RPM Transportation Consultants, LLC
1101 17th Avenue South • Nashville, TN 37212 • (615) 370-8410 • Fax (615) 370-8455

August 29, 2013

Mr. Jeff Fleming
Kingsport Development Services
201 W Market St
Kingsport, TN 37660

Re: Summary of Preliminary Findings, Center Street Road Diet

Dear Jeff,

I am writing to present the results of our preliminary analysis for the proposed Center Street Road Diet. As was agreed, we have completed a planning-level assessment of a reconfiguration of the existing cross-section of Center Street, using the Sullivan Street and Shelby Street intersections as test intersections. The purpose of this letter is to present the findings of the analysis of these two intersections for the City's use in making a determination as to whether to continue planning for the Center Street Road Diet.

In our discussions, it was made evident that you are already familiar with the benefits of the road diet proposal. In addition to the livability improvements for downtown businesses, patrons, workers, and visitors, you are aware of the mobility enhancements such as the provision of bicycle lanes, additional parking/loading/bus stop areas, and statistically fewer traffic crashes that typically accompany road diets such as this one. Our task, however, is not to itemize these benefits, but to objectively describe the traffic impacts of reallocating a portion of the through roadway capacity for other uses.

The intersections of Center Street and Sullivan Street and Center Street and Shelby Street were selected for analysis by the Kingsport Traffic Division because these intersections represent critical intersections in the downtown area. In other words, it is believed that if the reduced capacity of a road diet can work at these intersections, it will work at all other intersections. City staff collected turning movement data at these two intersections for the AM peak (7:15 – 8:15), the midday peak (12:00 – 1:00), and the PM peak (3:00 – 4:00) hours. Staff also supplied signal timing data for these two intersections.

RPM developed three SimTraffic existing conditions microsimulation models for these two intersections, one for each AM, midday, and PM peak hour. A second set of models was then created to represent the proposed (road diet) cross-section conditions. The primary change made for the proposed condition was the removal of one through lane in the eastbound and westbound Center Street approaches

and the addition of a dedicated left turn lane on these same approaches. No other signal timing or phasing changes were made[1].

A comparison of the operational characteristics of the existing and proposed conditions are attached as Tables 1 and 2.

The following results from the intersection of Center Street and Shelby Street are noted:

- The removal of one through lane in each direction had no significant impact on delay or level of service at this intersection during any period of the day. At most, overall intersection delay increased by 1.8 seconds per vehicle (PM peak).

  One reason for so little change in delay is that, currently, lane utilization is very unbalanced along Center Street. For example, during one 15 minute period, 131 cars were counted traveling westbound on Center Street. Of the 131, only 25 cars (19% of the total) were in the inside through lane. Thus, removing one through lane does not result in major operational impacts and cannot be accurately described as losing one-half of the capacity of Center Street.

- Volume/capacity ratio comparisons indicate that no individual movement volumes will exceed approximately 55% of the available capacity of that movement with the lane reductions.

- Queue lengths on the Center Street through movements will get longer with the road diet, and growth of the 95th percentile queue length during the PM peak is substantial (approximately doubling). The worst case is the westbound through lane, where the 95th percentile queue length grows from 97 feet to 183 feet with the lane reductions. Further signal optimization is likely to mitigate this somewhat, but even at 183 feet, this queue is contained within the block and would not likely cause additional traffic problems. It should be noted that the 95th percentile queue represents the maximum queue for 95% of all PM peak hour cycles and the corresponding average queue length is 77 feet.

Sullivan Street presents several challenges to the road diet concept and, since it was selected for this preliminary assessment, presumably represents the most challenging intersection in the corridor. This intersection has more significant impacts with the reduction in travel lanes for several reasons.

[1] This includes the addition of any protected left turn phasing. This should be revisited in future analyses, but existing left turn movements are few and do not require a protected left turn phase for capacity reasons. Therefore, permitted only left turn phasing was maintained on all approaches at both intersections for the proposed conditions analysis.

First, and most importantly, this is a five-legged intersection and thus requires an additional signal phase to service all legs. The additional phase to service northbound Wexler Street uses approximately 16% of the intersection's cycle time.

Second, split times are currently allocated to all approaches in order to keep delay levels roughly equivalent. An alternative approach is to lower delay on the major approaches and allow approaches with lower turning volumes to have relatively more delay. This would lower overall signal delay and shorten the queues experienced on the major approaches.

Lastly, our analysis assumes that the Sullivan Street intersection operates as an isolated intersection. That is, the positive effects of signal coordination and a structured vehicle arrival pattern (platooning) are not accounted for because these intersections have been analyzed individually. Thus, we would expect that, once all intersections in the corridor are analyzed, delay and queue lengths would be decreased due to the traffic metering and platooning effects of adjacent intersections.

With the above aspects of the signal operation in mind, the following results from the intersection of Center Street and Sullivan Street are noted:

- The removal of one through lane in each direction had minor to moderate impacts on overall delay at this intersection during the midday and PM peak periods. At most, overall intersection delay increased by 18 seconds per vehicle (PM peak). Corresponding level of service remained an acceptable "C" both with and without the lane removals.

  Most individual movement delays remained at one minute or less. Left turns from Center Street are shown to have 60-80 second delays (despite a more optimistic HCM calculation of LOS B), but this is without the inclusion of a protected left turn phase. Signal optimization would lower these delays further.

- With the lane reductions (and existing signal timing and phasing), the westbound through lane is expected to approach capacity during the PM peak (v/c ratio of 0.91). All other movements remain well below capacity.

- Perhaps the most significant impact is that the average PM queue would extend from Sullivan Street almost to the Dale Street intersection (372 feet). The worst cycles would have westbound queues extending 608 feet (95^{th} percentile queue length), well past the signalized Dale Street intersection.

In summary, our analysis of these two intersections (supposed to represent the most challenging intersections in downtown Kingsport for the road diet proposal) showed that the most significant impacts to corridor operations appear to be limited to one approach of one intersection during one peak hour. Therefore, we

conclude that, even without changing signal operational parameters, the road diet concept is feasible. The existing imbalance of usage of the inside through lane on Center Street means that the four lanes of through capacity are not fully utilized and therefore only a fraction of through capacity would actually be lost with a road diet.

Our recommendation is that the City commence with a full analysis of all downtown intersections as a coordinated system in order to have a better understanding of the traffic impacts. This analysis would also allow optimization of signal operational parameters in order to more completely compare the existing operations with proposed operations. It would also result in a more complete recommendation concerning the limits of the proposed road diet. Specifically, it may well be concluded that the road diet should begin west of the Sullivan Street intersection in order preserve the traffic capacity here.

Please feel free to contact me should you have any questions regarding this preliminary analysis or its findings.

Sincerely,
RPM Transportation Consultants, LLC

Jeff Hammond, P.E.

Attachments

Copy: Tim Elsea, P.E. (with attachment)

Table 1. Comparison of Existing and Proposed Conditions, Center Street and Shelby Street

AM Peak (7:15 – 8:15)										
Lane Group	V/C Ratio		Total Delay (sec/veh)		LOS		Average Queue (ft)		95th % Queue (ft)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Eastbound Left	0.36	0.02	5.0	5.4	A	A	12	3	41	18
Eastbound Through, Right		0.52	1.3	2.5		A	18	29	56	93
Westbound Left	0.44	0.13	5.9	6.8	A	A	15	11	44	39
Westbound Through, Right		0.38	1.2	1.8		A	16	22	52	71
Northbound Left	0.14	0.14	41.7	40.9	D	D	12	12	39	39
Northbound Through, Right	0.17	0.17	46.7	46.6	C	C	15	15	42	42
Southbound Left	0.03	0.03	36.5	24.1	C	C	1	1	10	8
Southbound Through, Right	0.14	0.14	37.0	36.2	C	C	11	11	37	37
Overall Intersection			2.5	3.4	A	A				
Midday Peak (12:00 – 1:00)										
Lane Group	V/C Ratio		Total Delay (sec/veh)		LOS		Average Queue (ft)		95th % Queue (ft)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Eastbound Left	0.09	0.01	11.3	16.0	A	A	8	2	32	15
Eastbound Through, Right		0.13	3.1	3.5		A	15	21	45	58
Westbound Left	0.36	0.09	6.7	6.4	A	A	40	17	87	49
Westbound Through, Right		0.44	3.8	5.4		A	49	75	102	156
Northbound Left	0.51	0.51	39.4	38.6	D	D	46	42	95	92
Northbound Through, Right	0.45	0.45	37.4	35.6	B	B	37	38	70	73
Southbound Left	0.12	0.12	41.3	39.2	D	D	7	9	28	32
Southbound Through, Right	0.28	0.28	31.6	32.5	C	C	21	21	49	48
Overall Intersection			7.6	8.7	A	B				
PM Peak (3:00 – 4:00)										
Lane Group	V/C Ratio		Total Delay (sec/veh)		LOS		Average Queue (ft)		95th % Queue (ft)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Eastbound Left	0.29	0.05	12.1	13.9	A	A	26	7	64	29
Eastbound Through, Right		0.37	2.7	4.1		A	35	57	82	136
Westbound Left	0.43	0.07	8.4	9.3	A	A	34	12	76	39
Westbound Through, Right		0.55	2.8	4.9		A	44	77	97	183
Northbound Left	0.46	0.46	47.8	48.8	E	E	36	37	78	80
Northbound Through, Right	0.38	0.37	38.2	40.1	C	C	35	35	74	77
Southbound Left	0.14	0.14	34.1	39.6	D	D	5	5	25	24
Southbound Through, Right	0.25	0.25	45.5	42.2	C	C	21	22	54	54
Overall Intersection			5.5	7.3	A	A				

V/C ratio and LOS determined from HCM calculations, all other metrics averaged from five (5) 1-hour SimTraffic simulations of the peak hour.

Table 2. Comparison of Existing and Proposed Conditions, Center Street and Sullivan Street

AM Peak (7:15 – 8:15)										
Lane Group	V/C Ratio		Total Delay (sec/veh)		LOS		Average Queue (ft)		95th % Queue (ft)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Eastbound Left	0.46	0.02	26.9	37.6	B	A	23	1	59	7
Eastbound Through, Right		0.68	7.1	11.0		B	40	102	91	208
Westbound Left	0.47	0.10	19.9	25.4	B	B	22	3	66	13
Westbound Through, Right		0.62	7.3	11.1		B	28	98	79	213
Northbound (Wexler) Left, Through	0.15	0.15	55.9	45.0	C	C	11	10	34	33
Northbound (Wexler) Right	0.03	0.03	37.1	38.2	B	B	1	1	10	11
Northwestbound (Sullivan) Left	0.20	0.20	35.5	35.2	C	C	13	12	43	42
Northwestbound (Sullivan) Through, Right	0.39	0.39	29.1	29.6	C	C	49	48	94	92
Southeastbound (Sullivan) Left	0.34	0.34	33.4	32.3	C	C	8	8	32	33
Southeastbound (Sullivan) Through, Right	0.30	0.30	26.4	26.5	C	C	22	23	54	56
Overall Intersection			11.4	14.3	B	B				
Midday Peak (12:00 – 1:00)										
Lane Group	V/C Ratio		Total Delay (sec/veh)		LOS		Average Queue (ft)		95th % Queue (ft)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Eastbound Left	0.40	0.06	41.9	49.3	B	B	41	5	91	24
Eastbound Through, Right		0.58	10.0	16.2		B	52	144	102	279
Westbound Left	0.66	0.17	26.3	33.4	B	B	46	49	105	265
Westbound Through, Right		0.79	11.5	27.8		C	52	219	115	448
Northbound (Wexler) Left, Through	0.12	0.19	36.5	36.7	C	C	17	17	44	45
Northbound (Wexler) Right	0.12	0.02	30.0	31.6	B	B	3	3	18	18
Northwestbound (Sullivan) Left	0.26	0.26	27.5	26.6	C	C	51	18	70	48
Northwestbound (Sullivan) Through, Right	0.29	0.29	20.5	20.4	C	C	33	33	70	68
Southeastbound (Sullivan) Left	0.50	0.50	31.9	31.6	C	C	14	14	49	48
Southeastbound (Sullivan) Through, Right	0.25	0.25	21.3	21.5	B	B	27	28	64	64
Overall Intersection			13.9	23.2	B	C				

V/C ratio and LOS determined from HCM calculations, all other metrics averaged from five (5) 1-hour SimTraffic simulations of the peak hour.

Table 2. Comparison of Existing and Proposed Conditions, Center Street and Sullivan Street

PM Peak (3:00 – 4:00)										
Lane Group	V/C Ratio		Total Delay (sec/veh)		LOS		Average Queue (ft)		95th % Queue (ft)	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Eastbound Left	0.44	0.03	71.3	79.3	B	B	53	1	118	7
Eastbound Through, Right		0.65	12.1	21.7		B	73	203	149	394
Westbound Left	0.67	0.10	32.3	54.0	B	B	80	45	166	260
Westbound Through, Right		0.91	14.0	46.3		C	93	372	183	608
Northbound (Wexler) Left, Through	0.22	0.06	66.9	83.1	D	D	16	3	44	16
Northbound (Wexler) Right	0.03	0.20	43.4	41.7	C	D	2	17	14	46
Northwestbound (Sullivan) Left	0.48	0.48	48.8	39.2	D	D	41	40	93	92
Northwestbound (Sullivan) Through, Right	0.48	0.48	31.5	31.2	C	C	76	72	162	154
Southeastbound (Sullivan) Left	0.65	0.65	43.7	43.5	D	D	36	38	95	95
Southeastbound (Sullivan) Through, Right	0.31	0.31	27.5	26.4	C	C	31	31	78	80
Overall Intersection			18.3	35.8	C	C				

V/C ratio and LOS determined from HCM calculations, all other metrics averaged from five (5) 1-hour SimTraffic simulations of the peak hour.