TIMING EFFECTIVENESS STUDY
FOR
GWINNETT PLACE CID
SIGNAL RETIMING PROJECT

CSCMQ-0006-00(742)
METRO ATLANTA, P.I. NO. 0006742

Prepared For:
Gwinnett County and Georgia Department of Transportation

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1. INTRODUCTION

GWINNETT PLACE CID SIGNAL RETIMING PROJECT

The Gwinnett Place Community Improvement District (GPCID) signal system mentioned in this report has 3 major corridors which are located along Pleasant Hill Road, Satellite Boulevard, and Steve Reynolds Boulevard, in Duluth, Gwinnett County, Georgia. The major congestion generators for most of these systems are normal inbound and outbound commuter traffic during the peak periods; however, there are other generators located around GPCID (i.e. schools, restaurants, shopping, etc.)

Improved signal timing and coordination offer one of the most cost-effective and quickly implementable ways to reduce congestion and improve traffic flow. Wolverton & Associates, Inc. (W&A) developed new timing plans for the signals in this project. This report provides an analysis of the cost and benefit of the corridors analyzed in this project. The total number of traffic signals in this project is forty-nine (49).

This final timing report is divided into the following sections:

- Introduction
- Study Criteria
- Timing Effectiveness Summary
- System Timing Effectiveness Breakdown (3 Travel Routes)
    - Travel Time and Delay Studies
    - Environmental Pollution Emissions
    - Benefit Analysis
- Project Costs and Benefits
- Recommendations
- Appendix

2. STUDY CRITERIA

GWINNETT PLACE CID SIGNAL RETIMING PROJECT

Study Methodology and Techniques

The travel time, average speed, and delay studies were conducted in accordance with the procedures given in the *Manual of Transportation Engineering Studies*, published by the Institute of Transportation Engineers. Travel time, average speed, and delay studies were conducted along the 3 corridors analyzed during the AM, Mid-Day, and PM Peak Periods. A minimum of six (6) runs were collected in each direction. The "floating car" technique was used, whereby the driver passes as many cars as pass the driver. The study vehicle was unmarked and operated as inconspicuously as possible. The operator recorded the stops and travel time experienced during each run.

In addition to the traditional analysis of travel time runs described above, a before and after comparison using *GeoStats* data is provided in the appendix of this report. The *GeoStats* analysis was generated by entering the "before" coordination data comparing it with the new timing plans currently in operation. *GeoStats's* Routes Summary report was used to analyze total delay, fuel consumed, and several types of emissions.

Date and Time of Studies

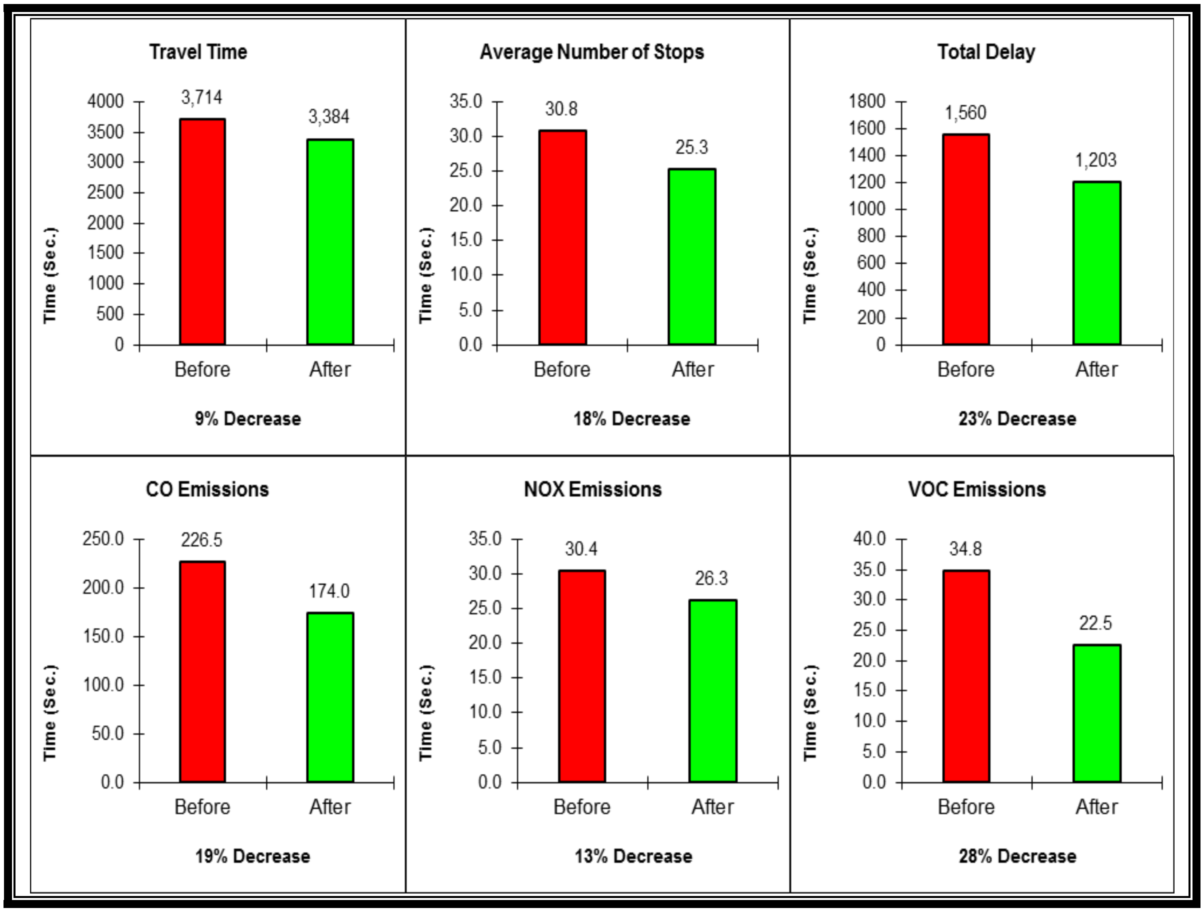
The "before" studies were conducted between August 20th and August 22nd, 2013 and the "after" studies were conducted between October 1st and October 3rd, 2013. The AM Peak studies were conducted between 7:00 a.m. and 9:00 a.m., Mid-Day Peak studies were conducted between 12:00 a.m. and 2:00 p.m., and PM Peak studies were conducted between 4:30 p.m. and 6:30 p.m. School was in session in Gwinnett County Schools, it started August 7, so both the "before" and "after" studies were conducted while school was in session.

3. TIMING EFFECTIVENESS SUMMARY

GWINNETT PLACE CID SIGNAL RETIMING PROJECT

Figure 1 shows the overall project effectiveness of the retiming for Travel Time, Number of Stops, Total Delay, CO Emissions, NOX Emissions, and VOC Emissions.

Figure 1 –GPCID Signal Retiming Effectiveness Summary



4. SYSTEM 1 – PLEASANT HILL ROAD

GWINNETT PLACE CID SIGNAL RETIMING PROJECT

Description of Study Corridor

System 1 – Pleasant Hill Road includes the twenty-three (23) traffic signals shown in Figure 2 and Table 1. Table 2 shows the final timing plans for System 1 – Pleasant Hill Road.

Figure 2 – System 1 – Pleasant Hill Road Limits

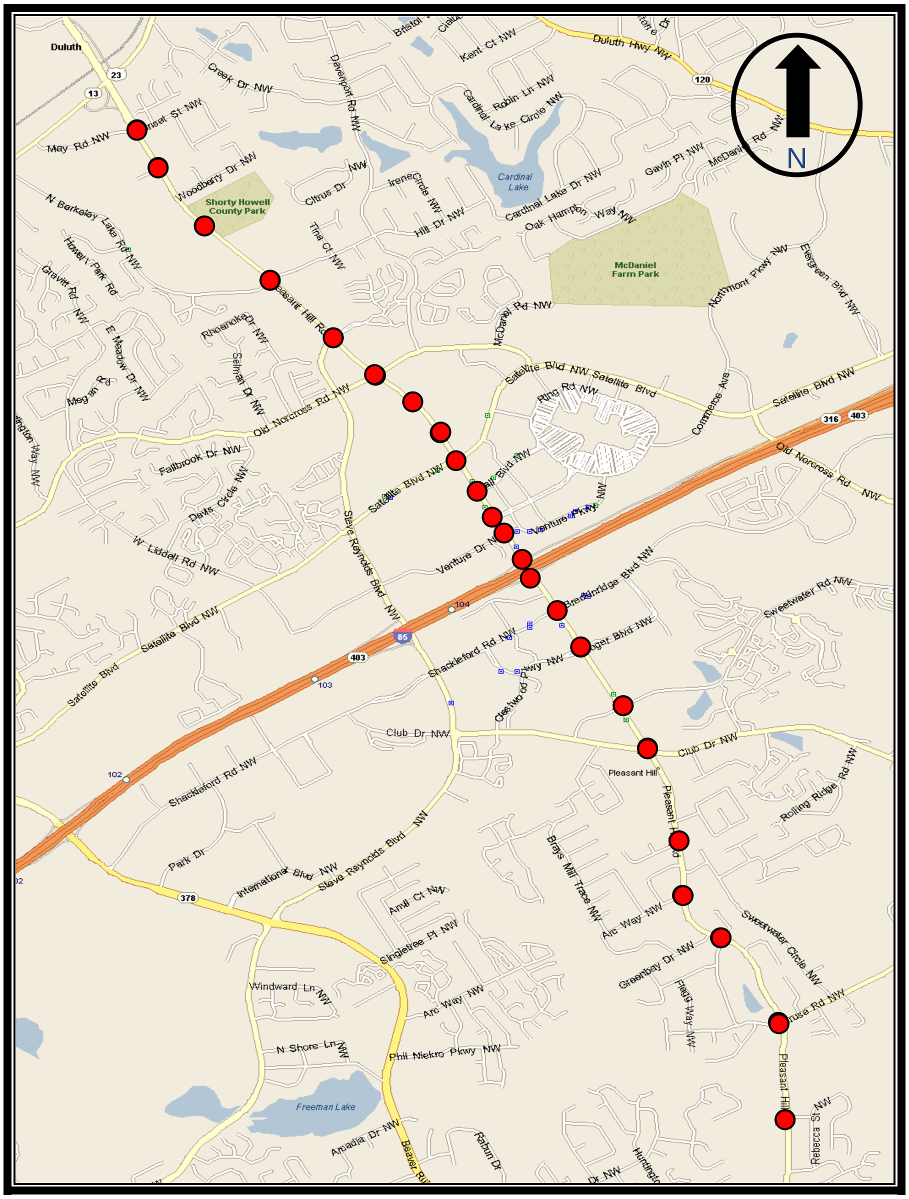


Table 1 – System 1 – Pleasant Hill Road Intersections

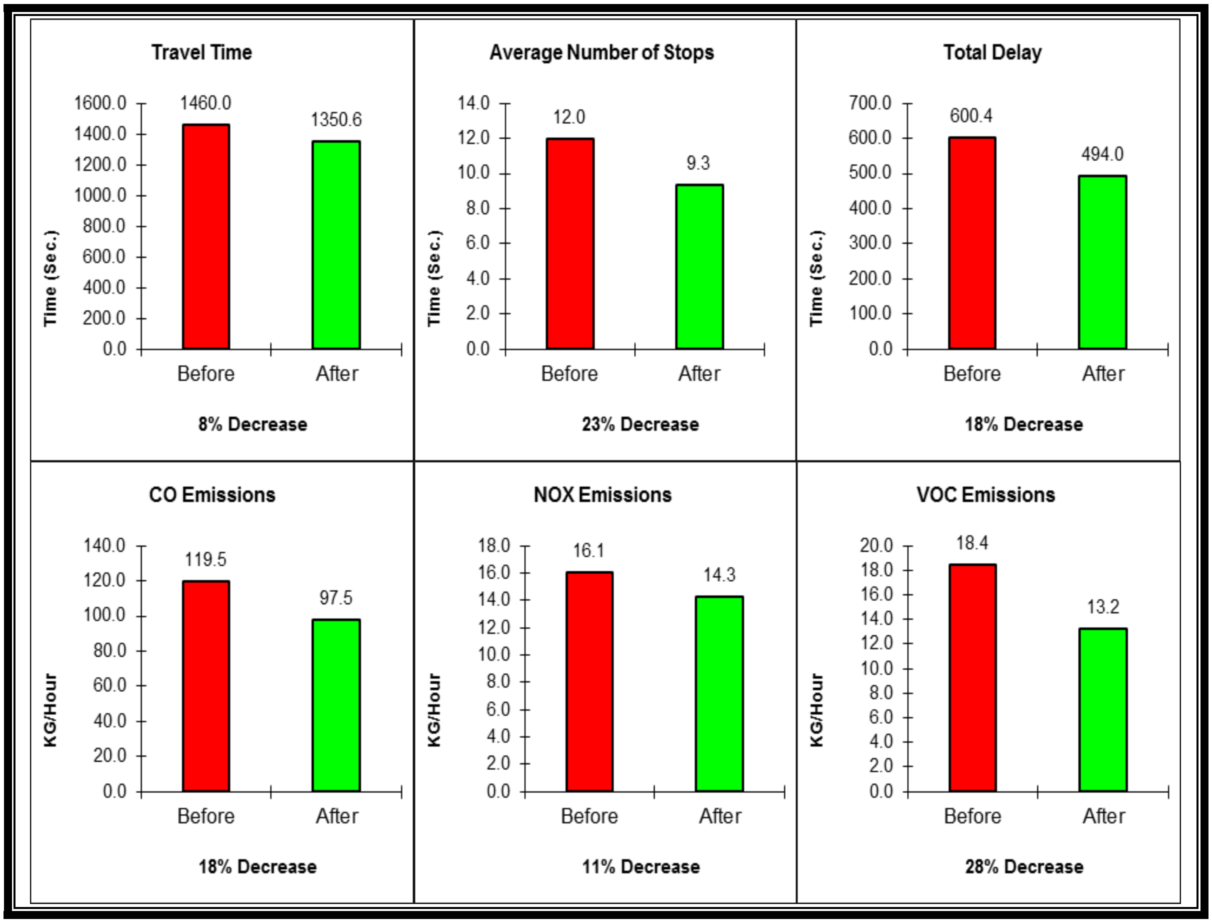
No.	Intersection	System	Maintaining Agency
1	Pleasant Hill Road @ Old Berkely Lake Road	Pleasant Hill Road Signal System	Gwinnett County
2	Pleasant Hill Road @ Woodberry Drive	Pleasant Hill Road Signal System	Gwinnett County
3	Pleasant Hill Road @ Shory Howell Park/Walmart	Pleasant Hill Road Signal System	Gwinnett County
4	Pleasant Hill Road @ Hill Drive/N. Berkely Lake Road	Pleasant Hill Road Signal System	Gwinnett County
5	Pleasant Hill Road @ Steve Reynolds Boulevard	Pleasant Hill Road Signal System	Gwinnett County
6	Pleasant Hill Road @ Old Norcross Road	Pleasant Hill Road Signal System	Gwinnett County
7	Pleasant Hill Road @ Gwinnett Prado	Pleasant Hill Road Signal System	Gwinnett County
8	Pleasant Hill Road @ Gwinnett Station	Pleasant Hill Road Signal System	Gwinnett County
9	Pleasant Hill Road @ Satellite Boulevard	Pleasant Hill Road Signal System	Gwinnett County
10	Pleasant Hill Road @ Mall Boulevard	Pleasant Hill Road Signal System	Gwinnett County
11	Pleasant Hill Road @ Gwinnett Place Drive	Pleasant Hill Road Signal System	Gwinnett County
12	Pleasant Hill Road @ Venture Drive	Pleasant Hill Road Signal System	Gwinnett County
13	Pleasant Hill Road @ I-85 SB	Pleasant Hill Road Signal System	Gwinnett County
14	Pleasant Hill Road @ I-85 NB	Pleasant Hill Road Signal System	Gwinnett County
15	Pleasant Hill Road @ Breckinridge Boulevard	Pleasant Hill Road Signal System	Gwinnett County
16	Pleasant Hill Road @ Crestwood Pkwy / Koger Blvd	Pleasant Hill Road Signal System	Gwinnett County
17	Pleasant Hill Road @ Sweetwater Road	Pleasant Hill Road Signal System	Gwinnett County
18	Pleasant Hill Road @ Club Drive	Pleasant Hill Road Signal System	Gwinnett County
19	Pleasant Hill Road @ Corley Place	Pleasant Hill Road Signal System	Gwinnett County
20	Pleasant Hill Road @ Arc Way	Pleasant Hill Road Signal System	Gwinnett County
21	Pleasant Hill Road @ Lake Hill Drive	Pleasant Hill Road Signal System	Gwinnett County
22	Pleasant Hill Road @ Cruse Road	Pleasant Hill Road Signal System	Gwinnett County
23	Pleasant Hill Road @ Mary Street	Pleasant Hill Road Signal System	Gwinnett County

Table 2 – System 1 – Pleasant Hill Road TOD Schedule

Day of Week	Hours of Operation	Cycle Length	Plan #
Monday - Thursday	00:01 - 06:00	100"	1/2/2
	06:00 - 09:30	150"	3/1/1
	09:30 - 11:30	130"	2/1/1
	11:30 - 15:30	150"	3/2/2
	15:30 - 20:00	170"	4/3/3
	20:00 - 22:00	130"	2/3/3
	22:00 - 00:01	100"	1/2/2
Friday	00:01 - 06:00	100"	1/2/2
	06:00 - 09:30	150"	3/1/1
	09:30 - 11:30	130"	2/1/1
	11:30 - 14:15	150"	3/2/2
	14:15 - 20:00	170"	4/3/3
	20:00 - 00:01	130"	2/3/3
Saturday	00:01 - 08:30	100"	1/2/2
	08:30 - 12:00	150"	3/4/2
	12:00 - 17:00	170"/85"	4/4/2
	17:00 - 21:30	150"	3/4/2
	21:30 - 00:01	130"	1/2/2
Sunday	00:01 - 09:30	100"	1/2/2
	09:30 - 11:30	130"	2/4/2
	11:30 - 20:30	150"	3/4/2
	20:30 - 00:01	130"	1/2/2

The travel run route for System 1 – Pleasant Hill Road included twenty-three (23) traffic signals. Figure 3 shows the overall effectiveness of the retiming for Travel Time, Number of Stops, Total Delay, CO Emissions, NOX Emissions, and VOC Emissions.

Figure 3 – System 1 – Pleasant Hill Road Effectiveness Summary



Travel Time and Delay Study

The following summary shows a comparison of the "before" and "after" travel time, average trip speed, delay, and number of stops recorded at the intersections while conducting the studies. Data are shown for each time period and direction of travel. Although this study does not detail the improvements made on the side street approaches, our team of engineers made great efforts to control queues. Details of each travel time run are shown in the Appendix.

Table 3 shows a summarization of the "before" and "after" travel time study data for the AM, Mid-Day, and PM Peak Periods along System 1 – Pleasant Hill Road.

Table 3 – System 1 – Pleasant Hill Road Speed and Delay Results

AM Peak	Pleasant Hill Road (NB)			Pleasant Hill Road (SB)		
	Before	**After**	**% Imp**	**Before**	**After**	**% Imp**
Travel Time (sec.)	779.4	675.6	13%	793.8	688.2	13%
Trip Speed (mph)	22.5	25.9	15%	22.0	25.4	15%
Total Delay (sec.)	326.4	231.6	29%	371.4	267.0	28%
Number of Stops	8.0	4.8	40%	6.9	5.3	24%

MD Peak	Pleasant Hill Road (NB)			Pleasant Hill Road (SB)		
	Before	**After**	**% Imp**	**Before**	**After**	**% Imp**
Travel Time (sec.)	648.6	642.0	1%	660.0	637.8	3%
Trip Speed (mph)	26.9	27.3	1%	26.4	27.4	4%
Total Delay (sec.)	234.0	214.2	8%	229.8	214.2	7%
Number of Stops	4.3	3.7	13%	5.3	4.9	7%

PM Peak	Pleasant Hill Road (NB)			Pleasant Hill Road (SB)		
	Before	**After**	**% Imp**	**Before**	**After**	**% Imp**
Travel Time (sec.)	778.8	693.6	11%	719.4	714.6	1%
Trip Speed (mph)	22.5	25.2	12%	24.3	24.4	0%
Total Delay (sec.)	350.4	275.4	21%	289.2	279.6	3%
Number of Stops	6.5	4.4	33%	5.0	5.0	0%

Environmental Pollution Emissions

Carbon monoxide, oxides of nitrogen, and volatile organic compounds (hydrocarbons) are three types of vehicle emissions that are regulated by federal law. New signal timing can reduce these pollutants by reducing the number of stops vehicles make and having vehicles travel at a faster average speed.

Table 4 is a comparison of the total "before" and "after" emission data for the AM, Mid-Day, and PM Peak Periods along System 1 – Pleasant Hill Road.

Table 4 – System 1 – Pleasant Hill Road Emission Results

AM Peak	Pleasant Hill Road		
	Before	After	% Imp
CO Emissions (kg/hr)	44.7984	30.2474	32%
NOx Emissions (kg/hr)	5.8495	4.6906	20%
VOC Emissions (kg/hr)	7.2328	3.7771	48%

MD Peak	Pleasant Hill Road		
	Before	After	% Imp
CO Emissions (kg/hr)	31.1841	26.4858	15%
NOx Emissions (kg/hr)	4.1259	4.0498	2%
VOC Emissions (kg/hr)	4.7862	3.3428	30%

PM Peak	Pleasant Hill Road		
	Before	After	% Imp
CO Emissions (kg/hr)	48.2420	36.0278	25%
NOx Emissions (kg/hr)	6.1714	5.4781	11%
VOC Emissions (kg/hr)	7.8724	4.6608	41%

Benefit Analysis

The reductions in delay and travel time documented previously are of much greater value than simply reducing driver frustration and inconvenience. Rather, time spent by people in traffic congestion is time that cannot be used for revenue producing activities. The time saved by drivers due to improved signal timing has a dollar value that can be calculated with the following formula:

S = R x V x D x O x C

Where:

S = Dollars saved
R = Travel time reduction
V = Volume
D = Days timing is in effect
O = Average vehicle occupancy
C = Cost of delay per person

Delay incurs direct costs upon motorists in the form of increased fuel consumption and the value of their time wasted while waiting in traffic. Motorists using System 1 – Pleasant Hill Road during the three (3) peak periods will save 102,742 hours and 61,645 gallons of gasoline each year because of improved traffic flow due to the new timing plans. A vehicle occupancy rate of 1.2, $12.00 per hour for the value of motorists' time, and $3.50 per gallon for gasoline was used. Table 5 shows the dollar value of the travel time improvements for the system signal timing in each direction during the AM peak, Mid-Day, and PM peak periods.

Table 5 – System 1 – Pleasant Hill Road Annual Benefit Results

			Annual Improvement				
			Travel Time		Fuel Consumption		Total
	Time Period	Volume	Veh-Hrs	Value	Gallons	Value	Dollars
Time and Fuel	Northbound						
	A.M. Peak	6000	43,250	$622,800	25,950	$90,825	$713,625
	MD	4200	1,925	$27,720	1,155	$4,043	$31,763
	P.M. Peak	4400	26,033	$374,880	15,620	$54,670	$429,550
	Southbound						
	A.M. Peak	3200	23,467	$337,920	14,080	$49,280	$387,200
	MD	4000	6,167	$88,800	3,700	$12,950	$101,750
	P.M. Peak	5700	1,900	$27,360	1,140	$3,990	$31,350
		Total	**102,742**	**1,479,480**	**61,645**	**215,758**	**$1,695,238**

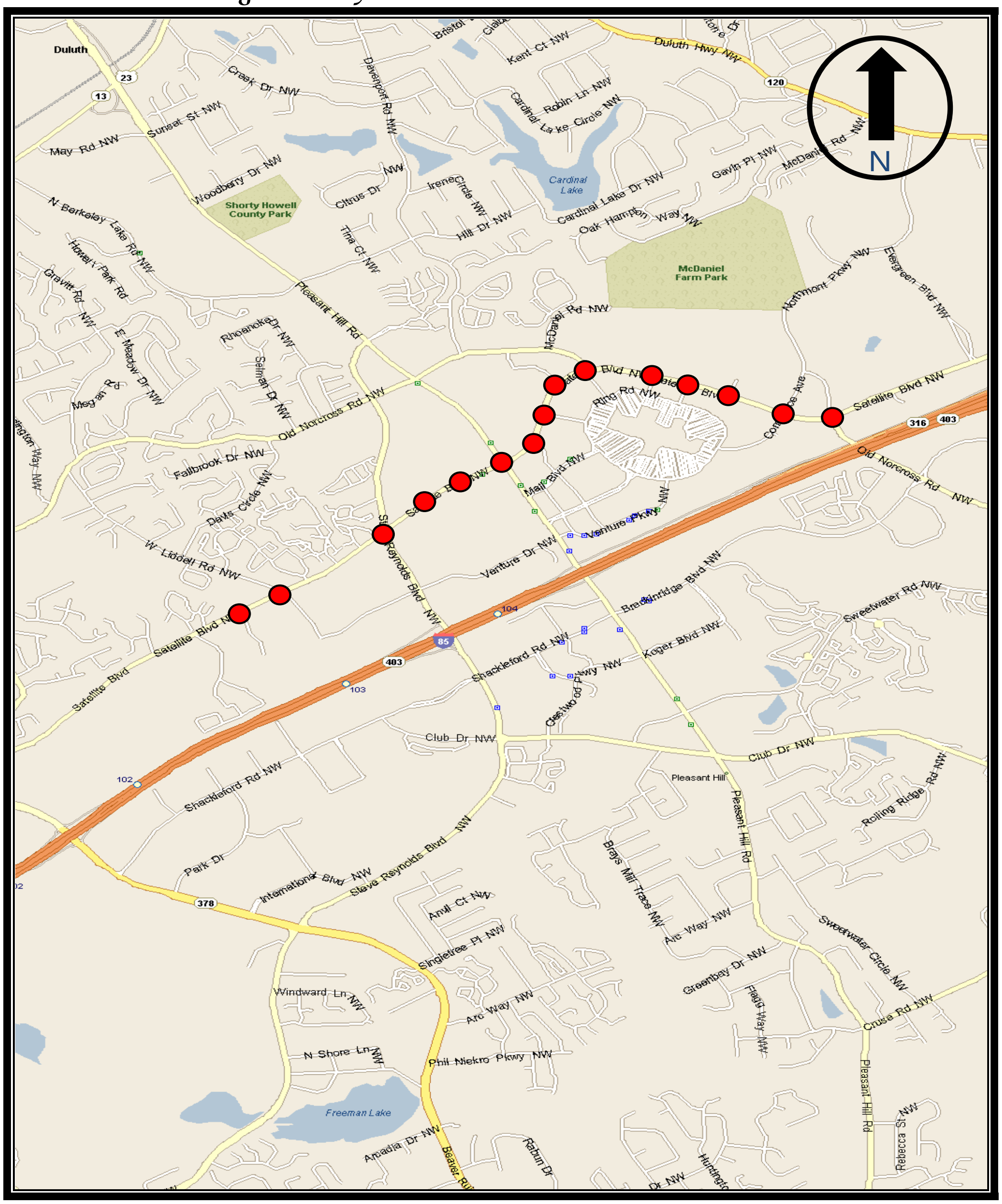
5. SYSTEM 2 – SATELLITE BOULEVARD

GWINNETT PLACE CID SIGNAL RETIMING PROJECT

Description of Study Corridor

System 2 – Satellite Boulevard includes the fifteen (15) traffic signals shown in Figure 4 and Table 6. Table 7 shows the final timing plans for System 2 – Satellite Boulevard.

Figure 4 – System 2 – Satellite Boulevard Limits



Wolverton & Associates

Table 6 – System 2 – Satellite Boulevard Intersections

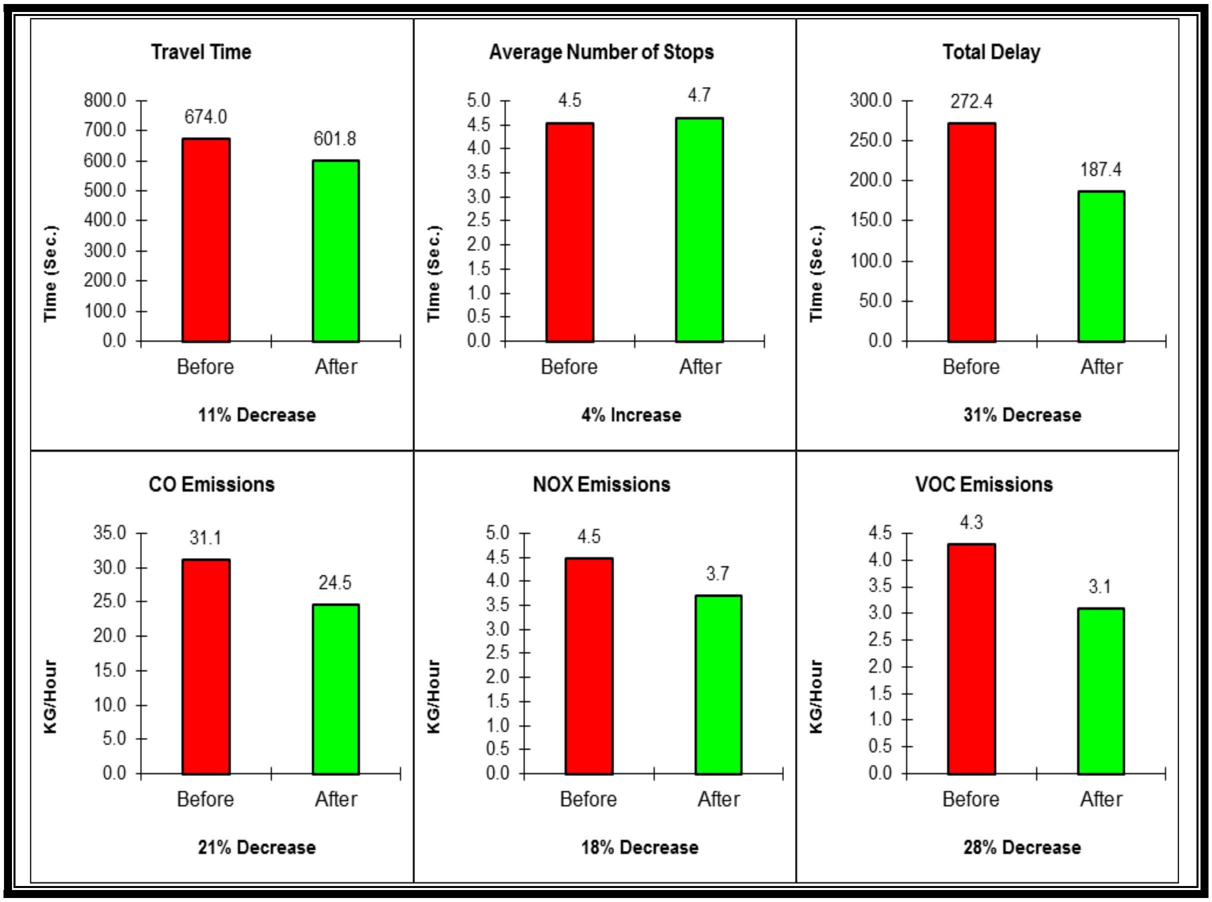
No.	Intersection	System	Maintaining Agency
1	Satellite Boulevard @ Satellite Pointe	Satellite Boulevard Signal System	Gwinnett County
2	Satellite Boulevard @ W Liddell Road	Satellite Boulevard Signal System	Gwinnett County
3	Satellite Boulevard @ Steve Reynolds Boulevard	Satellite Boulevard Signal System	Gwinnett County
4	Satellite Boulevard @ Gwinnett Commons	Satellite Boulevard Signal System	Gwinnett County
5	Satellite Boulevard @ Market Fair	Satellite Boulevard Signal System	Gwinnett County
6	Pleasant Hill Road @ Satellite Boulevard	Satellite Boulevard Signal System	Gwinnett County
7	Satellite Boulevard @ Market Street	Satellite Boulevard Signal System	Gwinnett County
8	Satellite Boulevard @ Merchant Way	Satellite Boulevard Signal System	Gwinnett County
9	Satellite Boulevard @ Bus Depot	Satellite Boulevard Signal System	Gwinnett County
10	Satellite Boulevard @ Old Norcross Road (W)	Satellite Boulevard Signal System	Gwinnett County
11	Satellite Boulevard @ Office Driveway # 1	Satellite Boulevard Signal System	Gwinnett County
12	Satellite Boulevard @ Tandy Key Lane	Satellite Boulevard Signal System	Gwinnett County
13	Satellite Boulevard @ Office Driveway # 2	Satellite Boulevard Signal System	Gwinnett County
14	Satellite Boulevard @ Commerce Avenue	Satellite Boulevard Signal System	Gwinnett County
15	Satellite Boulevard @ Old Norcross Road (E)	Satellite Boulevard Signal System	Gwinnett County

Table 7 – System 2 – Satellite Boulevard TOD Schedule

Day of Week	Hours of Operation	Cycle Length	Plan #
Monday - Thursday	00:01 - 06:00	Free	0/0/4
	06:00 - 09:30	150"	3/1/1
	09:30 - 11:30	130"	2/1/1
	11:30 - 15:30	150"	3/2/2
	15:30 - 20:00	170"	4/3/3
	20:00 - 22:00	130"	2/3/3
	22:00 - 00:01	Free	0/0/4
Friday	00:01 - 06:00	Free	0/0/4
	06:00 - 09:30	150"	3/1/1
	09:30 - 11:30	130"	2/1/1
	11:30 - 14:15	150"	3/2/2
	14:15 - 20:00	170"	4/3/3
	20:00 - 00:01	130"	2/3/3
Saturday	00:01 - 08:30	Free	0/0/4
	08:30 - 12:00	150"	3/4/2
	12:00 - 17:00	170"/85"	4/4/2
	17:00 - 21:30	150"	3/4/2
	21:30 - 00:01	Free	0/0/4
Sunday	00:01 - 09:30	Free	0/0/4
	09:30 - 11:30	130"	2/4/2
	11:30 - 20:30	150"	3/4/2
	20:30 - 00:01	Free	0/0/4

The travel run route for System 2 – Satellite Boulevard included fifteen (15) traffic signals. Figure 5 shows the overall effectiveness of the retiming for Travel Time, Number of Stops, Total Delay, CO Emissions, NOX Emissions, and VOC Emissions.

Figure 5 – System 2 – Satellite Boulevard Effectiveness Summary



Travel Time and Delay Study

The following summary shows a comparison of the "before" and "after" travel time, average trip speed, delay, and number of stops recorded at the intersections while conducting the studies. Data are shown for each time period and direction of travel. Although this study does not detail the improvements made on the side street approaches, our team of engineers made great efforts to control queues. Details of each travel time run are shown in the Appendix.

Table 8 shows a summarization of the "before" and "after" travel time study data for the AM, Mid-Day, and PM Peak Periods along System 2 – Satellite Boulevard.

Table 8 – System 2 – Satellite Boulevard Speed and Delay Results

AM Peak	Satellite Boulevard (EB)			Satellite Boulevard (WB)		
	Before	**After**	**% Imp**	**Before**	**After**	**% Imp**
Travel Time (sec.)	379.2	336.6	11%	357.6	289.2	19%
Trip Speed (mph)	22.5	25.3	13%	23.7	29.4	24%
Total Delay (sec.)	184.2	127.8	31%	162.0	88.8	45%
Number of Stops	2.6	3.4	-31%	2.1	1.4	35%

MD Peak	Satellite Boulevard (EB)			Satellite Boulevard (WB)		
	Before	**After**	**% Imp**	**Before**	**After**	**% Imp**
Travel Time (sec.)	322.8	307.8	5%	298.2	280.2	6%
Trip Speed (mph)	26.3	27.6	5%	28.5	30.3	6%
Total Delay (sec.)	116.4	96.6	17%	94.8	70.8	25%
Number of Stops	2.6	2.7	-6%	2.1	1.9	11%

PM Peak	Satellite Boulevard (EB)			Satellite Boulevard (WB)		
	Before	**After**	**% Imp**	**Before**	**After**	**% Imp**
Travel Time (sec.)	299.4	269.4	10%	364.8	322.2	12%
Trip Speed (mph)	28.4	31.5	11%	23.3	26.4	13%
Total Delay (sec.)	99.0	54.6	45%	160.8	123.6	23%
Number of Stops	1.4	2.1	-46%	2.8	2.4	12%

Although the number of stops has increased in the eastbound direction, all other categories have benefited from the new timings. These changes have helped to open up the westbound commute as well as to allow better traffic progression on both Steve Reynolds Boulevard and Pleasant Hill Road. Stops are counted as any time the speed goes below 5 mph; therefore, the increase in stops does not necessarily mean there were stops at more intersections.

Environmental Pollution Emissions

Carbon monoxide, oxides of nitrogen, and volatile oxygen compounds (hydrocarbons) are three types of vehicle emissions that are regulated by federal law. New signal timing can reduce these pollutants by reducing the number of stops vehicles make and having vehicles travel at a faster average speed.

Table 9 is a comparison of the total "before" and "after" emission data for the AM, Mid-Day, and PM Peak Periods along System 2 – Satellite Boulevard.

Table 9 – System 2 – Satellite Boulevard Emission Results

MD Peak	**Satellite Boulevard**		
	Before	**After**	**% Imp**
CO Emissions (kg/hr)	7.8672	7.2670	8%
NOx Emissions (kg/hr)	1.1956	1.1034	8%
VOC Emissions (kg/hr)	0.9848	0.9070	8%

MD Peak	**Satellite Boulevard**		
	Before	**After**	**% Imp**
CO Emissions (kg/hr)	7.8672	7.2670	8%
NOx Emissions (kg/hr)	1.1956	1.1034	8%
VOC Emissions (kg/hr)	0.9848	0.9070	8%

PM Peak	**Satellite Boulevard**		
	Before	**After**	**% Imp**
CO Emissions (kg/hr)	11.0703	8.5912	22%
NOx Emissions (kg/hr)	1.6117	1.3370	17%
VOC Emissions (kg/hr)	1.4879	1.0259	31%

Benefit Analysis

The reductions in delay and travel time documented previously are of much greater value than simply reducing driver frustration and inconvenience. Rather, time spent by people in traffic congestion is time that cannot be used for revenue producing activities. The time saved by drivers due to improved signal timing has a dollar value that can be calculated with the following formula:

S = R x V x D x O x C

Where:

S = Dollars saved
R = Travel time reduction
V = Volume
D = Days timing is in effect
O = Average vehicle occupancy
C = Cost of delay per person

Delay incurs direct costs upon motorists in the form of increased fuel consumption and the value of their time wasted while waiting in traffic. Motorists using System 2 – Satellite Boulevard during the three (3) peak periods will save 44,610 hours and 26,766 gallons of gasoline each year because of improved traffic flow due to the new timing plans. A vehicle occupancy rate of 1.2, $12.00 per hour for the value of motorists' time, and $3.50 per gallon for gasoline was used. Table 10 shows the dollar value of the travel time improvements for the system signal timing in each direction during the AM peak, Mid-Day, and PM peak periods.

Table 10 – System 2 – Satellite Boulevard Annual Benefit Results

Time and Fuel			Annual Improvement				
			Travel Time		Fuel Consumption		Total
	Time Period	**Volume**	**Veh-Hrs**	**Value**	**Gallons**	**Value**	**Dollars**
	Eastbound						
	A.M. Peak	1500	4,438	$63,900	2,663	$9,319	$73,219
	MD	2550	2,656	$38,250	1,594	$5,578	$43,828
	P.M. Peak	3950	8,229	$118,500	4,938	$17,281	$135,781
	Westbound						
	A.M. Peak	4000	19,000	$273,600	11,400	$39,900	$313,500
	MD	2550	3,188	$45,900	1,913	$6,694	$52,594
	P.M. Peak	2400	7,100	$102,240	4,260	$14,910	$117,150
		Total	**44,610**	**642,390**	**26,766**	**93,682**	**$736,072**

6. SYSTEM 3 – STEVE REYNOLDS BOULEVARD

GWINNETT PLACE CID SIGNAL RETIMING PROJECT

Description of Study Corridor

System 3 – Steve Reynolds Boulevard includes eight (8) traffic signals on Steve Reynolds Boulevard as well as eleven (11) traffic signals on Pleasant Hill Road and three (3) traffic signals on Club Drive shown in Figure 6 and Table 11. Table 12 shows the final timing plans for System 3 – Steve Reynolds Boulevard. This travel run route was requested by Gwinnett County to determine if it is faster to use Steve Reynolds Boulevard or Pleasant Hill Road to go end-to-end.

Figure 6 – System 3 – Steve Reynolds Boulevard Limits

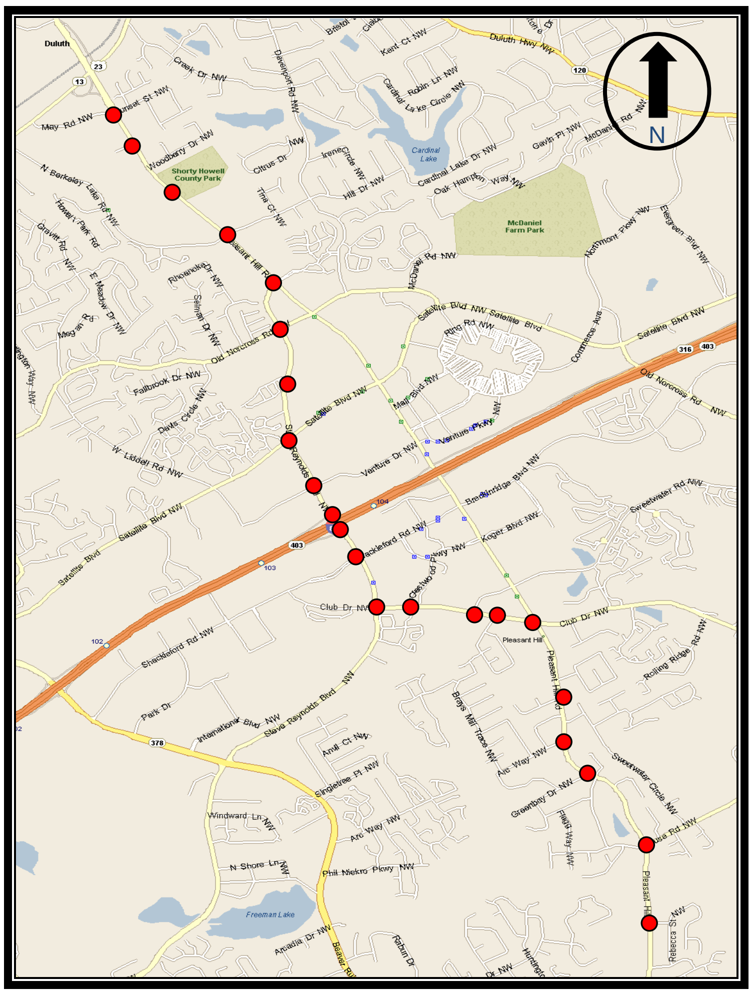


Table 11 – System 3 – Steve Reynolds Boulevard Intersections

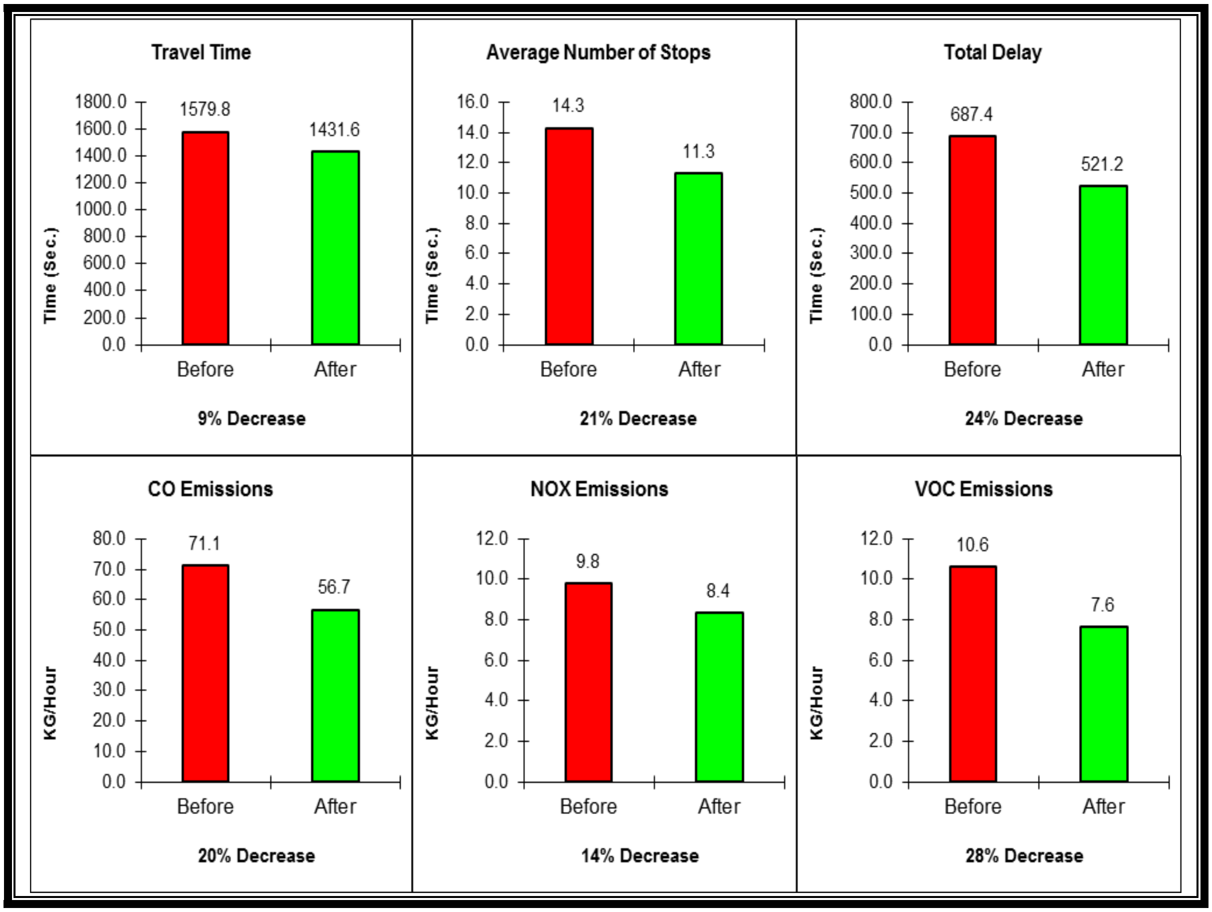
No.	Intersection	System	Maintaining Agency
1	Pleasant Hill Road @ Old Berkely Lake Road	Steve Reynolds Boulevard Signal System	Gwinnett County
2	Pleasant Hill Road @ Woodberry Drive	Steve Reynolds Boulevard Signal System	Gwinnett County
3	Pleasant Hill Road @ Shory Howell Park/Walmart	Steve Reynolds Boulevard Signal System	Gwinnett County
4	Pleasant Hill Road @ Hill Drive/N. Berkely Lake Road	Steve Reynolds Boulevard Signal System	Gwinnett County
5	Pleasant Hill Road @ Steve Reynolds Boulevard	Steve Reynolds Boulevard Signal System	Gwinnett County
6	Steve Reynolds Boulevard @ Old Norcross Road	Steve Reynolds Boulevard Signal System	Gwinnett County
7	Steve Reynolds Boulevard @ Chesden Drive	Steve Reynolds Boulevard Signal System	Gwinnett County
8	Steve Reynolds Boulevard @ Satellite Boulevard	Steve Reynolds Boulevard Signal System	Gwinnett County
9	Steve Reynolds Boulevard @ Venture Drive	Steve Reynolds Boulevard Signal System	Gwinnett County
10	Steve Reynolds Boulevard @ I-85 SB	Steve Reynolds Boulevard Signal System	Gwinnett County
11	Steve Reynolds Boulevard @ I-85 NB	Steve Reynolds Boulevard Signal System	Gwinnett County
12	Steve Reynolds Boulevard @ Shackleford Road	Steve Reynolds Boulevard Signal System	Gwinnett County
13	Steve Reynolds Boulevard @ Club Drive	Steve Reynolds Boulevard Signal System	Gwinnett County
14	Club Drive @ Crestwood Parkway	Steve Reynolds Boulevard Signal System	Gwinnett County
15	Club Drive @ Sweetwater Road	Steve Reynolds Boulevard Signal System	Gwinnett County
16	Club Drive @ Woodington Circle	Steve Reynolds Boulevard Signal System	Gwinnett County
17	Pleasant Hill Road @ Club Drive	Steve Reynolds Boulevard Signal System	Gwinnett County
18	Pleasant Hill Road @ Corley Place	Steve Reynolds Boulevard Signal System	Gwinnett County
19	Pleasant Hill Road @ Arc Way	Steve Reynolds Boulevard Signal System	Gwinnett County
20	Pleasant Hill Road @ Lake Hill Drive	Steve Reynolds Boulevard Signal System	Gwinnett County
21	Pleasant Hill Road @ Cruse Road	Steve Reynolds Boulevard Signal System	Gwinnett County
22	Pleasant Hill Road @ Mary Street	Steve Reynolds Boulevard Signal System	Gwinnett County

Table 12 – System 3 – Steve Reynolds Boulevard TOD Schedule

Day of Week	Hours of Operation	Cycle Length	Plan #
Monday - Thursday	00:01 - 06:00	Free	0/0/4
	06:00 - 09:30	150"	3/1/1
	09:30 - 11:30	130"	2/1/1
	11:30 - 15:30	150"	3/2/2
	15:30 - 20:00	170"	4/3/3
	20:00 - 22:00	130"	2/3/3
	22:00 - 00:01	Free	0/0/4
Friday	00:01 - 06:00	Free	0/0/4
	06:00 - 09:30	150"	3/1/1
	09:30 - 11:30	130"	2/1/1
	11:30 - 14:15	150"	3/2/2
	14:15 - 20:00	170"	4/3/3
	20:00 - 00:01	130"	2/3/3
Saturday	00:01 - 08:30	Free	0/0/4
	08:30 - 12:00	150"	3/4/2
	12:00 - 17:00	170"/85"	4/4/2
	17:00 - 21:30	150"	3/4/2
	21:30 - 00:01	Free	0/0/4
Sunday	00:01 - 09:30	Free	0/0/4
	09:30 - 11:30	130"	2/4/2
	11:30 - 20:30	150"	3/4/2
	20:30 - 00:01	Free	0/0/4

The travel run route for System 3 – Steve Reynolds Boulevard included eight (8) traffic signals as well as eleven (11) traffic signals on Pleasant Hill Road and three (3) traffic signals on Club Drive. Figure 7 shows the overall effectiveness of the retiming for Travel Time, Number of Stops, Total Delay, CO Emissions, NOX Emissions, and VOC Emissions.

Figure 7 – System 3 – Steve Reynolds Boulevard Effectiveness Summary



Travel Time and Delay Study

The following summary shows a comparison of the "before" and "after" travel time, average trip speed, delay, and number of stops recorded at the intersections while conducting the studies. Data are shown for each time period and direction of travel. Although this study does not detail the improvements made on the side street approaches, our team of engineers made great efforts to control queues. Details of each travel time run are shown in the Appendix.

Table 13 shows a summarization of the "before" and "after" travel time study data for the AM, Mid-Day, and PM Peak Periods along System 3 – Steve Reynolds Boulevard.

Table 13 – System 3 – Steve Reynolds Boulevard Speed and Delay Results

AM Peak	Steve Reynolds Boulevard (NB)			Steve Reynolds Boulevard (SB)		
	Before	**After**	**% Imp**	**Before**	**After**	**% Imp**
Travel Time (sec.)	913.2	824.4	10%	756.6	713.4	6%
Trip Speed (mph)	20.7	22.9	11%	24.9	26.4	6%
Total Delay (sec.)	462.0	343.2	26%	301.8	262.8	13%
Number of Stops	11.8	7.0	40%	7.4	5.3	28%

MD Peak	Steve Reynolds Boulevard (NB)			Steve Reynolds Boulevard (SB)		
	Before	**After**	**% Imp**	**Before**	**After**	**% Imp**
Travel Time (sec.)	750.6	676.8	10%	636.0	579.6	9%
Trip Speed (mph)	25.2	27.9	11%	29.7	32.5	10%
Total Delay (sec.)	312.6	226.8	27%	198.6	145.2	27%
Number of Stops	5.1	4.5	12%	4.3	3.1	28%

PM Peak	Steve Reynolds Boulevard (NB)			Steve Reynolds Boulevard (SB)		
	Before	**After**	**% Imp**	**Before**	**After**	**% Imp**
Travel Time (sec.)	781.8	766.8	2%	901.2	733.8	19%
Trip Speed (mph)	24.1	24.6	2%	20.9	25.7	23%
Total Delay (sec.)	331.8	297.0	10%	455.4	288.6	37%
Number of Stops	5.3	6.3	-17%	9.0	7.7	15%

Environmental Pollution Emissions

Carbon monoxide, oxides of nitrogen, and volatile oxygen compounds (hydrocarbons) are three types of vehicle emissions that are regulated by federal law. New signal timing can reduce these pollutants by reducing the number of stops vehicles make and having vehicles travel at a faster average speed.

Table 14 is a comparison of the total "before" and "after" emission data for the AM, Mid-Day, and PM Peak Periods along System 3 – Steve Reynolds Boulevard.

Table 14 – System 3 – Steve Reynolds Boulevard Emission Results

AM Peak	Steve Reynolds Boulevard		
	Before	**After**	**% Imp**
CO Emissions (kg/hr)	25.6993	19.9876	22%
NOx Emissions (kg/hr)	3.5260	3.0506	13%
VOC Emissions (kg/hr)	3.9129	2.5951	34%

MD Peak	Steve Reynolds Boulevard		
	Before	**After**	**% Imp**
CO Emissions (kg/hr)	16.4182	14.2383	13%
NOx Emissions (kg/hr)	2.3723	2.0799	12%
VOC Emissions (kg/hr)	2.2373	1.8688	16%

PM Peak	Steve Reynolds Boulevard		
	Before	**After**	**% Imp**
CO Emissions (kg/hr)	29.0132	22.5068	22%
NOx Emissions (kg/hr)	3.9284	3.2282	18%
VOC Emissions (kg/hr)	4.4541	3.1738	29%

Benefit Analysis

The reductions in delay and travel time documented previously are of much greater value than simply reducing driver frustration and inconvenience. Rather, time spent by people in traffic congestion is time that cannot be used for revenue producing activities. The time saved by drivers due to improved signal timing has a dollar value that can be calculated with the following formula:

S = R x V x D x O x C

Where:

S = Dollars saved
R = Travel time reduction
V = Volume
D = Days timing is in effect
O = Average vehicle occupancy
C = Cost of delay per person

Delay incurs direct costs upon motorists in the form of increased fuel consumption and the value of their time wasted while waiting in traffic. Motorists using System 3 – Steve Reynolds Boulevard during the three (3) peak periods will save 87,944 hours and 52,766 gallons of gasoline each year because of improved traffic flow due to the new timing plans. A vehicle occupancy rate of 1.2, $12.00 per hour for the value of motorists' time, and $3.50 per gallon for gasoline was used. Table 15 shows the dollar value of the travel time improvements for the system signal timing in each direction during the AM peak, Mid-Day, and PM peak periods.

Table 15 – System 3 – Steve Reynolds Boulevard Annual Benefit Results

Time and Fuel	Time Period	Volume	Annual Improvement				
			Travel Time		Fuel Consumption		Total
			Veh-Hrs	Value	Gallons	Value	Dollars
	Northbound						
	A.M. Peak	3350	20,658	$297,480	12,395	$43,383	$340,863
	MD	2200	11,275	$162,360	6,765	$23,678	$186,038
	P.M. Peak	2100	2,188	$31,500	1,313	$4,594	$36,094
	Southbound						
	A.M. Peak	1700	5,100	$73,440	3,060	$10,710	$84,150
	MD	2200	8,617	$124,080	5,170	$18,095	$142,175
	P.M. Peak	3450	40,106	$577,530	24,064	$84,223	$661,753
		Total	**87,944**	**1,266,390**	**52,766**	**184,682**	**$1,451,072**

7. PROJECT COSTS AND BENEFITS

GWINNETT PLACE CID SIGNAL RETIMING PROJECT

There are financial costs associated with the development and implementation of improved signal timing plans. However, there are also financial benefits that are derived from the improvements in traffic flow experienced by drivers using the roadways. Drivers will continue to benefit from improvements in traffic flow over the lifetime of the timing plans.

Signal timing plans have a useful lifetime. The end of the useful life of signal timing plans is reached when increases in development, roadway construction, and traffic demand are such that traffic flow is no longer efficiently accommodated by the plans. For the purpose of this cost/benefit analysis, it is assumed that the useful life of the Gwinnett Place CID signal retiming is two (2) years.

Annual Costs

The equivalent annual cost of the Gwinnett Place CID Signal Retiming project includes the cost of preparing, implementing, and documenting the timing plans, and the time-value (interest) of the capital invested.

The following formulas were used in determining the project's total annual costs:

$E = R \times C$

Where:

E = Equivalent Annual Cost

R = Capital Recovery Factor

C = Initial Cost, and

$R = i(1+i)^n \ / \ \{(1+i)^n - 1\}$

Where:

i = Annual Interest Rate

n = Useful Life of Timing Plans

Table 16 shows the equivalent annual costs of the signal timing plans for the Gwinnett Place CID Signal Retiming Project based upon the formulas and calculations described above. The data shown include the cost of initial timing plan development and implementation and interest.

Interest rates on the capital investment are shown in the range of 4 percent to 8 percent, which was considered sufficient to reflect conditions in the financial market. The timing plans for the forty-nine (49) coordinated signals in the Gwinnett Place CID Signal Retiming Project cost $181,884.27 to develop, implement, and document.

Table 16 – Equivalent Annual Costs of Timing Plans

Annual Interest Rate	Capital Recovery Factor	Equivalent Annual Cost
0.04	0.5302	$96,435
0.05	0.5378	$97,817
0.06	0.5454	$99,200
0.07	0.5531	$100,600
0.08	0.5608	$102,001

Benefits

The reductions in delay and travel time documented previously are of much greater value than simply reducing driver frustration and inconvenience. Rather, time spent by people in traffic congestion is time that cannot be used for revenue producing activities. The time saved by drivers due to improved signal timing has a dollar value that can be calculated with the following formula:

S = R x V x D x O x C

Where:

S = Dollars saved
R = Travel time reduction
V = Volume
D = Days timing is in effect
O = Average vehicle occupancy
C = Cost of delay per person

Delay incurs direct costs upon motorists in the form of increased fuel consumption and the value of their time wasted while waiting in traffic. Motorists using the 3 signal systems during the three (3) peak periods will save 235,296 hours and 141,178 gallons of gasoline each year because of improved traffic flow due to the new timing plans. A vehicle occupancy rate of 1.2, $12.00 per hour for the value of motorists' time and $3.50 per gallon for gasoline was used. Table 17 shows the dollar value of the travel time improvements for the Gwinnett Place CID Signal Retiming Project signal timing in each direction during the AM peak, Mid-Day, and PM peak periods.

Table 17 – GPCID Signal Retiming Annual Travel Time and Fuel Consumption Cost Savings

Time and Fuel	Time Period	Annual Improvement				
		Travel Time		Fuel Consumption		Total
		Veh-Hrs	Value	Gallons	Value	Dollars
	Northbound/Eastbound					
	A.M. Peak	68,346	$984,180	41,008	$143,526	$1,127,706
	Mid-Day	15,856	$228,330	9,514	$33,298	$261,628
	P.M. Peak	36,450	$524,880	21,870	$76,545	$601,425
	Southbound/Westbound					
	A.M. Peak	47,567	$684,960	28,540	$99,890	$784,850
	Mid-Day	17,971	$258,780	10,783	$37,739	$296,519
	P.M. Peak	49,106	$707,130	29,464	$103,123	$810,253
	Total	**235,296**	**$3,388,260**	**141,178**	**$494,121**	**$3,882,381**

Annual savings to motorists traveling in GPCID will be $3,388,260 in the form of reduced delay and $494,121 due to reduced fuel consumption, for a total annual savings of $3,882,381. Other benefits are derived from improved signal timing in addition to reduced time wasted by drivers due to delay and reduced fuel consumption. A potential source of benefits is the area of traffic accidents. The smoother traffic flow that results from improved signal timing often results in fewer accidents. Accident analysis was not a part of this study.

Benefit/Cost Analysis

An analysis of the benefit/cost ratio is an important measure of the effectiveness of a project. It provides a method of comparing the project cost to the benefits received by the motoring public.

A benefit/cost ratio was obtained for the Gwinnett Place CID Signal Retiming project by dividing the annual benefit to motorists (in the form of reduced delay and fuel consumption) by the equivalent annual project cost. A ratio value of 1 or greater indicates that annual benefits equal or exceed annual costs.

The annual benefit to motorists, in the form of reduced delay and fuel consumption, is $3,388,260. The equivalent annual cost of developing and implementing timing plans for the forty-nine (49) coordinated signals ranged from $96,435 at 4 percent interest to $102,001 at 8 percent interest. Table 18 illustrates the benefit/cost ratios at interest rates of 4 percent to 8 percent.

Table 18 – Benefit/Cost Analysis

Rate	Annual Cost	Delay	Consumption	Savings	Ratio
4%	$96,435	$3,388,260	$494,121	$3,882,381	40.26
5%	$97,817	$3,388,260	$494,121	$3,882,381	39.69
6%	$99,200	$3,388,260	$494,121	$3,882,381	39.14
7%	$100,600	$3,388,260	$494,121	$3,882,381	38.59
8%	$102,001	$3,388,260	$494,121	$3,882,381	38.06

The improved timing plans for the Gwinnett Place CID Signal Retiming project have benefit/cost ratios ranging from 38.06 to 1 to 40.26 to 1. Expressed in another way, the new timing plans for the Gwinnett Place CID Signal Retiming project pay for themselves approximately every 6 or 7 work days. Other benefits include lower driver frustration levels and potentially, a reduction of accidents. All of the improvements mentioned in the report are for the six hours of weekdays during the AM, Mid-Day, and PM Peak periods for the coordinated signal systems. New signal timing plans were also implemented during the off-peak hours and on weekends for the coordinated signal systems. However, “before” and “after” studies were not conducted during the off-peak hours or for weekends. Therefore, additional savings could not be quantified during these periods.

8. RECOMMENDATIONS

GWINNETT PLACE CID SIGNAL RETIMING PROJECT

With the new signal timing, the corridors have been greatly improved, but some long-term changes are recommended for improving the overall operation of the signal systems. It is recommended that (all directions assume Pleasant Hill Road runs north-south):

1. The communications should be updated so the TCC can communicate to all of the coordinated signals. Currently, three (3) signals do not communicate (Old Norcross @ Davenport, Old Norcross @ Kroger and Steve Reynolds @ Pleasant Hill Square).
2. Setback loops be installed for all intersections along Pleasant Hill Road that currently do not have them in order for intersections to be able to run in "Free" operation overnight. This will reduce side street delay significantly during the overnight hours. The intersections of Pleasant Hill @ the I-85 Ramps will HAVE to run coordinated at all times due to the diverging diamond configuration.
3. At the intersection of Pleasant Hill Road @ Venture Drive, it is recommended that the eastbound approach be given an add lane onto southbound Pleasant Hill similar to the geometry before the construction. This can be achieved by removing the decorative planter and moving the sidewalk back to the wall. This will allow for a 4th lane leaving the intersection of Venture Drive instead of the 4th lane being added just south of the intersection and only 3 travel lanes being utilized as the geometry is today.
4. For the intersections of Pleasant Hill Road @ I-85 NB and SB Ramps, it is recommended that an additional right lane be added on Pleasant Hill Road to allow right turns on red off of the interstate ramps. This will allow for less split to be given to ramps during the peaks, which will give more time for mainline flow of traffic.
5. Signage denoting the shared through right lane for the diverging diamond needs to be modified. Currently, drivers who are unfamiliar with the geometry (especially on the weekends) do not utilize all three through lanes going across the bridge. This is due to the I-85 shield painted in the shared lane approaching the bridge and a lack of signage for the lane uses. It is recommended that the I-85 shield be removed from the shared left (leave it in the left only lane) and additional signage be added approaching the bridge that shows lane assignments, as well as signage on the ramps to alert drivers of the lane assignments they will encounter on the bridge.
6. At the intersection of Pleasant Hill Road @ Sweetwater Road, the southbound left turn bay on Pleasant Hill can be lengthened to prevent queues from spilling into the through lanes. Currently this turn bay is back to back with the northbound left turn bay on Pleasant Hill onto Crestwood Road; however, this turn bay can be shortened due to smaller traffic volume.
7. At the intersection of Pleasant Hill Road @ Sweetwater Road, the westbound approach of Sweetwater can have the concrete median removed to allow for the left turn bay to be extended. This will allow the approach to be more efficient because the left turn traffic won't spill into the through lane and the through traffic can't block the left turn lane.
8. At the intersection of Pleasant Hill Road @ Sweetwater Road, the eastbound approach of Sweetwater can have the lanes striped so that the left lane approaching the intersection lines up with the left turn lane and the right lane approaching lines up with the through lane creating a right turn pocket instead of the left turn pocket. This will allow the approach to

be more efficient because the left turn traffic won't spill into the through lane and the through traffic can't block the left turn lane.

9. At the intersection of Steve Reynolds Boulevard and Old Norcross Road, we recommend that the phasing be switched so that Steve Reynolds Boulevard is the mainline and Old Norcross Road is the side street. This will allow traffic traveling down Steve Reynolds Boulevard more time to cross Old Norcross Road and will not "gap out" with a lack of traffic.
10. At the intersection of Steve Reynolds Boulevard @ Satellite Boulevard, it is recommended that the rightmost southbound left turn bay from Steve Reynolds onto Satellite be restriped as a third southbound through lane. Traffic making this left can be handled with a single turn bay and the extra through lane would make traffic heading towards I-85 more efficient and would allow more split to be given to Satellite Boulevard.
11. At the intersection of Steve Reynolds Boulevard @ Venture Drive, it is recommended that an additional northbound left turn lane be created from Steve Reynolds on to Venture. The third through lane is not crucial to the function of the intersection and the left turn movement is very heavy, especially during the weekend.
12. At the intersection of Steve Reynolds Boulevard @ Venture Drive, it is recommended that a second eastbound through lane be added to cross Steve Reynolds on venture. This traffic is also very heavy during the nights and weekends and even though the lane drops into the shopping center on the other side of Steve Reynolds, there is enough space for traffic to merge on Venture Drive so they can clear the intersection of Steve Reynolds more efficiently.
13. At the intersection of Satellite Boulevard @ Old Norcross Road East, it is recommended that on the northbound approach, the median be cut back slightly to allow more left turn lane storage and the through lanes be lined up with the dual left turn lanes. Through traffic and right turn traffic on this approach is minimal at this intersection; therefore, it will be more efficient to line up the lanes with the left turn which are very heavy.

APPENDIX – TRAVEL TIME RUNS

Pleasant Hill Road Travel Run Route

Scenario	Time Period	Route	Compass Direction	Avg Speed	Avg Travel Time	Avg # Stops	Avg Congested Time	VOC	CO	NOX
Before Runs	AM Peak	Pleasant Hill Road (SB)	S	22.04	13.23	6.88	6.19	0.9099	5.3893	0.6683
Before Runs	AM Peak	Pleasant Hill Road (NB)	N	22.54	12.99	8.00	5.44	0.7202	4.5921	0.6185
Before Runs	MD Peak	Pleasant Hill Road (SB)	S	26.44	11.00	5.25	3.83	0.5740	3.7637	0.5008
Before Runs	MD Peak	Pleasant Hill Road (NB)	N	26.92	10.81	4.25	3.90	0.5929	3.8403	0.5054
Before Runs	PM Peak	Pleasant Hill Road (SB)	S	24.32	11.99	5.00	4.82	0.7064	4.4374	0.5799
Before Runs	PM Peak	Pleasant Hill Road (NB)	N	22.52	12.98	6.50	5.84	0.8740	5.2156	0.6514
After Runs	AM Peak	Pleasant Hill Road (SB)	S	25.42	11.47	5.25	4.45	0.4322	3.4373	0.5279
After Runs	AM Peak	Pleasant Hill Road (NB)	N	25.85	11.26	4.80	3.86	0.3990	3.2080	0.5002
After Runs	MD Peak	Pleasant Hill Road (SB)	S	27.42	10.63	4.89	3.57	0.4010	3.2123	0.4948
After Runs	MD Peak	Pleasant Hill Road (NB)	N	27.27	10.70	3.70	3.57	0.4140	3.2468	0.4930
After Runs	PM Peak	Pleasant Hill Road (SB)	S	24.43	11.91	5.00	4.66	0.4603	3.5699	0.5469
After Runs	PM Peak	Pleasant Hill Road (NB)	N	25.24	11.56	4.38	4.59	0.4630	3.5635	0.5365

Steve Reynolds Boulevard Travel Run Route

Scenario	Time Period	Route	Compass Direction	Avg Speed	Avg Travel Time	Avg # Stops	Avg Congested Time	VOC	CO	NOX
Before Runs	AM Peak	Steve Reynolds Blvd (NB)	N	20.70	15.22	11.75	7.70	0.8394	5.4738	0.7506
Before Runs	AM Peak	Steve Reynolds Blvd (SB)	S	24.93	12.61	7.38	5.03	0.6476	4.3306	0.5951
Before Runs	MD Peak	Steve Reynolds Blvd (NB)	N	25.17	12.51	5.11	5.21	0.5341	3.9990	0.5904
Before Runs	MD Peak	Steve Reynolds Blvd (SB)	S	29.65	10.60	4.33	3.31	0.4829	3.4638	0.4879
Before Runs	PM Peak	Steve Reynolds Blvd (NB)	N	24.08	13.03	5.33	5.53	0.5857	4.2764	0.6237
Before Runs	PM Peak	Steve Reynolds Blvd (SB)	S	20.93	15.02	9.00	7.59	0.9346	5.8066	0.7590
After Runs	AM Peak	Steve Reynolds Blvd (NB)	N	22.88	13.74	7.00	5.72	0.5587	4.1960	0.6355
After Runs	AM Peak	Steve Reynolds Blvd (SB)	S	26.39	11.89	5.33	4.38	0.4256	3.4889	0.5423
After Runs	MD Peak	Steve Reynolds Blvd (NB)	N	27.86	11.28	4.50	3.78	0.5291	3.7187	0.5210
After Runs	MD Peak	Steve Reynolds Blvd (SB)	S	32.54	9.66	3.11	2.42	0.3204	2.7532	0.4244
After Runs	PM Peak	Steve Reynolds Blvd (NB)	N	24.59	12.78	6.25	4.95	0.6990	4.5398	0.6090
After Runs	PM Peak	Steve Reynolds Blvd (SB)	S	25.66	12.23	7.67	4.81	0.4944	3.7603	0.5650

Satellite Boulevard Travel Run Route

Scenario	Time Period	Route	Compass Direction	Avg Speed	Avg Travel Time	Avg # Stops	Avg Congested Time	VOC	CO	NOX
Before Runs	AM Peak	Satellite Blvd (EB)	E	22.48	6.32	2.62	3.07	0.3487	2.3314	0.3182
Before Runs	AM Peak	Satellite Blvd (WB)	W	23.74	5.96	2.12	2.70	0.3219	2.1707	0.2962
Before Runs	MD Peak	Satellite Blvd (EB)	E	26.30	5.38	2.56	1.94	0.2203	1.6689	0.2473
Before Runs	MD Peak	Satellite Blvd (WB)	W	28.50	4.97	2.11	1.58	0.1660	1.4163	0.2216
Before Runs	PM Peak	Satellite Blvd (EB)	E	28.36	4.99	1.44	1.65	0.1989	1.5416	0.2285
Before Runs	PM Peak	Satellite Blvd (WB)	W	23.30	6.08	2.78	2.68	0.2926	2.0754	0.2954
After Runs	AM Peak	Satellite Blvd (EB)	E	25.33	5.61	3.44	2.13	0.2308	1.7300	0.2573
After Runs	AM Peak	Satellite Blvd (WB)	W	29.35	4.82	1.38	1.48	0.2027	1.5178	0.2191
After Runs	MD Peak	Satellite Blvd (EB)	E	27.59	5.13	2.71	1.61	0.1913	1.5101	0.2290
After Runs	MD Peak	Satellite Blvd (WB)	W	30.34	4.67	1.88	1.18	0.1644	1.3397	0.2037
After Runs	PM Peak	Satellite Blvd (EB)	E	31.51	4.49	2.10	0.91	0.1368	1.1905	0.1880
After Runs	PM Peak	Satellite Blvd (WB)	W	26.39	5.37	2.44	2.06	0.2023	1.6204	0.2477