TRAFFIC STUDY

CITY COMMONS

RESIDENTIAL DEVELOPMENT

SOUTH COAST COMMUNITIES, LLC

City of Costa Mesa, CA

arch beach

CONSULTING

January 10, 2014

TRAFFIC STUDY

CITY COMMONS
RESIDENTIAL DEVELOPMENT

SOUTH COAST COMMUNITIES, LLC

City of Costa Mesa, California

Prepared by

arch beach
CONSULTING

Project No. 13-019
January 10, 2014

Contact
Arch Beach Consulting
1155 Camino Del Mar, #125
Del Mar, California 92014
office phone/fax (858) 925-6190
mobile phone (949) 637-9007
www.archbeachconsulting.com

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDICES

1.0 INTRODUCTION

The following presents a traffic study prepared by Arch Beach Consulting for South Coast Communities, LLC's proposed City Commons Residential Development (proposed project) in the City of Costa Mesa (City). The proposed project is the development of 28 single-family homes on a vacant parcel on the southwest corner of Harbor Boulevard and Hamilton Street in the City of Costa Mesa.

Based on information provided by the City, the project site is currently approved for General Commercial (retail) uses for up to 11,275 square feet. This use would generate approximately 766 daily trips. The proposed project, 28 single-family homes, would generate approximately 268 daily trips. The proposed project would generate approximately 498 *less* daily trips than the currently approved commercial uses on the site. Therefore, the following traffic study primarily focuses on the circulation and access operations of the proposed project along Charle Street and Hamilton Street at the Existing plus Project level.

This traffic study has been prepared based on consultation with the City Traffic Engineer, and is consistent with the traffic analysis methodologies of the City.

Purpose and Objectives of the Traffic Impact Study Update

The purpose of this traffic study is to evaluate the traffic and circulation impacts of the proposed project. The study objectives of this traffic study include:

- Documentation of existing traffic conditions and future with project traffic conditions corresponding to the "Existing plus Project" scenario.
- Determination of additional circulation and access features needed to achieve the City's levels of service requirements with implementation of the proposed project.

Site Location and Study Area

Regional access to the site is provided by Interstate 405 (I-405), State Route 55 (SR 55), and Pacific Coast Highway – State Route 1 (SR 1 – PCH), while local access to the site is provided by Harbor Boulevard, Hamilton Street, and Charle Street. Per consultation with the City Traffic Engineer, the study area intersections are as follows:

1. Harbor Boulevard/Hamilton Street
2. Charle Street/Hamilton Street
3. Charle Street/Main Project Driveway
4. Outbound Project Driveway/Hamilton Street

All four intersections are within the jurisdiction of the City.

Methodology

The signalized study area intersection of Harbor Boulevard/Hamilton Street was analyzed using the Intersection Capacity Utilization (ICU) methodology for weekday a.m. and p.m. peak hour levels of service (LOS). The ICU method determines the volume-to-capacity (V/C) ratio on a critical lane basis and determines LOS associated with each critical V/C ratio at the signalized intersection. All four study intersections were analyzed using the *Highway Capacity Manual* (HCM) "Operations" methodology. The HCM method determines the average control delay a driver may experience at the intersection, as well as provides queue lengths for the 95th percentile (design) queue.

The degree of congestion at an intersection is described by the level of service, which ranges from LOS A to LOS F, with LOS A representing free-flow conditions with little delay and LOS F representing over-saturated traffic flow throughout the peak hour. A complete description of the meaning of level of service can be found in the Highway Research Board Special Report 209, *Highway Capacity Manual* (HCM 2000). Brief descriptions of the six levels of service for signalized and unsignalized intersections based on the HCM methodology are shown in Table A. Table B below provides detailed descriptions of each level of service.

Table A – Level of Service Definitions

Level of Service	V/C Ratio or ICU (signalized)	Control Delay in Seconds (signalized)	Control Delay in Seconds (unsignalized)
A	0.00 – 0.60	0.0 – 10.0 seconds	0.0 – 10.0 seconds
B	0.61 – 0.70	10.1 – 20.0 seconds	10.1 – 15.0 seconds
C	0.71 – 0.80	20.1 – 35.0 seconds	15.1 – 25.0 seconds
D	0.81 – 0.90	35.1 – 55.0 seconds	25.1 – 35.0 seconds
E	0.91 – 1.00	55.1 – 80.0 seconds	35.1 – 50.0 seconds
F	1.01 or greater	80.1 seconds or greater	50.1 seconds or greater

Table B – Level of Service Descriptions

LOS	Description
A	No approach phase is fully utilized by traffic, and no vehicle waits longer than one red indication. Typically, the approach appears quite open, turns are made easily, and nearly all drivers find freedom of operation.
B	This service level represents stable operation, where an occasional approach phase is fully utilized and a substantial number are nearing full use. Many drivers begin to feel restricted within platoons of vehicles.
C	This level still represents stable operating conditions. Occasionally drivers may have to wait through more than one red signal indication, and backups may develop behind turning vehicles. Most drivers feel somewhat restricted, but not objectionably so.
D	This level encompasses a zone of increasing restriction approaching instability at the intersection. Delays to approaching vehicles may be substantial during short peaks within the peak period; however, enough cycles with lower demand occur to permit periodic clearance of developing queues, thus preventing excessive backups.
E	Capacity occurs at the upper end of this service level. It represents the most vehicles that any particular intersection approach can accommodate. Full utilization of every signal cycle is seldom attained no matter how great the demand.
F	This level describes forced flow operations at low speeds, where volumes exceed capacity. These conditions usually result from queues of vehicles backing up from a restriction downstream. Speeds are reduced substantially, and stoppages may occur for short or long periods of time due to the congestion. In the extreme case, both speed and volume can drop to zero.

Source: Highway Capacity Manual, Transportation Research Board, Special Report No. 209, Washington, D.C., 2000.

Significance Criteria

For signalized intersections, the proposed project would create a significant impact if it causes an intersection to operate from LOS D or better, to LOS E or F with addition of project traffic, or if the project contributes 0.010 ICU or more when the performance standard (LOS D) is exceeded.

For unsignalized intersections, LOS is based on the control delay, but delay is only assessed for those traffic movements that are stopped or must yield to through traffic. Some movements, including cross traffic on the minor street or left turns onto the major street are acceptable with long delays, provided through traffic and right turns from a major street do not experience any delays at stopped intersections. When delay for cross traffic is severe (LOS F), the intersection should be further evaluated for possible improvement with traffic signals. In some cases, this analysis determines that the delay is being experienced by a very low number of vehicles and traffic signals are not warranted. For this condition, the intersection does not need to be considered impacted, but measures to reduce delay may be considered, if appropriate. In other cases, the number of stopped vehicles is substantial and traffic signals may be justified as a mitigation measure.

Thus, an unsignalized intersection impact is considered to be significant if the traffic signal warrant analysis determines that a signal is justified (minimum of 100 trips per hour on the minor leg approach subject to delay, 150 trips if the approach has two lanes), and the project contributes more than 10 percent of the total future added trips.

Traffic Analysis Scenarios

This traffic study analyzed the following traffic scenarios:

Existing Condition

Existing traffic volumes were collected at the study area intersections in November 2013 during a typical weekday while the adjacent schools were in session. The existing traffic scenario constitutes the environmental setting in accordance with the California Environmental Quality Act (CEQA) analysis at the time that the hearing body reviews the proposed project.

Existing plus Project Condition

The Existing plus Project Condition traffic was developed by adding the proposed project traffic to the Existing (baseline) Condition. This scenario was the basis for determining project-specific impacts and mitigation measures.

2.0 PROJECT DESCRIPTION AND TRAFFIC GENERATION

The following section provides information on the operation of the proposed project relative to the local and regional circulation network.

Project Size and Description

Figure 1 illustrates the site plan of the proposed project. The project applicant is South Coast Communities, LLC. The proposed project is the City Commons residential development which would develop 28 single-family homes in a gated community on a vacant parcel on the southwest corner of Harbor Boulevard and Hamilton Street in the City of Costa Mesa. Primary access is proposed at a new full-access driveway on Charle Street, and secondary outbound-only and right-turn only access is proposed on Hamilton Street, approximately 50 feet west of Harbor Boulevard. All inbound access to the project site would occur from the driveway proposed on Charle Street. A single, two-way driveway aisle would traverse the site, between Hamilton Street and Charle Street, with homes loading on both sides of the street. Inbound and outbound access to and from the site would be controlled by sliding gates at the driveways.

Based on information provided by the City, the project site is currently approved for General Commercial (retail) uses for up to 11,275 square feet. This use would generate approximately 766 daily trips. The proposed project, 28 single-family homes, would generate approximately 268 daily trips. The proposed project would generate approximately 498 *less* daily trips than the currently approved commercial uses on the site.

Project Traffic

This section describes the trip generation, distribution, and assignment of the proposed project's traffic volumes on the study area transportation network facilities.

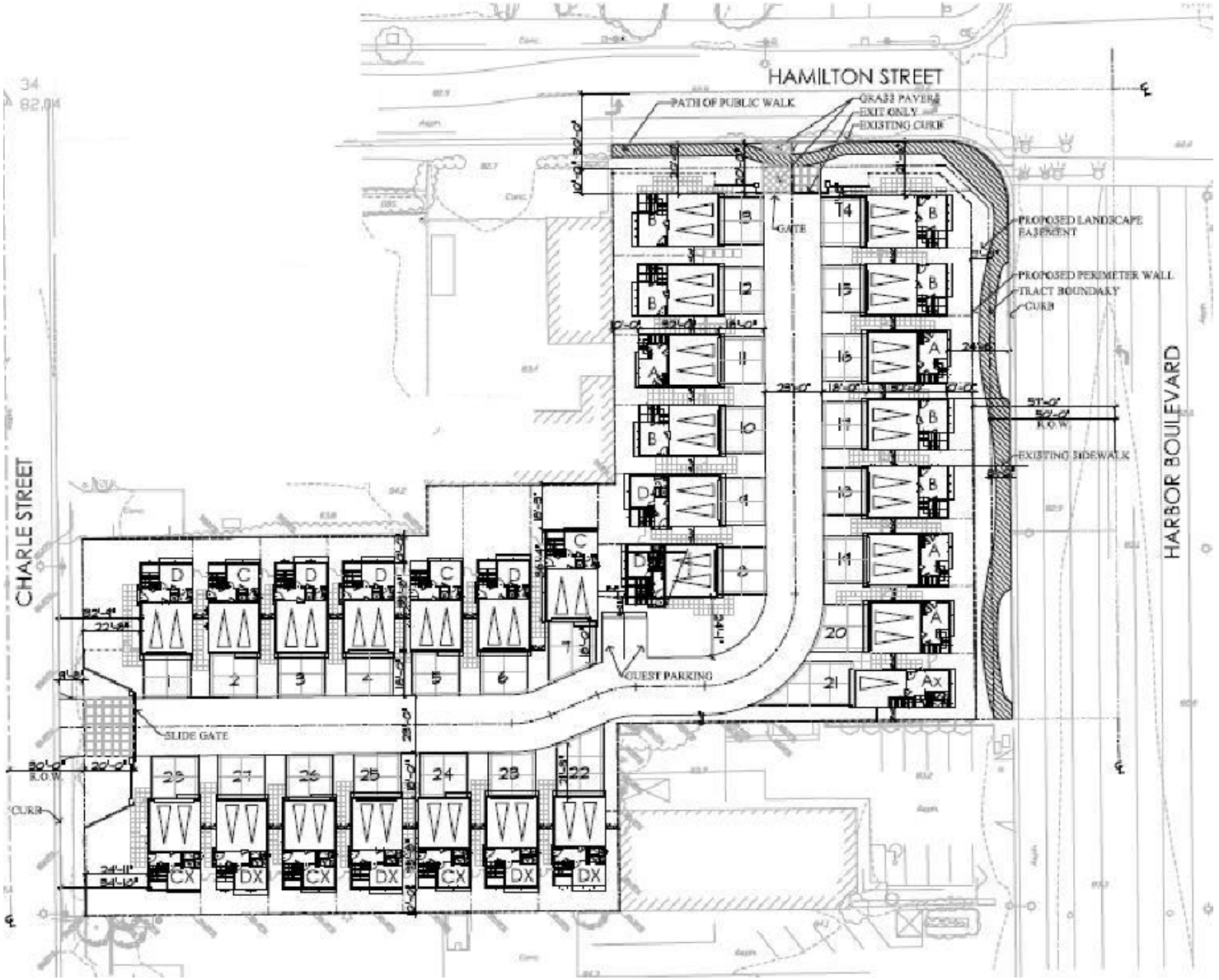
Trip Generation

Weekday daily, a.m. and p.m. peak hour trip generation estimates for the proposed project were developed using trip rates provided in the Institute of Transportation Engineers (ITE) *Trip Generation*, 9th *Edition.* Summaries of the trip generation rates and resulting vehicle trips for the proposed project are presented in Table C.

Table C – Project Trip Generation Estimates

Land Use	Size/Units	Daily	AM Peak Hour			PM Peak Hour		
			In	Out	Total	In	Out	Total
TRIP RATES								
Single-Family Detached Home	per DU	9.52	0.19	0.56	0.75	0.63	0.37	1.00
TRIP GENERATION								
Single-Family Detached Home	28 DUs	**267**	**5**	**16**	**21**	**18**	**10**	**28**

Notes: Trip rates from *Trip Generation, 9th Edition*, Institute of Transportation Engineers, 2012.



Source: Lim Chang Rohling & Associates, January 2014.

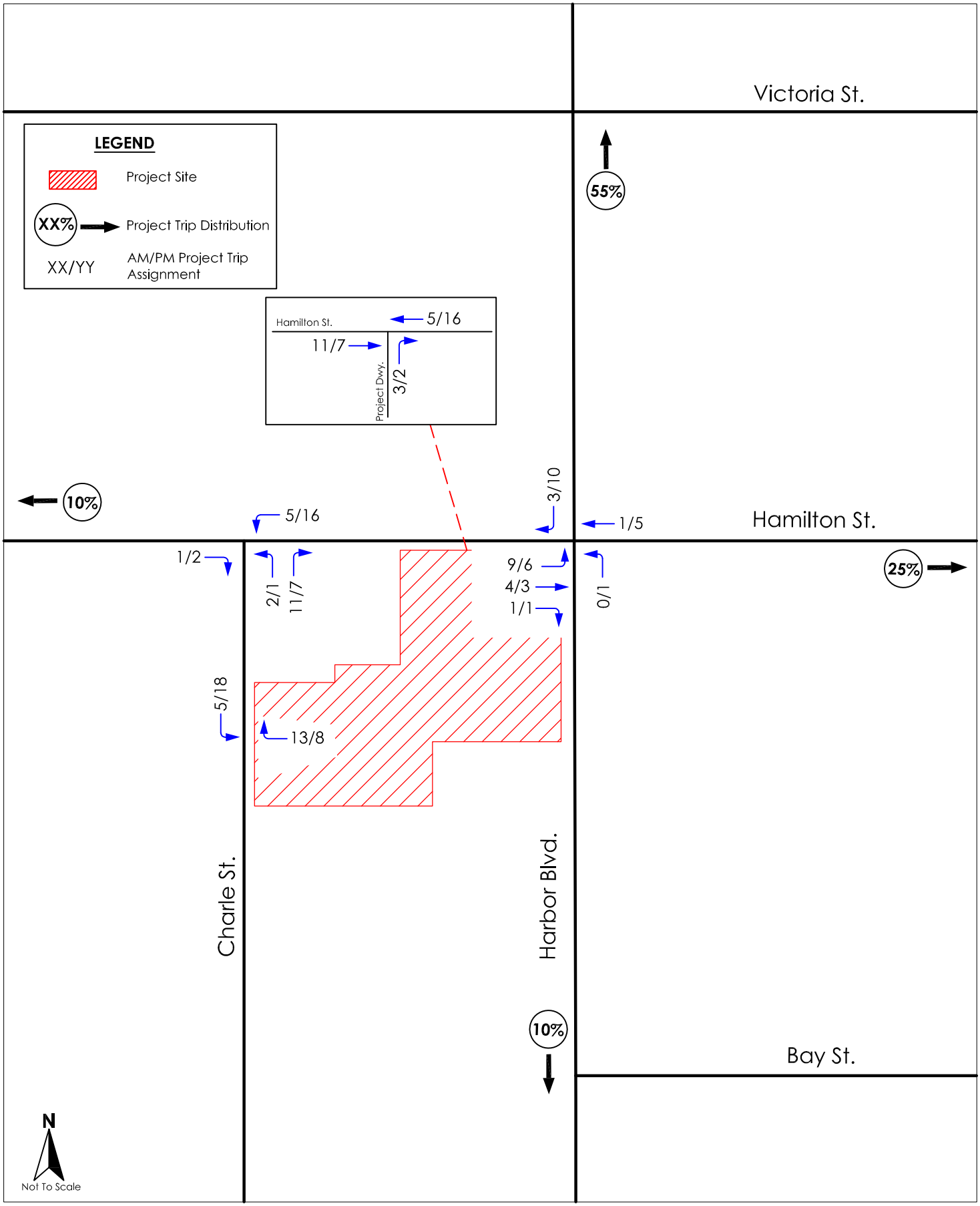
arch beach CONSULTING

Figure 1
Project Site Plan

According to the table, the proposed project would generate approximately 267 daily trips, 21 a.m. peak hour trips (5 inbound and 16 outbound), and 28 p.m. peak hour trips (18 inbound and 10 outbound).

Trip Distribution and Assignment

Trip distribution percentages for the proposed project were based on review of the existing traffic patterns at the Harbor Boulevard/Hamilton Street intersection. Figure 2 illustrates the trip distribution percentages for the proposed project. The trip distribution percentages at each intersection were applied to the proposed project's weekday a.m. and p.m. peak hour trip generation estimates to calculate the project trip assignment (i.e., turn movement volumes that the project would generate at each study area intersection). The resulting weekday a.m. and p.m. peak hour trip assignments are also shown on Figure 2.



arch beach CONSULTING

Figure 2
Project Trip Distribution and Assignment

3.0 EXISTING CONDITIONS ANALYSIS

The following section describes the existing traffic conditions in the project study area. Existing traffic volumes were collected in November 2013 during a typical week while adjacent schools were in session. This section describes the traffic conditions related to the following traffic scenarios:

- Existing Conditions
- Existing plus Project

Existing Traffic Conditions

Roadways

The following describes the roadways in the study area that would serve the proposed project:

Harbor Boulevard

Harbor Boulevard is a north-south Major Arterial on the City's Circulation Element that provides continuous access through the cities of Santa Ana, Garden Grove, Anaheim, Fullerton, and La Habra. Harbor Boulevard also provides access to I-405 and SR 55. At the Orange-Los Angeles County border, Harbor Boulevard becomes Fullerton Road. Within the study area, it is a six-lane divided road with a painted median serving as a two-way left-turn lane (TWLTL) providing access to commercial uses along the road. There are sidewalks on both sides, and on-street parking is not permitted on either side of the street. The posted speed limit is 40 miles per hour (MPH). In general, in the project vicinity, retail/commercial and light industrial land uses line Harbor Boulevard.

Hamilton Street

In the project vicinity, Hamilton Street is an east-west Collector on the City's Circulation Element that provides continuous access through residential neighborhoods between Placentia Avenue and SR 55. Within the study area, it is a two-lane undivided road. There are also sidewalks and Class II bike lanes on both sides, and on-street parking is permitted only on the north side of the street. The posted speed limit is 25 MPH. In general, in the project vicinity, residential land uses line Hamilton Street. Per counts collected in November 2013, the average daily traffic volume (ADT) on Hamilton Street, east of Charle Street is 7,500 ADT (raw count data provided in Appendix A).

Charle Street

Charle Street is a north-south street that provides access to multi-family residential uses, retail/commercial uses, and light industrial uses between Hamilton Street and Bernard Street. Within the study area, it is a two-lane undivided road. There are sidewalks, and on-street parking is permitted on both sides of the street. Per counts collected in November 2013, the average daily traffic volume (ADT) on Charle Street, south of Hamilton Street is 1,200 ADT (raw count data provided in Appendix A).

Intersection Geometrics and Traffic Volumes

Figure 3 illustrates the existing traffic controls and lane geometrics at the study area intersections. Figure 4 shows the existing a.m. and p.m. peak hour traffic volumes at the study intersections. The raw traffic volume count sheets are provided in Appendix A.

Levels of Service

Based on the analysis methodology described in Section 1.0, the existing a.m. and p.m. peak hour traffic volumes were input into the Traffix and Synchro LOS software to determine the intersection ICU, delay, and LOS values. Table D presents the results of the existing intersection LOS analysis, while the LOS calculation sheets are provided in Appendix B.

Table D – Existing Condition Intersection Level of Service Summary

Intersection	Control	AM Peak Hour		PM Peak Hour	
		V/C or Delay	LOS	V/C or Delay	LOS
1. Harbor Boulevard/Hamilton Street	signal	0.447 22.7 seconds	A C	0.552 26.1 seconds	A C
2. Charle Street/Hamilton Street	1-way stop	12.0 seconds	B	12.6 seconds	B
3. Charle Street/Main Project Driveway	1-way stop	*does not exist*		*does not exist*	
4. Outbound Project Driveway/Hamilton St	1-way stop	*does not exist*		*does not exist*	

Based on the existing LOS analysis, the two existing study area intersections are currently operating with satisfactory LOS (LOS D or better) during both peak hours.

Existing plus Project

Traffic generated by the proposed project was added to the existing scenario and the project impacts on the circulation system were analyzed. This scenario would determine project-specific impacts and mitigation measures (if required) with project traffic added to existing traffic volumes.

Traffic Volumes

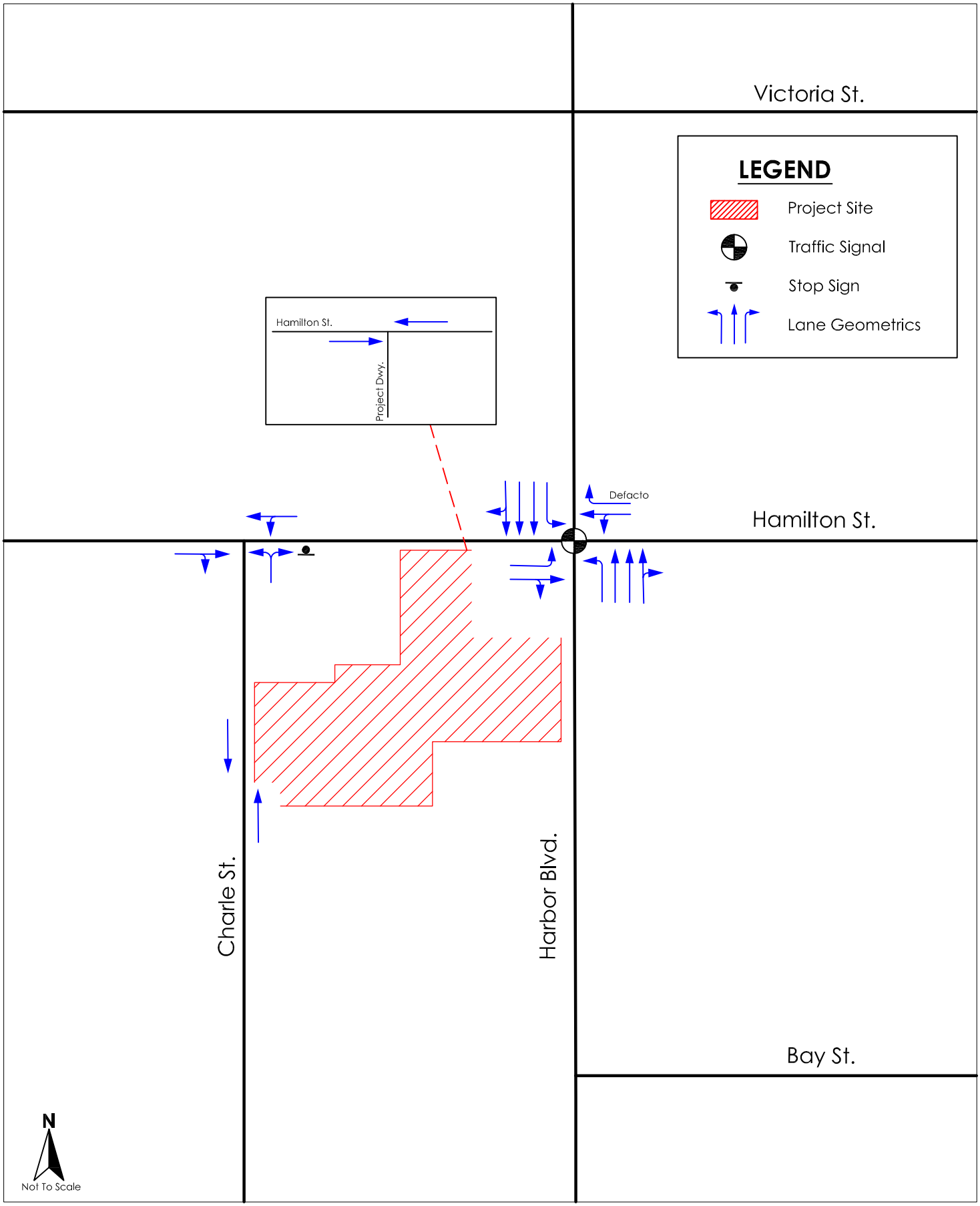
The proposed project trip assignment shown in Figure 2 was added to the existing traffic volumes in Figure 4 which resulted in the Existing plus Project traffic volumes. Figure 5 illustrates the Existing plus Project a.m. and p.m. peak hour traffic volumes.

Levels of Service

Based on the analysis methodology described in Section 1.0, the Existing plus Project a.m. and p.m. peak hour traffic volumes were input into the Traffix and Synchro LOS software to determine the intersection delay and LOS values. Table E presents the results of the Existing plus Project intersection LOS analysis, while the LOS calculation sheets are provided in Appendix B.

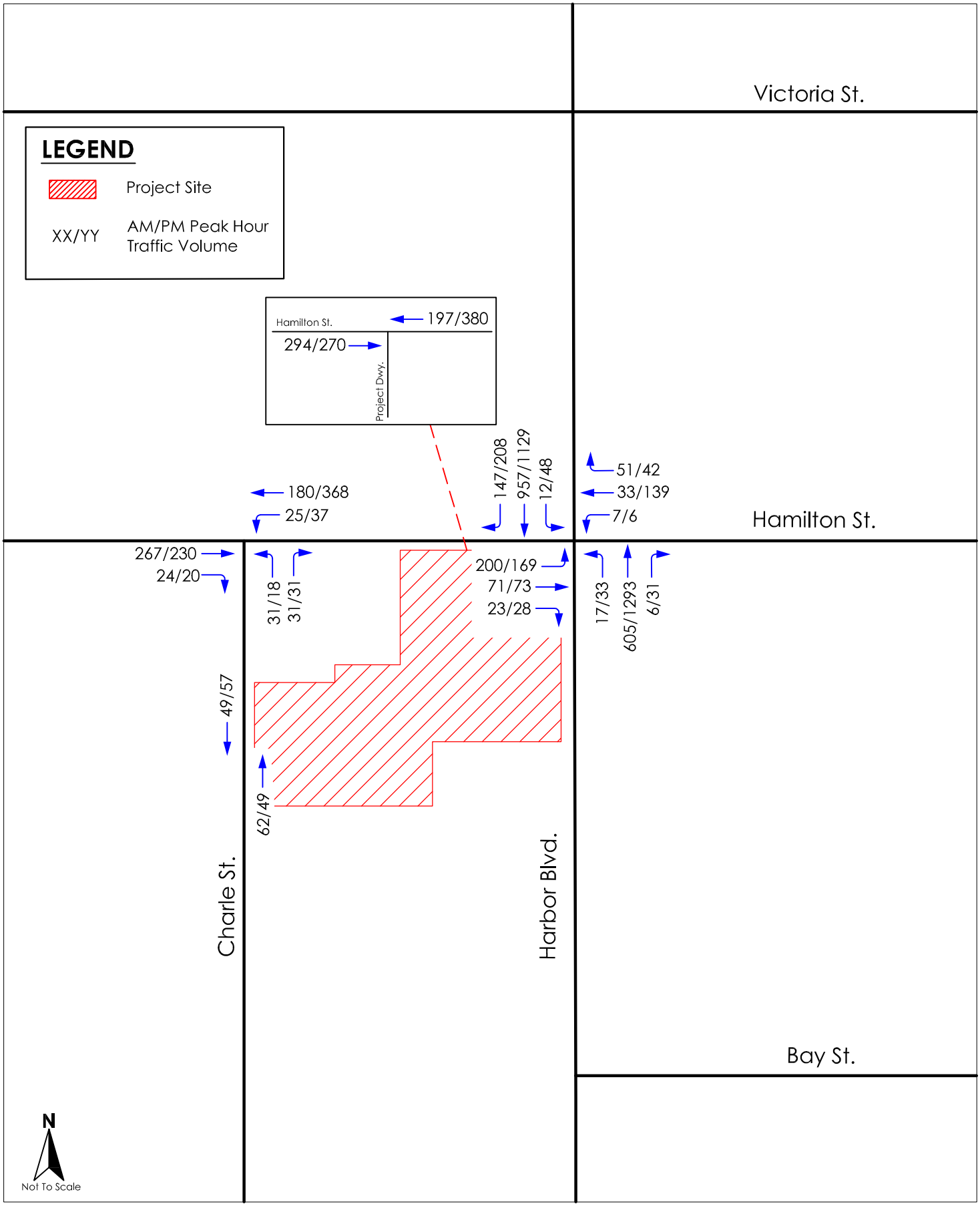
Based on the Existing plus Project LOS analysis, both existing study area intersections would continue to operate with satisfactory LOS (LOS D or better) with addition of traffic from the proposed project, and the two new access driveways would also operate with satisfactory LOS.

No mitigation measures are required.



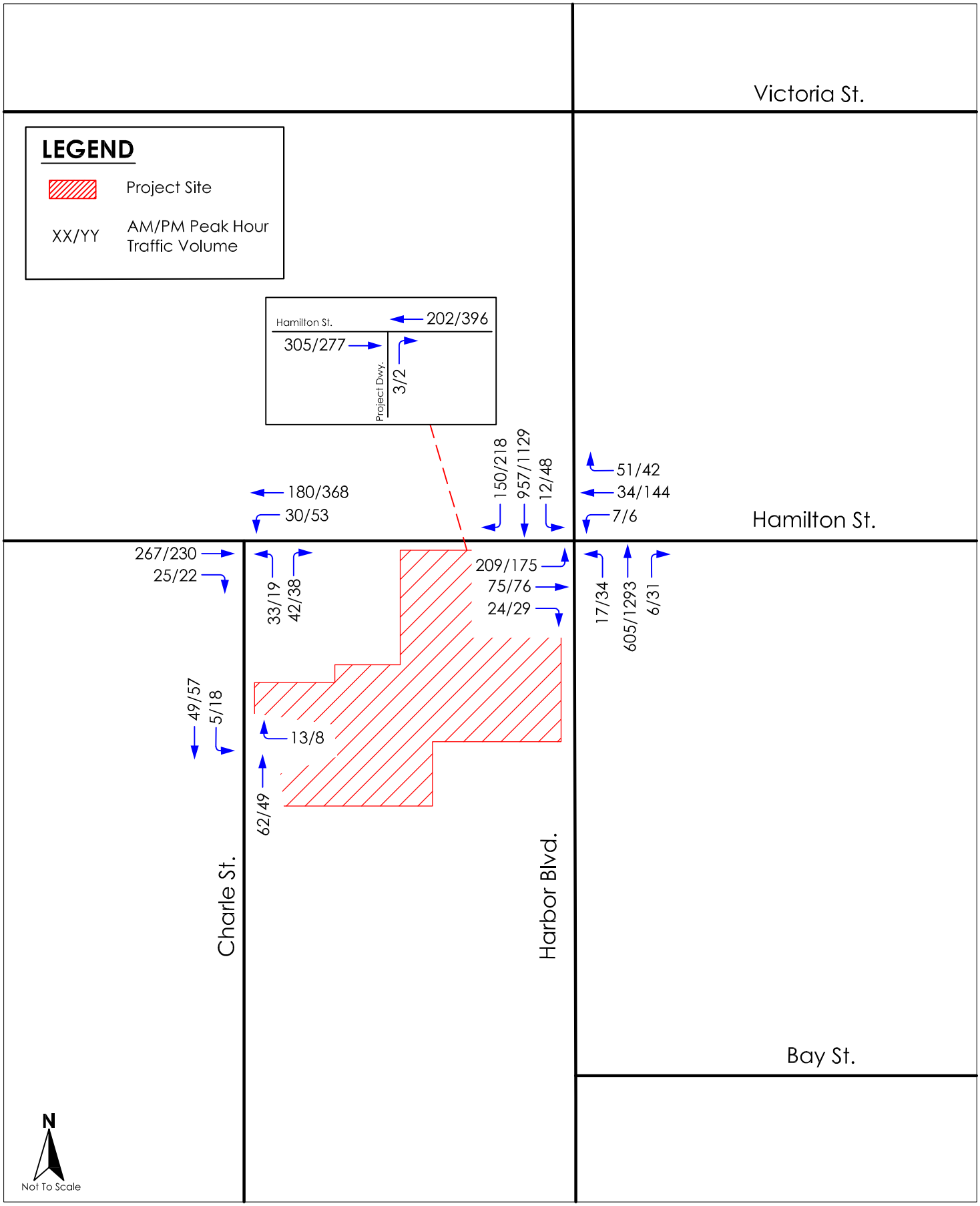
arch beach CONSULTING

Figure 3
Existing Traffic Controls
and Intersection Geometrics



arch beach CONSULTING

Figure 4
Existing AM and PM
Peak Hour Traffic Volumes



arch beach CONSULTING

Figure 5
Existing plus Project AM and PM Peak Hour Traffic Volumes

Table E – Existing plus Project Condition Intersection Level of Service Summary

Intersection	Control	Existing Condition				Existing plus Project				Difference		Impact?
		AM Peak Hour		PM Peak Hour		AM Peak Hour		PM Peak Hour				
		V/C or Delay	LOS	V/C or Delay	LOS	V/C or Delay	LOS	V/C or Delay	LOS	AM	PM	
1. Harbor Blvd/Hamilton St	signal	0.447 22.7 sec	A C	0.552 26.1 sec	A C	0.447 22.8 sec	A C	0.559 26.3 sec	A C	0.000 +0.1 sec	+0.007 +0.2 sec	no no
2. Charle St/Hamilton St	1-way stop	12.0 sec	B	12.6 sec	B	12.1 sec	B	12.8 sec	B	+0.1 sec	+0.2 sec	no
3. Charle St/Main Proj Dwy	1-way stop	*does not exist*		*does not exist*		8.7 sec	A	8.6 sec	A	+8.7 sec	+8.6 sec	no
4. Outbound Dwy/Hamilton St	1-way stop	*does not exist*		*does not exist*		10.1 sec	B	9.9 sec	A	+10.1 sec	+9.9 sec	no

4.0 ACCESS AND CIRCULATION

Project Access and Circulation

The proposed project would provide primary access off Charle Street via a new 23-foot wide driveway. This driveway would provide for full access for inbound and outbound project traffic. A secondary limited-access 23-foot wide driveway would be located towards the northeastern corner of the site, approximately 50 feet from Harbor Boulevard. This access would be limited to outbound right-turning traffic from the site only. All other site ingress/egress would occur off the primary driveway on Charle Street. Both driveways are proposed to be gated and controlled by a key card issued to residents. For guests, a call box would be provided at the Charle Street driveway.

Because of the close spacing between the secondary driveway and Harbor Boulevard (approximately 50 feet, from tangent of curve between the driveways), and the relatively high volume of eastbound left turning vehicles at the Harbor Boulevard/Hamilton Street intersection during the peak hours, the project would construct a raised island, or "pork chop", at the driveway to prevent outbound project vehicles to weave into the eastbound left turn lane at Harbor Boulevard/Hamilton Street. Project vehicles destined to travel northbound on Harbor Boulevard would be required to use the primary driveway on Charle Street to access the eastbound left turn storage lane at the intersection. This driveway treatment would require vehicles exiting this driveway to travel eastbound on Hamilton Street, or southbound on Harbor Boulevard. Figure 6 illustrates the conceptual plan for this driveway treatment.

A single, two-way 23-foot wide driveway aisle would traverse the site, between Hamilton Street and Charle Street, with homes loading on both sides of the street.

Emergency vehicle-only access would be provided at the secondary driveway on Hamilton Street. Emergency vehicles would be given inbound access at the gate via a key card or Knox box.

Queuing Analysis on Hamilton Street

A queuing analysis was prepared for the Existing plus Project conditions using the Synchro traffic analysis software which uses queuing analysis methodology consistent with the *Highway Capacity Manual* (HCM). This analysis focuses on the segment of Hamilton Street, between Charle Street and Harbor Boulevard. Copies of the analysis worksheets are provided in Appendix C. The following summarizes the results of the queuing analysis:

Harbor Boulevard/Hamilton Street (eastbound approach queue)

- Without the addition of project traffic, the 95th percentile (design) queue for eastbound left turn lane (lane with highest volume): 173 feet (approximately 8 cars) in the a.m. peak hour; and, 157 feet (approximately 7 cars) in the p.m. peak hour. The eastbound left-turn lane storage length is 150 feet. Therefore, the eastbound left turn queues currently exceed the storage capacity.
- With addition of project traffic, the 95th percentile (design) queue for eastbound left turn lane (lane with highest volume): 182 feet (approximately 8 cars) in the a.m. peak hour; and, 165 feet (approximately 7-8 cars) in the p.m. peak hour. With the addition of project traffic, the eastbound left turn storage capacity would continue to be exceeded by at least one car in the p.m. peak hour, from 7 cars to 8 cars (a.m. peak hour would remain at 8 cars).

- Because the Existing and Existing plus Project queues on the eastbound left turn lane exceed the storage capacity of 150 feet (by one car-length in the p.m. peak hour), it is recommended that the proposed project limit access to the eastbound left turn lane from its Hamilton Street outbound driveway by installing a raised median treatment ("pork chop") to eliminate project outbound vehicles weaving from the driveway to the left turn lane. Figure 6 illustrates this concept.

  In addition, it is recommended that the proposed project extend the length of the eastbound left-turn storage lane by an additional 50 feet, for a total storage length of 200 feet. This would involve minor re-striping of the existing pavement markings on Hamilton Street, and the loss of one on-street parking space to accommodate approximately 25 feet of additional red-curb (no parking) to accommodate the shift of the westbound transitional lane striping. This recommendation would improve the Existing (without project) queuing condition, as well as accommodate the Existing plus Project condition.

  The outbound driveway on Hamilton Street will be gated. This egress gate will be designed such that it opens only when vehicles approach the gate from inside the project site. In addition, "grass-crete" or turf pavers will be installed on the emergency-only ingress side of the gate to discourage drivers from trying to enter the project site on Hamilton Street.

Charle Street/Hamilton Street (westbound approach queue)

- 95th percentile (design) queue for westbound approach: two feet (one car) in a.m. peak hour; and, four feet (one car) in p.m. peak hour.
- The stacking distance between Charle Street and Harbor Boulevard is approximately 340 feet, therefore, there would be no queuing impacts.

Gate Queuing Analysis on Charle Street

A gate queuing analysis was prepared for the primary (gated) driveway on Charle Street using the Crommelin methodology from *Entrance-Exit Design and Control for Major Parking Facilities* (Robert Crommelin and Associates, Inc., October 1972). Using the appropriate *Parking Control Service Rate* numbers (Table 4 of report, see Appendix D) for vehicles entering and exiting the gated driveway, and applying to the Poisson distribution table of the report (page 8 of report, see Appendix D), the number of queued vehicles in an hour can be determined.

Per the Crommelin methodology, the design service rates for a "coded-card operated gate" are 340 vehicles per hour entering through the gate, and 320 vehicles per hour exiting through the gate. Based on the peak hour volumes of the proposed project, the peak inbound demand would occur during the p.m. peak hour with 18 inbound vehicles with a *traffic intensity* (see Poisson distribution table in Appendix D) of 0.05. The peak outbound demand would occur during the a.m. peak hour with 13 outbound vehicles with a *traffic intensity* of 0.04. Applying the traffic intensities from both peak hours at the gate on Charle Street, the reservoir required behind the gate would be less than one vehicle.

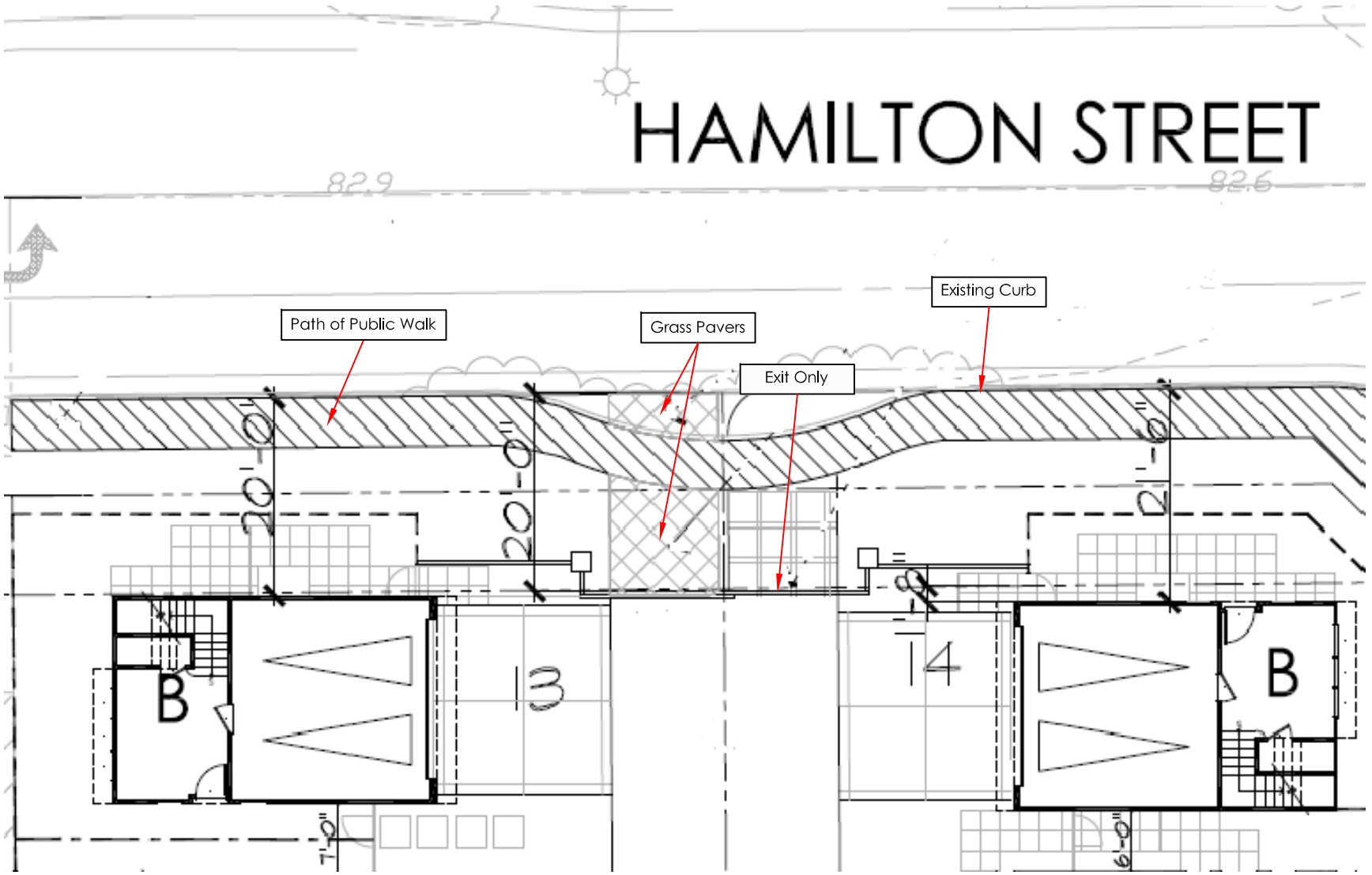
Therefore, the current design of the gated access on Charle Street would be adequate to serve the proposed project.

Recommendation

No significant impacts from the proposed project to on-site circulation, access, and queuing were found.

However, because the Existing and Existing plus Project queues on the eastbound left turn lane exceed the storage capacity of 150 feet (by one car-length in the p.m. peak hour), it is recommended that the proposed project limit access to the eastbound left turn lane from its Hamilton Street outbound driveway by installing a raised median treatment ("pork chop") to eliminate project outbound vehicles weaving from the driveway to the left turn lane. Figure 6 illustrates this concept.

In addition, it is recommended that the proposed project extend the length of the eastbound left-turn storage lane by an additional 50 feet, for a total storage length of 200 feet. This would involve minor re-striping of the existing pavement markings on Hamilton Street, and the loss of one on-street parking space to accommodate approximately 25 feet of additional red-curb (no parking) to accommodate the shift of the westbound transitional lane striping. This recommendation would improve the Existing (without project) queuing condition, as well as accommodate the Existing plus Project condition.



Source: Lim Chang Rohling & Associates, January 2014.

arch beach CONSULTING

Figure 6
Conceptual Outbound
Access Treatment

5.0 CONCLUSIONS AND RECOMMENDATIONS

The following section provides the conclusions and recommendations (if any) for the traffic analysis of the proposed project as noted above in Sections 3.0 – Existing Conditions, and 4.0 – Access and Circulation.

Project Trip Generation

The proposed project would generate approximately 267 daily trips, 21 a.m. peak hour trips (5 inbound and 16 outbound), and 28 p.m. peak hour trips (18 inbound and 10 outbound).

Based on information provided by the City, the project site is currently approved for General Commercial (retail) uses for up to 11,275 square feet. This use would generate approximately 766 daily trips. The proposed project, 28 single-family homes, would generate approximately 268 daily trips. The proposed project would generate approximately 498 *less* daily trips than the currently approved commercial uses on the site.

Existing plus Project

Based on the Existing plus Project LOS analysis, all study area intersections would continue to operate with satisfactory LOS (LOS D or better) with addition of traffic from the proposed project.

No mitigation measures are required.

Access and Circulation

No significant impacts from the proposed project to on-site circulation, access, and queuing were found.

However, because the Existing and Existing plus Project queues on the eastbound left turn lane exceed the storage capacity of 150 feet (by one car-length in the p.m. peak hour), it is recommended that the proposed project limit access to the eastbound left turn lane from its Hamilton Street outbound driveway by installing a raised median treatment ("pork chop") to eliminate project outbound vehicles weaving from the driveway to the left turn lane. The outbound driveway on Hamilton Street will be gated. This egress gate will be designed such that it opens only when vehicles approach the gate from inside the project site. In addition, "grass-crete" or turf pavers will be installed on the emergency-only ingress side of the gate to discourage drivers from trying to enter the project site on Hamilton Street.

In addition, it is recommended that the proposed project extend the length of the eastbound left-turn storage lane by an additional 50 feet, for a total storage length of 200 feet. This would involve minor re-striping of the existing pavement markings on Hamilton Street, and the loss of one on-street parking space to accommodate approximately 25 feet of additional red-curb (no parking) to accommodate the shift of the westbound transitional lane striping. This recommendation would improve the Existing (without project) queuing condition, as well as accommodate the Existing plus Project condition.

6.0 REFERENCES

City of Costa Mesa, *General Plan Circulation Element* (Chapter 3).

Robert Crommelin and Associates, Inc., *Entrance-Exit Design and Control for Major Parking Facilities*, October 1972.

Institute of Transportation Engineers, *Trip Generation, 9th Edition*, 2012.

Transportation Research Board, *Highway Capacity Manual*, Special Report No. 209, Washington, D.C., 2000.

APPENDIX A

Raw Traffic Volume Count Sheets

ITM Peak Hour Summary

Prepared by:

National Data & Surveying Services

Harbor Blvd and Hamilton St , Costa Mesa

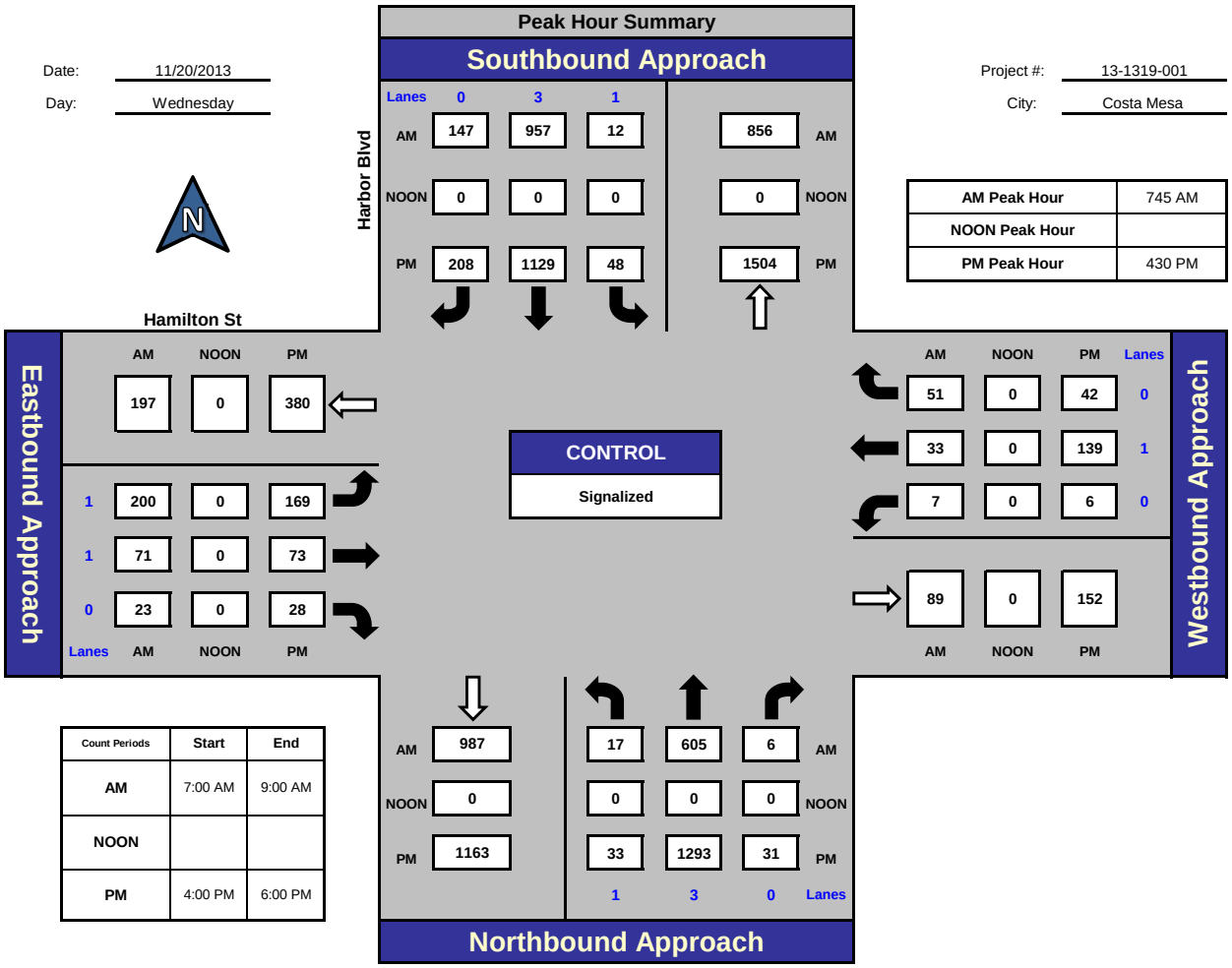
Date: 11/20/2013

Day: Wednesday

Project #: 13-1319-001

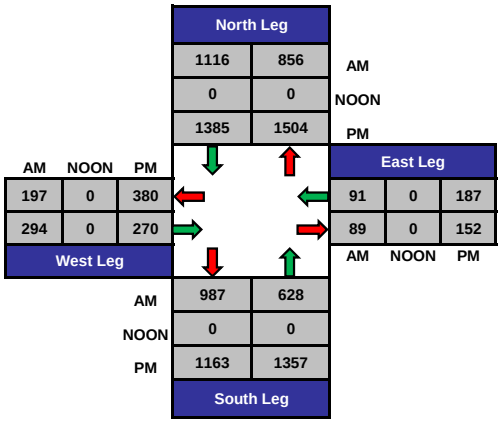
City: Costa Mesa

AM Peak Hour	745 AM
NOON Peak Hour	
PM Peak Hour	430 PM

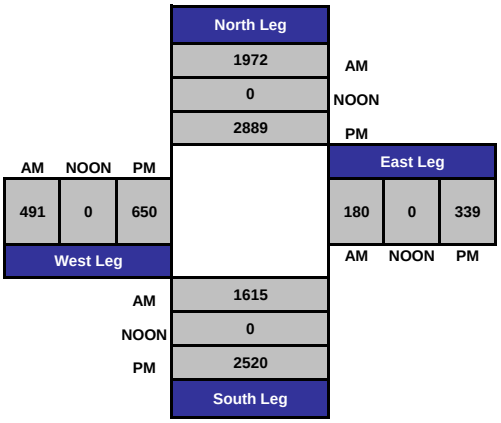


Count Periods	Start	End
AM	7:00 AM	9:00 AM
NOON		
PM	4:00 PM	6:00 PM

Total Ins & Outs



Total Volume Per Leg



ITM Peak Hour Summary

Prepared by:

National Data & Surveying Services

Charle St and Hamilton St , Costa Mesa

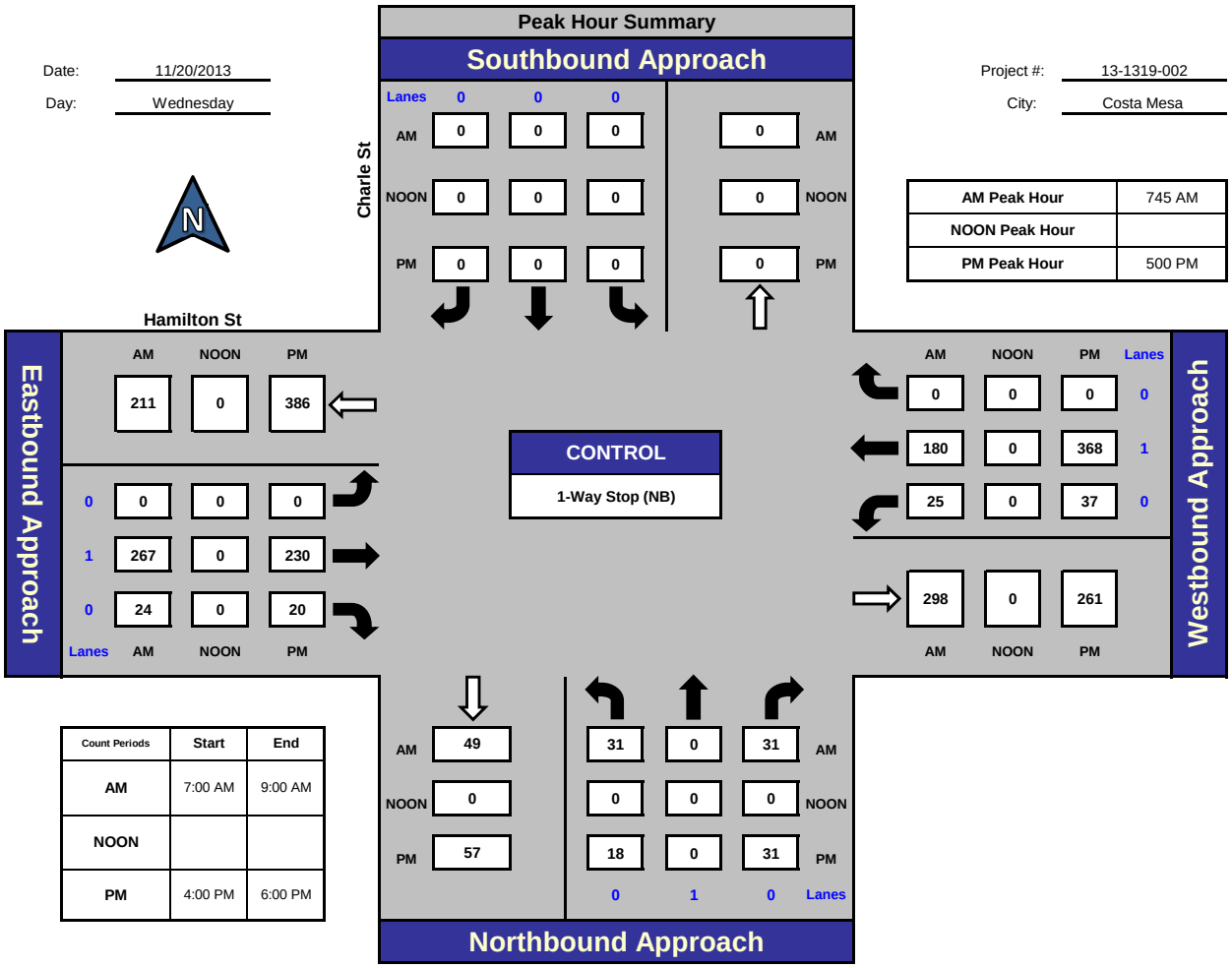
Date: 11/20/2013

Day: Wednesday

Project #: 13-1319-002

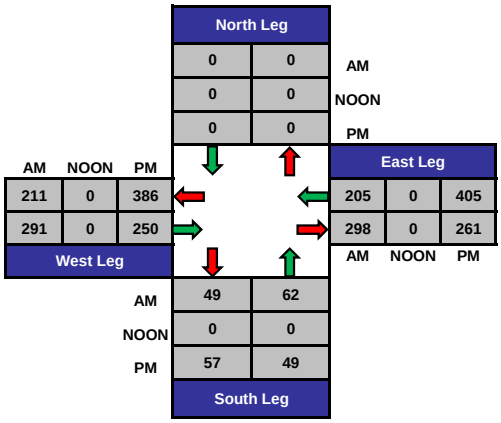
City: Costa Mesa

AM Peak Hour	745 AM
NOON Peak Hour	
PM Peak Hour	500 PM

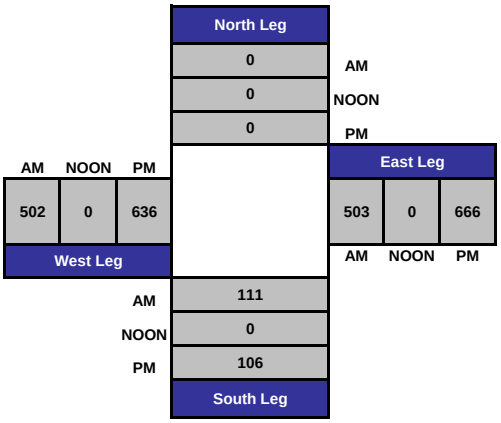


Count Periods	Start	End
AM	7:00 AM	9:00 AM
NOON		
PM	4:00 PM	6:00 PM

Total Ins & Outs



Total Volume Per Leg



Prepared by NDS/ATD

VOLUME

Hamilton St E/o Charle St

Day: Wednesday
Date: 11/20/2013

City: Costa Mesa
Project #: CA13_1320_001

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	3,856	3,645	7,501

AM Period	NB	SB	EB		WB		TOTAL		PM Period	NB	SB	EB		WB		TOTAL	
00:00			7		10		17		12:00			50		51		101	
00:15			5		12		17		12:15			51		43		94	
00:30			6		9		15		12:30			69		71		140	
00:45			1	19	3	34	4	53	12:45			57	227	45	210	102	437
01:00			2		7		9		13:00			61		50		111	
01:15			1		1		2		13:15			60		66		126	
01:30			5		4		9		13:30			64		51		115	
01:45			2	10	0	12	2	22	13:45			75	260	70	237	145	497
02:00			4		1		5		14:00			68		66		134	
02:15			1		4		5		14:15			71		76		147	
02:30			4		1		5		14:30			57		61		118	
02:45			1	10	1	7	2	17	14:45			55	251	56	259	111	510
03:00			1		3		4		15:00			76		45		121	
03:15			1		0		1		15:15			73		62		135	
03:30			0		1		1		15:30			72		59		131	
03:45			2	4	2	6	4	10	15:45			70	291	85	251	155	542
04:00			3		1		4		16:00			70		87		157	
04:15			4		1		5		16:15			76		100		176	
04:30			4		4		8		16:30			74		83		157	
04:45			5	16	4	10	9	26	16:45			72	292	87	357	159	649
05:00			8		2		10		17:00			57		101		158	
05:15			15		3		18		17:15			72		105		177	
05:30			22		2		24		17:30			76		111		187	
05:45			24	69	7	14	31	83	17:45			60	265	79	396	139	661
06:00			24		9		33		18:00			55		45		100	
06:15			25		22		47		18:15			42		74		116	
06:30			56		26		82		18:30			54		65		119	
06:45			55	160	32	89	87	249	18:45			56	207	66	250	122	457
07:00			57		26		83		19:00			63		59		122	
07:15			73		36		109		19:15			36		50		86	
07:30			68		51		119		19:30			41		35		76	
07:45			71	269	60	173	131	442	19:45			44	184	46	190	90	374
08:00			80		49		129		20:00			40		37		77	
08:15			80		44		124		20:15			41		52		93	
08:30			83		40		123		20:30			32		37		69	
08:45			62	305	42	175	104	480	20:45			24	137	52	178	76	315
09:00			78		39		117		21:00			22		30		52	
09:15			62		47		109		21:15			18		39		57	
09:30			65		46		111		21:30			22		23		45	
09:45			51	256	37	169	88	425	21:45			22	84	27	119	49	203
10:00			62		47		109		22:00			14		32		46	
10:15			49		47		96		22:15			15		26		41	
10:30			54		40		94		22:30			7		26		33	
10:45			46	211	41	175	87	386	22:45			13	49	16	100	29	149
11:00			67		53		120		23:00			6		13		19	
11:15			65		51		116		23:15			6		16		22	
11:30			60		37		97		23:30			12		13		25	
11:45			59	251	42	183	101	434	23:45			5	29	9	51	14	80
TOTALS				1580		1047		**2627**	**TOTALS**				2276		2598		**4874**
SPLIT %				60.1%		39.9%		**35.0%**	**SPLIT %**				46.7%		53.3%		**65.0%**

DAILY TOTALS	NB	SB	EB	WB	Total
	0	0	3,856	3,645	7,501

AM Peak Hour			07:45	11:45	**07:45**	**PM Peak Hour**			16:00	16:45	**16:45**
AM Pk Volume			314	207	**507**	**PM Pk Volume**			292	404	**681**
Pk Hr Factor			0.946	0.729	**0.968**	**Pk Hr Factor**			0.961	0.910	**0.910**
7 - 9 Volume	0	0	574	348	**922**	**4 - 6 Volume**	0	0	557	753	**1310**
7 - 9 Peak Hour			07:45	07:30	**07:45**	**4 - 6 Peak Hour**			16:00	16:45	**16:45**
7 - 9 Pk Volume	0	0	314	204	**507**	**4 - 6 Pk Volume**	0	0	292	404	**681**
Pk Hr Factor	0.000	0.000	0.946	0.850	**0.968**	**Pk Hr Factor**	0.000	0.000	0.961	0.910	**0.910**

Prepared by NDS/ATD

VOLUME

Charle St S/o Hamilton St

Day: Wednesday
Date: 11/20/2013

City: Costa Mesa
Project #: CA13_1320_002

DAILY TOTALS	NB	SB	EB	WB	Total
	601	570	0	0	1,171

AM Period	NB		SB		EB	WB	TOTAL		PM Period	NB		SB		EB	WB	TOTAL	
00:00	1		0				1		12:00	4		5				9	
00:15	0		7				7		12:15	6		9				15	
00:30	1		2				3		12:30	8		7				15	
00:45	0	2	0	9			0	11	12:45	7	25	8	29			15	54
01:00	1		1				2		13:00	7		7				14	
01:15	1		1				2		13:15	12		6				18	
01:30	2		2				4		13:30	8		7				15	
01:45	2	6	0	4			2	10	13:45	11	38	9	29			20	67
02:00	2		0				2		14:00	8		14				22	
02:15	0		0				0		14:15	11		9				20	
02:30	0		0				0		14:30	9		6				15	
02:45	0	2	1	1			1	3	14:45	8	36	6	35			14	71
03:00	0		0				0		15:00	12		10				22	
03:15	0		0				0		15:15	10		11				21	
03:30	0		0				0		15:30	13		9				22	
03:45	0		1	1			1	1	15:45	9	44	11	41			20	85
04:00	0		0				0		16:00	8		11				19	
04:15	0		0				0		16:15	10		11				21	
04:30	1		1				2		16:30	10		15				25	
04:45	0	1	0	1			0	2	16:45	17	45	21	58			38	103
05:00	0		0				0		17:00	12		11				23	
05:15	1		0				1		17:15	19		16				35	
05:30	2		1				3		17:30	13		11				24	
05:45	1	4	0	1			1	5	17:45	9	53	12	50			21	103
06:00	2		0				2		18:00	11		7				18	
06:15	6		3				9		18:15	9		11				20	
06:30	4		6				10		18:30	10		7				17	
06:45	8	20	9	18			17	38	18:45	10	40	11	36			21	76
07:00	7		8				15		19:00	15		3				18	
07:15	13		6				19		19:15	6		8				14	
07:30	15		6				21		19:30	3		7				10	
07:45	16	51	8	28			24	79	19:45	8	32	8	26			16	58
08:00	15		13				28		20:00	4		7				11	
08:15	11		11				22		20:15	7		12				19	
08:30	16		10				26		20:30	5		4				9	
08:45	9	51	8	42			17	93	20:45	4	20	5	28			9	48
09:00	12		10				22		21:00	3		4				7	
09:15	8		7				15		21:15	7		7				14	
09:30	8		4				12		21:30	6		4				10	
09:45	5	33	5	26			10	59	21:45	4	20	3	18			7	38
10:00	5		13				18		22:00	2		2				4	
10:15	7		6				13		22:15	1		3				4	
10:30	7		5				12		22:30	3		5				8	
10:45	7	26	12	36			19	62	22:45	3	9	1	11			4	20
11:00	14		8				22		23:00	0		1				1	
11:15	14		10				24		23:15	1		4				5	
11:30	5		6				11		23:30	2		2				4	
11:45	5	38	6	30			11	68	23:45	2	5	5	12			7	17
TOTALS		234		197				**431**	**TOTALS**		367		373				**740**
SPLIT %		54.3%		45.7%				**36.8%**	**SPLIT %**		49.6%		50.4%				**63.2%**

DAILY TOTALS	NB	SB	EB	WB	Total
	601	570	0	0	1,171

AM Peak Hour	07:15	07:45			**07:45**	**PM Peak Hour**	16:45	16:30			**16:30**
AM Pk Volume	59	42			**100**	**PM Pk Volume**	61	63			**121**
Pk Hr Factor	0.922	0.808			**0.893**	**Pk Hr Factor**	0.803	0.750			**0.796**
7 - 9 Volume	102	70	0	0	**172**	**4 - 6 Volume**	98	108	0	0	**206**
7 - 9 Peak Hour	07:15	07:45			**07:45**	**4 - 6 Peak Hour**	16:45	16:30			**16:30**
7 - 9 Pk Volume	59	42	0	0	**100**	**4 - 6 Pk Volume**	61	63	0	0	**121**
Pk Hr Factor	0.922	0.808	0.000	0.000	**0.893**	**Pk Hr Factor**	0.803	0.750	0.000	0.000	**0.796**

APPENDIX B

Intersection Level of Service Worksheets

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #1

Cycle (sec):	100	Critical Vol./Cap.(X):	0.447
Loss Time (sec):	5	Average Delay (sec/veh):	xxxxxx
Optimal Cycle:	22	Level Of Service:	A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	2	1 0	1 0	2	1 0	1 0	0	1 0	0 1	0	0 1
Volume Module:												
Base Vol:	17	605	6	12	957	147	200	71	23	7	33	51
Growth 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
Initial Bse:	17	605	6	12	957	147	200	71	23	7	33	51
User 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
PHF 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
PHF Volume:	17	605	6	12	957	147	200	71	23	7	33	51
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	17	605	6	12	957	147	200	71	23	7	33	51
PCE 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
MLF 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
FinalVolume:	17	605	6	12	957	147	200	71	23	7	33	51
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.97	0.03	1.00	2.60	0.40	1.00	0.76	0.24	0.18	0.82	1.00
Final Sat.:	1600	4753	47	1600	4161	639	1600	1209	391	280	1320	1600
Capacity Analysis Module:												
Vol/Sat:	0.01	0.13	0.13	0.01	0.23	0.23	0.13	0.06	0.06	0.00	0.03	0.03
Crit Moves:	****				****		****					****

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #1

Cycle (sec):	100	Critical Vol./Cap.(X):	0.552
Loss Time (sec):	5	Average Delay (sec/veh):	xxxxxx
Optimal Cycle:	26	Level Of Service:	A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	2 1	0	1 0	2 1	0	1 0	0 1	0	0 1	0 0	1
Volume Module:												
Base Vol:	33	1293	31	48	1129	208	169	73	28	6	139	42
Growth 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
Initial Bse:	33	1293	31	48	1129	208	169	73	28	6	139	42
User 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
PHF 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
PHF Volume:	33	1293	31	48	1129	208	169	73	28	6	139	42
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	33	1293	31	48	1129	208	169	73	28	6	139	42
PCE 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
MLF 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
FinalVolume:	33	1293	31	48	1129	208	169	73	28	6	139	42
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.93	0.07	1.00	2.53	0.47	1.00	0.72	0.28	0.04	0.96	1.00
Final Sat.:	1600	4688	112	1600	4053	747	1600	1156	444	66	1534	1600
Capacity Analysis Module:												
Vol/Sat:	0.02	0.28	0.28	0.03	0.28	0.28	0.11	0.06	0.06	0.00	0.09	0.03
Crit Moves:		****			****			****			****	

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #1

Cycle (sec):	100	Critical Vol./Cap.(X):	0.447
Loss Time (sec):	5	Average Delay (sec/veh):	xxxxxx
Optimal Cycle:	22	Level Of Service:	A

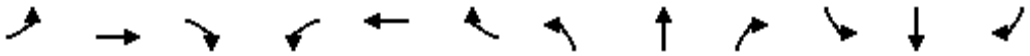
Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	2 1	0	1 0	2 1	0	1 0	0 1	0	0 1	0 0	1
Volume Module:												
Base Vol:	17	605	6	12	957	150	209	75	24	7	34	51
Growth 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
Initial Bse:	17	605	6	12	957	150	209	75	24	7	34	51
User 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
PHF 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
PHF Volume:	17	605	6	12	957	150	209	75	24	7	34	51
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	17	605	6	12	957	150	209	75	24	7	34	51
PCE 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
MLF 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
FinalVolume:	17	605	6	12	957	150	209	75	24	7	34	51
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.97	0.03	1.00	2.59	0.41	1.00	0.76	0.24	0.17	0.83	1.00
Final Sat.:	1600	4753	47	1600	4150	650	1600	1212	388	273	1327	1600
Capacity Analysis Module:												
Vol/Sat:	0.01	0.13	0.13	0.01	0.23	0.23	0.13	0.06	0.06	0.00	0.03	0.03
Crit Moves:	****				****		****				****	

Level Of Service Computation Report
ICU 1(Loss as Cycle Length %) Method (Base Volume Alternative)

Intersection #1

Cycle (sec):	100	Critical Vol./Cap.(X):	0.559
Loss Time (sec):	5	Average Delay (sec/veh):	xxxxxx
Optimal Cycle:	26	Level Of Service:	A

Approach:	North Bound			South Bound			East Bound			West Bound		
Movement:	L	T	R	L	T	R	L	T	R	L	T	R
Control:	Protected			Protected			Permitted			Permitted		
Rights:	Include			Include			Include			Include		
Min. Green:	0	0	0	0	0	0	0	0	0	0	0	0
Y+R:	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lanes:	1 0	2 1	0	1 0	2 1	0	1 0	0 1	0	0 1	0 0	1
Volume Module:												
Base Vol:	34	1293	31	48	1129	218	175	76	29	6	144	42
Growth 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
Initial Bse:	34	1293	31	48	1129	218	175	76	29	6	144	42
User 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
PHF 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
PHF Volume:	34	1293	31	48	1129	218	175	76	29	6	144	42
Reduct Vol:	0	0	0	0	0	0	0	0	0	0	0	0
Reduced Vol:	34	1293	31	48	1129	218	175	76	29	6	144	42
PCE 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
MLF 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
FinalVolume:	34	1293	31	48	1129	218	175	76	29	6	144	42
Saturation Flow Module:												
Sat/Lane:	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600	1600
Adjustment:	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Lanes:	1.00	2.93	0.07	1.00	2.51	0.49	1.00	0.72	0.28	0.04	0.96	1.00
Final Sat.:	1600	4688	112	1600	4023	777	1600	1158	442	64	1536	1600
Capacity Analysis Module:												
Vol/Sat:	0.02	0.28	0.28	0.03	0.28	0.28	0.11	0.07	0.07	0.00	0.09	0.03
Crit Moves:		****			****			****			****	



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	200	71	23	7	33	51	17	605	6	12	957	147
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		3.7	4.4		3.7	4.4	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.91		1.00	0.91	
Frt	1.00	0.96			0.92		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1795			1715		1770	5078		1770	4984	
Flt Permitted	0.66	1.00			0.98		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1237	1795			1691		1770	5078		1770	4984	
Peak-hour factor, PHF	0.91	0.91	0.91	0.73	0.73	0.73	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	220	78	25	10	45	70	18	637	6	13	1007	155
RTOR Reduction (vph)	0	13	0	0	46	0	0	1	0	0	23	0
Lane Group Flow (vph)	220	90	0	0	79	0	18	642	0	13	1139	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	31.0	31.0			31.0		12.3	35.6		12.3	35.6	
Effective Green, g (s)	31.0	31.0			31.0		12.3	35.6		12.3	35.6	
Actuated g/C Ratio	0.34	0.34			0.34		0.14	0.39		0.14	0.39	
Clearance Time (s)	4.0	4.0			4.0		3.7	4.4		3.7	4.4	
Lane Grp Cap (vph)	421	611			576		239	1987		239	1950	
v/s Ratio Prot		0.05					c0.01	0.13		0.01	c0.23	
v/s Ratio Perm	c0.18				0.05							
v/c Ratio	0.52	0.15			0.14		0.08	0.32		0.05	0.58	
Uniform Delay, d1	24.1	20.8			20.7		34.4	19.3		34.3	21.9	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.6	0.5			0.5		0.6	0.4		0.4	1.3	
Delay (s)	28.6	21.3			21.2		35.0	19.7		34.7	23.1	
Level of Service	C	C			C		C	B		C	C	
Approach Delay (s)		26.3			21.2			20.1			23.3	
Approach LOS		C			C			C			C	

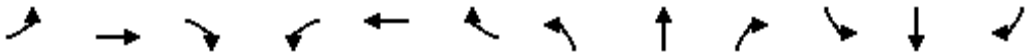
Intersection Summary			
HCM Average Control Delay	22.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	91.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	46.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	267	24	25	180	31	31
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.98	0.98	0.85	0.85	0.82	0.82
Hourly flow rate (vph)	272	24	29	212	38	38
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				310		
pX, platoon unblocked						
vC, conflicting volume			297		555	285
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			297		555	285
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			98		92	95
cM capacity (veh/h)			1264		481	754

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	297	241	76
Volume Left	0	29	38
Volume Right	24	0	38
cSH	1700	1264	587
Volume to Capacity	0.17	0.02	0.13
Queue Length 95th (ft)	0	2	11
Control Delay (s)	0.0	1.1	12.0
Lane LOS		A	B
Approach Delay (s)	0.0	1.1	12.0
Approach LOS			B

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	40.0%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	169	73	28	6	139	42	33	1293	31	48	1129	208
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		3.7	4.4		3.7	4.4	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.91		1.00	0.91	
Frt	1.00	0.96			0.97		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1785			1804		1770	5067		1770	4967	
Flt Permitted	0.53	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	993	1785			1795		1770	5067		1770	4967	
Peak-hour factor, PHF	0.88	0.88	0.88	0.85	0.85	0.85	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	192	83	32	7	164	49	35	1376	33	52	1227	226
RTOR Reduction (vph)	0	15	0	0	11	0	0	2	0	0	29	0
Lane Group Flow (vph)	192	100	0	0	209	0	35	1407	0	52	1424	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	31.0	31.0			31.0		12.3	35.6		12.3	35.6	
Effective Green, g (s)	31.0	31.0			31.0		12.3	35.6		12.3	35.6	
Actuated g/C Ratio	0.34	0.34			0.34		0.14	0.39		0.14	0.39	
Clearance Time (s)	4.0	4.0			4.0		3.7	4.4		3.7	4.4	
Lane Grp Cap (vph)	338	608			611		239	1982		239	1943	
v/s Ratio Prot		0.06					0.02	0.28		c0.03	c0.29	
v/s Ratio Perm	c0.19				0.12							
v/c Ratio	0.57	0.16			0.34		0.15	0.71		0.22	0.73	
Uniform Delay, d1	24.5	21.0			22.4		34.7	23.3		35.1	23.6	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	6.8	0.6			1.5		1.3	2.2		2.1	2.5	
Delay (s)	31.3	21.5			23.9		36.0	25.5		37.1	26.1	
Level of Service	C	C			C		D	C		D	C	
Approach Delay (s)		27.6			23.9			25.8			26.5	
Approach LOS		C			C			C			C	

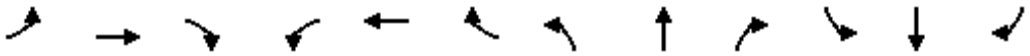
Intersection Summary			
HCM Average Control Delay	26.1	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	91.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	63.0%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	230	20	37	368	18	31
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.83	0.83	0.92	0.92	0.82	0.82
Hourly flow rate (vph)	277	24	40	400	22	38
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				310		
pX, platoon unblocked						
vC, conflicting volume			301		770	289
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			301		770	289
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		94	95
cM capacity (veh/h)			1260		357	750

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	301	440	60
Volume Left	0	40	22
Volume Right	24	0	38
cSH	1700	1260	534
Volume to Capacity	0.18	0.03	0.11
Queue Length 95th (ft)	0	2	9
Control Delay (s)	0.0	1.0	12.6
Lane LOS		A	B
Approach Delay (s)	0.0	1.0	12.6
Approach LOS			B

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	48.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	209	75	24	7	34	51	17	605	6	12	957	150
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		3.7	4.4		3.7	4.4	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.91		1.00	0.91	
Frt	1.00	0.96			0.93		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1795			1717		1770	5078		1770	4982	
Flt Permitted	0.66	1.00			0.98		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1232	1795			1694		1770	5078		1770	4982	
Peak-hour factor, PHF	0.91	0.91	0.91	0.73	0.73	0.73	0.95	0.95	0.95	0.95	0.95	0.95
Adj. Flow (vph)	230	82	26	10	47	70	18	637	6	13	1007	158
RTOR Reduction (vph)	0	13	0	0	46	0	0	1	0	0	23	0
Lane Group Flow (vph)	230	95	0	0	81	0	18	642	0	13	1142	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	31.0	31.0			31.0		12.3	35.6		12.3	35.6	
Effective Green, g (s)	31.0	31.0			31.0		12.3	35.6		12.3	35.6	
Actuated g/C Ratio	0.34	0.34			0.34		0.14	0.39		0.14	0.39	
Clearance Time (s)	4.0	4.0			4.0		3.7	4.4		3.7	4.4	
Lane Grp Cap (vph)	420	611			577		239	1987		239	1949	
v/s Ratio Prot		0.05					c0.01	0.13		0.01	c0.23	
v/s Ratio Perm	c0.19				0.05							
v/c Ratio	0.55	0.16			0.14		0.08	0.32		0.05	0.59	
Uniform Delay, d1	24.3	20.9			20.8		34.4	19.3		34.3	21.9	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.1	0.5			0.5		0.6	0.4		0.4	1.3	
Delay (s)	29.4	21.4			21.3		35.0	19.7		34.7	23.2	
Level of Service	C	C			C		C	B		C	C	
Approach Delay (s)		26.8			21.3			20.1			23.3	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	22.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	91.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	47.1%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	267	25	30	180	33	42
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.98	0.98	0.85	0.85	0.82	0.82
Hourly flow rate (vph)	272	26	35	212	40	51
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				443		
pX, platoon unblocked						
vC, conflicting volume			298		568	285
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			298		568	285
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			97		91	93
cM capacity (veh/h)			1263		471	754

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	298	247	91
Volume Left	0	35	40
Volume Right	26	0	51
cSH	1700	1263	596
Volume to Capacity	0.18	0.03	0.15
Queue Length 95th (ft)	0	2	13
Control Delay (s)	0.0	1.4	12.1
Lane LOS		A	B
Approach Delay (s)	0.0	1.4	12.1
Approach LOS			B

Intersection Summary			
Average Delay		2.3	
Intersection Capacity Utilization		41.1%	ICU Level of Service
Analysis Period (min)		15	

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	13	62	0	5	49
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	14	67	0	5	53
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	132	67			67	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	132	67			67	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	99			100	
cM capacity (veh/h)	859	996			1534	

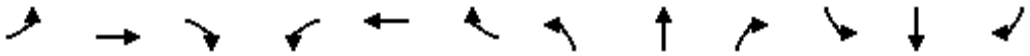
Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	14	67	59
Volume Left	0	0	5
Volume Right	14	0	0
cSH	996	1700	1534
Volume to Capacity	0.01	0.04	0.00
Queue Length 95th (ft)	1	0	0
Control Delay (s)	8.7	0.0	0.7
Lane LOS	A		A
Approach Delay (s)	8.7	0.0	0.7
Approach LOS	A		

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	16.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	305	0	0	202	0	3
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	332	0	0	220	0	3
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				133		
pX, platoon unblocked						
vC, conflicting volume			332		551	332
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			332		551	332
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1228		495	710

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	332	220	3
Volume Left	0	0	0
Volume Right	0	0	3
cSH	1700	1700	710
Volume to Capacity	0.20	0.13	0.00
Queue Length 95th (ft)	0	0	0
Control Delay (s)	0.0	0.0	10.1
Lane LOS			B
Approach Delay (s)	0.0	0.0	10.1
Approach LOS			B

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	26.1%	ICU Level of Service	A
Analysis Period (min)	15		



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	175	76	29	6	144	42	34	1293	31	48	1129	218
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		3.7	4.4		3.7	4.4	
Lane Util. Factor	1.00	1.00			1.00		1.00	0.91		1.00	0.91	
Frt	1.00	0.96			0.97		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1785			1805		1770	5067		1770	4962	
Flt Permitted	0.53	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	982	1785			1796		1770	5067		1770	4962	
Peak-hour factor, PHF	0.88	0.88	0.88	0.85	0.85	0.85	0.94	0.94	0.94	0.92	0.92	0.92
Adj. Flow (vph)	199	86	33	7	169	49	36	1376	33	52	1227	237
RTOR Reduction (vph)	0	15	0	0	11	0	0	2	0	0	32	0
Lane Group Flow (vph)	199	104	0	0	214	0	36	1407	0	52	1432	0
Turn Type	Perm			Perm			Prot			Prot		
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)	31.0	31.0			31.0		12.3	35.6		12.3	35.6	
Effective Green, g (s)	31.0	31.0			31.0		12.3	35.6		12.3	35.6	
Actuated g/C Ratio	0.34	0.34			0.34		0.14	0.39		0.14	0.39	
Clearance Time (s)	4.0	4.0			4.0		3.7	4.4		3.7	4.4	
Lane Grp Cap (vph)	335	608			612		239	1982		239	1941	
v/s Ratio Prot		0.06					0.02	0.28		c0.03	c0.29	
v/s Ratio Perm	c0.20				0.12							
v/c Ratio	0.59	0.17			0.35		0.15	0.71		0.22	0.74	
Uniform Delay, d1	24.8	21.0			22.5		34.7	23.3		35.1	23.7	
Progression Factor	1.00	1.00			1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	7.6	0.6			1.6		1.3	2.2		2.1	2.6	
Delay (s)	32.3	21.6			24.0		36.1	25.5		37.1	26.3	
Level of Service	C	C			C		D	C		D	C	
Approach Delay (s)		28.3			24.0			25.8			26.6	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	26.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	91.0	Sum of lost time (s)	12.1
Intersection Capacity Utilization	63.8%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	230	22	53	368	19	38
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.83	0.83	0.92	0.92	0.82	0.82
Hourly flow rate (vph)	277	27	58	400	23	46
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				443		
pX, platoon unblocked						
vC, conflicting volume			304		806	290
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			304		806	290
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		93	94
cM capacity (veh/h)			1257		335	749

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	304	458	70
Volume Left	0	58	23
Volume Right	27	0	46
cSH	1700	1257	531
Volume to Capacity	0.18	0.05	0.13
Queue Length 95th (ft)	0	4	11
Control Delay (s)	0.0	1.4	12.8
Lane LOS		A	B
Approach Delay (s)	0.0	1.4	12.8
Approach LOS			B

Intersection Summary			
Average Delay	1.9		
Intersection Capacity Utilization	49.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	0	8	49	0	18	57
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	9	53	0	20	62
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	154	53			53	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	154	53			53	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	99			99	
cM capacity (veh/h)	827	1014			1552	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	9	53	82
Volume Left	0	0	20
Volume Right	9	0	0
cSH	1014	1700	1552
Volume to Capacity	0.01	0.03	0.01
Queue Length 95th (ft)	1	0	1
Control Delay (s)	8.6	0.0	1.8
Lane LOS	A		A
Approach Delay (s)	8.6	0.0	1.8
Approach LOS	A		

Intersection Summary			
Average Delay	1.6		
Intersection Capacity Utilization	20.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	277	0	0	396	0	2
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	301	0	0	430	0	2
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				133		
pX, platoon unblocked					0.93	
vC, conflicting volume			301		732	301
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			301		670	301
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		100	100
cM capacity (veh/h)			1260		391	739

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	301	430	2
Volume Left	0	0	0
Volume Right	0	0	2
cSH	1700	1700	739
Volume to Capacity	0.18	0.25	0.00
Queue Length 95th (ft)	0	0	0
Control Delay (s)	0.0	0.0	9.9
Lane LOS			A
Approach Delay (s)	0.0	0.0	9.9
Approach LOS			A

Intersection Summary			
Average Delay		0.0	
Intersection Capacity Utilization		24.6%	ICU Level of Service
Analysis Period (min)		15	

APPENDIX C

Queuing Analysis Worksheets

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	220	103	125	18	643	13	1162
v/c Ratio	0.52	0.17	0.20	0.08	0.32	0.05	0.59
Control Delay	29.5	17.9	11.2	35.4	19.8	35.1	22.6
Queue Delay	219.4	13.6	0.0	0.0	0.0	0.0	0.0
Total Delay	248.9	31.5	11.2	35.4	19.8	35.1	22.6
Queue Length 50th (ft)	100	33	21	9	92	7	183
Queue Length 95th (ft)	173	70	42	29	121	23	229
Internal Link Dist (ft)		53	242		379		112
Turn Bay Length (ft)	150			90		125	
Base Capacity (vph)	421	624	622	239	1989	239	1972
Starvation Cap Reductn	271	494	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.47	0.79	0.20	0.08	0.32	0.05	0.59

Intersection Summary

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	192	115	220	35	1409	52	1453
v/c Ratio	0.57	0.18	0.35	0.15	0.71	0.22	0.74
Control Delay	32.4	17.7	22.7	36.5	25.7	37.7	25.6
Queue Delay	182.6	17.2	0.0	0.0	0.0	0.0	0.0
Total Delay	215.0	34.9	22.7	36.5	25.7	37.7	25.6
Queue Length 50th (ft)	89	36	86	18	244	27	248
Queue Length 95th (ft)	157	73	136	46	297	62	303
Internal Link Dist (ft)		53	242		379		112
Turn Bay Length (ft)	150			90		125	
Base Capacity (vph)	338	623	622	239	1984	239	1973
Starvation Cap Reductn	199	487	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.38	0.85	0.35	0.15	0.71	0.22	0.74

Intersection Summary

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	230	108	127	18	643	13	1165
v/c Ratio	0.55	0.17	0.20	0.08	0.32	0.05	0.59
Control Delay	30.3	18.1	11.4	35.4	19.8	35.1	22.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	30.3	18.1	11.4	35.4	19.8	35.1	22.6
Queue Length 50th (ft)	106	35	22	9	92	7	184
Queue Length 95th (ft)	182	73	43	29	121	23	229
Internal Link Dist (ft)		53	242		379		112
Turn Bay Length (ft)	150			90		125	
Base Capacity (vph)	419	624	623	239	1989	239	1973
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.55	0.17	0.20	0.08	0.32	0.05	0.59

Intersection Summary

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	199	119	225	36	1409	52	1464
v/c Ratio	0.59	0.19	0.36	0.15	0.71	0.22	0.74
Control Delay	33.6	17.9	22.8	36.6	25.7	37.7	25.7
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	33.6	17.9	22.8	36.6	25.7	37.7	25.7
Queue Length 50th (ft)	94	38	89	19	244	27	250
Queue Length 95th (ft)	165	76	139	47	297	62	306
Internal Link Dist (ft)		53	242		379		112
Turn Bay Length (ft)	150			90		125	
Base Capacity (vph)	335	623	623	239	1984	239	1973
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.59	0.19	0.36	0.15	0.71	0.22	0.74

Intersection Summary

APPENDIX D

Crommelin Methodology

Table 4

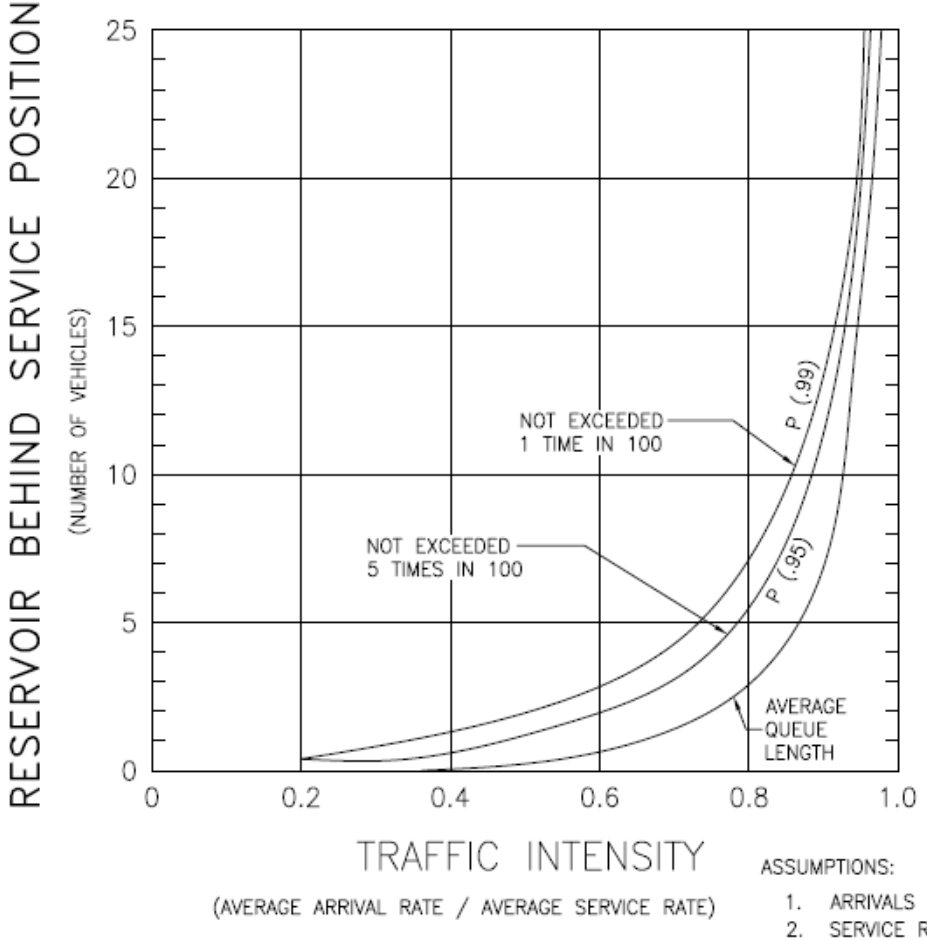
PARKING CONTROL SERVICE RATE

TYPE OF CONTROL	TYPICAL SERVICES RATES PER LANE [a] AVERAGE HEADWAY (Sec/Veh)	HOURLY CAPACITY Design [b] (Veh/Hr)	HOURLY CAPACITY Maximum (Veh/Hr)
Entering:			
Clear Aisle, no control	3.6	800	1,000
Ticket dispenser, no gate	5.0	575	720
Time Stamp and hand to driver	8.5	340	425
Coded-card operated gate	8.9	340	425
Cashier, flat fee, no gate			
No information given	9.2	310	390
Direction-info needed	14.8	195	250
Ticket Dispenser w/gate			
Sharp turn at approach	9.5	305	380
Easy direct approach	5.5	520	650
Coin operated gate	20.4	140	175
Internal:			
Clear aisle or ramp, no parking	2.0	1,200	1,800
Straight ramp w/bend at end	2.2	1,000	1,610
Circular ramp, 30’ R at C/L	2.2	840	1,650
Aisle with adjacent 9 x 18’ stalls			
Inbound	3.5	830	1,040
Outbound	8.6	335	420
Exiting:			
Light street congestion	7.2	400	500
Moderate street congestion	9.0	320	400
Coded-card/token-operated gate	9.0	320	400
Cashier, flat fee w/gate	13.4	215	270
Casher, variable fee w/gate	19.5	150	185
Coin operated gate	20.4	140	175

[a] Assumes no significant interference by pedestrians, other traffic, etc.

[b] Taken as 80% of maximum rate; require 6 car lengths reservoir in advance of control points.

RESERVOIR NEEDS VS TRAFFIC INTENSITY



1

ASSUMPTIONS:

1. ARRIVALS FOLLOW A POISSON DISTRIBUTION
2. SERVICE RATE CAN BE REPRESENTED BY AN EXPONENTIAL PROBABILITY FUNCTION.
3. FLOW IS EQUALLY DIVIDED BETWEEN EACH LANE IF MORE THAN ONE IS AVAILABLE.

APPENDIX A

Raw Traffic Volume Count Sheets

APPENDIX B

Intersection Level of Service Worksheets

APPENDIX C

Queuing Analysis Worksheets

APPENDIX D

Crommelin Methodology