Proposed City Market/Onion River Co-op (South End)

Traffic Impact Study Technical Appendix

July 27, 2016

- Traffic Volume Data
- Crash Data Summary
- Trip Generation Calculations
- Adjustment Factors (Seasonal / DHV and Growth)
- Supporting Traffic Volume Networks
- Intersection Capacity Analyses

Traffic Volume Data

Chittenden County RPC
110 West Canal Street, Suite 202
Winooski, VT 05404
www.ccrpcvt.org

ID: BURL22
LOC: Pine Street and Flynn Avenue
TOWN: BURLINGTON, VT/Sunny
COUNTERS: DM MC

File Name : BURL22
Site Code : BURL22
Start Date : 6/11/2014
Page No : 1

Groups Printed- Auto - Truck - Bus

	Pint Street From North Southbound					Flynn Avenue From East Westbound					Pine Street From South Northbound					Flynn Avenue From West Eastbound					
Start Time	Left	Thru	Right	Bike/Ped	App. Total	Left	Thru	Right	Bike/Ped	App. Total	Left	Thru	Right	Bike/Ped	App. Total	Left	Thru	Right	Bike/Ped	App. Total	Int. Total
07:00 AM	12	43	6	0	61	0	15	32	1	48	0	47	2	0	49	2	9	1	0	12	170
07:15 AM	17	52	7	2	78	1	14	43	0	58	3	66	0	1	70	2	13	1	2	18	224
07:30 AM	19	77	12	0	108	1	12	46	0	59	2	86	1	0	89	6	10	4	0	20	276
07:45 AM	23	92	25	0	140	4	27	56	3	90	3	87	5	0	95	7	18	3	0	28	353
Total	71	264	50	2	387	6	68	177	4	255	8	286	8	1	303	17	50	9	2	78	1023
08:00 AM	17	68	13	1	99	3	15	63	0	81	1	94	1	0	96	10	9	2	0	21	297
08:15 AM	30	78	10	1	119	5	23	46	2	76	4	95	5	0	104	7	14	5	1	27	326
08:30 AM	21	83	17	4	125	4	23	52	1	80	1	91	3	1	96	9	17	3	3	32	333
08:45 AM	20	62	15	2	99	2	26	65	0	93	2	106	1	2	111	12	12	5	1	30	333
Total	88	291	55	8	442	14	87	226	3	330	8	386	10	3	407	38	52	15	5	110	1289
*** BREAK ***																					
04:00 PM	68	139	12	1	220	5	9	27	0	41	2	76	8	1	87	9	20	7	1	37	385
04:15 PM	42	138	15	1	196	11	13	27	3	54	3	73	5	2	83	10	12	2	3	27	360
04:30 PM	77	174	13	3	267	3	17	30	0	50	2	80	7	1	90	12	22	9	1	44	451
04:45 PM	58	162	20	8	248	7	10	28	2	47	3	81	4	4	92	15	29	3	5	52	439
Total	245	613	60	13	931	26	49	112	5	192	10	310	24	8	352	46	83	21	10	160	1635
05:00 PM	45	174	16	2	237	11	24	36	1	72	3	78	8	2	91	17	25	8	0	50	450
05:15 PM	55	176	29	6	266	7	22	31	1	61	4	67	3	0	74	9	25	2	1	37	438
05:30 PM	57	190	10	3	260	14	15	28	3	60	0	80	4	1	85	9	19	4	1	33	438
05:45 PM	42	128	9	4	183	11	10	25	2	48	1	83	3	3	90	12	17	4	4	37	358
Total	199	668	64	15	946	43	71	120	7	241	8	308	18	6	340	47	86	18	6	157	1684
Grand Total	603	1836	229	38	2706	89	275	635	19	1018	34	1290	60	18	1402	148	271	63	23	505	5631
Apprch %	22.3	67.8	8.5	1.4		8.7	27	62.4	1.9		2.4	92	4.3	1.3		29.3	53.7	12.5	4.6		
Total %	10.7	32.6	4.1	0.7	48.1	1.6	4.9	11.3	0.3	18.1	0.6	22.9	1.1	0.3	24.9	2.6	4.8	1.1	0.4	9	
Auto	572	1787	219	13	2591	88	257	606	11	962	34	1250	59	6	1349	145	245	62	15	467	5369
% Auto	94.9	97.3	95.6	34.2	95.8	98.9	93.5	95.4	57.9	94.5	100	96.9	98.3	33.3	96.2	98	90.4	98.4	65.2	92.5	95.3
Truck	22	14	10	2	48	1	17	23	4	45	0	11	1	4	16	3	25	1	4	33	142
% Truck	3.6	0.8	4.4	5.3	1.8	1.1	6.2	3.6	21.1	4.4	0	0.9	1.7	22.2	1.1	2	9.2	1.6	17.4	6.5	2.5
Bus	9	35	0	23	67	0	1	6	4	11	0	29	0	8	37	0	1	0	4	5	120
% Bus	1.5	1.9	0	60.5	2.5	0	0.4	0.9	21.1	1.1	0	2.2	0	44.4	2.6	0	0.4	0	17.4	1	2.1

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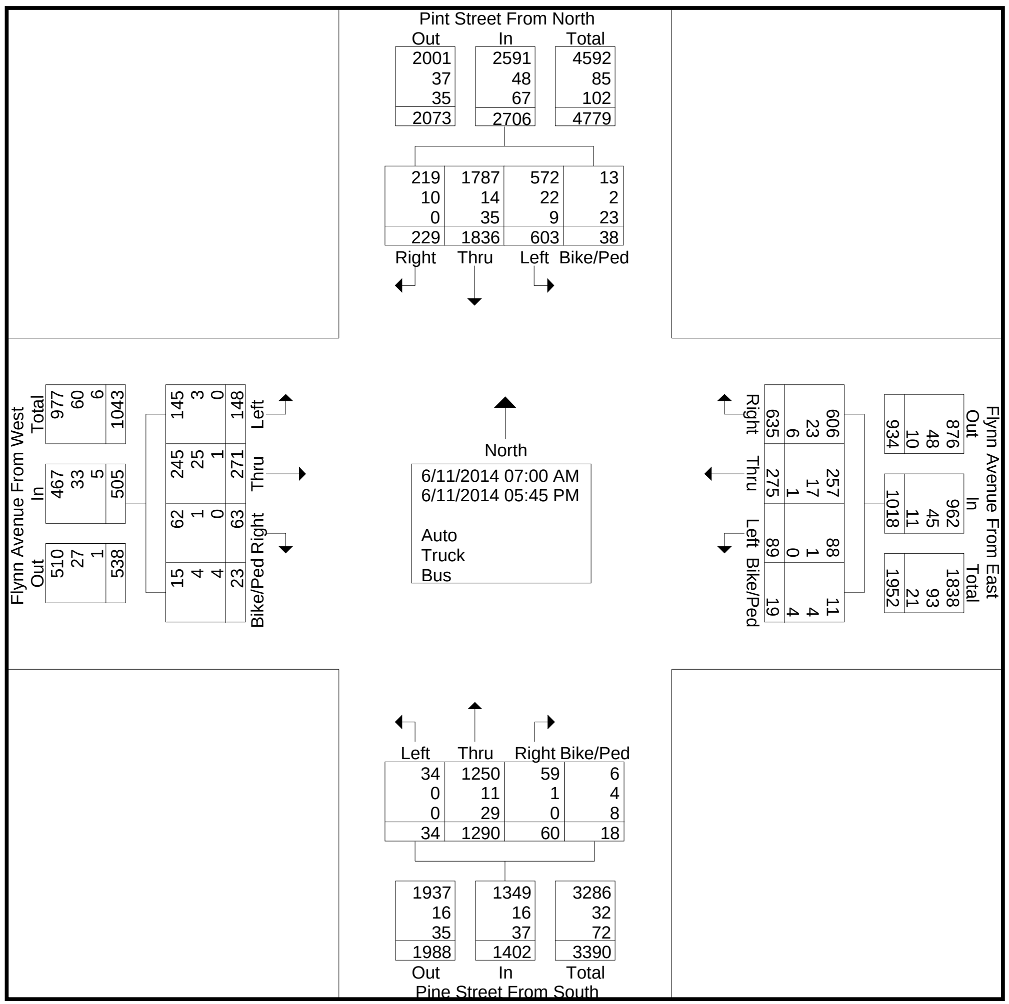

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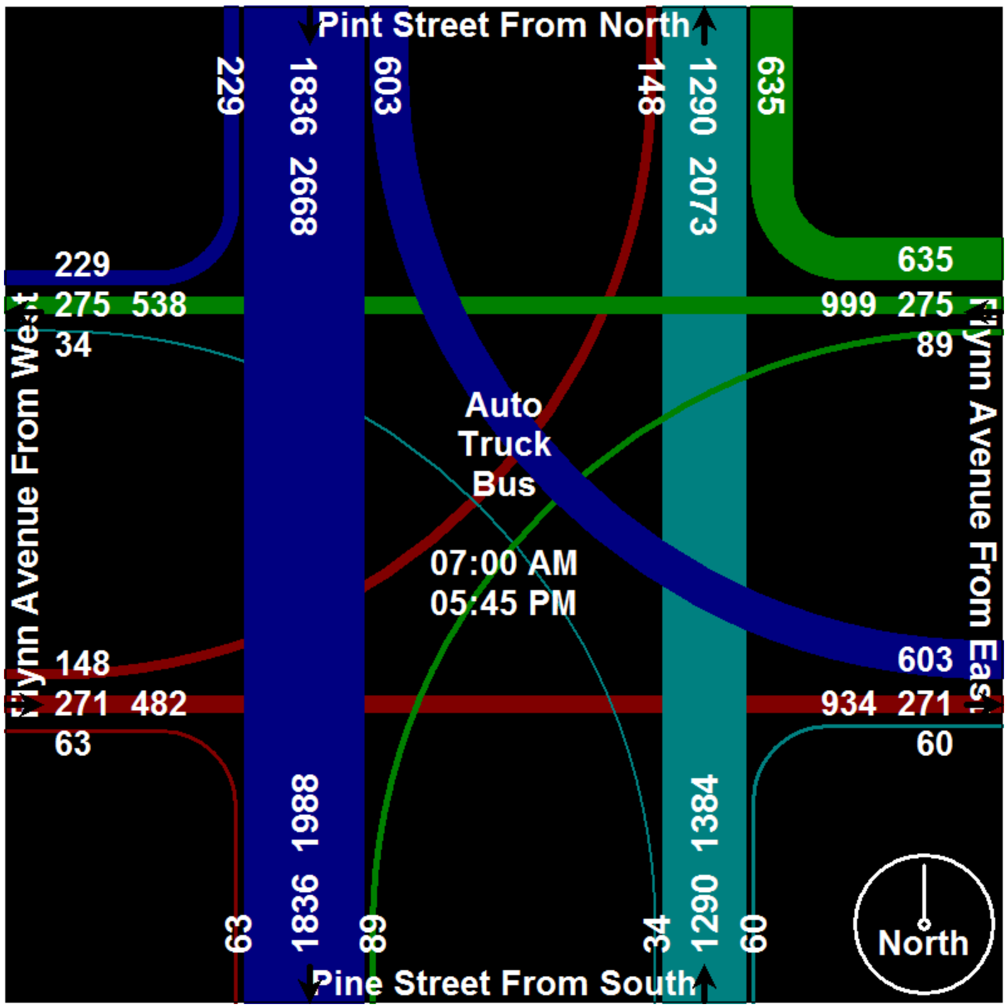

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Start Time	Left	Thru	Right	Bike/Ped	App. Total	Left	Thru	Right	Bike/Ped	App. Total	Left	Thru	Right	Bike/Ped	App. Total	Left	Thru	Right	Bike/Ped	App. Total	Int. Total
Peak Hour Analysis From 07:00 AM to 11:45 AM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 07:45 AM																					
07:45 AM	23	**92**	**25**	0	**140**	4	**27**	56	**3**	**90**	3	87	**5**	0	95	7	**18**	3	0	28	**353**
08:00 AM	17	68	13	1	99	3	15	**63**	0	81	1	94	1	0	96	**10**	9	2	0	21	297
08:15 AM	**30**	78	10	1	119	**5**	23	46	2	76	**4**	**95**	5	0	**104**	7	14	**5**	1	27	326
08:30 AM	21	83	17	**4**	125	4	23	52	1	80	1	91	3	**1**	96	9	17	3	**3**	**32**	333
Total Volume	91	321	65	6	483	16	88	217	6	327	9	367	14	1	391	33	58	13	4	108	1309
% App. Total	18.8	66.5	13.5	1.2		4.9	26.9	66.4	1.8		2.3	93.9	3.6	0.3		30.6	53.7	12	3.7		
PHF	.758	.872	.650	.375	.863	.800	.815	.861	.500	.908	.563	.966	.700	.250	.940	.825	.806	.650	.333	.844	.927

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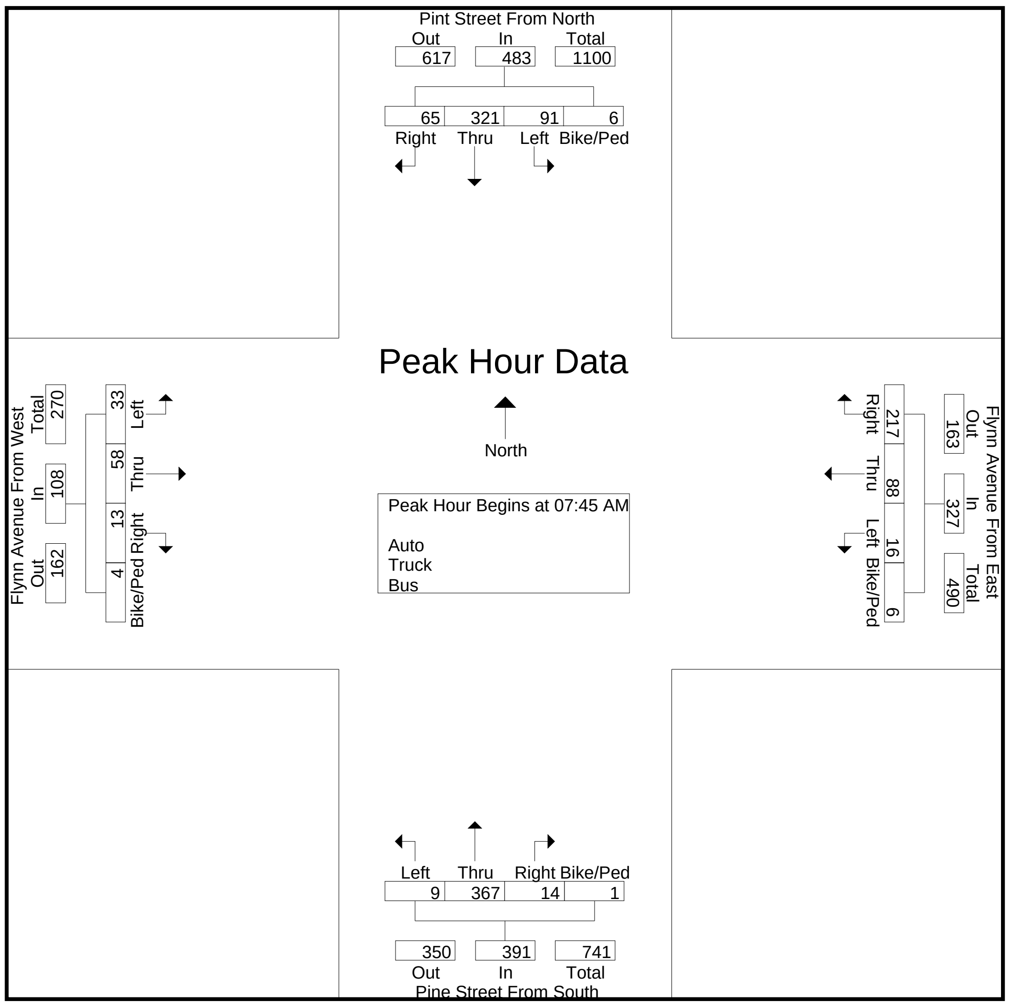

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	Pint Street From North Southbound					Flynn Avenue From East Westbound					Pine Street From South Northbound					Flynn Avenue From West Eastbound					
Start Time	Left	Thru	Right	Bike/Ped	App. Total	Left	Thru	Right	Bike/Ped	App. Total	Left	Thru	Right	Bike/Ped	App. Total	Left	Thru	Right	Bike/Ped	App. Total	Int. Total
Peak Hour Analysis From 12:00 PM to 05:45 PM - Peak 1 of 1																					
Peak Hour for Entire Intersection Begins at 04:30 PM																					
04:30 PM	**77**	174	13	3	**267**	3	17	30	0	50	2	80	7	1	90	12	22	**9**	1	44	**451**
04:45 PM	58	162	20	**8**	248	7	10	28	**2**	47	3	**81**	4	**4**	**92**	15	**29**	3	**5**	**52**	439
05:00 PM	45	174	16	2	237	**11**	**24**	**36**	1	**72**	3	78	**8**	2	91	**17**	25	8	0	50	450
05:15 PM	55	**176**	**29**	6	266	7	22	31	1	61	**4**	67	3	0	74	9	25	2	1	37	438
Total Volume	235	686	78	19	1018	28	73	125	4	230	12	306	22	7	347	53	101	22	7	183	1778
% App. Total	23.1	67.4	7.7	1.9		12.2	31.7	54.3	1.7		3.5	88.2	6.3	2		29	55.2	12	3.8		
PHF	.763	.974	.672	.594	.953	.636	.760	.868	.500	.799	.750	.944	.688	.438	.943	.779	.871	.611	.350	.880	.986

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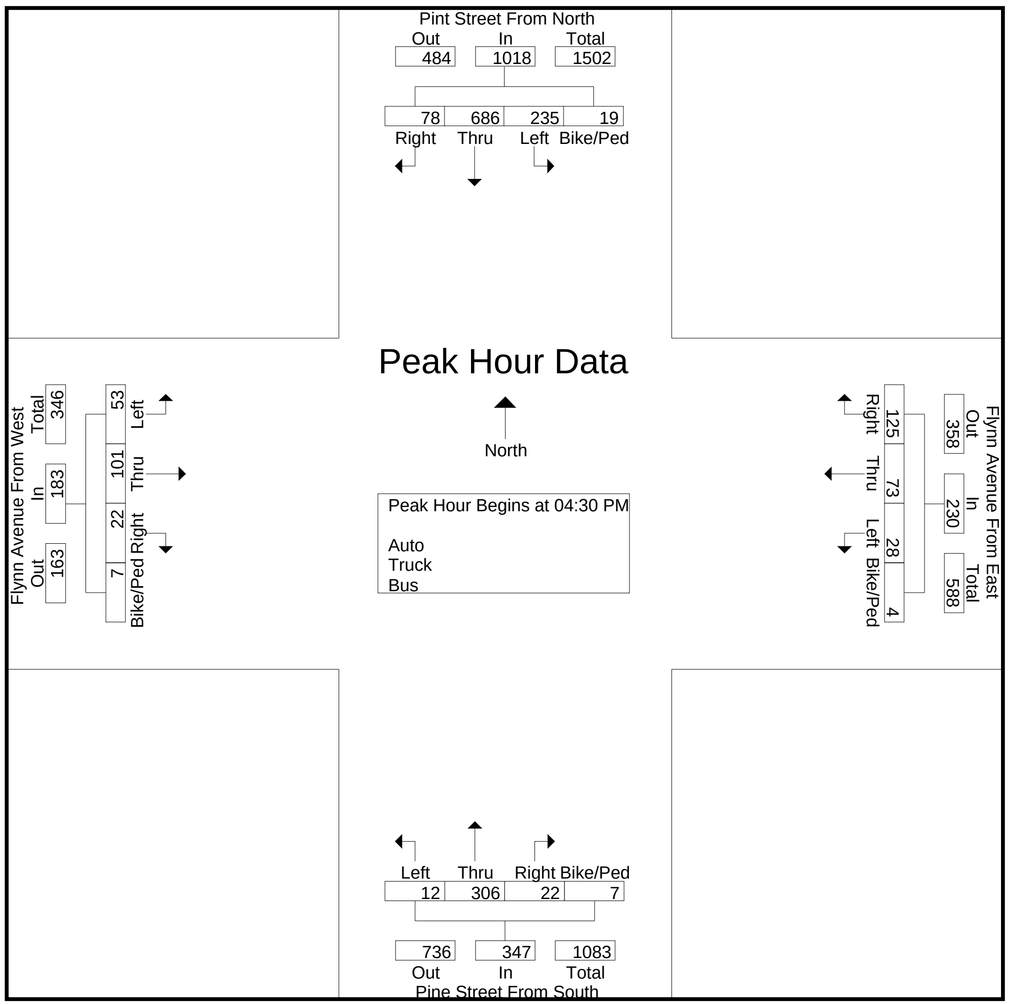

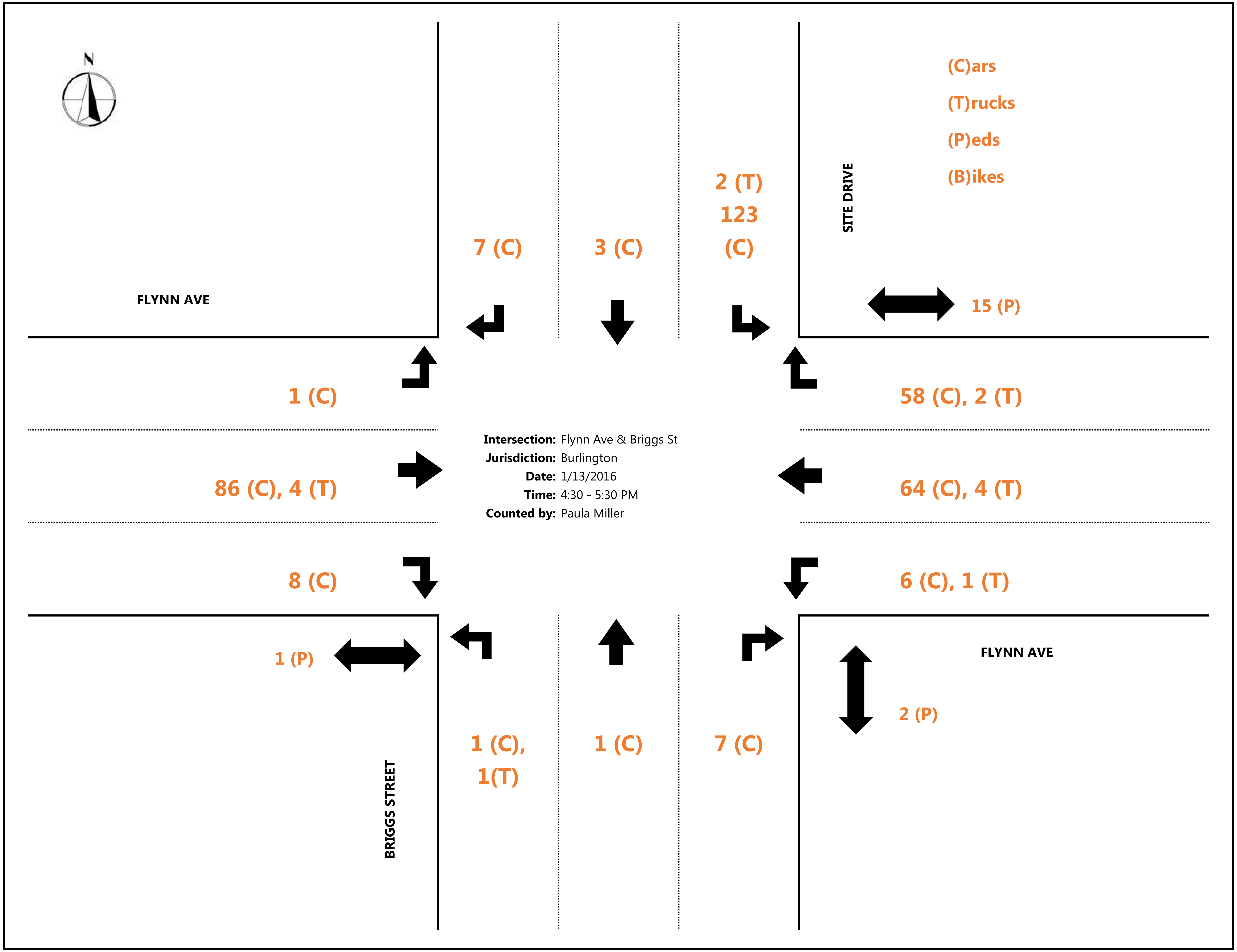
N
(C)ars
(T)rucks
(P)eds
(B)ikes
SITE DRIVE
FLYNN AVE
7 (C)
3 (C)
2 (T)
123
(C)
15 (P)
1 (C)
58 (C), 2 (T)
Intersection: Flynn Ave & Briggs St
Jurisdiction: Burlington
Date: 1/13/2016
Time: 4:30 - 5:30 PM
Counted by: Paula Miller
86 (C), 4 (T)
64 (C), 4 (T)
8 (C)
6 (C), 1 (T)
1 (P)
FLYNN AVE
2 (P)
1 (C),
1(T)
1 (C)
7 (C)
BRIGGS STREET

Crash Data Summary

Date: 01/11/2016 Source: SQL Server VCSG

Vermont Agency of Transportation

General Yearly Summaries - Crash Listing: State Highways and All Federal Aid Highway Systems

From 01/01/10 To 12/31/14 General Yearly Summaries Information

Route: FLYNN AVE., BURLINGTON (within 300 feet of Pine St)

*	Reporting Agency/ Number	Town	Mile Marker	Date MM/DD/YY	Time	Weather	Contributing Circumstances	Direction Of Collision	Number Of Injuries	Number Of Fatalities	Number Of Untimely Deaths	Direction	Road Group
Flynn	VT0040100/2010-3895	Burlington	0	2/20/2010	0:28	Clear	Inattention, No improper driving	No Turns, Thru moves only, Broadside ^<	1	0	0	E	FAU
Flynn	VT0040100/2010-17961	Burlington	0	7/26/2010	22:00	Clear	Inattention, Disregarded traffic signs, signals, markings, No improper driving	No Turns, Thru moves only, Broadside ^<	0	0	0	E	FAU
Flynn	VT0040100/2010-30113	Burlington	0	12/16/2010	7:23	Snow	Failure to keep in proper lane, No improper driving	Right Turn and Thru, Same Direction Sideswipe/Angle Crash ^^--	0	0	0	W	FAU
Flynn	VT0040100/2011-3917	Burlington	0	2/24/2011	21:20	Cloudy	Failed to yield right of way, Inattention	No Turns, Thru moves only, Broadside ^<	0	0	0		FAU
Flynn	VT0040100/2011BU09649	Burlington	0	5/10/2011	10:06	Clear	Failed to yield right of way, No improper driving	No Turns, Thru moves only, Broadside ^<	0	0	0	N	FAU
Flynn	VT0040100/0403BU15220	Burlington	0	7/9/2011	18:37	Clear	No improper driving	No Turns, Thru moves only, Broadside ^<	0	1	0		FAU
Flynn	VT0040100/2012BU014680	Burlington	0	6/17/2012	16:49	Clear	Other improper action	Same Direction Sideswipe	1	0	0		FAU
Flynn	VT0040100/2012BU16841	Burlington	0	7/8/2012	13:10	Clear	Failure to keep in proper lane, Inattention, No improper driving	Same Direction Sideswipe	0	0	0	E	FAU
Flynn	VT0040100/2013BU000201	Burlington	0	1/3/2013	8:05	Cloudy	Visibility obstructed, Inattention, No improper driving	Other - Explain in Narrative	0	0	0		FAU
Flynn	VT0040100/2014BU014067	Burlington	0	6/2/2014	10:16	Clear	Made an improper turn, No improper driving	Right Turn and Thru, Head On v^--	0	0	0	N	FAU
Flynn	VT0040100/2013BU021467	Burlington	0.01	8/17/2013	8:06	Cloudy	Failure to keep in proper lane, Unknown	Rear End	0	0	0		FAU
Flynn	VT0040100/2013BU025076	Burlington	0.01	9/19/2013	8:55	Clear	Unknown	Other - Explain in Narrative	0	0	0		FAU
Flynn	VT0040100/11BU1654	Burlington	0.02	1/24/2011	8:30	Clear		Opp Direction Sideswipe	0	0	0		FAU
Flynn	VT0040100/10-12054	Burlington	0.03	5/24/2010	15:52	Clear	Inattention, Distracted, No improper driving	Rear End	0	0	0	W	FAU
Flynn	VT0040100/2013BU029198	Burlington	0.04	10/28/2013	17:01	Clear	Other improper action	Opp Direction Sideswipe	0	0	0	S	FAU
Flynn	VT0040100/2014BU015414	Burlington	0.04	6/14/2014	8:00	Cloudy	Unknown	Other - Explain in Narrative	0	0	0		FAU
Flynn	VT0040100/2012BU003368	Burlington	0.042	2/8/2012	15:11	Clear	Made an improper turn, No improper driving	Right Turn and Thru, Broadside ^<--	0	0	0	W	FAU
Flynn	VT0040100/2013BU016646	Burlington	0.05	7/4/2013	8:48				0	0	0	E	FAU
Pine	VT0040100/2010-9616	Burlington	0	4/26/2010	14:18	Clear	Operating vehicle in erratic, reckless, careless, negligent, or aggressive manner, No im	Rear End	0	0	0		FAU
Pine	VT0040100/10BU15465	Burlington	0	7/1/2010	11:18	Cloudy	Inattention, No improper driving	Same Direction Sideswipe	0	0	0	S	FAU
Pine	VT0040100/2010-16008	Burlington	0	7/6/2010	21:30	Clear	No improper driving, Failed to yield right of way	No Turns, Thru moves only, Broadside ^<	0	0	0		FAU
Pine	VT0040100/10-24303	Burlington	0	10/1/2010	11:16	Rain	Failed to yield right of way, Inattention	No Turns, Thru moves only, Broadside ^<	0	0	0	N	FAU
Pine	VT0040100/10BU29345	Burlington	0	12/3/2010	21:30	Clear	Inattention, No improper driving	No Turns, Thru moves only, Broadside ^<	0	0	0	N	FAU
Pine	VT0040100/2011BU5163	Burlington	0	3/14/2011	7:58	Cloudy	No improper driving, Driving too fast for conditions	Rear End	0	0	0		FAU
Pine	VT0040100/2011BU24767	Burlington	0	10/19/2011	21:01	Rain	Inattention, No improper driving	Rear End	0	0	0	W	FAU
Pine	VT0040100/2011BU28337	Burlington	0	12/3/2011	2:37	Clear	Under the influence of medication/drugs/alcohol, No improper driving	Head On	0	0	0		FAU
Pine	VT0040100/2012BU012192	Burlington	0	5/22/2012	18:09	Clear	Technology Related Distraction, Inattention	Right Turn and Thru, Broadside ^<--	1	0	0		FAU
Pine	VT0040100/12BU016235	Burlington	0	7/3/2012	12:08	Clear	Followed too closely, Inattention, No improper driving	Rear End	0	0	0		FAU
Pine	VT0040100/2013BU006891	Burlington	0	3/28/2013	18:12	Clear		Right Turn and Thru, Same Direction Sideswipe/Angle Crash ^^--	0	0	0		FAU
Pine	VT0040100/2013BU009975	Burlington	0	5/1/2013	12:46	Clear	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in ro:	Opp Direction Sideswipe	0	0	0	N	FAU
Pine	VT0040100/2013BU011332	Burlington	0	5/13/2013	14:37	Cloudy	Inattention, Made an improper turn	Other - Explain in Narrative	0	0	0	N	FAU
Pine	VT0040100/2013BU023951	Burlington	0	9/9/2013	8:57	Clear	Other improper action, No improper driving	Other - Explain in Narrative	0	0	0	N	FAU
Pine	VT0040100/2013BU025871	Burlington	0	9/26/2013	6:26	Clear	No improper driving, Inattention	No Turns, Thru moves only, Broadside ^<	1	0	0	N	FAU
Pine	VT0040100/2014BU028821	Burlington	0	10/10/2014	18:02	Clear	Inattention, No improper driving	Opp Direction Sideswipe	0	0	0	E	FAU
Pine	VT0040100/11BU01914	Burlington	0.01	1/28/2011	7:40	Cloudy	No improper driving, Inattention	No Turns, Thru moves only, Broadside ^<	0	0	0	N	FAU
Pine	VT0040100/2013BU004988	Burlington	0.02	3/6/2013	8:17	Clear	No improper driving, Visibility obstructed, Inattention	Rear End	0	0	0	N	FAU
Flynn	VT0040100/10-5445	Burlington		3/9/2010	16:45	Clear		Rear End	0	0	0	300 Flynn / 300 Flynn Ave. (about 250 feet west of Pine)	
Flynn	VT0040100/2010-18182	Burlington		7/29/2010	18:10	Clear	Inattention	Same Direction Sideswipe	0	0	0	281 Flynn / 281 Flynn Ave	
Flynn	VT0040100/2014BU018215	Burlington		7/11/2014	8:59	Clear	Other improper action, No improper driving	Same Direction Sideswipe	0	0	0	300 Flynn / 300 Flynn Ave at Flynn Ave	

Total Crash Count = 39 **Fatal Crash Count = 1** **Injury Crash Count = 4** **PDO Crash Count = 34**

Note: FAU-5017 Flynn Ave.. MM 0.00-0.06.
Pine St. intersects Flynn Ave. at mile point 0.00.
LRoberts - Vtrans
Untimely Deaths are the result of death prior to a crash event. These deaths are not counted inthe Fatal/Fatality type counts. They are considered an Incapacitating Injury and are counted in Injury Type crashes.
THIS DOCUMENT IS EXEMPT FROM DISCOVERY OR ADMISSION UNDER 23 U.S.C. 409.

Flynn Ave @ Pine St - Crash Type (2010-2014)	#	%
Head On	1	3%
No Turns, Thru moves only, Broadside ^<	1	
No Turns, Thru moves only, Broadside ^<	2	
No Turns, Thru moves only, Broadside ^<	3	
No Turns, Thru moves only, Broadside ^<	4	
No Turns, Thru moves only, Broadside ^<	5	
No Turns, Thru moves only, Broadside ^<	6	
No Turns, Thru moves only, Broadside ^<	7	
No Turns, Thru moves only, Broadside ^<	8	
No Turns, Thru moves only, Broadside ^<	9	
No Turns, Thru moves only, Broadside ^<	10	26%
Opp Direction Sideswipe	1	
Opp Direction Sideswipe	2	
Opp Direction Sideswipe	3	
Opp Direction Sideswipe	4	10%
Other - Explain in Narrative	1	
Other - Explain in Narrative	2	
Other - Explain in Narrative	3	
Other - Explain in Narrative	4	
Other - Explain in Narrative	5	
Other - Explain in Narrative	6	15%
Rear End	1	
Rear End	2	
Rear End	3	
Rear End	4	
Rear End	5	
Rear End	6	
Rear End	7	
Rear End	8	21%
Right Turn and Thru, Broadside ^<--	1	
Right Turn and Thru, Broadside ^<--	2	
Right Turn and Thru, Head On v^--	3	
Right Turn and Thru, Same Direction Sideswipe/Angle Crash ^^--	4	
Right Turn and Thru, Same Direction Sideswipe/Angle Crash ^^--	5	13%
Same Direction Sideswipe	1	
Same Direction Sideswipe	2	
Same Direction Sideswipe	3	
Same Direction Sideswipe	4	
Same Direction Sideswipe	5	13%

Flynn Ave @ Pine St - Crash Cause (2010-2014)	#	%
Failed to yield right of way, Inattention	1	
Failed to yield right of way, Inattention	2	
Failed to yield right of way, No improper driving	3	
No improper driving, **Failed to yield right of way**	4	10%
Failure to keep in proper lane, Inattention, No improper driving	1	
Failure to keep in proper lane, No improper driving	2	
Failure to keep in proper lane, Unknown	3	8%
Followed too closely, Inattention, No improper driving	1	3%
Inattention	1	
Inattention, Disregarded traffic signs, signals, markings, No improper driving	2	
Inattention, Distracted, No improper driving	3	
Inattention, Made an improper turn	4	
Inattention, No improper driving	5	
Inattention, No improper driving	6	
Inattention, No improper driving	7	
Inattention, No improper driving	8	
Inattention, No improper driving	9	
No improper driving, **Inattention**	10	
No improper driving, **Inattention**	11	28%
Made an improper turn, No improper driving	1	
Made an improper turn, No improper driving	2	5%
No improper driving, **Driving too fast for conditions**	1	3%
No improper driving, **Visibility obstructed**, Inattention	1	3%
Operating vehicle in erratic, reckless, careless, negligent, or aggressive manner	1	3%
Other improper action	1	
Other improper action	2	
Other improper action, No improper driving	3	
Other improper action, No improper driving	4	10%
No improper driving	1	3%
Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway et	1	3%
Technology Related Distraction, Inattention	1	3%
Under the influence of medication/drugs/alcohol, No improper driving	1	3%
Unknown	1	
Unknown	2	
Unknown	3	
Unknown	4	
Unknown	5	
Unknown	6	15%
Visibility obstructed, Inattention, No improper driving	1	3%

Date: 01/11/2016 Source: SQL Server VCSG

Vermont Agency of Transportation

General Yearly Summaries - Town Highway Crash Listing: Non-Federal Aid Highways-Local

From 01/01/10 To 12/31/14 General Yearly Summaries Information

Reporting Agency/ Number	Date MM/DD/YY	Time	Weather	Contributing Circumstances	Direction Of Collision	Number Of Injuries	Number Of Fatalities	Number Of Untimely Deaths	Location
VT0040100/10-S44S	3/9/2010	16:4S	Clear		Rear End	0	0	0	300 Flynn Ave. (about 250 feet west of Pine)
VT0040100/2010-18182	7/29/2010	18:10	Clear	Inattention	Same Direction Sideswipe	0	0	0	281 Flynn Ave
VT0040100/10BU18394	7/31/2010	1S:30	Clear	No improper driving, Failed to yield right of way	gb	0	0	0	19S Flynn Ave at Briggs St.
VT0040100/2014BU01821S	7/11/2014	8:59	Clear	Other improper action, No improper driving	Same Direction Sideswipe	0	0	0	300 Flynn Ave at Flynn Ave
Totals:									

Total Crash Count = 4 **Fatal Crash Count = 0** **Injury Crash Count = 0** **PDO Crash Count = 4**

Note: 2010-2014 Burlington Town Highway Listing.
L. Roberts - Vtrans
Untimely Deaths are the result of death prior to a crash event. These deaths are not counted in the Fatal/Fatality type counts. They are considered an Incapacitating Injury and are counted in Injury Type crashe:
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Trip Generation Calculations

TABLE 1b

TRIP GENERATION SUMMARY *rev. 7/24/16*

Peak Period	Trip Generation (33874 square foot Groucery Store)				
Weekday Evening Peak hour	Total	Non-Auto	Pass-By	Diverted	New
Split (trip type)	*100%*	*20%*	*5%*	*35%*	*40%*
Enter	165	30	10	55	65
Exit	155	30	10	55	65
Total	320	60	20	110	130

ITE TRIP GENERATION WORKSHEET

(9th Edition, Updated 2012)

LANDUSE: Supermarket
LANDUSE CODE: 850

Independent Variable --- Peak Hour Traffic on Adjacent Street

JOB NAME: **City Market**
JOB NUMBER: **57843**

FLOOR AREA (KSF): 33.874 ksf

WEEKDAY

RATES:

	# Studies	R^2	Total Trip Ends Average	Total Trip Ends Low	Total Trip Ends High	Independent Variable Range Average	Independent Variable Range Low	Independent Variable Range High	Directional Distribution Enter	Directional Distribution Exit
DAILY	4	0.52	102.24	68.65	168.88	39	20	60	50%	50%
AM PEAK (ADJACENT ST)	13	NA	3.40	1.00	7.78	37	22	57	62%	38%
PM PEAK (ADJACENT ST)	62	0.52	9.48	3.53	20.29	56	10	142	51%	49%
PM PEAK (ADJACENT ST)	***21***	***-***	***8.87***	***VTrans Chittenden County Trip Rate***						

TRIPS:

	BY AVERAGE Total	BY AVERAGE Enter	BY AVERAGE Exit	*BY REGRESSION Total*	*BY REGRESSION Enter*	*BY REGRESSION Exit*
DAILY	3,463	58	58	*3,659*	*1,830*	*1,830*
AM PEAK (ADJACENT ST)	115	71	44	*NA*	*NA*	*NA*
PM PEAK (ADJACENT ST)	**321**	**164**	**157**	*350*	*178*	*171*
VTrans Rate - PM PEAK (ADJACENT ST)	**300**	**153**	**147**	*Too High - Don't Use.*		

Table 5.10
Pass-By Trips and Diverted Linked Trips
Weekday, p.m. Peak Period

Land Use 850—Supermarket

SIZE (1,000 SQ. FT. GFA)	LOCATION	WEEKDAY SURVEY DATE	NO. OF INTERVIEWS	TIME PERIOD	PRIMARY TRIP (%)	NON-PASS-BY TRIP (%)	DIVERTED LINKED TRIP (%)	PASS-BY TRIP (%)	AVERAGE DAILY TRAFFIC	SOURCE
30	Overland Park, KS	1987	40	4:30–5:30 p.m.	48	—	20	32	n/a	n/a
<25	Chicago suburbs, IL	1987	155	3:00–6:00 p.m.	—	44	—	56	n/a	Kenig, O'Hara, Humes, Flock
<25	Chicago suburbs, IL	1987	191	3:00–6:00 p.m.	—	43	—	57	n/a	Kenig, O'Hara, Humes, Flock
<25	Chicago suburbs, IL	1987	113	3:00–6:00 p.m.	—	44	—	56	n/a	Kenig, O'Hara, Humes, Flock
34	Omaha, NE	n/a	n/a	4:00–6:00 p.m.	29	—	27	44	15,200	University of Nebraska—Lincoln
66	Omaha, NE	n/a	n/a	4:00–6:00 p.m.	30	—	47	23	63,000	University of Nebraska—Lincoln
70	Omaha, NE	n/a	n/a	4:00–6:00 p.m.	30	—	44	26	34,300	University of Nebraska—Lincoln
31	Omaha, NE	n/a	n/a	4:00–6:00 p.m.	36	—	45	19	48,700	University of Nebraska—Lincoln
31	Omaha, NE	n/a	n/a	4:00–6:00 p.m.	40	—	32	28	23,500	University of Nebraska—Lincoln
55	Omaha, NE	n/a	n/a	4:00–6:00 p.m.	35	—	38	27	27,200	University of Nebraska—Lincoln
65	Omaha, NE	n/a	n/a	4:00–6:00 p.m.	25	—	50	25	44,700	University of Nebraska—Lincoln
31	Orlando, FL	1993	440	2:00–6:00 p.m.	—	65	—	35	n/a	TPD Inc.
Average Pass-By Trip Percentage: 36					38-34		31-38	41-36		

PASSBY LIMITED BY ADJACENT ST TRAFFIC MAX PASSBY ≈ 10% ON FLYNN AVE

PASSBY = 10% (FLYNN AVE)

DIVERTED = 35% (PINE ST, US 7, OTHER LOCAL STREETS)

NEW (PRIMARY) = 35% (CONSERVATIVE)

NONE AUTO (WALK BIKE TRANSIT) = 20%

Supermarket
(850)

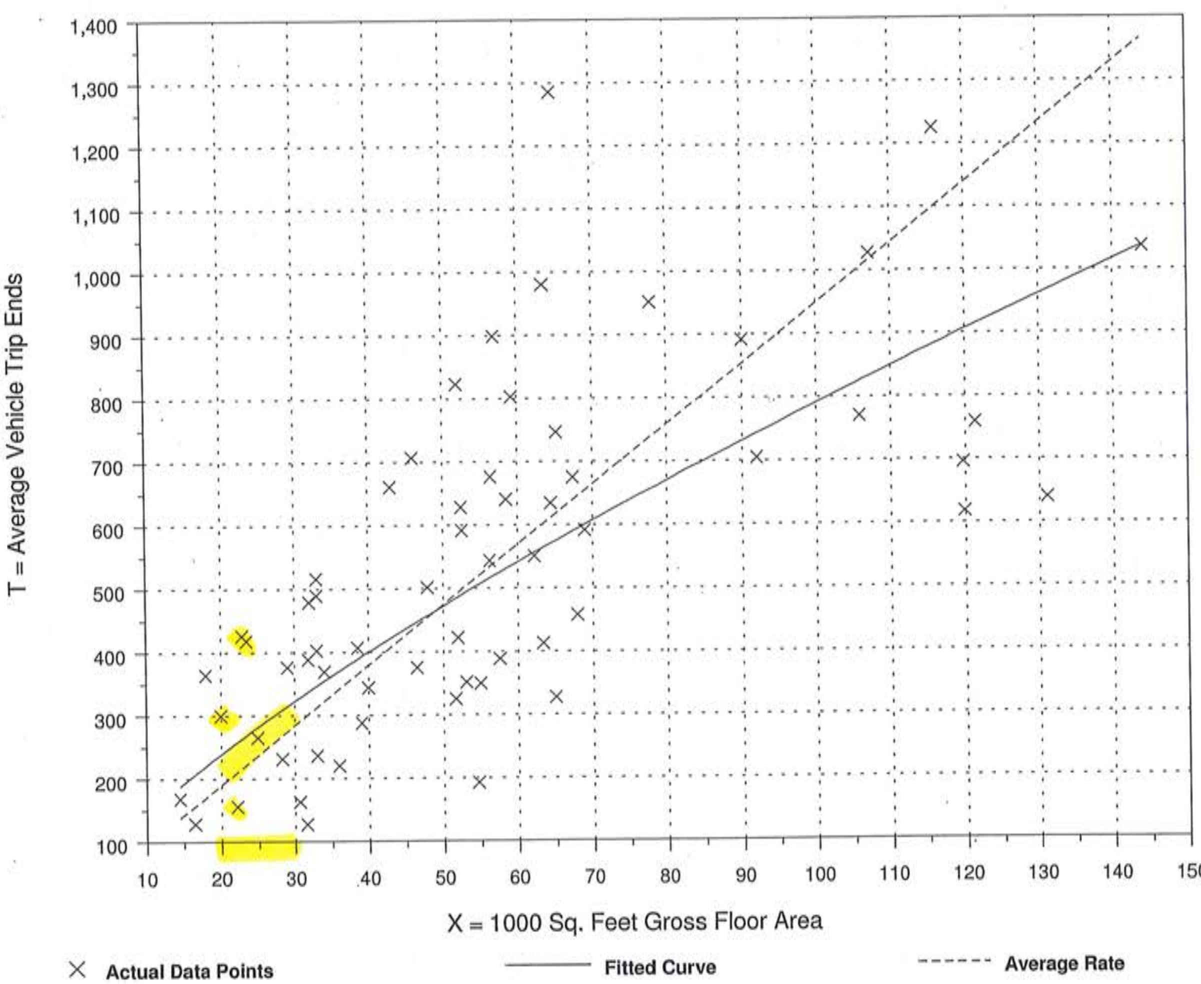
Average Vehicle Trip Ends vs: 1000 Sq. Feet Gross Floor Area
On a: Weekday,
Peak Hour of Adjacent Street Traffic,
One Hour Between 4 and 6 p.m.

Number of Studies: 62
Average 1000 Sq. Feet GFA: 56
Directional Distribution: 51% entering, 49% exiting

Trip Generation per 1000 Sq. Feet Gross Floor Area

Average Rate	Range of Rates	Standard Deviation
9.48	3.53 - 20.29	4.81

Data Plot and Equation



Fitted Curve Equation: $Ln(T) = 0.74 Ln(X) + 3.25$ **$R^2 = 0.52$**

Table 2. Summary of trip generation rate results and tests of statistically significant differences.

LUC	Time of Day	Independent Variable	ITE Rate	Statewide Rate	Number of Studies	SS* Differ from ITE	Chittenden Co. Rate	Number of Studies	SS* Differ from ITE	Outside of Chittenden Co. Rate	Number of Studies	SS* Differ from ITE	SS* Differ Between Chittenden Co. and Outside
90	AM	Spaces	0.72	0.36	6	YES		0			6		N/A
90	Mid	Spaces	0.62	0.34	6	YES		0			6		N/A
140	AM	1000 Sq. Ft. GFA	0.78	1.21	3	NO		1			2		N/A
140	Mid	1000 Sq. Ft. GFA	0.75	3.13	7	YES	0.79	2	NO	4.83	5	YES	YES
140	PM	1000 Sq. Ft. GFA	0.75	3.81	4	NO		1			3		N/A
310	AM	Rooms	0.56	0.60	8	NO		1			7		N/A
310	Mid	Rooms	0.52	0.37	15	YES	0.59	2	NO	0.24	13	YES	NO
310	PM	Rooms	0.61	0.66	8	NO		1			7		N/A
430	AM	Holes	2.23	2.02	9	NO		0			9		N/A
430	Mid	Holes	3.01	2.79	12	NO		0			12		N/A
430	PM	Holes	3.56	2.97	3	NO		0			3		N/A
820	AM	1000 Sq. Ft. GLA	1.00	2.32	49	YES	2.56	19	YES	2.06	30	YES	NO
820	Mid	1000 Sq. Ft. GLA	3.73	3.69	137	NO	3.75	54	NO	3.62	83	NO	NO
820	PM	1000 Sq. Ft. GLA	3.73	4.04	24	NO	4.30	8	YES	3.82	16	NO	NO
841	AM	1000 Sq. Ft. GFA	2.2	2.03	3	NO		0			3		N/A
841	Mid	1000 Sq. Ft. GFA	2.72	1.84	6	YES		0			6		N/A
850	AM	1000 Sq. Ft. GFA	10.05	2.82	30	YES	3.92	6	YES	3.17	24	YES	NO
850	Mid	1000 Sq. Ft. GFA	10.05	6.27	57	YES	7.31	21	YES	5.44	36	YES	YES
850	PM	1000 Sq. Ft. GFA	10.5	7.22	31	YES	8.87	10	YES	6.39	21	YES	YES
853	AM	1000 Sq. Ft. GFA	43.9	29.25	63	YES	27.93	10	NO	29.56	53	YES	NO
853	Mid	1000 Sq. Ft. GFA	62.57	29.62	87	YES	33.57	13	YES	29.05	74	YES	NO
853	PM	1000 Sq. Ft. GFA	59.69	35.17	51	YES	53.84	9	NO	32.47	42	YES	YES
862	AM	1000 Sq. Ft. GFA	3.08	1.37	4	YES		0			4		N/A
862	Mid	1000 Sq. Ft. GFA	3.32	2.23	14	YES		0			14		N/A
862	PM	1000 Sq. Ft. GFA	3.32	2.19	6	YES		0			6		N/A

Notes: * statistically significant.

Food Shopping in the Urban Environment: Parking Supply, Destination Choice and Mode Choice

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ABSTRACT

This research contributes to literature on the influence of urban form on travel behavior. It examines the specific impact of surface parking lots at supermarkets. Past studies have demonstrated that design elements of a neighborhood (density, mix of uses, street connectivity, sidewalk condition, tree cover, etc.) have correlations with travel behavior (vehicle miles traveled, walking trip rates, transit ridership, etc.). In the present case, those elements are controlled by selecting supermarkets in six Philadelphia neighborhoods all characterized by urban design features associated with high rates of walking. Travel behavior of residents within a one-half mile catchment shed of each supermarket is examined. Using a quasi-experimental methodology, two design typologies for supermarkets are analyzed. Three of the supermarkets are auto-oriented, with large setbacks from the street and large surface parking lots, while the other three are pedestrian-oriented. They are not set-back from the street, their entrances open to a sidewalk rather than a surface lot, and their available parking is structured or priced, even though parking is still free with grocery purchases. Using a discrete choice framework, binary logit models were developed demonstrating that surface parking lots encourage automobile access over pedestrian access. Moreover, while surface parking lots were shown to influence mode choice, they were not shown to increase use of a supermarket among nearby residents.

INTRODUCTION

This study investigates the influence of supermarket site design on food shopping access. Prior research demonstrates that decisions about food shopping (trip frequency, choice of destination and mode of transportation) vary based on household characteristics (e.g. size and income) and non-household characteristics (e.g. qualities of supermarkets and qualities of the built environment) (*1-11*). Scholars have tried to identify ways planners and policy makers can influence shopping travel patterns. Much research in this area aims to increase non-motorized mode share, with ultimate goals varying from reduced greenhouse gas emissions, oil consumption and road congestion to increased exercise and livability. Within this body of literature, the role of urban form in shaping travel habits is a key subject of study (*1, 7, 12-22*).

The present investigation examines a previously unexplored singular aspect of urban form on shopping travel patterns: the availability of surface parking lots. Past research has demonstrated that design elements of a neighborhood (density, mix of uses, sidewalk condition, tree cover, etc.) have a statistically significant impact on shopping travel behavior (*1, 7, 13, 15-22*). With a focus limited to food shopping, this study holds neighborhood design constant to evaluate the separate role of destination site design, specifically the presence or absence of a surface parking lot.

Using survey results from households in neighborhoods adjacent to 6 supermarkets in Philadelphia, PA, this paper shows that surface parking lots encourage automobile access over pedestrian access. Moreover, while surface parking lots are shown to influence mode choice, they do not show any advantage in terms of increased use of a supermarket by nearby residents.

PREVIOUS RESEARCH

Travel models estimate a utility derived from travel decisions. A utility can be calculated for a package of choices including mode, route, time of day, and even the destination itself. For food shopping, a decision about destination or mode on any particular day is likely to take several contextual factors into account. A shopper might walk to a nearby supermarket with higher prices instead of driving to a distant supermarket with lower prices on a day when he or she is short on time. Other dynamic factors can include the weather, types of items needed or the location of other activities the shopper will participate in that day (*5, 6*).

The relative proximity of a market is key, as food shopping is more likely to be locally-based than any other type of shopping trip (*6, 7*), but it is not the only factor. Research has identified considerations in choosing a destination that include quality of goods, atmosphere, selection, crowds, prices, proximity to other destinations (e.g., workplace), or loyalty to a particular brand (*6-8*). Households tend to have a primary grocery store, though many also make trips to non-primary stores, up to 3 or 4 times over the course of a month (*5, 7, 11*). Some evidence suggests that a significant number of food trips are small, perhaps for only one or two bags of groceries (*5, 2, 7, 11*). In studies on the topic of mode choice, scholars frequently examine scales of urbanism, comparing areas of high and low "D variables": density (population, employment, etc.), diversity (of land uses), design (street connectivity, street width, building setback, etc.), destination accessibility (e.g., average distance to destination), and distance to transit (*1, 7, 13, 15-22*).

Characteristics of shoppers themselves influence behavior. Studies demonstrate that income, ethnicity, number of children and number of available vehicles influence how often people shop, where they shop, and how they get there (*2, 4, 8, 9,11*). Bawa and Ghosh (*2*) suggest middle-income households are most pressed for time, making fewer shopping trips than either high- or low-income households. Rajamani et al. (*21*) found that higher income households in Portland, OR were more likely to drive to non-work destinations than lower-income households.

Ease of parking is a factor that has been suggested by other studies. Bell, Ho and Tang (*3*) assume parking as a component of a fixed cost variable in their model on supermarket choice. In an empirical study of consumers' shopping decision-making processes, Dellaert, et al. (*6*) encountered parking as a consideration, but not a statistically significant one. Van der Waerden et al. (*22*) observe that the probability of choosing particular parking lots can decrease as size of lot increases, perhaps because shoppers are averse to long walks through parking lots.

Recent research on mode choice pays particular attention to the question of self-selection, or the possibility that residents who choose to walk in "walkable" neighborhoods have chosen their environments purposefully, rather than fallen under the influence of them. Such a condition would seem to dim the prospects of using changes in urban form to influence behavior. However, studies have begun to demonstrate a statistically significant correlation between the built environment and travel behavior even after controlling for self-selection (*12-20*). Furthermore, the role of self-selection should not obscure the fact that demand for walkable communities in the US may well exceed current supply (*23*).

Past studies have reached the foreseeable conclusion that households far from shopping destinations are unlikely to make walking trips (*7*). Missing from the literature is a robust discussion of how the decision to drive 5 miles to a supermarket in a low-density exurb is different from the decision to drive one-half mile to a supermarket in a dense city. To address this gap, this research focuses only on households in dense urban environments living within a one-half mile walk shed of a supermarket. Understanding the effects of store design—in particular street setbacks and parking configuration—on travel behavior for this subset of shoppers could facilitate the development of policies that encourage (or discourage) walking as a strategy for reducing congestion and improving air quality and livability.

METHODOLOGY

The present study considers six neighborhoods adjacent to full-service supermarkets. The neighborhoods, all in Philadelphia, PA, can be characterized as dense residential districts, consisting mostly of attached row-homes and apartment buildings. Retail is a common ground floor use. Surrounding street networks are grids with sidewalks on both sides of the street. Few, if any, buildings are set back from the street. The largest variations between neighborhoods are found in tree coverage and vacancy rates. Past research has demonstrated that shoppers will avoid crossing a major arterial on foot (*7*), so neighborhoods with these circumstances were avoided. Supermarkets adjacent to dense, walkable neighborhoods but along big box retail corridors were also avoided under the assumption that even nearby residents would most likely view them as automobile destinations. One supermarket was located near railroad tracks, but surveying was limited to households on the same side of the tracks as the supermarket.

This research focuses on supermarket design with respect to auto or pedestrian orientation. The supermarkets were chosen in two sets of three. Half the supermarkets were selected because their sites include a large surface parking lot and half were chosen because their sites have little or no surface parking. For the purposes of this paper, the former three are referred to as “auto-oriented markets” (A1, A2 and A3) and the latter three are referred to as “pedestrian-oriented markets” (P1, P2 and P3) (Figures 1 and 2). While two of the pedestrian-oriented markets have above ground parking and one has a small side lot (15 spaces), they all exhibit urban design characteristics such as a zero setback from the street and a front door that opens directly onto a city sidewalk. By contrast, the “auto-oriented markets” have between 150 and 210 parking spaces, and setbacks from the street ranging between 190 and 280 feet (Table 1).

Rather than gathering data at supermarkets (*1, 11*), or broadly across the city irrespective of where or what kinds of food shopping opportunities exist (*7, 12-14, 16-20*), this study surveyed only those residents that live within a half-mile walking distance of a full-service chain supermarket. While the surveyed food shoppers represent a broad range of incomes and races, all live in neighborhoods that exhibit urban design characteristics consistently associated with high levels of pedestrian activity, including a high density and mix of land uses, street network connectivity, and the presence of sidewalks (*1, 7, 13, 15-22*).

TABLE 1 Supermarket Parking Supply

	Number of Parking Spots Dedicated to Food Shoppers	Location of Parking	Parking Policies / Other Parking	Front Door Setback from Facing Street
A1	150	Surface lot between main street and front entrance	All parking food shoppers only	280 ft.
A2	210	Surface lot between main street and front entrance	All parking food shoppers only	260 ft.
A3	180	Surface lot between main street and front entrance	All parking food shoppers only	190 ft.
P1	24 (400)[a]	Above supermarket	400 parking spaces available to public at hourly and daily rates; 400 parking spaces available for university permit parking; free parking under 2 hours with $10 food store purchase; $3 parking under 4 hours with movie ticket purchase	0 ft.
P2	15	Surface lot to the left of front door along sidewalk	All parking food shoppers only	0 ft.
P3[b]	30 (245)[a]	Above supermarket	245 parking spaces available to public at hourly, daily, and monthly rates; free parking under 2 hours with $10 food store purchase	0 ft.
	116	Above supermarket	All parking food shoppers only	0 ft.

[a] Additional parking available but not dedicated for shoppers
[b] There are two pedestrian-oriented supermarkets adjacent to each other at this site

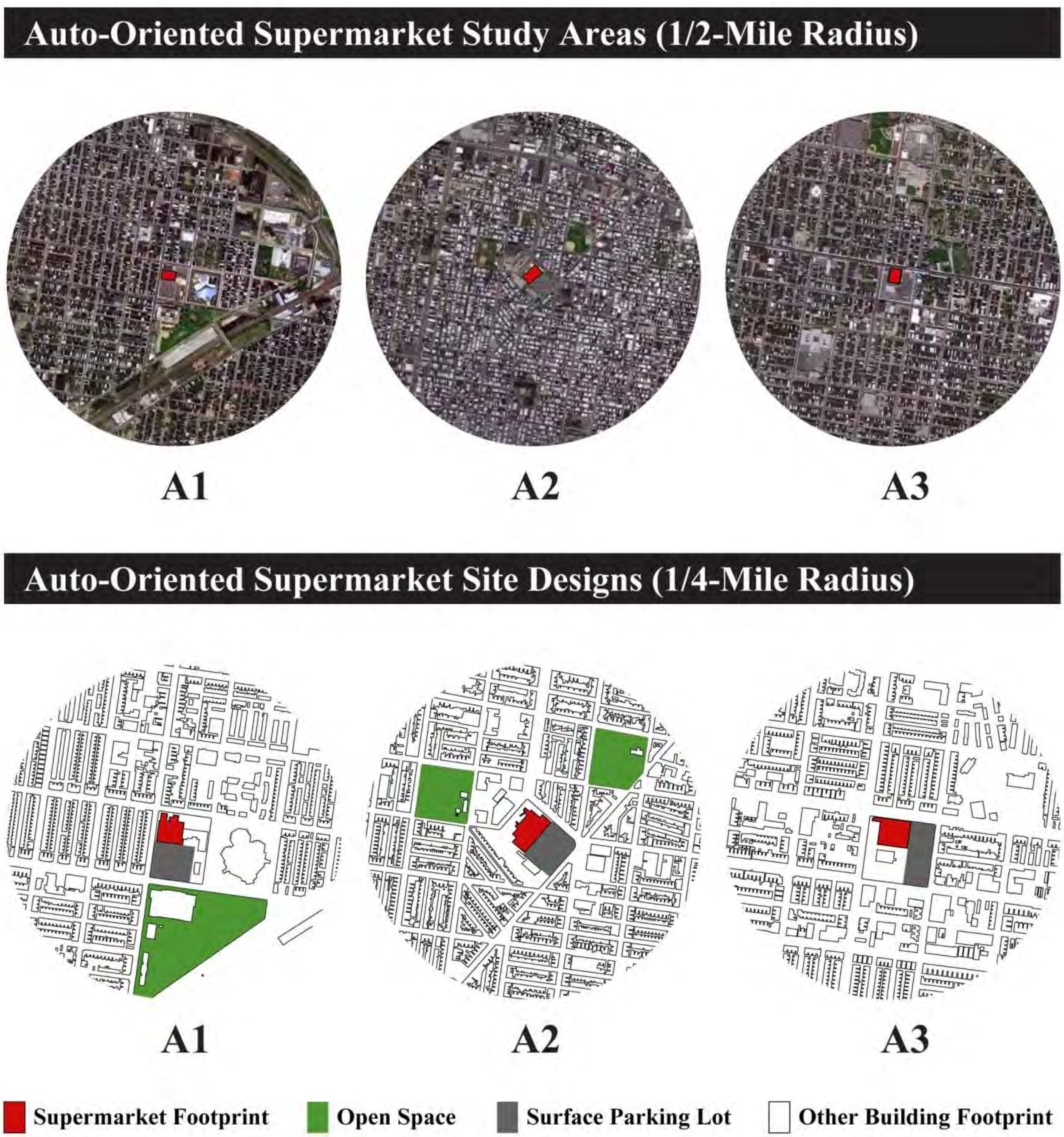


FIGURE 1 Auto-oriented supermarket study areas and site designs.

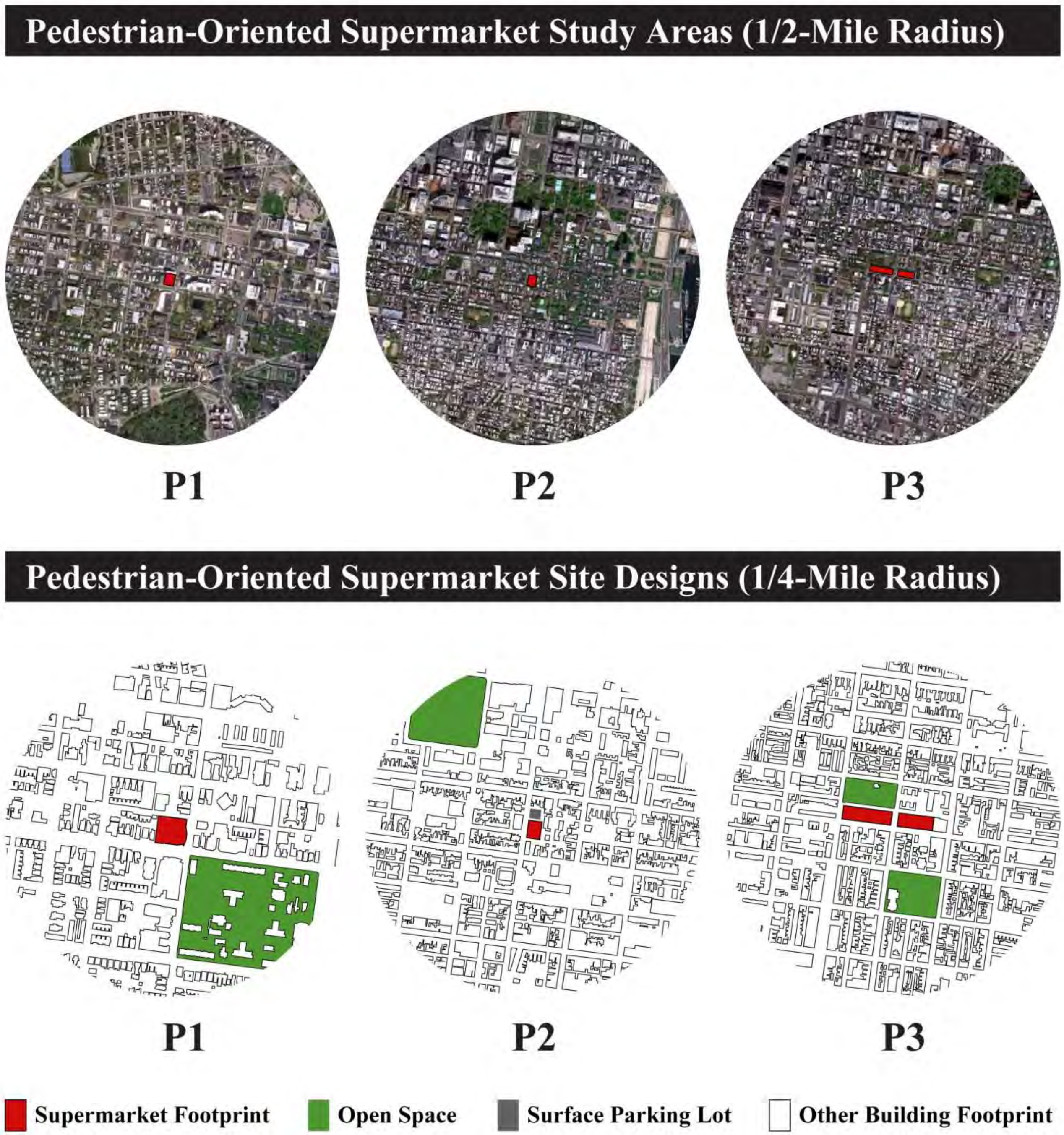


FIGURE 2 Pedestrian-oriented supermarket study areas and site designs. Note that P3 is comprised of two pedestrian-oriented supermarkets across the street from one another.

Data were collected using a 12-question postcard survey (Figure 3) distributed to 3,600 dwelling units, 600 per catchment area. The postcards were addressed and stamped; the instructions were that the primary food shopper of the household complete the survey and drop it in a mailbox. Because each survey asked about the nearby supermarket by name, each response could be classified according to market-neighborhood.

We employ a random utility discrete choice framework to analyze the choices of interest (*24*, *25*). In this framework, theory suggests that a decision-maker derives utility from his/her choice of mode and/or destination. Utility (*U*) is comprised of observed and unobserved elements. The observed portion is typically referred to as the systematic portion of utility. It is denoted *V* and is determined by characteristics of the person (*i*) who is making the choice and the characteristics of the competing choices and/or other explanatory variables (*j*). The remainder of the utility is captured in the residual term ε (*24, 25*). Hence utility is given as:

$$U = V + \varepsilon \qquad (1)$$

The probability that a mode (walking, in this case) is chosen is a function of the probability that the utility for walking is higher than the utility for not-walking.

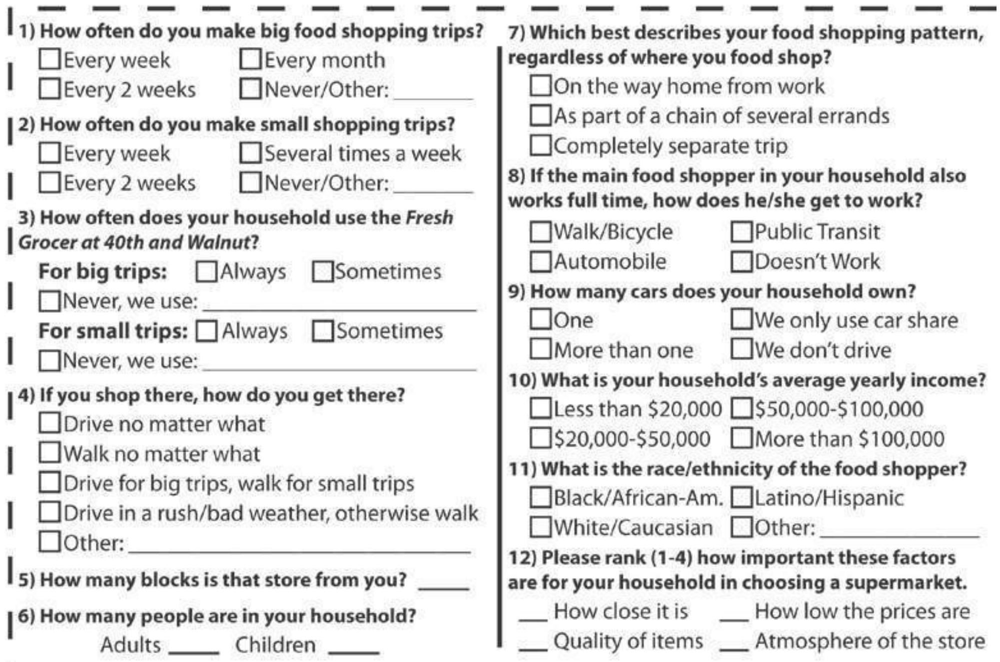
$$\begin{aligned} P_i(\text{walk}|\text{characteristics}_{ij,}) &= \Phi(V_{walk} + \varepsilon_{walk}) \\ &= \Pr(V_{walk} + \varepsilon_{walk} > V_{not\ walk} + \varepsilon_{not\ walk}) \\ &= \Pr(\varepsilon_{not\ walk} - \varepsilon_{walk} < V_{walk} - V_{not\ walk}) \end{aligned} \qquad (2)$$

The left-hand side of the equation is the probability that person (*i*) walks to the grocery store, given the characteristics of person (*i*) and the choice set or environment (*j*) faced by person (*i*). In this particular case, the environment variable pertains to the absence or presence of a surface parking lot at the supermarket.

We use the same methodological framework to study the probability that someone chooses his/her local supermarket. Equation (2) is modified:

$$\begin{aligned} P_i(\text{local supermarket}|\text{characteristics}_{ij,}) &= \Phi(V_{ls} + \varepsilon_{ls}) \\ &= \Pr(V_{ls} + \varepsilon_{ls} > V_{not\ ls} + \varepsilon_{not\ ls}) \\ &= \Pr(\varepsilon_{not\ ls} - \varepsilon_{ls} < V_{ls} - V_{not\ ls}) \end{aligned} \qquad (3)$$

The left-hand side is the probability that person (*i*) chooses his/her local supermarket, given the characteristics of person (*i*) and the choice set or environment (*j*) faced by person (*i*).



1) How often do you make big food shopping trips?
☐Every week ☐Every month
☐Every 2 weeks ☐Never/Other: ______

2) How often do you make small shopping trips?
☐Every week ☐Several times a week
☐Every 2 weeks ☐Never/Other: ______

3) How often does your household use the *Fresh Grocer at 40th and Walnut*?
For big trips: ☐Always ☐Sometimes
☐Never, we use: ______
For small trips: ☐Always ☐Sometimes
☐Never, we use: ______

4) If you shop there, how do you get there?
☐Drive no matter what
☐Walk no matter what
☐Drive for big trips, walk for small trips
☐Drive in a rush/bad weather, otherwise walk
☐Other: ______

5) How many blocks is that store from you? ______

6) How many people are in your household?
Adults ______ Children ______

7) Which best describes your food shopping pattern, regardless of where you food shop?
☐On the way home from work
☐As part of a chain of several errands
☐Completely separate trip

8) If the main food shopper in your household also works full time, how does he/she get to work?
☐Walk/Bicycle ☐Public Transit
☐Automobile ☐Doesn't Work

9) How many cars does your household own?
☐One ☐We only use car share
☐More than one ☐We don't drive

10) What is your household's average yearly income?
☐Less than $20,000 ☐$50,000-$100,000
☐$20,000-$50,000 ☐More than $100,000

11) What is the race/ethnicity of the food shopper?
☐Black/African-Am. ☐Latino/Hispanic
☐White/Caucasian ☐Other: ______

12) Please rank (1-4) how important these factors are for your household in choosing a supermarket.
___ How close it is ___ How low the prices are
___ Quality of items ___ Atmosphere of the store

FIGURE 3 Survey distributed to households.

RESULTS

Response rates and demographic data from the survey and from the Census for each market-neighborhood are shown in Table 2. The largest discrepancies between the survey and the Census are for market-neighborhood P1, and are likely due to the fact that this is a university area with a combination of permanent and temporary residents. The following sections highlight differences by neighborhood and by access to automobiles. Results of the models show that, controlling for distance, number of children, store loyalty, auto ownership and other factors, residents of study areas near auto-oriented supermarkets are more likely to drive, even though they are less likely to own automobiles, than their counterparts living near pedestrian-oriented markets. We also show that the presence or absence of surface parking lots does not engender greater store loyalty.

TABLE 2 Response Rates and Neighborhood Characteristics

	Response Rate	Household Income			Race/Ethnicity of Primary Shopper			Household Auto Ownership		
			Survey	Census[a]		Survey	Census[a]		Survey	Census[a]
A1	7.3%	<$20K	39%	48%	White/Caucasian	2%	1%	No cars	27%	51%
		$20-50K	32%	32%	Black/Af. Am.	89%	97%	One car	50%	34%
		$50-100K	9%	17%	Other	9%	2%	More than one	16%	15%
		>$100K	2%	3%						
A2	15.5%	<$20K	13%	43%	White/Caucasian	86%	86%	No cars	15%	44%
		$20-50K	33%	28%	Black/Af. Am.	1%	1%	One car	56%	39%
		$50-100K	33%	24%	Other	13%	13%	More than one	25%	17%
		>$100K	14%	5%						
A3	8.5%	<$20K	41%	39%	White/Caucasian	4%	2%	No cars	45%	49%
		$20-50K	39%	39%	Black/Af. Am.	90%	97%	One car	41%	40%
		$50-100K	16%	21%	Other	6%	1%	More than one	10%	11%
		>$100K	2%	1%						
P1	12.5%	<$20K	20%	68%	White/Caucasian	69%	58%	No cars	25%	67%
		$20-50K	32%	24%	Black/Af. Am.	11%	13%	One car	44%	21%
		$50-100K	31%	7%	Other	20%	28%	More than one	20%	12%
		>$100K	16%	1%						
P2	29.5%	<$20K	1%	10%	White/Caucasian	92%	91%	No cars	6%	26%
		$20-50K	7%	26%	Black/Af. Am.	2%	4%	One car	63%	58%
		$50-100K	24%	26%	Other	6%	5%	More than one	25%	16%
		>$100K	61%	38%						
P3	26.8%	<$20K	6%	29%	White/Caucasian	84%	80%	No cars	17%	57%
		$20-50K	17%	36%	Black/Af. Am.	5%	10%	One car	50%	40%
		$50-100K	30%	22%	Other	11%	10%	More than one	14%	4%
		>$100K	42%	13%						

[a] Data is according to the census tract containing the supermarket itself, which is in every case somewhat smaller than the half-mile radius study area

Neighborhood Differences

In auto-oriented market-neighborhoods, residents were found on average to be poorer (Figure 4), disproportionately Black or African-American (46% compared to 5% in the other neighborhoods), own fewer cars (Figure 5), and are more likely not to be working—whether retired or unemployed (31% versus 24% not working).

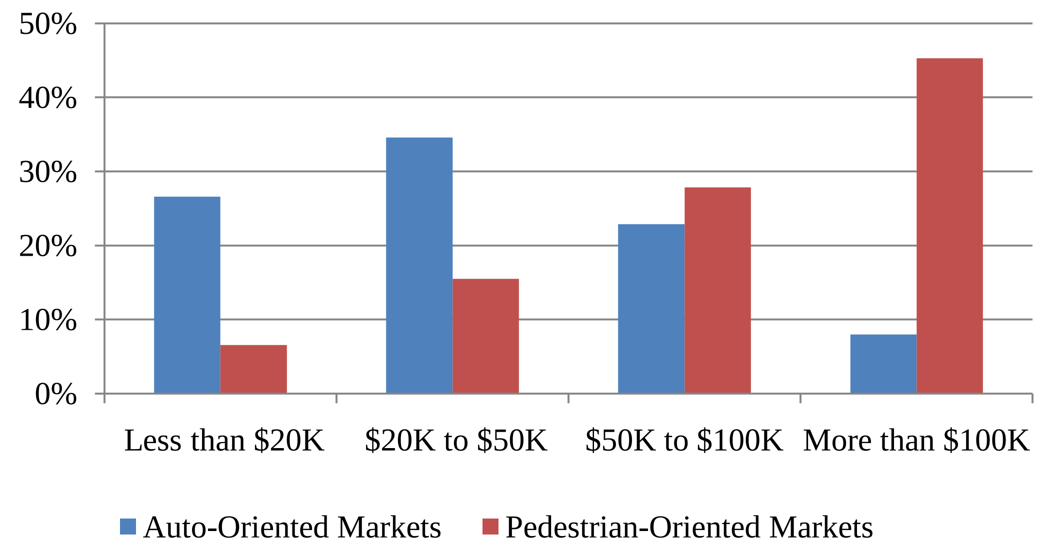


FIGURE 4 Income Distribution.

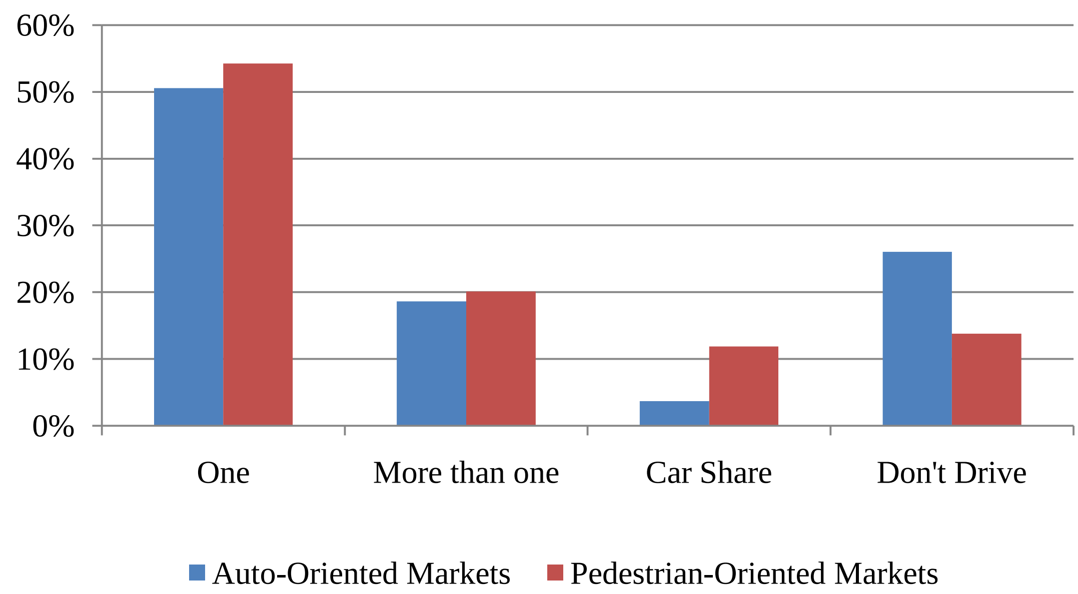


FIGURE 5 Ownership and Access to Cars.

Access Differences

In our sample, 10% of respondents indicated that they always drive to the grocery store, regardless of market-neighborhood. If you include those respondents who drive for "big trips" but walk for "small trips" (size interpreted by respondents), or who drive when they are in a hurry/during bad weather and walk when they are not, about 40% of respondents indicated that they drive sometimes to the store. Overall, 51% indicated that they always walk. The remainder use bicycles, take transit, receive deliveries or use other means. Limiting the sample to households that own cars or use car-sharing, the distribution shifts slightly. Among those households, about 45% drive for at least some trips while 44% of respondents always walk.

Table 3 shows each market-neighborhood's respective access mode share. A1, A2 and A3 have the highest driving mode shares. Restricting the sample to households with access to automobiles, the drive mode shares increase but only slightly for the pedestrian-oriented market-neighborhoods. Drive always mode share rises from 0.6% to 0.8% in the P3 market-neighborhood. Conversely, the drive always mode share for A1's market-neighborhood increases from 34% to 49% when controlling for household access to automobiles.

TABLE 3 Grocery Store Access

	Always Drive	Always Walk	Drive for Big Trips, Walk for Small Trips	Drive in a Rush or Bad Weather, Otherwise Walk	Other
A1	34.1%	38.6%	13.6%	2.3%	11.4%
A2	18.3%	35.5%	28.0%	10.8%	7.5%
A3	11.8%	41.2%	27.5%	7.8%	11.8%
P1	10.7%	52.0%	17.3%	6.7%	13.3%
P2	7.3%	51.4%	20.9%	13.6%	6.8%
P3	.6%	65.8%	16.8%	6.8%	9.9%
Total	10.0%	51.1%	20.5%	9.2%	9.3%

Over 50% of respondents always walk in each pedestrian-oriented market-neighborhood. At best, 41% of respondents always walk in auto-oriented market-neighborhoods. While 53% of respondents with access to an automobile always walk in pedestrian-oriented market-neighborhoods, only 22% of their counterparts in auto-oriented market-neighborhoods always walk.

Figures 6 and 7 show how income interacts with access mode. "Always walk" responses decrease with income until the highest income group for both pedestrian- and auto-oriented market-neighborhoods. The "always drive" response does not show an equivalent or reciprocal pattern.

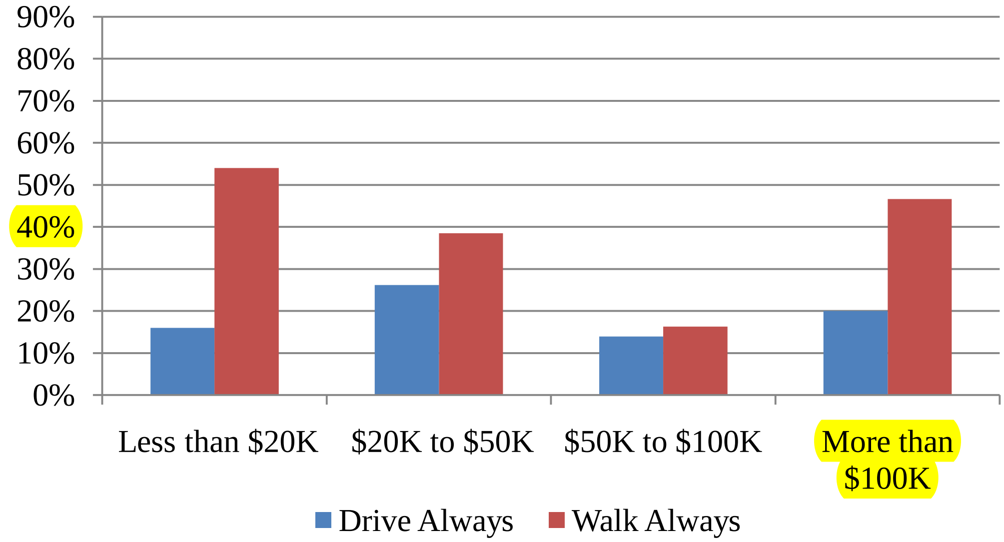


FIGURE 6 Access Mode by Income for Auto-Oriented Markets.

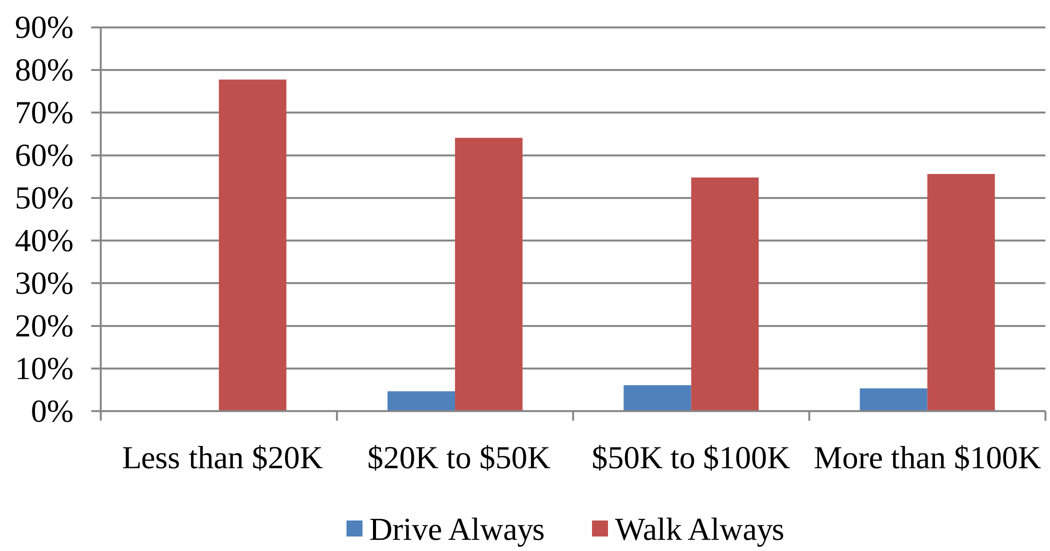


FIGURE 7 Access Mode by Income for Pedestrian-Oriented Markets.

Model

A mode-choice model was devised using the framework described in the methodology section. The model determined the probability a person would walk as a function of car ownership, household size, income, distance from the supermarket, usual journey-to-work mode and usual shopping pattern (chain or independent trip). Approximately 90% of respondents walk sometimes, while just over 50% walk always. Given the consistent answer sometimes walking, we determined that more insight would be gained by modeling the probability that someone is a committed walker (i.e., that they always walk to the grocery store).

The results of a binary logit model are given in Table 4. Once factors exerting influence have been controlled, the variables that have a negative effect on a respondent's decision to always walk to the grocery store include increasing distance from the store, number of children (though number of adults in the household is not a factor), access to a car (ownership or car-sharing) and whether the store has a surface parking lot. It also seems to be the case that Black/African-American residents are more likely to drive than their white or other race counterparts.

TABLE 4 Probability of Walking to a Nearby Supermarket [a]

Variable [b]	B	S.E.	Exp(B)	Significance [c,d]
Distance from store (blocks)	-.270	.054	.764	***
Number of children	-.230	.129	.794	*
Always use the neighborhood store for big shopping trips	.544	.252	1.723	**
Shop on the way home from work	.785	.457	2.192	*
Pedestrian-oriented design (no surface parking lot)	1.041	.281	2.832	***
Own one car	-2.182	.389	.113	***
Own more than one car	-2.610	.477	.074	***
Use car share	-1.094	.503	.335	**
Black/African-American	-1.092	.465	.335	**

[a] Only significant variables are shown
[b] Reference variables: non-drivers, other race
[c] *** significant at $\alpha = 0.99$; ** significant at $\alpha = 0.95$; * significant at $\alpha = 0.90$
[d] Cox and Snell R-squared = 0.278; Nagelkerke R-squared = 0.371

It is not entirely surprising that more people drive to shop when parking is readily available, or that fewer people drive when parking is scarce. A question with a less obvious answer is whether or not a supermarket is disadvantaged by having a low parking supply. To address this issue, the probability that a household shops locally as a function of the same variable set was modeled. That analysis found that the presence or absence of a surface parking lot does not have a statistically significant bearing on whether a person shops always or never at their local store. These results are shown in Table 5.

TABLE 5 Probability Respondent Always Uses Neighborhood Store for Big Trips [a]

Variable [b]	B	S.E.	Exp(B)	Significance [c,d]
Distance from store (blocks)	-.109	.050	.897	**
Number of adults	.460	.149	1.584	***
Primary shopper does not work	-.653	.377	.520	*
Pedestrian-oriented design (no surface parking lot)	-.108	.270	.898	
Own one car	-1.204	.306	.300	***
Own more than one car	-1.801	.437	.165	***
Use car share	-.986	.411	.373	**
White	.680	.378	1.974	*

[a] Only significant variables, and pedestrian-oriented design, are shown
[b] Reference variables: non-drivers, other race
[c] *** significant at $\alpha = 0.99$; ** significant at $\alpha = 0.95$; * significant at $\alpha = 0.90$
[d] Cox and Snell R-squared = 0.278; Nagelkerke R-squared = 0.371

Neither income, nor the presence or number of children, nor shopping pattern is relevant to neighborhood store loyalty. Car ownership, employment status and increased distance from the store are all associated with decreased likelihood of always shopping at a local store. The presence or absence of parking was found not to be a significant factor with respect to store loyalty.

DISCUSSION AND CONCLUSIONS

The results of this survey and modeling effort suggest that surface parking lots at urban supermarkets in Philadelphia, PA induce vehicular access without encouraging increased use of the supermarket among nearby residents. This finding adds to the debate about the impact of urban form on travel decisions and mode choice, but in a unique way that may have limited applicability in other environments. While most past research has examined scales of density, diversity, design and destination accessibility, this study purposefully set those scales aside. This approach was based on the assumption that some of degree of each of those variables is a prerequisite for observing meaningful levels of walking activity. To that end, the study examined only households in neighborhoods of attached row-houses and apartment buildings (density), with significant retail opportunities (diversity), with grided street and sidewalk networks and zero setback (design), and within a half-mile of a supermarket (destination accessibility). Given this general environment, the present study demonstrated that the specific presence or absence of a surface parking lot had a separate statistically significant impact on mode choice.

This study represents a potentially valuable finding for influencing policy (zoning, parking requirements, design guidelines, etc.) but only in a limited set of circumstances. Without similarly positive aspects of urban form already in place (density, diversity, etc.), surface parking lots are less likely to impact mode choice significantly; in fact, their absence may simply inhibit use. But where a majority of nearby residents always walk to the store, the value of including the quantity of surface parking observed in this study is called into question. And given that they don't induce additional store loyalty among nearby residents, the opportunity costs of such parking lots may be greater than their perceived value. Lots of such size could accommodate additional households or other retail, business or civic uses, all within less than one block of the supermarket. Since according to our survey, 62.4% of households use their local store always or sometimes for big trips and 88.3% of households use their local store always or sometimes for small trips, additional households could represent a significant pool of additional customers. Furthermore, the modeling effort demonstrated that distance (number of blocks) from stores did have an impact on store loyalty, suggesting that it would be in the best interests of supermarket owners to encourage high density adjacent to store entrances.

Still, there are unanswered questions about supermarket shopping in the market-neighborhoods studied in this research. Because the survey targeted nearby residents rather than all users of a particular supermarket, this research cannot help inform how many customers supermarkets are capturing beyond a half-mile radius. This question might interact with the problem of food deserts. As of 2005, Philadelphia suffered from the second lowest number of supermarkets per capita in an urban area, with an acute lack of access in lower income neighborhoods outside of the center of the city (*26*). The pedestrian-oriented markets in this study are all located within wealthy or gentrifying districts near the center of the city. In these areas, most residents live within a half-mile of a supermarket. Meanwhile, the automobile-oriented markets are located in neighborhoods further from the center of the city. While these neighborhoods are not necessarily less dense (all are comprised predominantly of row houses), their residents do not all enjoy supermarkets within a half-mile. Lower accessibility may increase the catchment area of these auto-oriented supermarkets and raise the value of large parking lots, despite the fact that nearby households have higher proportions of residents who never drive (26.1%) than households near pedestrian-oriented markets (13.8%).

These findings are applicable only in urban environments, which is in a sense a limitation. The study is also limited by the size and nature of the survey sample. Response rates were especially low from auto-oriented market-neighborhoods, which also tended to be lower income and have higher vacancy. Vacancy rates vary widely across the sampled market-neighborhoods, and that likely has an impact on decisions to walk. While the quasi-experimental methodology of this study sought identical environments in which to study the influence of surface parking lots, the reality of such research is a limited pool of potential subjects.

Future research should combine approaches by analyzing samples of nearby households as well as shoppers at a particular supermarket to develop a richer understanding of overall use patterns in urban environments. As the pedestrian-oriented markets in this study were associated with higher income neighborhoods (two of which might be considered gentrifying), future research could examine the role of land value in supermarket design or how supermarkets of different designs contribute to economic development. Data on the financial implications and outcomes for such supermarkets could add an interesting dimension. Future studies could also examine the impact of surface parking lots on other trip types. Food shopping is a useful topic to examine because nearly every household does it. However, in urban environments, the patterns of other trips may be similarly influenced by the presence or absence of surface parking lots.

ACKNOWLEDGEMENTS

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Adjustment Factors
(Seasonal / DHV and Growth)

Vermont Agency of Transportation
Permanent Count Station P6D001
Burlington: VT127 0.40 mi North of Manhatten Dr

2014 Average	Weekday 7:00 AM	Weekday 5:00 PM
January		1,250
February		1,305
March		1,353
April		1,393
May		1,436
June		1,434
July		1,386
August		1,421
September		1,417
October		1,461
November		1,274
December		1,188
Year Average		1,360
Peak Month		*1,461*

2014 DHV (30th Highest Hour) = 1,578

57/60 of the 60 highest hours are @ 7,8, or 9 AM.
Therefore, the DHV represents both a AM condition at this station.

Seasonally & Design Hour Volume Adjustment Factors

	2013 Raw Data Weekday *7:00 AM*	*2013 Raw Data* Weekday *5:00 PM*	**Adjustment Factors** Weekday *7:00 AM* *AM**	**Adjustment Factors** Weekday 5:00 PM **DHV****
Counts Dates:				
June		*1,434*		1.10
January		*1,250*		1.26

**DHV Adjustment Factors are calculated by dividing the 2013 DHV (30th Highest Hour) by the average month count.

2014	
Average (3 Stations)	
June	1.05
January	1.23

Vermont Agency of Transportation
Permanent Count Station P6D040
Colchester: US7 0.6 mi South of Blakely Rd

2014 Average	Weekday 7:00 AM	Weekday 5:00 PM
January		1,464
February		1,440
March		1,491
April		1,613
May		1,703
June		1,765
July		1,620
August		1,685
September		1,694
October		1,694
November		1,511
December		1,403
Year Average		1,590
Peak Month		*1,765*

2014 DHV (30th Highest Hour) = 1,780

59/60 of the 60 highest hours are @ 4 or 5 PM.

Therefore, the DHV represents a PM condition at this station.

Seasonally & Design Hour Volume Adjustment Factors

Counts Dates:	*2013 Raw Data* Weekday *5:00 PM*	Adjustment Factors Weekday *7:00 AM* AM*	Adjustment Factors Weekday 5:00 PM DHV**
June	*1,765*		1.01
January	*1,464*		1.22

**DHV Adjustment Factors are calculated by dividing the 2013 DHV (30th Highest Hour) by the average month count.

Vermont Agency of Transportation
Permanent Count Station P6D061
Williston: US2 0.2 mi East of Industrial Ave

2014 Average	Weekday 8:00 AM 4:00 PM
January	975
February	987
March	1,016
April	1,101
May	1,117
June	1,124
July	1,067
August	1,100
September	1,026
October	1,110
November	1,020
December	1,005
Year Average	1,054
Peak Month	*1,124*

2014 DHV (30th Highest Hour) = 1,187

34/60 of the 60 highest hours are late afternoon / early evening (3/4/5/6 PM).
Therefore, the DHV represents an afternoon / PM condition at this station.

Seasonally & Design Hour Volume Adjustment Factors

	2013 Raw Data *Weekday* *5:00 PM*	**Adjustment Factors** Weekday 4:00 PM **DHV****
Counts Dates:		
June	*1,124*	1.06
January	975	1.22

**DHV Adjustment Factors are calculated by dividing the 2013 DHV (30th Highest Hour) by the average month count.

2014 Growth Factors by Regression Analysis Group

A: Interstate Highways

Site ID	Route No	Town	Regression Analysis Year	20 Year GF 2014 to 2034	Short term GF 2009 to 2014
P6C002	I91	Sheffield	1995	1.12	1.06
P6C015	I93	Waterford	1995	1.35	1.08
P6D091	I89	South Burlington	1995	1.17	0.98
P6D092	I89	Colchester	1995	1.20	1.03
P6F096	I89	Swanton	1995	1.16	1.08
P6N001	I91	Fairlee	1995	1.15	0.84
P6N002	I91	Bradford	1995	1.13	0.98
P6P082	I91	Derby	1995	0.85	1.00
P6R001	US4	Fair Haven	1995	1.06	0.90
P6W089	I89	Waterbury	1995	1.17	1.05
P6X071	I91	Vernon	1995	0.91	0.98
P6X072	I91	Brattleboro	1995	0.93	0.89
P6X073	I91	Putney	1995	0.93	0.97
P6X074	I91	Rockingham	1995	1.02	0.97
P6Y001	I89	Bethel	1995	1.16	1.03
P6Y002	I91	Norwich	1995	1.12	0.97
			GROUP AVG	1.09	0.99

B: Urban

Site ID	Route No	Town	Regression Analysis Year	20 Year GF 2014 to 2034	Short term GF 2009 to 2014
P6D001	VT127	Burlington	1995	0.72	0.96
P6D040	US7	Colchester	1995	1.16	1.01
P6D129	VT2A	Williston	1995	0.92	0.99
P6R022	US7	Rutland Town	1995	0.89	0.98
P6W004	VT62	Barre City	1995	1.02	0.94
P6W006	US302	Berlin	1995	0.87	0.99
P6W014	US302	Barre City	1995	0.86	
P6W024	US2	Montpelier	1995	1.00	1.07
P6X011	US5	Brattleboro	1995	0.90	1.04
			GROUP AVG	0.93	1.00

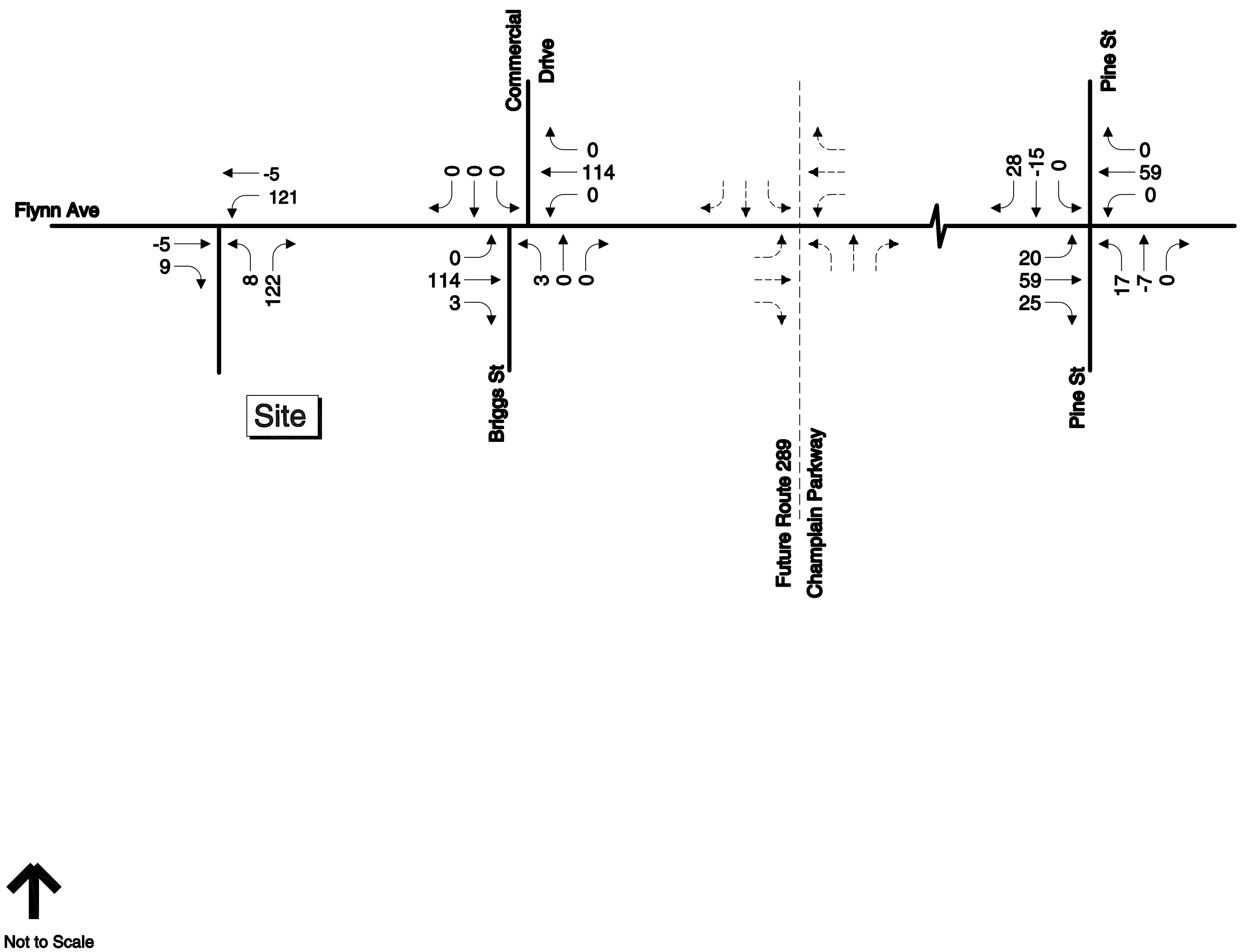
Continued on Next Page...

URBAN GROUP GROWTH NEGATIVE FLAT OR A MAXIMUM OF 1.16 OVER 20 YEARS = 0.75% ANNUAL GROWTH MAX

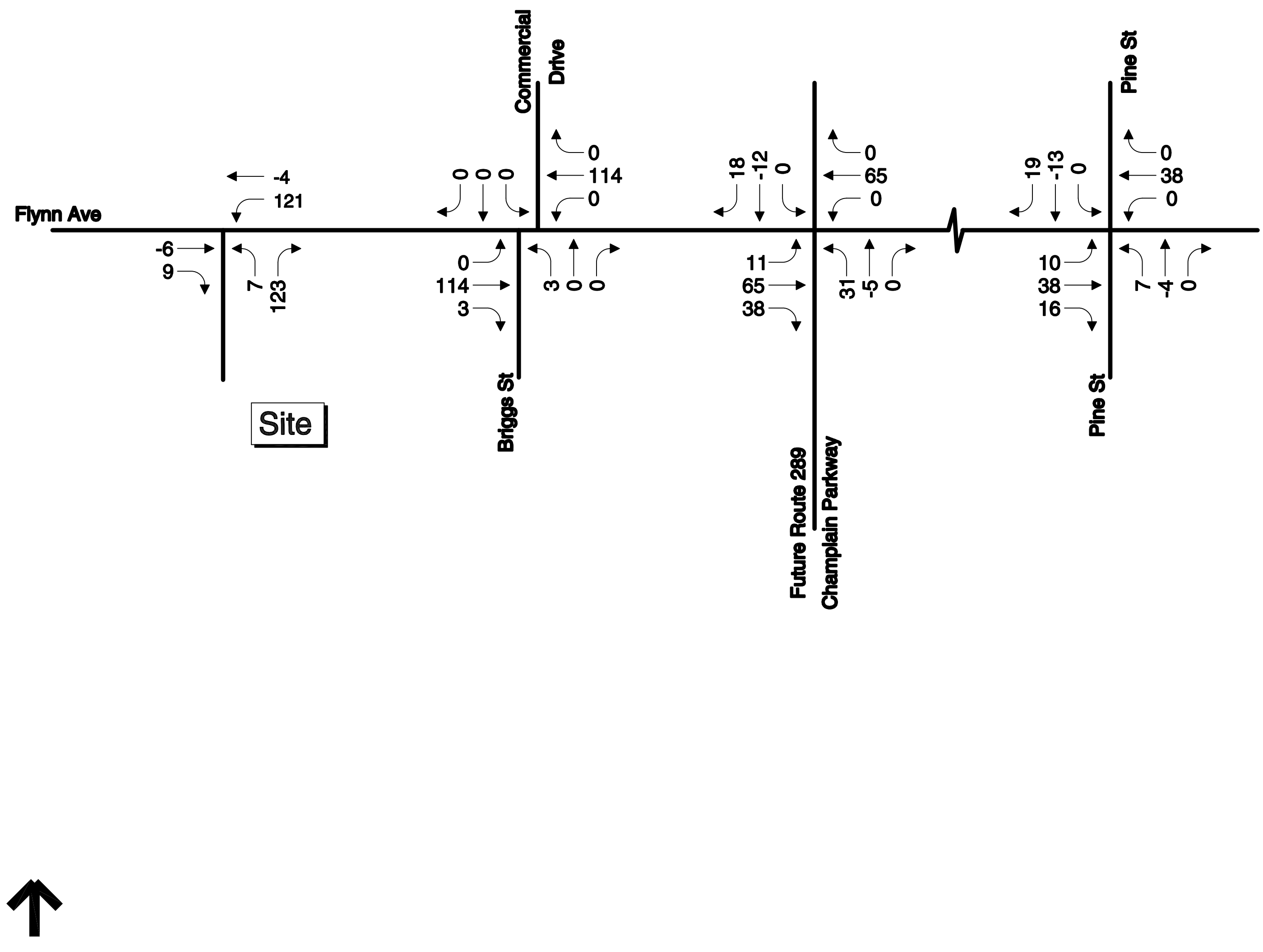
B: Urban

					Short Term Growth				2009	to	2014	1.00
					20 Year Growth				2014	to	2034	0.93
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
2009	1.00											
2010	1.00	1.00										
2011	1.00	1.00	1.00									
2012	1.00	1.00	1.00	1.00								
2013	1.00	1.00	1.00	1.00	1.00							
2014	1.00	1.00	1.00	1.00	1.00	1.00						
2015						1.00	1.00					
2016						0.99	1.00	1.00				
2017						0.99	0.99	1.00	1.00			
2018						0.99	0.99	0.99	1.00	1.00		
2019						0.98	0.99	0.99	0.99	1.00	1.00	
2020						0.98	0.98	0.99	0.99	0.99	1.00	1.00
2021						0.98	0.98	0.98	0.99	0.99	0.99	1.00
2022						0.97	0.98	0.98	0.98	0.99	0.99	0.99
2023						0.97	0.97	0.98	0.98	0.98	0.99	0.99
2024						0.97	0.97	0.97	0.98	0.98	0.98	0.99
2025						0.96	0.96	0.97	0.97	0.98	0.98	0.98
2026						0.96	0.96	0.96	0.97	0.97	0.98	0.98
2027						0.95	0.96	0.96	0.96	0.97	0.97	0.97
2028						0.95	0.95	0.96	0.96	0.96	0.97	0.97
2029						0.95	0.95	0.95	0.96	0.96	0.96	0.97
2030						0.94	0.95	0.95	0.95	0.96	0.96	0.96
2031						0.94	0.94	0.95	0.95	0.95	0.96	0.96
2032						0.94	0.94	0.94	0.95	0.95	0.95	0.96
2033						0.93	0.94	0.94	0.94	0.95	0.95	0.95
2034						0.93	0.93	0.94	0.94	0.94	0.95	0.95
2035						0.93	0.93	0.93	0.94	0.94	0.94	0.95
2036						0.92	0.93	0.93	0.93	0.94	0.94	0.94
2037						0.92	0.92	0.93	0.93	0.93	0.94	0.94
2038						0.92	0.92	0.92	0.93	0.93	0.93	0.94
2039						0.91	0.92	0.92	0.92	0.93	0.93	0.93
2040						0.91	0.91	0.92	0.92	0.92	0.93	0.93
2041						0.91	0.91	0.91	0.92	0.92	0.92	0.92
2042						0.90	0.91	0.91	0.91	0.91	0.92	0.92
2043						0.90	0.90	0.90	0.91	0.91	0.91	0.92
2044						0.90	0.90	0.90	0.90	0.91	0.91	0.91
2045						0.89	0.89	0.90	0.90	0.90	0.91	0.91
2046						0.89	0.89	0.89	0.90	0.90	0.90	0.91
2047						0.88	0.89	0.89	0.89	0.90	0.90	0.90
2048						0.88	0.88	0.89	0.89	0.89	0.90	0.90
2049						0.88	0.88	0.88	0.89	0.89	0.89	0.90
2050						0.87	0.88	0.88	0.88	0.89	0.89	0.89
2051						0.87	0.87	0.88	0.88	0.88	0.89	0.89
2052						0.87	0.87	0.87	0.88	0.88	0.88	0.89
2053						0.86	0.87	0.87	0.87	0.88	0.88	0.88
2054						0.86	0.86	0.87	0.87	0.87	0.88	0.88
2055						0.86	0.86	0.86	0.87	0.87	0.87	0.87
2056						0.85	0.86	0.86	0.86	0.87	0.87	0.87
2057						0.85	0.85	0.86	0.86	0.86	0.86	0.87
2058						0.85	0.85	0.85	0.85	0.86	0.86	0.86
2059						0.84	0.85	0.85	0.85	0.85	0.86	0.86

Supporting Traffic Volume Networks



Site Generated Trips
Weekday Evening
Peak Hour Traffic Volumes



Site Generated Trips
Weekday Evening
With Champlain Parkway
Peak Hour Traffic Volumes

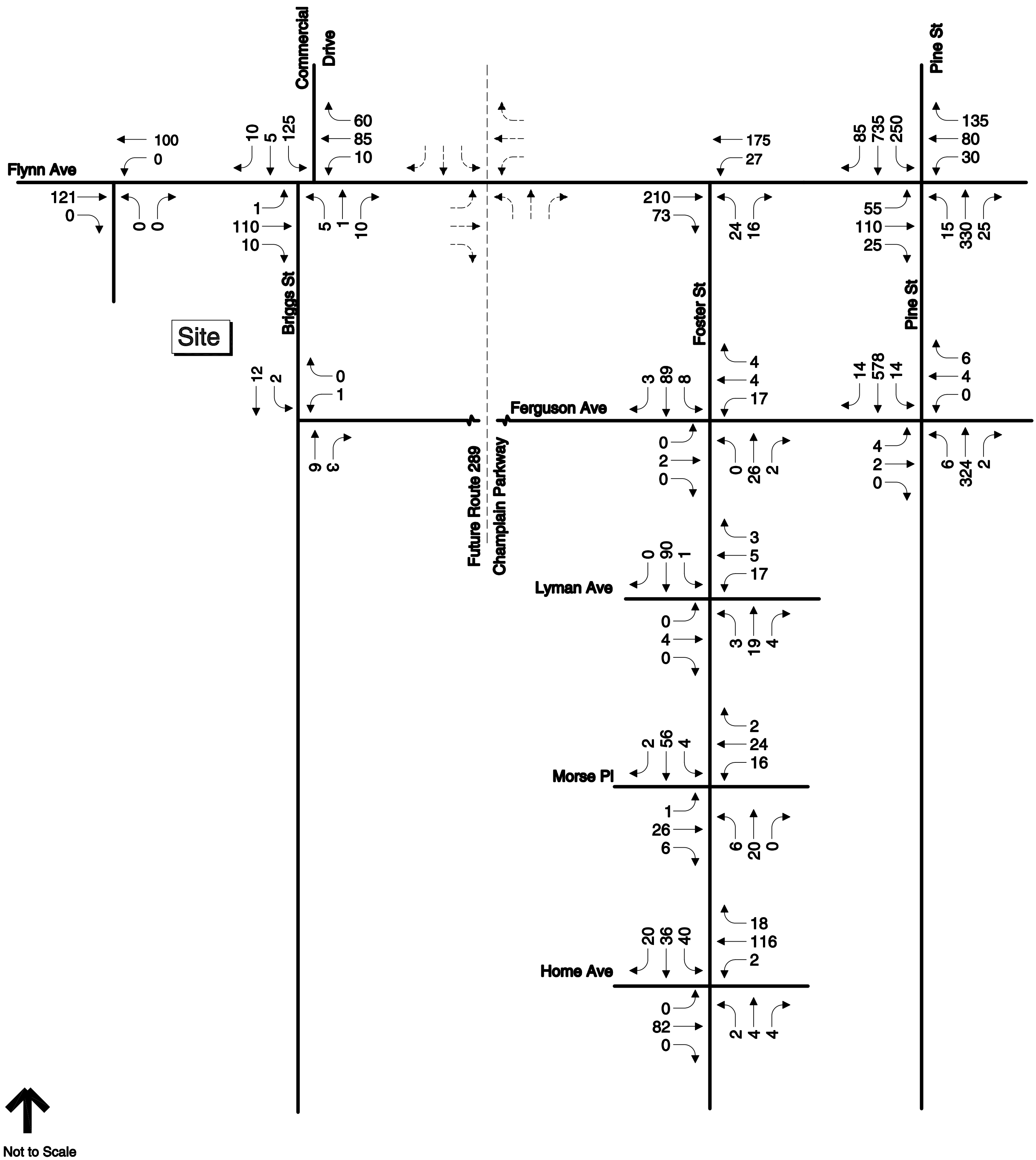
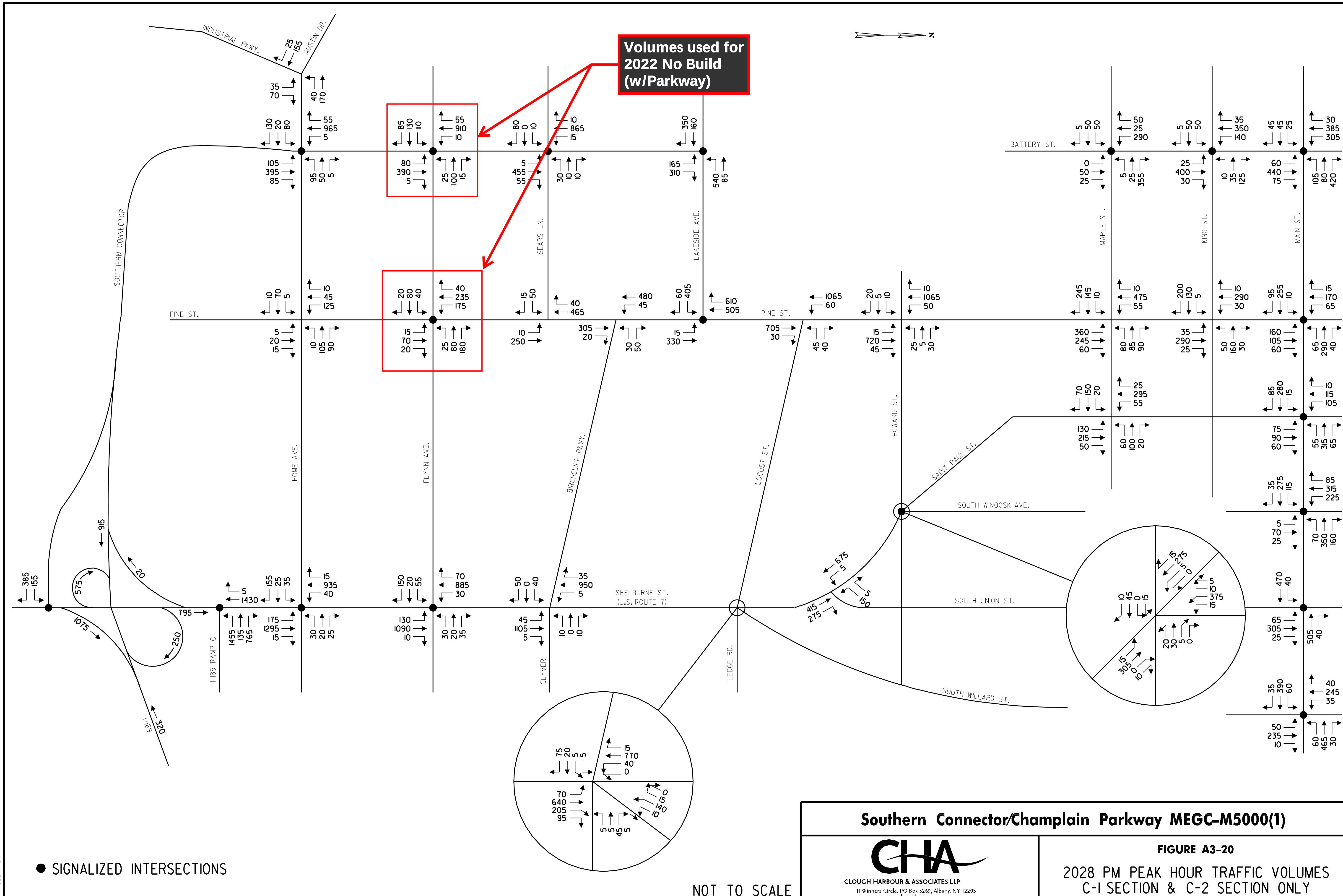


Figure 12
2017 No Build Weekday Evening Expanded Peak Hour Traffic Volumes



Southern Connector/Champlain Parkway MEGC-M5000(1)

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FIGURE A3-20

2028 PM PEAK HOUR TRAFFIC VOLUMES
C-1 SECTION & C-2 SECTION ONLY

Intersection
Capacity Analysis

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	55	110	25	30	80	135	15	330	25	250	735	85
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		4.0	4.0	
Lane Util. Factor		1.00			1.00			1.00		1.00	1.00	
Frpb, ped/bikes		0.99			0.96			1.00		1.00	0.99	
Flpb, ped/bikes		0.99			1.00			1.00		0.99	1.00	
Frt		0.98			0.93			0.99		1.00	0.98	
Flt Protected		0.99			0.99			1.00		0.95	1.00	
Satd. Flow (prot)		1524			1384			1837		1742	1803	
Flt Permitted		0.83			0.95			0.95		0.39	1.00	
Satd. Flow (perm)		1283			1321			1757		717	1803	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	55	110	25	30	80	135	15	330	25	250	735	85
RTOR Reduction (vph)	0	9	0	0	71	0	0	4	0	0	6	0
Lane Group Flow (vph)	0	181	0	0	174	0	0	366	0	250	814	0
Confl. Peds. (#/hr)	26		14	11		23	14		11	23		26
Heavy Vehicles (%)	4%	4%	4%	6%	6%	6%	2%	2%	2%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	5	5	5
Parking (#/hr)	5	5	5	5	5	5						
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		8			4			2		1	6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		10.7			10.7			16.7		26.8	26.8	
Effective Green, g (s)		12.7			12.7			18.7		28.8	28.8	
Actuated g/C Ratio		0.26			0.26			0.38		0.58	0.58	
Clearance Time (s)		6.0			6.0			6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		329			338			663		543	1049	
v/s Ratio Prot										0.06	c0.45	
v/s Ratio Perm		c0.14			0.13			0.21		0.21		
v/c Ratio		0.55			0.51			0.55		0.46	0.78	
Uniform Delay, d1		15.9			15.8			12.1		6.4	7.9	
Progression Factor		1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2		2.0			1.3			1.0		0.6	3.7	
Delay (s)		17.9			17.1			13.1		7.0	11.5	
Level of Service		B			B			B		A	B	
Approach Delay (s)		17.9			17.1			13.1			10.5	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	12.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	49.5	Sum of lost time (s)	14.0
Intersection Capacity Utilization	94.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	1	110	10	10	85	60	5	1	10	125	5	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1	110	10	10	85	60	5	1	10	125	5	10
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					869							
pX, platoon unblocked												
vC, conflicting volume	145			120			264	282	115	262	257	115
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	145			120			264	282	115	262	257	115
tC, single (s)	4.1			4.1			7.2	6.6	6.3	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	100			99			99	100	99	82	99	99
cM capacity (veh/h)	1425			1449			657	609	916	680	644	940

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	121	155	16	140
Volume Left	1	10	5	125
Volume Right	10	60	10	10
cSH	1425	1449	793	692
Volume to Capacity	0.00	0.01	0.02	0.20
Queue Length 95th (ft)	0	1	2	19
Control Delay (s)	0.1	0.5	9.6	11.5
Lane LOS	A	A	A	B
Approach Delay (s)	0.1	0.5	9.6	11.5
Approach LOS			A	B

Intersection Summary			
Average Delay	4.3		
Intersection Capacity Utilization	36.3%	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)	55	115	25	30	85	140	15	345	25	260	765	90
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		4.0	4.0	
Lane Util. Factor		1.00			1.00			1.00		1.00	1.00	
Frpb, ped/bikes		0.99			0.96			1.00		1.00	0.99	
Flpb, ped/bikes		0.99			1.00			1.00		0.99	1.00	
Frt		0.98			0.93			0.99		1.00	0.98	
Flt Protected		0.99			0.99			1.00		0.95	1.00	
Satd. Flow (prot)		1526			1384			1838		1742	1802	
Flt Permitted		0.82			0.95			0.96		0.38	1.00	
Satd. Flow (perm)		1272			1324			1759		705	1802	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	55	115	25	30	85	140	15	345	25	260	765	90
RTOR Reduction (vph)	0	9	0	0	71	0	0	4	0	0	6	0
Lane Group Flow (vph)	0	186	0	0	184	0	0	381	0	260	849	0
Confl. Peds. (#/hr)	26		14	11		23	14		11	23		26
Heavy Vehicles (%)	4%	4%	4%	6%	6%	6%	2%	2%	2%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	5	5	5
Parking (#/hr)	5	5	5	5	5	5						
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		8			4			2		1	6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		10.9			10.9			17.5		27.6	27.6	
Effective Green, g (s)		12.9			12.9			19.5		29.6	29.6	
Actuated g/C Ratio		0.26			0.26			0.39		0.59	0.59	
Clearance Time (s)		6.0			6.0			6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		324			338			679		538	1056	
v/s Ratio Prot										0.06	c0.47	
v/s Ratio Perm		c0.15			0.14			0.22		0.22		
v/c Ratio		0.57			0.55			0.56		0.48	0.80	
Uniform Delay, d1		16.4			16.3			12.1		6.5	8.2	
Progression Factor		1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2		2.5			1.8			1.1		0.7	4.5	
Delay (s)		18.9			18.1			13.2		7.2	12.7	
Level of Service		B			B			B		A	B	
Approach Delay (s)		18.9			18.1			13.2			11.4	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	13.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	50.5	Sum of lost time (s)	14.0
Intersection Capacity Utilization	97.5%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	1	115	10	10	90	60	5	1	10	125	5	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1	115	10	10	90	60	5	1	10	125	5	10
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					869							
pX, platoon unblocked												
vC, conflicting volume	150			125			274	292	120	272	267	120
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	150			125			274	292	120	272	267	120
tC, single (s)	4.1			4.1			7.2	6.6	6.3	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	100			99			99	100	99	81	99	99
cM capacity (veh/h)	1419			1443			647	601	910	670	636	934

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	126	160	16	140
Volume Left	1	10	5	125
Volume Right	10	60	10	10
cSH	1419	1443	785	682
Volume to Capacity	0.00	0.01	0.02	0.21
Queue Length 95th (ft)	0	1	2	19
Control Delay (s)	0.1	0.5	9.7	11.6
Lane LOS	A	A	A	B
Approach Delay (s)	0.1	0.5	9.7	11.6
Approach LOS			A	B

Intersection Summary			
Average Delay	4.2		
Intersection Capacity Utilization	36.6%	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)	75	169	53	30	139	135	35	323	25	250	720	113
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		4.0	4.0	
Lane Util. Factor		1.00			1.00			1.00		1.00	1.00	
Frpb, ped/bikes		0.99			0.97			1.00		1.00	0.99	
Flpb, ped/bikes		0.99			1.00			1.00		0.99	1.00	
Frt		0.98			0.94			0.99		1.00	0.98	
Flt Protected		0.99			1.00			1.00		0.95	1.00	
Satd. Flow (prot)		1518			1417			1832		1742	1789	
Flt Permitted		0.79			0.95			0.89		0.39	1.00	
Satd. Flow (perm)		1218			1351			1630		712	1789	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	75	169	53	30	139	135	35	323	25	250	720	113
RTOR Reduction (vph)	0	12	0	0	46	0	0	4	0	0	8	0
Lane Group Flow (vph)	0	285	0	0	258	0	0	379	0	250	825	0
Confl. Peds. (#/hr)	26		14	11		23	14		11	23		26
Heavy Vehicles (%)	4%	4%	4%	6%	6%	6%	2%	2%	2%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	5	5	5
Parking (#/hr)	5	5	5	5	5	5						
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		8			4			2		1	6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		13.0			13.0			18.0		28.0	28.0	
Effective Green, g (s)		15.0			15.0			20.0		30.0	30.0	
Actuated g/C Ratio		0.28			0.28			0.38		0.57	0.57	
Clearance Time (s)		6.0			6.0			6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		344			382			615		519	1012	
v/s Ratio Prot										0.05	c0.46	
v/s Ratio Perm		c0.23			0.19			0.23		0.22		
v/c Ratio		0.83			0.68			0.62		0.48	0.81	
Uniform Delay, d1		17.8			16.8			13.4		7.3	9.3	
Progression Factor		1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2		15.0			4.7			1.8		0.7	5.1	
Delay (s)		32.8			21.5			15.2		8.0	14.4	
Level of Service		C			C			B		A	B	
Approach Delay (s)		32.8			21.5			15.2			12.9	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	17.5	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	53.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	108.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	1	224	13	10	199	60	8	1	10	125	5	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1	224	13	10	199	60	8	1	10	125	5	10
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					869							
pX, platoon unblocked												
vC, conflicting volume	259			237			494	512	230	492	488	229
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	259			237			494	512	230	492	488	229
tC, single (s)	4.1			4.1			7.2	6.6	6.3	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	100			99			98	100	99	74	99	99
cM capacity (veh/h)	1294			1313			460	451	789	479	478	813

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	238	269	19	140
Volume Left	1	10	8	125
Volume Right	13	60	10	10
cSH	1294	1313	589	493
Volume to Capacity	0.00	0.01	0.03	0.28
Queue Length 95th (ft)	0	1	2	29
Control Delay (s)	0.0	0.4	11.3	15.2
Lane LOS	A	A	B	C
Approach Delay (s)	0.0	0.4	11.3	15.2
Approach LOS			B	C

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	42.7%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	116	9	121	95	8	122
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	116	9	121	95	8	122
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1120		
pX, platoon unblocked						
vC, conflicting volume			125		458	120
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			125		458	120
tC, single (s)			4.1		6.4	7.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	4.2
p0 queue free %			92		98	83
cM capacity (veh/h)			1443		514	722

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	125	216	130
Volume Left	0	121	8
Volume Right	9	0	122
cSH	1700	1443	705
Volume to Capacity	0.07	0.08	0.18
Queue Length 95th (ft)	0	7	17
Control Delay (s)	0.0	4.6	11.3
Lane LOS		A	B
Approach Delay (s)	0.0	4.6	11.3
Approach LOS			B

Intersection Summary			
Average Delay	5.2		
Intersection Capacity Utilization	36.3%	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)	75	174	53	30	144	140	35	338	25	260	750	118
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		4.0	4.0	
Lane Util. Factor		1.00			1.00			1.00		1.00	1.00	
Frpb, ped/bikes		0.99			0.96			1.00		1.00	0.99	
Flpb, ped/bikes		0.99			1.00			1.00		0.99	1.00	
Frt		0.98			0.94			0.99		1.00	0.98	
Flt Protected		0.99			1.00			1.00		0.95	1.00	
Satd. Flow (prot)		1518			1401			1833		1739	1784	
Flt Permitted		0.80			0.95			0.77		0.40	1.00	
Satd. Flow (perm)		1231			1342			1413		740	1784	
Peak-hour factor, PHF	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Adj. Flow (vph)	75	174	53	30	144	140	35	338	25	260	750	118
RTOR Reduction (vph)	0	8	0	0	30	0	0	3	0	0	6	0
Lane Group Flow (vph)	0	294	0	0	284	0	0	395	0	260	862	0
Confl. Peds. (#/hr)	26		14	11		23	14		11	23		26
Heavy Vehicles (%)	4%	4%	4%	6%	6%	6%	2%	2%	2%	1%	1%	1%
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	5	5	5
Parking (#/hr)	5	5	5	5	5	5						
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		8			4			2		1	6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		22.6			22.6			31.3		41.4	41.4	
Effective Green, g (s)		24.6			24.6			33.3		43.4	43.4	
Actuated g/C Ratio		0.32			0.32			0.44		0.57	0.57	
Clearance Time (s)		6.0			6.0			6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		398			434			619		502	1018	
v/s Ratio Prot										0.04	c0.48	
v/s Ratio Perm		c0.24			0.21			0.28		0.25		
v/c Ratio		0.74			0.65			0.64		0.52	0.85	
Uniform Delay, d1		22.8			22.0			16.7		9.8	13.5	
Progression Factor		1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2		7.0			3.5			2.2		0.9	6.6	
Delay (s)		29.9			25.6			18.8		10.7	20.2	
Level of Service		C			C			B		B	C	
Approach Delay (s)		29.9			25.6			18.8			18.0	
Approach LOS		C			C			B			B	

Intersection Summary			
HCM 2000 Control Delay	20.9	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	76.0	Sum of lost time (s)	14.0
Intersection Capacity Utilization	111.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	1	229	13	10	204	60	8	1	10	125	5	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	1	229	13	10	204	60	8	1	10	125	5	10
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					869							
pX, platoon unblocked												
vC, conflicting volume	264			242			504	522	236	502	498	234
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	264			242			504	522	236	502	498	234
tC, single (s)	4.1			4.1			7.2	6.6	6.3	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.6	4.1	3.4	3.5	4.0	3.3
p0 queue free %	100			99			98	100	99	73	99	99
cM capacity (veh/h)	1289			1307			453	445	784	471	471	808

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	243	274	19	140
Volume Left	1	10	8	125
Volume Right	13	60	10	10
cSH	1289	1307	582	486
Volume to Capacity	0.00	0.01	0.03	0.29
Queue Length 95th (ft)	0	1	3	30
Control Delay (s)	0.0	0.4	11.4	15.4
Lane LOS	A	A	B	C
Approach Delay (s)	0.0	0.4	11.4	15.4
Approach LOS			B	C

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	43.0%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Volume (veh/h)	121	9	121	100	8	122
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	1.00	1.00	1.00	1.00	1.00	1.00
Hourly flow rate (vph)	121	9	121	100	8	122
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh)						
Upstream signal (ft)				1120		
pX, platoon unblocked						
vC, conflicting volume			130		468	126
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			130		468	126
tC, single (s)			4.1		6.4	7.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	4.2
p0 queue free %			92		98	83
cM capacity (veh/h)			1437		507	717

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	130	221	130
Volume Left	0	121	8
Volume Right	9	0	122
cSH	1700	1437	699
Volume to Capacity	0.08	0.08	0.19
Queue Length 95th (ft)	0	7	17
Control Delay (s)	0.0	4.5	11.3
Lane LOS		A	B
Approach Delay (s)	0.0	4.5	11.3
Approach LOS			B

Intersection Summary			
Average Delay	5.1		
Intersection Capacity Utilization	36.9%	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)	40	80	20	25	80	180	15	70	20	175	235	40
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	14	12	12	14	12	12	14	12	12	14	12
Total Lost time (s)		4.0			4.0			4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00			1.00		1.00	1.00	
Frpb, ped/bikes		0.99			0.96			0.99		1.00	0.99	
Flpb, ped/bikes		0.99			1.00			1.00		0.98	1.00	
Frt		0.96			0.91			0.97		1.00	0.98	
Flt Protected		0.99			1.00			0.99		0.95	1.00	
Satd. Flow (prot)		1922			1810			1923		1711	1762	
Flt Permitted		0.83			0.96			0.92		0.61	1.00	
Satd. Flow (perm)		1609			1748			1791		1106	1762	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	44	89	22	28	89	200	17	78	22	194	261	44
RTOR Reduction (vph)	0	6	0	0	58	0	0	8	0	0	3	0
Lane Group Flow (vph)	0	149	0	0	259	0	0	109	0	194	302	0
Confl. Peds. (#/hr)	26		14	11		23	14		11	23		26
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	5	5	5
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		8			4			2		1	6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		12.6			12.6			9.8		22.5	22.5	
Effective Green, g (s)		14.6			14.6			11.8		24.5	24.5	
Actuated g/C Ratio		0.31			0.31			0.25		0.52	0.52	
Clearance Time (s)		6.0			6.0			6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		498			541			448		687	916	
v/s Ratio Prot										0.05	c0.17	
v/s Ratio Perm		0.09			c0.15			0.06		0.09		
v/c Ratio		0.30			0.48			0.24		0.28	0.33	
Uniform Delay, d1		12.4			13.2			14.1		6.1	6.5	
Progression Factor		1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2		0.3			0.7			0.3		0.2	0.2	
Delay (s)		12.7			13.8			14.4		6.3	6.8	
Level of Service		B			B			B		A	A	
Approach Delay (s)		12.7			13.8			14.4			6.6	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	10.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.43		
Actuated Cycle Length (s)	47.1	Sum of lost time (s)	12.0
Intersection Capacity Utilization	44.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	1	190	10	10	120	60	5	1	10	125	5	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1	211	11	11	133	67	6	1	11	139	6	11
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					179							
pX, platoon unblocked	0.96						0.96	0.96		0.96	0.96	0.96
vC, conflicting volume	200			222			422	441	217	419	413	167
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	152			222			382	402	217	380	374	118
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			99	100	99	75	99	99
cM capacity (veh/h)	1378			1347			541	513	823	545	532	901

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	223	211	18	156
Volume Left	1	11	6	139
Volume Right	11	67	11	11
cSH	1378	1347	685	561
Volume to Capacity	0.00	0.01	0.03	0.28
Queue Length 95th (ft)	0	1	2	28
Control Delay (s)	0.0	0.5	10.4	13.9
Lane LOS	A	A	B	B
Approach Delay (s)	0.0	0.5	10.4	13.9
Approach LOS			B	B

Intersection Summary			
Average Delay	4.0		
Intersection Capacity Utilization	38.6%	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)	110	130	85	25	100	15	80	390	5	10	910	55
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	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	1.00		1.00	0.99	
Flt Protected		0.98			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1752			1826		1770	1863		1770	1844	
Flt Permitted		0.71			0.83		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1270			1531		1770	1863		1770	1844	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	122	144	94	28	111	17	89	433	6	11	1011	61
RTOR Reduction (vph)	0	9	0	0	3	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	351	0	0	153	0	89	439	0	11	1071	0
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)		33.0			33.0		10.0	91.0		2.8	83.8	
Effective Green, g (s)		34.0			34.0		11.0	92.0		3.8	84.8	
Actuated g/C Ratio		0.23			0.23		0.07	0.61		0.03	0.57	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		287			347		129	1142		44	1042	
v/s Ratio Prot							c0.05	0.24		0.01	c0.58	
v/s Ratio Perm		c0.28			0.10							
v/c Ratio		1.22			0.44		0.69	0.38		0.25	1.03	
Uniform Delay, d1		58.0			49.8		67.8	14.7		71.7	32.6	
Progression Factor		1.00			1.00		1.02	0.86		1.01	0.90	
Incremental Delay, d2		128.1			0.9		13.5	0.9		2.5	32.6	
Delay (s)		186.1			50.7		82.4	13.5		75.1	61.8	
Level of Service		F			D		F	B		E	E	
Approach Delay (s)		186.1			50.7			25.1			62.0	
Approach LOS		F			D			C			E	

Intersection Summary			
HCM 2000 Control Delay	73.0	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	91.8%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	50	118	36	25	118	180	22	66	20	175	222	59
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	14	12	12	14	12	12	14	12	12	14	12
Total Lost time (s)		4.0			4.0			4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00			1.00		1.00	1.00	
Frpb, ped/bikes		0.99			0.96			0.99		1.00	0.99	
Flpb, ped/bikes		0.99			1.00			1.00		0.98	1.00	
Frt		0.96			0.91			0.97		1.00	0.98	
Flt Protected		0.99			1.00			0.99		0.95	1.00	
Satd. Flow (prot)		1922			1810			1923		1711	1762	
Flt Permitted		0.83			0.96			0.92		0.61	1.00	
Satd. Flow (perm)		1609			1748			1791		1106	1762	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	56	131	40	28	131	200	24	73	22	194	247	66
RTOR Reduction (vph)	0	5	0	0	57	0	0	8	0	0	3	0
Lane Group Flow (vph)	0	222	0	0	302	0	0	111	0	194	310	0
Confl. Peds. (#/hr)	26		14	11		23	14		11	23		26
Bus Blockages (#/hr)	0	0	0	0	0	0	0	0	0	5	5	5
Turn Type	Perm	NA		Perm	NA		Perm	NA		pm+pt	NA	
Protected Phases		8			4			2		1	6	
Permitted Phases	8			4			2			6		
Actuated Green, G (s)		13.6			13.6			10.0		22.7	22.7	
Effective Green, g (s)		15.6			15.6			12.0		24.7	24.7	
Actuated g/C Ratio		0.32			0.32			0.25		0.51	0.51	
Clearance Time (s)		6.0			6.0			6.0		6.0	6.0	
Vehicle Extension (s)		3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)		519			564			444		674	901	
v/s Ratio Prot										0.05	c0.18	
v/s Ratio Perm		0.14			c0.17			0.06		0.10		
v/c Ratio		0.43			0.54			0.25		0.29	0.34	
Uniform Delay, d1		12.8			13.4			14.5		6.5	7.0	
Progression Factor		1.00			1.00			1.00		1.00	1.00	
Incremental Delay, d2		0.6			1.0			0.3		0.2	0.2	
Delay (s)		13.4			14.4			14.8		6.7	7.2	
Level of Service		B			B			B		A	A	
Approach Delay (s)		13.4			14.4			14.8			7.0	
Approach LOS		B			B			B			A	

Intersection Summary			
HCM 2000 Control Delay	11.2	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.46		
Actuated Cycle Length (s)	48.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	55.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	1	304	13	10	234	60	8	1	10	125	5	10
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	1	338	14	11	260	67	9	1	11	139	6	11
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					179							
pX, platoon unblocked	0.91						0.91	0.91		0.91	0.91	0.91
vC, conflicting volume	327			352			677	696	345	674	670	293
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	213			352			597	618	345	594	589	176
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			98	100	98	62	99	99
cM capacity (veh/h)	1237			1207			366	365	698	370	379	790

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	353	338	21	156
Volume Left	1	11	9	139
Volume Right	14	67	11	11
cSH	1237	1207	488	385
Volume to Capacity	0.00	0.01	0.04	0.40
Queue Length 95th (ft)	0	1	3	48
Control Delay (s)	0.0	0.4	12.7	20.6
Lane LOS	A	A	B	C
Approach Delay (s)	0.0	0.4	12.7	20.6
Approach LOS			B	C

Intersection Summary			
Average Delay	4.1		
Intersection Capacity Utilization	44.7%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
3: Flynn Ave

7/25/2016

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	195	9	121	131	20	7	0	123	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Hourly flow rate (vph)	0	217	10	134	146	22	8	0	137	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)					430							
pX, platoon unblocked												
vC, conflicting volume	168			227			647	658	222	784	652	157
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	168			227			647	658	222	784	652	157
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			90			98	100	83	100	100	100
cM capacity (veh/h)	1410			1342			354	346	818	239	348	889

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	227	302	144
Volume Left	0	134	8
Volume Right	10	22	137
cSH	1410	1342	764
Volume to Capacity	0.00	0.10	0.19
Queue Length 95th (ft)	0	8	17
Control Delay (s)	0.0	4.0	10.8
Lane LOS		A	B
Approach Delay (s)	0.0	4.0	10.8
Approach LOS			B

Intersection Summary			
Average Delay	4.1		
Intersection Capacity Utilization	43.6%	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)	121	195	123	25	165	15	111	385	5	10	898	73
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	4.0		4.0	4.0	
Lane Util. Factor		1.00			1.00		1.00	1.00		1.00	1.00	
Frt		0.96			0.99		1.00	1.00		1.00	0.99	
Flt Protected		0.98			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1752			1826		1770	1863		1770	1844	
Flt Permitted		0.71			0.83		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1270			1531		1770	1863		1770	1844	
Peak-hour factor, PHF	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Adj. Flow (vph)	134	217	137	28	183	17	123	428	6	11	998	81
RTOR Reduction (vph)	0	9	0	0	2	0	0	0	0	0	1	0
Lane Group Flow (vph)	0	479	0	0	226	0	123	434	0	11	1078	0
Turn Type	Perm	NA		Perm	NA		Prot	NA		Prot	NA	
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4			8								
Actuated Green, G (s)		40.0			40.0		10.0	84.0		2.8	76.8	
Effective Green, g (s)		41.0			41.0		11.0	85.0		3.8	77.8	
Actuated g/C Ratio		0.27			0.27		0.07	0.57		0.03	0.52	
Clearance Time (s)		5.0			5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		347			418		129	1055		44	956	
v/s Ratio Prot							c0.07	0.23		0.01	c0.58	
v/s Ratio Perm		c0.38			0.15							
v/c Ratio		1.38			0.54		0.95	0.41		0.25	1.13	
Uniform Delay, d1		54.5			46.5		69.2	18.4		71.7	36.1	
Progression Factor		1.00			1.00		1.00	0.85		0.94	0.83	
Incremental Delay, d2		187.7			1.4		62.4	1.1		2.5	68.7	
Delay (s)		242.2			47.9		131.8	16.8		69.9	98.8	
Level of Service		F			D		F	B		E	F	
Approach Delay (s)		242.2			47.9			42.2			98.5	
Approach LOS		F			D			D			F	

Intersection Summary			
HCM 2000 Control Delay	110.0	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.16		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	17.0
Intersection Capacity Utilization	106.6%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	121	195	123	25	165	15	111	385	5	10	898	73
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	5.0		4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor		1.00	1.00		1.00		1.00	1.00		1.00	1.00	
Frt		0.96	0.85		0.99		1.00	1.00		1.00	0.99	
Flt Protected		0.98	1.00		0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)		1752	1583		1826		1770	1863		1770	1844	
Flt Permitted		0.71	1.00		0.83		0.95	1.00		0.95	1.00	
Satd. Flow (perm)		1270	1583		1531		1770	1863		1770	1844	
Peak-hour factor, PHF	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Adj. Flow (vph)	133	214	135	27	181	16	122	423	5	11	987	80
RTOR Reduction (vph)	0	0	47	0	1	0	0	0	0	0	2	0
Lane Group Flow (vph)	0	347	88	0	223	0	122	428	0	11	1065	0
Turn Type	Perm	NA	pm+ov	Perm	NA		Prot	NA		Prot	NA	
Protected Phases		4	5		8		5	2		1	6	
Permitted Phases	4		4	8								
Actuated Green, G (s)		38.0	50.0		38.0		12.0	88.0		2.8	78.8	
Effective Green, g (s)		39.0	50.0		39.0		13.0	89.0		3.8	79.8	
Actuated g/C Ratio		0.26	0.33		0.26		0.09	0.59		0.03	0.53	
Clearance Time (s)		5.0	5.0		5.0		5.0	5.0		5.0	5.0	
Vehicle Extension (s)		3.0	3.0		3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)		330	580		398		153	1105		44	981	
v/s Ratio Prot			0.01				c0.07	0.23		0.01	c0.58	
v/s Ratio Perm		c0.27	0.04		0.15							
v/c Ratio		1.05	0.15		0.56		0.80	0.39		0.25	1.09	
Uniform Delay, d1		55.5	35.1		48.1		67.2	16.1		71.7	35.1	
Progression Factor		1.00	1.00		1.00		1.03	0.88		1.07	1.00	
Incremental Delay, d2		63.7	0.1		1.7		23.2	1.0		2.5	52.6	
Delay (s)		119.2	35.2		49.8		92.5	15.1		79.4	87.9	
Level of Service		F	D		D		F	B		E	F	
Approach Delay (s)		95.7			49.8			32.3			87.8	
Approach LOS		F			D			C			F	

Intersection Summary			
HCM 2000 Control Delay	72.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	18.0
Intersection Capacity Utilization	99.1%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			