FUTURE 375

I-375 ALTERNATIVES STUDY

Traffic Operations Analysis

Existing Conditions and Illustrative Alternatives

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TABLE OF CONTENTS

Executive Summary 1
Existing and Future No-Build Conditions 1
Illustrative Alternative Analyses 1
1 INTRODUCTION 4
1.1 Purpose 4
1.2 Report Organization 4
2 Existing Operations Analysis 5
2.1 Study Area 5
2.2 Data Collection 6
2.2.1 Intersection Geometry, Speed Limits, and signal timings 6
2.2.2 Vehicle Counts 7
2.3 Operations Analysis 7
2.3.1 Methodology 7
2.3.2 Delay and Level of Service Results for Existing Conditions 9
2.4 Crash Safety Analysis 11
2.4.1 Crash Definitions 12
2.4.2 Intersection Crash Summary 13
2.4.3 Segment Crash Summary 13
2.4.4 Non-Motorized Crash Summary 18
3 Future No-Build Conditions Analysis 20
3.1 Travel Forecasting Model Process 20
3.2 2040 No-Build Traffic Volumes 20
3.3 2040 Traffic Operations 20
4 Illustrative Alternative Analysis 27
4.1 Illustrative Alternatives 27
4.1.1 Primary Study Area Alternatives 27
4.1.2 I-75/I-375/Gratiot Connector Interchange 30
4.1.3 Jefferson Avenue (east of I-375) 31
4.1.4 Jefferson Avenue (west of I-375) 32
4.2 Analysis Methodology 33
4.3 Primary Study Area Analysis 34
4.3.1 Anticipated V/C Performance 34
4.3.2 Forecasted Volume Redistribution 47
4.4 Secondary Study Area Analysis 52
4.4.1 I-75/I-375/Gratiot Connector Interchange 52
4.4.2 Jefferson Avenue (east of I-375) 54
4.4.3 Jefferson Avenue (west of I-375) 55

List of Tables

Table 1: Level of Service Criteria for Signalized Intersections 9
Table 2: Freeway & Ramp Junction Level of Service Criteria 9
Table 3: Existing Intersection Delay and Level of Service 10
Table 4: Existing Interchange Level of Service 11
Table 5: Existing Freeway Segment Level of Service 11
Table 6: Intersection Crash History, 2010-2012 14
Table 7: Freeway Segment Crash History, 2010-2012 15
Table 8: Freeway Ramp Crash History, 2010-2012 17
Table 9: 2040 No Build Intersection Delay and Level of Service 25
Table 10: Future No Build Interchange Level of Service 26
Table 11: Future No Build Segment Level of Service 26

List of Figures

Figure 1: Site Location 4
Figure 2: Study Area 6
Figure 3: Existing Volumes 5
Figure 4: Existing Volumes 6
Figure 5: Existing Volumes 7
Figure 6: Existing Volumes 8
Figure 7: Non-Motorized Crashes, 2010-2012 19
Figure 8: Future No-Build Volumes 21
Figure 9: Future No-Build Volumes 22
Figure 10: Future No-Build Volumes 23
Figure 11: Future No-Build Volumes 24
Figure 12: I-375 Alternative 1 Cross-Section 27
Figure 13: I-375 Alternative 2 Cross-Section 28
Figure 14: I-375 Alternative 3 Cross-Section 28
Figure 15: I-375 Alternative 4 Cross-Section 29
Figure 16: I-375 Alternative 5 Cross-Section 29
Figure 17: I-375 Alternative 6 Cross-Section 30
Figure 18: I-75/I-375/Gratiot Connector Interchange Alternative 1 30
Figure 19: I-75/I-375/Gratiot Connector Interchange Alternative 2 31
Figure 20: Jefferson Avenue East Alternative 1 Cross-Section 32
Figure 21: Jefferson Avenue East Alternative 2 Cross-Section 32
Figure 22: Jefferson Avenue West Alternative 1 33
Figure 23: Jefferson Avenue West Alternative 2 33
Figure 24: 2040 AM Peak Hour Conditions - Alternative 1 35
Figure 25: 2040 PM Peak Hour Conditions - Alternative 1 36
Figure 26: 2040 AM Peak Hour Conditions - Alternative 2 37
Figure 27: 2040 PM Peak Hour Conditions - Alternative 2 38
Figure 28: 2040 AM Peak Hour Conditions - Alternative 3 39
Figure 29: 2040 PM Peak Hour Conditions - Alternative 3 40
Figure 30: 2040 AM Peak Hour Conditions - Alternative 4 41
Figure 31: 2040 PM Peak Hour Conditions - Alternative 4 42
Figure 32: 2040 AM Peak Hour Conditions - Alternative 5 43
Figure 33: 2040 PM Peak Hour Conditions - Alternative 5 44
Figure 34: 2040 AM Peak Hour Conditions - Alternative 6 45

Figure 35: 2040 PM Peak Hour Conditions - Alternative 6 46
Figure 36: 2040 AM Peak Hour Conditions - Interchange Alternative 1 48
Figure 37: 2040 PM Peak Hour Conditions - Interchange Alternative 1..... 49
Figure 38: AM Peak Hourly Volume Shifts - I-375 Alternative 4 50
Figure 39: PM Peak Hourly Volume Shifts - I-375 Alternative 4 51
Figure 40: 2040 AM Peak Hour Conditions - Interchange Alternative 2 52
Figure 41: 2040 PM Peak Hour Conditions - Interchange Alternative 2..... 53
Figure 42: 2040 AM Peak Hour Conditions - E. Jefferson Alternative 2 54
Figure 43: 2040 PM Peak Hour Conditions - E. Jefferson Alternative 2 54
Figure 44: 2040 AM Peak Hour Performance - W. Jefferson Alternative 1 55
Figure 45: 2040 PM Peak Hour Performance - W. Jefferson Alternative 1 55

Executive Summary

I-375 is a one-mile long interstate highway spur that connects I-75 to Jefferson Avenue in downtown Detroit. The purpose of the I-375 Alternatives Study is to consider operations for reconstructing or replacing the I-375 roadway and bridges to meet projected multi-modal travel demand and other community goals. This traffic operations analysis report documents the existing observed motorized traffic conditions along the corridor and within the secondary study areas (including the I-75/I-375 interchange, and Jefferson Avenue east and west of I-375), projected "no-build" travel demand, and a screening-level assessment of each of the illustrative alternatives from a traffic operations standpoint. It is meant as a tool to identify existing and projected needs (or opportunities) with regards to traffic operations, and to identify potential operational issues associated with the illustrative alternatives which may require further detailed study and/or design refinement.

Existing and Future No-Build Conditions

Analysis of existing conditions was conducted, considering both operations and traffic safety throughout the primary and secondary study areas. All study intersections and freeway segments currently operate at acceptable levels of service (LOS D or better) during typical AM and PM peak hours of travel. However, several locations of interest were identified as having elevated crash rates based on three years of representative crash data:

- Jefferson Ave and Woodward Ave
- Monroe and South I-375 Service Drive
- Gratiot at St. Antoine/Madison
- NB & SB I-375: Jefferson to Larned
- SB I-375: Larned Off Ramp to Monroe Off Ramp
- NB I-75 to NB I-75 Ramp: N I-75 to Split

Mitigation of the contributing factors to these elevated crash rate locations were considered in the development of illustrative alternatives.

A planning horizon of 2040 was investigated using an updated version of the Southeast Michigan Council of Governments (SEMCOG) regional travel demand model. This model considers general growth and demographic trends in the area, as well as specific development input. Nearly all study area intersection and freeway segments are expected to continue to operate at LOS D or better except for the following locations:

- SB I-375/Madison Avenue Off-Ramp (LOS E, AM Peak Hour)
- SB I-375/Weaving segment between Fisher Fwy EB on-ramp and Monroe off-ramp (LOS F, AM Peak Hour)

Illustrative Alternative Analyses

For this screening level analysis, forecasted volumes in combination with link capacity from the regional model were utilized to develop Volume/Capacity (V/C) ratios for study area roadway links. V/C is a high-level measure of saturation of a roadway link, and provides an indicator of potential problem areas. A V/C ratio of greater than 1.0 indicates that the anticipated volume on the link exceeds the theoretical

link capacity, which takes into account the functional classification of the roadway, the posted speed, and the number of travel lanes. This is an indicator of potential congestion along the link.

It should be noted that link capacity at the regional model level is not sensitive to certain operational features or issues, including traffic signalization and phasing, turn lanes and other factors. Further, application of the regional model for analysis of a central business district area is challenging due to the density of the roadway network and the strong influence of parking lot access on the volume distribution, factors which are not typically well reflected at the regional model level. As such, this analysis is intended to be a high-level screening tool to identify potential issue areas, which will be studied further for alternatives which advance to the practical alternative stage.

The following tables summarize the relevant findings for each of the Illustrative Alternatives.

Operational and Safety Findings – I-375 Illustrative Alternatives

Alternative	Operations Findings	Safety Findings
Alternative 1	Most study area facilities anticipated to operate below capacity. Little change to No-Build operations.	Does not address/mitigate safety issues identified.
Alternative 2	Service drive congestion may increase near Jefferson Avenue due to additional traffic feeding new riverfront connection. No other changes anticipated.	Reduced volume of traffic using Jefferson curve due to new riverfront connection.
Alternative 3	Most study area facilities anticipated to operate below capacity during both peak hours of travel.	Eliminates the Jefferson curve and need for weaving maneuver between Monroe and Lafayette. Increased volume of traffic through signalized intersections. Special consideration required for freeway end transition.
Alternative 4	Potential congestion anticipated north of Lafayette in the peak direction of travel during both the AM and PM peak hours due to reduced capacity from freeway to arterial. Some traffic is anticipated to divert to other routes, including M-10.	Eliminates the Jefferson curve and need for weaving maneuver between I-75, Monroe and Lafayette. Increased volume of traffic through signalized intersections. Special consideration required for freeway end transition.
Alternative 5	Potential congestion anticipated north of Lafayette in the peak direction of travel during both the AM and PM peak hours due to reduced capacity from freeway to arterial. Some traffic is anticipated to divert to other routes, including M-10.	Eliminates the Jefferson curve and need for weaving maneuver between I-75, Monroe and Lafayette. Increased volume of traffic through signalized intersections. Special consideration required for freeway end transition.
Alternative 6	Potential congestion anticipated north of Lafayette in the peak direction of travel during both the AM and PM peak hours due to reduced capacity from freeway to arterial. Some traffic is anticipated to divert to other routes, including M-10.	Eliminates the Jefferson curve and need for weaving maneuver between I-75, Monroe and Lafayette. Increased volume of traffic through signalized intersections. Special consideration required for freeway end transition.

Operational and Safety Findings – Secondary Study Area Illustrative Alternatives

Alternative	Operations Findings	Safety Findings
I-75/I-375/Gratiot Connector Interchange		
Alternative 1	Interchange area is anticipated to operate below capacity during each peak hour, or similar relative to No-Build alternative. Additional volume expected along Gratiot Avenue due to new access point.	Eliminates left-side entry and exit at Madison. Increased volume of traffic through signalized intersections.
Alternative 2	Interchange area is anticipated to operate below capacity during each peak hour, except for the intersection area with Gratiot Avenue, which may experience congestion. Traffic from Gratiot Connected expected to divert to other routes, including Mack Avenue and I-94.	Simplifies interchange, reducing driver confusion. Makes access to the I-375 roadway a traditional exit, thereby easing the freeway-to-surface transition.
Jefferson Avenue East of I-375		
Alternative 1	No change relative to the No-Build alternative; three travel lanes maintained in each direction during peak periods.	Raised median provides access control and reduces left turns across the roadway; provides shorter pedestrian crossing with stop mid-crossing.
Alternative 2	Lane reduction anticipated to result in some congestion, particularly westbound during the AM peak hour near Rivard.	5-lane section with buffered bike lanes provides shortest single-phase pedestrian crossing.
Jefferson Avenue West of I-375		
Alternative 1	Prohibition of eastbound left turn at Woodward would reduce eastbound queuing, shift most traffic to Larned off-ramp, with sufficient capacity to support shift.	Would directly address rear-end crash issues experienced due to limited left-turn queuing at Woodward.
Alternative 2	Prohibition of eastbound left turn at Woodward would reduce eastbound queuing, shift most traffic to Larned off-ramp, with sufficient capacity to support shift. Prohibition of southbound left-turn at Woodward would result in traffic shifts to Griswold and Randolph; may increase congestion on those approaches.	Would directly address rear-end crash issues and pedestrian crash issues experienced due to limited left-turn queuing and southbound turn conflict with the pedestrian phase at Woodward.

In general, potential congestion issues identified through this screening analysis indicate areas of concern which may require further geometric refinement and detailed operational analysis during the practical alternatives phase of study.

1 INTRODUCTION

1.1 Purpose

The purpose of this report is to detail the traffic analysis for the I-375 project within the city of Detroit, Michigan. As part of this project, traffic conditions along I-375 were analyzed between I-75 and Jefferson Avenue. The analysis also includes secondary study locations along Jefferson Ave, Gratiot Avenue, and at the I-75/I-375 Interchange. This report details the existing traffic conditions along the corridor as well as future year analysis, for the year 2040, including an analysis of Illustrative Alternatives.

Figure 1: Site Location

1.2 Report Organization

Section 2 of this report documents existing operational and safety conditions throughout the project area. Section 3 of this report summarizes future (2040) No-Build Conditions, including a description of the travel forecasting process and assumptions. Section 4 includes an evaluation of the Illustrative Alternatives for I-375, East and West Jefferson Avenue, and the I-75/I-375 interchange.

2 Existing Operations Analysis

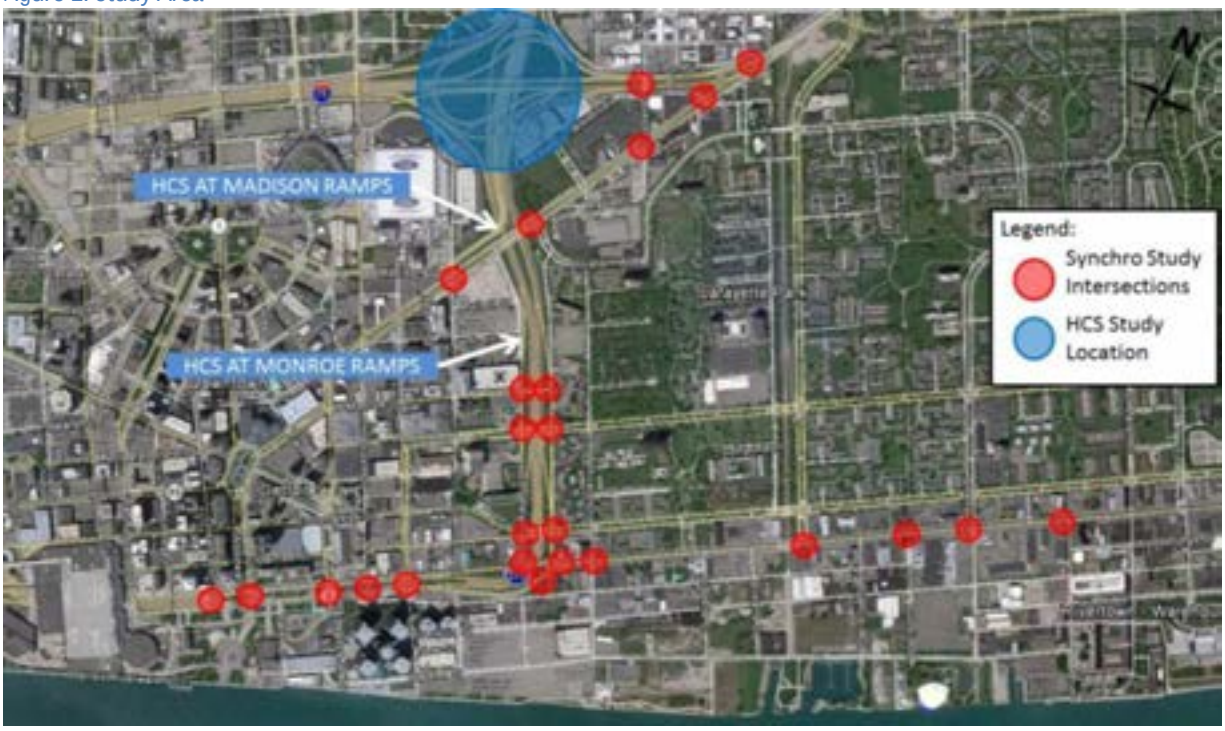
This chapter details the analysis of the existing roadway network and presents the existing intersection performance, which will provide a baseline from which to understand the impact of different design alternatives.

2.1 Study Area

The geographic limits of the modeling efforts include25 signalized intersections, as well as freeway ramps and segments along the I-375 service drives, I-75 interchange, Gratiot Connector, and Jefferson Avenue. The following is a complete list of the signalized intersections included in the AM and PM Synchro models (see Figure 1).

- NB and SB I-375 Service Drive and Monroe Street
- NB and SB I-375 Service Drive and East Lafayette Street
- NB and SB I-375 Service Drive and Larned/Congress Street
- NB and SB I-375 Service Drive and Jefferson Avenue
- Jefferson Avenue and Griswold Street
- Jefferson Avenue and Woodward Avenue
- Jefferson Avenue and Randolph Street
- Jefferson Avenue and Brush Street
- Jefferson Avenue and Beaubien Street
- Jefferson Avenue and Chrysler Drive
- Jefferson Avenue and Rivard Street
- Jefferson Avenue and St. Aubin Street
- Jefferson Avenue and Dubois Street
- Jefferson Avenue and Chene Street
- Jefferson Avenue and Joseph Campau Avenue
- Gratiot Avenue and St. Antoine Street/Madison Street
- Gratiot Avenue and Antietam Avenue
- Gratiot Avenue and Russell Street
- Gratiot Avenue and East Fisher Freeway Service Drive
- Gratiot Avenue and East Fisher Freeway
- Russell Street and Napoleon Street/West Fisher Freeway Service Drive

Figure 2: Study Area



2.2 Data Collection

This section describes the data collected for the study including traffic counts, speed limits, intersection geometries, existing signal timings, and crash data.

2.2.1 Intersection Geometry, Speed Limits, and signal timings

Intersection geometry, speed limits, and signal timings were obtained from a series of Synchro models provided by MDOT and the City of Detroit. The Synchro models were the result of city and state optimization projects, as well as maintenance and special events models. MDOT special event models include existing conditions of the freeway system near Ford Field and Comerica Park. City of Detroit Synchro files include the entire Downtown area from M-10 to I-375 south of I-75.

I-375 – I-375 from the I-75 interchange to Jefferson Avenue is currently a 6 lane depressed freeway which bypasses Gratiot Avenue, Monroe street, Lafayette street, Larned/Congress street and eventually ends at Jefferson Avenue. The freeway is equipped with a 3 lane service drive per direction from Gratiot Avenue to Jefferson Avenue. On and off ramps are available north of Larned Street and north of Monroe Street. The freeway and service drives posted speeds are 55mph and 25mph respectively.

Gratiot Avenue – Gratiot Avenue (M-3) is a state trunkline arterial connecting downtown Detroit to the North East Metro Region. In the study area from the I-75 connector to St. Antoine, Gratiot is a 6 lane boulevard road with mainly on-street parking occupying the right most lane for both directions, with peak period parking restrictions. The principal intersections at Russell, Rivard, and Antietam all include

direct left turns with dedicated left turn lanes. St. Antoine. Gratiot has a posted speed limit of 35 mph north of Antietam Avenue, and 25 mph to the south.

Jefferson Avenue (west of I-375) – Jefferson Avenue west of I-375 includes the study intersections of Beaubien Street, Brush Street, Randolph Street, Woodward Avenue, and Griswold Street. This stretch of Jefferson Avenue is generally an 8 lane boulevard road connecting M-10 to I-375. Direct Lefts are allowed at Woodward Avenue and Beaubien Street; Crossovers are provided at Woodward and Beaubien for all other left turn movements.

Jefferson Avenue (east of I-375) – Jefferson Avenue east of I-375 includes the 5 study intersections of Rivard street, St. Aubin Street, Dubois Street, Chene Street and Joseph Campau Avenue. The one mile stretch is 9 nine lanes wide throughout, with a center two-way left turn median providing left turn lanes at all the intersections. On-street parking is allowed in the outside lanes in both directions during all times of day.

2.2.2 Vehicle Counts

Existing AM and PM peak hour volumes were obtained through a series of Synchro models and traffic counts from MDOT and the City of Detroit. Gratiot Avenue volumes came from a Signal optimization study in 2010 as well as more recent counts in 2011 and 2012 conducted by MDOT in the area. I-375 counts were conducted by MDOT from 2010 to 2013 at the freeway ramps, the service drives, and I-75/I-375 interchange. East Jefferson counts were provided by City of Detroit Optimization files from 2012. West Jefferson counts were provided by City of Detroit optimizations files from 2006 as well as 2013 turning movement counts by MDOT at Beaubien and Randolph Streets. Existing peak hour traffic volumes are depicted in Figures 3-6.

2.3 Operations Analysis

2.3.1 Methodology

Synchro 8 was used for the purpose of traffic operations analysis. Synchro can provide Measures of Effectiveness (MOEs) such as volume to capacity ratio, vehicle delay, and Level of service for each intersection approach as well as total intersection delay. This ability makes Synchro 8 an ideal tool for comparing intersections with changes in geometry and peak hour volumes. For the purposes of this project, the intersection delay and Level of Service was chosen for an MOE.

Highway Capacity Software (HCS) 2010 (V.6.50) was used to measure the level of service at the freeway interchange of I-375 and I-75, and along the I-375 corridor. HCS uses peak volumes and freeway geometrics such as number of lanes and length of acceleration lane to determine the capacity and Level of service of freeway infrastructure. Tables 4 and 5 show the results of the HCS analysis for the I-375/I-75 freeway interchange.

Tables 1 and 2 summarize the level of service criteria for signalized intersections and freeway segments.

Figure 3: Existing Volumes

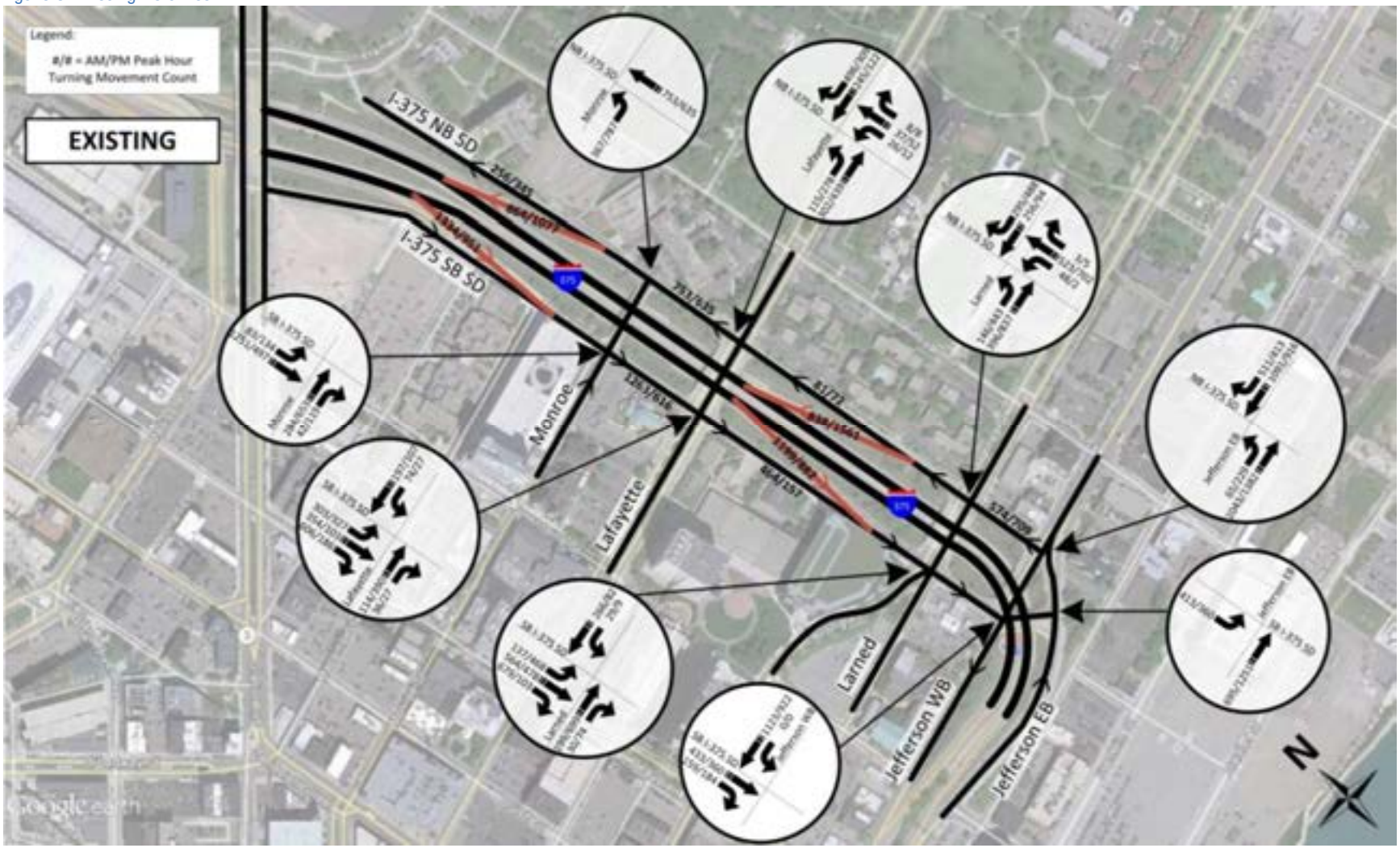


Figure 4: Existing Volumes

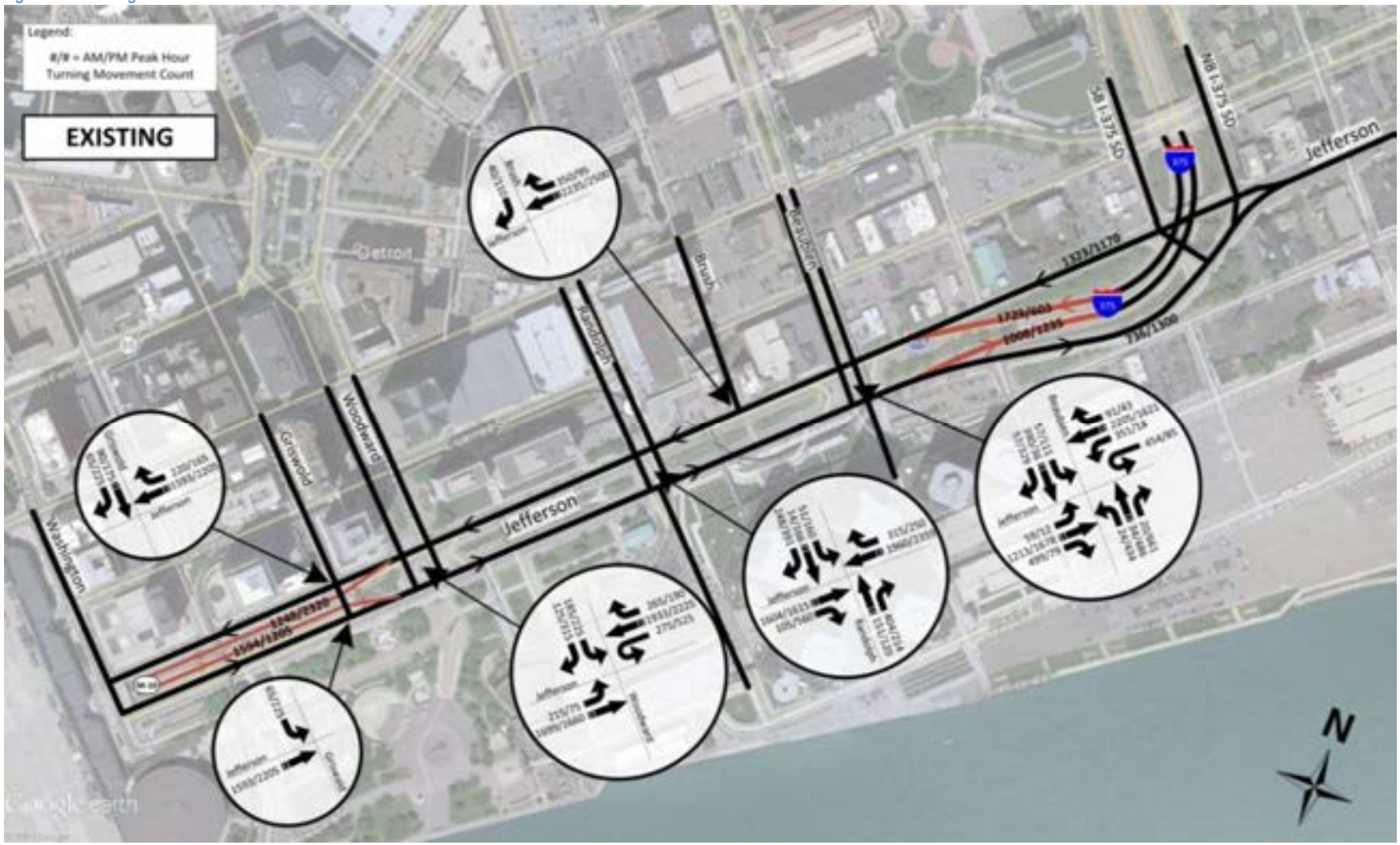


Figure 5: Existing Volumes

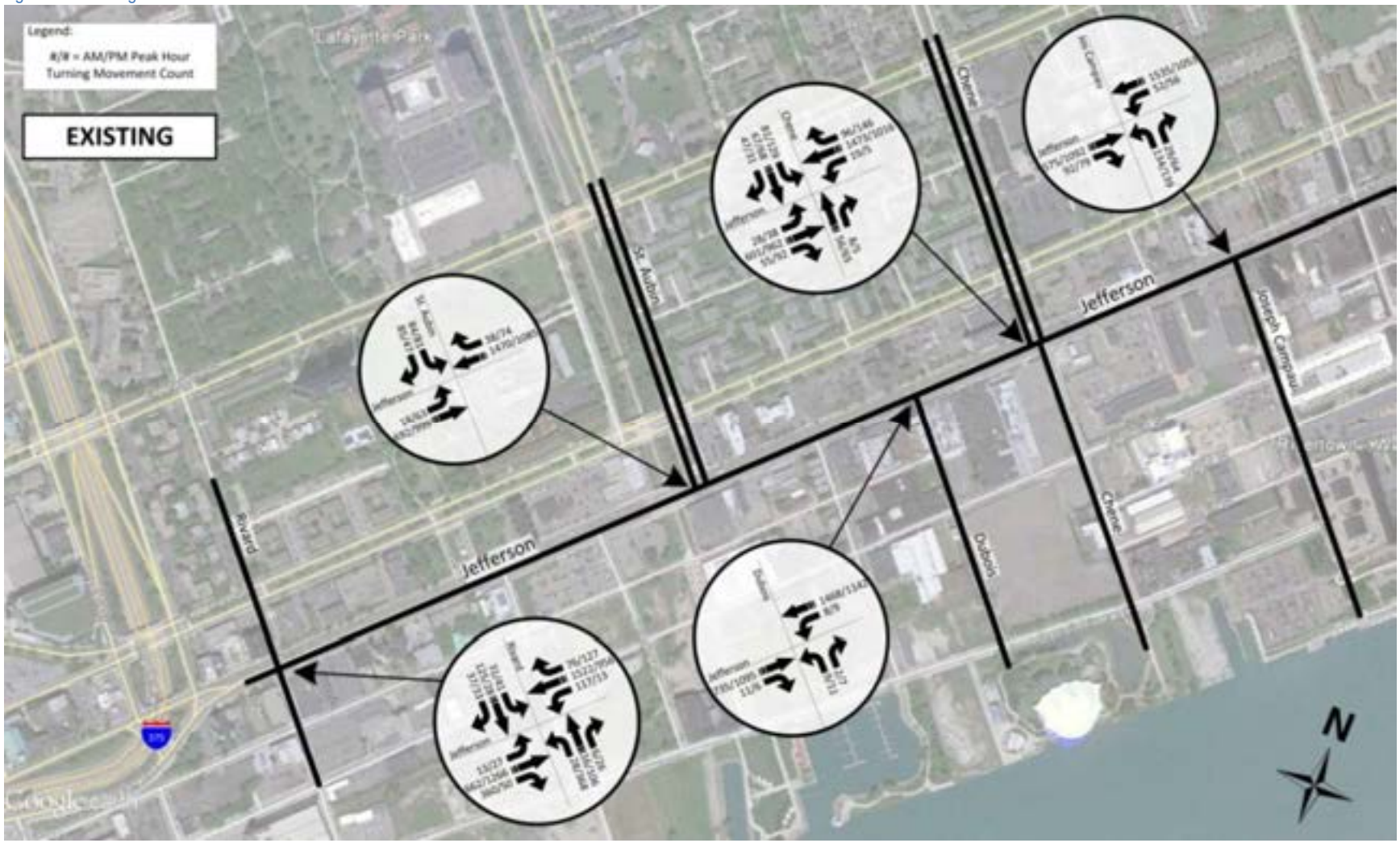


Figure 6: Existing Volumes

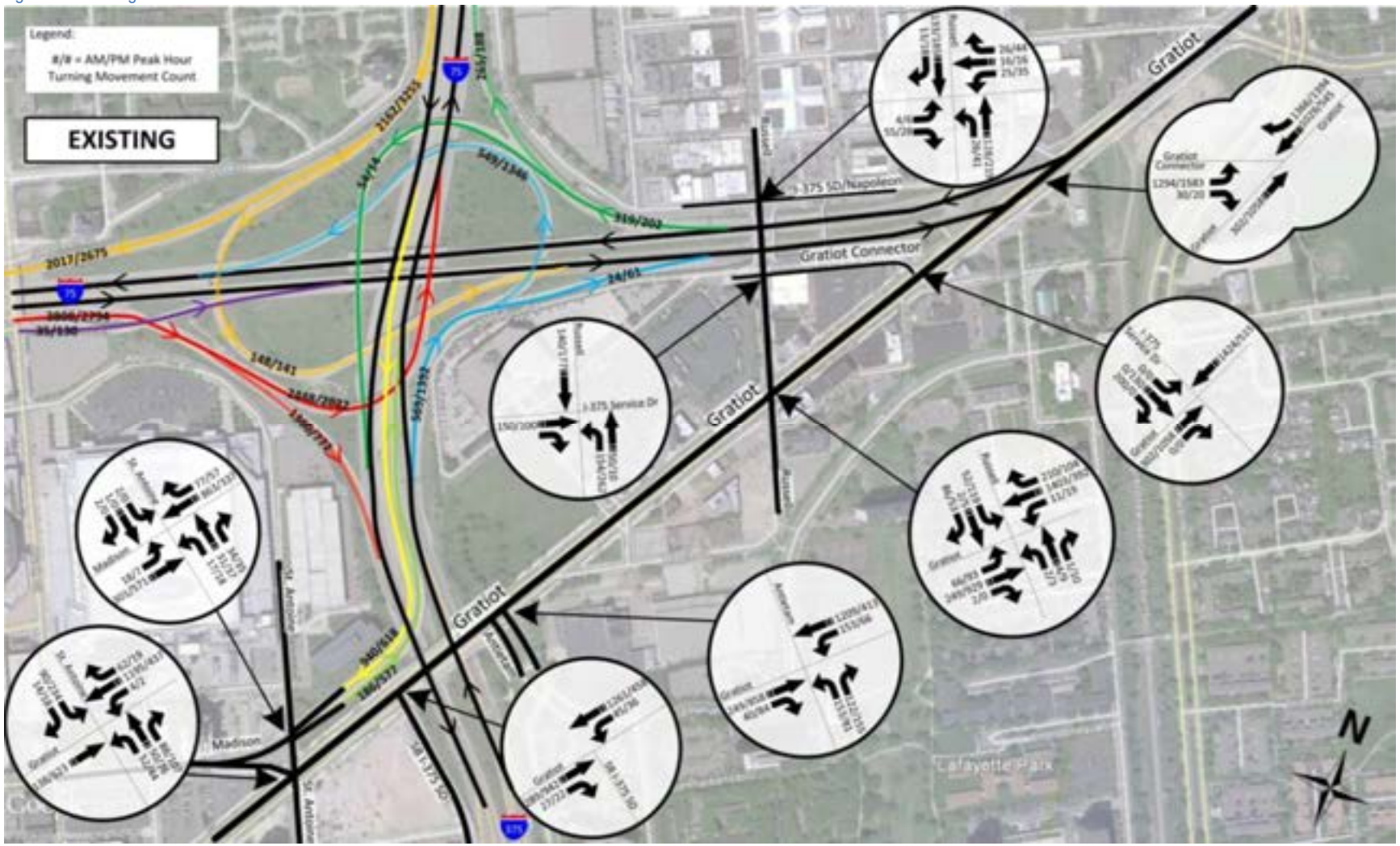


Table 1: Level of Service Criteria for Signalized Intersections

LOS	INTERSECTION DELAY (SECONDS PER VEHICLE)	COMMENTS
A	<= 10	Best signal operation; minimal delays
B	> 10 - 20	Good signal operation; low delays
C	> 20 - 35	Good signal operation; noticeable delays but no queues
D	> 35 - 55	Fair signal operation; acceptable delays; short queues
E	> 55 - 80	At-capacity signal operation; moderate delays and queues
F	> 80	Worst signal operation; long delays and queues

Table 2: Freeway & Ramp Junction Level of Service Criteria

Level of Service (LOS)	Basic Segment Density (pcphpl)	Merge / Diverge Segment Density (pcphpl)	Weave Segment Density (pcphpl)
A	≤ 11	≤ 10	≤ 10
B	> 11 - 18	> 10 – 20	> 10 - 20
C	> 18 - 26	> 20 – 28	> 20 - 28
D	> 26 - 35	> 28 – 35	> 28 - 35
E	> 35 - 45	> 35	> 35
F	> 45	Demand > Capacity	Demand > Capacity

2.3.2 Delay and Level of Service Results for Existing Conditions

Tables 3, 4 and 5 summarize the existing AM and PM peak operational performance for study intersections and freeway segments.

As illustrated in the tables, all intersection and freeway segments currently operate at LOS D or better, which is typically considered an acceptable threshold for urban intersection and freeway operations by both MDOT and the City of Detroit.

Table 3: Existing Intersection Delay and Level of Service

Intersection	HCM 2000 Control Delay (seconds/vehicle) / Level of Service	
	Existing AM	Existing PM
I-375 NB Service Dr/Monroe St.	10.5/B	13.1/B
I-375 SB Service Dr/Monroe St.	12.4/B	16.5/B
I-375 NB Service Dr/Lafayette Blvd.	14.4/B	12.0/B
I-375 SB Service Dr/ Lafayette Blvd.	32.9/C	11.2/B
I-375 NB Service Dr/Larned St.	16.5/B	50.1/D
I-375 SB Service Dr/Larned St.	19.5/B	20.0/C
I-375 NB Service Dr/Jefferson Ave.	2.4/A	7.5/A
I-375 SB Service Dr/Jefferson Ave.	4.8/A	14.3/B
EB Jefferson/ I-375	6.5/A	10.6/B
Jefferson Ave./Griswold St.	6.1/A	7.9/A
Jefferson Ave./Woodward Ave.	12.7/B	6.3/A
Jefferson Ave./Randolph St.	9.8/A	13.2/B
Jefferson Ave./Brush St.	5.9/A	8.0/A
Jefferson Ave./Beaubien St.	11.1/B	16.1/B
Jefferson Ave./Rivard St.	9.8/A	25.7/C
Jefferson Ave./St Aubin St.	4.5/A	4.2/A
Jefferson Ave./Dubois St.	1.3/A	2.3/A
Jefferson Ave./Chene St.	7.2/A	10.5/B
Jefferson Ave./Jos Campau Ave.	9.0/A	7.1/A
Gratiot Ave./Gratiot Connector	34.6/C	26.4/C
Gratiot Ave./Fisher Service Drive	19.1/B	17.1/B
Gratiot Ave./Russell St.	21.5/C	9.3/A
Gratiot Ave./Antietam Ave.	7.6/A	11.5/B
Gratiot Ave./St Antoine St.	46.6/D	29.0/C
Madison St./St Antoine St	9.7/A	7.9/A
Russell St./Napoleon St.	11.8/B	12.4/B

Table 4: Existing Interchange Level of Service

Ramp/Weave	HCS 2010 Density(pc/mi/ln) / Level of Service	
	Existing AM	Existing PM
NB I-375 to EB Fisher Fwy	14.0/B	16.2/B
EB Fisher Fwy Service Dr. to EB Fisher Fwy	14.1/B	15.5/B
Madison Ave. to NB I-375 On Ramp	14.1/B	22.0/C
EB Fisher Fwy to NB I-375 On Ramp	21.2/C	23.8/C
NB-I-375 Weave from Fisher WB On-Ramp to Mack Off-Ramp	24.1/C	26.1/C
NB-I-375 Weave form Monroe On-Ramp to Fisher Off-Ramp	11.2/B	12.5/B
SB I-375 Diverge at Madison Ave Off-Ramp	30.3/D	19.2/B
SB I-375 Weave from Fisher EB On-Ramp to Monroe Off-Ramp	30.8/D	15.2/B
SB I-375 Weave from Mack On-Ramp to Fisher Off-Ramp	28.4/D	25.6/B

Table 5: Existing Freeway Segment Level of Service

Segment	HCS 2010 Density(pc/mi/ln) / Level of Service	
	Existing AM	Existing PM
EB Fisher between SB I-375 Off and Fisher Service Dr. On	10.9/A	11.9/B
EB Fisher between I-375 SB On and I-375 NB On	8.6/A	10.1/A
EB Fisher between Service Dr. On and I-75 SB On	11.5/B	13.1/B
NB I-375 between Fisher Off Ramp and Madison On Ramp	10.5/A	16.2/B
NB I-375 between Jefferson and Larned	4.7/A	12.1/B
NB I-375 between Larned and Monroe	8.6/A	18.2/C
NB I-75 from Fisher EB On Ramp to Fisher WB On Ramp	21.2/C	25.3/C
SB I-375 between Fisher WB On-Ramp and Fisher EB On-Ramp	14.2/B	8.1/A
SB I-375 between Larned and Jefferson	16.9/B	5.9/A
SB I-375 between Mack Off-Ramp and Mack On-Ramp	28.4/D	24.3/C
SB I-375 between Madison Off-Ramp and Fisher On-Ramp	18.5/C	10.7/A

2.4 Crash Safety Analysis

A crash analysis was performed to identify high crash locations throughout the study area. Segment crash data was obtained from the www.semcog.org website for study area roadways. A crash within 150

ft. of an intersection's PR mile point was considered an intersection crash. The time period for the analysis was 36 months (3 years) from January 1, 2010 to December 31, 2012.

2.4.1 Crash Definitions

The crash summaries define crashes by six types and four injury severity classifications. The definitions of the crash types are taken directly from the State of Michigan *UD-10 Traffic Crash Report Manual,* revised in January, 2014. The manual was produced and distributed by the Michigan Department of State Police, and the Office of Highway Safety Planning. The crash types are based on the intended direction of travel, regardless of point(s) of impact or direction vehicles ultimately face after the crash.

- Single Motor Vehicle: A single or multiple unit crash which involves only one motor vehicle as defined in the manual. This includes those cases in which a motor vehicle was: 1) the only traffic unit; and 2) the only motor vehicle involved in a collision with a bicyclist, pedestrian, animal, railroad train, or any other non-motorized object. Any motorized (i.e., self-propelled) vehicle or device is considered a "motor vehicle" even though the vehicle or device may not be defined as a motor vehicle on the Michigan Motor Vehicle Code or other applicable legislation.
- Head On: The intended direction of travel of both vehicles must be towards each other. The directions that the vehicles are facing when they come to rest, or the points of impact on the vehicles, are not the determining factors.
- Head On Left Turn: When two vehicles are approaching head on and at least one is attempting to turn left.
- Angle: This will be marked when the intended direction of travel is basically perpendicular for both drivers and there is a side impact of approximately 90 degrees. If the side impact takes place during a "Head On-Left Turn," "Rear-end-Left Turn," or "Rear-end-Right Turn," it is not an "Angle".
- Rear-end: When the vehicles are traveling in the same direction with one behind the other. Area of damage on the vehicles is not the determining factor. Any crash involving any vehicle backing into another is not considered a "rear-end" crash.
- Sideswipe: Vehicles traveling in the same direction, or vehicles traveling in opposite directions, making side contact or if a vehicle spins out of control and makes contact with another vehicle traveling in the same direction. "Sideswipe" differs from "Angle" in that a sideswipe is a glancing impact and should not in itself stop the forward movement of the vehicle. An angle crash is a more direct impact and may stop the forward movement of one vehicle.
- Other/Unknown: The crash does not fit in one of the other selections.

The definitions of the injury severity classification are taken directly from the State of Michigan *UD-10 Traffic Crash Report Manual*, revised January, 2014.

- Fatal Injury (K): Any injury that results in death due to a motor vehicle traffic crash.
- Incapacitating Injury (A): Any injury, other than fatal, which prevents the injured person from walking, driving, or normally continuing the activities which he or she was capable of performing prior to the motor vehicle traffic crash.
- Non-incapacitating Evident Injury (B): Any injury, other than fatal and incapacitating, which is evident at the scene of the crash.
- Possible Injury (C): Any injury reported or claimed which is not a fatal, incapacitating, or non-incapacitating evident injury.

2.4.2 Intersection Crash Summary

Crash frequency per year and crash rate per million entering vehicles were calculated and compared to SEMCOG critical frequency and crash rate. The 95% confidence critical spot crash rate was calculated for each intersection. Each intersections average daily traffic (ADT) and the corresponding average crash rate for similar intersections. The crash rate normalizes crash frequency based on exposure (number of vehicles traversing the intersection). The ADT used for the crash rate calculations was obtained from the 24-hour approach counts available on the SEMCOG website. Table 6 summarizes the total number of crashes at each study intersection for the analysis period. Intersections that have crash frequency and/or crash rate higher than critical values are highlighted in red.

The three intersections were found to have a crash rate higher than their corresponding critical crash rate. Each of these intersections did not pass the crash frequency test:

- Jefferson Ave and Woodward Ave - There were a total of 112 crashes in 36 months at this location. The predominant crash types were rear-ends (52) and sideswipe-same (30). These may be result of congestion (stop-and-go traffic) at the intersection as well as the three left-turn lanes for the southbound approach. This intersection is in the central downtown area and many unfamiliar drivers drawn to the city for festivals or sporting events may be contributing to the crash issue here. There is also a contributing issue of poor left-turn operation at this location which results in eastbound congestion, particularly during the AM peak period.
- Monroe and South I-375 Service Drive- There were a total of 20 crashes in 36 months at this location. The predominant crash types were rear-ends (5) and sideswipe-same (6). These may be result of congestion at the intersection that is further exacerbated by the proximity of the Greektown Casino parking structure entrance. Also, speeding may be a factor causing the rear-end crashes due to traffic not slowing down fully from exiting I-375.
- Gratiot at St. Antoine/Madison- There were a total of 36 crashes in the 36 months at this location. The predominant crash types were rear-ends (10), single motor vehicle (8), sideswipe-same (7), and angle (7). The curvature of Madison and the dual left-turn onto Gratiot may be causing the sideswipe-same. Improper timing and the use of a cross-span may be contributing to the angle crashes at this location.

2.4.3 Segment Crash Summary

A segment crash analysis was also summarized for each of the study segments along I-375 including the ramps with I-75 and Gratiot Connector.

Tables 7 and 8 summarize the crash histories for freeway segments and ramps, respectively, for the three-year analysis period. Crash frequencies per year and crash rate per million miles traveled per year were calculated. The ADT used for the crash rate calculations was obtained from the 24-hour approach counts available on the SEMCOG website. Segments that have higher crash frequency and/or crash rate are highlighted in red.

Table 6: Intersection Crash History, 2010-2012

Intersection	ADT	Angle	Head-on	Head-on / Left Turn	Rear-end	Sideswipe Opposite Direction	Sideswipe Same Direction	Single Motor Vehicle	Other / Unknown	Total Crashes	Crash Frequency	Crash Rate*
Jefferson at Griswold	46,284	4	1	0	24	0	10	4	3	46	15	0.91
Jefferson at Woodward	64,042	14	0	1	52	4	30	7	4	112	37	1.60
Jefferson at Randolph	61,872	13	0	1	36	4	21	8	7	90	30	1.33
Jefferson at Brush	31,007	2	0	0	3	1	7	1	2	16	5	0.47
Jefferson at Beaubien	68,135	12	1	0	24	2	19	5	2	65	22	0.87
WB Jefferson at S 375 Service Dr.	17,579	5	0	0	3	0	2	0	0	10	3	0.52
EB Jefferson at S 375 Service Dr.	20,441	0	0	0	2	0	3	0	0	5	2	0.22
Jefferson at N 375 Service Dr.	31,410	2	0	0	8	0	5	0	1	16	5	0.47
Jefferson at Rivard	35,493	7	0	0	11	3	8	3	4	36	12	0.93
Jefferson at St. Aubin	28,470	1	0	1	4	2	4	1	2	15	5	0.48
Jefferson at Dubois	28,300	0	0	1	2	0	1	0	0	4	1	0.13
Jefferson at Chene	31,510	9	1	1	14	3	7	1	2	38	13	1.10
Jefferson at Joseph Campau	29,650	3	0	0	13	2	1	0	2	21	7	0.65
Larned at S 375 Service Dr.	24,863	4	0	0	8	1	6	0	2	21	7	0.77
Larned at N 375 Service Dr.	20,952	3	0	0	4	1	1	1	1	11	4	0.48
Lafayette at S 375 Service Dr.	24,030	4	0	0	3	0	9	0	2	18	6	0.68
Lafayette at N 375 Service Dr.	12,770	3	0	0	3	0	4	0	0	10	3	0.72
Monroe at S 375 Service Dr.	14,179	4	0	0	5	2	6	1	2	20	7	1.29
Monroe at N 375 Service Dr.	9,574	0	0	0	0	0	0	0	0	0	0	0.00
Gratiot at St. Antoine/Madison	21,568	7	2	0	10	0	7	8	2	36	12	1.52
Gratiot at Antietam	16,480	1	0	0	2	0	1	2	2	8	3	0.44
Gratiot at Russell	20,634	2	0	0	5	0	8	1	3	19	6	0.84
Gratiot at Fisher Service Dr.	18,630	0	0	1	1	0	0	0	0	2	1	0.10
Gratiot at Fisher Fwy	34,635	0	0	0	12	1	5	0	1	19	6	0.50
Russell at Napoleon/Fisher Service Dr.	8,653	2	0	0	1	1	1	1	2	8	3	0.84

*Crash rate is the average number of crashes per million entering vehicles

Table 7: Freeway Segment Crash History, 2010-2012

Location		Length (miles)	ADT	Angle	Head-on	Head-on / Left Turn	Other / Unknown	Rear-end	Rear-end	Sideswipe Opposite Direction	Sideswipe Same Direction	Single Motor Vehicle	Total Crashes	Crash Frequency	Crash Rate*
NB 375	Jefferson to Larned St.	0.25	4,956	1			3	2		1	1	7	15	5	11.06
	Larned St. to Larned On Ramp	0.17	4,956					1				3	4	1	4.34
	Larned On Ramp to Monroe On Ramp	0.23	14,910	1				1		1	2	7	12	4	3.20
	Monroe On Ramp to I-75 S Off Ramp	0.25	36,700	1			1	11			2	5	20	7	1.99
	I-75 S off Ramp to Madison On Ramp	0.07	23,763					1			1		2	1	1.10
	Madison On Ramp to I-75 N On Ramp	0.15	31,540					3			5	3	11	4	2.12
SB 375	Jefferson to Larned St.	0.24	10,305				1	9			3	17	30	10	11.08
	Larned St. to Larned Off Ramp	0.18	10,305					5			1	2	8	3	3.94
	Larned Off Ramp to Monroe Off Ramp	0.29	25,538	3			3	17		1	9	3	36	12	4.44
	Monroe Off Ramp to I-375 S On Ramp	0.14	42,566				4	6			1	8	19	6	2.91
	I-375 S On Ramp to Gratiot Conn On Ramp	0.08	29,660					1			1	4	6	2	2.31
	Gratiot Conn On Ramp to Madison Off Ramp	0.11	29,329					1					1	0	0.28
	Madison On Ramp to I-75 S Off Ramp	0.18	36582					4			2	1	7	2	0.97
NB 75	Clifford On Ramp to I-75 N Off Ramp	0.21	61498	2			2	8			6	9	27	9	1.91
	I-75 N Off Ramp to I-75 N Off Ramp	0.14	69154	1				2			6	4	13	4	1.23
	I-75 Off Ramp to Mack On Ramp	0.2	72765	2		1	1	5			7	5	21	7	1.32
SB 75	Mack On Ramp to I-75 S Off Ramp	0.28	76411		1		3	2			3	6	15	5	0.64
	I-75 S off Ramp to Clifford St.	0.26	62497		1		2	5			13	6	27	9	1.52

*Crash rate is the average number of crashes per million entering vehicles

Table 7 (Cont.): Freeway Segment Crash History, 2010-2012

Location		Length (miles)	ADT	Angle	Head-on	Head-on / Left Turn	Other / Unknown	Rear-end	Rear-end	Sideswipe Opposite Direction	Sideswipe Same Direction	Single Motor Vehicle	Total Crashes	Crash Frequency	Crash Rate*
NB Gratiot Conn	I-75 N Off Ramp to Brush On Ramp	0.3	10978					5				1	6	2	1.66
	Brush On Ramp to I-75 S On Ramp	0.13	12501	1				1		1	4		7	2	3.93
	I-75 S On Ramp to I-375 N On Ramp	0.09	15032										0	0	0.00
	I-375 On Ramp to Gratiot	0.24	15569	1							1	1	3	1	0.73
SB Gratiot Conn	I-75 S On Ramp to I-375 N On Ramp	0.32	25199	1			1	6			3	7	18	6	2.04
	I-375 On Ramp to I-75 Off Ramp	0.34	12799					3			4	6	13	4	2.73
	I-75 Off Ramp to Orleans St	0.14	16741				2					2	4	1	1.56
	Orleans St. to Gratiot	0.09	15327					1				1	2	1	1.32

*Crash rate is the average number of crashes per million entering vehicles

Table 8: Freeway Ramp Crash History, 2010-2012

Location		Distance (miles)	ADT	Angle	Head-on	Head-on / Left Turn	Other / Unknown	Rear-end	Sideswipe Opposite Direction	Sideswipe Same Direction	Single Motor Vehicle	Total Crashes	Crash Frequency	Crash Rate*
Larned/N I 375 Ramp		0.12	14910							1		1	0.33	0.51
Monroe/N I 375 Ramp		0.11	16834					1		3		4	1.33	1.97
Madison/N I 375 Ramp		0.27	7777				1				1	2	0.67	0.87
N I 375/N Connector 8 Ramp	N I 375 to Split	0.14	12937						1	1	1	3	1.00	1.51
N I 375/N Connector 8 Ramp	Split to Gratiot	0.14	537							1	4	5	1.67	60.74
N I 375/S I 75 Ramp	Split to S I 75	0.36	12400							2	2	4	1.33	0.82
S I 375/Larned Ramp		0.13	15233					2			2	4	1.33	1.84
S I 375/Monroe Ramp		0.15	17028					3				3	1.00	1.07
S I 375/Madison Ramp		0.34	7253					1		2	3	6	2.00	2.22
N I 75/ N I 75	N I 75 to Split	0.22	50520	1				2		1	1	5	1.67	0.41
N I 75/ N I 75	Split to N I 75	0.27	37614	1				11		9	17	38	12.67	3.42
N I 75/S I 375 Ramp	Split to S I 375	0.17	12906								2	2	0.67	0.83
S I 75/ S I 75	S I 75 to Split	0.1	39829					9		1	8	18	6.00	4.13
S I 75/ S I 75	Split to S I 75	0.44	37298					1		4	4	9	3.00	0.50
S I 75/N Connector 8 Ramp	Split to Gratiot Conn	0.17	2531					2		1	3	6	2.00	12.73
N I 75 Service Drive/N Connector 8 Ramp		0.23	1523	1			2	1		1	3	8	2.67	20.86
S Connector 8/N I 75 Ramp	Fisher to Split	0.12	3942					1			1	2	0.67	3.86
S Connector 8/N I 75 Ramp	Split to N I 75	0.16	3611					1		1		2	0.67	3.16
S Connector 8/S I 375 Ramp	Split to S I 375	0.34	331							1		1	0.33	8.11

*Crash rate is the average number of crashes per million entering vehicles

The three segments shown in red Table 7 have been identified as crash locations of interest. NB and SB I-375 from Jefferson and Larned had crash frequencies and crash rates higher than the corresponding critical values. SB I-375 from Larned off-ramp to Monroe off-ramp passed the crash frequency test but not the crash rate test.

- NB & SB I-375: Jefferson to Larned- There were a total of 45 crashes in 36 months at this location. The predominant crash types were single motor vehicle (24) and rear-ends (11). The tight horizontal curvature of I-375 in this area may be contributing to the single motor vehicle crashes in this segment. The rear-end crashes, which are most predominant in the southbound direction (approaching the freeway end) may be occurring along this segment due to congestion near Beaubien Street and limited sight distance.
- SB I-375: Larned off Ramp to Monroe off Ramp- There were a total of 36 crashes in 36 months at this location. The predominant crash type was rear-ends (17). The rear-end crashes may be occurring along this segment due to congestion. Larned is a heavily used commuter exit that often backs traffic up to Monroe.

The four ramps shown in red Table 8 have been identified as crash locations of interest. Three ramps passed the critical crash rate test including: NB I-375 to Gratiot, SB I-75 to Gratiot, and NB I-75 Service Drive to Gratiot Connector. NB I-75 to NB I-75 ramp passed the crash frequency test. These four ramps will be evaluated further for discernable crash patterns.

- NB I-375 to N Connector Ramp: Split to Gratiot- There were a total of 5 crashes in 36 months at this location. The predominant crash type was single motor vehicle (4). The tight horizontal curvature of the ramp may be contributing to the single motor vehicle crashes in this segment. The crash rate calculation can over represent low volume locations. This ramp has an ADT of 537 vehicles and the calculated crash rate is 60.74. This crash rate is nearly four times higher than the critical crash rate even though only 5 crashes occurred on this ramp in the last three years. It is clear that is value is biased.
- NB I-75 to NB I-75 Ramp: N I-75 to Split- There were a total of 38 crashes in 36 months at this location. The predominant crash types were single motor vehicle (17) and rear-end (11). The tight horizontal curvature of the ramp and limited shoulder width may be contributing to the single motor vehicle crashes in this segment. The rear-end crashes may be a result of congestion (stop-and-go traffic) occurring on this ramp.
- SB I-75 to NB Connector Ramp: Split to Gratiot Connector- There were a total of 6 crashes in 36 months at this location. The predominant crash types were single motor vehicle (3) and rear-end (2). The tight horizontal curvature of the ramp and limited shoulder width may be contributing to the single motor vehicle crashes in this segment.
- NB I-75 Service Drive to NB Connector- There were a total of 8 crashes in 36 months at this location. The predominant crash types were single motor vehicle (3) and other (2). The crash rate calculation can over represent low volume locations. This ramp has an ADT of 1523 vehicles and the calculated crash rate is 20.86. This crash rate is more than three times higher than the critical crash rate even though only 8 crashes occurred on this ramp in the last three years. It is possible that this location may not be a hazard.

2.4.4 Non-Motorized Crash Summary

Twelve (12) pedestrian crashes and two (2) bicycle crashes occurred at the 25 study locations within the three years of crash history. There was three A-injury crashes, one B-injury crash, five C-injury crashes,

and three no injuries. The A-injury crashes occurred at Jefferson & Woodward, Gratiot & Antietam, and Gratiot & Russell. Of the two (2) bicycle crashes, one was a C-injury crash and the other was no injury. The figure below illustrates the locations of the pedestrian and bicycle crashes.

Figure 7: Non-Motorized Crashes, 2010-2012

Source: SEMCOG

3 Future No-Build Conditions Analysis

3.1 Travel Forecasting Model Process

Future year analysis was conducted for the year 2040 using the Southeast Michigan Council of Governments (SEMCOG) regional travel demand forecasting model. The SEMCOG model uses socio-economic data for the region to predict trends in population and employment which influence travel demand and travel patterns in future years.

Given the narrow area of the region under study, specific assumptions with regards to downtown development were expected to significantly influence the results of the forecast and resulting needs of the I-375 corridor. In order to generate the most accurate forecast possible reflecting development activities in advanced planning or under construction, development assumptions were updated or verified for three key, potential high-yield areas of downtown:

- Wayne County Jail Development Site: Construction of a new county jail facility at the corner of I-375 and Gratiot Avenue has been halted, and Wayne County is currently exploring the sale of the property, to be repurposed as a multi-use residential and commercial development. This change would greatly increase the trip intensity and need for access to this site.
- RiverEast Development: General Motors plans a mixed-use residential development on riverfront property immediately east of the Renaissance Center, on what is currently primarily surface parking.
- Blue Cross/Blue Shield of Michigan: Assumptions were updated for employment on BCBSM's campus immediately adjacent to I-375.

3.2 2040 No-Build Traffic Volumes

Once these development assumptions were verified or updated by SEMCOG, the regional model was used to forecast 2040 peak hourly traffic volumes under the "No-Build" Condition, in which no changes to I-375 or other study area roadways are assumed. Rather than direct output from the regional model, forecast hourly volumes were prepared using the differential method, where the total growth percentage by link between the 2010 base-year model and the 2040 forecast is applied to the existing traffic count to determine the forecasted volume. This method is a more accurate means of forecasting volumes at a micro-level using the macro-scale regional model results.

Figures 8-11 depict the forecasted AM and PM peak hour volumes for the study area under the No-Build Condition.

3.3 2040 Traffic Operations

Intersection, freeway segment and ramp operations were evaluated for the study area using the 2040 No-Build traffic volumes. Tables 9, 10 and 11 depict operational performance for study area intersections, ramps, and freeway segments, respectively.

Figure 8: Future No-Build Volumes

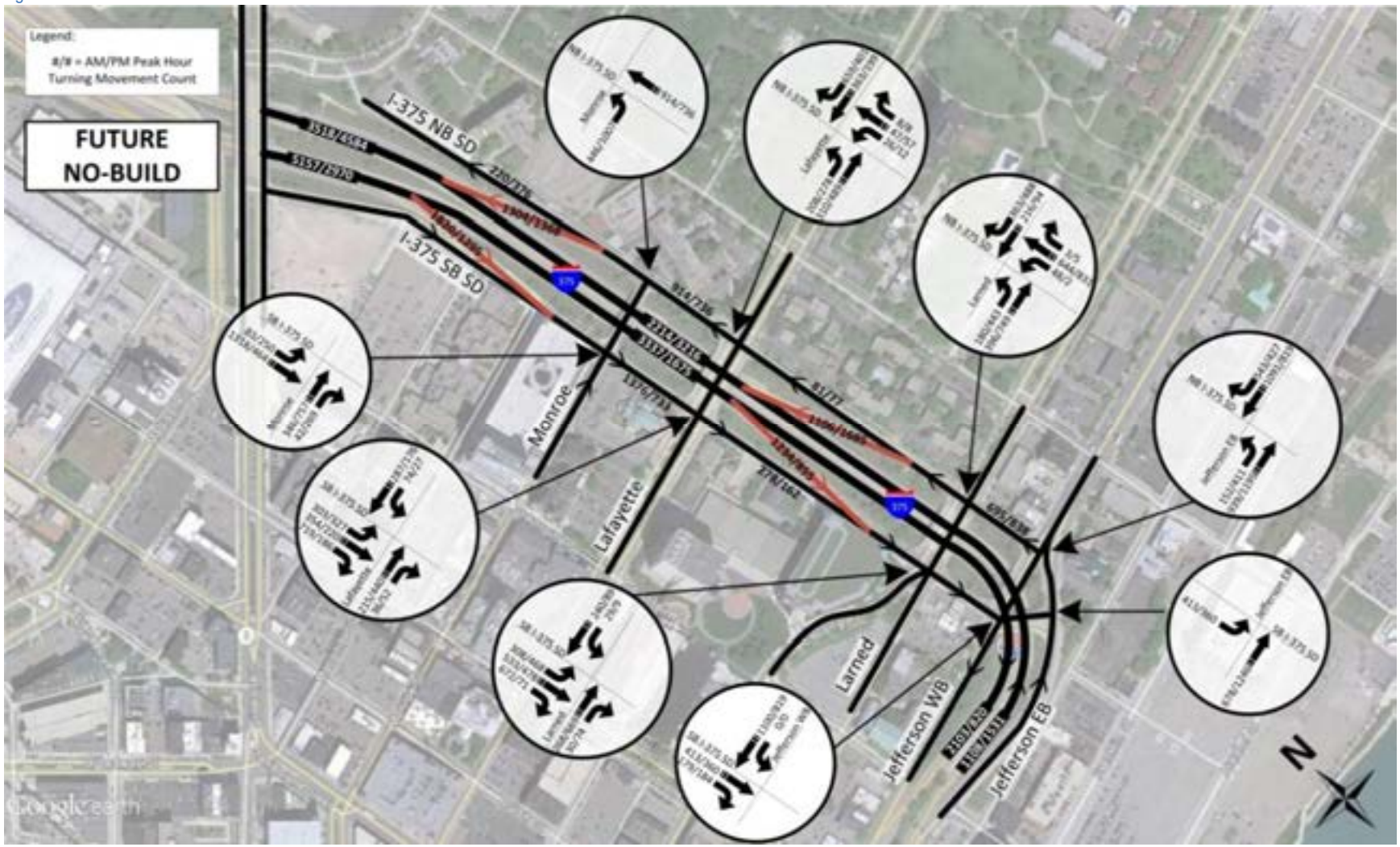


Figure 9: Future No-Build Volumes

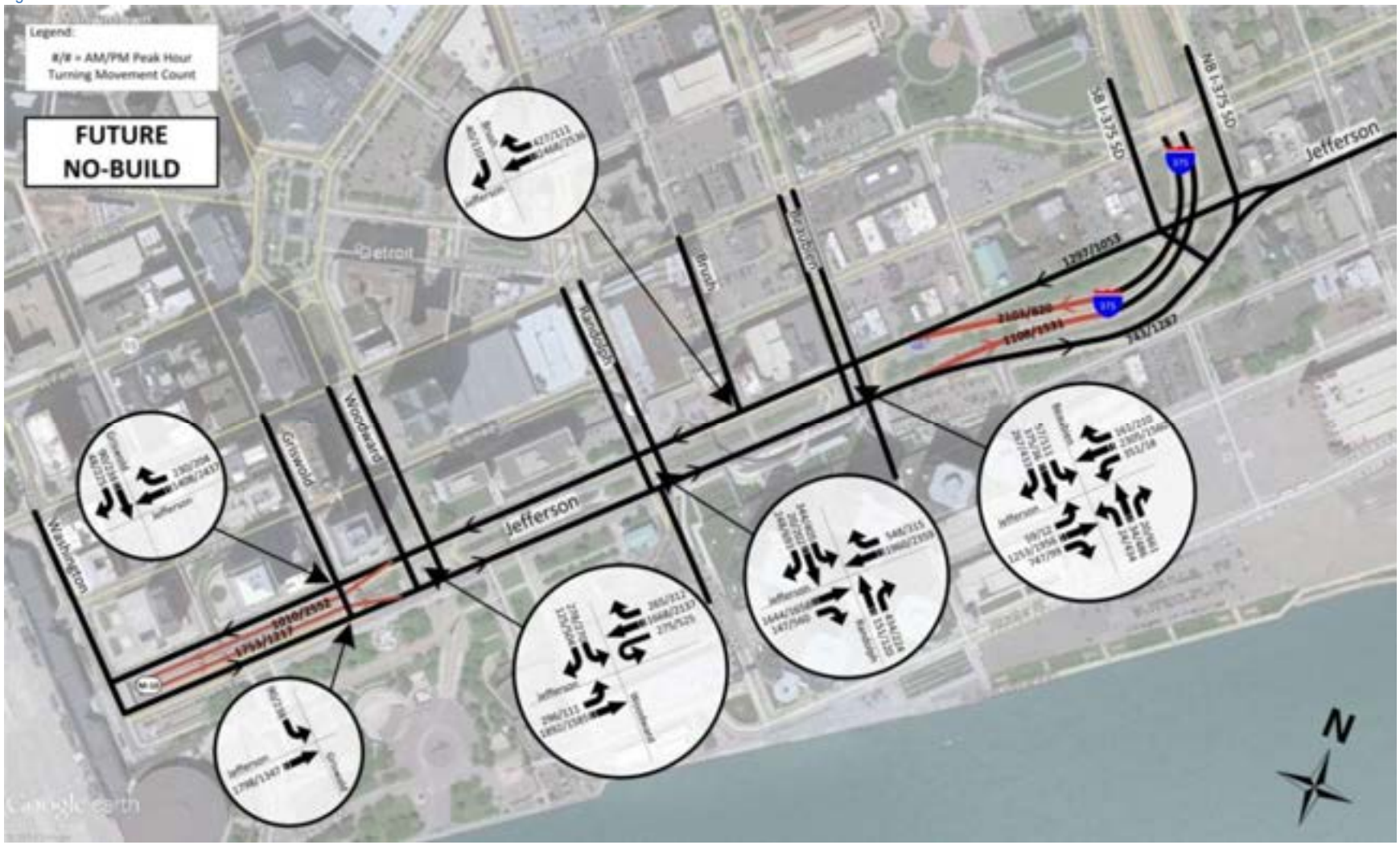


Figure 10: Future No-Build Volumes

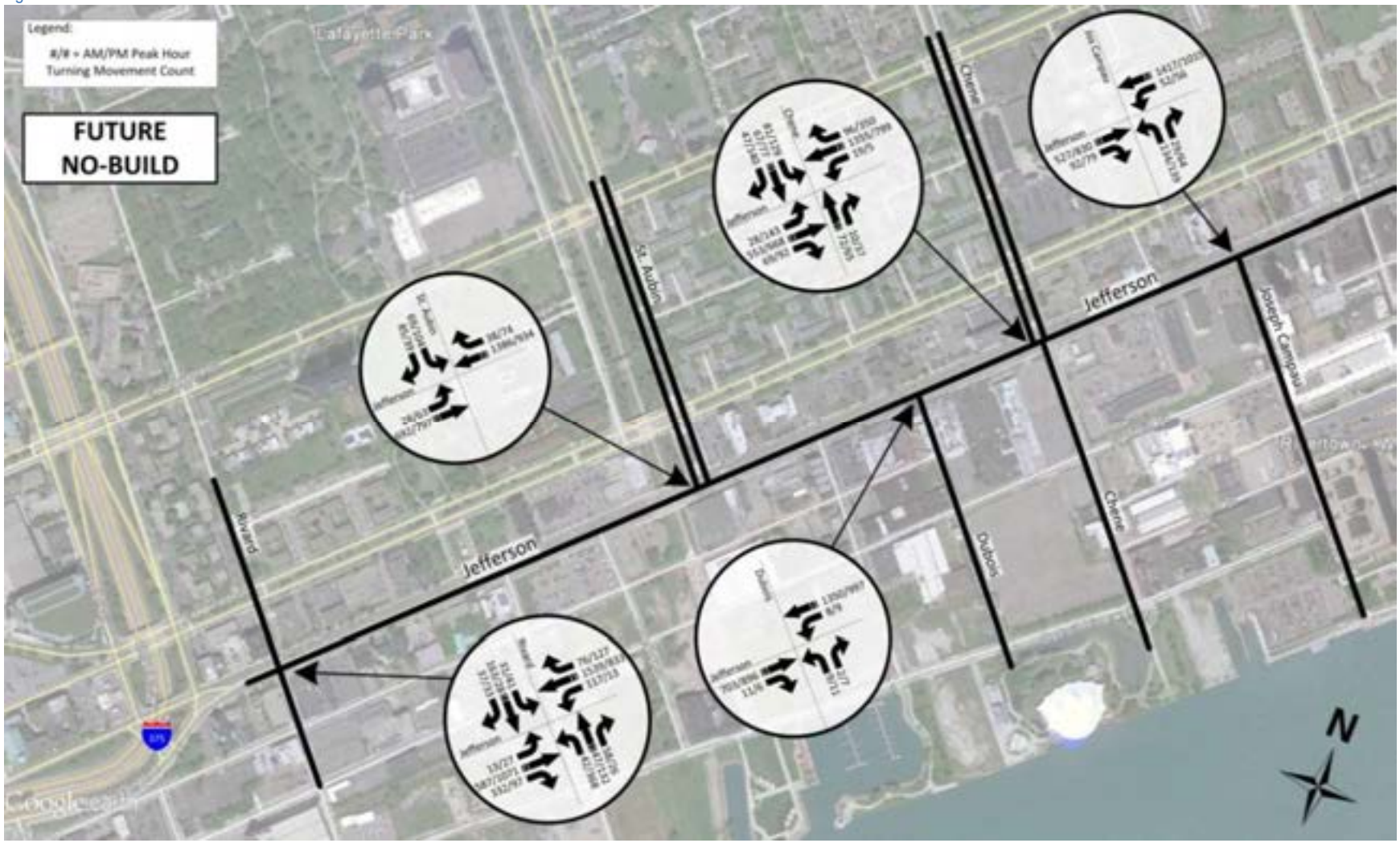


Figure 11: Future No-Build Volumes

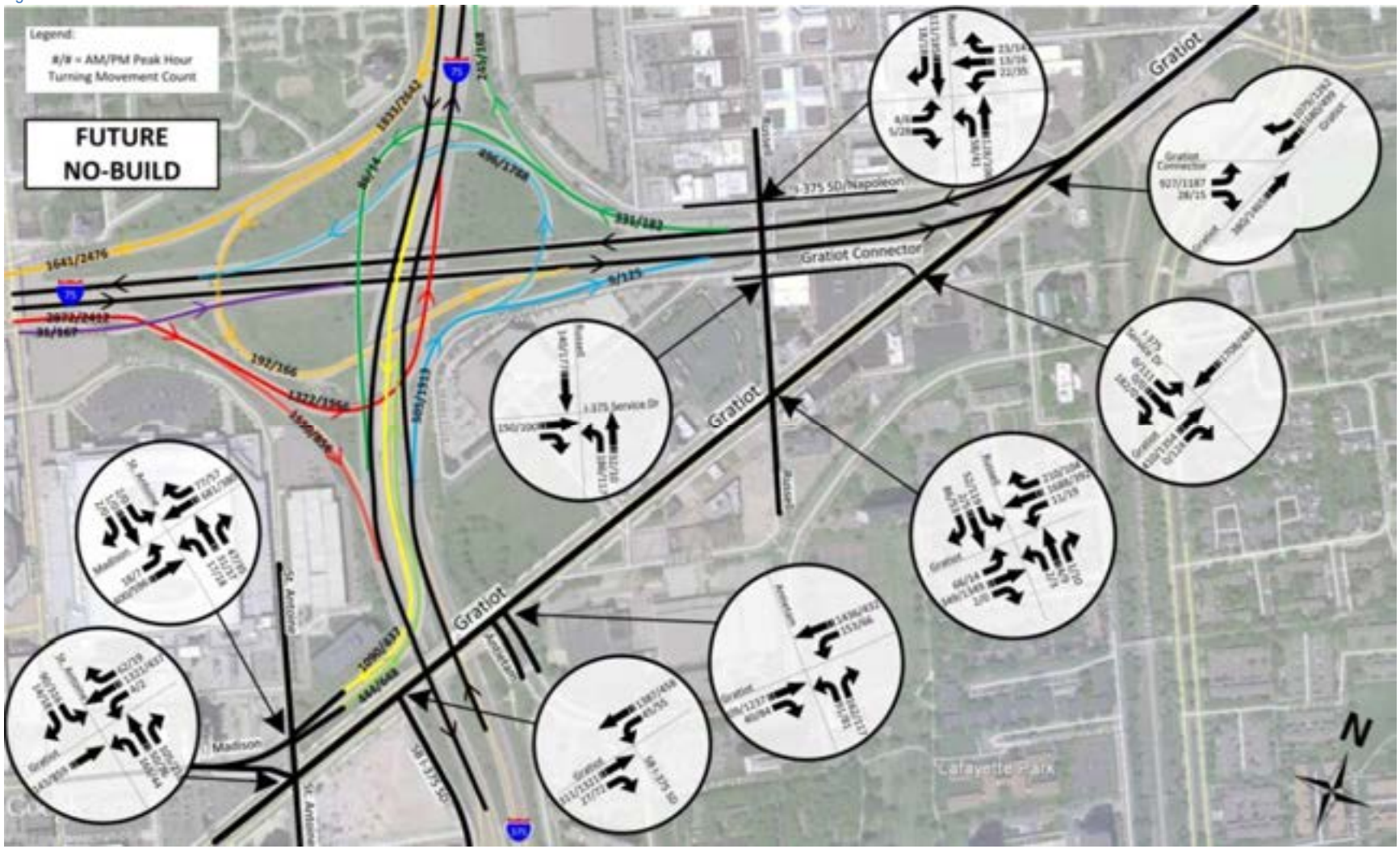


Table 9: 2040 No Build Intersection Delay and Level of Service

Intersection	HCM 2000 Control Delay (seconds/vehicle) / Level of Service	
	FNB AM	FNB PM
I-375 NB Service Dr/Monroe St.	16.2/B	29.0/C
I-375 SB Service Dr/Monroe St.	13.0/B	18.1/B
I-375 NB Service Dr/Lafayette Blvd.	16.8/B	12.6/B
I-375 SB Service Dr/ Lafayette Blvd.	7.7/A	12.0/B
I-375 NB Service Dr/Larned St.	17.3/B	48.5/D
I-375 SB Service Dr/Larned St.	18.7/B	20.0/C
I-375 NB Service Dr/Jefferson Ave.	4.5/A	10.5/B
I-375 SB Service Dr/Jefferson Ave.	13.4/B	17.2/B
EB Jefferson/ I-375	6.4/A	12.5/B
Jefferson Ave./Griswold St.	6.5/A	9.6/A
Jefferson Ave./Woodward Ave.	11.9/B	10.8/B
Jefferson Ave./Randolph St.	10.8/B	37.9/D
Jefferson Ave./Brush St.	8.1/A	8.5/A
Jefferson Ave./Beaubien St.	14.7/B	15.6/B
Jefferson Ave./Rivard St.	14.1/B	25.6/C
Jefferson Ave./St Aubin St.	4.2/A	5.0/A
Jefferson Ave./Dubois St.	1.3/A	2.4/A
Jefferson Ave./Chene St.	7.6/A	12.4/B
Jefferson Ave./Jos Campau Ave.	9.0/A	7.9/A
Gratiot Ave./Gratiot Connector	50.7/D	20.1/C
Gratiot Ave./Fisher Service Drive	20.1/C	20.6/C
Gratiot Ave./Russell St.	34.6/C	9.9/A
Gratiot Ave./Antietam Ave.	6.8/A	12.1/B
Gratiot Ave./St Antoine St.	26.2/C	47.2/D
Madison St./St Antoine St	9.5/A	7.9/A
Russell St./Napoleon St.	11.9/B	12.1/B

Table 10: Future No Build Interchange Level of Service

RAMP/Weave	HCS 2010 Density(pc/mi/ln) / Level of Service	
	FNB AM	FNB PM
NB I-375 to EB Fisher Fwy	8.0/A	9.1/A
EB Fisher Fwy Service Dr. to EB Fisher Fwy	10.5/B	11.9/B
Madison Ave. to NB I-375 On Ramp	23.9/C	23.6/C
EB Fisher Fwy to NB I-375 On Ramp	20.1/C	32.7/D
NB-I-375 Weave from Fisher WB On-Ramp to Mack Off-Ramp	25.8/C	23.2/C
NB-I-375 Weave form Monroe On-Ramp to Fisher Off-Ramp	21.8/C	27.5/C
SB I-375 Diverge at Madison Ave Off-Ramp	36.0/E	19.3/B
SB I-375 Weave from Fisher EB On-Ramp to Monroe Off-Ramp	40.0/F	19.4/B
SB I-375 Weave from Mack On-Ramp to Fisher Off-Ramp	30.8/D	24.0/C

Table 11: Future No Build Segment Level of Service

Segment	HCS 2010 Density(pc/mi/ln) / Level of Service	
	FNB AM	FNB PM
EB Fisher between SB I-375 Off and Fisher Service Dr. On	6.9/A	7.3/A
EB Fisher between I-375 SB On and I-375 NB On	6.1/A	7.1/A
EB Fisher between Service Dr. On and I-75 SB On	7.2/A	8.9/A
NB I-375 between Fisher Off Ramp and Madison On Ramp	19.6/C	17.4/B
NB I-375 between Jefferson and Larned	10.8/A	15.0/B
NB I-375 between Larned and Monroe	14.4/B	20.9/C
NB I-75 from Fisher EB On Ramp to Fisher WB On Ramp	23.8/C	24.3/C
SB I-375 between Fisher WB On-Ramp and Fisher EB On-Ramp	17.6/B	10.3/A
SB I-375 between Larned and Jefferson	20.5/C	8.0/A
SB I-375 between Mack Off-Ramp and Mack On-Ramp	30.9/D	22.7/C
SB I-375 between Madison Off-Ramp and Fisher On-Ramp	22.9/C	13.7/B

As shown in tables 9, 10, and 11, the overall performance is expected to decline slightly for future conditions due to the higher traffic volumes that are projected for the year 2040. However, all study intersections are anticipated to continue to operate at LOS D or better during both peak hours. With regards to freeway facilities, the Madison Exit Ramp, and the Fisher to SB I-375 weave are expected to decline from LOS D in existing condition to LOS E and F, respectively, by 2040.

4 Illustrative Alternative Analysis

A variety of illustrative alternatives were developed for a first-level screening analysis using the regional forecasting model. This section describes these alternatives, the method of analysis utilized, and the analysis findings.

4.1 Illustrative Alternatives

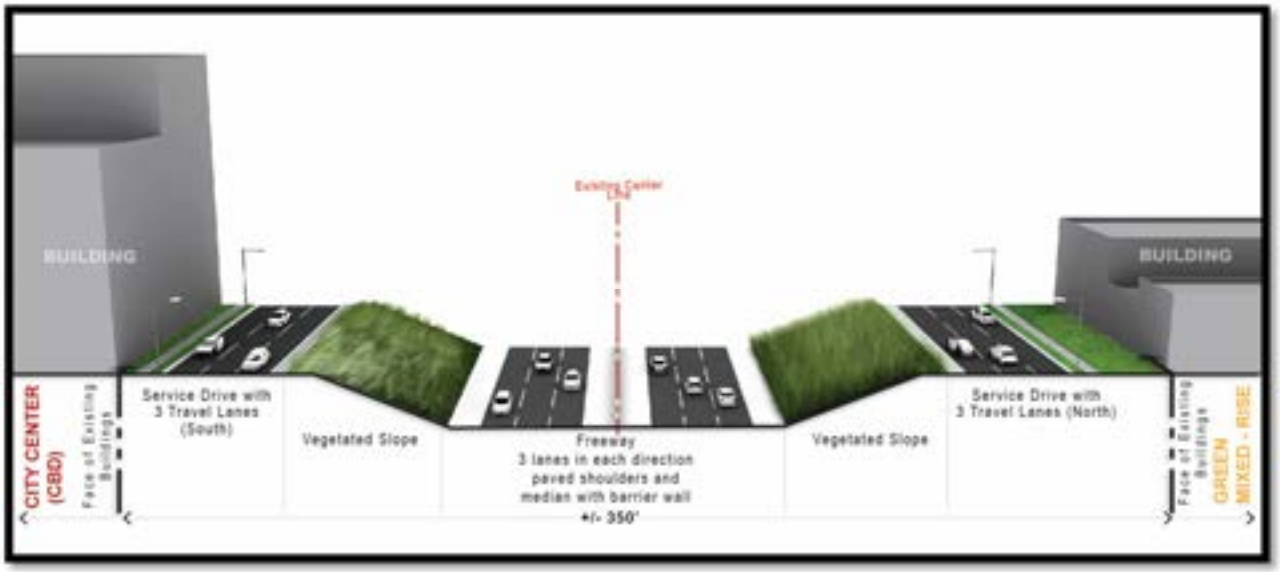
Six illustrative alternatives were identified for the I-375 corridor itself (primary study area), while two each were identified for the secondary areas, including the I-75/I-375 interchange, Gratiot Connector, and Jefferson Avenue east and west of I-375. Not all alternatives would differ in terms of traffic operations or capacity, but instead differ in the placement of roadways and/or other features that do not impact traffic capacity. The following is a brief summary of the alternatives:

4.1.1 Primary Study Area Alternatives

Six alternatives were developed for the primary study area:

Alternative 1: Alternative 1 is equivalent to the No-Build Condition in terms of traffic capacity and operations, with the exception of proposed ramp improvements/widening to the southbound off-ramps at Lafayette and Larned/E. Jefferson.

Figure 12: I-375 Alternative 1 Cross-Section



Alternative 2: Alternative 2 is identical to Alternative 1, with the addition of a roadway extension from the Jefferson Avenue surface-level extending to Atwater Street to serve the East Riverfront area. No changes to the freeway or service drives are proposed.

Alternative 3: Under Alternative 3, the I-375 freeway would transition to a surface street south of Lafayette Avenue, and include signalized intersections at Larned Street and Jefferson Avenue. The surface roadway was assumed to be four lanes in each direction between Lafayette and Jefferson. The surface roadway would continue through Jefferson Avenue to Atwater, with two lanes in each direction. The freeway portion would be shifted to the west.

Figure 13: I-375 Alternative 2 Cross-Section

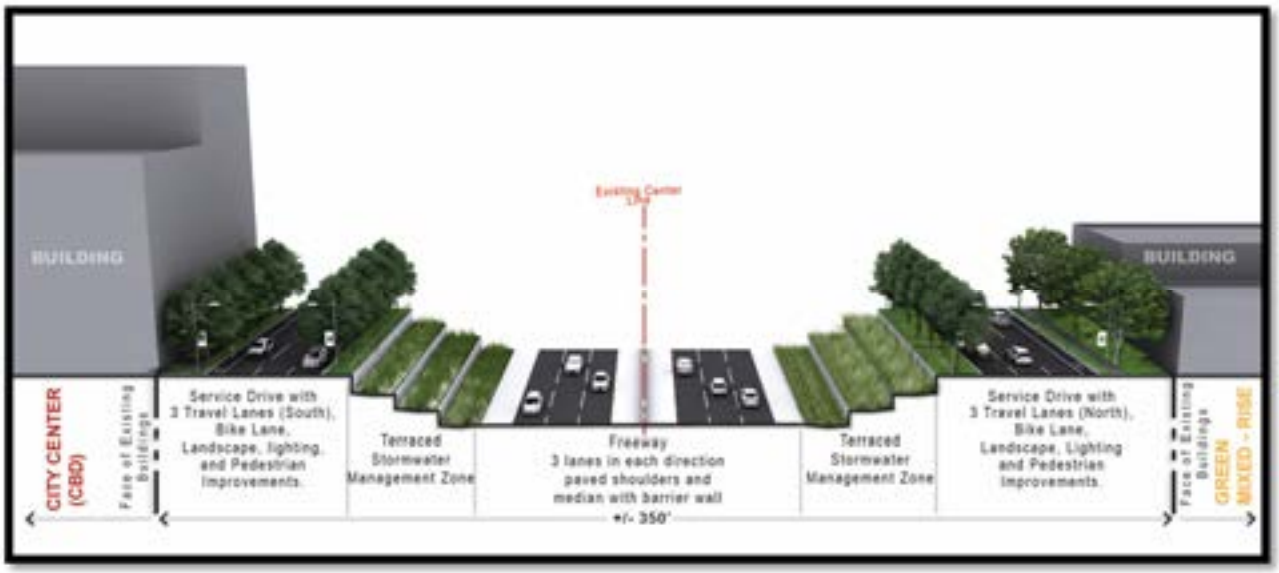
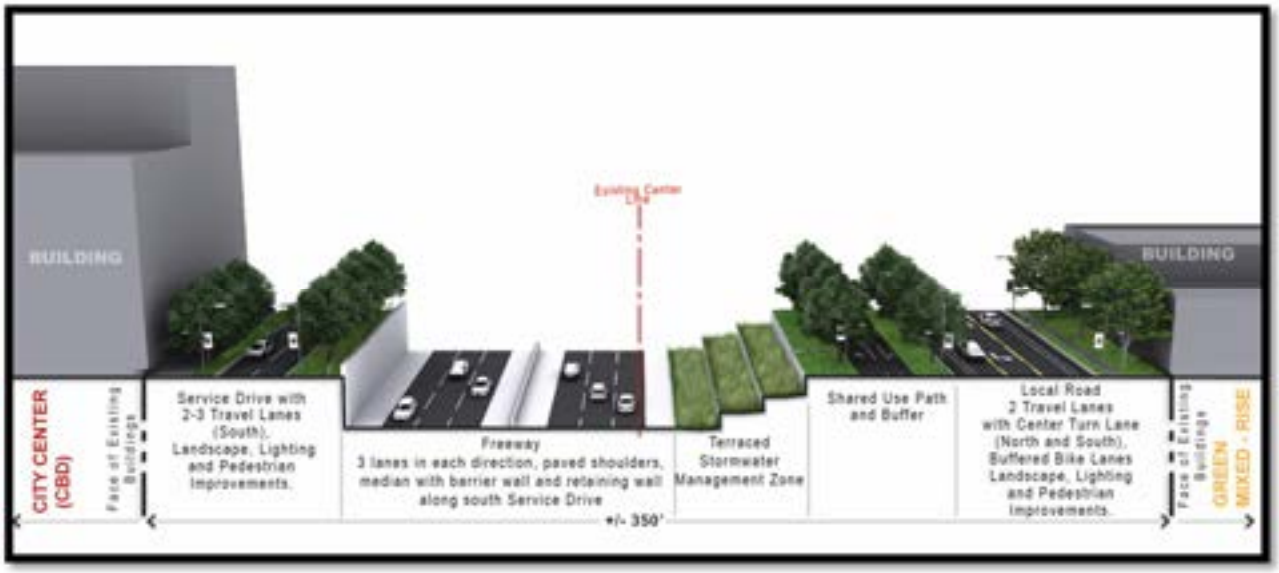


Figure 14: I-375 Alternative 3 Cross-Section



Alternative 4: Under Alternative 4, the I-375 freeway would transition to a surface street, with four lanes in each direction, south of Gratiot Avenue, coming to a surface intersection near Clinton Street. The roadway would be aligned on the east side of the corridor. Both service drives would be eliminated under this scenario. The roadway would continue south of Jefferson Avenue to Atwater Street with two lanes in each direction.

Alternative 5: Similar to Alternative 4, Alternative 5 would include a surface roadway with four lanes in each direction from south of Gratiot Avenue. However, under this alternative, the surface roadway would be aligned along the west (central business district) side of the corridor. The roadway would continue south of Jefferson Avenue to Atwater Street with two lanes in each direction. In addition, the northbound service drive would be maintained as a two-way local access roadway.

Figure 15: I-375 Alternative 4 Cross-Section

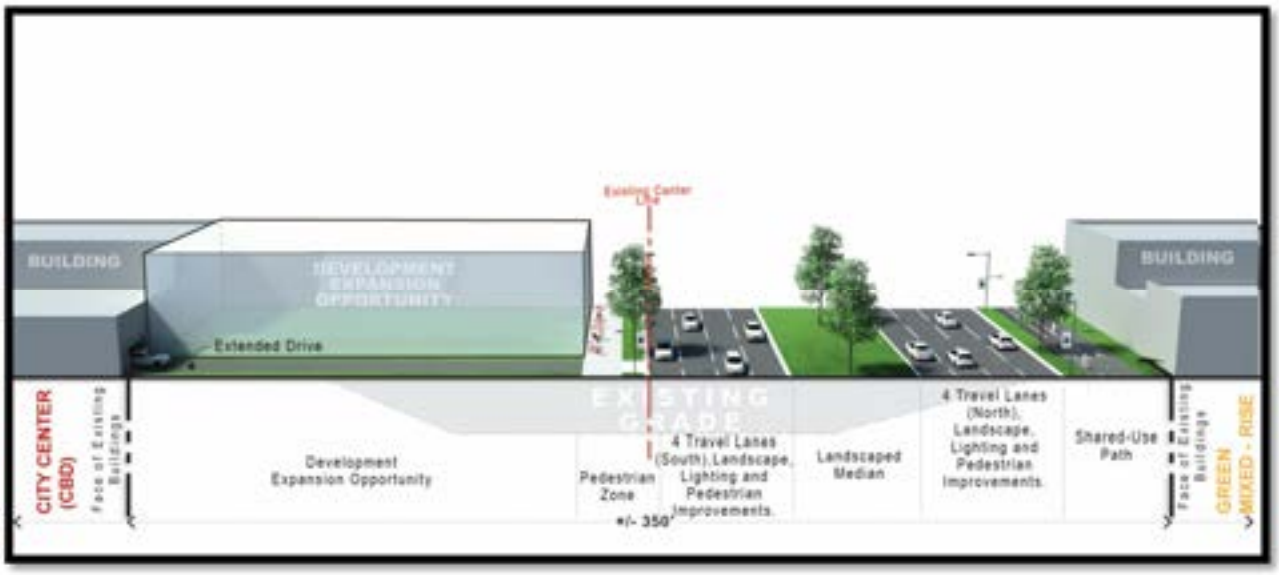
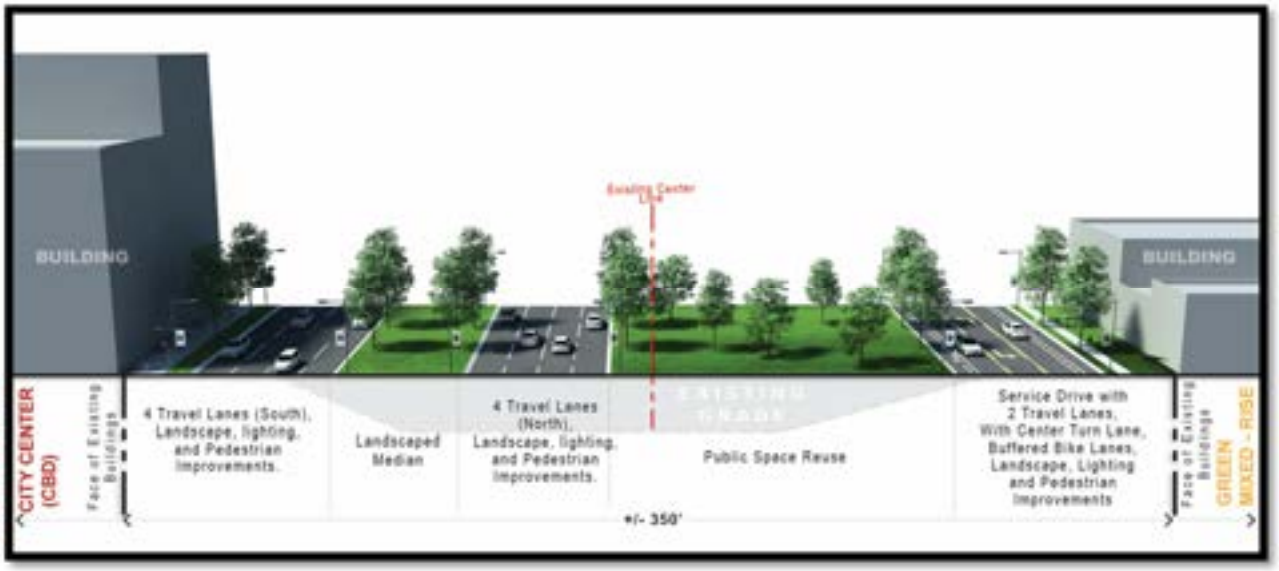
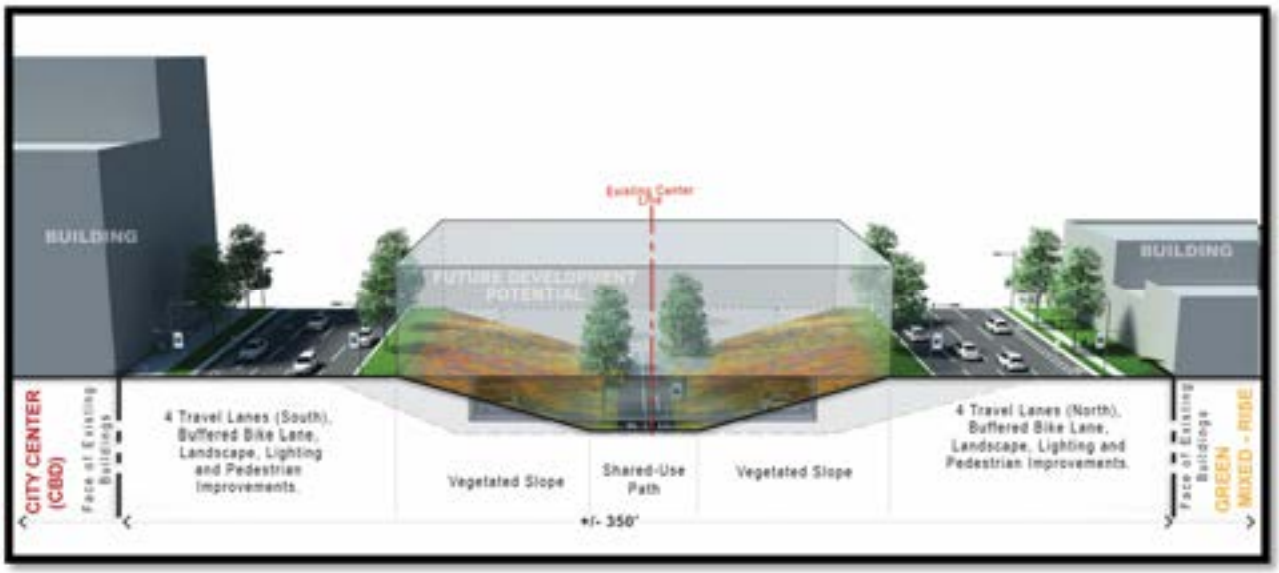


Figure 16: I-375 Alternative 5 Cross-Section



Alternative 6: Under Alternative 6, the surface roadway south of Gratiot Avenue would take the form of two one-way roadways, aligned with the existing services drives, with four lanes in each direction. The roadway would continue south of Jefferson Avenue to Atwater Street with two lanes in each direction.

Figure 17: I-375 Alternative 6 Cross-Section

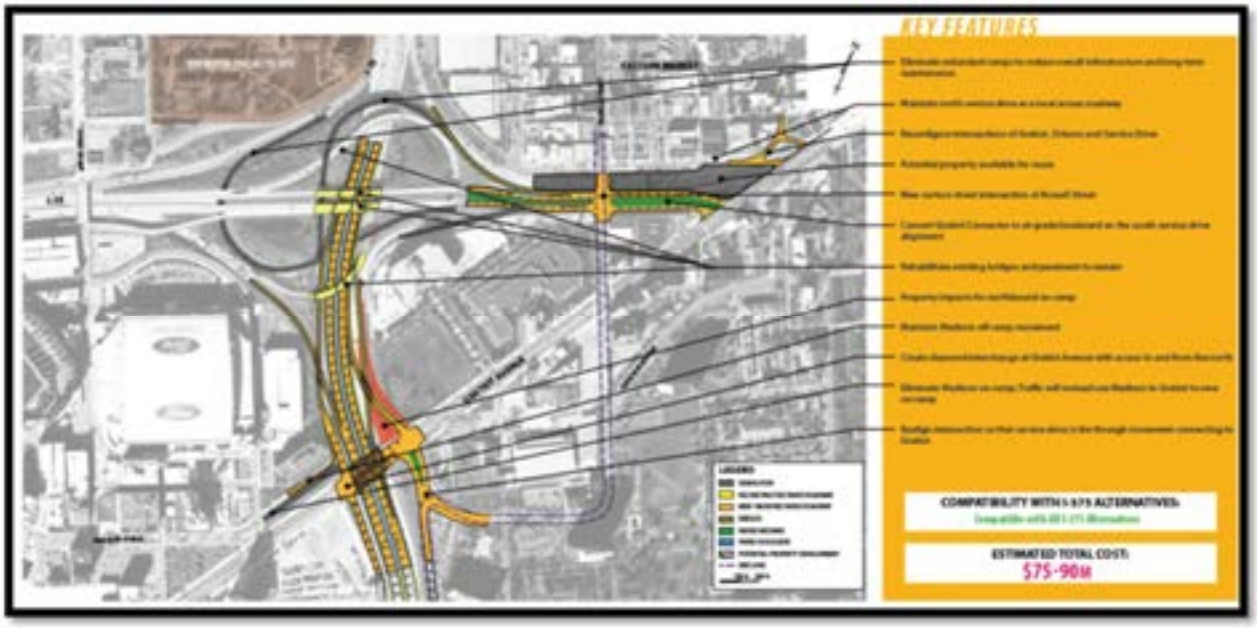


4.1.2 I-75/I-375/Gratiot Connector Interchange

Two principal concepts were developed for the interchange area:

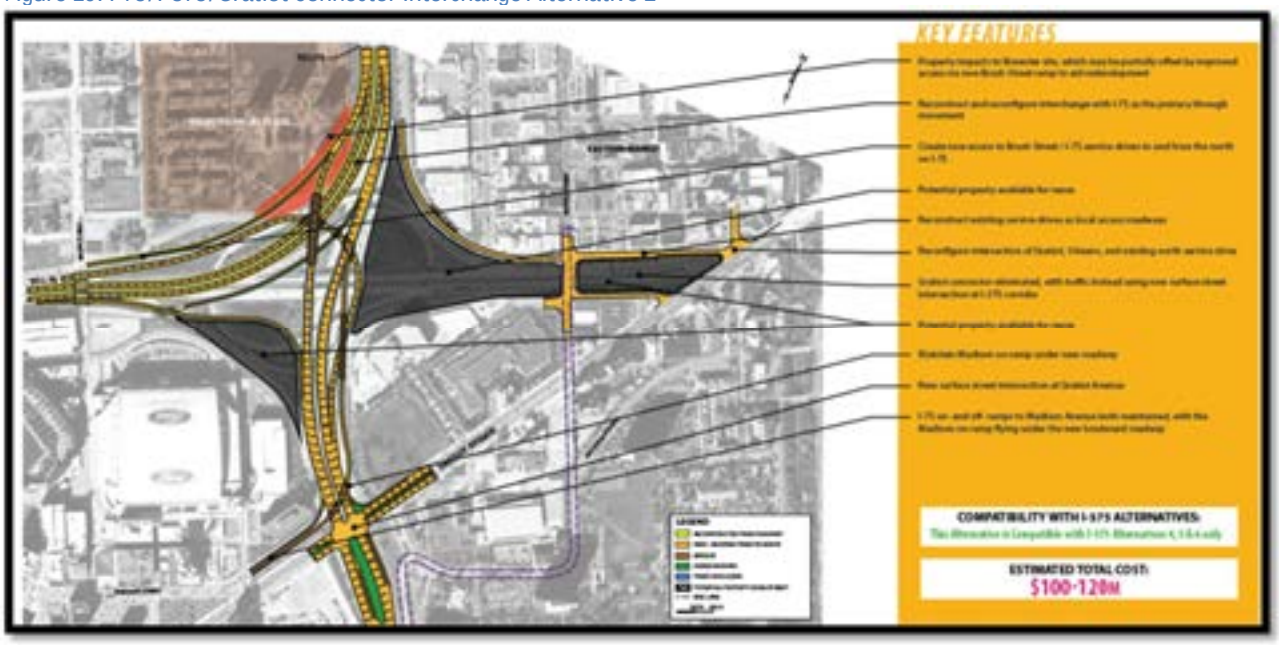
Alternative 1: Alternative 1 is intended as a lower-cost refinement of the interchange are, which would eliminate the current left-hand ramps to Madison Avenue, and create a more traditional interchange at Gratiot Avenue. It would also include conversion of the Gratiot Connector to a surface roadway with a signalized intersection at Russell Street. This alternative is compatible with all six of the I-375 alternatives.

Figure 18: I-75/I-375/Gratiot Connector Interchange Alternative 1



Alternative 2: Under this alternative, the interchange area would be completely reconstructed, with I-75 reconfigured as the through-traffic movement. A surface street intersection would be created with Gratiot Avenue at I-375, replacing the need for the Gratiot Connector and allowing for its elimination. In addition, new access would be created to and from the north on I-75 at Brush Street, and access to Madison Avenue maintained. This alternative is compatible only with I-375 Alternatives 4, 5 and 6.

Figure 19: I-75/I-375/Gratiot Connector Interchange Alternative 2



4.1.3 Jefferson Avenue (east of I-375)

Two concepts were identified for this section of Jefferson Avenue, from I-375 to Joseph Campau Avenue, either of which is compatible with any of the I-375 alternatives. Jefferson Avenue in this section is currently four lanes 10-foot lanes in each direction, with a continuous center left-turn lane. However, the outside travel lanes allow for on-street parking during all time periods, and therefore do not have any traffic-carrying capacity.

Alternative 1: This alternative would include three lanes of traffic in each direction, with the creation of a center median. On-street parking would be allowed in the outside lanes only during off-peak periods. Left turns would be made directly at the intersections using turn lanes cut into the median space.

Alternative 2: Under this alternative, Jefferson Avenue would be reduced to two lanes of travel in each direction with a continuous center-left turn lane. Dedicated on-street parking would be provided outside of the travel lanes. In addition, a buffered bike lane would be incorporated into the corridor.

Figure 20: Jefferson Avenue East Alternative 1 Cross-Section

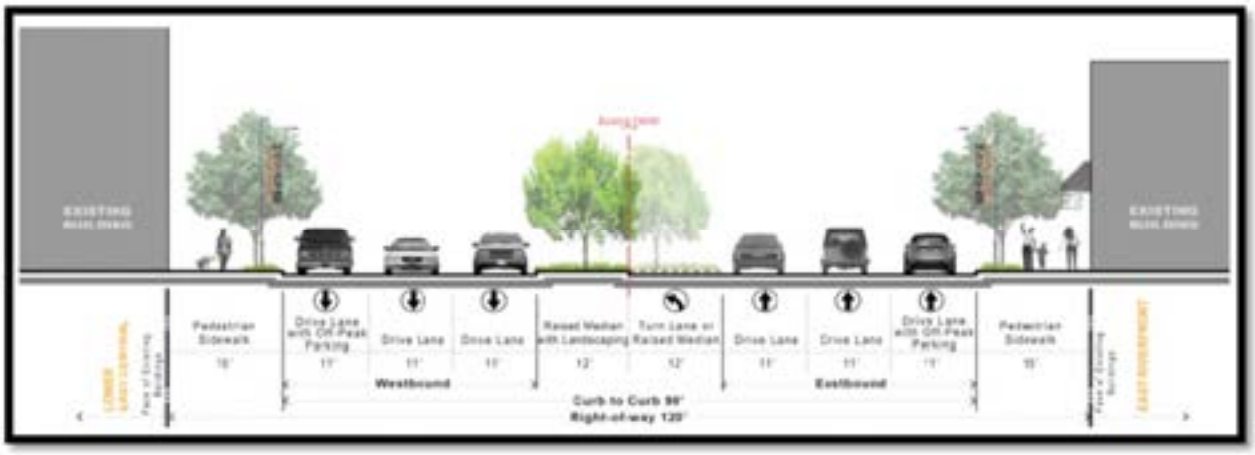
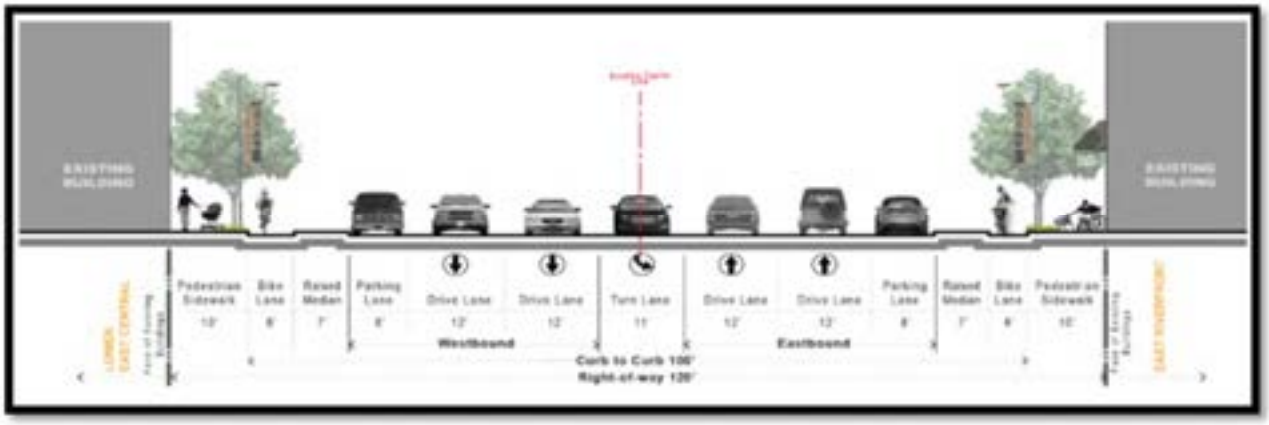


Figure 21: Jefferson Avenue East Alternative 2 Cross-Section



4.1.4 Jefferson Avenue (west of I-375)

Two concepts were developed for Jefferson Avenue west of I-375. While these concepts include some operational changes and improvements, the modifications proposed are too minor to be able to be tested at a regional model level in this first level of screening.

Alternative 1: This alternative includes elimination of the direct left-turn from eastbound Jefferson Avenue to northbound Woodward Avenue. In addition, the direct left-turn from westbound Jefferson Avenue to southbound Beaubien Street would be relocated to a cross-over lane west of the intersection. This alternative is intended to be most compatible with I- 375 Alternatives 1 and 2; however, improvements shown at Woodward Avenue would be compatible with all I-375 alternatives.

Alternative 2: Under this alternative, all direct left-turns at Woodward Avenue would be eliminated and re-routed to other downtown roadways. In addition, all direct left-turns at Beaubien Street would be relocated to new cross-over lanes. This alternative would be compatible with I-375 Alternatives 3-6 only; however, improvements shown at Woodward Avenue would be compatible with all I-375 alternatives.

Figure 22: Jefferson Avenue West Alternative 1

Figure 23: Jefferson Avenue West Alternative 2

4.2 Analysis Methodology

For this screening level analysis, forecasted volumes in combination with link capacity from the regional model were utilized to develop Volume/Capacity (V/C) ratios for study area roadway links. V/C is a high-level measure of saturation of a roadway link, and provides an indicator of potential problem areas. A V/C ratio of greater than 1.0 indicates that the anticipated volume on the link exceeds the theoretical link capacity, which takes into account the functional classification of the roadway, the posted speed, and the number of travel lanes. This is an indicator of potential congestion along the link.

It should be noted that link capacity at the regional model level is not sensitive to certain operational features or issues, including traffic signalization and phasing, turn lanes and other factors. Further, application of the regional model for analysis of a central business district area is challenging due to the density of the roadway network and the strong influence of parking lot access on the volume distribution, factors which are not typically well reflected at the regional model level. As such, this

analysis is intended to be a high-level screening tool to identify potential issue areas, which will be studied further for alternatives which advance to the practical alternative stage.

4.3 Primary Study Area Analysis

4.3.1 Anticipated V/C Performance

The following figures depict AM and PM peak hour V/C performance for each of the I-375 alternatives, including forecast hourly volumes for study area roadway links. The I-375 alternatives were evaluated assuming no changes to the I-75/I-375/Gratiot Connector interchange and no significant changes to access to Gratiot Avenue. This represents a baseline condition for what is anticipated to be the first phase of any improvements to the corridor area, and is a worst-case scenario in terms of traffic load to be carried by the I-375 corridor.

Figures 24 – 36 depict the AM and PM peak hour conditions under each of the six illustrative alternatives.

As illustrated in the figures, most I-375 corridor segments are anticipated to experience a V/C ratio of less than 1.0 during both the AM and PM peak hours. The following is a description of notable sections anticipated to experience a V/C of 1.0 or greater:

- Southbound Service Drive (Larned to Jefferson): Under Alternative 2 during the AM peak, this link is anticipated to be over capacity. This increase in V/C over Alternative 1 is due to increased load on the service drive serving the new riverfront connector roadway, which would draw traffic off of I-375 sooner.
- Southbound I-375 (Surface Roadway) between I-75 and Monroe: during the AM peak hour, southbound I-375 is anticipated to experience a V/C over 1.0 under Alternatives 4-6, where I-375 would be converted to a surface street.
- Northbound I-375 (Surface Roadway) between Monroe and I-75: during the PM peak hour, northbound I-375 is anticipated to experience a V/C over 1.0 under Alternatives 4-6, where I-375 would be a surface street.

These conditions may indicate the need for an additional through lane or turn lane or preferential signal operations in this segment to address the capacity requirements. Testing of such improvements are beyond the capabilities of the regional model at this screening level, and would be explored through more detailed operational modeling for alternatives advancing to the Practical Alternatives phase of study.

Figure 24: 2040 AM Peak Hour Conditions - Alternative 1

Figure 25: 2040 PM Peak Hour Conditions - Alternative 1

Figure 26: 2040 AM Peak Hour Conditions - Alternative 2

Figure 27: 2040 PM Peak Hour Conditions - Alternative 2

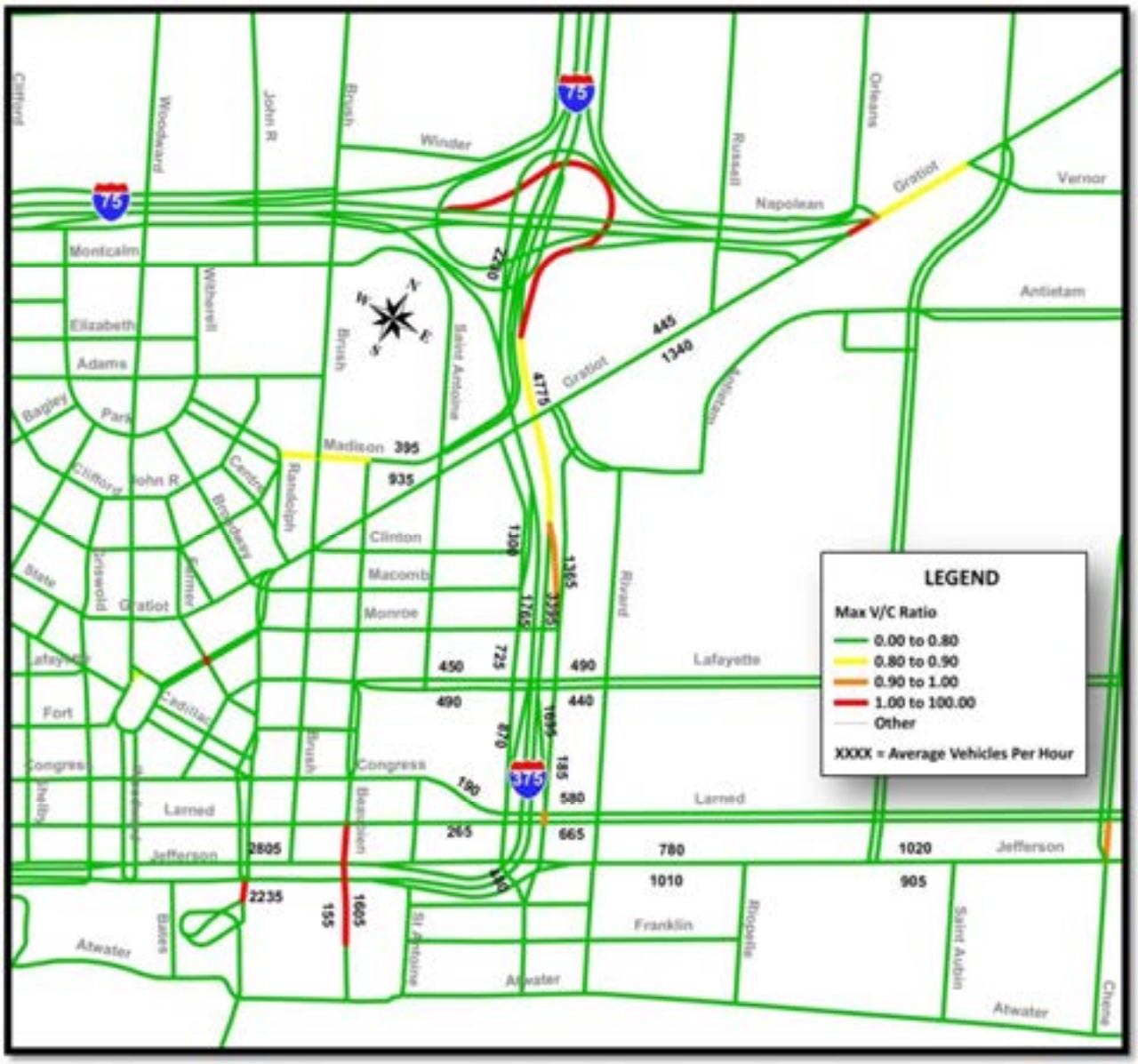


Figure 28: 2040 AM Peak Hour Conditions - Alternative 3

Figure 29: 2040 PM Peak Hour Conditions - Alternative 3

Figure 30: 2040 AM Peak Hour Conditions - Alternative 4

Figure 31: 2040 PM Peak Hour Conditions - Alternative 4

Figure 32: 2040 AM Peak Hour Conditions - Alternative 5

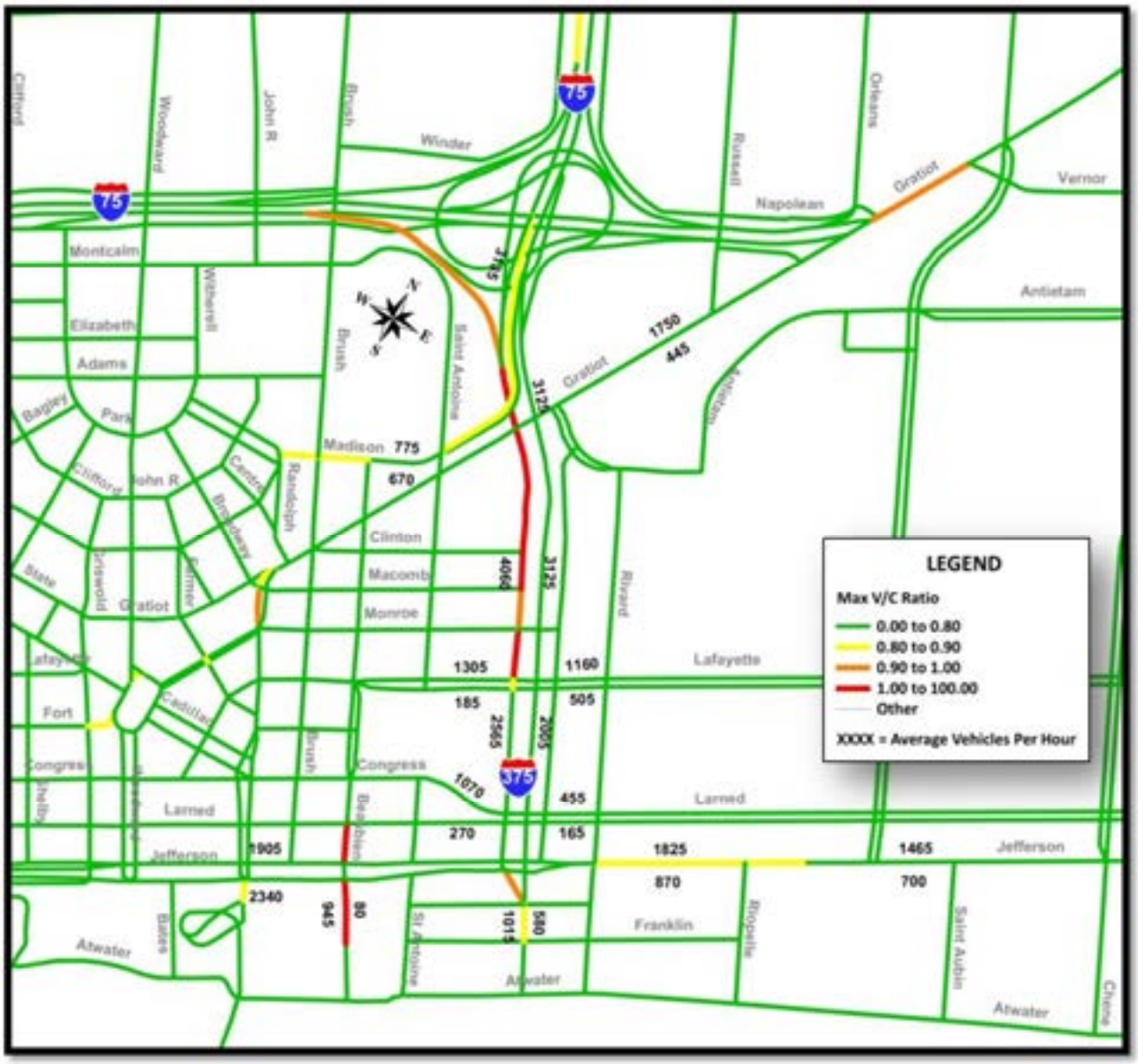


Figure 33: 2040 PM Peak Hour Conditions - Alternative 5

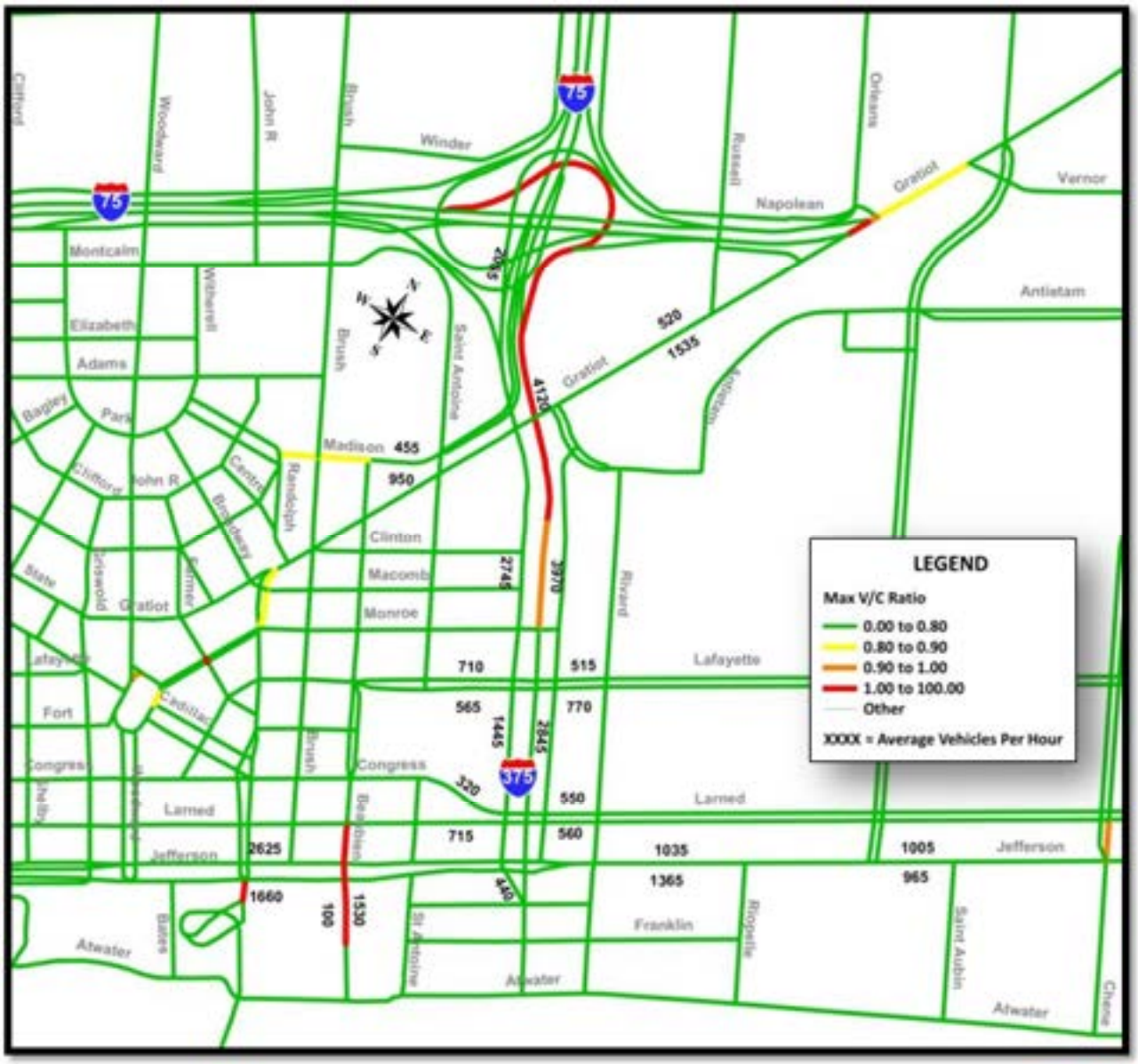


Figure 34: 2040 AM Peak Hour Conditions - Alternative 6

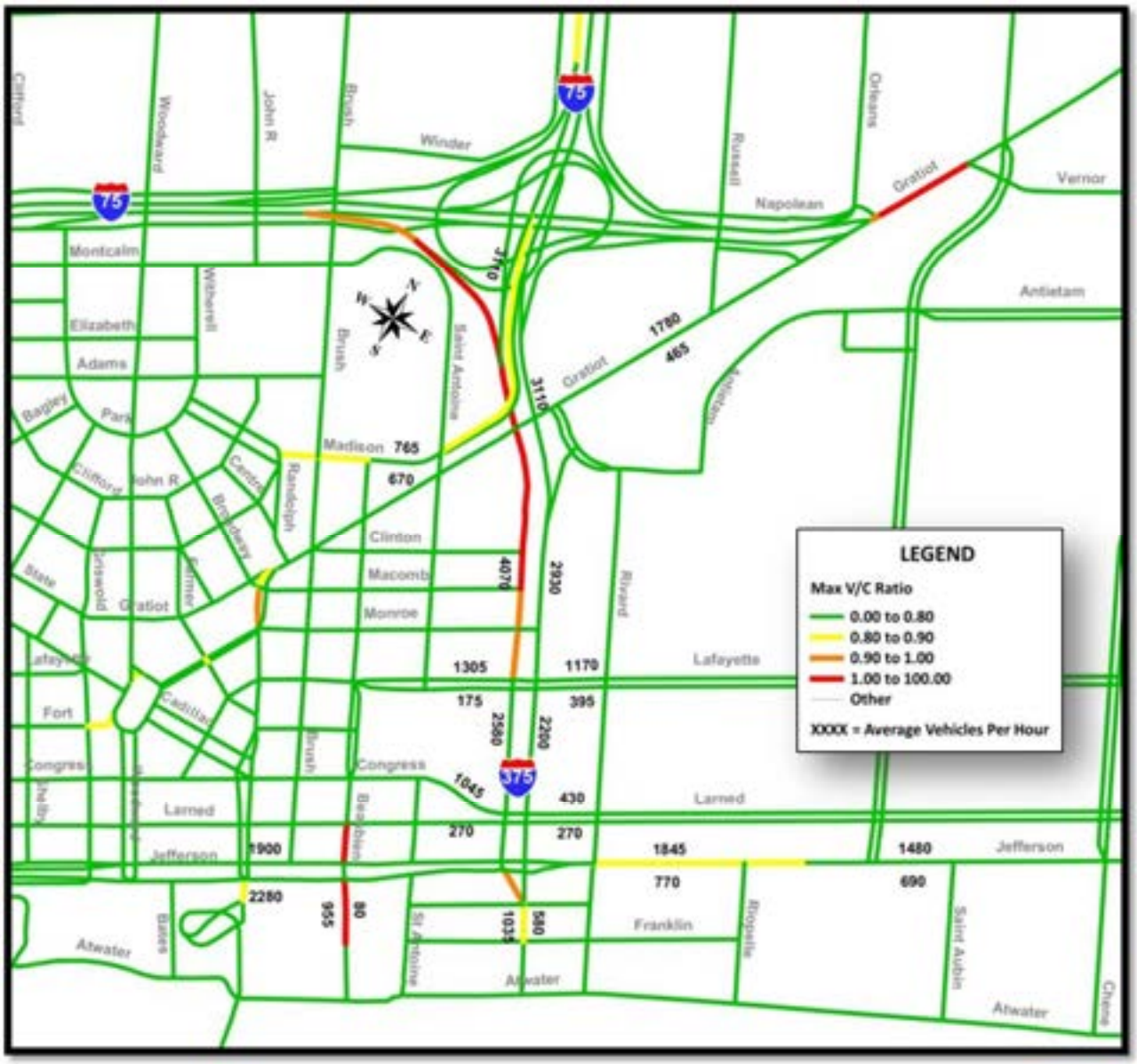
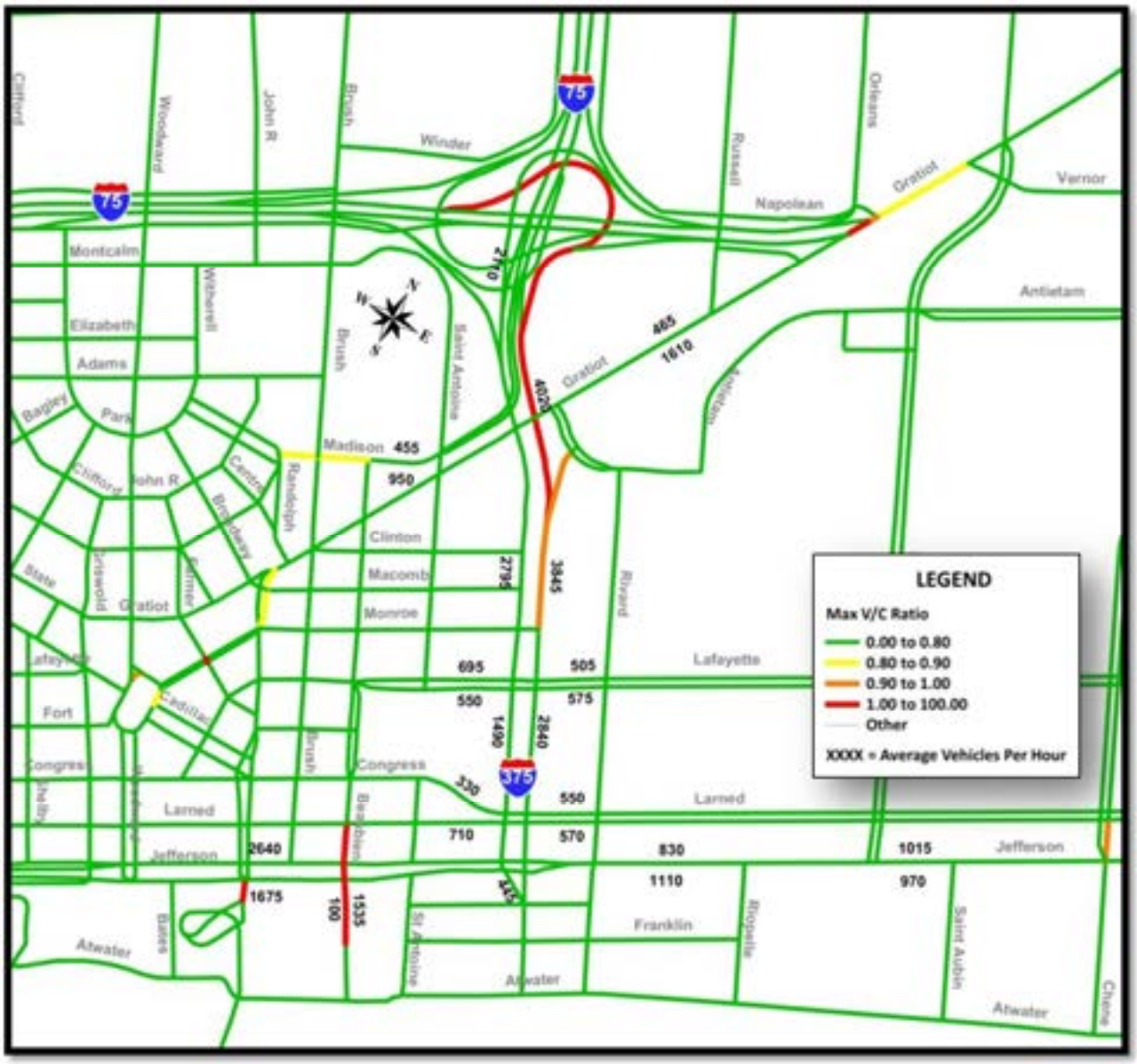


Figure 35: 2040 PM Peak Hour Conditions - Alternative 6



4.3.2 Forecasted Volume Redistribution

The regional forecasting model dynamically reassigns traffic based on the route anticipated to provide the shortest travel time, with the least congestion. This therefore allows the examination of how changes to the I-375 corridor, including reduction of traffic-carrying capacity, would result in shifts of traffic to other routes. Two principal drivers of traffic shifting were examined with this analysis:

Direct Connection to Gratiot Avenue

Connectivity at the north end of the corridor to southbound Gratiot Avenue is indirect and inconvenient, requiring traffic to exit at Madison Avenue and make a series of turn movements to access Gratiot. The impact of a more direct connection between I-375 and Gratiot Avenue was examined by incorporating Interchange Alternative 1, with a direct Gratiot interchange, into the regional model, along with I-375 Alternative 3. This allowed direct comparison of the results to determine how much I-375 traffic may be drawn off of the corridor to Gratiot Avenue to make connections into other parts of the central business district. Figures 36 and 37 illustrate the anticipated performance of this alternative during the AM and PM peak hours, respectively.

As seen in the figures, the additional volume on Gratiot Avenue resulting from the new direct connection (approximately 500 vehicles in the inbound direction during the AM peak period, and 400 vehicles/hour in the outbound direction during the PM peak period) is largely being drawn from other locations, and does not result in a corresponding reduction in volume further south along I-375. The greatest benefit of this connection may be the connection to the southbound service drive, in order to access the Wayne County Jail site.

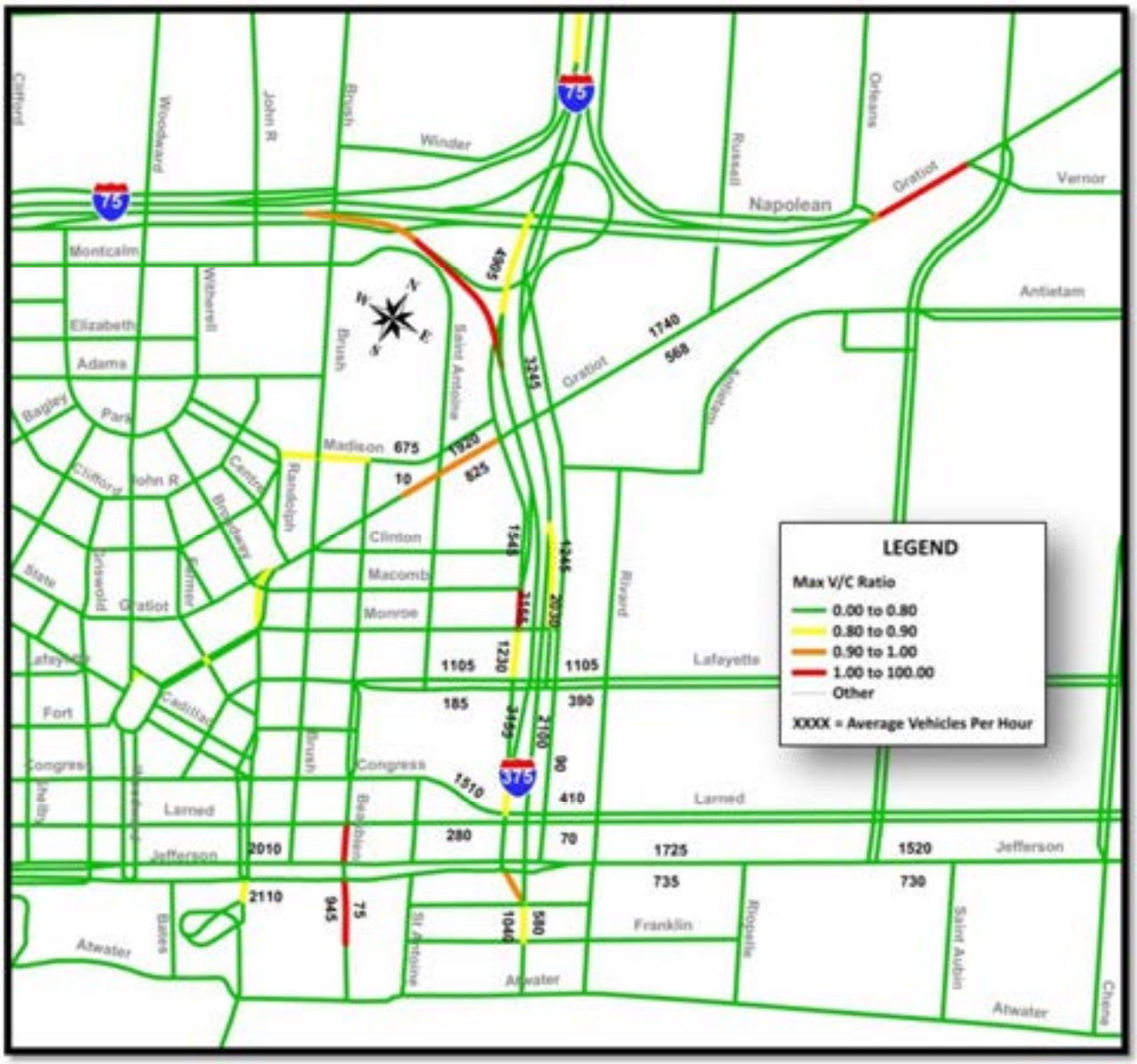
Reduced Capacity along I-375 Corridor

Under I-375 Alternatives 3-6, capacity along the I-375 corridor is planned to be reduced, through conversion of all or part of the freeway to a surface street, and reduction of overall lane capacity within the corridor. This is likely to result in a shift of some traffic otherwise anticipated to use I-375 to other uncongested nearby routes, particularly M-10, to access downtown.

As seen by comparing volume information between Alternative 1 and Alternatives 4-6 (full surface street alternatives), peak hour/peak direction volumes along the I-375 corridor (combination of both service drive and freeway volumes) are anticipated to decrease by approximately 600-1,000 vehicles per hour within the corridor. This indicates a predicted shift in some corridor traffic to other downtown routes which provide a better travel time. For traffic diverting for their entire route, M-10 is projected to carry the majority of the shifted traffic, with an addition of roughly 300 vehicles/hour, while still maintaining a V/C ratio below 0.8. Some traffic is projected to leave the I-375 corridor further north, including along Madison, Lafayette and Larned. Other affected downtown routes are projected to operate at a V/C of below 0.8, indicating generally good performance.

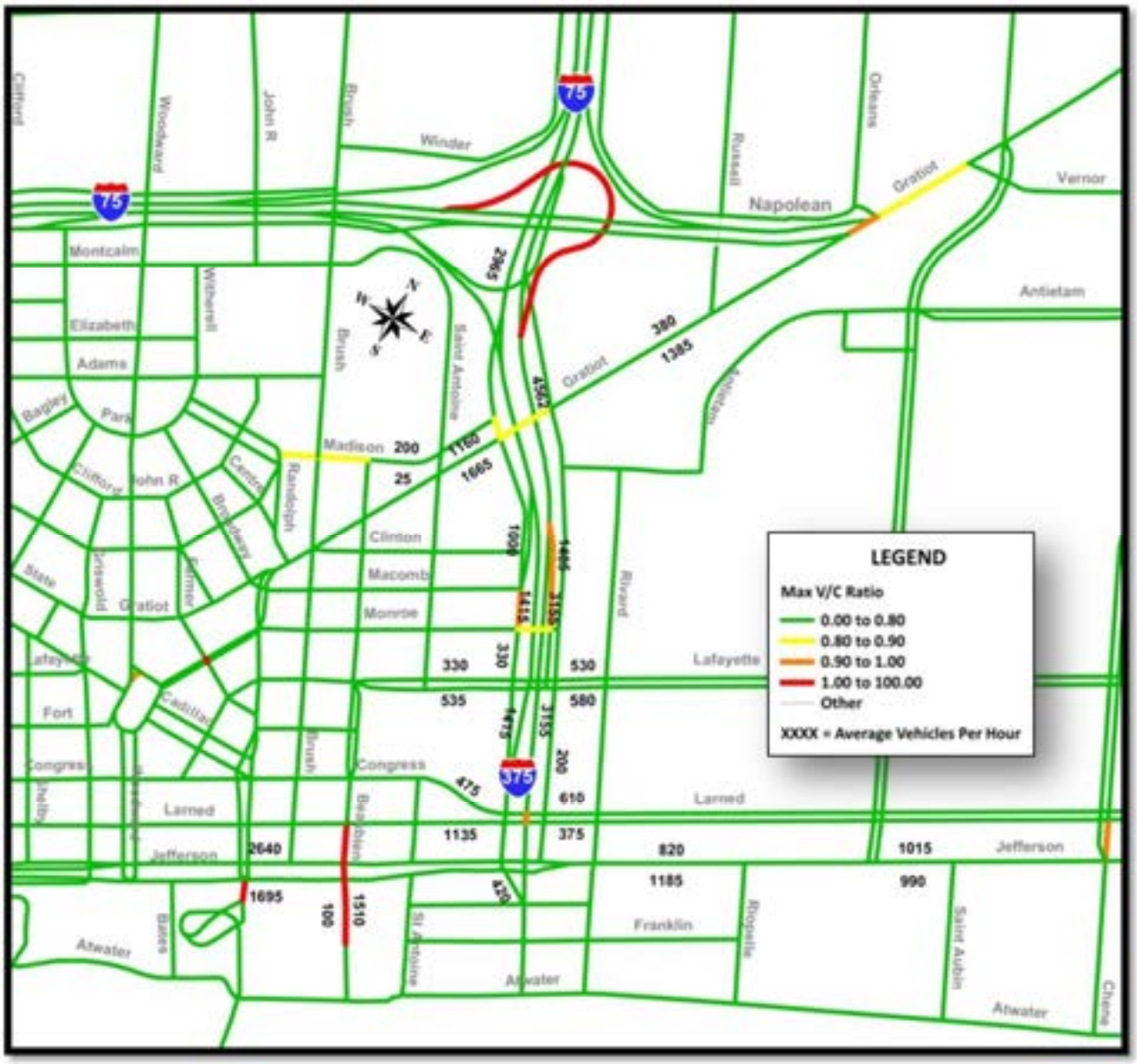
It should be noted again that the application of the regional model at this micro scale is intended to observe general shifts and trends in traffic, and not to represent exact volume changes in all locations. Generally, this exercise illustrates that other parts of the downtown roadway network are capable of absorbing projected volume shifts off of the I-375 corridor while maintaining acceptable levels of performance.

Figure 36: 2040 AM Peak Hour Conditions - Interchange Alternative 1



*Note: Assumes I-375 Alternative 3

Figure 37: 2040 PM Peak Hour Conditions - Interchange Alternative 1



*Note: Assumes I-375 Alternative 3

Figure 38: 2040 AM Peak Hourly Volume Shifts - I-375 Alternative 4

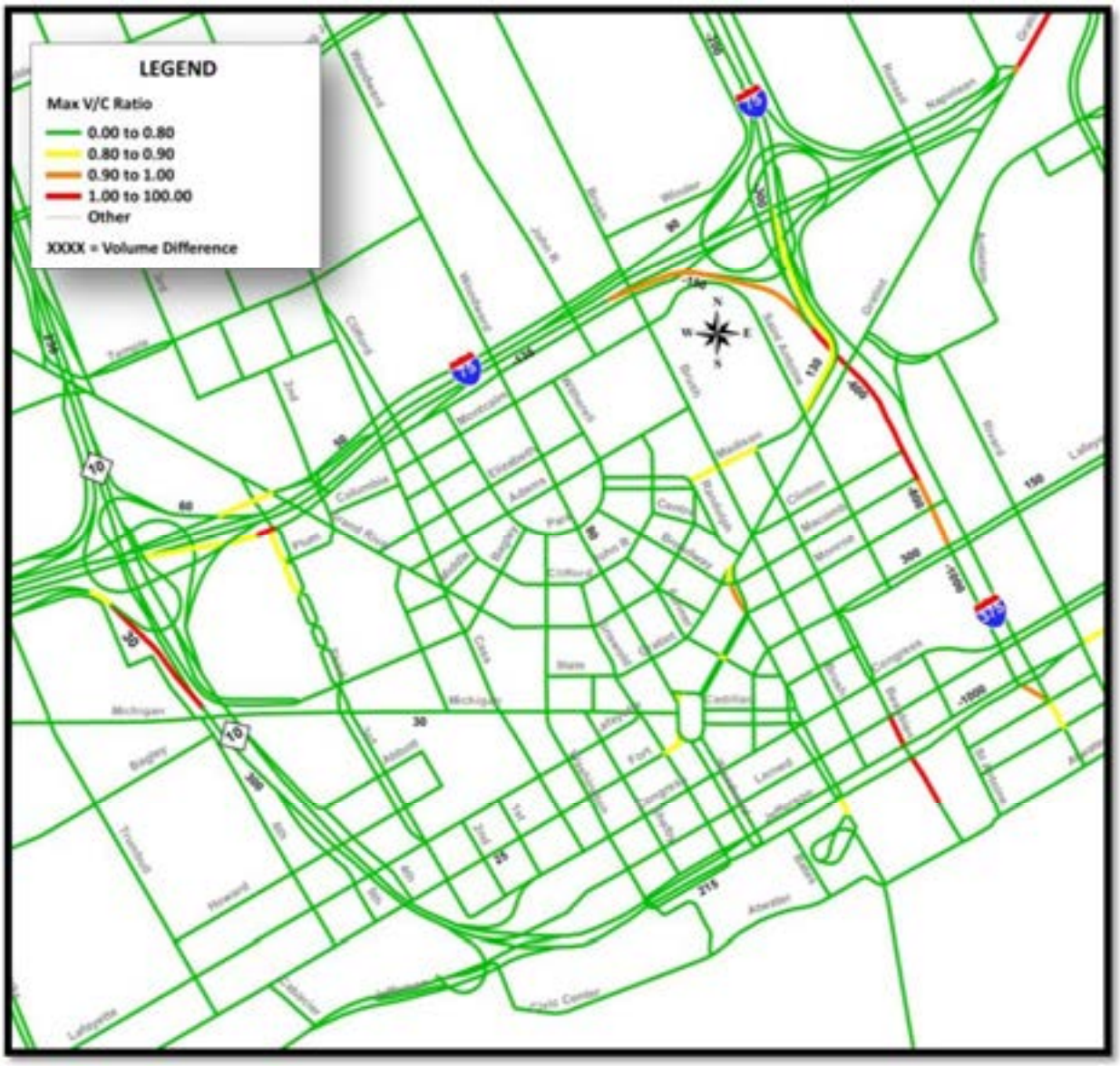
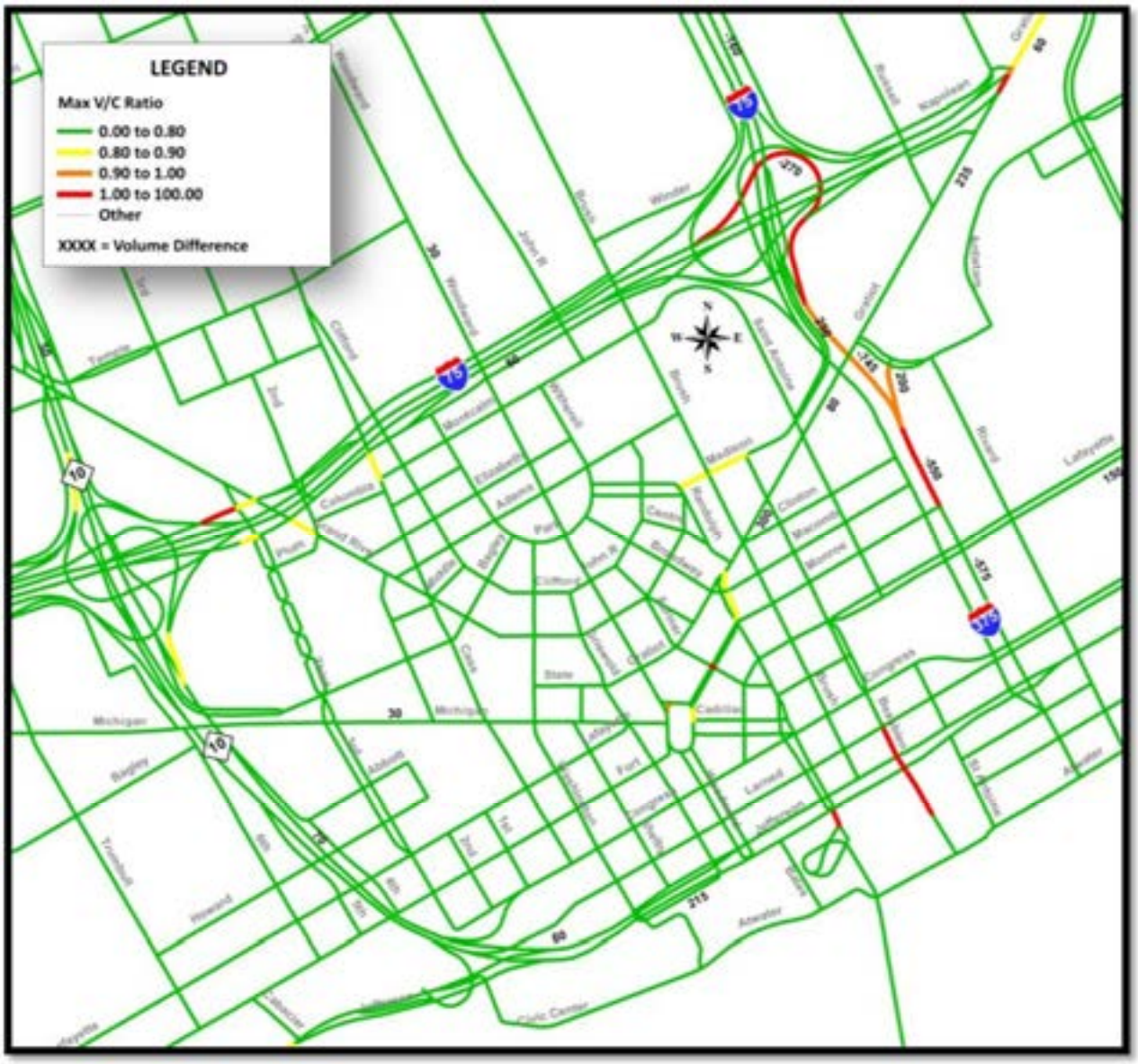


Figure 39: 2040 PM Peak Hourly Volume Shifts - I-375 Alternative 4

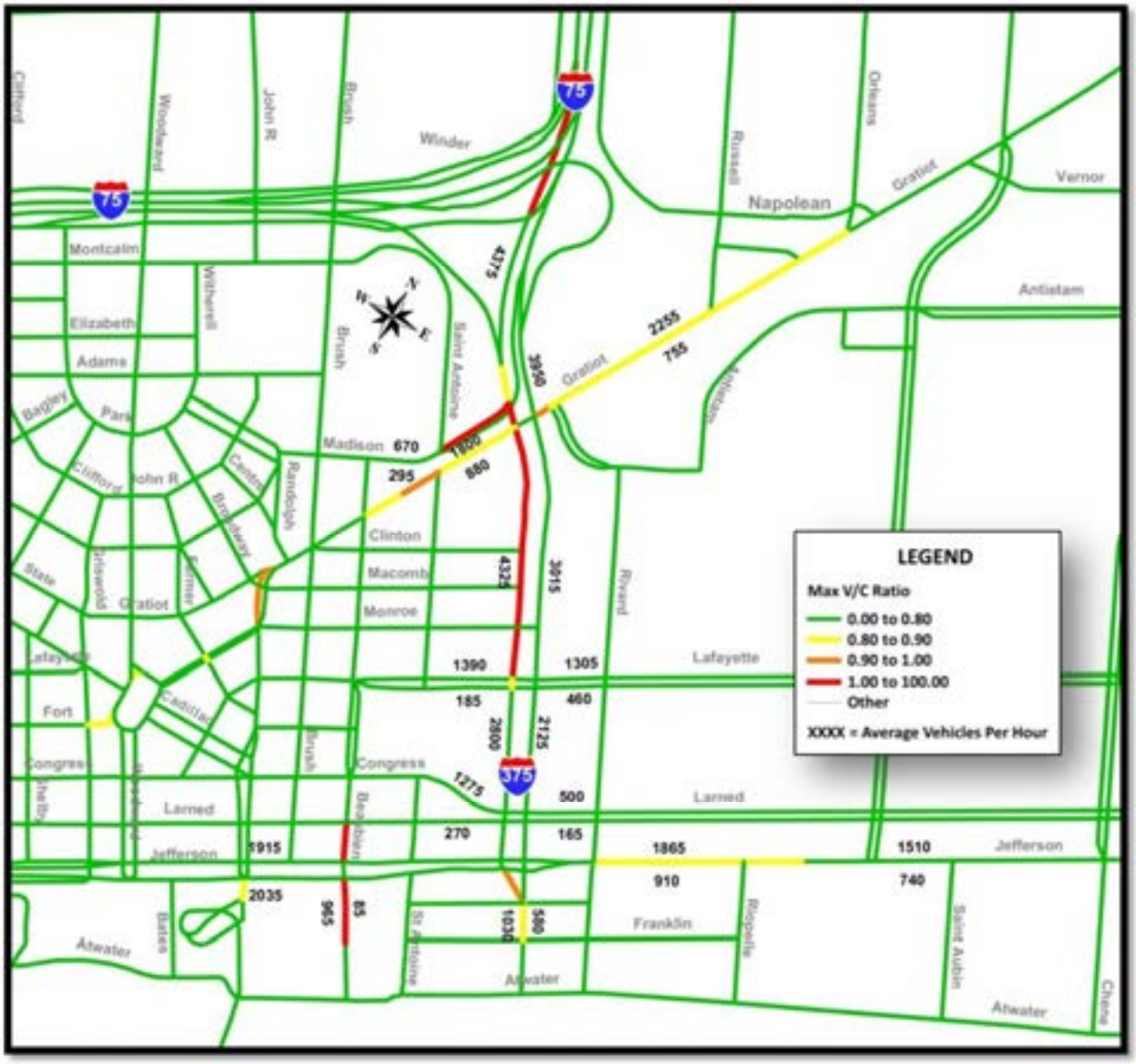


4.4 Secondary Study Area Analysis

4.4.1 I-75/I-375/Gratiot Connector Interchange

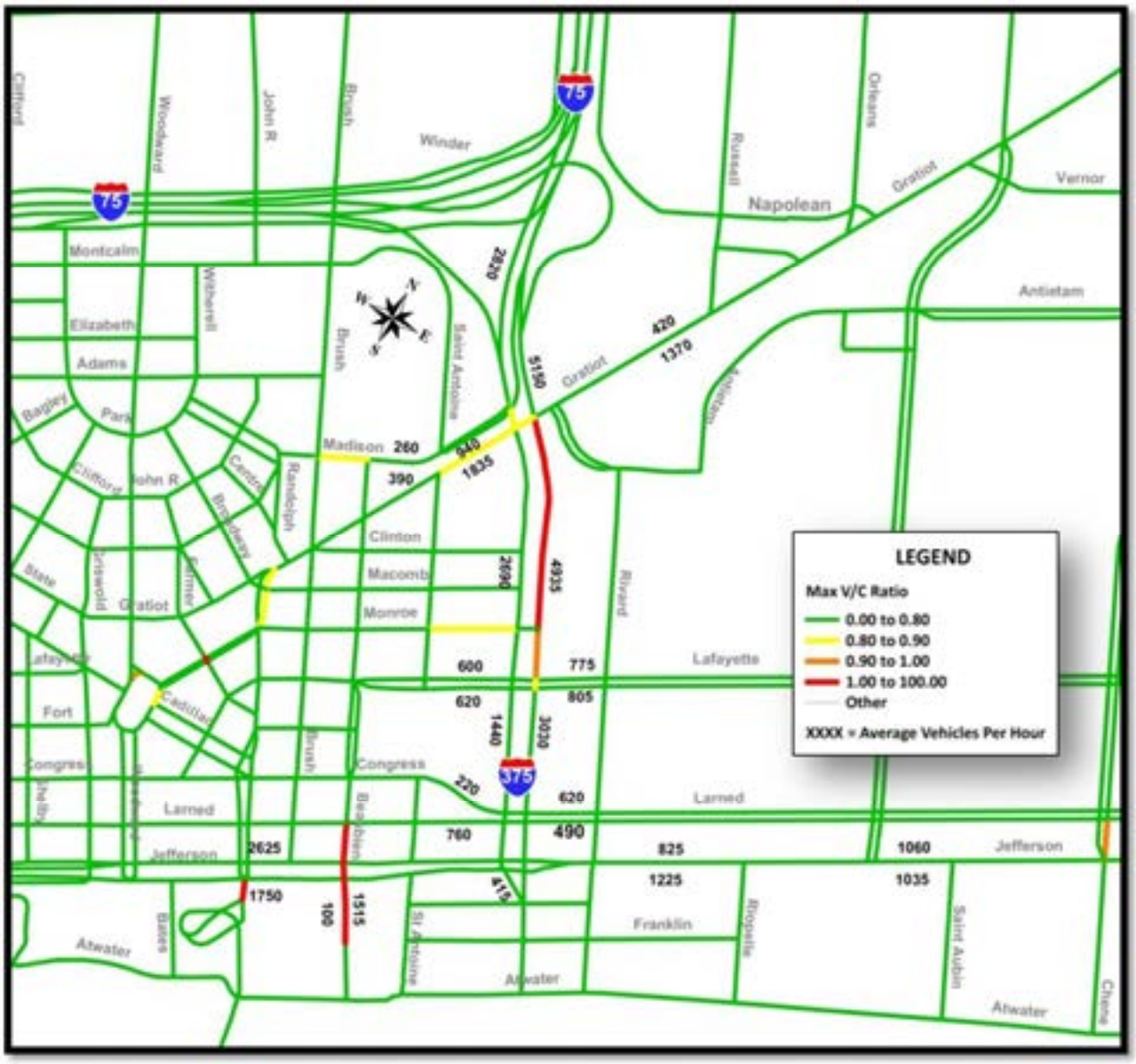
Two alternatives were identified for the I-75/I-375/Gratiot Connector interchange, as discussed in Section 4.1. Refer to Figures 36 and 37 for 2040 performance for Interchange Alternative 1 under the AM and PM peak hours, respectively. Anticipated 2040 performance for Interchange Alternative 2 (shown together with I-375 Alternative 4) is shown in Figures 40 and 41 for the AM and PM peak hours, respectively.

Figure 40: 2040 AM Peak Hour Conditions - Interchange Alternative 2



*Note: Includes I-375 Alternative 4

Figure 41: 2040 PM Peak Hour Conditions - Interchange Alternative 2



*Note: Includes I-375 Alternative 4

As shown in the figures, the proposed at-grade intersection between the new I-375 roadway and Gratiot Avenue would be a high-volume junction, with many of the approach links projected to be at or above capacity by the 2040 planning horizon. This may require consideration of additional thru or turn lanes, special turn movement treatments, or other measures to achieve adequate levels of service.

It should be noted that the elimination of the Gratiot Connector is not projected to greatly increase volumes at the new at-grade intersection, in part due to the anticipated level of congestion at the intersection. Instead, the regional model predicts that much of that traffic will divert to other routes outside of the study area, including Mack Avenue (to access I-75) and I-94.

4.4.2 Jefferson Avenue (east of I-375)

Two alternatives were developed for Jefferson Avenue east of I-375. From the standpoint of traffic capacity, the alternatives differ in that Alternative 1 maintains the existing three travel lanes in each direction (not counting the existing fourth lane which accommodates on-street parking), while Alternative 2 would reduce the corridor to two travel lanes in each direction.

All previous I-375 alternative figures show Jefferson Avenue east of I-375 modeled as Alternative 1. The following figures illustrate anticipated 2040 conditions for Alternative 2 (with a reduction of one travel lane in each direction) during both the AM and PM peak hours of travel.

Figure 42: 2040 AM Peak Hour Conditions - E. Jefferson Alternative 2

Figure 43: 2040 PM Peak Hour Conditions - E. Jefferson Alternative 2

As seen in the figures, under Alternative 1 Jefferson Avenue is anticipated to operate at a V/C less than 0.8, with the exception of westbound Jefferson immediately east of Rivard, where V/C is projected to be between 0.9 and 1.0 by 2040. With the elimination of one travel lane in each direction under Alternative 2, that performance is projected to degrade to V/C of greater than 1.0 at this location during the AM peak period. This may require more detailed operational analysis, and possibly the transition to an additional lane of travel in this segment to maintain adequate performance.

4.4.3 Jefferson Avenue (west of I-375)

The operational differences between alternatives for Jefferson Avenue west of I-375 are centered on operations and turn restrictions proposed at the intersection of Jefferson and Woodward Avenues. Under Alternative 1, the eastbound left turn is proposed to be eliminated, with traffic diverting to other routes. Under Alternative 2, the southbound left turn is additionally proposed to be eliminated. Figures 44-47 illustrate the volume differences anticipated with these shifts in traffic due to the proposed turn prohibitions.

Figure 44: 2040 AM Peak Hour Performance - W. Jefferson Alternative 1

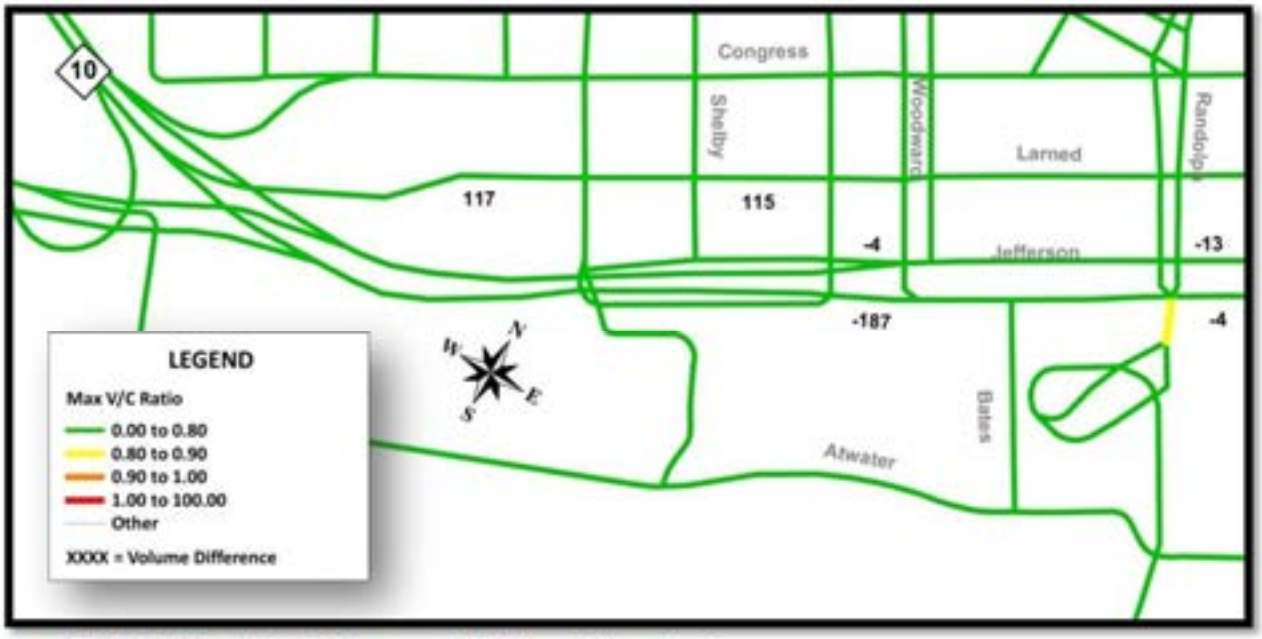


Figure 45: 2040 PM Peak Hour Performance - W. Jefferson Alternative 1

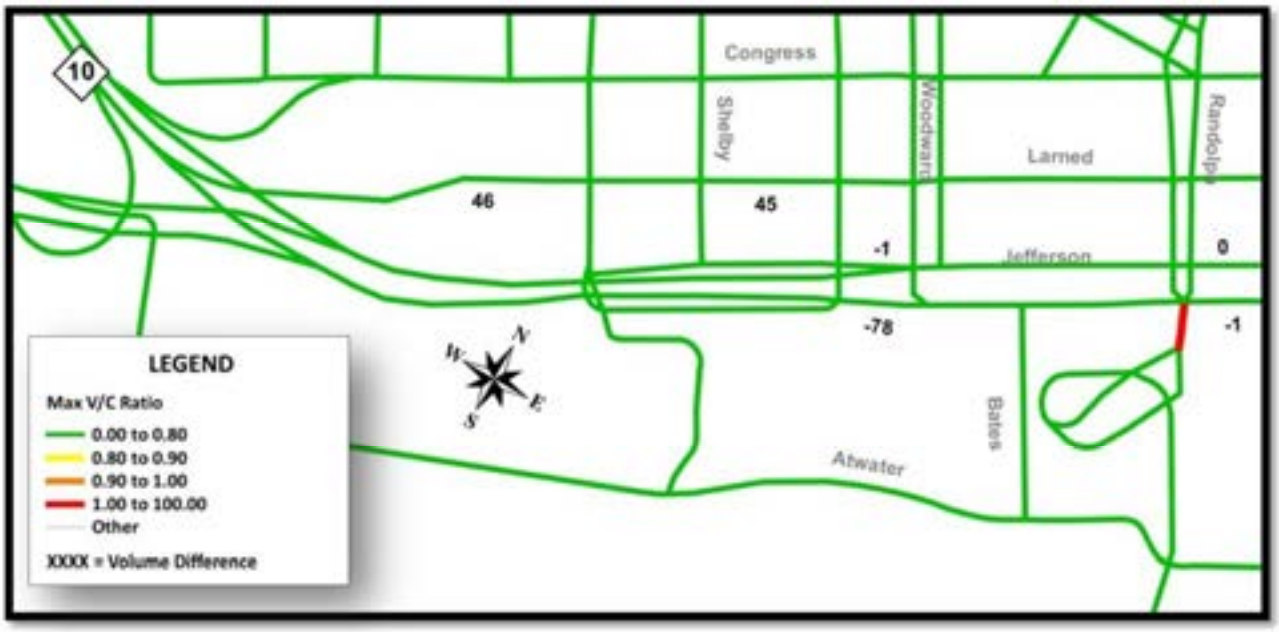


Figure 46: 2040 AM Peak Hour Performance - W. Jefferson Alternative 2

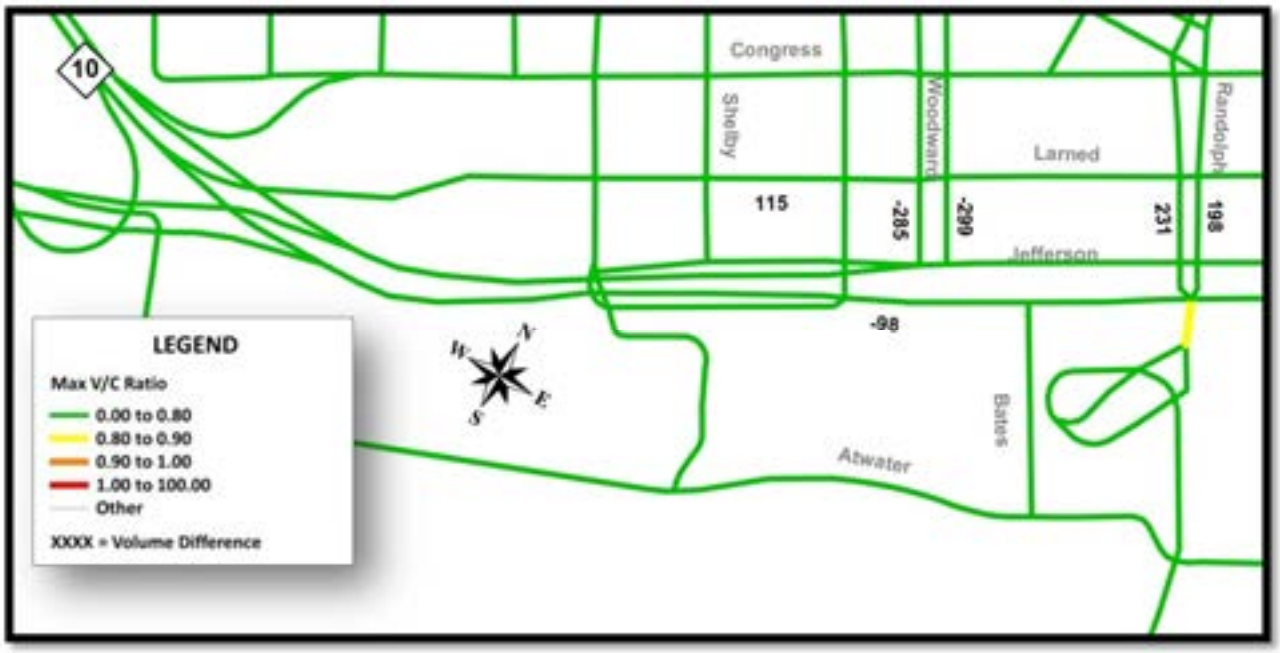
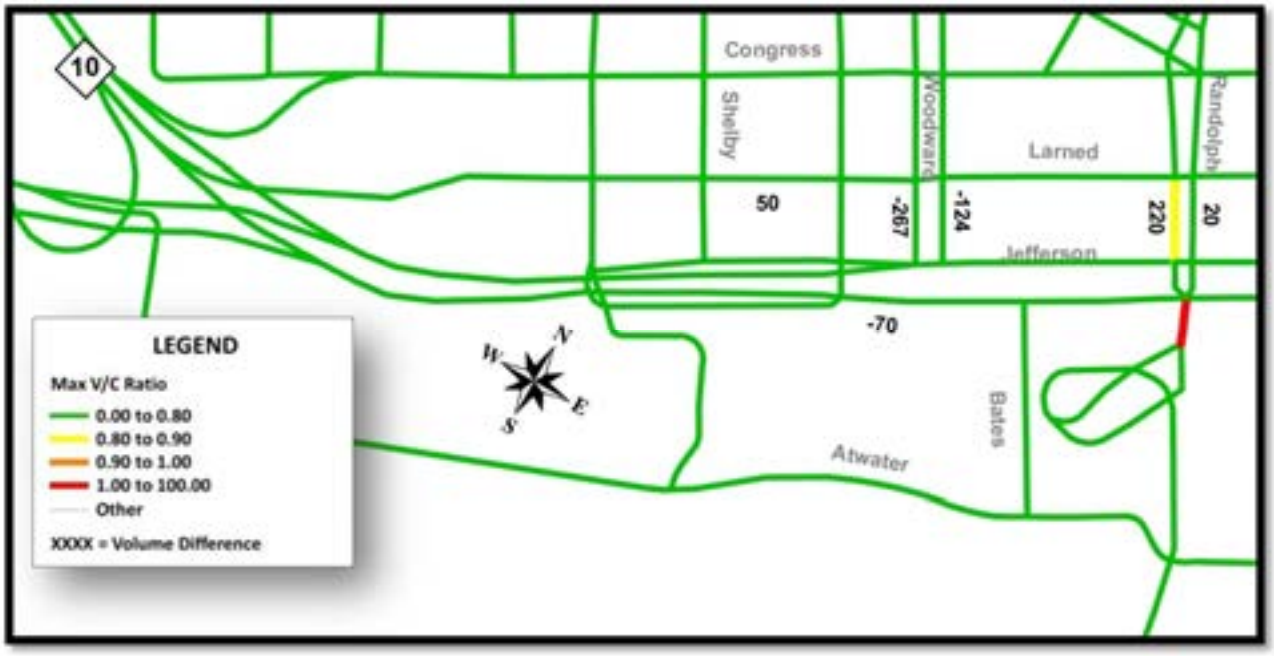


Figure 47: 2040 PM Peak Hour Performance - W. Jefferson Alternative 2



The following is a summary of observations related to these alternatives:

<u>Eastbound Left-Turn Prohibition at Woodward</u>

- The traffic that is turning left at this location today would primarily divert to exiting M-10 at Larned Street to reach Woodward. Some traffic (particularly traffic originating from Jefferson west of M-10) may continue east on Jefferson to the cross-over lane east of Randolph.

- While Larned is still expected to operate well below capacity, it is suggested that strict enforcement of peak-hour parking prohibitions would be necessary to maintain sufficient capacity for this movement.

Southbound Left-Turn Prohibition at Woodward

- Southbound left-turning traffic would likely divert to Randolph to reach eastbound Jefferson Avenue. Some traffic may instead continue on Larned instead of Jefferson.
- Southbound approaches at Griswold and Randolph experience some PM peak hour congestion today, and may require updated signal timings and peak-period on-street parking restrictions to accommodate additional volume.

APPENDIX A-1
Existing Year Signalized intersections Measures of Effectiveness
AM PEAK

HCM Signalized Intersection Capacity Analysis
3: I 375 NB Service Drive/NB I-375 Service Drive & E. Lafayette Blvd.

8/15/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	115	302	0	0	245	496	26	37	8	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5			5.5			7.7				
Lane Util. Factor	1.00	0.91			0.91			0.95				
Frt	1.00	1.00			0.90			0.98				
Flt Protected	0.95	1.00			1.00			0.98				
Satd. Flow (prot)	1770	5085			4575			3415				
Flt Permitted	0.29	1.00			1.00			0.98				
Satd. Flow (perm)	540	5085			4575			3415				
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	125	328	0	0	266	539	28	40	9	0	0	0
RTOR Reduction (vph)	0	0	0	0	366	0	0	7	0	0	0	0
Lane Group Flow (vph)	125	328	0	0	439	0	0	70	0	0	0	0
Turn Type	pm+pt	NA			NA		Perm	NA				
Protected Phases	7	4			8			2				
Permitted Phases	4						2					
Actuated Green, G (s)	40.5	40.5			22.5			16.3				
Effective Green, g (s)	40.5	40.5			22.5			16.3				
Actuated g/C Ratio	0.58	0.58			0.32			0.23				
Clearance Time (s)	5.5	5.5			5.5			7.7				
Lane Grp Cap (vph)	532	2942			1470			795				
v/s Ratio Prot	c0.04	0.06			c0.10							
v/s Ratio Perm	0.09							0.02				
v/c Ratio	0.23	0.11			0.30			0.09				
Uniform Delay, d1	9.9	6.6			17.8			21.0				
Progression Factor	0.85	0.88			1.00			0.78				
Incremental Delay, d2	1.0	0.1			0.5			0.2				
Delay (s)	9.3	5.9			18.3			16.6				
Level of Service	A	A			B			B				
Approach Delay (s)		6.9			18.3			16.6			0.0	
Approach LOS		A			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	14.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.22		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	18.7
Intersection Capacity Utilization	81.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	367	0	0	753	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3			5.8		
Lane Util. Factor	*0.82			*0.63		
Frt	1.00			1.00		
Flt Protected	0.95			1.00		
Satd. Flow (prot)	2902			2347		
Flt Permitted	0.95			1.00		
Satd. Flow (perm)	2902			2347		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	399	0	0	818	0	0
RTOR Reduction (vph)	195	0	0	0	0	0
Lane Group Flow (vph)	204	0	0	818	0	0
Turn Type	Prot			NA		
Protected Phases	4			2		
Permitted Phases						
Actuated Green, G (s)	18.5			39.4		
Effective Green, g (s)	18.5			39.4		
Actuated g/C Ratio	0.26			0.56		
Clearance Time (s)	6.3			5.8		
Lane Grp Cap (vph)	766			1321		
v/s Ratio Prot	c0.07			c0.35		
v/s Ratio Perm						
v/c Ratio	0.27			0.62		
Uniform Delay, d1	20.4			10.3		
Progression Factor	0.07			1.22		
Incremental Delay, d2	0.8			2.1		
Delay (s)	2.1			14.6		
Level of Service	A			B		
Approach Delay (s)	2.1			14.6	0.0	
Approach LOS	A			B	A	

Intersection Summary			
HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	58.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	114	36	74	197	0	0	0	0	303	354	606
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5		5.5	5.5						7.7	
Lane Util. Factor		0.91		1.00	0.91						0.91	
Frt		0.96		1.00	1.00						0.93	
Flt Protected		1.00		0.95	1.00						0.99	
Satd. Flow (prot)		4903		1770	5085						4663	
Flt Permitted		1.00		0.64	1.00						0.99	
Satd. Flow (perm)		4903		1200	5085						4663	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	124	39	80	214	0	0	0	0	329	385	659
RTOR Reduction (vph)	0	26	0	0	0	0	0	0	0	0	236	0
Lane Group Flow (vph)	0	137	0	80	214	0	0	0	0	0	1137	0
Turn Type		NA		Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		22.5		22.5	22.5						34.3	
Effective Green, g (s)		22.5		22.5	22.5						34.3	
Actuated g/C Ratio		0.32		0.32	0.32						0.49	
Clearance Time (s)		5.5		5.5	5.5						7.7	
Lane Grp Cap (vph)		1575		385	1634						2284	
v/s Ratio Prot		0.03			0.04							
v/s Ratio Perm				c0.07							0.24	
v/c Ratio		0.09		0.21	0.13						0.50	
Uniform Delay, d1		16.6		17.3	16.8						12.0	
Progression Factor		1.00		1.23	1.21						3.04	
Incremental Delay, d2		0.1		1.1	0.2						0.7	
Delay (s)		16.7		22.4	20.6						37.3	
Level of Service		B		C	C						D	
Approach Delay (s)		16.7			21.1			0.0			37.3	
Approach LOS		B			C			A			D	

Intersection Summary			
HCM 2000 Control Delay	32.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.38		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	13.2
Intersection Capacity Utilization	81.7%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	284	42	0	0	0	0	0	0	83	1251	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3								5.8	
Lane Util. Factor		*0.82	1.00								0.91	
Frt		1.00	0.85								1.00	
Flt Protected		1.00	1.00								1.00	
Satd. Flow (prot)		3055	1583								5070	
Flt Permitted		1.00	1.00								1.00	
Satd. Flow (perm)		3055	1583								5070	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	309	46	0	0	0	0	0	0	90	1360	0
RTOR Reduction (vph)	0	0	31	0	0	0	0	0	0	0	16	0
Lane Group Flow (vph)	0	309	15	0	0	0	0	0	0	0	1434	0
Turn Type		NA	Perm							Perm	NA	
Protected Phases		2									4	
Permitted Phases			2							4		
Actuated Green, G (s)		20.2	20.2								38.7	
Effective Green, g (s)		20.2	20.2								38.7	
Actuated g/C Ratio		0.29	0.29								0.55	
Clearance Time (s)		5.3	5.3								5.8	
Lane Grp Cap (vph)		881	456								2802	
v/s Ratio Prot		c0.10										
v/s Ratio Perm			0.01								0.28	
v/c Ratio		0.35	0.03								0.51	
Uniform Delay, d1		19.7	17.9								9.8	
Progression Factor		1.00	1.00								1.00	
Incremental Delay, d2		1.1	0.1								0.7	
Delay (s)		20.8	18.0								10.4	
Level of Service		C	B								B	
Approach Delay (s)		20.4			0.0			0.0			10.4	
Approach LOS		C			A			A			B	

Intersection Summary			
HCM 2000 Control Delay	12.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.1
Intersection Capacity Utilization	85.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	SBT	SBR	NEL	NER
Lane Configurations						
Volume (vph)	0	302	1029	1366	929	395
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.1	10.1	10.1	9.0	
Lane Util. Factor		0.91	0.86	0.86	0.94	
Frt		1.00	0.94	0.85	0.96	
Flt Protected		1.00	1.00	1.00	0.97	
Satd. Flow (prot)		5085	4518	1362	4848	
Flt Permitted		1.00	1.00	1.00	0.97	
Satd. Flow (perm)		5085	4518	1362	4848	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	328	1118	1485	1010	429
RTOR Reduction (vph)	0	0	100	180	25	0
Lane Group Flow (vph)	0	328	1761	562	1414	0
Turn Type		NA	NA	Perm	Prot	
Protected Phases		2	6		4	
Permitted Phases				6		
Actuated Green, G (s)		58.9	54.9	54.9	46.0	
Effective Green, g (s)		58.9	54.9	54.9	46.0	
Actuated g/C Ratio		0.49	0.46	0.46	0.38	
Clearance Time (s)		6.1	10.1	10.1	9.0	
Lane Grp Cap (vph)		2495	2066	623	1858	
v/s Ratio Prot		0.06	0.39		c0.29	
v/s Ratio Perm				c0.41		
v/c Ratio		0.13	0.94dr	0.90	0.76	
Uniform Delay, d1		16.6	28.9	30.1	32.2	
Progression Factor		0.28	1.00	1.00	1.00	
Incremental Delay, d2		0.1	4.7	18.8	3.0	
Delay (s)		4.8	33.6	48.9	35.2	
Level of Service		A	C	D	D	
Approach Delay (s)		4.8	38.0		35.2	
Approach LOS		A	D		D	

Intersection Summary			
HCM 2000 Control Delay	34.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	19.1
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	4	0	55	25	16	26	26	128	0	0	133	13
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0		5.9	5.9			5.9	5.9
Lane Util. Factor	1.00		1.00	1.00	1.00		1.00	0.95			1.00	1.00
Frpb, ped/bikes	1.00		0.97	1.00	0.98		1.00	1.00			1.00	0.97
Flpb, ped/bikes	0.99		1.00	0.99	1.00		1.00	1.00			1.00	1.00
Frt	1.00		0.85	1.00	0.91		1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00	0.95	1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)	1714		1546	1781	1642		1780	3574			1863	1471
Flt Permitted	0.73		1.00	0.95	1.00		0.66	1.00			1.00	1.00
Satd. Flow (perm)	1313		1546	1781	1642		1245	3574			1863	1471
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	4	0	60	27	17	28	28	139	0	0	145	14
RTOR Reduction (vph)	0	0	35	0	16	0	0	0	0	0	0	9
Lane Group Flow (vph)	4	0	25	27	29	0	28	139	0	0	145	5
Confl. Peds. (#/hr)	11		11	11		11	4		2	2		4
Heavy Vehicles (%)	4%	0%	1%	0%	4%	2%	1%	1%	0%	0%	2%	7%
Turn Type	Perm		Perm	Perm	NA		Perm	NA			NA	Perm
Protected Phases					8			2			6	
Permitted Phases	4		4	8			2					6
Actuated Green, G (s)	25.0		25.0	25.0	25.0		23.1	23.1			23.1	23.1
Effective Green, g (s)	25.0		25.0	25.0	25.0		23.1	23.1			23.1	23.1
Actuated g/C Ratio	0.42		0.42	0.42	0.42		0.39	0.39			0.39	0.39
Clearance Time (s)	6.0		6.0	6.0	6.0		5.9	5.9			5.9	5.9
Lane Grp Cap (vph)	547		644	742	684		479	1375			717	566
v/s Ratio Prot					c0.02			0.04			c0.08	
v/s Ratio Perm	0.00		0.02	0.02			0.02					0.00
v/c Ratio	0.01		0.04	0.04	0.04		0.06	0.10			0.20	0.01
Uniform Delay, d1	10.2		10.4	10.4	10.4		11.6	11.8			12.3	11.4
Progression Factor	1.00		1.00	1.00	1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	0.0		0.1	0.1	0.1		0.2	0.1			0.6	0.0
Delay (s)	10.3		10.5	10.5	10.5		11.8	12.0			12.9	11.4
Level of Service	B		B	B	B		B	B			B	B
Approach Delay (s)		10.5			10.5			11.9			12.8	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	11.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.12		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	11.9
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	575	92	52	1535	134	29
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3		5.3	5.3	6.5	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frpb, ped/bikes	1.00		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		0.99	1.00	1.00	
Frt	0.98		1.00	1.00	0.98	
Flt Protected	1.00		0.95	1.00	0.96	
Satd. Flow (prot)	4957		1853	5085	1573	
Flt Permitted	1.00		0.36	1.00	0.96	
Satd. Flow (perm)	4957		699	5085	1573	
Peak-hour factor, PHF	0.90	0.90	0.95	0.95	0.73	0.73
Adj. Flow (vph)	639	102	55	1616	184	40
RTOR Reduction (vph)	25	0	0	0	10	0
Lane Group Flow (vph)	716	0	55	1616	214	0
Confl. Peds. (#/hr)		6	6		11	9
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Parking (#/hr)	10			10	10	
Turn Type	NA		Perm	NA	Prot	
Protected Phases	1			1	2	
Permitted Phases			1			
Actuated Green, G (s)	53.7		53.7	53.7	14.5	
Effective Green, g (s)	53.7		53.7	53.7	14.5	
Actuated g/C Ratio	0.67		0.67	0.67	0.18	
Clearance Time (s)	5.3		5.3	5.3	6.5	
Vehicle Extension (s)	0.2		0.2	0.2	3.0	
Lane Grp Cap (vph)	3327		469	3413	285	
v/s Ratio Prot	0.14			c0.32	c0.14	
v/s Ratio Perm			0.08			
v/c Ratio	0.22		0.12	0.47	0.75	
Uniform Delay, d1	5.1		4.7	6.3	31.0	
Progression Factor	0.80		1.00	1.00	1.00	
Incremental Delay, d2	0.1		0.5	0.5	10.6	
Delay (s)	4.2		5.2	6.8	41.7	
Level of Service	A		A	A	D	
Approach Delay (s)	4.2			6.8	41.7	
Approach LOS	A			A	D	

Intersection Summary			
HCM 2000 Control Delay	9.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	11.8
Intersection Capacity Utilization	51.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	28	601	55	19	1473	96	0	56	8	81	67	47
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	10	10	12	10	10	12	12	16	12	12	11	12
Total Lost time (s)	6.3	6.3		6.3	6.3			6.6		6.6	6.6	6.6
Lane Util. Factor	1.00	0.91		1.00	0.91			1.00		1.00	0.95	0.95
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.99			0.98		1.00	0.99	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00		0.95	1.00	1.00
Satd. Flow (prot)	1688	4553		1739	4697			2119		1879	1530	1567
Flt Permitted	0.12	1.00		0.36	1.00			1.00		0.70	1.00	1.00
Satd. Flow (perm)	215	4553		654	4697			2119		1394	1530	1567
Peak-hour factor, PHF	0.88	0.88	0.88	0.94	0.94	0.94	0.80	0.80	0.80	0.87	0.87	0.87
Adj. Flow (vph)	32	683	62	20	1567	102	0	70	10	93	77	54
RTOR Reduction (vph)	0	11	0	0	7	0	0	7	0	0	3	39
Lane Group Flow (vph)	32	734	0	20	1662	0	0	73	0	93	79	10
Confl. Peds. (#/hr)	6					6	11		2	2		11
Heavy Vehicles (%)	5%	5%	5%	2%	2%	2%	5%	5%	5%	1%	1%	1%
Parking (#/hr)		10			10						10	
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	Perm
Protected Phases		1			1			2			2	
Permitted Phases	1			1						2		2
Actuated Green, G (s)	56.3	56.3		56.3	56.3			10.8		10.8	10.8	10.8
Effective Green, g (s)	56.3	56.3		56.3	56.3			10.8		10.8	10.8	10.8
Actuated g/C Ratio	0.70	0.70		0.70	0.70			0.14		0.14	0.14	0.14
Clearance Time (s)	6.3	6.3		6.3	6.3			6.6		6.6	6.6	6.6
Vehicle Extension (s)	0.2	0.2		0.2	0.2			3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	151	3204		460	3305			286		188	206	211
v/s Ratio Prot		0.16			c0.35			0.03			0.05	
v/s Ratio Perm	0.15			0.03						c0.07		0.01
v/c Ratio	0.21	0.23		0.04	0.50			0.26		0.49	0.38	0.05
Uniform Delay, d1	4.1	4.2		3.6	5.4			31.0		32.1	31.6	30.1
Progression Factor	1.64	1.38		0.37	0.50			1.00		1.00	1.00	1.00
Incremental Delay, d2	3.1	0.2		0.2	0.5			0.5		2.0	1.2	0.1
Delay (s)	9.9	5.9		1.5	3.2			31.5		34.1	32.7	30.2
Level of Service	A	A		A	A			C		C	C	C
Approach Delay (s)		6.1			3.2			31.5			32.8	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	7.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.9
Intersection Capacity Utilization	55.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	735	11	8	1468	9	2
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Lane Width	10	12	10	10	12	12
Total Lost time (s)	5.0		5.0	5.0	6.5	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frpb, ped/bikes	1.00		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		0.99	1.00	1.00	
Frt	1.00		1.00	1.00	0.97	
Flt Protected	1.00		0.95	1.00	0.96	
Satd. Flow (prot)	4641		1704	4700	1873	
Flt Permitted	1.00		0.34	1.00	0.96	
Satd. Flow (perm)	4641		614	4700	1873	
Peak-hour factor, PHF	0.95	0.95	0.94	0.94	0.69	0.69
Adj. Flow (vph)	774	12	9	1562	13	3
RTOR Reduction (vph)	1	0	0	0	3	0
Lane Group Flow (vph)	785	0	9	1562	13	0
Confl. Peds. (#/hr)		10	10		7	
Heavy Vehicles (%)	4%	4%	3%	3%	0%	0%
Parking (#/hr)	10			10		
Turn Type	NA		Perm	NA	Prot	
Protected Phases	1			1	2	
Permitted Phases			1			
Actuated Green, G (s)	64.8		64.8	64.8	3.7	
Effective Green, g (s)	64.8		64.8	64.8	3.7	
Actuated g/C Ratio	0.81		0.81	0.81	0.05	
Clearance Time (s)	5.0		5.0	5.0	6.5	
Vehicle Extension (s)	0.2		0.2	0.2	3.0	
Lane Grp Cap (vph)	3759		497	3807	86	
v/s Ratio Prot	0.17			c0.33	c0.01	
v/s Ratio Perm			0.01			
v/c Ratio	0.21		0.02	0.41	0.15	
Uniform Delay, d1	1.7		1.5	2.2	36.6	
Progression Factor	0.88		0.32	0.23	1.00	
Incremental Delay, d2	0.1		0.1	0.3	0.8	
Delay (s)	1.7		0.5	0.8	37.5	
Level of Service	A		A	A	D	
Approach Delay (s)	1.7			0.8	37.5	
Approach LOS	A			A	D	

Intersection Summary			
HCM 2000 Control Delay	1.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	42.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	18	692	1470	38	84	85
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Lane Width	10	11	10	12	10	10
Total Lost time (s)	6.4	6.4	6.4		6.3	6.3
Lane Util. Factor	1.00	0.91	0.91		0.97	0.91
Frpb, ped/bikes	1.00	1.00	1.00		1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		0.96	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00
Satd. Flow (prot)	1703	4821	4725		3089	1426
Flt Permitted	0.14	1.00	1.00		0.96	1.00
Satd. Flow (perm)	248	4821	4725		3089	1426
Peak-hour factor, PHF	0.94	0.94	0.95	0.95	0.83	0.83
Adj. Flow (vph)	19	736	1547	40	101	102
RTOR Reduction (vph)	0	0	3	0	34	48
Lane Group Flow (vph)	19	736	1584	0	105	16
Confl. Peds. (#/hr)	7			7	7	1
Heavy Vehicles (%)	4%	4%	2%	2%	0%	0%
Parking (#/hr)		10	10		10	
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		1	1		2	
Permitted Phases	1					2
Actuated Green, G (s)	58.7	58.7	58.7		8.6	8.6
Effective Green, g (s)	58.7	58.7	58.7		8.6	8.6
Actuated g/C Ratio	0.73	0.73	0.73		0.11	0.11
Clearance Time (s)	6.4	6.4	6.4		6.3	6.3
Vehicle Extension (s)	0.2	0.2	0.2		3.0	3.0
Lane Grp Cap (vph)	181	3537	3466		332	153
v/s Ratio Prot		0.15	c0.34		c0.03	
v/s Ratio Perm	0.08					0.01
v/c Ratio	0.10	0.21	0.46		0.32	0.10
Uniform Delay, d1	3.1	3.3	4.3		33.0	32.2
Progression Factor	1.00	1.00	0.19		1.00	1.00
Incremental Delay, d2	1.2	0.1	0.4		0.6	0.3
Delay (s)	4.2	3.5	1.2		33.5	32.5
Level of Service	A	A	A		C	C
Approach Delay (s)		3.5	1.2		33.2	
Approach LOS		A	A		C	

Intersection Summary			
HCM 2000 Control Delay	4.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.7
Intersection Capacity Utilization	44.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	13	662	360	117	1522	76	28	16	6	31	125	37
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	10	10	12	10	10	12	12	14	12	12	16	12
Total Lost time (s)	5.8	5.8		5.8	5.8			6.4			6.4	
Lane Util. Factor	1.00	0.91		1.00	0.91			1.00			1.00	
Frpb, ped/bikes	1.00	0.99		1.00	1.00			1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.95		1.00	0.99			0.98			0.97	
Flt Protected	0.95	1.00		0.95	1.00			0.97			0.99	
Satd. Flow (prot)	1720	4628		1738	4707			1994			1855	
Flt Permitted	0.12	1.00		0.19	1.00			0.63			0.93	
Satd. Flow (perm)	220	4628		339	4707			1297			1736	
Peak-hour factor, PHF	0.95	0.95	0.95	0.88	0.88	0.88	0.64	0.64	0.64	0.84	0.84	0.84
Adj. Flow (vph)	14	697	379	133	1730	86	44	25	9	37	149	44
RTOR Reduction (vph)	0	119	0	0	6	0	0	7	0	0	13	0
Lane Group Flow (vph)	14	957	0	133	1810	0	0	71	0	0	217	0
Confl. Peds. (#/hr)	6		8	8		6	2		14	14		2
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	2%	2%	2%	0%	0%	0%
Parking (#/hr)					10						10	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		6		5	2			4			8	
Permitted Phases	6			2			4			8		
Actuated Green, G (s)	32.9	32.9		44.1	44.1			13.7			13.7	
Effective Green, g (s)	32.9	32.9		44.1	44.1			13.7			13.7	
Actuated g/C Ratio	0.47	0.47		0.63	0.63			0.20			0.20	
Clearance Time (s)	5.8	5.8		5.8	5.8			6.4			6.4	
Vehicle Extension (s)	0.2	0.2		2.0	0.2			3.0			3.0	
Lane Grp Cap (vph)	103	2175		321	2965			253			339	
v/s Ratio Prot		0.21		0.03	c0.38							
v/s Ratio Perm	0.06			0.23				0.05			c0.13	
v/c Ratio	0.14	0.44		0.41	0.61			0.28			0.64	
Uniform Delay, d1	10.5	12.4		6.3	7.8			24.0			25.9	
Progression Factor	0.60	0.49		1.00	1.00			1.00			1.00	
Incremental Delay, d2	2.7	0.6		0.3	0.9			0.6			4.1	
Delay (s)	8.9	6.7		6.6	8.7			24.6			30.0	
Level of Service	A	A		A	A			C			C	
Approach Delay (s)		6.7			8.6			24.6			30.0	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	9.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	64.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	1593	220	0	0	0	0	90	65
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	12	12	12	12	12	12
Total Lost time (s)					3.0						3.0	
Lane Util. Factor					0.81						0.95	
Frt					0.98						0.95	
Flt Protected					1.00						1.00	
Satd. Flow (prot)					6239						2936	
Flt Permitted					1.00						1.00	
Satd. Flow (perm)					6239						2936	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.92	0.79	0.90	0.90	0.90	0.85	0.60	0.94
Adj. Flow (vph)	0	0	0	0	1732	278	0	0	0	0	150	69
RTOR Reduction (vph)	0	0	0	0	36	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	1974	0	0	0	0	0	219	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	18%	3%	3%	3%	3%	7%	2%
Turn Type					NA						NA	
Protected Phases					6						4	
Permitted Phases					6							
Actuated Green, G (s)					45.0						19.0	
Effective Green, g (s)					48.0						26.0	
Actuated g/C Ratio					0.60						0.32	
Clearance Time (s)					6.0						10.0	
Lane Grp Cap (vph)					3743						954	
v/s Ratio Prot					c0.32						c0.07	
v/s Ratio Perm												
v/c Ratio					0.53						0.23	
Uniform Delay, d1					9.4						19.7	
Progression Factor					0.10						1.00	
Incremental Delay, d2					0.5						0.6	
Delay (s)					1.4						20.3	
Level of Service					A						C	
Approach Delay (s)		0.0			1.4			0.0			20.3	
Approach LOS		A			A			A			C	

Intersection Summary			
HCM 2000 Control Delay	3.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	44.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	SEL	SER	SER2
Lane Configurations											
Volume (vph)	0	0	0	0	1688	0	0	0	0	185	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	12	12	12	11	11
Total Lost time (s)					3.0					3.0	3.0
Lane Util. Factor					0.86					0.64	1.00
Frt					1.00					0.85	0.85
Flt Protected					1.00					1.00	1.00
Satd. Flow (prot)					5521					2680	1364
Flt Permitted					1.00					1.00	1.00
Satd. Flow (perm)					5521					2680	1364
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.96	0.90	0.90	0.90	0.90	0.94	0.94
Adj. Flow (vph)	0	0	0	0	1758	0	0	0	0	197	133
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	183	55
Lane Group Flow (vph)	0	0	0	0	1758	0	0	0	0	71	21
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	0%	3%
Turn Type					NA					Prot	Prot
Protected Phases					9					4	4
Permitted Phases					9						
Actuated Green, G (s)					49.0					15.0	15.0
Effective Green, g (s)					52.0					22.0	22.0
Actuated g/C Ratio					0.65					0.28	0.28
Clearance Time (s)					6.0					10.0	10.0
Lane Grp Cap (vph)					3588					737	375
v/s Ratio Prot					c0.32					c0.03	0.02
v/s Ratio Perm											
v/c Ratio					0.49					0.10	0.06
Uniform Delay, d1					7.2					21.6	21.4
Progression Factor					0.03					1.00	1.00
Incremental Delay, d2					0.4					0.3	0.3
Delay (s)					0.6					21.9	21.6
Level of Service					A					C	C
Approach Delay (s)		0.0			0.6		0.0		21.8		
Approach LOS		A			A		A		C		

Intersection Summary			
HCM 2000 Control Delay	3.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	27.5
Intersection Capacity Utilization	61.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	1960	315	0	154	0	0	61	248
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	12	11	12	12	11	11
Total Lost time (s)					3.0			3.0			3.0	3.0
Lane Util. Factor					0.81			0.91			0.91	0.91
Frt					0.98			1.00			0.90	0.85
Flt Protected					1.00			1.00			1.00	1.00
Satd. Flow (prot)					6365			4381			2653	1254
Flt Permitted					1.00			1.00			1.00	1.00
Satd. Flow (perm)					6365			4381			2653	1254
Peak-hour factor, PHF	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.88	0.90	0.90	0.73	0.73
Adj. Flow (vph)	0	0	0	0	2130	342	0	175	0	0	84	340
RTOR Reduction (vph)	0	0	0	0	36	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	2436	0	0	175	0	0	254	170
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	2%	2%
Turn Type					NA			NA			NA	Prot
Protected Phases					6			8			4	4
Permitted Phases												
Actuated Green, G (s)					46.0			22.0			18.0	18.0
Effective Green, g (s)					49.0			25.0			25.0	25.0
Actuated g/C Ratio					0.61			0.31			0.31	0.31
Clearance Time (s)					6.0			6.0			10.0	10.0
Lane Grp Cap (vph)					3898			1369			829	391
v/s Ratio Prot					c0.38			0.04			0.10	c0.14
v/s Ratio Perm												
v/c Ratio					0.62			0.13			0.31	0.43
Uniform Delay, d1					9.7			19.7			20.9	21.9
Progression Factor					0.44			0.14			1.00	1.00
Incremental Delay, d2					0.5			0.2			1.0	3.5
Delay (s)					4.8			2.9			21.9	25.4
Level of Service					A			A			C	C
Approach Delay (s)		0.0			4.8			2.9			23.3	
Approach LOS		A			A			A			C	

Intersection Summary			
HCM 2000 Control Delay	7.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	48.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	2235	350	0	0	0	0	0	40
Ideal Flow (vphpl)	1900	1900	2000	2000	1900	1900	2000	2000	2000	1900	2000	1900
Lane Width	12	12	12	12	11	12	12	12	12	12	12	11
Total Lost time (s)					3.0							3.0
Lane Util. Factor					0.81							0.88
Frt					0.98							0.85
Flt Protected					1.00							1.00
Satd. Flow (prot)					6430							2473
Flt Permitted					1.00							1.00
Satd. Flow (perm)					6430							2473
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.89	0.89	0.90	0.90	0.90	0.90	0.90	0.82
Adj. Flow (vph)	0	0	0	0	2511	393	0	0	0	0	0	49
RTOR Reduction (vph)	0	0	0	0	35	0	0	0	0	0	0	23
Lane Group Flow (vph)	0	0	0	0	2869	0	0	0	0	0	0	26
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%	3%	3%	3%	3%	3%	0%
Turn Type					NA							Prot
Protected Phases					6							4
Permitted Phases												
Actuated Green, G (s)					46.5							22.0
Effective Green, g (s)					49.0							25.0
Actuated g/C Ratio					0.61							0.31
Clearance Time (s)					5.5							6.0
Lane Grp Cap (vph)					3938							772
v/s Ratio Prot					c0.45							c0.01
v/s Ratio Perm												
v/c Ratio					0.73							0.03
Uniform Delay, d1					10.8							19.1
Progression Factor					0.55							1.00
Incremental Delay, d2					0.8							0.1
Delay (s)					6.8							19.2
Level of Service					A							B
Approach Delay (s)		0.0			6.8			0.0			19.2	
Approach LOS		A			A			A			B	

Intersection Summary			
HCM 2000 Control Delay	7.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	49.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	351	2205	91	24	93	0	0	447	57
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	13	13	12	12	11	12
Total Lost time (s)					3.0		3.0	3.0			3.0	
Lane Util. Factor					0.86		0.91	0.91			0.91	
Frt					0.99		1.00	1.00			0.98	
Flt Protected					0.99		0.95	1.00			1.00	
Satd. Flow (prot)					5510		1441	3034			3697	
Flt Permitted					0.99		0.35	1.00			1.00	
Satd. Flow (perm)					5510		528	3034			3697	
Peak-hour factor, PHF	0.90	0.90	0.90	0.91	0.91	0.91	0.86	0.86	0.86	0.88	0.88	0.88
Adj. Flow (vph)	0	0	0	386	2423	100	28	108	0	0	508	65
RTOR Reduction (vph)	0	0	0	0	6	0	0	0	0	0	4	0
Lane Group Flow (vph)	0	0	0	0	2903	0	28	108	0	0	570	0
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	6%	6%	6%	14%	14%	14%
Parking (#/hr)											10	10
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					6			8			4	
Permitted Phases				6	6		8					
Actuated Green, G (s)					47.0		21.1	21.1			17.1	
Effective Green, g (s)					50.0		24.0	24.0			24.0	
Actuated g/C Ratio					0.62		0.30	0.30			0.30	
Clearance Time (s)					6.0		5.9	5.9			9.9	
Lane Grp Cap (vph)					3443		158	910			1109	
v/s Ratio Prot											c0.15	
v/s Ratio Perm					0.53		0.05	0.04				
v/c Ratio					0.84		0.18	0.12			0.51	
Uniform Delay, d1					11.9		20.7	20.3			23.2	
Progression Factor					1.00		0.19	0.95			1.00	
Incremental Delay, d2					2.7		2.4	0.3			1.7	
Delay (s)					14.6		6.5	19.6			24.9	
Level of Service					B		A	B			C	
Approach Delay (s)		0.0			14.6			16.9			24.9	
Approach LOS		A			B			B			C	

Intersection Summary			
HCM 2000 Control Delay	16.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	102.1%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBR2	NBL2	NBT	NBR	NET	SWL	SWT	SWR2
Lane Configurations									
Volume (vph)	90	14	52	50	88	138	4	1195	62
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0	6.0	6.0		6.0		6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	1.00		0.95		0.95	1.00
Frpb, ped/bikes	1.00	0.88	1.00	0.97		1.00		1.00	0.94
Flpb, ped/bikes	1.00	1.00	0.96	1.00		1.00		1.00	1.00
Frt	1.00	0.85	1.00	0.90		1.00		1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00		1.00		1.00	1.00
Satd. Flow (prot)	3252	1323	1616	1312		3101		3101	1416
Flt Permitted	0.95	1.00	0.95	1.00		1.00		0.95	1.00
Satd. Flow (perm)	3252	1323	1616	1312		3101		2960	1416
Peak-hour factor, PHF	0.87	0.87	0.79	0.79	0.79	0.74	0.89	0.89	0.89
Adj. Flow (vph)	103	16	66	63	111	186	4	1343	70
RTOR Reduction (vph)	0	15	0	71	0	0	0	0	40
Lane Group Flow (vph)	103	1	66	103	0	186	0	1347	30
Confl. Peds. (#/hr)		32	32		36				13
Parking (#/hr)				10		10		10	
Turn Type	Prot	Perm	Perm	NA		NA	Perm	NA	Perm
Protected Phases	4			3		2		2	
Permitted Phases		4	3				2		2
Actuated Green, G (s)	8.0	8.0	25.0	25.0		39.0		39.0	39.0
Effective Green, g (s)	8.0	8.0	25.0	25.0		39.0		39.0	39.0
Actuated g/C Ratio	0.09	0.09	0.28	0.28		0.43		0.43	0.43
Clearance Time (s)	6.0	6.0	6.0	6.0		6.0		6.0	6.0
Lane Grp Cap (vph)	289	117	448	364		1343		1282	613
v/s Ratio Prot	c0.03			c0.08		0.06			
v/s Ratio Perm		0.00	0.04					c0.46	0.02
v/c Ratio	0.36	0.01	0.15	0.28		0.14		1.05	0.05
Uniform Delay, d1	38.6	37.4	24.5	25.5		15.4		25.5	14.8
Progression Factor	1.00	1.00	1.00	1.00		1.00		0.77	0.79
Incremental Delay, d2	3.4	0.2	0.7	1.9		0.2		37.1	0.1
Delay (s)	42.0	37.6	25.2	27.4		15.6		56.6	11.8
Level of Service	D	D	C	C		B		E	B
Approach Delay (s)	41.4			26.8		15.6		54.4	
Approach LOS	D			C		B		D	

Intersection Summary			
HCM 2000 Control Delay	46.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	78.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	2	4	1	52	2	86	66	249	2	11	1403	210
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)		6.0			6.0		5.8	5.8		5.8	5.8	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00			0.99		1.00	1.00		1.00	0.99	
Flpb, ped/bikes		1.00			1.00		1.00	1.00		0.99	1.00	
Frt		0.98			0.92		1.00	1.00		1.00	0.98	
Flt Protected		0.99			0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1450			1327		1676	3097		1656	3016	
Flt Permitted		0.93			0.87		0.08	1.00		0.58	1.00	
Satd. Flow (perm)		1365			1182		147	3097		1006	3016	
Peak-hour factor, PHF	0.88	0.88	0.88	0.64	0.64	0.64	0.88	0.88	0.88	0.94	0.94	0.94
Adj. Flow (vph)	2	5	1	81	3	134	75	283	2	12	1493	223
RTOR Reduction (vph)	0	1	0	0	0	0	0	1	0	0	13	0
Lane Group Flow (vph)	0	7	0	0	218	0	75	284	0	12	1703	0
Confl. Peds. (#/hr)	13		7	7		13	15		6	6		15
Parking (#/hr)		10			10			10			10	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		18.0			18.0		60.2	60.2		60.2	60.2	
Effective Green, g (s)		18.0			18.0		60.2	60.2		60.2	60.2	
Actuated g/C Ratio		0.20			0.20		0.67	0.67		0.67	0.67	
Clearance Time (s)		6.0			6.0		5.8	5.8		5.8	5.8	
Lane Grp Cap (vph)		273			236		98	2071		672	2017	
v/s Ratio Prot								0.09			c0.56	
v/s Ratio Perm		0.01			c0.18		0.51			0.01		
v/c Ratio		0.03			0.92		0.77	0.14		0.02	0.84	
Uniform Delay, d1		29.0			35.3		10.1	5.4		5.0	11.3	
Progression Factor		1.00			1.00		1.31	0.73		1.00	1.00	
Incremental Delay, d2		0.2			41.7		42.2	0.1		0.0	4.5	
Delay (s)		29.1			77.0		55.4	4.1		5.0	15.9	
Level of Service		C			E		E	A		A	B	
Approach Delay (s)		29.1			77.0			14.8			15.8	
Approach LOS		C			E			B			B	

Intersection Summary			
HCM 2000 Control Delay	21.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	11.8
Intersection Capacity Utilization	91.1%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Volume (vph)	249	40	153	1209	153	122
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0		6.0	6.0	6.0	6.0
Lane Util. Factor	0.95		1.00	0.95	1.00	1.00
Frpb, ped/bikes	1.00		1.00	1.00	1.00	0.95
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3275		1670	3101	1676	1216
Flt Permitted	1.00		0.54	1.00	0.95	1.00
Satd. Flow (perm)	3275		950	3101	1676	1216
Peak-hour factor, PHF	0.82	0.82	0.91	0.91	0.86	0.86
Adj. Flow (vph)	304	49	168	1329	178	142
RTOR Reduction (vph)	14	0	0	0	0	115
Lane Group Flow (vph)	339	0	168	1329	178	27
Confl. Peds. (#/hr)		2	2			31
Parking (#/hr)				10		10
Turn Type	NA		Perm	NA	Prot	Perm
Protected Phases	2			2	4	
Permitted Phases			2			4
Actuated Green, G (s)	61.0		61.0	61.0	17.0	17.0
Effective Green, g (s)	61.0		61.0	61.0	17.0	17.0
Actuated g/C Ratio	0.68		0.68	0.68	0.19	0.19
Clearance Time (s)	6.0		6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	2219		643	2101	316	229
v/s Ratio Prot	0.10			c0.43	c0.11	
v/s Ratio Perm			0.18			0.02
v/c Ratio	0.15		0.26	0.63	0.56	0.12
Uniform Delay, d1	5.2		5.7	8.2	33.1	30.3
Progression Factor	0.57		0.26	0.23	1.00	1.00
Incremental Delay, d2	0.1		0.5	0.8	7.1	1.0
Delay (s)	3.1		2.0	2.6	40.2	31.3
Level of Service	A		A	A	D	C
Approach Delay (s)	3.1			2.5	36.3	
Approach LOS	A			A	D	

Intersection Summary			
HCM 2000 Control Delay	7.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL2	WBT	SBL	SBT	SBR2	NER	NER2
Lane Configurations							
Volume (vph)	29	266	137	564	679	199	30
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000
Lane Width	11	11	11	11	11	12	12
Total Lost time (s)	5.7	5.7	5.7	5.7	5.7	9.2	
Lane Util. Factor	1.00	0.91	1.00	0.95	1.00	0.76	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	0.98	1.00	
Flpb, ped/bikes	0.99	1.00	0.99	1.00	1.00	1.00	
Frt	1.00	1.00	1.00	1.00	0.85	0.85	
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00	
Satd. Flow (prot)	1591	4600	1611	3241	1414	3033	
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00	
Satd. Flow (perm)	1591	4600	1611	3241	1414	3033	
Peak-hour factor, PHF	0.92	0.92	0.95	0.95	0.95	0.92	0.92
Adj. Flow (vph)	32	289	144	594	715	216	33
RTOR Reduction (vph)	0	0	0	0	305	0	0
Lane Group Flow (vph)	32	289	144	594	410	249	0
Confl. Peds. (#/hr)	7		5		4		
Heavy Vehicles (%)	3%	3%	2%	2%	2%	15%	15%
Bus Blockages (#/hr)	0	2	0	0	2	0	0
Turn Type	Perm	NA	Perm	NA	Perm	Perm	
Protected Phases		1		4			
Permitted Phases	1		4		4	3	
Actuated Green, G (s)	32.3	32.3	26.3	26.3	26.3	28.8	
Effective Green, g (s)	32.3	32.3	26.3	26.3	26.3	28.8	
Actuated g/C Ratio	0.46	0.46	0.38	0.38	0.38	0.41	
Clearance Time (s)	5.7	5.7	5.7	5.7	5.7	9.2	
Lane Grp Cap (vph)	734	2122	605	1217	531	1247	
v/s Ratio Prot		c0.06		0.18			
v/s Ratio Perm	0.02		0.09		c0.29	c0.08	
v/c Ratio	0.04	0.14	0.24	0.49	0.77	0.20	
Uniform Delay, d1	10.4	10.8	15.0	16.7	19.2	13.2	
Progression Factor	0.50	0.53	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.1	0.9	1.4	10.5	0.4	
Delay (s)	5.3	5.8	15.9	18.1	29.7	13.6	
Level of Service	A	A	B	B	C	B	
Approach Delay (s)		5.8		23.6			
Approach LOS		A		C			

Intersection Summary			
HCM 2000 Control Delay	19.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	17.1
Intersection Capacity Utilization	62.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	146	396	0	0	256	295	48	523	3	0	0	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	11	11	12	12	11	12	12	12	12	12	12	12
Total Lost time (s)	5.7	5.7			5.7			5.7				
Lane Util. Factor	1.00	0.91			0.91			0.91				
Frpb, ped/bikes	1.00	1.00			1.00			1.00				
Flpb, ped/bikes	1.00	1.00			1.00			1.00				
Frt	1.00	1.00			0.92			1.00				
Flt Protected	0.95	1.00			1.00			1.00				
Satd. Flow (prot)	1529	4398			4283			4744				
Flt Permitted	0.39	1.00			1.00			1.00				
Satd. Flow (perm)	620	4398			4283			4744				
Peak-hour factor, PHF	0.85	0.85	0.85	0.91	0.91	0.91	0.95	0.95	0.95	0.92	0.92	0.92
Adj. Flow (vph)	172	466	0	0	281	324	51	551	3	0	0	0
RTOR Reduction (vph)	0	0	0	0	148	0	0	1	0	0	0	0
Lane Group Flow (vph)	172	466	0	0	457	0	0	604	0	0	0	0
Confl. Peds. (#/hr)	5						5		4			
Heavy Vehicles (%)	8%	8%	8%	2%	2%	2%	3%	3%	3%	2%	2%	2%
Turn Type	pm+pt	NA			NA		Perm	NA				
Protected Phases	5	1			2			4				
Permitted Phases	1						4					
Actuated Green, G (s)	32.3	32.3			18.3			26.3				
Effective Green, g (s)	32.3	32.3			18.3			26.3				
Actuated g/C Ratio	0.46	0.46			0.26			0.38				
Clearance Time (s)	5.7	5.7			5.7			5.7				
Lane Grp Cap (vph)	393	2029			1119			1782				
v/s Ratio Prot	c0.05	0.11			0.11							
v/s Ratio Perm	c0.15							0.13				
v/c Ratio	0.44	0.23			0.41			0.34				
Uniform Delay, d1	14.9	11.4			21.4			15.6				
Progression Factor	0.91	0.89			1.00			0.94				
Incremental Delay, d2	3.5	0.3			1.1			0.5				
Delay (s)	17.1	10.3			22.5			15.2				
Level of Service	B	B			C			B				
Approach Delay (s)		12.1			22.5			15.2			0.0	
Approach LOS		B			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	16.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	17.1
Intersection Capacity Utilization	49.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	1668	265	20	195	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	11	12	12	12	12	12	12
Total Lost time (s)					3.0			3.0				
Lane Util. Factor					0.86			0.91				
Frt					0.98			1.00				
Flt Protected					1.00			1.00				
Satd. Flow (prot)					5407			4647				
Flt Permitted					1.00			1.00				
Satd. Flow (perm)					5407			4647				
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.95	0.95	0.86	0.86	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	0	1756	279	23	227	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	181	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	2035	0	0	69	0	0	0	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	0%	0%	3%	3%	3%	3%
Turn Type					NA		Perm	NA				
Protected Phases					6			8				
Permitted Phases					6		8					
Actuated Green, G (s)					46.0			19.0				
Effective Green, g (s)					52.0			22.0				
Actuated g/C Ratio					0.65			0.28				
Clearance Time (s)					9.0			6.0				
Lane Grp Cap (vph)					3514			1277				
v/s Ratio Prot					c0.38							
v/s Ratio Perm								0.01				
v/c Ratio					0.58			0.05				
Uniform Delay, d1					7.9			21.3				
Progression Factor					1.38			4.01				
Incremental Delay, d2					0.6			0.1				
Delay (s)					11.5			85.7				
Level of Service					B			F				
Approach Delay (s)		0.0			11.5			85.7			0.0	
Approach LOS		A			B			F			A	

Intersection Summary			
HCM 2000 Control Delay	19.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	31.5
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1639	0	0	90	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0	
Lane Util. Factor		0.86			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5711			2945	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5711			2945	
Peak-hour factor, PHF	0.90	0.92	0.92	0.92	0.60	0.92
Adj. Flow (vph)	0	1782	0	0	150	0
RTOR Reduction (vph)	0	0	0	0	25	0
Lane Group Flow (vph)	0	1782	0	0	125	0
Heavy Vehicles (%)	3%	3%	3%	3%	7%	3%
Turn Type		NA			Prot	
Protected Phases		2			8	
Permitted Phases		2				
Actuated Green, G (s)		33.5			23.0	
Effective Green, g (s)		48.0			26.0	
Actuated g/C Ratio		0.60			0.32	
Clearance Time (s)		17.5			6.0	
Lane Grp Cap (vph)		3426			957	
v/s Ratio Prot		c0.31			c0.04	
v/s Ratio Perm						
v/c Ratio		0.52			0.13	
Uniform Delay, d1		9.3			19.0	
Progression Factor		1.00			0.01	
Incremental Delay, d2		0.6			0.3	
Delay (s)		9.9			0.4	
Level of Service		A			A	
Approach Delay (s)		9.9	0.0		0.4	
Approach LOS		A	A		A	

Intersection Summary			
HCM 2000 Control Delay	9.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	44.7%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1729	0	0	185	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0	
Lane Util. Factor		0.86			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5711			3152	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5711			3152	
Peak-hour factor, PHF	0.90	0.95	0.90	0.90	0.94	0.90
Adj. Flow (vph)	0	1820	0	0	197	0
RTOR Reduction (vph)	0	0	0	0	34	0
Lane Group Flow (vph)	0	1820	0	0	163	0
Heavy Vehicles (%)	3%	3%	3%	3%	0%	3%
Turn Type		NA			Prot	
Protected Phases		2			8	
Permitted Phases						
Actuated Green, G (s)		33.5			19.0	
Effective Green, g (s)		52.0			22.0	
Actuated g/C Ratio		0.65			0.28	
Clearance Time (s)		21.5			6.0	
Lane Grp Cap (vph)		3712			866	
v/s Ratio Prot		c0.32			c0.05	
v/s Ratio Perm						
v/c Ratio		0.49			0.19	
Uniform Delay, d1		7.2			22.2	
Progression Factor		0.41			0.79	
Incremental Delay, d2		0.4			0.5	
Delay (s)		3.4			18.1	
Level of Service		A			B	
Approach Delay (s)		3.4	0.0		18.1	
Approach LOS		A	A		B	

Intersection Summary			
HCM 2000 Control Delay	4.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	46.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1604	105	0	0	0	0	151	404	51	14	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	11	11	12	12	12	12	12	12	12	12	12
Total Lost time (s)		3.0	3.0					3.0	3.0		3.0	
Lane Util. Factor		0.86	0.88					0.91	0.91		0.95	
Frt		1.00	0.85					0.92	0.85		1.00	
Flt Protected		1.00	1.00					1.00	1.00		0.96	
Satd. Flow (prot)		5468	2378					2767	1284		3065	
Flt Permitted		1.00	1.00					1.00	1.00		0.65	
Satd. Flow (perm)		5468	2378					2767	1284		2084	
Peak-hour factor, PHF	0.87	0.95	0.95	0.90	0.90	0.90	0.88	0.88	0.88	0.73	0.73	0.73
Adj. Flow (vph)	0	1688	111	0	0	0	0	172	459	70	19	0
RTOR Reduction (vph)	0	0	43	0	0	0	0	18	28	0	0	0
Lane Group Flow (vph)	0	1688	68	0	0	0	0	374	211	0	89	0
Heavy Vehicles (%)	4%	4%	4%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Turn Type		NA	Prot					NA	Prot	Perm	NA	
Protected Phases		2	2					4	4		8	
Permitted Phases										8		
Actuated Green, G (s)		46.0	46.0					18.0	18.0		22.0	
Effective Green, g (s)		49.0	49.0					25.0	25.0		25.0	
Actuated g/C Ratio		0.61	0.61					0.31	0.31		0.31	
Clearance Time (s)		6.0	6.0					10.0	10.0		6.0	
Lane Grp Cap (vph)		3349	1456					864	401		651	
v/s Ratio Prot		c0.31	0.03					0.14	c0.16			
v/s Ratio Perm											0.04	
v/c Ratio		0.50	0.05					0.43	0.53		0.14	
Uniform Delay, d1		8.7	6.2					21.9	22.6		19.8	
Progression Factor		1.01	1.06					1.00	1.00		0.12	
Incremental Delay, d2		0.5	0.1					1.6	4.9		0.4	
Delay (s)		9.3	6.6					23.4	27.5		2.7	
Level of Service		A	A					C	C		A	
Approach Delay (s)		9.1			0.0			25.0			2.7	
Approach LOS		A			A			C			A	

Intersection Summary			
HCM 2000 Control Delay	12.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	66.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑↑↑↑				
Volume (vph)	0	2059	0	0	0	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)		3.0				
Lane Util. Factor		0.81				
Frt		1.00				
Flt Protected		1.00				
Satd. Flow (prot)		7788				
Flt Permitted		1.00				
Satd. Flow (perm)		7788				
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	2288	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	2288	0	0	0	0
Heavy Vehicles (%)	3%	4%	3%	3%	3%	3%
Turn Type		NA				
Protected Phases		2				
Permitted Phases						
Actuated Green, G (s)		46.5				
Effective Green, g (s)		49.0				
Actuated g/C Ratio		0.61				
Clearance Time (s)		5.5				
Lane Grp Cap (vph)		4770				
v/s Ratio Prot		c0.29				
v/s Ratio Perm						
v/c Ratio		0.48				
Uniform Delay, d1		8.5				
Progression Factor		0.50				
Incremental Delay, d2		0.3				
Delay (s)		4.6				
Level of Service		A				
Approach Delay (s)		4.6	0.0		0.0	
Approach LOS		A	A		A	

Intersection Summary			
HCM 2000 Control Delay	4.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	49.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	59	1213	499	0	0	0	0	58	20	57	741	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	11	11	12	12	12	12	11	11	13	13	12
Total Lost time (s)		3.0						3.0	3.0	3.0	3.0	
Lane Util. Factor		0.86						0.91	0.88	1.00	0.95	
Frt		0.96						1.00	0.85	1.00	1.00	
Flt Protected		1.00						1.00	1.00	0.95	1.00	
Satd. Flow (prot)		5279						4257	2333	1472	2945	
Flt Permitted		1.00						1.00	1.00	0.71	1.00	
Satd. Flow (perm)		5279						4257	2333	1099	2945	
Peak-hour factor, PHF	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.86	0.86	0.88	0.88	0.90
Adj. Flow (vph)	64	1318	542	0	0	0	0	67	23	65	842	0
RTOR Reduction (vph)	0	9	0	0	0	0	0	0	16	0	0	0
Lane Group Flow (vph)	0	1915	0	0	0	0	0	67	7	65	842	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	6%	6%	14%	14%	14%
Turn Type	Perm	NA						NA	Prot	Perm	NA	
Protected Phases		2						4	4		8	
Permitted Phases	2									8		
Actuated Green, G (s)		47.0						17.1	17.1	21.1	21.1	
Effective Green, g (s)		50.0						24.0	24.0	24.0	24.0	
Actuated g/C Ratio		0.62						0.30	0.30	0.30	0.30	
Clearance Time (s)		6.0						9.9	9.9	5.9	5.9	
Lane Grp Cap (vph)		3299						1277	699	329	883	
v/s Ratio Prot								0.02	0.00		c0.29	
v/s Ratio Perm		0.36								0.06		
v/c Ratio		0.58						0.05	0.01	0.20	0.95	
Uniform Delay, d1		8.8						19.9	19.7	20.8	27.5	
Progression Factor		0.11						1.00	1.00	0.10	0.76	
Incremental Delay, d2		0.7						0.1	0.0	1.2	17.3	
Delay (s)		1.6						20.0	19.7	3.3	38.1	
Level of Service		A						B	B	A	D	
Approach Delay (s)		1.6			0.0			19.9			35.6	
Approach LOS		A			A			B			D	

Intersection Summary			
HCM 2000 Control Delay	12.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	102.1%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	200	0	0	0	0	302	0	0	1424	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)		6.0						10.1			6.1	
Lane Util. Factor		1.00						0.91			0.95	
Frt		0.85						1.00			1.00	
Flt Protected		1.00						1.00			1.00	
Satd. Flow (prot)		1667						5353			3725	
Flt Permitted		1.00						1.00			1.00	
Satd. Flow (perm)		1667						5353			3725	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	217	0	0	0	0	328	0	0	1548	0
RTOR Reduction (vph)	0	38	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	179	0	0	0	0	0	328	0	0	1548	0
Turn Type	Perm	NA		D.Pm		Prot		NA			NA	
Protected Phases		8				8		2			6	
Permitted Phases	8			8		8						
Actuated Green, G (s)		49.0						54.9			58.9	
Effective Green, g (s)		49.0						54.9			58.9	
Actuated g/C Ratio		0.41						0.46			0.49	
Clearance Time (s)		6.0						10.1			6.1	
Lane Grp Cap (vph)		680						2448			1828	
v/s Ratio Prot		c0.11						0.06			c0.42	
v/s Ratio Perm												
v/c Ratio		0.26						0.13			0.85	
Uniform Delay, d1		23.5						18.8			26.6	
Progression Factor		1.00						1.00			0.59	
Incremental Delay, d2		0.9						0.1			2.8	
Delay (s)		24.5						18.9			18.4	
Level of Service		C						B			B	
Approach Delay (s)		24.5			0.0			18.9			18.4	
Approach LOS		C			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	19.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.1
Intersection Capacity Utilization	59.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	17	31	34	2	1	2	18	301	0	0	863	77
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			0.95			0.95	
Frt		0.94			0.95			1.00			0.99	
Flt Protected		0.99			0.98			1.00			1.00	
Satd. Flow (prot)		1832			1819			3715			3680	
Flt Permitted		0.96			0.95			0.88			1.00	
Satd. Flow (perm)		1773			1761			3284			3680	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	34	37	2	1	2	20	327	0	0	938	84
RTOR Reduction (vph)	0	26	0	0	1	0	0	0	0	0	7	0
Lane Group Flow (vph)	0	63	0	0	4	0	0	347	0	0	1015	0
Turn Type	Perm	NA		Perm	NA		Perm	NA			NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4					
Actuated Green, G (s)		25.6			25.6			55.4			55.4	
Effective Green, g (s)		25.6			25.6			55.4			55.4	
Actuated g/C Ratio		0.28			0.28			0.62			0.62	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Lane Grp Cap (vph)		504			500			2021			2265	
v/s Ratio Prot											c0.28	
v/s Ratio Perm		c0.04			0.00			0.11				
v/c Ratio		0.12			0.01			0.17			0.45	
Uniform Delay, d1		23.9			23.1			7.4			9.2	
Progression Factor		0.63			1.00			1.00			1.00	
Incremental Delay, d2		0.5			0.0			0.2			0.6	
Delay (s)		15.5			23.1			7.6			9.8	
Level of Service		B			C			A			A	
Approach Delay (s)		15.5			23.1			7.6			9.8	
Approach LOS		B			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	9.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.35		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	37.4%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (vph)	1123	0	0	0	0	0	433	159	0	0
Ideal Flow (vphpl)	1900	2000	1900	2000	2000	2000	2000	1900	1900	1900
Total Lost time (s)	6.0						5.7			
Lane Util. Factor	0.94						0.91			
Frt	1.00						0.96			
Flt Protected	0.95						1.00			
Satd. Flow (prot)	4990						5069			
Flt Permitted	0.95						1.00			
Satd. Flow (perm)	4990						5069			
Peak-hour factor, PHF	0.92	0.95	0.92	0.92	0.92	0.89	0.89	0.92	0.92	0.92
Adj. Flow (vph)	1221	0	0	0	0	0	487	173	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	27	0	0	0
Lane Group Flow (vph)	1221	0	0	0	0	0	633	0	0	0
Heavy Vehicles (%)	2%	3%	2%	2%	2%	4%	4%	2%	2%	2%
Turn Type	Prot						NA			
Protected Phases	1						3			
Permitted Phases										
Actuated Green, G (s)	35.0						23.3			
Effective Green, g (s)	35.0						23.3			
Actuated g/C Ratio	0.50						0.33			
Clearance Time (s)	6.0						5.7			
Vehicle Extension (s)	0.2						0.2			
Lane Grp Cap (vph)	2495						1687			
v/s Ratio Prot	c0.24						c0.12			
v/s Ratio Perm										
v/c Ratio	0.49						0.38			
Uniform Delay, d1	11.6						17.8			
Progression Factor	0.39						0.20			
Incremental Delay, d2	0.7						0.6			
Delay (s)	5.2						4.2			
Level of Service	A						A			
Approach Delay (s)	5.2			0.0			4.2		0.0	
Approach LOS	A			A			A		A	

Intersection Summary			
HCM 2000 Control Delay	4.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.7
Intersection Capacity Utilization	52.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	695	0	0	413	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)		6.0			5.7	
Lane Util. Factor		0.91			0.94	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5301			5253	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5301			5253	
Peak-hour factor, PHF	0.95	0.95	0.92	0.92	0.91	0.91
Adj. Flow (vph)	0	732	0	0	454	0
RTOR Reduction (vph)	0	0	0	0	300	0
Lane Group Flow (vph)	0	732	0	0	154	0
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%
Turn Type		NA			Prot	
Protected Phases		2			4	
Permitted Phases						
Actuated Green, G (s)		35.0			23.3	
Effective Green, g (s)		35.0			23.3	
Actuated g/C Ratio		0.50			0.33	
Clearance Time (s)		6.0			5.7	
Vehicle Extension (s)		0.2			0.2	
Lane Grp Cap (vph)		2650			1748	
v/s Ratio Prot		c0.14			c0.03	
v/s Ratio Perm						
v/c Ratio		0.28			0.09	
Uniform Delay, d1		10.2			16.0	
Progression Factor		1.00			0.01	
Incremental Delay, d2		0.3			0.1	
Delay (s)		10.4			0.2	
Level of Service		B			A	
Approach Delay (s)		10.4	0.0		0.2	
Approach LOS		B	A		A	

Intersection Summary			
HCM 2000 Control Delay	6.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.20		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.7
Intersection Capacity Utilization	60.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	1091	511	0	65	0	0	0	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)					5.8	5.8		5.4				
Lane Util. Factor					0.91	1.00		0.91				
Frt					1.00	0.85		1.00				
Flt Protected					1.00	1.00		1.00				
Satd. Flow (prot)					5353	1667		5250				
Flt Permitted					1.00	1.00		1.00				
Satd. Flow (perm)					5353	1667		5250				
Peak-hour factor, PHF	0.92	0.92	0.92	0.95	0.95	0.95	0.75	0.75	0.75	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	1148	538	0	87	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	144	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	1148	394	0	87	0	0	0	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	4%	4%	4%	2%	2%	2%
Turn Type					NA	Perm		NA				
Protected Phases					1			2				
Permitted Phases						1						
Actuated Green, G (s)					49.2	49.2		9.6				
Effective Green, g (s)					49.2	49.2		9.6				
Actuated g/C Ratio					0.70	0.70		0.14				
Clearance Time (s)					5.8	5.8		5.4				
Vehicle Extension (s)					0.2	0.2		0.2				
Lane Grp Cap (vph)					3762	1171		720				
v/s Ratio Prot					0.21			c0.02				
v/s Ratio Perm						c0.24						
v/c Ratio					0.31	0.34		0.12				
Uniform Delay, d1					3.9	4.0		26.5				
Progression Factor					0.21	0.00		1.20				
Incremental Delay, d2					0.2	0.6		0.3				
Delay (s)					1.0	0.6		32.0				
Level of Service					A	A		C				
Approach Delay (s)		0.0			0.9			32.0			0.0	
Approach LOS		A			A			C			A	

Intersection Summary			
HCM 2000 Control Delay	2.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.30		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.2
Intersection Capacity Utilization	57.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX A-2
Existing Year Signalized intersections Measures of Effectiveness
PM PEAK

HCM Signalized Intersection Capacity Analysis
3: I 375 NB Service Drive/NB I-375 Service Drive & E. Lafayette Blvd.

8/15/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	278	439	0	0	122	309	12	52	8	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5			5.5			7.7				
Lane Util. Factor	1.00	0.91			0.91			0.95				
Frt	1.00	1.00			0.89			0.98				
Flt Protected	0.95	1.00			1.00			0.99				
Satd. Flow (prot)	1770	5085			4539			3450				
Flt Permitted	0.47	1.00			1.00			0.99				
Satd. Flow (perm)	882	5085			4539			3450				
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	302	477	0	0	133	336	13	57	9	0	0	0
RTOR Reduction (vph)	0	0	0	0	233	0	0	7	0	0	0	0
Lane Group Flow (vph)	302	477	0	0	236	0	0	72	0	0	0	0
Turn Type	pm+pt	NA			NA		Perm	NA				
Protected Phases	7	4			8			2				
Permitted Phases	4						2					
Actuated Green, G (s)	42.5	42.5			21.5			14.3				
Effective Green, g (s)	42.5	42.5			21.5			14.3				
Actuated g/C Ratio	0.61	0.61			0.31			0.20				
Clearance Time (s)	5.5	5.5			5.5			7.7				
Lane Grp Cap (vph)	732	3087			1394			704				
v/s Ratio Prot	c0.09	0.09			0.05							
v/s Ratio Perm	c0.16							0.02				
v/c Ratio	0.41	0.15			0.17			0.10				
Uniform Delay, d1	8.2	6.0			17.7			22.6				
Progression Factor	1.06	0.93			1.00			0.88				
Incremental Delay, d2	1.7	0.1			0.3			0.2				
Delay (s)	10.4	5.6			18.0			20.1				
Level of Service	B	A			B			C				
Approach Delay (s)		7.5			18.0			20.1			0.0	
Approach LOS		A			B			C			A	

Intersection Summary			
HCM 2000 Control Delay	12.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	18.7
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	787	0	0	635	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3			5.8		
Lane Util. Factor	*0.82			*0.63		
Frt	1.00			1.00		
Flt Protected	0.95			1.00		
Satd. Flow (prot)	2902			2347		
Flt Permitted	0.95			1.00		
Satd. Flow (perm)	2902			2347		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	855	0	0	690	0	0
RTOR Reduction (vph)	195	0	0	0	0	0
Lane Group Flow (vph)	660	0	0	690	0	0
Turn Type	Prot			NA		
Protected Phases	4			2		
Permitted Phases						
Actuated Green, G (s)	23.0			34.9		
Effective Green, g (s)	23.0			34.9		
Actuated g/C Ratio	0.33			0.50		
Clearance Time (s)	6.3			5.8		
Lane Grp Cap (vph)	953			1170		
v/s Ratio Prot	c0.23			c0.29		
v/s Ratio Perm						
v/c Ratio	0.69			0.59		
Uniform Delay, d1	20.4			12.5		
Progression Factor	0.29			1.26		
Incremental Delay, d2	3.4			2.1		
Delay (s)	9.3			17.8		
Level of Service	A			B		
Approach Delay (s)	9.3			17.8	0.0	
Approach LOS	A			B	A	

Intersection Summary			
HCM 2000 Control Delay	13.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	61.6%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	390	27	27	107	0	0	0	0	327	103	186
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5		5.5	5.5						7.7	
Lane Util. Factor		0.91		1.00	0.91						0.91	
Frt		0.99		1.00	1.00						0.95	
Flt Protected		1.00		0.95	1.00						0.97	
Satd. Flow (prot)		5036		1770	5085						4729	
Flt Permitted		1.00		0.48	1.00						0.97	
Satd. Flow (perm)		5036		896	5085						4729	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	424	29	29	116	0	0	0	0	355	112	202
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	0	0	100	0
Lane Group Flow (vph)	0	442	0	29	116	0	0	0	0	0	569	0
Turn Type		NA		Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		21.5		21.5	21.5						35.3	
Effective Green, g (s)		21.5		21.5	21.5						35.3	
Actuated g/C Ratio		0.31		0.31	0.31						0.50	
Clearance Time (s)		5.5		5.5	5.5						7.7	
Lane Grp Cap (vph)		1546		275	1561						2384	
v/s Ratio Prot		c0.09			0.02							
v/s Ratio Perm				0.03							0.12	
v/c Ratio		0.29		0.11	0.07						0.24	
Uniform Delay, d1		18.4		17.4	17.2						9.8	
Progression Factor		1.00		0.69	0.73						0.56	
Incremental Delay, d2		0.5		0.8	0.1						0.2	
Delay (s)		18.9		12.8	12.6						5.7	
Level of Service		B		B	B						A	
Approach Delay (s)		18.9			12.7			0.0			5.7	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	11.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.26		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	13.2
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	653	119	0	0	0	0	0	0	134	497	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3								5.8	
Lane Util. Factor		*0.82	1.00								0.91	
Frt		1.00	0.85								1.00	
Flt Protected		1.00	1.00								0.99	
Satd. Flow (prot)		3055	1583								5032	
Flt Permitted		1.00	1.00								0.99	
Satd. Flow (perm)		3055	1583								5032	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	710	129	0	0	0	0	0	0	146	540	0
RTOR Reduction (vph)	0	0	83	0	0	0	0	0	0	0	38	0
Lane Group Flow (vph)	0	710	46	0	0	0	0	0	0	0	648	0
Turn Type		NA	Perm							Perm	NA	
Protected Phases		2									4	
Permitted Phases			2							4		
Actuated Green, G (s)		24.7	24.7								34.2	
Effective Green, g (s)		24.7	24.7								34.2	
Actuated g/C Ratio		0.35	0.35								0.49	
Clearance Time (s)		5.3	5.3								5.8	
Lane Grp Cap (vph)		1077	558								2458	
v/s Ratio Prot		c0.23										
v/s Ratio Perm			0.03								0.13	
v/c Ratio		0.66	0.08								0.26	
Uniform Delay, d1		19.1	15.1								10.5	
Progression Factor		1.00	1.00								1.00	
Incremental Delay, d2		3.2	0.3								0.3	
Delay (s)		22.3	15.4								10.8	
Level of Service		C	B								B	
Approach Delay (s)		21.2			0.0			0.0			10.8	
Approach LOS		C			A			A			B	

Intersection Summary			
HCM 2000 Control Delay	16.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.1
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	SBT	SBR	NEL	NER
Lane Configurations						
Volume (vph)	0	1058	545	1394	1583	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	10.1	10.1	9.0	
Lane Util. Factor		0.91	0.86	0.86	0.94	
Frt		1.00	0.92	0.85	1.00	
Flt Protected		1.00	1.00	1.00	0.95	
Satd. Flow (prot)		5085	4401	1362	4990	
Flt Permitted		1.00	1.00	1.00	0.95	
Satd. Flow (perm)		5085	4401	1362	4990	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1150	592	1515	1721	0
RTOR Reduction (vph)	0	0	210	378	0	0
Lane Group Flow (vph)	0	1150	1140	379	1721	0
Turn Type		NA	NA	Perm	Prot	
Protected Phases		2	6		4	
Permitted Phases				6		
Actuated Green, G (s)		54.0	49.9	49.9	41.0	
Effective Green, g (s)		54.0	49.9	49.9	41.0	
Actuated g/C Ratio		0.49	0.45	0.45	0.37	
Clearance Time (s)		6.0	10.1	10.1	9.0	
Lane Grp Cap (vph)		2496	1996	617	1859	
v/s Ratio Prot		0.23	0.26		c0.34	
v/s Ratio Perm				c0.28		
v/c Ratio		0.46	0.57	0.61	0.93	
Uniform Delay, d1		18.4	22.2	22.8	33.0	
Progression Factor		0.27	1.00	1.00	1.00	
Incremental Delay, d2		0.6	1.2	4.5	9.4	
Delay (s)		5.5	23.3	27.3	42.5	
Level of Service		A	C	C	D	
Approach Delay (s)		5.5	24.8		42.5	
Approach LOS		A	C		D	

Intersection Summary			
HCM 2000 Control Delay	26.4	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	19.1
Intersection Capacity Utilization	67.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	0	28	35	16	44	41	219	0	0	185	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0		5.9	5.9			5.9	5.9
Lane Util. Factor	1.00		1.00	1.00	1.00		1.00	0.95			1.00	1.00
Frpb, ped/bikes	1.00		0.95	1.00	0.97		1.00	1.00			1.00	0.96
Flpb, ped/bikes	0.98		1.00	0.97	1.00		0.99	1.00			1.00	1.00
Frt	1.00		0.85	1.00	0.89		1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00	0.95	1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)	1709		1522	1753	1604		1764	3574			1863	1454
Flt Permitted	0.71		1.00	0.95	1.00		0.63	1.00			1.00	1.00
Satd. Flow (perm)	1286		1522	1753	1604		1173	3574			1863	1454
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	0	30	38	17	48	45	238	0	0	201	20
RTOR Reduction (vph)	0	0	18	0	28	0	0	0	0	0	0	12
Lane Group Flow (vph)	7	0	13	38	37	0	45	238	0	0	201	8
Confl. Peds. (#/hr)	14		24	24		14	13		3	3		13
Heavy Vehicles (%)	4%	0%	1%	0%	4%	2%	1%	1%	0%	0%	2%	7%
Turn Type	Perm		Perm	Perm	NA		Perm	NA			NA	Perm
Protected Phases					8			2			6	
Permitted Phases	4		4	8			2					6
Actuated Green, G (s)	25.0		25.0	25.0	25.0		23.1	23.1			23.1	23.1
Effective Green, g (s)	25.0		25.0	25.0	25.0		23.1	23.1			23.1	23.1
Actuated g/C Ratio	0.42		0.42	0.42	0.42		0.39	0.39			0.39	0.39
Clearance Time (s)	6.0		6.0	6.0	6.0		5.9	5.9			5.9	5.9
Lane Grp Cap (vph)	535		634	730	668		451	1375			717	559
v/s Ratio Prot					c0.02			0.07			c0.11	
v/s Ratio Perm	0.01		0.01	0.02			0.04					0.01
v/c Ratio	0.01		0.02	0.05	0.06		0.10	0.17			0.28	0.01
Uniform Delay, d1	10.3		10.3	10.4	10.4		11.8	12.2			12.7	11.4
Progression Factor	1.00		1.00	1.00	1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	0.0		0.1	0.1	0.2		0.4	0.3			1.0	0.0
Delay (s)	10.3		10.3	10.6	10.6		12.2	12.4			13.7	11.5
Level of Service	B		B	B	B		B	B			B	B
Approach Delay (s)		10.3			10.6			12.4			13.5	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	12.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.16		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	11.9
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1092	79	56	1053	139	64
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3		5.3	5.3	6.5	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frpb, ped/bikes	1.00		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	
Frt	0.99		1.00	1.00	0.96	
Flt Protected	1.00		0.95	1.00	0.97	
Satd. Flow (prot)	5017		1856	5085	1521	
Flt Permitted	1.00		0.17	1.00	0.97	
Satd. Flow (perm)	5017		340	5085	1521	
Peak-hour factor, PHF	0.87	0.87	0.90	0.90	0.92	0.92
Adj. Flow (vph)	1255	91	62	1170	151	70
RTOR Reduction (vph)	9	0	0	0	22	0
Lane Group Flow (vph)	1337	0	62	1170	199	0
Confl. Peds. (#/hr)		12	12		2	3
Heavy Vehicles (%)	2%	2%	2%	2%	3%	3%
Parking (#/hr)	10			10	10	
Turn Type	NA		Perm	NA	Prot	
Protected Phases	1			1	2	
Permitted Phases			1			
Actuated Green, G (s)	53.4		53.4	53.4	14.8	
Effective Green, g (s)	53.4		53.4	53.4	14.8	
Actuated g/C Ratio	0.67		0.67	0.67	0.19	
Clearance Time (s)	5.3		5.3	5.3	6.5	
Vehicle Extension (s)	0.2		0.2	0.2	3.0	
Lane Grp Cap (vph)	3348		226	3394	281	
v/s Ratio Prot	c0.27			0.23	c0.13	
v/s Ratio Perm			0.18			
v/c Ratio	0.40		0.27	0.34	0.71	
Uniform Delay, d1	6.0		5.4	5.7	30.6	
Progression Factor	0.40		1.00	1.00	1.00	
Incremental Delay, d2	0.3		3.0	0.3	7.9	
Delay (s)	2.7		8.4	6.0	38.5	
Level of Service	A		A	A	D	
Approach Delay (s)	2.7			6.1	38.5	
Approach LOS	A			A	D	

Intersection Summary			
HCM 2000 Control Delay	7.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	11.8
Intersection Capacity Utilization	57.0%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	38	962	92	5	1016	146	0	65	5	129	68	31
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	10	10	12	10	10	12	12	16	12	12	11	12
Total Lost time (s)	6.3	6.3		6.3	6.3			6.6		6.6	6.6	6.6
Lane Util. Factor	1.00	0.91		1.00	0.91			1.00		1.00	0.95	0.95
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00		1.00	1.00	1.00
Frt	1.00	0.99		1.00	0.98			0.99		1.00	0.99	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00		0.95	1.00	1.00
Satd. Flow (prot)	1716	4639		1722	4594			2179		1899	1551	1586
Flt Permitted	0.21	1.00		0.23	1.00			1.00		0.69	1.00	1.00
Satd. Flow (perm)	376	4639		408	4594			2179		1379	1551	1586
Peak-hour factor, PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.67	0.67	0.67	0.93	0.93	0.93
Adj. Flow (vph)	42	1057	101	5	1069	154	0	97	7	139	73	33
RTOR Reduction (vph)	0	12	0	0	20	0	0	3	0	0	2	25
Lane Group Flow (vph)	42	1146	0	5	1203	0	0	101	0	139	74	5
Confl. Peds. (#/hr)	11					11	8		1	1		8
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	0%	0%	0%
Parking (#/hr)		10			10						10	
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	Perm
Protected Phases		1			1			2			2	
Permitted Phases	1			1						2		2
Actuated Green, G (s)	54.1	54.1		54.1	54.1			13.0		13.0	13.0	13.0
Effective Green, g (s)	54.1	54.1		54.1	54.1			13.0		13.0	13.0	13.0
Actuated g/C Ratio	0.68	0.68		0.68	0.68			0.16		0.16	0.16	0.16
Clearance Time (s)	6.3	6.3		6.3	6.3			6.6		6.6	6.6	6.6
Vehicle Extension (s)	0.2	0.2		0.2	0.2			3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	254	3137		275	3106			354		224	252	257
v/s Ratio Prot		0.25			c0.26			0.05			0.05	
v/s Ratio Perm	0.11			0.01						c0.10		0.00
v/c Ratio	0.17	0.37		0.02	0.39			0.28		0.62	0.29	0.02
Uniform Delay, d1	4.7	5.6		4.2	5.7			29.4		31.2	29.5	28.1
Progression Factor	1.56	1.69		0.92	0.84			1.00		1.00	1.00	1.00
Incremental Delay, d2	1.4	0.3		0.1	0.3			0.4		5.3	0.7	0.0
Delay (s)	8.7	9.7		4.0	5.1			29.9		36.5	30.1	28.2
Level of Service	A	A		A	A			C		D	C	C
Approach Delay (s)		9.7			5.1			29.9			33.5	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.9
Intersection Capacity Utilization	57.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	1095	6	9	1142	11	7
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Lane Width	10	12	10	10	12	12
Total Lost time (s)	5.0		5.0	5.0	6.5	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frpb, ped/bikes	1.00		1.00	1.00	0.99	
Flpb, ped/bikes	1.00		0.99	1.00	1.00	
Frt	1.00		1.00	1.00	0.95	
Flt Protected	1.00		0.95	1.00	0.97	
Satd. Flow (prot)	4740		1701	4700	1832	
Flt Permitted	1.00		0.22	1.00	0.97	
Satd. Flow (perm)	4740		400	4700	1832	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.75	0.75
Adj. Flow (vph)	1190	7	10	1241	15	9
RTOR Reduction (vph)	1	0	0	0	9	0
Lane Group Flow (vph)	1196	0	10	1241	15	0
Confl. Peds. (#/hr)		21	21		2	2
Heavy Vehicles (%)	2%	2%	3%	3%	0%	0%
Parking (#/hr)	10			10		
Turn Type	NA		Perm	NA	Prot	
Protected Phases	1			1	2	
Permitted Phases			1			
Actuated Green, G (s)	64.8		64.8	64.8	3.7	
Effective Green, g (s)	64.8		64.8	64.8	3.7	
Actuated g/C Ratio	0.81		0.81	0.81	0.05	
Clearance Time (s)	5.0		5.0	5.0	6.5	
Vehicle Extension (s)	0.2		0.2	0.2	3.0	
Lane Grp Cap (vph)	3839		324	3807	84	
v/s Ratio Prot	0.25			c0.26	c0.01	
v/s Ratio Perm			0.03			
v/c Ratio	0.31		0.03	0.33	0.18	
Uniform Delay, d1	1.9		1.5	2.0	36.7	
Progression Factor	0.93		1.12	0.90	1.00	
Incremental Delay, d2	0.2		0.2	0.2	1.1	
Delay (s)	2.0		1.8	2.0	37.8	
Level of Service	A		A	A	D	
Approach Delay (s)	2.0			2.0	37.8	
Approach LOS	A			A	D	

Intersection Summary			
HCM 2000 Control Delay	2.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.32		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	37.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	63	999	1085	74	81	47
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Lane Width	10	11	10	12	10	10
Total Lost time (s)	6.4	6.4	6.4		6.3	6.3
Lane Util. Factor	1.00	0.91	0.91		0.97	0.91
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		0.99	0.85
Flt Protected	0.95	1.00	1.00		0.96	1.00
Satd. Flow (prot)	1733	4916	4692		3102	1416
Flt Permitted	0.19	1.00	1.00		0.96	1.00
Satd. Flow (perm)	354	4916	4692		3102	1416
Peak-hour factor, PHF	0.95	0.95	0.88	0.88	0.89	0.89
Adj. Flow (vph)	66	1052	1233	84	91	53
RTOR Reduction (vph)	0	0	8	0	7	41
Lane Group Flow (vph)	66	1052	1309	0	92	4
Confl. Peds. (#/hr)	10			10	2	
Parking (#/hr)		10	10		10	
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		1	1		2	
Permitted Phases	1					2
Actuated Green, G (s)	60.3	60.3	60.3		7.0	7.0
Effective Green, g (s)	60.3	60.3	60.3		7.0	7.0
Actuated g/C Ratio	0.75	0.75	0.75		0.09	0.09
Clearance Time (s)	6.4	6.4	6.4		6.3	6.3
Vehicle Extension (s)	0.2	0.2	0.2		3.0	3.0
Lane Grp Cap (vph)	266	3705	3536		271	123
v/s Ratio Prot		0.21	c0.28		c0.03	
v/s Ratio Perm	0.19					0.00
v/c Ratio	0.25	0.28	0.37		0.34	0.03
Uniform Delay, d1	3.0	3.1	3.4		34.3	33.4
Progression Factor	1.00	1.00	0.37		1.00	1.00
Incremental Delay, d2	2.2	0.2	0.3		0.7	0.1
Delay (s)	5.2	3.3	1.5		35.1	33.5
Level of Service	A	A	A		D	C
Approach Delay (s)		3.4	1.5		34.6	
Approach LOS		A	A		C	

Intersection Summary			
HCM 2000 Control Delay	4.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.7
Intersection Capacity Utilization	51.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	1266	50	13	956	127	368	106	26	41	28	33
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	10	10	12	10	10	12	12	14	12	12	16	12
Total Lost time (s)	5.8	5.8		5.8	5.8			6.4			6.4	
Lane Util. Factor	1.00	0.91		1.00	0.91			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.98			0.99			0.96	
Flt Protected	0.95	1.00		0.95	1.00			0.96			0.98	
Satd. Flow (prot)	1739	4968		1739	4663			2039			1780	
Flt Permitted	0.15	1.00		0.14	1.00			0.70			0.75	
Satd. Flow (perm)	273	4968		260	4663			1490			1362	
Peak-hour factor, PHF	0.89	0.89	0.89	0.87	0.87	0.87	0.90	0.90	0.90	0.82	0.82	0.82
Adj. Flow (vph)	30	1422	56	15	1099	146	409	118	29	50	34	40
RTOR Reduction (vph)	0	5	0	0	23	0	0	3	0	0	17	0
Lane Group Flow (vph)	30	1473	0	15	1222	0	0	553	0	0	107	0
Confl. Peds. (#/hr)							3		3	3		3
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Parking (#/hr)					10						10	
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		6			2		7	4			8	
Permitted Phases	6			2			4			8		
Actuated Green, G (s)	28.2	28.2		28.2	28.2			29.6			29.6	
Effective Green, g (s)	28.2	28.2		28.2	28.2			29.6			29.6	
Actuated g/C Ratio	0.40	0.40		0.40	0.40			0.42			0.42	
Clearance Time (s)	5.8	5.8		5.8	5.8			6.4			6.4	
Vehicle Extension (s)	0.2	0.2		0.2	0.2			3.0			3.0	
Lane Grp Cap (vph)	109	2001		104	1878			630			575	
v/s Ratio Prot		c0.30			0.26							
v/s Ratio Perm	0.11			0.06				c0.37			0.08	
v/c Ratio	0.28	0.74		0.14	0.65			0.88			0.19	
Uniform Delay, d1	14.0	17.7		13.3	16.9			18.5			12.7	
Progression Factor	1.59	1.60		1.00	1.00			1.00			1.00	
Incremental Delay, d2	5.5	2.2		2.9	1.8			13.1			0.2	
Delay (s)	27.8	30.5		16.1	18.7			31.7			12.8	
Level of Service	C	C		B	B			C			B	
Approach Delay (s)		30.5			18.6			31.7			12.8	
Approach LOS		C			B			C			B	

Intersection Summary			
HCM 2000 Control Delay	25.7	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	18.6
Intersection Capacity Utilization	67.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	2205	165	0	0	0	0	175	225
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	12	12	12	12	12	12
Total Lost time (s)					3.0						3.0	
Lane Util. Factor					0.81						0.95	
Frt					0.99						0.93	
Flt Protected					1.00						1.00	
Satd. Flow (prot)					6347						2892	
Flt Permitted					1.00						1.00	
Satd. Flow (perm)					6347						2892	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.92	0.79	0.90	0.90	0.90	0.85	0.60	0.94
Adj. Flow (vph)	0	0	0	0	2397	209	0	0	0	0	292	239
RTOR Reduction (vph)	0	0	0	0	22	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	2584	0	0	0	0	0	531	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	18%	3%	3%	3%	3%	7%	2%
Turn Type					NA						NA	
Protected Phases					6						4	
Permitted Phases					6							
Actuated Green, G (s)					35.0						19.0	
Effective Green, g (s)					38.0						26.0	
Actuated g/C Ratio					0.54						0.37	
Clearance Time (s)					6.0						10.0	
Lane Grp Cap (vph)					3445						1074	
v/s Ratio Prot					c0.41						c0.18	
v/s Ratio Perm												
v/c Ratio					0.75						0.49	
Uniform Delay, d1					12.3						16.9	
Progression Factor					0.28						1.00	
Incremental Delay, d2					1.3						1.6	
Delay (s)					4.7						18.6	
Level of Service					A						B	
Approach Delay (s)		0.0			4.7			0.0			18.6	
Approach LOS		A			A			A			B	

Intersection Summary			
HCM 2000 Control Delay	7.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	50.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	SEL	SER	SER2
Lane Configurations											
Volume (vph)	0	0	0	0	2055	0	0	0	0	225	315
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	12	12	12	11	11
Total Lost time (s)					3.0					3.0	3.0
Lane Util. Factor					0.86					0.64	1.00
Frt					1.00					0.85	0.85
Flt Protected					1.00					1.00	1.00
Satd. Flow (prot)					5521					2668	1364
Flt Permitted					1.00					1.00	1.00
Satd. Flow (perm)					5521					2668	1364
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.96	0.90	0.90	0.90	0.90	0.94	0.94
Adj. Flow (vph)	0	0	0	0	2141	0	0	0	0	239	335
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	197	131
Lane Group Flow (vph)	0	0	0	0	2141	0	0	0	0	186	60
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	0%	3%
Turn Type					NA					Prot	Prot
Protected Phases					9					4	4
Permitted Phases					9						
Actuated Green, G (s)					39.0					15.0	15.0
Effective Green, g (s)					42.0					22.0	22.0
Actuated g/C Ratio					0.60					0.31	0.31
Clearance Time (s)					6.0					10.0	10.0
Lane Grp Cap (vph)					3312					838	428
v/s Ratio Prot					c0.39					c0.07	0.04
v/s Ratio Perm											
v/c Ratio					0.65					0.22	0.14
Uniform Delay, d1					9.1					17.7	17.2
Progression Factor					0.04					1.00	1.00
Incremental Delay, d2					0.7					0.6	0.7
Delay (s)					1.0					18.3	17.9
Level of Service					A					B	B
Approach Delay (s)		0.0			1.0		0.0		18.2		
Approach LOS		A			A		A		B		

Intersection Summary			
HCM 2000 Control Delay	4.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	27.5
Intersection Capacity Utilization	66.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	2359	250	0	136	0	0	299	391
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	12	11	12	12	11	11
Total Lost time (s)					3.0			3.0			3.0	3.0
Lane Util. Factor					0.81			0.91			0.91	0.91
Frt					0.99			1.00			0.94	0.85
Flt Protected					1.00			1.00			1.00	1.00
Satd. Flow (prot)					6406			4381			2775	1254
Flt Permitted					1.00			1.00			1.00	1.00
Satd. Flow (perm)					6406			4381			2775	1254
Peak-hour factor, PHF	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.88	0.90	0.90	0.73	0.73
Adj. Flow (vph)	0	0	0	0	2564	272	0	155	0	0	410	536
RTOR Reduction (vph)	0	0	0	0	27	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	2809	0	0	155	0	0	678	268
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	2%	2%
Turn Type					NA			NA			NA	Prot
Protected Phases					6			8			4	4
Permitted Phases												
Actuated Green, G (s)					36.0			22.0			18.0	18.0
Effective Green, g (s)					39.0			25.0			25.0	25.0
Actuated g/C Ratio					0.56			0.36			0.36	0.36
Clearance Time (s)					6.0			6.0			10.0	10.0
Lane Grp Cap (vph)					3569			1564			991	447
v/s Ratio Prot					c0.44			0.04			c0.24	0.21
v/s Ratio Perm												
v/c Ratio					0.79			0.10			0.68	0.60
Uniform Delay, d1					12.2			15.0			19.1	18.4
Progression Factor					0.11			0.24			1.00	1.00
Incremental Delay, d2					1.1			0.1			3.8	5.8
Delay (s)					2.5			3.7			23.0	24.2
Level of Service					A			A			C	C
Approach Delay (s)		0.0			2.5			3.7			23.3	
Approach LOS		A			A			A			C	

Intersection Summary			
HCM 2000 Control Delay	7.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	58.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	2500	95	0	0	0	0	0	110
Ideal Flow (vphpl)	1900	1900	2000	2000	1900	1900	2000	2000	2000	1900	2000	1900
Lane Width	12	12	12	12	11	12	12	12	12	12	12	11
Total Lost time (s)					3.0							3.0
Lane Util. Factor					0.81							0.88
Frt					0.99							0.85
Flt Protected					1.00							1.00
Satd. Flow (prot)					6527							2473
Flt Permitted					1.00							1.00
Satd. Flow (perm)					6527							2473
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.89	0.89	0.90	0.90	0.90	0.90	0.90	0.82
Adj. Flow (vph)	0	0	0	0	2809	107	0	0	0	0	0	134
RTOR Reduction (vph)	0	0	0	0	9	0	0	0	0	0	0	25
Lane Group Flow (vph)	0	0	0	0	2907	0	0	0	0	0	0	109
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%	3%	3%	3%	3%	3%	0%
Turn Type					NA							Prot
Protected Phases					6							4
Permitted Phases												
Actuated Green, G (s)					36.5							22.0
Effective Green, g (s)					39.0							25.0
Actuated g/C Ratio					0.56							0.36
Clearance Time (s)					5.5							6.0
Vehicle Extension (s)					3.0							3.0
Lane Grp Cap (vph)					3636							883
v/s Ratio Prot					c0.45							c0.04
v/s Ratio Perm												
v/c Ratio					0.80							0.12
Uniform Delay, d1					12.4							15.1
Progression Factor					0.61							1.00
Incremental Delay, d2					1.0							0.3
Delay (s)					8.6							15.4
Level of Service					A							B
Approach Delay (s)		0.0			8.6			0.0			15.4	
Approach LOS		A			A			A			B	

Intersection Summary			
HCM 2000 Control Delay	8.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.56		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	48.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	18	1621	43	434	498	0	0	147	329
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	13	13	12	12	11	12
Total Lost time (s)					3.0		3.0	3.0			3.0	
Lane Util. Factor					0.86		0.91	0.91			0.91	
Frt					1.00		1.00	1.00			0.90	
Flt Protected					1.00		0.95	1.00			1.00	
Satd. Flow (prot)					5551		1441	3034			3371	
Flt Permitted					1.00		0.39	1.00			1.00	
Satd. Flow (perm)					5551		593	3034			3371	
Peak-hour factor, PHF	0.90	0.90	0.90	0.91	0.91	0.91	0.86	0.86	0.86	0.88	0.88	0.88
Adj. Flow (vph)	0	0	0	20	1781	47	505	579	0	0	167	374
RTOR Reduction (vph)	0	0	0	0	5	0	0	0	0	0	10	0
Lane Group Flow (vph)	0	0	0	0	1843	0	505	579	0	0	531	0
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	6%	6%	6%	14%	14%	14%
Parking (#/hr)											10	10
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					6			8			4	
Permitted Phases				6	6		8					
Actuated Green, G (s)					37.0		21.1	21.1			17.1	
Effective Green, g (s)					40.0		24.0	24.0			24.0	
Actuated g/C Ratio					0.57		0.34	0.34			0.34	
Clearance Time (s)					6.0		5.9	5.9			9.9	
Lane Grp Cap (vph)					3172		203	1040			1155	
v/s Ratio Prot											0.16	
v/s Ratio Perm					0.33		c0.85	0.19				
v/c Ratio					0.58		2.49	0.56			1.00dr	
Uniform Delay, d1					9.6		23.0	18.7			17.9	
Progression Factor					1.70		0.29	0.10			1.00	
Incremental Delay, d2					0.8		679.1	1.4			1.3	
Delay (s)					17.1		685.9	3.3			19.3	
Level of Service					B		F	A			B	
Approach Delay (s)		0.0			17.1			321.3			19.3	
Approach LOS		A			B			F			B	

Intersection Summary			
HCM 2000 Control Delay	112.4	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.36		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	102.8%	ICU Level of Service	G
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

Movement	EBL	EBR2	NBL2	NBT	NBR	NET	SWL	SWT	SWR2
Lane Configurations									
Volume (vph)	234	18	44	76	107	623	2	437	19
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0	6.0	6.0		6.0		6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	1.00		0.95		0.95	1.00
Frpb, ped/bikes	1.00	0.93	1.00	0.97		1.00		1.00	0.97
Flpb, ped/bikes	1.00	1.00	0.97	1.00		1.00		1.00	1.00
Frt	1.00	0.85	1.00	0.91		1.00		1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00		1.00		1.00	1.00
Satd. Flow (prot)	3252	1396	1627	1330		3101		3101	1462
Flt Permitted	0.95	1.00	0.95	1.00		1.00		0.95	1.00
Satd. Flow (perm)	3252	1396	1627	1330		3101		2955	1462
Peak-hour factor, PHF	0.68	0.68	0.81	0.81	0.81	0.82	0.86	0.86	0.86
Adj. Flow (vph)	344	26	54	94	132	760	2	508	22
RTOR Reduction (vph)	0	23	0	50	0	0	0	0	13
Lane Group Flow (vph)	344	3	54	176	0	760	0	510	9
Confl. Peds. (#/hr)		26	26		33				2
Parking (#/hr)				10		10		10	
Turn Type	Prot	Perm	Perm	NA		NA	Perm	NA	Perm
Protected Phases	4			3		2		2	
Permitted Phases		4	3				2		2
Actuated Green, G (s)	12.0	12.0	25.0	25.0		35.0		35.0	35.0
Effective Green, g (s)	12.0	12.0	25.0	25.0		35.0		35.0	35.0
Actuated g/C Ratio	0.13	0.13	0.28	0.28		0.39		0.39	0.39
Clearance Time (s)	6.0	6.0	6.0	6.0		6.0		6.0	6.0
Lane Grp Cap (vph)	433	186	451	369		1205		1149	568
v/s Ratio Prot	c0.11			c0.13		c0.25			
v/s Ratio Perm		0.00	0.03					0.17	0.01
v/c Ratio	0.79	0.02	0.12	0.48		0.63		0.44	0.02
Uniform Delay, d1	37.8	33.9	24.3	27.1		22.3		20.3	16.9
Progression Factor	1.00	1.00	1.00	1.00		1.00		0.91	1.00
Incremental Delay, d2	14.0	0.2	0.5	4.4		2.5		1.2	0.0
Delay (s)	51.8	34.1	24.8	31.4		24.8		19.7	17.0
Level of Service	D	C	C	C		C		B	B
Approach Delay (s)	50.5			30.2		24.8		19.6	
Approach LOS	D			C		C		B	

Intersection Summary			
HCM 2000 Control Delay	29.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	60.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	3	9	10	119	5	53	93	929	0	19	392	104
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)		6.0			6.0		5.8	5.8		5.8	5.8	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		0.99			0.99		1.00	1.00		1.00	0.99	
Flpb, ped/bikes		1.00			0.99		0.98	1.00		1.00	1.00	
Frt		0.94			0.96		1.00	1.00		1.00	0.97	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1382			1371		1642	3101		1675	2964	
Flt Permitted		0.97			0.78		0.45	1.00		0.23	1.00	
Satd. Flow (perm)		1343			1109		770	3101		404	2964	
Peak-hour factor, PHF	0.92	0.92	0.92	0.94	0.94	0.94	0.88	0.88	0.88	0.91	0.91	0.91
Adj. Flow (vph)	3	10	11	127	5	56	106	1056	0	21	431	114
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	0	0	26	0
Lane Group Flow (vph)	0	16	0	0	188	0	106	1056	0	21	519	0
Confl. Peds. (#/hr)	19		11	11		19	15		2	2		15
Parking (#/hr)		10			10			10			10	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		21.0			21.0		57.2	57.2		57.2	57.2	
Effective Green, g (s)		21.0			21.0		57.2	57.2		57.2	57.2	
Actuated g/C Ratio		0.23			0.23		0.64	0.64		0.64	0.64	
Clearance Time (s)		6.0			6.0		5.8	5.8		5.8	5.8	
Lane Grp Cap (vph)		313			258		489	1970		256	1883	
v/s Ratio Prot								c0.34			0.18	
v/s Ratio Perm		0.01			c0.17		0.14			0.05		
v/c Ratio		0.05			0.73		0.22	0.54		0.08	0.28	
Uniform Delay, d1		26.8			31.9		6.9	9.1		6.3	7.2	
Progression Factor		1.00			1.00		0.35	0.28		1.00	1.00	
Incremental Delay, d2		0.3			16.5		0.9	0.9		0.6	0.4	
Delay (s)		27.1			48.4		3.3	3.5		6.9	7.6	
Level of Service		C			D		A	A		A	A	
Approach Delay (s)		27.1			48.4			3.4			7.6	
Approach LOS		C			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	9.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	11.8
Intersection Capacity Utilization	73.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Volume (vph)	858	84	66	413	81	155
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0		6.0	6.0	6.0	6.0
Lane Util. Factor	0.95		1.00	0.95	1.00	1.00
Frpb, ped/bikes	1.00		1.00	1.00	1.00	0.96
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.99		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3300		1673	3101	1676	1229
Flt Permitted	1.00		0.23	1.00	0.95	1.00
Satd. Flow (perm)	3300		414	3101	1676	1229
Peak-hour factor, PHF	0.86	0.86	0.93	0.93	0.78	0.78
Adj. Flow (vph)	998	98	71	444	104	199
RTOR Reduction (vph)	8	0	0	0	0	144
Lane Group Flow (vph)	1088	0	71	444	104	55
Confl. Peds. (#/hr)		5	5			22
Parking (#/hr)				10		10
Turn Type	NA		Perm	NA	Prot	Perm
Protected Phases	2			2	4	
Permitted Phases			2			4
Actuated Green, G (s)	64.0		64.0	64.0	14.0	14.0
Effective Green, g (s)	64.0		64.0	64.0	14.0	14.0
Actuated g/C Ratio	0.71		0.71	0.71	0.16	0.16
Clearance Time (s)	6.0		6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	2346		294	2205	260	191
v/s Ratio Prot	c0.33			0.14	c0.06	
v/s Ratio Perm			0.17			0.05
v/c Ratio	0.46		0.24	0.20	0.40	0.29
Uniform Delay, d1	5.6		4.5	4.4	34.2	33.6
Progression Factor	1.27		0.89	0.89	1.00	1.00
Incremental Delay, d2	0.5		1.9	0.2	4.5	3.8
Delay (s)	7.6		5.9	4.1	38.8	37.4
Level of Service	A		A	A	D	D
Approach Delay (s)	7.6			4.3	37.9	
Approach LOS	A			A	D	

Intersection Summary			
HCM 2000 Control Delay	11.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.2%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL2	WBT	SBL	SBT	SBR2	NER	NER2
Lane Configurations							
Volume (vph)	9	82	468	478	103	669	74
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000
Lane Width	11	11	11	11	11	12	12
Total Lost time (s)	5.7	5.7	6.0	6.0	6.0	8.7	
Lane Util. Factor	1.00	0.91	1.00	0.95	1.00	0.76	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	0.98	1.00	
Flpb, ped/bikes	0.99	1.00	0.99	1.00	1.00	1.00	
Frt	1.00	1.00	1.00	1.00	0.85	0.85	
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00	
Satd. Flow (prot)	1591	4600	1610	3241	1414	3033	
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00	
Satd. Flow (perm)	1591	4600	1610	3241	1414	3033	
Peak-hour factor, PHF	0.92	0.92	0.95	0.95	0.95	0.92	0.92
Adj. Flow (vph)	10	89	493	503	108	727	80
RTOR Reduction (vph)	0	0	0	0	66	0	0
Lane Group Flow (vph)	10	89	493	503	42	807	0
Confl. Peds. (#/hr)	7		5		4		
Heavy Vehicles (%)	3%	3%	2%	2%	2%	15%	15%
Bus Blockages (#/hr)	0	2	0	0	2	0	0
Turn Type	Perm	NA	Perm	NA	Perm	Perm	
Protected Phases		1		4			
Permitted Phases	1		4		4	3	
Actuated Green, G (s)	31.3	31.3	27.0	27.0	27.0	28.3	
Effective Green, g (s)	31.3	31.3	27.0	27.0	27.0	28.3	
Actuated g/C Ratio	0.45	0.45	0.39	0.39	0.39	0.40	
Clearance Time (s)	5.7	5.7	6.0	6.0	6.0	8.7	
Lane Grp Cap (vph)	711	2056	621	1250	545	1226	
v/s Ratio Prot		0.02		0.16			
v/s Ratio Perm	0.01		c0.31		0.03	c0.27	
v/c Ratio	0.01	0.04	0.79	0.40	0.08	0.66	
Uniform Delay, d1	10.8	10.9	19.0	15.6	13.6	16.9	
Progression Factor	0.12	0.14	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.0	10.1	1.0	0.3	2.8	
Delay (s)	1.3	1.5	29.1	16.6	13.9	19.7	
Level of Service	A	A	C	B	B	B	
Approach Delay (s)		1.5		21.9			
Approach LOS		A		C			

Intersection Summary			
HCM 2000 Control Delay	20.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	71.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	443	837	0	0	94	488	2	702	5	0	0	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	11	11	12	12	11	12	12	12	12	12	12	12
Total Lost time (s)	5.8	5.7			5.7			6.0				
Lane Util. Factor	1.00	0.91			0.91			0.91				
Frpb, ped/bikes	1.00	1.00			1.00			1.00				
Flpb, ped/bikes	1.00	1.00			1.00			1.00				
Frt	1.00	1.00			0.87			1.00				
Flt Protected	0.95	1.00			1.00			1.00				
Satd. Flow (prot)	1529	4398			4071			4765				
Flt Permitted	0.36	1.00			1.00			1.00				
Satd. Flow (perm)	580	4398			4071			4765				
Peak-hour factor, PHF	0.85	0.85	0.85	0.91	0.91	0.91	0.95	0.95	0.95	0.92	0.92	0.92
Adj. Flow (vph)	521	985	0	0	103	536	2	739	5	0	0	0
RTOR Reduction (vph)	0	0	0	0	59	0	0	1	0	0	0	0
Lane Group Flow (vph)	521	985	0	0	580	0	0	745	0	0	0	0
Confl. Peds. (#/hr)	5						5		4			
Heavy Vehicles (%)	8%	8%	8%	2%	2%	2%	3%	3%	3%	2%	2%	2%
Turn Type	pm+pt	NA			NA		Perm	NA				
Protected Phases	5	1			2			4				
Permitted Phases	1						4					
Actuated Green, G (s)	31.3	31.3			17.3			27.0				
Effective Green, g (s)	31.3	31.3			17.3			27.0				
Actuated g/C Ratio	0.45	0.45			0.25			0.39				
Clearance Time (s)	5.8	5.7			5.7			6.0				
Lane Grp Cap (vph)	370	1966			1006			1837				
v/s Ratio Prot	c0.16	0.22			0.14							
v/s Ratio Perm	c0.46							0.16				
v/c Ratio	1.41	0.50			1.26dr			0.41				
Uniform Delay, d1	19.7	13.8			23.1			15.7				
Progression Factor	0.79	0.69			1.00			0.64				
Incremental Delay, d2	196.5	0.8			2.4			0.6				
Delay (s)	212.1	10.3			25.5			10.7				
Level of Service	F	B			C			B				
Approach Delay (s)		80.1			25.5			10.7			0.0	
Approach LOS		F			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	50.1	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	68.5%	ICU Level of Service	C
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	2035	190	20	55	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	11	12	12	12	12	12	12
Total Lost time (s)					3.0			3.0				
Lane Util. Factor					0.86			0.91				
Frt					0.99			1.00				
Flt Protected					1.00			0.99				
Satd. Flow (prot)					5450			4607				
Flt Permitted					1.00			0.99				
Satd. Flow (perm)					5450			4607				
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.95	0.95	0.86	0.86	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	0	2142	200	23	64	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	60	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	2342	0	0	27	0	0	0	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	0%	0%	3%	3%	3%	3%
Turn Type					NA		Perm	NA				
Protected Phases					6			8				
Permitted Phases					6		8					
Actuated Green, G (s)					36.0			19.0				
Effective Green, g (s)					42.0			22.0				
Actuated g/C Ratio					0.60			0.31				
Clearance Time (s)					9.0			6.0				
Lane Grp Cap (vph)					3270			1447				
v/s Ratio Prot					c0.43							
v/s Ratio Perm								0.01				
v/c Ratio					0.72			0.02				
Uniform Delay, d1					9.8			16.6				
Progression Factor					0.34			1.00				
Incremental Delay, d2					0.9			0.0				
Delay (s)					4.2			16.6				
Level of Service					A			B				
Approach Delay (s)		0.0			4.2			16.6			0.0	
Approach LOS		A			A			B			A	

Intersection Summary			
HCM 2000 Control Delay	4.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.79		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	31.5
Intersection Capacity Utilization	64.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1335	0	0	175	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0	
Lane Util. Factor		0.86			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5711			2945	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5711			2945	
Peak-hour factor, PHF	0.90	0.92	0.92	0.92	0.60	0.92
Adj. Flow (vph)	0	1451	0	0	292	0
RTOR Reduction (vph)	0	0	0	0	36	0
Lane Group Flow (vph)	0	1451	0	0	256	0
Heavy Vehicles (%)	3%	3%	3%	3%	7%	3%
Turn Type		NA			Prot	
Protected Phases		2			8	
Permitted Phases		2				
Actuated Green, G (s)		23.5			23.0	
Effective Green, g (s)		38.0			26.0	
Actuated g/C Ratio		0.54			0.37	
Clearance Time (s)		17.5			6.0	
Lane Grp Cap (vph)		3100			1093	
v/s Ratio Prot		c0.25			c0.09	
v/s Ratio Perm						
v/c Ratio		0.47			0.23	
Uniform Delay, d1		9.8			15.1	
Progression Factor		1.00			0.01	
Incremental Delay, d2		0.5			0.4	
Delay (s)		10.3			0.6	
Level of Service		B			A	
Approach Delay (s)		10.3	0.0		0.6	
Approach LOS		B	A		A	

Intersection Summary			
HCM 2000 Control Delay	8.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	50.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1510	0	0	225	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0	
Lane Util. Factor		0.86			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5711			3152	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5711			3152	
Peak-hour factor, PHF	0.90	0.95	0.90	0.90	0.94	0.90
Adj. Flow (vph)	0	1589	0	0	239	0
RTOR Reduction (vph)	0	0	0	0	40	0
Lane Group Flow (vph)	0	1589	0	0	199	0
Heavy Vehicles (%)	3%	3%	3%	3%	0%	3%
Turn Type		NA			Prot	
Protected Phases		2			8	
Permitted Phases						
Actuated Green, G (s)		23.5			19.0	
Effective Green, g (s)		42.0			22.0	
Actuated g/C Ratio		0.60			0.31	
Clearance Time (s)		21.5			6.0	
Lane Grp Cap (vph)		3426			990	
v/s Ratio Prot		c0.28			c0.06	
v/s Ratio Perm						
v/c Ratio		0.46			0.20	
Uniform Delay, d1		7.8			17.6	
Progression Factor		0.54			0.61	
Incremental Delay, d2		0.4			0.4	
Delay (s)		4.6			11.1	
Level of Service		A			B	
Approach Delay (s)		4.6	0.0		11.1	
Approach LOS		A	A		B	

Intersection Summary			
HCM 2000 Control Delay	5.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	42.6%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1615	560	0	0	0	0	120	214	160	166	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	11	11	12	12	12	12	12	12	12	12	12
Total Lost time (s)		3.0	3.0					3.0	3.0		3.0	
Lane Util. Factor		0.86	0.88					0.91	0.91		0.95	
Frt		1.00	0.85					0.93	0.85		1.00	
Flt Protected		1.00	1.00					1.00	1.00		0.98	
Satd. Flow (prot)		5468	2378					2812	1284		3109	
Flt Permitted		1.00	1.00					1.00	1.00		0.70	
Satd. Flow (perm)		5468	2378					2812	1284		2219	
Peak-hour factor, PHF	0.87	0.95	0.95	0.90	0.90	0.90	0.88	0.88	0.88	0.73	0.73	0.73
Adj. Flow (vph)	0	1700	589	0	0	0	0	136	243	219	227	0
RTOR Reduction (vph)	0	0	261	0	0	0	0	11	30	0	0	0
Lane Group Flow (vph)	0	1700	328	0	0	0	0	242	96	0	446	0
Heavy Vehicles (%)	4%	4%	4%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Turn Type		NA	Prot					NA	Prot	Perm	NA	
Protected Phases		2	2					4	4		8	
Permitted Phases										8		
Actuated Green, G (s)		36.0	36.0					18.0	18.0		22.0	
Effective Green, g (s)		39.0	39.0					25.0	25.0		25.0	
Actuated g/C Ratio		0.56	0.56					0.36	0.36		0.36	
Clearance Time (s)		6.0	6.0					10.0	10.0		6.0	
Lane Grp Cap (vph)		3046	1324					1004	458		792	
v/s Ratio Prot		c0.31	0.14					0.09	0.07			
v/s Ratio Perm											c0.20	
v/c Ratio		0.56	0.25					0.24	0.21		0.56	
Uniform Delay, d1		10.0	8.0					15.8	15.6		18.1	
Progression Factor		1.40	5.54					1.00	1.00		0.13	
Incremental Delay, d2		0.7	0.4					0.6	1.0		2.2	
Delay (s)		14.7	44.6					16.4	16.7		4.6	
Level of Service		B	D					B	B		A	
Approach Delay (s)		22.4			0.0			16.5			4.6	
Approach LOS		C			A			B			A	

Intersection Summary			
HCM 2000 Control Delay	19.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	57.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑↑↑↑				
Volume (vph)	0	1989	0	0	0	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)		3.0				
Lane Util. Factor		0.81				
Frt		1.00				
Flt Protected		1.00				
Satd. Flow (prot)		7788				
Flt Permitted		1.00				
Satd. Flow (perm)		7788				
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	2210	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	2210	0	0	0	0
Heavy Vehicles (%)	3%	4%	3%	3%	3%	3%
Turn Type		NA				
Protected Phases		2				
Permitted Phases						
Actuated Green, G (s)		36.5				
Effective Green, g (s)		39.0				
Actuated g/C Ratio		0.56				
Clearance Time (s)		5.5				
Vehicle Extension (s)		3.0				
Lane Grp Cap (vph)		4339				
v/s Ratio Prot		c0.28				
v/s Ratio Perm						
v/c Ratio		0.51				
Uniform Delay, d1		9.6				
Progression Factor		0.66				
Incremental Delay, d2		0.4				
Delay (s)		6.7				
Level of Service		A				
Approach Delay (s)		6.7	0.0		0.0	
Approach LOS		A	A		A	

Intersection Summary			
HCM 2000 Control Delay	6.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	48.6%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	12	1678	79	0	0	0	0	920	661	111	54	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	11	11	12	12	12	12	11	11	13	13	12
Total Lost time (s)		3.0						3.0	3.0	3.0	3.0	
Lane Util. Factor		0.86						0.91	0.88	1.00	0.95	
Frt		0.99						1.00	0.85	1.00	1.00	
Flt Protected		1.00						1.00	1.00	0.95	1.00	
Satd. Flow (prot)		5482						4257	2333	1472	2945	
Flt Permitted		1.00						1.00	1.00	0.17	1.00	
Satd. Flow (perm)		5482						4257	2333	258	2945	
Peak-hour factor, PHF	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.86	0.86	0.88	0.88	0.90
Adj. Flow (vph)	13	1824	86	0	0	0	0	1070	769	126	61	0
RTOR Reduction (vph)	0	9	0	0	0	0	0	0	31	0	0	0
Lane Group Flow (vph)	0	1914	0	0	0	0	0	1070	738	126	61	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	6%	6%	14%	14%	14%
Turn Type	Perm	NA						NA	Prot	Perm	NA	
Protected Phases		2						4	4		8	
Permitted Phases	2									8		
Actuated Green, G (s)		37.0						17.1	17.1	21.1	21.1	
Effective Green, g (s)		40.0						24.0	24.0	24.0	24.0	
Actuated g/C Ratio		0.57						0.34	0.34	0.34	0.34	
Clearance Time (s)		6.0						9.9	9.9	5.9	5.9	
Lane Grp Cap (vph)		3132						1459	799	88	1009	
v/s Ratio Prot								0.25	0.32		0.02	
v/s Ratio Perm		0.35								c0.49		
v/c Ratio		0.61						0.73	0.92	1.43	0.06	
Uniform Delay, d1		9.9						20.2	22.1	23.0	15.4	
Progression Factor		0.07						1.00	1.00	0.31	0.61	
Incremental Delay, d2		0.8						3.3	17.9	243.3	0.1	
Delay (s)		1.4						23.5	40.1	250.5	9.5	
Level of Service		A						C	D	F	A	
Approach Delay (s)		1.4			0.0			30.4			171.9	
Approach LOS		A			A			C			F	

Intersection Summary			
HCM 2000 Control Delay	23.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	102.8%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	130	0	0	0	0	0	1058	0	0	515	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)		6.0						10.1			6.1	
Lane Util. Factor		1.00						0.91			0.95	
Frt		1.00						1.00			1.00	
Flt Protected		1.00						1.00			1.00	
Satd. Flow (prot)		1961						5353			3725	
Flt Permitted		1.00						1.00			1.00	
Satd. Flow (perm)		1961						5353			3725	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	141	0	0	0	0	0	1150	0	0	560	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	141	0	0	0	0	0	1150	0	0	560	0
Turn Type	Perm	NA		D.Pm		Prot		NA			NA	
Protected Phases		8				8		2			6	
Permitted Phases	8			8		8						
Actuated Green, G (s)		44.0						49.9			53.9	
Effective Green, g (s)		44.0						49.9			53.9	
Actuated g/C Ratio		0.40						0.45			0.49	
Clearance Time (s)		6.0						10.1			6.1	
Lane Grp Cap (vph)		784						2428			1825	
v/s Ratio Prot		c0.07						c0.21			0.15	
v/s Ratio Perm												
v/c Ratio		0.18						0.47			0.31	
Uniform Delay, d1		21.3						20.9			16.8	
Progression Factor		1.00						1.00			0.38	
Incremental Delay, d2		0.5						0.7			0.3	
Delay (s)		21.8						21.6			6.7	
Level of Service		C						C			A	
Approach Delay (s)		21.8			0.0			21.6			6.7	
Approach LOS		C			A			C			A	

Intersection Summary			
HCM 2000 Control Delay	17.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.34		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.1
Intersection Capacity Utilization	39.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	18	37	35	0	0	0	7	571	0	0	337	57
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)		4.0						4.0			4.0	
Lane Util. Factor		1.00						0.95			0.95	
Frt		0.95						1.00			0.98	
Flt Protected		0.99						1.00			1.00	
Satd. Flow (prot)		1839						3723			3645	
Flt Permitted		0.96						0.95			1.00	
Satd. Flow (perm)		1782						3540			3645	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	20	40	38	0	0	0	8	621	0	0	366	62
RTOR Reduction (vph)	0	25	0	0	0	0	0	0	0	0	15	0
Lane Group Flow (vph)	0	73	0	0	0	0	0	629	0	0	413	0
Turn Type	Perm	NA					Perm	NA			NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4					
Actuated Green, G (s)		27.0						55.0			55.0	
Effective Green, g (s)		27.0						55.0			55.0	
Actuated g/C Ratio		0.30						0.61			0.61	
Clearance Time (s)		4.0						4.0			4.0	
Lane Grp Cap (vph)		534						2163			2227	
v/s Ratio Prot											0.11	
v/s Ratio Perm		c0.04						c0.18				
v/c Ratio		0.14						0.29			0.19	
Uniform Delay, d1		23.0						8.3			7.7	
Progression Factor		0.12						1.00			1.00	
Incremental Delay, d2		0.5						0.3			0.2	
Delay (s)		3.3						8.6			7.9	
Level of Service		A						A			A	
Approach Delay (s)		3.3			0.0			8.6			7.9	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.24		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	31.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (vph)	922	0	0	0	0	0	360	184	0	0
Ideal Flow (vphpl)	1900	2000	1900	2000	2000	2000	2000	1900	1900	1900
Total Lost time (s)	6.0						5.7			
Lane Util. Factor	*0.91						0.91			
Frt	1.00						0.95			
Flt Protected	0.95						1.00			
Satd. Flow (prot)	4831						4936			
Flt Permitted	0.95						1.00			
Satd. Flow (perm)	4831						4936			
Peak-hour factor, PHF	0.95	0.95	0.92	0.92	0.92	0.83	0.83	0.83	0.92	0.92
Adj. Flow (vph)	971	0	0	0	0	0	434	222	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	55	0	0	0
Lane Group Flow (vph)	971	0	0	0	0	0	601	0	0	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	5%	5%	5%	2%	2%
Turn Type	Prot						NA			
Protected Phases	1						3			
Permitted Phases										
Actuated Green, G (s)	35.0						23.3			
Effective Green, g (s)	35.0						23.3			
Actuated g/C Ratio	0.50						0.33			
Clearance Time (s)	6.0						5.7			
Vehicle Extension (s)	0.2						0.2			
Lane Grp Cap (vph)	2415						1642			
v/s Ratio Prot	c0.20						c0.12			
v/s Ratio Perm										
v/c Ratio	0.40						0.37			
Uniform Delay, d1	11.0						17.7			
Progression Factor	1.53						0.53			
Incremental Delay, d2	0.5						0.6			
Delay (s)	17.2						10.0			
Level of Service	B						A			
Approach Delay (s)	17.2			0.0			10.0		0.0	
Approach LOS	B			A			A		A	

Intersection Summary			
HCM 2000 Control Delay	14.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.7
Intersection Capacity Utilization	58.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1251	0	0	360	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)		6.0			5.7	
Lane Util. Factor		0.91			0.94	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5406			5202	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5406			5202	
Peak-hour factor, PHF	0.83	0.83	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1507	0	0	391	0
RTOR Reduction (vph)	0	0	0	0	34	0
Lane Group Flow (vph)	0	1507	0	0	357	0
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%
Turn Type		NA			Prot	
Protected Phases		2			4	
Permitted Phases						
Actuated Green, G (s)		35.0			23.3	
Effective Green, g (s)		35.0			23.3	
Actuated g/C Ratio		0.50			0.33	
Clearance Time (s)		6.0			5.7	
Vehicle Extension (s)		0.2			0.2	
Lane Grp Cap (vph)		2703			1731	
v/s Ratio Prot		c0.28			c0.07	
v/s Ratio Perm						
v/c Ratio		0.56			0.21	
Uniform Delay, d1		12.1			16.7	
Progression Factor		1.03			0.02	
Incremental Delay, d2		0.6			0.3	
Delay (s)		13.2			0.6	
Level of Service		B			A	
Approach Delay (s)		13.2	0.0		0.6	
Approach LOS		B	A		A	

Intersection Summary			
HCM 2000 Control Delay	10.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.7
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	916	413	0	229	0	0	0	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)					5.8	5.8		5.4				
Lane Util. Factor					0.91	1.00		0.91				
Frt					1.00	0.85		1.00				
Flt Protected					1.00	1.00		1.00				
Satd. Flow (prot)					5301	1650		5353				
Flt Permitted					1.00	1.00		1.00				
Satd. Flow (perm)					5301	1650		5353				
Peak-hour factor, PHF	0.92	0.92	0.92	0.95	0.95	0.95	0.82	0.82	0.82	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	964	435	0	279	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	21	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	964	414	0	279	0	0	0	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type					NA	Perm		NA				
Protected Phases					1			2				
Permitted Phases						1						
Actuated Green, G (s)					49.2	49.2		9.6				
Effective Green, g (s)					49.2	49.2		9.6				
Actuated g/C Ratio					0.70	0.70		0.14				
Clearance Time (s)					5.8	5.8		5.4				
Vehicle Extension (s)					0.2	0.2		0.2				
Lane Grp Cap (vph)					3725	1159		734				
v/s Ratio Prot					0.18			c0.05				
v/s Ratio Perm						c0.25						
v/c Ratio					0.26	0.36		0.38				
Uniform Delay, d1					3.8	4.1		27.5				
Progression Factor					1.16	1.22		0.70				
Incremental Delay, d2					0.1	0.6		1.4				
Delay (s)					4.5	5.6		20.6				
Level of Service					A	A		C				
Approach Delay (s)		0.0			4.9			20.6			0.0	
Approach LOS		A			A			C			A	

Intersection Summary			
HCM 2000 Control Delay	7.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.2
Intersection Capacity Utilization	57.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX A-3
Existing Year HCS Measures of Effectiveness
AM PEAK

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	D Cook	Freeway/Dir of Travel	Fisher Fwy EB
Agency or Company	Parsons Brinckerhoff	Junction	On Ramp from NB 375
Date Performed	1/24/2014	Jurisdiction	MDOT
Analysis Time Period	AM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☑ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☐ No ☑ Off
L_{up} = ft	Acceleration Lane Length, L_A: 439	L_{down} = 500 ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = 1324 veh/h
	Freeway Volume, V_F: 1300	
	Ramp Volume, V_R: 24	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1300	0.94	Level	6	0	0.971	1.00	1424
Ramp	24	0.94	Level	6	0	0.971	1.00	26
UpStream								
DownStream	1324	0.94	Level	6	0	0.971	1.00	1451

Estimation of v_{12} — Merge Areas

$V_{12} = V_F (P_{FM})$

L_{EQ} = 9267.24 (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1424 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Estimation of v_{12} — Diverge Areas

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1450	Exhibit 13-8		No

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1450	Exhibit 13-8	4600:All	No

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 14.0 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

M_S = 0.307 (Exibit 13-11)

S_R= 51.0 mph (Exhibit 13-11)

S_0= 55.0 mph (Exhibit 13-11)

S = 51.0 mph (Exhibit 13-13)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	D Cook	Freeway/Dir of Travel	Fisher Fwy EB
Agency or Company	Parsons Brinckerhoff	Junction	On Ramp from Fisher EB Ser Dr
Date Performed	1/24/2014	Jurisdiction	MDOT
Analysis Time Period	AM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 1569 ft	Acceleration Lane Length, L_A: 185	L_{down} = ft
V_u = 3808 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 1094	
	Ramp Volume, V_R: 58	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1094	0.94	Level	6	0	0.971	1.00	1199
Ramp	58	0.94	Level	6	0	0.971	1.00	64
UpStream	3808	0.94	Level	6	0	0.971	1.00	4173
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1199 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1263	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1263	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 14.1 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.322 (Exibit 13-11)

S_R= 50.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*Fisher EB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*375 Off to Fisher Ser Dr On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1094*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*599*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*10.9*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*Fisher EB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*ChryslerSB On to 375 NB On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1300*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*475*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*8.6*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*Fisher EB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher ServOn to ChryslerSB On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1152*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*631*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*11.5*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	D Cook	Freeway/Dir of Travel	I-375/Chrysler NB
Agency or Company	Parsons Brinckerhoff	Junction	Madison On-Ramp
Date Performed	1/24/2014	Jurisdiction	MDOT
Analysis Time Period	AM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☑ Yes	☑ On
☑ No	☐ Off	Acceleration Lane Length, L_A	265	☐ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D		L_{down} =	815 ft
V_u =	veh/h	Freeway Volume, V_F	1615	V_D =	2448 veh/h
		Ramp Volume, V_R	186		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	35.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1615	0.94	Level	2	0	0.990	1.00	1735
Ramp	186	0.94	Level	2	0	0.990	1.00	200
UpStream								
DownStream	2448	0.94	Level	2	0	0.990	1.00	2630

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.585 using Equation (Exhibit 13-6)

V_{12} = 1015 pc/h

V_3 or V_{av34} 720 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1015 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1935	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1336	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 14.1 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.317 (Exibit 13-11)

S_R= 50.9 mph (Exhibit 13-11)

S_0= 54.6 mph (Exhibit 13-11)

S = 52.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	D Cook	Freeway/Dir of Travel	I-375/Chrysler NB
Agency or Company	Parsons Brinckerhoff	Junction	On Ramp from Fisher EB
Date Performed	1/24/2014	Jurisdiction	MDOT
Analysis Time Period	AM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes	☑ On	Ramp Number of Lanes, N	2	☐ Yes ☐ On
☐ No	☐ Off	Acceleration Lane Length, L_A	250	☑ No ☐ Off
L_{up} =	815 ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	186 veh/h	Freeway Volume, V_F	1801	V_D = veh/h
		Ramp Volume, V_R	2448	
		Freeway Free-Flow Speed, S_{FF}	55.0	
		Ramp Free-Flow Speed, S_{FR}	35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1801	0.94	Level	2	0	0.990	1.00	1935
Ramp	2448	0.94	Level	6	0	0.971	1.00	2682
UpStream	186	0.94	Level	2	0	0.990	1.00	200
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.555 using Equation (Exhibit 13-6)

V_{12} = 1074 pc/h

V_3 or V_{av34} 861 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 1105 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	4617	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3787	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 21.2 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.353 (Exibit 13-11)

S_R= 50.4 mph (Exhibit 13-11)

S_0= 53.8 mph (Exhibit 13-11)

S = 51.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher Off to Madison On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1615*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*578*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*10.5*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Jefferson to Larned On-Ramp*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*482*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*259*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*4.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Larned On to Monroe On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1320*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*473*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*8.6*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher EB On to Fisher WB On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4249*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1164*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*21.2*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	D Cook
Agency/Company	Parsons Brinckerhoff
Date Performed	1/24/2014
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	I-375 NB
Weaving Segment Location	Fisher WB On to Mack Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	5
Weaving segment length, L_S	1050ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3974	0.94	6	0	1.5	1.2	0.971	1.00	4354
V_{RF}	233	0.94	6	0	1.5	1.2	0.971	1.00	255
V_{FR}	540	0.94	6	0	1.5	1.2	0.971	1.00	592
V_{RR}	32	0.94	6	0	1.5	1.2	0.971	1.00	35
V_{NW}	4389							V =	5084
V_W	847								
VR	0.162								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	3.3 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	847 lc/h
Weaving lane changes, LC_W	1705 lc/h
Non-weaving lane changes, LC_{NW}	1243 lc/h
Total lane changes, LC_{ALL}	2948 lc/h
Non-weaving vehicle index, I_{NW}	1521

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5084 veh/h
Weaving segment capacity, c_w	9772 veh/h
Weaving segment v/c ratio	0.520
Weaving segment density, D	24.1 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.510
Weaving segment speed, S	43.5 mph
Average weaving speed, S_W	41.5 mph
Average non-weaving speed, S_{NW}	43.9 mph
Maximum weaving length, L_{MAX}	4149 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	D Cook
Agency/Company	Parsons Brinckerhoff
Date Performed	1/24/2014
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	I-375 SB
Weaving Segment Location	Monroe On and Fisher Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1342ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	939	0.94	2	0	1.5	1.2	0.990	1.00	1009
V_{RF}	501	0.94	2	0	1.5	1.2	0.990	1.00	538
V_{FR}	318	0.94	2	0	1.5	1.2	0.990	1.00	342
V_{RR}	250	0.94	2	0	1.5	1.2	0.990	1.00	269
V_{NW}	1278							V =	2137
V_W	880								
VR	0.408								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	538 lc/h
Interchange density, ID	3.2 int/mi	Weaving lane changes, LC_W	1173 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	220 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	1393 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	549

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2137 veh/h	Weaving intensity factor, W	0.233
Weaving segment capacity, c_w	7743 veh/h	Weaving segment speed, S	48.1 mph
Weaving segment v/c ratio	0.276	Average weaving speed, S_W	47.4 mph
Weaving segment density, D	11.2 pc/mi/ln	Average non-weaving speed, S_{NW}	48.5 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	5203 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	R Bezati	Freeway/Dir of Travel	I-375/Chrysler NB
Agency or Company	Parsons Brinckerhoff	Junction	Madison On-Ramp
Date Performed	5/28/2014	Jurisdiction	MDOT
Analysis Time Period	AM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes ☐ On
☐ No	☑ Off	Acceleration Lane Length, L_A	600	☑ No ☐ Off
L_{up} =	1540 ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	2162 veh/h	Freeway Volume, V_F	3788	V_D = veh/h
		Ramp Volume, V_R	940	
		Freeway Free-Flow Speed, S_{FF}	55.0	
		Ramp Free-Flow Speed, S_{FR}	35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3788	0.94	Level	2	0	0.990	1.00	4070
Ramp	940	0.94	Level	2	0	0.990	1.00	1010
UpStream	2162	0.94	Level	2	0	0.990	1.00	2323
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 781.72 (Equation 13-6 or 13-7)

P_{FM} = 0.594 using Equation (Exhibit 13-6)

V_{12} = 2419 pc/h

V_3 or V_{av34} 1651 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 2419 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5080	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3719	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 30.3 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.440 (Exibit 13-11)

S_R= 49.3 mph (Exhibit 13-11)

S_0= 51.9 mph (Exhibit 13-11)

S = 50.0 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher WB On to Fisher EB On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2902*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*780*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*14.2*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 SB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Larned Off and Jefferson End*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1729*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*929*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*16.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 SB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Mack Off to Mack On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5702*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1562*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*28.4*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 SB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Madison Off to Fisher WB On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2848*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1020*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*18.5*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	D Cook
Agency/Company	Parsons Brinckerhoff
Date Performed	1/24/2014
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	I-375 SB
Weaving Segment Location	Fisher EB On to Monroe Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	730ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1994	0.94	2	0	1.5	1.2	0.990	1.00	2142
V_{RF}	934	0.94	2	0	1.5	1.2	0.990	1.00	1004
V_{FR}	908	0.94	2	0	1.5	1.2	0.990	1.00	976
V_{RR}	426	0.94	2	0	1.5	1.2	0.990	1.00	458
V_{NW}	2600							V =	4535
V_W	1980								
VR	0.432								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1980 lc/h
Interchange density, ID	3.2 int/mi	Weaving lane changes, LC_W	2388 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	161 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	2549 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	607

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4535 veh/h	Weaving intensity factor, W	0.606
Weaving segment capacity, c_w	5497 veh/h	Weaving segment speed, S	37.1 mph
Weaving segment v/c ratio	0.825	Average weaving speed, S_W	39.9 mph
Weaving segment density, D	30.8 pc/mi/ln	Average non-weaving speed, S_{NW}	35.2 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	7046 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	D Cook
Agency/Company	Parsons Brinckerhoff
Date Performed	1/24/2014
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	I-375 SB
Weaving Segment Location	Mack On to Fisher Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	5
Weaving segment length, L_S	1452ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	3630	0.94	2	0	1.5	1.2	0.990	1.00	3900
V_{RF}	158	0.94	2	0	1.5	1.2	0.990	1.00	170
V_{FR}	2072	0.94	6	0	1.5	1.2	0.971	1.00	2270
V_{RR}	90	0.94	6	0	1.5	1.2	0.971	1.00	99
V_{NW}	3999							V =	6376
V_W	2440								
VR	0.379								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	170 lc/h
Interchange density, ID	3.3 int/mi	Weaving lane changes, LC_W	1233 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	2480 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	3713 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	1916

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	6376 veh/h	Weaving intensity factor, W	0.474
Weaving segment capacity, c_w	9145 veh/h	Weaving segment speed, S	45.4 mph
Weaving segment v/c ratio	0.697	Average weaving speed, S_W	42.1 mph
Weaving segment density, D	28.4 pc/mi/ln	Average non-weaving speed, S_{NW}	47.6 mph
Level of Service, LOS	D	Maximum weaving length, L_{MAX}	4880 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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APPENDIX A-4
Existing Year HCS Measures of Effectiveness
PM PEAK

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	D Cook	Freeway/Dir of Travel	Fisher Fwy EB
Agency or Company	Parsons Brinckerhoff	Junction	On Ramp from NB 375
Date Performed	1/24/2014	Jurisdiction	MDOT
Analysis Time Period	PM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☑ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☐ No ☑ Off
L_{up} = ft	Acceleration Lane Length, L_A: 439	L_{down} = 500 ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = 1583 veh/h
	Freeway Volume, V_F: 1522	
	Ramp Volume, V_R: 61	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1522	0.94	Level	6	0	0.971	1.00	1668
Ramp	61	0.94	Level	6	0	0.971	1.00	67
UpStream								
DownStream	1583	0.94	Level	6	0	0.971	1.00	1735

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 11081.09 (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1668 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1735	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1735	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 16.2 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.312 (Exibit 13-11)

S_R= 50.9 mph (Exhibit 13-11)

S_0= 55.0 mph (Exhibit 13-11)

S = 50.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	D Cook	Freeway/Dir of Travel	Fisher Fwy EB
Agency or Company	Parsons Brinckerhoff	Junction	On Ramp from Fisher EB Ser Dr
Date Performed	1/24/2014	Jurisdiction	MDOT
Analysis Time Period	PM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1569 ft

V_u = 2794 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	185
Deceleration Lane Length L_D	
Freeway Volume, V_F	1190
Ramp Volume, V_R	130
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	35.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	1190	0.94	Level	6	0	0.971	1.00	1304
Ramp	130	0.94	Level	6	0	0.971	1.00	142
UpStream	2794	0.94	Level	6	0	0.971	1.00	3062
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 1304 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1446	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	1446	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 15.5 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.325 (Exibit 13-11)

S_R= 50.8 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.8 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*Fisher EB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*375 Off to Fisher Ser Dr On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1190*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*652*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*11.9*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*Fisher EB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*ChryslerSB On to 375 NB On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1522*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*556*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*10.1*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*Fisher EB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher ServOn to ChryslerSB On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1320*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*723*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*13.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	D Cook	Freeway/Dir of Travel	I-375/Chrysler NB
Agency or Company	Parsons Brinckerhoff	Junction	Madison On-Ramp
Date Performed	1/24/2014	Jurisdiction	MDOT
Analysis Time Period	PM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☑ Yes	☑ On
☑ No	☐ Off	Acceleration Lane Length, L_A	265	☐ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D		L_{down} =	815 ft
V_u =	veh/h	Freeway Volume, V_F	2481	V_D =	2022 veh/h
		Ramp Volume, V_R	577		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	35.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2481	0.94	Level	2	0	0.990	1.00	2666
Ramp	577	0.94	Level	2	0	0.990	1.00	620
UpStream								
DownStream	2022	0.94	Level	2	0	0.990	1.00	2173

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.585 using Equation (Exhibit 13-6)

V_{12} = 1559 pc/h

V_3 or V_{av34} 1107 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1559 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3286	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2366	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 22.0 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.344 (Exibit 13-11)

S_R= 50.5 mph (Exhibit 13-11)

S_0= 53.5 mph (Exhibit 13-11)

S = 51.3 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	D Cook	Freeway/Dir of Travel	I-375/Chrysler NB
Agency or Company	Parsons Brinckerhoff	Junction	On Ramp from Fisher EB
Date Performed	1/24/2014	Jurisdiction	MDOT
Analysis Time Period	PM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes	☑ On	Ramp Number of Lanes, N	2	☐ Yes ☐ On
☐ No	☐ Off	Acceleration Lane Length, L_A	250	☑ No ☐ Off
L_{up} =	815 ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	577 veh/h	Freeway Volume, V_F	3058	V_D = veh/h
		Ramp Volume, V_R	2022	
		Freeway Free-Flow Speed, S_{FF}	55.0	
		Ramp Free-Flow Speed, S_{FR}	35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3058	0.94	Level	2	0	0.990	1.00	3286
Ramp	2022	0.94	Level	6	0	0.971	1.00	2216
UpStream	577	0.94	Level	2	0	0.990	1.00	620
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.555 using Equation (Exhibit 13-6)

V_{12} = 1824 pc/h

V_3 or V_{av34} 1462 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 1877 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5502	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4093	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 23.8 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.415 (Exibit 13-11)

S_R= 49.6 mph (Exhibit 13-11)

S_0= 51.7 mph (Exhibit 13-11)

S = 50.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher Off to Madison On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2481*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*889*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*16.2*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Jefferson to Larned On-Ramp*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1235*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*663*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*12.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Larned On to Monroe On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2796*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1001*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*18.2*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher EB On to Fisher WB On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*5080*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*4*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1392*	pc/h/ln	Design LOS	
S	*55.0*	mph	v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
D = v_p / S	*25.3*	pc/mi/ln	S	mph
LOS	*C*		D = v_p / S	pc/mi/ln
			Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	D Cook
Agency/Company	Parsons Brinckerhoff
Date Performed	1/24/2014
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	I-375 NB
Weaving Segment Location	Fisher WB On to Mack Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	5
Weaving segment length, L_S	1050ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	4675	0.94	6	0	1.5	1.2	0.971	1.00	5123
V_{RF}	173	0.94	6	0	1.5	1.2	0.971	1.00	190
V_{FR}	405	0.94	6	0	1.5	1.2	0.971	1.00	444
V_{RR}	15	0.94	6	0	1.5	1.2	0.971	1.00	16
V_{NW}	5139							V =	5605
V_W	634								
VR	0.110								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	634 lc/h
Interchange density, ID	3.3 int/mi	Weaving lane changes, LC_W	1492 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	2270 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	3762 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	1781

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5605 veh/h	Weaving intensity factor, W	0.619
Weaving segment capacity, c_w	9961 veh/h	Weaving segment speed, S	44.3 mph
Weaving segment v/c ratio	0.563	Average weaving speed, S_W	39.7 mph
Weaving segment density, D	26.1 pc/mi/ln	Average non-weaving speed, S_{NW}	44.9 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	3635 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	D Cook
Agency/Company	Parsons Brinckerhoff
Date Performed	1/24/2014
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	I-375 SB
Weaving Segment Location	Monroe On and Fisher Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1342ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	976	0.94	2	0	1.5	1.2	0.990	1.00	1049
V_{RF}	639	0.94	2	0	1.5	1.2	0.990	1.00	687
V_{FR}	344	0.94	2	0	1.5	1.2	0.990	1.00	370
V_{RR}	225	0.94	2	0	1.5	1.2	0.990	1.00	242
V_{NW}	1291							V =	2325
V_W	1057								
VR	0.450								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	687 lc/h
Interchange density, ID	3.2 int/mi	Weaving lane changes, LC_W	1322 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	223 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	1545 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	554

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2325 veh/h	Weaving intensity factor, W	0.253
Weaving segment capacity, c_w	7596 veh/h	Weaving segment speed, S	47.1 mph
Weaving segment v/c ratio	0.306	Average weaving speed, S_W	46.9 mph
Weaving segment density, D	12.5 pc/mi/ln	Average non-weaving speed, S_{NW}	47.2 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	5684 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	R Bezati	Freeway/Dir of Travel	I-375/Chrysler NB
Agency or Company	Parsons Brinckerhoff	Junction	Madison On-Ramp
Date Performed	5/28/2014	Jurisdiction	MDOT
Analysis Time Period	PM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes ☐ On
☐ No	☑ Off	Acceleration Lane Length, L_A	600	☑ No ☐ Off
L_{up} =	1540 ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	3255 veh/h	Freeway Volume, V_F	2268	V_D = veh/h
		Ramp Volume, V_R	618	
		Freeway Free-Flow Speed, S_{FF}	55.0	
		Ramp Free-Flow Speed, S_{FR}	35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	2268	0.94	Level	2	0	0.990	1.00	2437
Ramp	618	0.94	Level	2	0	0.990	1.00	664
UpStream	3255	0.94	Level	2	0	0.990	1.00	3497
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 358.21 (Equation 13-6 or 13-7)

P_{FM} = 0.594 using Equation (Exhibit 13-6)

V_{12} = 1448 pc/h

V_3 or V_{av34} 989 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 1448 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3101	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2285	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 19.2 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.317 (Exibit 13-11)

S_R= 50.9 mph (Exhibit 13-11)

S_0= 53.9 mph (Exhibit 13-11)

S = 51.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher WB On to Fisher EB On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1664*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*447*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*8.1*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 SB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Larned Off and Jefferson End*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*603*	veh/h	Peak-Hour Factor, PHF	*0.94*	
AADT		veh/day	%Trucks and Buses, P_T	*2*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*324*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*5.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 SB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Mack Off to Mack On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4869*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1334*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*24.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 SB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Madison Off to Fisher WB On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1650*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*591*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*10.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	D Cook
Agency/Company	Parsons Brinckerhoff
Date Performed	1/24/2014
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	I-375 SB
Weaving Segment Location	Fisher EB On to Monroe Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	730ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1014	0.94	2	0	1.5	1.2	0.990	1.00	1090
V_{RF}	471	0.94	2	0	1.5	1.2	0.990	1.00	506
V_{FR}	650	0.94	2	0	1.5	1.2	0.990	1.00	698
V_{RR}	301	0.94	2	0	1.5	1.2	0.990	1.00	323
V_{NW}	1413							V =	2592
V_W	1204								
VR	0.460								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1204 lc/h
Interchange density, ID	3.2 int/mi	Weaving lane changes, LC_W	1612 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	0 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1612 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	330

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	2592 veh/h	Weaving intensity factor, W	0.422
Weaving segment capacity, c_w	5165 veh/h	Weaving segment speed, S	43.2 mph
Weaving segment v/c ratio	0.502	Average weaving speed, S_W	43.1 mph
Weaving segment density, D	15.2 pc/mi/ln	Average non-weaving speed, S_{NW}	43.2 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	7363 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	D Cook
Agency/Company	Parsons Brinckerhoff
Date Performed	1/24/2014
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	I-375 SB
Weaving Segment Location	Mack On to Fisher Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	5
Weaving segment length, L_S	1452ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1999	0.94	2	0	1.5	1.2	0.990	1.00	2148
V_{RF}	269	0.94	2	0	1.5	1.2	0.990	1.00	289
V_{FR}	2870	0.94	6	0	1.5	1.2	0.971	1.00	3145
V_{RR}	385	0.94	6	0	1.5	1.2	0.971	1.00	422
V_{NW}	2570							V =	5945
V_W	3434								
VR	0.572								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	289 lc/h
Interchange density, ID	3.3 int/mi	Weaving lane changes, LC_W	1352 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	353 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	1705 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	1231

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5945 veh/h	Weaving intensity factor, W	0.257
Weaving segment capacity, c_w	6059 veh/h	Weaving segment speed, S	47.0 mph
Weaving segment v/c ratio	0.981	Average weaving speed, S_W	46.8 mph
Weaving segment density, D	25.6 pc/mi/ln	Average non-weaving speed, S_{NW}	47.2 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	7114 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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APPENDIX B-1
Future Year No-Build Signalized Intersections
Measures of Effectiveness
AM PEAK

HCM Signalized Intersection Capacity Analysis
3: I 375 NB Service Drive/NB I-375 Service Drive & E. Lafayette Blvd.

8/15/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	208	310	0	0	363	659	26	47	8	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5			5.5			7.7				
Lane Util. Factor	1.00	0.91			0.91			0.95				
Frt	1.00	1.00			0.90			0.98				
Flt Protected	0.95	1.00			1.00			0.98				
Satd. Flow (prot)	1770	5085			4594			3430				
Flt Permitted	0.17	1.00			1.00			0.98				
Satd. Flow (perm)	319	5085			4594			3430				
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	226	337	0	0	395	716	28	51	9	0	0	0
RTOR Reduction (vph)	0	0	0	0	417	0	0	7	0	0	0	0
Lane Group Flow (vph)	226	337	0	0	694	0	0	81	0	0	0	0
Turn Type	pm+pt	NA			NA		Perm	NA				
Protected Phases	7	4			8			2				
Permitted Phases	4						2					
Actuated Green, G (s)	40.5	40.5			22.5			16.3				
Effective Green, g (s)	40.5	40.5			22.5			16.3				
Actuated g/C Ratio	0.58	0.58			0.32			0.23				
Clearance Time (s)	5.5	5.5			5.5			7.7				
Lane Grp Cap (vph)	443	2942			1476			798				
v/s Ratio Prot	c0.09	0.07			0.15							
v/s Ratio Perm	c0.20							0.02				
v/c Ratio	0.51	0.11			0.47			0.10				
Uniform Delay, d1	16.0	6.7			19.0			21.1				
Progression Factor	0.83	0.79			1.00			0.91				
Incremental Delay, d2	3.8	0.1			1.1			0.2				
Delay (s)	17.1	5.4			20.1			19.5				
Level of Service	B	A			C			B				
Approach Delay (s)		10.1			20.1			19.5			0.0	
Approach LOS		B			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	16.8	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	18.7
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	446	0	0	914	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3			5.8		
Lane Util. Factor	*0.82			*0.63		
Frt	1.00			1.00		
Flt Protected	0.95			1.00		
Satd. Flow (prot)	2902			2347		
Flt Permitted	0.95			1.00		
Satd. Flow (perm)	2902			2347		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	485	0	0	993	0	0
RTOR Reduction (vph)	127	0	0	0	0	0
Lane Group Flow (vph)	358	0	0	993	0	0
Turn Type	Prot			NA		
Protected Phases	4			2		
Permitted Phases						
Actuated Green, G (s)	18.5			39.4		
Effective Green, g (s)	18.5			39.4		
Actuated g/C Ratio	0.26			0.56		
Clearance Time (s)	6.3			5.8		
Lane Grp Cap (vph)	766			1321		
v/s Ratio Prot	c0.12			c0.42		
v/s Ratio Perm						
v/c Ratio	0.47			0.75		
Uniform Delay, d1	21.6			11.6		
Progression Factor	0.66			1.11		
Incremental Delay, d2	1.9			3.4		
Delay (s)	16.1			16.3		
Level of Service	B			B		
Approach Delay (s)	16.1			16.3	0.0	
Approach LOS	B			B	A	

Intersection Summary			
HCM 2000 Control Delay	16.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	58.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	215	36	74	287	0	0	0	0	303	354	719
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5		5.5	5.5						7.7	
Lane Util. Factor		0.91		1.00	0.91						0.91	
Frt		0.98		1.00	1.00						0.92	
Flt Protected		1.00		0.95	1.00						0.99	
Satd. Flow (prot)		4976		1770	5085						4636	
Flt Permitted		1.00		0.58	1.00						0.99	
Satd. Flow (perm)		4976		1075	5085						4636	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	234	39	80	312	0	0	0	0	329	385	782
RTOR Reduction (vph)	0	26	0	0	0	0	0	0	0	0	158	0
Lane Group Flow (vph)	0	247	0	80	312	0	0	0	0	0	1338	0
Turn Type		NA		Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		22.5		22.5	22.5						34.3	
Effective Green, g (s)		22.5		22.5	22.5						34.3	
Actuated g/C Ratio		0.32		0.32	0.32						0.49	
Clearance Time (s)		5.5		5.5	5.5						7.7	
Lane Grp Cap (vph)		1599		345	1634						2271	
v/s Ratio Prot		0.05			0.06							
v/s Ratio Perm				c0.07							0.29	
v/c Ratio		0.15		0.23	0.19						0.59	
Uniform Delay, d1		17.0		17.4	17.2						12.8	
Progression Factor		1.00		1.03	1.00						0.18	
Incremental Delay, d2		0.2		1.3	0.2						1.0	
Delay (s)		17.2		19.2	17.3						3.3	
Level of Service		B		B	B						A	
Approach Delay (s)		17.2			17.7			0.0			3.3	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.45		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	13.2
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	346	42	0	0	0	0	0	0	83	1318	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3								5.8	
Lane Util. Factor		*0.82	1.00								0.91	
Frt		1.00	0.85								1.00	
Flt Protected		1.00	1.00								1.00	
Satd. Flow (prot)		3055	1583								5070	
Flt Permitted		1.00	1.00								1.00	
Satd. Flow (perm)		3055	1583								5070	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	376	46	0	0	0	0	0	0	90	1433	0
RTOR Reduction (vph)	0	0	31	0	0	0	0	0	0	0	16	0
Lane Group Flow (vph)	0	376	15	0	0	0	0	0	0	0	1507	0
Turn Type		NA	Perm							Perm	NA	
Protected Phases		2									4	
Permitted Phases			2							4		
Actuated Green, G (s)		20.2	20.2								38.7	
Effective Green, g (s)		20.2	20.2								38.7	
Actuated g/C Ratio		0.29	0.29								0.55	
Clearance Time (s)		5.3	5.3								5.8	
Lane Grp Cap (vph)		881	456								2802	
v/s Ratio Prot		c0.12										
v/s Ratio Perm			0.01								0.30	
v/c Ratio		0.43	0.03								0.54	
Uniform Delay, d1		20.2	17.9								10.0	
Progression Factor		1.00	1.00								1.00	
Incremental Delay, d2		1.5	0.1								0.7	
Delay (s)		21.7	18.0								10.7	
Level of Service		C	B								B	
Approach Delay (s)		21.3			0.0			0.0			10.7	
Approach LOS		C			A			A			B	

Intersection Summary			
HCM 2000 Control Delay	13.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.1
Intersection Capacity Utilization	85.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	SBT	SBR	NEL	NER
Lane Configurations						
Volume (vph)	0	380	1680	1079	927	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	10.1	10.1	9.0	
Lane Util. Factor		0.91	0.86	0.86	0.94	
Frt		1.00	0.97	0.85	1.00	
Flt Protected		1.00	1.00	1.00	0.95	
Satd. Flow (prot)		5085	4653	1362	4990	
Flt Permitted		1.00	1.00	1.00	0.95	
Satd. Flow (perm)		5085	4653	1362	4990	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	413	1826	1173	1008	0
RTOR Reduction (vph)	0	0	36	91	0	0
Lane Group Flow (vph)	0	413	2283	589	1008	0
Turn Type		NA	NA	Perm	Prot	
Protected Phases		2	6		4	
Permitted Phases				6		
Actuated Green, G (s)		59.0	54.9	54.9	46.0	
Effective Green, g (s)		59.0	54.9	54.9	46.0	
Actuated g/C Ratio		0.49	0.46	0.46	0.38	
Clearance Time (s)		6.0	10.1	10.1	9.0	
Lane Grp Cap (vph)		2500	2128	623	1912	
v/s Ratio Prot		0.08	c0.49		c0.20	
v/s Ratio Perm				0.43		
v/c Ratio		0.17	1.07	0.95	0.53	
Uniform Delay, d1		16.9	32.5	31.1	28.6	
Progression Factor		0.27	1.00	1.00	1.00	
Incremental Delay, d2		0.1	42.3	25.0	1.0	
Delay (s)		4.7	74.9	56.1	29.6	
Level of Service		A	E	E	C	
Approach Delay (s)		4.7	70.6		29.6	
Approach LOS		A	E		C	

Intersection Summary			
HCM 2000 Control Delay	55.1	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	19.1
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	4	0	5	22	13	23	58	128	0	0	111	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0		5.9	5.9			5.9	5.9
Lane Util. Factor	1.00		1.00	1.00	1.00		1.00	0.95			1.00	1.00
Frpb, ped/bikes	1.00		0.97	1.00	0.98		1.00	1.00			1.00	0.97
Flpb, ped/bikes	0.99		1.00	0.99	1.00		1.00	1.00			1.00	1.00
Frt	1.00		0.85	1.00	0.90		1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00	0.95	1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)	1714		1546	1781	1637		1779	3574			1863	1471
Flt Permitted	0.73		1.00	0.95	1.00		0.68	1.00			1.00	1.00
Satd. Flow (perm)	1320		1546	1781	1637		1272	3574			1863	1471
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	4	0	5	24	14	25	63	139	0	0	121	20
RTOR Reduction (vph)	0	0	3	0	15	0	0	0	0	0	0	12
Lane Group Flow (vph)	4	0	2	24	24	0	63	139	0	0	121	8
Confl. Peds. (#/hr)	11		11	11		11	4		2	2		4
Heavy Vehicles (%)	4%	0%	1%	0%	4%	2%	1%	1%	0%	0%	2%	7%
Turn Type	Perm		Perm	Perm	NA		Perm	NA			NA	Perm
Protected Phases					8			2			6	
Permitted Phases	4		4	8			2					6
Actuated Green, G (s)	25.0		25.0	25.0	25.0		23.1	23.1			23.1	23.1
Effective Green, g (s)	25.0		25.0	25.0	25.0		23.1	23.1			23.1	23.1
Actuated g/C Ratio	0.42		0.42	0.42	0.42		0.39	0.39			0.39	0.39
Clearance Time (s)	6.0		6.0	6.0	6.0		5.9	5.9			5.9	5.9
Lane Grp Cap (vph)	550		644	742	682		489	1375			717	566
v/s Ratio Prot					c0.01			0.04			c0.06	
v/s Ratio Perm	0.00		0.00	0.01			0.05					0.01
v/c Ratio	0.01		0.00	0.03	0.04		0.13	0.10			0.17	0.01
Uniform Delay, d1	10.2		10.2	10.3	10.4		11.9	11.8			12.1	11.4
Progression Factor	1.00		1.00	1.00	1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	0.0		0.0	0.1	0.1		0.5	0.1			0.5	0.0
Delay (s)	10.3		10.2	10.4	10.5		12.5	12.0			12.6	11.5
Level of Service	B		B	B	B		B	B			B	B
Approach Delay (s)		10.2			10.4			12.1			12.5	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	11.9	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.10		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	11.9
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	527	92	52	1417	134	29
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3		5.3	5.3	6.5	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frpb, ped/bikes	0.99		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		0.99	1.00	1.00	
Frt	0.98		1.00	1.00	0.98	
Flt Protected	1.00		0.95	1.00	0.96	
Satd. Flow (prot)	4947		1852	5085	1573	
Flt Permitted	1.00		0.38	1.00	0.96	
Satd. Flow (perm)	4947		738	5085	1573	
Peak-hour factor, PHF	0.90	0.90	0.95	0.95	0.73	0.73
Adj. Flow (vph)	586	102	55	1492	184	40
RTOR Reduction (vph)	29	0	0	0	10	0
Lane Group Flow (vph)	659	0	55	1492	214	0
Confl. Peds. (#/hr)		6	6		11	9
Heavy Vehicles (%)	2%	2%	2%	2%	1%	1%
Parking (#/hr)	10			10	10	
Turn Type	NA		Perm	NA	Prot	
Protected Phases	1			1	2	
Permitted Phases			1			
Actuated Green, G (s)	53.7		53.7	53.7	14.5	
Effective Green, g (s)	53.7		53.7	53.7	14.5	
Actuated g/C Ratio	0.67		0.67	0.67	0.18	
Clearance Time (s)	5.3		5.3	5.3	6.5	
Vehicle Extension (s)	0.2		0.2	0.2	3.0	
Lane Grp Cap (vph)	3320		495	3413	285	
v/s Ratio Prot	0.13			c0.29	c0.14	
v/s Ratio Perm			0.07			
v/c Ratio	0.20		0.11	0.44	0.75	
Uniform Delay, d1	5.0		4.7	6.1	31.0	
Progression Factor	0.79		1.00	1.00	1.00	
Incremental Delay, d2	0.1		0.5	0.4	10.6	
Delay (s)	4.1		5.1	6.5	41.7	
Level of Service	A		A	A	D	
Approach Delay (s)	4.1			6.5	41.7	
Approach LOS	A			A	D	

Intersection Summary			
HCM 2000 Control Delay	9.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	11.8
Intersection Capacity Utilization	49.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	28	553	69	19	1355	96	0	72	10	81	67	47
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	10	10	12	10	10	12	12	16	12	12	11	12
Total Lost time (s)	6.3	6.3		6.3	6.3			6.6		6.6	6.6	6.6
Lane Util. Factor	1.00	0.91		1.00	0.91			1.00		1.00	0.95	0.95
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00		1.00	1.00	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.99			0.98		1.00	0.99	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00		0.95	1.00	1.00
Satd. Flow (prot)	1687	4534		1739	4693			2121		1879	1530	1567
Flt Permitted	0.14	1.00		0.37	1.00			1.00		0.69	1.00	1.00
Satd. Flow (perm)	253	4534		680	4693			2121		1367	1530	1567
Peak-hour factor, PHF	0.88	0.88	0.88	0.94	0.94	0.94	0.80	0.80	0.80	0.87	0.87	0.87
Adj. Flow (vph)	32	628	78	20	1441	102	0	90	12	93	77	54
RTOR Reduction (vph)	0	16	0	0	8	0	0	6	0	0	3	42
Lane Group Flow (vph)	32	690	0	20	1535	0	0	96	0	93	79	7
Confl. Peds. (#/hr)	6					6	11		2	2		11
Heavy Vehicles (%)	5%	5%	5%	2%	2%	2%	5%	5%	5%	1%	1%	1%
Parking (#/hr)		10			10						10	
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	Perm
Protected Phases		1			1			2			2	
Permitted Phases	1			1						2		2
Actuated Green, G (s)	56.2	56.2		56.2	56.2			10.9		10.9	10.9	10.9
Effective Green, g (s)	56.2	56.2		56.2	56.2			10.9		10.9	10.9	10.9
Actuated g/C Ratio	0.70	0.70		0.70	0.70			0.14		0.14	0.14	0.14
Clearance Time (s)	6.3	6.3		6.3	6.3			6.6		6.6	6.6	6.6
Vehicle Extension (s)	0.2	0.2		0.2	0.2			3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	177	3185		477	3296			288		186	208	213
v/s Ratio Prot		0.15			c0.33			0.05			0.05	
v/s Ratio Perm	0.13			0.03						c0.07		0.00
v/c Ratio	0.18	0.22		0.04	0.47			0.33		0.50	0.38	0.03
Uniform Delay, d1	4.1	4.2		3.6	5.3			31.3		32.0	31.5	30.0
Progression Factor	1.59	1.38		0.40	0.53			1.00		1.00	1.00	1.00
Incremental Delay, d2	2.2	0.2		0.1	0.4			0.7		2.1	1.2	0.1
Delay (s)	8.6	5.9		1.6	3.2			31.9		34.1	32.6	30.0
Level of Service	A	A		A	A			C		C	C	C
Approach Delay (s)		6.0			3.2			31.9			32.7	
Approach LOS		A			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	7.6	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.9
Intersection Capacity Utilization	53.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	703	11	8	1350	9	2
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Lane Width	10	12	10	10	12	12
Total Lost time (s)	5.0		5.0	5.0	6.5	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frpb, ped/bikes	1.00		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		0.99	1.00	1.00	
Frt	1.00		1.00	1.00	0.97	
Flt Protected	1.00		0.95	1.00	0.96	
Satd. Flow (prot)	4640		1703	4700	1873	
Flt Permitted	1.00		0.35	1.00	0.96	
Satd. Flow (perm)	4640		636	4700	1873	
Peak-hour factor, PHF	0.95	0.95	0.94	0.94	0.69	0.69
Adj. Flow (vph)	740	12	9	1436	13	3
RTOR Reduction (vph)	1	0	0	0	3	0
Lane Group Flow (vph)	751	0	9	1436	13	0
Confl. Peds. (#/hr)		10	10		7	
Heavy Vehicles (%)	4%	4%	3%	3%	0%	0%
Parking (#/hr)	10			10		
Turn Type	NA		Perm	NA	Prot	
Protected Phases	1			1	2	
Permitted Phases			1			
Actuated Green, G (s)	64.8		64.8	64.8	3.7	
Effective Green, g (s)	64.8		64.8	64.8	3.7	
Actuated g/C Ratio	0.81		0.81	0.81	0.05	
Clearance Time (s)	5.0		5.0	5.0	6.5	
Vehicle Extension (s)	0.2		0.2	0.2	3.0	
Lane Grp Cap (vph)	3758		515	3807	86	
v/s Ratio Prot	0.16			c0.31	c0.01	
v/s Ratio Perm			0.01			
v/c Ratio	0.20		0.02	0.38	0.15	
Uniform Delay, d1	1.7		1.5	2.1	36.6	
Progression Factor	0.90		0.34	0.24	1.00	
Incremental Delay, d2	0.1		0.1	0.3	0.8	
Delay (s)	1.7		0.6	0.7	37.5	
Level of Service	A		A	A	D	
Approach Delay (s)	1.7			0.7	37.5	
Approach LOS	A			A	D	

Intersection Summary			
HCM 2000 Control Delay	1.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	40.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	28	692	1386	38	69	85
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Lane Width	10	11	10	12	10	10
Total Lost time (s)	6.4	6.4	6.4		6.3	6.3
Lane Util. Factor	1.00	0.91	0.91		0.97	0.91
Frpb, ped/bikes	1.00	1.00	1.00		1.00	0.99
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	1.00		0.95	0.85
Flt Protected	0.95	1.00	1.00		0.97	1.00
Satd. Flow (prot)	1703	4821	4724		3064	1426
Flt Permitted	0.16	1.00	1.00		0.97	1.00
Satd. Flow (perm)	280	4821	4724		3064	1426
Peak-hour factor, PHF	0.94	0.94	0.95	0.95	0.83	0.83
Adj. Flow (vph)	30	736	1459	40	83	102
RTOR Reduction (vph)	0	0	3	0	39	54
Lane Group Flow (vph)	30	736	1496	0	87	5
Confl. Peds. (#/hr)	7			7	7	1
Heavy Vehicles (%)	4%	4%	2%	2%	0%	0%
Parking (#/hr)		10	10		10	
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		1	1		2	
Permitted Phases	1					2
Actuated Green, G (s)	60.3	60.3	60.3		7.0	7.0
Effective Green, g (s)	60.3	60.3	60.3		7.0	7.0
Actuated g/C Ratio	0.75	0.75	0.75		0.09	0.09
Clearance Time (s)	6.4	6.4	6.4		6.3	6.3
Vehicle Extension (s)	0.2	0.2	0.2		3.0	3.0
Lane Grp Cap (vph)	211	3633	3560		268	124
v/s Ratio Prot		0.15	c0.32		c0.03	
v/s Ratio Perm	0.11					0.00
v/c Ratio	0.14	0.20	0.42		0.32	0.04
Uniform Delay, d1	2.7	2.9	3.6		34.3	33.4
Progression Factor	1.00	1.00	0.19		1.00	1.00
Incremental Delay, d2	1.4	0.1	0.4		0.7	0.1
Delay (s)	4.1	3.0	1.0		35.0	33.6
Level of Service	A	A	A		C	C
Approach Delay (s)		3.0	1.0		34.5	
Approach LOS		A	A		C	

Intersection Summary			
HCM 2000 Control Delay	4.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.7
Intersection Capacity Utilization	43.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	13	587	332	117	1539	76	42	47	58	31	163	37
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	10	10	12	10	10	12	12	14	12	12	16	12
Total Lost time (s)	5.8	5.8		5.8	5.8			6.4			6.4	
Lane Util. Factor	1.00	0.91		1.00	0.91			1.00			1.00	
Frpb, ped/bikes	1.00	0.99		1.00	1.00			0.99			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.95		1.00	0.99			0.95			0.98	
Flt Protected	0.95	1.00		0.95	1.00			0.99			0.99	
Satd. Flow (prot)	1720	4620		1738	4707			1927			1867	
Flt Permitted	0.13	1.00		0.21	1.00			0.72			0.91	
Satd. Flow (perm)	231	4620		387	4707			1410			1714	
Peak-hour factor, PHF	0.95	0.95	0.95	0.88	0.88	0.88	0.64	0.64	0.64	0.84	0.84	0.84
Adj. Flow (vph)	14	618	349	133	1749	86	66	73	91	37	194	44
RTOR Reduction (vph)	0	128	0	0	7	0	0	36	0	0	10	0
Lane Group Flow (vph)	14	839	0	133	1828	0	0	194	0	0	265	0
Confl. Peds. (#/hr)	6		8	8		6	2		14	14		2
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	2%	2%	2%	0%	0%	0%
Parking (#/hr)					10						10	
Turn Type	Perm	NA		pm+pt	NA		Perm	NA		Perm	NA	
Protected Phases		6		5	2			4			8	
Permitted Phases	6			2			4			8		
Actuated Green, G (s)	31.4	31.4		42.7	42.7			15.1			15.1	
Effective Green, g (s)	31.4	31.4		42.7	42.7			15.1			15.1	
Actuated g/C Ratio	0.45	0.45		0.61	0.61			0.22			0.22	
Clearance Time (s)	5.8	5.8		5.8	5.8			6.4			6.4	
Vehicle Extension (s)	0.2	0.2		2.0	0.2			3.0			3.0	
Lane Grp Cap (vph)	103	2072		342	2871			304			369	
v/s Ratio Prot		0.18		0.03	c0.39							
v/s Ratio Perm	0.06			0.21				0.14			c0.15	
v/c Ratio	0.14	0.40		0.39	0.64			0.64			0.72	
Uniform Delay, d1	11.3	13.0		6.6	8.7			25.0			25.5	
Progression Factor	0.98	1.08		1.00	1.00			1.00			1.00	
Incremental Delay, d2	2.7	0.6		0.3	1.1			4.3			6.5	
Delay (s)	13.8	14.6		6.9	9.8			29.3			32.0	
Level of Service	B	B		A	A			C			C	
Approach Delay (s)		14.6			9.6			29.3			32.0	
Approach LOS		B			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	14.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.73		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	68.4%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	1408	230	0	0	0	0	90	48
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	12	12	12	12	12	12
Total Lost time (s)					3.0						3.0	
Lane Util. Factor					0.81						0.95	
Frt					0.98						0.96	
Flt Protected					1.00						1.00	
Satd. Flow (prot)					6200						2956	
Flt Permitted					1.00						1.00	
Satd. Flow (perm)					6200						2956	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.92	0.79	0.90	0.90	0.90	0.85	0.60	0.94
Adj. Flow (vph)	0	0	0	0	1530	291	0	0	0	0	150	51
RTOR Reduction (vph)	0	0	0	0	43	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	1778	0	0	0	0	0	201	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	18%	3%	3%	3%	3%	7%	2%
Turn Type					NA						NA	
Protected Phases					6						4	
Permitted Phases					6							
Actuated Green, G (s)					45.0						19.0	
Effective Green, g (s)					48.0						26.0	
Actuated g/C Ratio					0.60						0.32	
Clearance Time (s)					6.0						10.0	
Lane Grp Cap (vph)					3720						960	
v/s Ratio Prot					c0.29						c0.07	
v/s Ratio Perm												
v/c Ratio					0.48						0.21	
Uniform Delay, d1					9.0						19.6	
Progression Factor					0.07						1.00	
Incremental Delay, d2					0.4						0.5	
Delay (s)					1.0						20.1	
Level of Service					A						C	
Approach Delay (s)		0.0			1.0			0.0			20.1	
Approach LOS		A			A			A			C	

Intersection Summary			
HCM 2000 Control Delay	2.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	47.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	SEL	SER	SER2
Lane Configurations											
Volume (vph)	0	0	0	0	1688	0	0	0	0	278	125
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	12	12	12	11	11
Total Lost time (s)					3.0					3.0	3.0
Lane Util. Factor					0.86					0.64	1.00
Frt					1.00					0.85	0.85
Flt Protected					1.00					1.00	1.00
Satd. Flow (prot)					5521					2685	1364
Flt Permitted					1.00					1.00	1.00
Satd. Flow (perm)					5521					2685	1364
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.96	0.90	0.90	0.90	0.90	0.94	0.94
Adj. Flow (vph)	0	0	0	0	1758	0	0	0	0	296	133
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	183	55
Lane Group Flow (vph)	0	0	0	0	1758	0	0	0	0	170	21
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	0%	3%
Turn Type					NA					Prot	Prot
Protected Phases					9					4	4
Permitted Phases					9						
Actuated Green, G (s)					49.0					15.0	15.0
Effective Green, g (s)					52.0					22.0	22.0
Actuated g/C Ratio					0.65					0.28	0.28
Clearance Time (s)					6.0					10.0	10.0
Lane Grp Cap (vph)					3588					738	375
v/s Ratio Prot					c0.32					c0.06	0.02
v/s Ratio Perm											
v/c Ratio					0.49					0.23	0.06
Uniform Delay, d1					7.2					22.4	21.4
Progression Factor					0.04					1.00	1.00
Incremental Delay, d2					0.4					0.7	0.3
Delay (s)					0.7					23.2	21.6
Level of Service					A					C	C
Approach Delay (s)		0.0			0.7		0.0		22.9		
Approach LOS		A			A		A		C		

Intersection Summary			
HCM 2000 Control Delay	5.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	27.5
Intersection Capacity Utilization	61.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	1960	548	0	154	0	0	360	248
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	12	11	12	12	11	11
Total Lost time (s)					3.0			3.0			3.0	3.0
Lane Util. Factor					0.81			0.91			0.91	0.91
Frt					0.97			1.00			0.96	0.85
Flt Protected					1.00			1.00			1.00	1.00
Satd. Flow (prot)					6287			4381			2836	1254
Flt Permitted					1.00			1.00			1.00	1.00
Satd. Flow (perm)					6287			4381			2836	1254
Peak-hour factor, PHF	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.88	0.90	0.90	0.73	0.73
Adj. Flow (vph)	0	0	0	0	2130	596	0	175	0	0	493	340
RTOR Reduction (vph)	0	0	0	0	63	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	2663	0	0	175	0	0	663	170
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	2%	2%
Turn Type					NA			NA			NA	Prot
Protected Phases					6			8			4	4
Permitted Phases												
Actuated Green, G (s)					46.0			22.0			18.0	18.0
Effective Green, g (s)					49.0			25.0			25.0	25.0
Actuated g/C Ratio					0.61			0.31			0.31	0.31
Clearance Time (s)					6.0			6.0			10.0	10.0
Lane Grp Cap (vph)					3850			1369			886	391
v/s Ratio Prot					c0.42			0.04			c0.23	0.14
v/s Ratio Perm												
v/c Ratio					0.69			0.13			0.75	0.43
Uniform Delay, d1					10.4			19.7			24.7	21.9
Progression Factor					0.40			0.13			1.00	1.00
Incremental Delay, d2					0.6			0.2			5.7	3.5
Delay (s)					4.7			2.8			30.4	25.4
Level of Service					A			A			C	C
Approach Delay (s)		0.0			4.7			2.8			29.4	
Approach LOS		A			A			A			C	

Intersection Summary			
HCM 2000 Control Delay	10.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	54.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	2468	427	0	0	0	0	0	40
Ideal Flow (vphpl)	1900	1900	2000	2000	1900	1900	2000	2000	2000	1900	2000	1900
Lane Width	12	12	12	12	11	12	12	12	12	12	12	11
Total Lost time (s)					3.0							3.0
Lane Util. Factor					0.81							0.88
Frt					0.98							0.85
Flt Protected					1.00							1.00
Satd. Flow (prot)					6418							2473
Flt Permitted					1.00							1.00
Satd. Flow (perm)					6418							2473
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.89	0.89	0.90	0.90	0.90	0.90	0.90	0.82
Adj. Flow (vph)	0	0	0	0	2773	480	0	0	0	0	0	49
RTOR Reduction (vph)	0	0	0	0	39	0	0	0	0	0	0	23
Lane Group Flow (vph)	0	0	0	0	3214	0	0	0	0	0	0	26
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%	3%	3%	3%	3%	3%	0%
Turn Type					NA							Prot
Protected Phases					6							4
Permitted Phases												
Actuated Green, G (s)					46.5							22.0
Effective Green, g (s)					49.0							25.0
Actuated g/C Ratio					0.61							0.31
Clearance Time (s)					5.5							6.0
Lane Grp Cap (vph)					3931							772
v/s Ratio Prot					c0.50							c0.01
v/s Ratio Perm												
v/c Ratio					0.82							0.03
Uniform Delay, d1					12.0							19.1
Progression Factor					0.62							1.00
Incremental Delay, d2					1.2							0.1
Delay (s)					8.7							19.2
Level of Service					A							B
Approach Delay (s)		0.0			8.7			0.0			19.2	
Approach LOS		A			A			A			B	

Intersection Summary			
HCM 2000 Control Delay	8.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	53.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	366	2305	161	24	93	0	0	494	267
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	13	13	12	12	11	12
Total Lost time (s)					3.0		3.0	3.0			3.0	
Lane Util. Factor					0.86		0.91	0.91			0.91	
Frt					0.99		1.00	1.00			0.95	
Flt Protected					0.99		0.95	1.00			1.00	
Satd. Flow (prot)					5492		1441	3034			3563	
Flt Permitted					0.99		0.20	1.00			1.00	
Satd. Flow (perm)					5492		301	3034			3563	
Peak-hour factor, PHF	0.90	0.90	0.90	0.91	0.91	0.91	0.86	0.86	0.86	0.88	0.88	0.88
Adj. Flow (vph)	0	0	0	402	2533	177	28	108	0	0	561	303
RTOR Reduction (vph)	0	0	0	0	11	0	0	0	0	0	3	0
Lane Group Flow (vph)	0	0	0	0	3101	0	28	108	0	0	861	0
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	6%	6%	6%	14%	14%	14%
Parking (#/hr)											10	10
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					6			8			4	
Permitted Phases				6	6		8					
Actuated Green, G (s)					47.0		21.1	21.1			17.1	
Effective Green, g (s)					50.0		24.0	24.0			24.0	
Actuated g/C Ratio					0.62		0.30	0.30			0.30	
Clearance Time (s)					6.0		5.9	5.9			9.9	
Lane Grp Cap (vph)					3432		90	910			1068	
v/s Ratio Prot											c0.24	
v/s Ratio Perm					0.56		0.09	0.04				
v/c Ratio					0.90		0.31	0.12			0.94dr	
Uniform Delay, d1					12.9		21.6	20.3			25.9	
Progression Factor					1.00		0.25	0.92			1.00	
Incremental Delay, d2					4.5		8.8	0.2			6.5	
Delay (s)					17.4		14.1	19.0			32.4	
Level of Service					B		B	B			C	
Approach Delay (s)		0.0			17.4			18.0			32.4	
Approach LOS		A			B			B			C	

Intersection Summary			
HCM 2000 Control Delay	20.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	116.8%	ICU Level of Service	H
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

Movement	EBL	EBR2	NBL2	NBT	NBR	NET	SWL	SWT	SWR2
Lane Configurations									
Volume (vph)	90	14	165	50	105	143	4	1321	62
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0	6.0	6.0		6.0		6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	1.00		0.95		0.95	1.00
Frpb, ped/bikes	1.00	0.88	1.00	0.96		1.00		1.00	0.94
Flpb, ped/bikes	1.00	1.00	0.96	1.00		1.00		1.00	1.00
Frt	1.00	0.85	1.00	0.90		1.00		1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00		1.00		1.00	1.00
Satd. Flow (prot)	3252	1323	1616	1300		3101		3101	1416
Flt Permitted	0.95	1.00	0.95	1.00		1.00		0.95	1.00
Satd. Flow (perm)	3252	1323	1616	1300		3101		2960	1416
Peak-hour factor, PHF	0.87	0.87	0.79	0.79	0.79	0.74	0.89	0.89	0.89
Adj. Flow (vph)	103	16	209	63	133	193	4	1484	70
RTOR Reduction (vph)	0	15	0	84	0	0	0	0	33
Lane Group Flow (vph)	103	1	209	112	0	193	0	1488	37
Confl. Peds. (#/hr)		32	32		36				13
Parking (#/hr)				10		10		10	
Turn Type	Prot	Perm	Perm	NA		NA	Perm	NA	Perm
Protected Phases	4			3		2		2	
Permitted Phases		4	3				2		2
Actuated Green, G (s)	8.0	8.0	17.0	17.0		47.0		47.0	47.0
Effective Green, g (s)	8.0	8.0	17.0	17.0		47.0		47.0	47.0
Actuated g/C Ratio	0.09	0.09	0.19	0.19		0.52		0.52	0.52
Clearance Time (s)	6.0	6.0	6.0	6.0		6.0		6.0	6.0
Lane Grp Cap (vph)	289	117	305	245		1619		1545	739
v/s Ratio Prot	c0.03			0.09		0.06			
v/s Ratio Perm		0.00	c0.13					c0.50	0.03
v/c Ratio	0.36	0.01	0.69	0.46		0.12		0.96	0.05
Uniform Delay, d1	38.6	37.4	34.0	32.4		11.0		20.7	10.5
Progression Factor	1.00	1.00	1.00	1.00		1.00		0.55	0.18
Incremental Delay, d2	3.4	0.2	11.9	6.0		0.2		12.2	0.1
Delay (s)	42.0	37.6	45.9	38.4		11.1		23.7	2.0
Level of Service	D	D	D	D		B		C	A
Approach Delay (s)	41.4			42.3		11.1		22.7	
Approach LOS	D			D		B		C	

Intersection Summary			
HCM 2000 Control Delay	26.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	2	4	1	52	2	86	66	349	2	11	1688	210
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)		6.0			6.0		5.8	5.8		5.8	5.8	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		1.00			0.99		1.00	1.00		1.00	0.99	
Flpb, ped/bikes		1.00			1.00		1.00	1.00		0.99	1.00	
Frt		0.98			0.92		1.00	1.00		1.00	0.98	
Flt Protected		0.99			0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1450			1327		1676	3099		1659	3029	
Flt Permitted		0.93			0.87		0.07	1.00		0.52	1.00	
Satd. Flow (perm)		1365			1182		117	3099		903	3029	
Peak-hour factor, PHF	0.88	0.88	0.88	0.64	0.64	0.64	0.88	0.88	0.88	0.94	0.94	0.94
Adj. Flow (vph)	2	5	1	81	3	134	75	397	2	12	1796	223
RTOR Reduction (vph)	0	1	0	0	0	0	0	0	0	0	11	0
Lane Group Flow (vph)	0	7	0	0	218	0	75	399	0	12	2008	0
Confl. Peds. (#/hr)	13		7	7		13	15		6	6		15
Parking (#/hr)		10			10			10			10	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		18.0			18.0		60.2	60.2		60.2	60.2	
Effective Green, g (s)		18.0			18.0		60.2	60.2		60.2	60.2	
Actuated g/C Ratio		0.20			0.20		0.67	0.67		0.67	0.67	
Clearance Time (s)		6.0			6.0		5.8	5.8		5.8	5.8	
Lane Grp Cap (vph)		273			236		78	2072		604	2026	
v/s Ratio Prot								0.13			c0.66	
v/s Ratio Perm		0.01			c0.18		0.64			0.01		
v/c Ratio		0.03			0.92		0.96	0.19		0.02	0.99	
Uniform Delay, d1		29.0			35.3		13.8	5.7		5.0	14.6	
Progression Factor		1.00			1.00		1.55	1.26		1.00	1.00	
Incremental Delay, d2		0.2			41.7		90.4	0.2		0.1	18.0	
Delay (s)		29.1			77.0		111.8	7.3		5.1	32.7	
Level of Service		C			E		F	A		A	C	
Approach Delay (s)		29.1			77.0			23.8			32.5	
Approach LOS		C			E			C			C	

Intersection Summary			
HCM 2000 Control Delay	34.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	11.8
Intersection Capacity Utilization	91.1%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Volume (vph)	309	40	153	1436	91	162
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0		6.0	6.0	6.0	6.0
Lane Util. Factor	0.95		1.00	0.95	1.00	1.00
Frpb, ped/bikes	1.00		1.00	1.00	1.00	0.95
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3288		1671	3101	1676	1216
Flt Permitted	1.00		0.50	1.00	0.95	1.00
Satd. Flow (perm)	3288		886	3101	1676	1216
Peak-hour factor, PHF	0.82	0.82	0.91	0.91	0.86	0.86
Adj. Flow (vph)	377	49	168	1578	106	188
RTOR Reduction (vph)	11	0	0	0	0	152
Lane Group Flow (vph)	415	0	168	1578	106	36
Confl. Peds. (#/hr)		2	2			31
Parking (#/hr)				10		10
Turn Type	NA		Perm	NA	Prot	Perm
Protected Phases	2			2	4	
Permitted Phases			2			4
Actuated Green, G (s)	61.0		61.0	61.0	17.0	17.0
Effective Green, g (s)	61.0		61.0	61.0	17.0	17.0
Actuated g/C Ratio	0.68		0.68	0.68	0.19	0.19
Clearance Time (s)	6.0		6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	2228		600	2101	316	229
v/s Ratio Prot	0.13			c0.51	c0.06	
v/s Ratio Perm			0.19			0.03
v/c Ratio	0.19		0.28	0.75	0.34	0.16
Uniform Delay, d1	5.3		5.8	9.5	31.6	30.5
Progression Factor	0.64		0.27	0.29	1.00	1.00
Incremental Delay, d2	0.2		0.3	0.6	2.8	1.4
Delay (s)	3.6		1.8	3.4	34.5	31.9
Level of Service	A		A	A	C	C
Approach Delay (s)	3.6			3.2	32.8	
Approach LOS	A			A	C	

Intersection Summary			
HCM 2000 Control Delay	6.8	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL2	WBT	SBL	SBT	SBR2	NER	NER2
Lane Configurations							
Volume (vph)	29	240	308	533	672	268	30
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000
Lane Width	11	11	11	11	11	12	12
Total Lost time (s)	5.7	5.7	5.7	5.7	5.7	9.2	
Lane Util. Factor	1.00	0.91	1.00	0.95	1.00	0.76	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	0.98	1.00	
Flpb, ped/bikes	0.99	1.00	0.99	1.00	1.00	1.00	
Frt	1.00	1.00	1.00	1.00	0.85	0.85	
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00	
Satd. Flow (prot)	1591	4600	1611	3241	1414	3033	
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00	
Satd. Flow (perm)	1591	4600	1611	3241	1414	3033	
Peak-hour factor, PHF	0.92	0.92	0.95	0.95	0.95	0.92	0.92
Adj. Flow (vph)	32	261	324	561	707	291	33
RTOR Reduction (vph)	0	0	0	0	330	0	0
Lane Group Flow (vph)	32	261	324	561	377	324	0
Confl. Peds. (#/hr)	7		5		4		
Heavy Vehicles (%)	3%	3%	2%	2%	2%	15%	15%
Bus Blockages (#/hr)	0	2	0	0	2	0	0
Turn Type	Perm	NA	Perm	NA	Perm	Perm	
Protected Phases		1		4			
Permitted Phases	1		4		4	3	
Actuated Green, G (s)	32.3	32.3	26.3	26.3	26.3	28.8	
Effective Green, g (s)	32.3	32.3	26.3	26.3	26.3	28.8	
Actuated g/C Ratio	0.46	0.46	0.38	0.38	0.38	0.41	
Clearance Time (s)	5.7	5.7	5.7	5.7	5.7	9.2	
Lane Grp Cap (vph)	734	2122	605	1217	531	1247	
v/s Ratio Prot		0.06		0.17			
v/s Ratio Perm	0.02		0.20		c0.27	c0.11	
v/c Ratio	0.04	0.12	0.54	0.46	0.71	0.26	
Uniform Delay, d1	10.4	10.8	17.1	16.5	18.6	13.6	
Progression Factor	0.45	0.46	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.1	0.1	3.4	1.3	7.9	0.5	
Delay (s)	4.7	5.1	20.5	17.8	26.5	14.1	
Level of Service	A	A	C	B	C	B	
Approach Delay (s)		5.0		22.2			
Approach LOS		A		C			

Intersection Summary			
HCM 2000 Control Delay	18.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	17.1
Intersection Capacity Utilization	62.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	180	396	0	0	216	363	48	644	3	0	0	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	11	11	12	12	11	12	12	12	12	12	12	12
Total Lost time (s)	5.7	5.7			5.7			5.7				
Lane Util. Factor	1.00	0.91			0.91			0.91				
Frpb, ped/bikes	1.00	1.00			1.00			1.00				
Flpb, ped/bikes	1.00	1.00			1.00			1.00				
Frt	1.00	1.00			0.91			1.00				
Flt Protected	0.95	1.00			1.00			1.00				
Satd. Flow (prot)	1529	4398			4219			4749				
Flt Permitted	0.37	1.00			1.00			1.00				
Satd. Flow (perm)	590	4398			4219			4749				
Peak-hour factor, PHF	0.85	0.85	0.85	0.91	0.91	0.91	0.95	0.95	0.95	0.92	0.92	0.92
Adj. Flow (vph)	212	466	0	0	237	399	51	678	3	0	0	0
RTOR Reduction (vph)	0	0	0	0	102	0	0	1	0	0	0	0
Lane Group Flow (vph)	212	466	0	0	534	0	0	731	0	0	0	0
Confl. Peds. (#/hr)	5						5		4			
Heavy Vehicles (%)	8%	8%	8%	2%	2%	2%	3%	3%	3%	2%	2%	2%
Turn Type	pm+pt	NA			NA		Perm	NA				
Protected Phases	5	1			2			4				
Permitted Phases	1						4					
Actuated Green, G (s)	32.3	32.3			18.3			26.3				
Effective Green, g (s)	32.3	32.3			18.3			26.3				
Actuated g/C Ratio	0.46	0.46			0.26			0.38				
Clearance Time (s)	5.7	5.7			5.7			5.7				
Lane Grp Cap (vph)	383	2029			1102			1784				
v/s Ratio Prot	c0.07	0.11			0.13							
v/s Ratio Perm	c0.19							0.15				
v/c Ratio	0.55	0.23			0.48			0.41				
Uniform Delay, d1	16.8	11.4			21.9			16.1				
Progression Factor	0.99	0.92			1.00			0.89				
Incremental Delay, d2	5.4	0.3			1.5			0.6				
Delay (s)	22.0	10.7			23.4			14.9				
Level of Service	C	B			C			B				
Approach Delay (s)		14.3			23.4			14.9			0.0	
Approach LOS		B			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	17.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	17.1
Intersection Capacity Utilization	52.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	1668	265	20	276	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	11	12	12	12	12	12	12
Total Lost time (s)					3.0			3.0				
Lane Util. Factor					0.86			0.91				
Frt					0.98			1.00				
Flt Protected					1.00			1.00				
Satd. Flow (prot)					5407			4653				
Flt Permitted					1.00			1.00				
Satd. Flow (perm)					5407			4653				
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.95	0.95	0.86	0.86	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	0	1756	279	23	321	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	183	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	2035	0	0	161	0	0	0	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	0%	0%	3%	3%	3%	3%
Turn Type					NA		Perm	NA				
Protected Phases					6			8				
Permitted Phases					6		8					
Actuated Green, G (s)					46.0			19.0				
Effective Green, g (s)					52.0			22.0				
Actuated g/C Ratio					0.65			0.28				
Clearance Time (s)					9.0			6.0				
Lane Grp Cap (vph)					3514			1279				
v/s Ratio Prot					c0.38							
v/s Ratio Perm								0.03				
v/c Ratio					0.58			0.13				
Uniform Delay, d1					7.9			21.8				
Progression Factor					1.39			2.50				
Incremental Delay, d2					0.5			0.2				
Delay (s)					11.5			54.6				
Level of Service					B			D				
Approach Delay (s)		0.0			11.5			54.6			0.0	
Approach LOS		A			B			D			A	

Intersection Summary			
HCM 2000 Control Delay	17.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	31.5
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1798	0	0	90	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0	
Lane Util. Factor		0.86			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5711			2945	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5711			2945	
Peak-hour factor, PHF	0.90	0.92	0.92	0.92	0.60	0.92
Adj. Flow (vph)	0	1954	0	0	150	0
RTOR Reduction (vph)	0	0	0	0	16	0
Lane Group Flow (vph)	0	1954	0	0	134	0
Heavy Vehicles (%)	3%	3%	3%	3%	7%	3%
Turn Type		NA			Prot	
Protected Phases		2			8	
Permitted Phases		2				
Actuated Green, G (s)		33.5			23.0	
Effective Green, g (s)		48.0			26.0	
Actuated g/C Ratio		0.60			0.32	
Clearance Time (s)		17.5			6.0	
Lane Grp Cap (vph)		3426			957	
v/s Ratio Prot		c0.34			c0.05	
v/s Ratio Perm						
v/c Ratio		0.57			0.14	
Uniform Delay, d1		9.7			19.1	
Progression Factor		1.00			0.01	
Incremental Delay, d2		0.7			0.3	
Delay (s)		10.4			0.5	
Level of Service		B			A	
Approach Delay (s)		10.4	0.0		0.5	
Approach LOS		B	A		A	

Intersection Summary			
HCM 2000 Control Delay	9.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	47.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1892	0	0	278	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0	
Lane Util. Factor		0.86			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5711			3152	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5711			3152	
Peak-hour factor, PHF	0.90	0.95	0.90	0.90	0.94	0.90
Adj. Flow (vph)	0	1992	0	0	296	0
RTOR Reduction (vph)	0	0	0	0	23	0
Lane Group Flow (vph)	0	1992	0	0	273	0
Heavy Vehicles (%)	3%	3%	3%	3%	0%	3%
Turn Type		NA			Prot	
Protected Phases		2			8	
Permitted Phases						
Actuated Green, G (s)		33.5			19.0	
Effective Green, g (s)		52.0			22.0	
Actuated g/C Ratio		0.65			0.28	
Clearance Time (s)		21.5			6.0	
Lane Grp Cap (vph)		3712			866	
v/s Ratio Prot		c0.35			c0.09	
v/s Ratio Perm						
v/c Ratio		0.54			0.32	
Uniform Delay, d1		7.5			23.0	
Progression Factor		0.38			0.65	
Incremental Delay, d2		0.5			0.9	
Delay (s)		3.4			15.8	
Level of Service		A			B	
Approach Delay (s)		3.4	0.0		15.8	
Approach LOS		A	A		B	

Intersection Summary			
HCM 2000 Control Delay	5.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	48.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1644	147	0	0	0	0	151	434	344	20	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	11	11	12	12	12	12	12	12	12	12	12
Total Lost time (s)		3.0	3.0					3.0	3.0		3.0	
Lane Util. Factor		0.86	0.88					0.91	0.91		0.95	
Frt		1.00	0.85					0.91	0.85		1.00	
Flt Protected		1.00	1.00					1.00	1.00		0.95	
Satd. Flow (prot)		5468	2378					2759	1284		3041	
Flt Permitted		1.00	1.00					1.00	1.00		0.60	
Satd. Flow (perm)		5468	2378					2759	1284		1921	
Peak-hour factor, PHF	0.87	0.95	0.95	0.90	0.90	0.90	0.88	0.88	0.88	0.73	0.73	0.73
Adj. Flow (vph)	0	1731	155	0	0	0	0	172	493	471	27	0
RTOR Reduction (vph)	0	0	60	0	0	0	0	17	28	0	0	0
Lane Group Flow (vph)	0	1731	95	0	0	0	0	393	228	0	498	0
Heavy Vehicles (%)	4%	4%	4%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Turn Type		NA	Prot					NA	Prot	Perm	NA	
Protected Phases		2	2					4	4		8	
Permitted Phases										8		
Actuated Green, G (s)		46.0	46.0					18.0	18.0		22.0	
Effective Green, g (s)		49.0	49.0					25.0	25.0		25.0	
Actuated g/C Ratio		0.61	0.61					0.31	0.31		0.31	
Clearance Time (s)		6.0	6.0					10.0	10.0		6.0	
Lane Grp Cap (vph)		3349	1456					862	401		600	
v/s Ratio Prot		c0.32	0.04					0.14	0.18			
v/s Ratio Perm											c0.26	
v/c Ratio		0.52	0.07					0.46	0.57		2.22dl	
Uniform Delay, d1		8.8	6.3					22.0	23.0		25.5	
Progression Factor		0.91	0.95					1.00	1.00		0.11	
Incremental Delay, d2		0.5	0.1					1.7	5.7		8.6	
Delay (s)		8.5	6.0					23.8	28.7		11.5	
Level of Service		A	A					C	C		B	
Approach Delay (s)		8.3			0.0			25.7			11.5	
Approach LOS		A			A			C			B	

Intersection Summary			
HCM 2000 Control Delay	12.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	77.6%	ICU Level of Service	D
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑↑↑↑				
Volume (vph)	0	2347	0	0	0	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)		3.0				
Lane Util. Factor		0.81				
Frt		1.00				
Flt Protected		1.00				
Satd. Flow (prot)		7788				
Flt Permitted		1.00				
Satd. Flow (perm)		7788				
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	2608	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	2608	0	0	0	0
Heavy Vehicles (%)	3%	4%	3%	3%	3%	3%
Turn Type		NA				
Protected Phases		2				
Permitted Phases						
Actuated Green, G (s)		46.5				
Effective Green, g (s)		49.0				
Actuated g/C Ratio		0.61				
Clearance Time (s)		5.5				
Lane Grp Cap (vph)		4770				
v/s Ratio Prot		c0.33				
v/s Ratio Perm						
v/c Ratio		0.55				
Uniform Delay, d1		9.0				
Progression Factor		0.76				
Incremental Delay, d2		0.4				
Delay (s)		7.2				
Level of Service		A				
Approach Delay (s)		7.2	0.0		0.0	
Approach LOS		A	A		A	

Intersection Summary			
HCM 2000 Control Delay	7.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	53.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	59	1253	747	0	0	0	0	58	20	57	741	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	11	11	12	12	12	12	11	11	13	13	12
Total Lost time (s)		3.0						3.0	3.0	3.0	3.0	
Lane Util. Factor		0.86						0.91	0.88	1.00	0.95	
Frt		0.95						1.00	0.85	1.00	1.00	
Flt Protected		1.00						1.00	1.00	0.95	1.00	
Satd. Flow (prot)		5213						4257	2333	1472	2945	
Flt Permitted		1.00						1.00	1.00	0.71	1.00	
Satd. Flow (perm)		5213						4257	2333	1099	2945	
Peak-hour factor, PHF	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.86	0.86	0.88	0.88	0.90
Adj. Flow (vph)	64	1362	812	0	0	0	0	67	23	65	842	0
RTOR Reduction (vph)	0	9	0	0	0	0	0	0	16	0	0	0
Lane Group Flow (vph)	0	2229	0	0	0	0	0	67	7	65	842	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	6%	6%	14%	14%	14%
Turn Type	Perm	NA						NA	Prot	Perm	NA	
Protected Phases		2						4	4		8	
Permitted Phases	2									8		
Actuated Green, G (s)		47.0						17.1	17.1	21.1	21.1	
Effective Green, g (s)		50.0						24.0	24.0	24.0	24.0	
Actuated g/C Ratio		0.62						0.30	0.30	0.30	0.30	
Clearance Time (s)		6.0						9.9	9.9	5.9	5.9	
Lane Grp Cap (vph)		3258						1277	699	329	883	
v/s Ratio Prot								0.02	0.00		c0.29	
v/s Ratio Perm		0.43								0.06		
v/c Ratio		0.93dr						0.05	0.01	0.20	0.95	
Uniform Delay, d1		9.8						19.9	19.7	20.8	27.5	
Progression Factor		0.32						1.00	1.00	0.13	0.68	
Incremental Delay, d2		1.0						0.1	0.0	0.8	12.9	
Delay (s)		4.2						20.0	19.7	3.5	31.6	
Level of Service		A						B	B	A	C	
Approach Delay (s)		4.2			0.0			19.9			29.6	
Approach LOS		A			A			B			C	

Intersection Summary			
HCM 2000 Control Delay	11.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	116.8%	ICU Level of Service	H
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	182	0	0	0	0	410	0	0	1708	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)		6.0						10.1			6.1	
Lane Util. Factor		1.00						0.91			0.95	
Frt		0.85						1.00			1.00	
Flt Protected		1.00						1.00			1.00	
Satd. Flow (prot)		1667						5353			3725	
Flt Permitted		1.00						1.00			1.00	
Satd. Flow (perm)		1667						5353			3725	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	198	0	0	0	0	446	0	0	1857	0
RTOR Reduction (vph)	0	38	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	160	0	0	0	0	0	446	0	0	1857	0
Turn Type	Perm	NA		D.Pm		Prot		NA			NA	
Protected Phases		8				8		2			6	
Permitted Phases	8			8		8						
Actuated Green, G (s)		49.0						54.9			58.9	
Effective Green, g (s)		49.0						54.9			58.9	
Actuated g/C Ratio		0.41						0.46			0.49	
Clearance Time (s)		6.0						10.1			6.1	
Lane Grp Cap (vph)		680						2448			1828	
v/s Ratio Prot		c0.10						0.08			c0.50	
v/s Ratio Perm												
v/c Ratio		0.23						0.18			1.02	
Uniform Delay, d1		23.2						19.3			30.6	
Progression Factor		1.00						1.00			0.30	
Incremental Delay, d2		0.8						0.2			10.9	
Delay (s)		24.0						19.4			19.9	
Level of Service		C						B			B	
Approach Delay (s)		24.0			0.0			19.4			19.9	
Approach LOS		C			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	20.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	16.1
Intersection Capacity Utilization	65.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	17	31	47	2	1	2	18	400	0	0	681	77
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)		4.5			4.5			4.5			4.5	
Lane Util. Factor		1.00			1.00			0.95			0.95	
Frt		0.93			0.95			1.00			0.98	
Flt Protected		0.99			0.98			1.00			1.00	
Satd. Flow (prot)		1814			1819			3717			3669	
Flt Permitted		0.96			0.95			0.91			1.00	
Satd. Flow (perm)		1763			1757			3380			3669	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	18	34	51	2	1	2	20	435	0	0	740	84
RTOR Reduction (vph)	0	36	0	0	1	0	0	0	0	0	10	0
Lane Group Flow (vph)	0	67	0	0	4	0	0	455	0	0	814	0
Turn Type	Perm	NA		Perm	NA		Perm	NA			NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4					
Actuated Green, G (s)		25.6			25.6			55.4			55.4	
Effective Green, g (s)		25.6			25.6			55.4			55.4	
Actuated g/C Ratio		0.28			0.28			0.62			0.62	
Clearance Time (s)		4.5			4.5			4.5			4.5	
Lane Grp Cap (vph)		501			499			2080			2258	
v/s Ratio Prot											c0.22	
v/s Ratio Perm		c0.04			0.00			0.13				
v/c Ratio		0.13			0.01			0.22			0.36	
Uniform Delay, d1		23.9			23.1			7.7			8.5	
Progression Factor		0.83			1.00			1.00			1.00	
Incremental Delay, d2		0.5			0.0			0.2			0.4	
Delay (s)		20.4			23.1			7.9			9.0	
Level of Service		C			C			A			A	
Approach Delay (s)		20.4			23.1			7.9			9.0	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	9.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.29		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	36.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (vph)	1100	0	0	0	0	0	413	179	0	0
Ideal Flow (vphpl)	1900	2000	1900	2000	2000	2000	2000	1900	1900	1900
Total Lost time (s)	6.0						5.7			
Lane Util. Factor	0.94						0.91			
Frt	1.00						0.96			
Flt Protected	0.95						1.00			
Satd. Flow (prot)	4990						5046			
Flt Permitted	0.95						1.00			
Satd. Flow (perm)	4990						5046			
Peak-hour factor, PHF	0.92	0.95	0.92	0.92	0.92	0.89	0.89	0.92	0.92	0.92
Adj. Flow (vph)	1196	0	0	0	0	0	464	195	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	29	0	0	0
Lane Group Flow (vph)	1196	0	0	0	0	0	630	0	0	0
Heavy Vehicles (%)	2%	3%	2%	2%	2%	4%	4%	2%	2%	2%
Turn Type	Prot						NA			
Protected Phases	1						3			
Permitted Phases										
Actuated Green, G (s)	35.0						23.3			
Effective Green, g (s)	35.0						23.3			
Actuated g/C Ratio	0.50						0.33			
Clearance Time (s)	6.0						5.7			
Vehicle Extension (s)	0.2						0.2			
Lane Grp Cap (vph)	2495						1679			
v/s Ratio Prot	c0.24						c0.12			
v/s Ratio Perm										
v/c Ratio	0.48						0.38			
Uniform Delay, d1	11.5						17.8			
Progression Factor	1.49						0.26			
Incremental Delay, d2	0.6						0.6			
Delay (s)	17.8						5.3			
Level of Service	B						A			
Approach Delay (s)	17.8			0.0			5.3		0.0	
Approach LOS	B			A			A		A	

Intersection Summary			
HCM 2000 Control Delay	13.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.44		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.7
Intersection Capacity Utilization	52.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	678	0	0	413	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)		6.0			5.7	
Lane Util. Factor		0.91			0.94	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5301			5253	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5301			5253	
Peak-hour factor, PHF	0.95	0.95	0.92	0.92	0.91	0.91
Adj. Flow (vph)	0	714	0	0	454	0
RTOR Reduction (vph)	0	0	0	0	303	0
Lane Group Flow (vph)	0	714	0	0	151	0
Heavy Vehicles (%)	3%	3%	2%	2%	2%	2%
Turn Type		NA			Prot	
Protected Phases		2			4	
Permitted Phases						
Actuated Green, G (s)		35.0			23.3	
Effective Green, g (s)		35.0			23.3	
Actuated g/C Ratio		0.50			0.33	
Clearance Time (s)		6.0			5.7	
Vehicle Extension (s)		0.2			0.2	
Lane Grp Cap (vph)		2650			1748	
v/s Ratio Prot		c0.13			c0.03	
v/s Ratio Perm						
v/c Ratio		0.27			0.09	
Uniform Delay, d1		10.1			16.0	
Progression Factor		1.00			0.01	
Incremental Delay, d2		0.3			0.1	
Delay (s)		10.4			0.2	
Level of Service		B			A	
Approach Delay (s)		10.4	0.0		0.2	
Approach LOS		B	A		A	

Intersection Summary			
HCM 2000 Control Delay	6.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.20		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.7
Intersection Capacity Utilization	59.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	1091	543	0	152	0	0	0	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)					5.8	5.8		5.4				
Lane Util. Factor					0.91	1.00		0.91				
Frt					1.00	0.85		1.00				
Flt Protected					1.00	1.00		1.00				
Satd. Flow (prot)					5353	1667		5250				
Flt Permitted					1.00	1.00		1.00				
Satd. Flow (perm)					5353	1667		5250				
Peak-hour factor, PHF	0.92	0.92	0.92	0.95	0.95	0.95	0.75	0.75	0.75	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	1148	572	0	203	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	46	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	1148	526	0	203	0	0	0	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	4%	4%	4%	2%	2%	2%
Turn Type					NA	Perm		NA				
Protected Phases					1			2				
Permitted Phases						1						
Actuated Green, G (s)					49.2	49.2		9.6				
Effective Green, g (s)					49.2	49.2		9.6				
Actuated g/C Ratio					0.70	0.70		0.14				
Clearance Time (s)					5.8	5.8		5.4				
Vehicle Extension (s)					0.2	0.2		0.2				
Lane Grp Cap (vph)					3762	1171		720				
v/s Ratio Prot					0.21			c0.04				
v/s Ratio Perm						c0.32						
v/c Ratio					0.31	0.45		0.28				
Uniform Delay, d1					3.9	4.5		27.1				
Progression Factor					0.21	0.03		1.23				
Incremental Delay, d2					0.2	1.0		1.0				
Delay (s)					1.0	1.1		34.2				
Level of Service					A	A		C				
Approach Delay (s)		0.0			1.0			34.2			0.0	
Approach LOS		A			A			C			A	

Intersection Summary			
HCM 2000 Control Delay	4.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.2
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX B-2
Future Year No-Build Signalized Intersections
Measures of Effectiveness
PM PEAK

HCM Signalized Intersection Capacity Analysis
3: I 375 NB Service Drive/NB I-375 Service Drive & E. Lafayette Blvd.

8/15/2014

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	278	489	0	0	199	401	12	57	8	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.5	5.5			5.5			7.7				
Lane Util. Factor	1.00	0.91			0.91			0.95				
Frt	1.00	1.00			0.90			0.98				
Flt Protected	0.95	1.00			1.00			0.99				
Satd. Flow (prot)	1770	5085			4575			3456				
Flt Permitted	0.36	1.00			1.00			0.99				
Satd. Flow (perm)	680	5085			4575			3456				
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	302	532	0	0	216	436	13	62	9	0	0	0
RTOR Reduction (vph)	0	0	0	0	302	0	0	7	0	0	0	0
Lane Group Flow (vph)	302	532	0	0	350	0	0	77	0	0	0	0
Turn Type	pm+pt	NA			NA		Perm	NA				
Protected Phases	7	4			8			2				
Permitted Phases	4						2					
Actuated Green, G (s)	42.5	42.5			21.5			14.3				
Effective Green, g (s)	42.5	42.5			21.5			14.3				
Actuated g/C Ratio	0.61	0.61			0.31			0.20				
Clearance Time (s)	5.5	5.5			5.5			7.7				
Lane Grp Cap (vph)	654	3087			1405			706				
v/s Ratio Prot	c0.10	0.10			0.08							
v/s Ratio Perm	c0.18							0.02				
v/c Ratio	0.46	0.17			0.25			0.11				
Uniform Delay, d1	10.5	6.0			18.2			22.7				
Progression Factor	0.92	0.77			1.00			0.75				
Incremental Delay, d2	2.2	0.1			0.4			0.2				
Delay (s)	12.0	4.8			18.6			17.3				
Level of Service	B	A			B			B				
Approach Delay (s)		7.4			18.6			17.3			0.0	
Approach LOS		A			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	12.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.40		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	18.7
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	1007	0	0	736	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.3			5.8		
Lane Util. Factor	*0.82			*0.63		
Frt	1.00			1.00		
Flt Protected	0.95			1.00		
Satd. Flow (prot)	2902			2347		
Flt Permitted	0.95			1.00		
Satd. Flow (perm)	2902			2347		
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1095	0	0	800	0	0
RTOR Reduction (vph)	144	0	0	0	0	0
Lane Group Flow (vph)	951	0	0	800	0	0
Turn Type	Prot			NA		
Protected Phases	4			2		
Permitted Phases						
Actuated Green, G (s)	23.0			34.9		
Effective Green, g (s)	23.0			34.9		
Actuated g/C Ratio	0.33			0.50		
Clearance Time (s)	6.3			5.8		
Lane Grp Cap (vph)	953			1170		
v/s Ratio Prot	c0.33			c0.34		
v/s Ratio Perm						
v/c Ratio	1.00			0.68		
Uniform Delay, d1	23.5			13.4		
Progression Factor	0.50			1.18		
Incremental Delay, d2	24.7			3.1		
Delay (s)	36.5			18.8		
Level of Service	D			B		
Approach Delay (s)	36.5			18.8	0.0	
Approach LOS	D			B	A	

Intersection Summary			
HCM 2000 Control Delay	29.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	67.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	440	52	27	176	0	0	0	0	327	220	186
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.5		5.5	5.5						7.7	
Lane Util. Factor		0.91		1.00	0.91						0.91	
Frt		0.98		1.00	1.00						0.96	
Flt Protected		1.00		0.95	1.00						0.98	
Satd. Flow (prot)		5004		1770	5085						4785	
Flt Permitted		1.00		0.43	1.00						0.98	
Satd. Flow (perm)		5004		808	5085						4785	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	478	57	29	191	0	0	0	0	355	239	202
RTOR Reduction (vph)	0	21	0	0	0	0	0	0	0	0	88	0
Lane Group Flow (vph)	0	514	0	29	191	0	0	0	0	0	708	0
Turn Type		NA		Perm	NA					Perm	NA	
Protected Phases		4			8						6	
Permitted Phases				8						6		
Actuated Green, G (s)		21.5		21.5	21.5						35.3	
Effective Green, g (s)		21.5		21.5	21.5						35.3	
Actuated g/C Ratio		0.31		0.31	0.31						0.50	
Clearance Time (s)		5.5		5.5	5.5						7.7	
Lane Grp Cap (vph)		1536		248	1561						2413	
v/s Ratio Prot		c0.10			0.04							
v/s Ratio Perm				0.04							0.15	
v/c Ratio		0.33		0.12	0.12						0.29	
Uniform Delay, d1		18.7		17.4	17.5						10.1	
Progression Factor		1.00		0.67	0.72						0.66	
Incremental Delay, d2		0.6		0.9	0.2						0.3	
Delay (s)		19.3		12.5	12.7						6.9	
Level of Service		B		B	B						A	
Approach Delay (s)		19.3			12.6			0.0			6.9	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM 2000 Control Delay	12.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.31		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	13.2
Intersection Capacity Utilization	80.8%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	757	269	0	0	0	0	0	0	250	464	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		5.3	5.3								5.8	
Lane Util. Factor		*0.82	1.00								0.91	
Frt		1.00	0.85								1.00	
Flt Protected		1.00	1.00								0.98	
Satd. Flow (prot)		3055	1583								4998	
Flt Permitted		1.00	1.00								0.98	
Satd. Flow (perm)		3055	1583								4998	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	823	292	0	0	0	0	0	0	272	504	0
RTOR Reduction (vph)	0	0	184	0	0	0	0	0	0	0	24	0
Lane Group Flow (vph)	0	823	108	0	0	0	0	0	0	0	752	0
Turn Type		NA	Perm							Perm	NA	
Protected Phases		2									4	
Permitted Phases			2							4		
Actuated Green, G (s)		24.7	24.7								34.2	
Effective Green, g (s)		24.7	24.7								34.2	
Actuated g/C Ratio		0.35	0.35								0.49	
Clearance Time (s)		5.3	5.3								5.8	
Lane Grp Cap (vph)		1077	558								2441	
v/s Ratio Prot		c0.27										
v/s Ratio Perm			0.07								0.15	
v/c Ratio		0.76	0.19								0.31	
Uniform Delay, d1		20.1	15.7								10.8	
Progression Factor		1.00	1.00								1.00	
Incremental Delay, d2		5.2	0.8								0.3	
Delay (s)		25.2	16.5								11.1	
Level of Service		C	B								B	
Approach Delay (s)		22.9			0.0			0.0			11.1	
Approach LOS		C			A			A			B	

Intersection Summary			
HCM 2000 Control Delay	18.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.1
Intersection Capacity Utilization	81.9%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	SBT	SBR	NEL	NER
Lane Configurations						
Volume (vph)	0	1465	499	1262	1187	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		6.0	10.1	10.1	9.0	
Lane Util. Factor		0.91	0.86	0.86	0.94	
Frt		1.00	0.92	0.85	1.00	
Flt Protected		1.00	1.00	1.00	0.95	
Satd. Flow (prot)		5085	4403	1362	4990	
Flt Permitted		1.00	1.00	1.00	0.95	
Satd. Flow (perm)		5085	4403	1362	4990	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1592	542	1372	1290	0
RTOR Reduction (vph)	0	0	208	374	0	0
Lane Group Flow (vph)	0	1592	1020	312	1290	0
Turn Type		NA	NA	Perm	Prot	
Protected Phases		2	6		4	
Permitted Phases				6		
Actuated Green, G (s)		54.0	49.9	49.9	41.0	
Effective Green, g (s)		54.0	49.9	49.9	41.0	
Actuated g/C Ratio		0.49	0.45	0.45	0.37	
Clearance Time (s)		6.0	10.1	10.1	9.0	
Lane Grp Cap (vph)		2496	1997	617	1859	
v/s Ratio Prot		c0.31	0.23		c0.26	
v/s Ratio Perm				0.23		
v/c Ratio		0.64	0.51	0.51	0.69	
Uniform Delay, d1		20.8	21.4	21.3	29.2	
Progression Factor		0.32	1.00	1.00	1.00	
Incremental Delay, d2		1.0	0.9	2.9	2.2	
Delay (s)		7.6	22.3	24.2	31.4	
Level of Service		A	C	C	C	
Approach Delay (s)		7.6	23.0		31.4	
Approach LOS		A	C		C	

Intersection Summary			
HCM 2000 Control Delay	20.1	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	19.1
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	6	0	28	35	16	141	41	106	2	0	185	18
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	6.0		6.0	6.0	6.0		5.9	5.9			5.9	5.9
Lane Util. Factor	1.00		1.00	1.00	1.00		1.00	0.95			1.00	1.00
Frpb, ped/bikes	1.00		0.95	1.00	0.97		1.00	1.00			1.00	0.96
Flpb, ped/bikes	0.99		1.00	0.97	1.00		0.99	1.00			1.00	1.00
Frt	1.00		0.85	1.00	0.86		1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00	0.95	1.00		0.95	1.00			1.00	1.00
Satd. Flow (prot)	1713		1522	1753	1555		1764	3564			1863	1454
Flt Permitted	0.65		1.00	0.95	1.00		0.63	1.00			1.00	1.00
Satd. Flow (perm)	1171		1522	1753	1555		1173	3564			1863	1454
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	7	0	30	38	17	153	45	115	2	0	201	20
RTOR Reduction (vph)	0	0	18	0	89	0	0	1	0	0	0	12
Lane Group Flow (vph)	7	0	13	38	81	0	45	116	0	0	201	8
Confl. Peds. (#/hr)	14		24	24		14	13		3	3		13
Heavy Vehicles (%)	4%	0%	1%	0%	4%	2%	1%	1%	0%	0%	2%	7%
Turn Type	Perm		Perm	Perm	NA		Perm	NA			NA	Perm
Protected Phases					8			2			6	
Permitted Phases	4		4	8			2					6
Actuated Green, G (s)	25.0		25.0	25.0	25.0		23.1	23.1			23.1	23.1
Effective Green, g (s)	25.0		25.0	25.0	25.0		23.1	23.1			23.1	23.1
Actuated g/C Ratio	0.42		0.42	0.42	0.42		0.39	0.39			0.39	0.39
Clearance Time (s)	6.0		6.0	6.0	6.0		5.9	5.9			5.9	5.9
Lane Grp Cap (vph)	487		634	730	647		451	1372			717	559
v/s Ratio Prot					c0.05			0.03			c0.11	
v/s Ratio Perm	0.01		0.01	0.02			0.04					0.01
v/c Ratio	0.01		0.02	0.05	0.12		0.10	0.08			0.28	0.01
Uniform Delay, d1	10.3		10.3	10.4	10.8		11.8	11.7			12.7	11.4
Progression Factor	1.00		1.00	1.00	1.00		1.00	1.00			1.00	1.00
Incremental Delay, d2	0.1		0.1	0.1	0.4		0.4	0.1			1.0	0.0
Delay (s)	10.3		10.3	10.6	11.2		12.2	11.8			13.7	11.5
Level of Service	B		B	B	B		B	B			B	B
Approach Delay (s)		10.3			11.1			12.0			13.5	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	12.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.20		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	11.9
Intersection Capacity Utilization	63.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	830	79	56	1015	139	64
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	5.3		5.3	5.3	6.5	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frpb, ped/bikes	1.00		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		0.99	1.00	1.00	
Frt	0.99		1.00	1.00	0.96	
Flt Protected	1.00		0.95	1.00	0.97	
Satd. Flow (prot)	4998		1851	5085	1521	
Flt Permitted	1.00		0.25	1.00	0.97	
Satd. Flow (perm)	4998		492	5085	1521	
Peak-hour factor, PHF	0.87	0.87	0.90	0.90	0.92	0.92
Adj. Flow (vph)	954	91	62	1128	151	70
RTOR Reduction (vph)	12	0	0	0	22	0
Lane Group Flow (vph)	1033	0	62	1128	199	0
Confl. Peds. (#/hr)		12	12		2	3
Heavy Vehicles (%)	2%	2%	2%	2%	3%	3%
Parking (#/hr)	10			10	10	
Turn Type	NA		Perm	NA	Prot	
Protected Phases	1			1	2	
Permitted Phases			1			
Actuated Green, G (s)	53.4		53.4	53.4	14.8	
Effective Green, g (s)	53.4		53.4	53.4	14.8	
Actuated g/C Ratio	0.67		0.67	0.67	0.19	
Clearance Time (s)	5.3		5.3	5.3	6.5	
Vehicle Extension (s)	0.2		0.2	0.2	3.0	
Lane Grp Cap (vph)	3336		328	3394	281	
v/s Ratio Prot	0.21			c0.22	c0.13	
v/s Ratio Perm			0.13			
v/c Ratio	0.31		0.19	0.33	0.71	
Uniform Delay, d1	5.6		5.1	5.7	30.6	
Progression Factor	0.62		1.00	1.00	1.00	
Incremental Delay, d2	0.2		1.3	0.3	7.9	
Delay (s)	3.7		6.3	5.9	38.5	
Level of Service	A		A	A	D	
Approach Delay (s)	3.7			6.0	38.5	
Approach LOS	A			A	D	

Intersection Summary			
HCM 2000 Control Delay	7.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	11.8
Intersection Capacity Utilization	52.2%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	143	668	92	5	799	350	0	65	37	129	77	140
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	10	10	12	10	10	12	12	16	12	12	11	12
Total Lost time (s)	6.3	6.3		6.3	6.3			6.6		6.6	6.6	6.6
Lane Util. Factor	1.00	0.91		1.00	0.91			1.00		1.00	0.95	0.95
Frpb, ped/bikes	1.00	1.00		1.00	0.99			1.00		1.00	0.99	0.98
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00		1.00	1.00	1.00
Frt	1.00	0.98		1.00	0.95			0.95		1.00	0.95	0.85
Flt Protected	0.95	1.00		0.95	1.00			1.00		0.95	1.00	1.00
Satd. Flow (prot)	1716	4615		1722	4445			2083		1899	1475	1586
Flt Permitted	0.21	1.00		0.33	1.00			1.00		0.66	1.00	1.00
Satd. Flow (perm)	382	4615		590	4445			2083		1320	1475	1586
Peak-hour factor, PHF	0.91	0.91	0.91	0.95	0.95	0.95	0.67	0.67	0.67	0.93	0.93	0.93
Adj. Flow (vph)	157	734	101	5	841	368	0	97	55	139	83	151
RTOR Reduction (vph)	0	19	0	0	85	0	0	28	0	0	23	92
Lane Group Flow (vph)	157	816	0	5	1124	0	0	124	0	139	101	18
Confl. Peds. (#/hr)	11					11	8		1	1		8
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	0%	0%	0%
Parking (#/hr)		10			10						10	
Turn Type	Perm	NA		Perm	NA			NA		Perm	NA	Perm
Protected Phases		1			1			2			2	
Permitted Phases	1			1						2		2
Actuated Green, G (s)	53.9	53.9		53.9	53.9			13.2		13.2	13.2	13.2
Effective Green, g (s)	53.9	53.9		53.9	53.9			13.2		13.2	13.2	13.2
Actuated g/C Ratio	0.67	0.67		0.67	0.67			0.16		0.16	0.16	0.16
Clearance Time (s)	6.3	6.3		6.3	6.3			6.6		6.6	6.6	6.6
Vehicle Extension (s)	0.2	0.2		0.2	0.2			3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	257	3109		397	2994			343		217	243	261
v/s Ratio Prot		0.18			0.25			0.06			0.07	
v/s Ratio Perm	c0.41			0.01						c0.11		0.01
v/c Ratio	0.61	0.26		0.01	0.38			0.36		0.64	0.41	0.07
Uniform Delay, d1	7.2	5.2		4.3	5.7			29.7		31.2	29.9	28.2
Progression Factor	1.65	1.63		0.93	0.84			1.00		1.00	1.00	1.00
Incremental Delay, d2	10.2	0.2		0.1	0.3			0.7		6.3	1.1	0.1
Delay (s)	22.1	8.6		4.0	5.2			30.3		37.5	31.1	28.3
Level of Service	C	A		A	A			C		D	C	C
Approach Delay (s)		10.8			5.2			30.3			32.7	
Approach LOS		B			A			C			C	

Intersection Summary			
HCM 2000 Control Delay	12.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.9
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (vph)	896	6	9	997	11	7
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Lane Width	10	12	10	10	12	12
Total Lost time (s)	5.0		5.0	5.0	6.5	
Lane Util. Factor	0.91		1.00	0.91	1.00	
Frpb, ped/bikes	1.00		1.00	1.00	0.99	
Flpb, ped/bikes	1.00		0.98	1.00	1.00	
Frt	1.00		1.00	1.00	0.95	
Flt Protected	1.00		0.95	1.00	0.97	
Satd. Flow (prot)	4738		1693	4700	1832	
Flt Permitted	1.00		0.28	1.00	0.97	
Satd. Flow (perm)	4738		499	4700	1832	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.75	0.75
Adj. Flow (vph)	974	7	10	1084	15	9
RTOR Reduction (vph)	1	0	0	0	9	0
Lane Group Flow (vph)	980	0	10	1084	15	0
Confl. Peds. (#/hr)		21	21		2	2
Heavy Vehicles (%)	2%	2%	3%	3%	0%	0%
Parking (#/hr)	10			10		
Turn Type	NA		Perm	NA	Prot	
Protected Phases	1			1	2	
Permitted Phases			1			
Actuated Green, G (s)	64.8		64.8	64.8	3.7	
Effective Green, g (s)	64.8		64.8	64.8	3.7	
Actuated g/C Ratio	0.81		0.81	0.81	0.05	
Clearance Time (s)	5.0		5.0	5.0	6.5	
Vehicle Extension (s)	0.2		0.2	0.2	3.0	
Lane Grp Cap (vph)	3837		404	3807	84	
v/s Ratio Prot	0.21			c0.23	c0.01	
v/s Ratio Perm			0.02			
v/c Ratio	0.26		0.02	0.28	0.18	
Uniform Delay, d1	1.8		1.5	1.9	36.7	
Progression Factor	0.87		1.19	1.06	1.00	
Incremental Delay, d2	0.2		0.1	0.2	1.1	
Delay (s)	1.7		1.9	2.2	37.8	
Level of Service	A		A	A	D	
Approach Delay (s)	1.7			2.2	37.8	
Approach LOS	A			A	D	

Intersection Summary			
HCM 2000 Control Delay	2.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.28		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	35.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	63	797	934	74	104	39
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Lane Width	10	11	10	12	10	10
Total Lost time (s)	6.4	6.4	6.4		6.3	6.3
Lane Util. Factor	1.00	0.91	0.91		0.97	0.91
Frpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Flpb, ped/bikes	1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.99		1.00	0.85
Flt Protected	0.95	1.00	1.00		0.95	1.00
Satd. Flow (prot)	1732	4916	4683		3117	1416
Flt Permitted	0.24	1.00	1.00		0.95	1.00
Satd. Flow (perm)	430	4916	4683		3117	1416
Peak-hour factor, PHF	0.95	0.95	0.88	0.88	0.89	0.89
Adj. Flow (vph)	66	839	1061	84	117	44
RTOR Reduction (vph)	0	0	9	0	4	36
Lane Group Flow (vph)	66	839	1136	0	117	4
Confl. Peds. (#/hr)	10			10	2	
Parking (#/hr)		10	10		10	
Turn Type	Perm	NA	NA		Prot	Perm
Protected Phases		1	1		2	
Permitted Phases	1					2
Actuated Green, G (s)	59.9	59.9	59.9		7.4	7.4
Effective Green, g (s)	59.9	59.9	59.9		7.4	7.4
Actuated g/C Ratio	0.75	0.75	0.75		0.09	0.09
Clearance Time (s)	6.4	6.4	6.4		6.3	6.3
Vehicle Extension (s)	0.2	0.2	0.2		3.0	3.0
Lane Grp Cap (vph)	321	3680	3506		288	130
v/s Ratio Prot		0.17	c0.24		c0.04	
v/s Ratio Perm	0.15					0.00
v/c Ratio	0.21	0.23	0.32		0.41	0.03
Uniform Delay, d1	3.0	3.0	3.3		34.2	33.0
Progression Factor	1.00	1.00	0.56		1.00	1.00
Incremental Delay, d2	1.4	0.1	0.2		0.9	0.1
Delay (s)	4.4	3.2	2.1		35.2	33.1
Level of Service	A	A	A		D	C
Approach Delay (s)		3.3	2.1		34.7	
Approach LOS		A	A		C	

Intersection Summary			
HCM 2000 Control Delay	5.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.33		
Actuated Cycle Length (s)	80.0	Sum of lost time (s)	12.7
Intersection Capacity Utilization	48.9%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	27	1071	97	13	833	127	368	132	26	41	28	33
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	10	10	12	10	10	12	12	14	12	12	16	12
Total Lost time (s)	5.8	5.8		5.8	5.8			6.4			6.4	
Lane Util. Factor	1.00	0.91		1.00	0.91			1.00			1.00	
Frpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00			1.00			1.00	
Frt	1.00	0.99		1.00	0.98			0.99			0.96	
Flt Protected	0.95	1.00		0.95	1.00			0.97			0.98	
Satd. Flow (prot)	1739	4934		1739	4652			2044			1780	
Flt Permitted	0.19	1.00		0.14	1.00			0.72			0.74	
Satd. Flow (perm)	347	4934		263	4652			1513			1350	
Peak-hour factor, PHF	0.89	0.89	0.89	0.87	0.87	0.87	0.90	0.90	0.90	0.82	0.82	0.82
Adj. Flow (vph)	30	1203	109	15	957	146	409	147	29	50	34	40
RTOR Reduction (vph)	0	14	0	0	28	0	0	3	0	0	17	0
Lane Group Flow (vph)	30	1298	0	15	1075	0	0	582	0	0	107	0
Confl. Peds. (#/hr)							3		3	3		3
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	0%	0%	0%	1%	1%	1%
Parking (#/hr)					10						10	
Turn Type	Perm	NA		Perm	NA		pm+pt	NA		Perm	NA	
Protected Phases		6			2		7	4			8	
Permitted Phases	6			2			4			8		
Actuated Green, G (s)	27.8	27.8		27.8	27.8			30.0			30.0	
Effective Green, g (s)	27.8	27.8		27.8	27.8			30.0			30.0	
Actuated g/C Ratio	0.40	0.40		0.40	0.40			0.43			0.43	
Clearance Time (s)	5.8	5.8		5.8	5.8			6.4			6.4	
Vehicle Extension (s)	0.2	0.2		0.2	0.2			3.0			3.0	
Lane Grp Cap (vph)	137	1959		104	1847			648			578	
v/s Ratio Prot		c0.26			0.23							
v/s Ratio Perm	0.09			0.06				c0.38			0.08	
v/c Ratio	0.22	0.66		0.14	0.58			0.90			0.18	
Uniform Delay, d1	13.9	17.3		13.5	16.5			18.6			12.4	
Progression Factor	1.62	1.63		1.00	1.00			1.00			1.00	
Incremental Delay, d2	3.3	1.6		2.9	1.3			15.2			0.2	
Delay (s)	25.9	29.7		16.4	17.9			33.8			12.6	
Level of Service	C	C		B	B			C			B	
Approach Delay (s)		29.6			17.9			33.8			12.6	
Approach LOS		C			B			C			B	

Intersection Summary			
HCM 2000 Control Delay	25.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	18.6
Intersection Capacity Utilization	66.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	2437	204	0	0	0	0	238	225
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	12	12	12	12	12	12
Total Lost time (s)					3.0						3.0	
Lane Util. Factor					0.81						0.95	
Frt					0.99						0.94	
Flt Protected					1.00						1.00	
Satd. Flow (prot)					6331						2917	
Flt Permitted					1.00						1.00	
Satd. Flow (perm)					6331						2917	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.92	0.79	0.90	0.90	0.90	0.85	0.60	0.94
Adj. Flow (vph)	0	0	0	0	2649	258	0	0	0	0	397	239
RTOR Reduction (vph)	0	0	0	0	25	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	2882	0	0	0	0	0	636	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	18%	3%	3%	3%	3%	7%	2%
Turn Type					NA						NA	
Protected Phases					6						4	
Permitted Phases					6							
Actuated Green, G (s)					35.0						19.0	
Effective Green, g (s)					38.0						26.0	
Actuated g/C Ratio					0.54						0.37	
Clearance Time (s)					6.0						10.0	
Lane Grp Cap (vph)					3436						1083	
v/s Ratio Prot					c0.46						c0.22	
v/s Ratio Perm												
v/c Ratio					0.84						0.59	
Uniform Delay, d1					13.4						17.7	
Progression Factor					0.40						1.00	
Incremental Delay, d2					2.1						2.3	
Delay (s)					7.4						20.0	
Level of Service					A						C	
Approach Delay (s)		0.0			7.4			0.0			20.0	
Approach LOS		A			A			A			C	

Intersection Summary			
HCM 2000 Control Delay	9.7	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	23.5
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	SEL	SER	SER2
Lane Configurations											
Volume (vph)	0	0	0	0	2137	0	0	0	0	270	504
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	12	12	12	11	11
Total Lost time (s)					3.0					3.0	3.0
Lane Util. Factor					0.86					0.64	1.00
Frt					1.00					0.85	0.85
Flt Protected					1.00					1.00	1.00
Satd. Flow (prot)					5521					2662	1364
Flt Permitted					1.00					1.00	1.00
Satd. Flow (perm)					5521					2662	1364
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.96	0.90	0.90	0.90	0.90	0.94	0.94
Adj. Flow (vph)	0	0	0	0	2226	0	0	0	0	287	536
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	197	197
Lane Group Flow (vph)	0	0	0	0	2226	0	0	0	0	320	109
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	0%	3%
Turn Type					NA					Prot	Prot
Protected Phases					9					4	4
Permitted Phases					9						
Actuated Green, G (s)					39.0					15.0	15.0
Effective Green, g (s)					42.0					22.0	22.0
Actuated g/C Ratio					0.60					0.31	0.31
Clearance Time (s)					6.0					10.0	10.0
Lane Grp Cap (vph)					3312					836	428
v/s Ratio Prot					c0.40					c0.12	0.08
v/s Ratio Perm											
v/c Ratio					0.67					0.38	0.25
Uniform Delay, d1					9.4					18.7	17.9
Progression Factor					0.04					1.00	1.00
Incremental Delay, d2					0.7					1.3	1.4
Delay (s)					1.0					20.0	19.3
Level of Service					A					C	B
Approach Delay (s)		0.0			1.0		0.0		19.8		
Approach LOS		A			A		A		B		

Intersection Summary			
HCM 2000 Control Delay	6.1	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	27.5
Intersection Capacity Utilization	73.2%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	2359	315	0	120	0	0	607	693
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	12	11	12	12	11	11
Total Lost time (s)					3.0			3.0			3.0	3.0
Lane Util. Factor					0.81			0.91			0.91	0.91
Frt					0.98			1.00			0.95	0.85
Flt Protected					1.00			1.00			1.00	1.00
Satd. Flow (prot)					6385			4381			2789	1254
Flt Permitted					1.00			1.00			1.00	1.00
Satd. Flow (perm)					6385			4381			2789	1254
Peak-hour factor, PHF	0.90	0.90	0.90	0.92	0.92	0.92	0.90	0.88	0.90	0.90	0.73	0.73
Adj. Flow (vph)	0	0	0	0	2564	342	0	136	0	0	832	949
RTOR Reduction (vph)	0	0	0	0	35	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	2871	0	0	136	0	0	1307	474
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	2%	2%
Turn Type					NA			NA			NA	Prot
Protected Phases					6			8			4	4
Permitted Phases												
Actuated Green, G (s)					36.0			22.0			18.0	18.0
Effective Green, g (s)					39.0			25.0			25.0	25.0
Actuated g/C Ratio					0.56			0.36			0.36	0.36
Clearance Time (s)					6.0			6.0			10.0	10.0
Lane Grp Cap (vph)					3557			1564			996	447
v/s Ratio Prot					c0.45			0.03			c0.47	0.38
v/s Ratio Perm												
v/c Ratio					0.81			0.09			1.31	1.06
Uniform Delay, d1					12.5			14.9			22.5	22.5
Progression Factor					0.11			0.13			1.00	1.00
Incremental Delay, d2					1.2			0.1			147.7	59.5
Delay (s)					2.6			2.1			170.2	82.0
Level of Service					A			A			F	F
Approach Delay (s)		0.0			2.6			2.1			146.7	
Approach LOS		A			A			A			F	

Intersection Summary			
HCM 2000 Control Delay	55.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	73.5%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	2536	111	0	0	0	0	0	110
Ideal Flow (vphpl)	1900	1900	2000	2000	1900	1900	2000	2000	2000	1900	2000	1900
Lane Width	12	12	12	12	11	12	12	12	12	12	12	11
Total Lost time (s)					3.0							3.0
Lane Util. Factor					0.81							0.88
Frt					0.99							0.85
Flt Protected					1.00							1.00
Satd. Flow (prot)					6522							2473
Flt Permitted					1.00							1.00
Satd. Flow (perm)					6522							2473
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.89	0.89	0.90	0.90	0.90	0.90	0.90	0.82
Adj. Flow (vph)	0	0	0	0	2849	125	0	0	0	0	0	134
RTOR Reduction (vph)	0	0	0	0	11	0	0	0	0	0	0	25
Lane Group Flow (vph)	0	0	0	0	2963	0	0	0	0	0	0	109
Heavy Vehicles (%)	3%	3%	3%	3%	2%	2%	3%	3%	3%	3%	3%	0%
Turn Type					NA							Prot
Protected Phases					6							4
Permitted Phases												
Actuated Green, G (s)					36.5							22.0
Effective Green, g (s)					39.0							25.0
Actuated g/C Ratio					0.56							0.36
Clearance Time (s)					5.5							6.0
Vehicle Extension (s)					3.0							3.0
Lane Grp Cap (vph)					3633							883
v/s Ratio Prot					c0.45							c0.04
v/s Ratio Perm												
v/c Ratio					0.82							0.12
Uniform Delay, d1					12.6							15.1
Progression Factor					0.68							1.00
Incremental Delay, d2					0.7							0.3
Delay (s)					9.3							15.4
Level of Service					A							B
Approach Delay (s)		0.0			9.3			0.0			15.4	
Approach LOS		A			A			A			B	

Intersection Summary			
HCM 2000 Control Delay	9.5	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.57		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.5
Intersection Capacity Utilization	49.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	18	1560	210	434	498	0	0	147	433
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	12	13	13	12	12	11	12
Total Lost time (s)					3.0		3.0	3.0			3.0	
Lane Util. Factor					0.86		0.91	0.91			0.91	
Frt					0.98		1.00	1.00			0.89	
Flt Protected					1.00		0.95	1.00			1.00	
Satd. Flow (prot)					5474		1441	3034			3339	
Flt Permitted					1.00		0.32	1.00			1.00	
Satd. Flow (perm)					5474		490	3034			3339	
Peak-hour factor, PHF	0.90	0.90	0.90	0.91	0.91	0.91	0.86	0.86	0.86	0.88	0.88	0.88
Adj. Flow (vph)	0	0	0	20	1714	231	505	579	0	0	167	492
RTOR Reduction (vph)	0	0	0	0	34	0	0	0	0	0	12	0
Lane Group Flow (vph)	0	0	0	0	1931	0	505	579	0	0	647	0
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	6%	6%	6%	14%	14%	14%
Parking (#/hr)											10	10
Turn Type				Perm	NA		Perm	NA			NA	
Protected Phases					6			8			4	
Permitted Phases				6	6		8					
Actuated Green, G (s)					37.0		21.1	21.1			17.1	
Effective Green, g (s)					40.0		24.0	24.0			24.0	
Actuated g/C Ratio					0.57		0.34	0.34			0.34	
Clearance Time (s)					6.0		5.9	5.9			9.9	
Lane Grp Cap (vph)					3128		168	1040			1144	
v/s Ratio Prot											0.19	
v/s Ratio Perm					0.35		c1.03	0.19				
v/c Ratio					0.62		3.01	0.56			1.31dr	
Uniform Delay, d1					9.9		23.0	18.7			18.8	
Progression Factor					1.58		0.30	0.10			1.00	
Incremental Delay, d2					0.9		913.2	1.4			2.0	
Delay (s)					16.6		920.0	3.3			20.8	
Level of Service					B		F	A			C	
Approach Delay (s)		0.0			16.6			430.3			20.8	
Approach LOS		A			B			F			C	

Intersection Summary			
HCM 2000 Control Delay	138.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.59		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	112.4%	ICU Level of Service	H
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

Movement	EBL	EBR2	NBL2	NBT	NBR	NET	SWL	SWT	SWR2
Lane Configurations									
Volume (vph)	316	18	44	76	218	859	2	437	19
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0	6.0	6.0	6.0		6.0		6.0	6.0
Lane Util. Factor	0.97	1.00	1.00	1.00		0.95		0.95	1.00
Frpb, ped/bikes	1.00	0.94	1.00	0.96		1.00		1.00	0.97
Flpb, ped/bikes	1.00	1.00	0.97	1.00		1.00		1.00	1.00
Frt	1.00	0.85	1.00	0.89		1.00		1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00		1.00		1.00	1.00
Satd. Flow (prot)	3252	1413	1627	1285		3101		3101	1462
Flt Permitted	0.95	1.00	0.95	1.00		1.00		0.95	1.00
Satd. Flow (perm)	3252	1413	1627	1285		3101		2951	1462
Peak-hour factor, PHF	0.68	0.68	0.81	0.81	0.81	0.82	0.86	0.86	0.86
Adj. Flow (vph)	465	26	54	94	269	1048	2	508	22
RTOR Reduction (vph)	0	22	0	14	0	0	0	0	14
Lane Group Flow (vph)	465	4	54	349	0	1048	0	510	8
Confl. Peds. (#/hr)		26	26		33				2
Parking (#/hr)				10		10		10	
Turn Type	Prot	Perm	Perm	NA		NA	Perm	NA	Perm
Protected Phases	4			3		2		2	
Permitted Phases		4	3				2		2
Actuated Green, G (s)	15.0	15.0	26.0	26.0		31.0		31.0	31.0
Effective Green, g (s)	15.0	15.0	26.0	26.0		31.0		31.0	31.0
Actuated g/C Ratio	0.17	0.17	0.29	0.29		0.34		0.34	0.34
Clearance Time (s)	6.0	6.0	6.0	6.0		6.0		6.0	6.0
Lane Grp Cap (vph)	542	235	470	371		1068		1016	503
v/s Ratio Prot	c0.14			c0.27		c0.34			
v/s Ratio Perm		0.00	0.03					0.17	0.01
v/c Ratio	0.86	0.02	0.11	0.94		0.98		0.50	0.02
Uniform Delay, d1	36.5	31.3	23.5	31.2		29.2		23.4	19.4
Progression Factor	1.00	1.00	1.00	1.00		1.00		0.92	1.00
Incremental Delay, d2	16.0	0.1	0.5	33.8		23.4		1.7	0.1
Delay (s)	52.5	31.5	24.0	65.0		52.6		23.3	19.5
Level of Service	D	C	C	E		D		C	B
Approach Delay (s)	51.4			59.7		52.6		23.1	
Approach LOS	D			E		D		C	

Intersection Summary			
HCM 2000 Control Delay	47.2	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	70.1%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	3	9	10	119	5	53	14	1349	0	19	392	104
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)		6.0			6.0		5.8	5.8		5.8	5.8	
Lane Util. Factor		1.00			1.00		1.00	0.95		1.00	0.95	
Frpb, ped/bikes		0.99			0.99		1.00	1.00		1.00	0.99	
Flpb, ped/bikes		1.00			0.99		0.98	1.00		1.00	1.00	
Frt		0.94			0.96		1.00	1.00		1.00	0.97	
Flt Protected		0.99			0.97		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1382			1371		1642	3101		1676	2964	
Flt Permitted		0.97			0.78		0.45	1.00		0.11	1.00	
Satd. Flow (perm)		1343			1109		770	3101		188	2964	
Peak-hour factor, PHF	0.92	0.92	0.92	0.94	0.94	0.94	0.88	0.88	0.88	0.91	0.91	0.91
Adj. Flow (vph)	3	10	11	127	5	56	16	1533	0	21	431	114
RTOR Reduction (vph)	0	8	0	0	0	0	0	0	0	0	26	0
Lane Group Flow (vph)	0	16	0	0	188	0	16	1533	0	21	519	0
Confl. Peds. (#/hr)	19		11	11		19	15		2	2		15
Parking (#/hr)		10			10			10			10	
Turn Type	Perm	NA		Perm	NA		Perm	NA		Perm	NA	
Protected Phases		4			4			2			2	
Permitted Phases	4			4			2			2		
Actuated Green, G (s)		21.0			21.0		57.2	57.2		57.2	57.2	
Effective Green, g (s)		21.0			21.0		57.2	57.2		57.2	57.2	
Actuated g/C Ratio		0.23			0.23		0.64	0.64		0.64	0.64	
Clearance Time (s)		6.0			6.0		5.8	5.8		5.8	5.8	
Lane Grp Cap (vph)		313			258		489	1970		119	1883	
v/s Ratio Prot								c0.49			0.18	
v/s Ratio Perm		0.01			c0.17		0.02			0.11		
v/c Ratio		0.05			0.73		0.03	0.78		0.18	0.28	
Uniform Delay, d1		26.8			31.9		6.1	11.8		6.7	7.2	
Progression Factor		1.00			1.00		0.45	0.29		1.00	1.00	
Incremental Delay, d2		0.3			16.5		0.1	2.5		3.2	0.4	
Delay (s)		27.1			48.4		2.8	5.9		9.9	7.6	
Level of Service		C			D		A	A		A	A	
Approach Delay (s)		27.1			48.4			5.8			7.7	
Approach LOS		C			D			A			A	

Intersection Summary			
HCM 2000 Control Delay	9.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	11.8
Intersection Capacity Utilization	72.5%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBT	NBR	SBL	SBT	NWL	NWR
Lane Configurations						
Volume (vph)	1237	84	66	432	81	117
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0		6.0	6.0	6.0	6.0
Lane Util. Factor	0.95		1.00	0.95	1.00	1.00
Frpb, ped/bikes	1.00		1.00	1.00	1.00	0.96
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.99		1.00	1.00	1.00	0.85
Flt Protected	1.00		0.95	1.00	0.95	1.00
Satd. Flow (prot)	3315		1676	3101	1676	1229
Flt Permitted	1.00		0.13	1.00	0.95	1.00
Satd. Flow (perm)	3315		225	3101	1676	1229
Peak-hour factor, PHF	0.86	0.86	0.93	0.93	0.78	0.78
Adj. Flow (vph)	1438	98	71	465	104	150
RTOR Reduction (vph)	5	0	0	0	0	61
Lane Group Flow (vph)	1531	0	71	465	104	89
Confl. Peds. (#/hr)		5	5			22
Parking (#/hr)				10		10
Turn Type	NA		Perm	NA	Prot	Perm
Protected Phases	2			2	4	
Permitted Phases			2			4
Actuated Green, G (s)	64.0		64.0	64.0	14.0	14.0
Effective Green, g (s)	64.0		64.0	64.0	14.0	14.0
Actuated g/C Ratio	0.71		0.71	0.71	0.16	0.16
Clearance Time (s)	6.0		6.0	6.0	6.0	6.0
Lane Grp Cap (vph)	2357		160	2205	260	191
v/s Ratio Prot	c0.46			0.15	0.06	
v/s Ratio Perm			0.32			c0.07
v/c Ratio	0.65		0.44	0.21	0.40	0.47
Uniform Delay, d1	7.0		5.5	4.4	34.2	34.6
Progression Factor	1.27		1.43	0.89	1.00	1.00
Incremental Delay, d2	0.6		8.4	0.2	4.5	8.0
Delay (s)	9.5		16.3	4.1	38.8	42.6
Level of Service	A		B	A	D	D
Approach Delay (s)	9.5			5.7	41.0	
Approach LOS	A			A	D	

Intersection Summary			
HCM 2000 Control Delay	12.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	82.3%	ICU Level of Service	E
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL2	WBT	SBL	SBT	SBR2	NER	NER2
Lane Configurations							
Volume (vph)	9	89	468	478	71	669	74
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000
Lane Width	11	11	11	11	11	12	12
Total Lost time (s)	5.7	5.7	6.0	6.0	6.0	8.7	
Lane Util. Factor	1.00	0.91	1.00	0.95	1.00	0.76	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	0.98	1.00	
Flpb, ped/bikes	0.99	1.00	0.99	1.00	1.00	1.00	
Frt	1.00	1.00	1.00	1.00	0.85	0.85	
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00	
Satd. Flow (prot)	1591	4600	1610	3241	1414	3033	
Flt Permitted	0.95	1.00	0.95	1.00	1.00	1.00	
Satd. Flow (perm)	1591	4600	1610	3241	1414	3033	
Peak-hour factor, PHF	0.92	0.92	0.95	0.95	0.95	0.92	0.92
Adj. Flow (vph)	10	97	493	503	75	727	80
RTOR Reduction (vph)	0	0	0	0	46	0	0
Lane Group Flow (vph)	10	97	493	503	29	807	0
Confl. Peds. (#/hr)	7		5		4		
Heavy Vehicles (%)	3%	3%	2%	2%	2%	15%	15%
Bus Blockages (#/hr)	0	2	0	0	2	0	0
Turn Type	Perm	NA	Perm	NA	Perm	Perm	
Protected Phases		1		4			
Permitted Phases	1		4		4	3	
Actuated Green, G (s)	31.3	31.3	27.0	27.0	27.0	28.3	
Effective Green, g (s)	31.3	31.3	27.0	27.0	27.0	28.3	
Actuated g/C Ratio	0.45	0.45	0.39	0.39	0.39	0.40	
Clearance Time (s)	5.7	5.7	6.0	6.0	6.0	8.7	
Lane Grp Cap (vph)	711	2056	621	1250	545	1226	
v/s Ratio Prot		0.02		0.16			
v/s Ratio Perm	0.01		c0.31		0.02	c0.27	
v/c Ratio	0.01	0.05	0.79	0.40	0.05	0.66	
Uniform Delay, d1	10.8	10.9	19.0	15.6	13.5	16.9	
Progression Factor	0.11	0.12	1.00	1.00	1.00	1.00	
Incremental Delay, d2	0.0	0.0	10.1	1.0	0.2	2.8	
Delay (s)	1.3	1.3	29.1	16.6	13.7	19.7	
Level of Service	A	A	C	B	B	B	
Approach Delay (s)		1.3		22.2			
Approach LOS		A		C			

Intersection Summary			
HCM 2000 Control Delay	20.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	71.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	443	749	0	0	94	488	2	831	5	0	0	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Lane Width	11	11	12	12	11	12	12	12	12	12	12	12
Total Lost time (s)	5.8	5.7			5.7			6.0				
Lane Util. Factor	1.00	0.91			0.91			0.91				
Frpb, ped/bikes	1.00	1.00			1.00			1.00				
Flpb, ped/bikes	1.00	1.00			1.00			1.00				
Frt	1.00	1.00			0.87			1.00				
Flt Protected	0.95	1.00			1.00			1.00				
Satd. Flow (prot)	1529	4398			4071			4766				
Flt Permitted	0.36	1.00			1.00			1.00				
Satd. Flow (perm)	580	4398			4071			4766				
Peak-hour factor, PHF	0.85	0.85	0.85	0.91	0.91	0.91	0.95	0.95	0.95	0.92	0.92	0.92
Adj. Flow (vph)	521	881	0	0	103	536	2	875	5	0	0	0
RTOR Reduction (vph)	0	0	0	0	39	0	0	1	0	0	0	0
Lane Group Flow (vph)	521	881	0	0	600	0	0	881	0	0	0	0
Confl. Peds. (#/hr)	5						5		4			
Heavy Vehicles (%)	8%	8%	8%	2%	2%	2%	3%	3%	3%	2%	2%	2%
Turn Type	pm+pt	NA			NA		Perm	NA				
Protected Phases	5	1			2			4				
Permitted Phases	1						4					
Actuated Green, G (s)	31.3	31.3			17.3			27.0				
Effective Green, g (s)	31.3	31.3			17.3			27.0				
Actuated g/C Ratio	0.45	0.45			0.25			0.39				
Clearance Time (s)	5.8	5.7			5.7			6.0				
Lane Grp Cap (vph)	370	1966			1006			1838				
v/s Ratio Prot	c0.16	0.20			0.15							
v/s Ratio Perm	c0.46							0.18				
v/c Ratio	1.41	0.45			1.33dr			0.48				
Uniform Delay, d1	19.7	13.4			23.3			16.2				
Progression Factor	0.78	0.68			1.00			0.43				
Incremental Delay, d2	196.0	0.6			2.6			0.8				
Delay (s)	211.3	9.6			25.9			7.7				
Level of Service	F	A			C			A				
Approach Delay (s)		84.6			25.9			7.7			0.0	
Approach LOS		F			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	48.5	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	17.5
Intersection Capacity Utilization	71.1%	ICU Level of Service	C
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	2137	312	20	89	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	12	11	11	12	12	12	12	12	12
Total Lost time (s)					3.0			3.0				
Lane Util. Factor					0.86			0.91				
Frt					0.98			1.00				
Flt Protected					1.00			0.99				
Satd. Flow (prot)					5415			4626				
Flt Permitted					1.00			0.99				
Satd. Flow (perm)					5415			4626				
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.95	0.95	0.86	0.86	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	0	0	0	2249	328	23	103	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	86	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	2577	0	0	40	0	0	0	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	0%	0%	3%	3%	3%	3%
Turn Type					NA		Perm	NA				
Protected Phases					6			8				
Permitted Phases					6		8					
Actuated Green, G (s)					36.0			19.0				
Effective Green, g (s)					42.0			22.0				
Actuated g/C Ratio					0.60			0.31				
Clearance Time (s)					9.0			6.0				
Lane Grp Cap (vph)					3249			1453				
v/s Ratio Prot					c0.48							
v/s Ratio Perm								0.01				
v/c Ratio					0.79			0.03				
Uniform Delay, d1					10.7			16.6				
Progression Factor					0.54			1.00				
Incremental Delay, d2					0.8			0.0				
Delay (s)					6.6			16.6				
Level of Service					A			B				
Approach Delay (s)		0.0			6.6			16.6			0.0	
Approach LOS		A			A			B			A	

Intersection Summary			
HCM 2000 Control Delay	7.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	31.5
Intersection Capacity Utilization	70.7%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1347	0	0	238	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0	
Lane Util. Factor		0.86			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5711			2945	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5711			2945	
Peak-hour factor, PHF	0.90	0.92	0.92	0.92	0.60	0.92
Adj. Flow (vph)	0	1464	0	0	397	0
RTOR Reduction (vph)	0	0	0	0	35	0
Lane Group Flow (vph)	0	1464	0	0	362	0
Heavy Vehicles (%)	3%	3%	3%	3%	7%	3%
Turn Type		NA			Prot	
Protected Phases		2			8	
Permitted Phases		2				
Actuated Green, G (s)		23.5			23.0	
Effective Green, g (s)		38.0			26.0	
Actuated g/C Ratio		0.54			0.37	
Clearance Time (s)		17.5			6.0	
Lane Grp Cap (vph)		3100			1093	
v/s Ratio Prot		c0.26			c0.12	
v/s Ratio Perm						
v/c Ratio		0.47			0.33	
Uniform Delay, d1		9.8			15.8	
Progression Factor		1.00			0.02	
Incremental Delay, d2		0.5			0.7	
Delay (s)		10.4			0.9	
Level of Service		B			A	
Approach Delay (s)		10.4	0.0		0.9	
Approach LOS		B	A		A	

Intersection Summary			
HCM 2000 Control Delay	8.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1585	0	0	270	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		3.0			3.0	
Lane Util. Factor		0.86			0.97	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5711			3152	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5711			3152	
Peak-hour factor, PHF	0.90	0.95	0.90	0.90	0.94	0.90
Adj. Flow (vph)	0	1668	0	0	287	0
RTOR Reduction (vph)	0	0	0	0	34	0
Lane Group Flow (vph)	0	1668	0	0	253	0
Heavy Vehicles (%)	3%	3%	3%	3%	0%	3%
Turn Type		NA			Prot	
Protected Phases		2			8	
Permitted Phases						
Actuated Green, G (s)		23.5			19.0	
Effective Green, g (s)		42.0			22.0	
Actuated g/C Ratio		0.60			0.31	
Clearance Time (s)		21.5			6.0	
Lane Grp Cap (vph)		3426			990	
v/s Ratio Prot		c0.29			c0.08	
v/s Ratio Perm						
v/c Ratio		0.49			0.26	
Uniform Delay, d1		7.9			17.9	
Progression Factor		0.56			0.46	
Incremental Delay, d2		0.5			0.5	
Delay (s)		4.9			8.8	
Level of Service		A			A	
Approach Delay (s)		4.9	0.0		8.8	
Approach LOS		A	A		A	

Intersection Summary			
HCM 2000 Control Delay	5.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	43.9%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	1658	560	0	0	0	0	120	224	405	202	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	11	11	12	12	12	12	12	12	12	12	12
Total Lost time (s)		3.0	3.0					3.0	3.0		3.0	
Lane Util. Factor		0.86	0.88					0.91	0.91		0.95	
Frt		1.00	0.85					0.93	0.85		1.00	
Flt Protected		1.00	1.00					1.00	1.00		0.97	
Satd. Flow (prot)		5468	2378					2807	1284		3082	
Flt Permitted		1.00	1.00					1.00	1.00		0.66	
Satd. Flow (perm)		5468	2378					2807	1284		2094	
Peak-hour factor, PHF	0.87	0.95	0.95	0.90	0.90	0.90	0.88	0.88	0.88	0.73	0.73	0.73
Adj. Flow (vph)	0	1745	589	0	0	0	0	136	255	555	277	0
RTOR Reduction (vph)	0	0	261	0	0	0	0	10	30	0	0	0
Lane Group Flow (vph)	0	1745	328	0	0	0	0	248	103	0	832	0
Heavy Vehicles (%)	4%	4%	4%	3%	3%	3%	3%	3%	3%	2%	2%	2%
Turn Type		NA	Prot					NA	Prot	Perm	NA	
Protected Phases		2	2					4	4		8	
Permitted Phases										8		
Actuated Green, G (s)		36.0	36.0					18.0	18.0		22.0	
Effective Green, g (s)		39.0	39.0					25.0	25.0		25.0	
Actuated g/C Ratio		0.56	0.56					0.36	0.36		0.36	
Clearance Time (s)		6.0	6.0					10.0	10.0		6.0	
Lane Grp Cap (vph)		3046	1324					1002	458		747	
v/s Ratio Prot		c0.32	0.14					0.09	0.08			
v/s Ratio Perm											c0.40	
v/c Ratio		0.57	0.25					0.25	0.22		1.64dl	
Uniform Delay, d1		10.1	8.0					15.9	15.7		22.5	
Progression Factor		1.30	4.67					1.00	1.00		0.16	
Incremental Delay, d2		0.8	0.4					0.6	1.1		53.2	
Delay (s)		13.9	37.6					16.5	16.9		56.8	
Level of Service		B	D					B	B		E	
Approach Delay (s)		19.9			0.0			16.6			56.8	
Approach LOS		B			A			B			E	

Intersection Summary			
HCM 2000 Control Delay	28.2	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	71.9%	ICU Level of Service	C
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑↑↑↑				
Volume (vph)	0	2287	0	0	0	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)		3.0				
Lane Util. Factor		0.81				
Frt		1.00				
Flt Protected		1.00				
Satd. Flow (prot)		7788				
Flt Permitted		1.00				
Satd. Flow (perm)		7788				
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	0	2541	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	0	2541	0	0	0	0
Heavy Vehicles (%)	3%	4%	3%	3%	3%	3%
Turn Type		NA				
Protected Phases		2				
Permitted Phases						
Actuated Green, G (s)		36.5				
Effective Green, g (s)		39.0				
Actuated g/C Ratio		0.56				
Clearance Time (s)		5.5				
Vehicle Extension (s)		3.0				
Lane Grp Cap (vph)		4339				
v/s Ratio Prot		c0.33				
v/s Ratio Perm						
v/c Ratio		0.59				
Uniform Delay, d1		10.2				
Progression Factor		0.66				
Incremental Delay, d2		0.4				
Delay (s)		7.2				
Level of Service		A				
Approach Delay (s)		7.2	0.0		0.0	
Approach LOS		A	A		A	

Intersection Summary			
HCM 2000 Control Delay	7.2	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.5
Intersection Capacity Utilization	49.3%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	12	1956	99	0	0	0	0	920	661	111	54	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	11	11	12	12	12	12	11	11	13	13	12
Total Lost time (s)		3.0						3.0	3.0	3.0	3.0	
Lane Util. Factor		0.86						0.91	0.88	1.00	0.95	
Frt		0.99						1.00	0.85	1.00	1.00	
Flt Protected		1.00						1.00	1.00	0.95	1.00	
Satd. Flow (prot)		5479						4257	2333	1472	2945	
Flt Permitted		1.00						1.00	1.00	0.17	1.00	
Satd. Flow (perm)		5479						4257	2333	258	2945	
Peak-hour factor, PHF	0.92	0.92	0.92	0.90	0.90	0.90	0.90	0.86	0.86	0.88	0.88	0.90
Adj. Flow (vph)	13	2126	108	0	0	0	0	1070	769	126	61	0
RTOR Reduction (vph)	0	10	0	0	0	0	0	0	31	0	0	0
Lane Group Flow (vph)	0	2237	0	0	0	0	0	1070	738	126	61	0
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	3%	6%	6%	14%	14%	14%
Turn Type	Perm	NA						NA	Prot	Perm	NA	
Protected Phases		2						4	4		8	
Permitted Phases	2									8		
Actuated Green, G (s)		37.0						17.1	17.1	21.1	21.1	
Effective Green, g (s)		40.0						24.0	24.0	24.0	24.0	
Actuated g/C Ratio		0.57						0.34	0.34	0.34	0.34	
Clearance Time (s)		6.0						9.9	9.9	5.9	5.9	
Lane Grp Cap (vph)		3130						1459	799	88	1009	
v/s Ratio Prot								0.25	0.32		0.02	
v/s Ratio Perm		0.41								c0.49		
v/c Ratio		0.71						0.73	0.92	1.43	0.06	
Uniform Delay, d1		10.9						20.2	22.1	23.0	15.4	
Progression Factor		0.08						1.00	1.00	0.27	0.59	
Incremental Delay, d2		1.2						3.3	17.9	240.2	0.1	
Delay (s)		2.1						23.5	40.1	246.5	9.2	
Level of Service		A						C	D	F	A	
Approach Delay (s)		2.1			0.0			30.4			169.0	
Approach LOS		A			A			C			F	

Intersection Summary			
HCM 2000 Control Delay	21.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	9.0
Intersection Capacity Utilization	112.4%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	111	0	0	0	0	0	0	1354	124	0	484	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)	6.0							10.1			6.1	
Lane Util. Factor	1.00							0.91			0.95	
Frt	1.00							0.99			1.00	
Flt Protected	0.95							1.00			1.00	
Satd. Flow (prot)	1863							5285			3725	
Flt Permitted	0.95							1.00			1.00	
Satd. Flow (perm)	1863							5285			3725	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	121	0	0	0	0	0	0	1472	135	0	526	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	10	0	0	0	0
Lane Group Flow (vph)	121	0	0	0	0	0	0	1597	0	0	526	0
Turn Type	Perm			D.Pm		Prot		NA			NA	
Protected Phases		8				8		2			6	
Permitted Phases	8			8		8						
Actuated Green, G (s)	44.0							49.9			53.9	
Effective Green, g (s)	44.0							49.9			53.9	
Actuated g/C Ratio	0.40							0.45			0.49	
Clearance Time (s)	6.0							10.1			6.1	
Lane Grp Cap (vph)	745							2397			1825	
v/s Ratio Prot								c0.30			0.14	
v/s Ratio Perm	c0.06											
v/c Ratio	0.16							0.67			0.29	
Uniform Delay, d1	21.2							23.5			16.7	
Progression Factor	1.00							1.00			0.40	
Incremental Delay, d2	0.5							1.5			0.3	
Delay (s)	21.6							25.0			6.9	
Level of Service	C							C			A	
Approach Delay (s)		21.6			0.0			25.0			6.9	
Approach LOS		C			A			C			A	

Intersection Summary			
HCM 2000 Control Delay	20.6	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.1
Intersection Capacity Utilization	46.7%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Volume (vph)	18	37	35	0	0	0	7	596	0	0	380	57
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)		4.0						4.0			4.0	
Lane Util. Factor		1.00						0.95			0.95	
Frt		0.95						1.00			0.98	
Flt Protected		0.99						1.00			1.00	
Satd. Flow (prot)		1839						3723			3653	
Flt Permitted		0.96						0.95			1.00	
Satd. Flow (perm)		1782						3539			3653	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	20	40	38	0	0	0	8	648	0	0	413	62
RTOR Reduction (vph)	0	25	0	0	0	0	0	0	0	0	13	0
Lane Group Flow (vph)	0	73	0	0	0	0	0	656	0	0	462	0
Turn Type	Perm	NA					Perm	NA			NA	
Protected Phases		2			6			4			8	
Permitted Phases	2			6			4					
Actuated Green, G (s)		27.0						55.0			55.0	
Effective Green, g (s)		27.0						55.0			55.0	
Actuated g/C Ratio		0.30						0.61			0.61	
Clearance Time (s)		4.0						4.0			4.0	
Lane Grp Cap (vph)		534						2162			2232	
v/s Ratio Prot											0.13	
v/s Ratio Perm		c0.04						c0.19				
v/c Ratio		0.14						0.30			0.21	
Uniform Delay, d1		23.0						8.4			7.8	
Progression Factor		0.06						1.00			1.00	
Incremental Delay, d2		0.3						0.4			0.2	
Delay (s)		1.6						8.7			8.0	
Level of Service		A						A			A	
Approach Delay (s)		1.6			0.0			8.7			8.0	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.9	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.25		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	31.8%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	WBL	WBR	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NER
Lane Configurations										
Volume (vph)	819	0	0	0	0	0	360	184	0	0
Ideal Flow (vphpl)	1900	2000	1900	2000	2000	2000	2000	1900	1900	1900
Total Lost time (s)	6.0						5.7			
Lane Util. Factor	*0.91						0.91			
Frt	1.00						0.95			
Flt Protected	0.95						1.00			
Satd. Flow (prot)	4831						4936			
Flt Permitted	0.95						1.00			
Satd. Flow (perm)	4831						4936			
Peak-hour factor, PHF	0.95	0.95	0.92	0.92	0.92	0.83	0.83	0.83	0.92	0.92
Adj. Flow (vph)	862	0	0	0	0	0	434	222	0	0
RTOR Reduction (vph)	0	0	0	0	0	0	74	0	0	0
Lane Group Flow (vph)	862	0	0	0	0	0	582	0	0	0
Heavy Vehicles (%)	2%	2%	2%	2%	2%	5%	5%	5%	2%	2%
Turn Type	Prot						NA			
Protected Phases	1						3			
Permitted Phases										
Actuated Green, G (s)	35.0						23.3			
Effective Green, g (s)	35.0						23.3			
Actuated g/C Ratio	0.50						0.33			
Clearance Time (s)	6.0						5.7			
Vehicle Extension (s)	0.2						0.2			
Lane Grp Cap (vph)	2415						1642			
v/s Ratio Prot	c0.18						c0.12			
v/s Ratio Perm										
v/c Ratio	0.36						0.35			
Uniform Delay, d1	10.7						17.7			
Progression Factor	1.71						0.83			
Incremental Delay, d2	0.4						0.6			
Delay (s)	18.6						15.2			
Level of Service	B						B			
Approach Delay (s)	18.6			0.0			15.2		0.0	
Approach LOS	B			A			B		A	

Intersection Summary			
HCM 2000 Control Delay	17.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.36		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.7
Intersection Capacity Utilization	56.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Volume (vph)	0	1246	0	0	360	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000
Total Lost time (s)		6.0			5.7	
Lane Util. Factor		0.91			0.94	
Frt		1.00			1.00	
Flt Protected		1.00			0.95	
Satd. Flow (prot)		5406			5202	
Flt Permitted		1.00			0.95	
Satd. Flow (perm)		5406			5202	
Peak-hour factor, PHF	0.83	0.83	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	1501	0	0	391	0
RTOR Reduction (vph)	0	0	0	0	34	0
Lane Group Flow (vph)	0	1501	0	0	357	0
Heavy Vehicles (%)	1%	1%	2%	2%	3%	3%
Turn Type		NA			Prot	
Protected Phases		2			4	
Permitted Phases						
Actuated Green, G (s)		35.0			23.3	
Effective Green, g (s)		35.0			23.3	
Actuated g/C Ratio		0.50			0.33	
Clearance Time (s)		6.0			5.7	
Vehicle Extension (s)		0.2			0.2	
Lane Grp Cap (vph)		2703			1731	
v/s Ratio Prot		c0.28			c0.07	
v/s Ratio Perm						
v/c Ratio		0.56			0.21	
Uniform Delay, d1		12.1			16.7	
Progression Factor		1.21			0.11	
Incremental Delay, d2		0.6			0.3	
Delay (s)		15.2			2.1	
Level of Service		B			A	
Approach Delay (s)		15.2	0.0		2.1	
Approach LOS		B	A		A	

Intersection Summary			
HCM 2000 Control Delay	12.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.7
Intersection Capacity Utilization	63.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	0	0	0	0	819	427	0	411	0	0	0	0
Ideal Flow (vphpl)	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Total Lost time (s)					5.8	5.8		5.4				
Lane Util. Factor					0.91	1.00		0.91				
Frt					1.00	0.85		1.00				
Flt Protected					1.00	1.00		1.00				
Satd. Flow (prot)					5301	1650		5353				
Flt Permitted					1.00	1.00		1.00				
Satd. Flow (perm)					5301	1650		5353				
Peak-hour factor, PHF	0.92	0.92	0.92	0.95	0.95	0.95	0.82	0.82	0.82	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	862	449	0	501	0	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	11	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	862	438	0	501	0	0	0	0
Heavy Vehicles (%)	2%	2%	2%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type					NA	Perm		NA				
Protected Phases					1			2				
Permitted Phases						1						
Actuated Green, G (s)					49.2	49.2		9.6				
Effective Green, g (s)					49.2	49.2		9.6				
Actuated g/C Ratio					0.70	0.70		0.14				
Clearance Time (s)					5.8	5.8		5.4				
Vehicle Extension (s)					0.2	0.2		0.2				
Lane Grp Cap (vph)					3725	1159		734				
v/s Ratio Prot					0.16			c0.09				
v/s Ratio Perm						c0.27						
v/c Ratio					0.23	0.38		0.68				
Uniform Delay, d1					3.7	4.2		28.7				
Progression Factor					1.17	1.18		0.71				
Incremental Delay, d2					0.1	0.7		4.6				
Delay (s)					4.4	5.7		25.2				
Level of Service					A	A		C				
Approach Delay (s)		0.0			4.9			25.2			0.0	
Approach LOS		A			A			C			A	

Intersection Summary			
HCM 2000 Control Delay	10.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	11.2
Intersection Capacity Utilization	55.2%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

APPENDIX B-3
Future Year No-Build HCS Measures of Effectiveness
AM PEAK

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	R Bezati	Freeway/Dir of Travel	Fisher Fwy EB
Agency or Company	Parsons Brinckerhoff	Junction	On Ramp from NB 375
Date Performed	5/28/2014	Jurisdiction	MDOT
Analysis Time Period	AM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☑ Yes ☐ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☐ No ☑ Off
L_{up} = ft	Acceleration Lane Length, L_A: 439	L_{down} = 500 ft
V_u = veh/h	Deceleration Lane Length L_D	V_D = 192 veh/h
	Freeway Volume, V_F: 918	
	Ramp Volume, V_R: 9	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	918	0.94	Level	6	0	0.971	1.00	1006
Ramp	9	0.94	Level	6	0	0.971	1.00	10
UpStream								
DownStream	192	0.94	Level	6	0	0.971	1.00	210

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 1341.23 (Equation 13-6 or 13-7)

P_{FM} = 0.659 using Equation (Exhibit 13-6)

V_{12} = 663 pc/h

V_3 or V_{av34} 343 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 663 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1016	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	673	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 8.0 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.298 (Exibit 13-11)

S_R= 51.1 mph (Exhibit 13-11)

S_0= 55.0 mph (Exhibit 13-11)

S = 52.4 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	R Bezati	Freeway/Dir of Travel	Fisher Fwy EB
Agency or Company	Parsons Brinckerhoff	Junction	On Ramp from Fisher EB Ser Dr
Date Performed	5/28/2014	Jurisdiction	MDOT
Analysis Time Period	AM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp

☑ Yes ☐ On

☐ No ☑ Off

L_{up} = 1569 ft

V_u = 2872 veh/h

Freeway Number of Lanes, N	2
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	185
Deceleration Lane Length L_D	
Freeway Volume, V_F	695
Ramp Volume, V_R	31
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	35.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	695	0.94	Level	6	0	0.971	1.00	762
Ramp	31	0.94	Level	6	0	0.971	1.00	34
UpStream	2872	0.94	Level	6	0	0.971	1.00	3147
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 762 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	796	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	796	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 10.5 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.317 (Exibit 13-11)

S_R= 50.9 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*Fisher EB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*375 Off to Fisher Ser Dr On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*695*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*381*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*6.9*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*Fisher EB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*ChryslerSB On to 375 NB On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*918*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*335*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*6.1*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*Fisher EB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher ServOn to ChryslerSB On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*726*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*398*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*7.2*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	R Bezati	Freeway/Dir of Travel	I-375/Chrysler NB
Agency or Company	Parsons Brinckerhoff	Junction	Madison On-Ramp
Date Performed	5/28/2014	Jurisdiction	MDOT
Analysis Time Period	AM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☐ Yes ☐ On	Freeway Number of Lanes, N: 3	☑ Yes ☑ On
☑ No ☐ Off	Ramp Number of Lanes, N: 1	☐ No ☐ Off
L_{up} = ft	Acceleration Lane Length, L_A: 265	L_{down} = 815 ft
V_u = veh/h	Deceleration Lane Length L_D:	V_D = 1322 veh/h
	Freeway Volume, V_F: 3013	
	Ramp Volume, V_R: 444	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3013	0.94	Level	2	0	0.990	1.00	3237
Ramp	444	0.94	Level	2	0	0.990	1.00	477
UpStream								
DownStream	1322	0.94	Level	2	0	0.990	1.00	1420

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.585 using Equation (Exhibit 13-6)

V_{12} = 1893 pc/h

V_3 or V_{av34} 1344 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1893 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3714	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2597	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 23.9 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.355 (Exibit 13-11)

S_R= 50.4 mph (Exhibit 13-11)

S_0= 52.8 mph (Exhibit 13-11)

S = 51.1 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	R Bezati	Freeway/Dir of Travel	I-375/Chrysler NB
Agency or Company	Parsons Brinckerhoff	Junction	On Ramp from Fisher EB
Date Performed	5/28/2014	Jurisdiction	MDOT
Analysis Time Period	AM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☑ On	Freeway Number of Lanes, N: 3	☐ Yes ☐ On
☐ No ☐ Off	Ramp Number of Lanes, N: 2	☑ No ☐ Off
L_{up} = 815 ft	Acceleration Lane Length, L_A: 250	L_{down} = ft
V_u = 444 veh/h	Deceleration Lane Length L_D	V_D = veh/h
	Freeway Volume, V_F: 3457	
	Ramp Volume, V_R: 1322	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	3457	0.94	Level	2	0	0.990	1.00	3714
Ramp	1322	0.94	Level	6	0	0.971	1.00	1449
UpStream	444	0.94	Level	2	0	0.990	1.00	477
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.555 using Equation (Exhibit 13-6)

V_{12} = 2061 pc/h

V_3 or V_{av34} 1653 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 2122 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5163	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3571	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 20.1 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.320 (Exibit 13-11)

S_R= 50.8 mph (Exhibit 13-11)

S_0= 51.1 mph (Exhibit 13-11)

S = 50.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher Off to Madison On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3013*	veh/h	Peak-Hour Factor, PHF	*0.94*	
AADT		veh/day	%Trucks and Buses, P_T	*2*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1079*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*19.6*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Jefferson to Larned On-Ramp*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1108*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*595*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*10.8*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Larned On to Monroe On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2214*	veh/h	Peak-Hour Factor, PHF	*0.94*	
AADT		veh/day	%Trucks and Buses, P_T	*2*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*793*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*14.4*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher EB On to Fisher WB On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4779*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1309*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*23.8*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	R Bezati
Agency/Company	Parsons Brinckerhoff
Date Performed	5/28/2014
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	I-375 NB
Weaving Segment Location	Fisher WB On to Mack Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	5
Weaving segment length, L_S	1050ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	4143	0.94	6	0	1.5	1.2	0.971	1.00	4540
V_{RF}	212	0.94	6	0	1.5	1.2	0.971	1.00	232
V_{FR}	636	0.94	6	0	1.5	1.2	0.971	1.00	697
V_{RR}	33	0.94	6	0	1.5	1.2	0.971	1.00	36
V_{NW}	4576							V =	5345
V_W	929								
VR	0.169								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc
Interchange density, ID	3.3 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	1 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	929 lc/h
Weaving lane changes, LC_W	1787 lc/h
Non-weaving lane changes, LC_{NW}	1498 lc/h
Total lane changes, LC_{ALL}	3285 lc/h
Non-weaving vehicle index, I_{NW}	1586

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5345 veh/h
Weaving segment capacity, c_w	9748 veh/h
Weaving segment v/c ratio	0.548
Weaving segment density, D	25.8 pc/mi/ln
Level of Service, LOS	C
Weaving intensity factor, W	0.556
Weaving segment speed, S	42.6 mph
Average weaving speed, S_W	40.7 mph
Average non-weaving speed, S_{NW}	43.0 mph
Maximum weaving length, L_{MAX}	4219 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	R Bezati
Agency/Company	Parsons Brinckerhoff
Date Performed	5/28/2014
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	I-375 SB
Weaving Segment Location	Monroe On and Fisher Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1342ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1982	0.94	2	0	1.5	1.2	0.990	1.00	2130
V_{RF}	1030	0.94	2	0	1.5	1.2	0.990	1.00	1107
V_{FR}	232	0.94	2	0	1.5	1.2	0.990	1.00	249
V_{RR}	274	0.94	2	0	1.5	1.2	0.990	1.00	294
V_{NW}	2424							V =	3743
V_W	1356								
VR	0.359								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	1107 lc/h
Interchange density, ID	3.2 int/mi	Weaving lane changes, LC_W	1742 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	456 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	2198 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	1041

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3743 veh/h	Weaving intensity factor, W	0.334
Weaving segment capacity, c_w	7905 veh/h	Weaving segment speed, S	43.4 mph
Weaving segment v/c ratio	0.473	Average weaving speed, S_W	45.0 mph
Weaving segment density, D	21.8 pc/mi/ln	Average non-weaving speed, S_{NW}	42.5 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	4656 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	R Bezati	Freeway/Dir of Travel	I-375/Chrysler NB
Agency or Company	Parsons Brinckerhoff	Junction	Madison On-Ramp
Date Performed	5/28/2014	Jurisdiction	MDOT
Analysis Time Period	AM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes ☐ On
☐ No	☑ Off	Acceleration Lane Length, L_A	600	☑ No ☐ Off
L_{up} =	1540 ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	1833 veh/h	Freeway Volume, V_F	4611	V_D = veh/h
		Ramp Volume, V_R	1090	
		Freeway Free-Flow Speed, S_{FF}	55.0	
		Ramp Free-Flow Speed, S_{FR}	35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	4611	0.94	Level	2	0	0.990	1.00	4954
Ramp	1090	0.94	Level	2	0	0.990	1.00	1171
UpStream	1833	0.94	Level	2	0	0.990	1.00	1969
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 1005.35 (Equation 13-6 or 13-7)

P_{FM} = 0.594 using Equation (Exhibit 13-6)

V_{12} = 2944 pc/h

V_3 or V_{av34} 2010 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 2944 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	6125	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	4468	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 36.0 (pc/mi/ln)

LOS = E (Exhibit 13-2)

Speed Determination

M_S = 0.619 (Exibit 13-11)

S_R= 47.0 mph (Exhibit 13-11)

S_0= 50.8 mph (Exhibit 13-11)

S = 47.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher WB On to Fisher EB On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3607*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*969*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*17.6*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 SB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Larned Off and Jefferson End*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2103*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1130*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*20.5*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*D Cook*	Highway/Direction of Travel	*I-375 SB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Mack Off to Mack On*
Date Performed	*1/24/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*6209*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1701*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*30.9*	pc/mi/ln
LOS	*D*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 SB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Madison Off to Fisher WB On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*AM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3521*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1261*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*22.9*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	R Bezati
Agency/Company	Parsons Brinckerhoff
Date Performed	5/28/2014
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	I-375 SB
Weaving Segment Location	Fisher EB On to Monroe Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	730ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2334	0.94	2	0	1.5	1.2	0.990	1.00	2508
V_{RF}	1003	0.94	2	0	1.5	1.2	0.990	1.00	1078
V_{FR}	1273	0.94	2	0	1.5	1.2	0.990	1.00	1368
V_{RR}	547	0.94	2	0	1.5	1.2	0.990	1.00	588
V_{NW}	3096							V =	5488
V_W	2446								
VR	0.441								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	lc/h
Interchange density, ID	3.2 int/mi	Weaving lane changes, LC_W	lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5488 veh/h	Weaving intensity factor, W	
Weaving segment capacity, c_w	5384 veh/h	Weaving segment speed, S	mph
Weaving segment v/c ratio	1.019	Average weaving speed, S_W	mph
Weaving segment density, D	pc/mi/ln	Average non-weaving speed, S_{NW}	mph
Level of Service, LOS	F	Maximum weaving length, L_{MAX}	7149 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	D Cook
Agency/Company	Parsons Brinckerhoff
Date Performed	1/24/2014
Analysis Time Period	AM

Site Information

Freeway/Dir of Travel	I-375 SB
Weaving Segment Location	Mack On to Fisher Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	5
Weaving segment length, L_S	1452ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	4443	0.94	2	0	1.5	1.2	0.990	1.00	4774
V_{RF}	168	0.94	2	0	1.5	1.2	0.990	1.00	181
V_{FR}	1766	0.94	6	0	1.5	1.2	0.971	1.00	1935
V_{RR}	67	0.94	6	0	1.5	1.2	0.971	1.00	73
V_{NW}	4847							V =	6895
V_W	2116								
VR	0.304								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc
Interchange density, ID	3.3 int/mi
Minimum RF lane changes, LC_{RF}	1 lc/pc
Minimum FR lane changes, LC_{FR}	0 lc/pc
Minimum RR lane changes, LC_{RR}	lc/pc
Minimum weaving lane changes, LC_{MIN}	181 lc/h
Weaving lane changes, LC_W	1244 lc/h
Non-weaving lane changes, LC_{NW}	2770 lc/h
Total lane changes, LC_{ALL}	4014 lc/h
Non-weaving vehicle index, I_{NW}	2322

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	6895 veh/h
Weaving segment capacity, c_w	10153 veh/h
Weaving segment v/c ratio	0.679
Weaving segment density, D	30.8 pc/mi/ln
Level of Service, LOS	D
Weaving intensity factor, W	0.504
Weaving segment speed, S	45.2 mph
Average weaving speed, S_W	41.6 mph
Average non-weaving speed, S_{NW}	47.0 mph
Maximum weaving length, L_{MAX}	4060 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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APPENDIX B-4
Future Year No-Build HCS Measures of Effectiveness
PM PEAK

RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	R Bezati	Freeway/Dir of Travel	Fisher Fwy EB
Agency or Company	Parsons Brinckerhoff	Junction	On Ramp from NB 375
Date Performed	5/28/2014	Jurisdiction	MDOT
Analysis Time Period	PM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp

☑ Yes ☑ On

☐ No ☐ Off

L_{up} = 500 ft

V_u = 166 veh/h

Freeway Number of Lanes, N	3
Ramp Number of Lanes, N	1
Acceleration Lane Length, L_A	439
Deceleration Lane Length L_D	
Freeway Volume, V_F	1062
Ramp Volume, V_R	125
Freeway Free-Flow Speed, S_{FF}	55.0
Ramp Free-Flow Speed, S_{FR}	35.0

Downstream Adj Ramp

☐ Yes ☐ On

☑ No ☐ Off

L_{down} = ft

V_D = veh/h

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	1062	0.94	Level	6	0	0.971	1.00	1164
Ramp	125	0.94	Level	6	0	0.971	1.00	137
UpStream	166	0.94	Level	6	0	0.971	1.00	182
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.590 using Equation (Exhibit 13-6)

V_{12} = 687 pc/h

V_3 or V_{av34} 477 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 687 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	1301	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	824	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 9.1 (pc/mi/ln)

LOS = A (Exhibit 13-2)

Speed Determination

M_S = 0.299 (Exibit 13-11)

S_R= 51.1 mph (Exhibit 13-11)

S_0= 55.0 mph (Exhibit 13-11)

S = 52.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	R Bezati	Freeway/Dir of Travel	Fisher Fwy EB
Agency or Company	Parsons Brinckerhoff	Junction	On Ramp from Fisher EB Ser Dr
Date Performed	5/28/2014	Jurisdiction	MDOT
Analysis Time Period	PM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Downstream Adj Ramp
☑ Yes ☐ On	Freeway Number of Lanes, N: 2	☐ Yes ☐ On
☐ No ☑ Off	Ramp Number of Lanes, N: 1	☑ No ☐ Off
L_{up} = 1569 ft	Acceleration Lane Length, L_A: 185	L_{down} = ft
V_u = 2412 veh/h	Deceleration Lane Length L_D:	V_D = veh/h
	Freeway Volume, V_F: 729	
	Ramp Volume, V_R: 167	
	Freeway Free-Flow Speed, S_{FF}: 55.0	
	Ramp Free-Flow Speed, S_{FR}: 35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	729	0.94	Level	6	0	0.971	1.00	799
Ramp	167	0.94	Level	6	0	0.971	1.00	183
UpStream	2412	0.94	Level	6	0	0.971	1.00	2643
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 1.000 using Equation (Exhibit 13-6)

V_{12} = 799 pc/h

V_3 or V_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☑ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	982	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	982	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 11.9 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.318 (Exibit 13-11)

S_R= 50.9 mph (Exhibit 13-11)

S_0= N/A mph (Exhibit 13-11)

S = 50.9 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*Fisher EB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*375 Off to Fisher Ser Dr On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*729*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*2*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*399*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*7.3*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*Fisher EB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*ChryslerSB On to 375 NB On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1062*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*388*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*7.1*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*Fisher EB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher ServOn to ChryslerSB On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*896*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*491*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*8.9*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	R Bezati	Freeway/Dir of Travel	I-375/Chrysler NB
Agency or Company	Parsons Brinckerhoff	Junction	Madison On-Ramp
Date Performed	5/28/2014	Jurisdiction	MDOT
Analysis Time Period	PM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp	
☐ Yes	☐ On	Ramp Number of Lanes, N	1	☑ Yes	☑ On
☑ No	☐ Off	Acceleration Lane Length, L_A	265	☐ No	☐ Off
L_{up} =	ft	Deceleration Lane Length L_D		L_{down} =	815 ft
V_u =	veh/h	Freeway Volume, V_F	2671	V_D =	1556 veh/h
		Ramp Volume, V_R	648		
		Freeway Free-Flow Speed, S_{FF}	55.0		
		Ramp Free-Flow Speed, S_{FR}	35.0		

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2671	0.94	Level	2	0	0.990	1.00	2870
Ramp	648	0.94	Level	2	0	0.990	1.00	696
UpStream								
DownStream	1556	0.94	Level	2	0	0.990	1.00	1672

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.585 using Equation (Exhibit 13-6)

V_{12} = 1679 pc/h

V_3 or V_{av34} 1191 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1679 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3566	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2576	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 23.6 (pc/mi/ln)

LOS = C (Exhibit 13-2)

Speed Determination

M_S = 0.354 (Exibit 13-11)

S_R= 50.4 mph (Exhibit 13-11)

S_0= 53.2 mph (Exhibit 13-11)

S = 51.2 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	R Bezati	Freeway/Dir of Travel	I-375/Chrysler NB
Agency or Company	Parsons Brinckerhoff	Junction	On Ramp from Fisher EB
Date Performed	5/28/2014	Jurisdiction	MDOT
Analysis Time Period	PM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes	☑ On	Ramp Number of Lanes, N	1	☐ Yes ☐ On
☐ No	☐ Off	Acceleration Lane Length, L_A	250	☑ No ☐ Off
L_{up} =	815 ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	648 veh/h	Freeway Volume, V_F	3319	V_D = veh/h
		Ramp Volume, V_R	1556	
		Freeway Free-Flow Speed, S_{FF}	55.0	
		Ramp Free-Flow Speed, S_{FR}	35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	v = V/PHF x f_{HV} x f_p
Freeway	3319	0.94	Level	2	0	0.990	1.00	3566
Ramp	1556	0.94	Level	6	0	0.971	1.00	1705
UpStream	648	0.94	Level	2	0	0.990	1.00	696
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = (Equation 13-6 or 13-7)

P_{FM} = 0.585 using Equation (Exhibit 13-6)

V_{12} = 2084 pc/h

V_3 or V_{av34} 1482 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☑ Yes ☐ No

If Yes, V_{12a} = 2084 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	5271	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	3789	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 32.7 (pc/mi/ln)

LOS = D (Exhibit 13-2)

Speed Determination

M_S = 0.476 (Exibit 13-11)

S_R= 48.8 mph (Exhibit 13-11)

S_0= 51.5 mph (Exhibit 13-11)

S = 49.5 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * V_{12}/2 ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher Off to Madison On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2671*	veh/h	Peak-Hour Factor, PHF	*0.94*	
AADT		veh/day	%Trucks and Buses, P_T	*2*	
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*	
Peak-Hr Direction Prop, D			General Terrain:	*Level*	
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*957*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*17.4*	pc/mi/ln
LOS	*B*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Jefferson to Larned On-Ramp*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*1531*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*823*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*15.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Larned On to Monroe On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*3216*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*3*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1152*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*20.9*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher EB On to Fisher WB On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4875*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1335*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*24.3*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	R Bezati
Agency/Company	Parsons Brinckerhoff
Date Performed	5/28/2014
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	I-375 NB
Weaving Segment Location	Fisher WB On to Mack Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	5
Weaving segment length, L_S	1050ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	4358	0.94	6	0	1.5	1.2	0.971	1.00	4775
V_{RF}	150	0.94	6	0	1.5	1.2	0.971	1.00	164
V_{FR}	313	0.94	6	0	1.5	1.2	0.971	1.00	343
V_{RR}	11	0.94	6	0	1.5	1.2	0.971	1.00	12
V_{NW}	4787							V =	5140
V_W	507								
VR	0.096								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	507 lc/h
Interchange density, ID	3.3 int/mi	Weaving lane changes, LC_W	1365 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	1787 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	3152 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	1659

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5140 veh/h	Weaving intensity factor, W	0.538
Weaving segment capacity, c_w	10015 veh/h	Weaving segment speed, S	45.7 mph
Weaving segment v/c ratio	0.513	Average weaving speed, S_W	41.0 mph
Weaving segment density, D	23.2 pc/mi/ln	Average non-weaving speed, S_{NW}	46.3 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	3499 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	R Bezati
Agency/Company	Parsons Brinckerhoff
Date Performed	5/28/2014
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	I-375 SB
Weaving Segment Location	Monroe On and Fisher Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	1342ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1836	0.94	2	0	1.5	1.2	0.990	1.00	1973
V_{RF}	781	0.94	2	0	1.5	1.2	0.990	1.00	839
V_{FR}	1342	0.94	2	0	1.5	1.2	0.990	1.00	1442
V_{RR}	571	0.94	2	0	1.5	1.2	0.990	1.00	614
V_{NW}	2587							V =	4820
V_W	2281								
VR	0.469								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	839 lc/h
Interchange density, ID	3.2 int/mi	Weaving lane changes, LC_W	1474 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	490 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	1964 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	1111

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	4820 veh/h	Weaving intensity factor, W	0.305
Weaving segment capacity, c_w	7396 veh/h	Weaving segment speed, S	44.3 mph
Weaving segment v/c ratio	0.652	Average weaving speed, S_W	45.6 mph
Weaving segment density, D	27.5 pc/mi/ln	Average non-weaving speed, S_{NW}	43.1 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	5895 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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RAMPS AND RAMP JUNCTIONS WORKSHEET

General Information / Site Information

Analyst	R Bezati	Freeway/Dir of Travel	I-375/Chrysler NB
Agency or Company	Parsons Brinckerhoff	Junction	Madison On-Ramp
Date Performed	5/28/2014	Jurisdiction	MDOT
Analysis Time Period	PM	Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Upstream Adj Ramp		Freeway Number of Lanes, N	3	Downstream Adj Ramp
☑ Yes	☐ On	Ramp Number of Lanes, N	1	☐ Yes ☐ On
☐ No	☑ Off	Acceleration Lane Length, L_A	600	☑ No ☐ Off
L_{up} =	1540 ft	Deceleration Lane Length L_D		L_{down} = ft
V_u =	2642 veh/h	Freeway Volume, V_F	2537	V_D = veh/h
		Ramp Volume, V_R	437	
		Freeway Free-Flow Speed, S_{FF}	55.0	
		Ramp Free-Flow Speed, S_{FR}	35.0	

Conversion to pc/h Under Base Conditions

(pc/h)	V (Veh/hr)	PHF	Terrain	%Truck	%Rv	f_{HV}	f_p	$v = V/PHF \times f_{HV} \times f_p$
Freeway	2537	0.94	Level	2	0	0.990	1.00	2726
Ramp	437	0.94	Level	2	0	0.990	1.00	470
UpStream	2642	0.94	Level	2	0	0.990	1.00	2839
DownStream								

Merge Areas

Estimation of v_{12}

$V_{12} = V_F (P_{FM})$

L_{EQ} = 378.54 (Equation 13-6 or 13-7)

P_{FM} = 0.594 using Equation (Exhibit 13-6)

V_{12} = 1620 pc/h

V_3 or V_{av34} 1106 pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☑ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☑ Yes ☐ No

If Yes, V_{12a} = 1620 pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_{FO}	3196	Exhibit 13-8		No

Flow Entering Merge Influence Area

	Actual	Max Desirable		Violation?
V_{R12}	2284	Exhibit 13-8	4600:All	No

Level of Service Determination (if not F)

$D_R = 5.475 + 0.00734\, v_R + 0.0078\, V_{12} - 0.00627\, L_A$

D_R = 19.3 (pc/mi/ln)

LOS = B (Exhibit 13-2)

Speed Determination

M_S = 0.317 (Exibit 13-11)

S_R= 50.9 mph (Exhibit 13-11)

S_0= 53.5 mph (Exhibit 13-11)

S = 51.6 mph (Exhibit 13-13)

Diverge Areas

Estimation of v_{12}

$V_{12} = V_R + (V_F - V_R)P_{FD}$

L_{EQ} = (Equation 13-12 or 13-13)

P_{FD} = using Equation (Exhibit 13-7)

V_{12} = pc/h

V_3 or V_{av34} pc/h (Equation 13-14 or 13-17)

Is V_3 or V_{av34} > 2,700 pc/h? ☐ Yes ☐ No

Is V_3 or V_{av34} > 1.5 * $V_{12}/2$ ☐ Yes ☐ No

If Yes, V_{12a} = pc/h (Equation 13-16, 13-18, or 13-19)

Capacity Checks

	Actual	Capacity		LOS F?
V_F		Exhibit 13-8		
$V_{FO} = V_F - V_R$		Exhibit 13-8		
V_R		Exhibit 13-10		

Flow Entering Diverge Influence Area

	Actual	Max Desirable		Violation?
V_{12}		Exhibit 13-8		

Level of Service Determination (if not F)

$D_R = 4.252 + 0.0086\, V_{12} - 0.009\, L_D$

D_R = (pc/mi/ln)

LOS = (Exhibit 13-2)

Speed Determination

D_s = (Exhibit 13-12)

S_R= mph (Exhibit 13-12)

S_0= mph (Exhibit 13-12)

S = mph (Exhibit 13-13)

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 NB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Fisher WB On to Fisher EB On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2114*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*568*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*10.3*	pc/mi/ln
LOS	*A*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 SB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Larned Off and Jefferson End*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*820*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*2*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*441*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*8.0*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*A*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 SB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Mack Off to Mack On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*4556*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*6*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length	*mi*
			Up/Down %	

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.971*

Speed Inputs

Lane Width		ft
Rt-Side Lat. Clearance		ft
Number of Lanes, N	*4*	
Total Ramp Density, TRD		ramps/mi
FFS (measured)	*55.0*	mph
Base free-flow Speed, BFFS		mph

Calc Speed Adj and FFS

f_{LW}		mph
f_{LC}		mph
TRD Adjustment		mph
FFS	*55.0*	mph

LOS and Performance Measures

Operational (LOS)

v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*1248*	pc/h/ln
S	*55.0*	mph
D = v_p / S	*22.7*	pc/mi/ln
LOS	*C*	

Design (N)

Design (N)

Design LOS		
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)		pc/h/ln
S		mph
D = v_p / S		pc/mi/ln
Required Number of Lanes, N		

Glossary

N - Number of lanes
V - Hourly volume
v_p - Flow rate
LOS - Level of service
S - Speed
D - Density
FFS - Free-flow speed
BFFS - Base free-flow speed
DDHV - Directional design hour volume

Factor Location

E_R - Exhibits 11-10, 11-12
E_T - Exhibits 11-10, 11-11, 11-13
f_p - Page 11-18
LOS, S, FFS, v_p - Exhibits 11-2, 11-3
f_{LW} - Exhibit 11-8
f_{LC} - Exhibit 11-9
TRD - Page 11-11

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BASIC FREEWAY SEGMENTS WORKSHEET

General Information		Site Information	
Analyst	*R Bezati*	Highway/Direction of Travel	*I-375 SB*
Agency or Company	*Parsons Brinckerhoff*	From/To	*Madison Off to Fisher WB On*
Date Performed	*5/28/2014*	Jurisdiction	*MDOT*
Analysis Time Period	*PM*	Analysis Year	*2014*

Project Description *I-375 Alternatives Study*

☑ Oper.(LOS) ☐ Des.(N) ☐ Planning Data

Flow Inputs

Volume, V	*2100*	veh/h	Peak-Hour Factor, PHF	*0.94*
AADT		veh/day	%Trucks and Buses, P_T	*2*
Peak-Hr Prop. of AADT, K			%RVs, P_R	*0*
Peak-Hr Direction Prop, D			General Terrain:	*Level*
DDHV = AADT x K x D		veh/h	Grade % Length Up/Down %	*mi*

Calculate Flow Adjustments

f_p	*1.00*	E_R	*1.2*
E_T	*1.5*	$f_{HV} = 1/[1+P_T(E_T - 1) + P_R(E_R - 1)]$	*0.990*

Speed Inputs			Calc Speed Adj and FFS		
Lane Width		ft			
Rt-Side Lat. Clearance		ft	f_{LW}		mph
Number of Lanes, N	*3*		f_{LC}		mph
Total Ramp Density, TRD		ramps/mi	TRD Adjustment		mph
FFS (measured)	*55.0*	mph	FFS	*55.0*	mph
Base free-flow Speed, BFFS		mph			

LOS and Performance Measures			Design (N)	
Operational (LOS)			Design (N)	
v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	*752*	pc/h/ln	Design LOS	
			v_p = (V or DDHV) / (PHF x N x f_{HV} x f_p)	pc/h/ln
S	*55.0*	mph	S	mph
D = v_p / S	*13.7*	pc/mi/ln	D = v_p / S	pc/mi/ln
LOS	*B*		Required Number of Lanes, N	

Glossary		Factor Location	
N - Number of lanes	S - Speed	E_R - Exhibits 11-10, 11-12	f_{LW} - Exhibit 11-8
V - Hourly volume	D - Density	E_T - Exhibits 11-10, 11-11, 11-13	f_{LC} - Exhibit 11-9
v_p - Flow rate	FFS - Free-flow speed	f_p - Page 11-18	TRD - Page 11-11
LOS - Level of service	BFFS - Base free-flow speed	LOS, S, FFS, v_p - Exhibits 11-2, 11-3	
DDHV - Directional design hour volume			

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	R Bezati
Agency/Company	Parsons Brinckerhoff
Date Performed	5/28/2014
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	I-375 SB
Weaving Segment Location	Fisher EB On to Monroe Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	4
Weaving segment length, L_S	730ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	1192	0.94	2	0	1.5	1.2	0.990	1.00	1281
V_{RF}	483	0.94	2	0	1.5	1.2	0.990	1.00	519
V_{FR}	922	0.94	2	0	1.5	1.2	0.990	1.00	991
V_{RR}	373	0.94	2	0	1.5	1.2	0.990	1.00	401
V_{NW}	1682							V =	3161
V_W	1510								
VR	0.473								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	2 lc	Minimum weaving lane changes, LC_{MIN}	1510 lc/h
Interchange density, ID	3.2 int/mi	Weaving lane changes, LC_W	1918 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	0 lc/h
Minimum FR lane changes, LC_{FR}	1 lc/pc	Total lane changes, LC_{ALL}	1918 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	393

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	3161 veh/h	Weaving intensity factor, W	0.484
Weaving segment capacity, c_w	5023 veh/h	Weaving segment speed, S	41.1 mph
Weaving segment v/c ratio	0.629	Average weaving speed, S_W	41.9 mph
Weaving segment density, D	19.4 pc/mi/ln	Average non-weaving speed, S_{NW}	40.3 mph
Level of Service, LOS	B	Maximum weaving length, L_{MAX}	7513 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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FREEWAY WEAVING WORKSHEET

General Information

Analyst	R Bezati
Agency/Company	Parsons Brinckerhoff
Date Performed	5/28/2014
Analysis Time Period	PM

Site Information

Freeway/Dir of Travel	I-375 SB
Weaving Segment Location	Mack On to Fisher Off
Analysis Year	2014

Project Description I-375 Alternatives Study

Inputs

Weaving configuration	One-Sided
Weaving number of lanes, N	5
Weaving segment length, L_S	1452ft
Freeway free-flow speed, FFS	55 mph
Segment type	Freeway
Freeway minimum speed, S_{MIN}	15
Freeway maximum capacity, C_{IFL}	2250
Terrain type	Level

Conversions to pc/h Under Base Conditions

	V (veh/h)	PHF	Truck (%)	RV (%)	E_T	E_R	f_{HV}	f_p	v (pc/h)
V_{FF}	2230	0.94	2	0	1.5	1.2	0.990	1.00	2396
V_{RF}	302	0.94	2	0	1.5	1.2	0.990	1.00	324
V_{FR}	2326	0.94	6	0	1.5	1.2	0.971	1.00	2549
V_{RR}	316	0.94	6	0	1.5	1.2	0.971	1.00	346
V_{NW}	2742							V =	5560
V_W	2873								
VR	0.512								

Configuration Characteristics

Minimum maneuver lanes, N_{WL}	3 lc	Minimum weaving lane changes, LC_{MIN}	324 lc/h
Interchange density, ID	3.3 int/mi	Weaving lane changes, LC_W	1387 lc/h
Minimum RF lane changes, LC_{RF}	1 lc/pc	Non-weaving lane changes, LC_{NW}	430 lc/h
Minimum FR lane changes, LC_{FR}	0 lc/pc	Total lane changes, LC_{ALL}	1817 lc/h
Minimum RR lane changes, LC_{RR}	lc/pc	Non-weaving vehicle index, I_{NW}	1314

Weaving Segment Speed, Density, Level of Service, and Capacity

Weaving segment flow rate, v	5560 veh/h	Weaving intensity factor, W	0.270
Weaving segment capacity, c_w	6773 veh/h	Weaving segment speed, S	46.9 mph
Weaving segment v/c ratio	0.821	Average weaving speed, S_W	46.5 mph
Weaving segment density, D	24.0 pc/mi/ln	Average non-weaving speed, S_{NW}	47.3 mph
Level of Service, LOS	C	Maximum weaving length, L_{MAX}	6397 ft

Notes

a. Weaving segments longer than the calculated maximum length should be treated as isolated merge and diverge areas using the procedures of Chapter 13, "Freeway Merge and Diverge Segments".
b. For volumes that exceed the weaving segment capacity, the level of service is "F".

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