James Island Connector
Bicycle Safety Analysis

Prepared for:

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ALTA PLANNING + DESIGN

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1.0 INTRODUCTION

The City of Charleston peninsula and James Island are separated by the Ashley River. There are only two bridge crossings over the Ashley River connecting the two areas today: the SC 30/James Island Connector bridge and the two US 17/Savannah Highway bridges. Bicycles are currently prohibited on each of these Ashley River crossings. As bicycles continue to grow as a mode choice in the Charleston area, the need to develop safe bicycle routes has become increasingly important.

SC 30/James Island Connector is a four-lane divided limited-access highway that connects the City of Charleston peninsula at Lockwood Drive and Calhoun Street to James Island at SC 171/Folly Road. It should be noted that Charleston County is currently conducting a feasibility study considering a dedicated bicycle lane on the northbound US 17/Savannah Highway T. Allen Legare Bridge.

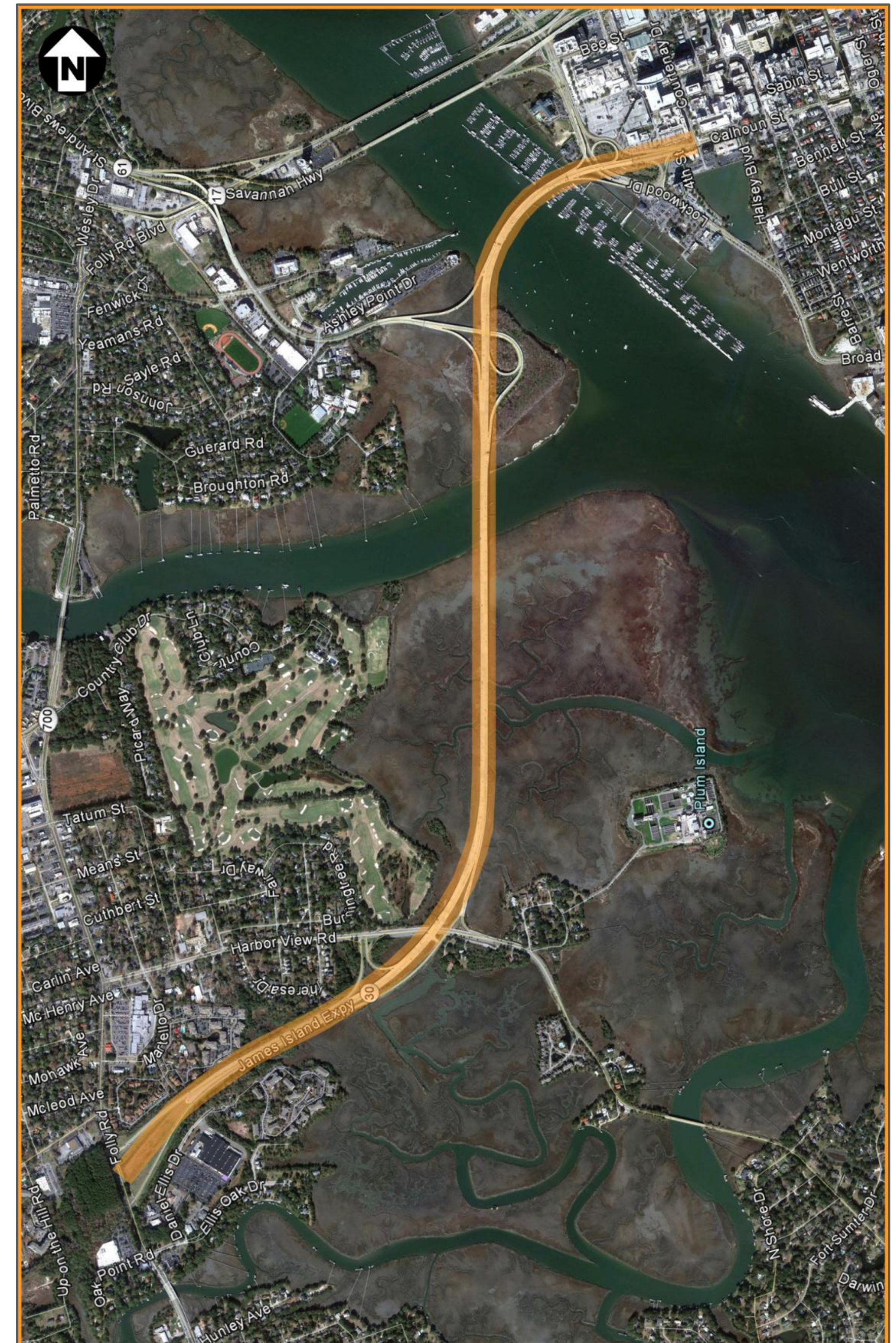
In June 2012, the South Carolina General Assembly amended the prohibition of certain vehicles on freeways to provide an exemption for bicyclists to travel on non-interstate freeways provided, in part, the City "determines that bicyclists…have no other reasonably safe or viable alternative route and the use of the freeway route is at least ten percent less than the shortest conventional alternate route".

Therefore, the City of Charleston initiated a study to review the potential of allowing bicycles within the existing boundaries of the SC 30/James Island Connector. The SC 30/James Island Connector study corridor is illustrated in Exhibit 1.1. With the potential of accommodating bicyclists on the James Island Connector, the safety of bicycle and vehicular users is of the utmost concern.

This report summarizes the procedures and findings of the analysis to determine the potential of allowing bicyclists to utilize the James Island Connector between the City of Charleston and James Island. It should be noted that the design of a wide range of bicycle facilities is a relatively new and emerging practice, especially considering the retrofitting of existing facilities that do not currently accommodate bicyclists. There are no accommodations that can make a bicycle facility 100% safe.

Finally, pedestrian access on the James Island Connector was not considered in this study.

Exhibit 1.1 – Project Location Map



1.1 TYPES OF BICYCLISTS

Populations can be separated into four groups of riders, which need to be considered when determining the potential of accommodating bicyclists on the James Island Connector. The groups, which were defined in the Portland Department of Transportation's *Central City Transportation Management Plan* update in 2006, are as follows.

1) Strong & Fearless – Bicyclists that are willing to ride "regardless of roadway conditions" and "riding is a strong part of their identity".

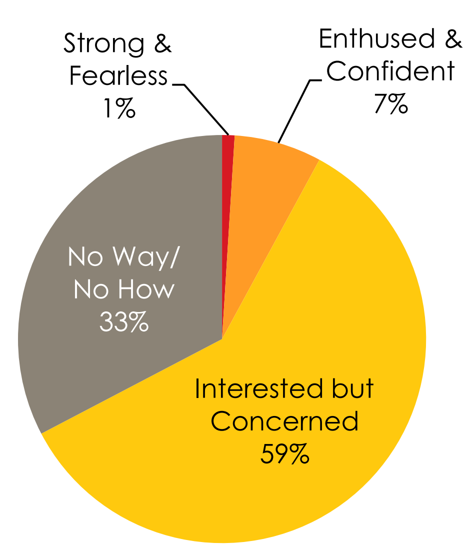
2) Enthused & Confident – Bicyclists that "are comfortable sharing the roadway with automotive traffic, but they prefer to do so operating on their own facilities." The enthused and confident bicyclists prefer "shorter trip distances, better bicycle facilities, and better trip-end facilities."

3) Interested but Concerned – These are the majority of bicyclists that "like riding a bicycle…and would like to ride more" and "would ride if they felt safer on the roadways."

4) No Way/No How – The final type of population group is "currently not interested in bicycling at all" due to age, physical ability, or general lack of interest.

Exhibit 1.2 gives estimated percentages of the general population that fall into each category. These percentages have been vetted nationally and for the purposes of this study are expected to be a fair representation of bicyclists in the Charleston area. As alternates were developed for the James Island Connector, these groups of bicycle riders were considered.

Exhibit 1.2 – Four Types of Bicyclists



1.2 REFERENCES

There are several industry references that were considered in determining the potential to accommodate bicyclists on the study James Island Connector corridor. These references include:

- AASTHO's *Guide for the Development of Bicycle Facilities*, 4th Edition (2012);
- AASHTO's *A Policy on Geometric Design of Highways and Streets*, 6th Edition (2011);
- FHWA's *Manual on Uniform Traffic Control Devices*, 2009 Edition;
- SCDOT's *Highway Design Manual* (2003);
- SCDOT's *Access & Roadside Management Standards* (2011);
- NACTO's *Urban Bikeway Design Guide*, 2nd Edition (2012);
- California Department of Transportation's *Complete Intersections: A Guide to Reconstructing Intersections and Interchanges for Bicyclists and Pedestrians*, 2010; and
- ITE's *Recommended Design Guidelines to Accommodate Pedestrians and Bicycles at Interchanges* (DRAFT 2014).

With the design of a broad range of bicycle facilities being a relatively new and emerging practice, especially considering the retrofitting of existing facilities that do not currently accommodate bicyclists, there is conflicting guidance and information on certain recommendations for bicycle facilities that had to be considered in this study.

1.3 MARK CLARK EXPRESSWAY EXTENSION

I-526/Mark Clark Expressway is currently planned by SCDOT and Charleston County to be extended from US 17/Savannah Highway south and east to SC 171/Folly Road, which is the endpoint of the study James Island Connector corridor. In the vicinity of the Folly Road interchange, the extension is proposed to have on-road bicycle lanes, a separate shared-use path on the south side, and a speed limit of 45 miles per hour (mph). Therefore, the impacts of the future extension of I-526/Mark Clark Expressway were also considered in this study.

2.0 EXISTING CONDITIONS

Existing conditions along the study James Island Connector corridor were evaluated, including existing roadway geometry, traffic volumes and speeds, crash history, pavement marking and signing, and lighting. Future traffic growth was also considered along the study corridor.

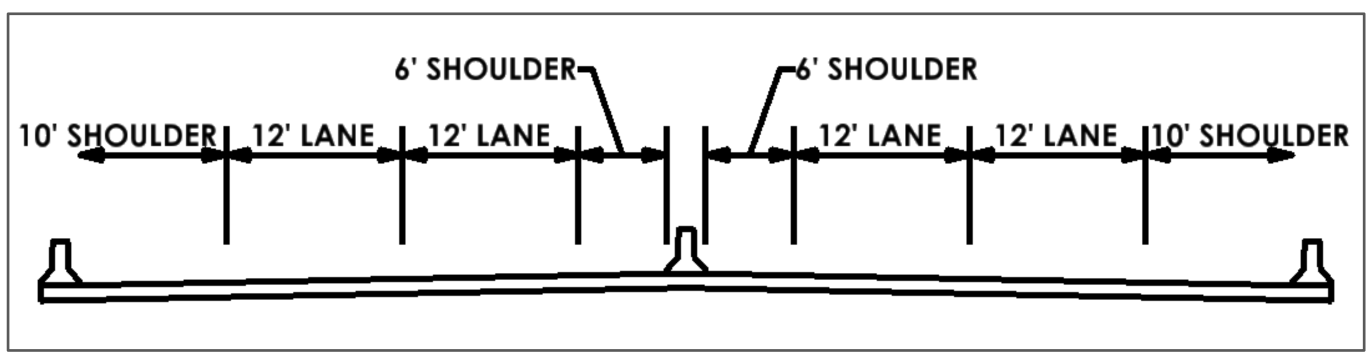
Several site visits to observe the existing operations of the James Island Connector were made as part of documenting the existing conditions.

2.1 ROADWAY GEOMETRY

The James Island Connector is a 2.8-mile, four-lane divided, limited-access highway that connects the City of Charleston peninsula at Lockwood Drive and Calhoun Street to James Island at SC 171/Folly Road. The posted speed limit is 55 mph along the James Island Connector and there are four interchanges along the study corridor route. The study corridor carried a 2014 AADT of approximately 39,800.

Between Folly Road and Harbor View Road, the James Island Connector is on grade with 12-foot travel lanes and varying paved shoulder widths of up to five feet. North and east of Harbor View Road, the James Island Connector primarily consists of an elevated bridge structure, the cross-section of which generally consists of 12-foot travel lanes with a ±6-foot inside shoulder and a ±10-foot outside shoulder/breakdown lane. A jersey barrier, approximately 32 inches in height, marks the inside and outside bridge walls. Exhibit 2.1 illustrates the typical James Island Connector cross-section.

Exhibit 2.1 – James Island Connector Bridge Deck Typical Section



2.1.1 Interchanges & Cross-Streets

There are four interchanges along the study James Island Connector corridor: SC 171/Folly Road, Harbor View Road, SC 61/Herbert T. Fielding Connector, and Lockwood Drive/Calhoun Street.

SC 171/Folly Road – The southern endpoint of the study corridor consists of a signalized intersection for westbound (north ramp) James Island Connector traffic and an unsignalized intersection for eastbound (south ramp) James Island Connector traffic. Folly Road is a five-lane principal arterial with a speed limit of 45 mph and exclusive bicycle lanes in both directions in the vicinity of the James Island Connector junction.

With the future extension of I-526/Mark Clark Expressway, the Folly Road junction will be an interchange with an overpass for James Island Connector/Mark Clark Expressway extension through traffic and a loop for westbound James Island Connector to southbound Folly Road traffic. The westbound (north) and eastbound (south) ramp terminal intersections at Folly Road will be signalized.

Harbor View Road – The James Island Connector interchange with Harbor View Road is a diamond configuration in the eastbound direction and a partial cloverleaf configuration in the westbound direction. Both ramp terminal intersections at Harbor View Road are two-way stop controlled. Harbor View Road is a five-lane minor arterial with a 40 mph speed limit and no exclusive bicycle lanes in the vicinity of the James Island Connector.

SC 61/Herbert Fielding Connector – The James Island Connector interchange with the Herbert Fielding Connector is a trumpet configuration where all movements are free-flow merges and diverges. The Herbert Fielding Connector is a five-lane principal arterial with a speed limit of 40 mph and no exclusive bicycle lanes in the vicinity of the James Island Connector.

Lockwood Drive/Calhoun Street – The northern endpoint of the study corridor consists of a partial cloverleaf interchange at Lockwood Drive. The James Island Connector through traffic transitions to Calhoun Street east of the interchange. Lockwood Drive is a four-lane divided principal arterial with a speed limit of 35 mph and no exclusive bicycle lanes in the vicinity of the James Island Connector. Calhoun Street is a four-lane undivided principal arterial with a speed limit of 25 mph and no exclusive bicycle lanes in the vicinity of the James Island Connector.

2.1.2 Ramp Sections

The entering and exiting ramps along the James Island Connector consist of both the tapered design and parallel design. Ramp widths vary from 20 feet to 30 feet, including paved shoulders. Striped ramp lane widths do vary but are primarily 16 feet.

2.2 EXISTING TRAFFIC VOLUMES & SPEEDS

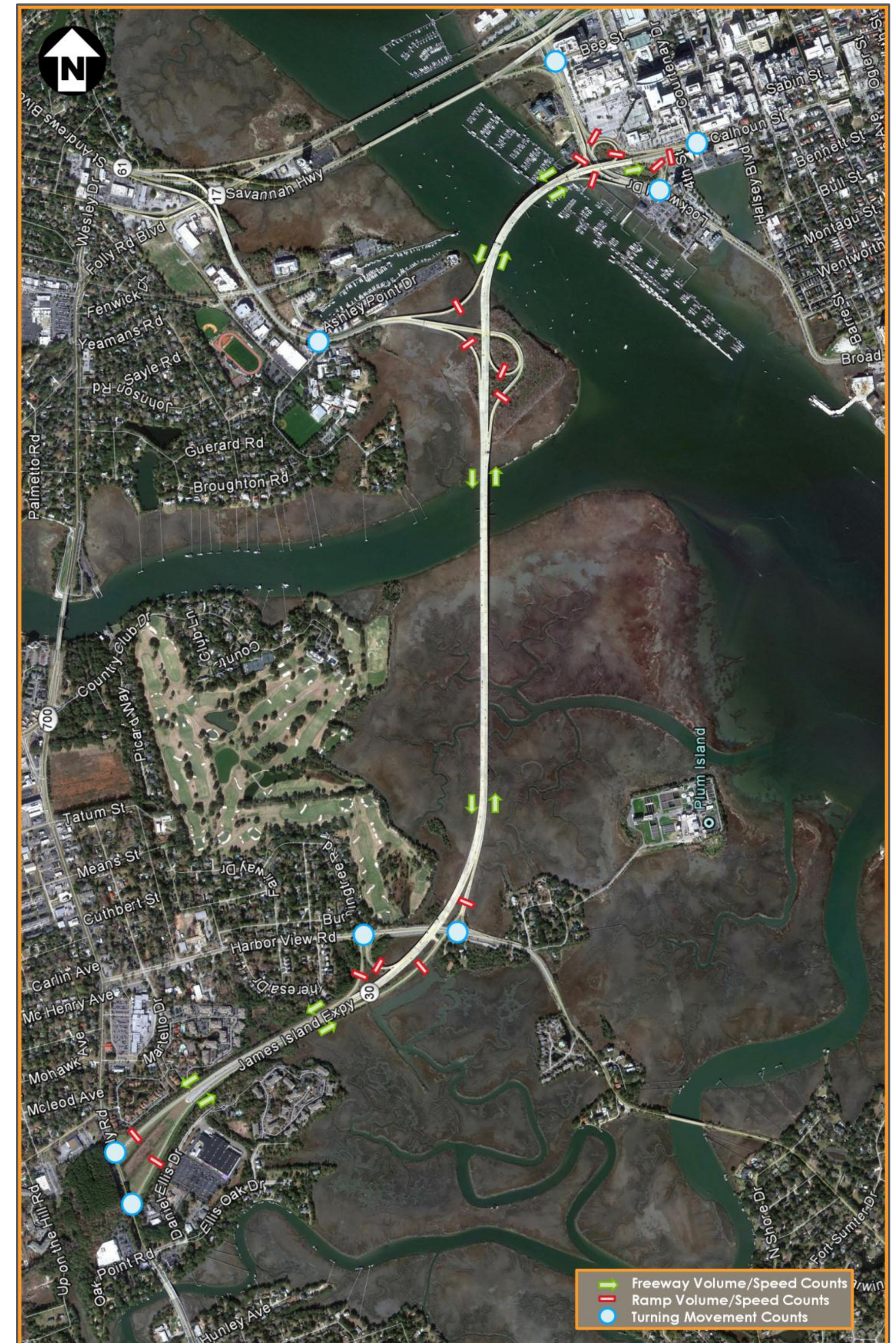
Between April and August 2013, the City of Charleston's Department of Traffic and Transportation collected traffic volumes and speed data along the study James Island Connector corridor and adjacent intersections. Exhibit 2.2 illustrates the traffic volume, speed, and intersection turning movement count location points.

Bi-directional daily traffic volume and speed data was collected for all sections of the study James Island Connector corridor. Intersection turning movement counts were collected during the AM peak period (from 7:00 AM to 9:00 AM), the midday peak period (from 11:00 AM to 1:00 PM), and the PM peak period (from 4:00 PM to 6:00 PM) at the following eight intersections:

1) James Island Connector Eastbound (South) Off-Ramp & SC 171/Folly Road;
2) James Island Connector Westbound (North) On-Ramp & SC 171/Folly Road;
3) James Island Connector Eastbound (South) Ramp & Harbor View Road;
4) James Island Connector Westbound (North) Ramp & Harbor View Road;
5) SC 61/Herbert Fielding Connector & Ashley Pointe Drive;
6) Lockwood Drive & Calhoun Street Ramp;
7) Calhoun Street & Courtenay Drive; and
8) Lockwood Drive & Bee Street.

Exhibits 2.3 through 2.5 illustrate the existing balanced 2013 traffic volume, speed, and intersection turning movement counts for the AM, midday, and PM peak hours, respectively.

Exhibit 2.2 – Traffic Data Collection Locations



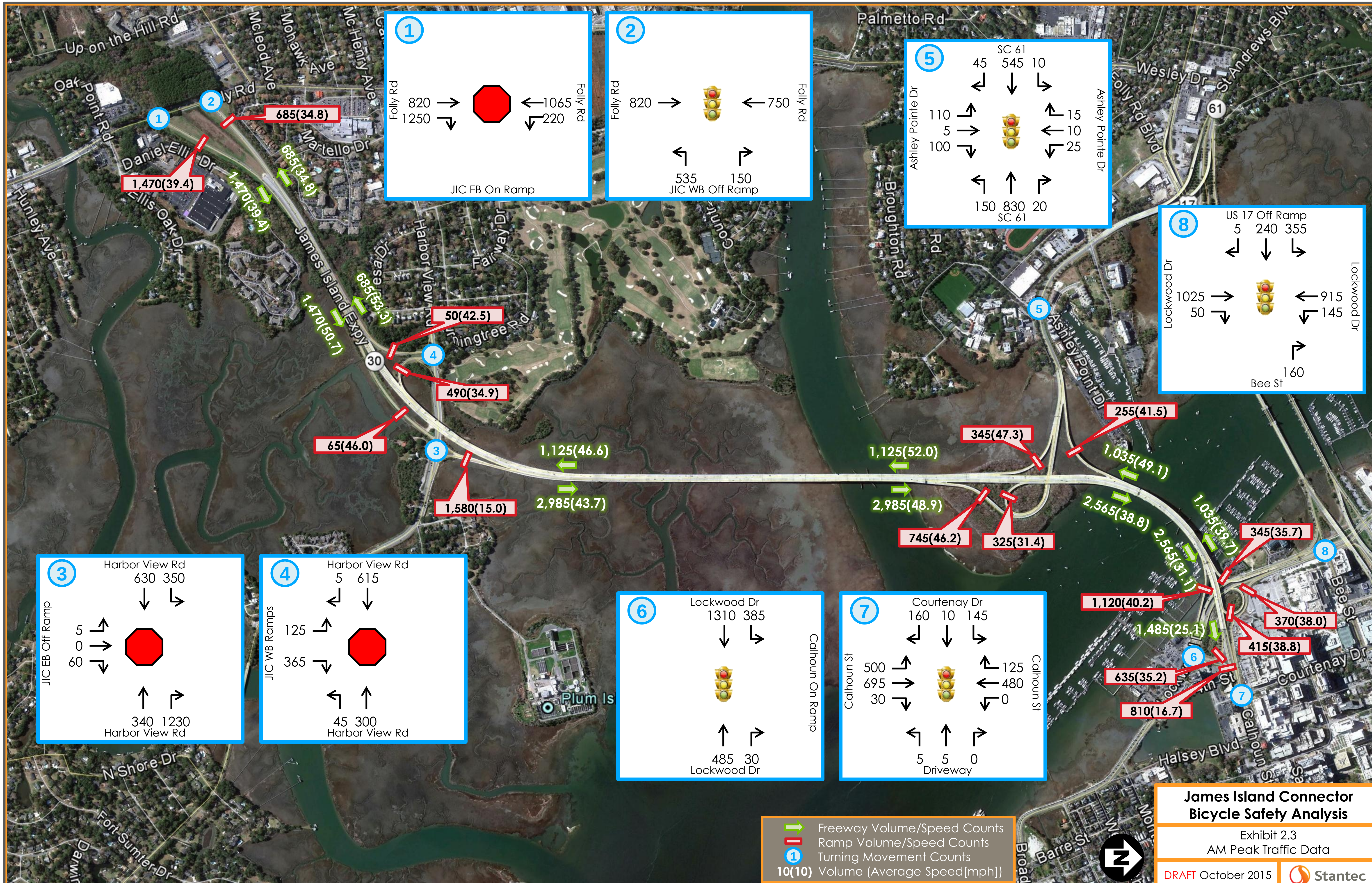


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Exhibit 2.3
AM Peak Traffic Data

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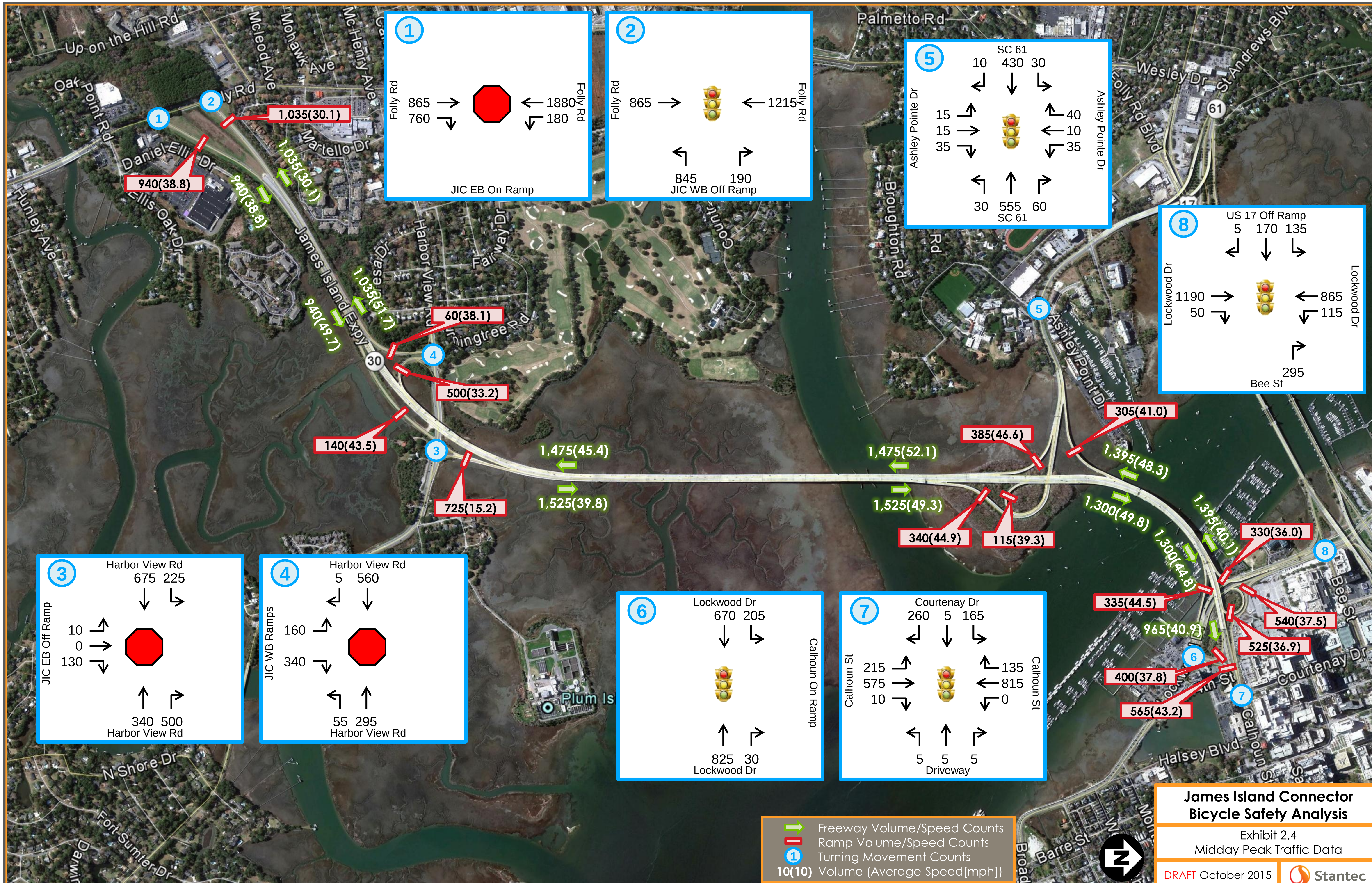

1
Folly Rd
865
760
1880
180
Folly Rd
JIC EB On Ramp
2
Folly Rd
865
1215
Folly Rd
845
190
JIC WB Off Ramp
5
SC 61
10 430 30
Ashley Pointe Dr
15
15
35
40
10
35
Ashley Pointe Dr
30 555 60
SC 61
8
US 17 Off Ramp
5 170 135
Lockwood Dr
1190
50
865
115
Lockwood Dr
295
Bee St
3
Harbor View Rd
675 225
JIC EB Off Ramp
10
0
130
340 500
Harbor View Rd
4
Harbor View Rd
5 560
JIC WB Ramps
160
340
55 295
Harbor View Rd
6
Lockwood Dr
670 205
Calhoun On Ramp
825 30
Lockwood Dr
7
Courtenay Dr
260 5 165
Calhoun St
215
575
10
135
815
0
Calhoun St
5 5 5
Driveway
1,035(30.1)
940(38.8)
1,035(30.1)
940(38.8)
1,035(51.7)
940(49.7)
60(38.1)
500(33.2)
140(43.5)
725(15.2)
1,475(45.4)
1,525(39.8)
1,475(52.1)
1,525(49.3)
385(46.6)
305(41.0)
340(44.9)
115(39.3)
1,395(48.3)
1,300(49.8)
1,395(40.1)
1,300(44.8)
330(36.0)
335(44.5)
540(37.5)
965(40.9)
525(36.9)
400(37.8)
565(43.2)
Up on the Hill Rd
Oak Point Rd
Folly Rd
Mcleod Ave
Mohawk Ave
Mc Henry Ave
Martello Dr
Daniel Ellis Dr
Ellis Oak Dr
Hunley Ave
James Island Expy
Harbor View Rd
Fairway Dr
Wingtree Rd
Country Club Dr
Broughton Rd
Palmetto Rd
Wesley Dr
St Andrews Blvd
Folly Rd Blvd
Ashley Point Dr
Bee St
Courtenay Dr
Calhoun St
Halsey Blvd
Barre St
Broad St
N Shore Dr
Fort Sumter Dr
Darwin
Plum Is
30
61
17
Freeway Volume/Speed Counts
Ramp Volume/Speed Counts
Turning Movement Counts
10(10) Volume (Average Speed[mph])
James Island Connector
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Exhibit 2.4
Midday Peak Traffic Data
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James Island Connector Bicycle Safety Analysis

Exhibit 2.5
PM Peak Traffic Data

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2.3 CRASH HISTORY

Traffic crash summaries for the James Island Connector were collected by the City of Charleston's Department of Traffic and Transportation between January 1, 2010 and August 28, 2013 for review in this study.

Based upon the data, a total of 279 crashes were reported along the James Island Connector and adjacent intersections, including three crashes involving bicycles. A summary of the total number of crashes by type is provided in Table 2.1.

Table 2.1 – Crash Data Summary

CRASH TYPE	CRASH FREQUENCY
Rear End	140
Single-Vehicle	75
Sideswipe	33
Angle	29
Backed Into	2
TOTAL	**279**

Based upon the traffic volume data and crash data, crash rates were determined for the study James Island Connector corridor mainline, ramps, and intersections. The crash rates are provided in Table 2.2 and the crash summary diagrams are provided in Appendix B.

The highest crash rates along the James Island Connector include the westbound off-ramp intersection with Folly Road – where the majority of the crashes are rear-end crashes of westbound James Island Connector traffic approaching the signalized intersection, the eastbound on-ramp intersection with Folly Road – where the majority of the crashes are angle crashes of southbound left-turn Folly Road traffic conflicting with northbound traffic, and the eastbound mainline approach to Lockwood Drive and Calhoun Street – where the majority of the crashes are rear-end crashes on the approach to Lockwood Drive and Calhoun Street.

Of the three crashes involving bicycles, there was one sideswipe crash between Harbor View Road and the Herbert Fielding Connector, one sideswipe crash near Calhoun Street, and one rear-end collision east of Harbor View Road. The sideswipe crash between Harbor View Road and the Herbert Fielding Connector was a fatal crash in which the bicyclist was thrown over the side of the bridge. The driver of a van that struck the bicyclist drifted into the breakdown lane and was cited with improper lane use.

Table 2.2 – Crash Data Summary

JAMES ISLAND CONNECTOR LOCATION	FACILITY TYPE	NUMBER OF CRASHES PER MILLION ENTERING VEHICLES
JIC Eastbound (South) Off-Ramp & SC 171/Folly Road	Intersection	1.19
JIC Westbound (North) On-Ramp & SC 171/Folly Road	Intersection	4.92
JIC Eastbound between SC 171/Folly Road and Harbor View Road	Mainline	0.28
JIC Westbound between SC 171/Folly Road and Harbor View Road	Mainline	0.57
JIC Eastbound (South) Ramp & Harbor View Road	Intersection	1.15
JIC Westbound (North) Ramp & Harbor View Road	Intersection	0.50
JIC Eastbound Off-Ramp to Harbor View Road	Ramp	0.07
JIC Westbound Off-Ramp to Harbor View Road	Ramp	0.29
Harbor View Road to JIC Eastbound On-Ramp	Ramp	0.27
JIC Eastbound between Harbor View Road and SC 61/Herbert Fielding Con.	Mainline	1.13
JIC Westbound between Harbor View Road and SC 61/Herbert Fielding Con.	Mainline	0.40
JIC Eastbound Off-Ramp to SC/Herbert Fielding Connector	Ramp	0.83
JIC Westbound Off-Ramp to SC/Herbert Fielding Connector	Ramp	0.49
SC 61/Herbert Fielding Connector to JIC Eastbound On-Ramp	Ramp	0.35
SC 61/Herbert Fielding Connector to JIC Westbound On-Ramp	Ramp	0.28
JIC Eastbound between SC 61/Herbert Fielding Con. and Lockwood Drive	Mainline	1.19
JIC Westbound between SC 61/Herbert Fielding Con. and Lockwood Drive	Mainline	0.45
JIC Eastbound Ramp to Calhoun Street	Ramp	0.83
Lockwood Drive On-Ramp to JIC Westbound	Ramp	0.37

2.4 Pavement Markings

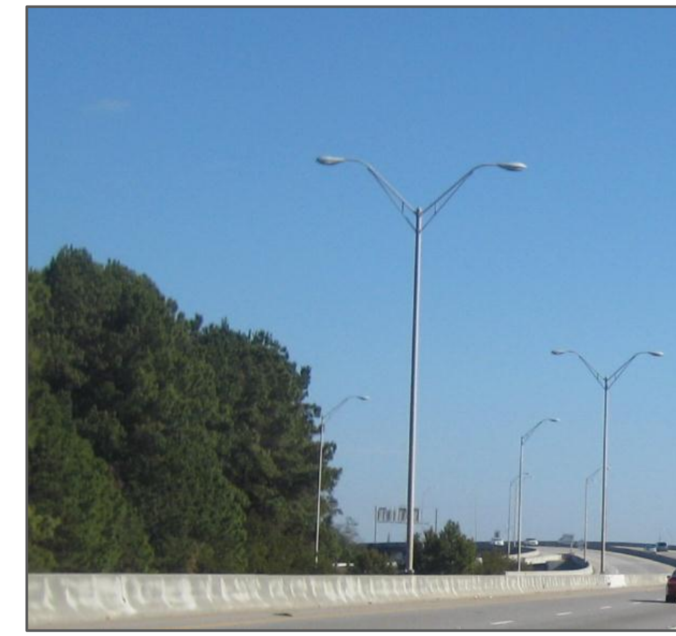
The existing pavement markings along the James Island Connector bridge deck cross-section generally consists of 12-foot travel lanes with a ±6-foot inside shoulder and a ±10-foot outside shoulder/breakdown lane. The existing striping is conventional thermoplastic as shown below.

2.5 Signing

The prohibition of non-motorized vehicles, including bicycles, is currently signed at the entrance ramps to the James Island Connector, an example of which is shown below. Typical guide, warning, and regulatory signing is also present along the study corridor.

2.6 Lighting

The majority of the study James Island Connector corridor roadway is currently lighted with single- and double-arm luminaires, as shown below.



2.7 Future Growth

A review was conducted to determine the future traffic growth projected for the James Island Connector. This review considered SCDOT historical traffic volume data and CHATS travel demand model projections conducted by Wilbur Smith for the Draft Environmental Impact Statement for the I-526/Mark Clark Expressway extension project.

Historical count data along the James Island Connector (SCDOT count stations #410 – between Folly Road and Harbor View Road and #412 – between Harbor View Road and SC 61) was reviewed over the past ten years. The results of the review indicate that the James Island Connector has experienced negative overall growth during this time period.

CHATS travel demand model projections conducted by Wilbur Smith were obtained from BCDCOG for review of traffic growth projections for the James Island Connector with and without consideration of the Mark Clark Expressway extension project. The results of this review indicate that the James Island Connector is projected to grow at an annual growth rate of less than one percent to the 2035 horizon year without consideration of the extension project. With consideration of the I-526/Mark Clark Expressway extension project, the annual growth along the study James Island Connector corridor is projected to be increased slightly.

3.0 CAPACITY ANALYSES

Existing level of service (LOS) conditions along the study James Island Connector corridor were evaluated for the study intersections and the ramp merge, diverge, and weaving areas.

3.1 INTERSECTION ANALYSIS

Using the existing traffic volumes, intersection analyses were conducted for the eight study intersections using the Transportation Research Board's *Highway Capacity Manual 2010 (HCM 2010)* methodologies of the *Synchro*, Version 8 software.

Intersection LOS grades range from LOS A to LOS F, which are directly related to the level of control delay at the intersection and characterize the operational conditions of the intersection traffic flow. LOS A operations typically represent ideal, free-flow conditions where vehicles experience little to no delays, and LOS F operations typically represent poor, forced-flow (bumper-to-bumper) conditions with high vehicular delays, and are generally considered undesirable. Table 3.1 summarizes the *HCM 2010* control delay thresholds associated with each LOS grade for unsignalized and signalized intersections.

Table 3.1 – *HCM 2010* LOS Criteria for Unsignalized & Signalized Intersections

UNSIGNALIZED INTERSECTIONS	
LOS	CONTROL DELAY PER VEHICLE (SECONDS)
A	≤ 10
B	> 10 and ≤ 15
C	> 15 and ≤ 25
D	> 25 and ≤ 35
E	> 35 and ≤ 50
F	> 50

SIGNALIZED INTERSECTIONS	
LOS	CONTROL DELAY PER VEHICLE (SECONDS)
A	≤ 10
B	> 10 and ≤ 20
C	> 20 and ≤ 35
D	> 35 and ≤ 55
E	> 55 and ≤ 80
F	> 80

As part of the intersection analysis, SCDOT's default *Synchro* parameters were utilized, including a peak-hour factor of 0.90. Existing heavy vehicle percentages based upon the existing traffic counts were utilized in the analysis. Existing lane geometry was also utilized throughout the study network.

Using the *Synchro* software, intersection analyses were conducted for the AM, midday, and PM peak hours. The results of the intersection analyses are summarized in Table 3.2 and illustrated in Exhibit 3.1. For the unsignalized study intersections, the LOS and delay results are shown for the worst-case minor-street approaches only, as based upon the *HCM* 2010 methodologies for unsignalized intersections. Worksheets documenting the existing intersection analyses are provided in Appendix C.

Table 3.2 – Intersection Analysis Results

INTERSECTION	INTERSECTION CONTROL	LOS/DELAY (SECONDS)		
		AM	MIDDAY	PM
1) James Island Connector Eastbound (South) Off-Ramp & SC 171/Folly Road	Two-Way STOP	B/12.2 (SB)	B/12.0 (SB)	B/10.9 (SB)
2) James Island Connector Westbound (North) On-Ramp & SC 171/Folly Road	Signalized	B/12.7	B/19.8	B/19.2
3) James Island Connector Eastbound (South) Ramp & Harbor View Road	Two-Way STOP	C/16.0 (NB)	B/14.9 (NB)	D/33.1 (NB)
4) James Island Connector Westbound (North) Ramp & Harbor View Road	Two-Way STOP	E/37.9 (NB)	E/45.8 (NB)	F/72.0 (NB)
5) SC 61/Herbert Fielding Connector & Ashley Pointe Drive	Signalized	A/9.5	A/6.8	A/7.1
6) Lockwood Drive & Calhoun Street Ramp	Signalized	A/7.7	A/7.0	A/7.7
7) Calhoun Street & Courtenay Drive	Signalized	B/14.9	C/22.4	F/100.7
8) Lockwood Drive & Bee Street	Signalized	E/78.8	E/55.9	F/80.6

Note: LOS/Delay is shown for the worst-case minor-street approach of the unsignalized intersections.

The results of the intersection analyses indicate that the study intersections currently operate at acceptable LOS conditions, with two exceptions. The signalized intersection of Calhoun Street & Courtenay Drive currently operates at undesirable LOS conditions for the PM peak hour, and the unsignalized intersection of James Island Connector Westbound (North) Ramp & Harbor View Road currently operates at undesirable LOS conditions for the PM peak hour.

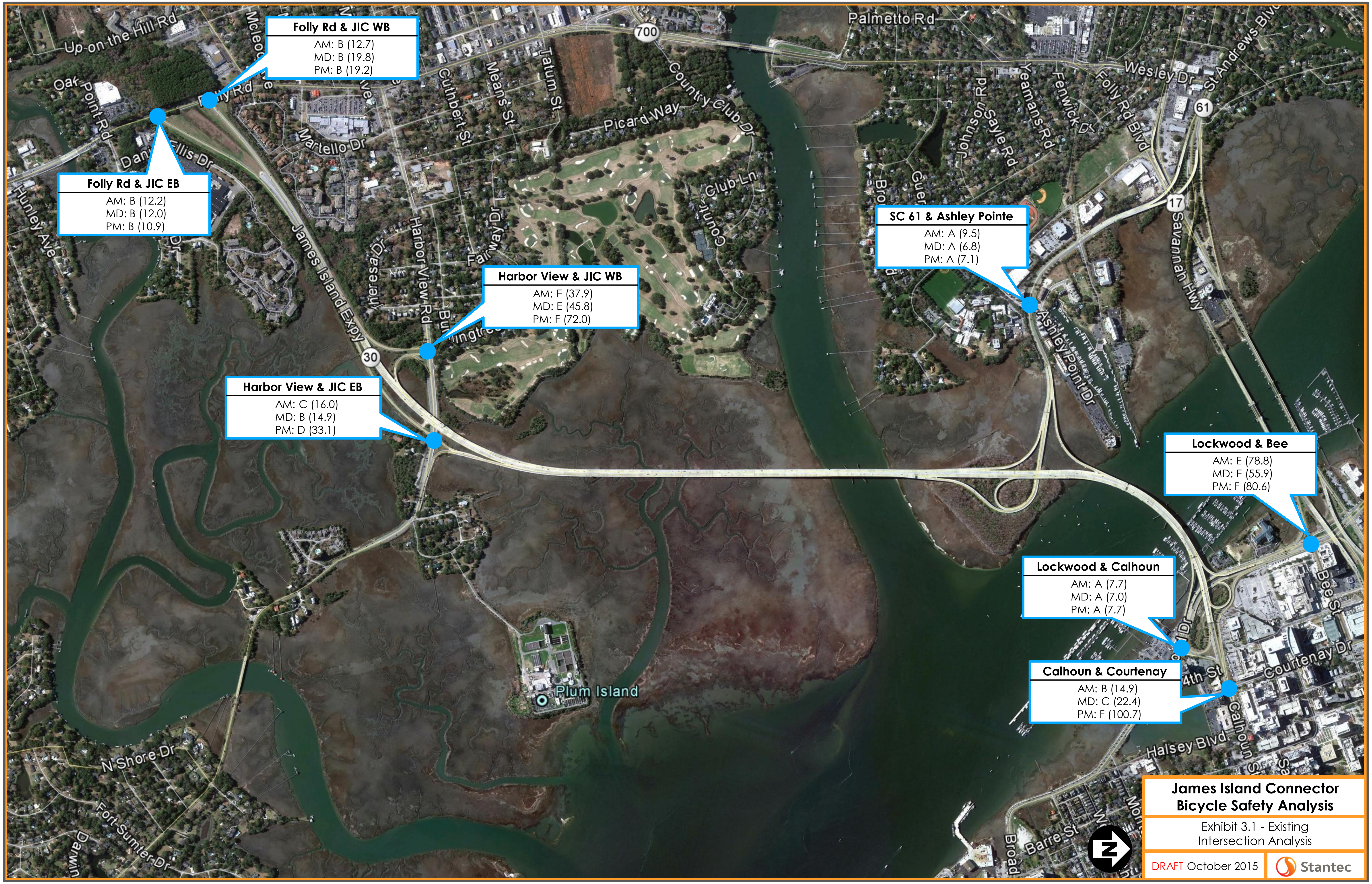


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Exhibit 3.1 - Existing Intersection Analysis

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3.2 RAMP MERGE/DIVERGE/WEAVING ANALYSIS

Using the existing traffic volumes, the James Island Connector ramp merge, diverge, and weaving areas were analyzed using the *Highway Capacity Software 2010 (HCS 2010)*. Ramp merge areas are where vehicles enter the freeway, ramp diverge areas are where vehicles exit the freeway, and weaving areas are where vehicles simultaneously enter and exit the freeway.

Ramp LOS grades range from LOS A to LOS F, which are directly related to the density and characterize the operational conditions of the traffic flow. LOS A operations typically represent ideal, uncongested conditions where vehicles experience little to no issue merging, diverging, or weaving; and LOS F operations typically represent poor, congested conditions with numerous conflicts in the merging, diverging, or weaving area, and are generally considered undesirable. Table 3.3 summarizes the *HCM 2010* density thresholds associated with each LOS grade for merge, diverge, and weaving segments.

Table 3.3 – *HCM 2010* LOS Criteria for Merge, Diverge, & Weaving Segments

LOS	DENSITY (PC/MI/LN)
A	≤ 10
B	> 10 and ≤ 20
C	> 20 and ≤ 28
D	> 28 and ≤ 35
E	> 35
F	Demand Exceeds Capacity

Using the *HCS 2010* software, ramp analyses were conducted for the AM, midday, and PM peak hours. The results of the ramp analyses are summarized in Table 3.4 and illustrated in Exhibit 3.2. Worksheets documenting the existing ramp merge, diverge, and weaving segment analyses are provided in Appendix D.

The results of the ramp merge, diverge, and weaving analyses indicate that the James Island Connector ramps currently operate at acceptable LOS conditions.

Table 3.4 – Ramp Merge/Diverge/Weaving Analysis Results

INTERCHANGE AREA	MOVEMENT TYPE	LOS/DENSITY (PC/MI/LN)		
		AM	MIDDAY	PM
JIC Eastbound Off-Ramp to Harbor View Drive	Diverge	A (3.9)	A (0)	A (0)
Harbor View Drive to JIC Eastbound On-Ramp	Merge	C (26.1)	B (16.5)	B (16.1)
JIC Westbound Off-Ramp to Harbor View Drive	Diverge	A (8.2)	B (11.7)	C (24.5)
Harbor View Drive to JIC Westbound On-Ramp	Merge	A (9.1)	B (11.5)	B (15.1)
JIC Eastbound Off-Ramp to SC/Herbert Fielding Connector	Diverge	C (21.1)	B (13.2)	B (12.6)
SC/Herbert Fielding Connector to JIC Eastbound On-Ramp	Merge	C (24.3)	B (11.2)	B (10.1)
JIC Westbound between On-Ramp from Lockwood Drive and Off-Ramp to SC/Herbert Fielding Connector	Weaving	A (10.3)	B (12.1)	B (17.4)
SC/Herbert Fielding Connector to JIC Westbound On-Ramp	Merge	B (12.7)	B (17.5)	C (25.0)
JIC Eastbound Off-Ramp to Lockwood Drive Northbound	Diverge	A (5.2)	A (0)	A (0)
Lockwood Drive Northbound On-Ramp to JIC Westbound	Merge	A (2.0)	A (5.1)	B (12.0)
JIC Eastbound Off-Ramp to Lockwood Drive Southbound	Diverge	B (17.8)	B (11.5)	B (11.6)

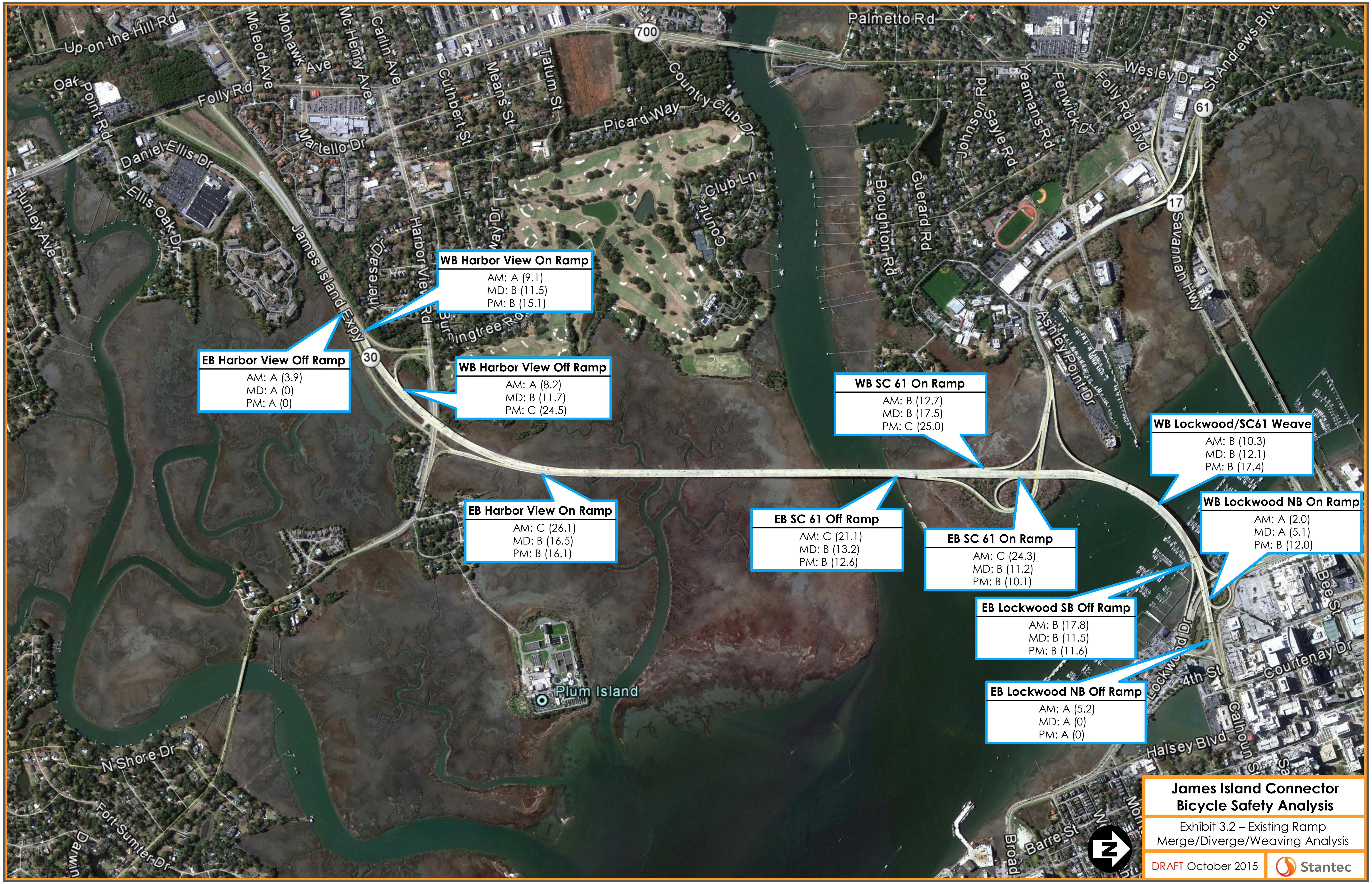

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Exhibit 3.2 – Existing Ramp Merge/Diverge/Weaving Analysis

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4.0 ALTERNATIVE BICYCLE ROUTE ANALYSIS

In June 2012, the South Carolina General Assembly amended section 56-5-3860, Code of Laws of South Carolina "to provide an exemption for bicyclists and pedestrians that may travel along non-interstate freeways under certain circumstances." Specifically, the law was amended to allow the City to authorize the exemption if the local governing body "determines that bicyclists and pedestrians have no other reasonably safe or viable alternative route and the use of the freeway route is at least ten percent less than the shortest conventional alternate route." An alternative bicycle route review was conducted to determine if bicycle travel can be legally accommodated along the James Island Connector.

Currently, there is no bicycle route between the City of Charleston peninsula and James Island. Therefore, the City of Charleston may authorize bicyclists to travel along the James Island Connector. However, improvements to the James Island Connector must be implemented to accommodate bicycle travel.

As previously noted, Charleston County is currently conducting a feasibility study considering a dedicated bicycle lane on the northbound US 17/Savannah Highway T. Allen Legare Bridge. Therefore, an alternate bicycle route review was also conducted considering the bicycle lane on the northbound US 17/Savannah Highway T. Allen Legare Bridge as being implemented. The endpoints for the alternative route review were the James Island Connector & SC 171/Folly Road intersection on the south and the Courtenay Drive midpoint between Calhoun Street and Bee Street on the north. The two routes are illustrated in Exhibit 4.1.

The distance utilizing the James Island Connector is approximately 3.11 miles and the distance utilizing the SC 171/Folly Road to US 17/Savannah Highway route is approximately 3.52 miles – 13 percent longer. Therefore, the City of Charleston may authorize bicyclists to travel along the James Island Connector with the implementation of the dedicated bicycle lane on the northbound US 17/Savannah Highway T. Allen Legare Bridge. However, improvements to the James Island Connector must be implemented to accommodate bicycle travel.

Exhibit 4.1 – Comparison of Alternative Routes

5.0 STATE OF THE PRACTICE REVIEW

With the potential of accommodating bicyclists on the James Island Connector, the safety of bicycle and vehicular users is of the utmost concern. Based upon a state of the practice review, it was determined that there is not another facility that exactly matches the challenges that accommodating bicyclists on the James Island Connector presents. However, there are a number of facilities that address certain challenges and conflicts. The two primary conflicts for accommodating bicyclists on limited-access facilities such as the James Island Connector that were considered in this study are 1) the close proximity of higher-speed vehicles to lower-speed bicyclists and 2) the crossing of the higher-speed vehicular paths with lower-speed bicycle paths.

Therefore, a review of existing bicycle routes on limited-access facilities and bicycle routes crossing on- and/or off-ramps was conducted to determine how these conflicts are mitigated in other locations in the United States. For comparison purposes, the James Island Connector has a four-lane, divided cross section, carried a 2014 AADT of approximately 39,800, and has a posted speed of 55 mph.

5.1 BICYCLE ROUTES ON LIMITED-ACCESS FACILITIES

Bicycle use is permitted on limited-access facilities across the United States. In Idaho, North Dakota, South Dakota, and Wyoming, bicycles are allowed on all interstates. In Alaska, Arizona, California, Colorado, Montana, Nevada, New Mexico, Oklahoma, Oregon, Texas, Utah, and Washington, bicyclists are allowed on interstates where no viable alternate route exists. For the majority of these routes that allow bicyclists, there are no bicycle-specific improvements (barriers, buffer areas, etc.).

In California, of the more than 4,000 miles of freeways, approximately 1,000 miles are open to bicyclists. At these locations, bicycles are typically directed to exit freeway off ramps and then re-enter the freeway via the adjacent on ramp. Where bicycles are prohibited on the freeway, the freeway on-ramps are signed as such.

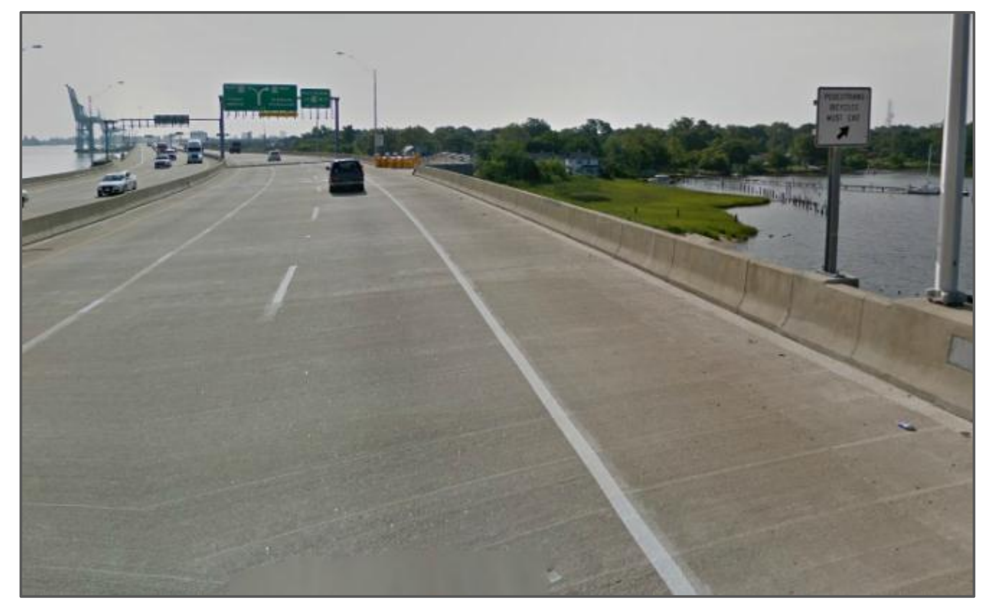
Several additional specific examples of similar locations are described herein.

WEST NORFOLK BRIDGE – PORTSMOUTH, VIRGINIA

In Virginia, bicyclists are permitted on the northern portion of the SR 164/West Norfolk Bridge across the Elizabeth River. Ramp structures are provided in each direction on the bridge connecting to a shared-use path. On the portion of the bridge where bicycles are allowed, a wide shoulder is present. Signs directing bicycles to exit are installed at the ramps connecting the shared use path.

The cross section of the elevated West Norfolk Bridge structure consists of two travel lanes in each direction separated by a jersey barrier with an inside shoulder of approximately six feet and a wide outside shoulder. This cross section is very similar to the James Island Connector. The 2012 AADT on the West Norfolk Bridge was 47,000 and the posted speed limit along the West Norfolk Bridge is 45 mph.

Bicyclists may use the bridge to cross the Elizabeth River but are required to exit to a shared use path prior to reaching any conflict area with motor vehicles. There are no bicycle lane markings on the bridge.



CASCO BAY BRIDGE – PORTLAND, MAINE

In Maine, bicyclists are allowed to use the SR 77 Casco Bay Bridge in Portland, a city with similar character to Charleston, as compared in a January 4, 2014 *Post and Courier* article (http://www.postandcourier.com/article/20140104/PC1201/140109809). Multi-use paths connect to both sides of the bridge.

The SR 77 Casco Bay Bridge cross section consists of two travel lanes, an inside shoulder of approximately four feet, and a wide outside shoulder with bike lane markings. The speed limit along the SR 77 Casco Bay Bridge is 40 mph and the 2010 AADT was 26,000.

In the southbound direction of the bridge, bicyclists must cross the on ramp from Commercial Street. The crossing is unmarked, but a bicycle warning sign with flashing beacons is present to notify drivers of the potential conflict with bicyclists. Pavement markings exist in the bike lane approaching the ramp gore area that state "[Bikes] yield to ramp traffic ahead" and a bicycle-level sign approaching the convergence states the same. No other gore area crossings exist in the southbound or northbound directions. The bridge is controlled access for the one-mile length, with the only access point in that segment being from the Commercial Street on ramp. An extended railing is present on the outer barrier walls, and it is understood that the railing was part of the original bridge construction.

SE HAWTHORNE BOULEVARD/SE MADISON STREET – PORTLAND, OREGON

On elevated sections of SE Hawthorne Boulevard and SE Madison Street in Portland, Oregon, bicycles are permitted in a buffered lane to the right of the traveled way. On SE Hawthorne Boulevard, bicyclists cross the off-ramp exit to SE Martin Luther King Jr Boulevard at a green-painted crosswalk. Signs are posted instructing motorists to yield to bikes at the crossing.

SE Hawthorne Boulevard and SE Madison Street are one-way pairs with cross sections that consist of two one-way travel lanes. Along SE Hawthorne Boulevard, there is a five-foot bike lane separated by a striped buffer area. For a portion of the elevated section, the buffer area is replaced by a bus lane for loading and unloading at a pedestrian ramp leading to the ground beneath the elevated section. Along SE Madison Street, there are two five-foot bike lanes with no striped buffer area. The posted speed limits along SE Hawthorne Boulevard and SE Madison Street are 35 mph.

SE Hawthorne Boulevard and SE Madison Street come together at the SW Hawthorne Bridge over the Willamette River, where bicyclists share an eight-foot wide sidewalk with pedestrians and both sides of the road. Prior to the elevated section, access to the Eastbank Esplanade shared use path is provided in both directions.

The structures also have an extended railing on the outer walls which serves as protection for bicyclists. Signing is present to alert motorists of the potential for bikes to be present in the area. This is a very active bicycle and pedestrian route.

CROSS ISLAND PARKWAY BRIDGE – HILTON HEAD ISLAND, SOUTH CAROLINA

Bicyclists are allowed to use the shoulder/breakdown lane of US 278/Cross Island Parkway Bridge over Broad Creek on Hilton Head Island, South Carolina. On either side of the bridge structure, dedicated paths are provided in both directions approaching and departing each end of the bridge.

The cross section of the Cross Island Parkway Bridge consists of two travel lanes in each direction separated by a jersey barrier. Each direction has an inside shoulder of approximately four feet and an outside shoulder of approximately ten feet. The 2012 AADT along US 278 was 25,000 vehicles per day and the posted speed limit is 45 mph.

The Cross Island Parkway Bridge cross section is similar to the James Island Connector. There are no bicycle lane markings on the bridge, but markings do exist on the shared use paths just prior to the convergence with the unmarked shoulders. Additionally, pictorial signing is present at the end of the shared use path warning bicyclists of the steep grade they will be traversing when crossing the Cross Island Parkway Bridge. At the end of the bridge, bicyclists are directed onto the shared use path and signing is present indicating they are prohibited on US 278 beyond that point. There are no extending railings on the bridge sections.

ISLE OF PALMS CONNECTOR BRIDGE – ISLE OF PALMS, SOUTH CAROLINA

Bicyclists are allowed on the SC 517/Isle of Palms Connector, which has a wide outside shoulder. The cross section of the Isle of Palms Connector Bridge consists of one travel lane in each direction separated by a 10-foot wide striped median. The outside shoulder width is approximately 10 feet. The 2012 AADT on the Isle of Palms Connector was approximately 16,700 and the speed limit is 55 mph.

Similar to the Cross Island Parkway Bridge in Hilton Head, shared use paths on the north end of the IOP Connector Bridge lead bicyclists to the unmarked shoulder on the bridge. There is no existing signing prohibiting bicyclists or warning of the adverse conditions they may experience in crossing the bridge. There are no extending railings on the bridge sections.

5.2 BICYCLE ROUTES CROSSING ON- AND OFF-RAMPS

Bicycle lanes cross on- and off-ramps of many limited-access facilities throughout the United States. Several examples of these crossings with specific crossing treatments are described herein.

<u>CASCO BAY BRIDGE – PORTLAND, MAINE</u>

On the SR 77 Casco Bay Bridge in Portland, Maine, bicyclists are required to yield to motor vehicles at the on ramp from Commercial Street. The crossing is unmarked, but a bicycle warning sign with flashing beacons is present to notify drivers of the potential conflict with bicyclists.

Pavement markings exist in the bike lane approaching the ramp gore area that state "[Bikes] yield to ramp traffic ahead" and a bicycle-level sign approaching the convergence states the same. No other gore area crossings exist in the southbound or northbound directions. An extended railing is present on the outer barrier walls. From 2007 to 2012, there were no reported crashes at the ramp crossing.

The SR 77 Casco Bay Bridge cross section consists of two travel lanes, an inside shoulder of approximately four feet, and a wide outside shoulder with bike lane markings. The speed limit along the SR 77 Casco Bay Bridge is 40 mph and the 2010 AADT was 26,000.

<u>I-4 & US 301 – TAMPA, FLORIDA</u>

At the I-4 & US 301 interchange in Tampa, Florida, bicyclists and pedestrians must cross free-flow merge and diverge areas at four locations in each direction along US 301. At this location, bicycles travel in a designated bike lane on US 301 while pedestrians use an adjacent sidewalk. At the merge and diverge area crossings, the bicyclists and pedestrians utilize a shared crosswalk. In this example, motorists must yield to bicyclists and pedestrians, which cross at a 90-degree angle to the ramps.

The free-flow ramps to/from I-4 along US 301 are similar to those found along the study James Island Connector corridor. The 2012 AADT on US 301 in the area was approximately 30,000 and the speed limit is 45 mph.

SE HAWTHORNE BOULEVARD – PORTLAND, OREGON

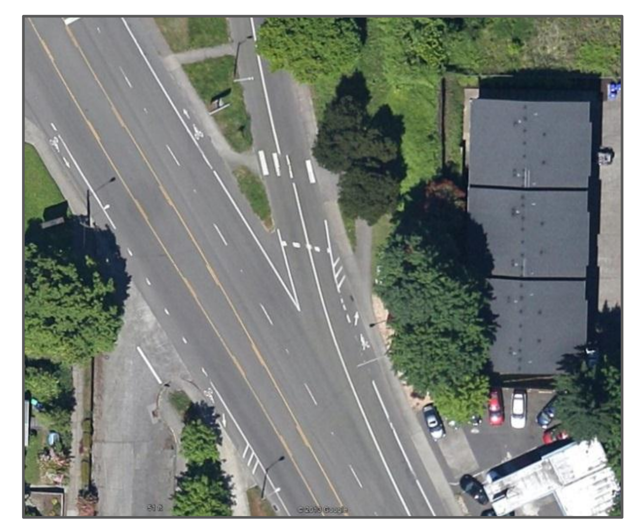
On an elevated section of SE Hawthorne Boulevard in Portland, Oregon, bicycles are permitted in a buffered lane to the right of the traveled way. Bicyclists cross the off-ramp exit to SE Martin Luther King Jr Boulevard at a green-painted crosswalk. Signs are posted instructing motorists to yield to bikes at the crossing. The structure also has an extended railing on the outer walls which serves as protection for bicyclists and pedestrians, which are also allowed on this structure. Signing is present to alert motorists of the potential for bikes to be present in the area. This is a very active bicycle and pedestrian route. The speed limit on SE Hawthorne Boulevard is 35 mph.

The green paint and signing allows bicyclists to proceed across the ramp without stopping, and the crossing angle allows the bicyclist to proceed without much reduction in speed. Green paint emphasizes the crossing to alert motorists of the potential for bicyclists, which can lead to a higher level of perceived safety for the bicyclists. This is more common on bicycle routes with high activity, and this configuration requires motorists to be alert for bicyclists at all times.

SW NAITO PARKWAY – PORTLAND, OREGON

Another example from Portland, Oregon, shows a bicycle lane being directed to the sidewalk to cross a free-flow ramp near a 70-degree angle under yield control for the bicycles. In areas where space is available for this treatment, this allows for improved sight distance for the bicyclist making the crossing while avoiding having to stop or dismount the bicycle. Multiple signs are present to alert motorists of the crossing.

At this location, SW Barbur Boulevard consists of three lanes approaching the ramp for SW Naito Parkway. The outside lane is an exclusive exit lane to SW Naito Parkway while the center lane is shared between the through movement on SW Barbur Boulevard and the exit for SW Naito Parkway. The ramp speed limit is 40 mph.



I-35 & DEAN KEETON STREET – AUSTIN, TEXAS

There are several bicycle crossing areas in Austin, Texas. Dean Keeton Street near the interchange with Interstate 35 frontage roads contains a buffer for bicyclists, green-painted crosswalks across the free-flow ramps into and out of the striped gore areas, and signing instructing motorists to yield to bikes at the crossings. Dean Keeton Street is a major thoroughfare through the University of Texas at Austin campus and has the potential for high bicycle activity during peak seasons.

Dean Keeton Street has a four-lane divided cross section with lanes being added and dropped at the frontage road on- and off-ramps. The primary conflict along the route is bicycles crossing at the on- and off-ramps to the I-35 frontage roads. The 2010 AADT on Dean Keeton Street was approximately 13,000 and the speed limit is 30 mph.

The green paint and signing allows bicyclists to proceed across the ramp without stopping, and the crossing angle allows the bicyclist to proceed without significant reduction in speed. This configuration requires motorists to be alert for bicyclists at all times. The buffered lane along Dean Keeton Street increases bicycle safety and comfort by providing a greater distance between bicyclists and adjacent motor vehicle traffic.

WELLS BRANCH PARKWAY – AUSTIN, TEXAS

Similar treatments are used on Wells Branch Parkway east of I-35 in Austin, Texas, which is approximately 10 miles north of Dean Keeton Street. Wells Branch Parkway is a four-lane divided facility with several exclusive left-turn lanes. The 2010 AADT along Wells Branch Parkway was approximately 15,000 and the speed limit is 40 mph.

The green paint and signing allows bicyclists to proceed across the ramp without stopping, and the crossing angle allows the bicyclist to proceed without much reduction in speed. For one ramp crossing, the bicyclist proceeds straight and would be required to look over his/her shoulder to yield to vehicles; therefore, it is important that motorists are aware of the bicycle crossing. The buffered lane along Wells Branch Parkway increases bicycle safety and comfort by providing a greater distance between bicyclists and adjacent motor vehicle traffic.

<u>BEN WHITE BOULEVARD & CONGRESS AVENUE – AUSTIN, TEXAS</u>

Also in Austin, Texas, there are plans to install green-painted bicycle crossings along Congress Avenue at US 290/Ben White Boulevard interchange free-flow ramps. A buffered bike lane currently exists on Congress Avenue. The existing crossings are striped with a dotted line without the green paint.

The 2012 AADT on Congress Avenue was approximately 35,000 and the speed limit is 40 mph. The cross section of Congress Avenue consists of two travel lanes in each direction separated by a two-way left-turn lane.

The bicycle crossings allow for bicyclists to proceed straight across the ramps without adjusting to a crossing angle with improved sight distance; therefore, motor vehicles are required to yield to bicycles at these crossings. This configuration requires motorists to be alert for bicyclists at all times because bicyclists have more difficulty looking over their shoulders to yield to oncoming traffic.

<u>I-26 & US 17A – SUMMERVILLE, SOUTH CAROLINA</u>

Across many interchanges along I-26 and throughout South Carolina, crosswalks across free-flow ramps connect pedestrians and bicycles on either side of the Interstate.

As an example, pedestrians and bicyclists walking their bicycles along the US 17A sidewalk over I-26 have to cross three free-flow ramp movements at crosswalks at the partial cloverleaf interchange. Signing is present to alert motorists of the crossings.

The 2012 AADT along US 17A was 39,200 and the posted speed limit is 45 mph.

6.0 JAMES ISLAND CONNECTOR ALTERNATES ANALYSIS

Based upon the existing conditions review, multiple site visits, state of the practice review, and the fact that there is no other viable route between the City of Charleston peninsula and James Island, several options for the James Island Connector were developed to determine the potential of accommodating bicycles along the study corridor.

For the evaluation, the types of bicyclists that are expected to use the James Island Connector were also considered. For the recommended alternate, design criteria was developed to accommodate bicycle lanes on the study corridor, which included consideration of the bicycle lane width, speed limit, railing heights, lighting, bicycle signing, vehicular signing, and pavement markings.

6.1 TYPES OF BICYCLISTS – JAMES ISLAND CONNECTOR

Based upon the primary conflicts for accommodating bicyclists on the James Island Connector, including the close proximity of higher-speed vehicles to lower-speed bicyclists and the crossing of the higher-speed vehicular paths with lower-speed bicycle paths, it is expected that only the Strong & Fearless and a portion of the Enthused & Confident types of bicycle riders will be attracted to use the facility. These types of riders were considered in the development and evaluation of the routing alternates.

6.2 ALTERNATE ANALYSIS

Alternates considering improvements for accommodating bicyclists on the James Island Connector and bicycle routing alternates along the study corridor were evaluated on potential costs, safety, directness, and consistency for accommodating bicyclists on the James Island Connector. In addition, a No Build alternate retaining the existing bicycle prohibition was also considered. These alternates are described herein.

<u>No Build (Retain Bicycle Prohibition)</u>

This option would maintain the current prohibition of bicyclists on the James Island Connector. However, based upon the results of the state of the practice review and the fact that there is no other viable route between the City of Charleston peninsula and James Island, maintaining the current prohibitions for bicyclists along the James Island Connection was not considered to be viable and was not considered further in this study.

<u>Alternate A – Remove Bicycle Prohibition (No Other Improvements)</u>

The alternate consists of removing the prohibition of bicyclists on the James Island Connector with no additional bicycle-specific improvements. This would result in bicycles being able to travel on the shoulder of the entire study corridor, including the adjacent ramp facilities to access the James Island Connector.

The primary concerns with this alternate are the lack of bicycle-specific improvement accommodations addressing the close proximity of higher-speed vehicles to lower-speed bicyclists and the crossings of higher-speed vehicular ramps by lower-speed bicycles at the ramp gore areas. These concerns are particularly magnified considering the recent crash on the James Island Connector between Harbor View Road and the Herbert Fielding Connector that resulted in a bicyclist being thrown over the side of the bridge after being struck by a van.

<u>Alternate B – Harbor View Road to SC 61/Herbert Fielding Connector Route</u>

Alternate B consists of allowing bicycles to travel along the James Island Connector between Harbor View Road and SC 61/Herbert Fielding Connector only. This alternate also considers improvements to accommodate bicyclists in this section, including speed limit reductions, railing extensions, enhanced lighting, bicycle signing, vehicular signing, and new pavement markings, which are discussed in further detail in the next chapter.

The advantages of this alternate include no crossings of the higher-speed vehicular ramps on the James Island Connector by lower-speed bicycles, similar to the configurations of the West Norfolk Bridge in Portsmouth, Virginia; the Cross Island Parkway Bridge in Hilton Head; and the IOP Connector in Isle of Palms.

There are several drawbacks with this alternate. This alternate would need to utilize the westbound off-ramp loop to Harbor View Road and the eastbound off-ramp loop to SC 61/Herbert Fielding Connector for bicyclists, both of which are constrained in width and would require bicyclists to “take the lane” from vehicles; it is not recommended for bicyclists to “take the lane” on the James Island Connector ramps as it would present a safety issue for bicyclists and vehicles.

In addition, this alternate would require bicyclists to cross multiple lanes on Harbor View Road; the need to install bicycle facilities along Harbor View Road and SC 61/Herbert Fielding Connector; and would require bicyclists to cross one ramp area at the merge of the two James Island Connector off-ramps to northbound SC 61/Herbert Fielding Connector. Furthermore, this alternate depends on the implementation of the dedicated bicycle lane for the northbound US 17/Savannah Highway T. Allen Legare Bridge to provide access between the City of Charleston peninsula and James Island, which would result in a circuitous and indirect route between the peninsula and James Island.

Alternate C – Full Length Route

Alternate C allows bicyclists to travel along the entire length of the James Island Connector between SC 171/Folly Road and Lockwood Drive/Calhoun Street. This alternate also restricts bicyclists from utilizing the westbound off-ramp loop to Harbor View Road, the eastbound off-ramp loop to SC 61/Herbert Fielding Connector, and the eastbound on-ramp loop from SC 61/Herbert Fielding Connector. Each of these ramps are constrained in width and would require bicyclists to "take the lane" from vehicles; it is not recommended for bicyclists to "take the lane" on the James Island Connector ramps as it would present a safety issue for bicyclists and vehicles.

This alternate also considers improvements to accommodate bicyclists in this section, including speed limit reductions, railing extensions, enhanced lighting, bicycle signing, vehicular signing, and new pavement markings, which are discussed in further detail in the next chapter.

The advantages of this alternate include it being the most direct route between the City of Charleston peninsula and James Island and consistent treatment of bicycle improvements at gore areas throughout the length of the Connector. Consistent treatments increase driver expectancy, which can contribute positively to bicyclist safety. Similar configurations to this alternate considering bicyclists on limited-access facilities and/or bicyclists crossing on- or off- ramps have been implemented most notably with the Casco Bay Bridge in Portland, Maine; SE Hawthorne Boulevard in Portland, Oregon; and the I-4 & US 301 interchange in Tampa, Florida. Most of the other example locations considered in the state of the practice review also have portions similar to this proposed alternate.

The drawbacks to this alternate include the potential costs for improving the entire length of the James Island Connector to accommodate bicyclists and the new crossings of higher-speed vehicular ramps by lower-speed bicycles.

Alternate D – Full Length Route, Must Exit at Harbor View Road

This alternate is same as Alternate C except that bicyclists would be required to exit and re-enter in both directions at the Harbor View Road interchange.

The advantages of this alternate would be four less crossings of the higher-speed vehicular ramps on the James Island Connector by lower-speed bicycles.

The drawbacks of this alternate would include requiring bicyclists to "take the lane" on the James Island Connector westbound off-ramp loop to Harbor View Road. It is not recommended for bicyclists to "take the lane" on the James Island Connector ramps as it would present a safety issue for bicyclists and vehicles. In addition, this alternate would require bicyclists in the eastbound direction to cross five lanes on Harbor View Road at an unsignalized intersection. Finally, this alternate would result in inconsistent bicycle treatments at the James Island Connector interchanges, which reduces vehicular and bicyclist expectancy.

6.3 ALTERNATE EVALUATION

The four alternates were evaluated on conceptual costs, overall safety impacts at each of the study interchanges, directness of the route between the City of Charleston peninsula and James Island, and consistency of improvements for accommodating bicyclists on the James Island Connector.

The alternates were graded on a three category scale, with the **green dots** representing a positive impact on each evaluation category, the **yellow dots** representing a neutral impact on each evaluation category, and the **red dots** representing a negative impact on each evaluation category. Points were then assigned to each of the alternates based upon the evaluation results; the **green dots** were assigned 2 points, the **yellow dots** were assigned 1 point, and the **red dots** were assigned 0 points. The results of this evaluation are illustrated in Table 6.1.

Table 6.1 – Bicycle Route Alternate Selection

EVALUATION CRITERIA	ALTERNATE A REMOVE PROHIBITION (NO OTHER IMPROVEMENTS)	ALTERNATE B HARBOR VIEW ROAD TO HERBERT FIELDING CON. ROUTE	ALTERNATE C FULL LENGTH ROUTE	ALTERNATE D FULL LENGTH ROUTE, MUST EXIT AT HARBOR VIEW ROAD
Potential Costs	🟢	🔴	🔴	🔴
Safety at SC 171/Folly Road	🔴	🟢	🟡	🟡
Safety at Harbor View Road	🔴	🔴	🟡	🔴
Safety at SC 61/Herbert Fielding Connector	🔴	🔴	🟡	🟡
Safety at Lockwood Drive/Calhoun Street	🔴	🟢	🟡	🟡
Route Directness	🟢	🔴	🟢	🟡
Bike Route Consistency	🟢	🟡	🟢	🟡
Total Points	**6**	**5**	**8**	**5**

Based upon the results of the analysis, Alternate C – Full Length Route is the recommended alternate for accommodating bicyclists on the James Island Connector.

7.0 CONCEPTUAL IMPROVEMENT DESIGN

Based upon the recommended Alternate C – Full Length Route, conceptual design criteria for improvements was developed to accommodate bicycle lanes on the study corridor. These criteria included consideration of the bicycle lane width, speed limit, railing heights, lighting, bicycle signing, vehicular signing, and pavement markings.

7.1 DESIGN ASSUMPTIONS

Bicycle Lane Width

Based upon AASHTO's *Guide for the Development of Bicycle Facilities*, 4th Edition (2012), a minimum bicycle lane of five feet is recommended if a curb or other roadside barrier is present due to the fact that bicyclists will "generally shy away from a vertical face." For sections that do not have a curb or other roadside barrier, a minimum bicycle lane of four feet is recommended.

With the available width along the majority of the James Island Connector, a bicycle lane width of six feet is recommended.

Speed Limit

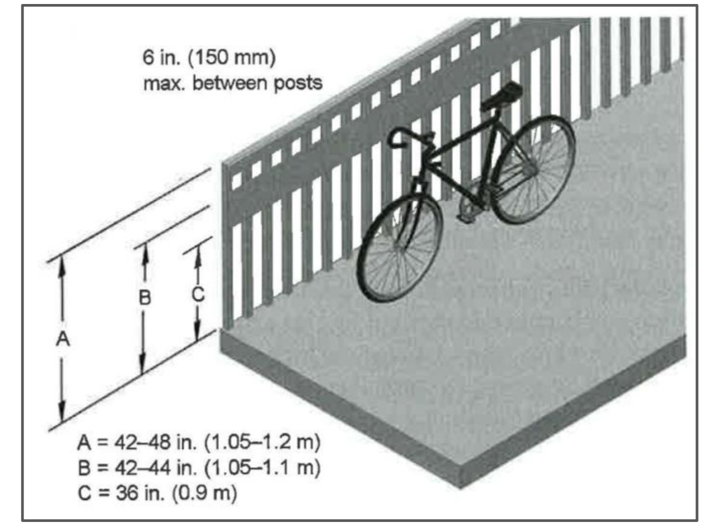
The speed limit along the James Island Connector is currently posted at 55 mph. To reduce the speed differential between vehicles and bicyclists, it is recommended that the speed limit be reduced to 45 mph and that the City of Charleston commit to a vigorous speed enforcement program to enforce this reduced speed limit. The 45 mph speed limit would be consistent with the proposed I-526/Mark Clark Expressway extension, which is also proposed to have on-road bicycle lanes, a separate shared-use path on the south side, and a speed limit of 45 mph. It would also be consistent with the majority of the facilities identified in the state of the practice review.

Railings

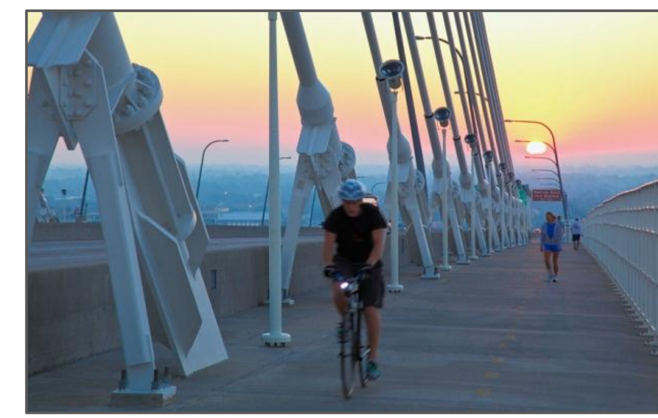
AASHTO's *Guide for the Development of Bicycle Facilities* provides recommendations for railings on shared use path on stand-alone structures, such as the bridge sections of the James Island Connector. A minimum railing height of 42 inches is recommended, with a railing height of 48 inches recommended at locations to help prevent bicyclists from falling over the railing during a crash. Exhibit 7.1 illustrates the recommended AASHTO rail sections for stand-along structures.

The existing jersey barriers marking the outside walls of the James Island Connector bridge sections are approximately 32 inches in height. Therefore, it is recommended to add approximately 16-inch railing extensions to the existing outside James Island Connector jersey barriers to meet the 48-inch recommendation.

Exhibit 7.1 – *Guide for the Development of Bicycle Facilities* Figure 5-11 Bridge Railing Exhibit



The bicycle/pedestrian path and associated railing on the Arthur Ravenel, Jr. Bridge in Charleston is shown at the right.



Examples of railing extensions on jerseys barriers for the Casco Bay Bridge in Portland, Maine (below-left) and SE Hawthorne Boulevard in Portland, Oregon (below-right) are shown below. Note that the proposed railing extensions are not anticipated to have a significant impact on views.

Lighting

The AASHTO *Guide for the Development of Bicycle Facilities* recommends that an average maintained horizontal illumination level of 0.5 to 2 foot-candles (5 to 22 lux) should be considered on shared-used path facilities.

The majority of the study James Island Connector corridor roadway is currently lighted. It is recommended that with the potential design of improvements to accommodate bicyclists on the James Island Connector, the lighting on the bicycle level be verified to ensure that they meet the AASHTO standards, especially at the crossing areas.

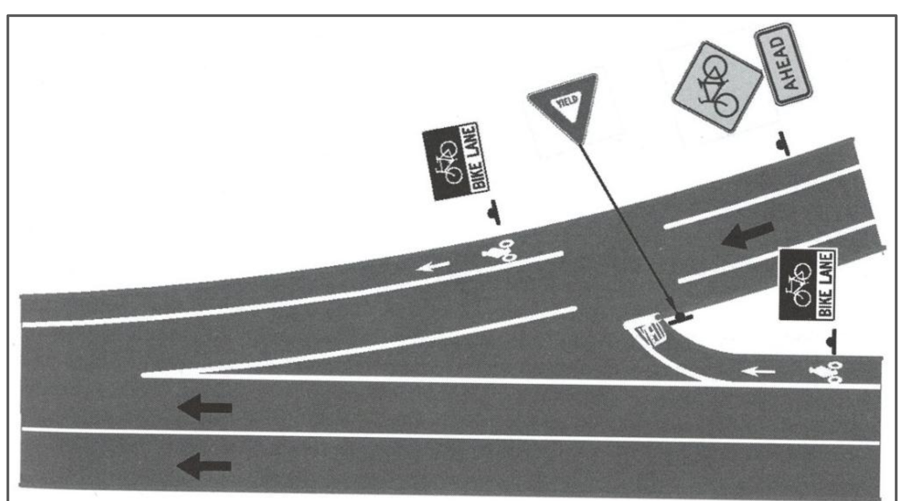
Bicycle Signing

To accommodate bicyclists on the James Island Connector, several bicycle-level sign assemblies are recommended to be installed. At the crossing of the James Island Connector on- and off-ramps, it is recommended that yield signs be installed for bicyclists indicating the need to yield to vehicular traffic. Exhibit 6.2 illustrates an option documented by AASHTO for signing of a bicycle lane with a free-flow merging roadway.

Furthermore, signing is recommended to be installed at entrances to the James Island Connector warning bicyclists of the potential for high winds and steep grades on the bridge sections. A similar sign at the entrance to the Arthur Ravenel, Jr. Bridge is shown at the right.

Finally, it is recommended to have bicycle-level mileage and time signs at regular intervals along the James Island Connector route.

Exhibit 7.2 – *Guide for the Development of Bicycle Facilities* Figure 4-42 Option 2 – Bike Lane and Free-Flow Merging Roadway



Vehicular Signing

In addition to bicycle-level signing, additional vehicular sign assemblies are recommended to be installed. It is recommended that a W11-1 Bicycle Warning Sign with a W16-9P Ahead plaque, as shown to the right, be installed in advance of all the on- and off-ramp crossing areas. According to the *Manual on Uniform Traffic Control Devices*, the W11-1 sign shall be 36" by 36" and the W16-9P plaque shall to be 30" by 18".

In addition, bike lane signs are also recommended to be installed a regular intervals. Advance warning beacons could also be considered for these sign assemblies, similar to the Casco Bay Bridge in Portland, Maine. Furthermore, actuation of the advance warning beacons could be considered as well.

Pavement Markings

Pavement markings along the James Island Connector will require modification prior to allowing bicycles on the study corridor. Generally, the proposed concept for the James Island Connector bicycle route will contain a striped buffer area with raised-profile thermoplastic markings delineating the right edgeline of the outside vehicular travel lane. The bicycle lane markings, including the buffer areas, shall be designed according to the guidelines listed in Chapter 3D of the *Manual on Uniform Traffic Control Devices* and the current FHWA guidance. This buffer area is similar to that on SE Hawthorne Boulevard in Portland, Oregon and the three locations in Austin, Texas.

The raised-profile thermoplastic oustide white edgeline of the outside vehicular travel lane will provide vehicles a tactile warning that they have left the travel lane and need to correct their path away from the bicycle lane. The Isle of Palms Connector has two configurations of raised-profile thermoplastic marking, raised thermoplastic buttons for the ashphalt section north of the bridge structure and raised "piano-bar" thermoplastic markings for the concrete bridge sections. Examples of these two pavement marking treatments are shown below.

For bicycle lane markings and areas where bicycles will potentially need to transition to use the traveled way by crossing a marking, it is recommended to use the standard white pavement markings to reduce the risk of a raised-profile marking deflecting the bicycle wheel.

Bicycle Lane Maintenance

It is recommended that a regular street-sweeping program be implemented for the James Island Connector bicycle lanes so that onroad punctures, and bicyclists repairing punctures in the bicycle lane, can be minimized.

7.2 DESIGN CRITERIA

Based upon the field reviews, state of the practice review, alternate selection, and design assumptions, a conceptual design plan for accomdating bicyclists on the James Island Connector was developed. A summary of the proposed design criteria used in the development of the conceptual plan is summarized in Table 7.1.

Table 7.1 – James Island Connector Proposed Design Criteria

DESIGN ITEM	PROPOSED CRITERIA
Inside Shoulder Width	4 feet
Through Travel Lane Width	12 feet
Ramp Lane Width	12-foot minimum
Buffer Width (with Chevron Marking)	4-foot minimum
Bicycle Lane Width	6 feet
Bicycle Crosswalk Width	8 feet
Speed Limit	45 mph
Inside Vehicular Travel Lane Edge Line	Yellow thermoplastic
Outside Vehicular Travel Lane Edge Line	White thermoplastic raised-profile markings
Railing Height	48" from pavement surface
Lighting	2 foot-candles at crossing areas

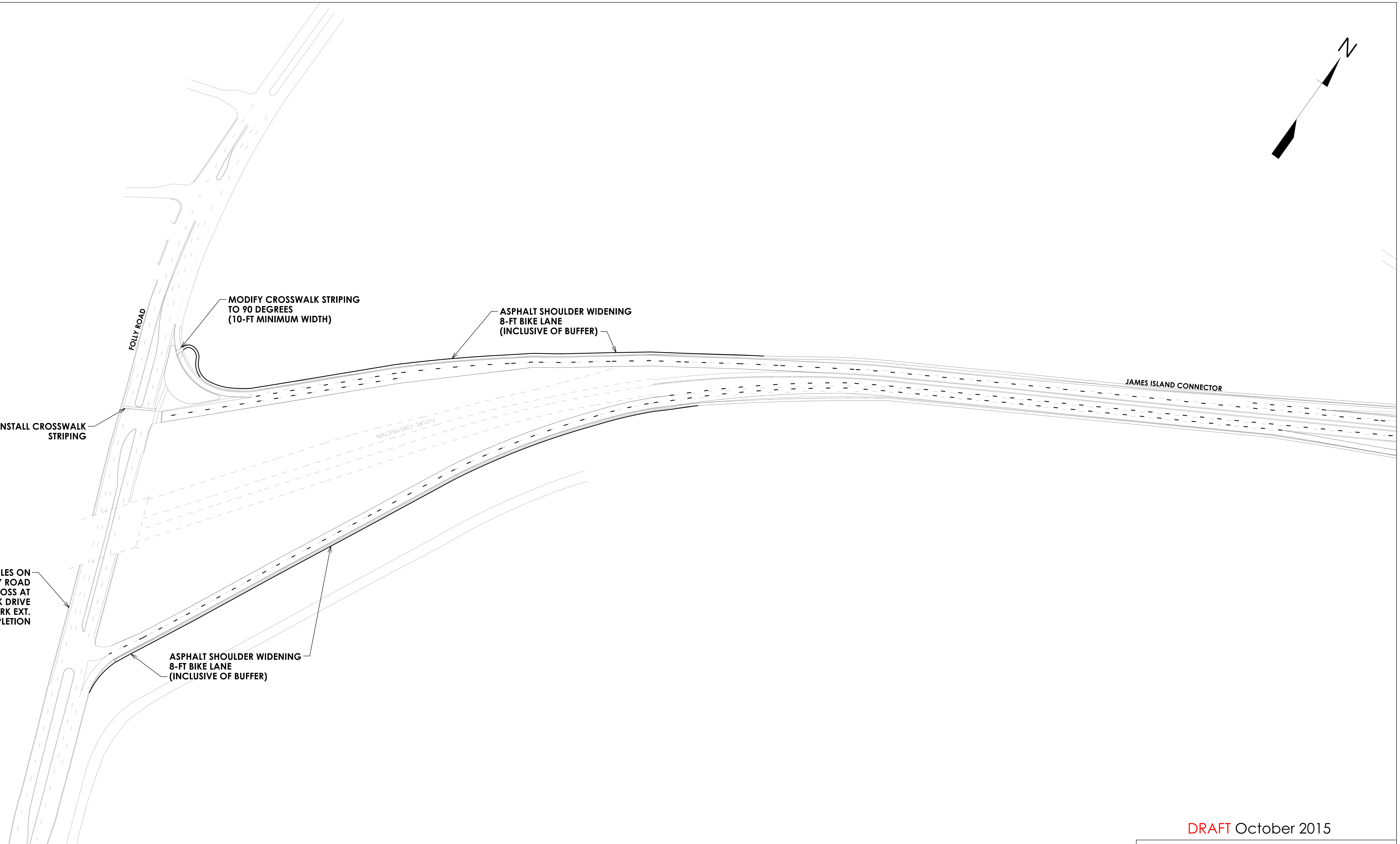
A six-foot bicycle lane is considered for implementation along the James Island Connector. To increase the outside shoulder widths to accommodate bicyclists, the inside shoulder is proposed to be reduced to four feet in width. Travel lane widths are proposed to remain at 12 feet in width. A striped buffer area will be provided where possible, which varies between two parallel white lines and a wider area with chevron markings. This buffer area will provide more recovery space for vehicles and bicycles without making the bike lane appear so wide that it might be mistaken for another travel lane. It should be noted that for the majority of the James Island Connector, the six-foot bicycle lane and adjacent buffer area will also provide adequate room for a vehicle to pull over in an emergency.

The conceptual design plan for accommodating bicyclists on the James Island Connector is illustrated in Exhibit 7.3.

7.3 DESIGN CONSTRAINT

There is one constrained location on the proposed conceptual plan. On the westbound approach to the Harbor View Road interchange, adequate width is not available to accommodate both the bicycle lane and the vehicular off-ramp lane. At this location, the width of the bicycle lane is shown to be four feet at the yield bar crossing the full-width westbound off-ramp to Harbor View Road.

A design exception may be required from SCDOT for the reduced bicycle lane width as shown in the concept plan, or alternately for a potentially reduced off-ramp lane width.



DRAFT October 2015

Stantec

SCALE IN FEET

0 100 200 400

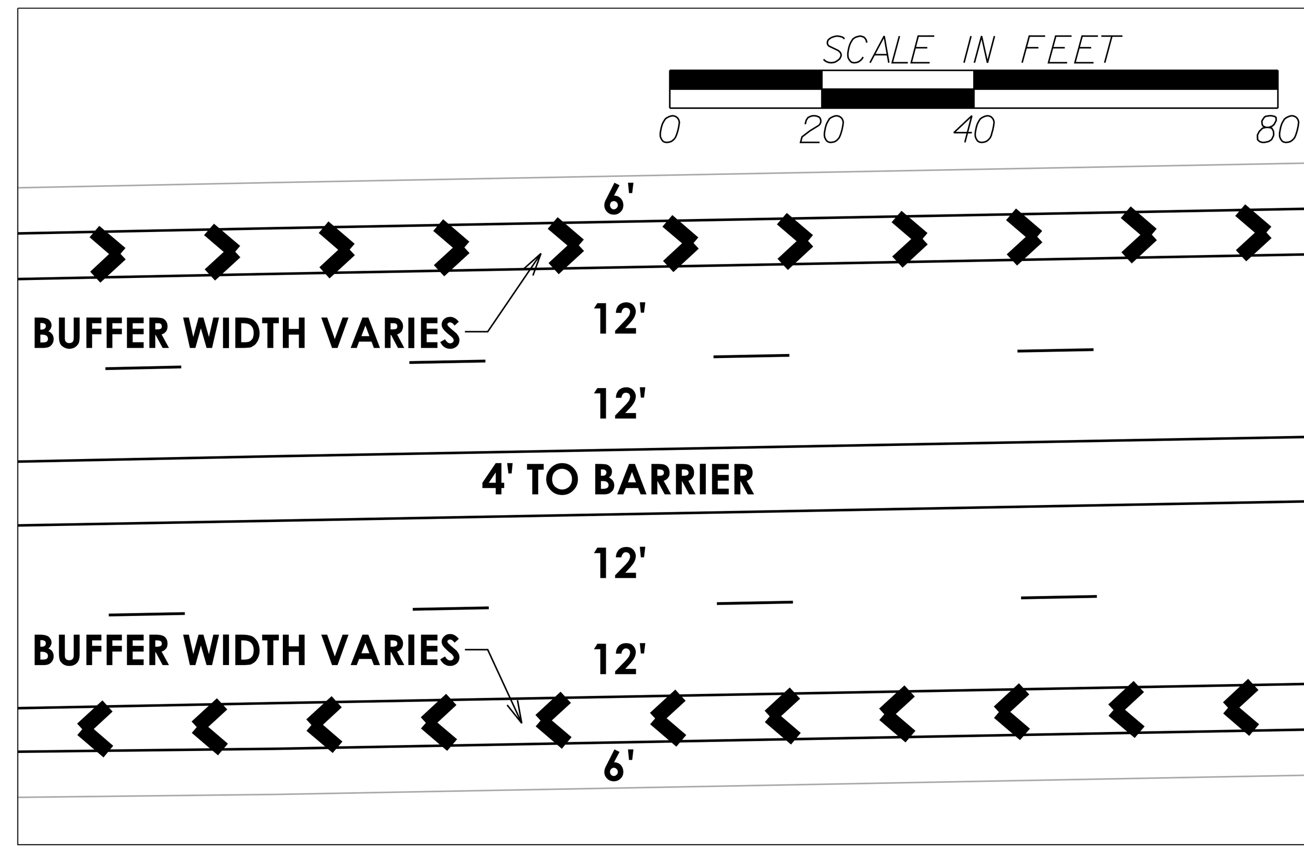
James Island Connector Concept Plan NOT FOR CONSTRUCTION	Exhibit 7.3.1

DRAFT October 2015

James Island Connector Concept Plan
NOT FOR CONSTRUCTION

Exhibit 7.3.2

TYPICAL STRAIGHTAWAY
FOR THE LENGTH OF THE
JAMES ISLAND CONNECTOR



DRAFT October 2015

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SCALE IN FEET
0 100 200 400

James Island Connector Concept Plan NOT FOR CONSTRUCTION	Exhibit 7.3.3

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SCALE IN FEET
0 100 200 400

James Island Connector Concept Plan
NOT FOR CONSTRUCTION

Exhibit 7.3.4

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James Island Connector Concept Plan
NOT FOR CONSTRUCTION

Exhibit 7.3.5

7.4 OPINION OF PROBABLE COST

Based upon the conceptual design plans, an opinion of probable cost was developed for implementation of recommendations to accommodate bicyclists on the James Island Connector considering Alternate C – Full Length Route. The opinion of probable cost is listed in Table 7.2, which includes preliminary engineering, construction engineering and inspection, and contingency. The total opinion of probable cost for the recommended improvements is $3,609,000.

It should be noted that right-of-way, utility, and wetland impacts of the recommended improvements were not evaluated in this study.

Table 7.2 – James Island Connector Concept Plan Opinion of Probable Cost

ITEM	PRICE
Mobilization, Insurance, Traffic Control	$285,000
New Pavement, Grading, Erosion Control	$113,000
Remove Existing & Apply New Pavement Markings	$245,000
Additional Signing	$20,000
16-Inch Railing Extensions	$1,665,000
CONSTRUCTION SUBTOTAL	*$2,328,000*
Preliminary Engineering (20%)	$466,000
Construction Engineering & Inspection (10%)	$233,000
Contingency (25%)	$582,000
CONCEPTUAL OPINION OF PROBABLE COST	**$3,609,000**

8.0 SUMMARY OF CONCLUSIONS & RECOMMENDATIONS

The City of Charleston peninsula and James Island are separated by the Ashley River. There are only two bridge crossings over the Ashley River connecting the two areas today: the SC 30/James Island Connector bridge and the two US 17/Savannah Highway bridges. Bicycles are currently prohibited on each of these Ashley River crossings. As bicycles continue to grow as a mode choice in the Charleston area, the need to develop safe bicycle routes has become increasingly important.

In June 2012, the South Carolina General Assembly amended the prohibition of certain vehicles on freeways to provide an exemption for bicyclists to travel on non-interstate freeways provided, in part, the City "determines that bicyclists…have no other reasonably safe or viable alternative route and the use of the freeway route is at least ten percent less than the shortest conventional alternate route". Therefore, the City of Charleston initiated a study to review the potential of allowing bicycles within the existing boundaries of the SC 30/James Island Connector. It should be noted that the design of bicycle facilities is a relatively new and emerging practice, especially considering the retrofitting of existing facilities that do not currently accommodate bicyclists. There are no accommodations that can make a bicycle facility 100% safe.

8.1 TYPES OF USERS

Populations can be separated into four groups of riders, the Strong & Fearless, the Enthused & Confident, the Interested but Concerned, and the No Way/No How.

Due to the close proximity of higher-speed vehicles to lower-speed bicyclists and the crossing of the higher-speed vehicular paths with lower-speed bicycle paths, it is expected that only the Strong & Fearless and a portion of the Enthused & Confident types of bicycle riders will be attracted to use the James Island Connector, which results in approximately less than 5% percent of people. With the potential for high winds and the steep grades on portion of the James Island Connector bridge sections, the route is not recommended for casual bicyclists.

8.2 ALTERNATIVE BICYCLE ROUTE ANALYSIS

An alternative bicycle route review was conducted to determine if bicycle travel can be legally accommodated along the James Island Connector. Currently, there is no bicycle route between the City of Charleston peninsula and James Island. Therefore, the City of Charleston can authorize bicyclists to travel along the James Island Connector. However, improvements to the James Island Connector must be implemented to accommodate bicycle travel.

Charleston County is currently conducting a feasibility study considering a dedicated bicycle lane on the northbound US 17/Savannah Highway T. Allen Legare Bridge. Therefore, an alternate bicycle route review was also conducted considering the bicycle lane on the northbound US 17/Savannah Highway T. Allen Legare Bridge as being implemented. The distance utilizing the James Island Connector is approximately 3.11 miles and the distance utilizing the SC 171/Folly Road to US 17/Savannah Highway route is approximately 3.52 miles – 13 percent longer. Therefore, the City of Charleston can authorize bicyclists to travel along the James Island Connector with the implementation of the dedicated bicycle lane on the northbound US 17/Savannah Highway T. Allen Legare Bridge. However, improvements to the James Island Connector must be implemented to accommodate bicycle travel.

8.3 JAMES ISLAND CONNECTOR ALTERNATE ANALYSIS

With the potential of accommodating bicyclists on the James Island Connector, the safety of bicycle and vehicular users is of the utmost concern. The two primary conflicts for accommodating bicyclists on limited-access facilities such as the James Island Connector are 1) the close proximity of higher-speed vehicles to lower-speed bicyclists and 2) the crossing of the higher-speed vehicular paths with lower-speed bicycle paths.

Based upon the existing conditions review, multiple site visits, state of the practice review, and the fact that there is no other viable route between the City of Charleston peninsula and James Island, several options for the James Island Connector were developed to determine the potential of accommodating bicycles along the study corridor.

The results of the evaluation indicated that Alternate C – Full Length Route is the recommended alternate for accommodating bicyclists on the James Island Connector. Alternate C would provide the most direct route and provides consistent operations at gore areas throughout the length of the James Island Connector. This increases driver expectancy, which can contribute positively to bicyclist safety.

It should be noted that an alternate consisting of removing the prohibition of bicyclists on the James Island Connector with no additional bicycle-specific accommodations was also considered. This alternate was not recommended due in part to the lack of bicycle-specific accommodations addressing the close proximity of higher-speed vehicles to lower-speed bicyclists and the crossings of higher-speed vehicular ramps by lower-speed bicycles at the ramp gore areas. These concerns are particularly magnified considering the recent crash on the James Island Connector between Harbor View Road and the Herbert Fielding Connector that resulted in a bicyclist being thrown over the side of the bridge after being struck by a van.

8.4 IMPLEMENTATION RECOMMENDATIONS

Based upon the recommended alternate, conceptual design plans for accommodating bicyclists on the James Island Connector were developed. The conceptual design plan considered a six-foot bicycle lane and a reduction of the inside shoulder to four feet in width. A striped buffer area will be provided where possible, which varies between two parallel white lines and a wider area with chevron markings. This buffer area will provide more recovery space for vehicles and bicycles without making the bike lane appear so wide that it might be mistaken for another travel lane. It should be noted that for the majority of the James Island Connector, the six-foot bicycle lane and adjacent buffer area will provide adequate room for a vehicle to pull over in an emergency. Additional recommended improvements include the following:

- **Speed Limit:** To reduce the speed differential between vehicles and bicyclists, it is recommended that the speed limit be reduced to 45 mph and that the City of Charleston commit to a vigorous speed enforcement program to enforce this reduced speed limit. This 45 mph speed limit would be consistent with the speed limit of the I-526/Mark Clark Expressway extension project and the majority of the facilities identified in the state of the practice review.

- **Railings:** It is recommended to add railing extensions to the existing outside jersey barriers of the James Island Connector bridge sections to meet the 48-inch recommendation for preventing bicyclists from falling over the railing during a crash.

- **Lighting:** It is recommended that with the potential design of improvements to accommodate bicyclists on the James Island Connector, the lighting on the bicycle level be verified to ensure that they meet the AASHTO standards, especially at the crossing areas.

- **Bicycle Signing:** It is recommended that yield signs be installed for bicyclists indicating the need to yield to vehicular traffic. Furthermore, signing is recommended to be installed at entrances to the James Island Connector warning bicyclists of the potential for high winds and steep grades on the bridge sections. Finally, it is recommended to have bicycle-level mileage and time signs at regular intervals along the James Island Connector route.

- **Vehicular Signing:** It is recommended that a W11-1 Bicycle Warning Sign with a W16-9P Ahead plaque be installed in advance of all the on- and off-ramp crossing areas. In addition, bike lane signs are also recommended to be installed a regular intervals. Advance warning beacons could also be considered for these sign assemblies.

- **Pavement Marking:** Generally, the proposed concept for the James Island Connector bicycle route will contain a striped buffer area with raised-profile thermoplastic markings delineating the right edgeline of the outside vehicular travel lane. The bicycle lane markings, including the buffer areas, shall be designed according to the guidelines listed in Chapter 3D of the *Manual on Uniform Traffic Control Devices*.

  The raised-profile thermoplastic white edgeline of the outside vehicular travel lane will provide vehicles a tactile warning that they have left the travel lane and need to correct their path away from the bicycle lane. For bicycle lane markings and areas where bicycles will potentially need to transition to use the traveled way by crossing a marking, it is recommended to use the standard white pavement markings to reduce the risk of a raised-profile marking deflecting the bicycle wheel.

- **Bicycle Lane Maintenance:** It is recommended that a regular street-sweeping program be implemented for the James Island Connector bicycle lanes so that onroad punctures, and bicyclists repairing punctures in the bicycle lane, can be minimized.

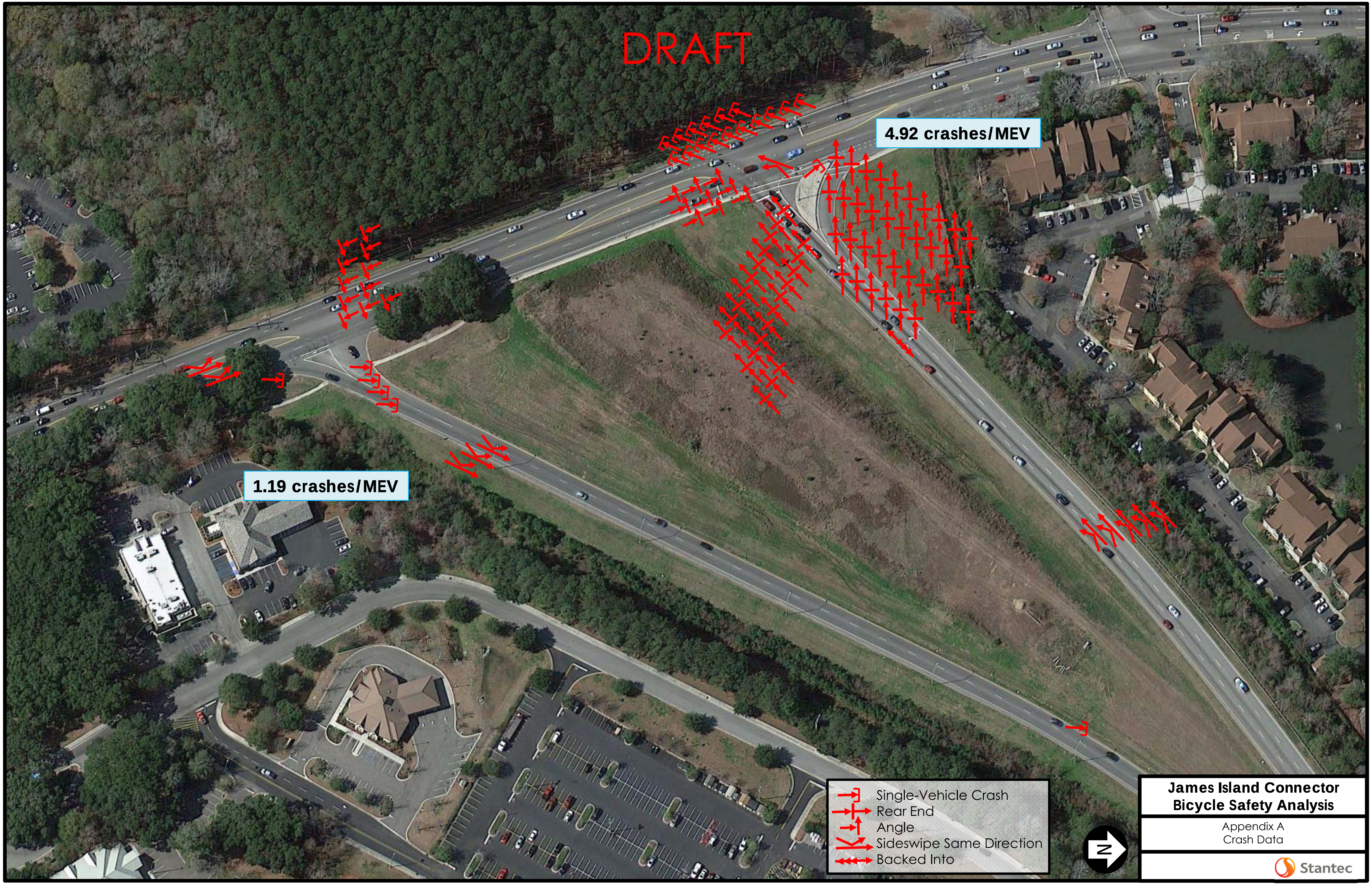
8.5 DESIGN CONSTRAINT

There is one constrained location on the proposed conceptual plan. On the westbound approach to the Harbor View Road interchange, adequate width is not available to accommodate both the bicycle lane and the vehicular off-ramp lane. At this location, the width of the bicycle lane is shown to be four feet at the yield bar crossing the full-width westbound off-ramp to Harbor View Road.

A design exception may be required from SCDOT for the reduced bicycle lane width as shown in the concept plan, or alternately for a potentially reduced off-ramp lane width.

Appendix A

CRASH DATA SUMMARY DIAGRAMS


DRAFT
4.92 crashes/MEV
1.19 crashes/MEV
Single-Vehicle Crash
Rear End
Angle
Sideswipe Same Direction
Backed Into
N
James Island Connector
Bicycle Safety Analysis
Appendix A
Crash Data
Stantec


DRAFT
0.57 crashes/MEV
0.28 crashes/MEV
Single-Vehicle Crash
Rear End
Angle
Sideswipe Same Direction
Backed Into
N
James Island Connector
Bicycle Safety Analysis
Appendix A
Crash Data
Stantec

James Island Connector Bicycle Safety Analysis

Appendix A
Crash Data

Stantec

James Island Connector
Bicycle Safety Analysis

Appendix A
Crash Data

Stantec

James Island Connector
Bicycle Safety Analysis

Appendix A
Crash Data

Stantec


DRAFT
0.45 crashes/MEV
1.19 crashes/MEV
0.37 crashes/MEV
0.76 crashes/MEV
Single-Vehicle Crash
Rear End
Angle
Sideswipe Same Direction
Backed Into
N
James Island Connector
Bicycle Safety Analysis
Appendix A
Crash Data
Stantec

Appendix B

SYNCHRO INTERSECTION ANALYSIS WORKSHEETS

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Intersection	
Int Delay, s/veh	0.8

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	0	820	1250	220	1065
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yeild	-	None
Storage Length	-	0	-	150	300	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	911	1389	244	1183

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	1992	456	0	0	911	0
Stage 1	911	-	-	-	-	-
Stage 2	1081	-	-	-	-	-
Critical Hdwy	6.84	6.94	-	-	4.14	-
Critical Hdwy Stg 1	5.84	-	-	-	-	-
Critical Hdwy Stg 2	5.84	-	-	-	-	-
Follow-up Hdwy	3.52	3.32	-	-	2.22	-
Pot Cap-1 Maneuver	53	551	-	-	743	-
Stage 1	352	-	-	-	-	-
Stage 2	287	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	36	551	-	-	743	-
Mov Cap-2 Maneuver	36	-	-	-	-	-
Stage 1	352	-	-	-	-	-
Stage 2	193	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	2.1
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	-	743	-
HCM Lane V/C Ratio	-	-	-	0.329	-
HCM Control Delay (s)	-	-	0	12.2	-
HCM Lane LOS	-	-	A	B	-
HCM 95th %tile Q(veh)	-	-	-	1.4	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	535	150	820	0	0	750
Number	7	14	6	16	5	2
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	0	0	1863
Adj Flow Rate, veh/h	594	0	911	0	0	833
Adj No. of Lanes	2	1	2	0	0	2
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	0	0	2
Cap, veh/h	753	347	2180	0	0	2180
Arrive On Green	0.22	0.00	0.62	0.00	0.00	0.62
Sat Flow, veh/h	3442	1583	3725	0	0	3725
Grp Volume(v), veh/h	594	0	911	0	0	833
Grp Sat Flow(s),veh/h/ln	1721	1583	1770	0	0	1770
Q Serve(g_s), s	11.8	0.0	9.7	0.0	0.0	8.6
Cycle Q Clear(g_c), s	11.8	0.0	9.7	0.0	0.0	8.6
Prop In Lane	1.00	1.00		0.00	0.00	
Lane Grp Cap(c), veh/h	753	347	2180	0	0	2180
V/C Ratio(X)	0.79	0.00	0.42	0.00	0.00	0.38
Avail Cap(c_a), veh/h	1468	675	2289	0	0	2289
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.00	0.00	1.00
Uniform Delay (d), s/veh	26.8	0.0	7.2	0.0	0.0	7.0
Incr Delay (d2), s/veh	1.9	0.0	0.1	0.0	0.0	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	5.8	0.0	4.7	0.0	0.0	4.2
LnGrp Delay(d),s/veh	28.7	0.0	7.3	0.0	0.0	7.1
LnGrp LOS	C		A			A
Approach Vol, veh/h	594		911			833
Approach Delay, s/veh	28.7		7.3			7.1
Approach LOS	C		A			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		50.8		21.9		50.8		
Change Period (Y+Rc), s		6.0		6.0		6.0		
Max Green Setting (Gmax), s		47.0		31.0		47.0		
Max Q Clear Time (g_c+I1), s		10.6		13.8		11.7		
Green Ext Time (p_c), s		34.1		2.1		33.1		

Intersection Summary	
HCM 2010 Ctrl Delay	12.7
HCM 2010 LOS	B

DRAFT

Intersection									
Int Delay, s/veh	1.7								

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR
Vol, veh/h	350	630	0	0	340	1230	5	0	60
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	Yeild	-	-	Yeild
Storage Length	150	-	-	-	-	250	-	-	40
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	389	700	0	0	378	1367	6	0	67

Major/Minor	Major1			Major2			Minor1		
Conflicting Flow All	378	0	0	700	0	0	1667	1856	350
Stage 1	-	-	-	-	-	-	1478	1478	-
Stage 2	-	-	-	-	-	-	189	378	-
Critical Hdwy	4.14	-	-	4.14	-	-	6.84	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	5.84	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.84	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32
Pot Cap-1 Maneuver	1177	-	-	893	-	-	87	73	646
Stage 1	-	-	-	-	-	-	176	188	-
Stage 2	-	-	-	-	-	-	824	614	-
Platoon blocked, %		-	-		-	-			
Mov Cap-1 Maneuver	1177	-	-	893	-	-	58	0	646
Mov Cap-2 Maneuver	-	-	-	-	-	-	58	0	-
Stage 1	-	-	-	-	-	-	118	0	-
Stage 2	-	-	-	-	-	-	824	0	-

Approach	EB	WB	NB
HCM Control Delay, s	3.4	0	16
HCM LOS			C

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR
Capacity (veh/h)	58	646	1177	-	-	893	-	-
HCM Lane V/C Ratio	0.096	0.103	0.33	-	-	-	-	-
HCM Control Delay (s)	73.5	11.2	9.6	-	-	0	-	-
HCM Lane LOS	F	B	A	-	-	A	-	-
HCM 95th %tile Q(veh)	0.3	0.3	1.5	-	-	0	-	-

Intersection	
Int Delay, s/veh	

Movement	SBL	SBT	SBR
Vol, veh/h	0	0	0
Conflicting Peds, #/hr	0	0	0
Sign Control	Stop	Stop	Stop
RT Channelized	-	-	None
Storage Length	-	-	-
Veh in Median Storage, #	-	0	-
Grade, %	-	0	-
Peak Hour Factor	90	90	90
Heavy Vehicles, %	2	2	2
Mvmt Flow	0	0	0

Major/Minor	
Conflicting Flow All	
Stage 1	
Stage 2	
Critical Hdwy	
Critical Hdwy Stg 1	
Critical Hdwy Stg 2	
Follow-up Hdwy	
Pot Cap-1 Maneuver	
Stage 1	
Stage 2	
Platoon blocked, %	
Mov Cap-1 Maneuver	
Mov Cap-2 Maneuver	
Stage 1	
Stage 2	

Approach	
HCM Control Delay, s	
HCM LOS	

Minor Lane/Major Mvmt

DRAFT

Intersection						
Int Delay, s/veh	4.7					

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	615	5	45	300	125	365
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	200	-	0	225
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	683	6	50	333	139	406

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	689	0	953	-
Stage 1	-	-	-	-	686	-
Stage 2	-	-	-	-	267	-
Critical Hdwy	-	-	4.14	-	6.84	-
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	-	-	2.22	-	3.52	-
Pot Cap-1 Maneuver	-	-	901	-	257	0
Stage 1	-	-	-	-	461	0
Stage 2	-	-	-	-	754	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	901	-	243	-
Mov Cap-2 Maneuver	-	-	-	-	243	-
Stage 1	-	-	-	-	461	-
Stage 2	-	-	-	-	712	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.2	37.9
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	243	-	-	-	901	-
HCM Lane V/C Ratio	0.572	-	-	-	0.055	-
HCM Control Delay (s)	37.9	0	-	-	9.2	-
HCM Lane LOS	E	A	-	-	A	-
HCM 95th %tile Q(veh)	3.2	-	-	-	0.2	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	110	5	100	25	10	15	150	830	20	10	545	45
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1863	1900	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	122	6	0	28	11	0	167	922	22	11	606	50
Adj No. of Lanes	0	1	1	0	1	1	1	2	0	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	264	8	176	215	70	176	580	2148	51	405	1814	149
Arrive On Green	0.11	0.11	0.00	0.11	0.11	0.00	0.07	0.61	0.61	0.01	0.55	0.55
Sat Flow, veh/h	1422	70	1583	1101	628	1583	1774	3533	84	1774	3311	273
Grp Volume(v), veh/h	128	0	0	39	0	0	167	462	482	11	323	333
Grp Sat Flow(s),veh/h/ln	1492	0	1583	1729	0	1583	1774	1770	1848	1774	1770	1815
Q Serve(g_s), s	4.2	0.0	0.0	0.0	0.0	0.0	2.6	9.2	9.2	0.2	6.8	6.8
Cycle Q Clear(g_c), s	5.5	0.0	0.0	1.3	0.0	0.0	2.6	9.2	9.2	0.2	6.8	6.8
Prop In Lane	0.95		1.00	0.72		1.00	1.00		0.05	1.00		0.15
Lane Grp Cap(c), veh/h	271	0	176	285	0	176	580	1076	1124	405	969	994
V/C Ratio(X)	0.47	0.00	0.00	0.14	0.00	0.00	0.29	0.43	0.43	0.03	0.33	0.33
Avail Cap(c_a), veh/h	516	0	450	546	0	450	905	1166	1217	625	969	994
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	28.7	0.0	0.0	26.9	0.0	0.0	5.8	6.9	6.9	6.7	8.4	8.4
Incr Delay (d2), s/veh	1.3	0.0	0.0	0.2	0.0	0.0	0.3	0.3	0.3	0.0	0.2	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	2.4	0.0	0.0	0.7	0.0	0.0	1.3	4.6	4.8	0.1	3.3	3.4
LnGrp Delay(d),s/veh	29.9	0.0	0.0	27.2	0.0	0.0	6.0	7.2	7.2	6.8	8.6	8.6
LnGrp LOS	C			C			A	A	A	A	A	A
Approach Vol, veh/h		128			39			1111			667	
Approach Delay, s/veh		29.9			27.2			7.0			8.5	
Approach LOS		C			C			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	10.8	42.6		13.4	6.7	46.6		13.4
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	17.0	36.0		19.0	9.0	44.0		19.0
Max Q Clear Time (g_c+I1), s	4.6	8.8		3.3	2.2	11.2		7.5
Green Ext Time (p_c), s	0.4	25.1		0.4	0.0	29.4		0.3

Intersection Summary		
HCM 2010 Ctrl Delay		9.5
HCM 2010 LOS		A

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	0	485	30	385	1310
Number			6	16	5	2
Initial Q (Qb), veh			0	0	0	0
Ped-Bike Adj(A_pbT)				1.00	1.00	
Parking Bus, Adj			1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln			1863	1900	1863	1863
Adj Flow Rate, veh/h			539	0	428	1456
Adj No. of Lanes			2	0	1	2
Peak Hour Factor			0.90	0.90	0.90	0.90
Percent Heavy Veh, %			2	2	2	2
Cap, veh/h			1996	0	490	3257
Arrive On Green			0.56	0.00	0.28	0.92
Sat Flow, veh/h			3725	0	1774	3632
Grp Volume(v), veh/h			539	0	428	1456
Grp Sat Flow(s),veh/h/ln			1770	0	1774	1770
Q Serve(g_s), s			5.9	0.0	17.3	4.2
Cycle Q Clear(g_c), s			5.9	0.0	17.3	4.2
Prop In Lane				0.00	1.00	
Lane Grp Cap(c), veh/h			1996	0	490	3257
V/C Ratio(X)			0.27	0.00	0.87	0.45
Avail Cap(c_a), veh/h			1996	0	1015	3627
HCM Platoon Ratio			1.00	1.00	1.00	1.00
Upstream Filter(I)			1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh			8.4	0.0	25.9	0.4
Incr Delay (d2), s/veh			0.1	0.0	5.0	0.1
Initial Q Delay(d3),s/veh			0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln			2.9	0.0	9.1	1.9
LnGrp Delay(d),s/veh			8.5	0.0	31.0	0.5
LnGrp LOS			A		C	A
Approach Vol, veh/h			539			1884
Approach Delay, s/veh			8.5			7.4
Approach LOS			A			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2			5	6		
Phs Duration (G+Y+Rc), s		75.1			26.8	48.4		
Change Period (Y+Rc), s		6.0			6.0	6.0		
Max Green Setting (Gmax), s		77.0			43.0	28.0		
Max Q Clear Time (g_c+I1), s		6.2			19.3	7.9		
Green Ext Time (p_c), s		62.9			1.5	19.8		

Intersection Summary	
HCM 2010 Ctrl Delay	7.7
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	500	695	30	0	480	125	5	5	0	145	10	160
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1710	1676	1710	0	1676	1710	1710	1676	1710	1710	1676	1676
Adj Flow Rate, veh/h	556	772	33	0	533	139	6	6	0	161	11	178
Adj No. of Lanes	0	2	0	0	2	0	0	1	0	0	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	0	2	2	2	2	2	2	2	2
Cap, veh/h	82	952	41	0	1642	426	71	48	0	255	12	301
Arrive On Green	0.66	0.66	0.66	0.00	0.66	0.66	0.21	0.21	0.00	0.21	0.21	0.21
Sat Flow, veh/h	3	1453	62	0	2588	650	50	226	0	839	57	1425
Grp Volume(v), veh/h	556	0	805	0	338	334	12	0	0	172	0	178
Grp Sat Flow(s),veh/h/ln	3	0	1515	0	1593	1562	276	0	0	896	0	1425
Q Serve(g_s), s	90.0	0.0	35.2	0.0	8.4	8.4	0.1	0.0	0.0	0.0	0.0	10.1
Cycle Q Clear(g_c), s	90.0	0.0	35.2	0.0	8.4	8.4	17.7	0.0	0.0	17.6	0.0	10.1
Prop In Lane	1.00		0.04	0.00		0.42	0.50		0.00	0.94		1.00
Lane Grp Cap(c), veh/h	0	0	993	0	1044	1024	118	0	0	267	0	301
V/C Ratio(X)	0.00	0.00	0.81	0.00	0.32	0.33	0.10	0.00	0.00	0.65	0.00	0.59
Avail Cap(c_a), veh/h	0	0	993	0	1044	1024	118	0	0	267	0	301
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	0.0	11.4	0.0	6.8	6.8	29.6	0.0	0.0	34.9	0.0	32.0
Incr Delay (d2), s/veh	0.0	0.0	7.2	0.0	0.8	0.8	1.7	0.0	0.0	11.4	0.0	8.3
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	0.0	16.5	0.0	3.9	3.9	0.3	0.0	0.0	5.1	0.0	4.6
LnGrp Delay(d),s/veh	0.0	0.0	18.5	0.0	7.6	7.6	31.3	0.0	0.0	46.4	0.0	40.3
LnGrp LOS			B		A	A	C			D		D
Approach Vol, veh/h		1361			672			12			350	
Approach Delay, s/veh		11.0			7.6			31.3			43.3	
Approach LOS		B			A			C			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		65.0		25.0		65.0		25.0
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		59.0		19.0		19.0		19.0
Max Q Clear Time (g_c+I1), s		92.0		19.6		10.4		19.7
Green Ext Time (p_c), s		0.0		0.0		8.5		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	14.9
HCM 2010 LOS	B

DRAFT

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	355	240	5	0	0	160	0	1025	50	145	915	0
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1863	0	1863	1863	0	1863	1900	1863	1863	0
Adj Flow Rate, veh/h	394	267	0	0	0	178	0	1139	56	161	1017	0
Adj No. of Lanes	0	1	1	0	1	2	0	2	0	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	0	2	2	0	2	2	2	2	0
Cap, veh/h	386	261	566	0	146	219	0	1086	53	146	1558	0
Arrive On Green	0.36	0.36	0.00	0.00	0.00	0.08	0.00	0.32	0.32	0.08	0.44	0.00
Sat Flow, veh/h	1078	731	1583	0	1863	2787	0	3527	169	1774	3632	0
Grp Volume(v), veh/h	661	0	0	0	0	178	0	587	608	161	1017	0
Grp Sat Flow(s),veh/h/ln	1809	0	1583	0	1863	1393	0	1770	1833	1774	1770	0
Q Serve(g_s), s	52.0	0.0	0.0	0.0	0.0	9.1	0.0	46.0	46.0	12.0	32.8	0.0
Cycle Q Clear(g_c), s	52.0	0.0	0.0	0.0	0.0	9.1	0.0	46.0	46.0	12.0	32.8	0.0
Prop In Lane	0.60		1.00	0.00		1.00	0.00		0.09	1.00		0.00
Lane Grp Cap(c), veh/h	647	0	566	0	146	219	0	560	580	146	1558	0
V/C Ratio(X)	1.02	0.00	0.00	0.00	0.00	0.81	0.00	1.05	1.05	1.10	0.65	0.00
Avail Cap(c_a), veh/h	647	0	566	0	205	307	0	560	580	146	1558	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	46.7	0.0	0.0	0.0	0.0	66.0	0.0	49.7	49.7	66.7	32.0	0.0
Incr Delay (d2), s/veh	41.0	0.0	0.0	0.0	0.0	10.9	0.0	51.2	50.8	103.6	1.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	33.2	0.0	0.0	0.0	0.0	3.9	0.0	30.4	31.4	10.1	16.2	0.0
LnGrp Delay(d),s/veh	87.7	0.0	0.0	0.0	0.0	76.9	0.0	100.9	100.5	170.3	33.0	0.0
LnGrp LOS	F					E		F	F	F	C	
Approach Vol, veh/h		661			178			1195			1178	
Approach Delay, s/veh		87.7			76.9			100.7			51.7	
Approach LOS		F			E			F			D	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		8
Phs Duration (G+Y+Rc), s		70.0		17.4	18.0	52.0		58.0
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s		64.0		16.0	12.0	46.0		52.0
Max Q Clear Time (g_c+I1), s		34.8		11.1	14.0	48.0		54.0
Green Ext Time (p_c), s		28.8		0.3	0.0	0.0		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	78.8
HCM 2010 LOS	E

Intersection	
Int Delay, s/veh	0.6

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	0	865	760	180	1880
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yeild	-	None
Storage Length	-	0	-	150	300	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	961	844	200	2089

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	2405	481	0	0	961	0
Stage 1	961	-	-	-	-	-
Stage 2	1444	-	-	-	-	-
Critical Hdwy	6.84	6.94	-	-	4.14	-
Critical Hdwy Stg 1	5.84	-	-	-	-	-
Critical Hdwy Stg 2	5.84	-	-	-	-	-
Follow-up Hdwy	3.52	3.32	-	-	2.22	-
Pot Cap-1 Maneuver	28	531	-	-	712	-
Stage 1	332	-	-	-	-	-
Stage 2	183	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	20	531	-	-	712	-
Mov Cap-2 Maneuver	20	-	-	-	-	-
Stage 1	332	-	-	-	-	-
Stage 2	132	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	1.1
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	-	712	-
HCM Lane V/C Ratio	-	-	-	0.281	-
HCM Control Delay (s)	-	-	0	12	-
HCM Lane LOS	-	-	A	B	-
HCM 95th %tile Q(veh)	-	-	-	1.2	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	845	190	865	0	0	1215
Number	7	14	6	16	5	2
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	0	0	1863
Adj Flow Rate, veh/h	939	0	961	0	0	1350
Adj No. of Lanes	2	1	2	0	0	2
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	0	0	2
Cap, veh/h	1066	490	1945	0	0	1945
Arrive On Green	0.31	0.00	0.55	0.00	0.00	0.55
Sat Flow, veh/h	3442	1583	3725	0	0	3725
Grp Volume(v), veh/h	939	0	961	0	0	1350
Grp Sat Flow(s),veh/h/ln	1721	1583	1770	0	0	1770
Q Serve(g_s), s	22.1	0.0	14.3	0.0	0.0	23.7
Cycle Q Clear(g_c), s	22.1	0.0	14.3	0.0	0.0	23.7
Prop In Lane	1.00	1.00		0.00	0.00	
Lane Grp Cap(c), veh/h	1066	490	1945	0	0	1945
V/C Ratio(X)	0.88	0.00	0.49	0.00	0.00	0.69
Avail Cap(c_a), veh/h	1252	576	1952	0	0	1952
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.00	0.00	1.00
Uniform Delay (d), s/veh	27.9	0.0	11.9	0.0	0.0	14.0
Incr Delay (d2), s/veh	6.8	0.0	0.2	0.0	0.0	1.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	11.4	0.0	7.0	0.0	0.0	11.7
LnGrp Delay(d),s/veh	34.7	0.0	12.1	0.0	0.0	15.1
LnGrp LOS	C		B			B
Approach Vol, veh/h	939		961			1350
Approach Delay, s/veh	34.7		12.1			15.1
Approach LOS	C		B			B

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		52.8		32.4		52.8		
Change Period (Y+Rc), s		6.0		6.0		6.0		
Max Green Setting (Gmax), s		47.0		31.0		47.0		
Max Q Clear Time (g_c+I1), s		25.7		24.1		16.3		
Green Ext Time (p_c), s		21.1		2.3		30.3		

Intersection Summary	
HCM 2010 Ctrl Delay	19.8
HCM 2010 LOS	B

Intersection	
Int Delay, s/veh	2.2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR
Vol, veh/h	225	675	0	0	340	500	10	0	130
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	Yeild	-	-	Yeild
Storage Length	150	-	-	-	-	250	-	-	40
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	250	750	0	0	378	556	11	0	144

Major/Minor	Major1			Major2			Minor1		
Conflicting Flow All	378	0	0	750	0	0	1439	1628	375
Stage 1	-	-	-	-	-	-	1250	1250	-
Stage 2	-	-	-	-	-	-	189	378	-
Critical Hdwy	4.14	-	-	4.14	-	-	6.84	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	5.84	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.84	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32
Pot Cap-1 Maneuver	1177	-	-	855	-	-	124	101	623
Stage 1	-	-	-	-	-	-	233	243	-
Stage 2	-	-	-	-	-	-	824	614	-
Platoon blocked, %		-	-		-	-			
Mov Cap-1 Maneuver	1177	-	-	855	-	-	98	0	623
Mov Cap-2 Maneuver	-	-	-	-	-	-	98	0	-
Stage 1	-	-	-	-	-	-	184	0	-
Stage 2	-	-	-	-	-	-	824	0	-

Approach	EB	WB	NB
HCM Control Delay, s	2.2	0	14.9
HCM LOS			B

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR
Capacity (veh/h)	98	623	1177	-	-	855	-	-
HCM Lane V/C Ratio	0.113	0.232	0.212	-	-	-	-	-
HCM Control Delay (s)	46.4	12.5	8.9	-	-	0	-	-
HCM Lane LOS	E	B	A	-	-	A	-	-
HCM 95th %tile Q(veh)	0.4	0.9	0.8	-	-	0	-	-

Intersection
Int Delay, s/veh

Movement	SBL	SBT	SBR
Vol, veh/h	0	0	0
Conflicting Peds, #/hr	0	0	0
Sign Control	Stop	Stop	Stop
RT Channelized	-	-	None
Storage Length	-	-	-
Veh in Median Storage, #	-	0	-
Grade, %	-	0	-
Peak Hour Factor	90	90	90
Heavy Vehicles, %	2	2	2
Mvmt Flow	0	0	0

Major/Minor
Conflicting Flow All
Stage 1
Stage 2
Critical Hdwy
Critical Hdwy Stg 1
Critical Hdwy Stg 2
Follow-up Hdwy
Pot Cap-1 Maneuver
Stage 1
Stage 2
Platoon blocked, %
Mov Cap-1 Maneuver
Mov Cap-2 Maneuver
Stage 1
Stage 2

Approach
HCM Control Delay, s
HCM LOS

Minor Lane/Major Mvmt

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Intersection	
Int Delay, s/veh	7.3

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	560	5	55	295	160	340
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	200	-	0	225
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	622	6	61	328	178	378

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	628	0	911	-
Stage 1	-	-	-	-	625	-
Stage 2	-	-	-	-	286	-
Critical Hdwy	-	-	4.14	-	6.84	-
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	-	-	2.22	-	3.52	-
Pot Cap-1 Maneuver	-	-	950	-	274	0
Stage 1	-	-	-	-	496	0
Stage 2	-	-	-	-	737	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	950	-	256	-
Mov Cap-2 Maneuver	-	-	-	-	256	-
Stage 1	-	-	-	-	496	-
Stage 2	-	-	-	-	690	-

Approach	EB	WB	NB
HCM Control Delay, s	0	1.4	45.8
HCM LOS			E

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	256	-	-	-	950	-
HCM Lane V/C Ratio	0.694	-	-	-	0.064	-
HCM Control Delay (s)	45.8	0	-	-	9.1	-
HCM Lane LOS	E	A	-	-	A	-
HCM 95th %tile Q(veh)	4.6	-	-	-	0.2	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	15	15	35	35	10	40	30	555	60	30	430	10
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1863	1900	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	17	17	0	39	11	0	33	617	67	33	478	11
Adj No. of Lanes	0	1	1	0	1	1	1	2	0	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	138	46	82	176	18	82	668	1952	212	563	2143	49
Arrive On Green	0.05	0.05	0.00	0.05	0.05	0.00	0.03	0.61	0.61	0.03	0.61	0.61
Sat Flow, veh/h	844	900	1583	1253	353	1583	1774	3221	349	1774	3537	81
Grp Volume(v), veh/h	34	0	0	50	0	0	33	338	346	33	239	250
Grp Sat Flow(s),veh/h/ln	1744	0	1583	1606	0	1583	1774	1770	1801	1774	1770	1848
Q Serve(g_s), s	0.0	0.0	0.0	0.6	0.0	0.0	0.4	5.3	5.4	0.4	3.5	3.5
Cycle Q Clear(g_c), s	1.0	0.0	0.0	1.6	0.0	0.0	0.4	5.3	5.4	0.4	3.5	3.5
Prop In Lane	0.50		1.00	0.78		1.00	1.00		0.19	1.00		0.04
Lane Grp Cap(c), veh/h	184	0	82	195	0	82	668	1072	1091	563	1072	1120
V/C Ratio(X)	0.18	0.00	0.00	0.26	0.00	0.00	0.05	0.32	0.32	0.06	0.22	0.22
Avail Cap(c_a), veh/h	631	0	525	607	0	525	1144	1359	1383	791	1112	1161
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	26.3	0.0	0.0	26.5	0.0	0.0	4.0	5.5	5.5	4.2	5.1	5.1
Incr Delay (d2), s/veh	0.5	0.0	0.0	0.7	0.0	0.0	0.0	0.2	0.2	0.0	0.1	0.1
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.5	0.0	0.0	0.8	0.0	0.0	0.2	2.6	2.6	0.2	1.7	1.8
LnGrp Delay(d),s/veh	26.7	0.0	0.0	27.2	0.0	0.0	4.0	5.7	5.7	4.2	5.2	5.2
LnGrp LOS	C			C			A	A	A	A	A	A
Approach Vol, veh/h		34			50			717			522	
Approach Delay, s/veh		26.7			27.2			5.6			5.2	
Approach LOS		C			C			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	7.6	40.7		8.9	7.6	40.7		8.9
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	17.0	36.0		19.0	9.0	44.0		19.0
Max Q Clear Time (g_c+I1), s	2.4	5.5		3.6	2.4	7.4		3.0
Green Ext Time (p_c), s	0.0	23.6		0.2	0.0	27.4		0.2

Intersection Summary	
HCM 2010 Ctrl Delay	6.8
HCM 2010 LOS	A

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	0	825	30	205	670
Number			6	16	5	2
Initial Q (Qb), veh			0	0	0	0
Ped-Bike Adj(A_pbT)				1.00	1.00	
Parking Bus, Adj			1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln			1863	1900	1863	1863
Adj Flow Rate, veh/h			917	0	228	744
Adj No. of Lanes			2	0	1	2
Peak Hour Factor			0.90	0.90	0.90	0.90
Percent Heavy Veh, %			2	2	2	2
Cap, veh/h			2400	0	282	3251
Arrive On Green			0.68	0.00	0.16	0.92
Sat Flow, veh/h			3725	0	1774	3632
Grp Volume(v), veh/h			917	0	228	744
Grp Sat Flow(s),veh/h/ln			1770	0	1774	1770
Q Serve(g_s), s			8.3	0.0	9.1	1.6
Cycle Q Clear(g_c), s			8.3	0.0	9.1	1.6
Prop In Lane				0.00	1.00	
Lane Grp Cap(c), veh/h			2400	0	282	3251
V/C Ratio(X)			0.38	0.00	0.81	0.23
Avail Cap(c_a), veh/h			2400	0	795	4039
HCM Platoon Ratio			1.00	1.00	1.00	1.00
Upstream Filter(I)			1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh			5.1	0.0	29.9	0.3
Incr Delay (d2), s/veh			0.1	0.0	5.5	0.0
Initial Q Delay(d3),s/veh			0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln			4.0	0.0	4.9	0.7
LnGrp Delay(d),s/veh			5.2	0.0	35.4	0.3
LnGrp LOS			A		D	A
Approach Vol, veh/h			917			972
Approach Delay, s/veh			5.2			8.6
Approach LOS			A			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2			5	6		
Phs Duration (G+Y+Rc), s		73.6			17.7	55.9		
Change Period (Y+Rc), s		6.0			6.0	6.0		
Max Green Setting (Gmax), s		84.0			33.0	45.0		
Max Q Clear Time (g_c+I1), s		3.6			11.1	10.3		
Green Ext Time (p_c), s		64.0			0.7	32.5		

Intersection Summary	
HCM 2010 Ctrl Delay	7.0
HCM 2010 LOS	A

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	215	575	10	0	815	135	5	5	5	165	5	260
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1710	1676	1710	0	1676	1710	1710	1676	1710	1710	1676	1676
Adj Flow Rate, veh/h	239	639	11	0	906	150	6	6	6	183	6	289
Adj No. of Lanes	0	2	0	0	2	0	0	1	0	0	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	0	2	2	2	2	2	2	2	2
Cap, veh/h	82	964	17	0	1763	292	53	46	23	204	4	317
Arrive On Green	0.64	0.64	0.64	0.00	0.64	0.64	0.22	0.22	0.22	0.22	0.22	0.22
Sat Flow, veh/h	3	1496	26	0	2820	453	0	207	104	562	18	1425
Grp Volume(v), veh/h	239	0	650	0	527	529	18	0	0	189	0	289
Grp Sat Flow(s),veh/h/ln	3	0	1521	0	1593	1597	311	0	0	581	0	1425
Q Serve(g_s), s	52.6	0.0	23.9	0.0	15.8	15.8	0.0	0.0	0.0	0.0	0.0	17.8
Cycle Q Clear(g_c), s	52.6	0.0	23.9	0.0	15.8	15.8	20.0	0.0	0.0	20.0	0.0	17.8
Prop In Lane	1.00		0.02	0.00		0.28	0.33		0.33	0.97		1.00
Lane Grp Cap(c), veh/h	0	0	980	0	1026	1029	122	0	0	208	0	317
V/C Ratio(X)	0.00	0.00	0.66	0.00	0.51	0.51	0.15	0.00	0.00	0.91	0.00	0.91
Avail Cap(c_a), veh/h	0	0	980	0	1026	1029	122	0	0	208	0	317
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	0.0	9.9	0.0	8.5	8.5	29.0	0.0	0.0	38.2	0.0	34.1
Incr Delay (d2), s/veh	0.0	0.0	3.5	0.0	1.8	1.8	2.5	0.0	0.0	42.6	0.0	32.5
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	0.0	10.9	0.0	7.4	7.4	0.4	0.0	0.0	7.1	0.0	9.8
LnGrp Delay(d),s/veh	0.0	0.0	13.5	0.0	10.3	10.3	31.5	0.0	0.0	80.7	0.0	66.7
LnGrp LOS			B		B	B	C			F		E
Approach Vol, veh/h		889			1056			18			478	
Approach Delay, s/veh		9.8			10.3			31.5			72.2	
Approach LOS		A			B			C			E	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		64.0		26.0		64.0		26.0
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		58.0		20.0		45.0		20.0
Max Q Clear Time (g_c+I1), s		54.6		22.0		17.8		22.0
Green Ext Time (p_c), s		3.4		0.0		26.7		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	22.4
HCM 2010 LOS	C

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	135	170	5	0	0	295	0	1190	50	115	865	0
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1863	0	1863	1863	0	1863	1900	1863	1863	0
Adj Flow Rate, veh/h	150	189	0	0	0	328	0	1322	56	128	961	0
Adj No. of Lanes	0	1	1	0	1	2	0	2	0	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	0	2	2	0	2	2	2	2	0
Cap, veh/h	167	210	327	0	244	365	0	1313	56	154	1823	0
Arrive On Green	0.21	0.21	0.00	0.00	0.00	0.13	0.00	0.38	0.38	0.09	0.52	0.00
Sat Flow, veh/h	806	1016	1583	0	1863	2787	0	3553	146	1774	3632	0
Grp Volume(v), veh/h	339	0	0	0	0	328	0	675	703	128	961	0
Grp Sat Flow(s),veh/h/ln	1822	0	1583	0	1863	1393	0	1770	1837	1774	1770	0
Q Serve(g_s), s	22.2	0.0	0.0	0.0	0.0	14.2	0.0	46.4	46.4	8.7	22.1	0.0
Cycle Q Clear(g_c), s	22.2	0.0	0.0	0.0	0.0	14.2	0.0	46.4	46.4	8.7	22.1	0.0
Prop In Lane	0.44		1.00	0.00		1.00	0.00		0.08	1.00		0.00
Lane Grp Cap(c), veh/h	377	0	327	0	244	365	0	672	697	154	1823	0
V/C Ratio(X)	0.90	0.00	0.00	0.00	0.00	0.90	0.00	1.01	1.01	0.83	0.53	0.00
Avail Cap(c_a), veh/h	775	0	674	0	244	365	0	672	697	174	1853	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	47.3	0.0	0.0	0.0	0.0	52.3	0.0	37.9	37.9	55.0	19.7	0.0
Incr Delay (d2), s/veh	7.9	0.0	0.0	0.0	0.0	24.2	0.0	36.1	36.0	25.5	0.3	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	11.9	0.0	0.0	0.0	0.0	6.7	0.0	29.3	30.4	5.4	10.9	0.0
LnGrp Delay(d),s/veh	55.2	0.0	0.0	0.0	0.0	76.5	0.0	74.0	74.0	80.5	20.0	0.0
LnGrp LOS	E					E		F	F	F	B	
Approach Vol, veh/h		339			328			1378			1089	
Approach Delay, s/veh		55.2			76.5			74.0			27.1	
Approach LOS		E			E			E			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		8
Phs Duration (G+Y+Rc), s		69.0		22.0	16.6	52.4		31.3
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s		64.0		16.0	12.0	46.0		52.0
Max Q Clear Time (g_c+I1), s		24.1		16.2	10.7	48.4		24.2
Green Ext Time (p_c), s		38.9		0.0	0.0	0.0		1.1

Intersection Summary	
HCM 2010 Ctrl Delay	55.9
HCM 2010 LOS	E

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Intersection						
Int Delay, s/veh	0.4					

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Vol, veh/h	0	0	775	845	145	2115
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Stop	Stop	Free	Free	Free	Free
RT Channelized	-	None	-	Yeild	-	None
Storage Length	-	0	-	150	300	-
Veh in Median Storage, #	0	-	0	-	-	0
Grade, %	0	-	0	-	-	0
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	861	939	161	2350

Major/Minor	Minor1		Major1		Major2	
Conflicting Flow All	2358	431	0	0	861	0
Stage 1	861	-	-	-	-	-
Stage 2	1497	-	-	-	-	-
Critical Hdwy	6.84	6.94	-	-	4.14	-
Critical Hdwy Stg 1	5.84	-	-	-	-	-
Critical Hdwy Stg 2	5.84	-	-	-	-	-
Follow-up Hdwy	3.52	3.32	-	-	2.22	-
Pot Cap-1 Maneuver	30	573	-	-	776	-
Stage 1	374	-	-	-	-	-
Stage 2	172	-	-	-	-	-
Platoon blocked, %			-	-		-
Mov Cap-1 Maneuver	24	573	-	-	776	-
Mov Cap-2 Maneuver	24	-	-	-	-	-
Stage 1	374	-	-	-	-	-
Stage 2	136	-	-	-	-	-

Approach	WB	NB	SB
HCM Control Delay, s	0	0	0.7
HCM LOS	A		

Minor Lane/Major Mvmt	NBT	NBR	WBLn1	SBL	SBT
Capacity (veh/h)	-	-	-	776	-
HCM Lane V/C Ratio	-	-	-	0.208	-
HCM Control Delay (s)	-	-	0	10.9	-
HCM Lane LOS	-	-	A	B	-
HCM 95th %tile Q(veh)	-	-	-	0.8	-

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	770	540	775	0	0	1490
Number	7	14	6	16	5	2
Initial Q (Qb), veh	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00	1.00		1.00	1.00	
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1863	1863	1863	0	0	1863
Adj Flow Rate, veh/h	856	0	861	0	0	1656
Adj No. of Lanes	2	1	2	0	0	2
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	0	0	2
Cap, veh/h	1017	468	1959	0	0	1959
Arrive On Green	0.30	0.00	0.55	0.00	0.00	0.55
Sat Flow, veh/h	3442	1583	3725	0	0	3725
Grp Volume(v), veh/h	856	0	861	0	0	1656
Grp Sat Flow(s),veh/h/ln	1721	1583	1770	0	0	1770
Q Serve(g_s), s	18.5	0.0	11.4	0.0	0.0	31.2
Cycle Q Clear(g_c), s	18.5	0.0	11.4	0.0	0.0	31.2
Prop In Lane	1.00	1.00		0.00	0.00	
Lane Grp Cap(c), veh/h	1017	468	1959	0	0	1959
V/C Ratio(X)	0.84	0.00	0.44	0.00	0.00	0.85
Avail Cap(c_a), veh/h	1473	678	1960	0	0	1960
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.00	0.00	1.00
Uniform Delay (d), s/veh	26.2	0.0	10.5	0.0	0.0	14.9
Incr Delay (d2), s/veh	3.1	0.0	0.2	0.0	0.0	3.6
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	9.2	0.0	5.5	0.0	0.0	15.9
LnGrp Delay(d),s/veh	29.3	0.0	10.6	0.0	0.0	18.5
LnGrp LOS	C		B			B
Approach Vol, veh/h	856		861			1656
Approach Delay, s/veh	29.3		10.6			18.5
Approach LOS	C		B			B

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		
Phs Duration (G+Y+Rc), s		50.0		29.5		50.0		
Change Period (Y+Rc), s		6.0		6.0		6.0		
Max Green Setting (Gmax), s		44.0		34.0		44.0		
Max Q Clear Time (g_c+I1), s		33.2		20.5		13.4		
Green Ext Time (p_c), s		10.8		2.9		30.4		

Intersection Summary	
HCM 2010 Ctrl Delay	19.2
HCM 2010 LOS	B

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Intersection	
Int Delay, s/veh	2

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR
Vol, veh/h	200	1590	0	0	285	470	5	0	100
Conflicting Peds, #/hr	0	0	0	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Free	Free	Stop	Stop	Stop
RT Channelized	-	-	None	-	-	Yeild	-	-	Yeild
Storage Length	150	-	-	-	-	250	-	-	40
Veh in Median Storage, #	-	0	-	-	0	-	-	0	-
Grade, %	-	0	-	-	0	-	-	0	-
Peak Hour Factor	90	90	90	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2	2	2	2
Mvmt Flow	222	1767	0	0	317	522	6	0	111

Major/Minor	Major1			Major2			Minor1		
Conflicting Flow All	317	0	0	1767	0	0	2369	2528	883
Stage 1	-	-	-	-	-	-	2211	2211	-
Stage 2	-	-	-	-	-	-	158	317	-
Critical Hdwy	4.14	-	-	4.14	-	-	6.84	6.54	6.94
Critical Hdwy Stg 1	-	-	-	-	-	-	5.84	5.54	-
Critical Hdwy Stg 2	-	-	-	-	-	-	5.84	5.54	-
Follow-up Hdwy	2.22	-	-	2.22	-	-	3.52	4.02	3.32
Pot Cap-1 Maneuver	1240	-	-	349	-	-	29	27	289
Stage 1	-	-	-	-	-	-	69	80	-
Stage 2	-	-	-	-	-	-	854	653	-
Platoon blocked, %		-	-		-	-			
Mov Cap-1 Maneuver	1240	-	-	349	-	-	24	0	289
Mov Cap-2 Maneuver	-	-	-	-	-	-	24	0	-
Stage 1	-	-	-	-	-	-	57	0	-
Stage 2	-	-	-	-	-	-	854	0	-

Approach	EB	WB	NB
HCM Control Delay, s	1	0	33.1
HCM LOS			D

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBL	EBT	EBR	WBL	WBT	WBR
Capacity (veh/h)	24	289	1240	-	-	349	-	-
HCM Lane V/C Ratio	0.231	0.384	0.179	-	-	-	-	-
HCM Control Delay (s)	195.5	25	8.5	-	-	0	-	-
HCM Lane LOS	F	D	A	-	-	A	-	-
HCM 95th %tile Q(veh)	0.7	1.7	0.7	-	-	0	-	-

Intersection
Int Delay, s/veh

Movement	SBL	SBT	SBR
Vol, veh/h	0	0	0
Conflicting Peds, #/hr	0	0	0
Sign Control	Stop	Stop	Stop
RT Channelized	-	-	None
Storage Length	-	-	-
Veh in Median Storage, #	-	0	-
Grade, %	-	0	-
Peak Hour Factor	90	90	90
Heavy Vehicles, %	2	2	2
Mvmt Flow	0	0	0

Major/Minor
Conflicting Flow All
Stage 1
Stage 2
Critical Hdwy
Critical Hdwy Stg 1
Critical Hdwy Stg 2
Follow-up Hdwy
Pot Cap-1 Maneuver
Stage 1
Stage 2
Platoon blocked, %
Mov Cap-1 Maneuver
Mov Cap-2 Maneuver
Stage 1
Stage 2

Approach
HCM Control Delay, s
HCM LOS

Minor Lane/Major Mvmt

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Intersection	
Int Delay, s/veh	10.9

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Vol, veh/h	745	5	5	285	185	1045
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	None	-	Free
Storage Length	-	-	200	-	0	225
Veh in Median Storage, #	0	-	-	0	0	-
Grade, %	0	-	-	0	0	-
Peak Hour Factor	90	90	90	90	90	90
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	828	6	6	317	206	1161

Major/Minor	Major1		Major2		Minor1	
Conflicting Flow All	0	0	833	0	1000	-
Stage 1	-	-	-	-	831	-
Stage 2	-	-	-	-	169	-
Critical Hdwy	-	-	4.14	-	6.84	-
Critical Hdwy Stg 1	-	-	-	-	5.84	-
Critical Hdwy Stg 2	-	-	-	-	5.84	-
Follow-up Hdwy	-	-	2.22	-	3.52	-
Pot Cap-1 Maneuver	-	-	796	-	240	0
Stage 1	-	-	-	-	388	0
Stage 2	-	-	-	-	843	0
Platoon blocked, %	-	-		-		
Mov Cap-1 Maneuver	-	-	796	-	238	-
Mov Cap-2 Maneuver	-	-	-	-	238	-
Stage 1	-	-	-	-	388	-
Stage 2	-	-	-	-	837	-

Approach	EB	WB	NB
HCM Control Delay, s	0	0.2	72
HCM LOS			F

Minor Lane/Major Mvmt	NBLn1	NBLn2	EBT	EBR	WBL	WBT
Capacity (veh/h)	238	-	-	-	796	-
HCM Lane V/C Ratio	0.864	-	-	-	0.007	-
HCM Control Delay (s)	72	0	-	-	9.6	-
HCM Lane LOS	F	A	-	-	A	-
HCM 95th %tile Q(veh)	7	-	-	-	0	-

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	15	15	55	35	15	40	80	880	55	55	655	35
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1863	1900	1863	1863	1863	1863	1900	1863	1863	1900
Adj Flow Rate, veh/h	17	17	0	39	17	0	89	978	61	61	728	39
Adj No. of Lanes	0	1	1	0	1	1	1	2	0	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	2	2	2	2	2	2	2	2	2
Cap, veh/h	118	52	82	147	26	82	568	2197	137	448	2193	117
Arrive On Green	0.05	0.05	0.00	0.05	0.05	0.00	0.05	0.65	0.65	0.04	0.64	0.64
Sat Flow, veh/h	769	991	1583	1133	494	1583	1774	3384	211	1774	3417	183
Grp Volume(v), veh/h	34	0	0	56	0	0	89	511	528	61	377	390
Grp Sat Flow(s),veh/h/ln	1760	0	1583	1627	0	1583	1774	1770	1825	1774	1770	1830
Q Serve(g_s), s	0.0	0.0	0.0	1.0	0.0	0.0	1.1	9.9	9.9	0.8	6.7	6.7
Cycle Q Clear(g_c), s	1.2	0.0	0.0	2.2	0.0	0.0	1.1	9.9	9.9	0.8	6.7	6.7
Prop In Lane	0.50		1.00	0.70		1.00	1.00		0.12	1.00		0.10
Lane Grp Cap(c), veh/h	169	0	82	172	0	82	568	1149	1185	448	1136	1175
V/C Ratio(X)	0.20	0.00	0.00	0.32	0.00	0.00	0.16	0.45	0.45	0.14	0.33	0.33
Avail Cap(c_a), veh/h	453	0	364	441	0	364	714	1196	1234	607	1196	1237
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	1.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00
Uniform Delay (d), s/veh	31.8	0.0	0.0	32.3	0.0	0.0	3.9	6.0	6.0	4.4	5.7	5.7
Incr Delay (d2), s/veh	0.6	0.0	0.0	1.1	0.0	0.0	0.1	0.3	0.3	0.1	0.2	0.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.7	0.0	0.0	1.1	0.0	0.0	0.6	4.8	4.9	0.4	3.3	3.4
LnGrp Delay(d),s/veh	32.4	0.0	0.0	33.3	0.0	0.0	4.0	6.3	6.3	4.5	5.8	5.8
LnGrp LOS	C			C			A	A	A	A	A	A
Approach Vol, veh/h		34			56			1128			828	
Approach Delay, s/veh		32.4			33.3			6.1			5.7	
Approach LOS		C			C			A			A	

Timer	1	2	3	4	5	6	7	8
Assigned Phs	1	2		4	5	6		8
Phs Duration (G+Y+Rc), s	9.3	50.6		9.6	8.8	51.1		9.6
Change Period (Y+Rc), s	6.0	6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s	9.0	47.0		16.0	9.0	47.0		16.0
Max Q Clear Time (g_c+I1), s	3.1	8.7		4.2	2.8	11.9		3.2
Green Ext Time (p_c), s	0.1	35.9		0.1	0.0	33.1		0.2

Intersection Summary	
HCM 2010 Ctrl Delay	7.1
HCM 2010 LOS	A

HCM 2010 Signalized Intersection Summary — 2013 Existing (PM Peak Hour)
6: Lockwood Dr & Calhoun St

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	0	1100	30	220	720
Number			6	16	5	2
Initial Q (Qb), veh			0	0	0	0
Ped-Bike Adj(A_pbT)				1.00	1.00	
Parking Bus, Adj			1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln			1863	1900	1863	1863
Adj Flow Rate, veh/h			1222	0	244	800
Adj No. of Lanes			2	0	1	2
Peak Hour Factor			0.90	0.90	0.90	0.90
Percent Heavy Veh, %			2	2	2	2
Cap, veh/h			2432	0	296	3281
Arrive On Green			0.69	0.00	0.17	0.93
Sat Flow, veh/h			3725	0	1774	3632
Grp Volume(v), veh/h			1222	0	244	800
Grp Sat Flow(s),veh/h/ln			1770	0	1774	1770
Q Serve(g_s), s			13.6	0.0	10.9	1.8
Cycle Q Clear(g_c), s			13.6	0.0	10.9	1.8
Prop In Lane				0.00	1.00	
Lane Grp Cap(c), veh/h			2432	0	296	3281
V/C Ratio(X)			0.50	0.00	0.82	0.24
Avail Cap(c_a), veh/h			2432	0	518	3617
HCM Platoon Ratio			1.00	1.00	1.00	1.00
Upstream Filter(I)			1.00	0.00	1.00	1.00
Uniform Delay (d), s/veh			6.1	0.0	33.1	0.3
Incr Delay (d2), s/veh			0.2	0.0	5.7	0.0
Initial Q Delay(d3),s/veh			0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln			6.5	0.0	5.8	0.8
LnGrp Delay(d),s/veh			6.3	0.0	38.8	0.3
LnGrp LOS			A		D	A
Approach Vol, veh/h			1222			1044
Approach Delay, s/veh			6.3			9.3
Approach LOS			A			A

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2			5	6		
Phs Duration (G+Y+Rc), s		82.2			19.7	62.5		
Change Period (Y+Rc), s		6.0			6.0	6.0		
Max Green Setting (Gmax), s		84.0			24.0	54.0		
Max Q Clear Time (g_c+I1), s		3.8			12.9	15.6		
Green Ext Time (p_c), s		72.4			0.8	37.5		

Intersection Summary	
HCM 2010 Ctrl Delay	7.7
HCM 2010 LOS	A

HCM 2010 Signalized Intersection Summary — 2013 Existing (PM Peak Hour)
7: Driveway/Courtenay Dr & Calhoun St

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	265	610	5	0	1275	70	25	20	5	135	5	555
Number	5	2	12	1	6	16	3	8	18	7	4	14
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1710	1676	1710	0	1676	1710	1710	1676	1710	1710	1676	1676
Adj Flow Rate, veh/h	294	678	6	0	1417	78	28	22	6	150	6	617
Adj No. of Lanes	0	2	0	0	2	0	0	1	0	0	1	1
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	0	2	2	2	2	2	2	2	2
Cap, veh/h	82	973	9	0	1979	109	85	52	9	273	9	317
Arrive On Green	0.64	0.64	0.64	0.00	0.64	0.64	0.22	0.22	0.22	0.22	0.22	0.22
Sat Flow, veh/h	3	1510	13	0	3155	169	112	234	42	876	40	1425
Grp Volume(v), veh/h	294	0	684	0	733	762	56	0	0	156	0	617
Grp Sat Flow(s),veh/h/ln	3	0	1523	0	1593	1647	387	0	0	916	0	1425
Q Serve(g_s), s	90.0	0.0	26.1	0.0	27.3	27.6	1.6	0.0	0.0	0.0	0.0	20.0
Cycle Q Clear(g_c), s	90.0	0.0	26.1	0.0	27.3	27.6	17.1	0.0	0.0	15.5	0.0	20.0
Prop In Lane	1.00		0.01	0.00		0.10	0.50		0.11	0.96		1.00
Lane Grp Cap(c), veh/h	0	0	982	0	1026	1061	146	0	0	282	0	317
V/C Ratio(X)	0.00	0.00	0.70	0.00	0.71	0.72	0.38	0.00	0.00	0.55	0.00	1.95
Avail Cap(c_a), veh/h	0	0	982	0	1026	1061	146	0	0	282	0	317
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	1.00	0.00	1.00	1.00	1.00	0.00	0.00	1.00	0.00	1.00
Uniform Delay (d), s/veh	0.0	0.0	10.3	0.0	10.5	10.6	31.4	0.0	0.0	33.2	0.0	35.0
Incr Delay (d2), s/veh	0.0	0.0	4.1	0.0	4.2	4.2	7.5	0.0	0.0	7.6	0.0	438.2
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	0.0	0.0	11.9	0.0	13.0	13.5	1.7	0.0	0.0	4.3	0.0	46.4
LnGrp Delay(d),s/veh	0.0	0.0	14.4	0.0	14.8	14.8	38.9	0.0	0.0	40.8	0.0	473.2
LnGrp LOS			B		B	B	D			D		F
Approach Vol, veh/h		978			1495			56			773	
Approach Delay, s/veh		10.1			14.8			38.9			385.9	
Approach LOS		B			B			D			F	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4		6		8
Phs Duration (G+Y+Rc), s		64.0		26.0		64.0		26.0
Change Period (Y+Rc), s		6.0		6.0		6.0		6.0
Max Green Setting (Gmax), s		58.0		20.0		45.0		20.0
Max Q Clear Time (g_c+I1), s		92.0		22.0		29.6		19.1
Green Ext Time (p_c), s		0.0		0.0		15.4		0.4

Intersection Summary	
HCM 2010 Ctrl Delay	100.7
HCM 2010 LOS	F

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Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	170	80	10	0	0	500	0	1350	25	90	1225	0
Number	3	8	18	7	4	14	1	6	16	5	2	12
Initial Q (Qb), veh	0	0	0	0	0	0	0	0	0	0	0	0
Ped-Bike Adj(A_pbT)	1.00		1.00	1.00		1.00	1.00		1.00	1.00		1.00
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj Sat Flow, veh/h/ln	1900	1863	1863	0	1863	1863	0	1863	1900	1863	1863	0
Adj Flow Rate, veh/h	189	89	0	0	0	556	0	1500	28	100	1361	0
Adj No. of Lanes	0	1	1	0	1	2	0	2	0	1	2	0
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Percent Heavy Veh, %	2	2	2	0	2	2	0	2	2	2	2	0
Cap, veh/h	195	92	251	0	249	373	0	1553	29	124	1971	0
Arrive On Green	0.16	0.16	0.00	0.00	0.00	0.13	0.00	0.44	0.44	0.07	0.56	0.00
Sat Flow, veh/h	1225	577	1583	0	1863	2787	0	3648	66	1774	3632	0
Grp Volume(v), veh/h	278	0	0	0	0	556	0	746	782	100	1361	0
Grp Sat Flow(s),veh/h/ln	1802	0	1583	0	1863	1393	0	1770	1851	1774	1770	0
Q Serve(g_s), s	18.4	0.0	0.0	0.0	0.0	16.0	0.0	49.1	49.3	6.6	33.1	0.0
Cycle Q Clear(g_c), s	18.4	0.0	0.0	0.0	0.0	16.0	0.0	49.1	49.3	6.6	33.1	0.0
Prop In Lane	0.68		1.00	0.00		1.00	0.00		0.04	1.00		0.00
Lane Grp Cap(c), veh/h	286	0	251	0	249	373	0	773	809	124	1971	0
V/C Ratio(X)	0.97	0.00	0.00	0.00	0.00	1.49	0.00	0.96	0.97	0.81	0.69	0.00
Avail Cap(c_a), veh/h	286	0	251	0	249	373	0	773	809	133	1982	0
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Upstream Filter(I)	1.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	1.00	0.00
Uniform Delay (d), s/veh	50.0	0.0	0.0	0.0	0.0	51.8	0.0	32.8	32.8	54.8	19.1	0.0
Incr Delay (d2), s/veh	45.3	0.0	0.0	0.0	0.0	235.0	0.0	23.9	23.7	28.1	1.0	0.0
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
%ile BackOfQ(50%),veh/ln	12.7	0.0	0.0	0.0	0.0	18.3	0.0	29.0	30.3	4.2	16.3	0.0
LnGrp Delay(d),s/veh	95.3	0.0	0.0	0.0	0.0	286.8	0.0	56.7	56.5	82.9	20.1	0.0
LnGrp LOS	F					F		E	E	F	C	
Approach Vol, veh/h		278			556			1528			1461	
Approach Delay, s/veh		95.3			286.8			56.6			24.4	
Approach LOS		F			F			E			C	

Timer	1	2	3	4	5	6	7	8
Assigned Phs		2		4	5	6		8
Phs Duration (G+Y+Rc), s		72.6		22.0	14.3	58.3		25.0
Change Period (Y+Rc), s		6.0		6.0	6.0	6.0		6.0
Max Green Setting (Gmax), s		67.0		16.0	9.0	52.0		19.0
Max Q Clear Time (g_c+I1), s		35.1		18.0	8.6	51.3		20.4
Green Ext Time (p_c), s		31.5		0.0	0.0	0.7		0.0

Intersection Summary	
HCM 2010 Ctrl Delay	80.6
HCM 2010 LOS	F

Appendix C

HCS RAMP MERGE, DIVERGE, AND WEAVING ANALYSIS WORKSHEETS

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           HCS 2010:  Freeway Merge and Diverge Segments Release 6.1
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```
Phone:                                   Fax:
E-mail:

_________________________________Diverge Analysis________________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   AM
Freeway/Dir of Travel:  JIC EB
Junction:               Harbor View Off Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data___________________________________

Type of analysis                            Diverge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           1470           vph

_________________________________Off Ramp Data___________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-Flow speed on ramp                     35.0           mph
Volume on ramp                              65             vph
Length of first accel/decel lane            1500           ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent ramp                                    vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1470        65                    vph
Peak-hour factor, PHF                  0.94        0.53
Peak 15-min volume, v15                391         31                    v
Trucks and buses                       1           2                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                             0.00    %   0.00    %           %
     Length                            0.00    mi  0.00    mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
```

```
Heavy vehicle adjustment, fHV          0.995       0.990
Driver population factor, fP           1.00        1.00
Flow rate, vp                          1572        124                   pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  1572   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks__________________________________

                           Actual        Maximum         LOS F?
     v  = v                1572          4500            No
      Fi   F
     v  = v - v            1448          4500            No
      FO   F   R
     v                     124           2000            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1572                 (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                1572          4400                 No
      12
_________________Level of Service Determination (if not F)______________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   4.3     pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence A

_____________________________Speed Estimation___________________________________

Intermediate speed variable,                 D  = 0.439
                                              S
Space mean speed in ramp influence area,     S  = 49.3    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 49.3    mph
________________________________________________________________________________
```

```
         HCS 2010:  Freeway Merge and Diverge Segments Release 6.1



Phone:                                     Fax:
E-mail:

_________________________________Diverge Analysis________________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   MD
Freeway/Dir of Travel:  JIC EB
Junction:               Harbor View Off Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data___________________________________

Type of analysis                            Diverge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           940            vph

_________________________________Off Ramp Data___________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-Flow speed on ramp                     35.0           mph
Volume on ramp                              140            vph
Length of first accel/decel lane            1500           ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent ramp                                    vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        940         140                   vph
Peak-hour factor, PHF                  0.88        0.84
Peak 15-min volume, v15                267         42                    v
Trucks and buses                       1           2                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                             0.00     %  0.00     %          %
     Length                            0.00    mi  0.00    mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
Heavy vehicle adjustment, fHV               0.995       0.990
Driver population factor, fP                1.00        1.00
Flow rate, vp                               1074        168                 pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  1074   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks__________________________________

                           Actual        Maximum         LOS F?
     v  = v                1074          4500            No
      Fi   F
     v  = v - v            906           4500            No
      FO   F   R
     v                     168           2000            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v       > 2700 pc/h?          No
      3     av34
Is   v  or v       > 1.5 v  /2           No
      3     av34          12
If yes, v    = 1074                  (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable          Violation?
     v                1074          4400                   No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009 L   =   -0.0    pc/mi/ln
                        R                  12         D
Level of service for ramp-freeway junction areas of influence A

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 D  = 0.443
                                              S
Space mean speed in ramp influence area,     S  = 49.2    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 49.2    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	JJ
Agency/Co.:	Stantec Consulting Services
Date performed:	11/27/2013
Analysis time period:	PM
Freeway/Dir of Travel:	JIC EB
Junction:	Harbor View Off Ramp
Jurisdiction:	
Analysis Year:	2013
Description:	

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	990	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	105	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	990		105			vph
Peak-hour factor, PHF	0.92		0.79			
Peak 15-min volume, v15	269		33			v
Trucks and buses	1		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.995		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	1081		134			pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1081 pc/h

Capacity Checks

	Actual		Maximum	LOS F?
$v_{Fi} = v_F$	1081		4500	No
$v_{FO} = v_F - v_R$	947		4500	No
v_R	134		2000	No
v_3 or v_{av34}	0	pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?			No	
Is v_3 or v_{av34} > 1.5 v_{12} /2			No	

If yes, v_{12A} = 1081 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1081	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 0.0+ pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.440	
Space mean speed in ramp influence area,	S_R = 49.3	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 49.3	mph

```
          HCS 2010:  Freeway Merge and Diverge Segments Release 6.1




Phone:                                      Fax:
E-mail:

_________________________________Merge Analysis_________________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   AM
Freeway/Dir of Travel:  EB
Junction:               Harborview On Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data__________________________________

Type of analysis                            Merge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           2985           vph

__________________________________On Ramp Data__________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-flow speed on ramp                     35.0           mph
Volume on ramp                              1580           vph
Length of first accel/decel lane            350            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)_____________________

Does adjacent ramp exist?                   No
Volume on adjacent Ramp                                    vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        2985        1580                  vph
Peak-hour factor, PHF                  0.95        0.92
Peak 15-min volume, v15                786         429                   v
Trucks and buses                       5           3                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                                     %           %           %
     Length                                    mi          mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
```



```
Heavy vehicle adjustment, fHV          0.976       0.985
Driver population factor, fP           1.00        1.00
Flow rate, vp                          3221        1743                  pcph

_________________________Estimation of V12 Merge Areas__________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3221   pc/h
                   12   F   FM

_______________________________Capacity Checks__________________________________

                           Actual        Maximum         LOS F?
     v                     4964          4500            Yes
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 3221                 (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area______________________
                      Actual        Max Desirable         Violation?
     v                4964          4600                  Yes
      R12
_________________Level of Service Determination (if not F)______________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   41.2    pc/mi/ln
          R                   R            12              A
Level of service for ramp-freeway junction areas of influence  F

______________________________Speed Estimation__________________________________

Intermediate speed variable,                  M  = 0.855
                                               S
Space mean speed in ramp influence area,      S  = 43.9    mph
                                               R
Space mean speed in outer lanes,              S  =  N/A    mph
                                               0
Space mean speed for all vehicles,            S  = 43.9    mph
________________________________________________________________________________
```

```
        HCS 2010:  Freeway Merge and Diverge Segments Release 6.1




Phone:                                       Fax:
E-mail:

_________________________________Merge Analysis________________________________

Analyst:                 JJ
Agency/Co.:              Stantec Consulting Services
Date performed:          11/27/2013
Analysis time period:    MD
Freeway/Dir of Travel:   EB
Junction:                Harborview On Ramp
Jurisdiction:
Analysis Year:           2013
Description:

__________________________________Freeway Data_________________________________

Type of analysis                            Merge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           1525           vph

__________________________________On Ramp Data_________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-flow speed on ramp                     35.0           mph
Volume on ramp                              725            vph
Length of first accel/decel lane            350            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent Ramp                                    vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1525        725                   vph
Peak-hour factor, PHF                  0.91        0.91
Peak 15-min volume, v15                419         199                   v
Trucks and buses                       5           3                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                                     %           %           %
     Length                                    mi          mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
```



```
Heavy vehicle adjustment, fHV          0.976       0.985
Driver population factor, fP           1.00        1.00
Flow rate, vp                          1718        809                   pcph

_________________________Estimation of V12 Merge Areas__________________________

                  L   =            (Equation 13-6 or 13-7)
                   EQ
                  P   =    1.000   Using Equation  0
                   FM
                  v   = v  (P   ) =  1718   pc/h
                   12    F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum        LOS F?
     v                     2527          4500           No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34          12
If yes, v    = 1718                  (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                2527          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   22.6    pc/mi/ln
          R                   R            12            A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.345
                                              S
Space mean speed in ramp influence area,     S  = 50.5     mph
                                              R
Space mean speed in outer lanes,             S  =  N/A     mph
                                              0
Space mean speed for all vehicles,           S  = 50.5     mph
_______________________________________________________________________________
```

```
         HCS 2010:  Freeway Merge and Diverge Segments Release 6.1



Phone:                                      Fax:
E-mail:

_________________________________Merge Analysis_________________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   PM
Freeway/Dir of Travel:  EB
Junction:               Harborview On Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data__________________________________

Type of analysis                            Merge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           1555           vph

__________________________________On Ramp Data__________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-flow speed on ramp                     35.0           mph
Volume on ramp                              670            vph
Length of first accel/decel lane            350            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent Ramp                                    vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1555        670                   vph
Peak-hour factor, PHF                  0.97        0.96
Peak 15-min volume, v15                401         174                   v
Trucks and buses                       5           3                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                                     %           %           %
     Length                                    mi          mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
```



```
Heavy vehicle adjustment, fHV           0.976       0.985
Driver population factor, fP            1.00        1.00
Flow rate, vp                           1643        708                  pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  1643   pc/h
                   12   F   FM

______________________________Capacity Checks_________________________________

                             Actual        Maximum         LOS F?
     v                       2351          4500            No
      FO
     v  or v                 0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?             No
      3     av34
Is   v  or v      > 1.5 v  /2              No
      3     av34         12
If yes, v    = 1643                  (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                        Actual        Max Desirable         Violation?
     v                  2351          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   21.3    pc/mi/ln
                              R             R          12            A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.337
                                              S
Space mean speed in ramp influence area,     S  = 50.6    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 50.6    mph
_______________________________________________________________________________
```

```
         HCS 2010:  Freeway Merge and Diverge Segments Release 6.1




Phone:                                    Fax:
E-mail:

_________________________________Diverge Analysis_______________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   AM
Freeway/Dir of Travel:  JIC WB
Junction:               Harbor View Off Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data__________________________________

Type of analysis                            Diverge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           1125           vph

_________________________________Off Ramp Data__________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-Flow speed on ramp                     25.0           mph
Volume on ramp                              490            vph
Length of first accel/decel lane            750            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent ramp                                    vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1125        490                   vph
Peak-hour factor, PHF                  0.84        0.85
Peak 15-min volume, v15                335         144                   v
Trucks and buses                       4           6                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                             0.00    %   0.00    %           %
     Length                            0.00    mi  0.00    mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
```

```
Heavy vehicle adjustment, fHV          0.980       0.971
Driver population factor, fP           1.00        1.00
Flow rate, vp                          1366        594                   pcph
_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  1366   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                1366          4500            No
      Fi   F
     v  = v - v            772           4500            No
      FO   F   R
     v                     594           1900            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1366                  (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                1366          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,              D = 4.252 + 0.0086 v  - 0.009  L   =   9.2     pc/mi/ln
                       R                  12          D
Level of service for ramp-freeway junction areas of influence A

_____________________________Speed Estimation__________________________________

Intermediate speed variable,             D  = 0.611
                                          S
Space mean speed in ramp influence area,  S  = 47.1    mph
                                          R
Space mean speed in outer lanes,         S  =  N/A    mph
                                          0
Space mean speed for all vehicles,       S  = 47.1    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	JJ
Agency/Co.:	Stantec Consulting Services
Date performed:	11/27/2013
Analysis time period:	MD
Freeway/Dir of Travel:	JIC WB
Junction:	Harbor View Off Ramp
Jurisdiction:	
Analysis Year:	2013
Description:	

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	1475	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	25.0	mph
Volume on ramp	500	vph
Length of first accel/decel lane	750	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	1475		500			vph
Peak-hour factor, PHF	0.94		0.89			
Peak 15-min volume, v15	392		140			v
Trucks and buses	4		6			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.980		0.971			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	1601		579			pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1601 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	1601	4500	No
$v_{FO} = v_F - v_R$	1022	4500	No
v_R	579	1900	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	

If yes, v_{12A} = 1601 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	1601	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 11.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.610	
Space mean speed in ramp influence area,	S_R = 47.1	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 47.1	mph

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Phone:                                    Fax:
E-mail:

_________________________________Diverge Analysis______________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   PM
Freeway/Dir of Travel:  JIC WB
Junction:               Harbor View Off Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data__________________________________

Type of analysis                            Diverge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           2530           vph

_________________________________Off Ramp Data__________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-Flow speed on ramp                     25.0           mph
Volume on ramp                              1230           vph
Length of first accel/decel lane            750            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent ramp                                    vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        2530        1230                  vph
Peak-hour factor, PHF                  0.88        0.90
Peak 15-min volume, v15                719         342                   v
Trucks and buses                       4           6                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                             0.00    %   0.00    %           %
     Length                            0.00    mi  0.00    mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
Heavy vehicle adjustment, fHV          0.980       0.971
Driver population factor, fP           1.00        1.00
Flow rate, vp                          2933        1408                  pcph

_________________________Estimation of V12 Diverge Areas________________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  2933   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks__________________________________

                           Actual        Maximum         LOS F?
     v  = v                2933          4500            No
      Fi   F
     v  = v - v            1525          4500            No
      FO   F   R
     v                     1408          1900            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v       > 2700 pc/h?          No
      3     av34
Is   v  or v       > 1.5 v  /2           No
      3     av34          12
If yes, v    = 2933                  (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area______________________
                      Actual        Max Desirable         Violation?
     v                2933          4400                  No
      12
_________________Level of Service Determination (if not F)______________________

Density,              D = 4.252 + 0.0086 v  - 0.009  L   =   22.7    pc/mi/ln
                       R                  12          D
Level of service for ramp-freeway junction areas of influence C

_____________________________Speed Estimation___________________________________

Intermediate speed variable,                 D  = 0.685
                                              S
Space mean speed in ramp influence area,     S  = 46.1    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 46.1    mph
________________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

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________________________________Merge Analysis__________________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   AM
Freeway/Dir of Travel:  WB
Junction:               Harborview On Ramp
Jurisdiction:
Analysis Year:          2013
Description:

_________________________________Freeway Data___________________________________

Type of analysis                            Merge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           685            vph

_________________________________On Ramp Data___________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-flow speed on ramp                     35.0           mph
Volume on ramp                              50             vph
Length of first accel/decel lane            500            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent Ramp                                    vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        685         50                    vph
Peak-hour factor, PHF                  0.84        0.55
Peak 15-min volume, v15                204         23                    v
Trucks and buses                       4           2                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                                     %           %           %
     Length                                    mi          mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
Heavy vehicle adjustment, fHV          0.980       0.990
Driver population factor, fP           1.00        1.00
Flow rate, vp                          832         92                    pcph

_________________________Estimation of V12 Merge Areas__________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  832    pc/h
                   12   F   FM

_______________________________Capacity Checks__________________________________

                           Actual        Maximum         LOS F?
     v                     924           4500            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 832                (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable          Violation?
     v                924           4600                   No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   9.5     pc/mi/ln
                              R                12          A
Level of service for ramp-freeway junction areas of influence  A

_____________________________Speed Estimation___________________________________

Intermediate speed variable,                 M  = 0.296
                                              S
Space mean speed in ramp influence area,     S  = 51.2    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 51.2    mph
________________________________________________________________________________
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         HCS 2010:  Freeway Merge and Diverge Segments Release 6.1




Phone:                                   Fax:
E-mail:

_________________________________Merge Analysis________________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   MD
Freeway/Dir of Travel:  WB
Junction:               Harborview On Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data_________________________________

Type of analysis                            Merge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           1035           vph

__________________________________On Ramp Data_________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-flow speed on ramp                     35.0           mph
Volume on ramp                              60             vph
Length of first accel/decel lane            500            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent Ramp                                    vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1035        60                    vph
Peak-hour factor, PHF                  0.94        0.72
Peak 15-min volume, v15                275         21                    v
Trucks and buses                       4           2                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                                     %           %           %
     Length                                    mi          mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
Heavy vehicle adjustment, fHV          0.980       0.990
Driver population factor, fP           1.00        1.00
Flow rate, vp                          1123        84                    pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  1123   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     1207          4500            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34          12
If yes, v    = 1123                 (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                1207          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L  =   11.7    pc/mi/ln
          R                   R            12            A
Level of service for ramp-freeway junction areas of influence  B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                M  = 0.299
                                             S
Space mean speed in ramp influence area,    S  = 51.1    mph
                                             R
Space mean speed in outer lanes,            S  =  N/A    mph
                                             0
Space mean speed for all vehicles,          S  = 51.1    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.1


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Phone:                                   Fax:
E-mail:

_________________________________Merge Analysis________________________________

Analyst:                 JJ
Agency/Co.:              Stantec Consulting Services
Date performed:          11/27/2013
Analysis time period:    PM
Freeway/Dir of Travel:   WB
Junction:                Harborview On Ramp
Jurisdiction:
Analysis Year:           2013
Description:

__________________________________Freeway Data_________________________________

Type of analysis                            Merge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           1310           vph

__________________________________On Ramp Data_________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-flow speed on ramp                     35.0           mph
Volume on ramp                              10             vph
Length of first accel/decel lane            500            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent Ramp                                    vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1310        10                    vph
Peak-hour factor, PHF                  0.88        0.50
Peak 15-min volume, v15                372         5                     v
Trucks and buses                       4           2                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                                     %           %           %
     Length                                    mi          mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
Heavy vehicle adjustment, fHV          0.980       0.990
Driver population factor, fP           1.00        1.00
Flow rate, vp                          1518        20                    pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L   =            (Equation 13-6 or 13-7)
                   EQ
                  P   =    1.000   Using Equation  0
                   FM
                  v   = v  (P   ) =  1518   pc/h
                   12    F   FM

______________________________Capacity Checks__________________________________

                           Actual        Maximum         LOS F?
     v                     1538          4500            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34           12
If yes, v    = 1518                  (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                1538          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   14.3    pc/mi/ln
                              R             12          A
Level of service for ramp-freeway junction areas of influence  B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.304
                                              S
Space mean speed in ramp influence area,     S  = 51.0    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 51.0    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	JJ
Agency/Co.:	Stantec Consulting Services
Date performed:	11/27/2013
Analysis time period:	AM
Freeway/Dir of Travel:	JIC EB
Junction:	SC 61 Off Ramp
Jurisdiction:	
Analysis Year:	2013
Description:	

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	2985	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	25.0	mph
Volume on ramp	745	vph
Length of first accel/decel lane	170	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2985		745			vph
Peak-hour factor, PHF	0.97		0.89			
Peak 15-min volume, v15	769		209			v
Trucks and buses	4		2			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.980		0.990			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	3139		845			pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3139 pc/h

Capacity Checks

	Actual		Maximum	LOS F?
$v_{Fi} = v_F$	3139		4500	No
$v_{FO} = v_F - v_R$	2294		4500	No
v_R	845		1900	No
v_3 or v_{av34}	0	pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?			No	
Is v_3 or v_{av34} > 1.5 v_{12}/2			No	

If yes, v_{12A} = 3139 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	3139	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 29.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.634	
Space mean speed in ramp influence area,	S_R = 46.8	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 46.8	mph

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         HCS 2010:  Freeway Merge and Diverge Segments Release 6.1




Phone:                                    Fax:
E-mail:

_________________________________Diverge Analysis______________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   MD
Freeway/Dir of Travel:  JIC EB
Junction:               SC 61 Off Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data_________________________________

Type of analysis                            Diverge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0          mph
Volume on freeway                           1525          vph

_________________________________Off Ramp Data_________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-Flow speed on ramp                     25.0          mph
Volume on ramp                              340           vph
Length of first accel/decel lane            170           ft
Length of second accel/decel lane                         ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent ramp                                   vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp                                 ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1525        340                   vph
Peak-hour factor, PHF                  0.95        0.83
Peak 15-min volume, v15                401         102                   v
Trucks and buses                       4           2                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                             0.00     %  0.00     %          %
     Length                            0.00     mi 0.00     mi         mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
```



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Heavy vehicle adjustment, fHV          0.980       0.990
Driver population factor, fP           1.00        1.00
Flow rate, vp                          1637        414                   pcph

_________________________Estimation of V12 Diverge Areas______________________

                  L  =             (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  1637   pc/h
                   12   R     F   R   FD

______________________________Capacity Checks__________________________________

                          Actual        Maximum         LOS F?
     v  = v               1637          4500            No
      Fi   F
     v  = v - v           1223          4500            No
      FO   F   R
     v                    414           1900            No
      R
     v  or v              0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?          No
      3     av34
Is   v  or v      > 1.5 v  /2           No
      3     av34         12
If yes, v    = 1637                 (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                1637          4400                  No
      12
_________________Level of Service Determination (if not F)____________________

Density,               D = 4.252 + 0.0086 v  - 0.009 L   =   16.8    pc/mi/ln
                        R                   12         D
Level of service for ramp-freeway junction areas of influence B

____________________________Speed Estimation___________________________________

Intermediate speed variable,                D  = 0.595
                                             S
Space mean speed in ramp influence area,    S  = 47.3    mph
                                             R
Space mean speed in outer lanes,            S  =  N/A    mph
                                             0
Space mean speed for all vehicles,          S  = 47.3    mph
_______________________________________________________________________________
```

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         HCS 2010:  Freeway Merge and Diverge Segments Release 6.1




Phone:                                    Fax:
E-mail:

_________________________________Diverge Analysis______________________________

Analyst:                  JJ
Agency/Co.:               Stantec Consulting Services
Date performed:           11/27/2013
Analysis time period:     PM
Freeway/Dir of Travel:    JIC EB
Junction:                 SC 61 Off Ramp
Jurisdiction:
Analysis Year:            2013
Description:

__________________________________Freeway Data_________________________________

Type of analysis                            Diverge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           1555           vph

_________________________________Off Ramp Data__________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-Flow speed on ramp                     25.0           mph
Volume on ramp                              445            vph
Length of first accel/decel lane            170            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent ramp                                    vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1555        445                   vph
Peak-hour factor, PHF                  0.93        0.93
Peak 15-min volume, v15                418         120                   v
Trucks and buses                       4           2                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                             0.00     %  0.00     %           %
     Length                            0.00     mi 0.00     mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
```



```
Heavy vehicle adjustment, fHV          0.980       0.990
Driver population factor, fP           1.00        1.00
Flow rate, vp                          1705        483                   pcph

_________________________Estimation of V12 Diverge Areas________________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  1705   pc/h
                   12   R     F   R   FD

______________________________Capacity Checks__________________________________

                           Actual        Maximum          LOS F?
     v  = v                1705          4500             No
      Fi   F
     v  = v - v            1222          4500             No
      FO   F   R
     v                     483           1900             No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1705                 (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                1705          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,                D = 4.252 + 0.0086 v  - 0.009 L   =   17.4    pc/mi/ln
                         R                  12         D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,               D  = 0.601
                                            S
Space mean speed in ramp influence area,   S  = 47.2    mph
                                            R
Space mean speed in outer lanes,           S  =  N/A    mph
                                            0
Space mean speed for all vehicles,         S  = 47.2    mph
_______________________________________________________________________________
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         HCS 2010:  Freeway Merge and Diverge Segments Release 6.1




Phone:                                   Fax:
E-mail:

_________________________________Merge Analysis________________________________

Analyst:                 JJ
Agency/Co.:              Stantec Consulting Services
Date performed:          11/27/2013
Analysis time period:    AM
Freeway/Dir of Travel:   EB
Junction:                SC 61 On Ramp
Jurisdiction:
Analysis Year:           2013
Description:

__________________________________Freeway Data_________________________________

Type of analysis                            Merge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           2565           vph

__________________________________On Ramp Data_________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-flow speed on ramp                     25.0           mph
Volume on ramp                              325            vph
Length of first accel/decel lane            750            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent Ramp                                    vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                     Freeway     Ramp        Adjacent
                                                                Ramp
Volume, V (vph)                         2565        325                  vph
Peak-hour factor, PHF                   0.85        0.77
Peak 15-min volume, v15                 754         106                  v
Trucks and buses                        3           11                   %
Recreational vehicles                   0           0                    %
Terrain type:                           Level       Level
     Grade                                      %           %           %
     Length                                     mi          mi          mi
Trucks and buses PCE, ET                1.5         1.5
Recreational vehicle PCE, ER            1.2         1.2
```

```
Heavy vehicle adjustment, fHV           0.985       0.948
Driver population factor, fP            1.00        1.00
Flow rate, vp                           3063        445                  pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  3063   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     3508          4500            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 3063                  (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                3508          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   27.9    pc/mi/ln
          R                  R            12            A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.414
                                              S
Space mean speed in ramp influence area,     S  = 49.6    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 49.6    mph
_______________________________________________________________________________
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HCS 2010: Freeway Merge and Diverge Segments Release 6.1

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Phone: Fax:
E-mail:

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________________________________Merge Analysis________________________________

Analyst:                 JJ
Agency/Co.:              Stantec Consulting Services
Date performed:          11/27/2013
Analysis time period:    MD
Freeway/Dir of Travel:   EB
Junction:                SC 61 On Ramp
Jurisdiction:
Analysis Year:           2013
Description:

_________________________________Freeway Data__________________________________

Type of analysis                            Merge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0          mph
Volume on freeway                           1300          vph

_________________________________On Ramp Data__________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-flow speed on ramp                     25.0          mph
Volume on ramp                              115           vph
Length of first accel/decel lane            750           ft
Length of second accel/decel lane                         ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent Ramp                                   vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp                                 ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1300        115                   vph
Peak-hour factor, PHF                  0.91        0.87
Peak 15-min volume, v15                357         33                    v
Trucks and buses                       3           11                    %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                                    %           %           %
     Length                                   mi          mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
Heavy vehicle adjustment, fHV          0.985       0.948
Driver population factor, fP           1.00        1.00
Flow rate, vp                          1450        139                   pcph

_________________________Estimation of V12 Merge Areas__________________________

                  L   =            (Equation 13-6 or 13-7)
                   EQ
                  P   =    1.000   Using Equation  0
                   FM
                  v   = v  (P  ) =  1450    pc/h
                   12    F   FM

______________________________Capacity Checks___________________________________

                           Actual        Maximum         LOS F?
     v                     1589          4500            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1450                (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                1589          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   13.1    pc/mi/ln
          R                   R            12             A
Level of service for ramp-freeway junction areas of influence  B

____________________________Speed Estimation___________________________________

Intermediate speed variable,               M  = 0.303
                                            S
Space mean speed in ramp influence area,   S  = 51.1    mph
                                            R
Space mean speed in outer lanes,           S  =  N/A    mph
                                            0
Space mean speed for all vehicles,         S  = 51.1    mph
________________________________________________________________________________
```

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          HCS 2010:  Freeway Merge and Diverge Segments Release 6.1
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Phone:                                      Fax:
E-mail:
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_________________________________Merge Analysis________________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   MD
Freeway/Dir of Travel:  EB
Junction:               SC 61 On Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data_________________________________

Type of analysis                            Merge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           1225           vph

__________________________________On Ramp Data_________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-flow speed on ramp                     25.0           mph
Volume on ramp                              115            vph
Length of first accel/decel lane            750            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent Ramp                                    vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1225        115                   vph
Peak-hour factor, PHF                  0.97        0.80
Peak 15-min volume, v15                316         36                    v
Trucks and buses                       3           11                    %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                                     %           %           %
     Length                                    mi          mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
Heavy vehicle adjustment, fHV          0.985       0.948
Driver population factor, fP           1.00        1.00
Flow rate, vp                          1282        152                   pcph

_________________________Estimation of V12 Merge Areas__________________________

                  L  =           (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  1282    pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     1434          4500            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1282                (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                1434          4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L  =   11.9    pc/mi/ln
                              R             12            A
Level of service for ramp-freeway junction areas of influence  B

____________________________Speed Estimation___________________________________

Intermediate speed variable,               M  = 0.300
                                            S
Space mean speed in ramp influence area,   S  = 51.1    mph
                                            R
Space mean speed in outer lanes,           S  =  N/A    mph
                                            0
Space mean speed for all vehicles,         S  = 51.1    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Weaving Release 6.1

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	JJ
Agency/Co.:	
Date Performed:	11/27/2013
Analysis Time Period:	AM
Freeway/Dir of Travel:	JIC WB
Weaving Location:	Lockwood to SC 61
Analysis Year:	2013
Description:	

Inputs

Segment Type	Freeway	
Weaving configuration	One-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	1300	ft
Freeway free-flow speed, FFS	55	mi/h
Minimum segment speed, SMIN	35	mi/h
Freeway maximum capacity, cIFL	2250	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

Conversion to pc/h Under Base Conditions

	Volume Components				
	VFF	VRF	VFR	VRR	
Volume, V	435	345	255	0	veh/h
Peak hour factor, PHF	0.83	0.95	0.71	0.90	
Peak 15-min volume, v15	131	91	90	0	
Trucks and buses	4	11	1	0	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.980	0.948	0.995	1.000	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	535	383	361	0	pc/h

Volume ratio, VR 0.582

Configuration Characteristics

Number of maneuver lanes, NWL	2	ln
Interchange density, ID	1.00	int/mi
Minimum RF lane changes, LCRF	0	lc/pc
Minimum FR lane changes, LCFR	0	lc/pc
Minimum RR lane changes, LCRR		lc/pc
Minimum weaving lane changes, LCMIN	0	lc/h
Weaving lane changes, LCW	193	lc/h
Non-weaving vehicle index, INW	70	
Non-weaving lane change, LCNW	237	lc/h
Total lane changes, LCALL	430	lc/h

Weaving and Non-Weaving Speeds

Weaving intensity factor, W	0.094	
Average weaving speed, SW	53.3	mi/h
Average non-weaving speed, SNW	53.0	mi/h

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Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	53.1	mi/h
Weaving segment density, D	8.0	pc/mi/ln
Level of service, LOS	A	
Weaving segment v/c ratio	0.310	
Weaving segment flow rate, v	1279	pc/h
Weaving segment capacity, cW	4045	veh/h

Limitations on Weaving Segments

If limit reached, see note.

	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	8797	1300	a,b
		Maximum	Analyzed	
Density-based capacty, cIWL (pc/h/ln)		2250	1676	c
		Maximum	Analyzed	
v/c ratio		1.00	0.310	d

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

b. 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."

c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.

d. Volumes exceed the weaving segment capacity. The level of service is F.

HCS 2010: Freeway Weaving Release 6.1

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	JJ
Agency/Co.:	
Date Performed:	11/27/2013
Analysis Time Period:	MD
Freeway/Dir of Travel:	JIC WB
Weaving Location:	Lockwood to SC 61
Analysis Year:	2013
Description:	

Inputs

Segment Type	Freeway	
Weaving configuration	One-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	1300	ft
Freeway free-flow speed, FFS	55	mi/h
Minimum segment speed, SMIN	35	mi/h
Freeway maximum capacity, cIFL	2250	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

Conversion to pc/h Under Base Conditions

	Volume Components				
	VFF	VRF	VFR	VRR	
Volume, V	760	330	305	0	veh/h
Peak hour factor, PHF	0.92	0.95	0.70	0.90	
Peak 15-min volume, v15	207	87	109	0	
Trucks and buses	4	11	1	0	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.980	0.948	0.995	1.000	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	843	366	438	0	pc/h

Volume ratio, VR 0.488

Configuration Characteristics

Number of maneuver lanes, NWL	2	ln
Interchange density, ID	1.00	int/mi
Minimum RF lane changes, LCRF	0	lc/pc
Minimum FR lane changes, LCFR	0	lc/pc
Minimum RR lane changes, LCRR		lc/pc
Minimum weaving lane changes, LCMIN	0	lc/h
Weaving lane changes, LCW	193	lc/h
Non-weaving vehicle index, INW	110	
Non-weaving lane change, LCNW	300	lc/h
Total lane changes, LCALL	493	lc/h

Weaving and Non-Weaving Speeds

Weaving intensity factor, W	0.105	
Average weaving speed, SW	53.1	mi/h
Average non-weaving speed, SNW	52.4	mi/h

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Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	52.7	mi/h
Weaving segment density, D	10.4	pc/mi/ln
Level of service, LOS	B	
Weaving segment v/c ratio	0.335	
Weaving segment flow rate, v	1647	pc/h
Weaving segment capacity, cW	4820	veh/h

Limitations on Weaving Segments

If limit reached, see note.

	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	7688	1300	a,b
		Maximum	Analyzed	
Density-based capacty, cIWL (pc/h/ln)		2250	1761	c
		Maximum	Analyzed	
v/c ratio		1.00	0.335	d

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

b. 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."

c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.

d. Volumes exceed the weaving segment capacity. The level of service is F.

HCS 2010: Freeway Weaving Release 6.1

Phone: Fax:
E-mail:

Operational Analysis

Analyst:	JJ
Agency/Co.:	
Date Performed:	11/27/2013
Analysis Time Period:	PM
Freeway/Dir of Travel:	JIC WB
Weaving Location:	Lockwood to SC 61
Analysis Year:	2013
Description:	

Inputs

Segment Type	Freeway	
Weaving configuration	One-Sided	
Number of lanes, N	3	ln
Weaving segment length, LS	1300	ft
Freeway free-flow speed, FFS	55	mi/h
Minimum segment speed, SMIN	35	mi/h
Freeway maximum capacity, cIFL	2250	pc/h/ln
Terrain type	Level	
Grade	0.00	%
Length	0.00	mi

Conversion to pc/h Under Base Conditions

	Volume Components				
	VFF	VRF	VFR	VRR	
Volume, V	1305	595	570	0	veh/h
Peak hour factor, PHF	0.90	0.89	0.91	0.90	
Peak 15-min volume, v15	363	167	157	0	
Trucks and buses	4	11	1	0	%
Recreational vehicles	0	0	0	0	%
Trucks and buses PCE, ET	1.5	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	0.980	0.948	0.995	1.000	
Driver population adjustment, fP	1.00	1.00	1.00	1.00	
Flow rate, v	1479	705	630	0	pc/h

Volume ratio, VR 0.474

Configuration Characteristics

Number of maneuver lanes, NWL	2	ln
Interchange density, ID	1.00	int/mi
Minimum RF lane changes, LCRF	0	lc/pc
Minimum FR lane changes, LCFR	0	lc/pc
Minimum RR lane changes, LCRR		lc/pc
Minimum weaving lane changes, LCMIN	0	lc/h
Weaving lane changes, LCW	193	lc/h
Non-weaving vehicle index, INW	192	
Non-weaving lane change, LCNW	431	lc/h
Total lane changes, LCALL	624	lc/h

Weaving and Non-Weaving Speeds

Weaving intensity factor, W	0.127	
Average weaving speed, SW	52.8	mi/h
Average non-weaving speed, SNW	50.5	mi/h

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Weaving Segment Speed, Density, Level of Service and Capacity

Weaving segment speed, S	51.5	mi/h
Weaving segment density, D	18.2	pc/mi/ln
Level of service, LOS	B	
Weaving segment v/c ratio	0.556	
Weaving segment flow rate, v	2814	pc/h
Weaving segment capacity, cW	4960	veh/h

Limitations on Weaving Segments

If limit reached, see note.

	Minimum	Maximum	Actual	Note
Weaving length (ft)	300	7529	1300	a,b
		Maximum	Analyzed	
Density-based capacty, cIWL (pc/h/ln)		2250	1773	c
		Maximum	Analyzed	
v/c ratio		1.00	0.556	d

Notes:

a. In weaving segments shorter than 300 ft, weaving vehicles are assumed to make only necessary lane changes.

b. 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."

c. The density-based capacity exceeds the capacity of a basic freeway segment, under equivalent ideal conditions.

d. Volumes exceed the weaving segment capacity. The level of service is F.

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            HCS 2010:  Freeway Merge and Diverge Segments Release 6.1



Phone:                                  Fax:
E-mail:

_________________________________Merge Analysis________________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   AM
Freeway/Dir of Travel:  WB
Junction:               SC 61 On Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data_________________________________

Type of analysis                             Merge
Number of lanes in freeway                   2
Free-flow speed on freeway                   55.0           mph
Volume on freeway                            1125           vph

__________________________________On Ramp Data_________________________________

Side of freeway                              Right
Number of lanes in ramp                      1
Free-flow speed on ramp                      40.0           mph
Volume on ramp                               345            vph
Length of first accel/decel lane             350            ft
Length of second accel/decel lane                           ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                    No
Volume on adjacent Ramp                                     vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp                                   ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                     Freeway      Ramp        Adjacent
                                                                 Ramp
Volume, V (vph)                         1125         345                   vph
Peak-hour factor, PHF                   0.92         0.82
Peak 15-min volume, v15                 306          105                   v
Trucks and buses                        3            4                     %
Recreational vehicles                   0            0                     %
Terrain type:                           Level        Level
     Grade                                      %            %            %
     Length                                     mi           mi           mi
Trucks and buses PCE, ET                1.5          1.5
Recreational vehicle PCE, ER            1.2          1.2
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Heavy vehicle adjustment, fHV           0.985        0.980
Driver population factor, fP            1.00         1.00
Flow rate, vp                           1241         429                   pcph
_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  1241   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                            Actual        Maximum         LOS F?
     v                      1670          4500            No
      FO
     v  or v                0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?            No
      3     av34
Is   v  or v      > 1.5 v  /2             No
      3     av34         12
If yes, v    = 1241                 (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                       Actual        Max Desirable         Violation?
     v                 1670          4600                  No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   16.1    pc/mi/ln
                              R              12          A
Level of service for ramp-freeway junction areas of influence  B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.314
                                              S
Space mean speed in ramp influence area,     S  = 50.9    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 50.9    mph
_______________________________________________________________________________
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          HCS 2010:  Freeway Merge and Diverge Segments Release 6.1




Phone:                                       Fax:
E-mail:

_________________________________Merge Analysis________________________________

Analyst:                 JJ
Agency/Co.:              Stantec Consulting Services
Date performed:          11/27/2013
Analysis time period:    MD
Freeway/Dir of Travel:   WB
Junction:                SC 61 On Ramp
Jurisdiction:
Analysis Year:           2013
Description:

__________________________________Freeway Data_________________________________

Type of analysis                             Merge
Number of lanes in freeway                   2
Free-flow speed on freeway                   55.0           mph
Volume on freeway                            1475           vph

__________________________________On Ramp Data_________________________________

Side of freeway                              Right
Number of lanes in ramp                      1
Free-flow speed on ramp                      40.0           mph
Volume on ramp                               385            vph
Length of first accel/decel lane             350            ft
Length of second accel/decel lane                           ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                    No
Volume on adjacent Ramp                                     vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp                                   ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                     Freeway     Ramp        Adjacent
                                                                Ramp
Volume, V (vph)                         1475        385                   vph
Peak-hour factor, PHF                   0.86        0.78
Peak 15-min volume, v15                 429         123                   v
Trucks and buses                        3           4                     %
Recreational vehicles                   0           0                     %
Terrain type:                           Level       Level
     Grade                                      %           %           %
     Length                                     mi          mi          mi
Trucks and buses PCE, ET                1.5         1.5
Recreational vehicle PCE, ER            1.2         1.2
```

```
Heavy vehicle adjustment, fHV           0.985       0.980
Driver population factor, fP            1.00        1.00
Flow rate, vp                           1741        503                   pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  1741   pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     2244          4500            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1741                  (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable          Violation?
     v                2244          4600                   No
      R12
_________________Level of Service Determination (if not F)____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   20.6    pc/mi/ln
                              R            12             A
Level of service for ramp-freeway junction areas of influence  C

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.330
                                              S
Space mean speed in ramp influence area,     S  = 50.7    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 50.7    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

DRAFT

Phone: Fax:
E-mail:

Merge Analysis

Analyst: JJ
Agency/Co.: Stantec Consulting Services
Date performed: 11/27/2013
Analysis time period: PM
Freeway/Dir of Travel: WB
Junction: SC 61 On Ramp
Jurisdiction:
Analysis Year: 2013
Description:

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	2530	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	40.0	mph
Volume on ramp	630	vph
Length of first accel/decel lane	350	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2530	630		vph
Peak-hour factor, PHF	0.91	0.84		
Peak 15-min volume, v15	695	188		v
Trucks and buses	3	4		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.985	0.980		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	2822	765		pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 2822 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3587	4500	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	
If yes, v_{12A} = 2822		(Equation 13-15, 13-16, 13-18, or 13-19)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	3587	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 30.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	M_S = 0.434	
Space mean speed in ramp influence area,	S_R = 49.4	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 49.4	mph

```
          HCS 2010:  Freeway Merge and Diverge Segments Release 6.1




Phone:                                   Fax:
E-mail:

_________________________________Diverge Analysis______________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   AM
Freeway/Dir of Travel:  JIC EB
Junction:               Lockwood NB Off Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data_________________________________

Type of analysis                            Diverge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           1485           vph

_________________________________Off Ramp Data_________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-Flow speed on ramp                     25.0           mph
Volume on ramp                              635            vph
Length of first accel/decel lane            1500           ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent ramp                                    vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1485        635                   vph
Peak-hour factor, PHF                  0.94        0.80
Peak 15-min volume, v15                395         198                   v
Trucks and buses                       4           4                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                             0.00    %   0.00    %           %
     Length                            0.00    mi  0.00    mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
```



```
Heavy vehicle adjustment, fHV          0.980       0.980
Driver population factor, fP           1.00        1.00
Flow rate, vp                          1611        810                   pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  1611   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                1611          4500            No
      Fi   F
     v  = v - v            801           4500            No
      FO   F   R
     v                     810           1900            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 1611                  (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable         Violation?
     v                1611          4400                  No
      12
_________________Level of Service Determination (if not F)_____________________

Density,               D = 4.252 + 0.0086 v  - 0.009  L   =   4.6     pc/mi/ln
                        R                  12          D
Level of service for ramp-freeway junction areas of influence A

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                D  = 0.631
                                             S
Space mean speed in ramp influence area,    S  = 46.8    mph
                                             R
Space mean speed in outer lanes,            S  =  N/A    mph
                                             0
Space mean speed for all vehicles,          S  = 46.8    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

Diverge Analysis

```
Analyst:                 JJ
Agency/Co.:              Stantec Consulting Services
Date performed:          11/27/2013
Analysis time period:    MD
Freeway/Dir of Travel:   JIC EB
Junction:                Lockwood NB Off Ramp
Jurisdiction:
Analysis Year:           2013
Description:
```

Freeway Data

```
Type of analysis                        Diverge
Number of lanes in freeway              2
Free-flow speed on freeway              55.0          mph
Volume on freeway                       965           vph
```

Off Ramp Data

```
Side of freeway                         Right
Number of lanes in ramp                 1
Free-Flow speed on ramp                 25.0          mph
Volume on ramp                          400           vph
Length of first accel/decel lane        1500          ft
Length of second accel/decel lane                     ft
```

Adjacent Ramp Data (if one exists)

```
Does adjacent ramp exist?               No
Volume on adjacent ramp                               vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp                             ft
```

Conversion to pc/h Under Base Conditions

```
Junction Components                Freeway     Ramp        Adjacent
                                                           Ramp
Volume, V (vph)                    965         400                   vph
Peak-hour factor, PHF              0.94        0.84
Peak 15-min volume, v15            257         119                   v
Trucks and buses                   4           4                     %
Recreational vehicles              0           0                     %
Terrain type:                      Level       Level
     Grade                         0.00    %   0.00    %           %
     Length                        0.00    mi  0.00    mi          mi
Trucks and buses PCE, ET           1.5         1.5
Recreational vehicle PCE, ER       1.2         1.2
Heavy vehicle adjustment, fHV      0.980       0.980
Driver population factor, fP       1.00        1.00
Flow rate, vp                      1047        486                   pcph
```

Estimation of V12 Diverge Areas

```
                  L   =              (Equation 13-12 or 13-13)
                   EQ
                  P   =    1.000   Using Equation  0
                   FD
                  v   = v   + (v - v ) P   =  1047   pc/h
                   12    R      F   R   FD
```

Capacity Checks

```
                                Actual        Maximum         LOS F?
     v  = v                     1047          4500            No
      Fi   F
     v  = v - v                 561           4500            No
      FO   F   R
     v                          486           1900            No
      R
     v  or v                    0    pc/h     (Equation 13-14 or 13-17)
      3    av34
Is   v  or v      > 2700 pc/h?                No
      3    av34
Is   v  or v      > 1.5 v  /2                 No
      3    av34          12
If yes, v    = 1047                   (Equation 13-15, 13-16, 13-18, or 13-19)
         12A
```

Flow Entering Diverge Influence Area

```
                      Actual        Max Desirable          Violation?
     v                1047          4400                   No
      12
```

Level of Service Determination (if not F)

```
Density,              D = 4.252 + 0.0086 v  - 0.009  L   =   -0.2    pc/mi/ln
                       R                   12          D
Level of service for ramp-freeway junction areas of influence A
```

Speed Estimation

```
Intermediate speed variable,                D  = 0.602
                                             S
Space mean speed in ramp influence area,    S  = 47.2    mph
                                             R
Space mean speed in outer lanes,            S  =  N/A    mph
                                             0
Space mean speed for all vehicles,          S  = 47.2    mph
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

Phone: Fax:
E-mail:

Diverge Analysis

Analyst:	JJ
Agency/Co.:	Stantec Consulting Services
Date performed:	11/27/2013
Analysis time period:	PM
Freeway/Dir of Travel:	JIC EB
Junction:	Lockwood NB Off Ramp
Jurisdiction:	
Analysis Year:	2013
Description:	

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	925	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	25.0	mph
Volume on ramp	295	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	925		295			vph
Peak-hour factor, PHF	0.95		0.90			
Peak 15-min volume, v15	243		82			v
Trucks and buses	4		4			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.980		0.980			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	993		334			pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 993 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	993	4500	No
$v_{FO} = v_F - v_R$	659	4500	No
v_R	334	1900	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12} /2		No	

If yes, v_{12A} = 993 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	993	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$ = -0.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable,	D_S = 0.588	
Space mean speed in ramp influence area,	S_R = 47.4	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 47.4	mph

```
         HCS 2010:  Freeway Merge and Diverge Segments Release 6.1




Phone:                                   Fax:
E-mail:

_________________________________Merge Analysis_________________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   AM
Freeway/Dir of Travel:  WB
Junction:               Lockwood NB On Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data__________________________________

Type of analysis                            Merge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           275            vph

__________________________________On Ramp Data__________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-flow speed on ramp                     35.0           mph
Volume on ramp                              415            vph
Length of first accel/decel lane            1500           ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent Ramp                                    vph
Position of adjacent Ramp
Type of adjacent Ramp
Distance to adjacent Ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                     Freeway     Ramp        Adjacent
                                                                Ramp
Volume, V (vph)                         275         415                   vph
Peak-hour factor, PHF                   0.78        0.86
Peak 15-min volume, v15                 88          121                   v
Trucks and buses                        4           4                     %
Recreational vehicles                   0           0                     %
Terrain type:                           Level       Level
     Grade                                      %           %           %
     Length                                     mi          mi          mi
Trucks and buses PCE, ET                1.5         1.5
Recreational vehicle PCE, ER            1.2         1.2
```



```
Heavy vehicle adjustment, fHV           0.980       0.980
Driver population factor, fP            1.00        1.00
Flow rate, vp                           360         492                   pcph

_________________________Estimation of V12 Merge Areas_________________________

                  L  =            (Equation 13-6 or 13-7)
                   EQ
                  P  =    1.000   Using Equation  0
                   FM
                  v  = v  (P  ) =  360    pc/h
                   12   F   FM

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v                     852           4500            No
      FO
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3     av34
Is   v  or v      > 2700 pc/h?           No
      3     av34
Is   v  or v      > 1.5 v  /2            No
      3     av34         12
If yes, v    = 360               (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

________________________Flow Entering Merge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                852           4600                 No
      R12
_________________Level of Service Determination (if not F)_____________________

Density, D = 5.475 + 0.00734 v  + 0.0078 v   - 0.00627 L   =   2.5     pc/mi/ln
                              R             12          A
Level of service for ramp-freeway junction areas of influence  A

_____________________________Speed Estimation__________________________________

Intermediate speed variable,                 M  = 0.225
                                              S
Space mean speed in ramp influence area,     S  = 52.1    mph
                                              R
Space mean speed in outer lanes,             S  =  N/A    mph
                                              0
Space mean speed for all vehicles,           S  = 52.1    mph
_______________________________________________________________________________
```

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

DRAFT

Phone: Fax:
E-mail:

Merge Analysis

Analyst: JJ
Agency/Co.: Stantec Consulting Services
Date performed: 11/27/2013
Analysis time period: MD
Freeway/Dir of Travel: WB
Junction: Lockwood NB On Ramp
Jurisdiction:
Analysis Year: 2013
Description:

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	540	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	525	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	540	525		vph
Peak-hour factor, PHF	0.88	0.94		
Peak 15-min volume, v15	153	140		v
Trucks and buses	4	4		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.980	0.980		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	626	570		pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 626 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	1196	4500	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	

If yes, v_{12A} = 626 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	1196	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 5.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence A

Speed Estimation

Intermediate speed variable, M_S = 0.229

Space mean speed in ramp influence area, S_R = 52.0 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 52.0 mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

DRAFT

Phone: Fax:
E-mail:

Merge Analysis

Analyst:	JJ
Agency/Co.:	Stantec Consulting Services
Date performed:	11/27/2013
Analysis time period:	PM
Freeway/Dir of Travel:	WB
Junction:	Lockwood NB On Ramp
Jurisdiction:	
Analysis Year:	2013
Description:	

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	890	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	985	vph
Length of first accel/decel lane	1500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	890	985		vph
Peak-hour factor, PHF	0.91	0.84		
Peak 15-min volume, v15	245	293		v
Trucks and buses	4	4		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	0.980	0.980		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	998	1196		pcph

Estimation of V12 Merge Areas

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

P_{FM} = 1.000 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 998 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	2194	4500	No
v_3 or v_{av34}	0 pc/h	(Equation 13-14 or 13-17)	
Is v_3 or v_{av34} > 2700 pc/h?		No	
Is v_3 or v_{av34} > 1.5 v_{12}/2		No	
If yes, v_{12A} = 998		(Equation 13-15, 13-16, 13-18, or 13-19)	

Flow Entering Merge Influence Area

	Actual	Max Desirable	Violation?
v_{R12}	2194	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734 v_R + 0.0078 v_{12} - 0.00627 L_A$ = 12.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.251	
Space mean speed in ramp influence area,	S_R = 51.7	mph
Space mean speed in outer lanes,	S_0 = N/A	mph
Space mean speed for all vehicles,	S = 51.7	mph

HCS 2010: Freeway Merge and Diverge Segments Release 6.1

DRAFT

Phone: Fax:
E-mail:

Diverge Analysis

Analyst: JJ
Agency/Co.: Stantec Consulting Services
Date performed: 11/27/2013
Analysis time period: AM
Freeway/Dir of Travel: JIC EB
Junction: Lockwood SB Off Ramp
Jurisdiction:
Analysis Year: 2013
Description:

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	2	
Free-flow speed on freeway	55.0	mph
Volume on freeway	2565	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1120	vph
Length of first accel/decel lane	100	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	2565		1120			vph
Peak-hour factor, PHF	0.96		0.93			
Peak 15-min volume, v15	668		301			v
Trucks and buses	3		5			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	0.985		0.976			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	2712		1234			pcph

Estimation of V12 Diverge Areas

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

P_{FD} = 1.000 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2712 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	2712	4500	No
$v_{FO} = v_F - v_R$	1478	4500	No
v_R	1234	2000	No

v_3 or v_{av34} 0 pc/h (Equation 13-14 or 13-17)

Is v_3 or v_{av34} > 2700 pc/h? No

Is v_3 or v_{av34} > 1.5 v_{12} /2 No

If yes, v_{12A} = 2712 (Equation 13-15, 13-16, 13-18, or 13-19)

Flow Entering Diverge Influence Area

	Actual	Max Desirable	Violation?
v_{12}	2712	4400	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 26.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable, D_S = 0.539

Space mean speed in ramp influence area, S_R = 48.0 mph

Space mean speed in outer lanes, S_0 = N/A mph

Space mean speed for all vehicles, S = 48.0 mph

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          HCS 2010:  Freeway Merge and Diverge Segments Release 6.1





Phone:                                  Fax:
E-mail:

_________________________________Diverge Analysis______________________________

Analyst:                JJ
Agency/Co.:             Stantec Consulting Services
Date performed:         11/27/2013
Analysis time period:   MD
Freeway/Dir of Travel:  JIC EB
Junction:               Lockwood SB Off Ramp
Jurisdiction:
Analysis Year:          2013
Description:

__________________________________Freeway Data_________________________________

Type of analysis                            Diverge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           1300           vph

_________________________________Off Ramp Data_________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-Flow speed on ramp                     35.0           mph
Volume on ramp                              335            vph
Length of first accel/decel lane            100            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent ramp                                    vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1300        335                  vph
Peak-hour factor, PHF                  0.96        0.74
Peak 15-min volume, v15                339         113                   v
Trucks and buses                       3           5                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                             0.00    %   0.00    %           %
     Length                            0.00    mi  0.00    mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
```



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Heavy vehicle adjustment, fHV          0.985       0.976
Driver population factor, fP           1.00        1.00
Flow rate, vp                          1374        464                  pcph

_________________________Estimation of V12 Diverge Areas______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =     1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  1374   pc/h
                   12   R     F   R   FD

_______________________________Capacity Checks_________________________________

                           Actual        Maximum         LOS F?
     v  = v                1374          4500            No
      Fi   F
     v  = v - v            910           4500            No
      FO   F   R
     v                     464           2000            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3    av34
Is   v  or v       > 2700 pc/h?          No
      3    av34
Is   v  or v       > 1.5 v  /2           No
      3    av34          12
If yes, v    = 1374                  (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable        Violation?
     v                1374          4400                 No
      12
_________________Level of Service Determination (if not F)_____________________

Density,              D = 4.252 + 0.0086 v  - 0.009  L   =   15.2    pc/mi/ln
                       R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,               D  = 0.470
                                            S
Space mean speed in ramp influence area,   S  = 48.9    mph
                                            R
Space mean speed in outer lanes,           S  =  N/A    mph
                                            0
Space mean speed for all vehicles,         S  = 48.9    mph
_______________________________________________________________________________
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DRAFT

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Phone:                                   Fax:
E-mail:

_________________________________Diverge Analysis______________________________

Analyst:                 JJ
Agency/Co.:              Stantec Consulting Services
Date performed:          11/27/2013
Analysis time period:    PM
Freeway/Dir of Travel:   JIC EB
Junction:                Lockwood SB Off Ramp
Jurisdiction:
Analysis Year:           2013
Description:

__________________________________Freeway Data_________________________________

Type of analysis                            Diverge
Number of lanes in freeway                  2
Free-flow speed on freeway                  55.0           mph
Volume on freeway                           1225           vph

_________________________________Off Ramp Data_________________________________

Side of freeway                             Right
Number of lanes in ramp                     1
Free-Flow speed on ramp                     35.0           mph
Volume on ramp                              300            vph
Length of first accel/decel lane            100            ft
Length of second accel/decel lane                          ft

_________________________Adjacent Ramp Data (if one exists)____________________

Does adjacent ramp exist?                   No
Volume on adjacent ramp                                    vph
Position of adjacent ramp
Type of adjacent ramp
Distance to adjacent ramp                                  ft

____________________Conversion to pc/h Under Base Conditions___________________

Junction Components                    Freeway     Ramp        Adjacent
                                                               Ramp
Volume, V (vph)                        1225        300                   vph
Peak-hour factor, PHF                  0.98        0.91
Peak 15-min volume, v15                312         82                    v
Trucks and buses                       3           5                     %
Recreational vehicles                  0           0                     %
Terrain type:                          Level       Level
     Grade                             0.00    %   0.00    %           %
     Length                            0.00    mi  0.00    mi          mi
Trucks and buses PCE, ET               1.5         1.5
Recreational vehicle PCE, ER           1.2         1.2
Heavy vehicle adjustment, fHV          0.985       0.976
Driver population factor, fP           1.00        1.00
Flow rate, vp                          1269        338                   pcph

_________________________Estimation of V12 Diverge Areas_______________________

                  L  =            (Equation 13-12 or 13-13)
                   EQ
                  P  =    1.000   Using Equation  0
                   FD
                  v  = v  + (v - v ) P  =  1269   pc/h
                   12   R     F   R   FD

______________________________Capacity Checks__________________________________

                           Actual        Maximum         LOS F?
     v  = v                1269          4500            No
      Fi   F
     v  = v - v            931           4500            No
      FO   F   R
     v                     338           2000            No
      R
     v  or v               0    pc/h     (Equation 13-14 or 13-17)
      3    av34
Is   v  or v      > 2700 pc/h?           No
      3    av34
Is   v  or v      > 1.5 v  /2            No
      3    av34         12
If yes, v    = 1269                 (Equation 13-15, 13-16, 13-18, or 13-19)
         12A

______________________Flow Entering Diverge Influence Area_____________________
                      Actual        Max Desirable          Violation?
     v                1269          4400                   No
      12
_________________Level of Service Determination (if not F)_____________________

Density,              D = 4.252 + 0.0086 v  - 0.009  L   =   14.3    pc/mi/ln
                       R                  12          D
Level of service for ramp-freeway junction areas of influence B

_____________________________Speed Estimation__________________________________

Intermediate speed variable,             D  = 0.458
                                          S
Space mean speed in ramp influence area, S  = 49.0    mph
                                          R
Space mean speed in outer lanes,         S  =  N/A    mph
                                          0
Space mean speed for all vehicles,       S  = 49.0    mph
_______________________________________________________________________________
```