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TECHNICAL MEMORANDUM

Sausalito Gate 6 Road Intersection

Alternatives Operational Analysis

Date: November 18, 2013

Project #: 13396

To: Jason Ling, PE

From: Aaron Elias, PE; Erin Ferguson; and Mark Bowman, PE

This memorandum documents the traffic operations analysis results for the Gate 6 Road-N Bridge Boulevard/Bridgeway Boulevard – US 101 NB on/off ramps intersection (Gate 6 Road Intersection). Kittelson & Associates, Inc. (KAI) conducted the peak hour analysis for the existing intersection configuration and six alternatives proposed improvements to the intersection. This document is organized into four parts: 1) Background; 2) Overview of Proposed Intersection Improvement Options; 3) Data Collected; and 4) Findings.

BACKGROUND

The existing Gate 6 Road intersection has a high volume of bicycles transitioning from the Mill Valley-Sausalito Path to the southbound bicycle lane on Bridgeway which leads into downtown Sausalito. This transition requires a left turn from Gate 6 Road which was observed to have 213 bicycles during the Saturday peak hour. To better accommodate bicycles at this intersection, six different alternatives for intersection improvements are being considered.

Of these six alternatives, one has been identified as the preferred option based on this traffic analysis, a qualitative assessment of advantages and disadvantages for each option, and discussion between the City, County, and Caltrans staff. The remainder of this technical memorandum documents the traffic analysis performed for the six alternatives.

OVERVIEW OF PROPOSED INTERSECTION IMPROVEMENT OPTIONS

There are a total of six (6) proposed alternatives for improving the Gate 6 Road intersection. The details of these six options include:

- Alternative 1 (Bike & Left Turn Lanes) - Coverts the existing lane configuration on Gate 6 Road from a shared left/through lane and an exclusive right turn lane into an exclusive left turn lane, a bike lane, and a shared right/through lane. The change in lane configuration proposed in this alternative can also be incorporated into Alternatives 2, 4, and 5 without impacting the analyzed level of service results.

- Alternative 2 (Gate 6 ½ Road Connector) – Bicyclists heading towards Sausalito would be routed from the existing shared use path adjacent to the US 101 NB ramps to Gate 6½ Road. This would orient bicyclists to approach the intersection of Gate 6 Road and Bridgeway in the left-turn lane on Gate 6 Road rather than the shared use path.
- Alternative 3 (Bicycle Signal) – Install a bicycle signal to improve access for bicyclist crossing the intersection from the shared use path to the bicycle lane on the west side of Bridgeway Boulevard heading toward Sausalito.
- Alternative 4 (Path Improvement) – Reroute bicyclists along the existing sidewalk adjacent to Gate 6 Road so that they can approach the intersection of Gate 6 Road and Bridgeway/US 101 NB along Gate 6 Road.
- Alternative 5 (Bike Box) – Install a bike box on Gate 6 Road to better position bicyclists to access the bike lane along the west side of Bridgeway Boulevard heading toward Sausalito.
- Alternative 6 (Two-Stage Crossing) – Implement a two-stage bicycle only crossing that will cross US 101 NB Ramps and N. Bridge Boulevard.

DATA COLLECTED

Traffic Count Data

Vehicle turning movement counts, bicycle counts, and pedestrian counts were collected at the Gate 6 Road intersection during the following time periods:

- Thursday April 11, 2013 from 7-9 AM
- Thursday April 11, 2013 from 11 AM – 1 PM
- Thursday April 11, 2013 from 4-6 PM
- Saturday April 13, 2013 from 11 AM – 3 PM

KAI reviewed the vehicle, pedestrian, and bicycle data collected during these periods to determine the best peak hour for analyzing the various intersection options. Saturday from 1:00 to 2:00 p.m. was the peak hour selected because it had the highest vehicle volume as well as the highest bicycle volumes of the collected data.

Signal Timing Data

Signal timing sheets documenting the existing signal timing for the Gate 6 Road intersection were obtained from Caltrans. The intersection is currently operating a fully-actuated uncoordinated signal using a 170 controller. Bridgeway and the US 101 NB ramps have protected left turn phases while N. Bridge Boulevard and Gate 6 Road are running split phase (signal allows only one direction at a time). The following adjustments were made to the existing signal timing for each of the six options:

- Alternative 1 (Bike & Left Turn Lane) – A leading pedestrian interval¹ was also added to the Gate 6 Road signal phase to improve pedestrian visibility. All other signal timing remained the same.
- Alternative 2 (Gate 6 ½ Road Connector) – A leading pedestrian interval was added to the Gate 6 Road signal phase to improve pedestrian visibility. All other signal timing remained the same.
- Alternative 3 (Bicycle Signal) – Added a bicycle only signal phase. Right turn on red is prohibited from Gate 6 Road during the bicycle signal phase.
- Alternative 4 (Path Improvement) – A leading pedestrian interval was added to the Gate 6 Road signal phase to improve pedestrian visibility. All other signal timing remained the same.
- Alternative 5 (Bike Box) – Added a leading pedestrian interval to improve pedestrian visibility. All other signal timing remained the same.
- Alternative 6 (Two-Stage Crossing) – Added a bicycle phase for bicyclist to cross the US 101 NB ramps and N. Bridge Boulevard.

Of these six improvements, Alternatives 2, 4, and 5 have only minimal impact because they are primarily path realignments for bicycles. Only the addition of the leading pedestrian interval alters the results over existing. The two remaining options (Alternative 3 (Bike Signal) and Alternative 6 (Two Stage Crossing)) had more substantial impacts due to the addition of new bicycle phases. The primary assumptions used for these two scenarios include:

- Alternative 3 (Bicycle Signal) – Bicycle signal green time was assumed to be 15 seconds exceeding the calculated AASHTO bicycle minimum green interval by a little more than three (3) seconds.
- Alternative 6 (Two-Stage Crossing) – Timing for the bicycle signals for the two-stage crossing used the pedestrian crossing speed of 3.5 feet per second to determine the time needed. This is conservative and also accommodates any pedestrians who cross inadvertently using the bicycle-only crossings.

FINDINGS

Table 1 presents the level-of-service findings for the existing conditions and the six alternative improvement options. Attached are the Synchro analysis worksheets that provide additional detailed output.

¹ A leading pedestrian interval, or LPI, is a traffic signal strategy that assigns pedestrians an exclusive signal phase of about 3-5 seconds allowing pedestrians to begin crossing before vehicles get the green light.

Table 1 - Intersection LOS Results for Gate 6 Road and Bridgeway/US 101 NB

Scenario	Delay	LOS
Existing Conditions	27.0	C
Alternative 1 – Bike & Left Turn Lane	29.5	C
Alternative 2 – Gate 6 1/2 Connector	29.5	C
Alternative 3 – Bicycle Signal	34.9	C
Alternative 4 – Path Improvement	29.5	C
Alternative 5 – Bike Box	29.5	C
Alternative 6 – Two-Stage Crossing	31.4	C

As Table 1 shows, each of the alternatives maintains the existing LOS C. Alternative 3 has the most impact increasing the average vehicle delay by almost 11 seconds. Alternative 6 has the second highest impact with an increase of about 7 seconds per vehicle over existing conditions. All other alternatives increased the average vehicle delay by 2.5 seconds as a result of adding the leading pedestrian interval to improve the visibility of pedestrians to motorists to encourage motorists to yield to pedestrians in the crosswalk.

Of the six alternatives tested, Alternative 3 is the strongest option for improving the bicyclist's experience and minimizing conflicts at the intersection because it provides an exclusive bicycle signal for crossing from the Mill Valley-Sausalito Path to southbound Bridgeway. While this improvement still maintains LOS C for the intersection, it does have the largest increase in vehicle delay compared to the existing conditions.

Alternatives 1, 2 and 4 primarily involve path improvements for bicyclists to access the intersection. The primary benefits of these three options are that pedestrians are better accommodated through the use of leading pedestrian intervals when crossing Bridgeway and that intersection operations are impacted the least for the auto drivers. The bicyclists would also have an improved experience at the intersection with these alternatives as they better direct bicyclists in crossing the street. However, the path improvements require bicyclists to divert from the most direct path to the intersection. This may result to low compliance limiting the benefits of these alternatives.

HCM Signalized Intersection Capacity Analysis

2: N. Bridgeway Avenue/Gate 6 Road & US 101 Ramps/Bridgeway

11/22/2013



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	21	171	72	198	751	60	286	82	839	60	41	82
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		0.95	0.95	0.88		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	0.99		1.00	1.00	1.00		1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		0.96	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00		0.97	1.00
Satd. Flow (prot)	1805	3610	1568	1736	3533		1681	1722	2814		1695	1589
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00		0.97	1.00
Satd. Flow (perm)	1805	3610	1568	1736	3533		1681	1722	2814		1694	1589
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	21	174	73	202	766	61	292	84	856	61	42	84
RTOR Reduction (vph)	0	0	61	0	4	0	0	0	483	0	0	61
Lane Group Flow (vph)	21	174	12	202	823	0	187	189	373	0	103	23
Confl. Peds. (#/hr)						57				98		
Confl. Bikes (#/hr)						12						5
Heavy Vehicles (%)	0%	0%	3%	4%	0%	0%	2%	2%	1%	7%	0%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Split	NA	pt+ov	Perm	NA	Perm
Protected Phases	5	2		1	6		8	8	8 1		7	
Permitted Phases			2							7		7
Actuated Green, G (s)	2.4	16.1	16.1	18.5	32.2		18.7	18.7	41.2		25.7	25.7
Effective Green, g (s)	2.4	16.1	16.1	18.5	32.2		18.7	18.7	41.2		25.7	25.7
Actuated g/C Ratio	0.03	0.17	0.17	0.20	0.34		0.20	0.20	0.44		0.27	0.27
Clearance Time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0			4.0	4.0
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	2.0			2.0	2.0
Lane Grp Cap (vph)	45	615	267	339	1203		332	340	1226		460	432
v/s Ratio Prot	0.01	0.05		c0.12	c0.23		c0.11	0.11	0.13			
v/s Ratio Perm			0.01								c0.06	0.01
v/c Ratio	0.47	0.28	0.05	0.60	0.68		0.56	0.56	0.30		0.22	0.05
Uniform Delay, d1	45.4	34.2	32.8	34.6	26.8		34.2	34.2	17.3		26.7	25.4
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	2.8	0.3	0.1	1.9	1.6		1.3	1.1	0.1		0.1	0.0
Delay (s)	48.2	34.4	32.9	36.5	28.4		35.5	35.3	17.4		26.8	25.4
Level of Service	D	C	C	D	C		D	D	B		C	C
Approach Delay (s)		35.1			30.0			22.9			26.2	
Approach LOS		D			C			C			C	

Intersection Summary

HCM 2000 Control Delay	27.0	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	94.5	Sum of lost time (s)	15.5
Intersection Capacity Utilization	58.9%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis

2: N. Bridgeway Avenue/Gate 6 Road & US 101 Ramps/Bridgeway

11/22/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	21	171	72	198	751	60	286	82	839	60	41	82
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		0.95	0.95	0.88	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	1.00	0.99		1.00	1.00	1.00	1.00	0.99	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	0.92	1.00	
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85	1.00	0.90	
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00	0.95	1.00	
Satd. Flow (prot)	1805	3610	1568	1736	3531		1681	1722	2814	1555	1691	
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00	0.95	1.00	
Satd. Flow (perm)	1805	3610	1568	1736	3531		1681	1722	2814	1555	1691	
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	21	174	73	202	766	61	292	84	856	61	42	84
RTOR Reduction (vph)	0	0	61	0	3	0	0	0	494	0	44	0
Lane Group Flow (vph)	21	174	12	202	824	0	187	189	362	61	82	0
Confl. Peds. (#/hr)						57				98		
Confl. Bikes (#/hr)						12						5
Heavy Vehicles (%)	0%	0%	3%	4%	0%	0%	2%	2%	1%	7%	0%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Split	NA	pt+ov	Perm	NA	
Protected Phases	5	2		1	6		8	8	8 1		7	
Permitted Phases			2							7		
Actuated Green, G (s)	2.4	16.4	16.4	19.1	33.1		19.2	19.2	42.3	25.6	25.6	
Effective Green, g (s)	2.4	16.4	16.4	19.1	33.1		19.2	19.2	42.3	25.6	25.6	
Actuated g/C Ratio	0.02	0.16	0.16	0.19	0.33		0.19	0.19	0.42	0.26	0.26	
Clearance Time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)	43	591	256	331	1167		322	330	1189	397	432	
v/s Ratio Prot	0.01	0.05		c0.12	c0.23		c0.11	0.11	0.13		c0.05	
v/s Ratio Perm			0.01							0.04		
v/c Ratio	0.49	0.29	0.05	0.61	0.71		0.58	0.57	0.30	0.15	0.19	
Uniform Delay, d1	48.2	36.8	35.3	37.1	29.2		36.8	36.7	19.1	28.9	29.1	
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	3.2	0.3	0.1	2.3	2.0		1.7	1.5	0.1	0.1	0.1	
Delay (s)	51.4	37.0	35.3	39.4	31.2		38.5	38.2	19.2	28.9	29.2	
Level of Service	D	D	D	D	C		D	D	B	C	C	
Approach Delay (s)		37.7			32.8			25.1			29.1	
Approach LOS		D			C			C			C	
Intersection Summary												
HCM 2000 Control Delay			29.5			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.50									
Actuated Cycle Length (s)			100.1			Sum of lost time (s)			17.5			
Intersection Capacity Utilization			62.6%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: N. Bridgeway Avenue/Gate 6 Road & US 101 Ramps/Bridgeway

11/22/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	21	171	72	198	751	60	286	82	839	60	41	82
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		0.95	0.95	0.88		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	0.99		1.00	1.00	1.00		1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		0.95	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00		0.97	1.00
Satd. Flow (prot)	1805	3610	1568	1736	3531		1681	1722	2814		1690	1589
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00		0.97	1.00
Satd. Flow (perm)	1805	3610	1568	1736	3531		1681	1722	2814		1690	1589
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	21	174	73	202	766	61	292	84	856	61	42	84
RTOR Reduction (vph)	0	0	61	0	3	0	0	0	494	0	0	63
Lane Group Flow (vph)	21	174	12	202	824	0	187	189	362	0	103	21
Confl. Peds. (#/hr)						57				98		
Confl. Bikes (#/hr)						12						5
Heavy Vehicles (%)	0%	0%	3%	4%	0%	0%	2%	2%	1%	7%	0%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Split	NA	pt+ov	Perm	NA	Perm
Protected Phases	5	2		1	6		8	8	8 1		7	
Permitted Phases			2							7		7
Actuated Green, G (s)	2.4	16.4	16.4	19.1	33.1		19.2	19.2	42.3		25.6	25.6
Effective Green, g (s)	2.4	16.4	16.4	19.1	33.1		19.2	19.2	42.3		25.6	25.6
Actuated g/C Ratio	0.02	0.16	0.16	0.19	0.33		0.19	0.19	0.42		0.26	0.26
Clearance Time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0			4.0	4.0
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	2.0			2.0	2.0
Lane Grp Cap (vph)	43	591	256	331	1167		322	330	1189		432	406
v/s Ratio Prot	0.01	0.05		c0.12	c0.23		c0.11	0.11	0.13			
v/s Ratio Perm			0.01								0.06	0.01
v/c Ratio	0.49	0.29	0.05	0.61	0.71		0.58	0.57	0.30		0.24	0.05
Uniform Delay, d1	48.2	36.8	35.3	37.1	29.2		36.8	36.7	19.1		29.5	28.1
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.2	0.3	0.1	2.3	2.0		1.7	1.5	0.1		0.1	0.0
Delay (s)	51.4	37.0	35.3	39.4	31.2		38.5	38.2	19.2		29.6	28.1
Level of Service	D	D	D	D	C		D	D	B		C	C
Approach Delay (s)		37.7			32.8			25.1			29.0	
Approach LOS		D			C			C			C	
Intersection Summary												
HCM 2000 Control Delay			29.5			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.51									
Actuated Cycle Length (s)			100.1			Sum of lost time (s)			17.5			
Intersection Capacity Utilization			58.9%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: N. Bridgeway Avenue/Gate 6 Road & US 101 Ramps/Bridgeway

11/22/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	21	171	72	198	751	60	286	82	839	60	41	82
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		0.95	0.95	0.88		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	0.99		1.00	1.00	1.00		1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00		0.97	1.00
Satd. Flow (prot)	1805	3610	1568	1736	3531		1681	1722	2814		1764	1584
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00		0.97	1.00
Satd. Flow (perm)	1805	3610	1568	1736	3531		1681	1722	2814		1763	1584
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	21	174	73	202	766	61	292	84	856	61	42	84
RTOR Reduction (vph)	0	0	62	0	4	0	0	0	549	0	0	0
Lane Group Flow (vph)	21	174	11	202	823	0	187	189	307	0	103	84
Confl. Peds. (#/hr)						57				10		
Confl. Bikes (#/hr)						12						5
Heavy Vehicles (%)	0%	0%	3%	4%	0%	0%	2%	2%	1%	7%	0%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Split	NA	pt+ov	Perm	NA	Perm
Protected Phases	5	2		1	6		8	8	8 1		7	
Permitted Phases			2							7		7
Actuated Green, G (s)	2.1	15.1	15.1	16.6	29.6		15.3	15.3	35.9		15.8	15.8
Effective Green, g (s)	2.1	15.1	15.1	16.6	29.6		15.3	15.3	35.9		15.8	15.8
Actuated g/C Ratio	0.02	0.15	0.15	0.17	0.30		0.15	0.15	0.36		0.16	0.16
Clearance Time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0			4.0	4.0
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	2.0			2.0	2.0
Lane Grp Cap (vph)	37	545	236	288	1045		257	263	1010		278	250
v/s Ratio Prot	0.01	0.05		c0.12	c0.23		c0.11	0.11	0.11			
v/s Ratio Perm			0.01								c0.06	0.05
v/c Ratio	0.57	0.32	0.05	0.70	0.79		0.73	0.72	0.30		0.37	0.34
Uniform Delay, d1	48.5	37.9	36.3	39.4	32.3		40.4	40.3	23.1		37.7	37.4
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	11.3	0.3	0.1	6.2	4.0		8.4	7.6	0.1		0.3	0.3
Delay (s)	59.8	38.2	36.4	45.5	36.3		48.8	47.9	23.1		38.0	37.7
Level of Service	E	D	D	D	D		D	D	C		D	D
Approach Delay (s)		39.4			38.1			30.8			37.9	
Approach LOS		D			D			C			D	
Intersection Summary												
HCM 2000 Control Delay			34.9			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.54									
Actuated Cycle Length (s)			100.0			Sum of lost time (s)			21.5			
Intersection Capacity Utilization			58.9%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: N. Bridgeway Avenue/Gate 6 Road & US 101 Ramps/Bridgeway

11/22/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	21	171	72	198	751	60	286	82	839	60	41	82
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		0.95	0.95	0.88		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	0.99		1.00	1.00	1.00		1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		0.95	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00		0.97	1.00
Satd. Flow (prot)	1805	3610	1568	1736	3531		1681	1722	2814		1690	1589
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00		0.97	1.00
Satd. Flow (perm)	1805	3610	1568	1736	3531		1681	1722	2814		1690	1589
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	21	174	73	202	766	61	292	84	856	61	42	84
RTOR Reduction (vph)	0	0	61	0	3	0	0	0	494	0	0	63
Lane Group Flow (vph)	21	174	12	202	824	0	187	189	362	0	103	21
Confl. Peds. (#/hr)						57				98		
Confl. Bikes (#/hr)						12						5
Heavy Vehicles (%)	0%	0%	3%	4%	0%	0%	2%	2%	1%	7%	0%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Split	NA	pt+ov	Perm	NA	Perm
Protected Phases	5	2		1	6		8	8	8 1		7	
Permitted Phases			2							7		7
Actuated Green, G (s)	2.4	16.4	16.4	19.1	33.1		19.2	19.2	42.3		25.6	25.6
Effective Green, g (s)	2.4	16.4	16.4	19.1	33.1		19.2	19.2	42.3		25.6	25.6
Actuated g/C Ratio	0.02	0.16	0.16	0.19	0.33		0.19	0.19	0.42		0.26	0.26
Clearance Time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0			4.0	4.0
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	2.0			2.0	2.0
Lane Grp Cap (vph)	43	591	256	331	1167		322	330	1189		432	406
v/s Ratio Prot	0.01	0.05		c0.12	c0.23		c0.11	0.11	0.13			
v/s Ratio Perm			0.01								0.06	0.01
v/c Ratio	0.49	0.29	0.05	0.61	0.71		0.58	0.57	0.30		0.24	0.05
Uniform Delay, d1	48.2	36.8	35.3	37.1	29.2		36.8	36.7	19.1		29.5	28.1
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.2	0.3	0.1	2.3	2.0		1.7	1.5	0.1		0.1	0.0
Delay (s)	51.4	37.0	35.3	39.4	31.2		38.5	38.2	19.2		29.6	28.1
Level of Service	D	D	D	D	C		D	D	B		C	C
Approach Delay (s)		37.7			32.8			25.1			29.0	
Approach LOS		D			C			C			C	
Intersection Summary												
HCM 2000 Control Delay			29.5			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.51									
Actuated Cycle Length (s)			100.1			Sum of lost time (s)			17.5			
Intersection Capacity Utilization			58.9%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: N. Bridgeway Avenue/Gate 6 Road & US 101 Ramps/Bridgeway

11/22/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	21	171	72	198	751	60	286	82	839	60	41	82
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0	4.0		4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		0.95	0.95	0.88		1.00	1.00
Frpb, ped/bikes	1.00	1.00	1.00	1.00	0.99		1.00	1.00	1.00		1.00	0.98
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		0.95	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00		0.97	1.00
Satd. Flow (prot)	1805	3610	1568	1736	3531		1681	1722	2814		1690	1589
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00		0.97	1.00
Satd. Flow (perm)	1805	3610	1568	1736	3531		1681	1722	2814		1690	1589
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	21	174	73	202	766	61	292	84	856	61	42	84
RTOR Reduction (vph)	0	0	61	0	3	0	0	0	494	0	0	63
Lane Group Flow (vph)	21	174	12	202	824	0	187	189	362	0	103	21
Confl. Peds. (#/hr)						57				98		
Confl. Bikes (#/hr)						12						5
Heavy Vehicles (%)	0%	0%	3%	4%	0%	0%	2%	2%	1%	7%	0%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Split	NA	pt+ov	Perm	NA	Perm
Protected Phases	5	2		1	6		8	8	8 1		7	
Permitted Phases			2							7		7
Actuated Green, G (s)	2.4	16.4	16.4	19.1	33.1		19.2	19.2	42.3		25.6	25.6
Effective Green, g (s)	2.4	16.4	16.4	19.1	33.1		19.2	19.2	42.3		25.6	25.6
Actuated g/C Ratio	0.02	0.16	0.16	0.19	0.33		0.19	0.19	0.42		0.26	0.26
Clearance Time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0			4.0	4.0
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	2.0			2.0	2.0
Lane Grp Cap (vph)	43	591	256	331	1167		322	330	1189		432	406
v/s Ratio Prot	0.01	0.05		c0.12	c0.23		c0.11	0.11	0.13			
v/s Ratio Perm			0.01								0.06	0.01
v/c Ratio	0.49	0.29	0.05	0.61	0.71		0.58	0.57	0.30		0.24	0.05
Uniform Delay, d1	48.2	36.8	35.3	37.1	29.2		36.8	36.7	19.1		29.5	28.1
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	3.2	0.3	0.1	2.3	2.0		1.7	1.5	0.1		0.1	0.0
Delay (s)	51.4	37.0	35.3	39.4	31.2		38.5	38.2	19.2		29.6	28.1
Level of Service	D	D	D	D	C		D	D	B		C	C
Approach Delay (s)		37.7			32.8			25.1			29.0	
Approach LOS		D			C			C			C	
Intersection Summary												
HCM 2000 Control Delay			29.5			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.51									
Actuated Cycle Length (s)			100.1			Sum of lost time (s)			17.5			
Intersection Capacity Utilization			58.9%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												

HCM Signalized Intersection Capacity Analysis

2: N. Bridgeway Avenue/Gate 6 Road & US 101 Ramps/Bridgeway

11/22/2013

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	21	171	72	198	751	60	286	82	839	60	41	82
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0	3.0		4.0	4.0
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95		0.95	0.95	0.88		1.00	1.00
Frpb, ped/bikes	1.00	1.00	0.67	1.00	0.99		1.00	1.00	0.98		1.00	0.78
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00
Frt	1.00	1.00	0.85	1.00	0.99		1.00	1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00		0.97	1.00
Satd. Flow (prot)	1805	3610	1057	1736	3528		1681	1722	2750		1772	1253
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	0.97	1.00		0.97	1.00
Satd. Flow (perm)	1805	3610	1057	1736	3528		1681	1722	2750		1772	1253
Peak-hour factor, PHF	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
Adj. Flow (vph)	21	174	73	202	766	61	292	84	856	61	42	84
RTOR Reduction (vph)	0	0	54	0	4	0	0	0	530	0	0	65
Lane Group Flow (vph)	21	174	19	202	823	0	187	189	326	0	103	19
Confl. Peds. (#/hr)						57			10			
Confl. Bikes (#/hr)			213			12						213
Heavy Vehicles (%)	0%	0%	3%	4%	0%	0%	2%	2%	1%	7%	0%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Split	NA	pm+ov	Split	NA	Perm
Protected Phases	5	2		1	6		8	8	1	7	7	
Permitted Phases			2						8			7
Actuated Green, G (s)	2.3	29.0	29.0	17.6	44.3		25.2	25.2	42.8		25.1	25.1
Effective Green, g (s)	2.3	29.0	29.0	17.6	44.3		25.2	25.2	42.8		25.1	25.1
Actuated g/C Ratio	0.02	0.26	0.26	0.16	0.39		0.22	0.22	0.38		0.22	0.22
Clearance Time (s)	3.0	4.5	4.5	3.0	4.5		4.0	4.0	3.0		4.0	4.0
Vehicle Extension (s)	2.0	3.0	3.0	2.0	3.0		2.0	2.0	2.0		2.0	2.0
Lane Grp Cap (vph)	36	931	272	271	1390		376	386	1047		395	279
v/s Ratio Prot	0.01	0.05		c0.12	c0.23		c0.11	0.11	0.05		c0.06	
v/s Ratio Perm			0.02						0.07			0.01
v/c Ratio	0.58	0.19	0.07	0.75	0.59		0.50	0.49	0.31		0.26	0.07
Uniform Delay, d1	54.6	32.5	31.5	45.3	26.9		38.1	38.0	24.4		36.0	34.4
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00	1.00		1.00	1.00
Incremental Delay, d2	14.6	0.1	0.1	9.3	0.7		0.4	0.4	0.1		0.1	0.0
Delay (s)	69.1	32.6	31.6	54.6	27.6		38.4	38.4	24.5		36.1	34.5
Level of Service	E	C	C	D	C		D	D	C		D	C
Approach Delay (s)		35.2			32.9			28.7			35.4	
Approach LOS		D			C			C			D	
Intersection Summary												
HCM 2000 Control Delay			31.4			HCM 2000 Level of Service			C			
HCM 2000 Volume to Capacity ratio			0.52									
Actuated Cycle Length (s)			112.4			Sum of lost time (s)			15.5			
Intersection Capacity Utilization			60.0%			ICU Level of Service			B			
Analysis Period (min)			15									
c Critical Lane Group												