

Addendum #2

Catoctin Creek Towne Center

As of February 18, 2014

Contents:

1. Updated Staff Proffer Recommendations (pg. 27-28 of January 27, 2014 staff report)
– *NOTE: Proffers and recommendations not yet reviewed for legal sufficiency*
2. Traffic Impact Analysis Addendum (to Include Mayfair Development Traffic)

- b. Turn lanes at all site entrances as warranted by the town or VDOT. This includes entrance 1 to the residential site and both entrances to the commercial portion of the site.
 - c. Internal roadways to be privately owned.
- 5. Will construct a 6' wide pedestrian trail around the exterior of the property with a connection to the W&OD Trail.
- 6. Will provide a cash contribution of .10 per square foot of gross floor area to the Town to be distributed to the fire department and the rescue squad; equals approximately \$44,000.
- 7. Establishes the tree preservation area of 4± acres.

Staff recommends that the Proffers be revised to include:

- 1. Please include a statement that all VDOT required transportation improvements will be constructed.
- 2. Include a warrant study for traffic signals at Hirst Rd/Maple St and #1, #2 and #3 entrances to the residential and commercial portions of the site.
- 3. More detail for internal pedestrian pathways prior to site plan approval. System must connect to W&OD Trail.
- 4. A 100 foot ROW dedication for future transportation needs along the North Maple section of the property in case additional turn lanes are required. The ROW would extend from the site entrance on Maple Street across from the High School to the corner of the property at Hirst and Maple
- 5. Provide street and trail lighting at all intersections and areas that pedestrians may be crossing roadways and the W&OD Trail.
- 6. Residential development in the PDH-15 and commercial development in the MC will be constructed concurrently. No more than two residential buildings shall be completed prior to the commercial site obtaining required grading and building permits and grading of the site in the MC area has commenced.
- 7. The applicant will preserve the 4± acre site at the western end of the property as a tree preservation and scenic area. Walking trails will be open to the general public.
- 8. All site improvements will be constructed in accordance with applicable local and state standards.
- 9. A tree inventory per the requirements of the ZO shall be conducted prior to grading.
- 10. Appropriate traffic mitigation shall ensure that the background level of service is maintained or improved.
- 11. The applicant will construct an all-purpose trail around the perimeter of the site that connects to the W&OD Trail.

12. Prior to the approval of any site plan, an internal pedestrian/bicycle network shall be defined on the site plan.
13. Parking and landscaping requirements shall be constructed in accordance with the ZO.
14. Reduce density to 140 units.
15. Provide a cash contribution of \$_____ to the police department to help offset capital expenditures.
16. Construct a _____ square foot visitor's center by the W&OD Trail. Include bike racks.
17. Add the following uses to the prohibited use list:
 - a. Funeral Homes
 - b. Auto Sales and Service
 - c. Auto Repair
 - d. Auto Used Car Lot
 - e. Auto Truck and Sales
 - f. Motorcycle or Off Road Vehicle Sales and Service
18. The preservation of the 4 acre forest should be done through a conservation easement given to the Town. However, the land must always remain with the 13 acre parcel so that density requirements are met. In order to qualify for 176 units in a PDH-15 there needs to be a minimum of 11.75 acres.
19. The applicant will obtain Earth Craft Multi-family certification for the residential site and buildings.

Staff Comments. Staff recommends that the Planning Commission consider the following issues during their review:

1. Is the application in overall compliance with the Comprehensive Plan? If not, are there conditions that if implemented would bring it into compliance?
2. Does the size and economic impact of the development meet the Plan's objective of increasing the assessable value of commercial lands within the Town?
3. Will it be beneficial to the Town for the developer to provide affordable rental units?
4. There are numerous transportation issues. Do the proposed mitigations and proffers offered by the applicant result in compliance with the Plan?

Staff recommends approval of the rezoning requests with the following conditions:

1. Residential development and commercial development will be constructed concurrently. No more than two residential buildings shall be completed prior to commencement of construction of the commercial site.



February 17, 2014

Mr. Alex Vanegas, CPM
Director of Public Works
221 South Nursery Avenue
Purcellville, Virginia 20132

Re: Catoctin Creek Towne Center
Traffic Impact Analysis Addendum (to Include Mayfair Development Traffic)
Town of Purcellville, Virginia

Dear Mr. Vanegas:

Bowman Consulting Group (BCG) has prepared this addendum to the Catoctin Creek Towne Center Traffic Impact Analysis (TIA) (dated September, 2013) in response to questions that have arisen during the zoning process. Specifically, the addendum addresses the traffic impacts of one additional background development (Mayfair). The Mayfair development was not identified during the scoping process as a background development to be included in the TIA.

Executive Summary

The inclusion of the traffic generated by the Mayfair development (106 single family dwelling units and 151 townhomes) would slightly degrade several of the study intersections on Hirst Road under Background and Total Future traffic conditions. The additional traffic would not change the results of the turn lane warrant analysis at the Catoctin Creek Towne Center site entrances on Hirst Road.

Background

Mayfair is an approved but unbuilt residential project located north of VA Route 7 Bypass, west of Route 611 (Purcellville Road) and north of East Nichols Lane. For purposes of this analysis, it was assumed the project would consist of 106 single family dwelling units and 151 townhomes and would be complete by 2020.

The study intersections along Hirst Road were the only intersections included in this analysis as they would be the intersections most impacted by Mayfair traffic.

All Figures from the TIA mentioned below are included in Attachment A for reference.

Mayfair Trip Generation and Assignment

The trips that would be generated by Mayfair were estimated using the Institute of Transportation Engineers (ITE) *Trip Generation Manual*, 9th edition and are shown in Table A.

Table A also includes the trips that would be generated by the other background developments in 2020.

The trips that would be generated by the Mayfair development were distributed to the local roadway network based on the Residential Traffic Distribution (Figure 10) contained within the Autumn Hill

Development TIA prepared by the Timmons Group. The Mayfair trips shown in Table A were then assigned to the study intersections as shown on Figure A.

2020 Total Background Traffic Forecasts

The Mayfair trips shown on Figure A were then added to Figure 20 from the TIA (Background Future Traffic Forecasts (2020)) to yield the Background Future Traffic Forecasts – With Mayfair (2020) which are shown on Figure B.

Analysis of 2020 Background Peak Hour Traffic Conditions with Mayfair

The analysis of 2020 Background Peak Hour Traffic Conditions with Mayfair was based on the analysis procedures described in Section 2 of the TIA, the Future Lane Use and Traffic Control shown on Figure 7 of the TIA, and the Background Future Traffic Forecasts – With Mayfair (2020) shown on Figure B.

The calculation worksheets are included in Attachment B and the results of the analysis are summarized in Table B and shown graphically on Figure C. For comparative purposes, Table B shows the analysis results with and without the Mayfair development traffic.

As shown in Table B, each of the intersections would operate at similar levels of service with and without the Mayfair development with the following exceptions:

- The westbound through-right movement at the Hirst Road/Hatcher Road (Study Intersection #2) would degrade from a LOS D without Mayfair to a LOS F with Mayfair in the PM peak hour.
- The Hirst Road/Berlin Turnpike intersection (Study Intersection #5) would degrade from an overall LOS D without Mayfair to an overall LOS E with Mayfair in the PM peak hour. The intersection would operate at an overall LOS E in the AM peak hour with or without Mayfair.

2020 Total Future Traffic Forecasts

The Mayfair trips shown on Figure A were then added to Figure 23 from the TIA (Total Future Traffic Forecasts (2020)) to yield the Total Future Traffic Forecasts – With Mayfair (2020) which are shown on Figure D.

Analysis of 2020 Total Future Peak Hour Traffic Conditions with Mayfair

The analysis of 2020 Total Future Peak Hour Traffic Conditions with Mayfair was based on the analysis procedures described in Section 2 of the TIA, the Recommended Future Lane Use and Traffic Control shown on Figure 22 of the TIA, and the Total Future Traffic Forecasts – With Mayfair (2020) shown on Figure D.

The calculation worksheets are included in Attachment C and the results of the analysis are summarized in Table B and shown graphically on Figure E. For comparative purposes, Table B shows the analysis results with and without the Mayfair development traffic.

As shown in Table B, each of the intersections would operate at similar levels of service with and without the Mayfair development with the following exception:

- The northbound left movement at the Hirst Road/Berlin Turnpike Intersection (Study Intersection #5) would degrade from a LOS D without Mayfair to a LOS F with Mayfair in

the AM peak hour. The movement would operate at a LOS F in the PM peak hour with or without Mayfair.

Turn Lane Warrant Analysis

As shown in Table 8 of the TIA, the following turn lanes are warranted at the site entrances on Hirst Road (Study Intersections #3 and #8) in 2020 without Mayfair traffic:

- Hirst Road/Site Entrance #1 (Study Intersection #3)
 - o Eastbound right taper
 - o Westbound left turn lane with 200' of storage
- Hirst Road/Site Entrance #2 (Study Intersection #8)
 - o Eastbound right turn lane with 200' of storage
 - o Westbound left turn lane with 200' of storage

The turn lane warrant analysis for the eastbound right turn at the Hirst Road/Site Entrance #1 (Study Intersection #3) intersection was revised to determine if the inclusion of the Mayfair traffic would change the results of the analysis.

The analysis was completed using the Total Future Traffic Forecasts – With Mayfair (2020) shown on Figure D and Figure 3-26 from Appendix F of the VDOT Road Design manual.

The analysis worksheet is included in Attachment D and indicates that with the inclusion of the Mayfair traffic, an eastbound right turn taper only is still warranted at the intersection.

Conclusions

The inclusion of the traffic generated by the Mayfair development would slightly degrade several of the study intersections on Hirst Road under Background and Total Future traffic conditions. The additional traffic would not change the results of the turn lane warrant analysis at the site entrances on Hirst Road.

If you have any questions about the information contained herein, please do not hesitate to contact me at 804.616.3240.

Sincerely,
BOWMAN CONSULTING GROUP, LTD.



Erich W. Strohhacker, PE, PTOE
Transportation Team Leader

Attachment A

Figures from Catoctin Creek Towne Center TIA
and Autumn Hill Development TIA

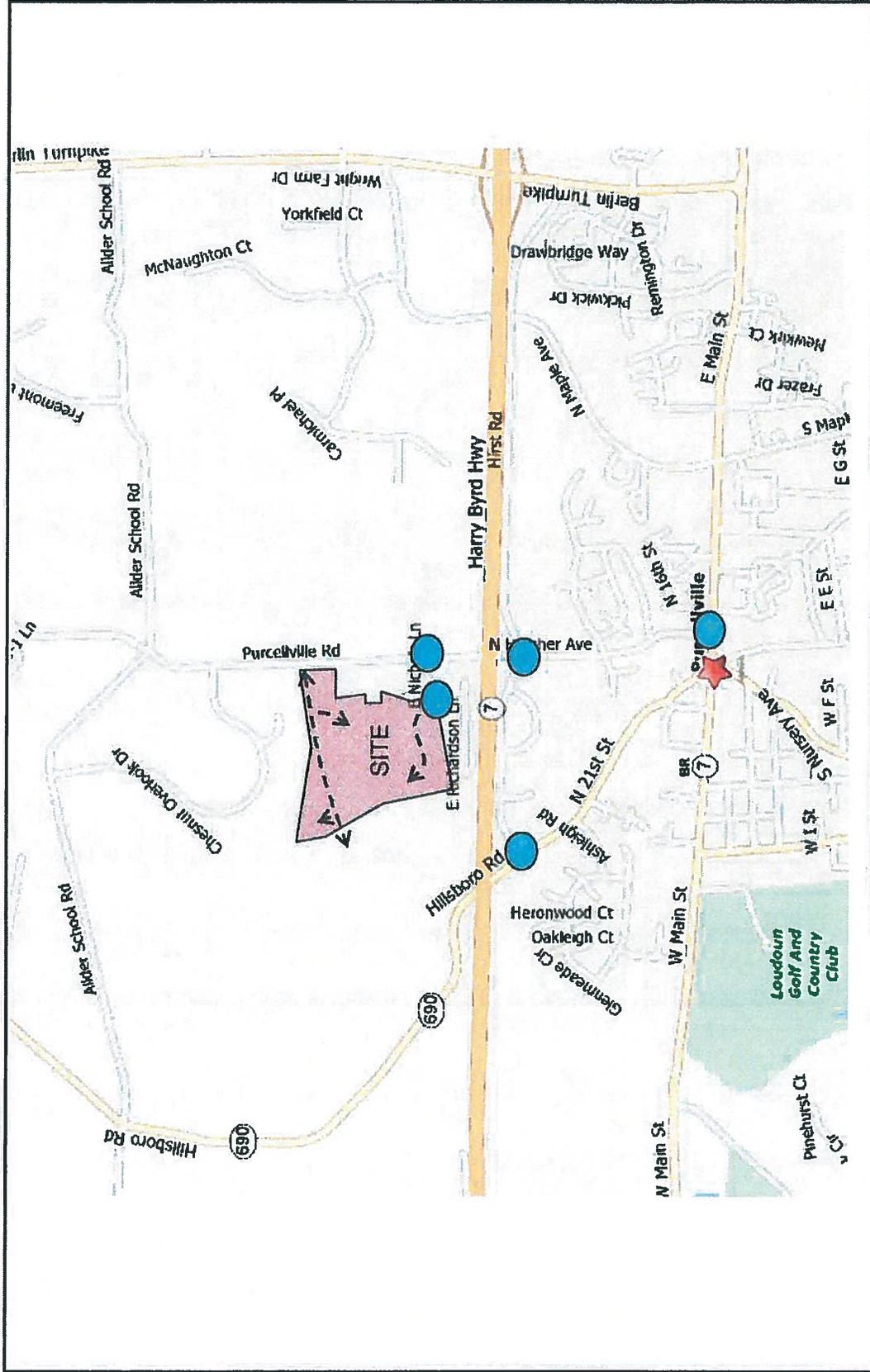
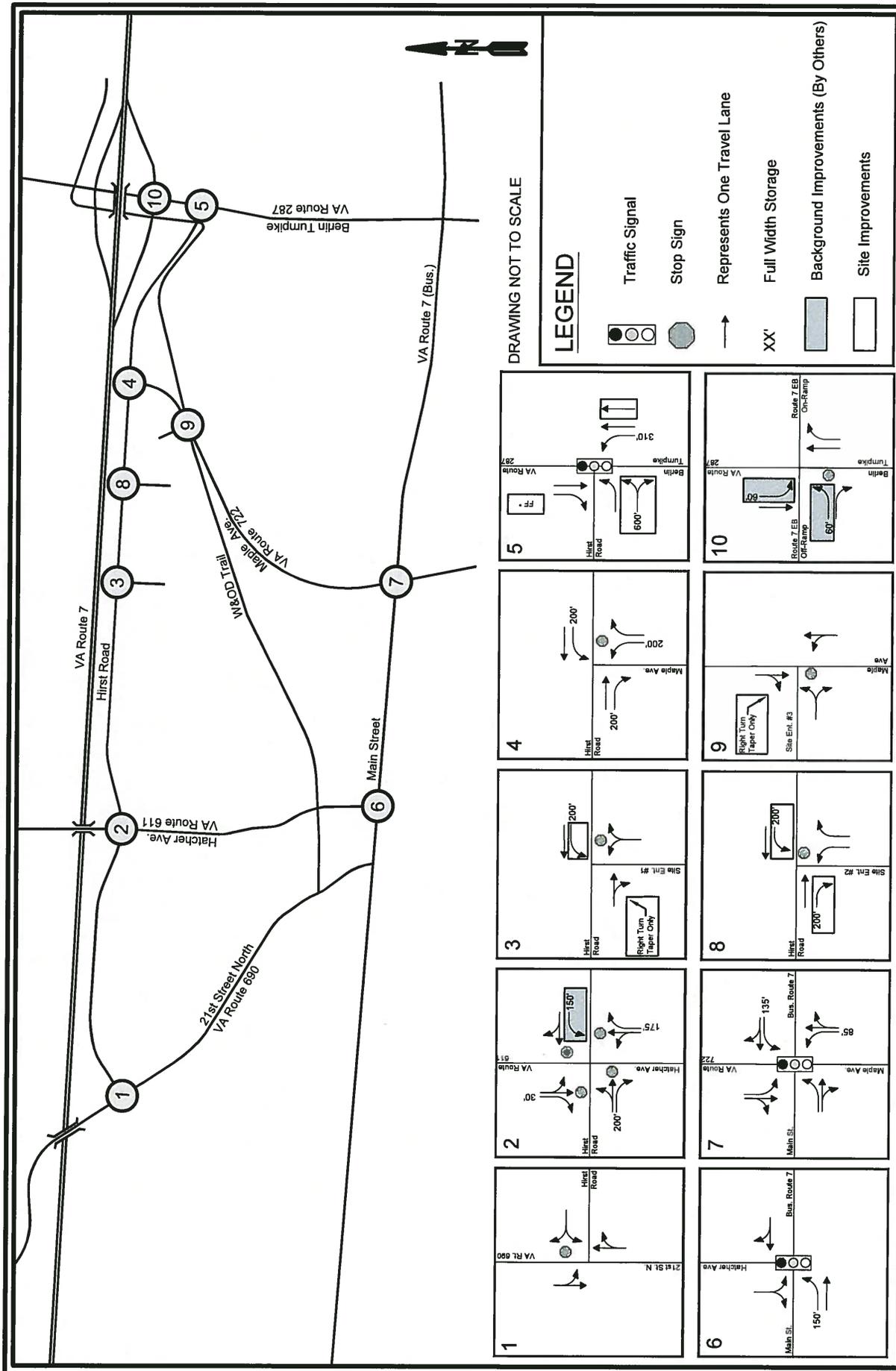


Figure 12

Autumn Hill Development
Proposed Study Intersections
Loudoun County, Virginia



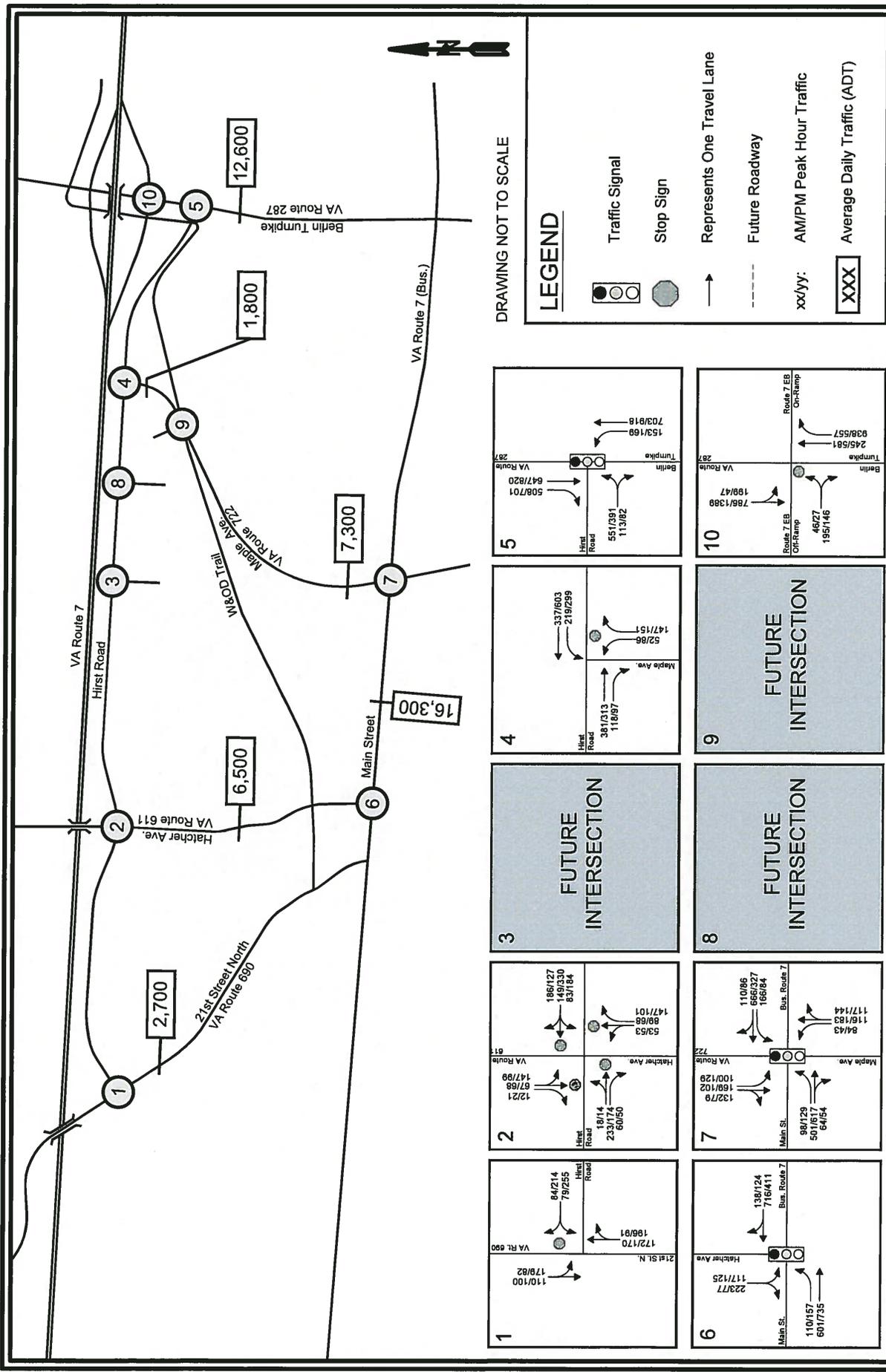
TIMMONS GROUP
YOUR VISION. ACHIEVED THROUGH OURS.



Background Future Traffic Forecasts (2020)

Catoctin Creek Towne Center
Purcellville, Virginia

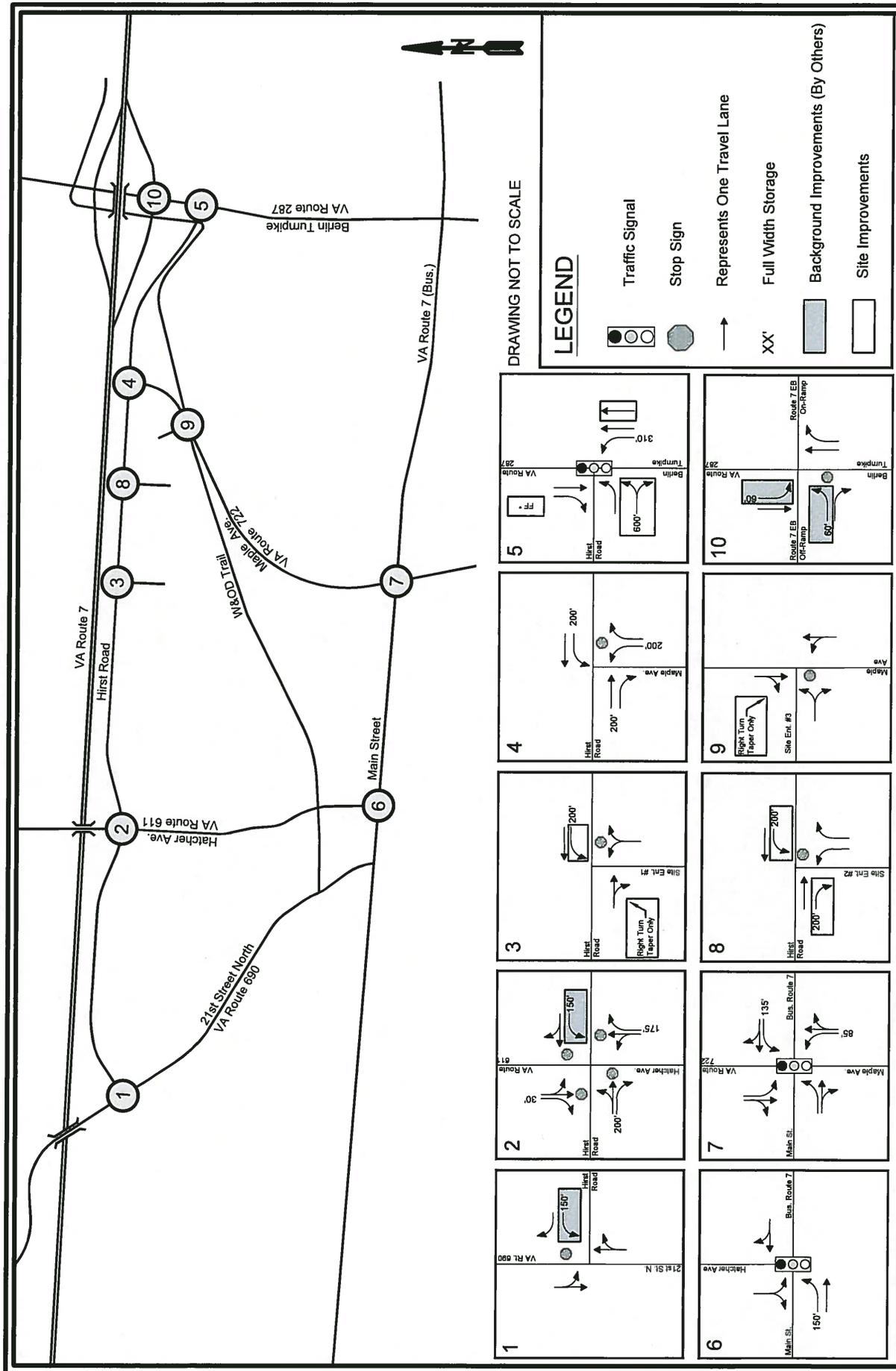
Figure 20
Job # 5384-01-001



Recommended Lane Use and Traffic Control (2020)
 Catotcin Creek Towne Center
 Purcellville, Virginia

Figure 22

Job # 5384-01-001



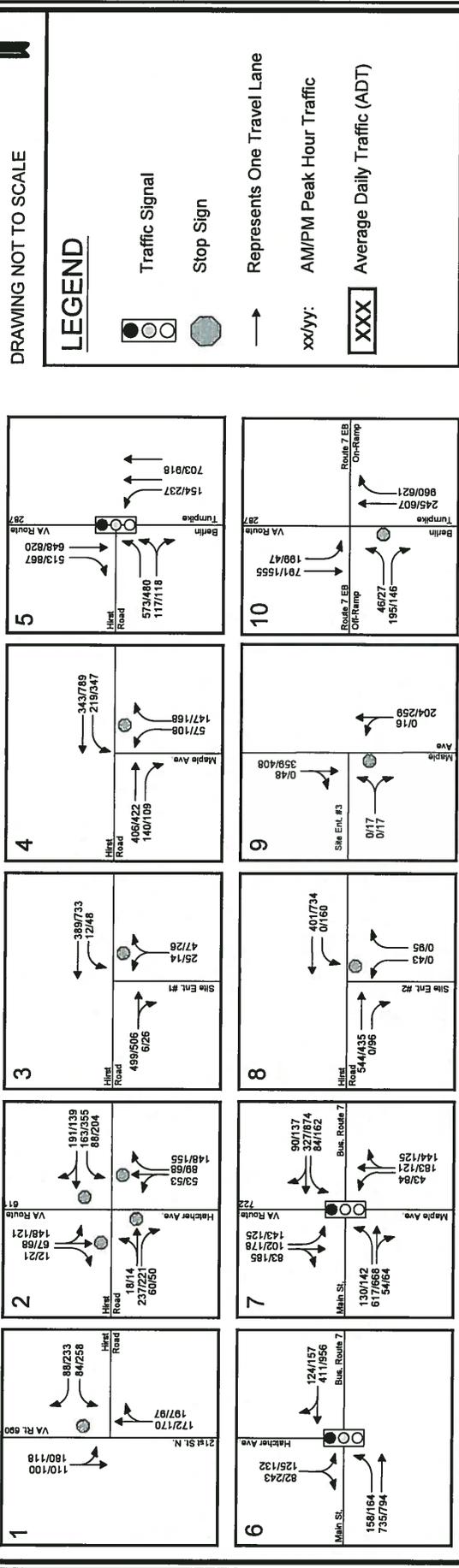
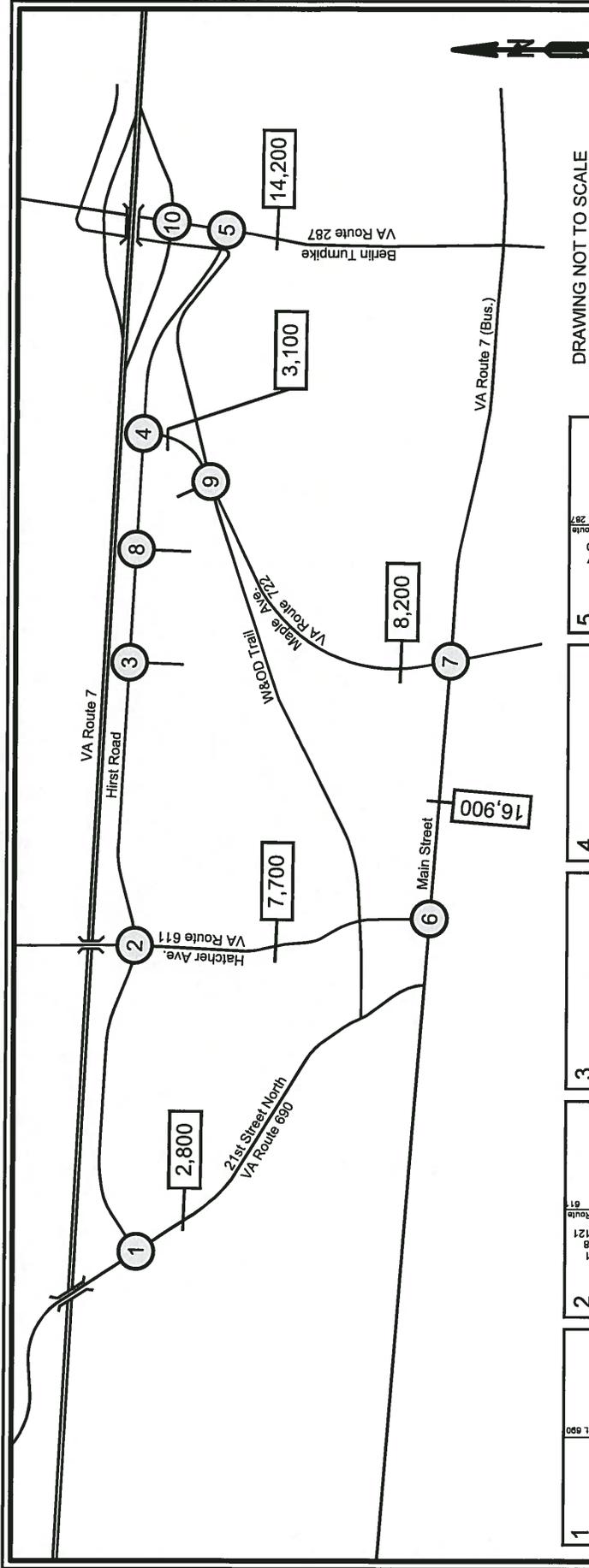


Figure 23

Total Future Traffic Forecasts (2020)
 Catotcin Creek Towne Center
 Purcellville, Virginia

Job # 5384-01-001

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Attachment B

Background (2020) Peak Hour Analysis Worksheets – With Mayfair

HCM Unsignalized Intersection Capacity Analysis
 1: Route 690 N/Route 690 N. & Hirst Road

Catoctin Creek Towne Center
 2/5/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↙		↑			↘
Volume (veh/h)	91	84	172	199	179	110
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	99	91	187	216	195	120
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	804	295			403	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	804	295			403	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	66	88			83	
cM capacity (veh/h)	293	744			1155	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	190	403	314
Volume Left	99	0	195
Volume Right	91	216	0
cSH	413	1700	1155
Volume to Capacity	0.46	0.24	0.17
Queue Length 95th (ft)	59	0	15
Control Delay (s)	20.9	0.0	6.0
Lane LOS	C		A
Approach Delay (s)	20.9	0.0	6.0
Approach LOS	C		

Intersection Summary			
Average Delay		6.5	
Intersection Capacity Utilization		57.1%	ICU Level of Service B
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis
 1: Route 690 N/Route 690 N. & Hirst Road

Catoctin Creek Towne Center
 2/5/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↙	↗	↕	↘	↖	↗
Volume (veh/h)	91	84	172	199	179	110
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	99	91	187	216	195	120
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	804	295			403	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	804	295			403	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	66	88			83	
cM capacity (veh/h)	293	744			1155	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	99	91	403	314
Volume Left	99	0	0	195
Volume Right	0	91	216	0
cSH	293	744	1700	1155
Volume to Capacity	0.34	0.12	0.24	0.17
Queue Length 95th (ft)	36	10	0	15
Control Delay (s)	23.4	10.5	0.0	6.0
Lane LOS	C	B		A
Approach Delay (s)	17.2		0.0	6.0
Approach LOS	C			

Intersection Summary			
Average Delay		5.7	
Intersection Capacity Utilization		52.0%	ICU Level of Service A
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis
 1: Route 690 N/Route 690 N. & Hirst Road

Catoctin Creek Towne Center
 2/5/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↙		↕	↘	↙	↘
Volume (veh/h)	262	214	170	104	82	100
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	285	233	185	113	89	109
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	528	241			298	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	528	241			298	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	40	71			93	
cM capacity (veh/h)	475	798			1263	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	517	298	198
Volume Left	285	0	89
Volume Right	233	113	0
cSH	580	1700	1263
Volume to Capacity	0.89	0.18	0.07
Queue Length 95th (ft)	264	0	6
Control Delay (s)	42.4	0.0	4.0
Lane LOS	E		A
Approach Delay (s)	42.4	0.0	4.0
Approach LOS	E		

Intersection Summary			
Average Delay		22.4	
Intersection Capacity Utilization		62.7%	ICU Level of Service B
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis
 1: Route 690 N/Route 690 N. & Hirst Road

Catoctin Creek Towne Center
 2/5/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	262	214	170	104	82	100
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	285	233	185	113	89	109
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	528	241			298	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	528	241			298	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	40	71			93	
cM capacity (veh/h)	475	798			1263	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	285	233	298	198
Volume Left	285	0	0	89
Volume Right	0	233	113	0
cSH	475	798	1700	1263
Volume to Capacity	0.60	0.29	0.18	0.07
Queue Length 95th (ft)	97	30	0	6
Control Delay (s)	23.3	11.4	0.0	4.0
Lane LOS	C	B		A
Approach Delay (s)	17.9		0.0	4.0
Approach LOS	C			

Intersection Summary			
Average Delay		9.9	
Intersection Capacity Utilization		49.6%	ICU Level of Service A
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis
 2: Hatcher Avenue & Hirst Road

Catoclin Creek Towne Center
 2/5/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↔		↔			↔	↔		↔	↔
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	21	233	60	83	149	209	53	94	147	233	85	24
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	253	65	90	162	227	58	102	160	253	92	26

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	276	65	479	160	160	346	26
Volume Left (vph)	23	0	90	58	0	253	0
Volume Right (vph)	0	65	227	0	160	0	26
Hadj (s)	0.08	-0.67	-0.21	0.21	-0.67	0.40	-0.67
Departure Headway (s)	8.4	7.7	7.7	8.8	7.9	8.6	7.5
Degree Utilization, x	0.65	0.14	1.0	0.39	0.35	0.82	0.05
Capacity (veh/h)	410	452	458	388	438	407	465
Control Delay (s)	24.3	10.7	78.1	16.1	14.0	39.8	9.8
Approach Delay (s)	21.7		78.1	15.0		37.7	
Approach LOS	C		F	C		E	

Intersection Summary	
Delay	42.1
Level of Service	E
Intersection Capacity Utilization	72.7% ICU Level of Service C
Analysis Period (min)	15

Queuing and Blocking Report
 Background AM Peak Hour - 2020 (with Mayfair)

Catoctin Creek Towne Center
 2/5/2014

Intersection: 2: Hatcher Avenue & Hirst Road

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	LT	R	LT	R
Maximum Queue (ft)	134	51	281	96	108	269	55
Average Queue (ft)	70	24	136	53	47	112	29
95th Queue (ft)	110	45	246	86	83	208	71
Link Distance (ft)	2673		4481	2619		3915	
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		200		175			30
Storage Blk Time (%)						57	2
Queuing Penalty (veh)						14	7

HCM Unsignalized Intersection Capacity Analysis
 2: Hatcher Avenue & Hirst Road

Catoctin Creek Towne Center
 2/5/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	21	233	60	83	149	209	53	94	147	233	85	24
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	253	65	90	162	227	58	102	160	253	92	26
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2				
Volume Total (vph)	276	65	90	389	160	160	346	26				
Volume Left (vph)	23	0	90	0	58	0	253	0				
Volume Right (vph)	0	65	0	227	0	160	0	26				
Hadj (s)	0.08	-0.67	0.53	-0.37	0.21	-0.67	0.40	-0.67				
Departure Headway (s)	7.9	7.2	8.1	7.2	8.2	7.3	8.1	7.1				
Degree Utilization, x	0.61	0.13	0.20	0.78	0.36	0.33	0.78	0.05				
Capacity (veh/h)	427	473	425	484	406	459	425	485				
Control Delay (s)	21.2	10.0	12.0	30.2	14.6	12.6	33.2	9.2				
Approach Delay (s)	19.1		26.8		13.6		31.5					
Approach LOS	C		D		B		D					
Intersection Summary												
Delay			23.4									
Level of Service			C									
Intersection Capacity Utilization			68.1%		ICU Level of Service				C			
Analysis Period (min)			15									

Queuing and Blocking Report
 Background AM Peak Hour - 2020 (Improved) With Mayfair

Catoctin Creek Towne Center
 2/5/2014

Intersection: 2: Hatcher Avenue & Hirst Road

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	L	TR	LT	R	LT	R
Maximum Queue (ft)	139	51	50	154	113	90	314	55
Average Queue (ft)	71	24	24	90	53	44	109	30
95th Queue (ft)	113	46	50	144	79	76	217	72
Link Distance (ft)	2672			4482	2612		3909	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)		200	150			175		30
Storage Blk Time (%)				0			58	2
Queuing Penalty (veh)				0			14	7

HCM Unsignalized Intersection Capacity Analysis
 2: Hatcher Avenue & Hirst Road

Catoctin Creek Towne Center
 2/5/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↔	↗		↔			↔	↗		↔	↗
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	27	174	50	184	330	215	53	87	101	147	78	28
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	29	189	54	200	359	234	58	95	110	160	85	30

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	218	54	792	152	110	245	30
Volume Left (vph)	29	0	200	58	0	160	0
Volume Right (vph)	0	54	234	0	110	0	30
Hadj (s)	0.10	-0.67	-0.09	0.22	-0.67	0.36	-0.67
Departure Headway (s)	7.6	6.8	6.8	8.1	7.2	8.1	7.0
Degree Utilization, x	0.46	0.10	1.0	0.34	0.22	0.55	0.06
Capacity (veh/h)	456	502	530	431	481	434	492
Control Delay (s)	15.8	9.4	256.7	14.0	11.0	19.2	9.3
Approach Delay (s)	14.5		256.7	12.7		18.1	
Approach LOS	B		F	B		C	

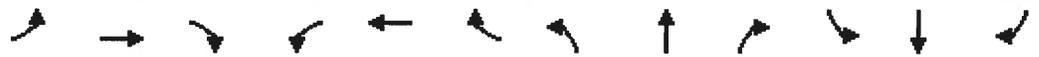
Intersection Summary	
Delay	134.6
Level of Service	F
Intersection Capacity Utilization	80.2%
ICU Level of Service	D
Analysis Period (min)	15

Intersection: 2: Hatcher Avenue & Hirst Road

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	LT	R	LT	R
Maximum Queue (ft)	135	63	786	99	69	99	55
Average Queue (ft)	63	24	488	48	30	63	32
95th Queue (ft)	104	49	719	75	53	95	69
Link Distance (ft)	2673		4481	2619		3915	
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		200		175			30
Storage Blk Time (%)						34	3
Queuing Penalty (veh)						9	8

HCM Unsignalized Intersection Capacity Analysis
 2: Hatcher Avenue & Hirst Road

Catoclin Creek Towne Center
 2/5/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗	↘	↖			↕	↗		↖	↘
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	27	174	50	184	330	215	53	87	101	147	78	28
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	29	189	54	200	359	234	58	95	110	160	85	30

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	218	54	200	592	152	110	245	30
Volume Left (vph)	29	0	200	0	58	0	160	0
Volume Right (vph)	0	54	0	234	0	110	0	30
Hadj (s)	0.10	-0.67	0.53	-0.24	0.22	-0.67	0.36	-0.67
Departure Headway (s)	7.7	6.9	7.4	6.7	8.1	7.2	8.1	7.1
Degree Utilization, x	0.47	0.10	0.41	1.0	0.34	0.22	0.55	0.06
Capacity (veh/h)	454	498	474	550	434	483	434	489
Control Delay (s)	16.0	9.5	14.4	91.6	14.0	11.0	19.4	9.4
Approach Delay (s)	14.7		72.1		12.7		18.2	
Approach LOS	B		F		B		C	

Intersection Summary	
Delay	43.4
Level of Service	E
Intersection Capacity Utilization	70.0% ICU Level of Service C
Analysis Period (min)	15

Intersection: 2: Hatcher Avenue & Hirst Road

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	L	TR	LT	R	LT	R
Maximum Queue (ft)	116	63	175	256	97	68	115	55
Average Queue (ft)	62	24	71	114	51	28	62	34
95th Queue (ft)	108	48	155	203	79	47	98	69
Link Distance (ft)	2672		4482		2612		3909	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	200		150		175		30	
Storage Blk Time (%)			0		4		32	
Queuing Penalty (veh)			0		8		9	

HCM Unsignalized Intersection Capacity Analysis
4: Maple Avenue & Hirst Road

Catoctin Creek Towne Center
2/5/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↖	↑	↖	↗
Volume (veh/h)	467	118	219	360	52	147
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	508	128	238	391	57	160
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			636		1375	508
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			636		1375	508
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			75		53	72
cM capacity (veh/h)			948		120	565
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	508	128	238	391	57	160
Volume Left	0	0	238	0	57	0
Volume Right	0	128	0	0	0	160
cSH	1700	1700	948	1700	120	565
Volume to Capacity	0.30	0.08	0.25	0.23	0.47	0.28
Queue Length 95th (ft)	0	0	25	0	53	29
Control Delay (s)	0.0	0.0	10.1	0.0	59.3	13.9
Lane LOS			B		F	B
Approach Delay (s)	0.0		3.8		25.7	
Approach LOS					D	
Intersection Summary						
Average Delay			5.4			
Intersection Capacity Utilization			50.0%		ICU Level of Service A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
4: Maple Avenue & Hirst Road

Catocin Creek Towne Center
2/5/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↖	↑	↖	↗
Volume (veh/h)	361	97	299	691	86	151
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	392	105	325	751	93	164
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			498		1793	392
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			498		1793	392
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			70		0	75
cM capacity (veh/h)			1066		62	656
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	392	105	325	751	93	164
Volume Left	0	0	325	0	93	0
Volume Right	0	105	0	0	0	164
cSH	1700	1700	1066	1700	62	656
Volume to Capacity	0.23	0.06	0.30	0.44	1.52	0.25
Queue Length 95th (ft)	0	0	32	0	206	25
Control Delay (s)	0.0	0.0	9.9	0.0	411.4	12.3
Lane LOS			A			B
Approach Delay (s)	0.0		3.0	157.1		
Approach LOS				F		
Intersection Summary						
Average Delay			23.8			
Intersection Capacity Utilization			50.3%	ICU Level of Service		A
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis
5: Route 287 & Hirst Road

Catoclin Creek Towne Center
2/5/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	637	113	153	703	648	531
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0		7.5	6.5	6.5	6.5
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1750		1770	1863	1863	1583
Flt Permitted	0.96		0.09	1.00	1.00	1.00
Satd. Flow (perm)	1750		173	1863	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	692	123	166	764	704	577
RTOR Reduction (vph)	6	0	0	0	0	372
Lane Group Flow (vph)	809	0	166	764	704	205
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases			2			6
Actuated Green, G (s)	38.0		48.5	48.5	35.5	35.5
Effective Green, g (s)	38.0		48.5	48.5	35.5	35.5
Actuated g/C Ratio	0.38		0.48	0.48	0.36	0.36
Clearance Time (s)	7.0		7.5	6.5	6.5	6.5
Vehicle Extension (s)	3.5		2.5	3.5	3.5	3.5
Lane Grp Cap (vph)	665		171	903	661	561
v/s Ratio Prot	c0.46		0.05	c0.41	c0.38	
v/s Ratio Perm			0.41			0.13
v/c Ratio	1.22		0.97	0.85	1.07	0.37
Uniform Delay, d1	31.0		23.0	22.5	32.2	23.9
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	110.7		59.9	9.6	53.6	1.8
Delay (s)	141.7		82.9	32.1	85.9	25.7
Level of Service	F		F	C	F	C
Approach Delay (s)	141.7			41.2	58.8	
Approach LOS	F			D	E	

Intersection Summary			
HCM 2000 Control Delay	75.7	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.18		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	102.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
5: Route 287 & Hirst Road



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	815	166	764	704	577
v/c Ratio	1.21	0.98	0.85	1.07	0.62
Control Delay	139.5	85.4	33.2	86.3	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	139.5	85.4	33.2	86.3	5.3
Queue Length 50th (ft)	~639	59	410	~498	0
Queue Length 95th (ft)	#873	#191	#642	#718	74
Internal Link Dist (ft)	1865		1079	425	
Turn Bay Length (ft)		310			400
Base Capacity (vph)	671	170	903	661	934
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.21	0.98	0.85	1.07	0.62

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
5: Route 287 & Hirst Road

Catoctin Creek Towne Center
2/5/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↙		↘	↑	↑	↗
Volume (vph)	439	82	169	918	820	789
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0		7.5	6.5	6.5	6.5
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1749		1770	1863	1863	1583
Flt Permitted	0.96		0.05	1.00	1.00	1.00
Satd. Flow (perm)	1749		93	1863	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	477	89	184	998	891	858
RTOR Reduction (vph)	4	0	0	0	0	393
Lane Group Flow (vph)	562	0	184	998	891	465
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases			2			6
Actuated Green, G (s)	45.0		91.5	91.5	72.5	72.5
Effective Green, g (s)	45.0		91.5	91.5	72.5	72.5
Actuated g/C Ratio	0.30		0.61	0.61	0.48	0.48
Clearance Time (s)	7.0		7.5	6.5	6.5	6.5
Vehicle Extension (s)	3.5		2.5	3.5	3.5	3.5
Lane Grp Cap (vph)	524		185	1136	900	765
v/s Ratio Prot	c0.32		0.08	c0.54	0.48	
v/s Ratio Perm			c0.53			0.29
v/c Ratio	1.07		0.99	0.88	0.99	0.61
Uniform Delay, d1	52.5		51.3	24.6	38.4	28.4
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	60.1		64.3	9.7	27.7	3.6
Delay (s)	112.6		115.6	34.3	66.1	31.9
Level of Service	F		F	C	E	C
Approach Delay (s)	112.6			47.0	49.3	
Approach LOS	F			D	D	

Intersection Summary

HCM 2000 Control Delay	58.8	HCM 2000 Level of Service	E
HCM 2000 Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	99.3%	ICU Level of Service	F
Analysis Period (min)	15		

c Critical Lane Group

Queues
5: Route 287 & Hirst Road



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	566	184	998	891	858
v/c Ratio	1.07	1.00	0.88	0.99	0.74
Control Delay	107.7	106.1	35.2	65.9	8.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	107.7	106.1	35.2	65.9	8.0
Queue Length 50th (ft)	~608	132	784	848	52
Queue Length 95th (ft)	#846	#299	1043	#1154	212
Internal Link Dist (ft)	1865		1079	422	
Turn Bay Length (ft)		310			400
Base Capacity (vph)	529	184	1136	900	1157
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.07	1.00	0.88	0.99	0.74

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Attachment C

Total Future (2020) Peak Hour Analysis Workseets – With Mayfair

HCM Unsignalized Intersection Capacity Analysis
 1: Route 690 N/Route 690 N. & Hirst Road

Catoctin Creek Towne Center
 2/5/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	Y		↑			↓
Volume (veh/h)	96	88	172	200	180	110
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	104	96	187	217	196	120
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	807	296			404	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	807	296			404	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	64	87			83	
cM capacity (veh/h)	292	744			1154	

Direction, Lane #	WB 1	NB 1	SB 1
Volume Total	200	404	315
Volume Left	104	0	196
Volume Right	96	217	0
cSH	411	1700	1154
Volume to Capacity	0.49	0.24	0.17
Queue Length 95th (ft)	65	0	15
Control Delay (s)	21.8	0.0	6.0
Lane LOS	C		A
Approach Delay (s)	21.8	0.0	6.0
Approach LOS	C		

Intersection Summary			
Average Delay		6.8	
Intersection Capacity Utilization		57.8%	ICU Level of Service B
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis
 1: Route 690 N/Route 690 N. & Hirst Road

Catoctin Creek Towne Center
 2/5/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↶	↷	↷			↶
Volume (veh/h)	96	88	172	200	180	110
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	104	96	187	217	196	120
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	807	296			404	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	807	296			404	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	64	87			83	
cM capacity (veh/h)	292	744			1154	

Direction, Lane #	WB 1	WB 2	NB 1	SB 1
Volume Total	104	96	404	315
Volume Left	104	0	0	196
Volume Right	0	96	217	0
cSH	292	744	1700	1154
Volume to Capacity	0.36	0.13	0.24	0.17
Queue Length 95th (ft)	39	11	0	15
Control Delay (s)	24.1	10.6	0.0	6.0
Lane LOS	C	B		A
Approach Delay (s)	17.6		0.0	6.0
Approach LOS	C			

Intersection Summary			
Average Delay		5.9	
Intersection Capacity Utilization		52.4%	ICU Level of Service A
Analysis Period (min)		15	

HCM Unsignalized Intersection Capacity Analysis
 1: Route 690 N/Route 690 N. & Hirst Road

Catoctin Towne Center
 2/5/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations	↙		↑		↘	
Volume (veh/h)	265	233	170	110	118	100
Sign Control	Stop		Free		Free	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	288	253	185	120	128	109
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None		None	
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	610	245			304	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	610	245			304	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	30	68			90	
cM capacity (veh/h)	411	794			1256	
Direction, Lane #	WB 1	NB 1	SB 1			
Volume Total	541	304	237			
Volume Left	288	0	128			
Volume Right	253	120	0			
cSH	531	1700	1256			
Volume to Capacity	1.02	0.18	0.10			
Queue Length 95th (ft)	373	0	9			
Control Delay (s)	72.1	0.0	4.8			
Lane LOS	F		A			
Approach Delay (s)	72.1	0.0	4.8			
Approach LOS	F					
Intersection Summary						
Average Delay			37.1			
Intersection Capacity Utilization			66.4%	ICU Level of Service	C	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 1: Route 690 N/Route 690 N. & Hirst Road

Catoctin Towne Center
 2/5/2014



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Volume (veh/h)	265	233	170	110	118	100
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	288	253	185	120	128	109
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type			None			None
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	610	245			304	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	610	245			304	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	30	68			90	
cM capacity (veh/h)	411	794			1256	
Direction, Lane #	WB 1	WB 2	NB 1	SB 1		
Volume Total	288	253	304	237		
Volume Left	288	0	0	128		
Volume Right	0	253	120	0		
cSH	411	794	1700	1256		
Volume to Capacity	0.70	0.32	0.18	0.10		
Queue Length 95th (ft)	131	34	0	9		
Control Delay (s)	31.8	11.6	0.0	4.8		
Lane LOS	D	B		A		
Approach Delay (s)	22.4		0.0	4.8		
Approach LOS	C					
Intersection Summary						
Average Delay			12.3			
Intersection Capacity Utilization			52.1%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 2: Hatcher Avenue & Hirst Road

Catoctin Creek Towne Center
 2/5/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↖	↗		↕			↖	↗		↖	↗
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	21	237	60	88	163	214	53	94	148	234	85	24
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	258	65	96	177	233	58	102	161	254	92	26

Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	280	65	505	160	161	347	26
Volume Left (vph)	23	0	96	58	0	254	0
Volume Right (vph)	0	65	233	0	161	0	26
Hadj (s)	0.07	-0.67	-0.20	0.21	-0.67	0.40	-0.67
Departure Headway (s)	8.4	7.7	7.8	8.8	7.9	8.6	7.6
Degree Utilization, x	0.66	0.14	1.0	0.39	0.35	0.83	0.05
Capacity (veh/h)	410	452	457	388	438	407	465
Control Delay (s)	24.9	10.7	95.7	16.1	14.0	40.3	9.8
Approach Delay (s)	22.2		95.7	15.1		38.2	
Approach LOS	C		F	C		E	

Intersection Summary	
Delay	48.6
Level of Service	E
Intersection Capacity Utilization	74.3% ICU Level of Service D
Analysis Period (min)	15

Intersection: 2: Hatcher Avenue & Hirst Road

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	LT	R	LT	R
Maximum Queue (ft)	120	50	176	96	90	240	55
Average Queue (ft)	62	22	112	44	41	118	24
95th Queue (ft)	103	41	178	73	70	208	66
Link Distance (ft)	2673		2817	2619		3915	
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		200		175			30
Storage Blk Time (%)						59	2
Queuing Penalty (veh)						14	7

HCM Unsignalized Intersection Capacity Analysis
 2: Hatcher Avenue & Hirst Road

Catoclin Creek Towne Center
 2/5/2014



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕	↗	↘	↕			↕	↗		↕	↗
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	21	237	60	88	163	214	53	94	148	234	85	24
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	23	258	65	96	177	233	58	102	161	254	92	26

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2
Volume Total (vph)	280	65	96	410	160	161	347	26
Volume Left (vph)	23	0	96	0	58	0	254	0
Volume Right (vph)	0	65	0	233	0	161	0	26
Hadj (s)	0.07	-0.67	0.53	-0.36	0.21	-0.67	0.40	-0.67
Departure Headway (s)	8.0	7.3	8.2	7.3	8.3	7.5	8.2	7.2
Degree Utilization, x	0.62	0.13	0.22	0.83	0.37	0.33	0.79	0.05
Capacity (veh/h)	423	468	423	482	400	452	420	478
Control Delay (s)	22.2	10.2	12.3	35.6	14.9	12.9	34.9	9.4
Approach Delay (s)	19.9		31.2		13.9		33.1	
Approach LOS	C		D		B		D	

Intersection Summary

Delay	25.6
Level of Service	D
Intersection Capacity Utilization	69.4%
ICU Level of Service	C
Analysis Period (min)	15

Intersection: 2: Hatcher Avenue & Hirst Road

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	L	TR	LT	R	LT	R
Maximum Queue (ft)	158	50	174	207	107	73	192	55
Average Queue (ft)	73	26	37	84	48	41	101	39
95th Queue (ft)	125	42	88	144	82	71	162	73
Link Distance (ft)	2672		2819		2612		3909	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)	200		150		175		30	
Storage Blk Time (%)					1		54	
Queuing Penalty (veh)					1		13	

HCM Unsignalized Intersection Capacity Analysis
2: Hatcher Avenue & Hirst Road

Catoctin Towne Center
2/5/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	27	221	50	204	355	227	53	87	155	169	78	28
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	29	240	54	222	386	247	58	95	168	184	85	30
Direction, Lane #	EB 1	EB 2	WB 1	NB 1	NB 2	SB 1	SB 2					
Volume Total (vph)	270	54	854	152	168	268	30					
Volume Left (vph)	29	0	222	58	0	184	0					
Volume Right (vph)	0	54	247	0	168	0	30					
Hadj (s)	0.09	-0.67	-0.09	0.22	-0.67	0.38	-0.67					
Departure Headway (s)	8.0	7.2	7.4	8.4	7.5	8.4	7.4					
Degree Utilization, x	0.60	0.11	1.0	0.35	0.35	0.63	0.06					
Capacity (veh/h)	438	479	491	416	462	417	469					
Control Delay (s)	20.9	9.9	363.4	14.7	13.3	23.5	9.7					
Approach Delay (s)	19.1		363.4	14.0		22.1						
Approach LOS	C		F	B		C						
Intersection Summary												
Delay			182.3									
Level of Service			F									
Intersection Capacity Utilization			87.1%	ICU Level of Service								E
Analysis Period (min)			15									

Intersection: 2: Hatcher Avenue & Hirst Road

Movement	EB	EB	WB	NB	NB	SB	SB
Directions Served	LT	R	LTR	LT	R	LT	R
Maximum Queue (ft)	94	47	876	90	97	142	55
Average Queue (ft)	60	25	619	34	40	83	35
95th Queue (ft)	92	43	897	58	61	130	70
Link Distance (ft)	2673		2817	2619		3915	
Upstream Blk Time (%)							
Queuing Penalty (veh)							
Storage Bay Dist (ft)		200		175			30
Storage Blk Time (%)						48	4
Queuing Penalty (veh)						13	9

HCM Unsignalized Intersection Capacity Analysis
 2: Hatcher Avenue & Hirst Road

Catoctin Towne Center
 2/5/2014

												
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Sign Control		Stop			Stop			Stop			Stop	
Volume (vph)	27	221	50	204	355	227	53	87	155	169	78	28
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	29	240	54	222	386	247	58	95	168	184	85	30
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2	SB 1	SB 2				
Volume Total (vph)	270	54	222	633	152	168	268	30				
Volume Left (vph)	29	0	222	0	58	0	184	0				
Volume Right (vph)	0	54	0	247	0	168	0	30				
Hadj (s)	0.09	-0.67	0.53	-0.24	0.22	-0.67	0.38	-0.67				
Departure Headway (s)	8.0	7.3	7.9	7.1	8.3	7.5	8.4	7.4				
Degree Utilization, x	0.60	0.11	0.49	1.0	0.35	0.35	0.63	0.06				
Capacity (veh/h)	438	476	448	513	420	466	418	468				
Control Delay (s)	21.2	10.0	17.0	150.9	14.6	13.3	23.4	9.7				
Approach Delay (s)	19.3		116.2		13.9		22.0					
Approach LOS	C		F		B		C					
Intersection Summary												
Delay			64.8									
Level of Service			F									
Intersection Capacity Utilization			75.8%		ICU Level of Service				D			
Analysis Period (min)			15									

Intersection: 2: Hatcher Avenue & Hirst Road

Movement	EB	EB	WB	WB	NB	NB	SB	SB
Directions Served	LT	R	L	TR	LT	R	LT	R
Maximum Queue (ft)	197	67	175	316	96	95	143	55
Average Queue (ft)	75	22	100	163	42	43	74	31
95th Queue (ft)	130	48	192	271	75	69	122	68
Link Distance (ft)	2672			2819	2612		3909	
Upstream Blk Time (%)								
Queuing Penalty (veh)								
Storage Bay Dist (ft)		200	150			175		30
Storage Blk Time (%)	0		0	15			46	4
Queuing Penalty (veh)	0		0	30			13	9

HCM Unsignalized Intersection Capacity Analysis
 3: Site Ent. #1 & Hirst Road

Catoctin Creek Towne Center
 2/5/2014

	→	↘	↙	←	↖	↗
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↕		↖	↗	↘	↙
Volume (veh/h)	585	6	12	412	25	47
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	636	7	13	448	27	51
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			642		1113	639
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			642		1113	639
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			99		88	89
cM capacity (veh/h)			942		227	476
Direction, Lane #	EB 1	WB 1	WB 2	NB 1		
Volume Total	642	13	448	78		
Volume Left	0	13	0	27		
Volume Right	7	0	0	51		
cSH	1700	942	1700	345		
Volume to Capacity	0.38	0.01	0.26	0.23		
Queue Length 95th (ft)	0	1	0	21		
Control Delay (s)	0.0	8.9	0.0	18.5		
Lane LOS		A		C		
Approach Delay (s)	0.0	0.3		18.5		
Approach LOS				C		
Intersection Summary						
Average Delay			1.3			
Intersection Capacity Utilization			42.1%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 3: Site Ent. #1 & Hirst Road

Catoctin Towne Center
 2/5/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	→		←	→	←	→
Volume (veh/h)	554	26	48	821	14	26
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	602	28	52	892	15	28
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			630		1613	616
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			630		1613	616
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			95		86	94
cM capacity (veh/h)			952		108	490
Direction, Lane #	EB 1	WB 1	WB 2	NB 1		
Volume Total	630	52	892	43		
Volume Left	0	52	0	15		
Volume Right	28	0	0	28		
cSH	1700	952	1700	219		
Volume to Capacity	0.37	0.05	0.52	0.20		
Queue Length 95th (ft)	0	4	0	18		
Control Delay (s)	0.0	9.0	0.0	25.4		
Lane LOS		A		D		
Approach Delay (s)	0.0	0.5		25.4		
Approach LOS				D		
Intersection Summary						
Average Delay			1.0			
Intersection Capacity Utilization			53.2%	ICU Level of Service	A	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
4: Maple Avenue & Hirst Road

Catoctin Creek Towne Center
2/5/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↖	↑	↖	↗
Volume (veh/h)	492	140	219	366	57	147
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	535	152	238	398	62	160
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage veh						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			687			535
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			687			535
tC, single (s)			4.1			6.2
tC, 2 stage (s)						
tF (s)			2.2			3.3
p0 queue free %			74			71
cM capacity (veh/h)			907			545
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	535	152	238	398	62	160
Volume Left	0	0	238	0	62	0
Volume Right	0	152	0	0	0	160
cSH	1700	1700	907	1700	113	545
Volume to Capacity	0.31	0.09	0.26	0.23	0.55	0.29
Queue Length 95th (ft)	0	0	26	0	65	30
Control Delay (s)	0.0	0.0	10.4	0.0	70.4	14.3
Lane LOS			B			B
Approach Delay (s)	0.0		3.9		30.0	
Approach LOS					D	
Intersection Summary						
Average Delay			5.9			
Intersection Capacity Utilization			51.4%		ICU Level of Service	A
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 4: Maple Avenue & Hirst Road

Catoctin Towne Center
 2/5/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↘	↑	↘	↗
Volume (veh/h)	470	109	347	877	108	168
Sign Control	Free		Free		Stop	
Grade	0%		0%		0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	511	118	377	953	117	183
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None		None			
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			629		2218	511
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			629		2218	511
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			60		0	68
cM capacity (veh/h)			953		29	563
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	511	118	377	953	117	183
Volume Left	0	0	377	0	117	0
Volume Right	0	118	0	0	0	183
cSH	1700	1700	953	1700	29	563
Volume to Capacity	0.30	0.07	0.40	0.56	4.05	0.32
Queue Length 95th (ft)	0	0	48	0	Err	35
Control Delay (s)	0.0	0.0	11.2	0.0	Err	14.4
Lane LOS			B			B
Approach Delay (s)	0.0		3.2		3921.4	
Approach LOS					F	
Intersection Summary						
Average Delay			522.5			
Intersection Capacity Utilization			59.9%		ICU Level of Service	B
Analysis Period (min)			15			

HCM Signalized Intersection Capacity Analysis
5: Route 287 & Hirst Road

Catoctin Creek Towne Center
2/5/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	659	117	154	703	648	536
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0		7.5	6.5	6.5	6.5
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1751		1770	1863	1863	1583
Flt Permitted	0.96		0.11	1.00	1.00	1.00
Satd. Flow (perm)	1751		199	1863	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	716	127	167	764	704	583
RTOR Reduction (vph)	7	0	0	0	0	389
Lane Group Flow (vph)	836	0	167	764	704	194
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases			2			6
Actuated Green, G (s)	34.0		42.5	42.5	30.0	30.0
Effective Green, g (s)	34.0		42.5	42.5	30.0	30.0
Actuated g/C Ratio	0.38		0.47	0.47	0.33	0.33
Clearance Time (s)	7.0		7.5	6.5	6.5	6.5
Vehicle Extension (s)	3.5		2.5	3.5	3.5	3.5
Lane Grp Cap (vph)	661		181	879	621	527
v/s Ratio Prot	c0.48		0.05	c0.41	c0.38	
v/s Ratio Perm			0.38			0.12
v/c Ratio	1.26		0.92	0.87	1.13	0.37
Uniform Delay, d1	28.0		20.7	21.3	30.0	22.8
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	131.1		45.1	11.4	78.9	2.0
Delay (s)	159.1		65.8	32.7	108.9	24.8
Level of Service	F		E	C	F	C
Approach Delay (s)	159.1			38.6	70.8	
Approach LOS	F			D	E	

Intersection Summary			
HCM 2000 Control Delay	85.3	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.24		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	103.8%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

Queues
5: Route 287 & Hirst Road



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	843	167	764	704	583
v/c Ratio	1.26	0.93	0.87	1.13	0.64
Control Delay	157.0	73.1	34.0	109.1	5.6
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	157.0	73.1	34.0	109.1	5.6
Queue Length 50th (ft)	~609	54	374	~470	0
Queue Length 95th (ft)	#838	#169	#606	#683	74
Internal Link Dist (ft)	1865		1079	429	
Turn Bay Length (ft)		310			400
Base Capacity (vph)	668	179	879	621	916
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.26	0.93	0.87	1.13	0.64

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
5: Route 287 & Hirst Road

Catoctin Creek Towne Center
2/5/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations	↙↘		↙	↑↑	↑	↗
Volume (vph)	659	117	154	703	648	536
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0		7.5	6.5	6.5	4.0
Lane Util. Factor	*0.60		1.00	0.95	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	2096		1770	3539	1863	1583
Flt Permitted	0.96		0.07	1.00	1.00	1.00
Satd. Flow (perm)	2096		139	3539	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	716	127	167	764	704	583
RTOR Reduction (vph)	7	0	0	0	0	0
Lane Group Flow (vph)	836	0	167	764	704	583
Turn Type	Prot		pm+pt	NA	NA	Free
Protected Phases	4		5	2	6	
Permitted Phases			2			Free
Actuated Green, G (s)	45.0		61.5	61.5	46.2	120.0
Effective Green, g (s)	45.0		61.5	61.5	46.2	120.0
Actuated g/C Ratio	0.38		0.51	0.51	0.39	1.00
Clearance Time (s)	7.0		7.5	6.5	6.5	
Vehicle Extension (s)	3.5		2.5	3.5	3.5	
Lane Grp Cap (vph)	786		177	1813	717	1583
v/s Ratio Prot	c0.40		c0.06	0.22	0.38	
v/s Ratio Perm			c0.42			0.37
v/c Ratio	1.06		0.94	0.42	0.98	0.37
Uniform Delay, d1	37.5		31.7	18.2	36.5	0.0
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	50.4		51.0	0.7	29.5	0.7
Delay (s)	87.9		82.7	18.9	66.0	0.7
Level of Service	F		F	B	E	A
Approach Delay (s)	87.9			30.4	36.4	
Approach LOS	F			C	D	

Intersection Summary

HCM 2000 Control Delay	48.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.02		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	82.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Queues
5: Route 287 & Hirst Road



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	843	167	764	704	583
v/c Ratio	1.06	0.95	0.42	0.98	0.37
Control Delay	86.8	84.0	19.1	66.5	0.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	86.8	84.0	19.1	66.5	0.7
Queue Length 50th (ft)	~596	80	187	533	0
Queue Length 95th (ft)	#804	#221	235	#790	0
Internal Link Dist (ft)	653		1079	429	
Turn Bay Length (ft)	600	310			
Base Capacity (vph)	792	175	1813	717	1583
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.06	0.95	0.42	0.98	0.37

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
5: Route 287 & Hirst Road

Catoctin Towne Center
2/5/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	528	118	237	918	820	955
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0		7.5	6.5	6.5	6.5
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frt	0.98		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1746		1770	1863	1863	1583
Flt Permitted	0.96		0.10	1.00	1.00	1.00
Satd. Flow (perm)	1746		177	1863	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	574	128	258	998	891	1038
RTOR Reduction (vph)	9	0	0	0	0	553
Lane Group Flow (vph)	693	0	258	998	891	485
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	4		5	2	6	
Permitted Phases			2			6
Actuated Green, G (s)	28.0		48.5	48.5	34.5	34.5
Effective Green, g (s)	28.0		48.5	48.5	34.5	34.5
Actuated g/C Ratio	0.31		0.54	0.54	0.38	0.38
Clearance Time (s)	7.0		7.5	6.5	6.5	6.5
Vehicle Extension (s)	3.5		2.5	3.5	3.5	3.5
Lane Grp Cap (vph)	543		210	1003	714	606
v/s Ratio Prot	c0.40		0.09	c0.54	0.48	
v/s Ratio Perm			c0.57			0.31
v/c Ratio	1.28		1.23	1.00	1.25	0.80
Uniform Delay, d1	31.0		23.3	20.6	27.8	24.7
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	138.1		137.4	27.2	123.1	10.7
Delay (s)	169.1		160.7	47.9	150.8	35.4
Level of Service	F		F	D	F	D
Approach Delay (s)	169.1			71.0	88.7	
Approach LOS	F			E	F	

Intersection Summary

HCM 2000 Control Delay	97.5	HCM 2000 Level of Service	F
HCM 2000 Volume to Capacity ratio	1.34		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	110.2%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	702	258	998	891	1038
v/c Ratio	1.27	1.24	1.00	1.25	0.90
Control Delay	166.0	163.8	49.6	150.6	15.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	166.0	163.8	49.6	150.6	15.8
Queue Length 50th (ft)	~508	~135	530	~638	54
Queue Length 95th (ft)	#725	#288	#827	#866	#441
Internal Link Dist (ft)	622		1079	429	
Turn Bay Length (ft)		310			400
Base Capacity (vph)	551	208	1003	714	1159
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	1.27	1.24	1.00	1.25	0.90

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Signalized Intersection Capacity Analysis
 5: Route 287 & Hirst Road

Catoclin Towne Center
 2/5/2014



Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Volume (vph)	528	118	237	918	820	955
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	7.0		7.5	6.5	6.5	4.0
Lane Util. Factor	*0.93		1.00	0.95	1.00	1.00
Frt	0.97		1.00	1.00	1.00	0.85
Flt Protected	0.96		0.95	1.00	1.00	1.00
Satd. Flow (prot)	3238		1770	3539	1863	1583
Flt Permitted	0.96		0.08	1.00	1.00	1.00
Satd. Flow (perm)	3238		155	3539	1863	1583
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	574	128	258	998	891	1038
RTOR Reduction (vph)	21	0	0	0	0	0
Lane Group Flow (vph)	681	0	258	998	891	1038
Turn Type	Prot		pm+pt	NA	NA	Free
Protected Phases	4		5	2	6	
Permitted Phases			2			Free
Actuated Green, G (s)	20.8		55.7	55.7	40.7	90.0
Effective Green, g (s)	20.8		55.7	55.7	40.7	90.0
Actuated g/C Ratio	0.23		0.62	0.62	0.45	1.00
Clearance Time (s)	7.0		7.5	6.5	6.5	
Vehicle Extension (s)	3.5		2.5	3.5	3.5	
Lane Grp Cap (vph)	748		230	2190	842	1583
v/s Ratio Prot	c0.21		0.09	0.28	0.48	
v/s Ratio Perm			c0.60			c0.66
v/c Ratio	0.91		1.12	0.46	1.06	0.66
Uniform Delay, d1	33.7		26.8	9.1	24.6	0.0
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	15.5		96.0	0.7	47.6	2.1
Delay (s)	49.2		122.8	9.8	72.2	2.1
Level of Service	D		F	A	E	A
Approach Delay (s)	49.2			33.0	34.5	
Approach LOS	D			C	C	

Intersection Summary			
HCM 2000 Control Delay	36.7	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	90.0	Sum of lost time (s)	21.0
Intersection Capacity Utilization	92.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

Queues
5: Route 287 & Hirst Road



Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	702	258	998	891	1038
v/c Ratio	0.91	1.13	0.46	1.06	0.66
Control Delay	50.6	121.9	10.0	73.6	2.1
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	50.6	121.9	10.0	73.6	2.1
Queue Length 50th (ft)	202	~122	145	~564	0
Queue Length 95th (ft)	#310	#275	187	#792	0
Internal Link Dist (ft)	622		1079	429	
Turn Bay Length (ft)	600	310			
Base Capacity (vph)	776	228	2191	843	1583
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.90	1.13	0.46	1.06	0.66

Intersection Summary

- ~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

HCM Unsignalized Intersection Capacity Analysis
 8: Site Ent. #2 & Hirst Road

Catoctin Creek Towne Center
 2/5/2014



Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↖	↑	↖	↗
Volume (veh/h)	630	0	0	424	0	0
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	685	0	0	461	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)						
pX, platoon unblocked						
vC, conflicting volume			685		1146	685
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			685		1146	685
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %						
cM capacity (veh/h)						

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	685	0	0	461	0	0
Volume Left	0	0	0	0	0	0
Volume Right	0	0	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.40	0.00	0.00	0.27	0.00	0.00
Queue Length 95th (ft)	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS					A	A
Approach Delay (s)	0.0		0.0		0.0	
Approach LOS					A	

Intersection Summary						
Average Delay			0.0			
Intersection Capacity Utilization			36.5%		ICU Level of Service	
Analysis Period (min)			15			

HCM Unsignalized Intersection Capacity Analysis
 8: Site Ent. #2 & Hirst Road

Catoctin Towne Center
 2/11/2014



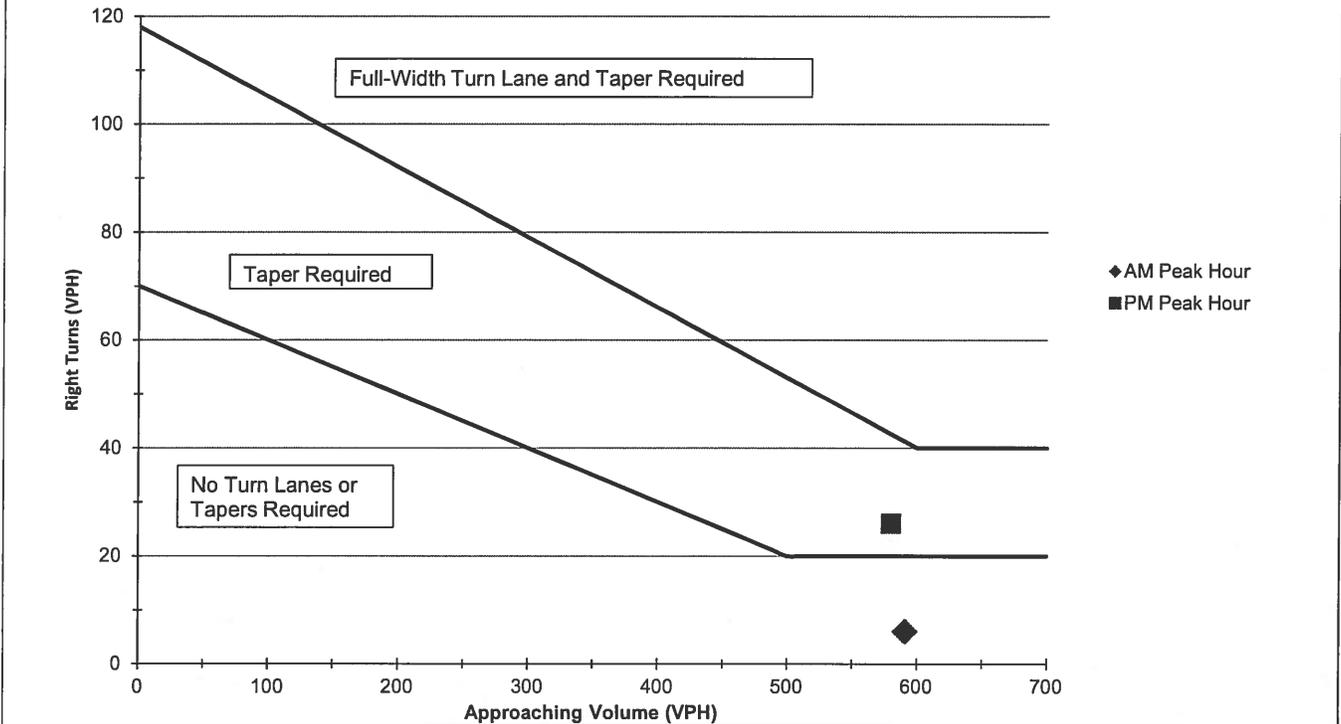
Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations	↑	↗	↖	↑	↖	↗
Volume (veh/h)	484	96	160	826	43	95
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	526	104	174	898	47	103
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None			None		
Median storage (veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			630		1772	526
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			630		1772	526
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			82		37	81
cM capacity (veh/h)			952		75	552
Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	526	104	174	898	47	103
Volume Left	0	0	174	0	47	0
Volume Right	0	104	0	0	0	103
cSH	1700	1700	952	1700	75	552
Volume to Capacity	0.31	0.06	0.18	0.53	0.63	0.19
Queue Length 95th (ft)	0	0	17	0	70	17
Control Delay (s)	0.0	0.0	9.6	0.0	112.8	13.0
Lane LOS			A			B
Approach Delay (s)	0.0		1.6		44.1	
Approach LOS					E	
Intersection Summary						
Average Delay			4.5			
Intersection Capacity Utilization			53.5%		ICU Level of Service A	
Analysis Period (min)			15			

Attachment D

Turn Lane Warrant Analysis

Right Turn Lane Warrant (2-Lane Highway)

Figure 3-26 from VDOT RDM Appendix F



Intersection: Hirst Road/Site Entrance #1 (Study Intersection #3)
 Approach: Eastbound Right
 Scenario: Total Future 2020 (With Mayfair)
 Speed Limit: 45 mph

	AM Peak Hour	PM Peak Hour
Approaching Volume	591	580
Right Turns	6	26
Right Turn Adjustment:	No	No
Adjusted Right Turns:	N/A	N/A