Technical Memorandum

To:	**Kevin Jeffers, PE**	**Date:**	**April 26, 2011**
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cc:	**Buzz Berger, PE WD Baldwin, PE Tony Wang, PE, PTOE**	**Job No.:**	**143256**
Subject:	**2010 Noon Peak Model Calibration and Evaluation of Proposed Traffic Signal Phasing under 2010 Noon Peak Hour Traffic Volumes**		

1. Introduction

This technical memo documents existing traffic conditions based on Level of Service (LOS) and delay outputs from the calibrated Noon (NN) peak hour VISSIM model for the Berkeley Street interchange area of the Point Defiance Bypass Traffic Study. It provides calibration results of intersection throughput volume and queue length (maximum) for each individual intersection of the calibrated 2010 NN peak condition model. In addition, it documents the evaluation of the proposed signal system under the base year (2010) existing traffic volumes. The 2010 NN Peak model with proposed traffic control is considered as the 2010 Build scenario. This memo documents results of the build scenario with and without Amtrak train operation. It also provides comparisons of intersection delay, LOS, and queue lengths (maximum) for individual intersections under the Existing and Build scenarios in the base year (2010).

The purpose of this memo is to present existing NN peak traffic operations at each intersection in the Berkeley Street interchange area, calibration results of existing condition VISSIM models, and evaluation results of the calibrated model with proposed signal phasing/timing.

2. Methodologies

Regular Noon (NN) peak hour VISSIM models development for the Berkeley Street interchange area was similar to the process presented in the earlier memo titled *Existing Conditions Technical Memorandum*. Detailed simulation model development information was presented in the same memo**.** The operational performance data provides comparisons between the simulation results and the observed field data for average delay, LOS, and maximum queue length.

The calibrated NN peak model was evaluated with the proposed signal phasing. Detailed information for the proposed signal system for the Berkeley Street Interchange was presented in the earlier memo titled *Proposed Signal Phasing/Timing and Traffic Operations Technical Memorandum*. The alternative phasing for the Berkeley Street was used.

3. Calibration Result

Table 1 compares the modeled traffic volumes and field collected volumes for each movement for the calibrated Berkeley Street existing NN peak model.

Table 2 compares the modeled maximum approach queue lengths and field observed maximum queue lengths (number of vehicles counted) for the calibrated Berkeley Street existing models.

As shown in **Table 1**, the traffic volumes as measured in the VISSIM simulation model are compared to the volumes collected in the field, with a difference of no more than ten percent at the intersection level. Some movements with very low traffic volumes have more than ten percent difference which is within an

acceptable range for these low volume locations (note that, for a low volume movement, even a single vehicle can represent a relatively large percentage difference). In **Table 2**, the maximum queue lengths as measured in the VISSIM simulation model are compared with the maximum queue lengths collected in the field, with a difference of no more than three vehicles. The queue lengths for major movements match closely. Therefore, it is concluded that the volumes and queues in the VISSIM model represent the existing traffic counts and queues as measured in the field.

Table 1 Berkeley Street - Comparison of Traffic Volumes

No.	Intersection	Movement	NN Peak Hour		
			VISSIM Output Volume (1)	Field Counts (2)	Percent Difference $\frac{(1)-(2)}{(2)}$
1a	Berkeley St & Union Ave	EBL	19	20	-5%
		EBT	85	93	-9%
		EBR	23	24	-4%
		WBL	68	70	-3%
		WBT	80	83	-4%
		WBR	416	422	-1%
		NBL	24	24	0%
		NBT	107	107	0%
		NBR	88	92	-4%
		SBL	178	197	-10%
		SBT	77	82	-6%
		SBR	16	19	-16%
		All	1187	1233	-4%
1b	Berkeley St & I-5 SB Ramp	EBT	243	265	-8%
		EBR	108	117	-8%
		WBL	190	190	0%
		WBT	440	444	-1%
		SBL	387	396	-2%
		SBR	126	131	-4%
		All	1499	1545	-3%
1c	Berkeley St & I-5 NB Ramp	EBL	93	103	-10%
		EBT	536	558	-4%
		WBT	434	434	0%
		WBR	683	684	0%
		NBL	197	200	-2%
		NBR	148	151	-2%
		All	2094	2132	-2%
Network Summary		All	4781	4910	-3%

Table 2 Berkeley Street - Comparison of Queue Lengths

No.	Intersection	Approach	NN Peak Hour		
			VISSIM Maximum Queue (vehicle) (1)[1]	Field Observed Queue (vehicle) (2)	Difference (1)-(2)
1a	Berkeley St & Union Ave	Eastbound	12.3	13.2	-0.9
		Westbound	10.5 (Full)[3]	8 (Full)	-
		Northbound	8.9	8	0.9
		Southbound	35.9	36	-0.1
1b	Berkeley St & I-5 SB Ramp	Eastbound	12 (Full)[3]	8 (Full)	-
		Westbound	6.9	7	-0.1
		Southbound	25	25	-0.0
1c	Berkeley St & I-5 NB Ramp	Eastbound	0	1	-1.0
		Westbound	26.5	N/A[2]	-
		Northbound	14	12	2.0

[1] Average value of 20 VISSIM runs and assumes 25 feet per vehicle.
[2] No videos were taken towards the military gate in order to comply with military restrictions.
[3] Vehicle extended into next intersection. The link was full with 8 vehicles queued.

4. 2010 Existing Condition Simulation Results

Table 3 includes detailed NN peak hour existing traffic conditions for Berkeley Street intersections based on the calibrated VISSIM models.

Table 3 Berkeley Street – Existing (No Build) Conditions from VISSIM Model Outputs (Noon Peak)

No.	Intersection	Movement	NN Peak Hour			
			VISSIM Output Volume	Movement Average Delay (second)	Average Queue (feet)	Max Queue (feet)
1a	Berkeley St & Union Ave	EBL	19	74.6	49	296
		EBT	85	91.2	57	308
		EBR	23	62.0	49	296
		WBL	68	17.3	46	262
		WBT	80	17.2	46	262
		WBR	416	18.7	33	241
		NBL	24	17.5	22	192
		NBT	107	20.8	22	192
		NBR	88	64.0	39	222
		SBL	178	219.1	348	898
		SBT	77	100.6	322	868
		SBR	16	107.1	322	868
		All	1187	65.0	-	-
1b	Berkeley St & I-5 SB Ramp	EBT	243	51.0	175	276
		EBR	108	8.0	196	300
		WBL	190	2.0	4	173
		WBT	440	11.0	5	173
		SBL	387	47.0	99	625
		SBR	126	43.0	100	626
		All	1499	25.0	-	-
1c	Berkeley St & I-5 NB Ramp	EBL	93	0.0	0	0
		EBT	536	1.0	0	0
		WBT	434	51.0	148	635
		WBR	683	18.0	164	663
		NBL	197	68.0	79	349
		NBR	148	1.0	0	0
		All	2094	23.0	-	-
Network Summary		All	4781	34.0	-	-

5. 2010 Proposed (Build) Condition Simulation Results

Table 4 illustrates detailed NN peak hour build scenario traffic conditions for Berkeley Street intersections with and without Amtrak train operation based on the calibrated VISSIM models.

Table 4 Berkeley Street – Proposed (Build) Conditions from VISSIM Model Outputs (Noon Peak)

No.	Intersection	Movement	NN Peak Hour with Train				NN Peak Hour without Train			
			VISSIM Output Volume	Movement Average Delay (second)	Average Queue (feet)	Max Queue (feet)	VISSIM Output Volume	Movement Average Delay (second)	Average Queue (feet)	Max Queue (feet)
1a	Berkeley St & Union Ave	EBL	19	46.9	31	227	20	47.7	30	206
		EBT	88	45.6	27	222	89	44.8	30	206
		EBR	23	29.4	31	227	23	26.1	26	202
		WBL	68	8.9	4	182	68	8.8	4	174
		WBT	79	6.6	4	182	80	6.4	4	174
		WBR	413	2.3	4	182	416	2.1	4	174
		NBL	23	69.1	62	309	24	64.0	56	299
		NBT	107	65.9	62	309	107	60.2	56	299
		NBR	88	66.2	62	309	88	60.0	56	299
		SBL	194	111.8	152	508	195	93.1	121	440
		SBT	81	110.2	152	508	81	92.7	121	440
		SBR	16	84.9	127	481	17	63.4	97	413
		All	1205	45.0	-	-	1212	39.4	-	-
1b	Berkeley St & I-5 SB Ramp	EBT	256	5.1	4	130	258	5.2	5	130
		EBR	114	3.5	1	74	114	3.5	1	68
		WBL	188	19.2	46	256	189	17.7	41	255
		WBT	433	12.5	47	256	437	10.8	41	255
		SBL	385	63.2	145	844	384	60.6	137	776
		SBR	127	51.4	146	844	126	48.0	137	777
		All	1509	27.8	-	-	1514	26.0	-	-
1c	Berkeley St & I-5 NB Ramp	EBL	97	34.3	43	241	98	34.8	44	240
		EBT	543	9.7	43	241	543	9.9	44	240
		WBT	430	85.9	245	907	433	72.7	201	795
		WBR	682	5.3	217	932	682	4.9	165	810
		NBL	193	100.6	122	500	195	84.6	104	449
		NBR	147	3.1	0	0	147	3.9	0	0
		All	2097	33.0	-	-	2102	28.9	-	-
Network Summary		All	4811	34.4	-	-	4829	30.6	-	-

6. 2010 Existing and Proposed (Build) Scenario Traffic Operational Performance Comparisons

Table 5 compares the 2010 Existing condition and the 2010 Build scenarios for each intersection in terms of intersection Level of Service (LOS), average delay, and overall network performance. These metrics are expressed in terms of average delay per vehicle during the regular NN peak hours in 2010.

Table 6 compares the future year simulation results between the 2010 Existing condition and the 2010 Build Scenarios for each intersection in terms of average and maximum queue lengths at each freeway off-ramp at the four interchange areas during regular NN peak hours in 2010.

Table 5 Berkeley Street 2010 Traffic Operational Performance Comparison - LOS[3] and Delay

No.	Intersection Name	NN Peak Hour LOS (Delay: sec/vehicle)		
		Existing Scenario	Proposed Control with Train Scenario	Proposed Control without Train Scenario
1a	Berkeley Street and Union Avenue	F (65.0) [1]	D(45.0) [2]	D (39.4) [2]
1b	Berkeley Street and SB I-5 Ramps	C (25.0)	C (27.8)	C (26.0)
1c	Berkeley Street and NB I-5 Ramps	C (23.0)	C (33.0)	C (28.9)
Network Overall		C (34.0)	C (34.4)	C (30.6)

Note: [1] Unsignalized Control; [2] Signalized Control; [3] Level of Service

Table 6 Berkeley Street Interchange Off-Ramp - 2010 Queue Length Comparison

I-5 Off-Ramps Berkeley Street VISSIM Outputs		NN Peak Hour		
		Existing Scenario	Proposed Control with Train Scenario	Proposed Control without Train Scenario
SB I-5 Off-Ramp	Maximum Queue Length (feet)	626	844	777
	Average Queue Length (feet)	100	146	137
NB I-5 Off-Ramp	Maximum Queue Length (feet)	349	500	449
	Average Queue Length (feet)	79	122	104

As shown in **Table 5**, the proposed signal control system maintains the same LOS as the existing scenario for the overall network. The proposed signal control system also maintains the same level of LOS as the existing scenario at ramp terminals. The proposed signal control system shows reduction of average delay at the Berkeley Street and Union Avenue intersection.

As shown in **Table 6**, the maximum queue lengths in the build scenario compared with the maximum queue lengths in the existing scenario, showed increases in queue lengths at the ramps. However, note that the ramp length from the gore point to the stop bar at the rap terminal is approximately 1000 feet. The proposed signal control system provides balanced distribution of green time over the intersections in the

interchange area as a whole. Allocation of more green time at the ramps may reduce queue lengths at the ramps but that would cause increase of delay and queue at other movements.

7. Conclusion

The proposed signal control system maintains the same LOS as existing scenario for the overall network. In addition, the proposed signal control system can also provide advance preemption to all intersections along Berkeley Street and thus can reduce the tendency for vehicles to queue on the tracks at Berkeley Street. The proposed signal control system also allows a balanced distribution of green time over the intersections in the interchange area as a whole.