

Appendix G

Concept Plans

AADT Figure

Trip Assignment

Capacity Analyses



- NOTES:
1. TRUCK TURNING MOVEMENT ASSESSMENT NOT COMPLETED.
 2. FULL STRIPING AND SIGNAGE NOT SHOWN.
 3. SHOULDERS NOT SHOWN.
 4. RIGHT OF WAY IS APPROXIMATE ONLY.

CONCEPTUAL ONLY
NOT FOR CONSTRUCTION

1 inch = 40 feet

Rev.	Date	Revision

Issued For	Date	By

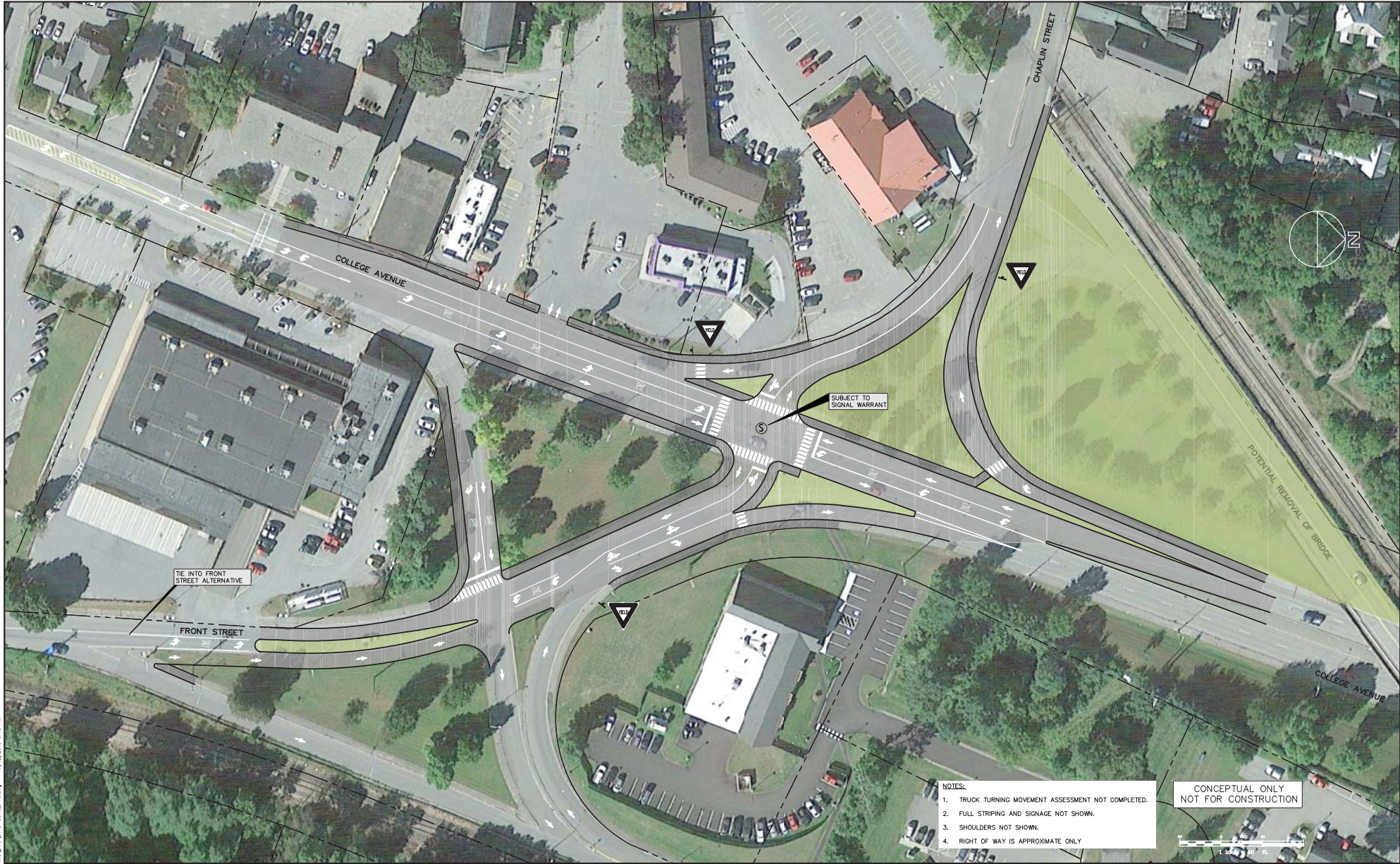
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File Name: 3110-CONCEPT.dwg		
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Drawing Name:	CONCEPTUAL LAYOUT - MINOR FRONT STREET
Project:	Waterville Feasibility Study Waterville, Maine
Client:	City of Waterville One Common St, Waterville, Me 04901

Drawing No.
A



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Client:	City of Waterville One Common St, Waterville, Me 04901

Drawing No.
D



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Issued For	Date	By

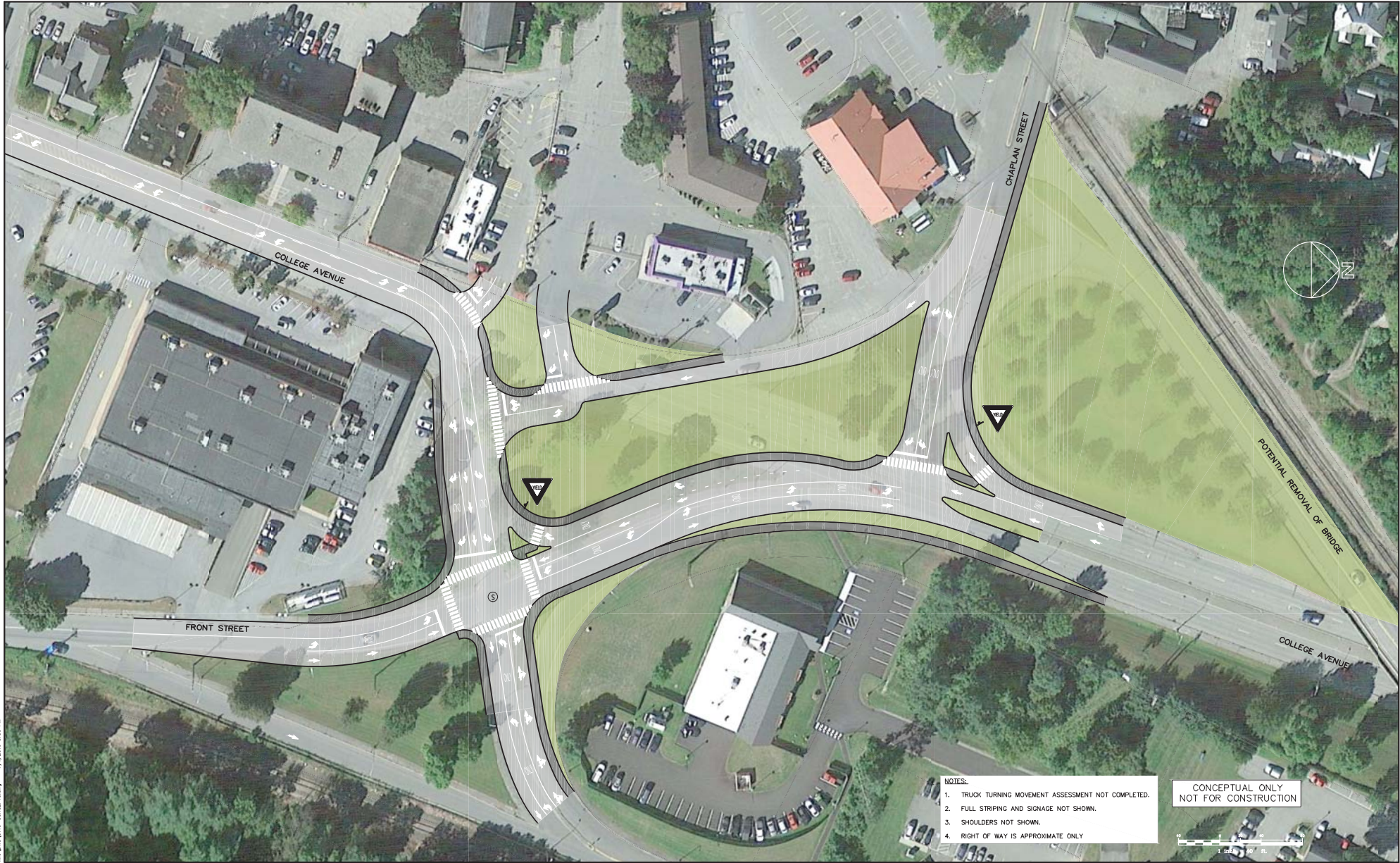
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Drawing Name:	CONCEPTUAL LAYOUT - MAJOR FRONT STREET
Project:	Waterville Feasibility Study Waterville, Maine
Client:	City of Waterville One Common St, Waterville, Me 04901

Drawing No.
B



- NOTES:
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Issued For	Date	By

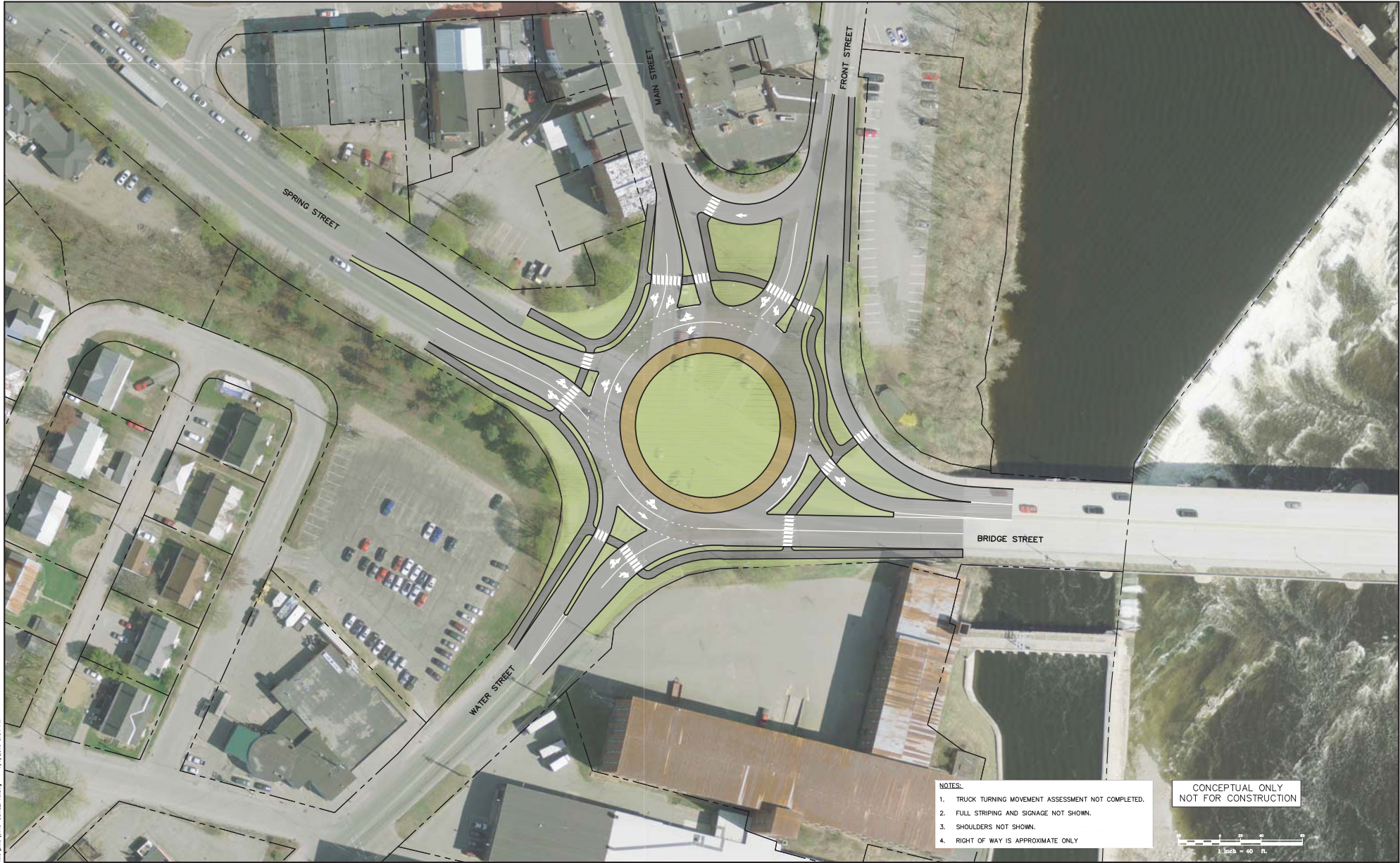
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Drawing Name:	CONCEPTUAL LAYOUT - MAJOR FRONT STREET
Project:	Waterville Feasibility Study Waterville, Maine
Client:	City of Waterville One Common St, Waterville, Me 04901

Drawing No.
E



- NOTES:
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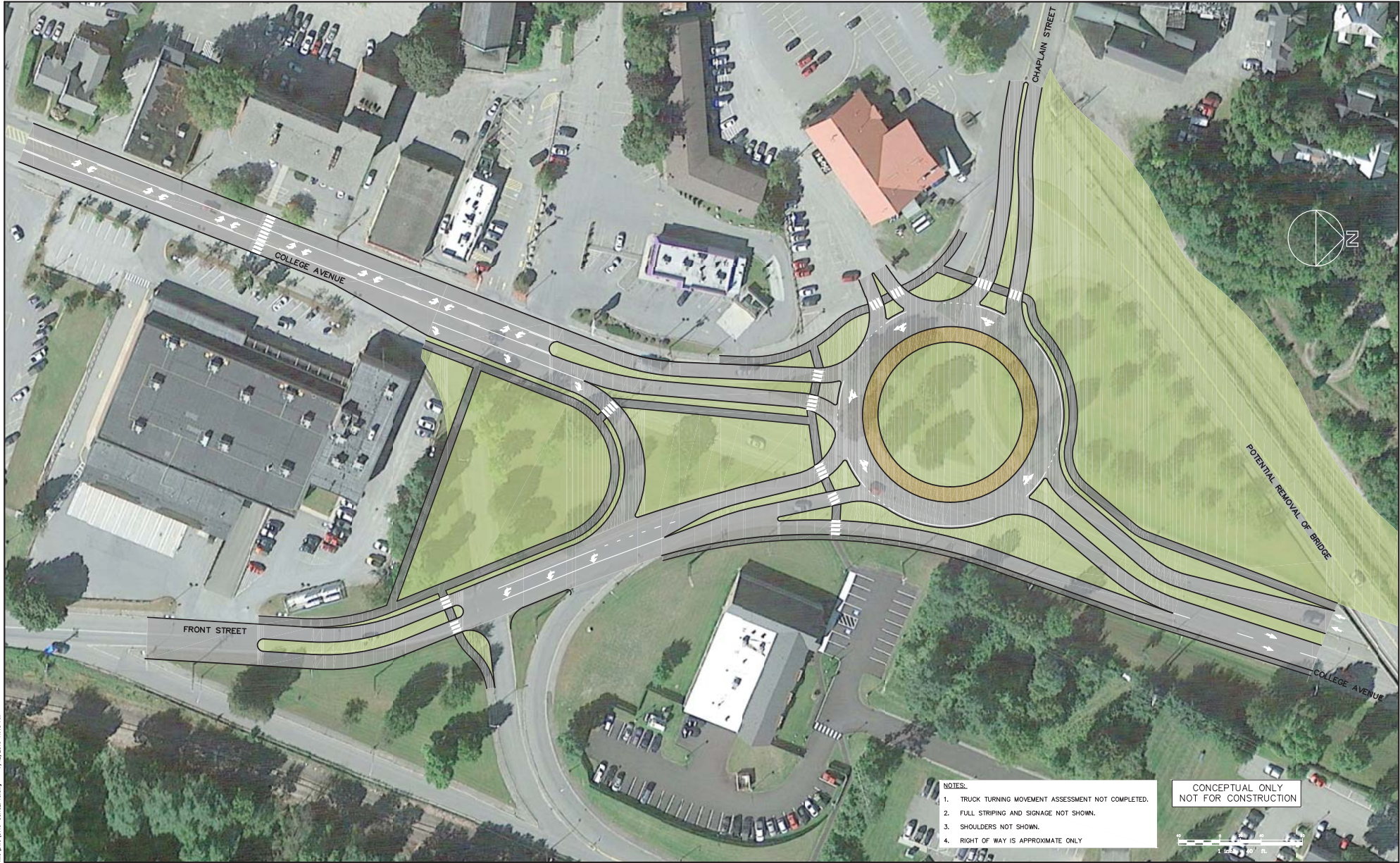
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Drawing Name:	CONCEPTUAL LAYOUT - ROUNDABOUT
Project:	Waterville Feasibility Study Waterville, Maine
Client:	City of Waterville One Common St, Waterville, Me 04901

Drawing No.
C-2



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Issued For	Date	By

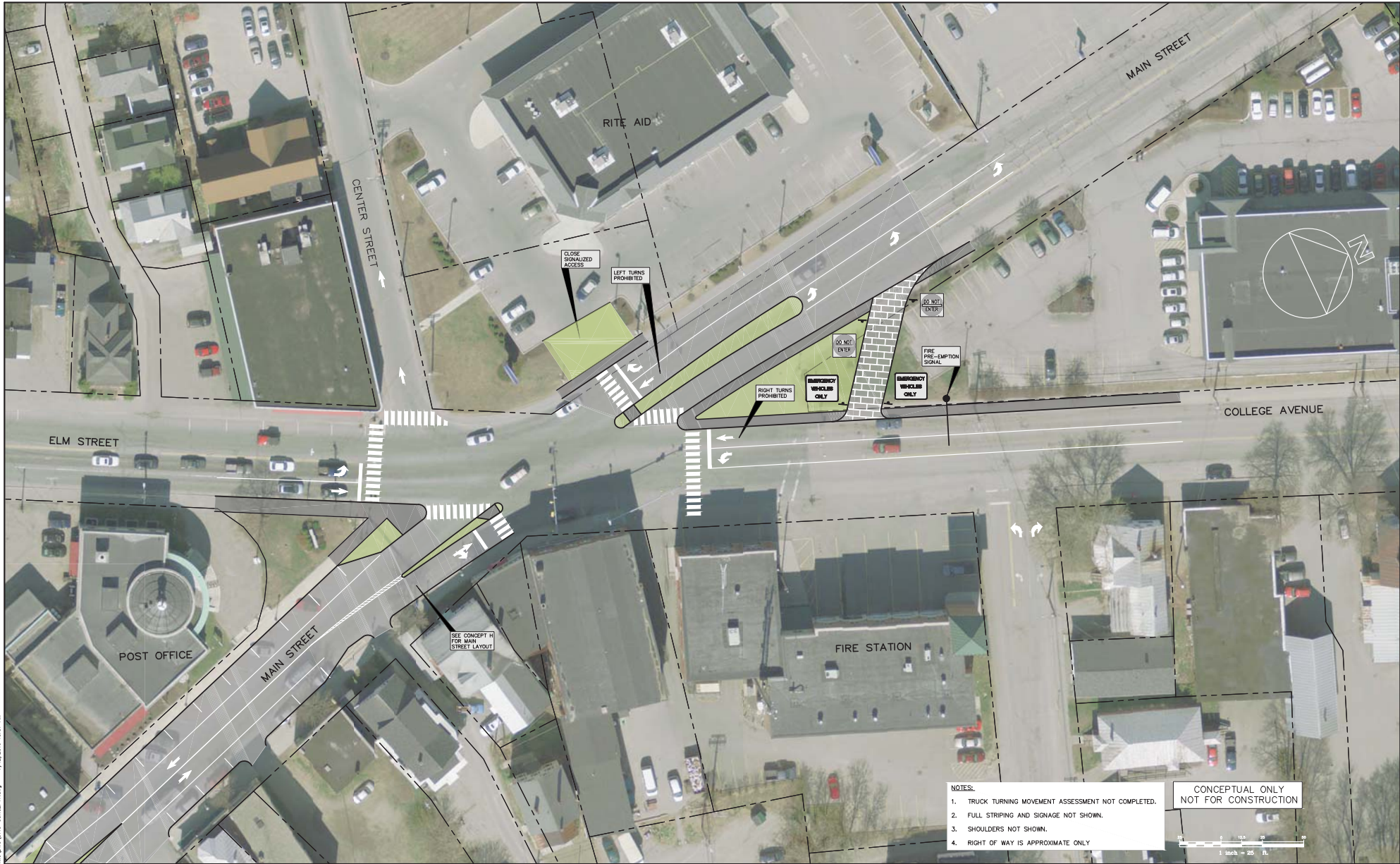
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Drawing Name:	CONCEPTUAL LAYOUT- ROUNDABOUT
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Client:	City of Waterville One Common St, Waterville, Me 04901

Drawing No.
F



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Issued For	Date	By

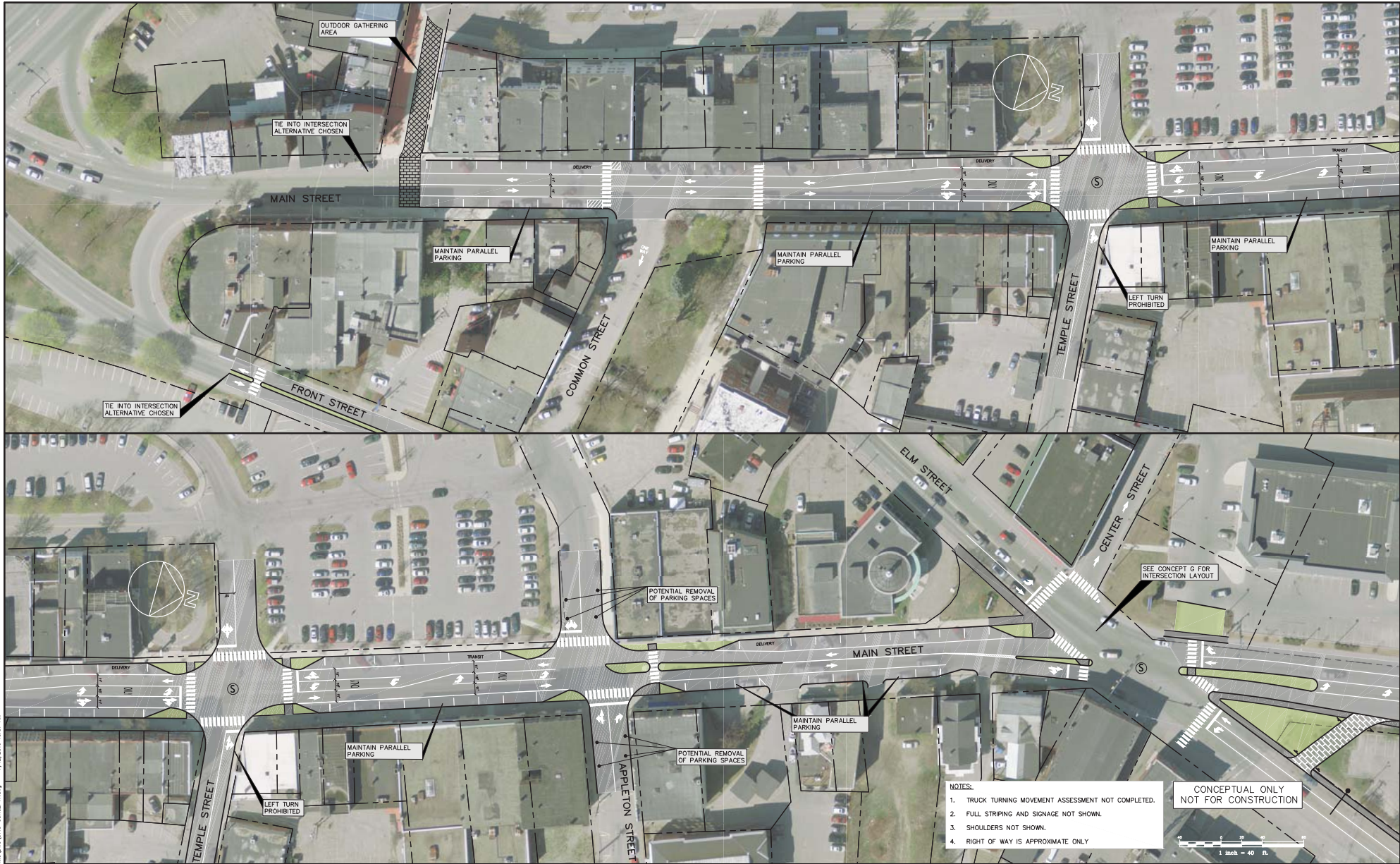
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Project:	Waterville Feasibility Study Waterville, Maine
Client:	City of Waterville One Common St, Waterville, Me 04901

Drawing No.
G



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Drawing Name:	CONCEPTUAL LAYOUT - MAIN STREET
Project:	Waterville Feasibility Study Waterville, Maine
Client:	City of Waterville One Common St, Waterville, Me 04901

Drawing No.
H



- NOTES:
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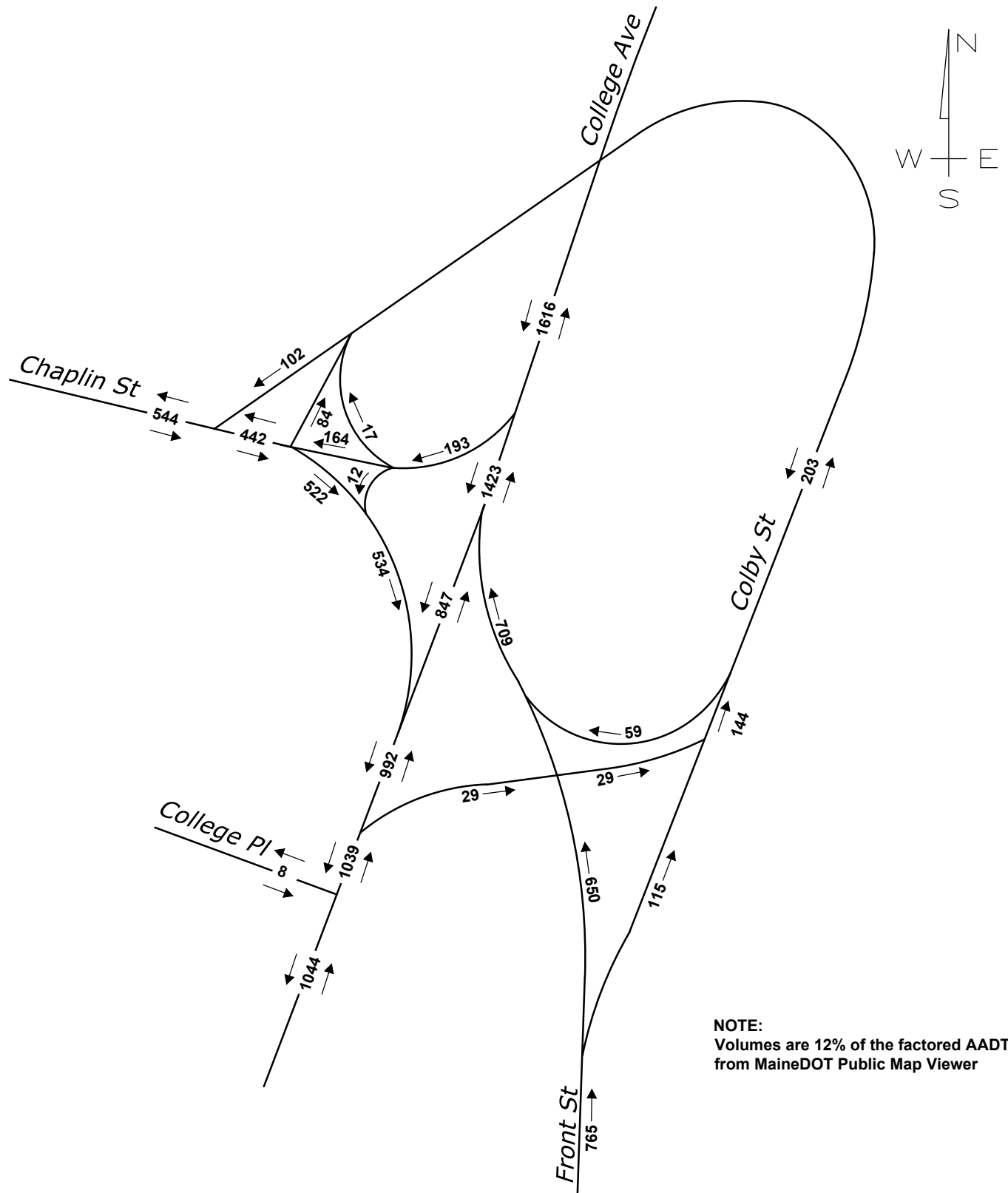
Drawing Name:	CONCEPTUAL LAYOUT - FRONT STREET
Project:	Waterville Feasibility Study
Client:	City of Waterville One Common St, Waterville, Me 04901

Drawing No.
I

Estimated Peak Hour Traffic Volumes

Figure No.

2



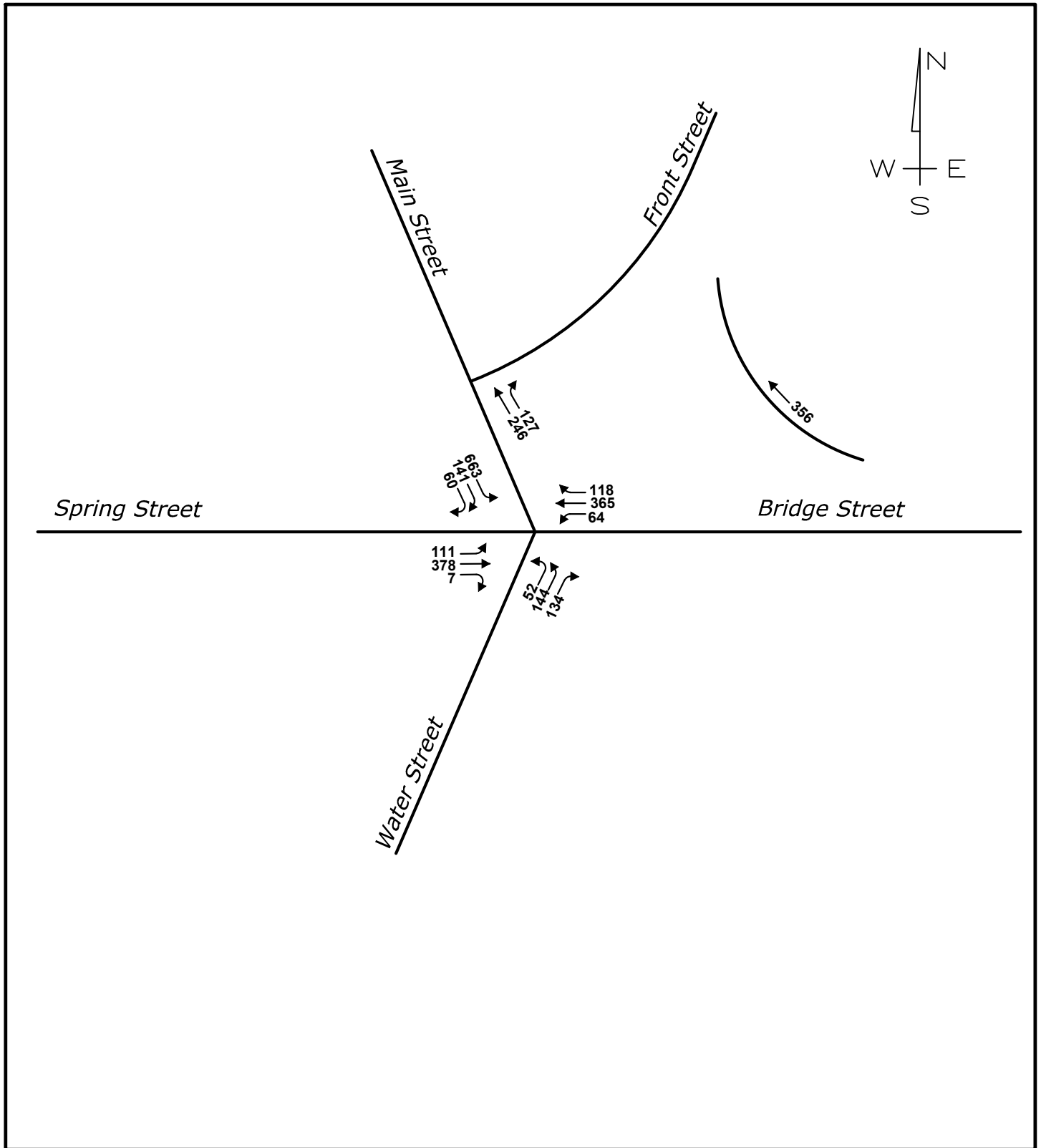
DOWNTOWN TRANSPORTATION STUDY WATERVILLE, MAINE

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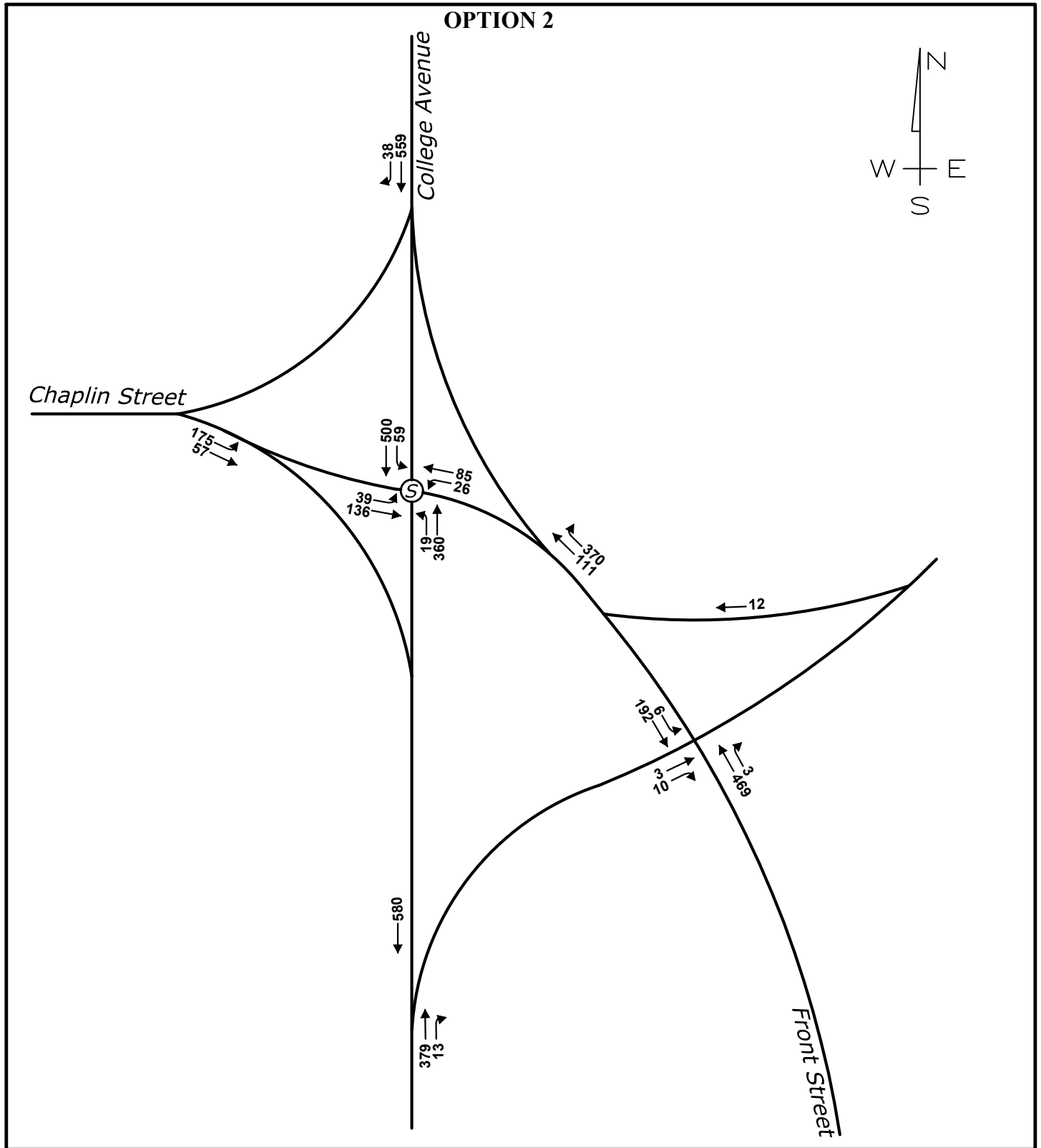


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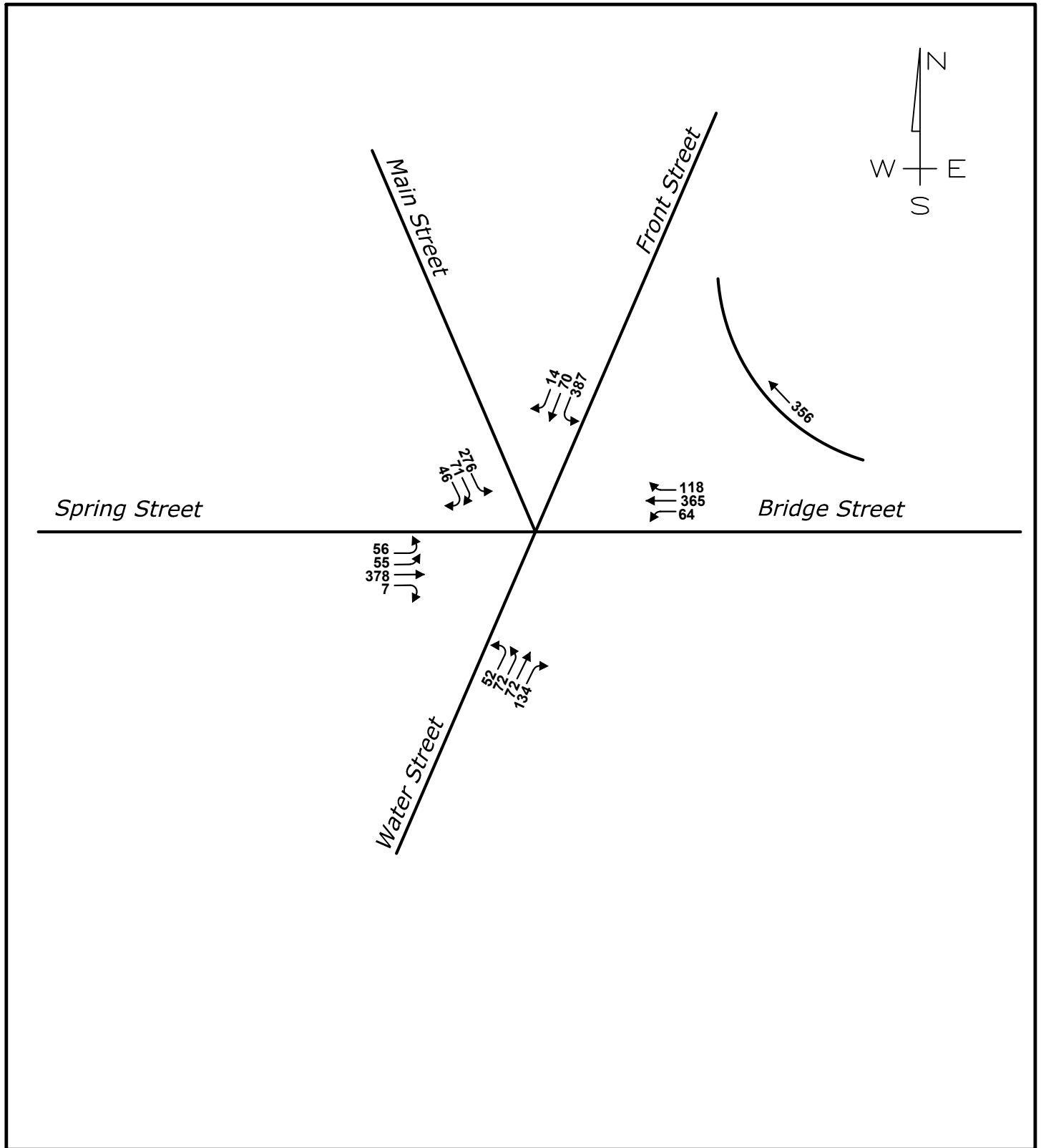


**DOWNTOWN TRANSPORTATION STUDY
WATERVILLE, MAINE**

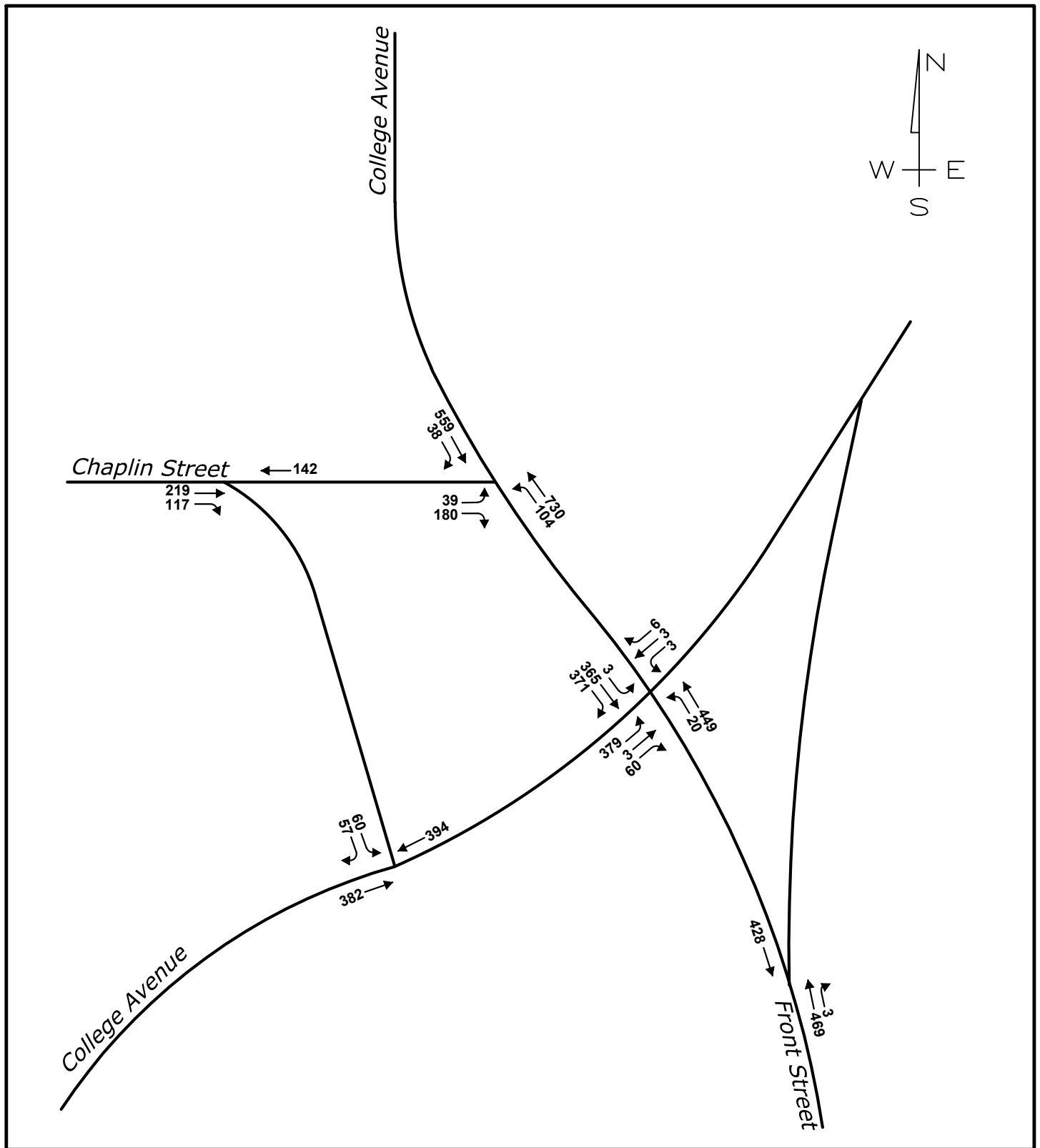


DOWNTOWN TRANSPORTATION STUDY
WATERVILLE, MAINE

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Checked: RED File Name: 3110-TRAFF2.dwg



**DOWNTOWN TRANSPORTATION STUDY
WATERVILLE, MAINE**



**DOWNTOWN TRANSPORTATION STUDY
WATERVILLE, MAINE**

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Draft: LAN Date: JUNE 2016
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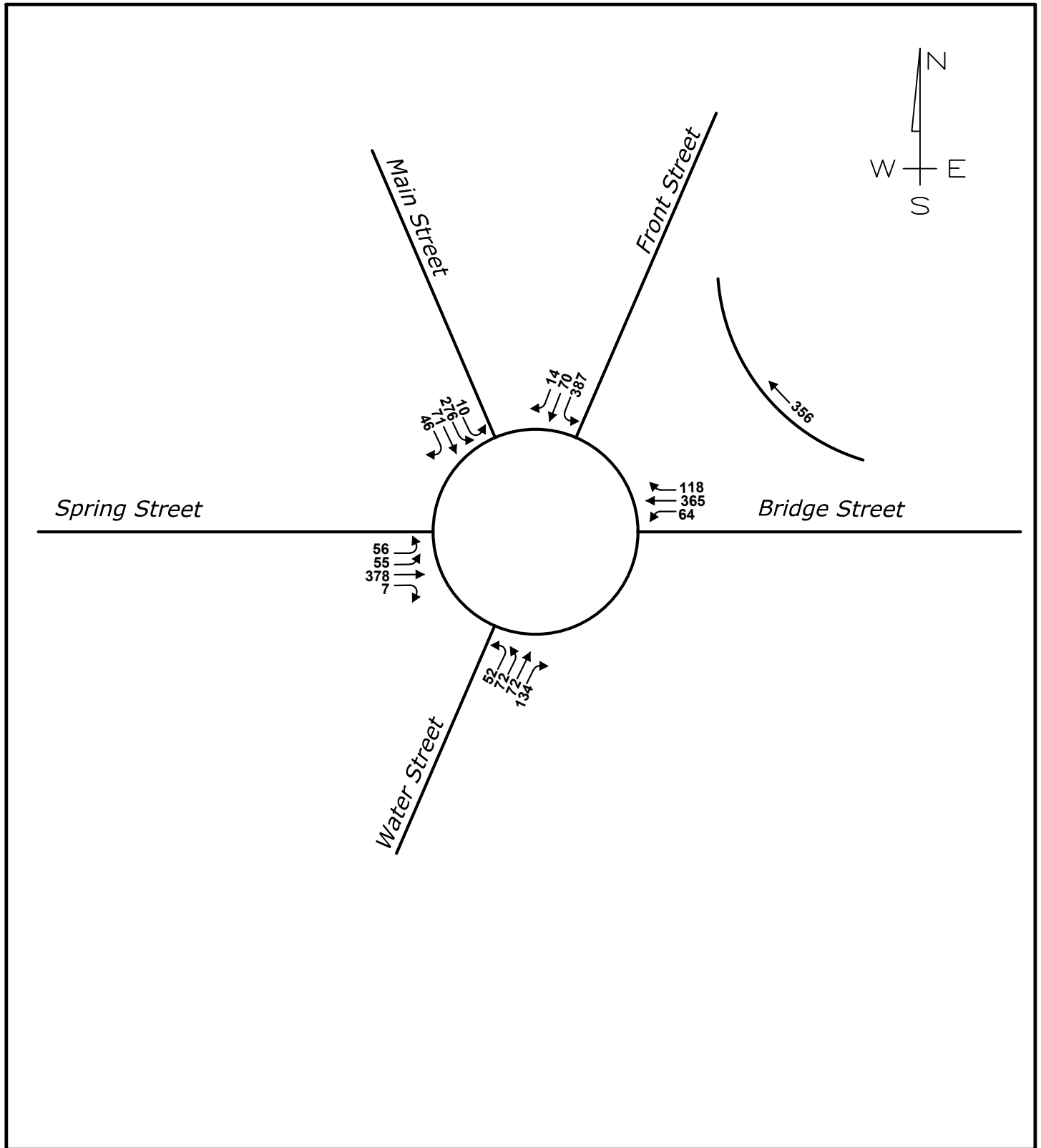
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**MULTI-LANE ROUNDABOUT 2037 PM POSTDEVELOPMENT
FRONT ST & MAIN ST 2-WAY ASSUMED VOLUMES**

Figure No.

4

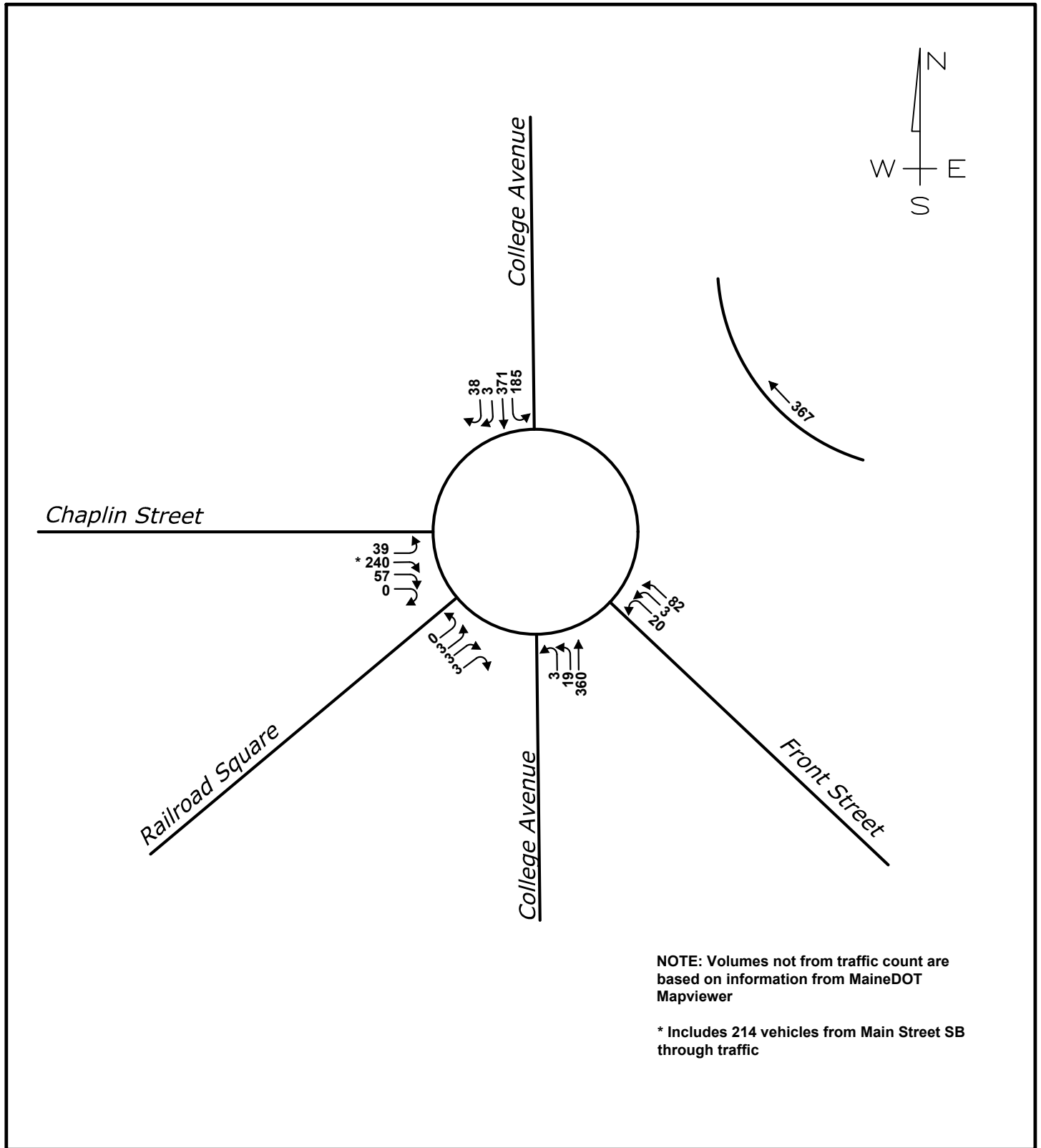


**DOWNTOWN TRANSPORTATION STUDY
WATERVILLE, MAINE**

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Checked: RED File Name: 3110-TRAFF2.dwg

SINGLE LANE ROUNDABOUT 2037 PM POSTDEVELOPMENT FRONT ST & MAIN ST 2-WAY ASSUMED VOLUMES

Figure No. **10**



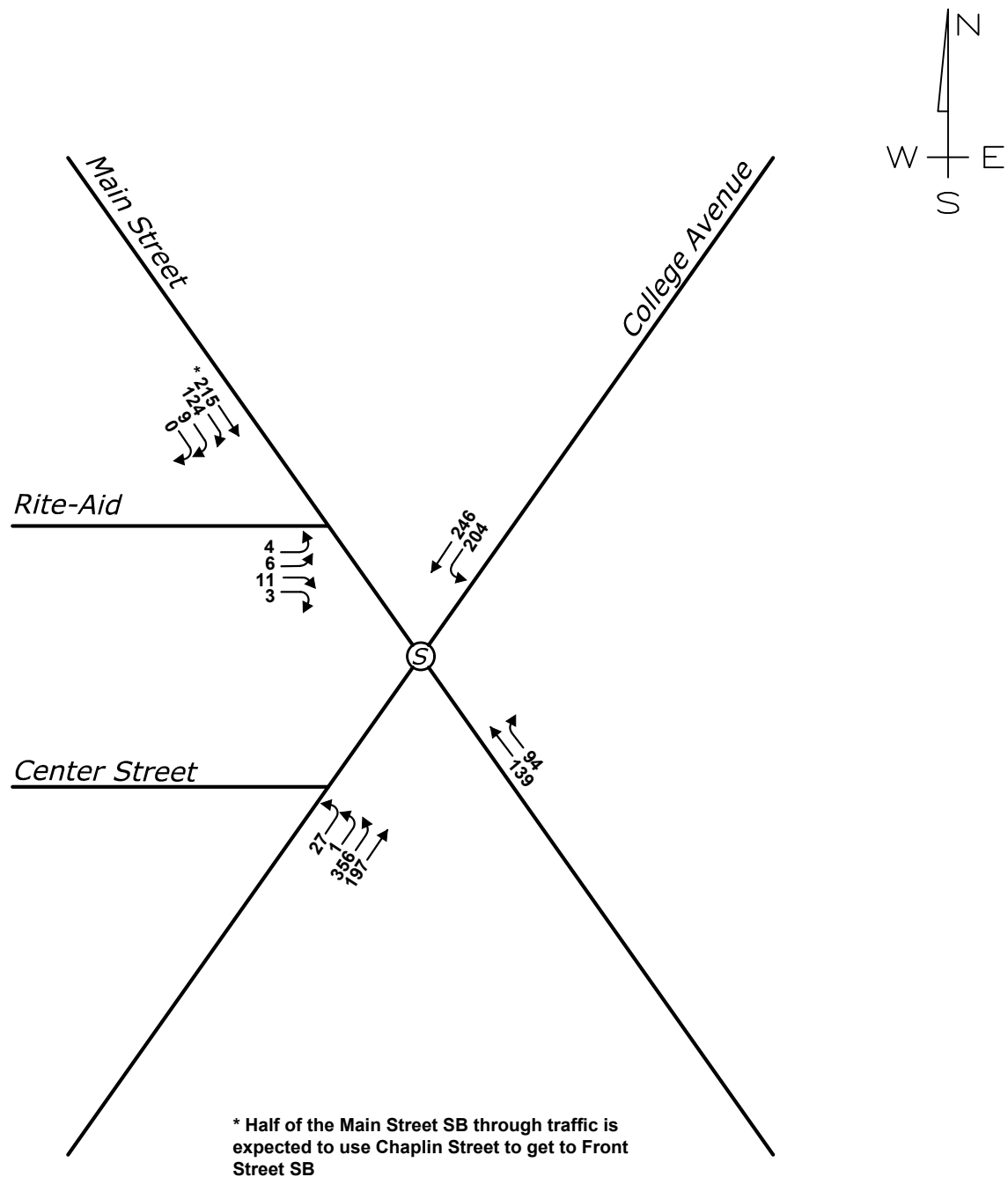
DOWNTOWN TRANSPORTATION STUDY WATERVILLE, MAINE

Design: ET Scale: NONE
Draft: LAN Date: JUNE 2016
Checked: RED File Name: 3110-TRAFF2.dwg

SIGNALIZED INTERSECTION 2037 PM POSTDEVELOPMENT FRONT ST & MAIN ST 2-WAY ASSUMED VOLUMES - FRONT MAJOR

Figure No.

7



DOWNTOWN TRANSPORTATION STUDY WATERVILLE, MAINE

Design: ET
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Scale: NONE
Date: JUNE 2016
File Name: 3110-TRAFF2.dwg



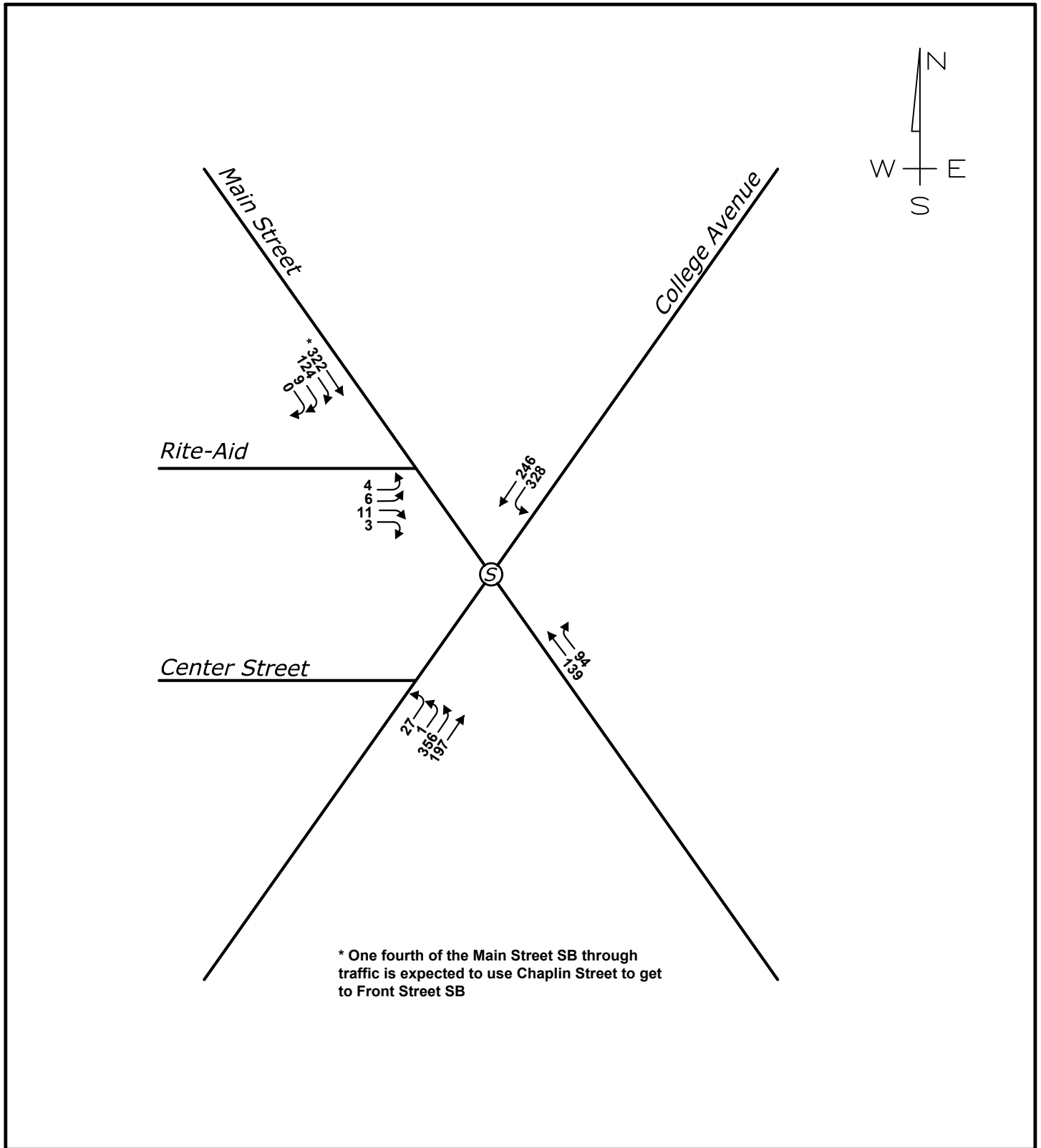
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**SIGNALIZED INTERSECTION 2037 PM POSTDEVELOPMENT
FRONT ST & MAIN ST 2-WAY ASSUMED VOLUMES - FRONT MINOR**

Figure No.

5



**DOWNTOWN TRANSPORTATION STUDY
WATERVILLE, MAINE**

Design: ET
Draft: LAN
Checked: RED
Scale: NONE
Date: JUNE 2016
File Name: 3110-TRAFF2.dwg

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2727	2765	2640	2704	2621	2692
Vehs Exited	2730	2781	2631	2713	2618	2695
Starting Vehs	65	67	55	67	67	62
Ending Vehs	62	51	64	58	70	62
Denied Entry Before	0	1	0	2	1	0
Denied Entry After	0	1	1	2	0	0
Travel Distance (mi)	938	947	899	927	890	920
Travel Time (hr)	66.4	69.4	62.2	65.4	61.9	65.1
Total Delay (hr)	31.2	33.9	28.5	30.7	28.5	30.6
Total Stops	1872	2028	1759	1840	1733	1846
Fuel Used (gal)	41.1	42.2	39.0	40.7	38.6	40.3

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	2727	2765	2640	2704	2621	2692
Vehs Exited	2730	2781	2631	2713	2618	2695
Starting Vehs	65	67	55	67	67	62
Ending Vehs	62	51	64	58	70	62
Denied Entry Before	0	1	0	2	1	0
Denied Entry After	0	1	1	2	0	0
Travel Distance (mi)	938	947	899	927	890	920
Travel Time (hr)	66.4	69.4	62.2	65.4	61.9	65.1
Total Delay (hr)	31.2	33.9	28.5	30.7	28.5	30.6
Total Stops	1872	2028	1759	1840	1733	1846
Fuel Used (gal)	41.1	42.2	39.0	40.7	38.6	40.3

3: Water Street/Front Street & Spring Street/Bridge Street & Main Street Performance by approach

Approach	EB	WB	SB	NE	All
Denied Del/Veh (s)	0.9	1.5	0.1	2.5	1.0
Total Del/Veh (s)	41.8	29.5	34.0	32.7	33.8
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

7: Front Street Performance by approach

Approach	EB	NB	SB	All
Denied Del/Veh (s)	0.0	0.0	0.1	0.0
Total Del/Veh (s)	4.4	13.8	0.4	9.5
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

8: Main Street Performance by approach

Approach	WB	NB	SB	All
Denied Del/Veh (s)	0.0	0.1	0.8	0.6
Total Del/Veh (s)	1.8	3.0	3.3	3.1
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

Total Network Performance

Denied Del/Veh (s)		1.3
Total Del/Veh (s)		38.7
Denied Entry Before		0
Denied Entry After		0

Intersection: 3: Water Street/Front Street & Spring Street/Bridge Street & Main Street

Movement	EB	EB	EB	EB	WB	WB	WB	SB	SB	SB	NE	NE
Directions Served	<	T	T	R	L	T	TR	L	LR	>	<L	R
Maximum Queue (ft)	196	230	178	44	209	261	255	289	292	225	199	302
Average Queue (ft)	78	132	88	1	49	141	144	221	224	30	133	37
95th Queue (ft)	151	203	174	31	123	222	226	294	296	155	205	188
Link Distance (ft)		640	640			1032	1032	265	265			595
Upstream Blk Time (%)								4	4			
Queuing Penalty (veh)								16	17			
Storage Bay Dist (ft)	100			125	160					175	100	
Storage Blk Time (%)	7	27	3		0	6	1		22		24	
Queuing Penalty (veh)	12	30	0		0	4	2		13		31	

Intersection: 7: Front Street

Movement	EB	NB
Directions Served	L	T
Maximum Queue (ft)	66	75
Average Queue (ft)	18	9
95th Queue (ft)	48	41
Link Distance (ft)	167	262
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 8: Main Street

Movement	WB	SB
Directions Served	R	T
Maximum Queue (ft)	56	305
Average Queue (ft)	13	38
95th Queue (ft)	39	188
Link Distance (ft)	167	689
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Network Summary

Network wide Queuing Penalty: 127

Intersection: 3: Water Street/Front Street & Spring Street/Bridge Street & Main Street

Phase	1	2	5	6	8	10
Movement(s) Served	WBL	EBT	EBL	WBT	NEL	SBL
Maximum Green (s)	8.0	29.0	11.0	26.0	19.0	36.0
Minimum Green (s)	4.0	4.0	4.0	4.0	4.0	4.0
Recall	None	None	None	C-Min	None	None
Avg. Green (s)	8.3	29.7	11.2	25.6	17.4	39.1
g/C Ratio	-0.01	-0.01	-0.01	-0.01	NA	NA
Cycles Skipped (%)	10	3	3	3	0	0
Cycles @ Minimum (%)	0	0	0	0	0	0
Cycles Maxed Out (%)	31	26	37	97	24	52
Cycles with Peds (%)	0	0	0	0	0	0

Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	1764	1682	1715	1689	1599	1686
Vehs Exited	1761	1673	1714	1695	1598	1689
Starting Vehs	28	28	27	32	29	28
Ending Vehs	31	37	28	26	30	32
Denied Entry Before	0	1	0	0	0	0
Denied Entry After	0	0	1	0	0	0
Travel Distance (mi)	659	627	638	630	597	630
Travel Time (hr)	29.2	27.7	28.0	28.0	26.0	27.8
Total Delay (hr)	6.2	5.7	5.8	5.9	5.0	5.7
Total Stops	902	861	878	860	762	851
Fuel Used (gal)	23.3	22.3	22.5	22.3	20.8	22.3

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	1764	1682	1715	1689	1599	1686
Vehs Exited	1761	1673	1714	1695	1598	1689
Starting Vehs	28	28	27	32	29	28
Ending Vehs	31	37	28	26	30	32
Denied Entry Before	0	1	0	0	0	0
Denied Entry After	0	0	1	0	0	0
Travel Distance (mi)	659	627	638	630	597	630
Travel Time (hr)	29.2	27.7	28.0	28.0	26.0	27.8
Total Delay (hr)	6.2	5.7	5.8	5.9	5.0	5.7
Total Stops	902	861	878	860	762	851
Fuel Used (gal)	23.3	22.3	22.5	22.3	20.8	22.3

3: College Ave & Chaplin Street/Front Street Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	1.2	0.0	0.0	0.7	0.4
Total Del/Veh (s)	10.1	5.6	8.7	8.6	7.9
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

5: College Ave & Colby Street Performance by approach

Approach	NB	SB	All
Denied Del/Veh (s)	0.3	0.0	0.1
Total Del/Veh (s)	0.6	2.4	1.6
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

6: Front Street & Colby Street Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	0.0	0.1	0.4	0.0	0.3
Total Del/Veh (s)	4.5	1.8	0.7	1.6	1.0
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

Total Network Performance

Denied Del/Veh (s)		0.6
Total Del/Veh (s)		11.4
Denied Entry Before		0
Denied Entry After		0

Intersection: 3: College Ave & Chaplin Street/Front Street

Movement	EB	EB	WB	WB	NB	NB	SB	SB	SB
Directions Served	LT	R	LT	R	L	T	L	T	R
Maximum Queue (ft)	112	10	110	132	66	173	77	186	11
Average Queue (ft)	58	0	44	29	15	79	29	100	0
95th Queue (ft)	99	7	86	92	48	138	59	158	8
Link Distance (ft)	568			266		337		783	783
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)		300	155		85		210		
Storage Blk Time (%)				0		4		0	
Queuing Penalty (veh)				0		1		0	

Intersection: 5: College Ave & Colby Street

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 6: Front Street & Colby Street

Movement	EB	EB	SB
Directions Served	T	R	L
Maximum Queue (ft)	25	30	23
Average Queue (ft)	2	7	2
95th Queue (ft)	15	28	15
Link Distance (ft)	234		
Upstream Blk Time (%)			
Queuing Penalty (veh)			
Storage Bay Dist (ft)		150	95
Storage Blk Time (%)			
Queuing Penalty (veh)			

Network Summary

Network wide Queuing Penalty: 1

Intersection: 3: College Ave & Chaplin Street/Front Street

Phase	1	2	4	5	6	8
Movement(s) Served	SBL NBTL EBTL	NBL	SBTL WBTL			
Maximum Green (s)	4.0	25.0	16.0	4.0	25.0	16.0
Minimum Green (s)	4.0	4.0	4.0	4.0	4.0	4.0
Recall	None	Min	None	None	Min	None
Avg. Green (s)	4.1	16.7	10.1	4.0	18.9	10.1
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	68	1	3	89	2	3
Cycles @ Minimum (%)	32	1	3	11	0	3
Cycles Maxed Out (%)	32	13	12	11	23	12
Cycles with Peds (%)	0	0	0	0	0	0

Controller Summary

Average Cycle Length (s): NA
Number of Complete Cycles : 0

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	2541	2670	2584	2539	2545	2575
Vehs Exited	2520	2660	2591	2526	2561	2572
Starting Vehs	57	55	80	54	74	63
Ending Vehs	78	65	73	67	58	68
Denied Entry Before	0	1	1	1	0	0
Denied Entry After	0	0	1	1	1	0
Travel Distance (mi)	800	837	816	800	807	812
Travel Time (hr)	62.0	67.7	64.4	62.4	63.6	64.0
Total Delay (hr)	31.7	36.2	33.7	32.3	33.0	33.4
Total Stops	1967	2186	2111	1992	2029	2058
Fuel Used (gal)	37.7	40.4	38.9	38.0	38.2	38.6

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	2541	2670	2584	2539	2545	2575
Vehs Exited	2520	2660	2591	2526	2561	2572
Starting Vehs	57	55	80	54	74	63
Ending Vehs	78	65	73	67	58	68
Denied Entry Before	0	1	1	1	0	0
Denied Entry After	0	0	1	1	1	0
Travel Distance (mi)	800	837	816	800	807	812
Travel Time (hr)	62.0	67.7	64.4	62.4	63.6	64.0
Total Delay (hr)	31.7	36.2	33.7	32.3	33.0	33.4
Total Stops	1967	2186	2111	1992	2029	2058
Fuel Used (gal)	37.7	40.4	38.9	38.0	38.2	38.6

3: Water Street/Front Street & Spring Street/Bridge Street & Main Street Performance by approach

Approach	EB	WB	SB	NE	SW	All
Denied Del/Veh (s)	0.9	1.5	0.6	3.1	0.2	1.2
Total Del/Veh (s)	42.5	31.3	46.7	34.5	51.6	39.9
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0

Total Network Performance

Denied Del/Veh (s)	1.2
Total Del/Veh (s)	44.3
Denied Entry Before	0
Denied Entry After	0

Intersection: 3: Water Street/Front Street & Spring Street/Bridge Street & Main Street

Movement	EB	EB	EB	WB	WB	WB	WB	SB	SB	NE	NE	NE
Directions Served	<L	T	T	L	T	TR	>	L	LR	<L	T	R
Maximum Queue (ft)	166	223	177	168	295	285	65	223	183	181	211	45
Average Queue (ft)	76	136	88	50	159	161	2	134	101	97	59	2
95th Queue (ft)	145	202	172	115	247	253	46	206	179	169	139	32
Link Distance (ft)		644	644		1036	1036		634	634		595	
Upstream Blk Time (%)												
Queuing Penalty (veh)												
Storage Bay Dist (ft)	100			160			230			100		100
Storage Blk Time (%)	8	26	3		11	3			0	14	1	
Queuing Penalty (veh)	15	29	0		7	10			0	28	4	

Intersection: 3: Water Street/Front Street & Spring Street/Bridge Street & Main Street

Movement	SW	SW
Directions Served	L	LTR
Maximum Queue (ft)	274	250
Average Queue (ft)	180	162
95th Queue (ft)	254	236
Link Distance (ft)	618	618
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		0
Queuing Penalty (veh)		0

Network Summary

Network wide Queuing Penalty: 94

Intersection: 3: Water Street/Front Street & Spring Street/Bridge Street & Main Street

Phase	1	2	4	5	6	8	10
Movement(s) Served	WBL	EBTL	SWTL	EBL	WBT	NETL	SBL
Maximum Green (s)	10.0	27.0	19.0	20.0	17.0	13.0	16.0
Minimum Green (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Recall	None	None	None	None	C-Min	None	None
Avg. Green (s)	8.7	29.5	20.8	12.6	24.9	12.6	17.6
g/C Ratio	-0.01	-0.01	NA	-0.01	-0.01	NA	NA
Cycles Skipped (%)	14	3	0	7	3	0	0
Cycles @ Minimum (%)	0	0	0	0	0	0	0
Cycles Maxed Out (%)	24	48	72	3	97	45	62
Cycles with Peds (%)	0	0	0	0	0	0	0

Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	1756	1817	1745	1842	1726	1778
Vehs Exited	1771	1808	1749	1848	1729	1780
Starting Vehs	30	17	34	25	26	25
Ending Vehs	15	26	30	19	23	22
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	1	0
Travel Distance (mi)	569	588	565	596	560	576
Travel Time (hr)	27.1	28.6	27.0	28.9	27.5	27.8
Total Delay (hr)	5.9	6.7	6.1	6.8	6.6	6.4
Total Stops	1091	1139	1101	1142	1143	1124
Fuel Used (gal)	21.9	22.9	21.9	23.1	21.7	22.3

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	1756	1817	1745	1842	1726	1778
Vehs Exited	1771	1808	1749	1848	1729	1780
Starting Vehs	30	17	34	25	26	25
Ending Vehs	15	26	30	19	23	22
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	1	0
Travel Distance (mi)	569	588	565	596	560	576
Travel Time (hr)	27.1	28.6	27.0	28.9	27.5	27.8
Total Delay (hr)	5.9	6.7	6.1	6.8	6.6	6.4
Total Stops	1091	1139	1101	1142	1143	1124
Fuel Used (gal)	21.9	22.9	21.9	23.1	21.7	22.3

3: College Avenue/Colby Street & Front Street Performance by approach

Approach	EB	WB	NB	SB	All
Denied Del/Veh (s)	0.0	0.0	0.0	0.0	0.0
Total Del/Veh (s)	12.3	12.4	8.0	5.0	7.8
Denied Entry Before	0	0	0	0	0
Denied Entry After	0	0	0	0	0

5: Colby Street Performance by approach

Approach	NB	SB	NE	All
Denied Del/Veh (s)	0.0	0.1	0.0	0.1
Total Del/Veh (s)	3.2	0.1	0.9	0.8
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

6: Front Street/College Avenue & Chaplin Street Performance by approach

Approach	EB	NB	SB	All
Denied Del/Veh (s)	0.0	0.0	0.3	0.1
Total Del/Veh (s)	10.3	2.0	1.1	2.8
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

8: College Avenue & Chaplin Street Performance by approach

Approach	EB	WB	SB	All
Denied Del/Veh (s)	0.2	0.0	0.0	0.1
Total Del/Veh (s)	0.9	3.5	14.0	3.7
Denied Entry Before	0	0	0	0
Denied Entry After	0	0	0	0

9: Chaplin Street Performance by approach

Approach	EB	WB	All
Denied Del/Veh (s)	0.3	0.0	0.2
Total Del/Veh (s)	0.8	0.4	0.7
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

10: Front Street & Colby Street Performance by approach

Approach	NB	SB	All
Denied Del/Veh (s)	0.4	0.0	0.2
Total Del/Veh (s)	0.2	1.5	0.8
Denied Entry Before	0	0	0
Denied Entry After	0	0	0

Total Network Performance

Denied Del/Veh (s)	0.3
Total Del/Veh (s)	12.5
Denied Entry Before	0
Denied Entry After	0

Intersection: 3: College Avenue/Colby Street & Front Street

Movement	EB	EB	EB	WB	WB	NB	NB	SB	SB	SB
Directions Served	L	T	R	L	TR	L	T	L	T	R
Maximum Queue (ft)	178	17	64	27	26	41	157	29	142	41
Average Queue (ft)	101	1	25	3	7	12	84	3	74	1
95th Queue (ft)	164	8	54	18	25	36	140	16	123	21
Link Distance (ft)	164	164		206	206	350			357	
Upstream Blk Time (%)	1									
Queuing Penalty (veh)	3									
Storage Bay Dist (ft)			80				210	110		275
Storage Blk Time (%)			0				0		1	
Queuing Penalty (veh)			0				0		5	

Intersection: 5: Colby Street

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 6: Front Street/College Avenue & Chaplin Street

Movement	EB	EB	NB	SB
Directions Served	L	R	L	R
Maximum Queue (ft)	71	91	72	12
Average Queue (ft)	23	43	32	0
95th Queue (ft)	54	76	62	5
Link Distance (ft)	225			655
Upstream Blk Time (%)				
Queuing Penalty (veh)				
Storage Bay Dist (ft)		200	220	
Storage Blk Time (%)				
Queuing Penalty (veh)				

Baseline

11/23/2016

Intersection: 8: College Avenue & Chaplin Street

Movement	EB	SB
Directions Served	T	LR
Maximum Queue (ft)	60	106
Average Queue (ft)	4	44
95th Queue (ft)	33	79
Link Distance (ft)	368	515
Upstream Blk Time (%)		
Queuing Penalty (veh)		
Storage Bay Dist (ft)		
Storage Blk Time (%)		
Queuing Penalty (veh)		

Intersection: 9: Chaplin Street

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Intersection: 10: Front Street & Colby Street

Movement
Directions Served
Maximum Queue (ft)
Average Queue (ft)
95th Queue (ft)
Link Distance (ft)
Upstream Blk Time (%)
Queuing Penalty (veh)
Storage Bay Dist (ft)
Storage Blk Time (%)
Queuing Penalty (veh)

Network Summary

Network wide Queuing Penalty: 8

Intersection: 3: College Avenue/Colby Street & Front Street

Phase	2	4	6	7	8
Movement(s) Served	NBTL	EBTL	SBTL	EBL	WBTL
Maximum Green (s)	25.0	25.0	25.0	10.0	10.0
Minimum Green (s)	4.0	4.0	4.0	4.0	4.0
Recall	None	None	None	None	None
Avg. Green (s)	14.6	10.0	14.6	9.4	6.2
g/C Ratio	-0.01	-0.01	-0.01	-0.01	-0.01
Cycles Skipped (%)	5	7	5	13	88
Cycles @ Minimum (%)	0	2	0	0	3
Cycles Maxed Out (%)	6	0	6	62	1
Cycles with Peds (%)	0	0	0	0	0

Controller Summary

Average Cycle Length (s): NA

Number of Complete Cycles : 0

Downtown Waterville Spring Street Intersection
Roundabout Calculations - Multilane Roundabout
2037 PM Peak Hour - Postdevelopment
Based on: HCM 2010, Volume 3, Chapter 21 - Roundabouts

	Step 1 (Convert to Flow Rates)			Step 2 (Adjust for Heavy Vehicles)					Step 3 (Determine Circulating and Exiting Vehicles)			
	Peak Veh / H	PHF (3)	Demand Flow Rate	Heavy Veh (%) (4)	Vol Heavy Vehicles	PCE	Raw Circulating	Raw Exiting	Circulating Flow	Exiting Flow	Adj, Circulating (4)	Adj, Exiting (4)
Water St NB												
L/T1/T2	196	0.92	213	1	2	215	1162	212	1263	230	1276	233
R	134	0.92	146	1	1	147	1162	212	1263	230	1276	233
Bridge St WB												
L/T/R1	547	0.92	595	1	6	601	317	1175	345	1277	348	1290
R2 (slip ramp)	356	0.92	387	1	4	391	317		345	0	348	0
Front St SW												
L1/T/R1	221	0.92	240	1	2	243	727	137	790	149	798	150
L1/L2	250	0.92	272	1	3	274	727	137	790	149	798	150
R (slip ramp)	10	0.92	11	1	0	11	727					
Main St SE												
L2/L1/T	189	0.92	205	1	2	207	952	246	1035	267	1045	270
L1/T/R	214	0.92	233	1	2	235	952	246	1035	267	1045	270
Spring St EB												
L1/L2/T (2)	233	0.92	253	1	3	256	878	477	954	518	964	524
T/R (2)	263	0.92	286	1	3	289	878	477	954	518	964	524

	Step 4 (Entry Flow Rates)	Step 5 (5) (Capacity)	Step 6 (Ped Impedance)	Step 7 (Convert to Veh/H)		Step 8 (v/c)	Step 9 (Control Delay in sec/veh)	Step 10 (7) (Approach LOS)
		Capacity (pc/h)	(6)	Heavy Veh Factor	Capacity veh / h	Entry Flow Rates veh/h	v/c	
Water St NB								
L/T1/T2	213	434	1.00	0.99	430	211	0.49	C
R	146	463	1.00	0.99	458	144	0.31	B
Bridge St WB								
L/T/R1	595	798	1.00	0.99	790	589	0.75	C
R2 (slip ramp)	387	972	1.00	0.99	962	383	0.40	A
Front St SW								
L1/T/R1	240	509	1.00	0.99	504	238	0.47	C
L1/L2	272	509	1.00	0.99	504	269	0.53	C
R2 (slip ramp)	11	863	1.00	0.99	854	11	0.01	A
Main St SE								
L2/L1/T	205	516	1.00	0.99	511	203	0.40	B
L1/T/R	233	544	1.00	0.99	538	230	0.43	B
Spring St EB								
L1/L2/T (2)	253	548	1.00	0.99	543	251	0.46	B
T/R (2)	286	576	1.00	0.99	570	283	0.50	B

Step 11 (Roundabout LOS (sec/veh))
15.7

Roundabout LOS
C

Step 12 (95th Percentile Queues)
Veh

Water St NB	
L/T1/T2	3
R	1
Bridge St WB	
L/T/R1	8
R2 (slip ramp)	2
Front St SW	
L1/T/R1	3
L1/L2	3
R (slip ramp)	0
Main St SE	
L2/L1/T	2
L1/T/R	2
Spring St EB	
L1/L2/T	3
T/R	3

Assumptions:

- Lane utilization based on HCM Exhibit 21-21
- PHF is 0.92 for all movements
- Assume 1 % Heavy Trucks during peak hours
- See HCM equations 21-1 thru 21-5
- Assumed no pedestrian activity
- Based on Unsignalized LOS Criteria

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	1831	1877	1837	1803	1762	1821
Vehs Exited	1836	1879	1835	1801	1771	1823
Starting Vehs	25	21	16	25	30	24
Ending Vehs	20	19	18	27	21	21
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	505	516	504	497	487	502
Travel Time (hr)	23.7	24.5	23.6	23.2	22.9	23.6
Total Delay (hr)	4.3	4.6	4.3	4.0	4.1	4.3
Total Stops	608	697	569	563	617	610
Fuel Used (gal)	20.1	20.8	20.0	19.7	19.3	20.0

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	1831	1877	1837	1803	1762	1821
Vehs Exited	1836	1879	1835	1801	1771	1823
Starting Vehs	25	21	16	25	30	24
Ending Vehs	20	19	18	27	21	21
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	505	516	504	497	487	502
Travel Time (hr)	23.7	24.5	23.6	23.2	22.9	23.6
Total Delay (hr)	4.3	4.6	4.3	4.0	4.1	4.3
Total Stops	608	697	569	563	617	610
Fuel Used (gal)	20.1	20.8	20.0	19.7	19.3	20.0

4: Railroad Square & College Ave & Front St/Chaplin St Performance by approach

Approach	NB	SB	SE	NW	NE	All
Denied Del/Veh (s)	0.3	0.5	0.3	2.9	0.1	1.1
Total Del/Veh (s)	8.1	6.1	8.7	4.0	5.7	6.4
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0

Total Network Performance

Denied Del/Veh (s)	1.1
Total Del/Veh (s)	7.3
Denied Entry Before	0
Denied Entry After	0

Intersection: 4: Railroad Square & College Ave & Front St/Chaplin St

Movement	NB	SB	SE	NW	NW	NE
Directions Served	<LT	LTR>	LTR	<LT	R	<LR
Maximum Queue (ft)	136	144	139	53	68	31
Average Queue (ft)	61	48	61	18	6	8
95th Queue (ft)	112	109	106	44	37	30
Link Distance (ft)	681	628	451	546		546
Upstream Blk Time (%)						
Queuing Penalty (veh)						
Storage Bay Dist (ft)					50	
Storage Blk Time (%)				0	0	
Queuing Penalty (veh)				1	0	

Network Summary

Network wide Queuing Penalty: 1

Downtown Waterville College Ave / Chaplin St Intersection
Roundabout Calculations - Assume Front and Main 2-Way
2037 PM Peak Hour - Postdevelopment
Based on: HCM 2010, Volume 3, Chapter 21 - Roundabouts

Step 1 (Convert to Flow Rates)				Step 2 (Adjust for Heavy Vehicles)			Step 3 (Determine Circulating and Exiting Vehicles)				Adj. Circulating (1)	Adj. Exiting (1)
Peak Veh / H	PHF	Demand Flow Rate		Heavy Veh (%)	Vol Heavy Vehicles	PCE	Raw Circulating	Raw Exiting	Circulating Flow Rate	Exiting Flow Rate		
College Ave NB	382	0.92	415	1	4	419	470	451	511	490	516	495
Bypass Lane NB		0.92	0	1	0	0	470		511		516	
Front St NW	105	0.92	114	1	1	115	424	428	461	465	465	470
Bypass Lane NW	367	0.92	399	1	4	403	424		461		465	
College Ave SB	597	0.92	649	1	6	655	127	402	138	437	139	441
Chaplin St EB	336	0.92	365	1	4	369	585	139	636	151	642	153
RR Square NE	9	0.92	10	1	0	10	912	9	991	10	1001	10

Step 4 (Entry Flow Rates)		Step 5 (2) (Capacity)		Step 6 (Ped Impedance)		Step 7 (Convert to Veh/H)		Step 8 (v/c)		Step 9 (Control Delay in sec/veh)		Step 10 (3) (Approach LOS)	
		Capacity (pc/h)			Heavy Veh Factor	Capacity veh / h	Entry Flow Rates veh/h	v/c					
College Ave NB	419	675		1	0.99	668	415	0.62		17.2		C	
Bypass Lane NB	0	706		1	0.99	699	0	0.00		5.1		A	
Front St NW	115	709		1	0.99	702	114	0.16		6.9		A	
Bypass Lane NW	403	727		1	0.99	720	399	0.55		14.0		B	
College Ave SB	655	983		1	0.99	973	649	0.67		14.3		B	
Chaplin St EB	369	595		1	0.99	589	365	0.62		19.1		C	
RR Square NE	10	415		1	0.99	411	10	0.02		9.1		A	

Step 11 (Roundabout LOS (sec/veh))		Roundabout LOS		Step 12 (95th Percentile Queues in Veh)	
	15.3		C		
				Water St NB	5
				Bypass Lane NB	0
				Bridge St WB	1
				Bypass Lane WB	4
				Front St SW	6
				Main St SE	5
				Spring St EB	0

1. Assume 1% heavy trucks
2. Equation 21-1 for single lane entry into single lane roundabout (e=2.718)
See HCM page 21-28 for sample problem
3. Based on Unsignalized LOS Criteria

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	1604	1686	1684	1584	1582	1626
Vehs Exited	1593	1683	1684	1538	1568	1614
Starting Vehs	60	60	53	46	51	54
Ending Vehs	71	63	53	92	65	69
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	968	1038	1033	957	974	994
Travel Time (hr)	64.9	73.5	71.5	66.7	62.8	67.9
Total Delay (hr)	23.5	29.2	27.5	25.8	20.9	25.4
Total Stops	1571	1743	1749	1544	1530	1627
Fuel Used (gal)	36.7	40.2	39.7	37.0	36.1	37.9

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	1604	1686	1684	1584	1582	1626
Vehs Exited	1593	1683	1684	1538	1568	1614
Starting Vehs	60	60	53	46	51	54
Ending Vehs	71	63	53	92	65	69
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0
Travel Distance (mi)	968	1038	1033	957	974	994
Travel Time (hr)	64.9	73.5	71.5	66.7	62.8	67.9
Total Delay (hr)	23.5	29.2	27.5	25.8	20.9	25.4
Total Stops	1571	1743	1749	1544	1530	1627
Fuel Used (gal)	36.7	40.2	39.7	37.0	36.1	37.9

3: Center Street/College Avenue & Elm Street/Main Street & Rite-Aid Performance by approach

Approach	EB	NB	SB	NW	SW	All
Denied Del/Veh (s)	0.1	0.2	0.2	0.2	0.2	0.2
Total Del/Veh (s)	43.0	61.6	36.8	40.0	56.8	51.8
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	0	0	0	0

Total Network Performance

Denied Del/Veh (s)	0.2
Total Del/Veh (s)	54.2
Denied Entry Before	0
Denied Entry After	0

Intersection: 3: Center Street/College Avenue & Elm Street/Main Street & Rite-Aid

Movement	EB	EB	NB	NB	SB	SB	NW	SW	SW
Directions Served	<L	R>	<LT	R	L	TR	R>	<	L
Maximum Queue (ft)	49	48	564	248	232	160	231	247	398
Average Queue (ft)	12	14	278	99	124	72	96	84	194
95th Queue (ft)	38	42	501	194	212	132	192	198	394
Link Distance (ft)	219	219	2116	2116	1015	1015	1032	1843	1843
Upstream Blk Time (%)									
Queuing Penalty (veh)									
Storage Bay Dist (ft)									
Storage Blk Time (%)									
Queuing Penalty (veh)									

Network Summary

Network wide Queuing Penalty: 0

Intersection: 3: Center Street/College Avenue & Elm Street/Main Street & Rite-Aid

Phase	1	2	3	10	14
Movement(s) Served	EBL	NBTL	SWL	SBTL	NWR
Maximum Green (s)	17.0	18.0	16.0	16.0	16.0
Minimum Green (s)	4.0	4.0	4.0	4.0	4.0
Recall	None	None	None	None	None
Avg. Green (s)	6.8	17.9	15.4	15.6	15.6
g/C Ratio	-0.01	NA	NA	NA	NA
Cycles Skipped (%)	66	0	0	0	0
Cycles @ Minimum (%)	0	0	0	0	0
Cycles Maxed Out (%)	0	94	83	83	83
Cycles with Peds (%)	0	0	0	0	0

Controller Summary

Average Cycle Length (s): NA
Number of Complete Cycles : 0

Summary of All Intervals

Run Number	1	2	3	4	5	Avg
Start Time	6:57	6:57	6:57	6:57	6:57	6:57
End Time	8:00	8:00	8:00	8:00	8:00	8:00
Total Time (min)	63	63	63	63	63	63
Time Recorded (min)	60	60	60	60	60	60
# of Intervals	2	2	2	2	2	2
# of Recorded Intervals	1	1	1	1	1	1
Vehs Entered	1833	1933	1888	1793	1817	1855
Vehs Exited	1730	1779	1746	1718	1723	1741
Starting Vehs	61	59	65	68	68	63
Ending Vehs	164	213	207	143	162	179
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	5	0	0	1
Travel Distance (mi)	1174	1218	1187	1159	1171	1182
Travel Time (hr)	121.5	144.5	153.2	103.3	100.9	124.7
Total Delay (hr)	71.5	92.7	103.0	53.9	51.0	74.4
Total Stops	1982	2175	2126	1919	1917	2023
Fuel Used (gal)	54.2	60.2	61.3	49.6	49.0	54.9

Interval #0 Information Seeding

Start Time	6:57
End Time	7:00
Total Time (min)	3
Volumes adjusted by Growth Factors.	
No data recorded this interval.	

Interval #1 Information Recording

Start Time	7:00
End Time	8:00
Total Time (min)	60
Volumes adjusted by Growth Factors.	

Run Number	1	2	3	4	5	Avg
Vehs Entered	1833	1933	1888	1793	1817	1855
Vehs Exited	1730	1779	1746	1718	1723	1741
Starting Vehs	61	59	65	68	68	63
Ending Vehs	164	213	207	143	162	179
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	5	0	0	1
Travel Distance (mi)	1174	1218	1187	1159	1171	1182
Travel Time (hr)	121.5	144.5	153.2	103.3	100.9	124.7
Total Delay (hr)	71.5	92.7	103.0	53.9	51.0	74.4
Total Stops	1982	2175	2126	1919	1917	2023
Fuel Used (gal)	54.2	60.2	61.3	49.6	49.0	54.9

3: Center Street/College Avenue & Elm Street/Main Street & Rite-Aid Performance by approach

Approach	EB	NB	SB	NW	SW	All
Denied Del/Veh (s)	0.1	0.2	0.3	0.2	0.2	0.2
Total Del/Veh (s)	39.9	117.7	214.0	32.8	146.1	137.7
Denied Entry Before	0	0	0	0	0	0
Denied Entry After	0	0	1	0	0	1

Total Network Performance

Denied Del/Veh (s)	0.2
Total Del/Veh (s)	139.3
Denied Entry Before	0
Denied Entry After	1

Intersection: 3: Center Street/College Avenue & Elm Street/Main Street & Rite-Aid

Movement	EB	EB	NB	NB	SB	SB	NW	SW	SW
Directions Served	<L	R>	<LT	R	L	TR	R>	<	L
Maximum Queue (ft)	40	52	855	507	1171	949	200	884	719
Average Queue (ft)	11	15	460	180	669	313	86	481	263
95th Queue (ft)	36	43	912	419	1439	1096	164	1032	738
Link Distance (ft)	219	219	2116	2116	1627	1627	1032	1843	1843
Upstream Blk Time (%)					4	1			
Queuing Penalty (veh)					0	0			
Storage Bay Dist (ft)									
Storage Blk Time (%)									
Queuing Penalty (veh)									

Network Summary

Network wide Queuing Penalty: 0

Intersection: 3: Center Street/College Avenue & Elm Street/Main Street & Rite-Aid

Phase	1	2	3	10	14
Movement(s) Served	EBL	NBTL	SWL	SBTL	NWR
Maximum Green (s)	8.0	17.0	16.0	16.0	16.0
Minimum Green (s)	4.0	4.0	4.0	4.0	4.0
Recall	None	None	None	None	None
Avg. Green (s)	6.6	17.2	16.1	15.9	15.9
g/C Ratio	-0.01	NA	NA	NA	NA
Cycles Skipped (%)	61	0	0	0	0
Cycles @ Minimum (%)	0	0	0	0	0
Cycles Maxed Out (%)	7	100	100	98	98
Cycles with Peds (%)	0	0	0	0	0

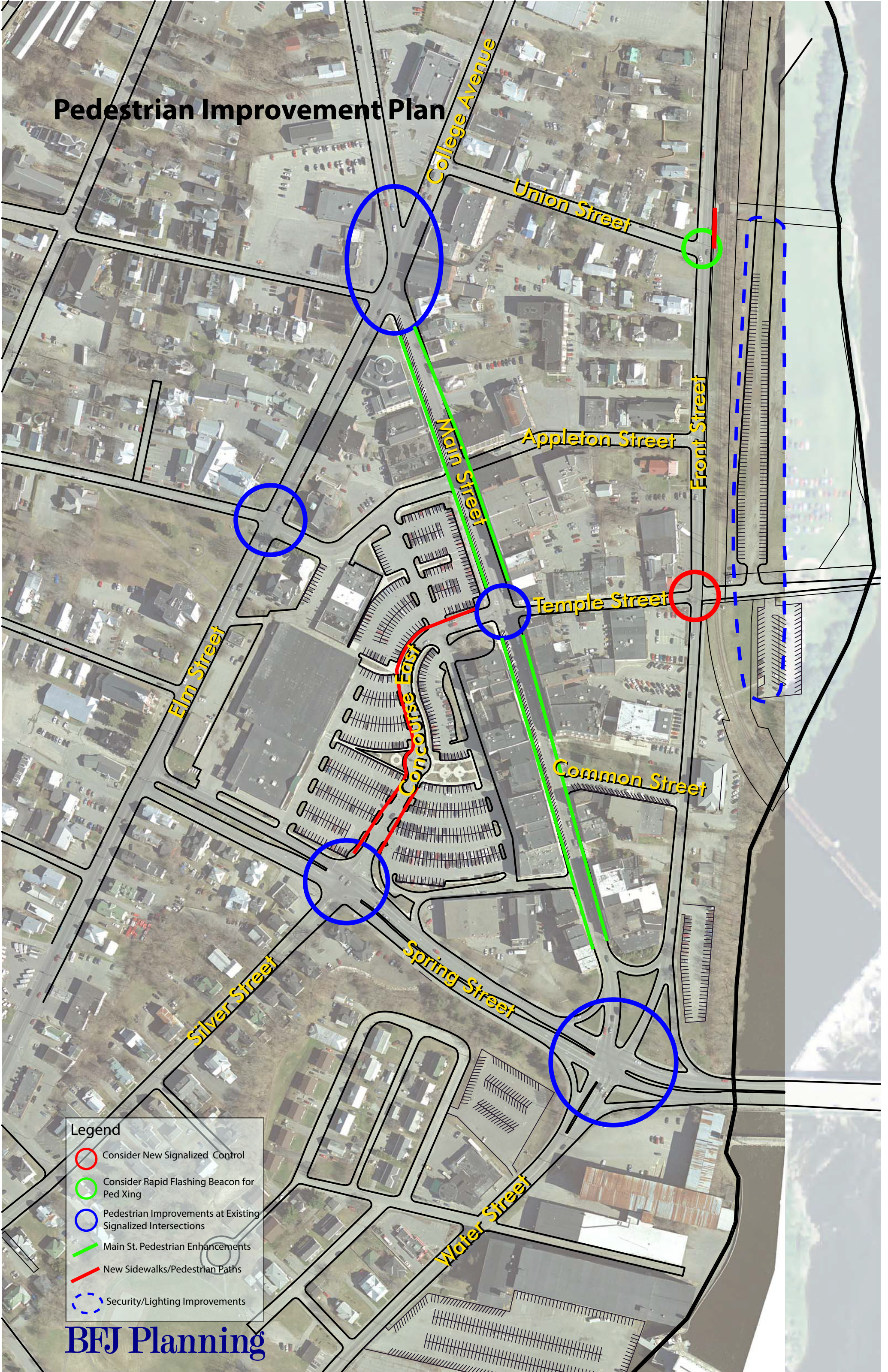
Controller Summary

Average Cycle Length (s): NA
Number of Complete Cycles : 0

Appendix H

Pedestrian Improvements Figure

Pedestrian Improvement Plan



Legend

Consider New Signalized Control

Consider Rapid Flashing Beacon for Ped Xing

Pedestrian Improvements at Existing Signalized Intersections

Main St. Pedestrian Enhancements

New Sidewalks/Pedestrian Paths

Security/Lighting Improvements

Appendix I

Safety Analysis

Waterville Downtown Traffic Circulation Safety Analysis Tech Memo December 2016

Introduction

One of the goals of this study is to recommend alternatives to increase safety in the downtown area for all modes of travel. As discussed previously, the project study area has nine high crash locations (HCLs) and 33 locations that meet one of the two HCL criteria. A safety analysis was completed to estimate the safety benefits for vehicular traffic from the proposed alternatives. To assist the GP study team, MaineDOT conducted a safety analysis of the proposed change in traffic circulation on downtown streets. The focus of this safety analysis is the facilities most affected by a conversion of Main Street and Front Street to two-way traffic: (1) the two one-way segments of Main Street and Front Street, (2) the intersection of Main Street / Elm Street / College Avenue, and (3) the proposed, signalized four-leg intersection of Front Street / Chaplin Street / College Avenue.

Some potential changes in the facilities include the following:

- Change two lane one-way traffic flows on Main Street and Front Street to two-way traffic flow with a single lane in each direction.
- Change angled on-street parking spaces on Main Street to parallel on-street parking. Some isolated locations may remain angled parking but the majority would be converted to parallel.
- Create a buffer between the travel lane and on-street parking along Main Street.
- Create a new at-grade intersection of Front Street / Chaplin Street / College Avenue.

AASHTO's *Highway Safety Manual (HSM)*, 1st Edition, Volume 2 was used to quantify the potential changes in the expected average crash frequency of these facilities for both the existing and proposed conditions.

Analysis

Main Street and Front Street

From 2013 to 2015 there were 92 total crashes on Main Street and Front Street, combined. Of these crashes, 37 were driveway related and 55 were non-driveway related. A Highway Safety Manual (HSM) analysis was completed on both the existing conditions and the proposed changes to quantify the potential safety impacts associated with these changes.

The HSM does not currently provide a method specifically for analyzing one-way streets. Therefore, to analyze the existing conditions of Main Street and Front Street, the two one-way roads were analyzed jointly as a two-way four-lane divided urban street. The analysis accounted for the combination of both angle and parallel parking along Main Street, reflecting the existing proportions of roadway associated with each type of parking. All intermediate access points along these two one-way streets were treated as either major or minor driveways.

For the proposed changes, both Main Street and Front Street were analyzed as separate two-lane two-way streets. These changes also include changing angled on-street parking spaces on Main Street to parallel on-street parking, with the exception of some isolated locations. This analysis also took into account that a portion of Front Street would have a center turning lane. Traffic volume shifts from Main Street to Front Street were also considered. With the proposed changes, Front Street would become the major route, so it is expected that thru traffic volumes on Main Street would decrease and thru traffic volumes on Front Street would increase.

The results of both the existing and proposed analyses are shown in Figure 1. The analysis of the existing conditions shows approximately 26 expected crashes per year on Front and Main Street, combined. With the proposed changes, the total expected crashes would be reduced from about 26 crashes per year on Front and Main Street, combined, to approximately 3 crashes per year on each road, or 6 crashes per year, combined.

Figure 1. HSM Segment Analysis for Front and Main Street.

Segment Alternative	Segment Type	Total Crashes per Year			Crash Estimate to Compare	Crashes per Year for Comparison		
		Observed	Calculated			Total	FI (fatal and injury)	PDO (property damage only)
			Predicted	Expected				
Existing (Front & Main, Combined)	4D	31.00	9.85	25.82	Expected	25.82	9.12	16.70
Main Street (Proposed)	2U	-	3.16	n/a	Predicted	3.16	1.13	2.03
Front Street (Proposed)	3T	-	3.01	n/a	Predicted	3.01	1.01	2.01
Front & Main Street, Proposed, Combined	-	-	6.17	n/a	-	6.17	2.14	4.04

Along with the reduction in angle parking, the large reduction of crashes from existing to proposed is likely attributed to the change in Main Street from a mixed facility in which thru traffic interacts directly and experiences conflicts with local access traffic (i.e. those looking for a parking space) to one where the thru traffic does not have to interact with local access traffic. Thru traffic is removed from Main Street and redirected to Front Street, which has no on-street parking, removing the conflict between thru and local access traffic, thus reducing the number of crashes.

Intersection of Main Street / Elm Street / College Avenue

There were 14 crashes at the intersection of Main Street / Elm Street / College Avenue from 2013 to 2015. The HSM was used to analyze both the existing intersection and the proposed changes to the intersection. The changes to the intersection include the conversion of Main Street from one-way traffic flow to two-way traffic flow and the addition of a protected left-turn pocket for those traveling north on Main Street wishing to access the Rite Aid parking lot. Right turns remain prohibited from Elm Street onto Main Street and from College Avenue onto Main Street due to the skew of the intersection. No other approach changes are proposed. Traffic volumes on Main Street are also a key component to the analysis. With the proposed one-way to two-way traffic flow changes, Front Street becomes the major route, thus a majority of Main Street thru-traffic would be redirected onto Front Street, thereby reducing the total volume of traffic entering this intersection. The results of the analysis, seen in Figure 2, show a slight decrease in expected crashes from 4.14 to 3.72 crashes per year. In the analysis, this reduction is credited mainly to the reduction in Main Street AADT.

Figure 2. HSM Safety Analysis for Main Street / Elm Street / College Avenue intersection.

Intersection Alternative	Intersection Type	Total Crashes per Year			Crash Estimate to Compare	Crashes per Year for Comparison		
		Observed	Calculated			Total	FI	PDO
			Predicted	Expected			(fatal and injury)	(property damage only)
Main/Elm/College Baseline/No-Build	4SG	4.67	2.43	4.14	Expected	4.14	1.71	2.42
Main/Elm/College Proposed	4SG	-	1.96	3.72	Expected	3.72	1.58	2.14

Proposed Intersection of Front Street / Chaplin Street / College Avenue

The conversion of Front Street and Main Street to two-way traffic flow would result in the creation of a new, signalized intersection at Front Street / Chaplin Street / College Avenue. The proposed intersection was analyzed via the HSM. The results of this analysis, shown in Figure 3, predict that there would be approximately 4 crashes per year at this intersection.

Figure 3. HSM Safety Analysis for Front Street / Chaplin Street / College Avenue intersection.

Intersection Alternative	Intersection Type	Total Crashes per Year			Crash Estimate to Compare	Crashes per Year for Comparison		
		Observed	Calculated			Total	FI	PDO
			Predicted	Expected			(fatal and injury)	(property damage only)
College/Front/Chaplin Proposed	4SG	-	3.80	-	Predicted	3.80	1.26	2.53

Safety Results

The results of the HSM analyses for these facilities were combined to compare the overall crashes per year for the existing conditions and the proposed changes. Figure 4 shows the per-year total, fatal-and-injury, and property-damage-only expected crash results from the analyses. The analyses predict a reduction in total crashes per year from 30 to 14, resulting in a decrease in annual fatal-and-injury crashes from 11 to 5 and a decrease in annual property-damage-only crashes from 19 to 9.

Figure 4. HSM Safety Analysis total combined crashes for existing and proposed alternatives.

	Total	FI	PDO
Existing	29.96	10.83	19.12
Proposed	13.69	4.98	8.71

Summary

This assessment of the proposed change from one-way traffic to two-way traffic, with reduced angle parking, shows that a reduction of crashes is likely along existing facilities, including the intersection of Main Street / Elm Street / College Avenue. Overall, the proposed changes could be expected to reduce total crashes at these facilities by more than half, even with the creation of a new intersection at Front Street / Chaplin Street / College Avenue.

Appendix J

Transit Route Figure

Potential Shuttle Bus Route

Hospital

Boys and Girls Club

North Street

Main Street

Common Street

Main Street
Common Street

BFJ Planning

