

# Grogans Mill Road at Research Forest Drive

## At Grade Alternatives Analysis

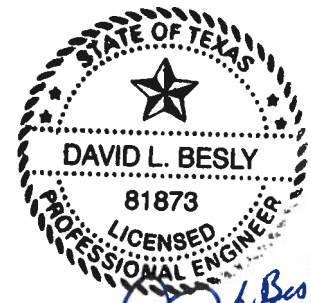
*Prepared for:*

Montgomery County Precinct 2

Bleyl Engineering Project No.: 12825

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*Prepared by:*



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## INTRODUCTION

### Authorization

Bleyl Engineering has prepared this report under the terms of a private agreement executed between the Montgomery County Precinct 2 and Bleyl Engineering.

### Purpose of Study

The purpose of the study is to analyze various at grade alternatives for the intersection of Grogans Mill Road at Research Forest Drive.

### Scope of Work

The project scope of work included the following tasks:

- 1) Project Overview
  - a) Scope of Project
  - b) Roadway Network
- 2) Intersection Alternatives
  - a) Widen Existing Intersection
  - b) Conventional Intersection
  - c) Displaced Left Turns
  - d) Low Impact Displaced Left Turns
- 3) Intersection Analysis
  - a) Level of Service Analysis
  - b) Intersection Alternatives
- 4) Conclusions

## PROJECT OVERVIEW

### Scope of Project

The intersection of Research Forest Drive (RFD) and Grogans Mill Road (GMR) is a major intersection that has been studied multiple times in the last decade. Studies to date have included summaries of results but no details of the study assumptions and model parameters. This study will look at the existing intersection geometry, using the HGAC 2030 and 2045 turning movements, and analyze four at-grade alternatives for increasing capacity in the intersection.

### Roadway Network

The 2016 Montgomery County Thoroughfare Plan classifies both Research Forest and Grogans Mill as Existing Major Thoroughfares. Research Forest in the study area is a 6-lane boulevard section, with landscaped raised medians, that provides east-west connectivity from I-45 to FM 2978 (8 miles). Grogans Mill south of Research Forest is a 4-lane boulevard section, with landscaped raised medians, that provides north-south connectivity from Sawdust to Research Forest (4 miles). Grogans Mill north of Research Forest transitions to a 2-lane rural section, with shoulders, that provides north-south connectivity from Research Forest to Vision Park (1 mile).

The existing intersection widens the median from 25' to 280' along both roadways, creating four signalized intersections of one-way roadways with 280' separating the signals. The approach roadways for the intersection have three lanes on Research Forest and two lanes on Grogans Mill. 100' right turn lanes without acceleration lanes on the outbound direction exist for the northbound to eastbound

movement and the eastbound to southbound movement. A channelized 300' right turn lane without acceleration lanes on the outbound direction was recently constructed for the southbound to westbound movement. **Exhibit 1 – (1) Existing** shows a schematic of the existing intersection geometry.

With the short separation distance, current operations often see the queue at one intersection backing up into the adjacent intersection, even though average delays at the intersection seem fine.

## INTERSECTION ALTERNATIVES

The most recent studies of the intersection have recommended a grade separation with Research Forest going over Grogans Mill, since 60% of the intersection traffic is east-west through movements. This study looks only at the feasibility of at-grade intersection options, which appeared to be understudied in previous reports.

### Widen Existing Intersection

This alternative uses the basic geometry of the existing intersection and adds additional lanes as follows to increase capacity and reduce queue backups in the intersection.

- Westbound – add an additional through lane, a dedicated left turn lane and a dedicated right turn lane.
- Eastbound – increase the length of the right turn lane to avoid queue blockages.
- Northbound – add an additional through lane and a dedicated left turn lane. Increase the length of the right turn lane to avoid queue blockages.

**Exhibit 2 – (2) Widening** shows a schematic of the widened intersection geometry.

### Conventional Intersection

This alternative scraps the existing intersection and builds a conventional cross intersection in the existing right-of way. The cross intersection eliminates the queue blockage found in the existing intersection, but concentrates all the movements at one intersection reducing the opportunity for overlapping movements.

- Westbound – 2 Left turn lanes, 3 through lanes and 1 right turn lane.
- Eastbound – 2 Left turn lanes, 3 through lanes and 1 right turn lane with an acceleration lane southbound.
- Northbound – 2 Left turn lanes, 2 through lanes and 1 right turn lane.
- Southbound – 1 Left turn lane, 2 through lanes and 1 right turn lane.

This option would allow most of the proposed intersection to be constructed while the existing intersection carries traffic, reducing impacts during construction. Following construction there would be opportunities to landscape the former roadway areas, since the existing wooded median would be reduced. A schematic of this intersection is shown in **Exhibit 3 – (3) Standard Intersection**.

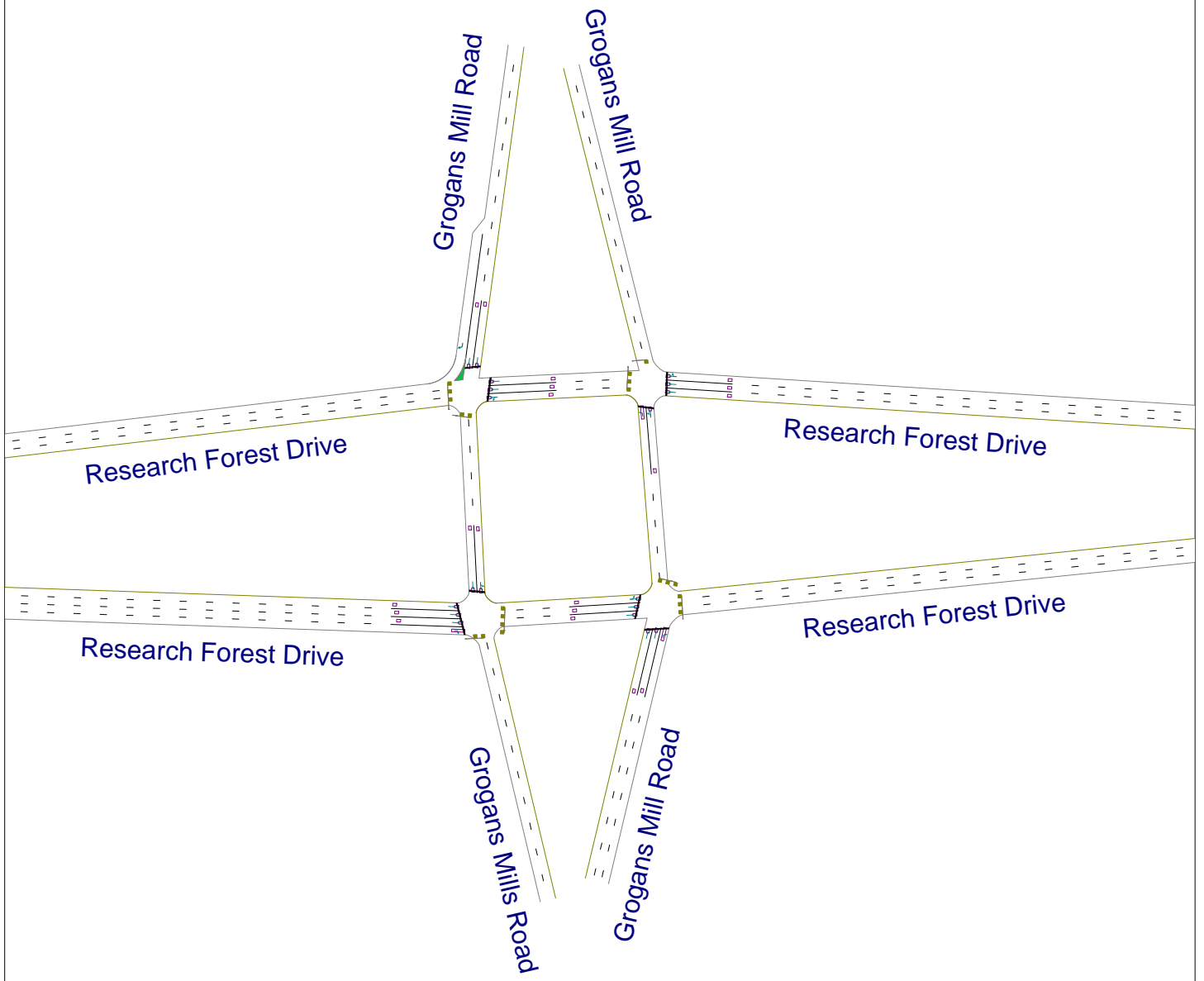
### Displaced Left Turns

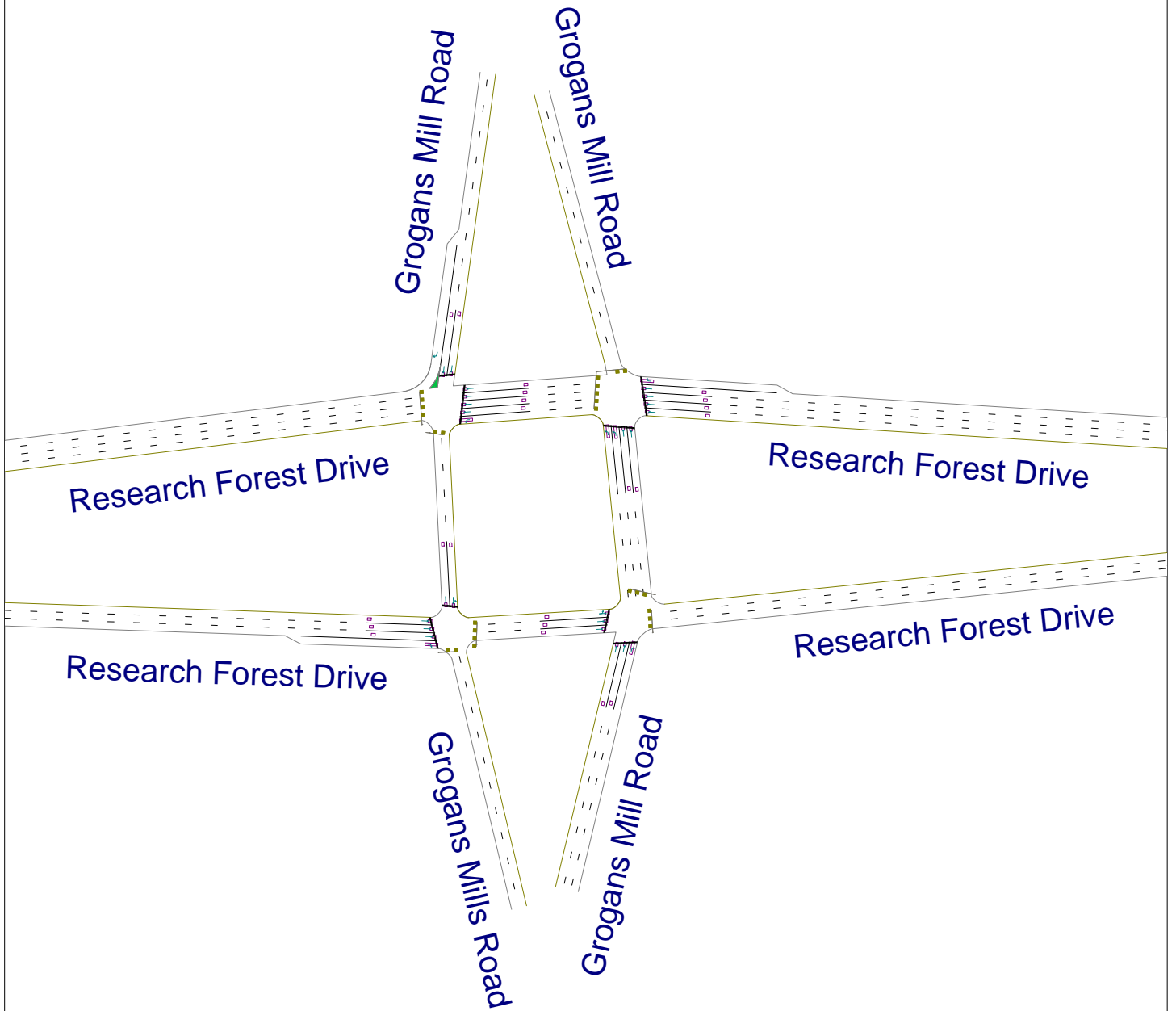
Left turns are the least efficient movement in a signalized intersection and generally have the lowest level of service. The displaced left turn concept relocates the northbound and southbound left turn movements from the primary intersection allowing all of the northbound and southbound movements to occur simultaneously at the primary intersection, allowing more green time for the eastbound and westbound movement. The eastbound and westbound traffic use a lane configuration similar to a standard intersection. The secondary intersections where the left turns are displaced are simple 2 phase signals that are coordinated with the main signals to take advantage of gaps in the northbound and southbound traffic to allow the left turning vehicles to cross over. This alternative requires additional

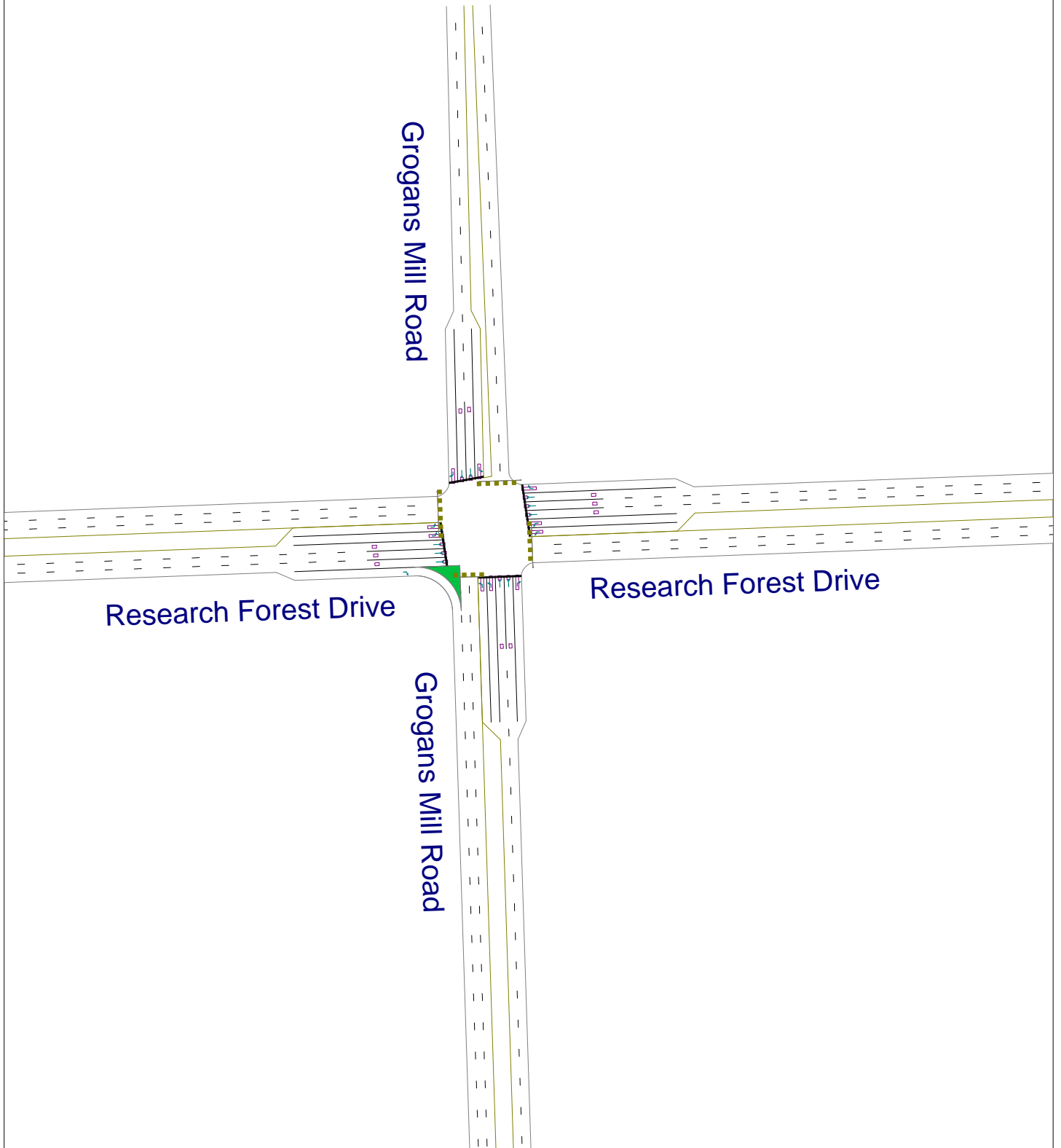
right-of-way over a standard intersection, but in this case, the right-of-way is available. **Exhibit 4 – (4) Displaced Left Turns** shows a schematic of the intersection geometry.

#### **Low Impact Displaced Left Turns**

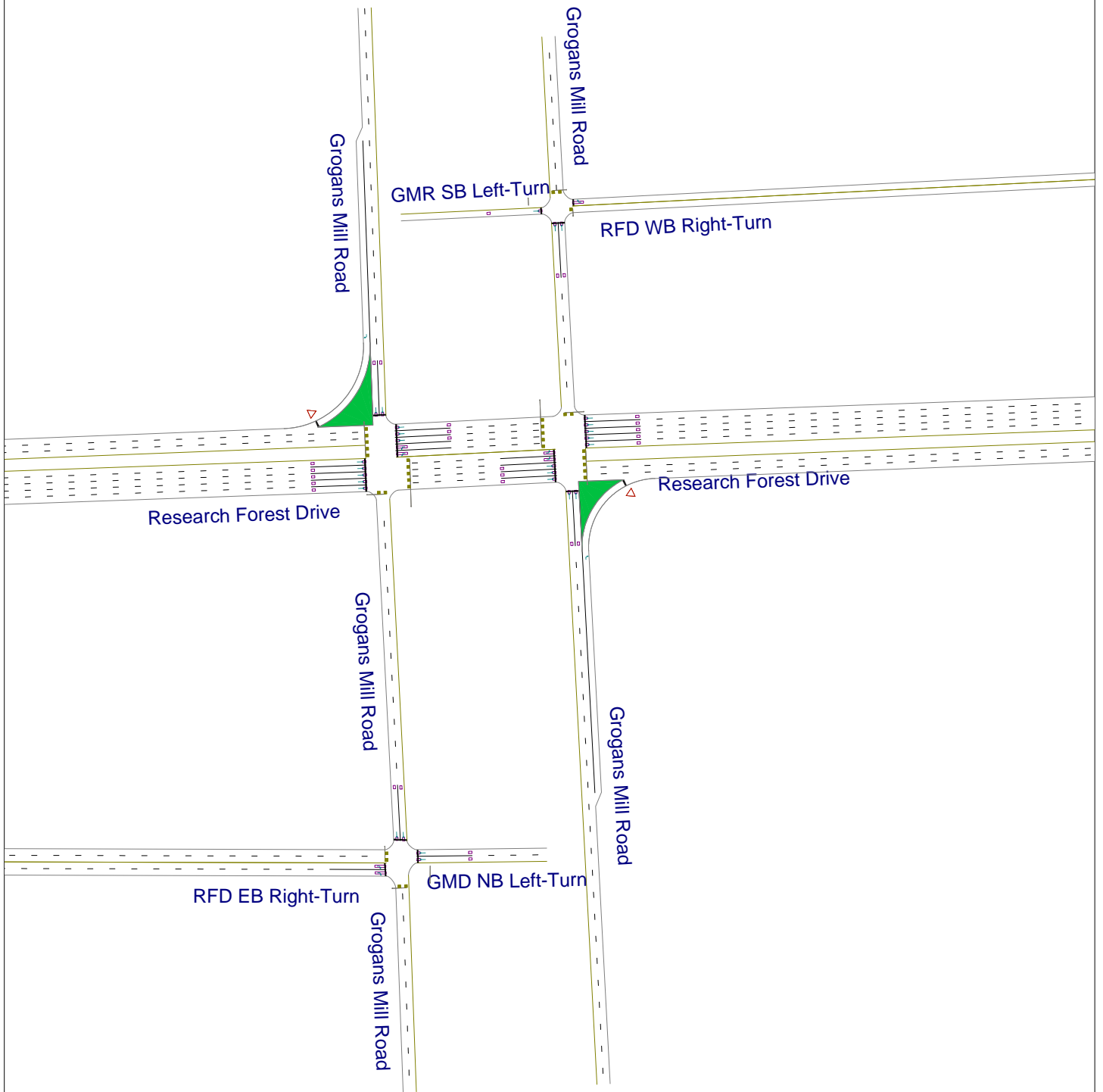
The Low Impact Displaced Left Turns alternative uses the existing pavement for Grogans Mill to displace the left turns by crossing the northbound and southbound traffic over north and south of the primary intersection. The eastbound and westbound traffic use a lane configuration similar to a standard intersection. A schematic of this intersection is shown in **Exhibit 5 – (5) Low Impact Displaced Left Turns**.

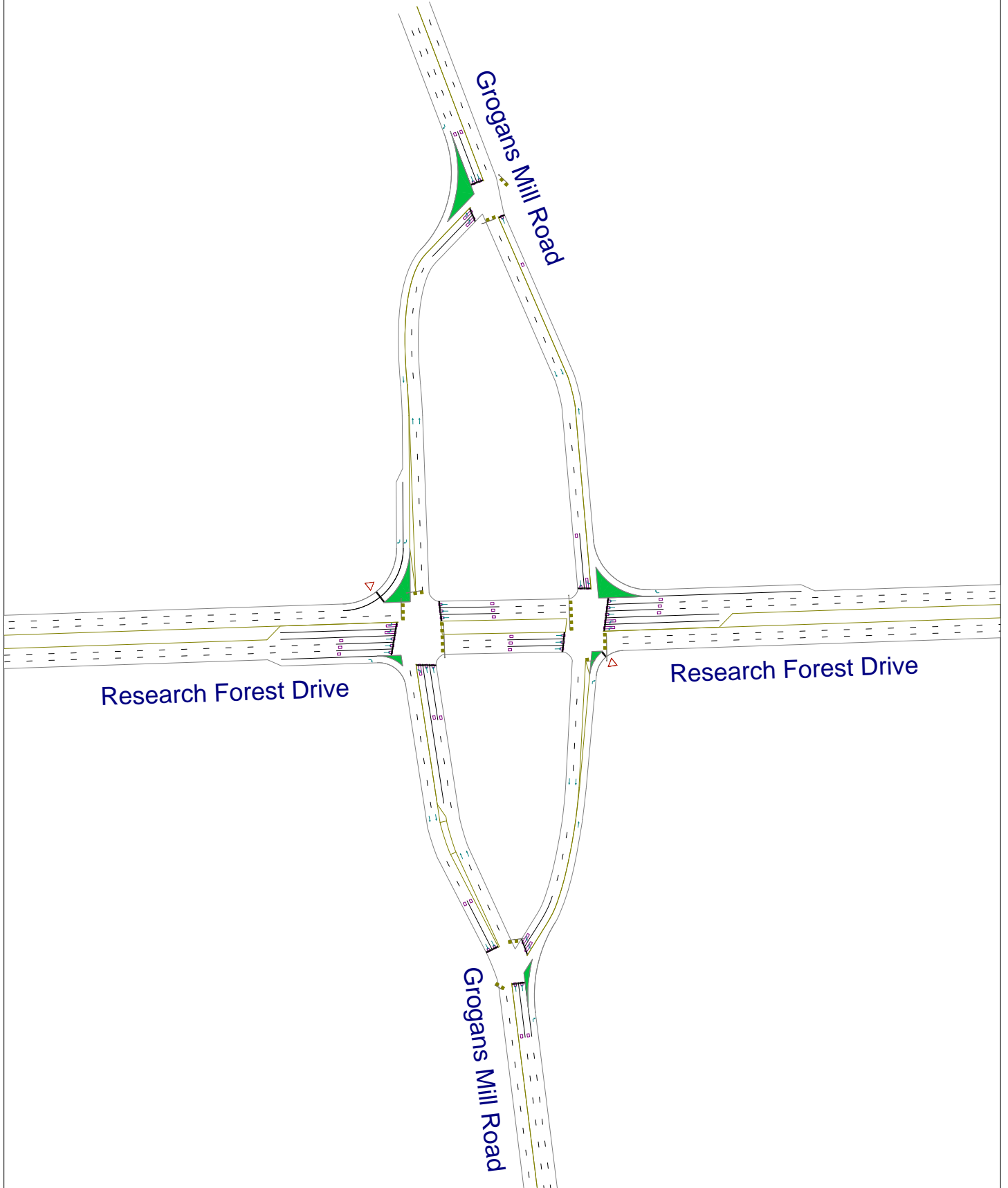












## INTERSECTION ANALYSIS

### Level of Service Analysis

Bleyl Engineering used Synchro 10 traffic software to analyze both signal and stop controlled intersections in the study area. The software calculates the anticipated delay per vehicle on a (n) movement, approach and intersection basis. The software also assigns a Level of Service (LOS) grade for each movement, approach and for the overall intersection. The LOS is a qualitative measure of the operating conditions experienced at an intersection or along a roadway when it is subject to varying traffic volumes. The six levels of service, LOS A through LOS F; describe the traffic operating conditions from best to worst, respectively. LOS E is considered the maximum capacity of an intersection.

For signalized intersections, LOS can be calculated using the methodology from the *Highway Capacity Manual, Sixth Edition: A Guide for Multimodal Mobility Analysis*, Transportation Research Board, 2016. Each LOS corresponds to a range of delay. LOS worsens as delay increases. Corresponding LOS and ranges of delay for signalized intersections is listed in **Table 1**.

**Table 1: Level of Service Criteria for Signalized Intersections.**

Level of Service	Control Delay Range (seconds)
A	≤ 10
B	>10 and ≤ 20
C	>20 and ≤ 35
D	>35 and ≤ 55
E	>55 and ≤ 80
F	> 80

### Intersection Alternatives

The Existing scenario was analyzed at the 2030 and 2045 conditions to compare with the various at grade alternatives. At Grogans Mill Road SB and Research Forest Drive WB, the Research Forest thru approach exceeds the 280' of storage length provided between the intersections with a 50% queue length of 734' in the 2045 PM Peak analysis. At Grogans Mill Road NB and Research Forest Drive WB, the Grogans Mill NB left-turn and thru movements exceed the 280' of storage length with 437' and 463' of 50% queue length, respectively. This indicates that these movements consistently back up through the intersection. Detailed analysis of the Existing scenario by movements can be found in **Appendix A: Intersection by Movement Analysis**.

In the Widening scenario, the signal timing was updated for optimal efficiency and a fourth thru lane was added to the westbound approach out of the intersection. With the additional lanes, the queuing issues from the Existing scenario are resolved and maintained in the existing 280' of storage between the intersections. The 2045 level of service improves to B. Detailed analysis of the Widening scenario by movements can be found in **Appendix A: Intersection by Movement Analysis**.

In the Standard Intersection scenario, the intersection of Grogans Mill Road at Research Forest Drive was rearranged into a singular intersection. Dual left-turns were utilized on the EB, WB, and NB approaches to manage the 50% queue lengths. The NB left-turn would require a storage length of 320' to contain the expected queue. Research Forest Drive EB would require a channelized right-turn lane for a free movement onto Grogans Mill Road with its own lane. The Standard Intersection resulted in a LOS C in the AM Peak and LOS E in the PM Peak for the 2045 analysis. This LOS could be improved with

additional lanes, however each additional lane adds significantly less capacity for increasing costs. Detailed analysis of the Standard Intersection scenario by movements can be found in **Appendix A: Intersection by Movement Analysis**.

The Displaced Left Turn scenario resulted in 50% queue lengths below 215' and LOS B for both the 2030 and 2045 conditions. Detailed analysis of the Displaced Left Turn scenario by movements can be found in **Appendix A: Intersection by Movement Analysis**.

The Low Impact Displaced Left Turn scenario had a 50% queue length of 519' for the Research Forest WB thru movement with a maximum 280' storage length, exceeding capacity in the 2045 PM Peak. The 2045 conditions resulted in a LOS C and LOS D in the AM and PM Peak hours, respectively. Detailed analysis of the Low Impact Displaced Left Turn scenario by movements can be found in **Appendix A: Intersection by Movement Analysis**.

A summary of the Level of Service at each of the alternatives is shown in **Table 2**.

**Table 2: Alternatives LOS Summary**

Alternative	Peak Hour	2030 Conditions		2045 Conditions	
		Delay (sec)	LOS	Delay (sec)	LOS
Existing	AM	14.3	B	26.3	C
	PM	30.1	C	40.3	D
Widening	AM	9.8	A	11.9	B
	PM	10.7	B	11.9	B
Standard Intersection	AM	28.3	C	32.7	D
	PM	43.2	D	56.0	E
Displaced Left Turns	AM	17.4	B	17.4	B
	PM	15.0	B	16.1	B
Low Impact Displaced Left Turns	AM	18.2	B	22.9	C
	PM	26.2	C	43.3	D

Detailed alternative analysis can be found in **Appendix B: Synchro Analysis**.

## CONCLUSION

The Existing scenario fails in 2030 and 2045 conditions not due to delays, but because of the vehicular back up through the intersection. The Standard Intersection does not perform better than the other alternatives due to a lower level of service. The Low Impact Displaced Left Turns scenario fails not due to delays, but because of the traffic back up through the intersection. The Widening and Displaced Left Turns scenarios are the most promising of the four analyzed when compared to the Existing conditions.

An at grade option is feasible at the 2045 condition via signal analysis and further analysis should be based on proposed construction costs and ROW impacts to continue forward.

## REFERENCES

1. *Highway Capacity Manual 2010*, Transportation Research Board, Washington, DC, 2010.
2. *Synchro 11*, Version 11.1, Trafficware LLC.
3. *Research Forest Drive and Lake Woodlands Drive – Project Summary Meeting*, Strand Associates, Inc., April 15, 2021.

**Appendix A: Intersection by Movement Analysis**

## Grogans Mill Road at Research Forest Drive Alternatives Intersection by Movement Analysis

Scenario: Existing

Intersection	Movement																											Total																
	Eastbound									Westbound									Northbound											Southbound														
	Left			Thru			Right			Left			Thru			Right			Left			Thru			Right			Left			Thru			Right										
	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue								
<b>2030 Existing A.M. Peak Hour</b>																																												
Grogans Mill Road NB at Research Forest Drive WB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			21.3 C	
Grogans Mill Road SB at Research Forest Drive WB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			18.1 B 56 18.5 B 65 11.8 B	
Grogans Mill Road SB at Research Forest Drive EB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			12.4 B 177 22.3 C 200 15.8 B	
Grogans Mill Road NB at Research Forest Drive EB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			3.0 A 17 16.9 B 32 18.4 B 57 5.7 A	
<b>2030 Existing P.M. Peak Hour</b>																																												
Grogans Mill Road NB at Research Forest Drive WB	/			/			/			/			/			/			/			/			/			/			/			/			/			26.6 C 227 83.3 F 236.0 83.8 F 242 47.0 D				
Grogans Mill Road SB at Research Forest Drive WB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			51.4 D ~386 16.4 B 47 19.8 B 92 45.0 D	
Grogans Mill Road SB at Research Forest Drive EB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			13.3 B 175 7.3 A 49 10.1 B 50.0 11.7 B	
Grogans Mill Road NB at Research Forest Drive EB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			3.5 A 27 15.9 B 34 22.9 C 105 7.5 A	
<b>2045 Existing A.M. Peak Hour</b>																																												
Grogans Mill Road NB at Research Forest Drive WB	/			/			/			/			/			/			/			/			/			/			/			/			/			45.5 D 376 20.4 C 81.0 63.0 E 234 46.0 D				
Grogans Mill Road SB at Research Forest Drive WB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			29.8 C 91 20.6 C 72 21.9 C 85 28.1 C	
Grogans Mill Road SB at Research Forest Drive EB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			13.3 C 220 31.7 C 279 24.9 C 134.0 20.0 C	
Grogans Mill Road NB at Research Forest Drive EB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			3.3 A 32 19.1 B 42 22.0 C 75 6.5 A	
<b>2045 Existing P.M. Peak Hour</b>																																												
Grogans Mill Road NB at Research Forest Drive WB	/			/			/			/			/			/			/			/			/			/			/			/			/			42.5 D 394 98.9 F ~437 97.8 F ~463 62.8 E				
Grogans Mill Road SB at Research Forest Drive WB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			68.8 E ~734 21.3 C 77 26.3 C 156 60.0 E	
Grogans Mill Road SB at Research Forest Drive EB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			18.1 B 295 11.0 B 105 14.5 B 85.0 16.2 B	
Grogans Mill Road NB at Research Forest Drive EB	/			/			/			/			/			/			/			/			/			/			/			/			/			/			4.7 A 37 20.7 C 58 30.3 C 178 10.0 B	

## Grogans Mill Road at Research Forest Drive Alternatives Intersection by Movement Analysis

Scenario: **Widening**

Intersection	Movement																										Total																	
	Eastbound						Westbound						Northbound						Southbound																									
	Left		Thru		Right		Left		Thru		Right		Left		Thru		Right		Left		Thru		Right		-																			
	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS																		
<b>2030 Widening A.M. Peak Hour</b>																																												
Grogans Mill Road NB at Research Forest Drive WB													10.6	B	177	4.3	A	21	12.0	B	30	14.4	B	53													<b>10.3</b>	<b>B</b>						
Grogans Mill Road SB at Research Forest Drive WB													1.8	A	0	4.3	A	43													17.3	B	52	17.5	B	59	<b>6.5</b>	<b>A</b>						
Grogans Mill Road SB at Research Forest Drive EB																															16.4	B	88				<b>15.2</b>	<b>B</b>						
Grogans Mill Road NB at Research Forest Drive EB																									3.0	A	15							15.9	B	30	17.5	B	52				<b>5.5</b>	<b>A</b>
<b>2030 Widening P.M. Peak Hour</b>																																												
Grogans Mill Road NB at Research Forest Drive WB													12.4	B	120	2.5	A	0	12.7	B	74	10.6	B	41													<b>11.8</b>	<b>B</b>						
Grogans Mill Road SB at Research Forest Drive WB													1.3	A	1	10.9	B	86													11.6	B	33	13.9	B	62	<b>10.6</b>	<b>B</b>						
Grogans Mill Road SB at Research Forest Drive EB																									15.1	B	150	7.4	A	36							6.7	A	32				<b>12.2</b>	<b>B</b>
Grogans Mill Road NB at Research Forest Drive EB																									5.3	A	24							11.2	B	24	16.1	B	70				<b>7.6</b>	<b>A</b>
<b>2045 Widening A.M. Peak Hour</b>																																												
Grogans Mill Road NB at Research Forest Drive WB													11.3	B	177	6.1	A	40	13.6	B	38	16.4	B	67													<b>11.7</b>	<b>B</b>						
Grogans Mill Road SB at Research Forest Drive WB													2.9	A	0	4.5	A	52													19.5	B	67	20.8	C	78	<b>7.4</b>	<b>A</b>						
Grogans Mill Road SB at Research Forest Drive EB																									12.9	B	204	32.6	C	258							25.2	C	115				<b>20.1</b>	<b>C</b>
Grogans Mill Road NB at Research Forest Drive EB																									3.3	A	30							17.9	B	39	20.8	C	69				<b>6.3</b>	<b>A</b>
<b>2045 Widening P.M. Peak Hour</b>																																												
Grogans Mill Road NB at Research Forest Drive WB													12.3	B	144	2.9	A	4	17.4	B	100	13.0	B	55													<b>13.1</b>	<b>B</b>						
Grogans Mill Road SB at Research Forest Drive WB													1.2	A	1	12.0	B	105													14.1	B	45	18.5	B	87	<b>12.1</b>	<b>B</b>						
Grogans Mill Road SB at Research Forest Drive EB																									15.1	B	182	10.0	B	65							8.6	A	41				<b>13.0</b>	<b>B</b>
Grogans Mill Road NB at Research Forest Drive EB																									5.1	A	28							13.6	B	34	23.1	C	100				<b>8.6</b>	<b>A</b>



### Grogans Mill Road at Research Forest Drive Alternatives Intersection by Movement Analysis

Scenario: **Standard Intersection**

Intersection	Movement																														Total							
	Eastbound									Westbound									Northbound									Southbound										
	Left			Thru			Right			Left			Thru			Right			Left			Thru			Right			Left			Thru			Right				
	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue		
<b>2030 Standard Intersection A.M. Peak Hour</b>																																						
Grogans Mill Road at Research Forest Drive	53.2	D	67	35.8	D	353	0.9	A	0	49.6	D	143	26.3	C	330	4.0	A	7	50.6	D	91	32.9	C	60	7.1	A	0	27.2	C	32	42.1	D	89	13.6	B	17	<b>28.3</b>	<b>C</b>
<b>2030 Standard Intersection P.M. Peak Hour</b>																																						
Grogans Mill Road at Research Forest Drive	64.0	E	66	49.7	D	397	0.4	A	0	56.3	E	78	52.7	D	434	7.3	A	13	53.4	D	264	24.9	C	60	10.3	B	48	24.1	C	35	43.7	D	78	46.5	D	126	<b>43.2</b>	<b>D</b>
<b>2045 Standard Intersection A.M. Peak Hour</b>																																						
Grogans Mill Road at Research Forest Drive	53.5	D	82	42.2	D	448	1.2	A	0	51.8	D	178	29.2	C	417	5.8	A	28	68.4	E	118	38.9	D	81	8.0	A	0	33.0	C	41	50.2	D	117	20.0	B	39	<b>32.7</b>	<b>C</b>
<b>2045 Standard Intersection P.M. Peak Hour</b>																																						
Grogans Mill Road at Research Forest Drive	70.9	E	75	53.1	D	447	0.5	A	0	78.7	E	91	76.7	E	~547	8.5	A	22	75.6	E	~317	26.3	C	74	15.0	B	86	25.4	C	40	45.7	D	93	73.2	E	166	<b>56.0</b>	<b>E</b>

### Grogans Mill Road at Research Forest Drive Alternatives Intersection by Movement Analysis

Scenario: **Displaced Left Turns**

Intersection	Movement																											Total								
	Eastbound									Westbound									Northbound											Southbound						
	Left			Thru			Right			Left			Thru			Right			Left			Thru			Right			Left			Thru			Right		
	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS				
<b>2030 Displaced Left Turns A.M. Peak Hour</b>																																				
Grogans Mill Road NB & GMR SB Left at Research Forest WB Drive Right				8.9	A	11										3.7	A	5				10.0	A	37										7.5	A	
Grogans Mill Road NB at Research Forest Drive WB	46.5	D	48	19.7	B	48							18.4	B	174							17.7	B	33	4.8	A	0							19.5	B	
Grogans Mill Road SB at Research Forest Drive EB				20.4	C	154				60.6	E	105	9.9	A	28													18.3	B	45	4.8	A	0	19.5	B	
Grogans Mill Road SB & GMR NB Left at Research Forest Drive EB Right							10.5	B	56				9.3	A	24													12.0	B	72				10.9	B	
<b>2030 Displaced Left Turns P.M. Peak Hour</b>																																				
Grogans Mill Road NB & GMR SB Left at Research Forest WB Drive Right				9.1	A	13										1.1	A	0				10.0	A	36										7.6	A	
Grogans Mill Road NB at Research Forest Drive WB	48.3	D	39	12.0	B	36							17.4	B	141							15.7	B	33	10.8	B	39							16.1	B	
Grogans Mill Road SB at Research Forest Drive EB				17.1	B	126				49.8	D	47	14.8	B	42													15.7	B	32	9.7	A	31	17.3	B	
Grogans Mill Road SB & GMR NB Left at Research Forest Drive EB Right							1.9	A	0				12.1	B	73													10.1	B	40				8.9	A	
<b>2045 Displaced Left Turns A.M. Peak Hour</b>																																				
Grogans Mill Road NB & GMR SB Left at Research Forest WB Drive Right				9.0	A	12										6.0	A	20				10.3	B	43										8.6	A	
Grogans Mill Road NB at Research Forest Drive WB	52.5	D	62	15.7	B	67							17.7	B	213							23.2	C	49	6.2	A	2							18.3	B	
Grogans Mill Road SB at Research Forest Drive EB				20.7	C	193				66.1	E	137	7.5	A	36													24.1	C	66	8.5	A	16	19.9	B	
Grogans Mill Road SB & GMR NB Left at Research Forest Drive EB Right							13.3	B	77				9.5	A	27													12.9	B	85				12.5	B	
<b>2045 Displaced Left Turns P.M. Peak Hour</b>																																				
Grogans Mill Road NB & GMR SB Left at Research Forest WB Drive Right				9.2	A	15										2.3	A	0				10.3	B	44										8.2	A	
Grogans Mill Road NB at Research Forest Drive WB	53.9	D	48	13.1	B	51							17.6	B	169							18.2	B	44	15.5	B	62							17.4	B	
Grogans Mill Road SB at Research Forest Drive EB				17.7	B	153				52.8	D	58	15.5	B	56													18.1	B	42	13.7	B	52	18.4	B	
Grogans Mill Road SB & GMR NB Left at Research Forest Drive EB Right							3.8	A	11				13.0	B	86													10.5	B	47				9.9	A	













### Grogans Mill Road at Research Forest Drive Alternatives Intersection by Movement Analysis

Scenario: **Low Impact Displaced Left Turns**

Intersection	Movement																																					
	Eastbound									Westbound									Northbound									Southbound									Total	
	Left			Thru			Right			Left			Thru			Right			Left			Thru			Right			-										
Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS	50% Queue	Delay (Sec)	LOS										
<b>2030 Low Impact Displaced Left Turns A.M. Peak Hour</b>																																						
Grogans Mill Road NB at Grogans Mill Road SB	30.5	C	89																13.8	B	86							16.5	B	56	3.8	A	0	18.1	B			
Grogans Mill Road NB at Research Forest Drive	41.6	D	45	29.1	C	239	5.7	A	0				5.2	A	21				27.8	C	57	18.7	B	18							1.7	A	0	16.3	B			
Grogans Mill Road SB at Research Forest Drive				9.7	A	25							43.1	D	98	20.7	C	226	3.1	A	0				2.2	A	0	10.8	B	28	18.3	B	125				16.7	B
Grogans Mill Road NB at Grogans Mill Road SB										34.1	C	140										23.6	C	96	5.2	A	0				26.1	C	146				26.2	C
<b>2030 Low Impact Displaced Left Turns P.M. Peak Hour</b>																																						
Grogans Mill Road NB at Grogans Mill Road SB	26.5	C	93																21.5	C	77							24.4	C	76	4.7	A	0	19.6	B			
Grogans Mill Road NB at Research Forest Drive	77.8	E	60	40.3	D	348	7.6	A	27				15.1	B	48				41.9	D	189	6.5	A	11							3.1	A	3	27.1	C			
Grogans Mill Road SB at Research Forest Drive				10.1	B	19							77.2	E	73	52.3	D	389	4.6	A	0				9.2	A	68	18.4	B	53	22.9	C	155				30.7	C
Grogans Mill Road NB at Grogans Mill Road SB										19.2	B	79										23.9	C	251	3.3	A	0				19.2	B	97				18.8	B
<b>2045 Low Impact Displaced Left Turns A.M. Peak Hour</b>																																						
Grogans Mill Road NB at Grogans Mill Road SB	32.6	C	92																			13.8	B	97							16.4	B	64	3.7	A	0	18.8	B
Grogans Mill Road NB at Research Forest Drive	46.8	D	52	42.1	D	276	6.2	A	0				6.6	A	23				36.2	D	87	25.6	C	32							1.9	A	0	22.1	C			
Grogans Mill Road SB at Research Forest Drive				14.0	B	49							53.6	D	113	23.0	C	259	3.0	A	0				3.8	A	2	11.3	B	31	22.4	C	149				20.4	C
Grogans Mill Road NB at Grogans Mill Road SB										45.1	D	248										26.2	C	115	5.5	A	0				32.7	C	175				32.7	C
<b>2045 Low Impact Displaced Left Turns P.M. Peak Hour</b>																																						
Grogans Mill Road NB at Grogans Mill Road SB	27.9	C	114																			23.8	C	95							27.5	C	100	4.9	A	0	21.3	C
Grogans Mill Road NB at Research Forest Drive	102.3	F	76	71.9	E	~464	13.1	B	78				47.2	D	~519				69.0	E	~346	6.9	A	13							4.5	A		52.3	D			
Grogans Mill Road SB at Research Forest Drive				20.4	C	~68							91.1	F	92	89.8	F	~551	4.7	A	0				11.4	B	101	21.1	C	67	26.8	C	205				50.3	D
Grogans Mill Road NB at Grogans Mill Road SB										21.2	C	98										27.4	C	333	3.3	A	0				21.5	C	136				21.3	C

## Appendix B: Synchro Analysis

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑		↑	↑				
Traffic Volume (vph)	0	0	0	0	2004	282	265	392	0	0	0	0
Future Volume (vph)	0	0	0	0	2004	282	265	392	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	0.91	0.91	0.95	0.95	1.00	1.00	1.00	1.00
Fr t					0.981							
Flt Protected							0.950	0.997				
Satd. Flow (prot)	0	0	0	0	4989	0	1665	1747	0	0	0	0
Flt Permitted							0.950	0.997				
Satd. Flow (perm)	0	0	0	0	4989	0	1665	1747	0	0	0	0
Right Turn on Red			Yes			Yes	Yes		Yes			Yes
Satd. Flow (RTOR)					62		25	25				
Link Speed (mph)		45			45			35				35
Link Distance (ft)		250			1466			303				507
Travel Time (s)		3.8			22.2			5.9				9.9
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
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	0	2178	307	288	426	0	0	0	0
Shared Lane Traffic (%)							10%					
Lane Group Flow (vph)	0	0	0	0	2485	0	259	455	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type					NA		Perm	NA				
Protected Phases					8			2				
Permitted Phases							2					
Minimum Split (s)					22.5		22.5	22.5				
Total Split (s)					40.0		25.0	25.0				
Total Split (%)					61.5%		38.5%	38.5%				
Maximum Green (s)					35.5		20.5	20.5				
Yellow Time (s)					3.5		3.5	3.5				
All-Red Time (s)					1.0		1.0	1.0				
Lost Time Adjust (s)					0.0		0.0	0.0				
Total Lost Time (s)					4.5		4.5	4.5				
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)					7.0		7.0	7.0				
Flash Dont Walk (s)					11.0		11.0	11.0				
Pedestrian Calls (#/hr)					0		0	0				
Act Effct Green (s)					35.5		20.5	20.5				
Actuated g/C Ratio					0.55		0.32	0.32				
v/c Ratio					0.90		0.48	0.80				
Control Delay					19.1		16.4	29.2				
Queue Delay					0.8		0.3	2.3				

# Lanes, Volumes, Timings

## 1: Research Forest Drive & Grogans Mill Road

Lane Group	Ø4	Ø6
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	4	6
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	40.0	25.0
Total Split (%)	62%	38%
Maximum Green (s)	35.5	20.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

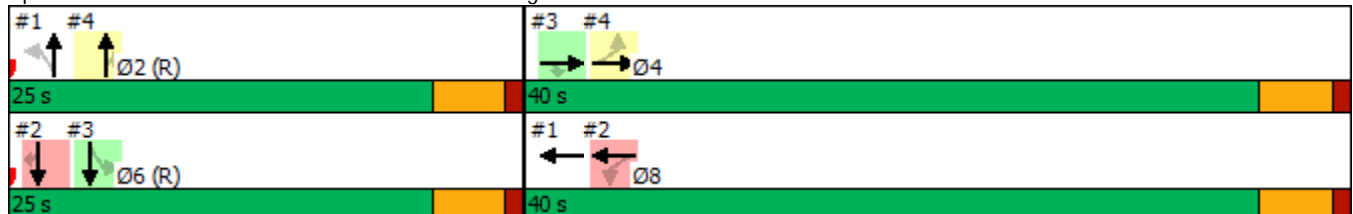


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay					20.0		16.7	31.5				
LOS					B		B	C				
Approach Delay					20.0			26.1				
Approach LOS					B			C				
Queue Length 50th (ft)					287		63	125				
Queue Length 95th (ft)					#379		m107	#321				
Internal Link Dist (ft)		170			1386			223			427	
Turn Bay Length (ft)												
Base Capacity (vph)					2752		542	568				
Starvation Cap Reductn					0		51	42				
Spillback Cap Reductn					89		0	0				
Storage Cap Reductn					0		0	0				
Reduced v/c Ratio					0.93		0.53	0.87				

Intersection Summary

Area Type:	Other
Cycle Length:	65
Actuated Cycle Length:	65
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	65
Control Type:	Pretimed
Maximum v/c Ratio:	0.90
Intersection Signal Delay:	21.3
Intersection LOS:	C
Intersection Capacity Utilization:	117.9%
ICU Level of Service:	H
Analysis Period (min):	15
#	95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
m	Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Research Forest Drive & Grogans Mill Road



Lane Group	Ø4	Ø6
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



# Lanes, Volumes, Timings

## 2: Research Forest Drive & Grogans Mill Road

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑						↑↑	↑
Traffic Volume (vph)	0	0	0	416	1853	0	0	0	0	0	331	218
Future Volume (vph)	0	0	0	416	1853	0	0	0	0	0	331	218
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	15
Storage Length (ft)	0		0	0		0	0		0	0		200
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Fr <sub>t</sub>												0.850
Fl <sub>t</sub> Protected					0.991							
Satd. Flow (prot)	0	0	0	0	4991	0	0	0	0	0	3505	1725
Fl <sub>t</sub> Permitted					0.991							
Satd. Flow (perm)	0	0	0	0	4991	0	0	0	0	0	3505	1725
Right Turn on Red			Yes	Yes		Yes			Yes			Yes
Satd. Flow (RTOR)					122							25
Link Speed (mph)		45			35			35			35	
Link Distance (ft)		1533			250			305			542	
Travel Time (s)		23.2			4.9			5.9			10.6	
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
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	452	2014	0	0	0	0	0	360	237
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	2466	0	0	0	0	0	360	237
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Perm	NA						NA	Perm
Protected Phases					8						6	
Permitted Phases				8								6
Minimum Split (s)				22.5	22.5						22.5	22.5
Total Split (s)				40.0	40.0						25.0	25.0
Total Split (%)				61.5%	61.5%						38.5%	38.5%
Maximum Green (s)				35.5	35.5						20.5	20.5
Yellow Time (s)				3.5	3.5						3.5	3.5
All-Red Time (s)				1.0	1.0						1.0	1.0
Lost Time Adjust (s)					0.0						0.0	0.0
Total Lost Time (s)					4.5						4.5	4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				7.0	7.0						7.0	7.0
Flash Dont Walk (s)				11.0	11.0						11.0	11.0
Pedestrian Calls (#/hr)				0	0						0	0
Act Effect Green (s)					35.5						20.5	20.5

## Lanes, Volumes, Timings

### 2: Research Forest Drive & Grogans Mill Road

Lane Group	Ø2	Ø4
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Width (ft)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	4
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	25.0	40.0
Total Split (%)	38%	62%
Maximum Green (s)	20.5	35.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		

# Lanes, Volumes, Timings

## 2: Research Forest Drive & Grogans Mill Road

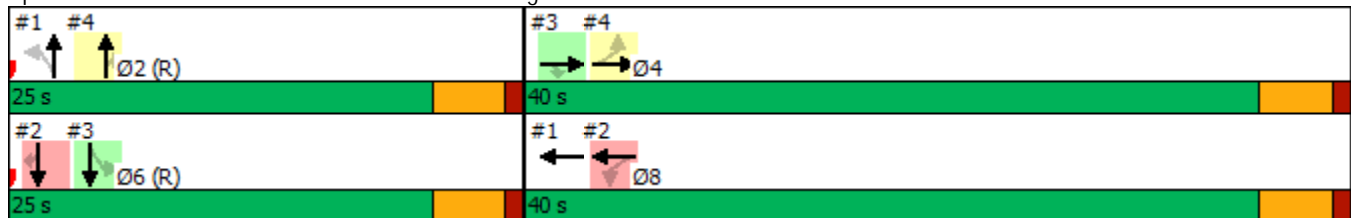


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio					0.55						0.32	0.32
v/c Ratio					0.89						0.33	0.42
Control Delay					7.7						18.0	18.5
Queue Delay					2.5						0.1	0.0
Total Delay					10.2						18.1	18.5
LOS					B						B	B
Approach Delay					10.2						18.2	
Approach LOS					B						B	
Queue Length 50th (ft)					66						56	65
Queue Length 95th (ft)					m100						88	122
Internal Link Dist (ft)		1453			170			225			462	
Turn Bay Length (ft)												200
Base Capacity (vph)					2781						1105	561
Starvation Cap Reductn					209						0	0
Spillback Cap Reductn					1						88	0
Storage Cap Reductn					0						0	0
Reduced v/c Ratio					0.96						0.35	0.42

### Intersection Summary

Area Type: Other  
 Cycle Length: 65  
 Actuated Cycle Length: 65  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 65  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.90  
 Intersection Signal Delay: 11.8      Intersection LOS: B  
 Intersection Capacity Utilization 65.2%      ICU Level of Service C  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.

### Splits and Phases: 2: Research Forest Drive & Grogans Mill Road















## Lanes, Volumes, Timings 2: Research Forest Drive & Grogans Mill Road

Synchro 11 Report

Lane Group	Ø2	Ø4
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
 3: Grogans Mills Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↗								↖↑	
Traffic Volume (vph)	0	1706	658	0	0	0	0	0	0	66	681	0
Future Volume (vph)	0	1706	658	0	0	0	0	0	0	66	681	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		150	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00
Frt			0.850									
Flt Protected												0.996
Satd. Flow (prot)	0	4940	1538	0	0	0	0	0	0	0	3491	0
Flt Permitted												0.996
Satd. Flow (perm)	0	4940	1538	0	0	0	0	0	0	0	3491	0
Right Turn on Red			Yes			Yes			Yes	Yes		Yes
Satd. Flow (RTOR)			47									25
Link Speed (mph)		45			45			35				35
Link Distance (ft)		1511			253			457				305
Travel Time (s)		22.9			3.8			8.9				5.9
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
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	1854	715	0	0	0	0	0	0	72	740	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1854	715	0	0	0	0	0	0	0	812	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA	Perm							Perm	NA	
Protected Phases		4									6	
Permitted Phases			4							6		
Minimum Split (s)		22.5	22.5							22.5	22.5	
Total Split (s)		40.0	40.0							25.0	25.0	
Total Split (%)		61.5%	61.5%							38.5%	38.5%	
Maximum Green (s)		35.5	35.5							20.5	20.5	
Yellow Time (s)		3.5	3.5							3.5	3.5	
All-Red Time (s)		1.0	1.0							1.0	1.0	
Lost Time Adjust (s)		0.0	0.0								0.0	
Total Lost Time (s)		4.5	4.5								4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		7.0	7.0							7.0	7.0	
Flash Dont Walk (s)		11.0	11.0							11.0	11.0	
Pedestrian Calls (#/hr)		0	0							0	0	
Act Effect Green (s)		35.5	35.5								20.5	
Actuated g/C Ratio		0.55	0.55								0.32	

# Lanes, Volumes, Timings

## 3: Grogans Mills Road & Research Forest Drive

Lane Group	Ø2	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	25.0	40.0
Total Split (%)	38%	62%
Maximum Green (s)	20.5	35.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		

Lanes, Volumes, Timings  
 3: Grogans Mills Road & Research Forest Drive

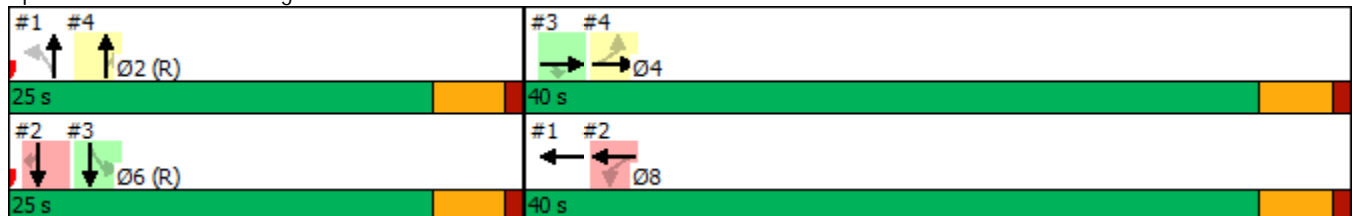


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.69	0.83									0.73
Control Delay		12.4	22.3									17.8
Queue Delay		0.0	0.0									0.2
Total Delay		12.4	22.3									18.0
LOS		B	C									B
Approach Delay		15.2										18.0
Approach LOS		B										B
Queue Length 50th (ft)		177	200									109
Queue Length 95th (ft)		227	#423									m132
Internal Link Dist (ft)		1431				173		377				225
Turn Bay Length (ft)			150									
Base Capacity (vph)		2698	861									1118
Starvation Cap Reductn		0	0									37
Spillback Cap Reductn		0	0									0
Storage Cap Reductn		0	0									0
Reduced v/c Ratio		0.69	0.83									0.75

Intersection Summary

Area Type: Other  
 Cycle Length: 65  
 Actuated Cycle Length: 65  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 65  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.90  
 Intersection Signal Delay: 15.8 Intersection LOS: B  
 Intersection Capacity Utilization 69.0% ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Grogans Mills Road & Research Forest Drive















Lane Group	Ø2	Ø8
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



# Lanes, Volumes, Timings

## 4: Grogans Mill Road & Research Forest Drive

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑						↑↑	↑			
Traffic Volume (vph)	191	1581	0	0	0	0	0	201	196	0	0	0
Future Volume (vph)	191	1581	0	0	0	0	0	201	196	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Fr t									0.850			
Flt Protected		0.995										
Satd. Flow (prot)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Flt Permitted		0.995										
Satd. Flow (perm)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Right Turn on Red	Yes		Yes				Yes		Yes			Yes
Satd. Flow (RTOR)		51							25			
Link Speed (mph)		45			45			35			35	
Link Distance (ft)		253			1475			442			303	
Travel Time (s)		3.8			22.3			8.6			5.9	
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
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	208	1718	0	0	0	0	0	218	213	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1926	0	0	0	0	0	218	213	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Perm	NA						NA	Perm			
Protected Phases		4						2				
Permitted Phases	4								2			
Minimum Split (s)	22.5	22.5						22.5	22.5			
Total Split (s)	40.0	40.0						25.0	25.0			
Total Split (%)	61.5%	61.5%						38.5%	38.5%			
Maximum Green (s)	35.5	35.5						20.5	20.5			
Yellow Time (s)	3.5	3.5						3.5	3.5			
All-Red Time (s)	1.0	1.0						1.0	1.0			
Lost Time Adjust (s)		0.0						0.0	0.0			
Total Lost Time (s)		4.5						4.5	4.5			
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	7.0	7.0						7.0	7.0			
Flash Dont Walk (s)	11.0	11.0						11.0	11.0			
Pedestrian Calls (#/hr)	0	0						0	0			
Act Effct Green (s)		35.5						20.5	20.5			
Actuated g/C Ratio		0.55						0.32	0.32			
v/c Ratio		0.70						0.20	0.42			
Control Delay		3.0						16.9	18.4			
Queue Delay		0.0						0.0	0.0			

Lanes, Volumes, Timings  
 4: Grogans Mill Road & Research Forest Drive

Lane Group	Ø6	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	6	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	25.0	40.0
Total Split (%)	38%	62%
Maximum Green (s)	20.5	35.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		

Lanes, Volumes, Timings  
 4: Grogans Mill Road & Research Forest Drive

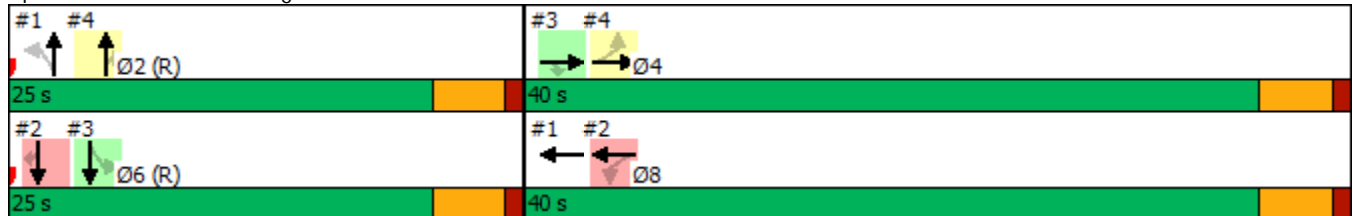


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		3.0						16.9	18.4			
LOS		A						B	B			
Approach Delay		3.0						17.6				
Approach LOS		A						B				
Queue Length 50th (ft)		17						32	57			
Queue Length 95th (ft)		24						56	112			
Internal Link Dist (ft)		173			1395			362			223	
Turn Bay Length (ft)												
Base Capacity (vph)		2759						1105	511			
Starvation Cap Reductn		30						0	0			
Spillback Cap Reductn		0						83	0			
Storage Cap Reductn		0						0	0			
Reduced v/c Ratio		0.71						0.21	0.42			

Intersection Summary













Area Type:	Other
Cycle Length:	65
Actuated Cycle Length:	65
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	65
Control Type:	Pretimed
Maximum v/c Ratio:	0.90
Intersection Signal Delay:	5.7
Intersection LOS:	A
Intersection Capacity Utilization	93.0%
ICU Level of Service	F
Analysis Period (min)	15

Splits and Phases: 4: Grogans Mill Road & Research Forest Drive



Lane Group	Ø6	Ø8
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑		↑	↑				
Traffic Volume (vph)	0	0	0	0	1782	158	693	389	0	0	0	0
Future Volume (vph)	0	0	0	0	1782	158	693	389	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	0.91	0.91	0.95	0.95	1.00	1.00	1.00	1.00
Fr t					0.988							
Flt Protected							0.950	0.986				
Satd. Flow (prot)	0	0	0	0	5024	0	1665	1728	0	0	0	0
Flt Permitted							0.950	0.986				
Satd. Flow (perm)	0	0	0	0	5024	0	1665	1728	0	0	0	0
Right Turn on Red			Yes			Yes	Yes		Yes			Yes
Satd. Flow (RTOR)					33		25	25				
Link Speed (mph)		45			45			35				35
Link Distance (ft)		250			1466			303				507
Travel Time (s)		3.8			22.2			5.9				9.9
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
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	0	1937	172	753	423	0	0	0	0
Shared Lane Traffic (%)							23%					
Lane Group Flow (vph)	0	0	0	0	2109	0	580	596	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type					NA		Perm	NA				
Protected Phases					8			2				
Permitted Phases							2					
Minimum Split (s)					22.5		22.5	22.5				
Total Split (s)					38.4		26.6	26.6				
Total Split (%)					59.1%		40.9%	40.9%				
Maximum Green (s)					33.9		22.1	22.1				
Yellow Time (s)					3.5		3.5	3.5				
All-Red Time (s)					1.0		1.0	1.0				
Lost Time Adjust (s)					0.0		0.0	0.0				
Total Lost Time (s)					4.5		4.5	4.5				
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)					7.0		7.0	7.0				
Flash Dont Walk (s)					11.0		11.0	11.0				
Pedestrian Calls (#/hr)					0		0	0				
Act Effct Green (s)					33.9		22.1	22.1				
Actuated g/C Ratio					0.52		0.34	0.34				
v/c Ratio					0.80		1.00	0.99				
Control Delay					15.5		58.7	55.5				
Queue Delay					11.1		24.6	28.3				

# Lanes, Volumes, Timings

## 1: Research Forest Drive & Grogans Mill Road

Lane Group	Ø4	Ø6
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	4	6
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	38.4	26.6
Total Split (%)	59%	41%
Maximum Green (s)	33.9	22.1
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		

# Lanes, Volumes, Timings

## 1: Research Forest Drive & Grogans Mill Road

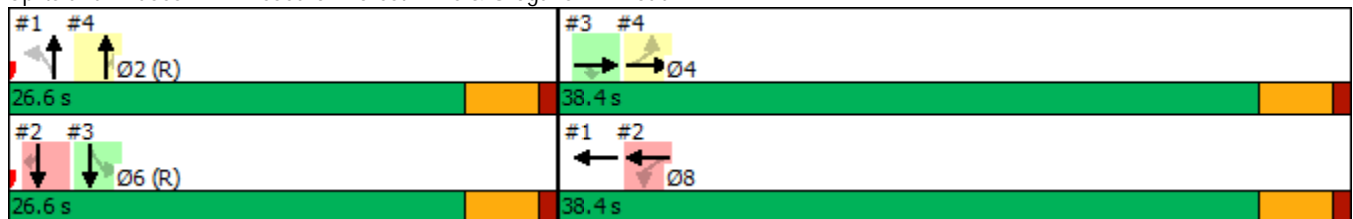


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay					26.6		83.3	83.8				
LOS					C		F	F				
Approach Delay					26.6			83.5				
Approach LOS					C			F				
Queue Length 50th (ft)					227		236	242				
Queue Length 95th (ft)					290		#445	#451				
Internal Link Dist (ft)		170			1386			223			427	
Turn Bay Length (ft)												
Base Capacity (vph)					2635		582	604				
Starvation Cap Reductn					0		42	51				
Spillback Cap Reductn					536		30	31				
Storage Cap Reductn					0		0	0				
Reduced v/c Ratio					1.00		1.07	1.08				

### Intersection Summary

Area Type: Other  
 Cycle Length: 65  
 Actuated Cycle Length: 65  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 65  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.02  
 Intersection Signal Delay: 47.0  
 Intersection LOS: D  
 Intersection Capacity Utilization 128.9%  
 ICU Level of Service H  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

### Splits and Phases: 1: Research Forest Drive & Grogans Mill Road



Lanes, Volumes, Timings  
1: Research Forest Drive & Grogans Mill Road

Lane Group	Ø4	Ø6
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



# Lanes, Volumes, Timings

## 2: Research Forest Drive & Grogans Mill Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑						↑↑	↑
Traffic Volume (vph)	0	0	0	204	2271	0	0	0	0	0	295	296
Future Volume (vph)	0	0	0	204	2271	0	0	0	0	0	295	296
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	15
Storage Length (ft)	0		0	0		0	0		0	0		200
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Fr <sub>t</sub>												0.850
Fl <sub>t</sub> Protected					0.996							
Satd. Flow (prot)	0	0	0	0	5016	0	0	0	0	0	3505	1725
Fl <sub>t</sub> Permitted					0.996							
Satd. Flow (perm)	0	0	0	0	5016	0	0	0	0	0	3505	1725
Right Turn on Red			Yes	Yes		Yes			Yes			Yes
Satd. Flow (RTOR)					34							25
Link Speed (mph)		45			35			35			35	
Link Distance (ft)		1533			250			305			542	
Travel Time (s)		23.2			4.9			5.9			10.6	
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
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	222	2468	0	0	0	0	0	321	322
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	2690	0	0	0	0	0	321	322
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Perm	NA						NA	Perm
Protected Phases					8						6	
Permitted Phases				8								6
Minimum Split (s)				22.5	22.5						22.5	22.5
Total Split (s)				38.4	38.4						26.6	26.6
Total Split (%)				59.1%	59.1%						40.9%	40.9%
Maximum Green (s)				33.9	33.9						22.1	22.1
Yellow Time (s)				3.5	3.5						3.5	3.5
All-Red Time (s)				1.0	1.0						1.0	1.0
Lost Time Adjust (s)					0.0						0.0	0.0
Total Lost Time (s)					4.5						4.5	4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				7.0	7.0						7.0	7.0
Flash Dont Walk (s)				11.0	11.0						11.0	11.0
Pedestrian Calls (#/hr)				0	0						0	0
Act Effect Green (s)					33.9						22.1	22.1

## Lanes, Volumes, Timings

### 2: Research Forest Drive & Grogans Mill Road

Lane Group	Ø2	Ø4
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Width (ft)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	4
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	26.6	38.4
Total Split (%)	41%	59%
Maximum Green (s)	22.1	33.9
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		

# Lanes, Volumes, Timings

## 2: Research Forest Drive & Grogans Mill Road

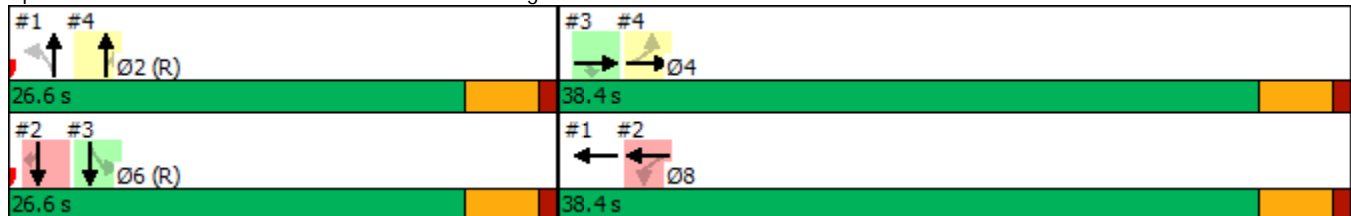


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio					0.52						0.34	0.34
v/c Ratio					1.02						0.27	0.53
Control Delay					30.8						16.4	19.8
Queue Delay					20.6						0.0	0.0
Total Delay					51.4						16.4	19.8
LOS					D						B	B
Approach Delay					51.4						18.1	
Approach LOS					D						B	
Queue Length 50th (ft)					-386						47	92
Queue Length 95th (ft)					m#483						76	164
Internal Link Dist (ft)		1453			170			225			462	
Turn Bay Length (ft)												200
Base Capacity (vph)					2632						1191	603
Starvation Cap Reductn					129						0	0
Spillback Cap Reductn					0						0	0
Storage Cap Reductn					0						0	0
Reduced v/c Ratio					1.07						0.27	0.53

### Intersection Summary

Area Type: Other  
 Cycle Length: 65  
 Actuated Cycle Length: 65  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 65  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.02  
 Intersection Signal Delay: 45.0      Intersection LOS: D  
 Intersection Capacity Utilization 73.8%      ICU Level of Service D  
 Analysis Period (min) 15  
 ~ 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.  
 m Volume for 95th percentile queue is metered by upstream signal.

### Splits and Phases: 2: Research Forest Drive & Grogans Mill Road



## Lanes, Volumes, Timings 2: Research Forest Drive & Grogans Mill Road

Synchro 11 Report

Lane Group	Ø2	Ø4
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

### Lanes, Volumes, Timings 3: Grogans Mills Road & Research Forest Drive

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↑								↔↑	
Traffic Volume (vph)	0	1624	392	0	0	0	0	0	0	80	419	0
Future Volume (vph)	0	1624	392	0	0	0	0	0	0	80	419	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		150	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00
Frt			0.850									
Flt Protected											0.992	
Satd. Flow (prot)	0	4940	1538	0	0	0	0	0	0	0	3477	0
Flt Permitted											0.992	
Satd. Flow (perm)	0	4940	1538	0	0	0	0	0	0	0	3477	0
Right Turn on Red			Yes			Yes			Yes	Yes		Yes
Satd. Flow (RTOR)			189									25
Link Speed (mph)		45			45			35			35	
Link Distance (ft)		1511			253			457			305	
Travel Time (s)		22.9			3.8			8.9			5.9	
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
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	1765	426	0	0	0	0	0	0	87	455	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1765	426	0	0	0	0	0	0	0	542	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA	Perm							Perm	NA	
Protected Phases		4									6	
Permitted Phases			4							6		
Minimum Split (s)		22.5	22.5							22.5	22.5	
Total Split (s)		38.4	38.4							26.6	26.6	
Total Split (%)		59.1%	59.1%							40.9%	40.9%	
Maximum Green (s)		33.9	33.9							22.1	22.1	
Yellow Time (s)		3.5	3.5							3.5	3.5	
All-Red Time (s)		1.0	1.0							1.0	1.0	
Lost Time Adjust (s)		0.0	0.0								0.0	
Total Lost Time (s)		4.5	4.5								4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		7.0	7.0							7.0	7.0	
Flash Dont Walk (s)		11.0	11.0							11.0	11.0	
Pedestrian Calls (#/hr)		0	0							0	0	
Act Effect Green (s)		33.9	33.9								22.1	
Actuated g/C Ratio		0.52	0.52								0.34	

# Lanes, Volumes, Timings

## 3: Grogans Mills Road & Research Forest Drive

Lane Group	Ø2	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphp)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	26.6	38.4
Total Split (%)	41%	59%
Maximum Green (s)	22.1	33.9
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		
Actuated g/C Ratio		

Lanes, Volumes, Timings  
 3: Grogans Mills Road & Research Forest Drive

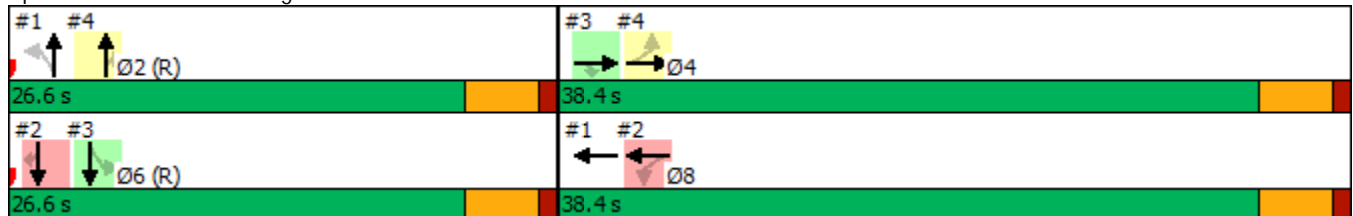


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.69	0.48									0.45
Control Delay		13.3	7.3									10.1
Queue Delay		0.0	0.0									0.0
Total Delay		13.3	7.3									10.1
LOS		B	A									B
Approach Delay		12.1										10.1
Approach LOS		B										B
Queue Length 50th (ft)		175	49									50
Queue Length 95th (ft)		224	109									m63
Internal Link Dist (ft)		1431				173		377				225
Turn Bay Length (ft)			150									
Base Capacity (vph)		2576	892									1198
Starvation Cap Reductn		0	0									0
Spillback Cap Reductn		0	0									0
Storage Cap Reductn		0	0									0
Reduced v/c Ratio		0.69	0.48									0.45

Intersection Summary

Area Type: Other  
 Cycle Length: 65  
 Actuated Cycle Length: 65  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 65  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.02  
 Intersection Signal Delay: 11.7 Intersection LOS: B  
 Intersection Capacity Utilization 52.8% ICU Level of Service A  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Grogans Mills Road & Research Forest Drive















Lane Group	Ø2	Ø8
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



# Lanes, Volumes, Timings

## 4: Grogans Mill Road & Research Forest Drive

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑						↑↑	↑			
Traffic Volume (vph)	169	1535	0	0	0	0	0	220	320	0	0	0
Future Volume (vph)	169	1535	0	0	0	0	0	220	320	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Fr t									0.850			
Flt Protected		0.995										
Satd. Flow (prot)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Flt Permitted		0.995										
Satd. Flow (perm)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Right Turn on Red	Yes		Yes				Yes		Yes			Yes
Satd. Flow (RTOR)		43							25			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		253			1475			442				303
Travel Time (s)		3.8			22.3			8.6				5.9
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
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	184	1668	0	0	0	0	0	239	348	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1852	0	0	0	0	0	239	348	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Perm	NA						NA	Perm			
Protected Phases		4						2				
Permitted Phases	4								2			
Minimum Split (s)	22.5	22.5						22.5	22.5			
Total Split (s)	38.4	38.4						26.6	26.6			
Total Split (%)	59.1%	59.1%						40.9%	40.9%			
Maximum Green (s)	33.9	33.9						22.1	22.1			
Yellow Time (s)	3.5	3.5						3.5	3.5			
All-Red Time (s)	1.0	1.0						1.0	1.0			
Lost Time Adjust (s)		0.0						0.0	0.0			
Total Lost Time (s)		4.5						4.5	4.5			
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	7.0	7.0						7.0	7.0			
Flash Dont Walk (s)	11.0	11.0						11.0	11.0			
Pedestrian Calls (#/hr)	0	0						0	0			
Act Effct Green (s)		33.9						22.1	22.1			
Actuated g/C Ratio		0.52						0.34	0.34			
v/c Ratio		0.70						0.20	0.63			
Control Delay		3.5						15.8	22.9			
Queue Delay		0.0						0.1	0.0			

# Lanes, Volumes, Timings

## 4: Grogans Mill Road & Research Forest Drive

Lane Group	Ø6	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	6	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	26.6	38.4
Total Split (%)	41%	59%
Maximum Green (s)	22.1	33.9
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		

Lanes, Volumes, Timings  
 4: Grogans Mill Road & Research Forest Drive

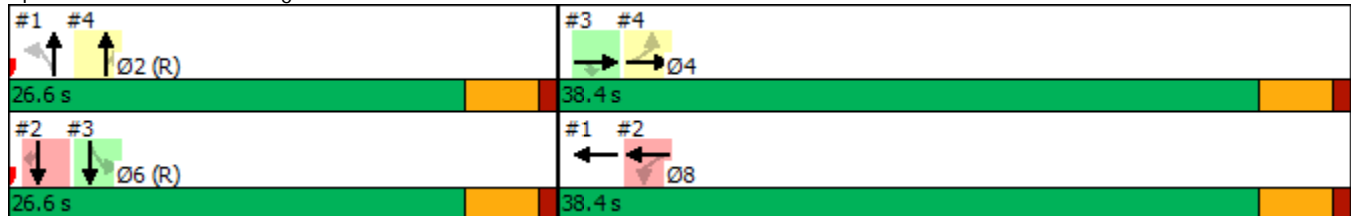


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		3.5						15.9	22.9			
LOS		A						B	C			
Approach Delay		3.5						20.0				
Approach LOS		A						C				
Queue Length 50th (ft)		27						34	105			
Queue Length 95th (ft)		32						58	187			
Internal Link Dist (ft)		173			1395			362			223	
Turn Bay Length (ft)												
Base Capacity (vph)		2634						1191	549			
Starvation Cap Reductn		27						0	0			
Spillback Cap Reductn		40						261	0			
Storage Cap Reductn		0						0	0			
Reduced v/c Ratio		0.71						0.26	0.63			

Intersection Summary













Area Type:	Other
Cycle Length:	65
Actuated Cycle Length:	65
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	65
Control Type:	Pretimed
Maximum v/c Ratio:	1.02
Intersection Signal Delay:	7.5
Intersection LOS:	A
Intersection Capacity Utilization	74.9%
ICU Level of Service	D
Analysis Period (min)	15

Splits and Phases: 4: Grogans Mill Road & Research Forest Drive



Lane Group	Ø6	Ø8
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
1: Research Forest Drive & Grogans Mill Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑		↖	↗				
Traffic Volume (vph)	0	0	0	0	2235	320	301	450	0	0	0	0
Future Volume (vph)	0	0	0	0	2235	320	301	450	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	1.00	1.00	0.91	0.91	0.95	0.95	1.00	1.00	1.00	1.00
Fr t					0.981							
Flt Protected							0.950	0.997				
Satd. Flow (prot)	0	0	0	0	4989	0	1665	1747	0	0	0	0
Flt Permitted							0.950	0.997				
Satd. Flow (perm)	0	0	0	0	4989	0	1665	1747	0	0	0	0
Right Turn on Red			Yes			Yes	Yes		Yes			Yes
Satd. Flow (RTOR)					62		23	23				
Link Speed (mph)		45			45			35				35
Link Distance (ft)		250			1466			303				507
Travel Time (s)		3.8			22.2			5.9				9.9
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
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	0	2429	348	327	489	0	0	0	0
Shared Lane Traffic (%)							10%					
Lane Group Flow (vph)	0	0	0	0	2777	0	294	522	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type					NA		Perm	NA				
Protected Phases					8			2				
Permitted Phases								2				
Minimum Split (s)					22.5		22.5	22.5				
Total Split (s)					44.2		25.8	25.8				
Total Split (%)					63.1%		36.9%	36.9%				
Maximum Green (s)					39.7		21.3	21.3				
Yellow Time (s)					3.5		3.5	3.5				
All-Red Time (s)					1.0		1.0	1.0				
Lost Time Adjust (s)					0.0		0.0	0.0				
Total Lost Time (s)					4.5		4.5	4.5				
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)					7.0		7.0	7.0				
Flash Dont Walk (s)					11.0		11.0	11.0				
Pedestrian Calls (#/hr)					0		0	0				
Act Effct Green (s)					39.7		21.3	21.3				
Actuated g/C Ratio					0.57		0.30	0.30				
v/c Ratio					0.97		0.56	0.95				
Control Delay					27.1		19.8	50.6				
Queue Delay					18.4		0.6	12.4				

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

Lane Group	Ø4	Ø6
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	4	6
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	44.2	25.8
Total Split (%)	63%	37%
Maximum Green (s)	39.7	21.3
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

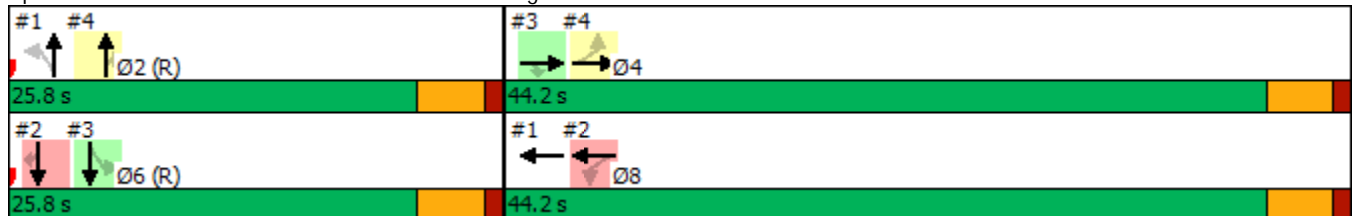


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay					45.5		20.4	63.0				
LOS					D		C	E				
Approach Delay					45.5			47.6				
Approach LOS					D			D				
Queue Length 50th (ft)					376		81	234				
Queue Length 95th (ft)					#545		m127	m#418				
Internal Link Dist (ft)		170			1386			223			427	
Turn Bay Length (ft)												
Base Capacity (vph)					2856		522	547				
Starvation Cap Reductn					0		53	32				
Spillback Cap Reductn					192		0	0				
Storage Cap Reductn					0		0	0				
Reduced v/c Ratio					1.04		0.63	1.01				

Intersection Summary

Area Type:	Other
Cycle Length:	70
Actuated Cycle Length:	70
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	70
Control Type:	Pretimed
Maximum v/c Ratio:	0.97
Intersection Signal Delay:	46.0
Intersection LOS:	D
Intersection Capacity Utilization:	131.9%
ICU Level of Service:	H
Analysis Period (min):	15
#	95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
m	Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Research Forest Drive & Grogans Mill Road



Lanes, Volumes, Timings  
1: Research Forest Drive & Grogans Mill Road

Lane Group	Ø4	Ø6
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



## Lanes, Volumes, Timings 2: Research Forest Drive & Grogans Mill Road

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑						↑↑	↑
Traffic Volume (vph)	0	0	0	471	2065	0	0	0	0	0	379	247
Future Volume (vph)	0	0	0	471	2065	0	0	0	0	0	379	247
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	15
Storage Length (ft)	0		0	0		0	0		0	0		200
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Fr <sub>t</sub>												0.850
Fl <sub>t</sub> Protected					0.991							
Satd. Flow (prot)	0	0	0	0	4991	0	0	0	0	0	3505	1725
Fl <sub>t</sub> Permitted					0.991							
Satd. Flow (perm)	0	0	0	0	4991	0	0	0	0	0	3505	1725
Right Turn on Red			Yes	Yes		Yes			Yes			Yes
Satd. Flow (RTOR)					122							23
Link Speed (mph)		45			35			35			35	
Link Distance (ft)		1533			250			305			542	
Travel Time (s)		23.2			4.9			5.9			10.6	
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
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	512	2245	0	0	0	0	0	412	268
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	2757	0	0	0	0	0	412	268
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Perm	NA						NA	Perm
Protected Phases					8						6	
Permitted Phases				8								6
Minimum Split (s)				22.5	22.5						22.5	22.5
Total Split (s)				44.2	44.2						25.8	25.8
Total Split (%)				63.1%	63.1%						36.9%	36.9%
Maximum Green (s)				39.7	39.7						21.3	21.3
Yellow Time (s)				3.5	3.5						3.5	3.5
All-Red Time (s)				1.0	1.0						1.0	1.0
Lost Time Adjust (s)					0.0						0.0	0.0
Total Lost Time (s)					4.5						4.5	4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				7.0	7.0						7.0	7.0
Flash Dont Walk (s)				11.0	11.0						11.0	11.0
Pedestrian Calls (#/hr)				0	0						0	0
Act Effect Green (s)					39.7						21.3	21.3

## Lanes, Volumes, Timings

### 2: Research Forest Drive & Grogans Mill Road

Lane Group	Ø2	Ø4
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Width (ft)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	4
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	25.8	44.2
Total Split (%)	37%	63%
Maximum Green (s)	21.3	39.7
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		

# Lanes, Volumes, Timings

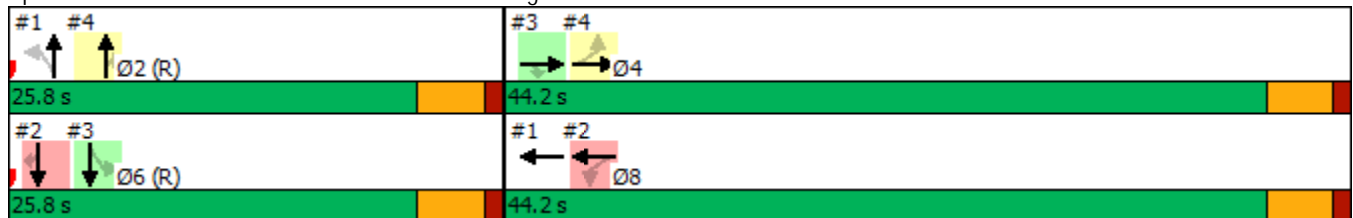
## 2: Research Forest Drive & Grogans Mill Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio					0.57						0.30	0.30
v/c Ratio					0.96						0.39	0.50
Control Delay					11.0						20.5	21.9
Queue Delay					18.8						0.1	0.0
Total Delay					29.8						20.6	21.9
LOS					C						C	C
Approach Delay					29.8						21.2	
Approach LOS					C						C	
Queue Length 50th (ft)					91						72	85
Queue Length 95th (ft)					m108						110	152
Internal Link Dist (ft)		1453			170			225			462	
Turn Bay Length (ft)												200
Base Capacity (vph)					2883						1066	540
Starvation Cap Reductn					232						0	0
Spillback Cap Reductn					1						125	0
Storage Cap Reductn					0						0	0
Reduced v/c Ratio					1.04						0.44	0.50

Intersection Summary	
Area Type:	Other
Cycle Length:	70
Actuated Cycle Length:	70
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	70
Control Type:	Pretimed
Maximum v/c Ratio:	0.97
Intersection Signal Delay:	28.1
Intersection LOS:	C
Intersection Capacity Utilization:	72.3%
ICU Level of Service:	C
Analysis Period (min):	15
m Volume for 95th percentile queue is metered by upstream signal.	

### Splits and Phases: 2: Research Forest Drive & Grogans Mill Road















## Lanes, Volumes, Timings 2: Research Forest Drive & Grogans Mill Road

Synchro 11 Report

Lane Group	Ø2	Ø4
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
3: Grogans Mills Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↗								↖↑	
Traffic Volume (vph)	0	1903	746	0	0	0	0	0	0	74	776	0
Future Volume (vph)	0	1903	746	0	0	0	0	0	0	74	776	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		150	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00
Frt			0.850									
Flt Protected												0.996
Satd. Flow (prot)	0	4940	1538	0	0	0	0	0	0	0	3491	0
Flt Permitted												0.996
Satd. Flow (perm)	0	4940	1538	0	0	0	0	0	0	0	3491	0
Right Turn on Red			Yes			Yes			Yes	Yes		Yes
Satd. Flow (RTOR)			25									23
Link Speed (mph)		45			45			35				35
Link Distance (ft)		1511			253			457				305
Travel Time (s)		22.9			3.8			8.9				5.9
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
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	2068	811	0	0	0	0	0	0	80	843	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	2068	811	0	0	0	0	0	0	0	923	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA	Perm							Perm	NA	
Protected Phases		4									6	
Permitted Phases			4							6		
Minimum Split (s)		22.5	22.5							22.5	22.5	
Total Split (s)		44.2	44.2							25.8	25.8	
Total Split (%)		63.1%	63.1%							36.9%	36.9%	
Maximum Green (s)		39.7	39.7							21.3	21.3	
Yellow Time (s)		3.5	3.5							3.5	3.5	
All-Red Time (s)		1.0	1.0							1.0	1.0	
Lost Time Adjust (s)		0.0	0.0								0.0	
Total Lost Time (s)		4.5	4.5								4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		7.0	7.0							7.0	7.0	
Flash Dont Walk (s)		11.0	11.0							11.0	11.0	
Pedestrian Calls (#/hr)		0	0							0	0	
Act Effect Green (s)		39.7	39.7								21.3	
Actuated g/C Ratio		0.57	0.57								0.30	

# Lanes, Volumes, Timings

## 3: Grogans Mills Road & Research Forest Drive

Lane Group	Ø2	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphp)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	25.8	44.2
Total Split (%)	37%	63%
Maximum Green (s)	21.3	39.7
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		
Actuated g/C Ratio		

Lanes, Volumes, Timings  
 3: Grogans Mills Road & Research Forest Drive

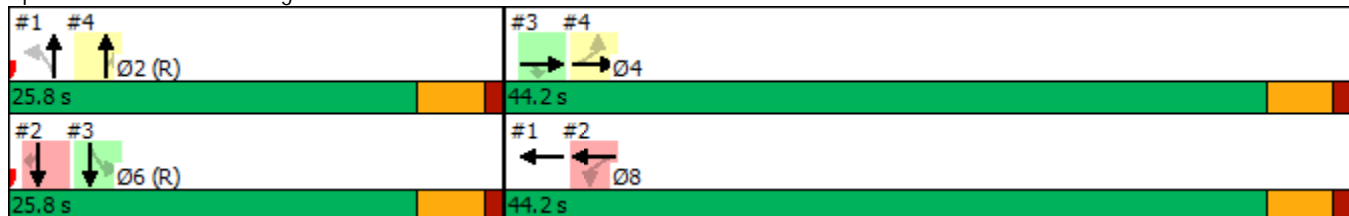


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.74	0.92									0.86
Control Delay		13.3	31.7									24.1
Queue Delay		0.0	0.0									0.8
Total Delay		13.3	31.7									24.9
LOS		B	C									C
Approach Delay		18.5										24.9
Approach LOS		B										C
Queue Length 50th (ft)		220	279									134
Queue Length 95th (ft)		276	#541									m163
Internal Link Dist (ft)		1431				173		377				225
Turn Bay Length (ft)			150									
Base Capacity (vph)		2801	883									1078
Starvation Cap Reductn		0	0									32
Spillback Cap Reductn		0	0									0
Storage Cap Reductn		0	0									0
Reduced v/c Ratio		0.74	0.92									0.88

Intersection Summary

Area Type: Other  
 Cycle Length: 70  
 Actuated Cycle Length: 70  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.97  
 Intersection Signal Delay: 20.0  
 Intersection LOS: C  
 Intersection Capacity Utilization 77.3%  
 ICU Level of Service D  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Grogans Mills Road & Research Forest Drive



Lane Group	Ø2	Ø8
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



# Lanes, Volumes, Timings

## 4: Grogans Mill Road & Research Forest Drive

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑						↑↑	↑			
Traffic Volume (vph)	216	1791	0	0	0	0	0	234	222	0	0	0
Future Volume (vph)	216	1791	0	0	0	0	0	234	222	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Fr t									0.850			
Flt Protected		0.995										
Satd. Flow (prot)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Flt Permitted		0.995										
Satd. Flow (perm)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Right Turn on Red	Yes		Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		50							23			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		253			1475			442				303
Travel Time (s)		3.8			22.3			8.6				5.9
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
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	235	1947	0	0	0	0	0	254	241	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	2182	0	0	0	0	0	254	241	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Perm	NA						NA	Perm			
Protected Phases		4						2				
Permitted Phases	4								2			
Minimum Split (s)	22.5	22.5						22.5	22.5			
Total Split (s)	44.2	44.2						25.8	25.8			
Total Split (%)	63.1%	63.1%						36.9%	36.9%			
Maximum Green (s)	39.7	39.7						21.3	21.3			
Yellow Time (s)	3.5	3.5						3.5	3.5			
All-Red Time (s)	1.0	1.0						1.0	1.0			
Lost Time Adjust (s)		0.0						0.0	0.0			
Total Lost Time (s)		4.5						4.5	4.5			
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	7.0	7.0						7.0	7.0			
Flash Dont Walk (s)	11.0	11.0						11.0	11.0			
Pedestrian Calls (#/hr)	0	0						0	0			
Act Effct Green (s)		39.7						21.3	21.3			
Actuated g/C Ratio		0.57						0.30	0.30			
v/c Ratio		0.76						0.24	0.49			
Control Delay		3.3						19.0	22.0			
Queue Delay		0.0						0.1	0.0			

Lanes, Volumes, Timings  
 4: Grogans Mill Road & Research Forest Drive

Lane Group	Ø6	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	6	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	25.8	44.2
Total Split (%)	37%	63%
Maximum Green (s)	21.3	39.7
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		

Lanes, Volumes, Timings  
 4: Grogans Mill Road & Research Forest Drive

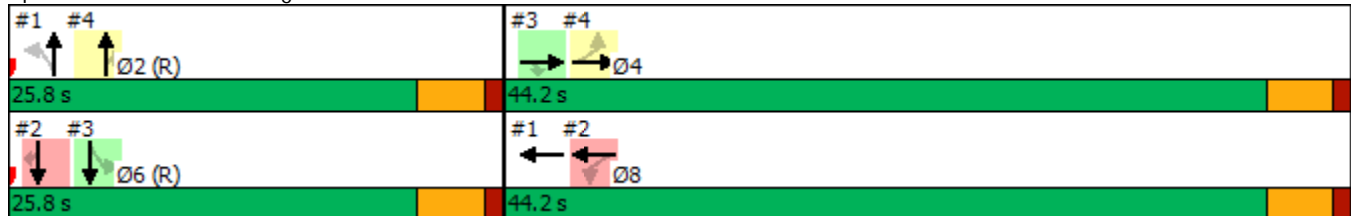


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		3.3						19.1	22.0			
LOS		A						B	C			
Approach Delay		3.3						20.5				
Approach LOS		A						C				
Queue Length 50th (ft)		32						42	75			
Queue Length 95th (ft)		31						70	140			
Internal Link Dist (ft)		173			1395			362			223	
Turn Bay Length (ft)												
Base Capacity (vph)		2863						1066	493			
Starvation Cap Reductn		16						0	0			
Spillback Cap Reductn		14						215	0			
Storage Cap Reductn		0						0	0			
Reduced v/c Ratio		0.77						0.30	0.49			

Intersection Summary













Area Type:	Other
Cycle Length:	70
Actuated Cycle Length:	70
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	70
Control Type:	Pretimed
Maximum v/c Ratio:	0.97
Intersection Signal Delay:	6.5
Intersection LOS:	A
Intersection Capacity Utilization	104.5%
ICU Level of Service	G
Analysis Period (min)	15

Splits and Phases: 4: Grogans Mill Road & Research Forest Drive



Lane Group	Ø6	Ø8
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

													
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations					↑↑↑		↑	↑					
Traffic Volume (vph)	0	0	0	0	1987	176	785	453	0	0	0	0	
Future Volume (vph)	0	0	0	0	1987	176	785	453	0	0	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Util. Factor	1.00	1.00	1.00	1.00	0.91	0.91	0.95	0.95	1.00	1.00	1.00	1.00	
Fr t	0.988												
Flt Protected							0.950	0.986					
Satd. Flow (prot)	0	0	0	0	5024	0	1665	1728	0	0	0	0	
Flt Permitted							0.950	0.986					
Satd. Flow (perm)	0	0	0	0	5024	0	1665	1728	0	0	0	0	
Right Turn on Red	Yes						Yes	Yes	Yes			Yes	
Satd. Flow (RTOR)					25	18		18					
Link Speed (mph)					45	45		35	35				
Link Distance (ft)					250	1466		303	507				
Travel Time (s)					3.8	22.2		5.9	9.9				
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	
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	3%	3%	3%	3%	3%	
Adj. Flow (vph)	0	0	0	0	2160	191	853	492	0	0	0	0	
Shared Lane Traffic (%)							23%						
Lane Group Flow (vph)	0	0	0	0	2351	0	657	688	0	0	0	0	
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No	
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right	
Median Width(ft)					0	0		12	12				
Link Offset(ft)					0	0		0	0				
Crosswalk Width(ft)					16	16		16	16				
Two way Left Turn Lane													
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Turning Speed (mph)	15	9		15	9		15	9		15	9		
Turn Type					NA	Perm		NA					
Protected Phases					8			2					
Permitted Phases							2						
Minimum Split (s)					22.5	22.5		22.5					
Total Split (s)					53.0	37.0		37.0					
Total Split (%)					58.9%	41.1%		41.1%					
Maximum Green (s)					48.5	32.5		32.5					
Yellow Time (s)					3.5	3.5		3.5					
All-Red Time (s)					1.0	1.0		1.0					
Lost Time Adjust (s)					0.0	0.0		0.0					
Total Lost Time (s)					4.5	4.5		4.5					
Lead/Lag													
Lead-Lag Optimize?													
Walk Time (s)					7.0	7.0		7.0					
Flash Dont Walk (s)					11.0	11.0		11.0					
Pedestrian Calls (#/hr)					0	0		0					
Act Effct Green (s)					48.5	32.5		32.5					
Actuated g/C Ratio					0.54	0.36		0.36					
v/c Ratio					0.86	1.07		1.08					
Control Delay					22.1	85.1		87.7					
Queue Delay					20.4	13.9		10.0					

# Lanes, Volumes, Timings

## 1: Research Forest Drive & Grogans Mill Road

Lane Group	Ø4	Ø6
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	4	6
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	53.0	37.0
Total Split (%)	59%	41%
Maximum Green (s)	48.5	32.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

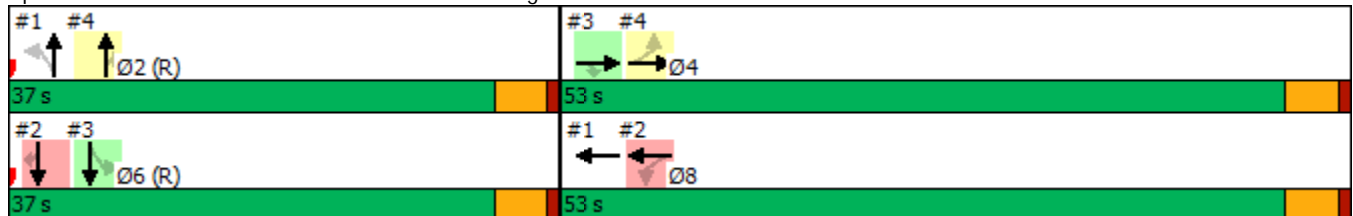


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay					42.5		98.9	97.8				
LOS					D		F	F				
Approach Delay					42.5			98.3				
Approach LOS					D			F				
Queue Length 50th (ft)					394		-437	-463				
Queue Length 95th (ft)					470		#664	#691				
Internal Link Dist (ft)		170			1386			223			427	
Turn Bay Length (ft)												
Base Capacity (vph)					2718		612	635				
Starvation Cap Reductn					0		77	81				
Spillback Cap Reductn					450		216	224				
Storage Cap Reductn					0		0	0				
Reduced v/c Ratio					1.04		1.66	1.67				

Intersection Summary

Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	90
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	90
Control Type:	Pretimed
Maximum v/c Ratio:	1.11
Intersection Signal Delay:	62.8
Intersection LOS:	E
Intersection Capacity Utilization	144.0%
ICU Level of Service	H
Analysis Period (min)	15
~ 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.	

Splits and Phases: 1: Research Forest Drive & Grogans Mill Road



Lanes, Volumes, Timings  
1: Research Forest Drive & Grogans Mill Road

Lane Group	Ø4	Ø6
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



# Lanes, Volumes, Timings

## 2: Research Forest Drive & Grogans Mill Road

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑						↑↑	↑
Traffic Volume (vph)	0	0	0	231	2541	0	0	0	0	0	339	336
Future Volume (vph)	0	0	0	231	2541	0	0	0	0	0	339	336
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	15
Storage Length (ft)	0		0	0		0	0		0	0		200
Storage Lanes	0		0	0		0	0		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	0.91	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Fr <sub>t</sub>												0.850
Fl <sub>t</sub> Protected					0.996							
Satd. Flow (prot)	0	0	0	0	5016	0	0	0	0	0	3505	1725
Fl <sub>t</sub> Permitted					0.996							
Satd. Flow (perm)	0	0	0	0	5016	0	0	0	0	0	3505	1725
Right Turn on Red			Yes	Yes		Yes			Yes			Yes
Satd. Flow (RTOR)					26							18
Link Speed (mph)		45			35			35			35	
Link Distance (ft)		1533			250			305			542	
Travel Time (s)		23.2			4.9			5.9			10.6	
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
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	251	2762	0	0	0	0	0	368	365
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	3013	0	0	0	0	0	368	365
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Perm	NA						NA	Perm
Protected Phases					8						6	
Permitted Phases				8								6
Minimum Split (s)				22.5	22.5						22.5	22.5
Total Split (s)				53.0	53.0						37.0	37.0
Total Split (%)				58.9%	58.9%						41.1%	41.1%
Maximum Green (s)				48.5	48.5						32.5	32.5
Yellow Time (s)				3.5	3.5						3.5	3.5
All-Red Time (s)				1.0	1.0						1.0	1.0
Lost Time Adjust (s)					0.0						0.0	0.0
Total Lost Time (s)					4.5						4.5	4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				7.0	7.0						7.0	7.0
Flash Dont Walk (s)				11.0	11.0						11.0	11.0
Pedestrian Calls (#/hr)				0	0						0	0
Act Effect Green (s)					48.5						32.5	32.5

## Lanes, Volumes, Timings

### 2: Research Forest Drive & Grogans Mill Road

Lane Group	Ø2	Ø4
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Width (ft)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	4
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	37.0	53.0
Total Split (%)	41%	59%
Maximum Green (s)	32.5	48.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		

# Lanes, Volumes, Timings

## 2: Research Forest Drive & Grogans Mill Road

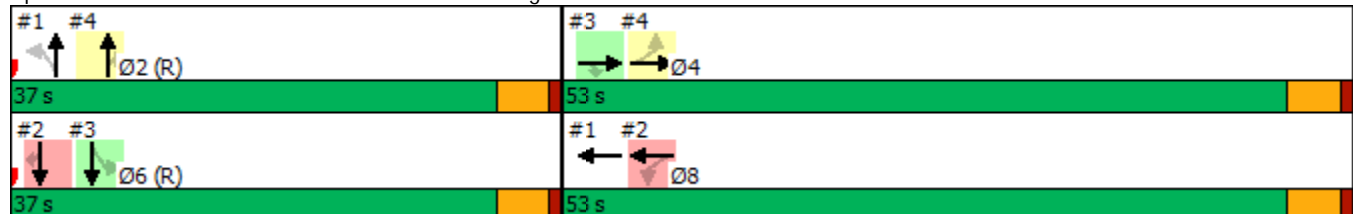


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio					0.54						0.36	0.36
v/c Ratio					1.11						0.29	0.58
Control Delay					68.6						21.3	26.3
Queue Delay					0.1						0.0	0.0
Total Delay					68.8						21.3	26.3
LOS					E						C	C
Approach Delay					68.8						23.8	
Approach LOS					E						C	
Queue Length 50th (ft)					-734						77	156
Queue Length 95th (ft)					m#757						112	247
Internal Link Dist (ft)		1453			170			225			462	
Turn Bay Length (ft)												200
Base Capacity (vph)					2715						1265	634
Starvation Cap Reductn					160						0	0
Spillback Cap Reductn					0						33	0
Storage Cap Reductn					0						0	0
Reduced v/c Ratio					1.18						0.30	0.58

### Intersection Summary

Area Type: Other  
 Cycle Length: 90  
 Actuated Cycle Length: 90  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.11  
 Intersection Signal Delay: 60.0 Intersection LOS: E  
 Intersection Capacity Utilization 82.1% ICU Level of Service E  
 Analysis Period (min) 15  
 ~ 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.  
 m Volume for 95th percentile queue is metered by upstream signal.

### Splits and Phases: 2: Research Forest Drive & Grogans Mill Road















## Lanes, Volumes, Timings 2: Research Forest Drive & Grogans Mill Road

Synchro 11 Report

Lane Group	Ø2	Ø4
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
 3: Grogans Mills Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↑								↑↑	
Traffic Volume (vph)	0	1811	444	0	0	0	0	0	0	90	480	0
Future Volume (vph)	0	1811	444	0	0	0	0	0	0	90	480	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		150	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00
Frt			0.850									
Flt Protected											0.992	
Satd. Flow (prot)	0	4940	1538	0	0	0	0	0	0	0	3477	0
Flt Permitted											0.992	
Satd. Flow (perm)	0	4940	1538	0	0	0	0	0	0	0	3477	0
Right Turn on Red			Yes			Yes			Yes	Yes		Yes
Satd. Flow (RTOR)			163									18
Link Speed (mph)		45			45			35			35	
Link Distance (ft)		1511			253			457			305	
Travel Time (s)		22.9			3.8			8.9			5.9	
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
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	1968	483	0	0	0	0	0	0	98	522	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1968	483	0	0	0	0	0	0	0	620	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA	Perm							Perm	NA	
Protected Phases		4									6	
Permitted Phases			4							6		
Minimum Split (s)		22.5	22.5							22.5	22.5	
Total Split (s)		53.0	53.0							37.0	37.0	
Total Split (%)		58.9%	58.9%							41.1%	41.1%	
Maximum Green (s)		48.5	48.5							32.5	32.5	
Yellow Time (s)		3.5	3.5							3.5	3.5	
All-Red Time (s)		1.0	1.0							1.0	1.0	
Lost Time Adjust (s)		0.0	0.0								0.0	
Total Lost Time (s)		4.5	4.5								4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		7.0	7.0							7.0	7.0	
Flash Dont Walk (s)		11.0	11.0							11.0	11.0	
Pedestrian Calls (#/hr)		0	0							0	0	
Act Effect Green (s)		48.5	48.5								32.5	
Actuated g/C Ratio		0.54	0.54								0.36	

# Lanes, Volumes, Timings

## 3: Grogans Mills Road & Research Forest Drive

Lane Group	Ø2	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphp)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	37.0	53.0
Total Split (%)	41%	59%
Maximum Green (s)	32.5	48.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		
Actuated g/C Ratio		

Lanes, Volumes, Timings  
 3: Grogans Mills Road & Research Forest Drive

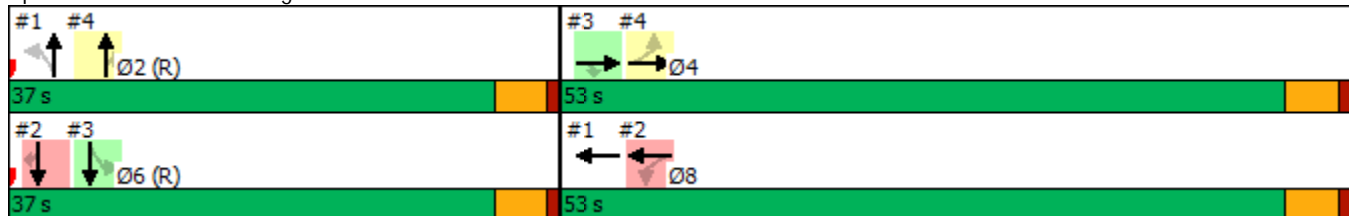


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.74	0.53									0.49
Control Delay		18.1	11.0									14.2
Queue Delay		0.0	0.0									0.4
Total Delay		18.1	11.0									14.5
LOS		B	B									B
Approach Delay		16.7										14.5
Approach LOS		B										B
Queue Length 50th (ft)		295	105									85
Queue Length 95th (ft)		354	191									m97
Internal Link Dist (ft)		1431				173			377			225
Turn Bay Length (ft)			150									
Base Capacity (vph)		2662	903									1267
Starvation Cap Reductn		0	0									229
Spillback Cap Reductn		0	0									0
Storage Cap Reductn		0	0									0
Reduced v/c Ratio		0.74	0.53									0.60

Intersection Summary

Area Type: Other  
 Cycle Length: 90  
 Actuated Cycle Length: 90  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.11  
 Intersection Signal Delay: 16.2  
 Intersection LOS: B  
 Intersection Capacity Utilization 58.4%  
 ICU Level of Service B  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.













Splits and Phases: 3: Grogans Mills Road & Research Forest Drive



Lane Group	Ø2	Ø8
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



Lanes, Volumes, Timings  
4: Grogans Mill Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑						↑↑	↑			
Traffic Volume (vph)	191	1710	0	0	0	0	0	262	362	0	0	0
Future Volume (vph)	191	1710	0	0	0	0	0	262	362	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Fr t									0.850			
Flt Protected		0.995										
Satd. Flow (prot)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Flt Permitted		0.995										
Satd. Flow (perm)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Right Turn on Red	Yes		Yes				Yes		Yes			Yes
Satd. Flow (RTOR)		33							18			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		253			1475			442				303
Travel Time (s)		3.8			22.3			8.6				5.9
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
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	208	1859	0	0	0	0	0	285	393	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	2067	0	0	0	0	0	285	393	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Perm	NA						NA	Perm			
Protected Phases		4						2				
Permitted Phases	4								2			
Minimum Split (s)	22.5	22.5						22.5	22.5			
Total Split (s)	53.0	53.0						37.0	37.0			
Total Split (%)	58.9%	58.9%						41.1%	41.1%			
Maximum Green (s)	48.5	48.5						32.5	32.5			
Yellow Time (s)	3.5	3.5						3.5	3.5			
All-Red Time (s)	1.0	1.0						1.0	1.0			
Lost Time Adjust (s)		0.0						0.0	0.0			
Total Lost Time (s)		4.5						4.5	4.5			
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	7.0	7.0						7.0	7.0			
Flash Dont Walk (s)	11.0	11.0						11.0	11.0			
Pedestrian Calls (#/hr)	0	0						0	0			
Act Effct Green (s)		48.5						32.5	32.5			
Actuated g/C Ratio		0.54						0.36	0.36			
v/c Ratio		0.76						0.23	0.68			
Control Delay		4.1						20.6	30.3			
Queue Delay		0.6						0.1	0.0			

# Lanes, Volumes, Timings

## 4: Grogans Mill Road & Research Forest Drive

Lane Group	Ø6	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	6	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	37.0	53.0
Total Split (%)	41%	59%
Maximum Green (s)	32.5	48.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		

Lanes, Volumes, Timings  
 4: Grogans Mill Road & Research Forest Drive

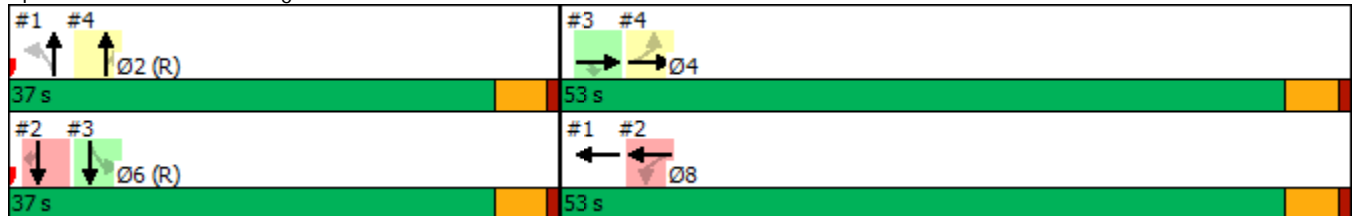


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		4.7						20.7	30.3			
LOS		A						C	C			
Approach Delay		4.7						26.3				
Approach LOS		A						C				
Queue Length 50th (ft)		37						58	178			
Queue Length 95th (ft)		42						88	283			
Internal Link Dist (ft)		173			1395			362			223	
Turn Bay Length (ft)												
Base Capacity (vph)		2715						1265	577			
Starvation Cap Reductn		30						0	0			
Spillback Cap Reductn		279						221	0			
Storage Cap Reductn		0						0	0			
Reduced v/c Ratio		0.85						0.27	0.68			

Intersection Summary













Area Type:	Other
Cycle Length:	90
Actuated Cycle Length:	90
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	90
Control Type:	Pretimed
Maximum v/c Ratio:	1.11
Intersection Signal Delay:	10.0
Intersection LOS:	B
Intersection Capacity Utilization	103.1%
ICU Level of Service	G
Analysis Period (min)	15

Splits and Phases: 4: Grogans Mill Road & Research Forest Drive



Lane Group	Ø6	Ø8
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑↑	↗	↘↘	↑↑				
Traffic Volume (vph)	0	0	0	0	2004	282	265	392	0	0	0	0
Future Volume (vph)	0	0	0	0	2004	282	265	392	0	0	0	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		200	0		0	0		0
Storage Lanes	0		0	0		1	2		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.86	1.00	0.97	0.95	1.00	1.00	1.00	1.00
Frt						0.850						
Flt Protected							0.950					
Satd. Flow (prot)	0	0	0	0	6408	1583	3400	3505	0	0	0	0
Flt Permitted							0.950					
Satd. Flow (perm)	0	0	0	0	6408	1583	3400	3505	0	0	0	0
Right Turn on Red			Yes			Yes	Yes		Yes			Yes
Satd. Flow (RTOR)						178	27					
Link Speed (mph)		45			45			35				35
Link Distance (ft)		250			1466			303				507
Travel Time (s)		3.8			22.2			5.9				9.9
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
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	0	2178	307	288	426	0	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	2178	307	288	426	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			24				24
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type					NA	Perm	Perm	NA				
Protected Phases					8			2				
Permitted Phases						8	2					
Minimum Split (s)					22.5	22.5	22.5	22.5				
Total Split (s)					37.0	37.0	23.0	23.0				
Total Split (%)					61.7%	61.7%	38.3%	38.3%				
Maximum Green (s)					32.5	32.5	18.5	18.5				
Yellow Time (s)					3.5	3.5	3.5	3.5				
All-Red Time (s)					1.0	1.0	1.0	1.0				
Lost Time Adjust (s)					0.0	0.0	0.0	0.0				
Total Lost Time (s)					4.5	4.5	4.5	4.5				
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)					7.0	7.0	7.0	7.0				
Flash Dont Walk (s)					11.0	11.0	11.0	11.0				
Pedestrian Calls (#/hr)					0	0	0	0				
Act Effct Green (s)					32.5	32.5	18.5	18.5				
Actuated g/C Ratio					0.54	0.54	0.31	0.31				

# Lanes, Volumes, Timings

## 1: Research Forest Drive & Grogans Mill Road

Lane Group	Ø4	Ø6
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphp)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	4	6
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	37.0	23.0
Total Split (%)	62%	38%
Maximum Green (s)	32.5	18.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		
Actuated g/C Ratio		

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

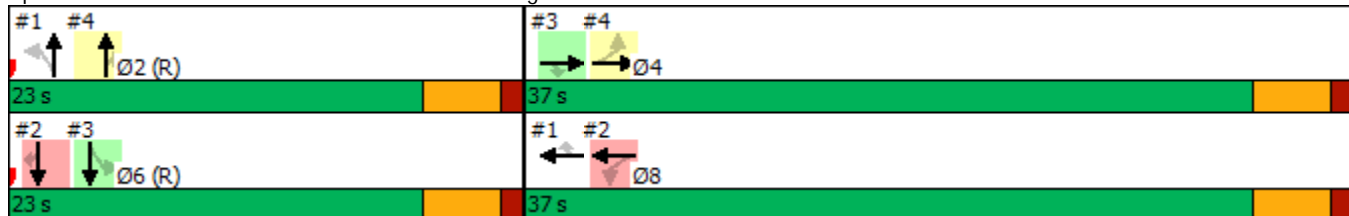


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio					0.63	0.33	0.27	0.39				
Control Delay					10.6	4.3	12.0	14.4				
Queue Delay					0.0	0.0	0.0	0.0				
Total Delay					10.6	4.3	12.0	14.4				
LOS					B	A	B	B				
Approach Delay					9.8			13.4				
Approach LOS					A			B				
Queue Length 50th (ft)					143	21	30	53				
Queue Length 95th (ft)					177	55	m50	m80				
Internal Link Dist (ft)		170			1386			223			427	
Turn Bay Length (ft)						200						
Base Capacity (vph)					3471	939	1067	1080				
Starvation Cap Reductn					0	0	0	0				
Spillback Cap Reductn					0	0	0	0				
Storage Cap Reductn					0	0	0	0				
Reduced v/c Ratio					0.63	0.33	0.27	0.39				

Intersection Summary

Area Type: Other  
 Cycle Length: 60  
 Actuated Cycle Length: 60  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 60  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.84  
 Intersection Signal Delay: 10.6  
 Intersection LOS: B  
 Intersection Capacity Utilization 47.9%  
 ICU Level of Service A  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.

















Splits and Phases: 1: Research Forest Drive & Grogans Mill Road



Lane Group	Ø4	Ø6
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



Lanes, Volumes, Timings  
 2: Research Forest Drive & Grogans Mill Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	416	1853	0	0	0	0	0	331	218
Future Volume (vph)	0	0	0	416	1853	0	0	0	0	0	331	218
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	15
Storage Length (ft)	0		0	0		0	0		0	0		200
Storage Lanes	0		0	1		0	0		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.86	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Fr <sub>t</sub>												0.850
Fl <sub>t</sub> Protected				0.950								
Satd. Flow (prot)	0	0	0	1752	6346	0	0	0	0	0	3505	1725
Fl <sub>t</sub> Permitted				0.950								
Satd. Flow (perm)	0	0	0	1752	6346	0	0	0	0	0	3505	1725
Right Turn on Red			Yes	Yes		Yes			Yes			Yes
Satd. Flow (RTOR)				238								27
Link Speed (mph)		45			35			35			35	
Link Distance (ft)		1533			250			305			542	
Travel Time (s)		23.2			4.9			5.9			10.6	
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
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	452	2014	0	0	0	0	0	360	237
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	452	2014	0	0	0	0	0	360	237
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Perm	NA						NA	Perm
Protected Phases					8						6	
Permitted Phases				8								6
Minimum Split (s)				22.5	22.5						22.5	22.5
Total Split (s)				37.0	37.0						23.0	23.0
Total Split (%)				61.7%	61.7%						38.3%	38.3%
Maximum Green (s)				32.5	32.5						18.5	18.5
Yellow Time (s)				3.5	3.5						3.5	3.5
All-Red Time (s)				1.0	1.0						1.0	1.0
Lost Time Adjust (s)				0.0	0.0						0.0	0.0
Total Lost Time (s)				4.5	4.5						4.5	4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				7.0	7.0						7.0	7.0
Flash Dont Walk (s)				11.0	11.0						11.0	11.0
Pedestrian Calls (#/hr)				0	0						0	0
Act Effect Green (s)				32.5	32.5						18.5	18.5

## Lanes, Volumes, Timings 2: Research Forest Drive & Grogans Mill Road

Lane Group	Ø2	Ø4
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Width (ft)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	4
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	23.0	37.0
Total Split (%)	38%	62%
Maximum Green (s)	18.5	32.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		

# Lanes, Volumes, Timings

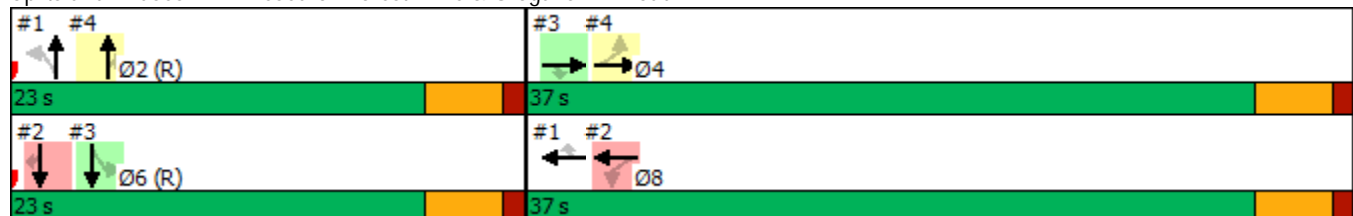
## 2: Research Forest Drive & Grogans Mill Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio				0.54	0.54						0.31	0.31
v/c Ratio				0.43	0.59						0.33	0.43
Control Delay				1.6	4.2						17.1	17.5
Queue Delay				0.3	0.1						0.0	0.0
Total Delay				1.8	4.3						17.1	17.5
LOS				A	A						B	B
Approach Delay					3.9						17.3	
Approach LOS					A						B	
Queue Length 50th (ft)				0	43						52	59
Queue Length 95th (ft)				0	51						83	114
Internal Link Dist (ft)		1453			170			225			462	
Turn Bay Length (ft)												200
Base Capacity (vph)				1058	3437						1080	550
Starvation Cap Reductn				182	342						0	0
Spillback Cap Reductn				0	0						0	0
Storage Cap Reductn				0	0						0	0
Reduced v/c Ratio				0.52	0.65						0.33	0.43

Intersection Summary	
Area Type:	Other
Cycle Length:	60
Actuated Cycle Length:	60
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	60
Control Type:	Pretimed
Maximum v/c Ratio:	0.84
Intersection Signal Delay:	6.5
Intersection LOS:	A
Intersection Capacity Utilization	47.9%
ICU Level of Service	A
Analysis Period (min)	15

Splits and Phases: 2: Research Forest Drive & Grogans Mill Road















## Lanes, Volumes, Timings 2: Research Forest Drive & Grogans Mill Road

Synchro 11 Report

Lane Group	Ø2	Ø4
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
3: Grogans Mills Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↑								↑↑	
Traffic Volume (vph)	0	1706	658	0	0	0	0	0	0	66	681	0
Future Volume (vph)	0	1706	658	0	0	0	0	0	0	66	681	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		200	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00
Frt			0.850									
Flt Protected												0.996
Satd. Flow (prot)	0	4940	1538	0	0	0	0	0	0	0	3491	0
Flt Permitted												0.996
Satd. Flow (perm)	0	4940	1538	0	0	0	0	0	0	0	3491	0
Right Turn on Red			Yes			Yes			Yes	Yes		Yes
Satd. Flow (RTOR)			43									27
Link Speed (mph)		45			45			35			35	
Link Distance (ft)		1511			253			457			305	
Travel Time (s)		22.9			3.8			8.9			5.9	
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
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	1854	715	0	0	0	0	0	0	72	740	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1854	715	0	0	0	0	0	0	0	812	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA	Perm							Perm	NA	
Protected Phases		4									6	
Permitted Phases			4							6		
Minimum Split (s)		22.5	22.5							22.5	22.5	
Total Split (s)		37.0	37.0							23.0	23.0	
Total Split (%)		61.7%	61.7%							38.3%	38.3%	
Maximum Green (s)		32.5	32.5							18.5	18.5	
Yellow Time (s)		3.5	3.5							3.5	3.5	
All-Red Time (s)		1.0	1.0							1.0	1.0	
Lost Time Adjust (s)		0.0	0.0								0.0	
Total Lost Time (s)		4.5	4.5								4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		7.0	7.0							7.0	7.0	
Flash Dont Walk (s)		11.0	11.0							11.0	11.0	
Pedestrian Calls (#/hr)		0	0							0	0	
Act Effect Green (s)		32.5	32.5								18.5	
Actuated g/C Ratio		0.54	0.54								0.31	

# Lanes, Volumes, Timings

## 3: Grogans Mills Road & Research Forest Drive

Lane Group	Ø2	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphp)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	23.0	37.0
Total Split (%)	38%	62%
Maximum Green (s)	18.5	32.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		
Actuated g/C Ratio		

Lanes, Volumes, Timings  
 3: Grogans Mills Road & Research Forest Drive

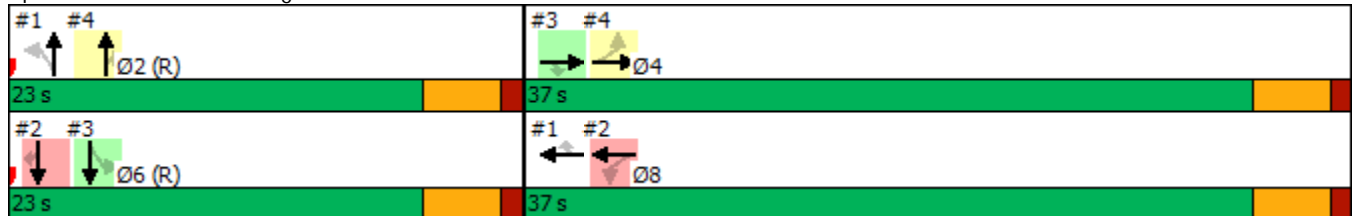


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.69	0.84									0.74
Control Delay		11.8	22.6									16.4
Queue Delay		0.0	0.0									0.0
Total Delay		11.8	22.6									16.4
LOS		B	C									B
Approach Delay		14.8										16.4
Approach LOS		B										B
Queue Length 50th (ft)		162	184									88
Queue Length 95th (ft)		210	#402									123
Internal Link Dist (ft)		1431				173			377			225
Turn Bay Length (ft)			200									
Base Capacity (vph)		2675	852									1095
Starvation Cap Reductn		0	0									0
Spillback Cap Reductn		0	0									0
Storage Cap Reductn		0	0									0
Reduced v/c Ratio		0.69	0.84									0.74

Intersection Summary

Area Type: Other  
 Cycle Length: 60  
 Actuated Cycle Length: 60  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 60  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.84  
 Intersection Signal Delay: 15.2 Intersection LOS: B  
 Intersection Capacity Utilization 69.0% ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.













Splits and Phases: 3: Grogans Mills Road & Research Forest Drive



Lane Group	Ø2	Ø8
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



Lanes, Volumes, Timings  
4: Grogans Mill Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑						↑↑	↑			
Traffic Volume (vph)	191	1581	0	0	0	0	0	201	196	0	0	0
Future Volume (vph)	191	1581	0	0	0	0	0	201	196	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Fr t									0.850			
Flt Protected		0.995										
Satd. Flow (prot)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Flt Permitted		0.995										
Satd. Flow (perm)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Right Turn on Red	Yes		Yes				Yes		Yes			Yes
Satd. Flow (RTOR)		55							27			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		253			1475			442				303
Travel Time (s)		3.8			22.3			8.6				5.9
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
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	208	1718	0	0	0	0	0	218	213	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1926	0	0	0	0	0	218	213	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Perm	NA						NA	Perm			
Protected Phases		4						2				
Permitted Phases	4								2			
Minimum Split (s)	22.5	22.5						22.5	22.5			
Total Split (s)	37.0	37.0						23.0	23.0			
Total Split (%)	61.7%	61.7%						38.3%	38.3%			
Maximum Green (s)	32.5	32.5						18.5	18.5			
Yellow Time (s)	3.5	3.5						3.5	3.5			
All-Red Time (s)	1.0	1.0						1.0	1.0			
Lost Time Adjust (s)		0.0						0.0	0.0			
Total Lost Time (s)		4.5						4.5	4.5			
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	7.0	7.0						7.0	7.0			
Flash Dont Walk (s)	11.0	11.0						11.0	11.0			
Pedestrian Calls (#/hr)	0	0						0	0			
Act Effct Green (s)		32.5						18.5	18.5			
Actuated g/C Ratio		0.54						0.31	0.31			
v/c Ratio		0.70						0.20	0.42			
Control Delay		3.0						15.9	17.5			
Queue Delay		0.0						0.0	0.0			

Lanes, Volumes, Timings  
 4: Grogans Mill Road & Research Forest Drive

Lane Group	Ø6	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	6	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	23.0	37.0
Total Split (%)	38%	62%
Maximum Green (s)	18.5	32.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		

# Lanes, Volumes, Timings

## 4: Grogans Mill Road & Research Forest Drive

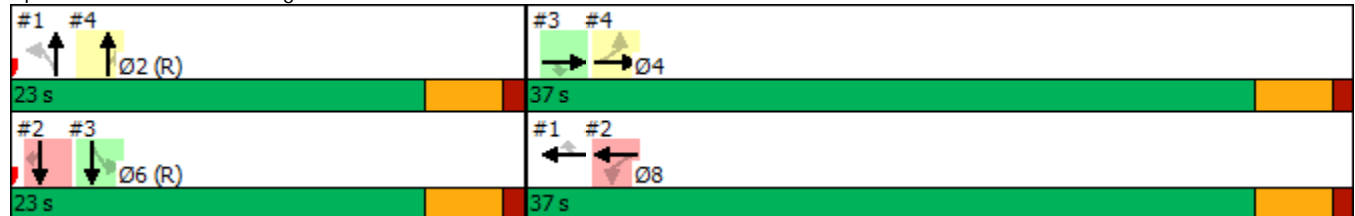


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		3.0						15.9	17.5			
LOS		A						B	B			
Approach Delay		3.0						16.7				
Approach LOS		A						B				
Queue Length 50th (ft)		15						30	52			
Queue Length 95th (ft)		23						53	105			
Internal Link Dist (ft)		173			1395			362			223	
Turn Bay Length (ft)												
Base Capacity (vph)		2739						1080	502			
Starvation Cap Reductn		29						0	0			
Spillback Cap Reductn		0						0	0			
Storage Cap Reductn		0						0	0			
Reduced v/c Ratio		0.71						0.20	0.42			

### Intersection Summary













Area Type:	Other
Cycle Length:	60
Actuated Cycle Length:	60
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	60
Control Type:	Pretimed
Maximum v/c Ratio:	0.84
Intersection Signal Delay:	5.5
Intersection LOS:	A
Intersection Capacity Utilization	54.1%
ICU Level of Service	A
Analysis Period (min)	15

### Splits and Phases: 4: Grogans Mill Road & Research Forest Drive



Lane Group	Ø6	Ø8
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
1: Research Forest Drive & Grogans Mill Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑↑	↑	↑↑	↑↑				
Traffic Volume (vph)	0	0	0	0	1782	158	693	389	0	0	0	0
Future Volume (vph)	0	0	0	0	1782	158	693	389	0	0	0	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		200	0		0	0		0
Storage Lanes	0		0	0		1	2		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.86	1.00	0.97	0.95	1.00	1.00	1.00	1.00
Frt						0.850						
Flt Protected							0.950					
Satd. Flow (prot)	0	0	0	0	6408	1583	3400	3505	0	0	0	0
Flt Permitted							0.950					
Satd. Flow (perm)	0	0	0	0	6408	1583	3400	3505	0	0	0	0
Right Turn on Red			Yes			Yes	Yes		Yes			Yes
Satd. Flow (RTOR)						172	33					
Link Speed (mph)		45			45			35				35
Link Distance (ft)		250			1466			303				507
Travel Time (s)		3.8			22.2			5.9				9.9
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
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	0	1937	172	753	423	0	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	1937	172	753	423	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			24				24
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type					NA	Perm	Perm	NA				
Protected Phases					8			2				
Permitted Phases						8	2					
Minimum Split (s)					22.5	22.5	22.5	22.5				
Total Split (s)					27.0	27.0	23.0	23.0				
Total Split (%)					54.0%	54.0%	46.0%	46.0%				
Maximum Green (s)					22.5	22.5	18.5	18.5				
Yellow Time (s)					3.5	3.5	3.5	3.5				
All-Red Time (s)					1.0	1.0	1.0	1.0				
Lost Time Adjust (s)					0.0	0.0	0.0	0.0				
Total Lost Time (s)					4.5	4.5	4.5	4.5				
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)					7.0	7.0	7.0	7.0				
Flash Dont Walk (s)					11.0	11.0	11.0	11.0				
Pedestrian Calls (#/hr)					0	0	0	0				
Act Effct Green (s)					22.5	22.5	18.5	18.5				
Actuated g/C Ratio					0.45	0.45	0.37	0.37				

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

Lane Group	Ø4	Ø6
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphp)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	4	6
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	27.0	23.0
Total Split (%)	54%	46%
Maximum Green (s)	22.5	18.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		
Actuated g/C Ratio		

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

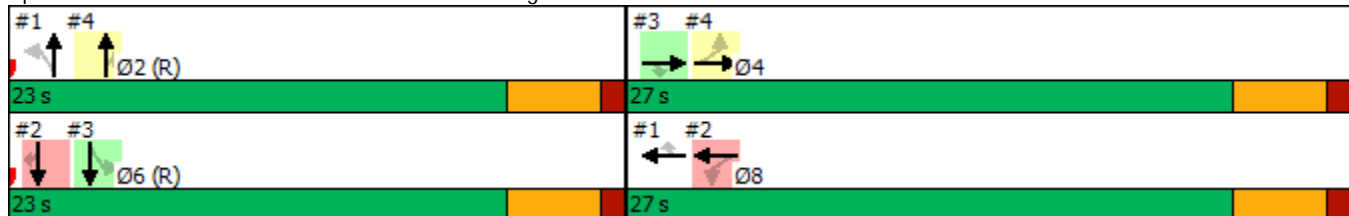


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio					0.67	0.21	0.59	0.33				
Control Delay					12.3	2.5	12.7	10.6				
Queue Delay					0.1	0.0	0.1	0.0				
Total Delay					12.4	2.5	12.8	10.6				
LOS					B	A	B	B				
Approach Delay					11.6			12.0				
Approach LOS					B			B				
Queue Length 50th (ft)					120	0	74	41				
Queue Length 95th (ft)					155	24	m108	m62				
Internal Link Dist (ft)		170			1386			223			427	
Turn Bay Length (ft)						200						
Base Capacity (vph)					2883	806	1278	1296				
Starvation Cap Reductn					0	0	66	0				
Spillback Cap Reductn					184	0	0	0				
Storage Cap Reductn					0	0	0	0				
Reduced v/c Ratio					0.72	0.21	0.62	0.33				

Intersection Summary

Area Type: Other  
 Cycle Length: 50  
 Actuated Cycle Length: 50  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 50  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.86  
 Intersection Signal Delay: 11.8 Intersection LOS: B  
 Intersection Capacity Utilization 68.8% ICU Level of Service C  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Research Forest Drive & Grogans Mill Road



















Lane Group	Ø4	Ø6
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



## Lanes, Volumes, Timings 2: Research Forest Drive & Grogans Mill Road

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	204	2271	0	0	0	0	0	295	296
Future Volume (vph)	0	0	0	204	2271	0	0	0	0	0	295	296
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	15
Storage Length (ft)	0		0	0		0	0		0	0		200
Storage Lanes	0		0	1		0	0		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.86	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Fr <sub>t</sub>												0.850
Fl <sub>t</sub> Protected				0.950								
Satd. Flow (prot)	0	0	0	1752	6346	0	0	0	0	0	3505	1725
Fl <sub>t</sub> Permitted				0.950								
Satd. Flow (perm)	0	0	0	1752	6346	0	0	0	0	0	3505	1725
Right Turn on Red			Yes	Yes		Yes			Yes			Yes
Satd. Flow (RTOR)				222								33
Link Speed (mph)		45			35			35			35	
Link Distance (ft)		1533			250			305			542	
Travel Time (s)		23.2			4.9			5.9			10.6	
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
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	222	2468	0	0	0	0	0	321	322
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	222	2468	0	0	0	0	0	321	322
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Perm	NA						NA	Perm
Protected Phases					8						6	
Permitted Phases				8								6
Minimum Split (s)				22.5	22.5						22.5	22.5
Total Split (s)				27.0	27.0						23.0	23.0
Total Split (%)				54.0%	54.0%						46.0%	46.0%
Maximum Green (s)				22.5	22.5						18.5	18.5
Yellow Time (s)				3.5	3.5						3.5	3.5
All-Red Time (s)				1.0	1.0						1.0	1.0
Lost Time Adjust (s)				0.0	0.0						0.0	0.0
Total Lost Time (s)				4.5	4.5						4.5	4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				7.0	7.0						7.0	7.0
Flash Dont Walk (s)				11.0	11.0						11.0	11.0
Pedestrian Calls (#/hr)				0	0						0	0
Act Effect Green (s)				22.5	22.5						18.5	18.5

## Lanes, Volumes, Timings

### 2: Research Forest Drive & Grogans Mill Road

Lane Group	Ø2	Ø4
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Width (ft)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	4
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	23.0	27.0
Total Split (%)	46%	54%
Maximum Green (s)	18.5	22.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		

Lanes, Volumes, Timings  
 2: Research Forest Drive & Grogans Mill Road

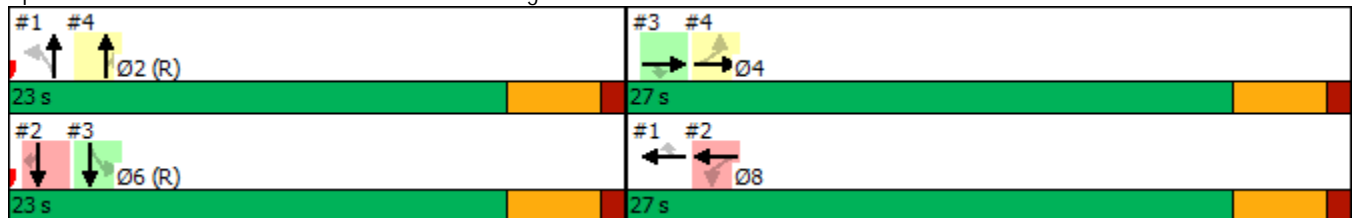


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio				0.45	0.45						0.37	0.37
v/c Ratio				0.24	0.86						0.25	0.49
Control Delay				1.1	10.6						11.6	13.9
Queue Delay				0.2	0.4						0.0	0.0
Total Delay				1.3	10.9						11.6	13.9
LOS				A	B						B	B
Approach Delay					10.1						12.7	
Approach LOS					B						B	
Queue Length 50th (ft)				1	86						33	62
Queue Length 95th (ft)				m5	99						56	120
Internal Link Dist (ft)		1453			170			225			462	
Turn Bay Length (ft)												200
Base Capacity (vph)				910	2855						1296	659
Starvation Cap Reductn				255	86						0	0
Spillback Cap Reductn				0	0						0	0
Storage Cap Reductn				0	0						0	0
Reduced v/c Ratio				0.34	0.89						0.25	0.49

Intersection Summary













Area Type: Other  
 Cycle Length: 50  
 Actuated Cycle Length: 50  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 50  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.86  
 Intersection Signal Delay: 10.6 Intersection LOS: B  
 Intersection Capacity Utilization 75.2% ICU Level of Service D  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Research Forest Drive & Grogans Mill Road



Lane Group	Ø2	Ø4
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
3: Grogans Mills Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↗								↖↑	
Traffic Volume (vph)	0	1624	392	0	0	0	0	0	0	80	419	0
Future Volume (vph)	0	1624	392	0	0	0	0	0	0	80	419	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		200	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00
Frt			0.850									
Flt Protected											0.992	
Satd. Flow (prot)	0	4940	1538	0	0	0	0	0	0	0	3477	0
Flt Permitted											0.992	
Satd. Flow (perm)	0	4940	1538	0	0	0	0	0	0	0	3477	0
Right Turn on Red			Yes			Yes			Yes	Yes		Yes
Satd. Flow (RTOR)			219									33
Link Speed (mph)		45			45			35			35	
Link Distance (ft)		1511			253			457			305	
Travel Time (s)		22.9			3.8			8.9			5.9	
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
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	1765	426	0	0	0	0	0	0	87	455	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1765	426	0	0	0	0	0	0	0	542	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA	Perm							Perm	NA	
Protected Phases		4									6	
Permitted Phases			4							6		
Minimum Split (s)		22.5	22.5							22.5	22.5	
Total Split (s)		27.0	27.0							23.0	23.0	
Total Split (%)		54.0%	54.0%							46.0%	46.0%	
Maximum Green (s)		22.5	22.5							18.5	18.5	
Yellow Time (s)		3.5	3.5							3.5	3.5	
All-Red Time (s)		1.0	1.0							1.0	1.0	
Lost Time Adjust (s)		0.0	0.0								0.0	
Total Lost Time (s)		4.5	4.5								4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		7.0	7.0							7.0	7.0	
Flash Dont Walk (s)		11.0	11.0							11.0	11.0	
Pedestrian Calls (#/hr)		0	0							0	0	
Act Effect Green (s)		22.5	22.5								18.5	
Actuated g/C Ratio		0.45	0.45								0.37	

# Lanes, Volumes, Timings

## 3: Grogans Mills Road & Research Forest Drive

Lane Group	Ø2	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphp)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	23.0	27.0
Total Split (%)	46%	54%
Maximum Green (s)	18.5	22.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		
Actuated g/C Ratio		

Lanes, Volumes, Timings  
 3: Grogans Mills Road & Research Forest Drive

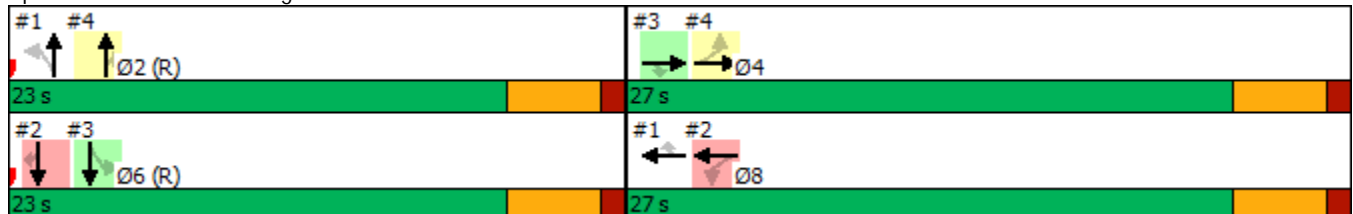


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.79	0.52									0.41
Control Delay		15.1	7.4									6.7
Queue Delay		0.0	0.0									0.0
Total Delay		15.1	7.4									6.7
LOS		B	A									A
Approach Delay		13.6										6.7
Approach LOS		B										A
Queue Length 50th (ft)		150	36									32
Queue Length 95th (ft)		202	93									45
Internal Link Dist (ft)		1431				173		377				225
Turn Bay Length (ft)			200									
Base Capacity (vph)		2223	812									1307
Starvation Cap Reductn		0	0									0
Spillback Cap Reductn		0	0									0
Storage Cap Reductn		0	0									0
Reduced v/c Ratio		0.79	0.52									0.41

Intersection Summary

Area Type:	Other
Cycle Length:	50
Actuated Cycle Length:	50
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	50
Control Type:	Pretimed
Maximum v/c Ratio:	0.86
Intersection Signal Delay:	12.2
Intersection LOS:	B
Intersection Capacity Utilization	52.8%
ICU Level of Service	A
Analysis Period (min)	15

Splits and Phases: 3: Grogans Mills Road & Research Forest Drive















Lane Group	Ø2	Ø8
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



# Lanes, Volumes, Timings

## 4: Grogans Mill Road & Research Forest Drive

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑						↑↑	↑			
Traffic Volume (vph)	169	1535	0	0	0	0	0	220	320	0	0	0
Future Volume (vph)	169	1535	0	0	0	0	0	220	320	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Fr t									0.850			
Flt Protected		0.995										
Satd. Flow (prot)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Flt Permitted		0.995										
Satd. Flow (perm)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Right Turn on Red	Yes		Yes				Yes		Yes			Yes
Satd. Flow (RTOR)		49							33			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		253			1475			442				303
Travel Time (s)		3.8			22.3			8.6				5.9
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
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	184	1668	0	0	0	0	0	239	348	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1852	0	0	0	0	0	239	348	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Perm	NA						NA	Perm			
Protected Phases		4						2				
Permitted Phases	4								2			
Minimum Split (s)	22.5	22.5						22.5	22.5			
Total Split (s)	27.0	27.0						23.0	23.0			
Total Split (%)	54.0%	54.0%						46.0%	46.0%			
Maximum Green (s)	22.5	22.5						18.5	18.5			
Yellow Time (s)	3.5	3.5						3.5	3.5			
All-Red Time (s)	1.0	1.0						1.0	1.0			
Lost Time Adjust (s)		0.0						0.0	0.0			
Total Lost Time (s)		4.5						4.5	4.5			
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	7.0	7.0						7.0	7.0			
Flash Dont Walk (s)	11.0	11.0						11.0	11.0			
Pedestrian Calls (#/hr)	0	0						0	0			
Act Effct Green (s)		22.5						18.5	18.5			
Actuated g/C Ratio		0.45						0.37	0.37			
v/c Ratio		0.81						0.18	0.58			
Control Delay		5.3						11.2	16.1			
Queue Delay		0.1						0.0	0.0			

# Lanes, Volumes, Timings

## 4: Grogans Mill Road & Research Forest Drive

Lane Group	Ø6	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	6	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	23.0	27.0
Total Split (%)	46%	54%
Maximum Green (s)	18.5	22.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		

Lanes, Volumes, Timings  
 4: Grogans Mill Road & Research Forest Drive

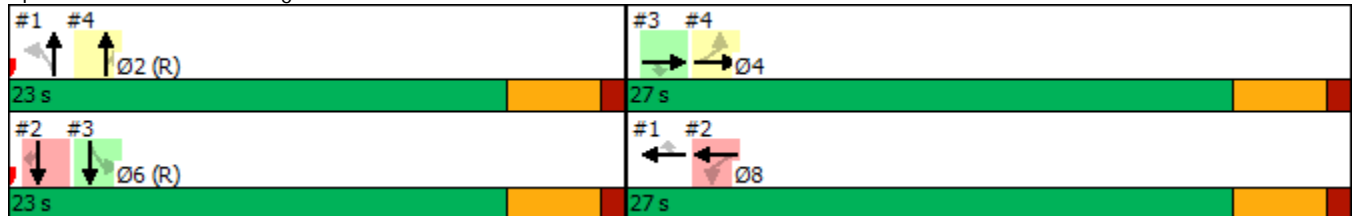


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		5.3						11.2	16.1			
LOS		A						B	B			
Approach Delay		5.3						14.1				
Approach LOS		A						B				
Queue Length 50th (ft)		24						24	70			
Queue Length 95th (ft)		54						43	138			
Internal Link Dist (ft)		173			1395			362			223	
Turn Bay Length (ft)												
Base Capacity (vph)		2281						1296	600			
Starvation Cap Reductn		19						0	0			
Spillback Cap Reductn		0						0	0			
Storage Cap Reductn		0						0	0			
Reduced v/c Ratio		0.82						0.18	0.58			

Intersection Summary













Area Type:	Other
Cycle Length:	50
Actuated Cycle Length:	50
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	50
Control Type:	Pretimed
Maximum v/c Ratio:	0.86
Intersection Signal Delay:	7.4
Intersection LOS:	A
Intersection Capacity Utilization	60.4%
ICU Level of Service	B
Analysis Period (min)	15

Splits and Phases: 4: Grogans Mill Road & Research Forest Drive



Lane Group	Ø6	Ø8
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
1: Research Forest Drive & Grogans Mill Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑↑	↗	↘↘	↑↑				
Traffic Volume (vph)	0	0	0	0	2235	320	301	450	0	0	0	0
Future Volume (vph)	0	0	0	0	2235	320	301	450	0	0	0	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		200	0		0	0		0
Storage Lanes	0		0	0		1	2		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.86	1.00	0.97	0.95	1.00	1.00	1.00	1.00
Frt						0.850						
Flt Protected							0.950					
Satd. Flow (prot)	0	0	0	0	6408	1583	3400	3505	0	0	0	0
Flt Permitted							0.950					
Satd. Flow (perm)	0	0	0	0	6408	1583	3400	3505	0	0	0	0
Right Turn on Red			Yes			Yes	Yes		Yes			Yes
Satd. Flow (RTOR)						127	25					
Link Speed (mph)		45			45			35				35
Link Distance (ft)		250			1466			303				507
Travel Time (s)		3.8			22.2			5.9				9.9
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
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	0	2429	348	327	489	0	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	2429	348	327	489	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			24				24
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type					NA	Perm	Perm	NA				
Protected Phases					8			2				
Permitted Phases						8	2					
Minimum Split (s)					22.5	22.5	22.5	22.5				
Total Split (s)					41.0	41.0	24.0	24.0				
Total Split (%)					63.1%	63.1%	36.9%	36.9%				
Maximum Green (s)					36.5	36.5	19.5	19.5				
Yellow Time (s)					3.5	3.5	3.5	3.5				
All-Red Time (s)					1.0	1.0	1.0	1.0				
Lost Time Adjust (s)					0.0	0.0	0.0	0.0				
Total Lost Time (s)					4.5	4.5	4.5	4.5				
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)					7.0	7.0	7.0	7.0				
Flash Dont Walk (s)					11.0	11.0	11.0	11.0				
Pedestrian Calls (#/hr)					0	0	0	0				
Act Effct Green (s)					36.5	36.5	19.5	19.5				
Actuated g/C Ratio					0.56	0.56	0.30	0.30				

# Lanes, Volumes, Timings

## 1: Research Forest Drive & Grogans Mill Road

Lane Group	Ø4	Ø6
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphp)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	4	6
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	41.0	24.0
Total Split (%)	63%	37%
Maximum Green (s)	36.5	19.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		
Actuated g/C Ratio		

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

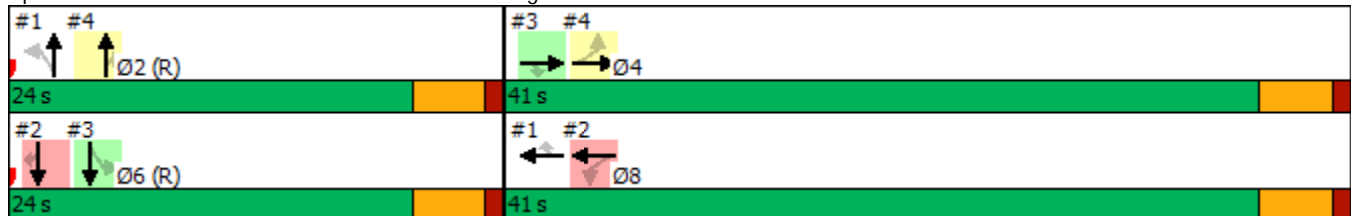


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio					0.68	0.37	0.32	0.47				
Control Delay					11.3	6.1	13.6	16.4				
Queue Delay					0.0	0.0	0.0	0.0				
Total Delay					11.3	6.1	13.6	16.4				
LOS					B	A	B	B				
Approach Delay					10.6			15.3				
Approach LOS					B			B				
Queue Length 50th (ft)					177	40	38	67				
Queue Length 95th (ft)					216	83	m59	m96				
Internal Link Dist (ft)		170			1386			223			427	
Turn Bay Length (ft)						200						
Base Capacity (vph)					3598	944	1037	1051				
Starvation Cap Reductn					0	0	0	0				
Spillback Cap Reductn					0	0	0	0				
Storage Cap Reductn					0	0	0	0				
Reduced v/c Ratio					0.68	0.37	0.32	0.47				

Intersection Summary

Area Type: Other  
 Cycle Length: 65  
 Actuated Cycle Length: 65  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 65  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.93  
 Intersection Signal Delay: 11.7 Intersection LOS: B  
 Intersection Capacity Utilization 52.7% ICU Level of Service A  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Research Forest Drive & Grogans Mill Road



Lane Group	Ø4	Ø6
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



# Lanes, Volumes, Timings

## 2: Research Forest Drive & Grogans Mill Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations				↙	↑↑↑↑						↑↑	↘
Traffic Volume (vph)	0	0	0	471	2065	0	0	0	0	0	379	247
Future Volume (vph)	0	0	0	471	2065	0	0	0	0	0	379	247
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	15
Storage Length (ft)	0		0	0		0	0		0	0		200
Storage Lanes	0		0	1		0	0		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.86	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Fr <sub>t</sub>												0.850
Fl <sub>t</sub> Protected				0.950								
Satd. Flow (prot)	0	0	0	1752	6346	0	0	0	0	0	3505	1725
Fl <sub>t</sub> Permitted				0.950								
Satd. Flow (perm)	0	0	0	1752	6346	0	0	0	0	0	3505	1725
Right Turn on Red			Yes	Yes		Yes			Yes			Yes
Satd. Flow (RTOR)				180								25
Link Speed (mph)		45			35			35			35	
Link Distance (ft)		1533			250			305			542	
Travel Time (s)		23.2			4.9			5.9			10.6	
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
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	512	2245	0	0	0	0	0	412	268
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	512	2245	0	0	0	0	0	412	268
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Perm	NA						NA	Perm
Protected Phases					8						6	
Permitted Phases				8								6
Minimum Split (s)				22.5	22.5						22.5	22.5
Total Split (s)				41.0	41.0						24.0	24.0
Total Split (%)				63.1%	63.1%						36.9%	36.9%
Maximum Green (s)				36.5	36.5						19.5	19.5
Yellow Time (s)				3.5	3.5						3.5	3.5
All-Red Time (s)				1.0	1.0						1.0	1.0
Lost Time Adjust (s)				0.0	0.0						0.0	0.0
Total Lost Time (s)				4.5	4.5						4.5	4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				7.0	7.0						7.0	7.0
Flash Dont Walk (s)				11.0	11.0						11.0	11.0
Pedestrian Calls (#/hr)				0	0						0	0
Act Effect Green (s)				36.5	36.5						19.5	19.5

## Lanes, Volumes, Timings

### 2: Research Forest Drive & Grogans Mill Road

Lane Group	Ø2	Ø4
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Width (ft)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	4
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	24.0	41.0
Total Split (%)	37%	63%
Maximum Green (s)	19.5	36.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		

# Lanes, Volumes, Timings

## 2: Research Forest Drive & Grogans Mill Road



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio				0.56	0.56						0.30	0.30
v/c Ratio				0.48	0.63						0.39	0.50
Control Delay				2.5	4.4						19.4	20.8
Queue Delay				0.4	0.2						0.1	0.0
Total Delay				2.9	4.5						19.5	20.8
LOS				A	A						B	C
Approach Delay					4.2						20.0	
Approach LOS					A						C	
Queue Length 50th (ft)				0	52						67	78
Queue Length 95th (ft)				0	59						103	143
Internal Link Dist (ft)		1453			170			225			462	
Turn Bay Length (ft)												200
Base Capacity (vph)				1062	3563						1051	535
Starvation Cap Reductn				192	388						0	0
Spillback Cap Reductn				5	0						111	0
Storage Cap Reductn				0	0						0	0
Reduced v/c Ratio				0.59	0.71						0.44	0.50

**Intersection Summary**

Area Type: Other

Cycle Length: 65

Actuated Cycle Length: 65

Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green

Natural Cycle: 65

Control Type: Pretimed

Maximum v/c Ratio: 0.93

Intersection Signal Delay: 7.4

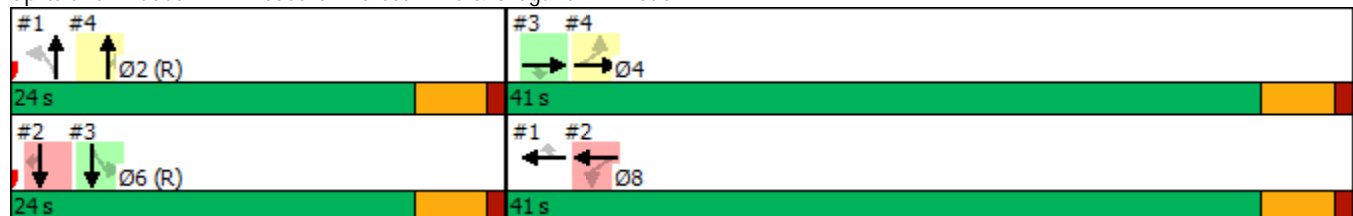
Intersection LOS: A

Intersection Capacity Utilization 52.7%

ICU Level of Service A

Analysis Period (min) 15

Splits and Phases: 2: Research Forest Drive & Grogans Mill Road















## Lanes, Volumes, Timings 2: Research Forest Drive & Grogans Mill Road

Synchro 11 Report

Lane Group	Ø2	Ø4
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
3: Grogans Mills Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↗								↖↑	
Traffic Volume (vph)	0	1903	746	0	0	0	0	0	0	74	776	0
Future Volume (vph)	0	1903	746	0	0	0	0	0	0	74	776	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		200	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00
Frt			0.850									
Flt Protected												0.996
Satd. Flow (prot)	0	4940	1538	0	0	0	0	0	0	0	3491	0
Flt Permitted												0.996
Satd. Flow (perm)	0	4940	1538	0	0	0	0	0	0	0	3491	0
Right Turn on Red			Yes			Yes			Yes	Yes		Yes
Satd. Flow (RTOR)			25									25
Link Speed (mph)		45			45			35				35
Link Distance (ft)		1511			253			457				305
Travel Time (s)		22.9			3.8			8.9				5.9
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
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	2068	811	0	0	0	0	0	0	80	843	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	2068	811	0	0	0	0	0	0	0	923	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA	Perm							Perm	NA	
Protected Phases		4									6	
Permitted Phases			4							6		
Minimum Split (s)		22.5	22.5							22.5	22.5	
Total Split (s)		41.0	41.0							24.0	24.0	
Total Split (%)		63.1%	63.1%							36.9%	36.9%	
Maximum Green (s)		36.5	36.5							19.5	19.5	
Yellow Time (s)		3.5	3.5							3.5	3.5	
All-Red Time (s)		1.0	1.0							1.0	1.0	
Lost Time Adjust (s)		0.0	0.0								0.0	
Total Lost Time (s)		4.5	4.5								4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		7.0	7.0							7.0	7.0	
Flash Dont Walk (s)		11.0	11.0							11.0	11.0	
Pedestrian Calls (#/hr)		0	0							0	0	
Act Effect Green (s)		36.5	36.5								19.5	
Actuated g/C Ratio		0.56	0.56								0.30	

# Lanes, Volumes, Timings

## 3: Grogans Mills Road & Research Forest Drive

Lane Group	Ø2	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	24.0	41.0
Total Split (%)	37%	63%
Maximum Green (s)	19.5	36.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		
Actuated g/C Ratio		

# Lanes, Volumes, Timings

## 3: Grogans Mills Road & Research Forest Drive

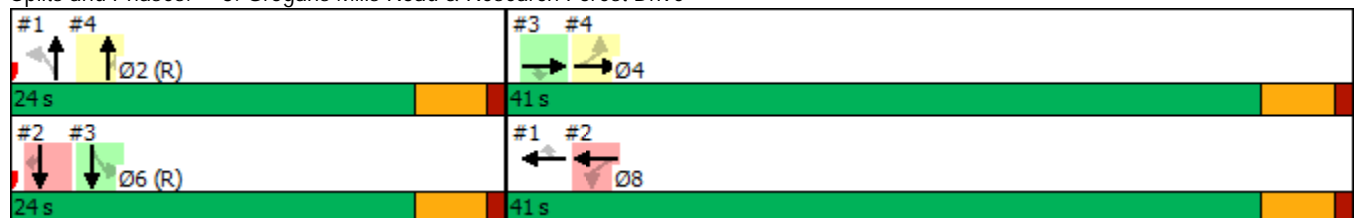


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.75	0.93									0.87
Control Delay		12.9	32.6									25.0
Queue Delay		0.0	0.0									0.2
Total Delay		12.9	32.6									25.2
LOS		B	C									C
Approach Delay		18.5										25.2
Approach LOS		B										C
Queue Length 50th (ft)		204	258									115
Queue Length 95th (ft)		259	#514									#287
Internal Link Dist (ft)		1431				173			377			225
Turn Bay Length (ft)			200									
Base Capacity (vph)		2774	874									1064
Starvation Cap Reductn		0	0									9
Spillback Cap Reductn		0	0									0
Storage Cap Reductn		0	0									0
Reduced v/c Ratio		0.75	0.93									0.87

### Intersection Summary

Area Type: Other  
 Cycle Length: 65  
 Actuated Cycle Length: 65  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 65  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.93  
 Intersection Signal Delay: 20.1  
 Intersection LOS: C  
 Intersection Capacity Utilization 77.3%  
 ICU Level of Service D  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

### Splits and Phases: 3: Grogans Mills Road & Research Forest Drive



Lane Group	Ø2	Ø8
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



# Lanes, Volumes, Timings

## 4: Grogans Mill Road & Research Forest Drive

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑						↑↑	↑			
Traffic Volume (vph)	216	1791	0	0	0	0	0	234	222	0	0	0
Future Volume (vph)	216	1791	0	0	0	0	0	234	222	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Fr t									0.850			
Flt Protected		0.995										
Satd. Flow (prot)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Flt Permitted		0.995										
Satd. Flow (perm)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Right Turn on Red	Yes		Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		53							25			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		253			1475			442				303
Travel Time (s)		3.8			22.3			8.6				5.9
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
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	235	1947	0	0	0	0	0	254	241	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	2182	0	0	0	0	0	254	241	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Perm	NA						NA	Perm			
Protected Phases		4						2				
Permitted Phases	4								2			
Minimum Split (s)	22.5	22.5						22.5	22.5			
Total Split (s)	41.0	41.0						24.0	24.0			
Total Split (%)	63.1%	63.1%						36.9%	36.9%			
Maximum Green (s)	36.5	36.5						19.5	19.5			
Yellow Time (s)	3.5	3.5						3.5	3.5			
All-Red Time (s)	1.0	1.0						1.0	1.0			
Lost Time Adjust (s)		0.0						0.0	0.0			
Total Lost Time (s)		4.5						4.5	4.5			
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	7.0	7.0						7.0	7.0			
Flash Dont Walk (s)	11.0	11.0						11.0	11.0			
Pedestrian Calls (#/hr)	0	0						0	0			
Act Effct Green (s)		36.5						19.5	19.5			
Actuated g/C Ratio		0.56						0.30	0.30			
v/c Ratio		0.77						0.24	0.49			
Control Delay		3.3						17.9	20.8			
Queue Delay		0.0						0.0	0.0			

# Lanes, Volumes, Timings

## 4: Grogans Mill Road & Research Forest Drive

Lane Group	Ø6	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	6	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	24.0	41.0
Total Split (%)	37%	63%
Maximum Green (s)	19.5	36.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		

Lanes, Volumes, Timings  
 4: Grogans Mill Road & Research Forest Drive

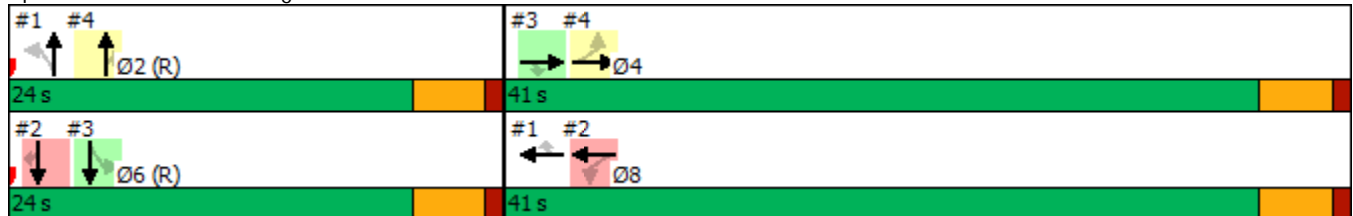


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		3.3						17.9	20.8			
LOS		A						B	C			
Approach Delay		3.3						19.4				
Approach LOS		A						B				
Queue Length 50th (ft)		30						39	69			
Queue Length 95th (ft)		30						65	131			
Internal Link Dist (ft)		173			1395			362			223	
Turn Bay Length (ft)												
Base Capacity (vph)		2837						1051	487			
Starvation Cap Reductn		15						0	0			
Spillback Cap Reductn		0						0	0			
Storage Cap Reductn		0						0	0			
Reduced v/c Ratio		0.77						0.24	0.49			

Intersection Summary













Area Type:	Other
Cycle Length:	65
Actuated Cycle Length:	65
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	65
Control Type:	Pretimed
Maximum v/c Ratio:	0.93
Intersection Signal Delay:	6.3
Intersection LOS:	A
Intersection Capacity Utilization	60.2%
ICU Level of Service	B
Analysis Period (min)	15

Splits and Phases: 4: Grogans Mill Road & Research Forest Drive



Lane Group	Ø6	Ø8
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations					↑↑↑↑	↑	↑↑	↑↑				
Traffic Volume (vph)	0	0	0	0	1987	176	785	453	0	0	0	0
Future Volume (vph)	0	0	0	0	1987	176	785	453	0	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		200	0		0	0		0
Storage Lanes	0		0	0		1	2		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.86	1.00	0.97	0.95	1.00	1.00	1.00	1.00
Frt						0.850						
Flt Protected							0.950					
Satd. Flow (prot)	0	0	0	0	6408	1583	3400	3505	0	0	0	0
Flt Permitted							0.950					
Satd. Flow (perm)	0	0	0	0	6408	1583	3400	3505	0	0	0	0
Right Turn on Red			Yes			Yes	Yes		Yes			Yes
Satd. Flow (RTOR)						166	30					
Link Speed (mph)		45			45			35				35
Link Distance (ft)		250			1466			303				507
Travel Time (s)		3.8			22.2			5.9				9.9
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
Heavy Vehicles (%)	2%	2%	2%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	0	2160	191	853	492	0	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	0	2160	191	853	492	0	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			24				24
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type					NA	Perm	Perm	NA				
Protected Phases					8			2				
Permitted Phases						8	2					
Minimum Split (s)					22.5	22.5	22.5	22.5				
Total Split (s)					31.6	31.6	23.4	23.4				
Total Split (%)					57.5%	57.5%	42.5%	42.5%				
Maximum Green (s)					27.1	27.1	18.9	18.9				
Yellow Time (s)					3.5	3.5	3.5	3.5				
All-Red Time (s)					1.0	1.0	1.0	1.0				
Lost Time Adjust (s)					0.0	0.0	0.0	0.0				
Total Lost Time (s)					4.5	4.5	4.5	4.5				
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)					7.0	7.0	7.0	7.0				
Flash Dont Walk (s)					11.0	11.0	11.0	11.0				
Pedestrian Calls (#/hr)					0	0	0	0				
Act Effct Green (s)					27.1	27.1	18.9	18.9				
Actuated g/C Ratio					0.49	0.49	0.34	0.34				

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

Lane Group	Ø4	Ø6
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	4	6
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	31.6	23.4
Total Split (%)	57%	43%
Maximum Green (s)	27.1	18.9
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		
Actuated g/C Ratio		

Lanes, Volumes, Timings  
 1: Research Forest Drive & Grogans Mill Road

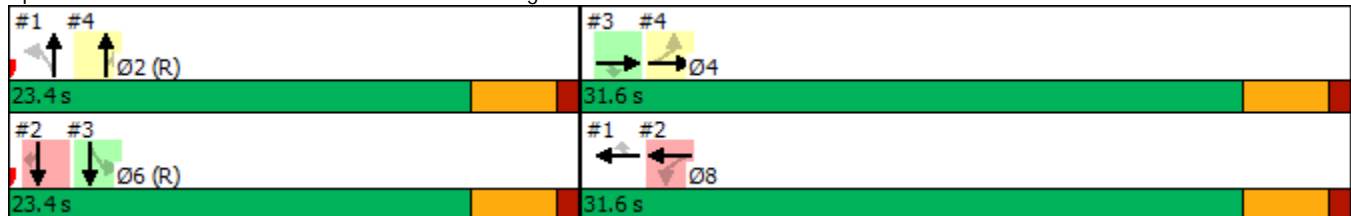


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio					0.68	0.22	0.72	0.41				
Control Delay					12.1	2.9	17.1	13.0				
Queue Delay					0.2	0.0	0.4	0.0				
Total Delay					12.3	2.9	17.4	13.0				
LOS					B	A	B	B				
Approach Delay					11.5			15.8				
Approach LOS					B			B				
Queue Length 50th (ft)					144	4	100	55				
Queue Length 95th (ft)					181	29	m138	m82				
Internal Link Dist (ft)		170			1386			223			427	
Turn Bay Length (ft)						200						
Base Capacity (vph)					3157	864	1188	1204				
Starvation Cap Reductn					0	0	65	0				
Spillback Cap Reductn					322	0	1	0				
Storage Cap Reductn					0	0	0	0				
Reduced v/c Ratio					0.76	0.22	0.76	0.41				

Intersection Summary

Area Type: Other  
 Cycle Length: 55  
 Actuated Cycle Length: 55  
 Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green  
 Natural Cycle: 55  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.88  
 Intersection Signal Delay: 13.1 Intersection LOS: B  
 Intersection Capacity Utilization 76.9% ICU Level of Service D  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Research Forest Drive & Grogans Mill Road



Lane Group	Ø4	Ø6
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



# Lanes, Volumes, Timings

## 2: Research Forest Drive & Grogans Mill Road

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations				↙	↑↑↑↑						↑↑	↗
Traffic Volume (vph)	0	0	0	231	2541	0	0	0	0	0	339	336
Future Volume (vph)	0	0	0	231	2541	0	0	0	0	0	339	336
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width (ft)	12	12	12	12	12	12	12	12	12	12	12	15
Storage Length (ft)	0		0	0		0	0		0	0		200
Storage Lanes	0		0	1		0	0		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	1.00	1.00	1.00	0.86	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Fr <sub>t</sub>												0.850
Fl <sub>t</sub> Protected				0.950								
Satd. Flow (prot)	0	0	0	1752	6346	0	0	0	0	0	3505	1725
Fl <sub>t</sub> Permitted				0.950								
Satd. Flow (perm)	0	0	0	1752	6346	0	0	0	0	0	3505	1725
Right Turn on Red			Yes	Yes		Yes			Yes			Yes
Satd. Flow (RTOR)				251								30
Link Speed (mph)		45			35			35				35
Link Distance (ft)		1533			250			305				542
Travel Time (s)		23.2			4.9			5.9				10.6
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
Heavy Vehicles (%)	5%	5%	5%	3%	3%	3%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	0	0	251	2762	0	0	0	0	0	368	365
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	0	251	2762	0	0	0	0	0	368	365
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		12			12			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type				Perm	NA							NA Perm
Protected Phases					8							6
Permitted Phases				8								6
Minimum Split (s)				22.5	22.5						22.5	22.5
Total Split (s)				31.6	31.6						23.4	23.4
Total Split (%)				57.5%	57.5%						42.5%	42.5%
Maximum Green (s)				27.1	27.1						18.9	18.9
Yellow Time (s)				3.5	3.5						3.5	3.5
All-Red Time (s)				1.0	1.0						1.0	1.0
Lost Time Adjust (s)				0.0	0.0						0.0	0.0
Total Lost Time (s)				4.5	4.5						4.5	4.5
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)				7.0	7.0						7.0	7.0
Flash Dont Walk (s)				11.0	11.0						11.0	11.0
Pedestrian Calls (#/hr)				0	0						0	0
Act Effect Green (s)				27.1	27.1						18.9	18.9

## Lanes, Volumes, Timings

### 2: Research Forest Drive & Grogans Mill Road

Lane Group	Ø2	Ø4
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Width (ft)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	4
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	23.4	31.6
Total Split (%)	43%	57%
Maximum Green (s)	18.9	27.1
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		

## Lanes, Volumes, Timings 2: Research Forest Drive & Grogans Mill Road

Synchro 11 Report

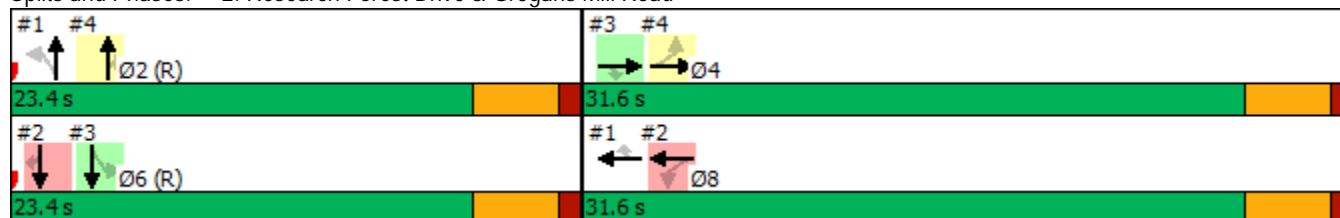


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Actuated g/C Ratio				0.49	0.49						0.34	0.34
v/c Ratio				0.25	0.88						0.31	0.60
Control Delay				0.9	11.4						14.1	18.5
Queue Delay				0.3	0.6						0.0	0.0
Total Delay				1.2	12.0						14.1	18.5
LOS				A	B						B	B
Approach Delay					11.1						16.3	
Approach LOS					B						B	
Queue Length 50th (ft)				1	105						45	87
Queue Length 95th (ft)				m4	118						73	161
Internal Link Dist (ft)		1453			170			225			462	
Turn Bay Length (ft)												200
Base Capacity (vph)				990	3126						1204	612
Starvation Cap Reductn				330	119						0	0
Spillback Cap Reductn				0	0						0	0
Storage Cap Reductn				0	0						0	0
Reduced v/c Ratio				0.38	0.92						0.31	0.60

### Intersection Summary

Area Type:	Other
Cycle Length:	55
Actuated Cycle Length:	55
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	55
Control Type:	Pretimed
Maximum v/c Ratio:	0.88
Intersection Signal Delay:	12.1
Intersection LOS:	B
Intersection Capacity Utilization:	83.2%
ICU Level of Service:	E
Analysis Period (min):	15
m Volume for 95th percentile queue is metered by upstream signal.	

### Splits and Phases: 2: Research Forest Drive & Grogans Mill Road



Lane Group	Ø2	Ø4
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

### Lanes, Volumes, Timings 3: Grogans Mills Road & Research Forest Drive

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑	↗								↖↑	
Traffic Volume (vph)	0	1811	444	0	0	0	0	0	0	90	480	0
Future Volume (vph)	0	1811	444	0	0	0	0	0	0	90	480	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		200	0		0	0		0	0		0
Storage Lanes	0		1	0		0	0		0	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	1.00
Frt			0.850									
Flt Protected											0.992	
Satd. Flow (prot)	0	4940	1538	0	0	0	0	0	0	0	3477	0
Flt Permitted											0.992	
Satd. Flow (perm)	0	4940	1538	0	0	0	0	0	0	0	3477	0
Right Turn on Red			Yes			Yes			Yes	Yes		Yes
Satd. Flow (RTOR)			148								30	
Link Speed (mph)		45			45			35			35	
Link Distance (ft)		1511			253			457			305	
Travel Time (s)		22.9			3.8			8.9			5.9	
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
Heavy Vehicles (%)	5%	5%	5%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	1968	483	0	0	0	0	0	0	98	522	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1968	483	0	0	0	0	0	0	0	620	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA	Perm							Perm	NA	
Protected Phases		4									6	
Permitted Phases			4							6		
Minimum Split (s)		22.5	22.5							22.5	22.5	
Total Split (s)		31.6	31.6							23.4	23.4	
Total Split (%)		57.5%	57.5%							42.5%	42.5%	
Maximum Green (s)		27.1	27.1							18.9	18.9	
Yellow Time (s)		3.5	3.5							3.5	3.5	
All-Red Time (s)		1.0	1.0							1.0	1.0	
Lost Time Adjust (s)		0.0	0.0								0.0	
Total Lost Time (s)		4.5	4.5								4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)		7.0	7.0							7.0	7.0	
Flash Dont Walk (s)		11.0	11.0							11.0	11.0	
Pedestrian Calls (#/hr)		0	0							0	0	
Act Effect Green (s)		27.1	27.1								18.9	
Actuated g/C Ratio		0.49	0.49								0.34	

# Lanes, Volumes, Timings

## 3: Grogans Mills Road & Research Forest Drive

Lane Group	Ø2	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	23.4	31.6
Total Split (%)	43%	57%
Maximum Green (s)	18.9	27.1
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effect Green (s)		
Actuated g/C Ratio		

# Lanes, Volumes, Timings

## 3: Grogans Mills Road & Research Forest Drive

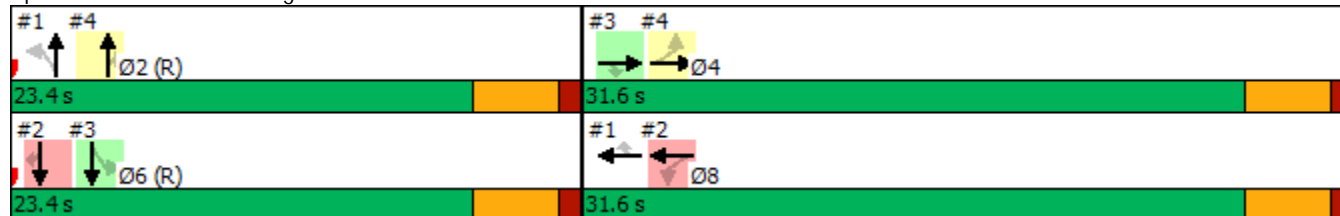


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.81	0.58									0.51
Control Delay		15.1	10.0									8.6
Queue Delay		0.0	0.0									0.0
Total Delay		15.1	10.0									8.6
LOS		B	B									A
Approach Delay		14.1										8.6
Approach LOS		B										A
Queue Length 50th (ft)		182	65									41
Queue Length 95th (ft)		240	142									64
Internal Link Dist (ft)		1431				173		377				225
Turn Bay Length (ft)			200									
Base Capacity (vph)		2434	832									1214
Starvation Cap Reductn		0	0									0
Spillback Cap Reductn		0	0									0
Storage Cap Reductn		0	0									0
Reduced v/c Ratio		0.81	0.58									0.51

### Intersection Summary

Area Type:	Other
Cycle Length:	55
Actuated Cycle Length:	55
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	55
Control Type:	Pretimed
Maximum v/c Ratio:	0.88
Intersection Signal Delay:	13.0
Intersection LOS:	B
Intersection Capacity Utilization	58.4%
ICU Level of Service	B
Analysis Period (min)	15













### Splits and Phases: 3: Grogans Mills Road & Research Forest Drive



Lane Group	Ø2	Ø8
v/c Ratio		
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		



Lanes, Volumes, Timings  
4: Grogans Mill Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑						↑↑	↑			
Traffic Volume (vph)	191	1710	0	0	0	0	0	262	362	0	0	0
Future Volume (vph)	191	1710	0	0	0	0	0	262	362	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	0.91	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Fr t									0.850			
Flt Protected		0.995										
Satd. Flow (prot)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Flt Permitted		0.995										
Satd. Flow (perm)	0	5011	0	0	0	0	0	3505	1568	0	0	0
Right Turn on Red	Yes		Yes				Yes		Yes			Yes
Satd. Flow (RTOR)		49							30			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		253			1475			442				303
Travel Time (s)		3.8			22.3			8.6				5.9
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
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	208	1859	0	0	0	0	0	285	393	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	2067	0	0	0	0	0	285	393	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Perm	NA						NA	Perm			
Protected Phases		4						2				
Permitted Phases	4								2			
Minimum Split (s)	22.5	22.5						22.5	22.5			
Total Split (s)	31.6	31.6						23.4	23.4			
Total Split (%)	57.5%	57.5%						42.5%	42.5%			
Maximum Green (s)	27.1	27.1						18.9	18.9			
Yellow Time (s)	3.5	3.5						3.5	3.5			
All-Red Time (s)	1.0	1.0						1.0	1.0			
Lost Time Adjust (s)		0.0						0.0	0.0			
Total Lost Time (s)		4.5						4.5	4.5			
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	7.0	7.0						7.0	7.0			
Flash Dont Walk (s)	11.0	11.0						11.0	11.0			
Pedestrian Calls (#/hr)	0	0						0	0			
Act Effct Green (s)		27.1						18.9	18.9			
Actuated g/C Ratio		0.49						0.34	0.34			
v/c Ratio		0.83						0.24	0.70			
Control Delay		5.0						13.6	23.1			
Queue Delay		0.1						0.0	0.0			

Lanes, Volumes, Timings  
 4: Grogans Mill Road & Research Forest Drive

Lane Group	Ø6	Ø8
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Heavy Vehicles (%)		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	6	8
Permitted Phases		
Minimum Split (s)	22.5	22.5
Total Split (s)	23.4	31.6
Total Split (%)	43%	57%
Maximum Green (s)	18.9	27.1
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		
Lead-Lag Optimize?		
Walk Time (s)	7.0	7.0
Flash Dont Walk (s)	11.0	11.0
Pedestrian Calls (#/hr)	0	0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		
Control Delay		
Queue Delay		

Lanes, Volumes, Timings  
 4: Grogans Mill Road & Research Forest Drive

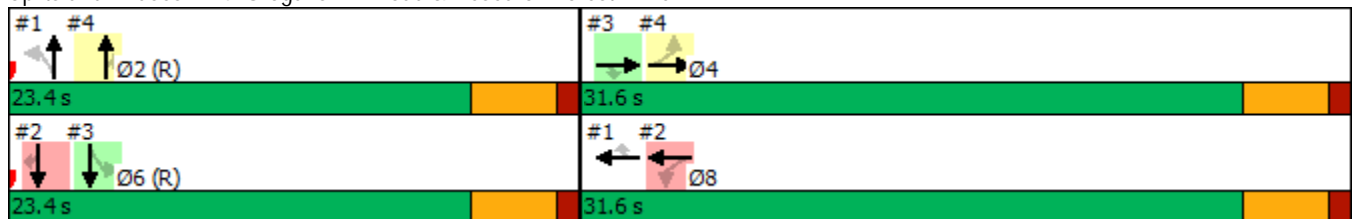


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Total Delay		5.1						13.6	23.1			
LOS		A						B	C			
Approach Delay		5.1						19.1				
Approach LOS		A						B				
Queue Length 50th (ft)		28						34	100			
Queue Length 95th (ft)		56						57	#214			
Internal Link Dist (ft)		173			1395			362			223	
Turn Bay Length (ft)												
Base Capacity (vph)		2493						1204	558			
Starvation Cap Reductn		23						0	0			
Spillback Cap Reductn		0						31	0			
Storage Cap Reductn		0						0	0			
Reduced v/c Ratio		0.84						0.24	0.70			

Intersection Summary

























Area Type:	Other
Cycle Length:	55
Actuated Cycle Length:	55
Offset:	0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green
Natural Cycle:	55
Control Type:	Pretimed
Maximum v/c Ratio:	0.88
Intersection Signal Delay:	8.6
Intersection LOS:	A
Intersection Capacity Utilization:	66.8%
ICU Level of Service:	C
Analysis Period (min):	15
# 95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.	

Splits and Phases: 4: Grogans Mill Road & Research Forest Drive



Lane Group	Ø6	Ø8
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
1: Grogans Mill Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	191	1515	658	416	1588	282	265	201	196	66	265	218
Future Volume (vph)	191	1515	658	416	1588	282	265	201	196	66	265	218
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	200		200	200		200	200		200
Storage Lanes	2		1	2		1	2		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	5085	1583	3335	4940	1538	3400	3505	1568	1752	3505	1568
Flt Permitted	0.950			0.950			0.950			0.615		
Satd. Flow (perm)	3433	5085	1583	3335	4940	1538	3400	3505	1568	1134	3505	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			384			286			213			207
Link Speed (mph)		45			45			35				35
Link Distance (ft)		1695			1734			1037				719
Travel Time (s)		25.7			26.3			20.2				14.0
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
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	208	1647	715	452	1726	307	288	218	213	72	288	237
Shared Lane Traffic (%)												
Lane Group Flow (vph)	208	1647	715	452	1726	307	288	218	213	72	288	237
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			24				24
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			8			2	6		6
Minimum Split (s)	9.5	20.0		9.5	20.0	20.0	9.5	20.0	20.0	9.5	20.0	20.0
Total Split (s)	14.0	41.0		22.0	49.0	49.0	17.0	26.8	26.8	10.2	20.0	20.0
Total Split (%)	14.0%	41.0%		22.0%	49.0%	49.0%	17.0%	26.8%	26.8%	10.2%	20.0%	20.0%
Maximum Green (s)	9.5	37.0		17.5	45.0	45.0	12.5	22.8	22.8	5.7	16.0	16.0
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	0.5		1.0	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.0		4.5	4.0	4.0	4.5	4.0	4.0	4.5	4.0	4.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Walk Time (s)		5.0			5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0			11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0			0	0		0	0		0	0
Act Effect Green (s)	9.5	37.0	100.0	17.5	45.0	45.0	12.5	22.8	22.8	21.2	16.0	16.0
Actuated g/C Ratio	0.10	0.37	1.00	0.18	0.45	0.45	0.12	0.23	0.23	0.21	0.16	0.16

Lanes, Volumes, Timings  
 1: Grogans Mill Road & Research Forest Drive

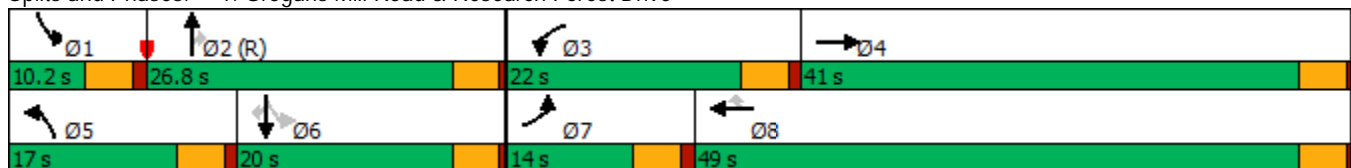


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.64	0.88	0.45	0.78	0.78	0.36	0.68	0.27	0.41	0.26	0.51	0.56
Control Delay	53.2	35.8	0.9	49.6	26.3	4.0	50.6	32.9	7.1	27.2	42.1	13.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.2	35.8	0.9	49.6	26.3	4.0	50.6	32.9	7.1	27.2	42.1	13.6
LOS	D	D	A	D	C	A	D	C	A	C	D	B
Approach Delay		27.5			27.8			32.4			29.0	
Approach LOS		C			C			C			C	
Queue Length 50th (ft)	67	353	0	143	330	7	91	60	0	32	89	17
Queue Length 95th (ft)	105	419	0	#204	392	55	136	94	57	65	132	89
Internal Link Dist (ft)		1615			1654			957			639	
Turn Bay Length (ft)	200		200	200		200	200		200	200		200
Base Capacity (vph)	326	1881	1583	583	2223	849	425	799	521	275	560	424
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.64	0.88	0.45	0.78	0.78	0.36	0.68	0.27	0.41	0.26	0.51	0.56

Intersection Summary

Area Type: Other  
 Cycle Length: 100  
 Actuated Cycle Length: 100  
 Offset: 0 (0%), Referenced to phase 2:NBT, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.88  
 Intersection Signal Delay: 28.3  
 Intersection LOS: C  
 Intersection Capacity Utilization 69.8%  
 ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Grogans Mill Road & Research Forest Drive



Lanes, Volumes, Timings  
 1: Grogans Mill Road & Research Forest Drive

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	169	1455	392	204	1578	158	693	220	320	80	215	296
Future Volume (vph)	169	1455	392	204	1578	158	693	220	320	80	215	296
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	200		200	200		200	200		200
Storage Lanes	2		1	2		1	2		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	5085	1583	3335	4940	1538	3400	3505	1568	1752	3505	1568
Flt Permitted	0.950			0.950			0.950			0.603		
Satd. Flow (perm)	3433	5085	1583	3335	4940	1538	3400	3505	1568	1112	3505	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			217			144			249			144
Link Speed (mph)		45			45			35			35	
Link Distance (ft)		1695			1734			1037			719	
Travel Time (s)		25.7			26.3			20.2			14.0	
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
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	184	1582	426	222	1715	172	753	239	348	87	234	322
Shared Lane Traffic (%)												
Lane Group Flow (vph)	184	1582	426	222	1715	172	753	239	348	87	234	322
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			8			2	6		6
Minimum Split (s)	9.5	20.0		9.5	20.0	20.0	9.5	20.0	20.0	9.5	20.0	20.0
Total Split (s)	13.0	40.0		16.0	43.0	43.0	32.0	43.3	43.3	10.7	22.0	22.0
Total Split (%)	11.8%	36.4%		14.5%	39.1%	39.1%	29.1%	39.4%	39.4%	9.7%	20.0%	20.0%
Maximum Green (s)	8.5	36.0		11.5	39.0	39.0	27.5	39.3	39.3	6.2	18.0	18.0
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	0.5		1.0	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.0		4.5	4.0	4.0	4.5	4.0	4.0	4.5	4.0	4.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Walk Time (s)		5.0			5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0			11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0			0	0		0	0		0	0
Act Effect Green (s)	8.5	36.0	110.0	11.5	39.0	39.0	27.5	39.3	39.3	23.7	18.0	18.0
Actuated g/C Ratio	0.08	0.33	1.00	0.10	0.35	0.35	0.25	0.36	0.36	0.22	0.16	0.16

Lanes, Volumes, Timings  
 1: Grogans Mill Road & Research Forest Drive

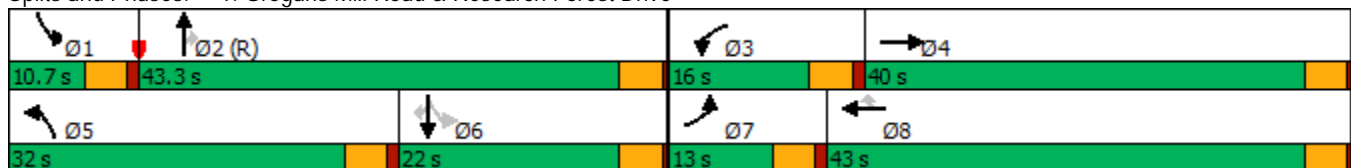


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.69	0.95	0.27	0.64	0.98	0.27	0.89	0.19	0.48	0.32	0.41	0.85
Control Delay	64.0	49.7	0.4	56.3	52.7	7.3	53.4	24.9	10.3	24.1	43.7	46.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	64.0	49.7	0.4	56.3	52.7	7.3	53.4	24.9	10.3	24.1	43.7	46.5
LOS	E	D	A	E	D	A	D	C	B	C	D	D
Approach Delay		41.3			49.4			37.1			42.5	
Approach LOS		D			D			D			D	
Queue Length 50th (ft)	66	397	0	78	434	13	264	60	48	35	78	126
Queue Length 95th (ft)	#112	#500	0	119	#549	60	#368	90	129	66	118	#283
Internal Link Dist (ft)		1615			1654			957			639	
Turn Bay Length (ft)	200		200	200		200	200		200	200		200
Base Capacity (vph)	265	1664	1583	348	1751	638	850	1252	720	275	573	377
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.69	0.95	0.27	0.64	0.98	0.27	0.89	0.19	0.48	0.32	0.41	0.85

Intersection Summary


































Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 2:NBT, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.98  
 Intersection Signal Delay: 43.2  
 Intersection LOS: D  
 Intersection Capacity Utilization 78.6%  
 ICU Level of Service D  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Grogans Mill Road & Research Forest Drive





Lanes, Volumes, Timings  
1: Grogans Mill Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  		 	  		 	 			 	
Traffic Volume (vph)	216	1687	746	471	1764	320	301	234	222	74	305	247
Future Volume (vph)	216	1687	746	471	1764	320	301	234	222	74	305	247
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	200		200	200		200	200		200
Storage Lanes	2		1	2		1	2		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	5085	1583	3335	4940	1538	3400	3505	1568	1752	3505	1568
Flt Permitted	0.950			0.950			0.950			0.595		
Satd. Flow (perm)	3433	5085	1583	3335	4940	1538	3400	3505	1568	1098	3505	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			355			275			241			207
Link Speed (mph)		45			45			35			35	
Link Distance (ft)		1695			1734			1037			719	
Travel Time (s)		25.7			26.3			20.2			14.0	
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
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	235	1834	811	512	1917	348	327	254	241	80	332	268
Shared Lane Traffic (%)												
Lane Group Flow (vph)	235	1834	811	512	1917	348	327	254	241	80	332	268
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			8			2	6		6
Minimum Split (s)	9.5	20.0		9.5	20.0	20.0	9.5	20.0	20.0	9.5	20.0	20.0
Total Split (s)	17.0	46.6		26.0	55.6	55.6	17.0	26.8	26.8	10.6	20.4	20.4
Total Split (%)	15.5%	42.4%		23.6%	50.5%	50.5%	15.5%	24.4%	24.4%	9.6%	18.5%	18.5%
Maximum Green (s)	12.5	42.6		21.5	51.6	51.6	12.5	22.8	22.8	6.1	16.4	16.4
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	0.5		1.0	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.0		4.5	4.0	4.0	4.5	4.0	4.0	4.5	4.0	4.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Walk Time (s)		5.0			5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0			11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0			0	0		0	0		0	0
Act Effect Green (s)	12.5	42.6	110.0	21.5	51.6	51.6	12.5	22.8	22.8	22.0	16.4	16.4
Actuated g/C Ratio	0.11	0.39	1.00	0.20	0.47	0.47	0.11	0.21	0.21	0.20	0.15	0.15

Lanes, Volumes, Timings  
 1: Grogans Mill Road & Research Forest Drive

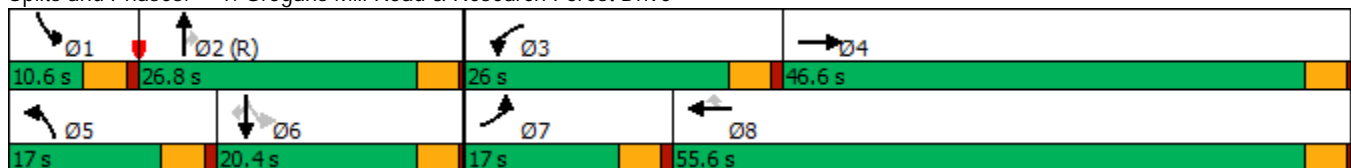


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.60	0.93	0.51	0.79	0.83	0.40	0.85	0.35	0.47	0.31	0.64	0.66
Control Delay	53.5	42.2	1.2	51.8	29.2	5.8	68.4	38.9	8.0	33.0	50.2	20.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	53.5	42.2	1.2	51.8	29.2	5.8	68.4	38.9	8.0	33.0	50.2	20.0
LOS	D	D	A	D	C	A	E	D	A	C	D	B
Approach Delay		31.6			30.4			41.6			36.2	
Approach LOS		C			C			D			D	
Queue Length 50th (ft)	82	448	0	178	417	28	118	81	0	41	117	39
Queue Length 95th (ft)	124	#554	0	#240	485	87	#192	120	65	80	166	128
Internal Link Dist (ft)		1615			1654			957			639	
Turn Bay Length (ft)	200		200	200		200	200		200	200		200
Base Capacity (vph)	390	1969	1583	651	2317	867	386	726	516	255	522	409
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.60	0.93	0.51	0.79	0.83	0.40	0.85	0.35	0.47	0.31	0.64	0.66



































Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 2:NBT, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.93  
 Intersection Signal Delay: 32.7  
 Intersection LOS: C  
 Intersection Capacity Utilization 76.8%  
 ICU Level of Service D  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Grogans Mill Road & Research Forest Drive



Lanes, Volumes, Timings  
1: Grogans Mill Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  		  	  		 	 			 	
Traffic Volume (vph)	191	1620	444	231	1756	176	785	262	362	90	249	336
Future Volume (vph)	191	1620	444	231	1756	176	785	262	362	90	249	336
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	200		200	200		200	200		200
Storage Lanes	2		1	2		1	2		1	1		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt			0.850			0.850			0.850			0.850
Flt Protected	0.950			0.950			0.950			0.950		
Satd. Flow (prot)	3433	5085	1583	3335	4940	1538	3400	3505	1568	1752	3505	1568
Flt Permitted	0.950			0.950			0.950			0.577		
Satd. Flow (perm)	3433	5085	1583	3335	4940	1538	3400	3505	1568	1064	3505	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			221			144			232			144
Link Speed (mph)		45			45			35			35	
Link Distance (ft)		1695			1734			1037			719	
Travel Time (s)		25.7			26.3			20.2			14.0	
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
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	208	1761	483	251	1909	191	853	285	393	98	271	365
Shared Lane Traffic (%)												
Lane Group Flow (vph)	208	1761	483	251	1909	191	853	285	393	98	271	365
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			24			24	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Prot	NA	Free	Prot	NA	Perm	Prot	NA	Perm	pm+pt	NA	Perm
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases			Free			8			2	6		6
Minimum Split (s)	9.5	20.0		9.5	20.0	20.0	9.5	20.0	20.0	9.5	20.0	20.0
Total Split (s)	13.0	42.8		14.0	43.8	43.8	31.8	42.0	42.0	11.2	21.4	21.4
Total Split (%)	11.8%	38.9%		12.7%	39.8%	39.8%	28.9%	38.2%	38.2%	10.2%	19.5%	19.5%
Maximum Green (s)	8.5	38.8		9.5	39.8	39.8	27.3	38.0	38.0	6.7	17.4	17.4
Yellow Time (s)	3.5	3.5		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	0.5		1.0	0.5	0.5	1.0	0.5	0.5	1.0	0.5	0.5
Lost Time Adjust (s)	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Lost Time (s)	4.5	4.0		4.5	4.0	4.0	4.5	4.0	4.0	4.5	4.0	4.0
Lead/Lag	Lead	Lag		Lead	Lag	Lag	Lead	Lag	Lag	Lead	Lag	Lag
Lead-Lag Optimize?	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Walk Time (s)		5.0			5.0	5.0		5.0	5.0		5.0	5.0
Flash Dont Walk (s)		11.0			11.0	11.0		11.0	11.0		11.0	11.0
Pedestrian Calls (#/hr)		0			0	0		0	0		0	0
Act Effect Green (s)	8.5	38.8	110.0	9.5	39.8	39.8	27.3	38.0	38.0	23.6	17.4	17.4
Actuated g/C Ratio	0.08	0.35	1.00	0.09	0.36	0.36	0.25	0.35	0.35	0.21	0.16	0.16

Lanes, Volumes, Timings  
 1: Grogans Mill Road & Research Forest Drive

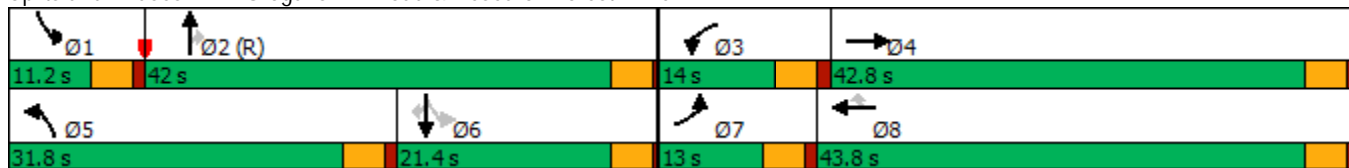


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.78	0.98	0.31	0.87	1.07	0.29	1.01	0.24	0.57	0.36	0.49	0.99
Control Delay	70.9	53.1	0.5	78.7	76.7	8.5	75.6	26.3	15.0	25.4	45.7	73.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	70.9	53.1	0.5	78.7	76.7	8.5	75.6	26.3	15.0	25.4	45.7	73.2
LOS	E	D	A	E	E	A	E	C	B	C	D	E
Approach Delay		44.3			71.4			50.8			56.7	
Approach LOS		D			E			D			E	
Queue Length 50th (ft)	75	447	0	91	-547	22	-317	74	86	40	93	166
Queue Length 95th (ft)	#134	#563	0	#163	#644	72	#450	108	185	73	136	#362
Internal Link Dist (ft)		1615			1654			957			639	
Turn Bay Length (ft)	200		200	200		200	200		200	200		200
Base Capacity (vph)	265	1793	1583	288	1787	648	843	1210	693	270	554	369
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.78	0.98	0.31	0.87	1.07	0.29	1.01	0.24	0.57	0.36	0.49	0.99

Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 2:NBT, Start of Green  
 Natural Cycle: 110  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.07  
 Intersection Signal Delay: 56.0  
 Intersection LOS: E  
 Intersection Capacity Utilization 87.1%  
 ICU Level of Service E  
 Analysis Period (min) 15  
 ~ 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.

















Splits and Phases: 1: Grogans Mill Road & Research Forest Drive



Lanes, Volumes, Timings

1: GMR SB Left-Turn/RFD WB Right-Turn & Grogans Mill Road

Synchro 11 Report

													
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations													
Traffic Volume (vph)	0	66	0	0	0	282	0	392	0	0	0	0	
Future Volume (vph)	0	66	0	0	0	282	0	392	0	0	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	
Fr <sub>t</sub>							0.865						
Fl <sub>t</sub> Protected													
Satd. Flow (prot)	0	1845	0	0	0	1596	0	3505	0	0	0	0	
Fl <sub>t</sub> Permitted													
Satd. Flow (perm)	0	1845	0	0	0	1596	0	3505	0	0	0	0	
Right Turn on Red	Yes		Yes			Yes			Yes			Yes	
Satd. Flow (RTOR)							273						
Link Speed (mph)	35						45	35		35			
Link Distance (ft)	272						1127	452		309			
Travel Time (s)	5.3						17.1	8.8		6.0			
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	
Adj. Flow (vph)	0	72	0	0	0	307	0	426	0	0	0	0	
Shared Lane Traffic (%)													
Lane Group Flow (vph)	0	72	0	0	0	307	0	426	0	0	0	0	
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No	
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right	
Median Width(ft)	0						0	0		0			
Link Offset(ft)	0						0	0		0			
Crosswalk Width(ft)	16						16	16		16			
Two way Left Turn Lane													
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Turning Speed (mph)	15		9	15		9	15		9	15		9	
Turn Type	NA						Perm	NA					
Protected Phases	4							2					
Permitted Phases							8						
Minimum Split (s)	22.5						22.5	22.5					
Total Split (s)	22.5						22.5	22.5					
Total Split (%)	50.0%						50.0%	50.0%					
Maximum Green (s)	18.0						18.0	18.0					
Yellow Time (s)	3.5						3.5	3.5					
All-Red Time (s)	1.0						1.0	1.0					
Lost Time Adjust (s)	0.0						0.0	0.0					
Total Lost Time (s)	4.5						4.5	4.5					
Lead/Lag													
Lead-Lag Optimize?													
Walk Time (s)	7.0						7.0	7.0					
Flash Dont Walk (s)	11.0						11.0	11.0					
Pedestrian Calls (#/hr)	0						0	0					
Act Effct Green (s)	18.0						18.0	18.0					
Actuated g/C Ratio	0.40						0.40	0.40					
v/c Ratio	0.10						0.38	0.30					
Control Delay	8.9						3.7	10.0					
Queue Delay	0.0						0.0	0.0					
Total Delay	8.9						3.7	10.0					

Lanes, Volumes, Timings

1: GMR SB Left-Turn/RFD WB Right-Turn & Grogans Mill Road

Synchro 11 Report

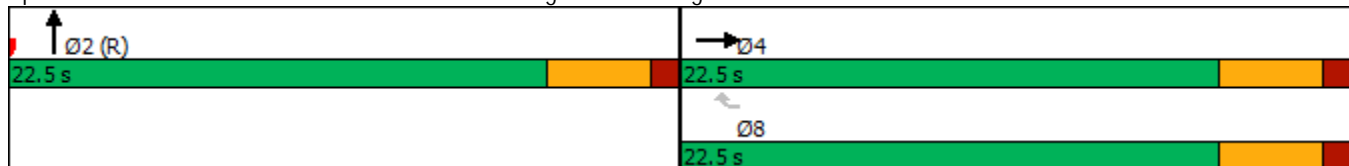


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS		A				A		A				
Approach Delay		8.9			3.7			10.0				
Approach LOS		A			A			A				
Queue Length 50th (ft)		11				5		37				
Queue Length 95th (ft)		29				40		62				
Internal Link Dist (ft)		192			1047			372			229	
Turn Bay Length (ft)												
Base Capacity (vph)		738				802		1402				
Starvation Cap Reductn		0				0		0				
Spillback Cap Reductn		0				0		0				
Storage Cap Reductn		0				0		0				
Reduced v/c Ratio		0.10				0.38		0.30				

Intersection Summary

























Area Type:	Other
Cycle Length:	45
Actuated Cycle Length:	45
Offset:	0 (0%), Referenced to phase 2:NBT and 6:, Start of Green
Natural Cycle:	45
Control Type:	Pretimed
Maximum v/c Ratio:	0.38
Intersection Signal Delay:	7.5
Intersection LOS:	A
Intersection Capacity Utilization:	35.8%
ICU Level of Service:	A
Analysis Period (min):	15

Splits and Phases: 1: GMR SB Left-Turn/RFD WB Right-Turn & Grogans Mill Road



## Lanes, Volumes, Timings 2: Grogans Mill Road & Research Forest Drive

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  			   			 				
Traffic Volume (vph)	191	1515	0	0	2004	0	0	201	196	0	0	0
Future Volume (vph)	191	1515	0	0	2004	0	0	201	196	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		550	0		0
Storage Lanes	2		0	0		0	0		1	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.91	1.00	1.00	0.81	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Frt									0.850			
Flt Protected	0.950											
Satd. Flow (prot)	3400	5036	0	0	7471	0	0	3505	1568	0	0	0
Flt Permitted	0.950											
Satd. Flow (perm)	3400	5036	0	0	7471	0	0	3505	1568	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)									213			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		321			1426			1144				452
Travel Time (s)		4.9			21.6			22.3				8.8
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
Adj. Flow (vph)	208	1647	0	0	2178	0	0	218	213	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	208	1647	0	0	2178	0	0	218	213	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Prot	NA			NA			NA	Perm			
Protected Phases	7	4			8			2				
Permitted Phases									2			
Minimum Split (s)	9.5	22.5			22.5			22.5	22.5			
Total Split (s)	10.7	27.0			30.4			23.9	23.9			
Total Split (%)	16.5%	41.5%			46.8%			36.8%	36.8%			
Maximum Green (s)	6.2	22.5			25.9			19.4	19.4			
Yellow Time (s)	3.5	3.5			3.5			3.5	3.5			
All-Red Time (s)	1.0	1.0			1.0			1.0	1.0			
Lost Time Adjust (s)	0.0	0.0			0.0			0.0	0.0			
Total Lost Time (s)	4.5	4.5			4.5			4.5	4.5			
Lead/Lag	Lead	Lag			Lag							
Lead-Lag Optimize?	Yes	Yes			Yes							
Walk Time (s)		7.0			7.0			7.0	7.0			
Flash Dont Walk (s)		11.0			11.0			11.0	11.0			
Pedestrian Calls (#/hr)		0			0			0	0			
Act Effct Green (s)	6.2	22.5			25.9			19.4	19.4			
Actuated g/C Ratio	0.10	0.35			0.40			0.30	0.30			
v/c Ratio	0.64	0.94			0.73			0.21	0.35			

Lanes, Volumes, Timings  
 2: Grogans Mill Road & Research Forest Drive

Lane Group	Ø3	Ø6
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	3	6
Permitted Phases		
Minimum Split (s)	9.5	22.5
Total Split (s)	14.1	23.9
Total Split (%)	22%	37%
Maximum Green (s)	9.6	19.4
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag	Lead	
Lead-Lag Optimize?	Yes	
Walk Time (s)		7.0
Flash Dont Walk (s)		11.0
Pedestrian Calls (#/hr)		0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		



Lanes, Volumes, Timings  
 2: Grogans Mill Road & Research Forest Drive

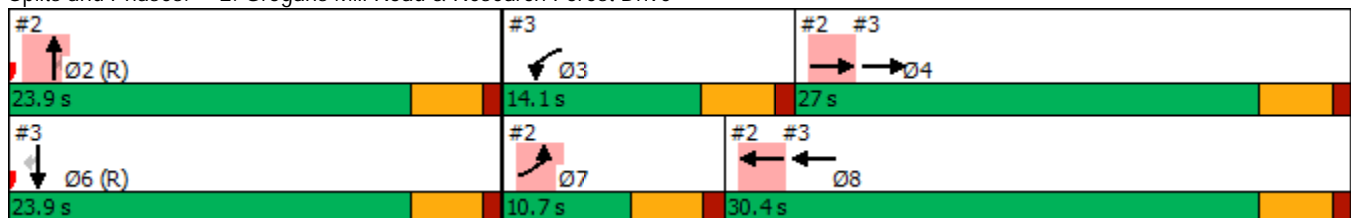


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay	46.5	19.7			18.4			17.7	4.8			
Queue Delay	0.0	0.0			0.0			0.0	0.0			
Total Delay	46.5	19.7			18.4			17.7	4.8			
LOS	D	B			B			B	A			
Approach Delay		22.7			18.4			11.3				
Approach LOS		C			B			B				
Queue Length 50th (ft)	48	48			174			33	0			
Queue Length 95th (ft)	m67	#64			210			57	42			
Internal Link Dist (ft)		241			1346			1064			372	
Turn Bay Length (ft)									550			
Base Capacity (vph)	324	1743			2976			1046	617			
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	0.64	0.94			0.73			0.21	0.35			

Intersection Summary

Area Type: Other  
 Cycle Length: 65  
 Actuated Cycle Length: 65  
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:, Start of Green  
 Natural Cycle: 65  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.94  
 Intersection Signal Delay: 19.5 Intersection LOS: B  
 Intersection Capacity Utilization 51.7% ICU Level of Service A  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Grogans Mill Road & Research Forest Drive



Lane Group	Ø3	Ø6
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
 3: Grogans Mill Road & Research Forest Drive



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑↑		↔↔	↑↑↑						↑↑	↔
Traffic Volume (vph)	0	1706	0	416	1588	0	0	0	0	0	265	218
Future Volume (vph)	0	1706	0	416	1588	0	0	0	0	0	265	218
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	0		500
Storage Lanes	0		0	2		0	0		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.81	1.00	0.97	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Frt												0.850
Flt Protected				0.950								
Satd. Flow (prot)	0	7471	0	3400	5036	0	0	0	0	0	3505	1568
Flt Permitted				0.950								
Satd. Flow (perm)	0	7471	0	3400	5036	0	0	0	0	0	3505	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)												237
Link Speed (mph)		45			45			35				35
Link Distance (ft)		1212			321			749				806
Travel Time (s)		18.4			4.9			14.6				15.7
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
Adj. Flow (vph)	0	1854	0	452	1726	0	0	0	0	0	288	237
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1854	0	452	1726	0	0	0	0	0	288	237
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA		Prot	NA						NA	Perm
Protected Phases		4		3	8						6	
Permitted Phases												6
Minimum Split (s)		22.5		9.5	22.5						22.5	22.5
Total Split (s)		27.0		14.1	30.4						23.9	23.9
Total Split (%)		41.5%		21.7%	46.8%						36.8%	36.8%
Maximum Green (s)		22.5		9.6	25.9						19.4	19.4
Yellow Time (s)		3.5		3.5	3.5						3.5	3.5
All-Red Time (s)		1.0		1.0	1.0						1.0	1.0
Lost Time Adjust (s)		0.0		0.0	0.0						0.0	0.0
Total Lost Time (s)		4.5		4.5	4.5						4.5	4.5
Lead/Lag		Lag		Lead	Lag							
Lead-Lag Optimize?		Yes		Yes	Yes							
Walk Time (s)		7.0			7.0						7.0	7.0
Flash Dont Walk (s)		11.0			11.0						11.0	11.0
Pedestrian Calls (#/hr)		0			0						0	0
Act Effect Green (s)		22.5		9.6	25.9						19.4	19.4
Actuated g/C Ratio		0.35		0.15	0.40						0.30	0.30
v/c Ratio		0.72		0.90	0.86						0.28	0.37

### Lanes, Volumes, Timings 3: Grogans Mill Road & Research Forest Drive

Lane Group	Ø2	Ø7
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	7
Permitted Phases		
Minimum Split (s)	22.5	9.5
Total Split (s)	23.9	10.7
Total Split (%)	37%	16%
Maximum Green (s)	19.4	6.2
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		Lead
Lead-Lag Optimize?		Yes
Walk Time (s)	7.0	
Flash Dont Walk (s)	11.0	
Pedestrian Calls (#/hr)	0	
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		

Lanes, Volumes, Timings  
 3: Grogans Mill Road & Research Forest Drive

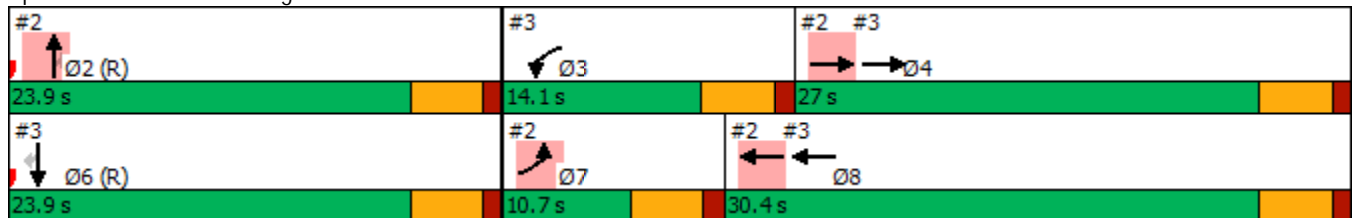


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay		20.4		60.6	9.9						18.3	4.8
Queue Delay		0.0		0.0	0.0						0.0	0.0
Total Delay		20.4		60.6	9.9						18.3	4.8
LOS		C		E	A						B	A
Approach Delay		20.4			20.5						12.2	
Approach LOS		C			C						B	
Queue Length 50th (ft)		154		105	28						45	0
Queue Length 95th (ft)		187		m#171	#64						73	44
Internal Link Dist (ft)		1132			241			669			726	
Turn Bay Length (ft)												500
Base Capacity (vph)		2586		502	2006						1046	634
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		0.72		0.90	0.86						0.28	0.37

Intersection Summary

Area Type:	Other
Cycle Length:	65
Actuated Cycle Length:	65
Offset:	0 (0%), Referenced to phase 2:NBT and 6:, Start of Green
Natural Cycle:	65
Control Type:	Pretimed
Maximum v/c Ratio:	0.94
Intersection Signal Delay:	19.5
Intersection LOS:	B
Intersection Capacity Utilization:	51.7%
ICU Level of Service:	A
Analysis Period (min):	15
#	95th percentile volume exceeds capacity, queue may be longer. Queue shown is maximum after two cycles.
m	Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Grogans Mill Road & Research Forest Drive


















Lane Group	Ø2	Ø7
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings

4: Grogans Mill Road & RFD EB Right-Turn/GMD NB Left-Turn

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	658	0	265	0	0	0	0	0	681	0
Future Volume (vph)	0	0	658	0	265	0	0	0	0	0	681	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	0.88	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Fr <sub>t</sub>			0.850									
Fl <sub>t</sub> Protected												
Satd. Flow (prot)	0	0	2760	0	3505	0	0	0	0	0	3505	0
Fl <sub>t</sub> Permitted												
Satd. Flow (perm)	0	0	2760	0	3505	0	0	0	0	0	3505	0
Right Turn on Red			Yes	Yes		Yes			Yes			Yes
Satd. Flow (RTOR)			165									
Link Speed (mph)		45			35			35			35	
Link Distance (ft)		1074			252			415			749	
Travel Time (s)		16.3			4.9			8.1			14.6	
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
Adj. Flow (vph)	0	0	715	0	288	0	0	0	0	0	740	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	715	0	288	0	0	0	0	0	740	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type			Perm		NA						NA	
Protected Phases					8						6	
Permitted Phases			4									
Minimum Split (s)			22.5		22.5						22.5	
Total Split (s)			22.5		22.5						22.5	
Total Split (%)			50.0%		50.0%						50.0%	
Maximum Green (s)			18.0		18.0						18.0	
Yellow Time (s)			3.5		3.5						3.5	
All-Red Time (s)			1.0		1.0						1.0	
Lost Time Adjust (s)			0.0		0.0						0.0	
Total Lost Time (s)			4.5		4.5						4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)			7.0		7.0						7.0	
Flash Dont Walk (s)			11.0		11.0						11.0	
Pedestrian Calls (#/hr)			0		0						0	
Act Effect Green (s)			18.0		18.0						18.0	
Actuated g/C Ratio			0.40		0.40						0.40	
v/c Ratio			0.59		0.21						0.53	
Control Delay			10.5		9.3						12.0	
Queue Delay			0.0		0.0						0.0	
Total Delay			10.5		9.3						12.0	

Lanes, Volumes, Timings

4: Grogans Mill Road & RFD EB Right-Turn/GMD NB Left-Turn

Synchro 11 Report

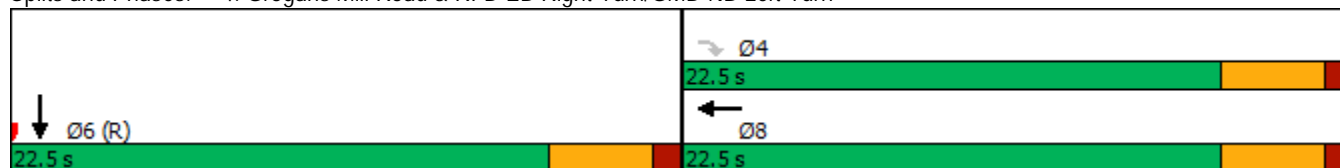


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS			B		A							B
Approach Delay		10.5			9.3							12.0
Approach LOS		B			A							B
Queue Length 50th (ft)			56		24							72
Queue Length 95th (ft)			102		43							111
Internal Link Dist (ft)		994			172			335				669
Turn Bay Length (ft)												
Base Capacity (vph)			1203		1402							1402
Starvation Cap Reductn			0		0							0
Spillback Cap Reductn			0		0							0
Storage Cap Reductn			0		0							0
Reduced v/c Ratio			0.59		0.21							0.53

Intersection Summary

Area Type:	Other
Cycle Length:	45
Actuated Cycle Length:	45
Offset:	0 (0%), Referenced to phase 2: and 6:SBT, Start of Green
Natural Cycle:	45
Control Type:	Pretimed
Maximum v/c Ratio:	0.59
Intersection Signal Delay:	10.9
Intersection LOS:	B
Intersection Capacity Utilization:	49.3%
ICU Level of Service:	A
Analysis Period (min):	15

Splits and Phases: 4: Grogans Mill Road & RFD EB Right-Turn/GMD NB Left-Turn

















Lanes, Volumes, Timings

1: GMR SB Left-Turn/RFD WB Right-Turn & Grogans Mill Road

Synchro 11 Report

														
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations		↑				↗		↑↑						
Traffic Volume (vph)	0	80	0	0	0	158	0	389	0	0	0	0		
Future Volume (vph)	0	80	0	0	0	158	0	389	0	0	0	0		
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00		
Fr <sub>t</sub>							0.865							
Fl <sub>t</sub> Protected														
Satd. Flow (prot)	0	1845	0	0	0	1596	0	3505	0	0	0	0		
Fl <sub>t</sub> Permitted														
Satd. Flow (perm)	0	1845	0	0	0	1596	0	3505	0	0	0	0		
Right Turn on Red	Yes		Yes			Yes			Yes			Yes		
Satd. Flow (RTOR)							276							
Link Speed (mph)					35					45				
Link Distance (ft)					272					1127				
Travel Time (s)					5.3					17.1				
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		
Adj. Flow (vph)	0	87	0	0	0	172	0	423	0	0	0	0		
Shared Lane Traffic (%)														
Lane Group Flow (vph)	0	87	0	0	0	172	0	423	0	0	0	0		
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No		
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right		
Median Width(ft)	0						0							
Link Offset(ft)	0						0							
Crosswalk Width(ft)	16						16							
Two way Left Turn Lane														
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Turning Speed (mph)	15		9	15		9	15		9	15		9		
Turn Type	NA						Perm		NA					
Protected Phases	4								2					
Permitted Phases							8							
Minimum Split (s)	22.5						22.5		22.5					
Total Split (s)	22.5						22.5		22.5					
Total Split (%)	50.0%						50.0%		50.0%					
Maximum Green (s)	18.0						18.0		18.0					
Yellow Time (s)	3.5						3.5		3.5					
All-Red Time (s)	1.0						1.0		1.0					
Lost Time Adjust (s)	0.0						0.0		0.0					
Total Lost Time (s)	4.5						4.5		4.5					
Lead/Lag														
Lead-Lag Optimize?														
Walk Time (s)	7.0						7.0		7.0					
Flash Dont Walk (s)	11.0						11.0		11.0					
Pedestrian Calls (#/hr)	0						0		0					
Act Effct Green (s)	18.0						18.0		18.0					
Actuated g/C Ratio	0.40						0.40		0.40					
v/c Ratio	0.12						0.21		0.30					
Control Delay	9.1						1.1		10.0					
Queue Delay	0.0						0.0		0.0					
Total Delay	9.1						1.1		10.0					

Lanes, Volumes, Timings

1: GMR SB Left-Turn/RFD WB Right-Turn & Grogans Mill Road

Synchro 11 Report

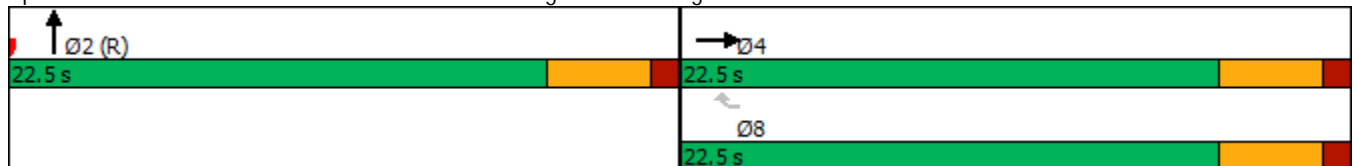


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS		A				A		A				
Approach Delay		9.1			1.1			10.0				
Approach LOS		A			A			A				
Queue Length 50th (ft)		13				0		36				
Queue Length 95th (ft)		33				8		61				
Internal Link Dist (ft)		192			1047			372			229	
Turn Bay Length (ft)												
Base Capacity (vph)		738				804		1402				
Starvation Cap Reductn		0				0		0				
Spillback Cap Reductn		0				0		0				
Storage Cap Reductn		0				0		0				
Reduced v/c Ratio		0.12				0.21		0.30				

Intersection Summary

























Area Type:	Other
Cycle Length:	45
Actuated Cycle Length:	45
Offset:	0 (0%), Referenced to phase 2:NBT and 6:, Start of Green
Natural Cycle:	45
Control Type:	Pretimed
Maximum v/c Ratio:	0.30
Intersection Signal Delay:	7.6
Intersection LOS:	A
Intersection Capacity Utilization:	28.0%
ICU Level of Service:	A
Analysis Period (min):	15

Splits and Phases: 1: GMR SB Left-Turn/RFD WB Right-Turn & Grogans Mill Road



## Lanes, Volumes, Timings 2: Grogans Mill Road & Research Forest Drive

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  			   			 				
Traffic Volume (vph)	169	1455	0	0	1782	0	0	220	320	0	0	0
Future Volume (vph)	169	1455	0	0	1782	0	0	220	320	0	0	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		550	0		0
Storage Lanes	2		0	0		0	0		1	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.91	1.00	1.00	0.81	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Frt									0.850			
Flt Protected	0.950											
Satd. Flow (prot)	3400	5036	0	0	7471	0	0	3505	1568	0	0	0
Flt Permitted	0.950											
Satd. Flow (perm)	3400	5036	0	0	7471	0	0	3505	1568	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)									204			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		321			1426			1144				452
Travel Time (s)		4.9			21.6			22.3				8.8
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
Adj. Flow (vph)	184	1582	0	0	1937	0	0	239	348	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	184	1582	0	0	1937	0	0	239	348	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Prot	NA			NA			NA	Perm			
Protected Phases	7	4			8			2				
Permitted Phases									2			
Minimum Split (s)	9.5	22.5			22.5			22.5	22.5			
Total Split (s)	9.5	26.5			27.0			23.5	23.5			
Total Split (%)	15.8%	44.2%			45.0%			39.2%	39.2%			
Maximum Green (s)	5.0	22.0			22.5			19.0	19.0			
Yellow Time (s)	3.5	3.5			3.5			3.5	3.5			
All-Red Time (s)	1.0	1.0			1.0			1.0	1.0			
Lost Time Adjust (s)	0.0	0.0			0.0			0.0	0.0			
Total Lost Time (s)	4.5	4.5			4.5			4.5	4.5			
Lead/Lag	Lead	Lag			Lag							
Lead-Lag Optimize?	Yes	Yes			Yes							
Walk Time (s)		7.0			7.0			7.0	7.0			
Flash Dont Walk (s)		11.0			11.0			11.0	11.0			
Pedestrian Calls (#/hr)		0			0			0	0			
Act Effct Green (s)	5.0	22.0			22.5			19.0	19.0			
Actuated g/C Ratio	0.08	0.37			0.38			0.32	0.32			
v/c Ratio	0.65	0.86			0.69			0.22	0.55			

## Lanes, Volumes, Timings 2: Grogans Mill Road & Research Forest Drive

Synchro 11 Report

Lane Group	Ø3	Ø6
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	3	6
Permitted Phases		
Minimum Split (s)	9.5	22.5
Total Split (s)	10.0	23.5
Total Split (%)	17%	39%
Maximum Green (s)	5.5	19.0
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag	Lead	
Lead-Lag Optimize?	Yes	
Walk Time (s)		7.0
Flash Dont Walk (s)		11.0
Pedestrian Calls (#/hr)		0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		

# Lanes, Volumes, Timings

## 2: Grogans Mill Road & Research Forest Drive

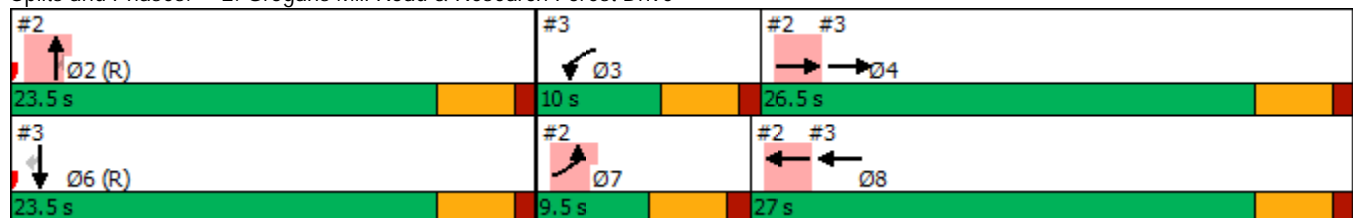


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay	48.3	12.0			17.4			15.7	10.8			
Queue Delay	0.0	0.0			0.0			0.0	0.0			
Total Delay	48.3	12.0			17.4			15.7	10.8			
LOS	D	B			B			B	B			
Approach Delay		15.8			17.4			12.8				
Approach LOS		B			B			B				
Queue Length 50th (ft)	39	36			141			33	39			
Queue Length 95th (ft)	m#61	#72			174			56	106			
Internal Link Dist (ft)		241			1346			1064			372	
Turn Bay Length (ft)									550			
Base Capacity (vph)	283	1846			2801			1109	635			
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	0.65	0.86			0.69			0.22	0.55			

### Intersection Summary

Area Type: Other  
 Cycle Length: 60  
 Actuated Cycle Length: 60  
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:, Start of Green  
 Natural Cycle: 60  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.91  
 Intersection Signal Delay: 16.1 Intersection LOS: B  
 Intersection Capacity Utilization 56.3% ICU Level of Service B  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

### Splits and Phases: 2: Grogans Mill Road & Research Forest Drive



Lane Group	Ø3	Ø6
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

### Lanes, Volumes, Timings 3: Grogans Mill Road & Research Forest Drive

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑↑		↔↔	↑↑↑						↑↑	↗
Traffic Volume (vph)	0	1624	0	204	1578	0	0	0	0	0	215	296
Future Volume (vph)	0	1624	0	204	1578	0	0	0	0	0	215	296
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	0		500
Storage Lanes	0		0	2		0	0		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.81	1.00	0.97	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Frt												0.850
Flt Protected				0.950								
Satd. Flow (prot)	0	7471	0	3400	5036	0	0	0	0	0	3505	1568
Flt Permitted				0.950								
Satd. Flow (perm)	0	7471	0	3400	5036	0	0	0	0	0	3505	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)												203
Link Speed (mph)		45			45			35				35
Link Distance (ft)		1212			321			749				806
Travel Time (s)		18.4			4.9			14.6				15.7
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
Adj. Flow (vph)	0	1765	0	222	1715	0	0	0	0	0	234	322
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1765	0	222	1715	0	0	0	0	0	234	322
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA		Prot	NA						NA	Perm
Protected Phases		4		3	8						6	
Permitted Phases												6
Minimum Split (s)		22.5		9.5	22.5						22.5	22.5
Total Split (s)		26.5		10.0	27.0						23.5	23.5
Total Split (%)		44.2%		16.7%	45.0%						39.2%	39.2%
Maximum Green (s)		22.0		5.5	22.5						19.0	19.0
Yellow Time (s)		3.5		3.5	3.5						3.5	3.5
All-Red Time (s)		1.0		1.0	1.0						1.0	1.0
Lost Time Adjust (s)		0.0		0.0	0.0						0.0	0.0
Total Lost Time (s)		4.5		4.5	4.5						4.5	4.5
Lead/Lag		Lag		Lead	Lag							
Lead-Lag Optimize?		Yes		Yes	Yes							
Walk Time (s)		7.0			7.0						7.0	7.0
Flash Dont Walk (s)		11.0			11.0						11.0	11.0
Pedestrian Calls (#/hr)		0			0						0	0
Act Effect Green (s)		22.0		5.5	22.5						19.0	19.0
Actuated g/C Ratio		0.37		0.09	0.38						0.32	0.32
v/c Ratio		0.64		0.71	0.91						0.21	0.51

# Lanes, Volumes, Timings

## 3: Grogans Mill Road & Research Forest Drive

Lane Group	Ø2	Ø7
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	7
Permitted Phases		
Minimum Split (s)	22.5	9.5
Total Split (s)	23.5	9.5
Total Split (%)	39%	16%
Maximum Green (s)	19.0	5.0
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		Lead
Lead-Lag Optimize?		Yes
Walk Time (s)	7.0	
Flash Dont Walk (s)	11.0	
Pedestrian Calls (#/hr)	0	
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		



Lanes, Volumes, Timings  
 3: Grogans Mill Road & Research Forest Drive

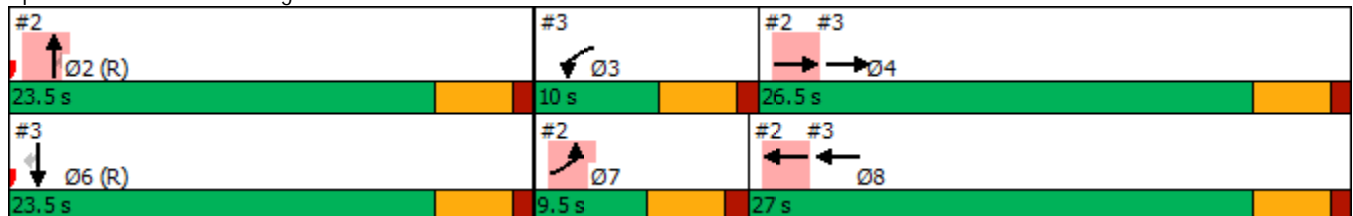


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay		17.1		49.8	14.8						15.7	9.7
Queue Delay		0.0		0.0	0.0						0.0	0.0
Total Delay		17.1		49.8	14.8						15.7	9.7
LOS		B		D	B						B	A
Approach Delay		17.1			18.9						12.2	
Approach LOS		B			B						B	
Queue Length 50th (ft)		126		47	42						32	31
Queue Length 95th (ft)		157		m#71	#102						55	92
Internal Link Dist (ft)		1132			241			669			726	
Turn Bay Length (ft)												500
Base Capacity (vph)		2739		311	1888						1109	635
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		0.64		0.71	0.91						0.21	0.51

Intersection Summary

Area Type: Other  
 Cycle Length: 60  
 Actuated Cycle Length: 60  
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:, Start of Green  
 Natural Cycle: 60  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.91  
 Intersection Signal Delay: 17.3  
 Intersection LOS: B  
 Intersection Capacity Utilization 56.3%  
 ICU Level of Service B  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Grogans Mill Road & Research Forest Drive


















Lane Group	Ø2	Ø7
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

# Lanes, Volumes, Timings

## 4: Grogans Mill Road & RFD EB Right-Turn/GMD NB Left-Turn

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	392	0	693	0	0	0	0	0	419	0
Future Volume (vph)	0	0	392	0	693	0	0	0	0	0	419	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	0.88	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Frt			0.850									
Flt Protected												
Satd. Flow (prot)	0	0	2760	0	3505	0	0	0	0	0	3505	0
Flt Permitted												
Satd. Flow (perm)	0	0	2760	0	3505	0	0	0	0	0	3505	0
Right Turn on Red			Yes	Yes		Yes			Yes			Yes
Satd. Flow (RTOR)			436									
Link Speed (mph)		45			35			35			35	
Link Distance (ft)		1074			252			415			749	
Travel Time (s)		16.3			4.9			8.1			14.6	
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
Adj. Flow (vph)	0	0	426	0	753	0	0	0	0	0	455	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	426	0	753	0	0	0	0	0	455	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type			Perm		NA						NA	
Protected Phases					8						6	
Permitted Phases			4									
Minimum Split (s)			22.5		22.5						22.5	
Total Split (s)			22.5		22.5						22.5	
Total Split (%)			50.0%		50.0%						50.0%	
Maximum Green (s)			18.0		18.0						18.0	
Yellow Time (s)			3.5		3.5						3.5	
All-Red Time (s)			1.0		1.0						1.0	
Lost Time Adjust (s)			0.0		0.0						0.0	
Total Lost Time (s)			4.5		4.5						4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)			7.0		7.0						7.0	
Flash Dont Walk (s)			11.0		11.0						11.0	
Pedestrian Calls (#/hr)			0		0						0	
Act Effect Green (s)			18.0		18.0						18.0	
Actuated g/C Ratio			0.40		0.40						0.40	
v/c Ratio			0.31		0.54						0.32	
Control Delay			1.9		12.1						10.1	
Queue Delay			0.0		0.0						0.0	
Total Delay			1.9		12.1						10.1	

Lanes, Volumes, Timings

4: Grogans Mill Road & RFD EB Right-Turn/GMD NB Left-Turn

Synchro 11 Report

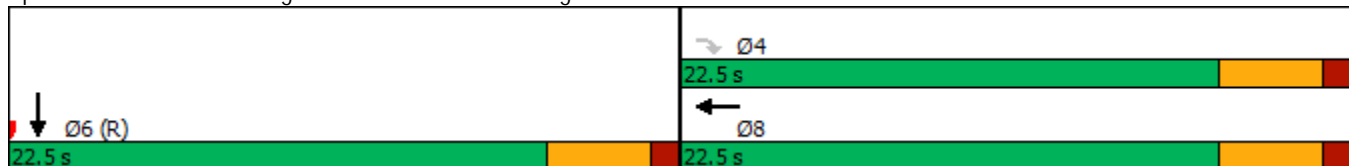


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS			A		B							B
Approach Delay		1.9			12.1							10.1
Approach LOS		A			B							B
Queue Length 50th (ft)			0		73							40
Queue Length 95th (ft)			19		114							66
Internal Link Dist (ft)		994			172			335				669
Turn Bay Length (ft)												
Base Capacity (vph)			1365		1402							1402
Starvation Cap Reductn			0		0							0
Spillback Cap Reductn			0		0							0
Storage Cap Reductn			0		0							0
Reduced v/c Ratio			0.31		0.54							0.32

Intersection Summary

Area Type:	Other
Cycle Length:	45
Actuated Cycle Length:	45
Offset:	0 (0%), Referenced to phase 2: and 6:SBT, Start of Green
Natural Cycle:	45
Control Type:	Pretimed
Maximum v/c Ratio:	0.54
Intersection Signal Delay:	8.9
Intersection LOS:	A
Intersection Capacity Utilization:	38.2%
ICU Level of Service:	A
Analysis Period (min):	15













Splits and Phases: 4: Grogans Mill Road & RFD EB Right-Turn/GMD NB Left-Turn



Lanes, Volumes, Timings

1: GMR SB Left-Turn/RFD WB Right-Turn & Grogans Mill Road

Synchro 11 Report

														
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR		
Lane Configurations		↑				↗		↑↑						
Traffic Volume (vph)	0	74	0	0	0	320	0	450	0	0	0	0		
Future Volume (vph)	0	74	0	0	0	320	0	450	0	0	0	0		
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900		
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00		
Fr <sub>t</sub>							0.865							
Fl <sub>t</sub> Protected														
Satd. Flow (prot)	0	1845	0	0	0	1596	0	3505	0	0	0	0		
Fl <sub>t</sub> Permitted														
Satd. Flow (perm)	0	1845	0	0	0	1596	0	3505	0	0	0	0		
Right Turn on Red	Yes		Yes			Yes			Yes			Yes		
Satd. Flow (RTOR)							221							
Link Speed (mph)					35					45				
Link Distance (ft)					272					1127				
Travel Time (s)					5.3					17.1				
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		
Adj. Flow (vph)	0	80	0	0	0	348	0	489	0	0	0	0		
Shared Lane Traffic (%)														
Lane Group Flow (vph)	0	80	0	0	0	348	0	489	0	0	0	0		
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No		
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right		
Median Width(ft)	0						0							
Link Offset(ft)	0						0							
Crosswalk Width(ft)	16						16							
Two way Left Turn Lane														
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Turning Speed (mph)	15		9	15		9	15		9	15		9		
Turn Type	NA						Perm		NA					
Protected Phases	4								2					
Permitted Phases							8							
Minimum Split (s)	22.5						22.5		22.5					
Total Split (s)	22.5						22.5		22.5					
Total Split (%)	50.0%						50.0%		50.0%					
Maximum Green (s)	18.0						18.0		18.0					
Yellow Time (s)	3.5						3.5		3.5					
All-Red Time (s)	1.0						1.0		1.0					
Lost Time Adjust (s)	0.0						0.0		0.0					
Total Lost Time (s)	4.5						4.5		4.5					
Lead/Lag														
Lead-Lag Optimize?														
Walk Time (s)	7.0						7.0		7.0					
Flash Dont Walk (s)	11.0						11.0		11.0					
Pedestrian Calls (#/hr)	0						0		0					
Act Effct Green (s)	18.0						18.0		18.0					
Actuated g/C Ratio	0.40						0.40		0.40					
v/c Ratio	0.11						0.45		0.35					
Control Delay	9.0						6.0		10.3					
Queue Delay	0.0						0.0		0.0					
Total Delay	9.0						6.0		10.3					

Lanes, Volumes, Timings

1: GMR SB Left-Turn/RFD WB Right-Turn & Grogans Mill Road

Synchro 11 Report

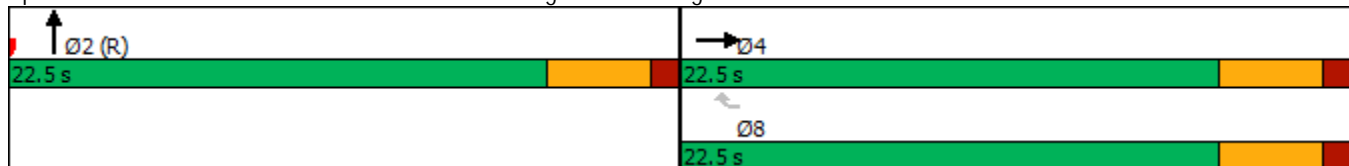


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS		A				A		B				
Approach Delay		9.0			6.0			10.3				
Approach LOS		A			A			B				
Queue Length 50th (ft)		12				20		43				
Queue Length 95th (ft)		31				63		71				
Internal Link Dist (ft)		192			1047			372			229	
Turn Bay Length (ft)												
Base Capacity (vph)		738				771		1402				
Starvation Cap Reductn		0				0		0				
Spillback Cap Reductn		0				0		0				
Storage Cap Reductn		0				0		0				
Reduced v/c Ratio		0.11				0.45		0.35				

Intersection Summary

























Area Type:	Other
Cycle Length:	45
Actuated Cycle Length:	45
Offset:	0 (0%), Referenced to phase 2:NBT and 6:., Start of Green
Natural Cycle:	45
Control Type:	Pretimed
Maximum v/c Ratio:	0.45
Intersection Signal Delay:	8.6
Intersection LOS:	A
Intersection Capacity Utilization	39.8%
ICU Level of Service	A
Analysis Period (min)	15

Splits and Phases: 1: GMR SB Left-Turn/RFD WB Right-Turn & Grogans Mill Road



## Lanes, Volumes, Timings 2: Grogans Mill Road & Research Forest Drive

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  			   			 				
Traffic Volume (vph)	216	1687	0	0	2235	0	0	234	222	0	0	0
Future Volume (vph)	216	1687	0	0	2235	0	0	234	222	0	0	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		550	0		0
Storage Lanes	2		0	0		0	0		1	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.91	1.00	1.00	0.81	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Frt									0.850			
Flt Protected	0.950											
Satd. Flow (prot)	3400	5036	0	0	7471	0	0	3505	1568	0	0	0
Flt Permitted	0.950											
Satd. Flow (perm)	3400	5036	0	0	7471	0	0	3505	1568	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)									234			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		321			1426			1144				452
Travel Time (s)		4.9			21.6			22.3				8.8
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
Adj. Flow (vph)	235	1834	0	0	2429	0	0	254	241	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	235	1834	0	0	2429	0	0	254	241	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Prot	NA			NA			NA	Perm			
Protected Phases	7	4			8			2				
Permitted Phases									2			
Minimum Split (s)	9.5	22.5			22.5			22.5	22.5			
Total Split (s)	12.1	34.0			38.9			24.0	24.0			
Total Split (%)	16.1%	45.3%			51.9%			32.0%	32.0%			
Maximum Green (s)	7.6	29.5			34.4			19.5	19.5			
Yellow Time (s)	3.5	3.5			3.5			3.5	3.5			
All-Red Time (s)	1.0	1.0			1.0			1.0	1.0			
Lost Time Adjust (s)	0.0	0.0			0.0			0.0	0.0			
Total Lost Time (s)	4.5	4.5			4.5			4.5	4.5			
Lead/Lag	Lead	Lag			Lag							
Lead-Lag Optimize?	Yes	Yes			Yes							
Walk Time (s)		7.0			7.0			7.0	7.0			
Flash Dont Walk (s)		11.0			11.0			11.0	11.0			
Pedestrian Calls (#/hr)		0			0			0	0			
Act Effct Green (s)	7.6	29.5			34.4			19.5	19.5			
Actuated g/C Ratio	0.10	0.39			0.46			0.26	0.26			
v/c Ratio	0.68	0.93			0.71			0.28	0.42			

Lanes, Volumes, Timings  
 2: Grogans Mill Road & Research Forest Drive

Lane Group	Ø3	Ø6
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	3	6
Permitted Phases		
Minimum Split (s)	9.5	22.5
Total Split (s)	17.0	24.0
Total Split (%)	23%	32%
Maximum Green (s)	12.5	19.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag	Lead	
Lead-Lag Optimize?	Yes	
Walk Time (s)		7.0
Flash Dont Walk (s)		11.0
Pedestrian Calls (#/hr)		0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		



# Lanes, Volumes, Timings

## 2: Grogans Mill Road & Research Forest Drive

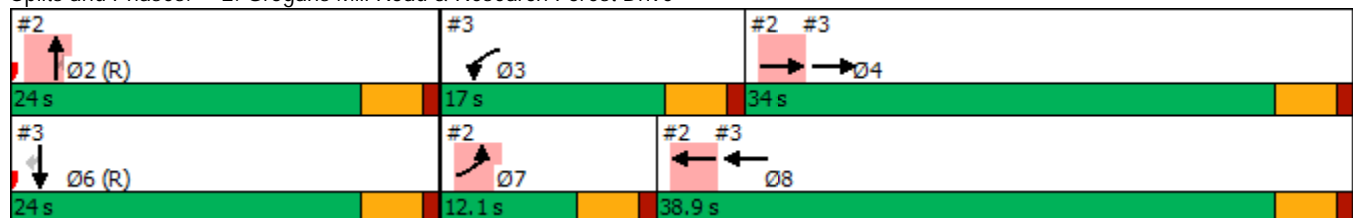


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay	52.5	15.7			17.7			23.2	6.2			
Queue Delay	0.0	0.0			0.0			0.0	0.0			
Total Delay	52.5	15.7			17.7			23.2	6.2			
LOS	D	B			B			C	A			
Approach Delay		19.9			17.7			14.9				
Approach LOS		B			B			B				
Queue Length 50th (ft)	62	67			213			49	2			
Queue Length 95th (ft)	m89	#107			249			80	54			
Internal Link Dist (ft)		241			1346			1064			372	
Turn Bay Length (ft)									550			
Base Capacity (vph)	344	1980			3426			911	580			
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	0.68	0.93			0.71			0.28	0.42			

### Intersection Summary













Area Type: Other  
 Cycle Length: 75  
 Actuated Cycle Length: 75  
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:, Start of Green  
 Natural Cycle: 75  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.93  
 Intersection Signal Delay: 18.3  
 Intersection LOS: B  
 Intersection Capacity Utilization 56.9%  
 ICU Level of Service B  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

### Splits and Phases: 2: Grogans Mill Road & Research Forest Drive



Lane Group	Ø3	Ø6
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings  
3: Grogans Mill Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑↑		↔↔	↑↑↑						↑↑	↔
Traffic Volume (vph)	0	1903	0	471	1764	0	0	0	0	0	305	247
Future Volume (vph)	0	1903	0	471	1764	0	0	0	0	0	305	247
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	0		500
Storage Lanes	0		0	2		0	0		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.81	1.00	0.97	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Frt												0.850
Flt Protected				0.950								
Satd. Flow (prot)	0	7471	0	3400	5036	0	0	0	0	0	3505	1568
Flt Permitted				0.950								
Satd. Flow (perm)	0	7471	0	3400	5036	0	0	0	0	0	3505	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)												224
Link Speed (mph)		45			45			35				35
Link Distance (ft)		1212			321			749				806
Travel Time (s)		18.4			4.9			14.6				15.7
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
Adj. Flow (vph)	0	2068	0	512	1917	0	0	0	0	0	332	268
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	2068	0	512	1917	0	0	0	0	0	332	268
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA		Prot	NA						NA	Perm
Protected Phases		4		3	8						6	
Permitted Phases												6
Minimum Split (s)		22.5		9.5	22.5						22.5	22.5
Total Split (s)		34.0		17.0	38.9						24.0	24.0
Total Split (%)		45.3%		22.7%	51.9%						32.0%	32.0%
Maximum Green (s)		29.5		12.5	34.4						19.5	19.5
Yellow Time (s)		3.5		3.5	3.5						3.5	3.5
All-Red Time (s)		1.0		1.0	1.0						1.0	1.0
Lost Time Adjust (s)		0.0		0.0	0.0						0.0	0.0
Total Lost Time (s)		4.5		4.5	4.5						4.5	4.5
Lead/Lag		Lag		Lead	Lag							
Lead-Lag Optimize?		Yes		Yes	Yes							
Walk Time (s)		7.0			7.0						7.0	7.0
Flash Dont Walk (s)		11.0			11.0						11.0	11.0
Pedestrian Calls (#/hr)		0			0						0	0
Act Effect Green (s)		29.5		12.5	34.4						19.5	19.5
Actuated g/C Ratio		0.39		0.17	0.46						0.26	0.26
v/c Ratio		0.70		0.90	0.83						0.36	0.47

### Lanes, Volumes, Timings 3: Grogans Mill Road & Research Forest Drive

Lane Group	Ø2	Ø7
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	7
Permitted Phases		
Minimum Split (s)	22.5	9.5
Total Split (s)	24.0	12.1
Total Split (%)	32%	16%
Maximum Green (s)	19.5	7.6
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		Lead
Lead-Lag Optimize?		Yes
Walk Time (s)	7.0	
Flash Dont Walk (s)	11.0	
Pedestrian Calls (#/hr)	0	
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		

Lanes, Volumes, Timings  
 3: Grogans Mill Road & Research Forest Drive

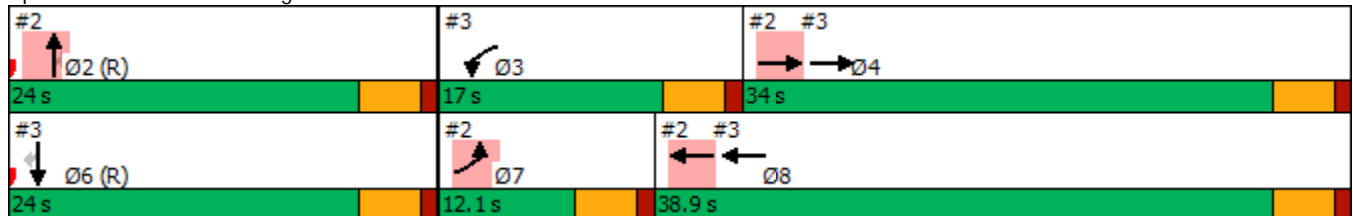


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay		20.7		66.1	7.5						24.1	8.5
Queue Delay		0.0		0.0	0.0						0.0	0.0
Total Delay		20.7		66.1	7.5						24.1	8.5
LOS		C		E	A						C	A
Approach Delay		20.7			19.8						17.1	
Approach LOS		C			B						B	
Queue Length 50th (ft)		193		137	36						66	16
Queue Length 95th (ft)		228		#220	36						102	74
Internal Link Dist (ft)		1132			241			669			726	
Turn Bay Length (ft)												500
Base Capacity (vph)		2938		566	2309						911	573
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		0.70		0.90	0.83						0.36	0.47

Intersection Summary

Area Type: Other  
 Cycle Length: 75  
 Actuated Cycle Length: 75  
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:, Start of Green  
 Natural Cycle: 75  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.93  
 Intersection Signal Delay: 19.9  
 Intersection LOS: B  
 Intersection Capacity Utilization 56.9%  
 ICU Level of Service B  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 3: Grogans Mill Road & Research Forest Drive



Lane Group	Ø2	Ø7
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

# Lanes, Volumes, Timings

## 4: Grogans Mill Road & RFD EB Right-Turn/GMD NB Left-Turn

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations			↗↗		↖↖						↖↖	
Traffic Volume (vph)	0	0	746	0	301	0	0	0	0	0	776	0
Future Volume (vph)	0	0	746	0	301	0	0	0	0	0	776	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	0.88	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Frt			0.850									
Flt Protected												
Satd. Flow (prot)	0	0	2760	0	3505	0	0	0	0	0	3505	0
Flt Permitted												
Satd. Flow (perm)	0	0	2760	0	3505	0	0	0	0	0	3505	0
Right Turn on Red			Yes	Yes		Yes			Yes			Yes
Satd. Flow (RTOR)			115									
Link Speed (mph)		45			35			35			35	
Link Distance (ft)		1074			252			415			749	
Travel Time (s)		16.3			4.9			8.1			14.6	
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
Adj. Flow (vph)	0	0	811	0	327	0	0	0	0	0	843	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	811	0	327	0	0	0	0	0	843	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type			Perm		NA						NA	
Protected Phases					8						6	
Permitted Phases			4									
Minimum Split (s)			22.5		22.5						22.5	
Total Split (s)			22.5		22.5						22.5	
Total Split (%)			50.0%		50.0%						50.0%	
Maximum Green (s)			18.0		18.0						18.0	
Yellow Time (s)			3.5		3.5						3.5	
All-Red Time (s)			1.0		1.0						1.0	
Lost Time Adjust (s)			0.0		0.0						0.0	
Total Lost Time (s)			4.5		4.5						4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)			7.0		7.0						7.0	
Flash Dont Walk (s)			11.0		11.0						11.0	
Pedestrian Calls (#/hr)			0		0						0	
Act Effect Green (s)			18.0		18.0						18.0	
Actuated g/C Ratio			0.40		0.40						0.40	
v/c Ratio			0.69		0.23						0.60	
Control Delay			13.3		9.5						12.9	
Queue Delay			0.0		0.0						0.0	
Total Delay			13.3		9.5						12.9	

Lanes, Volumes, Timings

4: Grogans Mill Road & RFD EB Right-Turn/GMD NB Left-Turn

Synchro 11 Report

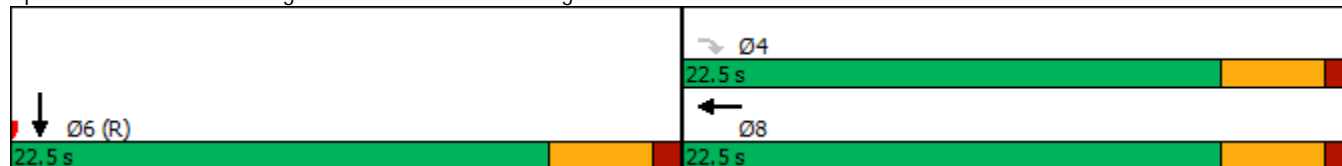


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS			B		A							B
Approach Delay		13.3			9.5							12.9
Approach LOS		B			A							B
Queue Length 50th (ft)			77		27							85
Queue Length 95th (ft)			132		48							130
Internal Link Dist (ft)		994			172			335				669
Turn Bay Length (ft)												
Base Capacity (vph)			1173		1402							1402
Starvation Cap Reductn			0		0							0
Spillback Cap Reductn			0		0							0
Storage Cap Reductn			0		0							0
Reduced v/c Ratio			0.69		0.23							0.60

Intersection Summary

Area Type:	Other
Cycle Length:	45
Actuated Cycle Length:	45
Offset:	0 (0%), Referenced to phase 2: and 6:SBT, Start of Green
Natural Cycle:	45
Control Type:	Pretimed
Maximum v/c Ratio:	0.69
Intersection Signal Delay:	12.5
Intersection LOS:	B
Intersection Capacity Utilization:	55.0%
ICU Level of Service:	B
Analysis Period (min):	15

Splits and Phases: 4: Grogans Mill Road & RFD EB Right-Turn/GMD NB Left-Turn

















Lanes, Volumes, Timings

1: GMR SB Left-Turn/RFD WB Right-Turn & Grogans Mill Road

Synchro 11 Report

													
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR	
Lane Configurations		↑				↗		↑↑					
Traffic Volume (vph)	0	90	0	0	0	176	0	453	0	0	0	0	
Future Volume (vph)	0	90	0	0	0	176	0	453	0	0	0	0	
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	
Fr <sub>t</sub>							0.865						
Fl <sub>t</sub> Protected													
Satd. Flow (prot)	0	1845	0	0	0	1596	0	3505	0	0	0	0	
Fl <sub>t</sub> Permitted													
Satd. Flow (perm)	0	1845	0	0	0	1596	0	3505	0	0	0	0	
Right Turn on Red	Yes		Yes			Yes			Yes			Yes	
Satd. Flow (RTOR)							219						
Link Speed (mph)	35						45	35		35			
Link Distance (ft)	272						1127	452		309			
Travel Time (s)	5.3						17.1	8.8		6.0			
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	
Adj. Flow (vph)	0	98	0	0	0	191	0	492	0	0	0	0	
Shared Lane Traffic (%)													
Lane Group Flow (vph)	0	98	0	0	0	191	0	492	0	0	0	0	
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No	
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right	
Median Width(ft)	0						0	0		0			
Link Offset(ft)	0						0	0		0			
Crosswalk Width(ft)	16						16	16		16			
Two way Left Turn Lane													
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Turning Speed (mph)	15		9	15		9	15		9	15		9	
Turn Type	NA						Perm	NA					
Protected Phases	4							2					
Permitted Phases							8						
Minimum Split (s)	22.5						22.5	22.5					
Total Split (s)	22.5						22.5	22.5					
Total Split (%)	50.0%						50.0%	50.0%					
Maximum Green (s)	18.0						18.0	18.0					
Yellow Time (s)	3.5						3.5	3.5					
All-Red Time (s)	1.0						1.0	1.0					
Lost Time Adjust (s)	0.0						0.0	0.0					
Total Lost Time (s)	4.5						4.5	4.5					
Lead/Lag													
Lead-Lag Optimize?													
Walk Time (s)	7.0						7.0	7.0					
Flash Dont Walk (s)	11.0						11.0	11.0					
Pedestrian Calls (#/hr)	0						0	0					
Act Effct Green (s)	18.0						18.0	18.0					
Actuated g/C Ratio	0.40						0.40	0.40					
v/c Ratio	0.13						0.25	0.35					
Control Delay	9.2						2.3	10.3					
Queue Delay	0.0						0.0	0.0					
Total Delay	9.2						2.3	10.3					

Lanes, Volumes, Timings

1: GMR SB Left-Turn/RFD WB Right-Turn & Grogans Mill Road

Synchro 11 Report

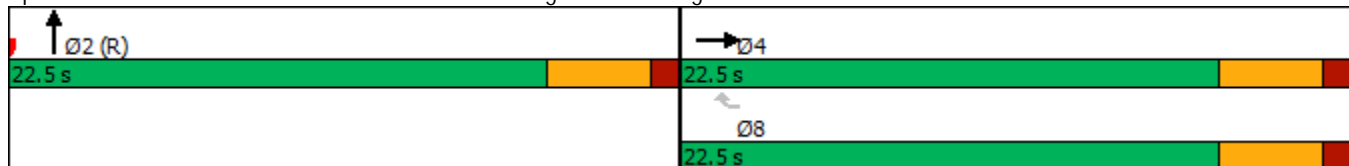


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS		A				A		B				
Approach Delay		9.2			2.3			10.3				
Approach LOS		A			A			B				
Queue Length 50th (ft)		15				0		44				
Queue Length 95th (ft)		36				22		71				
Internal Link Dist (ft)		192			1047			372			229	
Turn Bay Length (ft)												
Base Capacity (vph)		738				769		1402				
Starvation Cap Reductn		0				0		0				
Spillback Cap Reductn		0				0		0				
Storage Cap Reductn		0				0		0				
Reduced v/c Ratio		0.13				0.25		0.35				

























Intersection Summary

Area Type:	Other
Cycle Length:	45
Actuated Cycle Length:	45
Offset:	0 (0%), Referenced to phase 2:NBT and 6:, Start of Green
Natural Cycle:	45
Control Type:	Pretimed
Maximum v/c Ratio:	0.35
Intersection Signal Delay:	8.2
Intersection LOS:	A
Intersection Capacity Utilization:	30.9%
ICU Level of Service:	A
Analysis Period (min):	15

Splits and Phases: 1: GMR SB Left-Turn/RFD WB Right-Turn & Grogans Mill Road



Lanes, Volumes, Timings  
 2: Grogans Mill Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  			   			 				
Traffic Volume (vph)	191	1620	0	0	1987	0	0	262	362	0	0	0
Future Volume (vph)	191	1620	0	0	1987	0	0	262	362	0	0	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		550	0		0
Storage Lanes	2		0	0		0	0		1	0		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.91	1.00	1.00	0.81	1.00	1.00	0.95	1.00	1.00	1.00	1.00
Frt									0.850			
Flt Protected	0.950											
Satd. Flow (prot)	3400	5036	0	0	7471	0	0	3505	1568	0	0	0
Flt Permitted	0.950											
Satd. Flow (perm)	3400	5036	0	0	7471	0	0	3505	1568	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)									195			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		321			1426			1144				452
Travel Time (s)		4.9			21.6			22.3				8.8
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
Adj. Flow (vph)	208	1761	0	0	2160	0	0	285	393	0	0	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	208	1761	0	0	2160	0	0	285	393	0	0	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Prot	NA			NA			NA	Perm			
Protected Phases	7	4			8			2				
Permitted Phases									2			
Minimum Split (s)	9.5	22.5			22.5			22.5	22.5			
Total Split (s)	10.0	30.0			31.0			24.0	24.0			
Total Split (%)	15.4%	46.2%			47.7%			36.9%	36.9%			
Maximum Green (s)	5.5	25.5			26.5			19.5	19.5			
Yellow Time (s)	3.5	3.5			3.5			3.5	3.5			
All-Red Time (s)	1.0	1.0			1.0			1.0	1.0			
Lost Time Adjust (s)	0.0	0.0			0.0			0.0	0.0			
Total Lost Time (s)	4.5	4.5			4.5			4.5	4.5			
Lead/Lag	Lead	Lag			Lag							
Lead-Lag Optimize?	Yes	Yes			Yes							
Walk Time (s)		7.0			7.0			7.0	7.0			
Flash Dont Walk (s)		11.0			11.0			11.0	11.0			
Pedestrian Calls (#/hr)		0			0			0	0			
Act Effct Green (s)	5.5	25.5			26.5			19.5	19.5			
Actuated g/C Ratio	0.08	0.39			0.41			0.30	0.30			
v/c Ratio	0.72	0.89			0.71			0.27	0.65			

## Lanes, Volumes, Timings

### 2: Grogans Mill Road & Research Forest Drive

Lane Group	Ø3	Ø6
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	3	6
Permitted Phases		
Minimum Split (s)	9.5	22.5
Total Split (s)	11.0	24.0
Total Split (%)	17%	37%
Maximum Green (s)	6.5	19.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag	Lead	
Lead-Lag Optimize?	Yes	
Walk Time (s)		7.0
Flash Dont Walk (s)		11.0
Pedestrian Calls (#/hr)		0
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		

Lanes, Volumes, Timings  
 2: Grogans Mill Road & Research Forest Drive

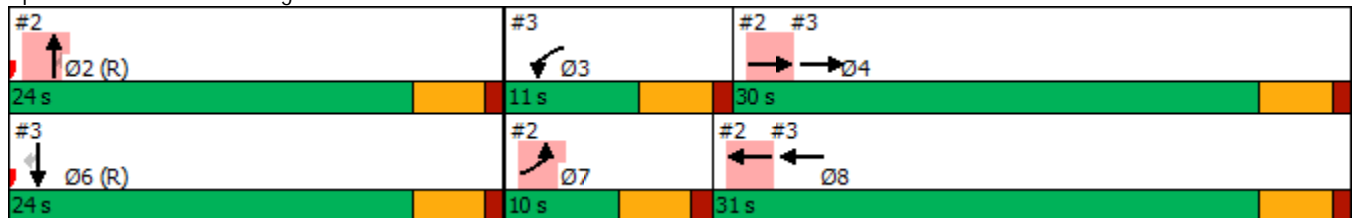


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay	53.9	13.1			17.6			18.2	15.5			
Queue Delay	0.0	0.0			0.0			0.0	0.0			
Total Delay	53.9	13.1			17.6			18.2	15.5			
LOS	D	B			B			B	B			
Approach Delay		17.4			17.6			16.6				
Approach LOS		B			B			B				
Queue Length 50th (ft)	48	51			169			44	62			
Queue Length 95th (ft)	m#77	#86			203			73	150			
Internal Link Dist (ft)		241			1346			1064			372	
Turn Bay Length (ft)									550			
Base Capacity (vph)	287	1975			3045			1051	606			
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	0.72	0.89			0.71			0.27	0.65			

Intersection Summary

Area Type: Other  
 Cycle Length: 65  
 Actuated Cycle Length: 65  
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:, Start of Green  
 Natural Cycle: 65  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.93  
 Intersection Signal Delay: 17.4 Intersection LOS: B  
 Intersection Capacity Utilization 62.2% ICU Level of Service B  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 2: Grogans Mill Road & Research Forest Drive



Lane Group	Ø3	Ø6
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

### Lanes, Volumes, Timings 3: Grogans Mill Road & Research Forest Drive

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑↑		↔↔	↑↑↑						↑↑	↔
Traffic Volume (vph)	0	1811	0	231	1756	0	0	0	0	0	249	336
Future Volume (vph)	0	1811	0	231	1756	0	0	0	0	0	249	336
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	0		0	0		0	0		500
Storage Lanes	0		0	2		0	0		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.81	1.00	0.97	0.91	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Frt												0.850
Flt Protected				0.950								
Satd. Flow (prot)	0	7471	0	3400	5036	0	0	0	0	0	3505	1568
Flt Permitted				0.950								
Satd. Flow (perm)	0	7471	0	3400	5036	0	0	0	0	0	3505	1568
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)												195
Link Speed (mph)		45			45			35				35
Link Distance (ft)		1212			321			749				806
Travel Time (s)		18.4			4.9			14.6				15.7
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
Adj. Flow (vph)	0	1968	0	251	1909	0	0	0	0	0	271	365
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1968	0	251	1909	0	0	0	0	0	271	365
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			0				0
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA		Prot	NA						NA	Perm
Protected Phases		4		3	8						6	
Permitted Phases												6
Minimum Split (s)		22.5		9.5	22.5						22.5	22.5
Total Split (s)		30.0		11.0	31.0						24.0	24.0
Total Split (%)		46.2%		16.9%	47.7%						36.9%	36.9%
Maximum Green (s)		25.5		6.5	26.5						19.5	19.5
Yellow Time (s)		3.5		3.5	3.5						3.5	3.5
All-Red Time (s)		1.0		1.0	1.0						1.0	1.0
Lost Time Adjust (s)		0.0		0.0	0.0						0.0	0.0
Total Lost Time (s)		4.5		4.5	4.5						4.5	4.5
Lead/Lag		Lag		Lead	Lag							
Lead-Lag Optimize?		Yes		Yes	Yes							
Walk Time (s)		7.0			7.0						7.0	7.0
Flash Dont Walk (s)		11.0			11.0						11.0	11.0
Pedestrian Calls (#/hr)		0			0						0	0
Act Effect Green (s)		25.5		6.5	26.5						19.5	19.5
Actuated g/C Ratio		0.39		0.10	0.41						0.30	0.30
v/c Ratio		0.67		0.74	0.93						0.26	0.60

### Lanes, Volumes, Timings 3: Grogans Mill Road & Research Forest Drive

Lane Group	Ø2	Ø7
Lane Configurations		
Traffic Volume (vph)		
Future Volume (vph)		
Ideal Flow (vphpl)		
Storage Length (ft)		
Storage Lanes		
Taper Length (ft)		
Lane Util. Factor		
Frt		
Flt Protected		
Satd. Flow (prot)		
Flt Permitted		
Satd. Flow (perm)		
Right Turn on Red		
Satd. Flow (RTOR)		
Link Speed (mph)		
Link Distance (ft)		
Travel Time (s)		
Peak Hour Factor		
Adj. Flow (vph)		
Shared Lane Traffic (%)		
Lane Group Flow (vph)		
Enter Blocked Intersection		
Lane Alignment		
Median Width(ft)		
Link Offset(ft)		
Crosswalk Width(ft)		
Two way Left Turn Lane		
Headway Factor		
Turning Speed (mph)		
Turn Type		
Protected Phases	2	7
Permitted Phases		
Minimum Split (s)	22.5	9.5
Total Split (s)	24.0	10.0
Total Split (%)	37%	15%
Maximum Green (s)	19.5	5.5
Yellow Time (s)	3.5	3.5
All-Red Time (s)	1.0	1.0
Lost Time Adjust (s)		
Total Lost Time (s)		
Lead/Lag		Lead
Lead-Lag Optimize?		Yes
Walk Time (s)	7.0	
Flash Dont Walk (s)	11.0	
Pedestrian Calls (#/hr)	0	
Act Effct Green (s)		
Actuated g/C Ratio		
v/c Ratio		



Lanes, Volumes, Timings  
 3: Grogans Mill Road & Research Forest Drive

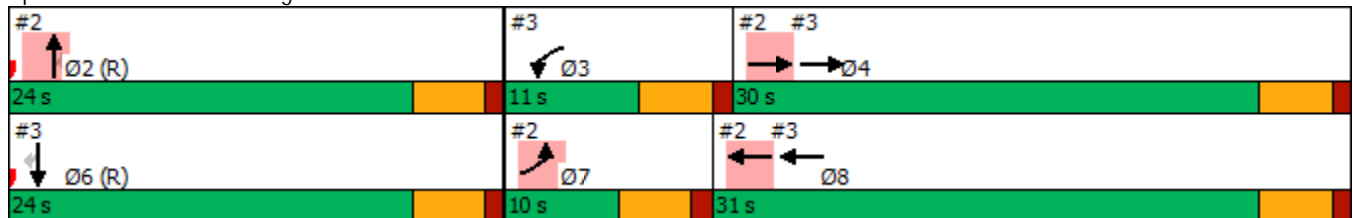


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Control Delay		17.7		52.8	15.5						18.1	13.7
Queue Delay		0.0		0.0	0.0						0.0	0.0
Total Delay		17.7		52.8	15.5						18.1	13.7
LOS		B		D	B						B	B
Approach Delay		17.7			19.8						15.6	
Approach LOS		B			B						B	
Queue Length 50th (ft)		153		58	56						42	52
Queue Length 95th (ft)		186		m#85	#111						70	132
Internal Link Dist (ft)		1132			241			669			726	
Turn Bay Length (ft)												500
Base Capacity (vph)		2930		340	2053						1051	606
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		0.67		0.74	0.93						0.26	0.60

Intersection Summary

Area Type: Other  
 Cycle Length: 65  
 Actuated Cycle Length: 65  
 Offset: 0 (0%), Referenced to phase 2:NBT and 6:, Start of Green  
 Natural Cycle: 65  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.93  
 Intersection Signal Delay: 18.4  
 Intersection LOS: B  
 Intersection Capacity Utilization 62.2%  
 ICU Level of Service B  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Grogans Mill Road & Research Forest Drive


















Lane Group	Ø2	Ø7
Control Delay		
Queue Delay		
Total Delay		
LOS		
Approach Delay		
Approach LOS		
Queue Length 50th (ft)		
Queue Length 95th (ft)		
Internal Link Dist (ft)		
Turn Bay Length (ft)		
Base Capacity (vph)		
Starvation Cap Reductn		
Spillback Cap Reductn		
Storage Cap Reductn		
Reduced v/c Ratio		
Intersection Summary		

Lanes, Volumes, Timings

4: Grogans Mill Road & RFD EB Right-Turn/GMD NB Left-Turn

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	444	0	785	0	0	0	0	0	480	0
Future Volume (vph)	0	0	444	0	785	0	0	0	0	0	480	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Util. Factor	1.00	1.00	0.88	1.00	0.95	1.00	1.00	1.00	1.00	1.00	0.95	1.00
Fr <sub>t</sub>			0.850									
Fl <sub>t</sub> Protected												
Satd. Flow (prot)	0	0	2760	0	3505	0	0	0	0	0	3505	0
Fl <sub>t</sub> Permitted												
Satd. Flow (perm)	0	0	2760	0	3505	0	0	0	0	0	3505	0
Right Turn on Red			Yes	Yes		Yes			Yes			Yes
Satd. Flow (RTOR)			348									
Link Speed (mph)		45			35			35			35	
Link Distance (ft)		1074			252			415			749	
Travel Time (s)		16.3			4.9			8.1			14.6	
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
Adj. Flow (vph)	0	0	483	0	853	0	0	0	0	0	522	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	0	483	0	853	0	0	0	0	0	522	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		0			0			0			0	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type			Perm		NA						NA	
Protected Phases					8						6	
Permitted Phases			4									
Minimum Split (s)			22.5		22.5						22.5	
Total Split (s)			22.5		22.5						22.5	
Total Split (%)			50.0%		50.0%						50.0%	
Maximum Green (s)			18.0		18.0						18.0	
Yellow Time (s)			3.5		3.5						3.5	
All-Red Time (s)			1.0		1.0						1.0	
Lost Time Adjust (s)			0.0		0.0						0.0	
Total Lost Time (s)			4.5		4.5						4.5	
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)			7.0		7.0						7.0	
Flash Dont Walk (s)			11.0		11.0						11.0	
Pedestrian Calls (#/hr)			0		0						0	
Act Effect Green (s)			18.0		18.0						18.0	
Actuated g/C Ratio			0.40		0.40						0.40	
v/c Ratio			0.37		0.61						0.37	
Control Delay			3.8		13.0						10.5	
Queue Delay			0.0		0.0						0.0	
Total Delay			3.8		13.0						10.5	

Lanes, Volumes, Timings

4: Grogans Mill Road & RFD EB Right-Turn/GMD NB Left-Turn

Synchro 11 Report

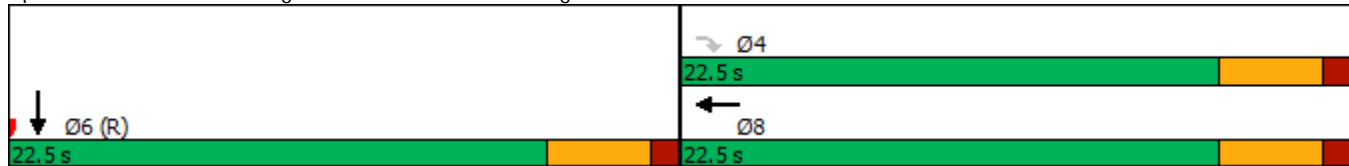


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
LOS			A		B							B
Approach Delay		3.8			13.0							10.5
Approach LOS		A			B							B
Queue Length 50th (ft)			11		86							47
Queue Length 95th (ft)			36		132							76
Internal Link Dist (ft)		994			172			335				669
Turn Bay Length (ft)												
Base Capacity (vph)			1312		1402							1402
Starvation Cap Reductn			0		0							0
Spillback Cap Reductn			0		0							0
Storage Cap Reductn			0		0							0
Reduced v/c Ratio			0.37		0.61							0.37












Intersection Summary

Area Type:	Other
Cycle Length:	45
Actuated Cycle Length:	45
Offset:	0 (0%), Referenced to phase 2: and 6:SBT, Start of Green
Natural Cycle:	45
Control Type:	Pretimed
Maximum v/c Ratio:	0.61
Intersection Signal Delay:	9.9
Intersection LOS:	A
Intersection Capacity Utilization:	42.5%
ICU Level of Service:	A
Analysis Period (min):	15

Splits and Phases: 4: Grogans Mill Road & RFD EB Right-Turn/GMD NB Left-Turn



Lanes, Volumes, Timings  
1: Grogans Mill Road

									
Lane Group	NBL	NBT	SBT	SBR	NEL	NER	Ø3	Ø6	Ø7
Lane Configurations									
Traffic Volume (vph)	0	282	331	218	392	0			
Future Volume (vph)	0	282	331	218	392	0			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900			
Lane Util. Factor	1.00	1.00	0.95	1.00	0.97	1.00			
Fr <sub>t</sub>				0.850					
Fl <sub>t</sub> Protected					0.950				
Satd. Flow (prot)	0	1845	3505	1568	3400	0			
Fl <sub>t</sub> Permitted					0.950				
Satd. Flow (perm)	0	1845	3505	1568	3400	0			
Right Turn on Red				Yes		Yes			
Satd. Flow (RTOR)				237					
Link Speed (mph)		35	35		35				
Link Distance (ft)		381	368		412				
Travel Time (s)		7.4	7.2		8.0				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92			
Adj. Flow (vph)	0	307	360	237	426	0			
Shared Lane Traffic (%)									
Lane Group Flow (vph)	0	307	360	237	426	0			
Enter Blocked Intersection	No	No	No	No	No	No			
Lane Alignment	Left	Left	Left	Right	Left	Right			
Median Width(ft)		0	0		24				
Link Offset(ft)		0	0		0				
Crosswalk Width(ft)		16	16		16				
Two way Left Turn Lane									
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00			
Turning Speed (mph)	15			9	15	9			
Turn Type		NA	NA	Perm	Prot				
Protected Phases			4		2		3	6	7
Permitted Phases		8		4					
Minimum Split (s)		22.5	22.5	22.5	22.5		9.5	22.5	9.5
Total Split (s)		35.0	30.0	30.0	24.0		16.0	24.0	11.0
Total Split (%)		50.0%	42.9%	42.9%	34.3%		23%	34%	16%
Maximum Green (s)		30.5	25.5	25.5	19.5		11.5	19.5	6.5
Yellow Time (s)		3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)		1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)		0.0	0.0	0.0	0.0				
Total Lost Time (s)		4.5	4.5	4.5	4.5				
Lead/Lag		Lag	Lag	Lag			Lead		Lead
Lead-Lag Optimize?		Yes	Yes	Yes			Yes		Yes
Walk Time (s)		7.0	7.0	7.0	7.0			7.0	
Flash Dont Walk (s)		11.0	11.0	11.0	11.0			11.0	
Pedestrian Calls (#/hr)		0	0	0	0			0	
Act Effect Green (s)		30.5	25.5	25.5	19.5				
Actuated g/C Ratio		0.44	0.36	0.36	0.28				
v/c Ratio		0.38	0.28	0.33	0.45				
Control Delay		13.8	16.5	3.8	30.5				
Queue Delay		0.0	0.0	0.0	0.0				
Total Delay		13.8	16.5	3.8	30.5				

Lanes, Volumes, Timings  
1: Grogans Mill Road

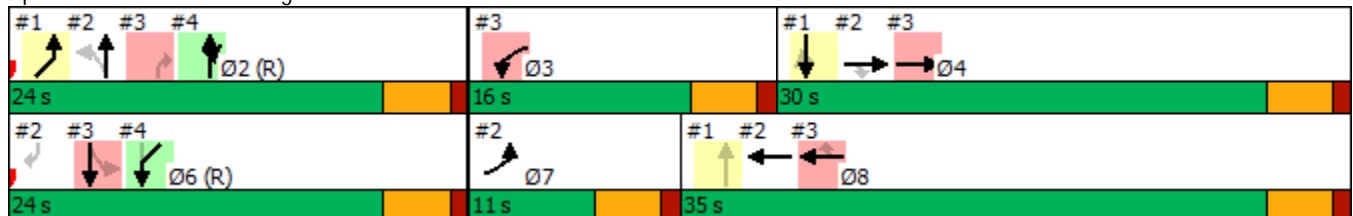


Lane Group	NBL	NBT	SBT	SBR	NEL	NER	Ø3	Ø6	Ø7
LOS		B	B	A	C				
Approach Delay		13.8	11.5		30.5				
Approach LOS		B	B		C				
Queue Length 50th (ft)		86	56	0	89				
Queue Length 95th (ft)		106	87	41	112				
Internal Link Dist (ft)		301	288		332				
Turn Bay Length (ft)									
Base Capacity (vph)		803	1276	721	947				
Starvation Cap Reductn		0	0	0	0				
Spillback Cap Reductn		0	0	0	0				
Storage Cap Reductn		0	0	0	0				
Reduced v/c Ratio		0.38	0.28	0.33	0.45				

Intersection Summary



























Area Type:	Other
Cycle Length:	70
Actuated Cycle Length:	70
Offset:	0 (0%), Referenced to phase 2:NEL and 6:, Start of Green
Natural Cycle:	70
Control Type:	Pretimed
Maximum v/c Ratio:	0.89
Intersection Signal Delay:	18.1
Intersection LOS:	B
Intersection Capacity Utilization:	33.5%
ICU Level of Service:	A
Analysis Period (min):	15

Splits and Phases: 1: Grogans Mill Road



## Lanes, Volumes, Timings 2: Grogans Mill Road & Research Forest Drive

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  			  			 				 
Traffic Volume (vph)	191	1515	658	0	1588	0	265	201	0	0	0	218
Future Volume (vph)	191	1515	658	0	1588	0	265	201	0	0	0	218
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	0		0	250		0	0		200
Storage Lanes	2		1	0		0	1		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	1.00	0.88
Frt			0.850									0.850
Flt Protected	0.950						0.950					
Satd. Flow (prot)	3433	5085	1583	0	4940	0	1752	3505	0	0	0	2760
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	3433	5085	1583	0	4940	0	1752	3505	0	0	0	2760
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			715									390
Link Speed (mph)		45			45			35				35
Link Distance (ft)		1441			320			383				412
Travel Time (s)		21.8			4.8			7.5				8.0
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
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	208	1647	715	0	1726	0	288	218	0	0	0	237
Shared Lane Traffic (%)												
Lane Group Flow (vph)	208	1647	715	0	1726	0	288	218	0	0	0	237
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Prot	NA	Perm		NA		Perm	NA				Perm
Protected Phases	7	4			8			2				
Permitted Phases			4				2					6
Minimum Split (s)	9.5	22.5	22.5		22.5		22.5	22.5				22.5
Total Split (s)	11.0	30.0	30.0		35.0		24.0	24.0				24.0
Total Split (%)	15.7%	42.9%	42.9%		50.0%		34.3%	34.3%				34.3%
Maximum Green (s)	6.5	25.5	25.5		30.5		19.5	19.5				19.5
Yellow Time (s)	3.5	3.5	3.5		3.5		3.5	3.5				3.5
All-Red Time (s)	1.0	1.0	1.0		1.0		1.0	1.0				1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0		0.0	0.0				0.0
Total Lost Time (s)	4.5	4.5	4.5		4.5		4.5	4.5				4.5
Lead/Lag	Lead	Lag	Lag		Lag							
Lead-Lag Optimize?	Yes	Yes	Yes		Yes							
Walk Time (s)		7.0	7.0		7.0		7.0	7.0				7.0
Flash Dont Walk (s)		11.0	11.0		11.0		11.0	11.0				11.0
Pedestrian Calls (#/hr)		0	0		0		0	0				0
Act Effct Green (s)	6.5	25.5	25.5		30.5		19.5	19.5				19.5
Actuated g/C Ratio	0.09	0.36	0.36		0.44		0.28	0.28				0.28

## Lanes, Volumes, Timings 2: Grogans Mill Road & Research Forest Drive

Synchro 11 Report

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Minimum Split (s)	9.5
Total Split (s)	16.0
Total Split (%)	23%
Maximum Green (s)	11.5
Yellow Time (s)	3.5
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Walk Time (s)	
Flash Dont Walk (s)	
Pedestrian Calls (#/hr)	
Act Effect Green (s)	
Actuated g/C Ratio	



Lanes, Volumes, Timings  
 2: Grogans Mill Road & Research Forest Drive

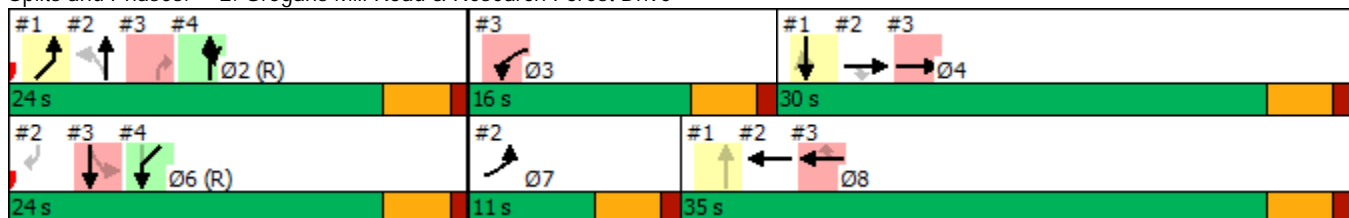


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.65	0.89	0.69		0.80		0.59	0.22				0.23
Control Delay	41.6	28.6	5.7		5.2		27.8	18.7				1.7
Queue Delay	0.0	0.5	0.0		0.0		0.0	0.0				0.0
Total Delay	41.6	29.1	5.7		5.2		27.8	18.7				1.7
LOS	D	C	A		A		C	B				A
Approach Delay		23.6			5.2			23.9				1.7
Approach LOS		C			A			C				A
Queue Length 50th (ft)	45	239	0		21		57	18				0
Queue Length 95th (ft)	#85	#331	65		49		131	47				0
Internal Link Dist (ft)		1361			240			303				332
Turn Bay Length (ft)	200		200				250					200
Base Capacity (vph)	318	1852	1031		2152		488	976				1050
Starvation Cap Reductn	0	0	0		0		0	0				0
Spillback Cap Reductn	0	38	0		0		0	0				0
Storage Cap Reductn	0	0	0		0		0	0				0
Reduced v/c Ratio	0.65	0.91	0.69		0.80		0.59	0.22				0.23

Intersection Summary

Area Type: Other  
 Cycle Length: 70  
 Actuated Cycle Length: 70  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.89  
 Intersection Signal Delay: 16.3  
 Intersection LOS: B  
 Intersection Capacity Utilization 64.2%  
 ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Grogans Mill Road & Research Forest Drive



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Lane Group	Ø3
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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Lanes, Volumes, Timings  
3: Grogans Mill Road & Research Forest Drive



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑		↗↘	↑↑↑	↗			↗	↘	↑	
Traffic Volume (vph)	0	1515	0	416	1588	282	0	0	196	66	265	0
Future Volume (vph)	0	1515	0	416	1588	282	0	0	196	66	265	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	200		350	0		0	0		0
Storage Lanes	0		0	2		1	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.865			
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	5085	0	3335	4940	1538	0	0	1596	1752	1845	0
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	5085	0	3335	4940	1538	0	0	1596	1752	1845	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						307			236			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		320			1457			323				425
Travel Time (s)		4.8			22.1			6.3				8.3
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
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	1647	0	452	1726	307	0	0	213	72	288	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1647	0	452	1726	307	0	0	213	72	288	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA		Prot	NA	Perm			Perm	Perm		NA
Protected Phases		4		3	8							6
Permitted Phases						8			2	6		
Minimum Split (s)		22.5		9.5	22.5	22.5			22.5	22.5		22.5
Total Split (s)		30.0		16.0	35.0	35.0			24.0	24.0		24.0
Total Split (%)		42.9%		22.9%	50.0%	50.0%			34.3%	34.3%		34.3%
Maximum Green (s)		25.5		11.5	30.5	30.5			19.5	19.5		19.5
Yellow Time (s)		3.5		3.5	3.5	3.5			3.5	3.5		3.5
All-Red Time (s)		1.0		1.0	1.0	1.0			1.0	1.0		1.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0			0.0	0.0		0.0
Total Lost Time (s)		4.5		4.5	4.5	4.5			4.5	4.5		4.5
Lead/Lag		Lag		Lead	Lag	Lag						
Lead-Lag Optimize?		Yes		Yes	Yes	Yes						
Walk Time (s)		7.0			7.0	7.0			7.0	7.0		7.0
Flash Dont Walk (s)		11.0			11.0	11.0			11.0	11.0		11.0
Pedestrian Calls (#/hr)		0			0	0			0	0		0
Act Effect Green (s)		25.5		11.5	30.5	30.5			19.5	19.5		19.5
Actuated g/C Ratio		0.36		0.16	0.44	0.44			0.28	0.28		0.28

### Lanes, Volumes, Timings 3: Grogans Mill Road & Research Forest Drive

Lane Group	Ø7
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Turn Type	
Protected Phases	7
Permitted Phases	
Minimum Split (s)	9.5
Total Split (s)	11.0
Total Split (%)	16%
Maximum Green (s)	6.5
Yellow Time (s)	3.5
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Walk Time (s)	
Flash Dont Walk (s)	
Pedestrian Calls (#/hr)	
Act Effct Green (s)	
Actuated g/C Ratio	

Lanes, Volumes, Timings  
 3: Grogans Mill Road & Research Forest Drive

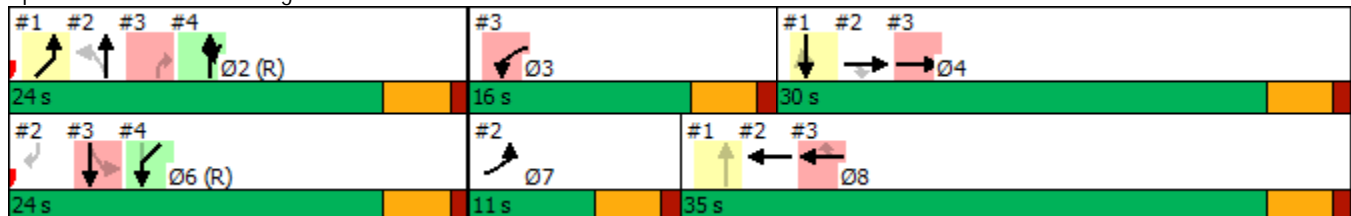


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.89		0.83	0.80	0.36			0.35	0.15	0.56	
Control Delay		9.7		43.1	20.7	3.1			2.2	10.8	18.3	
Queue Delay		0.0		0.0	0.0	0.0			0.0	0.0	0.0	
Total Delay		9.7		43.1	20.7	3.1			2.2	10.8	18.3	
LOS		A		D	C	A			A	B	B	
Approach Delay		9.7			22.6			2.2			16.8	
Approach LOS		A			C			A			B	
Queue Length 50th (ft)		25		98	226	0			0	28	125	
Queue Length 95th (ft)		m#62		#169	285	40			6	62	211	
Internal Link Dist (ft)		240			1377			243			345	
Turn Bay Length (ft)				200		350						
Base Capacity (vph)		1852		547	2152	843			614	488	513	
Starvation Cap Reductn		0		0	0	0			0	0	0	
Spillback Cap Reductn		0		0	0	0			0	0	0	
Storage Cap Reductn		0		0	0	0			0	0	0	
Reduced v/c Ratio		0.89		0.83	0.80	0.36			0.35	0.15	0.56	

Intersection Summary

Area Type: Other  
 Cycle Length: 70  
 Actuated Cycle Length: 70  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.89  
 Intersection Signal Delay: 16.7 Intersection LOS: B  
 Intersection Capacity Utilization 66.3% ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Grogans Mill Road & Research Forest Drive



Lane Group	Ø7
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

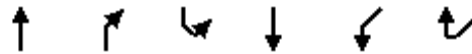
# Lanes, Volumes, Timings

## 4: Grogans Mill Road

	↑	↗	↘	↓	↙	↖				
Lane Group	NBT	NBR	SBL	SBT	SWL	SWR	Ø3	Ø4	Ø7	Ø8
Lane Configurations	↑↑	↗		↑↑	↖↗					
Traffic Volume (vph)	466	196	0	658	681	0				
Future Volume (vph)	466	196	0	658	681	0				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00				
Fr <sub>t</sub>		0.850								
Flt Protected					0.950					
Satd. Flow (prot)	3505	1568	0	3505	3400	0				
Flt Permitted					0.950					
Satd. Flow (perm)	3505	1568	0	3505	3400	0				
Right Turn on Red		Yes				Yes				
Satd. Flow (RTOR)		213								
Link Speed (mph)	35			35	35					
Link Distance (ft)	566			265	328					
Travel Time (s)	11.0			5.2	6.4					
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				
Adj. Flow (vph)	507	213	0	715	740	0				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	507	213	0	715	740	0				
Enter Blocked Intersection	No	No	No	No	No	No				
Lane Alignment	Left	Right	Left	Left	Left	Right				
Median Width(ft)	0			0	24					
Link Offset(ft)	0			0	0					
Crosswalk Width(ft)	16			16	16					
Two way Left Turn Lane										
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Turning Speed (mph)		9	15		15	9				
Turn Type	NA	Prot		NA	Prot					
Protected Phases	2!	2			6!		3	4	7	8
Permitted Phases				6						
Minimum Split (s)	22.5	22.5		22.5	22.5		9.5	22.5	9.5	22.5
Total Split (s)	24.0	24.0		24.0	24.0		16.0	30.0	11.0	35.0
Total Split (%)	34.3%	34.3%		34.3%	34.3%		23%	43%	16%	50%
Maximum Green (s)	19.5	19.5		19.5	19.5		11.5	25.5	6.5	30.5
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0					
Total Lost Time (s)	4.5	4.5		4.5	4.5					
Lead/Lag							Lead	Lag	Lead	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0
Pedestrian Calls (#/hr)	0	0		0	0			0		0
Act Effect Green (s)	19.5	19.5		19.5	19.5					
Actuated g/C Ratio	0.28	0.28		0.28	0.28					
v/c Ratio	0.52	0.36		0.73	0.78					
Control Delay	23.6	5.2		26.1	34.1					
Queue Delay	0.0	0.0		0.0	0.0					
Total Delay	23.6	5.2		26.1	34.1					

# Lanes, Volumes, Timings

## 4: Grogans Mill Road

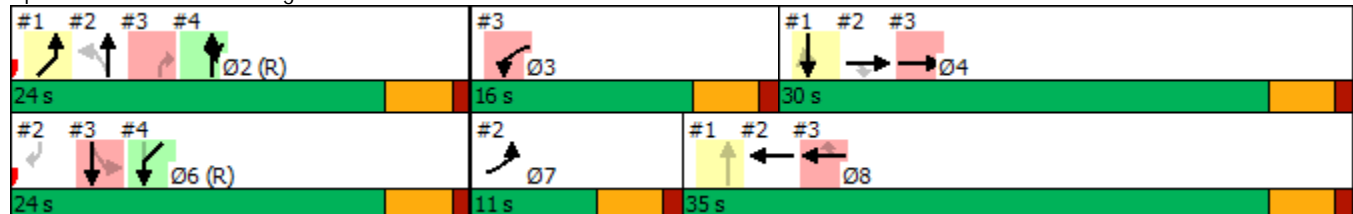


Lane Group	NBT	NBR	SBL	SBT	SWL	SWR	Ø3	Ø4	Ø7	Ø8
LOS	C	A		C	C					
Approach Delay	18.2			26.1	34.1					
Approach LOS	B			C	C					
Queue Length 50th (ft)	96	0		146	140					
Queue Length 95th (ft)	141	45		215	m194					
Internal Link Dist (ft)	486			185	248					
Turn Bay Length (ft)										
Base Capacity (vph)	976	590		976	947					
Starvation Cap Reductn	0	0		0	0					
Spillback Cap Reductn	0	0		0	0					
Storage Cap Reductn	0	0		0	0					
Reduced v/c Ratio	0.52	0.36		0.73	0.78					

### Intersection Summary

Area Type: Other  
 Cycle Length: 70  
 Actuated Cycle Length: 70  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.89  
 Intersection Signal Delay: 26.2  
 Intersection LOS: C  
 Intersection Capacity Utilization 45.1%  
 ICU Level of Service A  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.  
 ! Phase conflict between lane groups.

### Splits and Phases: 4: Grogans Mill Road
















# Lanes, Volumes, Timings

## 1: Grogans Mill Road

Synchro 11 Report

									
Lane Group	NBL	NBT	SBT	SBR	NEL	NER	Ø3	Ø6	Ø7
Lane Configurations									
Traffic Volume (vph)	0	158	295	296	389	0			
Future Volume (vph)	0	158	295	296	389	0			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900			
Lane Util. Factor	1.00	1.00	0.95	1.00	0.97	1.00			
Fr't				0.850					
Flt Protected					0.950				
Satd. Flow (prot)	0	1845	3505	1568	3400	0			
Flt Permitted					0.950				
Satd. Flow (perm)	0	1845	3505	1568	3400	0			
Right Turn on Red				Yes		Yes			
Satd. Flow (RTOR)				322					
Link Speed (mph)		35	35		35				
Link Distance (ft)		381	368		412				
Travel Time (s)		7.4	7.2		8.0				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92			
Adj. Flow (vph)	0	172	321	322	423	0			
Shared Lane Traffic (%)									
Lane Group Flow (vph)	0	172	321	322	423	0			
Enter Blocked Intersection	No	No	No	No	No	No			
Lane Alignment	Left	Left	Left	Right	Left	Right			
Median Width(ft)		0	0		24				
Link Offset(ft)		0	0		0				
Crosswalk Width(ft)		16	16		16				
Two way Left Turn Lane									
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00			
Turning Speed (mph)	15			9	15	9			
Turn Type		NA	NA	Perm	Prot				
Protected Phases			4		2		3	6	7
Permitted Phases		8		4					
Minimum Split (s)		22.5	22.5	22.5	22.5		9.5	22.5	9.5
Total Split (s)		40.2	38.9	38.9	48.9		12.2	48.9	10.9
Total Split (%)		40.2%	38.9%	38.9%	48.9%		12%	49%	11%
Maximum Green (s)		35.7	34.4	34.4	44.4		7.7	44.4	6.4
Yellow Time (s)		3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)		1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)		0.0	0.0	0.0	0.0				
Total Lost Time (s)		4.5	4.5	4.5	4.5				
Lead/Lag		Lag	Lag	Lag			Lead		Lead
Lead-Lag Optimize?		Yes	Yes	Yes			Yes		Yes
Walk Time (s)		7.0	7.0	7.0	7.0			7.0	
Flash Dont Walk (s)		11.0	11.0	11.0	11.0			11.0	
Pedestrian Calls (#/hr)		0	0	0	0			0	
Act Effect Green (s)		35.7	34.4	34.4	44.4				
Actuated g/C Ratio		0.36	0.34	0.34	0.44				
v/c Ratio		0.26	0.27	0.43	0.28				
Control Delay		21.5	24.4	4.7	26.5				
Queue Delay		0.0	0.0	0.0	0.0				
Total Delay		21.5	24.4	4.7	26.5				

Lanes, Volumes, Timings  
1: Grogans Mill Road

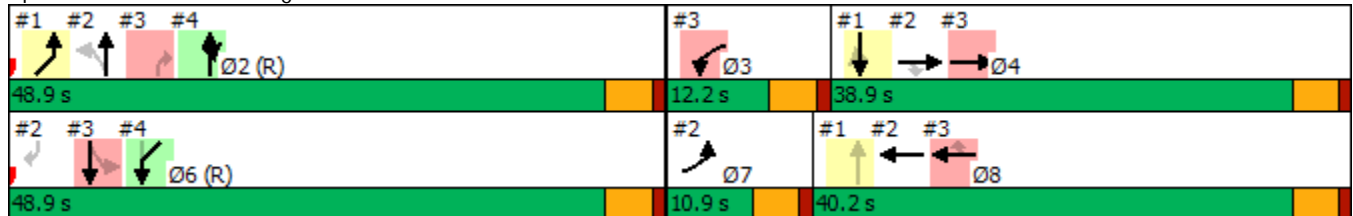


Lane Group	NBL	NBT	SBT	SBR	NEL	NER	Ø3	Ø6	Ø7
LOS		C	C	A	C				
Approach Delay		21.5	14.5		26.5				
Approach LOS		C	B		C				
Queue Length 50th (ft)		77	76	0	93				
Queue Length 95th (ft)		89	112	57	m130				
Internal Link Dist (ft)		301	288		332				
Turn Bay Length (ft)									
Base Capacity (vph)		658	1205	750	1509				
Starvation Cap Reductn		0	0	0	0				
Spillback Cap Reductn		0	0	0	0				
Storage Cap Reductn		0	0	0	0				
Reduced v/c Ratio		0.26	0.27	0.43	0.28				

Intersection Summary



























Area Type: Other  
 Cycle Length: 100  
 Actuated Cycle Length: 100  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.97  
 Intersection Signal Delay: 19.6  
 Intersection LOS: B  
 Intersection Capacity Utilization 26.9%  
 ICU Level of Service A  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Grogans Mill Road



## Lanes, Volumes, Timings 2: Grogans Mill Road & Research Forest Drive

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  			  			 				 
Traffic Volume (vph)	169	1455	392	0	1578	0	693	220	0	0	0	296
Future Volume (vph)	169	1455	392	0	1578	0	693	220	0	0	0	296
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	0		0	250		0	0		200
Storage Lanes	2		1	0		0	1		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	1.00	0.88
Frt			0.850									0.850
Flt Protected	0.950						0.950					
Satd. Flow (prot)	3433	5085	1583	0	4940	0	1752	3505	0	0	0	2760
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	3433	5085	1583	0	4940	0	1752	3505	0	0	0	2760
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			363									303
Link Speed (mph)		45			45			35				35
Link Distance (ft)		1441			320			383				412
Travel Time (s)		21.8			4.8			7.5				8.0
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
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	184	1582	426	0	1715	0	753	239	0	0	0	322
Shared Lane Traffic (%)												
Lane Group Flow (vph)	184	1582	426	0	1715	0	753	239	0	0	0	322
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Prot	NA	Perm		NA		Perm	NA				Perm
Protected Phases	7	4			8			2				
Permitted Phases			4				2					6
Minimum Split (s)	9.5	22.5	22.5		22.5		22.5	22.5				22.5
Total Split (s)	10.9	38.9	38.9		40.2		48.9	48.9				48.9
Total Split (%)	10.9%	38.9%	38.9%		40.2%		48.9%	48.9%				48.9%
Maximum Green (s)	6.4	34.4	34.4		35.7		44.4	44.4				44.4
Yellow Time (s)	3.5	3.5	3.5		3.5		3.5	3.5				3.5
All-Red Time (s)	1.0	1.0	1.0		1.0		1.0	1.0				1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0		0.0	0.0				0.0
Total Lost Time (s)	4.5	4.5	4.5		4.5		4.5	4.5				4.5
Lead/Lag	Lead	Lag	Lag		Lag							
Lead-Lag Optimize?	Yes	Yes	Yes		Yes							
Walk Time (s)		7.0	7.0		7.0		7.0	7.0				7.0
Flash Dont Walk (s)		11.0	11.0		11.0		11.0	11.0				11.0
Pedestrian Calls (#/hr)		0	0		0		0	0				0
Act Effect Green (s)	6.4	34.4	34.4		35.7		44.4	44.4				44.4
Actuated g/C Ratio	0.06	0.34	0.34		0.36		0.44	0.44				0.44

## Lanes, Volumes, Timings

### 2: Grogans Mill Road & Research Forest Drive

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Minimum Split (s)	9.5
Total Split (s)	12.2
Total Split (%)	12%
Maximum Green (s)	7.7
Yellow Time (s)	3.5
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Walk Time (s)	
Flash Dont Walk (s)	
Pedestrian Calls (#/hr)	
Act Effct Green (s)	
Actuated g/C Ratio	

# Lanes, Volumes, Timings

## 2: Grogans Mill Road & Research Forest Drive

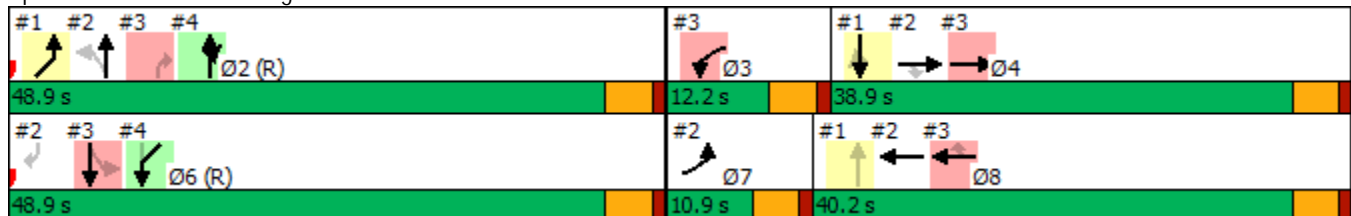


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.84	0.90	0.54		0.97		0.97	0.15				0.23
Control Delay	77.8	39.9	7.6		15.1		41.9	6.5				3.1
Queue Delay	0.0	0.4	0.0		0.0		0.0	0.0				0.0
Total Delay	77.8	40.3	7.6		15.1		41.9	6.5				3.1
LOS	E	D	A		B		D	A				A
Approach Delay		37.1			15.1			33.4				3.1
Approach LOS		D			B			C				A
Queue Length 50th (ft)	60	348	27		48		189	11				3
Queue Length 95th (ft)	#121	#425	108		m#60		#687	16				48
Internal Link Dist (ft)		1361			240			303				332
Turn Bay Length (ft)	200		200				250					200
Base Capacity (vph)	219	1749	782		1763		777	1556				1393
Starvation Cap Reductn	0	0	0		0		0	0				0
Spillback Cap Reductn	0	23	0		0		0	0				0
Storage Cap Reductn	0	0	0		0		0	0				0
Reduced v/c Ratio	0.84	0.92	0.54		0.97		0.97	0.15				0.23

### Intersection Summary

Area Type: Other  
 Cycle Length: 100  
 Actuated Cycle Length: 100  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.97  
 Intersection Signal Delay: 27.1  
 Intersection LOS: C  
 Intersection Capacity Utilization 90.5%  
 ICU Level of Service E  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

### Splits and Phases: 2: Grogans Mill Road & Research Forest Drive



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Lane Group	Ø3
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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### Lanes, Volumes, Timings 3: Grogans Mill Road & Research Forest Drive

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑		↗↘	↑↑↑	↗			↗	↘	↑	
Traffic Volume (vph)	0	1455	0	204	1578	158	0	0	320	80	215	0
Future Volume (vph)	0	1455	0	204	1578	158	0	0	320	80	215	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	200		350	0		0	0		0
Storage Lanes	0		0	2		1	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.865			
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	5085	0	3335	4940	1538	0	0	1596	1752	1845	0
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	5085	0	3335	4940	1538	0	0	1596	1752	1845	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						172			173			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		320			1457			323				425
Travel Time (s)		4.8			22.1			6.3				8.3
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
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	1582	0	222	1715	172	0	0	348	87	234	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1582	0	222	1715	172	0	0	348	87	234	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA		Prot	NA	Perm			Perm	Perm		NA
Protected Phases		4		3	8							6
Permitted Phases						8			2	6		
Minimum Split (s)		22.5		9.5	22.5	22.5			22.5	22.5		22.5
Total Split (s)		38.9		12.2	40.2	40.2			48.9	48.9		48.9
Total Split (%)		38.9%		12.2%	40.2%	40.2%			48.9%	48.9%		48.9%
Maximum Green (s)		34.4		7.7	35.7	35.7			44.4	44.4		44.4
Yellow Time (s)		3.5		3.5	3.5	3.5			3.5	3.5		3.5
All-Red Time (s)		1.0		1.0	1.0	1.0			1.0	1.0		1.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0			0.0	0.0		0.0
Total Lost Time (s)		4.5		4.5	4.5	4.5			4.5	4.5		4.5
Lead/Lag		Lag		Lead	Lag	Lag						
Lead-Lag Optimize?		Yes		Yes	Yes	Yes						
Walk Time (s)		7.0			7.0	7.0			7.0	7.0		7.0
Flash Dont Walk (s)		11.0			11.0	11.0			11.0	11.0		11.0
Pedestrian Calls (#/hr)		0			0	0			0	0		0
Act Effect Green (s)		34.4		7.7	35.7	35.7			44.4	44.4		44.4
Actuated g/C Ratio		0.34		0.08	0.36	0.36			0.44	0.44		0.44

Lanes, Volumes, Timings  
 3: Grogans Mill Road & Research Forest Drive

Lane Group	Ø7
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Turn Type	
Protected Phases	7
Permitted Phases	
Minimum Split (s)	9.5
Total Split (s)	10.9
Total Split (%)	11%
Maximum Green (s)	6.4
Yellow Time (s)	3.5
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Walk Time (s)	
Flash Dont Walk (s)	
Pedestrian Calls (#/hr)	
Act Effct Green (s)	
Actuated g/C Ratio	



Lanes, Volumes, Timings  
 3: Grogans Mill Road & Research Forest Drive

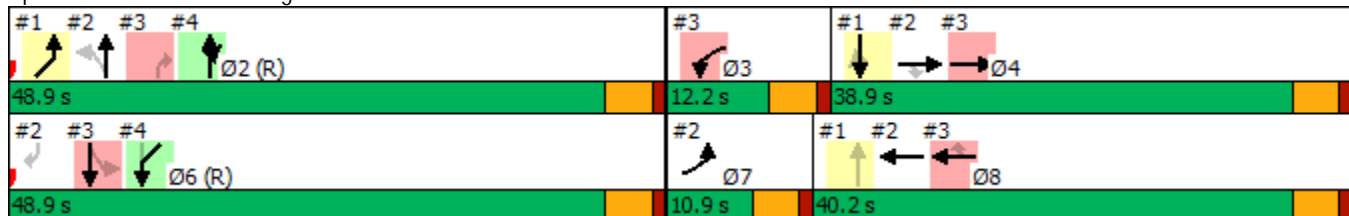


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.90		0.87	0.97	0.26			0.43	0.11	0.29	
Control Delay		10.1		77.2	48.2	4.6			9.2	18.4	22.9	
Queue Delay		0.0		0.0	4.1	0.0			0.0	0.0	0.0	
Total Delay		10.1		77.2	52.3	4.6			9.2	18.4	22.9	
LOS		B		E	D	A			A	B	C	
Approach Delay		10.1			51.1			9.2			21.7	
Approach LOS		B			D			A			C	
Queue Length 50th (ft)		19		73	389	0			68	53	155	
Queue Length 95th (ft)		m#62		#140	#503	43			80	102	241	
Internal Link Dist (ft)		240			1377			243			345	
Turn Bay Length (ft)				200		350						
Base Capacity (vph)		1749		256	1763	659			804	777	819	
Starvation Cap Reductn		0		0	0	0			0	0	0	
Spillback Cap Reductn		0		0	42	0			0	0	0	
Storage Cap Reductn		0		0	0	0			0	0	0	
Reduced v/c Ratio		0.90		0.87	1.00	0.26			0.43	0.11	0.29	

Intersection Summary

Area Type: Other  
 Cycle Length: 100  
 Actuated Cycle Length: 100  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.97  
 Intersection Signal Delay: 30.7  
 Intersection LOS: C  
 Intersection Capacity Utilization 63.6%  
 ICU Level of Service B  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Grogans Mill Road & Research Forest Drive



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Lane Group	Ø7
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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# Lanes, Volumes, Timings

## 4: Grogans Mill Road

	↑	↗	↘	↓	↙	↖				
Lane Group	NBT	NBR	SBL	SBT	SWL	SWR	Ø3	Ø4	Ø7	Ø8
Lane Configurations	↑↑	↗		↑↑	↘↘					
Traffic Volume (vph)	913	320	0	392	419	0				
Future Volume (vph)	913	320	0	392	419	0				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00				
Fr <sub>t</sub>		0.850								
Fl <sub>t</sub> Protected					0.950					
Satd. Flow (prot)	3505	1568	0	3505	3400	0				
Fl <sub>t</sub> Permitted					0.950					
Satd. Flow (perm)	3505	1568	0	3505	3400	0				
Right Turn on Red		Yes				Yes				
Satd. Flow (RTOR)		348								
Link Speed (mph)	35			35	35					
Link Distance (ft)	566			265	328					
Travel Time (s)	11.0			5.2	6.4					
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				
Adj. Flow (vph)	992	348	0	426	455	0				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	992	348	0	426	455	0				
Enter Blocked Intersection	No	No	No	No	No	No				
Lane Alignment	Left	Right	Left	Left	Left	Right				
Median Width(ft)	0			0	24					
Link Offset(ft)	0			0	0					
Crosswalk Width(ft)	16			16	16					
Two way Left Turn Lane										
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Turning Speed (mph)		9	15		15	9				
Turn Type	NA	Prot		NA	Prot					
Protected Phases	2!	2			6!		3	4	7	8
Permitted Phases				6						
Minimum Split (s)	22.5	22.5		22.5	22.5		9.5	22.5	9.5	22.5
Total Split (s)	48.9	48.9		48.9	48.9		12.2	38.9	10.9	40.2
Total Split (%)	48.9%	48.9%		48.9%	48.9%		12%	39%	11%	40%
Maximum Green (s)	44.4	44.4		44.4	44.4		7.7	34.4	6.4	35.7
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0					
Total Lost Time (s)	4.5	4.5		4.5	4.5					
Lead/Lag							Lead	Lag	Lead	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0
Pedestrian Calls (#/hr)	0	0		0	0			0		0
Act Effect Green (s)	44.4	44.4		44.4	44.4					
Actuated g/C Ratio	0.44	0.44		0.44	0.44					
v/c Ratio	0.64	0.39		0.27	0.30					
Control Delay	23.9	3.3		19.2	19.2					
Queue Delay	0.0	0.0		0.0	0.0					
Total Delay	23.9	3.3		19.2	19.2					

# Lanes, Volumes, Timings

## 4: Grogans Mill Road

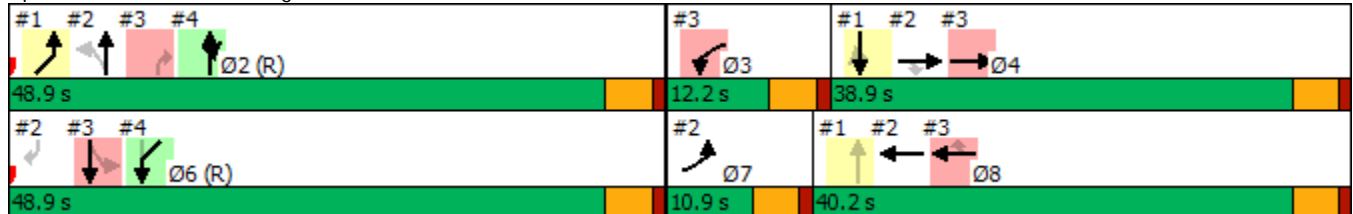


Lane Group	NBT	NBR	SBL	SBT	SWL	SWR	Ø3	Ø4	Ø7	Ø8
LOS	C	A		B	B					
Approach Delay	18.5			19.2	19.2					
Approach LOS	B			B	B					
Queue Length 50th (ft)	251	0		97	79					
Queue Length 95th (ft)	319	49		156	m98					
Internal Link Dist (ft)	486			185	248					
Turn Bay Length (ft)										
Base Capacity (vph)	1556	889		1556	1509					
Starvation Cap Reductn	0	0		0	0					
Spillback Cap Reductn	0	0		0	0					
Storage Cap Reductn	0	0		0	0					
Reduced v/c Ratio	0.64	0.39		0.27	0.30					











### Intersection Summary

Area Type: Other  
 Cycle Length: 100  
 Actuated Cycle Length: 100  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 90  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.97  
 Intersection Signal Delay: 18.8      Intersection LOS: B  
 Intersection Capacity Utilization 44.7%      ICU Level of Service A  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.  
 ! Phase conflict between lane groups.

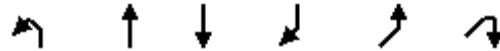
### Splits and Phases: 4: Grogans Mill Road



Lanes, Volumes, Timings  
1: Grogans Mill Road

									
Lane Group	NBL	NBT	SBT	SBR	NEL	NER	Ø3	Ø6	Ø7
Lane Configurations									
Traffic Volume (vph)	0	320	379	247	450	0			
Future Volume (vph)	0	320	379	247	450	0			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900			
Lane Util. Factor	1.00	1.00	0.95	1.00	0.97	1.00			
Fr <sub>t</sub>				0.850					
Fl <sub>t</sub> Protected					0.950				
Satd. Flow (prot)	0	1845	3505	1568	3400	0			
Fl <sub>t</sub> Permitted					0.950				
Satd. Flow (perm)	0	1845	3505	1568	3400	0			
Right Turn on Red				Yes		Yes			
Satd. Flow (RTOR)				268					
Link Speed (mph)		35	35		35				
Link Distance (ft)		381	368		412				
Travel Time (s)		7.4	7.2		8.0				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92			
Adj. Flow (vph)	0	348	412	268	489	0			
Shared Lane Traffic (%)									
Lane Group Flow (vph)	0	348	412	268	489	0			
Enter Blocked Intersection	No	No	No	No	No	No			
Lane Alignment	Left	Left	Left	Right	Left	Right			
Median Width(ft)		0	0		24				
Link Offset(ft)		0	0		0				
Crosswalk Width(ft)		16	16		16				
Two way Left Turn Lane									
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00			
Turning Speed (mph)	15			9	15	9			
Turn Type		NA	NA	Perm	Prot				
Protected Phases			4		2		3	6	7
Permitted Phases		8		4					
Minimum Split (s)		22.5	22.5	22.5	22.5		9.5	22.5	9.5
Total Split (s)		35.9	30.7	30.7	23.1		16.2	23.1	11.0
Total Split (%)		51.3%	43.9%	43.9%	33.0%		23%	33%	16%
Maximum Green (s)		31.4	26.2	26.2	18.6		11.7	18.6	6.5
Yellow Time (s)		3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)		1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)		0.0	0.0	0.0	0.0				
Total Lost Time (s)		4.5	4.5	4.5	4.5				
Lead/Lag		Lag	Lag	Lag			Lead		Lead
Lead-Lag Optimize?		Yes	Yes	Yes			Yes		Yes
Walk Time (s)		7.0	7.0	7.0	7.0			7.0	
Flash Dont Walk (s)		11.0	11.0	11.0	11.0			11.0	
Pedestrian Calls (#/hr)		0	0	0	0			0	
Act Effect Green (s)		31.4	26.2	26.2	18.6				
Actuated g/C Ratio		0.45	0.37	0.37	0.27				
v/c Ratio		0.42	0.31	0.36	0.54				
Control Delay		13.8	16.4	3.7	32.6				
Queue Delay		0.0	0.0	0.0	0.0				
Total Delay		13.8	16.4	3.7	32.6				

Lanes, Volumes, Timings  
1: Grogans Mill Road

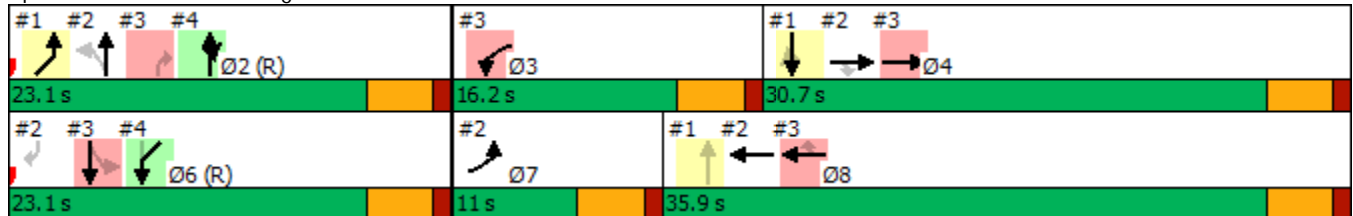


Lane Group	NBL	NBT	SBT	SBR	NEL	NER	Ø3	Ø6	Ø7
LOS		B	B	A	C				
Approach Delay		13.8	11.4		32.6				
Approach LOS		B	B		C				
Queue Length 50th (ft)		97	64	0	92				
Queue Length 95th (ft)		118	97	43	m139				
Internal Link Dist (ft)		301	288		332				
Turn Bay Length (ft)									
Base Capacity (vph)		827	1311	754	903				
Starvation Cap Reductn		0	0	0	0				
Spillback Cap Reductn		0	0	0	0				
Storage Cap Reductn		0	0	0	0				
Reduced v/c Ratio		0.42	0.31	0.36	0.54				

Intersection Summary



























Area Type: Other  
 Cycle Length: 70  
 Actuated Cycle Length: 70  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.96  
 Intersection Signal Delay: 18.8  
 Intersection LOS: B  
 Intersection Capacity Utilization 37.2%  
 ICU Level of Service A  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Grogans Mill Road



## Lanes, Volumes, Timings 2: Grogans Mill Road & Research Forest Drive

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  			  			 				 
Traffic Volume (vph)	216	1687	746	0	1764	0	301	234	0	0	0	247
Future Volume (vph)	216	1687	746	0	1764	0	301	234	0	0	0	247
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	0		0	250		0	0		200
Storage Lanes	2		1	0		0	1		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	1.00	0.88
Frt			0.850									0.850
Flt Protected	0.950						0.950					
Satd. Flow (prot)	3433	5085	1583	0	4940	0	1752	3505	0	0	0	2760
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	3433	5085	1583	0	4940	0	1752	3505	0	0	0	2760
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			811									378
Link Speed (mph)		45			45			35				35
Link Distance (ft)		1441			320			383				412
Travel Time (s)		21.8			4.8			7.5				8.0
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
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	235	1834	811	0	1917	0	327	254	0	0	0	268
Shared Lane Traffic (%)												
Lane Group Flow (vph)	235	1834	811	0	1917	0	327	254	0	0	0	268
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Prot	NA	Perm		NA		Perm	NA				Perm
Protected Phases	7	4			8			2				
Permitted Phases			4				2					6
Minimum Split (s)	9.5	22.5	22.5		22.5		22.5	22.5				22.5
Total Split (s)	11.0	30.7	30.7		35.9		23.1	23.1				23.1
Total Split (%)	15.7%	43.9%	43.9%		51.3%		33.0%	33.0%				33.0%
Maximum Green (s)	6.5	26.2	26.2		31.4		18.6	18.6				18.6
Yellow Time (s)	3.5	3.5	3.5		3.5		3.5	3.5				3.5
All-Red Time (s)	1.0	1.0	1.0		1.0		1.0	1.0				1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0		0.0	0.0				0.0
Total Lost Time (s)	4.5	4.5	4.5		4.5		4.5	4.5				4.5
Lead/Lag	Lead	Lag	Lag		Lag							
Lead-Lag Optimize?	Yes	Yes	Yes		Yes							
Walk Time (s)		7.0	7.0		7.0		7.0	7.0				7.0
Flash Dont Walk (s)		11.0	11.0		11.0		11.0	11.0				11.0
Pedestrian Calls (#/hr)		0	0		0		0	0				0
Act Effect Green (s)	6.5	26.2	26.2		31.4		18.6	18.6				18.6
Actuated g/C Ratio	0.09	0.37	0.37		0.45		0.27	0.27				0.27

## Lanes, Volumes, Timings

### 2: Grogans Mill Road & Research Forest Drive

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Minimum Split (s)	9.5
Total Split (s)	16.2
Total Split (%)	23%
Maximum Green (s)	11.7
Yellow Time (s)	3.5
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Walk Time (s)	
Flash Dont Walk (s)	
Pedestrian Calls (#/hr)	
Act Effect Green (s)	
Actuated g/C Ratio	



Lanes, Volumes, Timings  
 2: Grogans Mill Road & Research Forest Drive

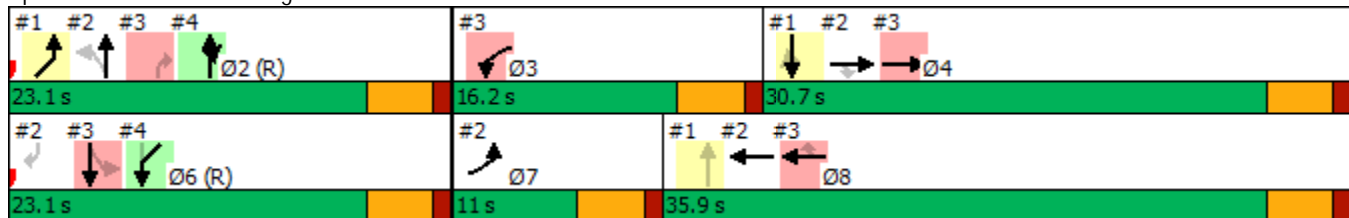


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.74	0.96	0.74		0.87		0.70	0.27				0.27
Control Delay	46.8	36.5	6.2		6.6		36.2	25.6				1.9
Queue Delay	0.0	5.6	0.0		0.0		0.0	0.0				0.0
Total Delay	46.8	42.1	6.2		6.6		36.2	25.6				1.9
LOS	D	D	A		A		D	C				A
Approach Delay		32.4			6.6			31.5				1.9
Approach LOS		C			A			C				A
Queue Length 50th (ft)	52	276	0		23		87	32				0
Queue Length 95th (ft)	#101	#387	71		59		#160	64				27
Internal Link Dist (ft)		1361			240			303				332
Turn Bay Length (ft)	200		200				250					200
Base Capacity (vph)	318	1903	1099		2215		465	931				1010
Starvation Cap Reductn	0	0	0		0		0	0				0
Spillback Cap Reductn	0	67	0		0		0	0				0
Storage Cap Reductn	0	0	0		0		0	0				0
Reduced v/c Ratio	0.74	1.00	0.74		0.87		0.70	0.27				0.27

Intersection Summary

Area Type: Other  
 Cycle Length: 70  
 Actuated Cycle Length: 70  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.96  
 Intersection Signal Delay: 22.1  
 Intersection LOS: C  
 Intersection Capacity Utilization 70.6%  
 ICU Level of Service C  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Grogans Mill Road & Research Forest Drive



Lane Group	Ø3
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

### Lanes, Volumes, Timings 3: Grogans Mill Road & Research Forest Drive

Synchro 11 Report



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑		↗↘	↑↑↑	↗			↗	↘	↑	
Traffic Volume (vph)	0	1687	0	471	1764	320	0	0	222	74	305	0
Future Volume (vph)	0	1687	0	471	1764	320	0	0	222	74	305	0
Ideal Flow (vphp)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	200		350	0		0	0		0
Storage Lanes	0		0	2		1	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.865			
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	5085	0	3335	4940	1538	0	0	1596	1752	1845	0
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	5085	0	3335	4940	1538	0	0	1596	1752	1845	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						348			236			
Link Speed (mph)		45			45			35				35
Link Distance (ft)		320			1457			323				425
Travel Time (s)		4.8			22.1			6.3				8.3
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
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	1834	0	512	1917	348	0	0	241	80	332	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1834	0	512	1917	348	0	0	241	80	332	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA		Prot	NA	Perm			Perm	Perm		NA
Protected Phases		4		3	8							6
Permitted Phases						8			2	6		
Minimum Split (s)		22.5		9.5	22.5	22.5			22.5	22.5		22.5
Total Split (s)		30.7		16.2	35.9	35.9			23.1	23.1		23.1
Total Split (%)		43.9%		23.1%	51.3%	51.3%			33.0%	33.0%		33.0%
Maximum Green (s)		26.2		11.7	31.4	31.4			18.6	18.6		18.6
Yellow Time (s)		3.5		3.5	3.5	3.5			3.5	3.5		3.5
All-Red Time (s)		1.0		1.0	1.0	1.0			1.0	1.0		1.0
Lost Time Adjust (s)		0.0		0.0	0.0	0.0			0.0	0.0		0.0
Total Lost Time (s)		4.5		4.5	4.5	4.5			4.5	4.5		4.5
Lead/Lag		Lag		Lead	Lag	Lag						
Lead-Lag Optimize?		Yes		Yes	Yes	Yes						
Walk Time (s)		7.0			7.0	7.0			7.0	7.0		7.0
Flash Dont Walk (s)		11.0			11.0	11.0			11.0	11.0		11.0
Pedestrian Calls (#/hr)		0			0	0			0	0		0
Act Effect Green (s)		26.2		11.7	31.4	31.4			18.6	18.6		18.6
Actuated g/C Ratio		0.37		0.17	0.45	0.45			0.27	0.27		0.27

### Lanes, Volumes, Timings

#### 3: Grogans Mill Road & Research Forest Drive

Lane Group	Ø7
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Turn Type	
Protected Phases	7
Permitted Phases	
Minimum Split (s)	9.5
Total Split (s)	11.0
Total Split (%)	16%
Maximum Green (s)	6.5
Yellow Time (s)	3.5
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Walk Time (s)	
Flash Dont Walk (s)	
Pedestrian Calls (#/hr)	
Act Effct Green (s)	
Actuated g/C Ratio	

Lanes, Volumes, Timings  
3: Grogans Mill Road & Research Forest Drive

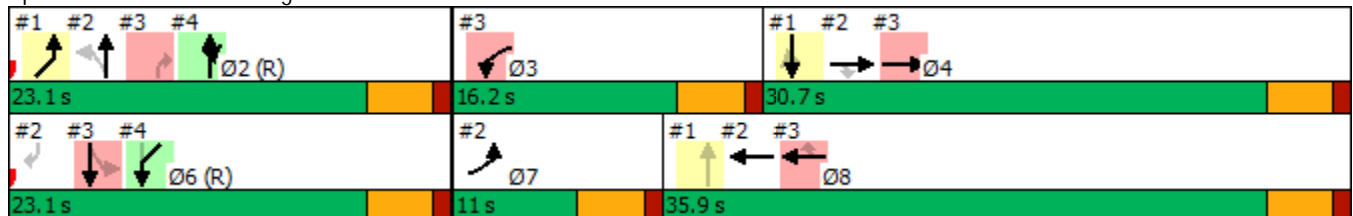


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		0.96		0.92	0.87	0.40			0.40	0.17	0.68	
Control Delay		14.0		53.6	22.9	3.0			3.8	11.3	22.4	
Queue Delay		0.0		0.0	0.1	0.0			0.0	0.0	0.0	
Total Delay		14.0		53.6	23.0	3.0			3.8	11.3	22.4	
LOS		B		D	C	A			A	B	C	
Approach Delay		14.0			26.1			3.8			20.3	
Approach LOS		B			C			A			C	
Queue Length 50th (ft)		49		113	259	0			2	31	149	
Queue Length 95th (ft)		m#62		#199	326	41			16	68	#241	
Internal Link Dist (ft)		240			1377			243			345	
Turn Bay Length (ft)				200		350						
Base Capacity (vph)		1903		557	2215	881			597	465	490	
Starvation Cap Reductn		0		0	0	0			0	0	0	
Spillback Cap Reductn		0		0	21	0			0	0	0	
Storage Cap Reductn		0		0	0	0			0	0	0	
Reduced v/c Ratio		0.96		0.92	0.87	0.40			0.40	0.17	0.68	

Intersection Summary

Area Type: Other  
 Cycle Length: 70  
 Actuated Cycle Length: 70  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.96  
 Intersection Signal Delay: 20.4 Intersection LOS: C  
 Intersection Capacity Utilization 73.3% ICU Level of Service D  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 3: Grogans Mill Road & Research Forest Drive



Lane Group	Ø7
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

Lanes, Volumes, Timings  
4: Grogans Mill Road

	↑	↗	↘	↓	↙	↖				
Lane Group	NBT	NBR	SBL	SBT	SWL	SWR	Ø3	Ø4	Ø7	Ø8
Lane Configurations	↑↑	↗		↑↑	↖↖					
Traffic Volume (vph)	535	222	0	746	776	0				
Future Volume (vph)	535	222	0	746	776	0				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00				
Fr <sub>t</sub>		0.850								
Flt Protected					0.950					
Satd. Flow (prot)	3505	1568	0	3505	3400	0				
Flt Permitted					0.950					
Satd. Flow (perm)	3505	1568	0	3505	3400	0				
Right Turn on Red		Yes				Yes				
Satd. Flow (RTOR)		241								
Link Speed (mph)	35			35	35					
Link Distance (ft)	566			265	328					
Travel Time (s)	11.0			5.2	6.4					
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				
Adj. Flow (vph)	582	241	0	811	843	0				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	582	241	0	811	843	0				
Enter Blocked Intersection	No	No	No	No	No	No				
Lane Alignment	Left	Right	Left	Left	Left	Right				
Median Width(ft)	0			0	24					
Link Offset(ft)	0			0	0					
Crosswalk Width(ft)	16			16	16					
Two way Left Turn Lane										
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Turning Speed (mph)		9	15		15	9				
Turn Type	NA	Prot		NA	Prot					
Protected Phases	2!	2			6!		3	4	7	8
Permitted Phases				6						
Minimum Split (s)	22.5	22.5		22.5	22.5		9.5	22.5	9.5	22.5
Total Split (s)	23.1	23.1		23.1	23.1		16.2	30.7	11.0	35.9
Total Split (%)	33.0%	33.0%		33.0%	33.0%		23%	44%	16%	51%
Maximum Green (s)	18.6	18.6		18.6	18.6		11.7	26.2	6.5	31.4
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0					
Total Lost Time (s)	4.5	4.5		4.5	4.5					
Lead/Lag							Lead	Lag	Lead	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0
Pedestrian Calls (#/hr)	0	0		0	0			0		0
Act Effect Green (s)	18.6	18.6		18.6	18.6					
Actuated g/C Ratio	0.27	0.27		0.27	0.27					
v/c Ratio	0.63	0.41		0.87	0.93					
Control Delay	26.2	5.5		32.7	45.1					
Queue Delay	0.0	0.0		0.0	0.0					
Total Delay	26.2	5.5		32.7	45.1					

# Lanes, Volumes, Timings

## 4: Grogans Mill Road

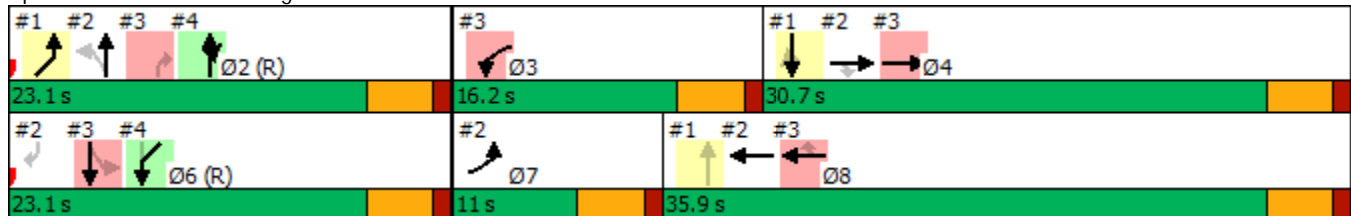


Lane Group	NBT	NBR	SBL	SBT	SWL	SWR	Ø3	Ø4	Ø7	Ø8
LOS	C	A		C	D					
Approach Delay	20.1			32.7	45.1					
Approach LOS	C			C	D					
Queue Length 50th (ft)	115	0		175	172					
Queue Length 95th (ft)	166	49		#278	m#242					
Internal Link Dist (ft)	486			185	248					
Turn Bay Length (ft)										
Base Capacity (vph)	931	593		931	903					
Starvation Cap Reductn	0	0		0	0					
Spillback Cap Reductn	0	0		0	0					
Storage Cap Reductn	0	0		0	0					
Reduced v/c Ratio	0.63	0.41		0.87	0.93					

### Intersection Summary







Area Type: Other  
 Cycle Length: 70  
 Actuated Cycle Length: 70  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 70  
 Control Type: Pretimed  
 Maximum v/c Ratio: 0.96  
 Intersection Signal Delay: 32.7  
 Intersection LOS: C  
 Intersection Capacity Utilization 50.3%  
 ICU Level of Service A  
 Analysis Period (min) 15  
 # 95th percentile volume exceeds capacity, queue may be longer.  
 Queue shown is maximum after two cycles.  
 m Volume for 95th percentile queue is metered by upstream signal.  
 ! Phase conflict between lane groups.

### Splits and Phases: 4: Grogans Mill Road





Lanes, Volumes, Timings  
1: Grogans Mill Road

									
Lane Group	NBL	NBT	SBT	SBR	NEL	NER	Ø3	Ø6	Ø7
Lane Configurations		↑	↑↑	↗	↗↗				
Traffic Volume (vph)	0	176	339	336	453	0			
Future Volume (vph)	0	176	339	336	453	0			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900			
Lane Util. Factor	1.00	1.00	0.95	1.00	0.97	1.00			
Fr't				0.850					
Flt Protected					0.950				
Satd. Flow (prot)	0	1845	3505	1568	3400	0			
Flt Permitted					0.950				
Satd. Flow (perm)	0	1845	3505	1568	3400	0			
Right Turn on Red				Yes		Yes			
Satd. Flow (RTOR)				365					
Link Speed (mph)		35	35		35				
Link Distance (ft)		381	368		412				
Travel Time (s)		7.4	7.2		8.0				
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92			
Adj. Flow (vph)	0	191	368	365	492	0			
Shared Lane Traffic (%)									
Lane Group Flow (vph)	0	191	368	365	492	0			
Enter Blocked Intersection	No	No	No	No	No	No			
Lane Alignment	Left	Left	Left	Right	Left	Right			
Median Width(ft)		0	0		24				
Link Offset(ft)		0	0		0				
Crosswalk Width(ft)		16	16		16				
Two way Left Turn Lane									
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00			
Turning Speed (mph)	15			9	15	9			
Turn Type		NA	NA	Perm	Prot				
Protected Phases			4		2		3	6	7
Permitted Phases		8		4					
Minimum Split (s)		22.5	22.5	22.5	22.5		9.5	22.5	9.5
Total Split (s)		44.0	42.1	42.1	54.5		13.4	54.5	11.5
Total Split (%)		40.0%	38.3%	38.3%	49.5%		12%	50%	10%
Maximum Green (s)		39.5	37.6	37.6	50.0		8.9	50.0	7.0
Yellow Time (s)		3.5	3.5	3.5	3.5		3.5	3.5	3.5
All-Red Time (s)		1.0	1.0	1.0	1.0		1.0	1.0	1.0
Lost Time Adjust (s)		0.0	0.0	0.0	0.0				
Total Lost Time (s)		4.5	4.5	4.5	4.5				
Lead/Lag		Lag	Lag	Lag			Lead		Lead
Lead-Lag Optimize?		Yes	Yes	Yes			Yes		Yes
Walk Time (s)		7.0	7.0	7.0	7.0			7.0	
Flash Dont Walk (s)		11.0	11.0	11.0	11.0			11.0	
Pedestrian Calls (#/hr)		0	0	0	0			0	
Act Effect Green (s)		39.5	37.6	37.6	50.0				
Actuated g/C Ratio		0.36	0.34	0.34	0.45				
v/c Ratio		0.29	0.31	0.47	0.32				
Control Delay		23.8	27.5	4.9	27.9				
Queue Delay		0.0	0.0	0.0	0.0				
Total Delay		23.8	27.5	4.9	27.9				

Lanes, Volumes, Timings  
1: Grogans Mill Road

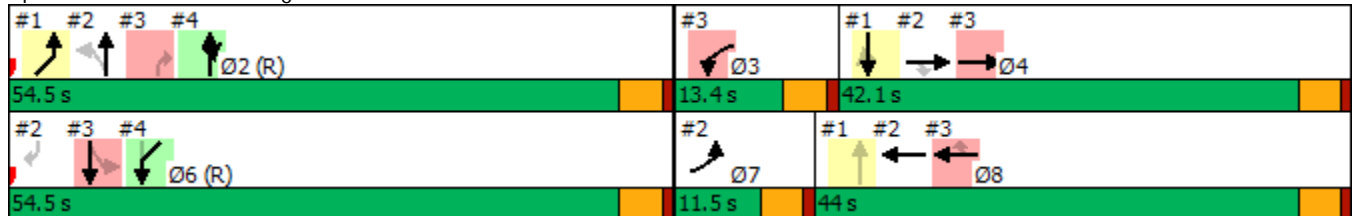


Lane Group	NBL	NBT	SBT	SBR	NEL	NER	Ø3	Ø6	Ø7
LOS		C	C	A	C				
Approach Delay		23.8	16.2		27.9				
Approach LOS		C	B		C				
Queue Length 50th (ft)		95	100	0	114				
Queue Length 95th (ft)		107	139	63	m145				
Internal Link Dist (ft)		301	288		332				
Turn Bay Length (ft)									
Base Capacity (vph)		662	1198	776	1545				
Starvation Cap Reductn		0	0	0	0				
Spillback Cap Reductn		0	0	0	0				
Storage Cap Reductn		0	0	0	0				
Reduced v/c Ratio		0.29	0.31	0.47	0.32				



























Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 110  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.08  
 Intersection Signal Delay: 21.3  
 Intersection LOS: C  
 Intersection Capacity Utilization 29.8%  
 ICU Level of Service A  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Grogans Mill Road



Lanes, Volumes, Timings  
2: Grogans Mill Road & Research Forest Drive

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	 	  			  			 				 
Traffic Volume (vph)	191	1620	444	0	1756	0	785	262	0	0	0	336
Future Volume (vph)	191	1620	444	0	1756	0	785	262	0	0	0	336
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	200		200	0		0	250		0	0		200
Storage Lanes	2		1	0		0	1		0	0		1
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	0.97	0.91	1.00	1.00	0.91	1.00	1.00	0.95	1.00	1.00	1.00	0.88
Frt			0.850									0.850
Flt Protected	0.950						0.950					
Satd. Flow (prot)	3433	5085	1583	0	4940	0	1752	3505	0	0	0	2760
Flt Permitted	0.950						0.950					
Satd. Flow (perm)	3433	5085	1583	0	4940	0	1752	3505	0	0	0	2760
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)			335									302
Link Speed (mph)		45			45			35				35
Link Distance (ft)		1441			320			383				412
Travel Time (s)		21.8			4.8			7.5				8.0
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
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	208	1761	483	0	1909	0	853	285	0	0	0	365
Shared Lane Traffic (%)												
Lane Group Flow (vph)	208	1761	483	0	1909	0	853	285	0	0	0	365
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12				12
Link Offset(ft)		0			0			0				0
Crosswalk Width(ft)		16			16			16				16
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type	Prot	NA	Perm		NA		Perm	NA				Perm
Protected Phases	7	4			8			2				
Permitted Phases			4				2					6
Minimum Split (s)	9.5	22.5	22.5		22.5		22.5	22.5				22.5
Total Split (s)	11.5	42.1	42.1		44.0		54.5	54.5				54.5
Total Split (%)	10.5%	38.3%	38.3%		40.0%		49.5%	49.5%				49.5%
Maximum Green (s)	7.0	37.6	37.6		39.5		50.0	50.0				50.0
Yellow Time (s)	3.5	3.5	3.5		3.5		3.5	3.5				3.5
All-Red Time (s)	1.0	1.0	1.0		1.0		1.0	1.0				1.0
Lost Time Adjust (s)	0.0	0.0	0.0		0.0		0.0	0.0				0.0
Total Lost Time (s)	4.5	4.5	4.5		4.5		4.5	4.5				4.5
Lead/Lag	Lead	Lag	Lag		Lag							
Lead-Lag Optimize?	Yes	Yes	Yes		Yes							
Walk Time (s)		7.0	7.0		7.0		7.0	7.0				7.0
Flash Dont Walk (s)		11.0	11.0		11.0		11.0	11.0				11.0
Pedestrian Calls (#/hr)		0	0		0		0	0				0
Act Effct Green (s)	7.0	37.6	37.6		39.5		50.0	50.0				50.0
Actuated g/C Ratio	0.06	0.34	0.34		0.36		0.45	0.45				0.45

## Lanes, Volumes, Timings

### 2: Grogans Mill Road & Research Forest Drive

Lane Group	Ø3
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Minimum Split (s)	9.5
Total Split (s)	13.4
Total Split (%)	12%
Maximum Green (s)	8.9
Yellow Time (s)	3.5
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Walk Time (s)	
Flash Dont Walk (s)	
Pedestrian Calls (#/hr)	
Act Effct Green (s)	
Actuated g/C Ratio	

# Lanes, Volumes, Timings

## 2: Grogans Mill Road & Research Forest Drive

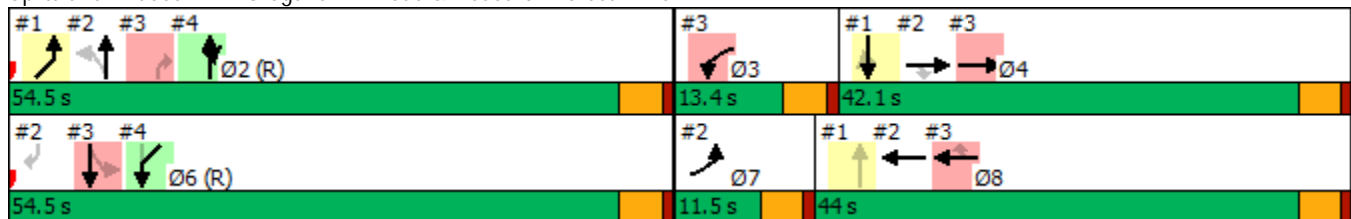


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio	0.95	1.01	0.63		1.08		1.07	0.18				0.26
Control Delay	102.3	61.3	13.1		47.2		69.0	6.9				4.5
Queue Delay	0.0	10.6	0.0		0.0		0.0	0.0				0.0
Total Delay	102.3	71.9	13.1		47.2		69.0	6.9				4.5
LOS	F	E	B		D		E	A				A
Approach Delay		62.9			47.2			53.5				4.5
Approach LOS		E			D			D				A
Queue Length 50th (ft)	76	-464	78		-519		-346	13				13
Queue Length 95th (ft)	#152	#577	194		m#60		#872	m22				65
Internal Link Dist (ft)		1361			240			303				332
Turn Bay Length (ft)	200		200				250					200
Base Capacity (vph)	218	1738	761		1773		796	1593				1419
Starvation Cap Reductn	0	0	0		0		0	0				0
Spillback Cap Reductn	0	52	0		0		0	0				0
Storage Cap Reductn	0	0	0		0		0	0				0
Reduced v/c Ratio	0.95	1.04	0.63		1.08		1.07	0.18				0.26

### Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 110  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.08  
 Intersection Signal Delay: 52.3 Intersection LOS: D  
 Intersection Capacity Utilization 100.4% ICU Level of Service G  
 Analysis Period (min) 15  
 ~ 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.  
 m Volume for 95th percentile queue is metered by upstream signal.













### Splits and Phases: 2: Grogans Mill Road & Research Forest Drive



Lane Group	Ø3
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

### Lanes, Volumes, Timings 3: Grogans Mill Road & Research Forest Drive

Synchro 11 Report

												
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑		↗↘	↑↑↑	↗			↗	↘	↑	
Traffic Volume (vph)	0	1620	0	231	1756	176	0	0	362	90	249	0
Future Volume (vph)	0	1620	0	231	1756	176	0	0	362	90	249	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Storage Length (ft)	0		0	200		350	0		0	0		0
Storage Lanes	0		0	2		1	0		1	1		0
Taper Length (ft)	25			25			25			25		
Lane Util. Factor	1.00	0.91	1.00	0.97	0.91	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt						0.850			0.865			
Flt Protected				0.950						0.950		
Satd. Flow (prot)	0	5085	0	3335	4940	1538	0	0	1596	1752	1845	0
Flt Permitted				0.950						0.950		
Satd. Flow (perm)	0	5085	0	3335	4940	1538	0	0	1596	1752	1845	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						191			172			
Link Speed (mph)		45			45			35			35	
Link Distance (ft)		320			1457			323			425	
Travel Time (s)		4.8			22.1			6.3			8.3	
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
Heavy Vehicles (%)	2%	2%	2%	5%	5%	5%	3%	3%	3%	3%	3%	3%
Adj. Flow (vph)	0	1761	0	251	1909	191	0	0	393	98	271	0
Shared Lane Traffic (%)												
Lane Group Flow (vph)	0	1761	0	251	1909	191	0	0	393	98	271	0
Enter Blocked Intersection	No	No	No	No	No	No	No	No	No	No	No	No
Lane Alignment	Left	Left	Right	Left	Left	Right	Left	Left	Right	Left	Left	Right
Median Width(ft)		24			24			12			12	
Link Offset(ft)		0			0			0			0	
Crosswalk Width(ft)		16			16			16			16	
Two way Left Turn Lane												
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Turning Speed (mph)	15		9	15		9	15		9	15		9
Turn Type		NA		Prot	NA	Perm			Perm	Perm		NA
Protected Phases		4		3	8							6
Permitted Phases						8			2	6		
Minimum Split (s)		22.5		9.5	22.5	22.5			22.5	22.5	22.5	
Total Split (s)		42.1		13.4	44.0	44.0			54.5	54.5	54.5	
Total Split (%)		38.3%		12.2%	40.0%	40.0%			49.5%	49.5%	49.5%	
Maximum Green (s)		37.6		8.9	39.5	39.5			50.0	50.0	50.0	
Yellow Time (s)		3.5		3.5	3.5	3.5			3.5	3.5	3.5	
All-Red Time (s)		1.0		1.0	1.0	1.0			1.0	1.0	1.0	
Lost Time Adjust (s)		0.0		0.0	0.0	0.0			0.0	0.0	0.0	
Total Lost Time (s)		4.5		4.5	4.5	4.5			4.5	4.5	4.5	
Lead/Lag		Lag		Lead	Lag	Lag						
Lead-Lag Optimize?		Yes		Yes	Yes	Yes						
Walk Time (s)		7.0			7.0	7.0			7.0	7.0	7.0	
Flash Dont Walk (s)		11.0			11.0	11.0			11.0	11.0	11.0	
Pedestrian Calls (#/hr)		0			0	0			0	0	0	
Act Effect Green (s)		37.6		8.9	39.5	39.5			50.0	50.0	50.0	
Actuated g/C Ratio		0.34		0.08	0.36	0.36			0.45	0.45	0.45	

### Lanes, Volumes, Timings 3: Grogans Mill Road & Research Forest Drive

Lane Group	Ø7
Lane Configurations	
Traffic Volume (vph)	
Future Volume (vph)	
Ideal Flow (vphpl)	
Storage Length (ft)	
Storage Lanes	
Taper Length (ft)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Peak Hour Factor	
Heavy Vehicles (%)	
Adj. Flow (vph)	
Shared Lane Traffic (%)	
Lane Group Flow (vph)	
Enter Blocked Intersection	
Lane Alignment	
Median Width(ft)	
Link Offset(ft)	
Crosswalk Width(ft)	
Two way Left Turn Lane	
Headway Factor	
Turning Speed (mph)	
Turn Type	
Protected Phases	7
Permitted Phases	
Minimum Split (s)	9.5
Total Split (s)	11.5
Total Split (%)	10%
Maximum Green (s)	7.0
Yellow Time (s)	3.5
All-Red Time (s)	1.0
Lost Time Adjust (s)	
Total Lost Time (s)	
Lead/Lag	Lead
Lead-Lag Optimize?	Yes
Walk Time (s)	
Flash Dont Walk (s)	
Pedestrian Calls (#/hr)	
Act Effct Green (s)	
Actuated g/C Ratio	



# Lanes, Volumes, Timings

## 3: Grogans Mill Road & Research Forest Drive

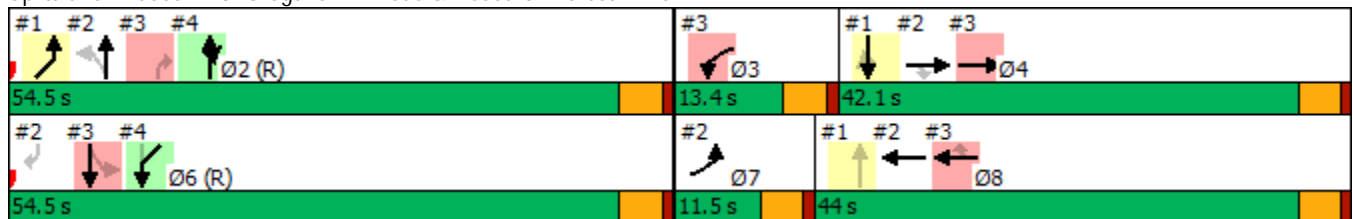


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
v/c Ratio		1.01		0.93	1.08	0.28			0.48	0.12	0.32	
Control Delay		20.4		91.1	79.9	4.7			11.4	21.1	26.8	
Queue Delay		0.0		0.0	9.9	0.0			0.0	0.0	0.0	
Total Delay		20.4		91.1	89.8	4.7			11.4	21.1	26.8	
LOS		C		F	F	A			B	C	C	
Approach Delay		20.4			83.0			11.4			25.3	
Approach LOS		C			F			B			C	
Queue Length 50th (ft)		-68		92	-551	0			101	67	205	
Queue Length 95th (ft)		m#62		#171	#647	47			110	123	293	
Internal Link Dist (ft)		240			1377			243			345	
Turn Bay Length (ft)				200		350						
Base Capacity (vph)		1738		269	1773	674			819	796	838	
Starvation Cap Reductn		0		0	0	0			0	0	0	
Spillback Cap Reductn		0		0	102	0			0	0	0	
Storage Cap Reductn		0		0	0	0			0	0	0	
Reduced v/c Ratio		1.01		0.93	1.14	0.28			0.48	0.12	0.32	

### Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 110  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.08  
 Intersection Signal Delay: 50.3  
 Intersection LOS: D  
 Intersection Capacity Utilization 70.0%  
 ICU Level of Service C  
 Analysis Period (min) 15  
 ~ 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.  
 m Volume for 95th percentile queue is metered by upstream signal.

### Splits and Phases: 3: Grogans Mill Road & Research Forest Drive



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Lane Group	Ø7
v/c Ratio	
Control Delay	
Queue Delay	
Total Delay	
LOS	
Approach Delay	
Approach LOS	
Queue Length 50th (ft)	
Queue Length 95th (ft)	
Internal Link Dist (ft)	
Turn Bay Length (ft)	
Base Capacity (vph)	
Starvation Cap Reductn	
Spillback Cap Reductn	
Storage Cap Reductn	
Reduced v/c Ratio	
Intersection Summary	

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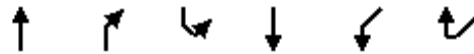
# Lanes, Volumes, Timings

## 4: Grogans Mill Road

	↑	↗	↘	↓	↙	↖				
Lane Group	NBT	NBR	SBL	SBT	SWL	SWR	Ø3	Ø4	Ø7	Ø8
Lane Configurations	↑↑	↗		↑↑	↖↗					
Traffic Volume (vph)	1047	362	0	444	480	0				
Future Volume (vph)	1047	362	0	444	480	0				
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900				
Lane Util. Factor	0.95	1.00	1.00	0.95	0.97	1.00				
Fr't		0.850								
Flt Protected					0.950					
Satd. Flow (prot)	3505	1568	0	3505	3400	0				
Flt Permitted					0.950					
Satd. Flow (perm)	3505	1568	0	3505	3400	0				
Right Turn on Red		Yes				Yes				
Satd. Flow (RTOR)		393								
Link Speed (mph)	35			35	35					
Link Distance (ft)	566			265	328					
Travel Time (s)	11.0			5.2	6.4					
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92				
Adj. Flow (vph)	1138	393	0	483	522	0				
Shared Lane Traffic (%)										
Lane Group Flow (vph)	1138	393	0	483	522	0				
Enter Blocked Intersection	No	No	No	No	No	No				
Lane Alignment	Left	Right	Left	Left	Left	Right				
Median Width(ft)	0			0	24					
Link Offset(ft)	0			0	0					
Crosswalk Width(ft)	16			16	16					
Two way Left Turn Lane										
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00				
Turning Speed (mph)		9	15		15	9				
Turn Type	NA	Prot		NA	Prot					
Protected Phases	2!	2			6!		3	4	7	8
Permitted Phases				6						
Minimum Split (s)	22.5	22.5		22.5	22.5		9.5	22.5	9.5	22.5
Total Split (s)	54.5	54.5		54.5	54.5		13.4	42.1	11.5	44.0
Total Split (%)	49.5%	49.5%		49.5%	49.5%		12%	38%	10%	40%
Maximum Green (s)	50.0	50.0		50.0	50.0		8.9	37.6	7.0	39.5
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5	3.5	3.5
All-Red Time (s)	1.0	1.0		1.0	1.0		1.0	1.0	1.0	1.0
Lost Time Adjust (s)	0.0	0.0		0.0	0.0					
Total Lost Time (s)	4.5	4.5		4.5	4.5					
Lead/Lag							Lead	Lag	Lead	Lag
Lead-Lag Optimize?							Yes	Yes	Yes	Yes
Walk Time (s)	7.0	7.0		7.0	7.0			7.0		7.0
Flash Dont Walk (s)	11.0	11.0		11.0	11.0			11.0		11.0
Pedestrian Calls (#/hr)	0	0		0	0			0		0
Act Effect Green (s)	50.0	50.0		50.0	50.0					
Actuated g/C Ratio	0.45	0.45		0.45	0.45					
v/c Ratio	0.71	0.42		0.30	0.34					
Control Delay	27.4	3.3		21.5	21.2					
Queue Delay	0.0	0.0		0.0	0.0					
Total Delay	27.4	3.3		21.5	21.2					

# Lanes, Volumes, Timings

## 4: Grogans Mill Road



Lane Group	NBT	NBR	SBL	SBT	SWL	SWR	Ø3	Ø4	Ø7	Ø8
LOS	C	A		C	C					
Approach Delay	21.2			21.5	21.2					
Approach LOS	C			C	C					
Queue Length 50th (ft)	333	0		136	98					
Queue Length 95th (ft)	413	53		202	m116					
Internal Link Dist (ft)	486			185	248					
Turn Bay Length (ft)										
Base Capacity (vph)	1593	927		1593	1545					
Starvation Cap Reductn	0	0		0	0					
Spillback Cap Reductn	0	0		0	0					
Storage Cap Reductn	0	0		0	0					
Reduced v/c Ratio	0.71	0.42		0.30	0.34					

### Intersection Summary

Area Type: Other  
 Cycle Length: 110  
 Actuated Cycle Length: 110  
 Offset: 0 (0%), Referenced to phase 2:NEL and 6:, Start of Green  
 Natural Cycle: 110  
 Control Type: Pretimed  
 Maximum v/c Ratio: 1.08  
 Intersection Signal Delay: 21.3      Intersection LOS: C  
 Intersection Capacity Utilization 50.1%      ICU Level of Service A  
 Analysis Period (min) 15  
 m Volume for 95th percentile queue is metered by upstream signal.  
 ! Phase conflict between lane groups.

### Splits and Phases: 4: Grogans Mill Road

