, due to incidents or some other issue. However, removal of those days, when it is shown that such queue lengths do occur, may understate the mean maximum queue.

Table 2: Mean Maximum Queue Lengths, Summer 2022

Date	Maximum Queue Length Cited in MDTA Emails (miles)		Basis of Computation of Mean Maximum Queue	Mean Maximum Queue (miles)	
	Westbound	Eastbound		Westbound	Eastbound
5/15/22	0.5	3.5	True Mean, using all values	4.2	2.7
5/22/22	5.5	3.0	Mean, without "0" values	5.7	3.5
5/30/22	7.5	0.0	Mean, without "0" values and without >10 mile "outliers"	4.5	3.5
6/5/22	0.5	3.0			
6/12/22	12.6	3.5			
6/19/22	0.0	6.0			
6/26/23	6.5	3.5			
7/3/22	0.0	3.5			
7/10/22	0.0	2.5			
7/17/22	0.0	2.5			
7/24/22	4.5	3.0			
7/31/22	2.5	3.5			
8/7/22	3.0	4.5			
8/14/22	8.3	3.5			
8/21/22	4.5	3.0			
8/28/22	7.5	0.0			
9/4/22	0.0	3.5			
9/5/22	13.7	0.0			
9/11/22	3.0	0.0			

A third spreadsheet was then developed, to allow simultaneous execution of the spreadsheet shown in Figure 1 for each of the days in question, and to further allow for computation of the mean maximum queue for a variety of QSV values.

This spreadsheet was executed, using values of QSV ranging from 1,100 to 1,200 vphpl. The intent of this effort was to identify a range of values for QSV that would cover all three of the mean maximum queues shown in Table 2. The results of these analyses are shown in Table 3.

Table 3: Computation of Range of Potential Queue Start Volumes

Basis of Computation of Mean Maximum Queue		Mean Maximum Queue (miles)	
		Westbound	Eastbound
True Mean, using all values		4.5	2.8
Mean, without "0" values		5.7	3.5
Mean, without "0" values and without >10 mile "outliers"		4.5	3.5
	Assumed Queue Start Volume (vphpl)	Mean Queue Length (miles)	
		Westbound	Eastbound
	1100	5.9	4.4
	1125	4.9	3.9
	1150	3.9	3.4
	1175	3.1	3.0
	1200	2.2	2.6
	Range of Queue Start Volumes to Encompass Possible Maximum Queues (vphpl)	1100 - 1150	1125 - 1200

As shown in Table 3, QSVs of 1,100 to 1,150 vphpl covered the three possible westbound mean maximum queues. QSVs of 1,125 to 1,200 covered the two possible eastbound mean maximum queues.

DISCUSSION

On the basis of the computations described above, it was felt that a QSV of 1,150 vphpl provided a reasonable value for comparison of alternatives in BCST2. A check of this value against the HCM was then performed.

The volume-to-capacity ratio at the point at which queuing begins was calculated to be 0.758 (1,150 vphpl/1,517 vphpl). This volume corresponds to LOS D. This value is consistent with the HCM, which states (on page 670):

"LOS D is the level at which speeds begin to decline with increasing flows, with density increasing more quickly. Freedom to maneuver within the traffic stream is seriously limited, and drivers experience reduced physical and psychological comfort levels. Even minor incidents can be expected to create queuing because the traffic stream has little space to absorb disruptions."

In essence, the transition from the approach roadway to the Bay Bridge, and the corresponding reduction in the capacity per lane, results in a permanent "minor incident", or in this case a bottleneck, at the start of the Bridge, with queues extending back onto the approach roadways. Queues get longer when volumes exceed 1,150 vphpl and begin to diminish when approach volumes drop below that level.

CONCLUSION

For the purposes of the BCST2, a queue start volume of 1,150 vphpl appears to be a realistic value, and will be used in forecasts of queues originating at the Bay Bridge.

APPENDIX C

Highway Capacity Manual and Queuing Spreadsheet Analyses

C1. Introduction to Appendix C

The tools which were used in the initial evaluation of existing conditions are listed immediately below, along with a very brief description of their use.

- Highway Capacity Manual (HCM)[2]: The HCM was used to compute levels of service (LOS) at the Bay Bridge and on segments of U.S. 50/301 within the study area, including weaving sections and ramps at their junctions with U.S. 50/301.
- Queuing Spreadsheet: This tool (developed by the BCST2 Team expressly for this project, based upon HCM parameters) was used to compute queue lengths and durations at the Bay Bridge and was calibrated based on observations of existing conditions.

The two tools identified above provided performance measures at multiple individual locations within the study area. These initial results were used to help identify and define a number of potential improvement strategies for further analysis.

Each of the HCM analyses identified LOS at a single specific segment and did not consider external factors that could and would affect traffic operations. Such external factors include queues from downstream segments, such as the Bay Bridge. Thus, the HCM analyses represented a best-case condition. The queuing spreadsheet described above was used to supplement the HCM analyses, to address this limitation, and to provide additional depth for the initial evaluation.

VISSIM, a microsimulation model, was then used to perform detailed analyses of the corridor, assessing measures such as throughput, queuing, and travel time/speed. The VISSIM model used the results of the HCM and queuing analyses described above as a starting point.

As noted above, the HCM analyses were preliminary, and provided a starting point for the detailed VISSIM analyses. The HCM analyses provide performance metrics which do not necessarily provide the same level of detail as VISSIM. The VISSIM outputs will be the primary data used for analysis.

Further, HCM analyses of future conditions do not consider restrictions on traffic volumes, which may occur due to upstream bottlenecks.

[2] National Academies of Sciences, Engineering, and Medicine. 2022. *Highway Capacity Manual 7th Edition: A Guide for Multimodal Mobility Analysis*. Washington, DC: The National Academies Press. https://doi.org/10.17226/26432.

C.2 2045 Alternative A: No-Build

C.2.1 HCM Analysis and Queuing Analysis of the Bay Bridge

Using the travel demand forecasts described in Chapter 6, HCM and queuing analyses were performed for the Bay Bridge for Alternative A (No-Build) for both NSWD and SWED conditions. The results of the queuing analyses are shown in **Table C-1** and are described below.

- Queues are expected on NSWDs, even with two-way traffic in operation. During the PM peak period, queues in both directions would be expected.

- Queues are expected to increase over existing conditions on SWEDs, reaching more than ten miles on a typical summer Friday or summer Sunday.

C.2.2. HCM Analysis of U.S. 50/301 in the Remainder of the Study Area

The HCM analyses for Alternative A (No-Build) are summarized in **Tables C-2 and C-3**. As noted previously, the HCM analyses represent a best-case condition, and do not consider external factors such as queuing from the Bay Bridge or other potential bottlenecks. Further, HCM analyses of future conditions do not consider restrictions on traffic volumes, which may occur due to upstream bottlenecks.

Tables C-2 and C-3, as well as the results for Existing Conditions (discussed in Chapter 5), provide the following results.

1. In the eastbound direction:
    a. On SWEDs, the LOS is generally lower for Alternative A (No-Build) as compared to the Existing conditions, and is at LOS E for most of the freeway and weaving segments. This result is to be expected, due to the increase in volumes between 2022 and 2045.
    b. On NSWDs, the differential in LOS between Alternative A (No-Build) and the Existing condition is less than for SWED. However, a number of freeway and weaving segments do drop to LOS E, particularly at the western end of the Study Area.

2. Results for the westbound direction are similar to those noted for the eastbound direction.

Table C-1: Alternative A: No-Build 2045 Hourly Levels of Service and Queue Lengths Across the Bay Bridge

Time	Typical NSWD					Typical Summer Weekend Day						
	Eastbound			Westbound		Eastbound (Friday)				Westbound (Sunday)**		
	LOS	Queue (miles)	Queue Longer Than 1 Mile	LOS	Queue (miles)	Queue Longer Than 1 Mile	LOS	Queue (miles)	Queue Longer Than 1 Mile	LOS	Queue (miles)	Queue Longer Than 1 Mile
12-1AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
1-2AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
2-3AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
3-4AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
4-5AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
5-6AM	A	0.0	-	B	0.0	-	A	0.0	-	A	0.0	-
6-7AM	A	0.0	-	C	0.1	-	A	0.0	-	A	0.0	-
7-8AM	B	0.0	-	C(1)	1.1	✓	C*	0.0	-	A	0.0	-
8-9AM	B	0.0	-	C(1)	1.1	✓	D*	0.0	-	B	0.0	-
9-10AM	B	0.0	-	B(1)	0.3	-	D*	0.0	-	B	0.0	-
10-11AM	B*	0.0	-	B(1)	0.9	-	E*	1.5	✓	C(1)	1.1	✓
11AM-12PM	C*	0.0	-	B(1)	1.2	✓	F*	3.7	✓	C(1)	3.1	✓
12-1PM	C*	0.0	-	B(1)	1.6	✓	F*	6.1	✓	D(1)	5.6	✓
1-2PM	C*	0.0	-	B(1)	2.2	✓	F*	8.4	✓	D(1)	8.2	✓
2-3PM*	C*	0.1	-	B(1)	3.0	✓	F*	>10	✓	D(1)	>10	✓
3-4PM	D*	1.3	✓	B(1)	3.8	✓	F*	>10	✓	C(1)	>10	✓
4-5PM	D*	3.2	✓	B(1)	4.6	✓	F*	>10	✓	C(1)	>10	✓
5-6PM	D*	4.1	✓	B(1)	4.9	✓	F*	>10	✓	D(1)	>10	✓
6-7PM	C*(1)	3.1	✓	A(1)	4.2	✓	E*	>10	✓	C(1)	>10	✓
7-8PM	B*(1)	0.5	-	A(1)	2.7	✓	D*	>10	✓	C(1)	>10	✓
8-9PM	A	0.0	-	A	0.0	-	D*	>10	✓	C(1)	>10	✓
9-10PM	A	0.0	-	A	0.0	-	C*(1)	>10	✓	B(1)	>10	✓
10-11PM	A	0.0	-	A	0.0	-	B*(1)	>10	✓	A(1)	>10	✓
11PM-12AM	A	0.0	-	A	0.0	-	A*(1)	5.7	✓	A(1)	>10	✓
Max. Queue	-	4.1	-	-	4.9	-	-	>10	-	-	>10	-
Hours with Queue > 1.0 Mile	-	-	4	-	-	11	-	-	14	-	-	14

***** Assuming two-way operation on the westbound bridge.

****** Assuming 3 lanes in the westbound peak-flow direction, this never overlaps the eastbound peak-flow.

(1) Computed LOS, based on approach volume. LOS is actually D or E, due to the queue (the unserved demand) from the preceding hour.

Table C-2: Alternative A: No-Build 2045 HCM Analyses, U.S. 50/301 Eastbound

Segment Name	Segment Type	SWED (Friday Peak)		NSWD (PM Peak)	
		No-Build 2045		No-Build 2045	
		Density	LOS	Density	LOS
Off Ramp to MD 2/MD 450	Diverge	33.6	D	31.9	D
Inside MD 2/MD 450 Interchange	Basic Freeway	33.1	D	31.4	D
On Ramp from MD 2/MD 450	Merge	N/A	F	N/A	F
East of MD 2/MD 450	Basic Freeway	N/A	F	N/A	F
Ferguson Rd Off Ramp	Diverge	29.2	D	29.0	D
Inside Ferguson Rd Interchange	Basic Freeway	39.2	E	36.8	E
On Ramp from Ferguson Rd	Merge	27.1	C	26.6	C
East of Ferguson Rd	Basic Freeway	41.5	E	39.8	E
Off Ramp to Buschs Frontage Rd	Diverge	27.7	C	26.9	C
Inside Buschs Frontage Rd Interchange	Basic Freeway	36.5	E	35.2	E
Weave from Buschs Frontage Rd to MD 179	Weaving	42.2	E	44.9	F
East of MD 179	Basic Freeway	35.6	E	32.5	D
Off Ramp to Whitehall Rd (Exit 30)	Diverge	28.9	D	26.9	C
Inside Whitehall Rd (Exit 30) Interchange	Basic Freeway	33.6	D	30.9	D
On Ramp to Whitehall Rd (Exit 30)	Merge	26.6	C	25.2	C
Whitehall Rd (Exit 30) to Whitehall Rd (Exit 31)	Basic Freeway	34.7	D	32.3	D
Lane Addition East of Whitehall Rd	Basic Freeway	-	-	-	-
Off Ramp to Whitehall Rd (Exit 31)	Diverge	-	-	-	-
Inside Whitehall Rd (Exit 31) Interchange	Basic Freeway	-	-	-	-
On Ramp from Whitehall Rd (Exit 31)	Merge	-	-	-	-
Whitehall Rd (Exit 31) to Oceanic Dr	Basic Freeway	-	-	-	-
Off Ramp to Oceanic Dr	Diverge	30.9	D	29.3	D
Inside Oceanic Dr Interchange	Basic Freeway	34.2	D	31.6	D
On Ramp from Oceanic Dr	Merge	30.4	D	28.5	D
Western Side of Bay Bridge	Basic Highway	N/A	F	N/A	F
Eastern Side of Bay Bridge	Basic Highway	N/A	F	42.1	E
Off Ramp to MD 8	Diverge	26.8	C	24.2	C

Segment Name	Segment Type	SWED (Friday Peak)		NSWD (PM Peak)	
		No-Build 2045		No-Build 2045	
		Density	LOS	Density	LOS
Inside MD 8 Interchange	Basic Freeway	32.4	D	27.5	D
Weave from MD 8 to Thompson Creek Rd	Weaving	40.6	E	37.7	E
Inside Thompson Creek Rd Interchange	Basic Freeway	34.8	D	31.6	D
On Ramp from Thompson Creek Rd	Merge	29.6	D	27.4	C
East of Thompson Creek Rd	Basic Freeway	39.6	E	35.7	E
Lane Reduction East of Thompson Creek Rd	Basic Freeway	-	-	-	-
Off Ramp to Cox Neck Rd	Diverge	31.5	D	29.3	D
Inside Cox Neck Rd Interchange	Basic Freeway	37.6	E	33.6	D
Weave from Cox Neck Rd to Dominion Rd	Weaving	39.3	E	36.9	E
Inside Dominion Rd Interchange	Basic Freeway	34.7	D	30.4	D
On Ramp from Dominion Rd	Merge	27.1	C	24.8	C
East of Dominion Rd	Basic Freeway	38.1	E	34.2	D
Off Ramp to S Piney Rd	Diverge	26.5	C	24.1	C
Inside S Piney Rd Interchange	Basic Freeway	36.6	E	32.7	D
Weave from S Piney Rd to Dundee Ave	Weaving	35.6	E	31.6	D
Inside Dundee Ave Interchange	Basic Freeway	38.4	E	34.3	D
Weave from Dundee Ave to Main St/MD18 (Exit 41)	Weaving	35.5	E	31.0	D
Inside Main St/MD18 (Exit 41) Interchange	Basic Freeway	38.0	E	34.0	D
On Ramp from Main St/MD18 (Exit 41)	Merge	29.2	D	26.6	C
R Clayton Mitchell Jr Bridge	Basic Freeway	38.5	E	34.4	D
Off Ramp to Kent Narrows Rd	Diverge	25.2	C	22.9	C
Inside Kent Narrows Rd Interchange	Basic Freeway	37.6	E	33.8	D
On Ramp from Kent Narrows Rd	Merge	25.9	C	23.2	C
East of Kent Narrows Rd	Basic Freeway	39.0	E	34.7	D
Off Ramp to Main St/MD18 (Exit 43A)	Diverge	26.6	C	24.2	C
Inside Main St/MD 18 (Exit 43A) Interchange	Basic Freeway	38.1	E	33.9	D
Weave from Main St/MD18 (Exit 43A) to Chester River Beach Rd	Weaving	34.6	D	31.4	D
Inside Chester River Beach Rd Interchange	Basic Freeway	36.9	E	32.8	D

Segment Name	Segment Type	SWED (Friday Peak)		NSWD (PM Peak)	
		No-Build 2045		No-Build 2045	
		Density	LOS	Density	LOS
Weave from Chester River Beach Rd to Station Ln	Weaving	33.3	D	29.7	D
Inside Station Ln Interchange	Basic Freeway	37.3	E	33.0	D
Weave from Station Ln to Evans Ave	Weaving	33.1	D	29.2	D
Inside Evans Ave Interchange	Basic Freeway	36.8	E	32.5	D
Weave from Evans Ave to Hess Rd	Weaving	32.3	D	28.2	D
Inside Hess Rd Interchange	Basic Freeway	36.9	E	32.6	D
Weave from Hess Rd to Nesbit Rd	Weaving	33.2	D	29.3	D
Inside Nesbit Rd Interchange	Basic Freeway	36.0	E	31.3	D
On Ramp from Nesbit Rd	Merge	30.5	D	22.4	C
East of Nesbit Rd	Basic Freeway	37.3	E	32.7	D
US 50/US 301 Split	Diverge	16.0	B	17.9	B
US 50 East of US 50/US 301 Split	Basic Highway	38.0	E	25.6	C
US 301 Split East of MD18	Basic Highway	16.6	B	18.6	C

Table C-3: Alternative A: No-Build 2045 HCM Analyses, U.S. 50/301 Westbound

Segment Name	Segment Type	SWED (Sun. Peak)		NSWD (AM Peak)	
		No-Build 2045		No-Build 2045	
		Density	LOS	Density	LOS
US 50 East of US 50/US 301 Merge	Basic Highway	41.5	E	21.6	C
US 301 East of US 50/US 301 Merge	Basic Highway	16.4	B	16.0	B
US 50/US 301 Merge*	Merge	39.0	E	28.1	D
West of US 50/US 301 Merge	Basic Freeway	39.0	E	28.1	D
Off Ramp to Blackbeard Rd	Diverge	25.5	C	18.8	B
Under Nesbit Rd	Basic Freeway	37.0	E	26.8	D
Weave from Winchester Creek to Hissey Rd	Weaving	34.4	D	25.2	C
Inside Hissey Rd Interchange	Basic Freeway	35.5	E	26.5	D
Weave from Hissy Rd to Winchester Creek	Weaving	34.3	D	24.6	C
Evans Ave	Basic Freeway	37.7	E	28.1	D
Weave from Evans Ave to VFW Ave	Weaving	33.3	D	23.9	C
Inside VFW Ave Interchange	Basic Freeway	36.6	E	27.6	D
On Ramp from VFW Ave	Merge	22.6	C	16.7	B
West of VFW Ave	Basic Freeway	36.8	E	27.8	D
Weave from Chester River Beach Rd to Jackson Creek Rd	Weaving	34.9	D	27.5	C
Jackson Creek Rd	Basic Freeway	36.4	E	28.9	D
On Ramp from Jackson Creek Rd	Merge	26.9	C	21.3	C
West of Jackson Creek Rd	Basic Freeway	38.2	E	30.0	D
Off Ramp to Kent Narrows Rd	Diverge	25.1	C	20.3	C
Kent Narrows Rd	Basic Freeway	36.3	E	29.0	D
On Ramp from Kent Narrows Rd	Merge	28.1	D	22.8	C
R Clayton Mitchell Jr Bridge	Basic Freeway	37.0	E	29.4	D
Off Ramp to Piney Narrows Rd	Diverge	26.2	C	21.0	C
Piney Narrows Rd	Basic Freeway	35.9	E	28.0	D
On Ramp from Piney Narrows Rd	Merge	24.5	C	18.8	B
West of Piney Narrows Rd	Basic Freeway	37.0	E	28.9	D
Off Ramp to Piney Creek Rd	Diverge	27.2	C	22.2	C

Segment Name	Segment Type	SWED (Sun. Peak)		NSWD (AM Peak)	
		No-Build 2045		No-Build 2045	
		Density	LOS	Density	LOS
Piney Creek Rd	Basic Freeway	35.6	E	28.3	D
On Ramp from Piney Creek Rd	Merge	23.5	C	18.3	B
West of Piney Creek Rd	Basic Freeway	36.2	E	29.0	D
Off Ramp to Chester Station Ln	Diverge	26.2	C	21.3	C
Chester Station Ln	Basic Freeway	35.6	E	28.3	D
Weave from Chester Station Ln to Castle Marina Rd	Weaving	33.1	D	25.9	C
Castle Marina Rd	Basic Freeway	33.8	D	26.0	C
On Ramp from Castle Marina Rd	Merge	28.5	D	25.2	C
West of Castle Marina Rd	Basic Freeway	37.3	E	31.3	D
Lane Addition West of Castle Marina Rd	Basic Freeway	-	-	-	-
Off Ramp to Duke St	Diverge	25.6	C	21.5	C
Duke St	Basic Freeway	36.6	E	30.0	D
Weave from Duke St to MD 8	Weaving	36.2	E	27.5	C
Inside MD 8 Interchange	Basic Freeway	33.2	D	23.9	C
On Ramp from MD 8	Merge	26.0	C	22.6	C
Eastern Side of Bay Bridge	Basic Highway	N/A	F	41.6	E
Western Side of Bay Bridge	Basic Highway	N/A	F	36.5	E
Off Ramp to Oceanic Dr	Diverge	27.9	C	24.0	C
Inside Oceanic Dr Interchange	Basic Freeway	33.8	D	27.9	D
On Ramp from Oceanic Dr	Merge	28.7	D	24.5	C
West of Oceanic Dr	Basic Freeway	35.3	E	29.0	D
Lane Reduction West of Oceanic Dr	Basic Freeway	-	-	-	-
Off Ramp to MD 179	Diverge	28.7	D	24.0	C
Inside MD 179 Interchange	Basic Freeway	35.0	D	26.9	D
On Ramp from MD 179	Merge	29.1	D	26.7	C
West of MD 179	Basic Freeway	42.7	E	34.7	D
Off Ramp to Bay Dale Dr	Diverge	29.5	D	25.7	C
Inside Bay Dale Dr Interchange	Basic Freeway	41.2	E	31.9	D

Segment Name	Segment Type	SWED (Sun. Peak)		NSWD (AM Peak)	
		No-Build 2045		No-Build 2045	
		Density	LOS	Density	LOS
On Ramp from Bay Dale Dr	Merge	N/A	F	N/A	F
West of Bay Dale Dr	Basic Freeway	N/A	F	N/A	F
Off Ramp to MD 648	Diverge	N/A	F	31.5	D
Inside MD 648 Interchange	Basic Freeway	N/A	F	44.8	E
On Ramp from MD 648	Merge	N/A	F	N/A	F
West of MD 648	Basic Freeway	N/A	F	N/A	F
Off Ramp to MD 2	Diverge	31.4	D	29.2	D
Inside MD 2/MD 450 Interchange	Basic Freeway	35.6	E	29.8	D
Off Ramp to MD 450	Diverge	30.7	D	26.9	C
Over Boulters Way	Basic Freeway	34.1	D	28.2	D
On Ramp from MD 2	Merge	N/A	F	N/A	F

C.3 Alternatives B/C: 6-8-6

C.3.1 HCM Analysis and Queuing Analysis of the Bay Bridge

Using the travel demand forecasts described in Chapter 6, HCM and queuing analyses were performed for the Bay Bridge for both NSWD and SWED conditions. The results of the queuing analyses are shown in **Table C-4.**

Per **Table C-4** for Alternatives B/C: 6-8-6:

1. For NSWD conditions, no queuing is anticipated.

2. For SWED conditions, queues in excess of seven miles in length are expected. Queues longer than one mile are forecast to persist for up to ten hours.

C.3.2 HCM Analysis of U.S. 50/301 in the Remainder of the Study Area

The HCM analyses for Alternatives B/C: 6-8-6 are summarized in **Tables C-5** and **C-6**. As noted previously, the HCM analyses represent a best-case condition and do not consider external factors such as queuing from the Bay Bridge or other potential bottlenecks. Further, HCM analyses of future conditions do not consider restrictions on traffic volumes, which may occur due to upstream bottlenecks.

Table C-4: 2045 Alternatives B and C (6-8-6) Hourly Levels of Service and Queue Lengths Across the Bay Bridge

Time	Typical NSWD					Typical Summer Weekend Day						
	Eastbound			Westbound		Eastbound (Friday)				Westbound (Sunday)**		
	LOS	Queue (miles)	Queue Longer Than 1 Mile	LOS	Queue (miles)	Queue Longer Than 1 Mile	LOS	Queue (miles)	Queue Longer Than 1 Mile	LOS	Queue (miles)	Queue Longer Than 1 Mile
12-1AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
1-2AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
2-3AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
3-4AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
4-5AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
5-6AM	A	0.0	-	B	0.0	-	A	0.0	-	A	0.0	-
6-7AM	A	0.0	-	C	0.0	-	B	0.0	-	A	0.0	-
7-8AM	B	0.0	-	C	0.0	-	B	0.0	-	A	0.0	-
8-9AM	B	0.0	-	C	0.0	-	C	0.0	-	B	0.0	-
9-10AM	B	0.0	-	B	0.0	-	C	0.0	-	C	0.0	-
10-11AM	B	0.0	-	B	0.0	-	D	0.2	-	D	0.0	-
11AM-12PM	B	0.0	-	B	0.0	-	D	1.1	✓	D	0.7	-
12-1PM	B	0.0	-	B	0.0	-	D	2.5	✓	D	2.0	✓
1-2PM	B	0.0	-	B	0.0	-	D	3.5	✓	D	3.3	✓
2-3PM	C	0.0	-	B	0.0	-	D	4.3	✓	D	4.5	✓
3-4PM	C	0.0	-	B	0.0	-	D	5.1	✓	D	5.4	✓
4-5PM	C	0.0	-	B	0.0	-	D	6.2	✓	D	6.1	✓
5-6PM	C	0.0	-	B	0.0	-	D	7.3	✓	D	7.0	✓
6-7PM	B	0.0	-	A	0.0	-	C(1)	6.8	✓	D	7.7	✓
7-8PM	B	0.0	-	A	0.0	-	C(1)	4.6	✓	D	8.0	✓
8-9PM	A	0.0	-	A	0.0	-	C(1)	2.1	✓	C(1)	7.3	✓
9-10PM	A	0.0	-	A	0.0	-	B	0.0	-	C(1)	4.9	✓
10-11PM	A	0.0	-	A	0.0	-	A	0.0	-	B(1)	0.3	-
11PM-12AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
Max. Queue	-	0.0	-	-	0.0	-	-	7.3	-	-	8.0	-
Hours with Queue > 1.0 Mile	-	-	0	-	-	0	-	-	10	-	-	10

(1) Computed LOS based on approach volume. LOS is actually D or E, due to the queue (the unserved demand) from the preceding hour.

Table C-5: 2045 Alternatives B and C (6-8-6) HCM Analyses, U.S. 50/301 Eastbound

Segment Name	Segment Type	SWED (Friday Peak)		NSWD (PM Peak)	
		6-8-6		6-8-6	
		Density	LOS	Density	LOS
Over Severn River Bridge	Basic Freeway	39.1	E	41.7	E
Off Ramp to MD 2/MD 450	Diverge	37.0	E	32.7	D
Inside MD 2/MD 450 Interchange	Basic Freeway	36.4	E	32.2	D
On Ramp from MD 2/MD 450	Merge	N/A	F	N/A	F
East of MD 2/MD 450	Basic Freeway	N/A	F	N/A	F
Ferguson Rd Off Ramp	Diverge	31.5	D	29.6	D
Inside Ferguson Rd Interchange	Basic Freeway	N/A	F	37.8	E
On Ramp from Ferguson Rd	Merge	N/A	F	27.3	C
East of Ferguson Rd	Basic Freeway	N/A	F	41.2	E
Off Ramp to Buschs Frontage Rd	Diverge	30.0	D	27.5	C
Inside Buschs Frontage Rd Interchange	Basic Freeway	41.4	E	36.1	E
Weave from Buschs Frontage Rd to MD 179	Weaving	47.8	F	46.4	F
East of MD 179	Basic Freeway	39.9	E	33.3	D
Off Ramp to Whitehall Rd (Exit 30)	Diverge	31.2	D	27.5	C
Inside Whitehall Rd (Exit 30) Interchange	Basic Freeway	37.4	E	31.6	D
On Ramp to Whitehall Rd (Exit 30)	Merge	29.2	D	25.7	C
Whitehall Rd (Exit 30) to Whitehall Rd (Exit 31)	Basic Freeway	38.7	E	33.1	D
Lane Addition East of Whitehall Rd	Basic Freeway	28.8	D	24.8	C
Off Ramp to Whitehall Rd (Exit 31)	Diverge	-	-	-	-
Inside Whitehall Rd (Exit 31) Interchange	Basic Freeway	-	-	-	-
On Ramp from Whitehall Rd (Exit 31)	Merge	-	-	-	-
Whitehall Rd (Exit 31) to Oceanic Dr	Basic Freeway	-	-	-	-
Off Ramp to Oceanic Dr	Diverge	24.7	C	21.8	C
Inside Oceanic Dr Interchange	Basic Freeway	28.4	D	24.2	C
On Ramp from Oceanic Dr	Merge	25.0	C	22.3	C
Western Side of Bay Bridge	Basic Highway	40.8	E	28.5	D
Eastern Side of Bay Bridge	Basic Highway	37.1	E	34.2	D
Off Ramp to MD 8	Diverge	22.6	C	19.7	B
Inside MD 8 Interchange	Basic Freeway	27.0	D	21.1	C
Weave from MD 8 to Thompson Creek Rd	Weaving	46.1	F	30.2	D
Inside Thompson Creek Rd Interchange	Basic Freeway	28.8	D	24.2	C
On Ramp from Thompson Creek Rd	Merge	23.5	C	20.5	C
East of Thompson Creek Rd	Basic Freeway	32.1	D	27.4	D
Lane Reduction East of Thompson Creek Rd	Basic Freeway	N/A	F	36.6	E
Off Ramp to Cox Neck Rd	Diverge	33.8	D	29.7	D
Inside Cox Neck Rd Interchange	Basic Freeway	43.6	E	34.3	D
Weave from Cox Neck Rd to Dominion Rd	Weaving	44.6	F	38.1	E
Inside Dominion Rd Interchange	Basic Freeway	38.9	E	31.1	D
On Ramp from Dominion Rd	Merge	29.9	D	25.4	C

Segment Name	Segment Type	SWED (Friday Peak)		NSWD (PM Peak)	
		6-8-6		6-8-6	
		Density	LOS	Density	LOS
East of Dominion Rd	Basic Freeway	44.3	E	34.9	D
Off Ramp to S Piney Rd	Diverge	28.8	D	24.6	C
Inside S Piney Rd Interchange	Basic Freeway	41.9	E	33.5	D
Weave from S Piney Rd to Dundee Ave	Weaving	39.9	E	32.4	D
Inside Dundee Ave Interchange	Basic Freeway	44.6	E	35.0	D
Weave from Dundee Ave to Main St/MD18 (Exit 41)	Weaving	39.7	E	31.9	D
Inside Main St/MD18 (Exit 41) Interchange	Basic Freeway	44.1	E	34.8	D
On Ramp from Main St/MD18 (Exit 41)	Merge	31.8	D	27.2	C
R Clayton Mitchell Jr Bridge	Basic Freeway	44.9	E	35.1	E
Off Ramp to Kent Narrows Rd	Diverge	27.4	C	23.4	C
Inside Kent Narrows Rd Interchange	Basic Freeway	43.4	E	34.6	D
On Ramp from Kent Narrows Rd	Merge	28.6	D	23.8	C
East of Kent Narrows Rd	Basic Freeway	N/A	F	35.5	E
Off Ramp to Main St/MD18 (Exit 43A)	Diverge	28.8	D	24.7	C
Inside Main St/MD 18 (Exit 43A) Interchange	Basic Freeway	44.2	E	34.7	D
Weave from Main St/MD18 (Exit 43A) to Chester River Beach Rd	Weaving	38.8	E	32.3	D
Inside Chester River Beach Rd Interchange	Basic Freeway	42.2	E	33.6	D
Weave from Chester River Beach Rd to Station Ln	Weaving	37.2	E	30.6	D
Inside Station Ln Interchange	Basic Freeway	42.8	E	33.9	D
Weave from Station Ln to Evans Ave	Weaving	36.9	E	30.1	D
Inside Evans Ave Interchange	Basic Freeway	41.9	E	33.3	D
Weave from Evans Ave to Hess Rd	Weaving	36.0	E	28.9	D
Inside Hess Rd Interchange	Basic Freeway	42.1	E	33.3	D
Weave from Hess Rd to Nesbit Rd	Weaving	37.2	E	30.1	D
Inside Nesbit Rd Interchange	Basic Freeway	40.6	E	32.1	D
On Ramp from Nesbit Rd	Merge	34.4	D	22.9	C
East of Nesbit Rd	Basic Freeway	42.7	E	33.5	D
US 50/US 301 Split	Diverge	17.5	B	18.4	B
US 50 East of US 50/US 301 Split	Basic Highway	N/A	F	26.4	C
US 301 Split East of MD18	Basic Highway	18.1	C	19.0	C

Table C-6: 2045 Alternatives B and C (6-8-6) HCM Analyses, U.S. 50/301 Westbound

Segment Name	Segment Type	SWED (Sun. Peak) 6-8-6		NSWD (AM Peak) 6-8-6	
		Density	LOS	Density	LOS
US 50 East of US 50/US 301 Merge	Basic Highway	N/A	F	22.2	C
US 301 East of US 50/US 301 Merge	Basic Highway	17.9	B	16.3	B
US 50/US 301 Merge*	Merge	44.9	E	28.7	D
West of US 50/US 301 Merge	Basic Freeway	44.9	E	28.7	D
Off Ramp to Blackbeard Rd	Diverge	27.5	C	19.2	B
Under Nesbit Rd	Basic Freeway	41.9	E	27.5	D
Weave from Winchester Creek to Hissey Rd	Weaving	38.1	E	25.8	C
Inside Hissey Rd Interchange	Basic Freeway	39.6	E	27.1	D
Weave from Hissy Rd to Winchester Creek	Weaving	38.1	E	25.3	C
Evans Ave	Basic Freeway	42.9	E	28.8	D
Weave from Evans Ave to VFW Ave	Weaving	36.9	E	24.5	C
Inside VFW Ave Interchange	Basic Freeway	41.2	E	28.3	D
On Ramp from VFW Ave	Merge	24.8	C	17.2	B
West of VFW Ave	Basic Freeway	41.6	E	28.5	D
Weave from Chester River Beach Rd to Jackson Creek Rd	Weaving	38.8	E	28.3	D
Jackson Creek Rd	Basic Freeway	41.0	E	29.6	D
On Ramp from Jackson Creek Rd	Merge	29.3	D	21.8	C
West of Jackson Creek Rd	Basic Freeway	43.8	E	30.8	D
Off Ramp to Kent Narrows Rd	Diverge	27.2	C	20.7	C
Kent Narrows Rd	Basic Freeway	40.8	E	29.7	D
On Ramp from Kent Narrows Rd	Merge	30.5	D	23.3	C
R Clayton Mitchell Jr Bridge	Basic Freeway	41.9	E	30.1	D
Off Ramp to Piney Narrows Rd	Diverge	28.2	D	21.5	C
Piney Narrows Rd	Basic Freeway	40.2	E	28.6	D
On Ramp from Piney Narrows Rd	Merge	26.9	C	19.3	B
West of Piney Narrows Rd	Basic Freeway	41.9	E	29.6	D
Off Ramp to Piney Creek Rd	Diverge	29.2	D	22.7	C
Piney Creek Rd	Basic Freeway	39.7	E	29.0	D
On Ramp from Piney Creek Rd	Merge	25.8	C	18.8	B
West of Piney Creek Rd	Basic Freeway	40.6	E	29.7	D
Off Ramp to Chester Station Ln	Diverge	28.2	D	21.8	C
Chester Station Ln	Basic Freeway	39.8	E	29.0	D
Weave from Chester Station Ln to Castle Marina Rd	Weaving	36.9	E	26.7	C
Castle Marina Rd	Basic Freeway	37.2	E	26.6	D
On Ramp from Castle Marina Rd	Merge	30.9	D	25.8	C
West of Castle Marina Rd	Basic Freeway	42.3	E	32.0	D
Lane Addition West of Castle Marina Rd	Basic Freeway	30.3	D	24.0	C
Off Ramp to Duke St	Diverge	19.0	B	14.3	B

Segment Name	Segment Type	SWED (Sun. Peak)		NSWD (AM Peak)	
		6-8-6		6-8-6	
		Density	LOS	Density	LOS
Duke St	Basic Freeway	29.9	D	23.1	C
Weave from Duke St to MD 8	Weaving	31.3	D	22.2	C
Inside MD 8 Interchange	Basic Freeway	27.3	D	18.4	C
On Ramp from MD 8	Merge	19.6	B	17.3	B
Eastern Side of Bay Bridge	Basic Highway	40.8	E	30.9	D
Western Side of Bay Bridge	Basic Highway	37.1	E	28.5	D
Off Ramp to Oceanic Dr	Diverge	21.7	C	16.9	B
Inside Oceanic Dr Interchange	Basic Freeway	27.5	D	21.5	C
On Ramp from Oceanic Dr	Merge	22.5	C	18.3	B
West of Oceanic Dr	Basic Freeway	28.4	D	22.3	C
Lane Reduction West of Oceanic Dr	Basic Freeway	40.5	E	29.7	D
Off Ramp to MD 179	Diverge	30.8	D	24.5	C
Inside MD 179 Interchange	Basic Freeway	40.1	E	27.6	D
On Ramp from MD 179	Merge	N/A	F	27.4	C
West of MD 179	Basic Freeway	N/A	F	35.8	E
Off Ramp to Bay Dale Dr	Diverge	N/A	F	26.3	C
Inside Bay Dale Dr Interchange	Basic Freeway	N/A	F	32.8	D
On Ramp from Bay Dale Dr	Merge	N/A	F	N/A	F
West of Bay Dale Dr	Basic Freeway	N/A	F	N/A	F
Off Ramp to MD 648	Diverge	N/A	F	N/A	F
Inside MD 648 Interchange	Basic Freeway	N/A	F	N/A	F
On Ramp from MD 648	Merge	N/A	F	N/A	F
West of MD 648	Basic Freeway	N/A	F	N/A	F
Off Ramp to MD 2	Diverge	33.5	D	29.7	D
Inside MD 2/MD 450 Interchange	Basic Freeway	40.3	E	30.6	D
Off Ramp to MD 450	Diverge	32.5	D	27.4	C
Over Boulters Way	Basic Freeway	38.1	E	28.8	D
On Ramp from MD 2	Merge	N/A	F	N/A	F
Over Severn River Bridge	Basic Freeway	N/A	F	N/A	F

Tables C-5 and C-6 show the following results for Alternatives B/C: 6-8-6:

1. On SWEDs, in the eastbound direction, the freeway/weaving segments in the vicinity of the Bridge, where four eastbound lanes will be provided, will typically operate at acceptable levels of service (LOS D or better). Most of the remainder of the freeway/weaving segments will typically operate at LOS E or F.

2. On NSWDs, in the eastbound direction, the freeway/weaving segments at the western end of the study area will generally operate at LOS E or F. From MD 179 through the remainder of the study area, LOS will typically operate at D or better.

In the westbound direction, conditions are similar to those noted for the eastbound direction on both SWEDs and NSWDs.

C .4 Alternatives D/E: 8-8-8

C.4.1 HCM Analysis and Queuing Analysis of the Bay Bridge

Using the travel demand forecasts described in Chapter 6, HCM and queuing analyses were performed for the Bay Bridge for both NSWD and SWED conditions. The results of the queuing analyses are shown in **Table C-7**.

Table C-7: 2045 Build 8-8-8 Hourly Levels of Service and Queue Lengths Across the Bay Bridge

Time	Typical NSWD						Typical Summer Weekend Day					
	Eastbound			Westbound			Eastbound (Friday)			Westbound (Sunday)		
	LOS	Queue (miles)	Queue Longer than 1 Mile	LOS	Queue (miles)	Queue Longer than 1 Mile	LOS	Queue (miles)	Queue Longer than 1 Mile	LOS	Queue (miles)	Queue Longer than 1 Mile
12-1AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
1-2AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
2-3AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
3-4AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
4-5AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
5-6AM	A	0.0	-	B	0.0	-	A	0.0	-	A	0.0	-
6-7AM	A	0.0	-	C	0.0	-	B	0.0	-	A	0.0	-
7-8AM	B	0.0	-	C	0.0	-	B	0.0	-	A	0.0	-
8-9AM	B	0.0	-	C	0.0	-	C	0.0	-	B	0.0	-
9-10AM	B	0.0	-	B	0.0	-	C	0.0	-	C	0.0	-
10-11AM	B	0.0	-	B	0.0	-	D	0.4	-	D	0.1	-
11AM-12PM	B	0.0	-	B	0.0	-	D	1.4	✓	D	0.9	-
12-1PM	B	0.0	-	B	0.0	-	D	2.6	✓	D	2.2	✓
1-2PM	B	0.0	-	B	0.0	-	D	3.7	✓	D	3.4	✓
2-3PM	C	0.0	-	B	0.0	-	D	4.5	✓	D	4.5	✓
3-4PM	C	0.0	-	B	0.0	-	D	5.3	✓	D	5.5	✓
4-5PM	C	0.1	-	B	0.0	-	D	6.4	✓	D	6.3	✓
5-6PM	C	0.0	-	B	0.0	-	D	7.5	✓	D	7.2	✓
6-7PM	B	0.0	-	A	0.0	-	C(1)	7.4	✓	D	8.0	✓
7-8PM	B	0.0	-	A	0.0	-	C(1)	5.9	✓	D	8.4	✓
8-9PM	A	0.0	-	A	0.0	-	C(1)	4.1	✓	C(1)	8.2	✓
9-10PM	A	0.0	-	A	0.0	-	B(1)	1.1	✓	C(1)	6.5	✓
10-11PM	A	0.0	-	A	0.0	-	A	0.0	-	B(1)	3.1	✓
11PM-12AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
Max. Queue	-	0.1	-	-	0.0	-	-	7.5	-	-	8.4	-
Hours with Queue > 1.0 Mile	-	-	0	-	-	0	-	-	11	-	-	11

(1) Computed LOS based on approach volume. LOS is actually D or E, due to the queue (the unserved demand) from the preceding hour.

Table C-7 for Alternatives D/E: 8-8-8 indicates that the conditions are similar to those noted for the 6-8-6 scenario. There are no queues anticipated in either direction on NSWDs, but queues longer than seven miles are expected, with queues longer than one mile lasting for more than ten hours.

C.4.2 HCM Analysis of U.S. 50/301 in the Remainder of the Study Area

The HCM analyses for Alternatives D/E: 8-8-8 are summarized in **Tables C-8 and C-9**. As noted previously, the HCM analyses represent a best-case condition, and do not consider external factors such as queuing from the Bay Bridge or other potential bottlenecks. Further, HCM analyses of future conditions do not consider restrictions on traffic volumes, which may occur due to upstream bottlenecks.

Table C-8: 2045 Build 8-8-8 HCM Analyses, U.S. 50/301 Eastbound

Segment Name	Segment Type	SWED (Friday Peak)		NSWD (PM Peak)	
		8-8-8		8-8-8	
		Density	LOS	Density	LOS
Over Severn River Bridge	Basic Freeway	40.8	E	42.3	E
Off Ramp to MD 2/MD 450	Diverge	38.5	E	33.0	D
Inside MD 2/MD 450 Interchange	Basic Freeway	38.0	E	32.4	D
On Ramp from MD 2/MD 450	Merge	37.8	E	35.4	E
East of MD 2/MD 450	Basic Freeway	37.8	E	35.4	E
Ferguson Rd Off Ramp	Diverge	26.5	C	25.3	C
Inside Ferguson Rd Interchange	Basic Freeway	33.3	D	28.5	D
On Ramp from Ferguson Rd	Merge	20.3	C	18.3	B
East of Ferguson Rd	Basic Freeway	34.6	D	30.4	D
Off Ramp to Buschs Frontage Rd	Diverge	24.2	C	21.1	C
Inside Buschs Frontage Rd Interchange	Basic Freeway	31.4	D	27.3	D
Weave from Buschs Frontage Rd to MD 179	Weaving	38.5	E	36.3	E
East of MD 179	Basic Freeway	30.6	D	25.2	C
Off Ramp to Whitehall Rd (Exit 30)	Diverge	24.3	C	20.2	C
Inside Whitehall Rd (Exit 30) Interchange	Basic Freeway	29.0	D	24.0	C
On Ramp to Whitehall Rd (Exit 30)	Merge	21.6	C	18.9	B
Whitehall Rd (Exit 30) to Whitehall Rd (Exit 31)	Basic Freeway	29.9	D	25.1	C
Lane Addition East of Whitehall Rd	Basic Freeway	-	-	-	-
Off Ramp to Whitehall Rd (Exit 31)	Diverge	-	-	-	-
Inside Whitehall Rd (Exit 31) Interchange	Basic Freeway	-	-	-	-
On Ramp from Whitehall Rd (Exit 31)	Merge	-	-	-	-
Whitehall Rd (Exit 31) to Oceanic Dr	Basic Freeway	-	-	-	-
Off Ramp to Oceanic Dr	Diverge	25.5	C	22.0	C
Inside Oceanic Dr Interchange	Basic Freeway	29.5	D	24.5	C
On Ramp from Oceanic Dr	Merge	25.8	C	22.5	C
Western Side of Bay Bridge	Basic Highway	42.6	E	34.7	D
Eastern Side of Bay Bridge	Basic Highway	38.7	E	31.9	D
Off Ramp to MD 8	Diverge	23.4	C	20.0	B
Inside MD 8 Interchange	Basic Freeway	28.0	D	21.3	C
Weave from MD 8 to Thompson Creek Rd	Weaving	37.2	E	30.7	D
Inside Thompson Creek Rd Interchange	Basic Freeway	29.9	D	24.5	C
On Ramp from Thompson Creek Rd	Merge	24.3	C	20.7	C
East of Thompson Creek Rd	Basic Freeway	33.2	D	27.6	D
Lane Reduction East of Thompson Creek Rd	Basic Freeway	-	-	-	-
Off Ramp to Cox Neck Rd	Diverge	26.5	C	22.5	C
Inside Cox Neck Rd Interchange	Basic Freeway	32.0	D	25.9	C
Weave from Cox Neck Rd to Dominion Rd	Weaving	35.9	E	29.9	D
Inside Dominion Rd Interchange	Basic Freeway	29.9	D	23.6	C
On Ramp from Dominion Rd	Merge	21.5	C	18.1	B

Segment Name	Segment Type	SWED (Friday Peak)		NSWD (PM Peak)	
		8-8-8		8-8-8	
		Density	LOS	Density	LOS
East of Dominion Rd	Basic Freeway	32.3	D	26.4	D
Off Ramp to S Piney Rd	Diverge	21.4	C	17.0	B
Inside S Piney Rd Interchange	Basic Freeway	31.4	D	25.3	C
Weave from S Piney Rd to Dundee Ave	Weaving	32.2	D	25.5	C
Inside Dundee Ave Interchange	Basic Freeway	32.5	D	26.5	D
Weave from Dundee Ave to Main St/MD18 (Exit 41)	Weaving	32.0	D	25.0	C
Inside Main St/MD18 (Exit 41) Interchange	Basic Freeway	32.3	D	26.3	D
On Ramp from Main St/MD18 (Exit 41)	Merge	23.3	C	19.6	B
R Clayton Mitchell Jr Bridge	Basic Freeway	32.6	D	26.6	D
Off Ramp to Kent Narrows Rd	Diverge	19.7	B	15.2	B
Inside Kent Narrows Rd Interchange	Basic Freeway	32.0	D	26.1	D
On Ramp from Kent Narrows Rd	Merge	19.3	B	15.5	B
East of Kent Narrows Rd	Basic Freeway	32.8	D	26.9	D
Off Ramp to Main St/MD18 (Exit 43A)	Diverge	21.1	C	16.6	B
Inside Main St/MD 18 (Exit 43A) Interchange	Basic Freeway	32.3	D	26.3	D
Weave from Main St/MD18 (Exit 43A) to Chester River Beach Rd	Weaving	31.2	D	25.4	C
Inside Chester River Beach Rd Interchange	Basic Freeway	31.5	D	25.4	C
Weave from Chester River Beach Rd to Station Ln	Weaving	30.0	D	24.0	C
Inside Station Ln Interchange	Basic Freeway	31.8	D	25.6	C
Weave from Station Ln to Evans Ave	Weaving	29.8	D	23.6	C
Inside Evans Ave Interchange	Basic Freeway	31.4	D	25.2	C
Weave from Evans Ave to Hess Rd	Weaving	29.1	D	22.7	C
Inside Hess Rd Interchange	Basic Freeway	31.5	D	25.2	C
Weave from Hess Rd to Nesbit Rd	Weaving	30.0	D	23.7	C
Inside Nesbit Rd Interchange	Basic Freeway	30.8	D	24.3	C
On Ramp from Nesbit Rd	Merge	19.1	B	15.3	B
East of Nesbit Rd	Basic Freeway	31.7	D	25.3	C
US 50/US 301 Split	Diverge	24.8	C	17.1	B
US 50 East of US 50/US 301 Split	Basic Highway	N/A	F	26.7	D
US 301 Split East of MD18	Basic Highway	18.8	C	19.2	B

Table C-9: 2045 Build 8-8-8 HCM Analyses, U.S. 50/301 Westbound

Segment Name	Segment Type	SWED (Sun. Peak)		NSWD (AM Peak)	
		8-8-8		8-8-8	
		Density	LOS	Density	LOS
US 50 East of US 50/US 301 Merge	Basic Highway	N/A	F	22.2	C
US 301 East of US 50/US 301 Merge	Basic Highway	18.6	C	16.4	B
US 50/US 301 Merge*	Merge	32.5	D	21.6	C
West of US 50/US 301 Merge	Basic Freeway	32.5	D	21.6	C
Off Ramp to Blackbeard Rd	Diverge	20.4	C	12.1	B
Under Nesbit Rd	Basic Freeway	31.3	D	20.6	C
Weave from Winchester Creek to Hissey Rd	Weaving	30.9	D	20.2	C
Inside Hissey Rd Interchange	Basic Freeway	30.2	D	20.4	C
Weave from Hissy Rd to Winchester Creek	Weaving	30.8	D	19.9	B
Evans Ave	Basic Freeway	31.8	D	21.6	C
Weave from Evans Ave to VFW Ave	Weaving	29.8	D	19.2	B
Inside VFW Ave Interchange	Basic Freeway	31.0	D	21.2	C
On Ramp from VFW Ave	Merge	17.6	B	11.5	B
West of VFW Ave	Basic Freeway	31.2	D	21.4	C
Weave from Chester River Beach Rd to Jackson Creek Rd	Weaving	31.3	D	22.1	C
Jackson Creek Rd	Basic Freeway	30.9	D	22.2	C
On Ramp from Jackson Creek Rd	Merge	20.6	C	14.7	B
West of Jackson Creek Rd	Basic Freeway	32.1	D	23.1	C
Off Ramp to Kent Narrows Rd	Diverge	20.1	C	13.2	B
Kent Narrows Rd	Basic Freeway	30.8	D	22.2	C
On Ramp from Kent Narrows Rd	Merge	22.3	C	16.6	B
R Clayton Mitchell Jr Bridge	Basic Freeway	31.3	D	22.5	C
Off Ramp to Piney Narrows Rd	Diverge	20.7	C	14.2	B
Piney Narrows Rd	Basic Freeway	30.5	D	21.5	C
On Ramp from Piney Narrows Rd	Merge	17.9	B	12.1	B
West of Piney Narrows Rd	Basic Freeway	31.3	D	22.2	C
Off Ramp to Piney Creek Rd	Diverge	21.9	C	14.9	B
Piney Creek Rd	Basic Freeway	30.3	D	21.8	C
On Ramp from Piney Creek Rd	Merge	16.8	B	11.5	B
West of Piney Creek Rd	Basic Freeway	30.7	D	22.2	C
Off Ramp to Chester Station Ln	Diverge	20.4	C	14.0	B
Chester Station Ln	Basic Freeway	30.3	D	21.8	C
Weave from Chester Station Ln to Castle Marina Rd	Weaving	29.8	C	20.8	B
Castle Marina Rd	Basic Freeway	28.9	D	20.0	C
On Ramp from Castle Marina Rd	Merge	23.1	C	19.7	B
West of Castle Marina Rd	Basic Freeway	31.5	D	24.0	C
Lane Addition West of Castle Marina Rd	Basic Freeway	-	-	-	-
Off Ramp to Duke St	Diverge	19.8	B	14.3	B

Segment Name	Segment Type	SWED (Sun. Peak)		NSWD (AM Peak)	
		8-8-8		8-8-8	
		Density	LOS	Density	LOS
Duke St	Basic Freeway	31.0	D	23.1	C
Weave from Duke St to MD 8	Weaving	32.6	D	22.2	C
Inside MD 8 Interchange	Basic Freeway	28.4	D	18.4	C
On Ramp from MD 8	Merge	20.3	C	17.2	B
Eastern Side of Bay Bridge	Basic Highway	42.6	E	30.9	D
Western Side of Bay Bridge	Basic Highway	38.7	E	28.5	D
Off Ramp to Oceanic Dr	Diverge	22.5	C	16.9	B
Inside Oceanic Dr Interchange	Basic Freeway	28.5	D	21.5	C
On Ramp from Oceanic Dr	Merge	23.2	C	18.3	B
West of Oceanic Dr	Basic Freeway	29.5	D	22.3	C
Lane Reduction West of Oceanic Dr	Basic Freeway	-	-	-	-
Off Ramp to MD 179	Diverge	23.7	C	18.2	B
Inside MD 179 Interchange	Basic Freeway	29.4	D	20.7	C
On Ramp from MD 179	Merge	22.7	C	20.1	C
West of MD 179	Basic Freeway	33.1	D	26.3	D
Off Ramp to Bay Dale Dr	Diverge	23.9	C	18.9	B
Inside Bay Dale Dr Interchange	Basic Freeway	32.5	D	24.6	C
On Ramp from Bay Dale Dr	Merge	28.5	D	27.7	C
West of Bay Dale Dr	Basic Freeway	36.9	E	30.8	D
Off Ramp to MD 648	Diverge	27.2	C	23.2	C
Inside MD 648 Interchange	Basic Freeway	36.7	E	30.6	D
On Ramp from MD 648	Merge	29.2	D	26.0	C
West of MD 648	Basic Freeway	36.7	E	30.8	D
Off Ramp to MD 2	Diverge	36.7	E	30.8	D
Inside MD 2/MD 450 Interchange	Basic Freeway	42.9	E	30.6	D
Off Ramp to MD 450	Diverge	33.3	D	27.4	C
Over Boulters Way	Basic Freeway	40.3	E	28.9	D
On Ramp from MD 2	Merge	N/A	F	N/A	F
Over Severn River Bridge	Basic Freeway	N/A	F	N/A	F

Tables C-8 and C-9 for Alternatives D/E: 8-8-8 show the following results.

1. In the vicinity of the Bay Bridge, where eight lanes were provided under Alternatives D/E: 8-8-8, conditions are nearly identical between Alternatives B/C: 6-8-6 and Alternatives D/E: 8-8-8.
2. Operational issues exist at the western end of the study area, primarily between the Study Limit and MD 179.

C.5 Alternatives F/G: 8-10-8

C.5.1 HCM Analysis and Queuing Analysis of the Bay Bridge

Using the travel demand forecasts described in Chapter 6, HCM and queuing analyses were performed for the Bay Bridge for both NSWD and SWED conditions. The results of the queuing analyses are shown in **Table C-10**.

Table C-10: 2045 Build 8-10-8 Hourly Levels of Service and Queue Lengths Across the Bay Bridge

Time	Typical NSWD						Typical Summer Weekend Day					
	Eastbound			Westbound			Eastbound (Friday)			Westbound (Sunday)		
	LOS	Queue (miles)	Queue Longer Than 1 Mile	LOS	Queue (miles)	Queue Longer Than 1 Mile	LOS	Queue (miles)	Queue Longer Than 1 Mile	LOS	Queue (miles)	Queue Longer than 1 mile
12-1AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
1-2AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
2-3AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
3-4AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
4-5AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
5-6AM	A	0.0	-	B	0.0	-	A	0.0	-	A	0.0	-
6-7AM	A	0.0	-	C	0.0	-	B	0.0	-	A	0.0	-
7-8AM	B	0.0	-	C	0.0	-	B	0.0	-	A	0.0	-
8-9AM	B	0.0	-	C	0.0	-	C	0.0	-	B	0.0	-
9-10AM	B	0.0	-	B	0.0	-	C	0.0	-	C	0.0	-
10-11AM	B	0.0	-	B	0.0	-	D	0.0	-	D	0.0	-
11AM-12PM	B	0.0	-	B	0.0	-	D	0.0	-	D	0.0	-
12-1PM	B	0.0	-	B	0.0	-	D	0.0	-	D	0.0	-
1-2PM	B	0.0	-	B	0.0	-	D	0.0	-	D	0.0	-
2-3PM	C	0.0	-	B	0.0	-	D	0.0	-	D	0.0	-
3-4PM	C	0.0	-	B	0.0	-	D	0.0	-	D	0.0	-
4-5PM	C	0.0	-	B	0.0	-	D	0.0	-	D	0.0	-
5-6PM	C	0.0	-	B	0.0	-	D	0.0	-	D	0.0	-
6-7PM	B	0.0	-	A	0.0	-	C	0.0	-	D	0.0	-
7-8PM	B	0.0	-	A	0.0	-	C	0.0	-	D	0.0	-
8-9PM	A	0.0	-	A	0.0	-	C	0.0	-	C	0.0	-
9-10PM	A	0.0	-	A	0.0	-	B	0.0	-	C	0.0	-
10-11PM	A	0.0	-	A	0.0	-	A	0.0	-	B	0.0	-
11PM-12AM	A	0.0	-	A	0.0	-	A	0.0	-	A	0.0	-
Max. Queue	-	0.0	-	-	0.0	-	-	0.0	-	-	0.0	-
Hours with Queue > 1.0 Mile	-	-	0	-	-	0	-	-	0	-	-	0

Table C-10 for Alternatives F/G: 8-10-8 shows that no queues are expected at the Bay Bridge in either direction on NSWDs or SWEDs.

C.5.2 HCM Analysis of U.S. 50/301 in the Remainder of the Study Area

The HCM analyses for Alternative F/G: 8-10-8 are summarized in **Tables C-11 and C-12**. As noted previously, the HCM analyses represent a best-case condition, and do not consider external factors such as queuing from the Bay Bridge or other potential bottlenecks. Further, HCM analyses of future conditions do not consider restrictions on traffic volumes which may occur due to upstream bottlenecks.

Table C-11: 2045 Build 8-10-8 HCM Analyses, U.S. 50/301 Eastbound

Segment Name	Segment Type	SWED (Friday Peak)		NSWD (PM Peak)	
		8-10-8		8-10-8	
		Density	LOS	Density	LOS
Over Severn River Bridge	Basic Freeway	40.9	E	42.3	E
Off Ramp to MD 2/MD 450	Diverge	38.6	E	33.0	D
Inside MD 2/MD 450 Interchange	Basic Freeway	38.0	E	32.4	D
On Ramp from MD 2/MD 450	Merge	37.8	E	35.4	E
East of MD 2/MD 450	Basic Freeway	37.8	E	35.4	E
Ferguson Rd Off Ramp	Diverge	29.7	D	25.3	C
Inside Ferguson Rd Interchange	Basic Freeway	33.3	D	28.5	D
On Ramp from Ferguson Rd	Merge	20.3	C	18.3	B
East of Ferguson Rd	Basic Freeway	34.6	D	30.4	D
Off Ramp to Buschs Frontage Rd	Diverge	24.2	C	21.1	C
Inside Buschs Frontage Rd Interchange	Basic Freeway	31.4	D	27.3	D
Weave from Buschs Frontage Rd to MD 179	Weaving	38.5	E	36.3	E
East of MD 179	Basic Freeway	30.6	D	25.2	C
Off Ramp to Whitehall Rd (Exit 30)	Diverge	24.3	C	20.2	C
Inside Whitehall Rd (Exit 30) Interchange	Basic Freeway	29.0	D	24.0	C
On Ramp to Whitehall Rd (Exit 30)	Merge	21.6	C	18.9	B
Whitehall Rd (Exit 30) to Whitehall Rd (Exit 31)	Basic Freeway	29.9	D	25.1	C
Lane Addition East of Whitehall Rd	Basic Freeway	23.9	C	20.1	C
Off Ramp to Whitehall Rd (Exit 31)	Diverge	-	-	-	-
Inside Whitehall Rd (Exit 31) Interchange	Basic Freeway	-	-	-	-
On Ramp from Whitehall Rd (Exit 31)	Merge	-	-	-	-
Whitehall Rd (Exit 31) to Oceanic Dr	Basic Freeway	-	-	-	-
Off Ramp to Oceanic Dr	Diverge	22.3	C	20.2	C
Inside Oceanic Dr Interchange	Basic Freeway	23.6	C	19.6	C
On Ramp from Oceanic Dr	Merge	21.4	C	19.2	B
Western Side of Bay Bridge	Basic Highway	31.9	D	26.8	D
Eastern Side of Bay Bridge	Basic Highway	29.5	D	24.7	C
Off Ramp to MD 8	Diverge	20.3	C	18.4	B
Inside MD 8 Interchange	Basic Freeway	22.4	C	17.1	B
Weave from MD 8 to Thompson Creek Rd	Weaving	30.3	D	25.1	C
Inside Thompson Creek Rd Interchange	Basic Freeway	23.9	C	19.6	C
On Ramp from Thompson Creek Rd	Merge	19.9	B	17.3	B
East of Thompson Creek Rd	Basic Freeway	26.6	D	22.1	C
Lane Reduction East of Thompson Creek Rd	Basic Freeway	33.3	D	27.6	D
Off Ramp to Cox Neck Rd	Diverge	26.6	C	22.5	C
Inside Cox Neck Rd Interchange	Basic Freeway	32.0	D	25.9	C
Weave from Cox Neck Rd to Dominion Rd	Weaving	35.9	E	29.9	D

Segment Name	Segment Type	SWED (Friday Peak)		NSWD (PM Peak)	
		8-10-8		8-10-8	
		Density	LOS	Density	LOS
Inside Dominion Rd Interchange	Basic Freeway	29.9	D	23.6	C
On Ramp from Dominion Rd	Merge	21.5	C	18.1	B
East of Dominion Rd	Basic Freeway	32.3	D	26.4	D
Off Ramp to S Piney Rd	Diverge	21.4	C	17.0	B
Inside S Piney Rd Interchange	Basic Freeway	31.4	D	25.3	C
Weave from S Piney Rd to Dundee Ave	Weaving	32.2	D	25.5	C
Inside Dundee Ave Interchange	Basic Freeway	32.5	D	26.5	D
Weave from Dundee Ave to Main St/MD18 (Exit 41)	Weaving	32.0	D	25.0	C
Inside Main St/MD18 (Exit 41) Interchange	Basic Freeway	32.3	D	26.3	D
On Ramp from Main St/MD18 (Exit 41)	Merge	23.3	C	19.6	B
R Clayton Mitchell Jr Bridge	Basic Freeway	32.6	D	26.6	D
Off Ramp to Kent Narrows Rd	Diverge	19.7	B	15.2	B
Inside Kent Narrows Rd Interchange	Basic Freeway	32.0	D	26.1	D
On Ramp from Kent Narrows Rd	Merge	19.3	B	15.5	B
East of Kent Narrows Rd	Basic Freeway	32.9	D	26.9	D
Off Ramp to Main St/MD18 (Exit 43A)	Diverge	21.1	C	16.6	B
Inside Main St/MD 18 (Exit 43A) Interchange	Basic Freeway	32.3	D	26.3	D
Weave from Main St/MD18 (Exit 43A) to Chester River Beach Rd	Weaving	31.3	D	25.4	C
Inside Chester River Beach Rd Interchange	Basic Freeway	31.6	D	25.4	C
Weave from Chester River Beach Rd to Station Ln	Weaving	30.1	D	24.0	C
Inside Station Ln Interchange	Basic Freeway	31.8	D	25.6	C
Weave from Station Ln to Evans Ave	Weaving	29.8	D	23.6	C
Inside Evans Ave Interchange	Basic Freeway	31.4	D	25.2	C
Weave from Evans Ave to Hess Rd	Weaving	29.1	D	22.7	C
Inside Hess Rd Interchange	Basic Freeway	31.5	D	25.2	C
Weave from Hess Rd to Nesbit Rd	Weaving	30.0	D	23.7	C
Inside Nesbit Rd Interchange	Basic Freeway	30.8	D	24.3	C
On Ramp from Nesbit Rd	Merge	19.1	B	15.3	B
East of Nesbit Rd	Basic Freeway	31.7	D	25.3	C
US 50/US 301 Split	Diverge	26.2	C	17.1	B
US 50 East of US 50/US 301 Split	Basic Highway	N/A	F	26.7	D
US 301 Split East of MD18	Basic Highway	18.8	C	19.2	B

Table C-12: 2045 Build 8-10-8 HCM Analyses, U.S. 50/301 Westbound

Segment Name	Segment Type	SWED (Sun. Peak) 8-10-8		NSWD (AM Peak) 8-10-8	
		Density	LOS	Density	LOS
US 50 East of US 50/US 301 Merge	Basic Highway	N/A	F	22.2	C
US 301 East of US 50/US 301 Merge	Basic Highway	18.7	C	16.4	B
US 50/US 301 Merge*	Merge	32.5	D	21.6	C
West of US 50/US 301 Merge	Basic Freeway	32.5	D	21.6	C
Off Ramp to Blackbeard Rd	Diverge	31.8	C	12.1	B
Under Nesbit Rd	Basic Freeway	31.3	D	20.6	C
Weave from Winchester Creek to Hissey Rd	Weaving	30.8	D	20.2	C
Inside Hissey Rd Interchange	Basic Freeway	30.3	D	20.4	C
Weave from Hissy Rd to Winchester Creek	Weaving	30.8	D	19.9	B
Evans Ave	Basic Freeway	31.8	D	21.6	C
Weave from Evans Ave to VFW Ave	Weaving	29.8	D	19.2	B
Inside VFW Ave Interchange	Basic Freeway	31.0	D	21.2	C
On Ramp from VFW Ave	Merge	17.6	B	11.5	B
West of VFW Ave	Basic Freeway	31.2	D	21.4	C
Weave from Chester River Beach Rd to Jackson Creek Rd	Weaving	31.3	D	22.1	C
Jackson Creek Rd	Basic Freeway	30.9	D	22.2	C
On Ramp from Jackson Creek Rd	Merge	20.6	C	14.7	B
West of Jackson Creek Rd	Basic Freeway	32.1	D	23.1	C
Off Ramp to Kent Narrows Rd	Diverge	20.1	C	13.2	B
Kent Narrows Rd	Basic Freeway	30.8	D	22.2	C
On Ramp from Kent Narrows Rd	Merge	22.3	C	16.6	B
R Clayton Mitchell Jr Bridge	Basic Freeway	31.3	D	22.5	C
Off Ramp to Piney Narrows Rd	Diverge	20.7	C	14.2	B
Piney Narrows Rd	Basic Freeway	30.5	D	21.5	C
On Ramp from Piney Narrows Rd	Merge	17.9	B	12.1	B
West of Piney Narrows Rd	Basic Freeway	31.3	D	22.2	C
Off Ramp to Piney Creek Rd	Diverge	21.9	C	14.9	B
Piney Creek Rd	Basic Freeway	30.3	D	21.8	C
On Ramp from Piney Creek Rd	Merge	16.8	B	11.5	B
West of Piney Creek Rd	Basic Freeway	30.7	D	22.2	C
Off Ramp to Chester Station Ln	Diverge	20.4	C	14.0	B
Chester Station Ln	Basic Freeway	30.3	D	21.8	C
Weave from Chester Station Ln to Castle Marina Rd	Weaving	29.8	C	20.8	B
Castle Marina Rd	Basic Freeway	28.9	D	20.0	C
On Ramp from Castle Marina Rd	Merge	23.1	C	19.7	B
West of Castle Marina Rd	Basic Freeway	31.5	D	24.0	C
Lane Addition West of Castle Marina Rd	Basic Freeway	25.2	C	19.2	C

Segment Name	Segment Type	SWED (Sun. Peak)		NSWD (AM Peak)	
		8-10-8		8-10-8	
		Density	LOS	Density	LOS
Off Ramp to Duke St	Diverge	16.3	B	12.6	B
Duke St	Basic Freeway	24.8	C	18.5	C
Weave from Duke St to MD 8	Weaving	26.6	C	18.3	B
Inside MD 8 Interchange	Basic Freeway	22.7	C	14.7	B
On Ramp from MD 8	Merge	16.0	B	14.7	B
Eastern Side of Bay Bridge	Basic Highway	31.9	D	23.9	C
Western Side of Bay Bridge	Basic Highway	29.5	D	22.0	C
Off Ramp to Oceanic Dr	Diverge	19.1	B	15.2	B
Inside Oceanic Dr Interchange	Basic Freeway	22.8	C	17.2	B
On Ramp from Oceanic Dr	Merge	18.7	B	15.2	B
West of Oceanic Dr	Basic Freeway	23.6	C	17.8	B
Lane Reduction West of Oceanic Dr	Basic Freeway	29.5	D	22.3	C
Off Ramp to MD 179	Diverge	23.7	C	18.2	B
Inside MD 179 Interchange	Basic Freeway	29.4	D	20.7	C
On Ramp from MD 179	Merge	22.7	C	20.1	C
West of MD 179	Basic Freeway	33.1	D	26.3	D
Off Ramp to Bay Dale Dr	Diverge	23.9	C	18.9	B
Inside Bay Dale Dr Interchange	Basic Freeway	32.5	D	24.6	C
On Ramp from Bay Dale Dr	Merge	28.5	D	27.7	C
West of Bay Dale Dr	Basic Freeway	36.9	E	30.8	D
Off Ramp to MD 648	Diverge	27.2	C	23.2	C
Inside MD 648 Interchange	Basic Freeway	36.7	E	30.6	D
On Ramp from MD 648	Merge	29.2	D	26.0	C
West of MD 648	Basic Freeway	36.7	E	30.8	D
Off Ramp to MD 2	Diverge	36.7	E	30.8	D
Inside MD 2/MD 450 Interchange	Basic Freeway	42.9	E	30.6	D
Off Ramp to MD 450	Diverge	33.3	D	27.4	C
Over Boulters Way	Basic Freeway	40.3	E	28.9	D
On Ramp from MD 2	Merge	N/A	F	N/A	F
Over Severn River Bridge	Basic Freeway	N/A	F	N/A	F

Tables C-11 and C-12 for Alternatives F/G: 8-10-8 show the following results.

1. LOS is generally in the acceptable range (LOS D or better) throughout the study area, including on the Bay Bridge itself.

2. The primary exception to this is at the western end on SWEDs, approximately between MD 179 and the Study Limit.